NYC GREEN INFRASTRUCTURE

2020 Annual Report

Environmental Protection

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GRASS TOP INFILTRATION BASIN, QUEENS

Hi!

The New York City Department of Environmental Protection (DEP) is excited to present the 2020 Green Infrastructure Annual Report. The Annual Report provides an update on the NYC Green Infrastructure Program (or the "Program"), including achievements and advancements through 2020, and outlines what is in store for 2021. Previous Annual Reports and the Green Infrastructure Plan can be found on DEP's green infrastructure webpage. 2020 was a challenging year for the Program due to the COVID-19 pandemic. Fiscal uncertainties and project delays caused by the pandemic have affected green infrastructure construction timelines. Despite this, the Program still had a tremendous year in 2020, with over 3,000 Right-of-Way (ROW) green infrastructure practices constructed, continued construction on schoolyard retrofits, and designs advanced on over a hundred public properties.

Green infrastructure provides more than just stormwater management for New Yorkers. While the primary goal of the Program is to reduce combined sewer overflows (CSO) into New York Harbor in a cost-effective way, the distributed projects also provide community and environmental benefits to the city's neighborhoods and residents. These "co-benefits" include increased urban greening, urban heat island reduction, and more habitat for birds and pollinators around the city. The Program also seeks out strategic opportunities to implement green infrastructure in the separately sewered areas of the city to reduce polluted stormwater runoff, distributing green infrastructure co-benefits even further across the city.

By retrofitting NYC's streets, sidewalks and other public properties with standard green infrastructure practices, incentivizing green infrastructure on private property, promulgating new stormwater regulations, exploring daylighting opportunities in the Bronx and implementing stormwater recovery and reuse projects, DEP is well on its way toward the 2030 CSO reduction goal of 1.67 billion gallons per year (BGY). As reported in past years, the Program has successfully installed and continues to install thousands of ROW rain gardens and other green infrastructure practices in the City's combined sewer areas, and

thousands more green infrastructure practices are in planning and design phases.

Program staff do more than just design and build projects; they also perform maintenance of green infrastructure constructed in the ROW, oversee construction and enforce green infrastructure protection regulations, conduct research and development on green infrastructure, engage elected officials and civic stakeholders, work with private and public property owners implementing green infrastructure using incentives or through regulations, review and track green infrastructure projects using GreenHUB (see 2018 Annual Report for more details), and lead planning, mapping, reporting and data management efforts.

In 2020, the Program continued active construction for the ROW green infrastructure that was started in 2019. DEP thanks NYC Economic Development Corporation (EDC) and NYC Department of Design and Construction (DDC) for their leadership in continuing this important work throughout the pandemic, working with contractors to quickly implement safety protocols using Center for Disease Control guidance so that the work could continue safely and with as little disruption as possible. Their commitment to the Program and ability to adapt to the circumstances allowed green infrastructure construction to continue when many other public and private construction jobs were paused throughout the city, which helped keep contractors working and the Program moving forward.

DEP's in-house construction management team, established in 2020, continued going to construction sites throughout the pandemic. The team's presence in the field has been critical for providing oversight during critical phases of green infrastructure construction, and also for coordinating with other contractors performing street work for utility companies and private developers to ensure that these other construction activities do not adversely impact the function of green infrastructure assets. DEP has developed protocols and training materials for green infrastructure protections to be implemented during utility construction and has continued coordination with utilities and other City agencies involved with construction work on streets and sidewalks.

Throughout 2020, DEP staff continued to engage the public in various public meetings at the beginning of the year, as well as virtual workshops during the pandemic (see Exhibit B). This outreach has been critical to the success of the Program and also includes hundreds of correspondences and phone conversations with residents and local organizations.

PROGRAM HIGHLIGHTS

1,504
Greened Acres from 2010-2020

11,050
Assets constructed or in construction

$1B +
Committed since 2012

Looking ahead to 2021, DEP has various initiatives planned including construction of green infrastructure on public properties, launch of the new private property retrofit incentive program, promulgation of the new Unified Stormwater Rule and finalization of design of the Program's first area-wide porous pavement project.

The COVID-19 pandemic has brought a wave of hardship and fiscal uncertainty to the City of New York. While the Program experienced some challenges related to staffing and contract delays, GI design, construction and maintenance continued throughout 2020.

IMPLEMENTATION PROGRAM UPDATE

RAIN GARDEN WITH PRETREATMENT FOREBAY, QUEENS

RIGHT-OF-WAY GREEN INFRASTRUCTURE

The public 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 Program thus far. In 2012, DEP launched area-wide green infrastructure projects, in partnership with the Department of Transportation (DOT) and the Department of Parks and Recreation (Parks). To date, these area-wide projects have led to the vast majority of Program accomplishments, measured by assets constructed, greened acres managed, and CSO volume reduced.

ROW implementation is focused in Priority CSO and in limited areas within the East River/Open Waters (EROW) CSO tributaries to improve public access and water quality in confined waterways. By and large, this effort has been a tremendous success and over 660,000 square feet (SF) of pervious surfaces have been added to NYC streets and sidewalks. Most of the Priority CSO areas have been saturated with ROW green infrastructure practices, and DEP is continuing to implement area-wide projects for the selected EROW areas.

While the pandemic created many delays and hurdles for the Program, ROW construction continued through 2021 and more than 3,000 practices were constructed through 19 active construction projects across the Westchester Creek, Bronx River, Newtown Creek, Flushing Creek, and Jamaica Bay watersheds. Many of these construction contracts are expected to be complete in 2021.

Design work will also continue through 2021 and is nearing completion for area-wide projects in Gravesend Bay and Jamaica Bay CSO tributary areas. New area-wide construction contracts will kick off

Over 660,000 square feet of pervious surfaces have been added to NYC streets and sidewalks

soon in EROW and Flushing Creek CSO tributary areas.

The types of green infrastructure practices constructed in the ROW have evolved with the Program over the years. DEP's expanded green infrastructure toolbox improves upon the original ROW bioswale design by addressing issues such as varying field conditions and concerns from the community (see Figure 1 for photos and descriptions). Designs for new and revised ROW green infrastructure types are included in the updated version of the ROW Green Infrastructure Design Standards, which were published on the DEP website in June 2020.

In addition to updating the standard details and drawings, DEP continuously works to streamline implementation of ROW green infrastructure. In 2020, DEP finalized internal guidance documents for DEP staff, consultants, and contractors on every step of ROW green infrastructure implementation from design through construction, including a handbook summarizing typical construction sequencing with photos and relevant excerpts from the construction contract books and specifications.

DEP's increased field presence has also been vital for maintaining quality control over the thousands of ROW green infrastructure assets being constructed. On any given week in 2020, DEP staff visited 10-20 construction projects at various stages ranging from utility markouts prior to excavation, through post-construction hydrant testing to verify that the ROW green infrastructure will function properly during storm events. More information on DEP's construction oversight work is detailed in the CONSTRUCTION MANAGEMENT, INSPECTION, and ENFORCEMENT section.

To distinguish the growing number of rain gardens in the ROW from typical street landscaping, DEP is installing signs mounted to the rain garden tree guards in select areas throughout the city. These new informational signs are intended to raise awareness of rain gardens, differentiating them from standard tree pits and communicating their function and importance to people walking by.

Detailed descriptions of the area-wide implementation strategy and the design and construction processes are described in previous Annual Reports. Photos of ROW green infrastructure construction can be found on DEP's Flickr webpage.

ROW RAIN GARDEN WITH INFORMATIONAL SIGNAGE

FIGURE 1: RIGHT-OF-WAY GREEN INFRASTRUCTURE TOOLBOX

The standard rain garden continues to be the most widely implemented type of ROW green infrastructure practice. The latest design improvements include new planting plans, a concrete walking strip, and sediment capture mechanisms to trap debris and reduce erosion.

Rain gardens with "Type D" inlets utilize a catch basin grate in the roadway instead of a curb cut inlet to redirect stormwater runoff into the practice. This reduces debris that flows onto the soil bed and also minimizes soil erosion from high intensity storms.

Infiltration basins are designed to match the existing sidewalk (concrete or grass strip). Although they do not provide the same greening co-benefits as rain gardens, they are the preferred alternative in high-density residential, industrial, or commercial areas where sidewalk space is limited and plants may not thrive.

Permeable pavement installations in the roadway are ideal for neighborhoods with limited opportunity for green infrastructure on sidewalks due to existing trees, driveways, and other siting constraints.

Note: Constructed assets may differ from above images due to site-specific conditions and changes in design.

GREEN INFRASTRUCTURE PROTECTIONS: BUILDING AND UTILITY COORDINATION

RAIN GARDEN PROTECTION DURING NEARBY CONSTRUCTION, QUEENS

The protection of green infrastructure after its construction is necessary to ensure that the assets provide the long term benefits they were installed to provide. Typical damages DEP staff observe in the field arise from land use activities on adjacent properties or from nearby routine and non-routine construction activity. Substances other than stormwater runoff can find their way into the assets and clog voids, which may prevent the systems from functioning normally. In other cases, construction equipment or materials are stored too close or within the assets themselves and pose a threat. With thousands of new green infrastructure locations and so much construction activity happening in and around New York City streets, it is important to take a proactive approach to green infrastructure protection by informing the broader contractor community about how to identify green infrastructure and protect it during street or onsite construction work.

Over the past year, DEP has made great strides towards increasing awareness of green infrastructure protection requirements by working closely with DOT and utility companies. The DOT permit which contractors obtain prior to performing roadway work now include two stipulations that are triggered whenever construction work is proposed in close proximity to ROW green infrastructure. These stipulations require the permittee to properly protect the nearby green infrastructure practices for the duration of the construction. In addition to these permits, many construction contracts for utility work now include language requiring protection of green infrastructure as part of the construction work.

At a minimum, contractors working nearby green infrastructure practices are required to do the following:

- control construction runoff and debris at the source to the extent possible
- install protection measures at all nearby and downstream green infrastructure practices, before starting any construction work
- set up physical barriers to discourage people, equipment, and materials from entering the green infrastructure practices
- avoid stepping in the planting bed when installing protection measures
- never stockpile materials within or on top of a green infrastructure practice
- keep protective measures in place until completion of construction activity
- properly remove all protective measure after completion
- coordinate with DEP prior to the start of activities and throughout the construction, as necessary

RAIN GARDENS IN CONSTRUCTION, QUEENS

DEP provides training on green infrastructure protection for contractors, engineers, and supervisors who work with and for Consolidated Edison, National Grid, and DOT, who perform the majority of the street and sidewalk work in the city. The training sessions provide comprehensive guidance on proper protection measures for the different green infrastructure design types, and includes detailed information such as how to identify green infrastructure practices on the sidewalks and streets, descriptions of appropriate materials to use for the green infrastructure protection measures, and tips for installing the protection measures. These trainings also provide a space for open conversations between DEP and the construction community to address concerns from the utilities, construction managers, and contractors. The latest guidance on protection requirements, including detailed descriptions and graphics, can be found on the DEP website.

During 2020, in response to restrictions imposed by the pandemic, DEP moved to virtual platforms in lieu of in-person trainings. DEP conducted five virtual meetings over the summer and fall of 2020 to provide guidance on the correct green infrastructure protection measure during construction. Furthermore, DEP has been coordinating with DOB on private development activities in the ROW including work that includes scaffolding and the Builders Pavement Plan. DEP and DOB drafted a bulletin for sidewalk shed placement around green infrastructure to ensure the green infrastructure assets are protected.

Since 2020, a team of in-house field staff has been authorized to enforce the green infrastructure protection requirements and impose penalties on individuals or entities causing damage to green infrastructure. More information on the field staff team is detailed in the CONSTRUCTION MANAGEMENT, INSPECTION AND ENFORCEMENT section.

With the new construction permitting requirements and increased outreach on green infrastructure protection requirements and enforcement activities, in 2020, DEP received an increased number of notifications from contractors both familiar with and new to the green infrastructure protections program. Several field visits were made with DOT inspectors to provide first-hand experience on what both agencies should expect and how to improve protocols. DEP will continue to work with agency partners and the construction community to improve green infrastructure protection techniques and update the guidance accordingly to provide more clarity.

PERMEABLE PAVEMENT PROTECTION DURING NEARBY CONSTRUCTION, QUEENS

LARGE SCALE STREET MEDIANS

In 2019, DEP formed an In-House Design team tasked with identifying 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 also more cost-effective because they manage more stormwater runoff than typical ROW assets and concentrate maintenance needs in central locations.

DEP's In-House Design team is applying its expertise to individually design these large-scale practices and to site them to address the unique challenges associated with their specific locations. These practices are different from those in DEP's standard ROW green infrastructure toolbox in that they utilize distribution pipes and larger storage areas to capture and convey larger volumes of stormwater runoff.

DEP established the initial list of large scale street median projects by first identifying all potential medians across the city and then prioritizing the medians based on the following criteria: availability of surface space within the median, feasibility of diverting additional runoff to the median to allow more stormwater capture, and avoidance of utility conflicts.

Currently, the team has a portfolio of 19 potential sites. As of spring 2021, four projects have final or near final designs and are in the bid procurement stage. These four sites have the potential to manage approximately 4.6 million gallons per year (MGY) of stormwater runoff; in addition they will improve the neighborhood aesthetics and provide significant benefit to the local community, as illustrated in the before and after images for a proposed project. Additional projects are expected to be advanced in 2021.

As the Green Infrastructure Program matures, DEP will continue to rely on in-house expertise to identify and develop other opportunities for green infrastructure on publicly owned spaces, including in areas that were previously considered unavailable for stormwater capture.

EXISTING CONDITIONS AT WINCHESTER BLVD AND HILLSIDE AVE, QUEENS

RENDERING OF LARGE SCALE GREEN INFRASTRUCTURE IMPLEMENTATION FOR WINCHESTER BLVD, HILLSIDE AVE, AND MARTIN VAN BUREN H.S.,QUEENS

PUBLIC PROPERTY RETROFITS

SUBSURFACE DETENTION SYSTEM CONSTRUCTION AT P.S. 932, BROOKLYN

DEP has been working with key public agency partners to implement green infrastructure retrofits on publicly owned land. This program area is typically referred to as "Public On-site." In 2020, DEP continued green infrastructure design and construction with core agency partners including Parks, DOE, SCA, and NYCHA.

Design Work

DEP continues to advance green infrastructure designs under its agency-targeted design contracts for parks, schools and NYCHA properties.

2020 design accomplishments for the Parks projects include completion of design at 46 playgrounds and parklands, many of which have moved into the construction procurement stage. Initial walkthroughs to evaluate potential green infrastructure opportunities were completed at 31 sites, with additional projects designed in coordination with Park's State of Good Repair Program.

Design completion milestones were also met for synthetic turf field projects at 10 schoolyards in Brooklyn, Queens, and the Bronx. Although DEP is providing the sole funding for these improvement projects, the design team has leveraged experience working on Trust for Public Land (TPL) partnership projects to provide the best design to meet both the needs of the schools and the stormwater management goals. In fact, the engineers and landscape architects, using their experience gained on previous TPL projects, have been working with TPL to facilitate input and approval from the school principals throughout design development. Additional school design projects that began in 2020 include 2 partnerships on SCA capital projects, 11 large athletic field campuses, and 5 other large schoolyards,

TABLE 1: PUBLIC PROPERTY RETROFITS BY PROJECT STATUS

Project Status	Parks/ Playgrounds	Public Schools	NYCHA Housing	Other Public	Total
In Construction/ Constructed	40	40	13	8	101
In Design	101	53	20	3	177
Potential	97	28	27	7	159
Total	**238**	**121**	**60**	**18**	**437**

with final design expected to be completed in 2021.

For NYCHA projects, despite contracting delays due to the pandemic, DEP registered a new NYCHA design task order to begin initial site visits and design at 6 NYCHA developments, with more expected to begin in early 2021.

The Public On-site Design Manual continues to be an important resource for DEP initiated green infrastructure retrofits on public property and for agencies working on their own green infrastructure projects. The Manual can be downloaded from the DEP website. Version 2 is anticipated to be online Spring 2021.

Construction Progress

The COVID-19 pandemic led to a significant delay in 2020 public on-site construction. Despite that, DEP and DOE Division of School Facilities were still able to begin construction on 7 projects and expect 9 additional projects to begin construction in 2021. These projects consist of subsurface detention systems and rain gardens. Additionally, construction of green infrastructure at NYCHA Gowanus Houses completed in 2020.

DEP also continues to work with DDC's Public Buildings Unit in order to facilitate retrofits with its client City agencies, and more projects with other City agencies are in progress; construction of a rain garden and green roof project at the DDC-managed Taxi and Limousine Commission property in Queens is expected to commence in 2021.

As of the publication of this report, 36 Parks and NYCHA projects are mobilizing for 2021 construction through DEP's partnership with EDC. Additionally, DEP is finalizing its first construction bid from the design contracts mentioned in the previous section. This bid will include projects at 30 Parks and 1 NYCHA property. After this bid package is released DEP expects a continuous rollout of subsequent packages, marking a significant expansion in the Program's on-site implementation.

DEP recognizes these agencies for sharing its mission and for facilitating the design and construction of green infrastructure retrofits on public properties. In addition to the water quality benefits, these partnership projects include many co-benefits that will deliver real improvements to New York City's schools, parks, housing, and other City-owned property.

Individual sites in the pipeline for each watershed are listed in the WATERSHED section of this report. Photos of constructed projects can be seen on DEP's Flickr webpage.

RAIN GARDEN CONSTRUCTION AT P.S. 139, QUEENS

PERMEABLE PAVEMENT AT NYCHA GOWANUS HOUSES, BROOKLYN

Partnership With Trust For Public Land

DEP would like to highlight its long running and successful partnership on green schoolyard retrofits with The Trust for Public Land. TPL is a national conservation group working to protect land for public use and their work within NYC schoolyards has been transformative. The DEP TPL partnership began with the PlaNYC 2030 Schoolyards to Playgrounds Initiative, which kicked-off in 2013, and is one of the Green Infrastructure Program's earliest partnerships. Combining TPL's schoolyard renovations with DEP's stormwater management objectives was a natural fit. Adding green infrastructure elements such as rain gardens, stormwater turf fields, permeable surfaces, trees and subsurface storage systems into the playground designs help soften these playgrounds and allow them to absorb stormwater more efficiently, which benefits the surrounding community and NYC waterways.

Through the DEP TPL Schoolyards to Playgrounds Initiative, TPL has constructed 21 projects with more than 30 additional projects in design and planning stages as summarized in Table 2 below. DEP project managers regularly discuss all aspects of project planning, design and construction with TPL partners. TPL not only works closely with DEP, DOE, and SCA on these projects, but also elected officials and other public and private organizations to foster community-wide support for these important projects.

TPL playground projects incorporate student, teacher and school staff input into each schoolyard design and this in turn helps to ensure that the most frequent users of the playgrounds have a voice in the layout of new and updated features and can better understand how the different features work as a system. Where feasible, school playgrounds are open to the public after school hours to foster a sense of community and to make outdoor space more accessible. DEP commends TPL for the work they do to include students in the design process of their projects instilling a sense of environmental stewardship within future generations and helping DEP meet citywide stormwater management goals.

TPL TURF FIELD CONSTRUCTION AT I.S. 339, BRONX

TABLE 2: TPL SCHOOLYARD RETROFITS BY PROJECT STATUS

Project Status	Schoolyards
Constructed/In Construction	23
In Design	34
Planning	3
Total	**60**

PLANTING DAY AT P.S. 84, QUEENS

PLANTING DAY AT P.S. 84, QUEENS

GREEN INFRASTRUCTURE AT P.S. 84, QUEENS

The TPL-led schoolyard retrofit at P.S. 84 was designed with input from teachers and students. Two synthetic turf fields with a total area of 3,431 SF is designed to capture 700,000 gallons of stormwater each year, reducing CSO volume released into the East River and Long Island Sound. The schoolyard is open to the community during non-school hours and serves nearly 18,000 residents within a 10-minute walk of home. DEP's contribution of $500,000 for the green infrastructure practices helps this project contribute to NYC stormwater management goals and make this site more absorbent for the surrounding community.

TPL TURF FIELD CONSTRUCTION AT P.S. 84, QUEENS

TPL TURF FIELD AT P.S. 84, QUEENS

TIBBETTS BROOK AND VAN CORTLANDT LAKE PARK IMPROVEMENTS

Tibbetts Brook originates in Yonkers and flows through Van Cortlandt Park in the Bronx before discharging into Van Cortlandt Lake. Since the early 1900s, the stream has been diverted from Van Cortlandt Lake through an 8' 0" diameter tunnel that connects to a combined sewer flowing to the Wards Island Wastewater Resource Recovery Facility (WRRF). During wet-weather events, overflow from the combined sewer discharges to the Harlem River at an outfall on W. 192nd St. (referred to as WI-056), which, volumetrically, is one of the largest CSO discharge points in NYC. During the development of the EROW Long Term Control Plan (LTCP) DEP identified Tibbetts Brook as a unique opportunity for a green infrastructure project with significant CSO reduction opportunities. The City has initiated review of property rights and easements necessary for acquisition and is working with relelvant property owners.

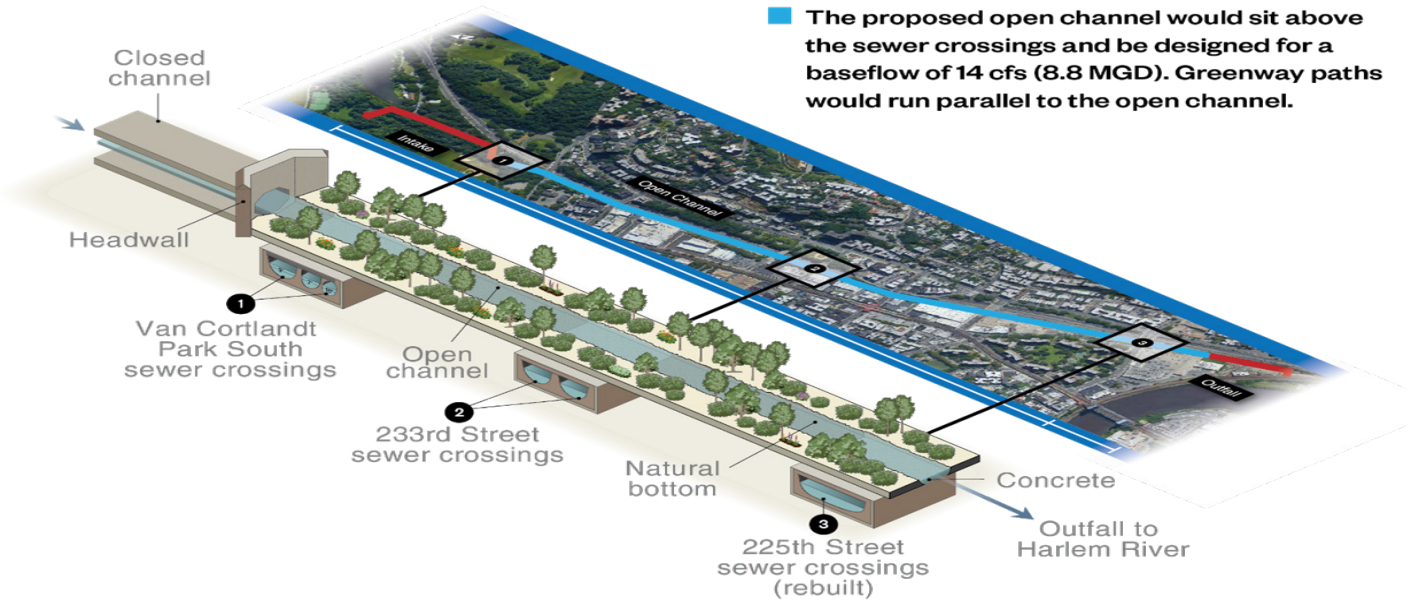
Figure 2 below shows the approximately 1.5-mile route of the proposed project, including a 1-mile long segment of open channel and two smaller segments of underground pipes. The proposed project has two components: 1. Van Cortlandt Lake improvements for additional dynamic storage, and 2. Baseflow daylighting of Tibbetts Brook. Baseflow daylighting could include additional storm flow up to 31 cubic feet per second (CFS), which, in combination with Van Cortlandt Lake improvements, could provide an annual CSO reduction of up to 228 million gallons. In addition, Parks' proposed 0.8-mile greenway extension will continue the existing greenway from Van Cortlandt Park to W. 230th Street with an asphalt path and vegetated buffers. The extension would link with the 1.4-mile greenway in Van Cortlandt Park that opened in 2020, providing a safe and enjoyable corridor to link into Westchester County[1].

Project Highlights

- Health benefits: A safe, recreational trail provides the space and connections for healthy exercise.
- Equity: Project provides for an exceptional amenity; 3.8 acres of public open space
- Environmental improvements: The City will provide a landscaped and beautified corridor to replace the corridor that has been neglected and experienced illegal dumping, and construct a greenway with a sustainable, ADA-compliant design.
- Estimated CSO reduction: 228 MGY
- Estimated Greened Acres: 600

More information on the Tibbetts Brook and Van Cortlandt Lake improvements project is available in the Citywide Open Waters LTCP, which is posted on DEP's website.

FIGURE 2: TIBBETTS BROOK AND VAN CORTLANDT LAKE PARK IMPROVEMENTS



1 Green Wave: A Plan for Cycling in New York City.

STORMWATER REDUCTION & REUSE

DEP has launched in the EROW waterbodies stormwater reduction and reuse projects 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 combined sewer system (CSS), contributing to the Program's goal to reduce CSOs by 1.67 BGY.

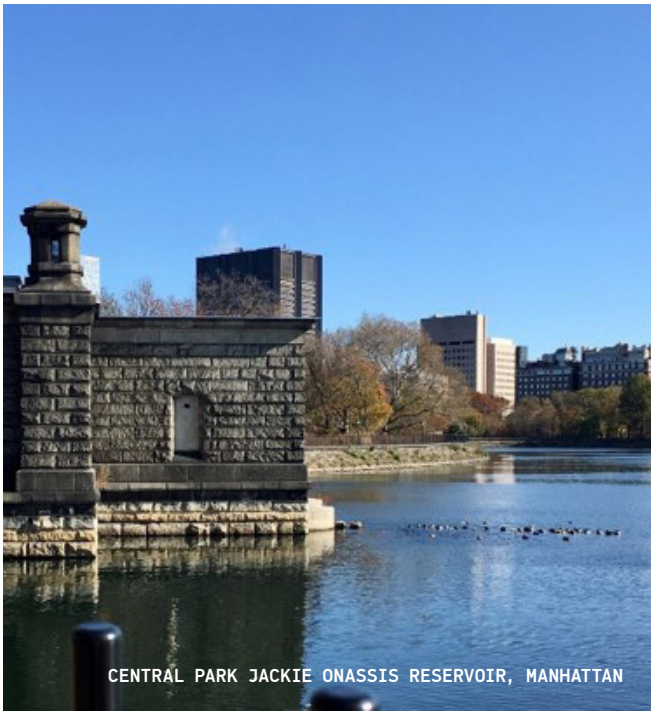
Through these projects and others, DEP has been actively working to reduce flows to sewers and wastewater facilities through water conservation and reuse, as part of an integrated approach to water resources management in New York City.

Central Park

In 2020, DEP continued coordinating with Central Park Conservancy (CPC) and Parks on the North End Recirculation Project. The project will save up to an estimated 0.83 Millions of Gallons per Day (MGD) of potable water by recirculating stormwater between the park's northern waterbodies, including the Harlem Meer. In Fall 2020, a major milestone was achieved when project design commenced. DEP and CPC continue to meet and coordinate regularly to discuss design alternatives, operation and maintenance, and to quantify the multiple benefits of this integrated, One Water project. In addition to the potable water reduction, other benefits include CSO reduction of up to 3 MGY in the East River and improved water quality in the park's northern waterbodies. In 2020, DEP also continued coordinating with Parks to execute a Memorandum of Understanding (MOU) to facilitate the funding transfer from DEP to Parks. DEP anticipates executing this MOU in 2021.

Prospect Park

In 2020, DEP continued 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 estimate 1 MGD or more of potable water, to maintain health and aesthetics. In December 2020, DEP and Parks executed an MOU for this project and completed the funding transfer from DEP to Parks. In Spring 2021, PPA anticipates hiring an engineering firm to design this project. DEP and PPA will continue to meet regularly during design and construction, with construction anticipated to begin in 2021 or early 2022. As an integrated, One Water project, this valve replacement is expected to reduce CSOs during rain events to Gravesend Bay and the Upper Bay by 12 MGY.



CENTRAL PARK JACKIE ONASSIS RESERVOIR, MANHATTAN

PROSPECT PARK LAKE VALVE REPLACEMENT, BROOKLYN

PRIVATE PROPERTY INITIATIVES

399 SANDS GREEN ROOF IN CONSTRUCTION, BROOKLYN

Green Infrastructure Grant Program

Since its introduction in 2011, the Grant Program has sought to strengthen public-private partnerships and public engagement in regards to the design, construction, and maintenance of green infrastructure on private property throughout New York City. In 2019, the Grant Program's underlying rules were amended to shift the focus of the Program to green roof retrofits. This shift allows for a clear distinction between the Grant Program and the forthcoming Private Incentive Retrofit Program by focusing the Grant Program on green roof funding and the new program on larger, site-level green infrastructure opportunities. In 2020, improvements were made to the Program to streamline the application and contract execution process for condominium properties.

As a result of pandemic-driven procurement impacts, several Grant Program contract registrations were delayed in 2020. Despite these constraints, in spring 2020, Brooklyn Urban Retail Partners completed the construction of two green roof projects at the new Wegman's complex at the Brooklyn Navy Yard. Together the roofs total 23,201 square feet and manage over 2.5 million gallons of stormwater annually. DEP's first MS4 grant project also completed construction in the fall of 2020. The Nicotra Group constructed a 32,874 square foot agricultural rooftop farm at Corporate Commons Three in Staten Island. Produce grown on the rooftop farm will be sold locally with surplus being donated to a local food pantry in Staten Island. Additionally, public educational tours will be offered to cultivate interest in green infrastructure within the community. The project will manage over 3 million gallons of stormwater annually and will be Staten Island's largest green roof as of the date of this report. In spring 2021, Two Bridgeset Associates L.P. will begin construction on a community courtyard at Two Bridges Tower in Manhattan. The project includes the installation of a 3,292 square foot bioretention system and planting beds.

Five additional Grant Program projects are at final design and in the contract execution phase, with construction anticipated to kick off over 2021-2022. These projects include three green roofs on residential buildings and two rain garden projects. To date, DEP has committed more than $13 million to 33 private property owners to build green infrastructure projects.

DEP has committed more than $13 million to 33 private property owners to build green infrastructure projects

Private Property Retrofit Incentive Program

In November 2018, DEP issued a Request for Proposals (RFP) to select a Program Administrator and initiate a new Private Property Retrofit Incentive program, marking a significant expansion of DEP's private incentives for green infrastructure. As of spring 2021, DEP is finalizing the $53 million contract with the selected Program Administrator. The Administrator will be responsible for connecting with private property owners across the city and installing green infrastructure to manage up to 200 Greened Acres. The program will focus on properties over 50,000 square feet in total lot area in order to maximize the cost effectiveness of the projects. Projects are expected to begin in 2021. (See Exhibit D for a description of "Greened Acres.")

Green Roof Tax Abatement

Administered by NYC Department of Finance with application review and approval by DOB, the Green Roof Tax Abatement provides a one-time property tax abatement for properties that install green roofs. In 2019, New York State authorized the City to designate priority community districts to receive an enhanced tax abatement for green roof installation. Properties within the priority districts will receive a tax abatement of $15 per square foot for the installation of a green roof. All other community districts will receive the standard tax abatement of $5.23 per square foot. The list of priority districts and the final rule were released in January 2021 and can be found on the NYC Mayor's Office of Sustainability website.

Local Laws 92 and 94 of 2019

As of November 2019, all new buildings and alterations of existing buildings where the entire roof deck or roof assembly is being replaced must provide a sustainable roofing zone covering 100% of the roof. The sustainable roof zone must include a solar photovoltaic system, a green roof system or a combination of the two. Vertical and horizontal enlargements must also comply with these requirements. For more information about the requirements of Local Law 92 and 94, see the DOB's Bulletin 2019-010.

Collectively, the enhanced NYC Green Roof Tax Abatement and Local Laws of 2019 will substantially increase the number of green roofs across the city. DEP looks forward to working with the relevant agencies to provide green roof design resources and best practices and to track constructed projects toward citywide stormwater management goals.

CORPORATE COMMONS THREE GREEN ROOF CONSTRUCTION, STATEN ISLAND
©BROOKLYN GRANGE ROOFTOP FARM

2012 Stormwater Performance Standard

New development and redevelopment projects often require a sewer certification from DEP for new sewer connections to confirm the adequacy of the existing sewer to receive flow from the development. Sewer certifications require either a Site Connection Proposal (SCP) or a House Connection Proposal (HCP). DEP tracks the number of new SCPs and HCPs submitted to the Agency that are affected by the 2012 Stormwater Performance Standard (or Stormwater Rule). Since the rule took effect in July 2012, approximately 2,019 sites have been required to meet reduced stormwater release rates of 0.25 CFS or 10% of the allowable flow, whichever is greater.

DEP continues to review the site plans for projects regulated by the rule and incorporate them into GreenHUB so that the projects can be tracked in the same manner that DEP's publicly-funded projects are tracked. Approximately 595 assets and 252 Greened Acres, summarized in Table 3 below, have been incorporated into GreenHUB and reported in Table 4.

DEP is developing new stormwater regulations, referred to as the Unified Stormwater Rule, which will supersede the 2012 Stormwater Performance Standard. These new stormwater regulations are discussed on the following pages.

TABLE 3: SUMMARY OF STORMWATER PERFORMANCE STANDARD ASSETS AND GREENED ACRES IN GREENHUB

GI Type	Asset Count	Greened Acres
Subsurface Retention	22	5.9
Green Roof	1	0.1
Other Rooftop System	213	51.7
Detention System	278	140.8
Drywell	34	5.8
Multiple GI Compnents	47	42.3
Total	**595**	**252**

NYC stormwater regulations apply to public and private property and project metrics are tracked in the same way DEP-funded projects are tracked

Unified Stormwater Rule and New NYC Stormwater Manual

As reported in previous Green Infrastructure Annual Reports and in the New York City Stormwater Management Program Plan (SWMPP), DEP intends to propose amendments to Chapters 31 and 19.1 of Title 15 of the Rules of the City of New York (RCNY) as part of a Unified Stormwater Rule. The Unified Stormwater Rule, to be administered citywide, will update and align Chapter 31 stormwater quantity and flow rate requirements with Chapter 19.1 Construction/Post-Construction permitting program water quality requirements. Under Chapter 31 amendments, the Unified Stormwater Rule increases the amount of stormwater required to be managed on-site and further restricts the release rates for all new and redevelopment projects that require a DEP House or Site Connection Proposal (HCP or SCP).

Additionally, under Chapter 19.1 amendments, sites that disturb 20,000 square foot or more of soil or increase impervious surfaces by 5,000 square feet or more will also be required to manage the Water Quality Volume (WQv), currently defined as 1.5", using stormwater management practices (SMPs) dictated by DEP SMP hierarchies. DEP has developed hierarchies for both combined and separate sewer areas. The SMP hierarchies prioritize vegetated retention SMPs for both drainage areas with stormwater volume control and stormwater treatment communicated as the underlying goals for combined and separate sewer areas, respectively.

For sites that trigger the Chapter 19.1 component of the Unified Stormwater Rule, the hierarchy is mandatory, meaning that developers must start with the most preferred SMP and provide documentation of site con-

straints that prevent implementation in order to move to the next SMP. The combined and separate sewer SMP hierarchies are shown below as Figure 3 and Figure 4. The priority level of each SMP group is indicated by tiers with different colors, where the darker shades of green or blue indicate higher tier SMPs.

The Unified Stormwater Rule will lead to a substantial improvement in the way that individual new and redeveloped properties manage stormwater. In some cases stormwater will be entirely prevented from entering the city sewer system through retention; in all cases stormwater that does enter the system will be reduced and/or treated and released at a much lower rate, allowing the system to operate more efficiently during peak wet weather events. 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 will contribute to the Program's 2030 CSO reduction goal and continue on beyond the Program, helping to institutionalize green infrastructure in new development across the city.

In September 2020, New York City Council passed Local Law 91 enabling DEP to move forward with the Chapter 19.1 amendments necessary to package the Unified Stormwater Rule amendments. Draft rules are anticipated to be published in 2021 and to go into effect in 2022. A new New York City Stormwater Manual will accompany the Unified Stormwater Rule to provide clear guidance on requirements and design options. The draft manual will be published with the draft rules in 2021.

In 2020, DEP held six public agency briefings and five private industry and stakeholder briefings on the MS4 legislation expansion and forthcoming Unified Stormwater Rule. Public outreach will continue throughout 2021 as the draft rules and manual are released. More details on the Unified Stormwater Rule and forthcoming outreach can be found on DEP's website.

The draft Unified Stormwater Rule and New York City Stormwater Manual will be published in 2021

FIGURE 3: MUNICIPAL SEPARATE STORM SEWER SYSTEM AREA STORMWATER MANAGEMENT PRACTICE HIERARCHY

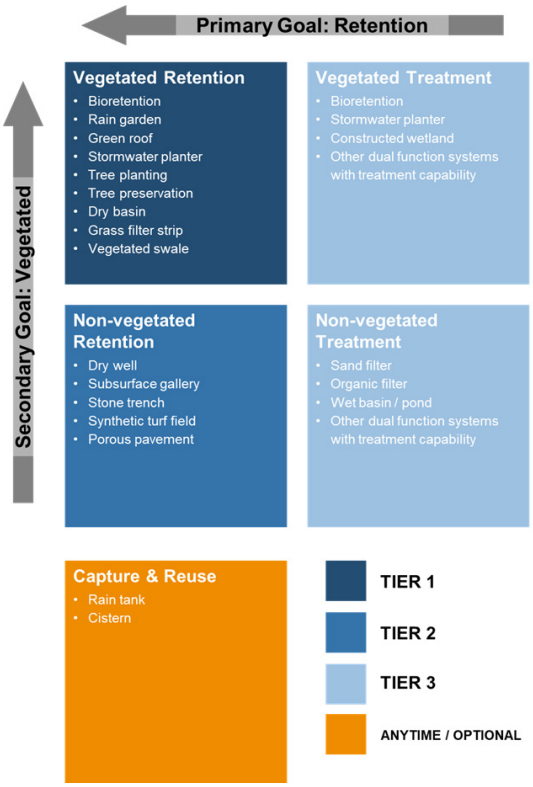
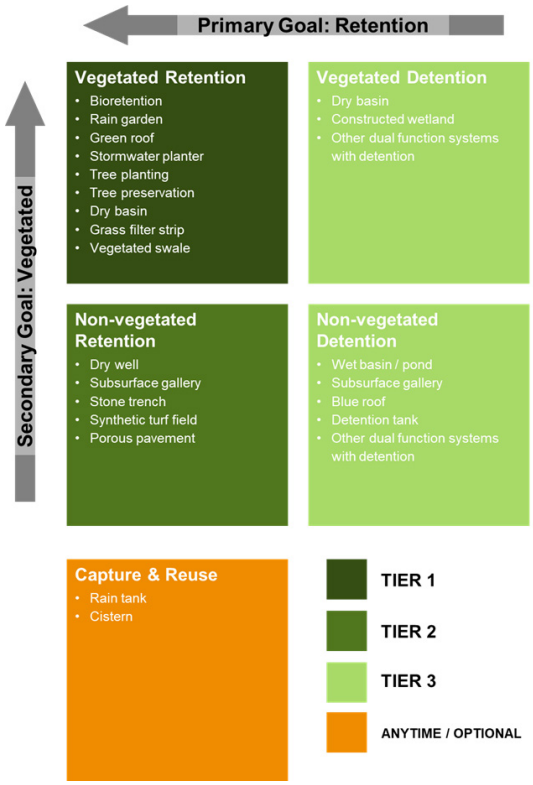


FIGURE 4: COMBINED SEWER SYSTEM AREA STORMWATER MANAGEMENT PRACTICE HIERARCHY



Construction Management, Inspection, and Enforcement

DEP has constructed or is currently in construction on over 10,000 ROW green infrastructure assets throughout the city. De- spite these numbers, green infrastructure is still a relatively new field in the construction industry. Many aspects of green infrastructure construction are unique to the way in which these assets function, and DEP identified the need to further the understanding of the personnel involved at all levels – from laborers and site supervisors, to inspectors and construction managers overseeing the construction projects.

The DEP in-house field team continues to provide construction oversight and inspection of green infrastructure construction, as well as enforcement for green infrastructure protection requirements. Inspectors work closely with project managers and superintendents on active and upcoming construction projects in both the ROW and on public property, to confirm that green infrastructure practices are built as designed and function properly. Inspectors help contractors to understand updated design standards, present lessons learned from previous projects, and highlight components that are critical to the performance of green infrastructure practices.

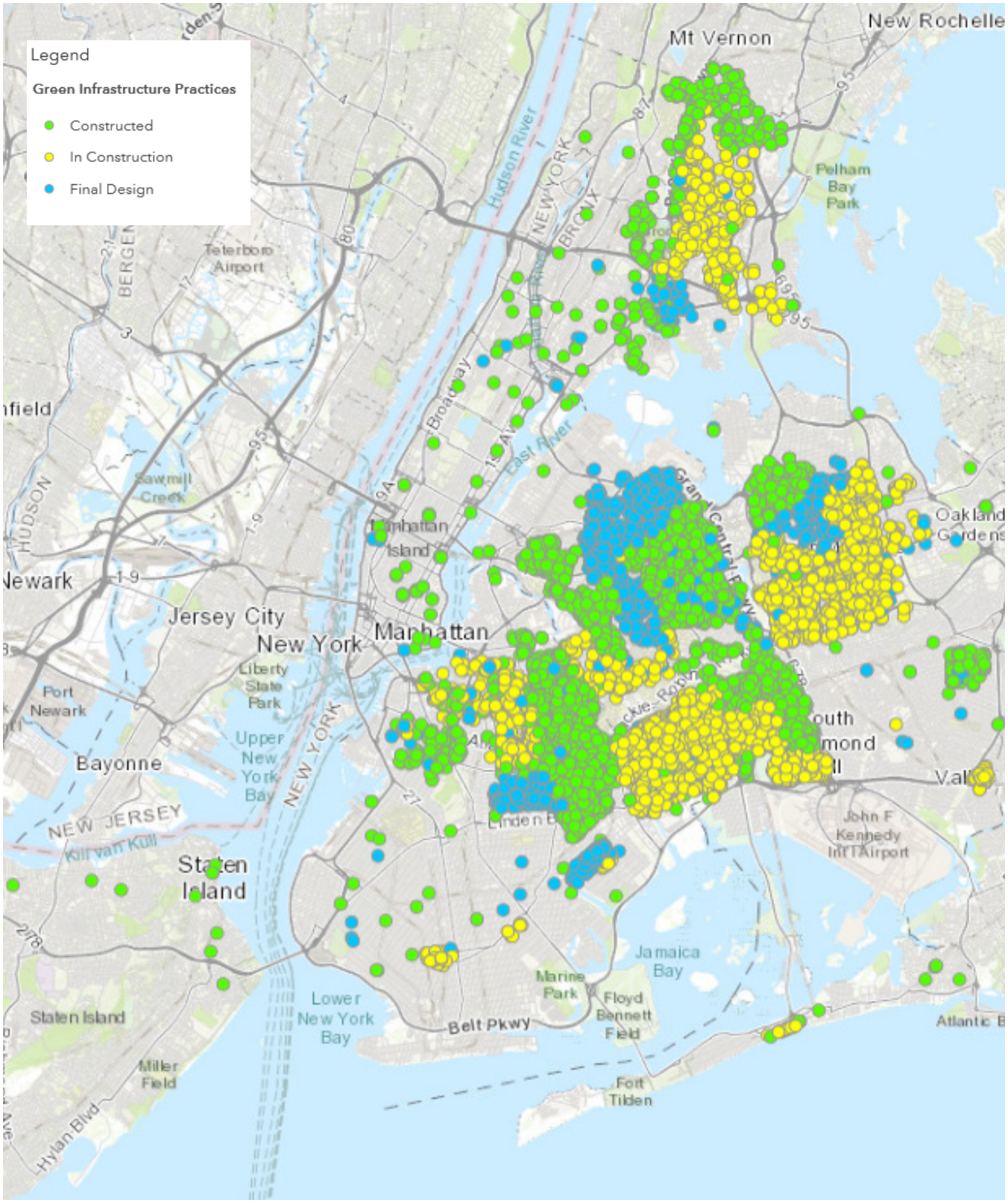
As part of this effort, the in-house field team has created an Inspection Report and Checklist (IRC) to collect as much information as possible about constructed assets during field inspections. The IRC helps DEP inspectors and project managers keep track of critical components at each stage of green infrastructure construction, and ensures that all issues are addressed as early as possible to prevent the contractor from having to redo work later during final inspections.

DEP's increased presence in the field is a great opportunity for the program to evaluate the effectiveness of current practices and to identify areas for improvement. This field team will continue green infrastructure construction oversight inspections and enforcement activities to protect green infrastructure.

EXCAVATED SITE WITH GEOTEXTILE FABRIC

INFILTRATION BASINS IN CONSTRUCTION

GREEN INFRASTRUCTURE PROGRAM MAP



View the complete map at nyc.gov/dep/gimap

Watersheds by the Numbers

PROGRESS TOWARD 1.67 BILLION GALLONS PER YEAR OF CSO REDUCTION

DEP's Performance Metrics Report (PMR) submitted to the Department of Environmental Conservation (DEC) on-June 30, 2016 and approved on July 5, 2017, showed that DEP can achieve 507 MGY of CSO reductions with the initial milestone target for 2015 as outlined in the Consent Order[1], primarily from retention green infrastructure assets. DEP is ultimately working toward a reduction of 1.67 BGY by 2030 through green infrastructure implementation. While some of the projects included in the 507 MGY reduction are still underway and are part of the 2015 Contingency Plan (see Exhibit C), DEP anticipates reaching the 507 MGY by the end of 2021. Specific pandemic-related schedule delays are yet to be determined (TBD), as indicated in the table in Exhibit C. However, many of the projects are in the ground and already providing CSO reduction benefits. Table 4 below shows all assets either constructed or in construction as of the publication of this report.

For the 2020 milestone, DEP continues to make significant progress to design and build green infrastructure and is preparing to submit a Contingency Plan in 2021.

TABLE 4: STORMWATER MANAGED AND EQUIVALENT GREENED ACRES, 2010-2020

Watershed	Total Assets[2]	Total Equivalent Greened Acres
Alley Creek	1	0
Bronx River	446	93
Coney Island Creek	49	9
Flushing Bay	772	82
Flushing Creek	1,879	196
Gowanus Canal	127	23
Hutchinson River	208	41
Jamaica Bay	4,634	559
Newtown Creek	1,586	163
Westchester Creek	230	23
Total Watershed	**9,932**	**1,188**
East River/Open Waters	1,118	316
Total Citywide[3]	**11,050**	**1,504**

Note: The Annual Report and its contents, including this table, provide yearly updates for public consumption and transparency for our stakeholder community. It should not be interpreted as a milestone compliance document. The Program's compliance with the Consent Order is based on milestone certifications submitted to DEC at five year intervals. For the milestone submittal schedule, see the Order here. In addition, assets and Greened Acres may increase or decrease in any given year due to rejections during construction, termination of construction contracts or other unforeseen circumstances.

1 (DEC # CO2-2000107-8, as modified).
2 Assets constructed or in construction in 2020.
3 Sum may not add up to total due to rounding.

WATERSHED GREENED ACRES BREAKDOWN

The figures below are meant to help illustrate where the Greened Acres are being constructed and what the practices generating the Greened Acres are. Readers should note that these graphics represent a one-time snapshot and that actual numbers may change due to unexpected field conditions encountered during construction.

The graphics cover these four 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
- **Private** – implemented through incentives provided by DEP or through stormwater regulations

Figure 5 shows how many Greened Acres have been implemented or are being implemented in each of the implementation areas. The figure provides an additional breakout for the private program area to differentiate between incentivized and regulated green infrastructure. As shown, the majority of the Greened Acres, over 90% of those reported out, are being implemented through the ROW program. As described earlier, DEP is still inputting private regulated sites into GreenHUB and this number will continue to increase over the next reporting cycles.

Figure 6 shows the breakdown of Greened Acres by green infrastructure type for each of the primary Program implementation areas. The figure shows that rain gardens make up over 70% of the green infrastructure assets constructed in the ROW, while a large portion of onsite implementation is permeable pavement. Table 3 in the PRIVATE PROPERTY INITIATIVES section gives a full breakdown of green infrastructure types implemented in private regulated sites, which are primarily detention practices.

FIGURE 5: BREAKDOWN OF GREENED ACRES BY PROGRAM AREA

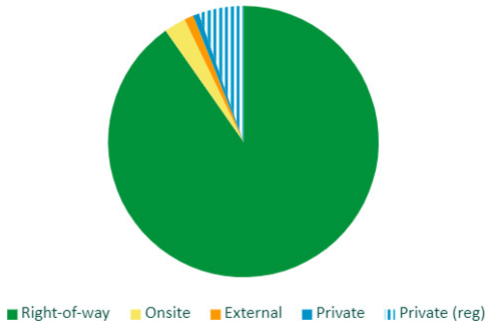
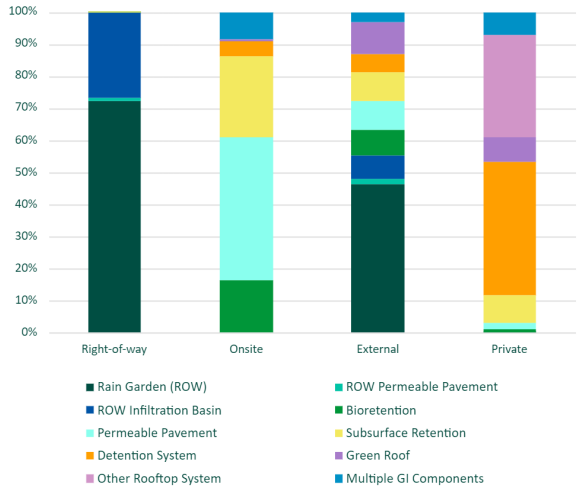


FIGURE 6: BREAKDOWN OF PROGRAM AREA GREENED ACRES BY GREEN INFRASTRUCTURE TYPE



DEP's publicly funded projects are those for which DEP is directly involved in the design and construction, and consist of the ROW area-wide projects, public property retrofit projects implemented jointly with our agency partners, and private property projects built through the Green Infrastructure Grant Program. Of the total green infrastructure assets and associated Greened Acres reported in Table 4, DEP's publicly funded projects encompass **10,259 assets** with an equivalent **1,126 Greened Acres.**

Green Infrastructure Watershed Maps

DEP continues to present the green infrastructure implementation and planning updates at a watershed level in order to show stakeholders the magnitude and scale of the work completed and planned in each of the City's watersheds to reduce CSOs and provide the co-benefits resulting from green infrastructure projects.

HOW DOES DEP IDENTIFY POTENTIAL PROJECTS WITHIN A WATERSHED?

The watershed maps illustrate DEP's area-wide approach to evaluating green infrastructure opportunities block-by-block and site-by-site in each watershed, starting with the Priority CSO watersheds. Once this area-wide survey is completed, DEP implements green infrastructure at each feasible location through ROW and public property retrofits, private property initiatives or other strategic partnerships. These maps also include green infrastructure and ecosystem restoration projects that DEP is undertaking in non-combined sewer areas as part of other City initiatives.

The 2020 accomplishments provide a quick visual representation of all the work in each watershed that "rolls up" to the Program-wide information presented in Table 4. Each page also includes a list of all upcoming projects that DEP is working hard to bring to reality. The result is a comprehensive, watershed-by-watershed snapshot of DEP's current and projected Program.

As previously described, all of the green infrastructure assets that are constructed and in construction are tracked and counted. Each asset contributes to the overarching goals of the Program to reduce CSO volume and provide co-benefits for New Yorkers. DEP expects to achieve 1.67 billion gallons of CSO volume reduction per year by 2030.

THE MAPS SHOW PROJECTS IN SEPARATELY SEWERED AREAS OF THE CITY. ARE THESE PROJECTS COUNTED IN TABLE 4 AND IN THE WATERSHED ACHIEVEMENTS?

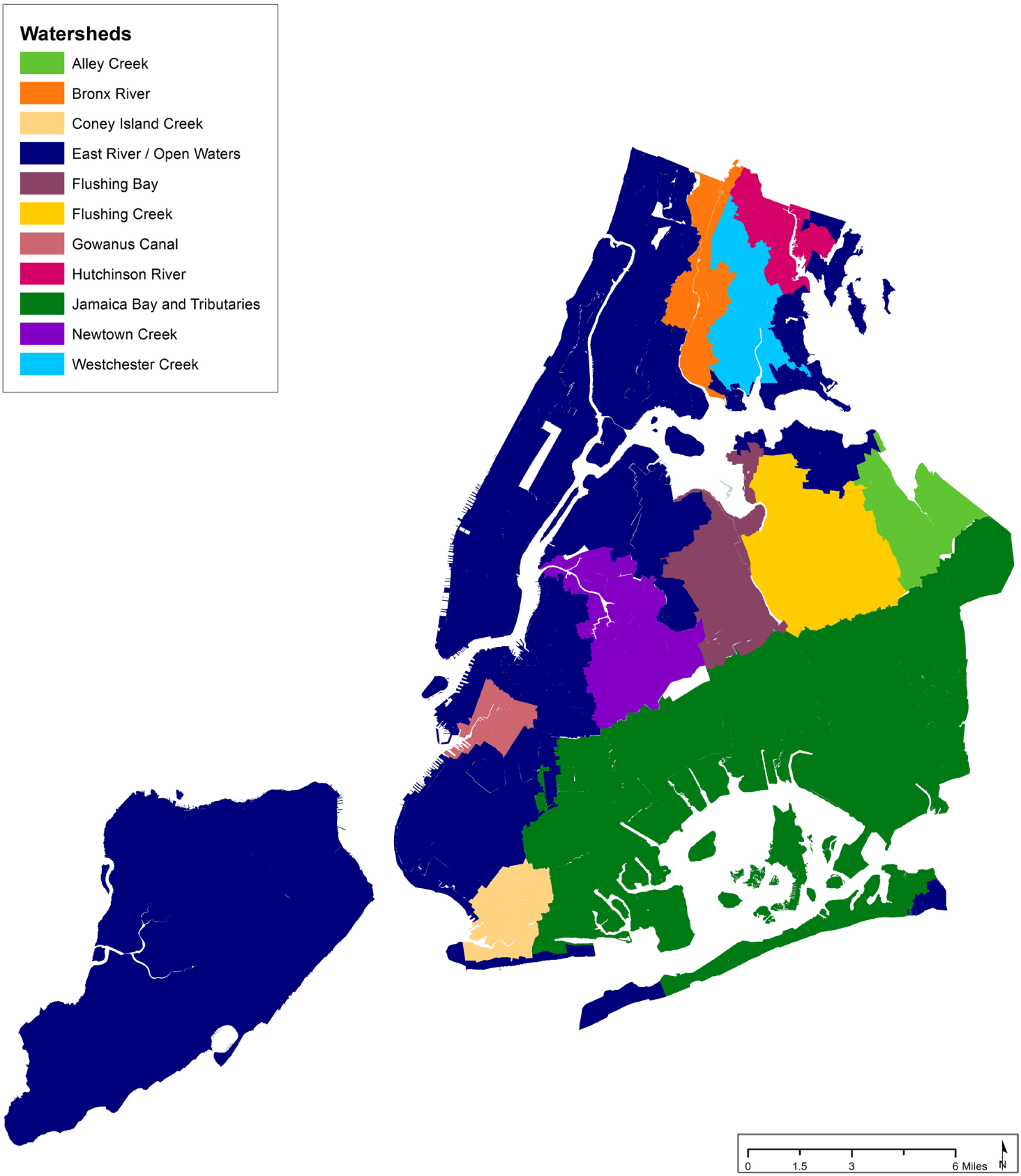
The green infrastructure projects that DEP is installing in the separately sewered areas of the City are shown in the maps in order to provide a full picture of green infrastructure implementation in each of the watersheds. They are not counted toward CSO volume reduction and not included in Table 4 or the watershed achievement numbers.

NOW THAT DEP IS TRACKING THE SITE CONNECTION PERMITS IN GREENHUB, ARE THOSE PROJECTS SHOWN IN THE MAP?

Green infrastructure on private property that was not installed through the Green Infrastructure Grant Program, including SCPs, are not mapped at this time. However, the assets are counted in Table 4 and in the watershed achievements, as they are a part of DEP's efforts to achieve 1.67 billion gallons of CSO volume reduction per year by 2030.

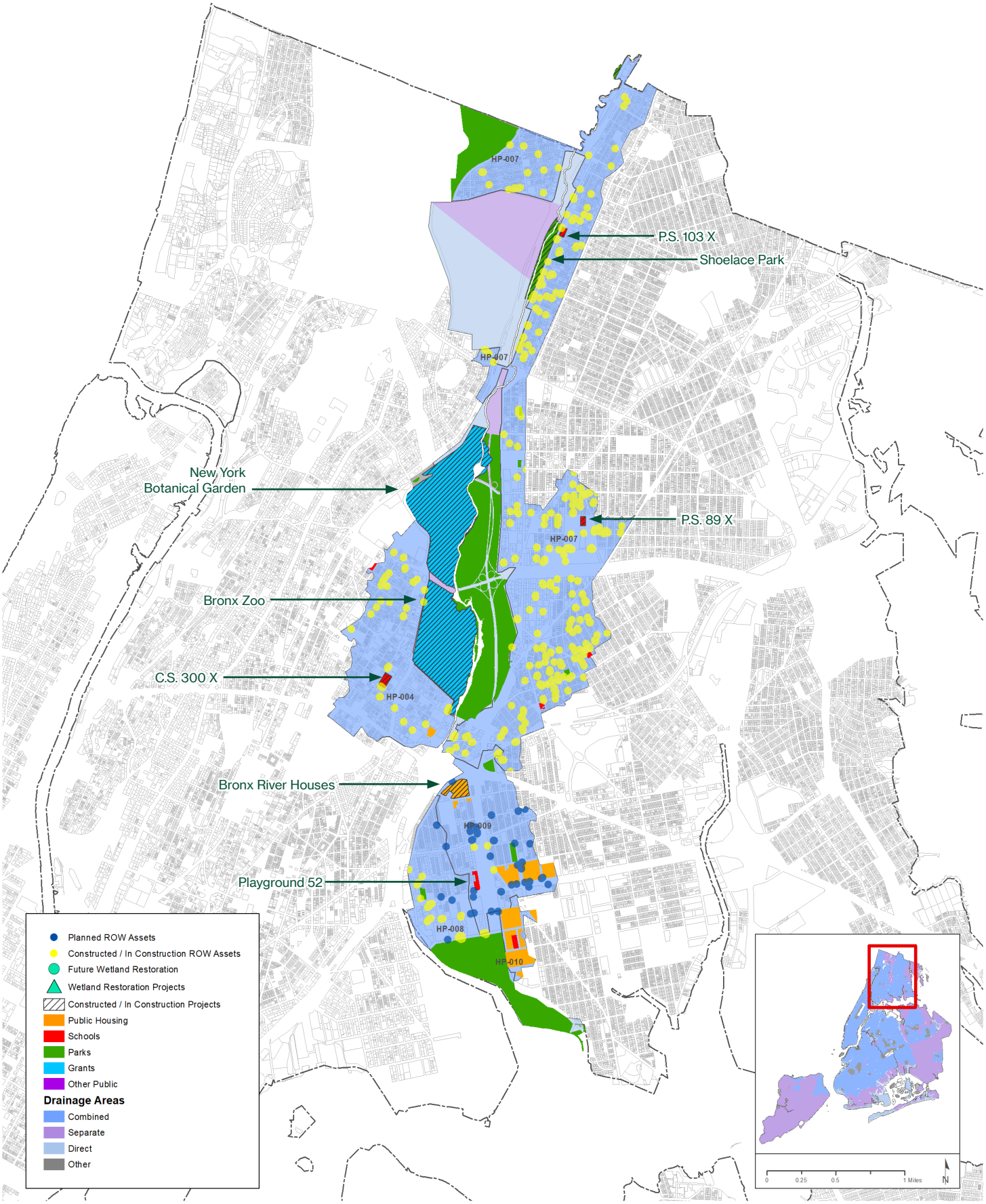
RAIN GARDEN, QUEENS

WATERSHED MAP KEY



BRONX RIVER WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



BRONX RIVER WATERSHED

2010-2020 ACCOMPLISHMENTS

446 Assets Constructed and In Construction

116.4M Annual Gallons of Stormwater Managed*

93 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

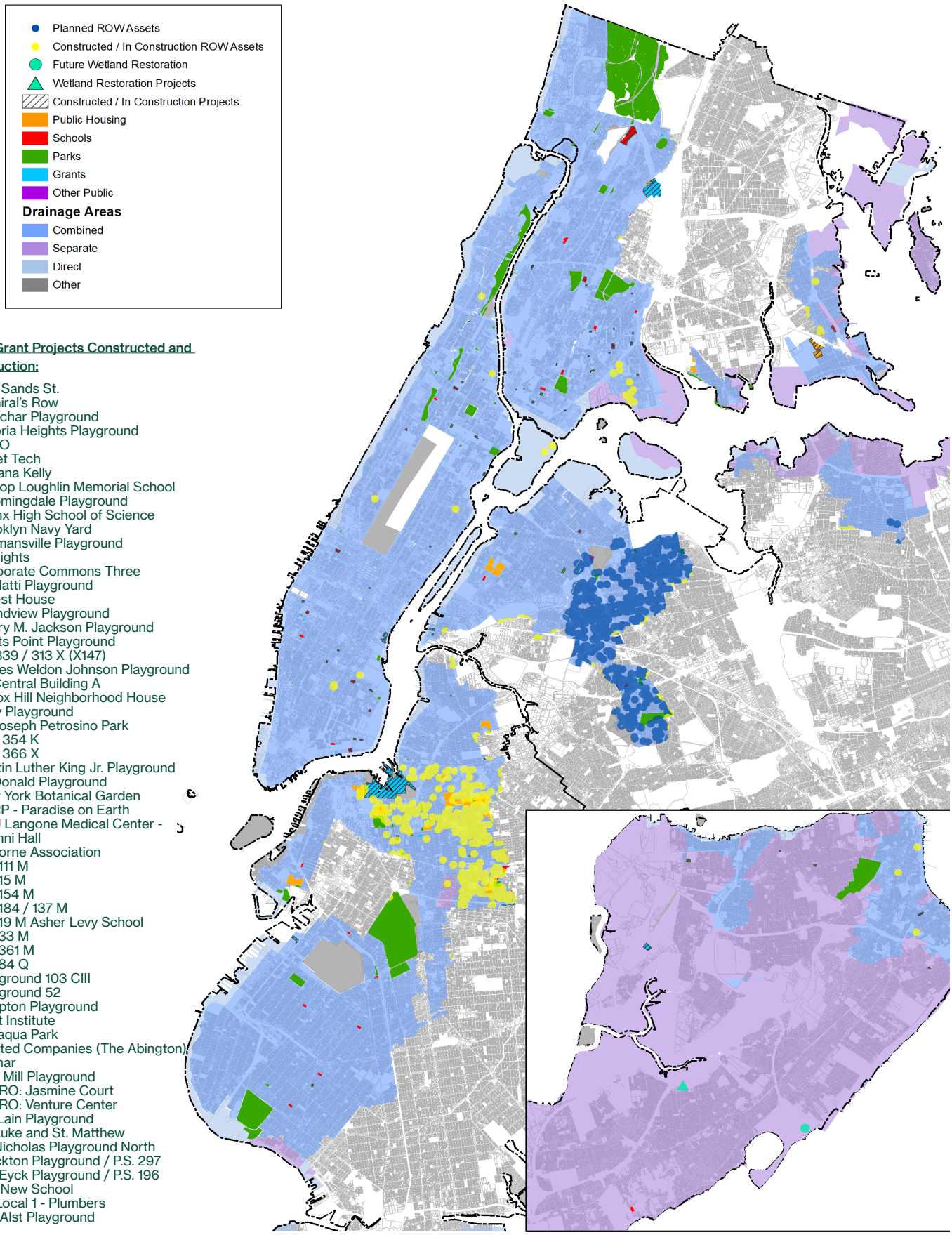
UPCOMING PUBLIC & GRANT PROJECTS**

- 1010 East 178TH Street
- Bronx Park
- Bronx River Addition
- Clason Point Gardens
- Colgate Close Park
- I.S. 123 X
- I.S. 45 Annex
- Matthews Muliner Playground
- Noble Playground
- P.S. 107 X
- P.S. 64 X
- P.S. 83 X
- Parkside Playground
- Sack Wern
- Sotomayor Houses
- Soundview
- Soundview Park
- Watson Gleason Playground

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

EAST RIVER / OPEN WATERS

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



Public & Grant Projects Constructed and In Construction:

- 399 Sands St.
- Admiral's Row
- Arrochar Playground
- Astoria Heights Playground
- ATCO
- Ballet Tech
- Banana Kelly
- Bishop Loughlin Memorial School
- Bloomingdale Playground
- Bronx High School of Science
- Brooklyn Navy Yard
- Carmansville Playground
- Citylights
- Corporate Commons Three
- DeMatti Playground
- Forest House
- Grandview Playground
- Henry M. Jackson Playground
- Hunts Point Playground
- I.S. 339 / 313 X (X147)
- James Weldon Johnson Playground
- La Central Building A
- Lenox Hill Neighborhood House
- Levy Playground
- Lt. Joseph Petrosino Park
- M.S. 354 K
- M.S. 366 X
- Martin Luther King Jr. Playground
- McDonald Playground
- New York Botanical Garden
- NYRP - Paradise on Earth
- NYU Langone Medical Center - Alumni Hall
- Osborne Association
- P.S. 111 M
- P.S. 15 M
- P.S. 154 M
- P.S. 184 / 137 M
- P.S. 19 M Asher Levy School
- P.S. 33 M
- P.S. 361 M
- P.S. 84 Q
- Playground 103 CIII
- Playground 52
- Plimpton Playground
- Pratt Institute
- Ranaqua Park
- Related Companies (The Abington)
- Salmar
- Saw Mill Playground
- SoBRO: Jasmine Court
- SoBRO: Venture Center
- Sol Lain Playground
- St. Luke and St. Matthew
- St. Nicholas Playground North
- Stockton Playground / P.S. 297
- Ten Eyck Playground / P.S. 196
- The New School
- UA Local 1 - Plumbers
- Van Alst Playground

EAST RIVER / OPEN WATERS

2010-2020 ACCOMPLISHMENTS

1,118 Assets Constructed and In Construction

397.4M Annual Gallons of Stormwater Managed*

316 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

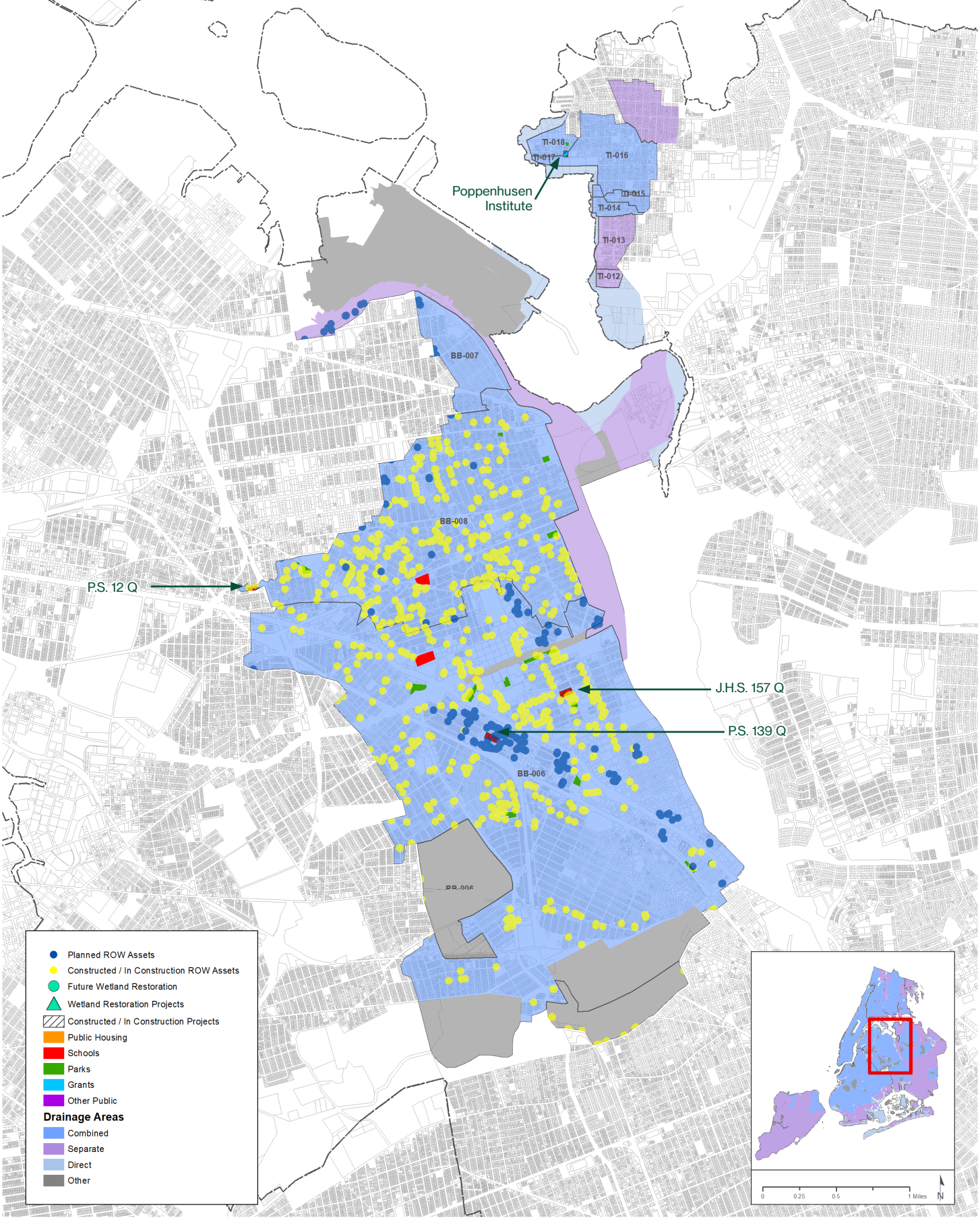
UPCOMING PUBLIC & GRANT PROJECTS**

- 115th Precinct Off Street Parking
- 115th Precinct Off Street Parking
- 40th Precinct
- Albany
- Albert J. Parham Playground
- Alice Kornegay Triangle Playground
- Asser Levy Recreation Center and Pool
- Aurum Condominum
- Bailey Playground
- Bedford Stuyvesant Restoration
- Bowne Park
- Bushwick Pool Building
- Chelsea Recreation Center
- Claremont Park
- Colonel Charles Young Playground
- Cooper Park
- Crotona Park Boathouse
- Dry Dock Pool Building
- Dyker Playground
- E. Elmhurst Playground
- Elmhurst Park Decorative Fountain
- Epiphany Playground
- Farragut
- Fort Greene Park
- Gertrude Ederle Recreation Center
- Golconda Playground
- Greenwood Playground
- Hansborough Recreation Center
- Highbridge Recreation Center
- I.S. 220 K
- I.S. 390 - The School of Integrated Learning
- I.S. 7 R
- J.H.S. 227 K
- Juniper Valley Park Field House
- Kingsbridge Heights Community Center
- Lafayette
- Laguardia Landing Lights
- London Terrace Towers
- M.S. 223 K
- M.S. 224 X (X139)
- M.S. 267 X (X158)
- M.S. 306 X
- M.S. 584 X (X162)
- Mafera Park
- Magenta Playground
- Marble Hill Playground
- Marcy
- Montefiore (Moses)
- Morningside Park
- NYC Lab School
- P.S. 10 K
- P.S. 111 Q
- P.S. 130 K
- P.S. 146 Brooklyn New School, Brooklyn Collaborative Studies
- P.S. 180 M
- P.S. 2 M
- P.S. 204 K
- P.S. 243 K - Weeksville School
- P.S. 297 K - Abraham Stockton
- P.S. 368 / I.S. 33
- P.S. 58 Q
- P.S. 59 K - William Floyd
- P.S. 66 X
- P.S. 71 K
- Parade Grounds Recreation Center
- Patrick O'Rourke Playground
- Pelham Fritz Recreation Center
- Peter Minuit Playground
- Poe Park Visitors Center
- Potomac Playground
- Ravenswood
- Raymond Bush Playground
- Recreation Center 54
- Renaissance Playground
- Sedgewick & Dickenson
- Seton Park
- Sheltering Arms Poolhouse
- Silver Lake Park transverse road
- Spuyten Duyvil Playground
- St. James Recreation Center
- St. John's Recreation Center
- St. Mary's Recreation Center
- St. Michael's Playground
- St. Nicholas Park
- Star Spangled Playground
- Sumner
- Sunset Park Recreation Center
- Taaffe Playground
- Thomas Jefferson Park
- Tompkins
- Tony Dapolito Recreation Center
- Two Bridges Neighborhood Council
- Van Cortlandt Park
- Whitman
- Williambridge Oval

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

FLUSHING BAY WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



FLUSHING BAY WATERSHED

2010-2020 ACCOMPLISHMENTS

772 Assets Constructed and In Construction

103M Annual Gallons of Stormwater Managed*

82 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

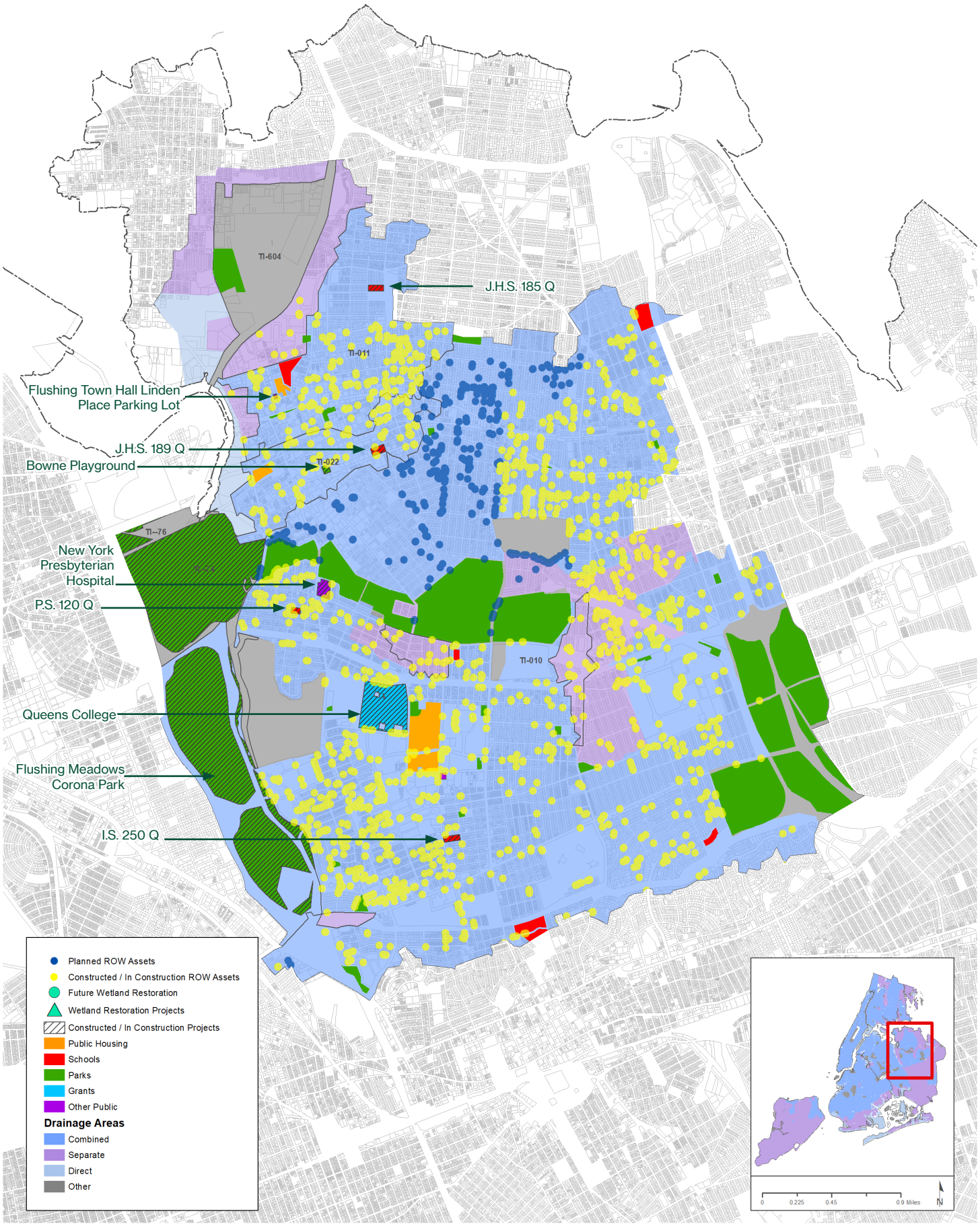
UPCOMING PUBLIC & GRANT PROJECTS**

- Annadale Playground/PS 175
- Barrier Playground
- Corona Golf Playground
- Ehrenreich-Austin Playground
- Frank D. O'Connor Playground
- Hoffman Park
- Horace Harding Playground
- Lost Battalion Hall Recreation Center
- Louis Armstrong Community Center
- Louis Armstrong Playground
- Newtown H.S. Athletic Field
- P.S. 744 Q
- Playground 115
- Real Good Park
- Russell Sage Playground/JHS 190Q
- The Painter's Playground/PS 174

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

FLUSHING CREEK WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



FLUSHING CREEK WATERSHED

2010-2020 ACCOMPLISHMENTS

1,879 Assets Constructed and In Construction

246.3M Annual Gallons of Stormwater Managed*

196 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

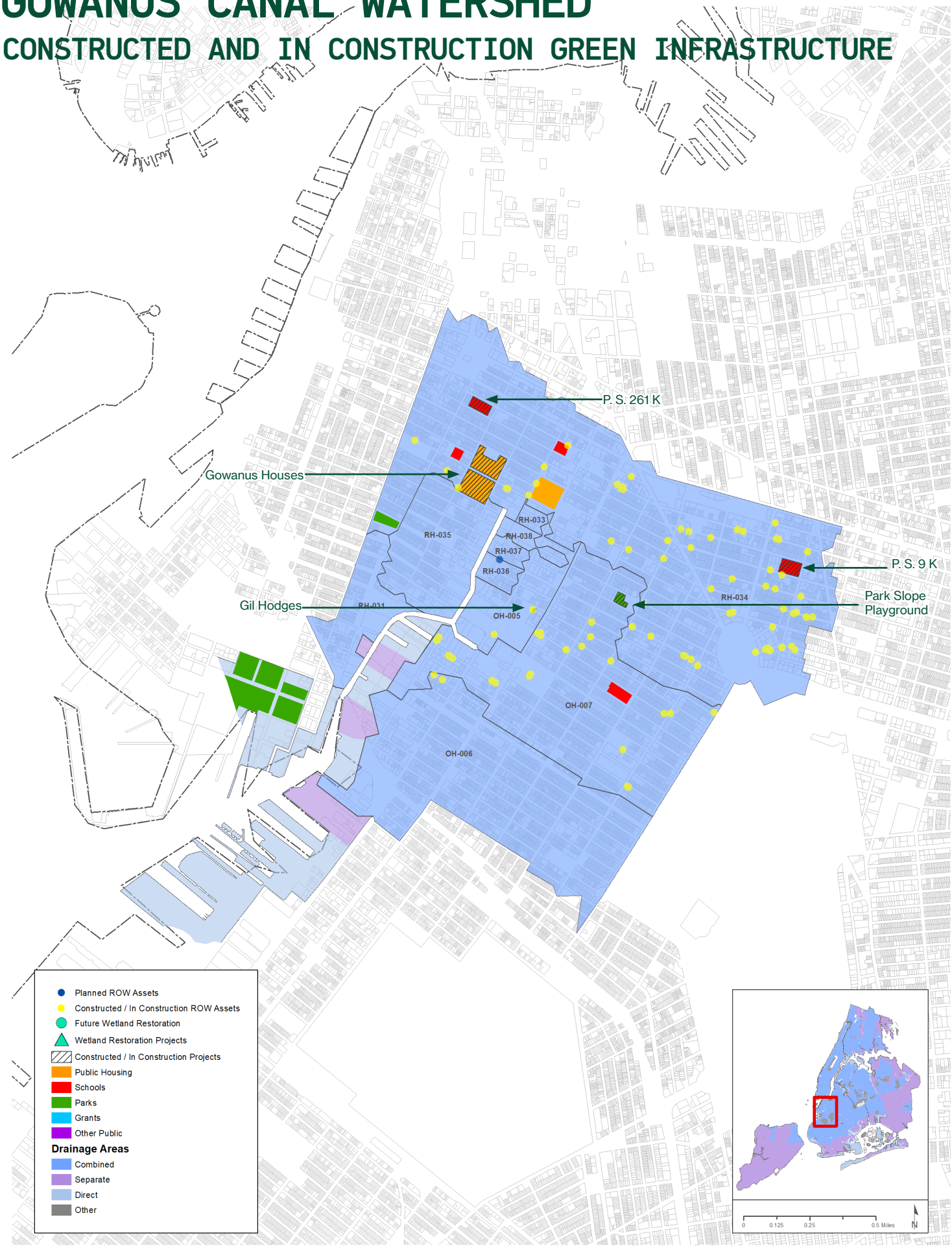
UPCOMING PUBLIC & GRANT PROJECTS**

- 107th Precinct
- Bayside H.S. Athletic Field
- Bland
- Cedar Grove Playground
- Colden Playground
- College Point Fields
- Cunningham Park
- Daniel Carter Beard Mall
- Electric Playground
- Emerald Playground
- Flushing Greens
- Flushing H.S. Athletic Field (Levitts Field)
- Francis Lewis Playground
- Fresh Meadows Park
- Fresh Meadows Playground
- Holy Cow Playground
- Hoover - Manton Playgrounds
- Jamaica H.S.
- Judge Moses Weinstein Playground
- Kissena Corridor Park
- Kissena Park
- LATIMER GARDENS
- Margaret I. Carman Green - Weeping Beech
- Murray Hill Playground
- P.S. 163 Q
- P.S. 178 Q
- Plaut Triangle
- Playground Seventy Five
- POMONOK
- Pomonok Playground
- Queens Valley Playground
- Saul Weprin Playground
- Thomas A. Edison Voc H.S.
- Utopia Playground

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

GOWANUS CANAL WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



GOWANUS CANAL WATERSHED

2010-2020 ACCOMPLISHMENTS

127 Assets Constructed and In Construction

28.5M Annual Gallons of Stormwater Managed*

23 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

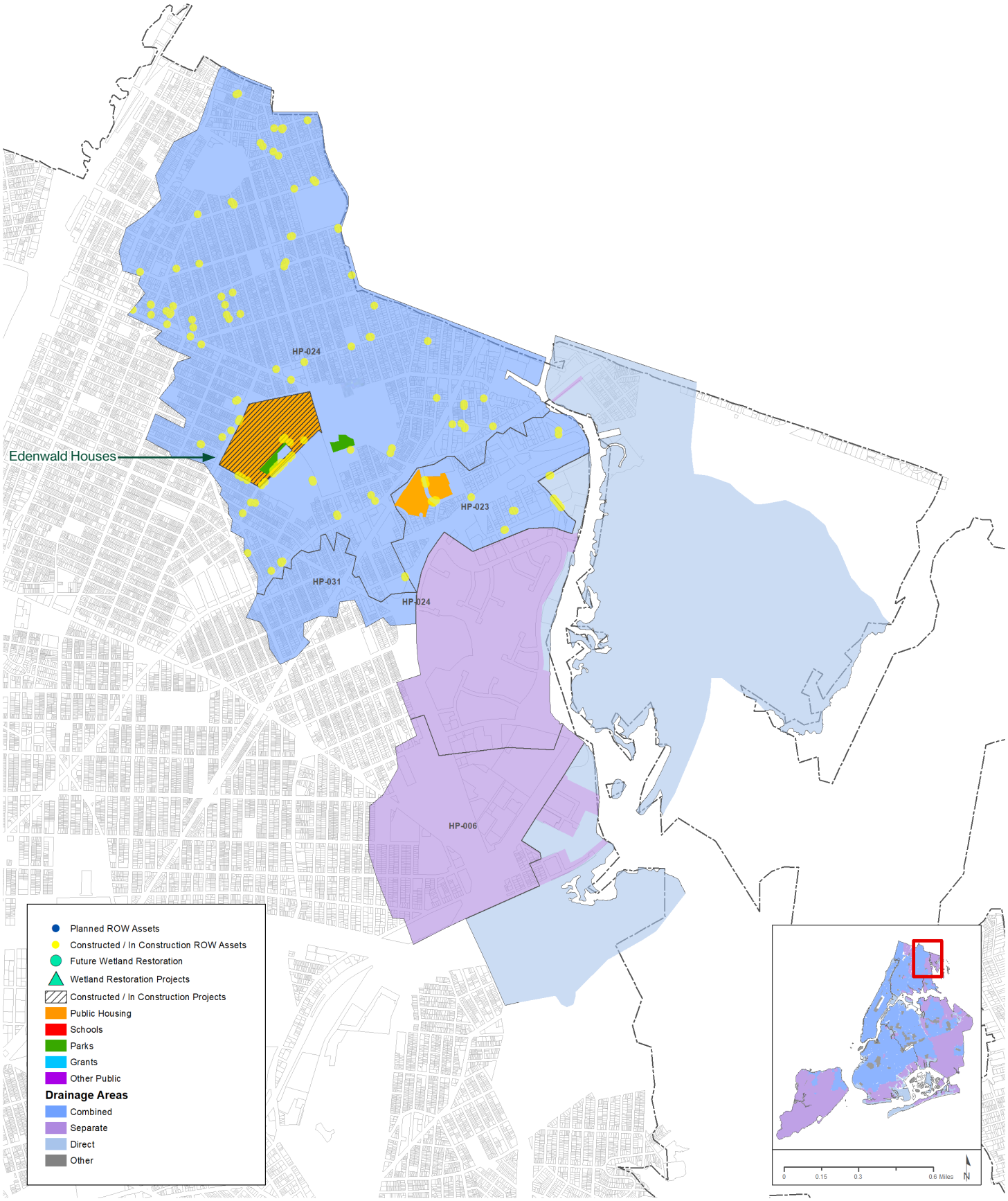
UPCOMING PUBLIC & GRANT PROJECTS**

- Boerum Park
- Carroll Park
- P.S. 321 K
- P.S. 38 K
- Prospect Park Shops
- Red Hook Recreation Center
- Redhook East & West
- Wyckoff Gardens

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

HUTCHINSON RIVER WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



HUTCHINSON RIVER WATERSHED

2010-2020 ACCOMPLISHMENTS

208 Assets Constructed and In Construction

51.1M Annual Gallons of Stormwater Managed*

41 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

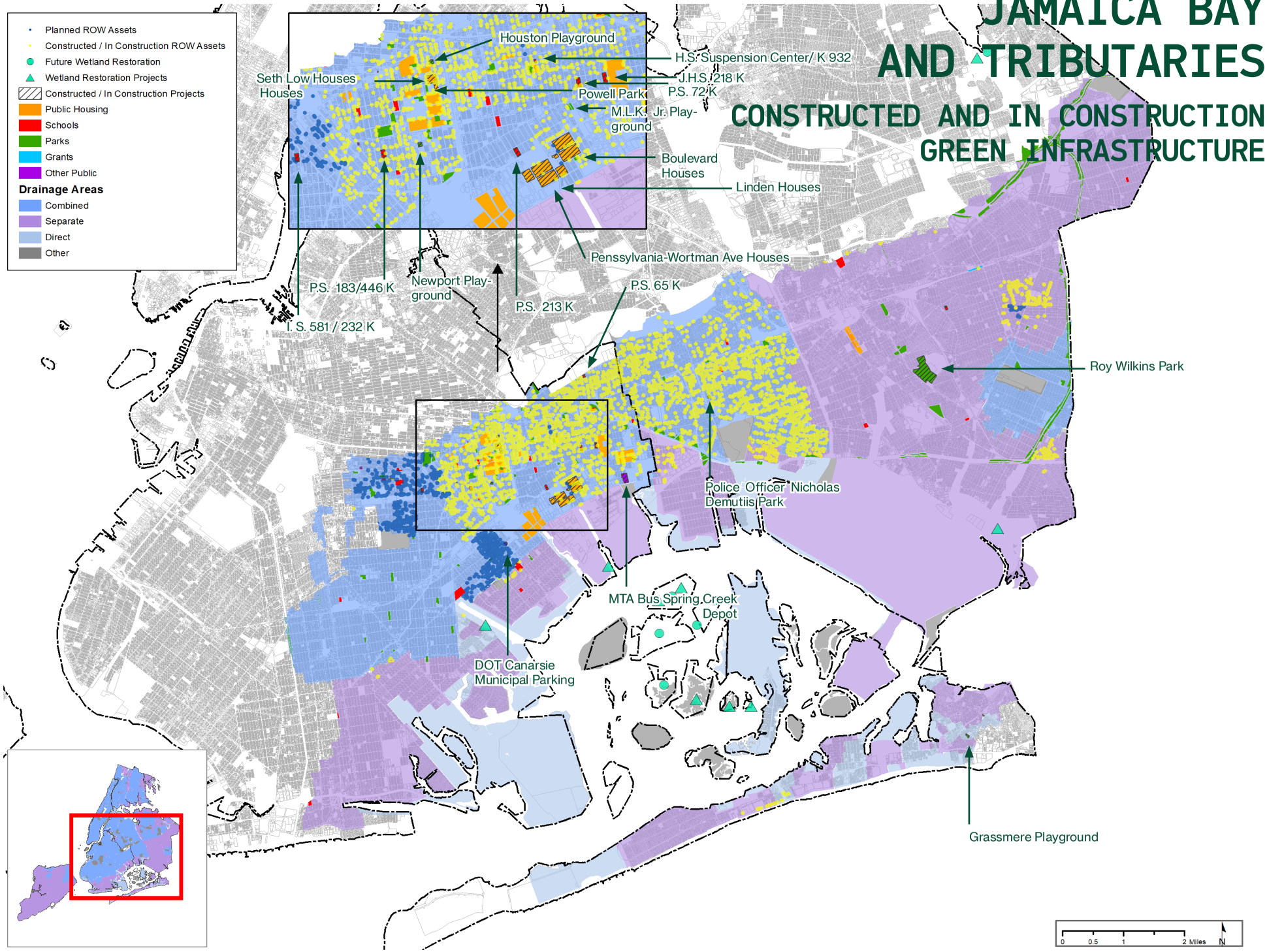
UPCOMING PUBLIC & GRANT PROJECTS**

- Boston Secor Houses
- Edenwald Playground
- Stars & Stripes Playground

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

JAMAICA BAY AND TRIBUTARIES

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



JAMAICA BAY AND TRIBUTARIES

2010-2020 ACCOMPLISHMENTS

4,634 Assets Constructed and In Construction

701.9M Annual Gallons of Stormwater Managed*

559 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

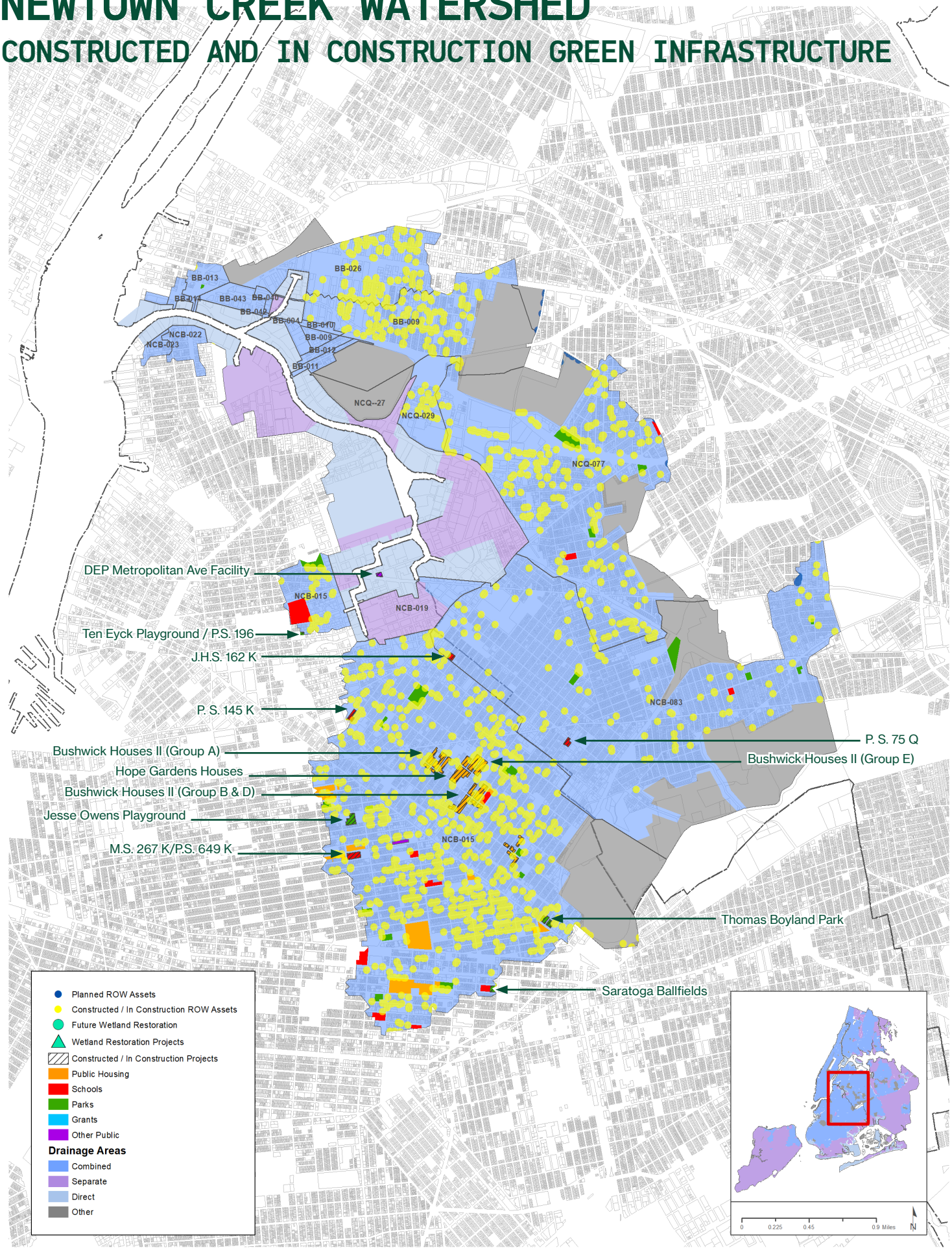
UPCOMING PUBLIC & GRANT PROJECTS**

- 71st Precinct
- 73rd Precinct Off Street Parking C
- Amersfort Park
- Andries Playground
- Belmont Playground / PS 214
- Belmont Sutter
- Betsy Head Park Building
- Boys and Girls H.S. Athletic Field (Old)
- Breukelen
- Brownsville
- Brownsville Recreation Center
- Cambria Playground
- Canarsie H.S.
- Carter G. Woodson Children's Park
- Centreville Playground
- Chester Playground
- City Line Park
- Cynthia Jenkins School (Q37)
- Cypress Hills
- Delphin H. Greene Playground
- Detective Keith Williams Park
- Dr. Richard Green Playground
- East New York City Line
- East NY Voc. H.S. of Transit Tech K
- East Springfield Playground
- Elton Playground
- Engine 283
- Fiorentino Plaza
- Fox Playground (Brooklyn)
- Fraser Square
- Glenmore Plaza
- Grace Playground
- Hamilton Metz Field
- Harold Schneiderman Playground
- Highland Park (Brooklyn)
- Howard Avenue
- Howard Houses
- Howard Playground
- Howard Pool Building
- Hughes Apartments
- I.S. 323 K
- Jerome Playground
- Linwood Playground
- Livonia Park
- London Planetree Playground
- Marc And Jason's Playground
- Maurice A Fitzgerald Playground
- Nehemiah Park
- Ocean Hill Playground
- P.S. 115 K
- P.S. 13 K
- P.S. 156 / I.S. 392 K
- P.S. 165 K
- P.S. 191 K
- P.S. 221 K
- P.S. 223 Q
- P.S. 315 / 152 K
- P.S. 328 K
- P.S. 62 Q
- P.S. 91 K
- Paerdegat Park
- Phil "Scooter" Rizzuto Park
- Pink Houses
- Pink Playground
- Power Playground
- Railroad Park
- Railroad Playground
- Reid Apartments
- Remsen Playground
- Richmond Hill H.S.
- Robert E. Venable Park
- South Jamaica Houses I & II
- South Shore Educational Campus
- Sutter Ballfields
- Thomas Jefferson H.S.
- Tilden Houses
- TLC Woodside Facility Renovation
- Tudor Park
- Van Dyke I
- Van Dyke II
- Van Dyke Playground
- Vito Locascio Field
- Wilson Playground
- Windsor Terrance Public Library
- Wingate Park
- Woodruff Playground

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

NEWTOWN CREEK WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



NEWTOWN CREEK WATERSHED

2010-2020 ACCOMPLISHMENTS

1,586 Assets Constructed and In Construction

205.2M Annual Gallons of Stormwater Managed*

163 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

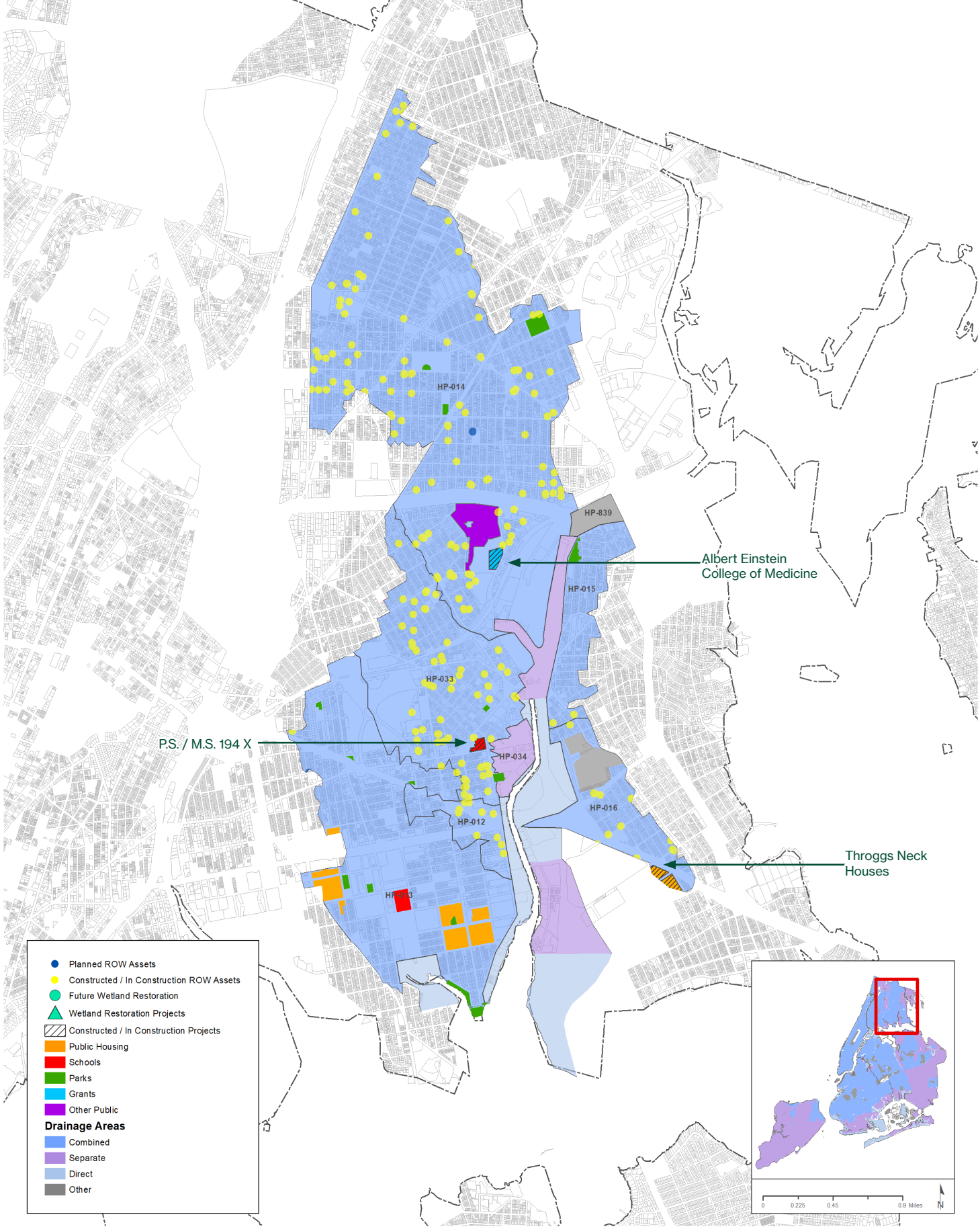
UPCOMING PUBLIC & GRANT PROJECTS**

- 81st Precinct Off Street Parking
- Arrow Community Center
- Boys and Girls H.S.
- Brevoort Houses
- Bridge and Tunnel Park
- Bushwick II CDA (Group C)
- Bushwick Playground
- Classon Playground
- Cooper Park
- El Shabazz Playground
- Eleanor Roosevelt Playground
- Evergreen Playground
- Fermi Playground
- Frank Principe Park
- Frontera Park
- Grand Street Campus
- Grand Street Campus
- I.S. 394 K
- I.S. 73 Q
- IS 119/Pinocchio Playground
- Jackie Robinson Playground
- Kingsborough Houses
- Lafayette Playground
- Maria Hernandez Park
- Metropolitan Pool and Fitness Center
- Middle Village Playground
- Ocean HIII Apartments
- Orcale Playground
- P.S. 153 Q
- P.S. 178 K
- P.S. 309 K
- P.S. 377 K
- P.S. 5 K
- P.S. 91 Q
- Reiff Playground
- Roosevelt I Houses
- Roosevelt II Houses
- Rosemarys Playground
- Saratoga Houses
- South Pacific Playground
- Stuyvesant Gardens I
- Tiger Playground
- "Uncle" Vito E. Maranzano Glendale Playground
- Woods Playground

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

WESTCHESTER CREEK WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



WESTCHESTER CREEK WATERSHED

2010-2020 ACCOMPLISHMENTS

230 Assets Constructed and In Construction

28.4M Annual Gallons of Stormwater Managed*

23 Equivalent Greened Acres

* Annual gallons of stormwater managed = asset capacity (cf/1 in rainfall event)*46.25 (in/yr) (typical annual rainfall)*7.48 (gal/cf)

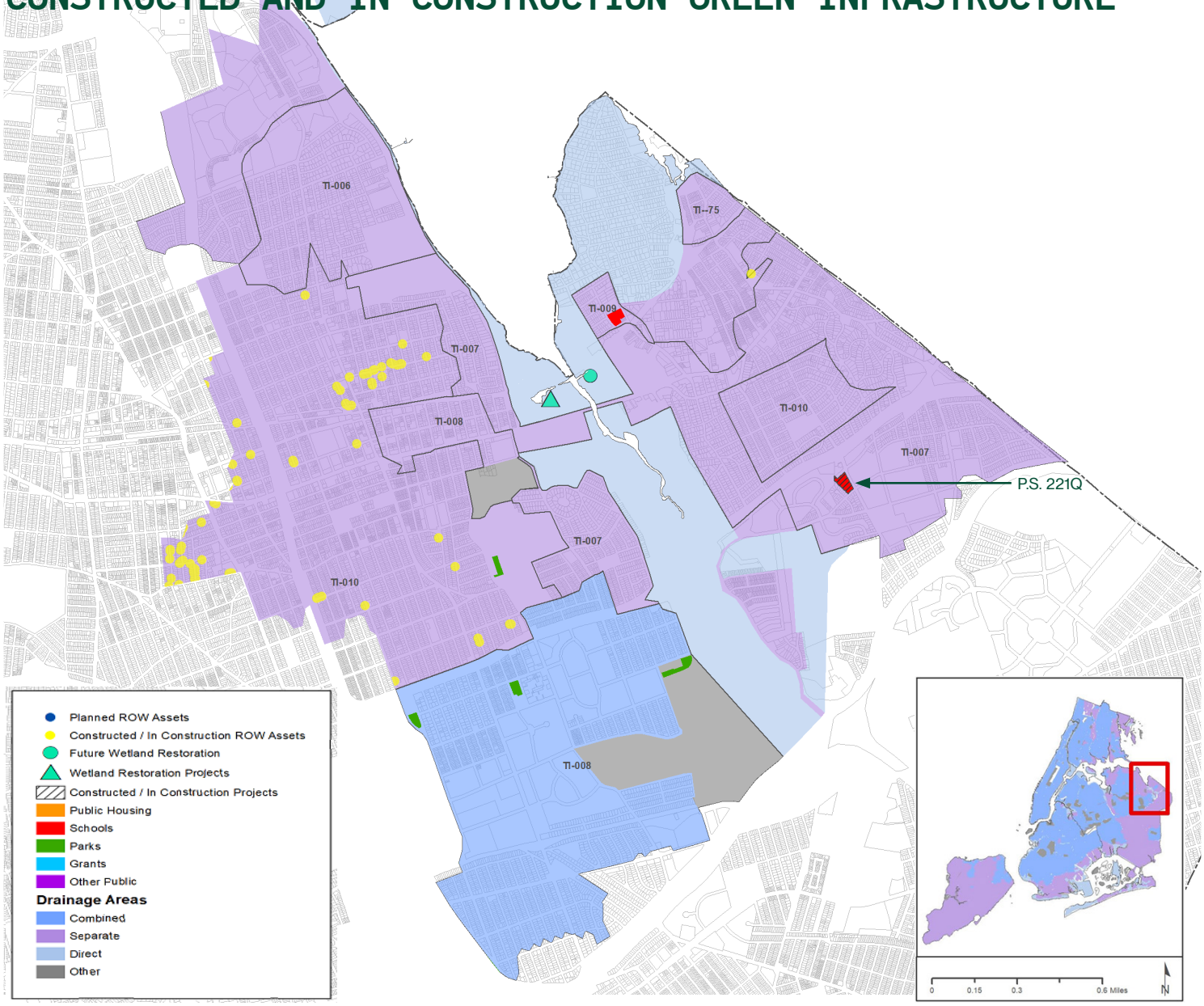
UPCOMING PUBLIC & GRANT PROJECTS**

- 49th Precinct
- Adlai E. Stevenson Educational Campus
- Allerton Playground
- CASTLE HILL
- Castle Hill Little League Field
- Castle Hill Park
- Chief Dennis L. Devlin Park
- Colucci Playground
- Eastchester Playground
- Haffen Park
- MONROE
- Randall Playground
- Space Time Playground
- Story Playground
- Taylor Playground
- The Pearly Gates
- Virginia Playground

** Not counted toward stormwater managed or greened acres above. Subject to change based on feasibility and/or other project constraints.

ALLEY CREEK WATERSHED

CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE

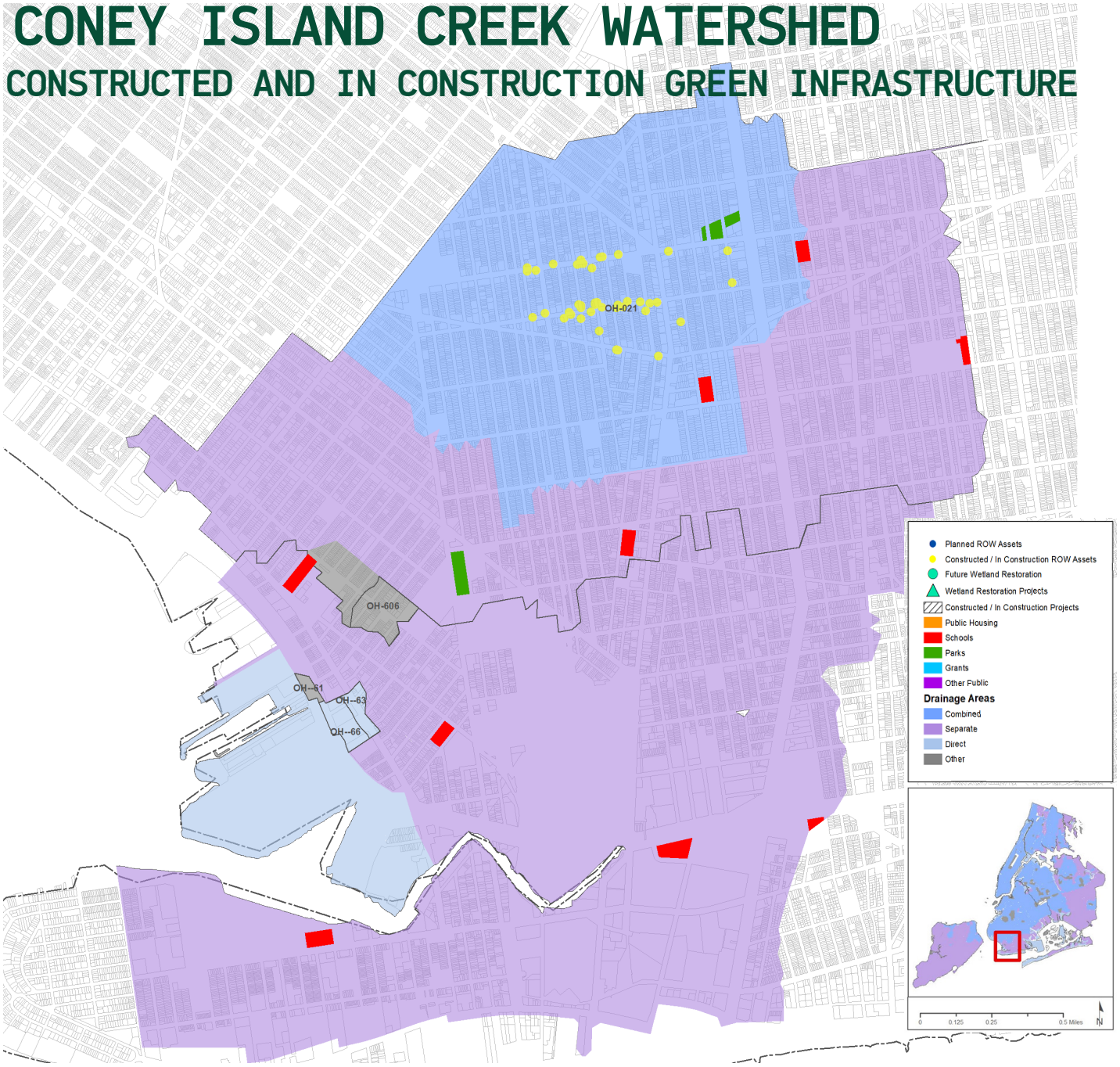


The Alley Creek and Little Neck Bay watershed is served by the Tallman Island WRRF and contains a complex wastewater and stormwater system comprised of combined and separately sewered areas as well as direct drainage. The annual wet weather discharge volume to the watershed is predominately stormwater and direct drainage runoff. The 5 million gallon Alley Creek CSO retention facility has been in operation since 2011, reducing overflows by 132 MGY. Accordingly, the watershed has not been considered a priority for ROW green infrastructure implementation in the combined sewer areas. However, DEP is pursuing retrofit opportunities on several public properties for green infrastructure implementation. Through DEP's partnership with TPL, green infrastructure was constructed in the separate sewer area of the watershed, at P.S. 221. There are 8 upcoming projects - 4 are in design: Alley Park, Oakland Gardens, Seven Gables Playground and Tall Oak Playground; and 4 are in the planning phase: P.S. 98, 53rd Ave & 221 St. median, 56th Ave & 221 St. median and 58th Ave & 221 St. median.

In addition, there have been efforts to restore and build wetlands in Alley Creek for water quality improvements and ecological habitat benefits. The Alley Creek wetland is an enormous natural resource in northern Queens, and DEP expanded it by adding 1.5 acres. DEP also designed a "treatment wetland" in Alley Creek to target pollutant load reductions and to better quantify water quality and environmental improvements of wetland expansions in the receiving waters.

CONEY ISLAND CREEK WATERSHED

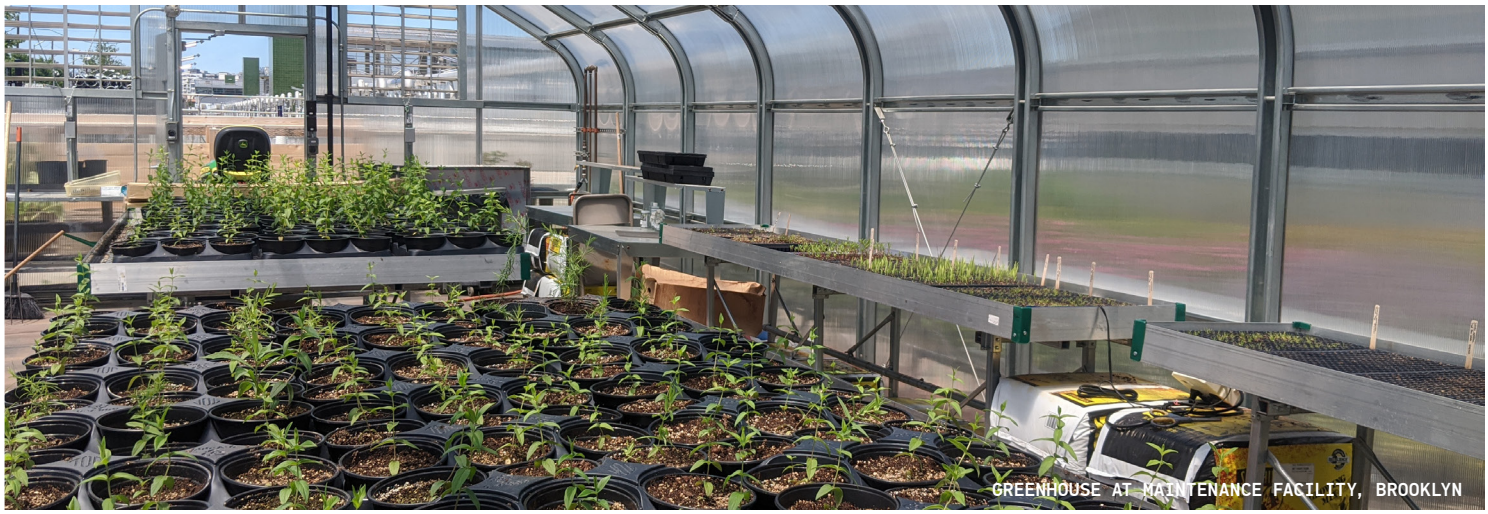
CONSTRUCTED AND IN CONSTRUCTION GREEN INFRASTRUCTURE



The Coney Island Creek watershed is an urban tributary to Gravesend Bay, which itself is tributary to the Lower New York Bay. Water quality in Coney Island Creek is influenced by multiple sources, including stormwater discharges, dry-weather sources and CSOs. The annual wet weather discharge volume to the watershed is predominately stormwater and direct drainage runoff.

DEP has completed pump station upgrades which have been operational since 2014, reducing overflows by 68% from 245 MGY to 75 MGY. Accordingly, the watershed had not been considered a priority for ROW green infrastructure implementation in the combined sewer areas in the early years of the program. However, DEP is continuing efforts to apply an integrated approach for stormwater management. DEP is currently investigating green infrastructure opportunities at public schools in the combined sewer areas, and a few public properties as part of the City's MS4 Stormwater Management Program. There are 12 upcoming projects, 6 in design: Col. David Marcus Playground, P.S. 95K (Gravesend), P.S. 212, I.S. 234, P.S. 238, P.S. 215; and 6 in planning: Avenue R Mall, Bath Playground, Mark Twain Intermediate School, I.S. 303 (Rachel Carson H.S.), William E. Grady CTE H.S., and Scarangelia Park. There are also green infrastructure projects funded through the New York Rising program (see RELATED INITIATIVES).

GREEN INFRASTRUCTURE MAINTENANCE



GREENHOUSE AT MAINTENANCE FACILITY, BROOKLYN

RIGHT-OF-WAY MAINTENANCE

The DEP maintenance crews provide maintenance for the thousands of constructed green infrastructure practices in the ROW. Planning for hiring and training is paced with new construction and transition of assets from contractor guarantee to full maintenance, so that DEP's maintenance program grows as the number of new rain gardens, infiltration basins and other ROW asset types increases. Table 5 below shows the growth of the team since 2014. In 2020, the hiring of seasonal staff was greatly affected by the onset of the COVID-19 pandemic. DEP was able to continue to maintain ROW green infrastructure practices, but at a reduced level of service. DEP has two maintenance facilities, one in Brooklyn and another in the Bronx, to eliminate excess travel time and to improve the overall efficiency of the teams. A satellite facility in Brooklyn is under development and another facility in Maspeth, Queens is in the planning phase.

The maintenance crews perform a variety of tasks to keep the rain gardens functional and attractive. To ensure performance, the teams typically remove weeds, prune, and replace dead plants as well as remove sediment from inlets, outlets, stone columns and soil to make sure stormwater flows into and within the rain garden properly. For appearance, the teams remove litter and trim plants. These actions keep the curb appeal of the rain gardens and preserve sight lines to keep pedestrians and vehicles safe. Although the amount of maintenance each rain garden needs varies by the rain garden's size, the neighborhood (commercial or residential areas), and by the season, a crew visits every rain garden about once a week.

With the addition of infiltration basins to the ROW green infrastructure practice toolkit, maintenance needs and

TABLE 5: DEP ROW GREEN INFRASTRUCTURE MAINTENANCE STAFFING BY YEAR

Total Headcount Per Calendar Year*						
2014	2015	2016	2017	2018	2019	2020
15	23	25	62	103	104	49**

* Total Headcount includes both full-time and seasonal titles.
** Hiring was affected by the pandemic

tasks have diversified. For infiltration basins, the primary maintenance need is to ensure that the inlet is free of litter so that stormwater can enter the basin properly. Additionally, infiltration basins have a basket that works to remove as much litter and sediment as possible before the stormwater runoff reaches the stone layers of the practice. This basket needs to be emptied at regular intervals, which depend on the location of the infiltration basin and surrounding land use, to ensure that it is functioning properly.

New staff is trained using the ROW Green Infrastructure Operations and Maintenance Manual, along with on-the-job-training provided by current crew leaders and supervisors. Additional training is offered for select staff to undergo horticulture and plant care training or certifications through a continued partnership with the New York Botanical Garden.

To manage the operations of the rain gardens, crew leaders conduct evaluations before beginning site maintenance. Maintenance data allows program managers to understand where and how frequently rain gardens are being maintained, the type of work being done, the level of effort required, and any reoccurring issues. By understanding the level of effort required to keep rain gardens in good condition, managers can allocate resources as needed. These evaluations also allow the maintenance team to resolve larger issues like damage from construction or utility work that cannot be corrected through routine maintenance alone. DEP handles this type of specialized maintenance work through designated contracts.

If the public witnesses any issues with a particular rain garden between maintenance visits, they can call 311 as indicated on the blue “rain garden” decals on each rain garden. Staff at the City’s 311 call centers are trained to process rain garden-related requests. The public can also use 311 online to report a broken tree guard, trash, or flooding. Through 311, public requests are directed to DEP’s maintenance staff and the response is tracked.

PUBLIC PROPERTY RETROFITS MAINTENANCE

DEP and its partners have ensured that all other green infrastructure will be maintained over the long term. DEP has accepted maintenance responsibility for green infrastructure implemented within developments owned by NYCHA and performs the work through a maintenance contract. DOE’s Division of School Facilities has agreed to incorporate the maintenance of green infrastructure practices into their typical schoolyard tasks. Similarly, Parks has incorporated green infrastructure maintenance into the borough maintenance and operations crew responsibilities. DEP has committed to an ongoing and open dialogue with all of our partnering agencies to provide support, adjust designs, and consider other changes to implementation of practices as the Program grows.

STEWARDSHIP

In 2020, the Green Infrastructure Maintenance Rain Garden Stewardship Program began initiatives to focus on collaborations with more neighborhood groups, and started developing material for an education program to offer to schools. Although the COVID-19 pandemic affected public outreach and programming, 22 individual stewards and 5 neighborhood groups representing a total of 8 neighborhoods were trained and onboarded to be part of the stewardship program in 2020. Volunteers have also assisted with planting in a total of 16 rain gardens in 2020.

REPLANTING DURING STEWARDSHIP EVENT

RELATED INITIATIVES

PAT AULETTA STEEPLECHASE PIER ON CONEY ISLAND, BROOKLYN

NYC STORMWATER MANAGEMENT PROGRAM (SWMP)

The NYC Stormwater Management Program (SWMP) plan consists of the City's measures to reduce the pollution potential of stormwater discharging into and from the MS4. The City developed and implements the SWMP in compliance with its MS4 permit. 14 City agencies are responsible for implementing the SWMP in the MS4 area, which comprises approximately 30%-40% of NYC. There are 3 SWMP programs that include green infrastructure requirements: Construction and Post-Construction, Pollution Prevention/Good Housekeeping for Municipal Facilities and Operations (PPGH), and Special Conditions for Impaired Waters.

As described earlier, the Construction and Post-Construction program requires certain new and redevelopment projects to apply for permits. Projects required to implement post-construction stormwater management practices are encouraged to follow NYC's preferred hierarchy, which prioritizes on-site vegetated infiltration options such as rain gardens. In 2020, 42 new projects were reviewed. Of the reviewed projects, 22 will require post-construction stormwater management practices, 12 of which will include green infrastructure.

As part of the PPGH program, agencies use standardized criteria to evaluate the feasibility of implementing green infrastructure during planned municipal upgrades in the MS4 area. An agency will include green infrastructure in any planned municipal upgrade project (defined as per internal guidance as a capital project in excess of $2M) for which the agency determines that installation of green infrastructure is feasible and cost-effective.

The "Special Conditions for Impaired Waters" section of the permit requires the City to evaluate green infrastructure opportunities in MS4 areas that meet certain criteria; only Coney Island Creek meets those criteria at this time. DEP evaluated school and park sites in the Coney Island Creek MS4 area for green infrastructure feasibility and is proceeding with the design of green infrastructure practices at four schools and one park. The green infrastructure practices will be designed to accommodate a 90th percentile storm (1.5" of rainfall).

More information on the City's SWMP activities is provided on DEP's website.

DEP is currently in design on green infrastructure practices at 4 schools and 1 park in the Coney Island Island MS4 area

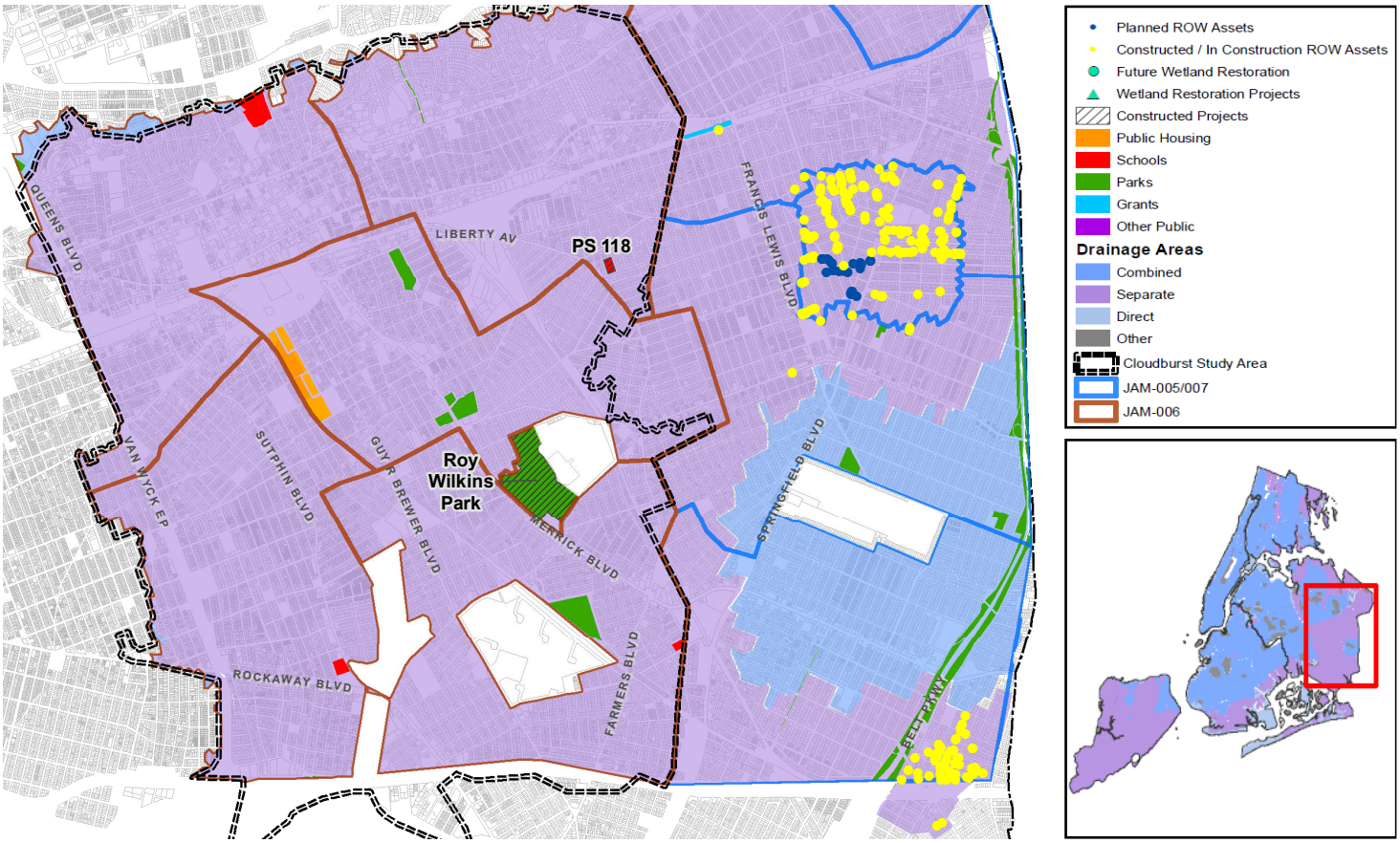
SOUTHEAST QUEENS

New York City has seen significant flooding events caused by extreme rain and is anticipating that flooding may become worse with climate change. In Southeast Queens, flooding has been a chronic issue for over 70 years and has been exacerbated by increasing rainfall, loss of permeable surfaces, and reduced groundwater. Over the past 10 years, Community Boards 12 and 13 have had more flooding complaints than any other area of New York City. In OneNYC, Mayor de Blasio identified alleviating flooding in Southeast Queens as a priority initiative. DEP's 10-Year Capital Budget allocates $1.5 billion over the next decade to plan and begin full sewer build-out and to provide short term relief wherever possible. Full build-out requires approximately 450 miles of new storm sewers, upgrades to 260 miles of sanitary sewers, and 30 miles of combined sewers to be completed over many years. To supplement ongoing sewer buildouts, DEP is partnering with other City agencies to implement green infrastructure in the ROW and on public properties as another tool to reduce localized flooding. Additionally, DEP has been actively engaging other cities that have experienced extreme rain events to exchange knowledge and develop innovative approaches for stormwater management and climate change (see following section on CLOUDBURST PILOT PROJECTS).

In 2020, DEP completed construction of over 100 ROW green infrastructure practices around the St. Albans and Cambria Heights neighborhoods. Additional practices will be constructed in conjunction with a street and sewer upgrade project that is currently in the planning stage. Implementation of ROW green infrastructure in Southeast Queens is also being carried out through the New York Rising Community Reconstruction Program (NYRCR), around the Rosedale neighborhood (see more in the NEW YORK RISING section). Additionally, DEP has started investigating new pilot designs incorporating ROW green infrastructure elements to address localized flooding issues, and anticipates finalizing these designs in 2021.

DEP is also implementing green infrastructure in Parks within Southeast Queens, such as the rain garden at Roy Wilkins Park which went into construction in 2020, as well as other projects currently in design including Detective Keith Williams Park, Railroad Park, and Cambria Playground as shown in Figure 7 below.

FIGURE 7: GREEN INFRASTRUCTURE IN SOUTHEAST QUEENS



CLOUDBURST PILOT PROJECTS

To complement storm sewer and green infrastructure work in Southeast Queens, DEP is also implementing pilot projects identified as part of a study to assess risks, prioritize responses, develop neighborhood-based solutions, and assess costs and benefits for managing extreme rain events, or "cloudbursts." The Cloudburst Resiliency Planning Study adapted an approach developed in Copenhagen to manage large volumes of stormwater using streets and open space, and has created a unique learning exchange between Copenhagen and New York City. By modeling the flow of floodwater over the local topography, the study determines opportunities to slow and safely convey water to minimize damages and maximize co-benefits to the community.

As a result of the Cloudburst Resiliency Planning Study two pilot projects were identified in Southeast Queens to help demonstrate the feasibility of implementing the cloudburst approach. These projects aim to supplement ongoing sewer buildouts and act as a buffer for storms that are not captured by sewers due to the size of the storm or the lack of fully built-out storm sewer infrastructure. This effort will reduce flooding in areas where grey infrastructure takes longer to implement and will alleviate chronic flooding of upstream areas.

DEP is currently in design phases for two cloudburst pilot projects in Southeast Queens. One of these projects, in St. Albans, is seeking to design and construct a stormwater management system in the ROW using green infrastructure and cloudburst streets to mitigate flooding. A second project is located at the South Jamaica Houses, which is a NYCHA campus including 8 city blocks in South Jamaica, Queens and is home to approximately 2,600 residents. South Jamaica Houses were chosen to provide relief upstream in order to allow for more flow to enter the sewer system downstream and reduce flooding. This project will maximize stormwater capture for up to 2.3 inches of rainfall per hour for climate resiliency. Aside from flood mitigation, another focus of this pilot is to show how cloudburst infrastructure can go beyond just managing stormwater and offer many co-benefits by reimagining the urban fabric of communities. DEP anticipates construction will begin at South Jamaica houses in 2022.

A third project to identify potential opportunities to implement stormwater management solutions to reduce flood risk from cloudburst type events is currently underway at the Clinton Houses NYCHA campus. This project's intent is to utilize available community spaces to implement feasible stormwater management solutions in order to delay, store and discharge the runoff within and outside of the Clinton House campus, thereby reducing flood risk from cloudburst events within the area.

RENDERING OF NYCHA SOUTH JAMAICA HOUSES CLOUDBURST PROJECT

DEP is implementing pilot projects to manage extreme rain events or "cloudbursts"

NEW YORK RISING

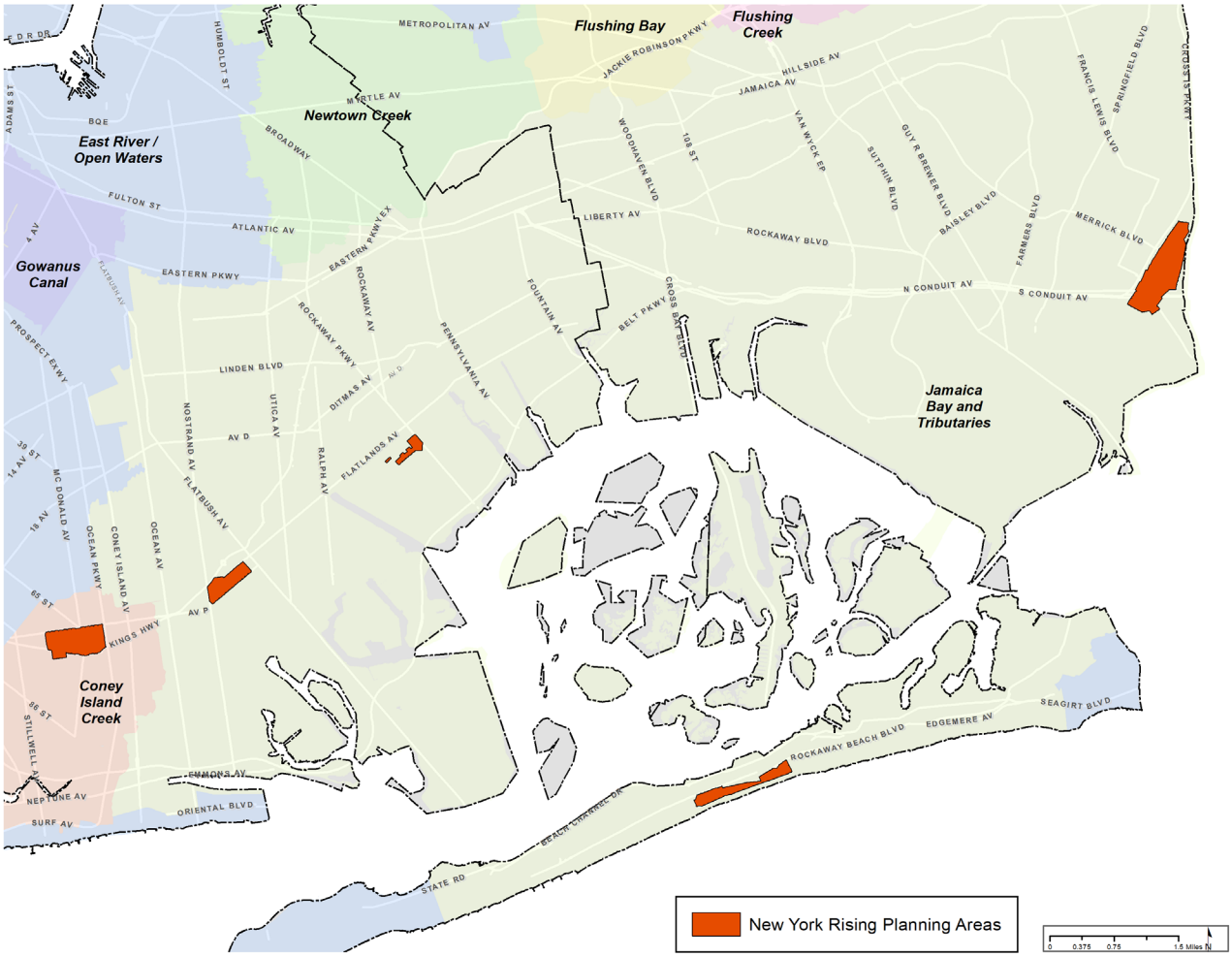
DEP, in partnership with the Mayor's Office, has been working with the NYRCR and the Governor's Office of Storm Recovery (GOSR) on a series of projects in neighborhoods heavily impacted by Hurricanes Sandy and Irene. NYRCR's role is to facilitate rebuilding and revitalization assistance and work with local agencies to help implement projects. The projects include the planning and design of green infrastructure within the boundaries of six NYRCR Planning Areas:

- Gravesend / Bensonhurst
- Southeast Brooklyn Waterfront
- Canarsie
- Rockaway West
- Idlewild Watershed

Figure 8 below shows the planning areas. These projects are limited by the grant funds allocated for each planning area, which has limited the scope.

Construction of more than 100 ROW rain gardens and the green infrastructure installations at M.S. 72 is being implemented through the Dormitory Authority of the State of New York. The rain gardens are anticipated to be substantially complete by summer 2021.

FIGURE 8: NEW YORK RISING PLANNING AREAS



ECOLOGICAL SERVICES AND WETLAND RESTORATION

In the academic and wetland restoration communities, there have been recent attention and studies on the ability of wetlands to sequester pathogens, improve water quality, and reduce nutrient levels. With this knowledge, natural and constructed wetlands have been widely utilized for water quality enhancement. Table 6 summarizes the total acres of tidal wetland restoration resulting from DEP-funded or cost-shared projects to date.

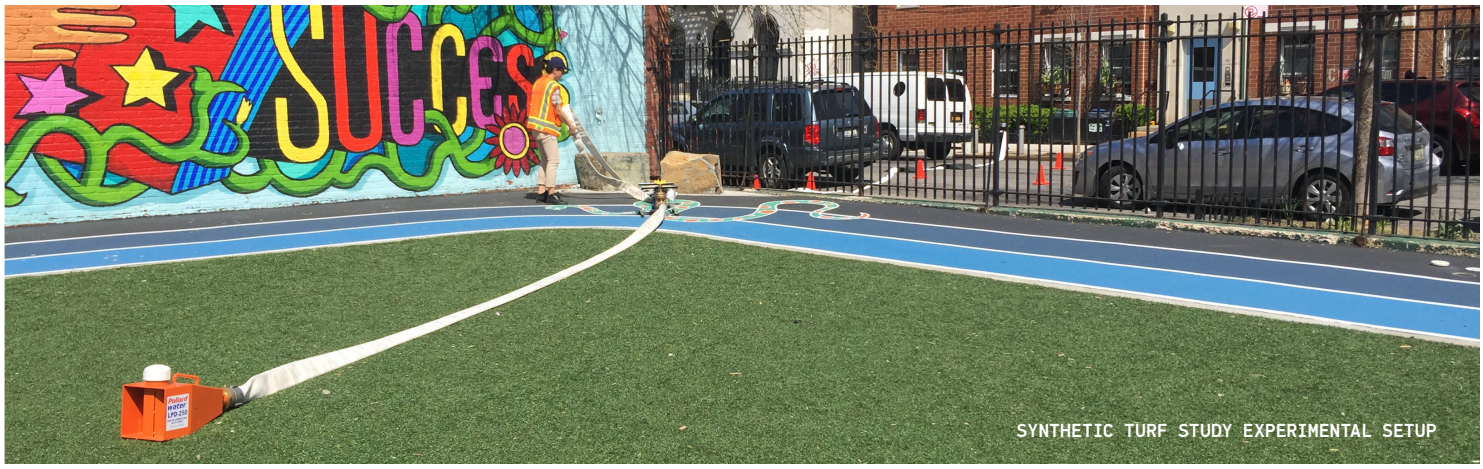
Within a tidal environment, marshes are able to dissipate tidal flow energies approximately one order of magnitude when the flows encounter vegetated marsh surface and flow velocity continues to decrease, as vegetation density increases. These tidal patterns have important implications for the assessment of water quality parameters associated with fecal indicator bacteria (FIB) because they may provide a method to remove suspended bacteria and deposit them within marshes. This flooding and ebbing of salt marsh habitats can increase the mortality, and subsequently decrease negative impacts, of FIB by sequestering these bacteria within the marsh sediments and increasing the ultraviolet light exposure, which kills FIB.

In Alley Creek, DEP completed a 1-acre tidal marsh in June 2019. Additional plantings were added and surveying work was done in 2020. The Alley Creek Pilot Wetland FIB sampling program is being planned to monitor various spatial configurations of wetland and tidal channels to achieve maximum water quality benefits. This work was anticipated to begin in 2020 but has been delayed due to the pandemic.

TABLE 6: TIDAL WETLANDS RESTORED OR FUNDED BY DEP

Sites Completed	Acres
Elders East (cost share)	38
Paerdegat	8
Idlewild	5
Powell's Cove	1
Hendrix Creek (cost share)	2
Elders West (cost share)	34
Yellow Bar (cost share)	42
Black Wall (cost share)	20.5
Ruler's Bar (cost share)	9.8
Brookfield	3.5
Alley Creek	8
Alley Creek Marsh	1.5
Total Installed	173.3
Future Sites	**Acres**
Oakwood Beach (cost share)	35
Additional Jamaica Bay Marsh Islands (cost share)	20
Total Planned	55

ADAPTIVE MANAGEMENT



SYNTHETIC TURF STUDY EXPERIMENTAL SETUP

RESEARCH AND DEVELOPMENT PROGRAM

DEP's comprehensive Research and Development (R&D) Program collects crucial performance and co-benefit data for a variety of green infrastructure practices. Work completed under the R&D Program supports the Green Infrastructure Program as well as the development and execution of LTCPs by reviewing performance over time, ensuring performance-based maintenance and operations, and by conducting cost-benefit analyses of various green infrastructure designs.

Through this effort, DEP has been collecting and analyzing data on rain gardens and other types of green infrastructure since 2016, working with engineers, scientists, and other industry professionals to develop and implement various data collection methodologies including sensors installed in place capturing real-time data, simulated runoff testing at constructed green infrastructure locations utilizing a flow meter and dissipator to manually adjust runoff flow, small scale laboratory-type setups in semi-controlled environments, and modeling studies calibrated with field data wherever available. The methodologies were tailored for each research question and take into account many logistical considerations: equipment specifications (accuracy, precision, etc); how accessible certain components of the green infrastructure practice are for installing the equipment; and how to route water to the practice. The methodologies also take into account statistical considerations such as how many different locations to collect data on and number of rain events to analyze or trials to conduct. There has been considerable work that has gone into fine-tuning the data collection methods in the field to ensure that the collected data are representative of how green infrastructure typically functions during actual precipitation. Quality control has been a critical component of the R&D work, as with any other monitoring program, and the team works to verify that the equipment is operating correctly through routine checks of the data, regular calibration of sensors, and as-needed repair and replacement of equipment. Additionally, the work to process the data has also been important to make sense of all the monitoring, most of which has been done through automation to minimize biases or preventable errors.

To-date, a total of 653 rain events averaging 0.65-inch depth have been captured across three monitoring seasons from 2017-2019 in the real-time data collection setup consisting of rain gauges, pressure transducers, and soil moisture sensors. In parallel to this work, hundreds of simulated runoff tests, multiple rounds of soil surface infiltration tests using double-ring infiltrometers, measurements of soil profiles, soil sample analyses, plant health assessments, and numerous model runs looking at flow patterns of runoff have been conducted as part of the R&D program.

Findings from some of this earlier work have been presented at various conferences and are summarized in previous annual reports. Most of the field activities and subsequent data analyses for the monitoring effort were put on pause in 2020 due to restrictions associated with the pandemic. For 2021, DEP is gearing up to resume the ongoing studies as well as to begin new monitoring studies.

PERMEABLE PAVEMENT PILOT – LOCAL LAW 80 (2013)

In 2013, the New York City Council passed Local Law 80 (of 2013) requiring DEP and DOT to study permeable pavement installations in the City's streets and sidewalks.

As noted in previous annual reports, DEP and DOT identified three neighborhoods in which to pilot porous pavement installations. DEP's first pilot project was the porous concrete panel project in Rego Park, a neighborhood in the Flushing Bay watershed. This project was followed by installation of porous concrete panels and permeable pavers in the Wakefield neighborhood of the Hutchinson River watershed. The installations in both of these neighborhoods are 4-ft wide sections of permeable pavement along the street gutter abutting the sidewalk curb (i.e. the parking lanes), starting and stopping at the intersection. Underneath the porous concrete and permeable pavers are approximately 1.5-ft of broken stone to increase the stormwater storage capacity of these systems. In 2020, DEP completed construction of porous asphalt on four streets in Newtown Creek. Two of the four streets have the porous asphalt laid in the parking lanes as was done in the other pilot neighborhoods, while the other two streets have porous asphalt installed curb to curb, the full width of the roadway.

Following the construction, DEP has been conducting limited monitoring studies to evaluate the performance of these installations. DEP has completed data collection for the Flushing Bay and Hutchinson River projects, with data collection ongoing for the Newtown Creek project.

DOT has completed the design for permeable sidewalks in three areas of the city. Construction for these installations was delayed due to the pandemic and is currently planned for 2021, to be followed by monitoring to study pedestrian comfort. A final report will be prepared by DEP and DOT after post-construction data are collected and analyzed for all study areas.

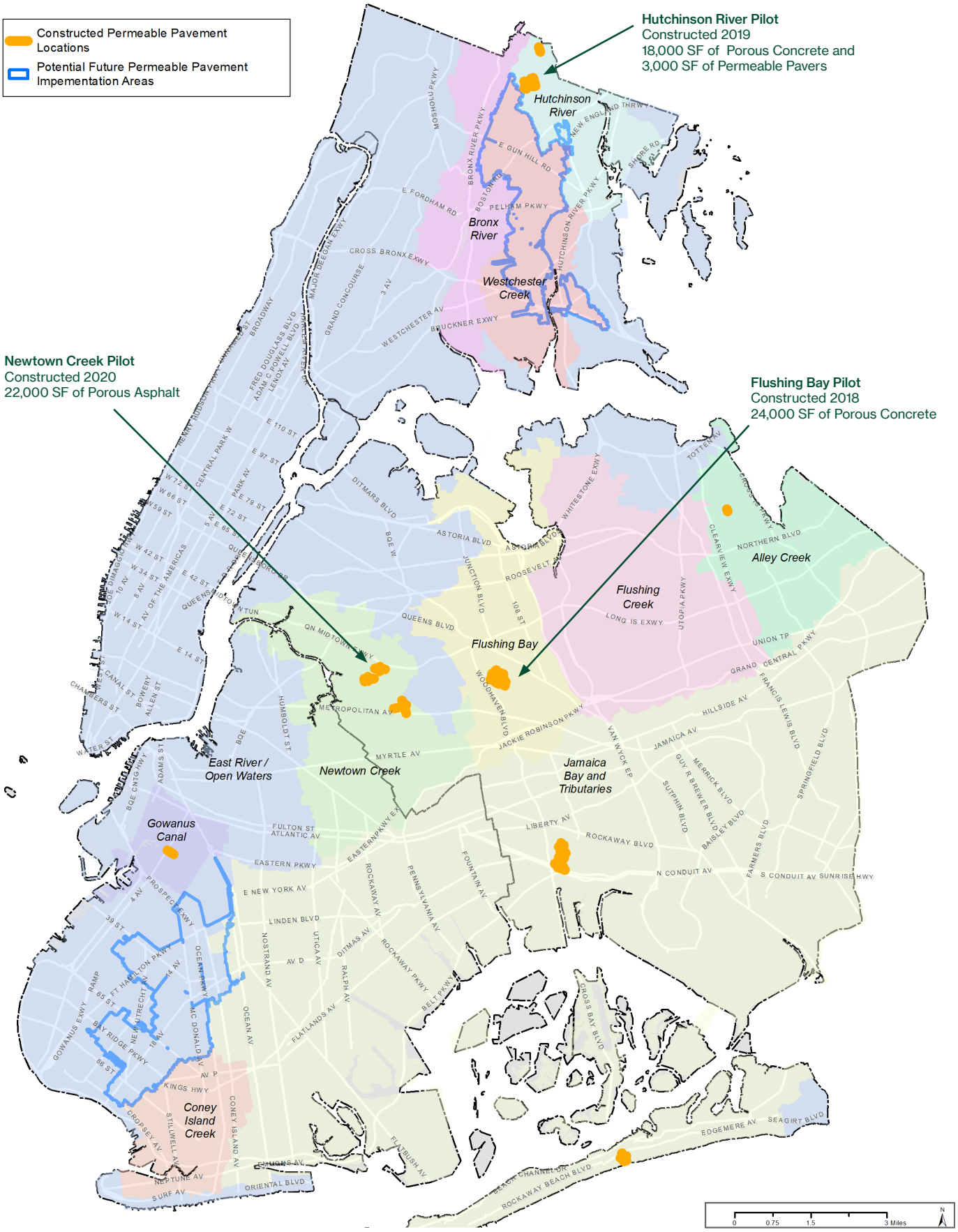
Between the Flushing Bay pilot and the Hutchinson River pilot, DEP made a number of changes to the design and installation of the porous concrete gutters to improve the structural integrity and stormwater management of permeable pavement systems. DEP is continuing to learn from these pilot projects and also through collaboration with other municipalities that are implementing permeable pavement streets. Despite initial challenges encountered to implement these pilot projects, DEP is finding that permeable pavement has the potential to capture large volumes of stormwater as each installation can span nearly the full length of a block, a much larger area than the standard ROW rain garden. As such, DEP is considering construction of porous pavement in the roadway on a larger scale as part of ROW implementation, and is working, as part of the next update to the ROW Green Infrastructure Practices Standards, on developing standards for ROW porous concrete to replace the current porous pavement design guidelines.

In parallel to the Green Infrastructure Program and these Local Law 80 permeable pavement pilots, DEP has been actively looking at porous pavement as a means to reduce localized flooding. Construction of permeable pavement on the roadway surface is much less disruptive compared to the work required for underground infrastructure, which means that permeable pavement can provide immediate benefit to communities in the outlying areas of the city where sewer expansion and upgrade work is planned but has yet to be implemented.

Locations of streets with permeable pavement including the three DEP neighborhood pilot projects and select locations where DEP has installed permeable pavement in response to localized flooding issues, are shown in Figure 9.

FULL ROADWAY-WIDTH POROUS ASPHALT, QUEENS

FIGURE 9: PERMEABLE PAVEMENT OVERVIEW IN NYC



LOOKING AHEAD TO 2021

ROW RAIN GARDEN, QUEENS

Note: Due to resource uncertainties created by the COVID-19 pandemic, some of the initiatives listed below may be delayed.

01 2015 MILESTONE CERTIFICATION

DEP's submittal of the 2015 certification projects to meet the initial 2015 milestone for 1181 Greened Acres resulting in a reduction of 507 MGY of combined sewer overflows was delayed in 2020 due to the COVID-19 pandemic. DEP anticipates that many of the projects will be complete in 2021, despite continued setbacks.

02 2020 GREEN INFRASTRUCTURE CONTINGENCY PLAN

In 2021, DEP will be submitting the Program's 2020 Contingency Plan. The Contingency Plan, required under the Order, will lay out the path for achieving the 2020 milestone, which will include a combination of publicly-funded projects and achievements stemming from stormwater regulations.

03 UNIFIED STORMWATER RULES AND NEW STORMWATER DESIGN MANUAL

DEP expects to publish the draft Unified Stormwater Rule package in 2021 along with the updated New York City Stormwater Manual (see PRIVATE PROPERTY INITIATIVES for more details). The new manual will provide a comprehensive overview of NYC stormwater regulations and technical guidance for implementation.

04 PUBLIC ONSITE CONSTRUCTION

DEP completed designs for many public property retrofit projects in parks, schools, and public housing between 2019 and 2020. Procurement for these projects was delayed in 2020 due to the pandemic. DEP will be kicking off the construction for many of these sites in 2021 (see PUBLIC PROPERTY RETROFITS for more information).

05 PRIVATE PROPERTY RETROFIT INCENTIVE PROGRAM LAUNCH

The Private Property Retrofit Incentive Program, which will be one of the nation's largest and most innovative investments in private property green infrastructure by green stormwater infrastructure programs, was delayed in 2020 due to the pandemic. DEP is working to launch this program in 2021 (see PRIVATE PROPERTY INITIATIVES for more details).

06 GREEN INFRASTRUCTURE MAINTENANCE SOP

As green infrastructure implementation is expanding beyond the CSO goals and into the MS4 program and flooding mitigation projects, DEP identified the need to develop standard operating procedures (SOP) for green infrastructure maintenance. DEP will be developing these SOPs for in-house maintenance staff, other city agencies, and private entities implementing green infrastructure to meet stormwater regulations.

07 POROUS PAVEMENT STANDARDS

From the initial stormwater pilots in 2010 to the Local Law 80/2013 pilots, DEP has learned a lot about porous pavement and is continuously making improvements to the design. DEP is working to develop standard designs and details for the ROW, and anticipates adding this to the ROW Green Infrastructure Standard Designs.

08 NYC STORMWATER FLOOD MAPS AND RESILIENCY PLAN

In coordination with the Mayor's Office of Resiliency (MOR), DEP has been carrying out extensive modeling to identify areas of the city prone to flooding due to increased precipitation. This effort, initiated by Local Law 172 of 2018, will result in the release of the NYC Stormwater Resiliency Plan and an online interactive map of flood-prone areas of the city under various precipitation events. Green infrastructure will play an essential role in evaluating infrastructure opportunities for these areas, including cloudburst efforts and other projects, such as the large-scale ROW projects, which have modified storage capabilities to allow for flood alleviation.

09 HARBOR PROTECTORS LAUNCH

On Earth Day 2021, DEP launched an innovative stewardship program which recruits volunteers to become Harbor Protectors and participate in activities such as cleaning catch basins, stenciling educational/informational messages on the sidewalks near catch basins, caring for rain gardens and participating in shoreline cleanups. These stewardship actions simultaneously beautify communities while keeping pollution out of New York City's waterways, aiding DEP in its critical mission to protect and improve water quality across the five boroughs. For more information visit our website.

EXHIBIT A - PROGRAM SPENDING AND BUDGET

CAPITAL ENCUMBRANCE, 10-YEAR BUDGET AND EXPENSE BUDGET

TABLE 7: ENCUMBERED CAPITAL FUNDING BY FISCAL YEAR

Fiscal Year	Encumbered Capital Funding
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	$203,085,478
FY20	$160,754,308
FY21[1]	$139,763,474
Total	**$1,041,650,550**

TABLE 8: CAPITAL IMPROVEMENT PROGRAM BUDGET, FY 22-31

Fiscal Year	Approved FY 2022 Preliminary Capital Improvement Program
FY21[2]	$114,887,526
FY22- FY31	$518,833,000
Total	**$633,720,526**

PROGRAM GRAND TOTAL[3]	**$1,663,946,861**

TABLE 9: EXPENSE BUDGET - OTHER THAN PERSONNEL SERVICES ONLY (OTPS)

Fiscal Year	OTPS Expenditures
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
Total	**$24,688,863**
Fiscal Year	**OTPS Budget, as of FY22 Preliminary Plan**
FY21	$5,781,618
FY22	$6,178,758
GRAND TOTAL	**$36,649,239**

1 FY21 encumbered as of 3/31/2021.
2 FY21 remaining as of 3/31/2021.
3 Program Grand Total is based on the total encumbered and the Approved FY22 Preliminary January Capital Improvement Plan (FY22-31).

EXHIBIT B - COMMUNITY OUTREACH

GREEN INFRASTRUCTURE PUBLIC OUTREACH MEETINGS

TABLE 10: 2020 PUBLIC GREEN INFRASTRUCTURE MEETINGS

Date	Community Member(s)	Type of Outreach	Attendees
January			
29	LTCP Public Meeting (ER/OW Recommended Plan)	Meeting	50
May			
22	MS4 Program's Annual Report	Virtual	114
June			
23	NYC Impervious Area GIS Analysis	Virtual	189
August			
18	Green Infrastructure 2019 Annual Report Presentation	Virtual	75
November			
5	Unified Stormwater Rule Public Meeting	Virtual	40
December			
9	Green Infrastructure Grant Program Workshop	Virtual	22

EXHIBIT C - 2015 CONTINGENCY PLAN

The 2015 Contingency Plan submitted on June 27, 2016 and approved by DEC on July 5, 2017, outlined the plan for managing 1,181 impervious equivalent greened acres. The table below is the list of completed or in construction projects that will provide those greened acres and their status.

TABLE 11: STATUS OF GREEN INFRASTRUCTURE 1.5% CONTINGENCY PLAN PROJECTS

Waterbodies	Area-Wide ROW Project	Status as of April 2021		Reported Substantial Construction Completion Date[1]	Actual/Projected Substantial Construction Completion Date as of April 2021[2]
		Number of Bids	Issued/Anticipated Notice to Proceed (NTP) Date		
Flushing Creek	TI-011	Construction Bid 1	June 2016	December 2019	June 2017
		Construction Bid 2	September 2018		June 2020
Newtown Creek	BB Cluster	Construction Bid 1	January 2017	December 2019	March 2019
		Construction Bid 2	August 2019		December 2020
Jamaica Bay	JAM-003	Construction Bid 1	August 2016	December 2019	December 2017
		Construction Bid 2	January 2019		July 2020
		Construction Bid 3	July 2019		June 2020
		Construction Bid 4	December 2020		June 2022
		Construction Bid 5	December 2019		April 2021
EROW/Wallabout	NCB-014	Construction Bid 1	September 2018	December 2020	December 2019
		Construction Bid 2	December 2019		July 2021
EROW/Bowery Bay	BB-005	Construction Bid 1	TBD	December 2020	TBD
		Construction Bid 2	TBD		TBD
Westchester Creek	HP-014/033/016	Construction Bid 1	July 2019	December 2020	December 2020
		Construction Bid 2	July 2019		
Flushing Creek	TI-010	Construction Bid 1	September 2019	December 2020	December 2020
		Construction Bid 2	March 2021		September 2022
		Construction Bid 3	December 2019		December 2021
		Construction Bid 4	December 2019		December 2021
		Construction Bid 5	June 2020		December 2021
		Construction Bid 6	December 2019		April 2021
Bronx River	HP-007/004/002	Construction Bid 1	November 2019	December 2020	December 2020
		Construction Bid 2	November 2019		
Jamaica Bay	26W-005/004	Construction Bid 1	December 2019	December 2020	December 2020
		Construction Bid 2	December 2019		
		Construction Bid 3	December 2019		
		Construction Bid 4	December 2019		
		Construction Bid 5	December 2019		

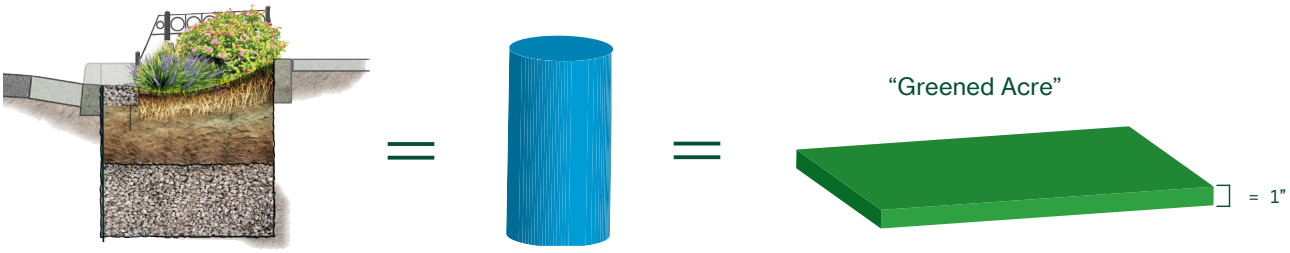
1 The Anticipated Construction Completion date as reported in the June 27, 2016 Contingency Plan.
2 Projects with TBD in the projected status column are those whose schedules have been significantly impacted by the COVID-19 pandemic and for which DEP is unable to determine a completion date at the time of publishing this report.

EXHIBIT D - WHAT IS A “GREENED ACRE”?

A “greened acre” is another way of saying “equivalent impervious acre” but it’s easier to say and understand. It represents a volume of runoff managed by a green infrastructure practice. If you take that volume and spread it out evenly at a 1” depth over an impervious area – that area represents a “greened acre.” Here are some questions we think our stakeholders might ask:

HOW DO YOU CALCULATE A “GREENED ACRE”?

Let’s use a rain garden on the sidewalk as an example – a particular rain garden might hold 250 cubic feet of runoff. If you spread that volume over an area at 1” deep, its greened acres would be 3,000 square feet, or 0.07 greened acres (GA). Like many other U.S. cities, DEP starts with the water holding capacity of each green infrastructure practice and “backs out” the equivalent impervious area that would be managed if that volume was spread over an area at 1” depth.



ROW rain garden (section view) = 250 CF Stormwater managed = Stormwater spread over 3,000 SF at 1” deep = 0.07 Greened Acres

WHY CHANGE THE TERMINOLOGY?

DEC approved DEP’s Performance Metrics Report (PMR) in the summer of 2017, thereby establishing the 2030 CSO volume reduction target for the Program. Because the PMR established a relationship between the green infrastructure projects to runoff reduction and actual CSO reduction, it is time to update and more accurately represent the metrics and targets in a volumetric unit. The “greened acre” metric is just that.

Additionally, updating the public and stormwater stakeholders on our CSO volume reduction progress will be much easier going forward. DEP works hard to measure the green infrastructure’s performance, or the volume of stormwater managed, in all types of rain events. Ultimately, that performance data is used to assess CSO volume reductions. Rain events can vary in a typical year – some are short and intense, some are long with less than a few inches over many hours. These variations in precipitation affect the way the green infrastructure practices perform and also dictate how much runoff during that particular rain event will be managed and ultimately the resulting CSO volume reduction.

WILL THE GREEN INFRASTRUCTURE PROGRAM REPORTING CHANGE?

Fundamentally, no. DEP will continue to report on greened acres, annual stormwater volume managed, and funding expended and budgeted (see Exhibit A) in each Annual Report, in accordance with the CSO Order. Additionally, at each milestone DEP will update the CSO volume reductions for all green infrastructure practices implemented by the milestone date.

ACRONYMS

BGY billion gallons per year

CFS cubic feet per second

CPC Central Park Conservancy

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

Department of Parks and Recreation/Parks

EDC Economic Development Corporation

EROW East River/Open Waters

FDNY New York Fire Department

FIB Fecal Indicator Bacteria

GOSR Governor's Office of Storm Recovery

HCP House Connection Proposal

HPD Department of Housing Preservation and Development

LTCP Long-Term Control Plan

MGD million gallons per day

MGY million gallons per year

MOR Mayor's Office of Resiliency

MOU memorandum of understanding

MS4 Municipal Separate Storm Sewer System

NTP Notice to Proceed

NYC New York City

NYCHA New York City Housing Authority

NYRCR New York Rising Community Reconstruction Program

NYPD New York Police Department

NYS New York State

PMR Performance Metrics Report

PPA Prospect Park Alliance

PPGH Pollution Prevention/Good Housekeeping for Municipal Facilities and Operations

R&D Research and Development

RFI Request for Information

RFP Request for Proposals

ROW right-of-way

SCA School Construction Authority

SCP Site Connection Proposal

SMP stormwater management practice

SRIJB Science and Resiliency Institute at Jamaica Bay

SWMP Stormwater Management Program

SWMPP Stormwater Management Program Plan

TBD to be determined

TPL Trust for Public Land

WQv Water Quality Volume

WRRF Wastewater Resource Recovery Facility

/nycwater

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nyc.gov/dep/greeninfrastructure

NYC Environmental Protection