October 2021

NEW YORK CITY HOUSING AUTHORITY

Climate Change at NYCHA

A Plan to Adapt


EXIT

From the Executive Vice President of Capital Projects

Dear New Yorkers,

Changes in the climate are impacting our lives. Temperature, rainfall, and rising sea levels affect our homes, our communities, and our resources. Part of preserving public housing is being prepared and protecting what we have against these changes.

The summer of 2021 set heat wave temperature records across the nation; at the same time, long stretches of cold weather continue to affect NYCHA, such as a cold December that froze underground water lines and shut down some boiler plants in 2018. New York City has had historic levels of rainfall and flash flooding, most recently tropical storm Henri and Hurricane Ida.

After Hurricane Sandy in 2012, NYCHA was awarded almost three billion dollars, the largest single grant in FEMA history, to repair and protect over 200 of the most severely damaged buildings from future similar storms. While Sandy devasted NYCHA, it also brought the largest investment in public housing since its inception and put NYCHA on the path to ensuring future climate hazards are incorporated into NYCHA's operations, capital planning, and long-term planning.

NYCHA is working proactively to prepare for changing conditions by analyzing where and how a changing climate will affect NYCHA residents and properties, and by developing strategies to reduce resulting risks.

The Climate Adaptation Plan is a call to action and an invitation as NYCHA works with our residents, environmental advocates, community-based organizations, and other agencies to leverage the information we have to adapt to the changing climate.

In partnership,

J. Steven Lovci

Executive Vice President
of Capital Projects

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Introduction

Climate change is a reality in New York City: summers are getting hotter, rain is becoming heavier and more frequent, and sea level rise is making us more vulnerable to coastal flooding. NYCHA is working to be ready for the threats posed by a changing climate through building climate adaptation strategies into its capital investments.

The Climate Adaptation Plan outlines NYCHA's approach to mitigating climate-induced hazards that will impact NYCHA developments and their immediate surroundings. In 2014, NYCHA created an office of Recovery and Resilience within Capital Projects Division to, first, repair damage that was done at developments impacted by Hurricane Sandy; second, build resilience to similar storms that may occur in the future; and third, to analyze and advise on future climate hazards for the Authority. NYCHA's 2016 Sustainability Agenda then set forth an intent to incorporate climate change resiliency into Agency planning; this plan makes progress on that goal by detailing a path to climate resiliency. In 2020, NYCHA looked closely at the projections the New York City Panel on Climate Change made for how changing climate conditions are likely to affect New York City and analyzed NYCHA's vulnerabilities. NYCHA has developed a set of strategies, detailed here, to both continue to assess climate-related risks and address them.

In this plan, NYCHA lays out the Agency's current understanding of how climate-induced hazards will affect NYCHA in the coming decades; points out where there are specific vulnerabilities to climate-induced hazards; and provides an approach to preparing NYCHA for a changing climate.

The New York City Panel on Climate Change projects that New York City will be exposed to three major climate hazards in the coming decades: **extreme heat**, **coastal flooding**, and **extreme rain**. This Plan is aimed primarily at mitigating these hazards for NYCHA property and residents. Beyond these three threats, **groundwater rise**, **extreme winds**, and continued **cold snaps** will also affect New York City. The plan does not address these threats in as much detail but sets the intention to monitor their potential impacts and mitigate them where threats are known. A secondary set of hazards comes from climate-induced disruptions to city services and infrastructure that are essential to NYCHA residents and properties. Secondary hazards include **power outages**, **disruptions to the city's water supply**, **transportation system interruptions**, and **natural gas network disruptions**. While the providers of these utilities retain primary responsibility for the resiliency of these services, NYCHA will monitor vulnerabilities to service disruptions and opportunities to build layered resilience to them on NYCHA properties. The Climate Adaptation Plan is not an emergency plan—it outlines how NYCHA will adapt its buildings and infrastructure to changed climate conditions, not how NYCHA will structure the response to crises. NYCHA has an in-house office of Emergency Management to respond to emergency needs and ensure that NYCHA residents are part of citywide plans to address outages and other hazards.

NYCHA's approach to climate adaptation rests on three principles:

- First, NYCHA will ensure the longevity of all current investments by considering future climate conditions in every current and future project.

- Second, NYCHA will be proactive in seeking funding to address the most acute climate-induced vulnerabilities; and,

- Third, NYCHA will continue to monitor emerging climate science as well as the effectiveness of adaptation strategies in order to adjust and update plans as more information is available about how a changing climate will affect New York City and NYCHA properties.

This plan sets seven goals that put this approach into action. Adaptation, however, is bigger than NYCHA. Efforts to adapt to a changing climate also involve coordination with City, State, and Federal initiatives. While NYCHA will experience the effects of a changing climate, many threats cannot be solved at the individual property level. NYCHA will continue to work with City, State, and Federal government agencies as well as other partners to contribute to neighborhood-scale and regional efforts to make New York City more resilient, and to ensure that such efforts benefit NYCHA residents.

GOAL 1

Build Resilience into NYCHA's Capital Work

NYCHA will strive to ensure that capital investments made now will be resilient to future climate hazards by analyzing climate-induced vulnerabilities and integrating resiliency measures into the planning process. This is a crucial juncture at which to think deeply about resiliency. NYCHA is in the midst of a historic effort to correct deficiencies in housing quality and invest in capital improvements that will sustain New York City's public housing for generations to come.

NYCHA's immediate priorities are the elimination of lead, mold, and pests from NYCHA residences; provision of reliable heat and elevator service; and improved inspections. NYCHA has developed plans to finance the capital work required to stabilize housing quality across its portfolio, addressing these core areas and improving quality of life for residents.

While immediate improvements for residents are NYCHA's focus, it is essential to consider changing climate along with them. Integrating the most current knowledge about future climate conditions into the portfolio gives NYCHA the opportunity to protect residents from future climate hazards. Doing this will accelerate NYCHA's path to climate resiliency and achieve efficiencies by coordinating efforts with planned capital and development investments.

Several overarching strategies outline how NYCHA is working holistically to inform the way capital plans account for future climate conditions.

STRATEGY 1

Identify Geographic Areas and Populations Most Vulnerable to Climate-Induced Hazards

The impacts of a changing climate will be felt unevenly in New York City, with hazards affecting different geographies and populations by different degrees. Preparing for coastal flooding, for example, requires NYCHA to focus on properties closest to the waterfront; preparing for extreme heat, on the other hand, leads NYCHA to focus on the resident populations most vulnerable to heat-related illness. With the analysis built into this plan and continuing efforts to deepen understanding, NYCHA is working to identify climate vulnerabilities that should be addressed through retrofit plans and other initiatives. A summary of how and where each major climate hazard is likely to affect NYCHA is presented here, based primarily on comparing NYCHA's location and populations with projections of future climate conditions created by the New York City Panel on Climate Change (NPCC). The NPCC is an independent advisory body that synthesizes scientific information on climate change and advises City policymakers on local resiliency and adaptation strategies to protect against rising temperatures, increased flooding, and other hazards. The most recent NPCC report was released in 2019.[1] A development-by-development summary of this information is provided in the Appendix. Moving forward, NYCHA will work to develop a more fine-tuned understanding of the likely costs, both physical and social, of climate-induced hazards.

With projections of future conditions comes inherent uncertainty: the New York City Panel on Climate Change releases projections at a range of probabilities for every decade, yet new information about the speed and severity of climate-related impacts emerges regularly. So too does information about the best ways to mitigate climate hazards and new emerging technologies. NYCHA's plan to adapt to a changing climate relies on monitoring scientific advances as well as the lived experience of mitigation techniques.

Extreme Heat

New York City's summers are getting hotter: compared to a historical average of two heat waves and 18 days above 90 degrees Fahrenheit, the New York City Panel on Climate Change expects that NYC will see about twice as many heat waves and hot days on average during the 2020's, and about three times as many by the 2050s TABLE 1. This means New York City's climate would be similar to the historical average for Birmingham, Alabama by the 2050s.[2]

Heat is already the deadliest climate-related hazard in New York City. Under existing conditions, hot weather leads to 450 emergency room visits, 150 hospital admissions, and 115 deaths in the city in an average year.[3] The more frequent, longer, and more intense heat events that NPCC expects to see in the future will likely have proportionally greater effects on New Yorkers' health. In addition to the critical risks to New Yorkers' health that extreme heat poses, heat also affects quality of life in important ways by imposing limits on social contact and daily activities when it is very hot outside. Heat risk can be divided into two categories: Thermal Safety, risks to individuals' health and life and thermal comfort, risks to quality of life. Mitigating both kinds of risks is important for maintaining NYCHA residents' safety and quality of life.

TABLE 1

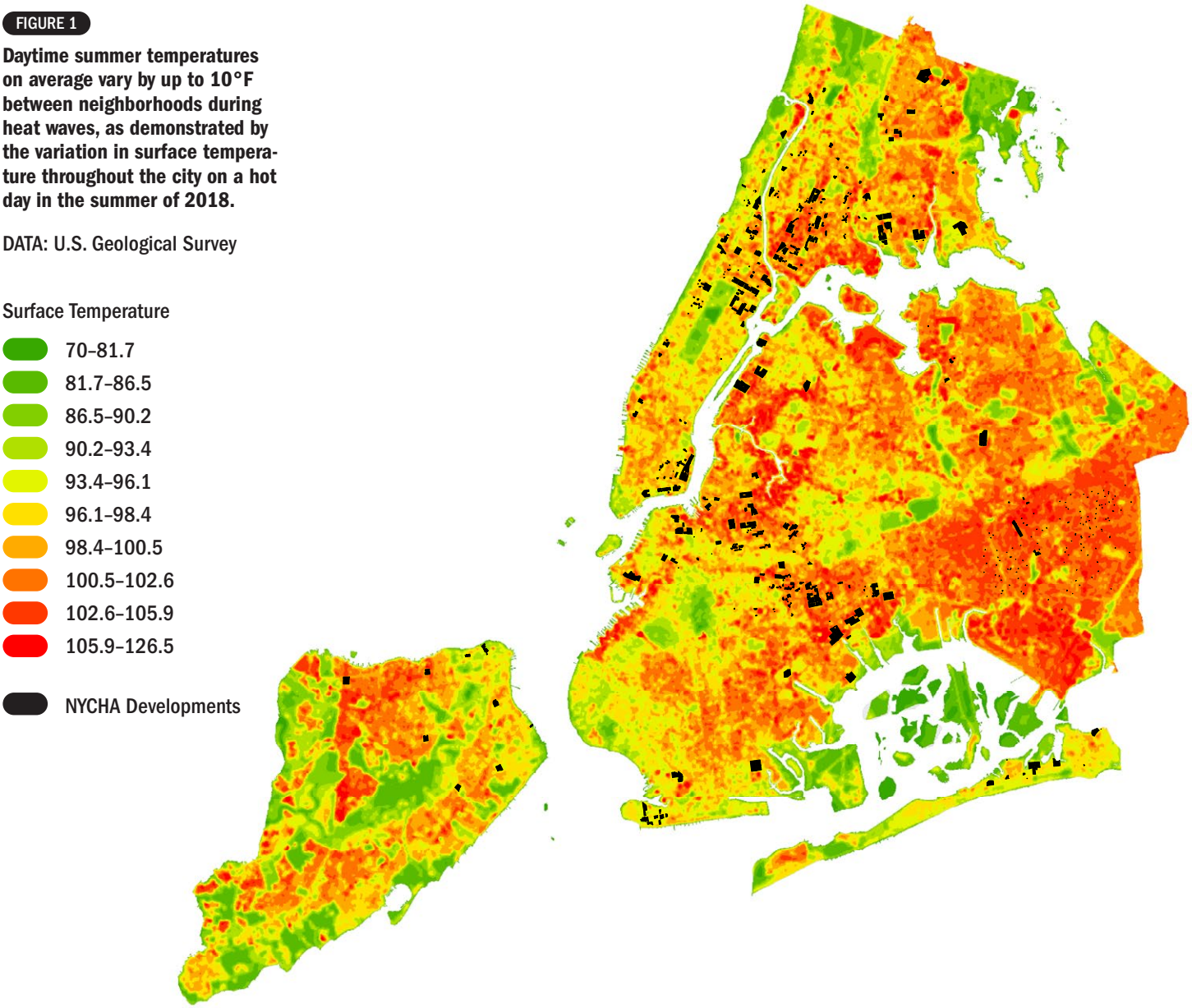
NPCC projected increases in extreme heat through the 2080s.

	Number of Heat Waves	Duration of Average Heat Wave (days)	Maximum Temperature At or Above 90 degrees F (days)	Maximum Temperature At or Above 100 degrees F (days)
Baseline (1971–2000)	2	4	18	0.4
2020s	4	5	33	2
2050s	7	6	57	7
2080s	9	8	87	20

FIGURE 1

Daytime summer temperatures on average vary by up to 10°F between neighborhoods during heat waves, as demonstrated by the variation in surface temperature throughout the city on a hot day in the summer of 2018.

DATA: U.S. Geological Survey



Not all New York City neighborhoods are equally exposed to extreme heat. Like other cities, New York experiences higher temperatures than surrounding areas because of its' dense levels of human activity, sparse vegetation, and high levels of coverage with dark, impervious surfaces. This is known as the Urban Heat Island (UHI) effect. But, within the city, the strength of the UHI effect varies based on neighborhood characteristics, resulting in temperature differences between neighborhoods of up to ten degrees on hot days. NYCHA developments are disproportionately clustered in some of the New York City Neighborhoods that tend to experience the hottest days, such as the South Bronx, East Harlem, and Brownsville FIGURE 1.

Similarly, not all New York City residents are equally sensitive to the effects of extreme heat. Those most at risk from extreme heat are older adults, those who are obese, those with chronic medical conditions or mental health conditions, those who abuse drugs or alcohol, and certain other groups. Damaging health effects of heat are aggravated by lack of access to indoor cooling, poverty, and social isolation.[4]

The New York City Department of Health and Mental Hygiene has created a Heat Vulnerability Index (HVI) based on five characteristics that are statistically associated with higher neighborhood-level risk of heat mortality for its residents. Two of those factors are

physical: the daytime summer surface temperature of the neighborhood and the percent of green space (combined tree, shrub, and grass cover) in a neighborhood. Three of those factors are socioeconomic: the percent of people living under the federal poverty level, percent non-Latino Black population, and percent without access to air conditioning. The HVI aggregates these factors to provide a citywide view of which neighborhoods are most likely to experience adverse health effects and death as a result of extreme heat. The Heat Vulnerability Index ranges from 1 (least vulnerable) to 5 (most vulnerable) and is assigned by community district. Although the HVI is a crucial tool for targeting heat mitigation solutions at the neighborhood scale, it is not well-suited for use in understanding differences in heat-related vulnerability among NYCHA developments. This is because the three socioeconomic factors that go into the heat vulnerability index are also highly correlated with NYCHA residence: the percent of people living under the federal poverty level, percent non-Latino Black population, and percent without access to air conditioning are generally higher than the citywide average for any NYCHA development. NYCHA therefore considers all NYCHA developments to have an elevated vulnerability to the health effects of extreme heat compared to New York City as a whole, a position supported by NYC DOHMH.

There are nevertheless certain developments with higher concentrations of heat-vulnerable residents. Seniors are among those most likely to experience health effects of extreme heat, and NYCHA must be particularly attentive to how extreme heat affects its senior residents. Forty NYCHA developments are senior developments exclusively, and 12 are partially senior developments. However, developments have a median 20% of residents over the age of 62 regardless of their designation as senior developments, and 52 developments that are not designated as partially or fully senior developments have over 25% senior residents. Additionally, programs that seek to protect NYCHA residents from extreme heat should pay special attention to residents with underlying health conditions and with limited mobility. DOHMH recommends that when NYCHA determines which developments are most in need of interventions aimed at improving thermal safety, it looks first at building residents' rate of access to cooling and the proportion of residents with registered mobility impairments or dependence on life-sustaining medical equipment. When prioritizing developments most in need of interventions aimed at increasing thermal comfort—making the outdoor environment more comfortable in times of extreme heat—NYCHA will look at the relative summer temperature of the development's neighborhood and at the percent vegetative cover of the development itself. Each development for which NYCHA has data on AC prevalence is assigned a rank of "Lowest", "Average", or "Higher", reflecting the relative level of AC prevalence at the site (Appendix), providing a guide to which developments are most in need of cooling interventions to help NYCHA's Capital Planning Department use these two aspects of heat mitigation most effectively.

Extreme Rain

Heavy rainfall can inundate low-lying areas beyond the coast. Total annual precipitation is very variable from year to year, but the New York City Panel on Climate Change reports a long-term trend of increase, with the average annual amount going up by 0.8 inches each decade between 1900 and 2013.[5] Along with an overall increase in expected rainfall amounts, NPCC expects to see an increase in the number of extreme

TABLE 2

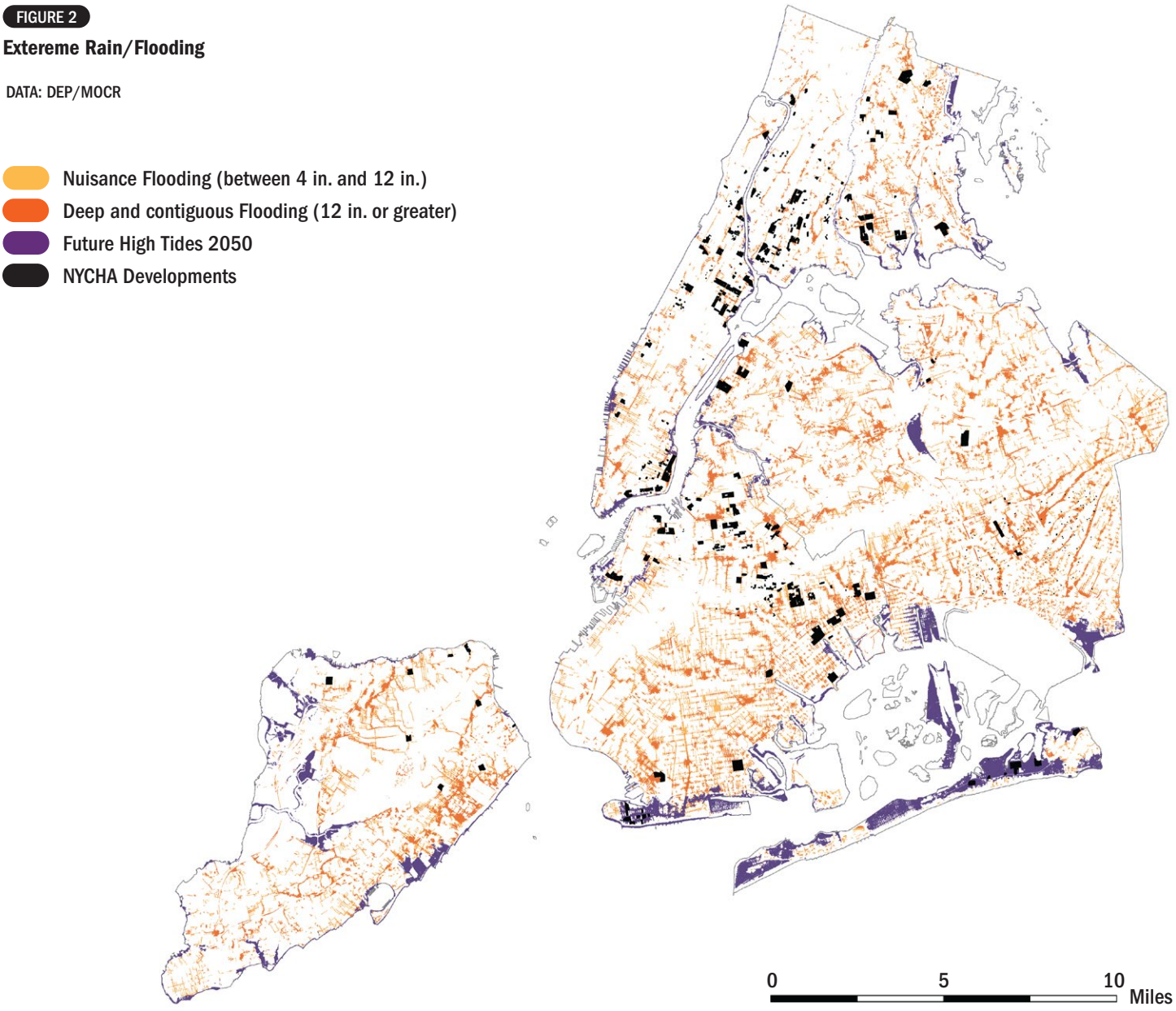
Projections for extreme rain events through 2080s (NPCC2).

	Baseline # of occurrences (1971–2000)	2020s high estimate	2050s high estimate	2080s high estimate
Rainfall at or above 1" per day	13	16	17	18
Rainfall at or above 2" per day	3	5	5	5
Rainfall at or above 4" per day	0.3	0.5	0.5	0.7

FIGURE 2

Extereme Rain/Flooding

DATA: DEP/MOCR



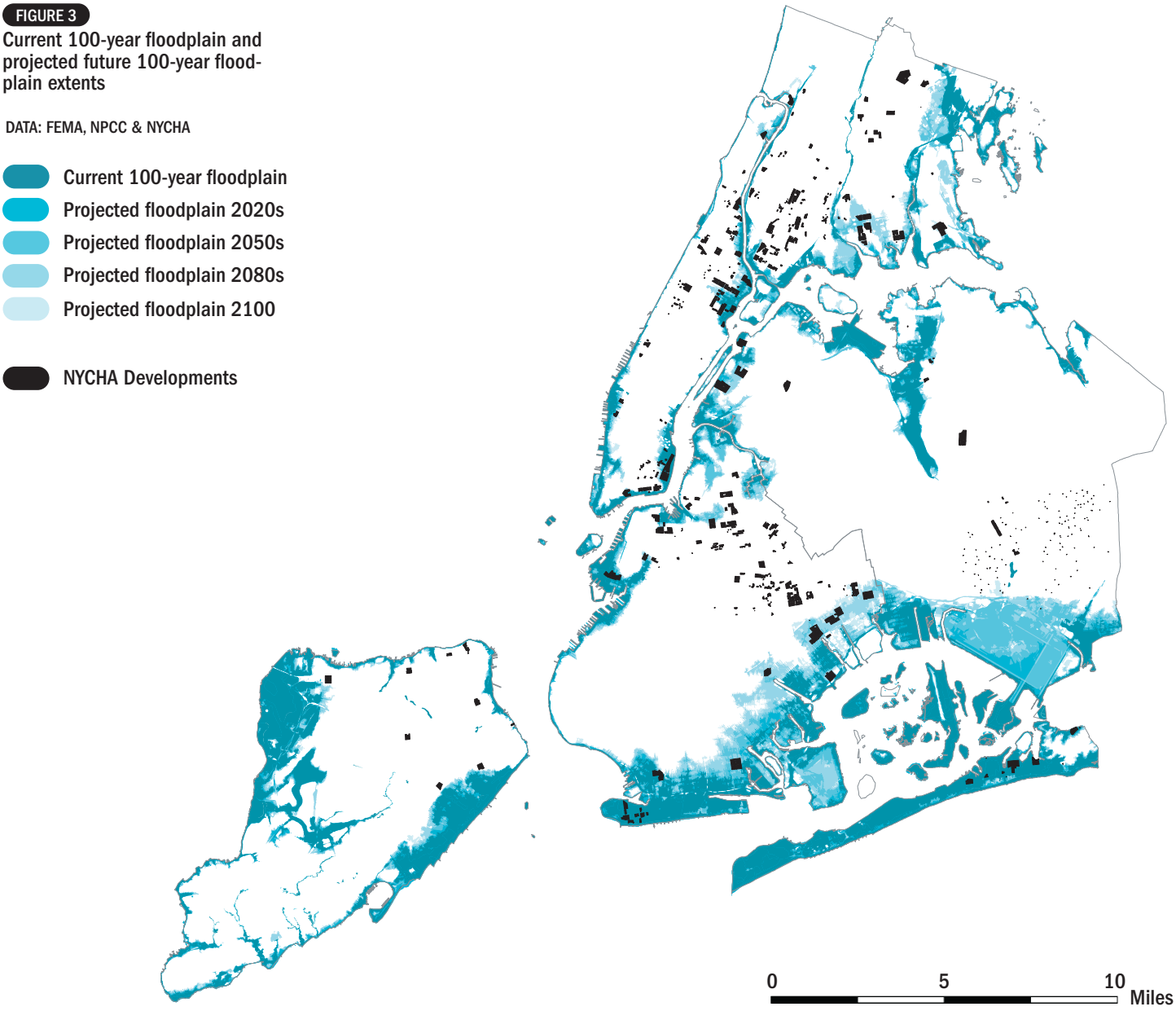
rain events (defined as rainfall at or above one inch per day) in the coming decades, as described in TABLE 2.

Variation in vulnerability to stormwater flooding among NYCHA's properties is dependent on sites' physical characteristics as well as the condition and size of stormwater drains both on NYCHA campuses and in the neighborhoods where developments are located. Certain parts of the city are already experiencing rainwater-driven street flooding and are likely to face worsening impacts in the future. In 2021, New York City's Department of Environmental Protection and Mayor's Office of Climate Resiliency released models showing areas likely to flood during heavy rains.[6] Models presented two scenarios: a moderate stormwater flood (2 inches of rain in one hour, also referred to as the 10 year storm, with approximately a 10% chance of occurrence in any given year) and an extreme rainstorm (3.5 inches of rain falling within one hour, also referred to as the 100-year storm, with approximately 1% chance of occurrence in any given year). FIGURE 2 depicts the Extreme Stormwater Flood scenario, under which large swaths of Staten Island, Southern Brooklyn, and Southeast Queens should expect to see disrupted roads, damage to property, and possibly other impacts. Based on their locations relative to these modeled impacts, NYCHA

FIGURE 3

Current 100-year floodplain and projected future 100-year floodplain extents

DATA: FEMA, NPCC & NYCHA



developments are assigned a rating of high, medium, or low priority for stormwater mitigation in the Appendix.

Coastal Flooding

Sea level rise causes coastal flooding in two ways: it leads to more frequent and intense coastal storms with increased potential for storm surge flooding such as that seen during Hurricane Sandy, and it leads to higher tides, causing regular nuisance flooding, also called "sunny day flooding." This assessment seeks to understand NYCHA's vulnerabilities to both storm-induced and nuisance flooding that result from sea level rise. Storm surge flooding is perhaps the most familiar climate hazard for NYCHA, as it affected 35 developments and resulted in significant damage and loss of service during and after Hurricane Sandy. The storm surge during Sandy was made worse by its occurrence at high tide, and New York City experienced a total storm tide (the combination of storm surge height and the high tide level) of 11.1 feet, generating the highest water level ever recorded in New York Harbor. The estimate of the storm tide of a "100-year flood"—a flood having a 1% chance of occurring in any given year—ranges from 6.7 to 11.3 feet.[7]

TABLE 3

Number of NYCHA buildings in 100-year flood plain will increase as the 100-year floodplain grows

	Number of NYCHA Buildings within 100-year Flood Zone
Effective Flood Insurance rate Maps (2007)	185
Preliminary Flood Insurance Rate Maps (2015)	275
Projected 100-year Floodplain, 2020s (NPCC)	315
Projected 100-year Floodplain, 2050s (NPCC)	473
Projected 100-year Floodplain, 2080s (NPCC)	791
Projected 100-year Floodplain, 2100 (NPCC)	921

As time goes on, the number of buildings and developments located in areas at risk of storm surge flooding will expand TABLE 3. When FEMA issued Flood Insurance Rate Maps in 2007, only 185 NYCHA buildings were in the 100-year floodplain; that number increased to 275 when flood maps were updated with the 2015 Preliminary Flood Insurance Rate Maps. The NPCC projects a steadily expanding 100-year floodplain throughout the century—if these projections hold, 921 of NYCHA's buildings will be in the 100-year floodplain by 2100. Developments' current floodplain location, as well as the number of buildings within the development expected to fall within 100-year floodplains projected in the 2020s, 2050s, 2080s, and 2100 are included in the Appendix.

Developments worst-affected by Hurricane Sandy were in the Rockaways, Coney Island, Red Hook, and along the East River (Astoria, East Harlem, and the Lower East Side). With rising sea levels, NYCHA expects to see the biggest increases in storm surge vulnerability at NYCHA developments near the East River and on the inland side of Jamaica Bay FIGURES 4 & 5.

FIGURE 4

East Harlem Developments closest to the coast have buildings within the current 100-year floodplain. By 2100, the 100-year floodplain will extend farther inland.

DATA: FEMA, NPCC & NYCHA

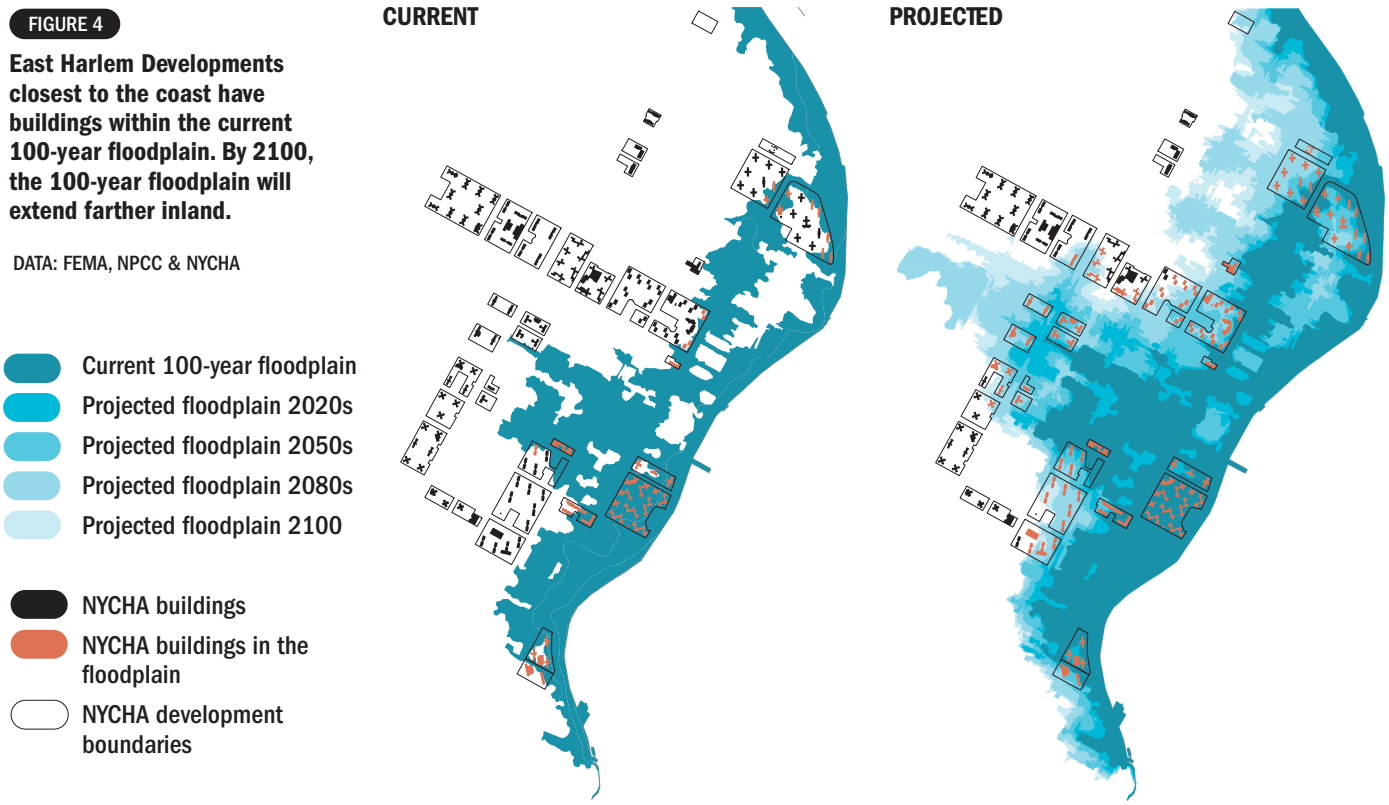


FIGURE 5

NYCHA Developments on the inland side of Jamaica Bay are not in the current 100-year flood plain. By 2100, these same developments are within the projected floodplain.

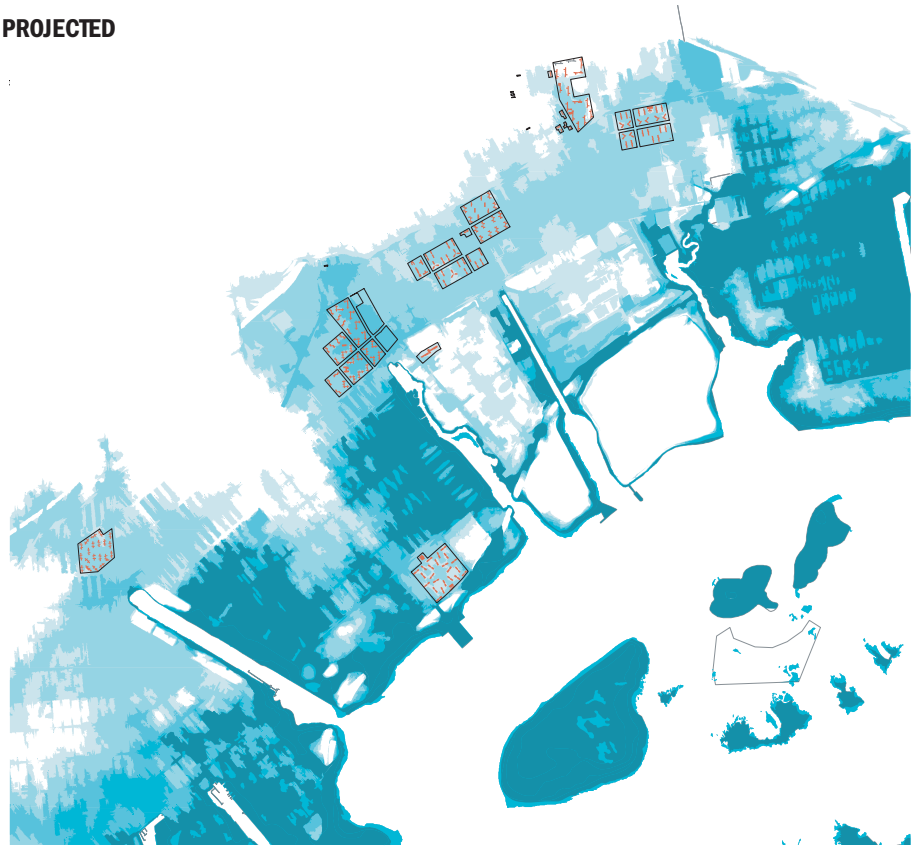
DATA: FEMA, NPCC & NYCHA

- Current 100-year floodplain
- Projected floodplain 2020s
- Projected floodplain 2050s
- Projected floodplain 2080s
- Projected floodplain 2100

- NYCHA buildings
- NYCHA buildings in the floodplain
- NYCHA development boundaries

CURRENT

PROJECTED

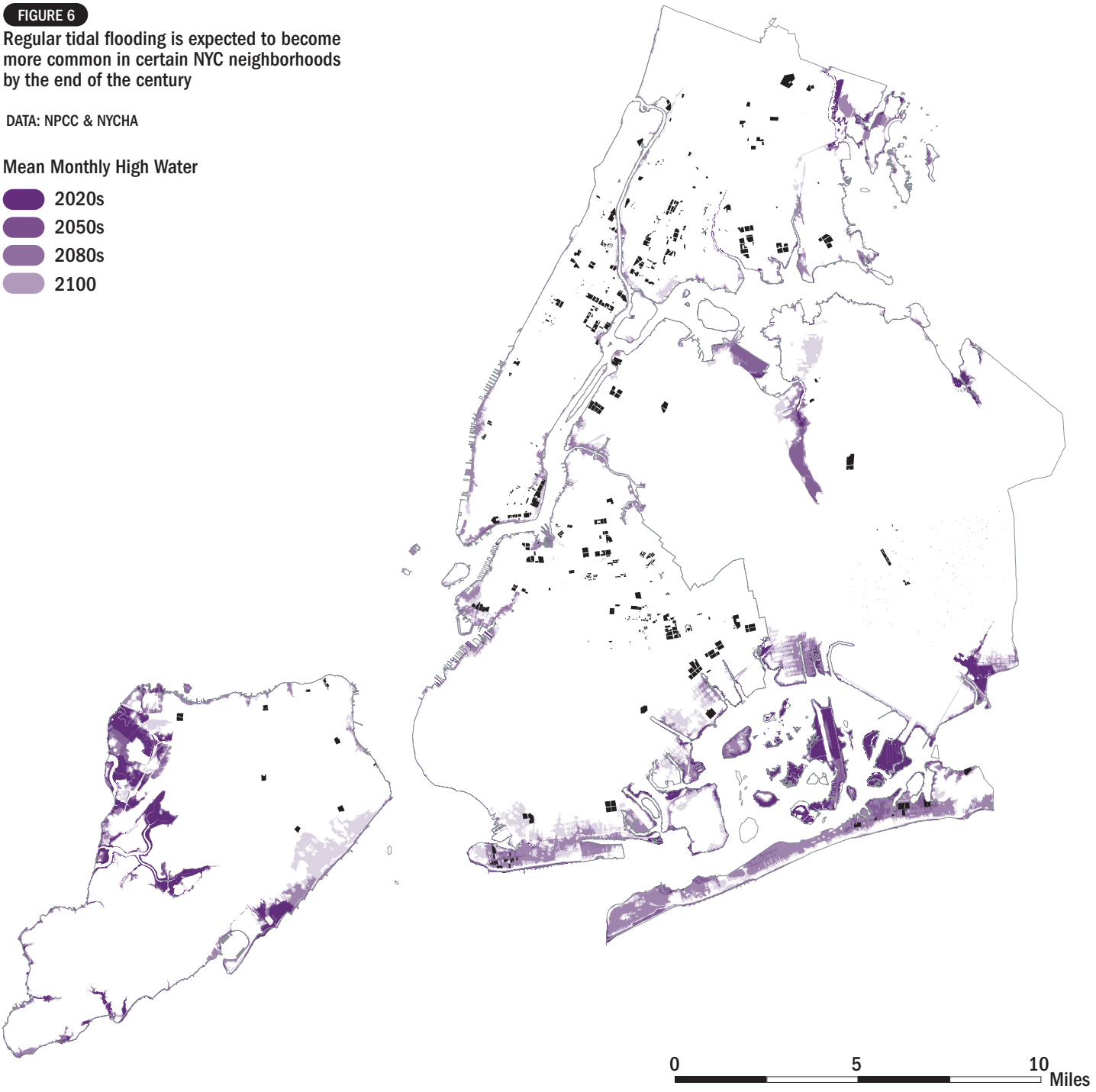


0 1 2 Miles

FIGURE 6

Regular tidal flooding is expected to become more common in certain NYC neighborhoods by the end of the century

DATA: NPCC & NYCHA



Tidal flooding, also called "sunny-day flooding" or nuisance flooding, is flooding that occurs on a regular basis as a result of tides that are higher because of sea level rise. In New York City, the average number of days in which nuisance flooding is experienced per year has gone from 32 between 1955–1984 to 63 between 1985–2014.[8] Neighborhoods that may be affected most by tidal flooding include Coney Island and the Rockaway Peninsula, both of which are home to many NYCHA residents, though most of these developments have already received flood protection measures through the Hurricane Sandy Recovery & Resilience program FIGURE 6. Future tidal flooding may also be limited by the coastal flood protection projects currently being planned by the Army Corps of Engineers.

Additional Hazards:
Groundwater Rise, Heavy Winds, Cold Snaps

Beyond the three primary climate-induced hazards of extreme heat, heavy downpours, and sea level rise, NYCHA will be monitoring the potential for additional hazards to affect NYCHA property and residents. Among these are groundwater rise, extreme winds, and cold snaps.

Groundwater Rise

Groundwater rise is likely to eventually cause basement flooding in developments with high water tables and exacerbate the effects of rainwater-driven flooding.[9] NYCHA will work to identify buildings where basements may be deeper than the projected level of groundwater rise in 2050 and develop strategies to limit the damage that would result from flooding that is caused or exacerbated by rising levels of groundwater. NYCHA already is aware of certain developments with shallow depth to groundwater; where known, this information is provided in the Appendix.

Extreme Winds

More extreme winds are expected in New York City in the future. The extent of changed conditions, and the resulting vulnerabilities, are the subject of current study, and NYCHA will continue to assess what additional vulnerabilities extreme wind conditions will present as more information becomes available. At present, the NYC Department of Buildings does not project that extreme winds will cause severe damages to the majority of NYCHA's portfolio. However, extreme wind can lead to extensive loss of trees and branches and have additional effects on buildings such as driving precipitation which leads to water infiltration.

Cold Snaps

Overall, cold weather is expected to decrease as climate conditions change in the coming decades. From a baseline average of 71 days with a minimum temperature at or below 32°F from 1971–2000, NPCC expects to see a decrease of approximately 25% in the 2020s, more than 33% by the 2050s, and approximately 50% by the 2080s.[10] But cold snaps are expected to persist and may have different impacts in the context of an overall warmer winter. For example, snow followed by warm weather can result in heavy, wet snow that is more damaging to buildings and plants. Heavy rain following a cold snap can cause increased flooding because of the combined effects of melting snow and ice and heavy rain. And winter storms can cause more hazardous storm surge during cold conditions. NYCHA must also be attentive to its pipes that are underground and above the frost line, and will work to understand whether more frequent freeze-thaw cycles that New York City will experience have the potential to increase disruptions to potable water and steam heat service.

Secondary Hazards:
Utility Outages, Transportation System Disruptions, Other Emergency Conditions

A secondary set of hazards comes from climate-induced disruptions to city services and infrastructure that are essential to NYCHA residents and properties. Secondary hazards include power outages, disruptions to the city's water supply, transportation system interruptions, and natural gas network disruptions.[11] While the providers of these utilities retain primary responsibility for the resiliency of these services, NYCHA will monitor vulnerabilities to service disruptions and opportunities to build layered resilience to them on NYCHA properties. NYCHA's in-house office of Emergency Management will continue to respond to emergency needs and ensure that NYCHA residents are part of citywide plans to address outages and other hazards.

STRATEGY 2

Develop a screening tool that all capital projects will use to identify climate risks that are relevant to the project being planned, aligned with the Mayor's Office of Resiliency's Climate Resiliency Design Guidelines.

The New York City Panel on Climate Change has released projections detailing how various climate hazards will affect New York City at several points in the future, describing conditions NYCHA should expect to see in the current decade, 2050's, 2080's, and in 2100 or beyond. But not all buildings or building components will last through the end of this century. Using the methodology detailed in the Climate Resiliency Design Guidelines published by the Mayor's Office of Resiliency as a guide, NYCHA will match the time horizon of projected climate conditions to the useful life of the investments being made, thereby integrating protections in a cost-effective manner.

Local Law 41 of 2021 requires that, by 2026, all City-funded capital projects with a value of $10 million or more use the Climate Resiliency Design Guidelines and meet a minimum resiliency score. NYCHA's projects are funded by a mixture of sources and not all projects would be subject to this requirement; however, NYCHA wishes to establish a consistent method for evaluating the resiliency of capital projects and modifying them to incorporate resiliency measures that will cost-effectively protect NYCHA property. To do this, NYCHA will develop a screening tool for use by all NYCHA capital projects that will help project managers identify where assets are subject to climate-related hazards and consider modifications that will increase resiliency where those vulnerabilities exist.

STRATEGY 3

Update NYCHA's Design Guidelines for Residential Rehabilitation to include site and resilient design.

NYCHA has looked closely at the climate-related hazards that are expected to affect New York City in the coming decades and identified geographic areas and NYCHA populations likely to be most affected by each. Moving forward, NYCHA is working to develop a more fine-tuned understanding of the likely costs, both physical and social, of climate-induced hazards. NYCHA's Design Guidelines for the Rehabilitation of Residential Buildings were developed in 2016 to guide the development of specifications and standards for NYCHA capital projects. As NYCHA's understanding of climate hazards and effective mitigation tools evolves, the Design Guidelines will be updated, and will include guidance on incorporating resilient site and building features into NYCHA projects, with consideration for NYCHA's specific operational and maintenance needs.

STRATEGY 4

Coordinate with PACT partners to include resilient design into the programs.

NYCHA is working to rehabilitate approximately one-third of its original housing stock through partnerships with private developers, using the Permanent Affordability Commitment Together program ("PACT"). NYCHA's partners are already required to use the Enterprise Green Communities Criteria in all of its projects. NYCHA will continue to coordinate with its partners about climate hazards

and effective techniques to mitigate those hazards, and will ensure that climate hazards and mitigation will be incorporated into the planning process for PACT conversions and renovations.

STRATEGY 5

Secure Funding to address NYCHA's most acute climate vulnerabilities.

NYCHA will use its climate vulnerability analysis to prioritize sites at highest risk and seek funding from FEMA and other sources to protect them before disaster strikes. Sources of potential funding to mitigate climate hazards include FEMA hazard mitigation programs and a proposed state bond act that would fund resiliency measures. With increasing danger from climate hazards and the stated intention of the Biden administration to use the full force of the federal government to address climate concerns, other sources may become available, and NYCHA will be ready with well-developed project plans that would mitigate risk for NYCHA properties and residents.

FEMA Funds

NYCHA was the recipient of over $3 billion of disaster recovery funding to rebuild after Hurricane Sandy and build resilience to future storms. Congress has recognized, however, that funding disasters after they happen is expensive compared to mitigating the effects of hazards before they happen. In 2018, Congress authorized FEMA to allocate up to 6% of the annual budget on pre-disaster mitigation, a substantial increase from historic mitigation funding availability. While FEMA did not allocate the full 6% in the previous administration, the current Federal administration has made a commitment to fully funding pre-hazard mitigation.

FEMA developed a program called Building Resilient Infrastructure and Communities (BRIC) that was intended to allow for larger resiliency projects and encourage the use of innovative methods for building resiliency. The first round of applications through this program was accepted in 2020. NYCHA worked with the New York City Department of Health and Mental Hygiene to develop new methods to quantify the benefits of providing reliable cooling to NYCHA residents, allowing for the submission of New York City's first-ever application for pre-disaster funding related to extreme heat mitigation. FEMA has indicated that the maximum funding for pre-hazard mitigation will be available for applications in the 2021 BRIC cycle. Rigorous analysis of the risks and the potential benefits of mitigation strategies are crucial for securing funding from FEMA, and NYCHA will continue to work to maximize NYCHA's ability to protect its campuses and residents by quantifying the benefits of resilience investments and developing compelling mitigation project scopes.

New York State Resiliency Funds

New York State legislature passed the Mother Nature Bond Act in early 2020, intending to provide a state-level source of funding for resiliency measures. Though the bond act was approved by the legislature, it additionally required a public vote to enact. Because of the COVID-19 pandemic and related budget concerns, it was not put before voters as intended in November of 2020, but the bond act may go before voters in the future, or the State may develop another mechanism for assisting local governments with resiliency investments.

GOAL 2

Foster the Health of NYCHA's Urban Forest

NYCHA is the second largest owner of open green space in New York City, second only to the New York City Parks Department. Trees provide much-needed aesthetics, quality of life, protection from air pollution, and mental health benefits.[12] Beyond those benefits, NYCHA's enormous tree asset provides an important resource for heat mitigation on NYCHA campuses, many of which contain dense tree canopy cover. Research shows that the cooling effects of tree canopy cover provide the greatest benefit when a neighborhood reaches about 40% canopy cover.[13] Additionally, trees that are clustered together provide greater cooling benefits on a neighborhood scale than do individual trees planted throughout a neighborhood, so enhancing NYCHA's tree canopy cover may provide entire New York City neighborhoods with substantial passive cooling power.[14]

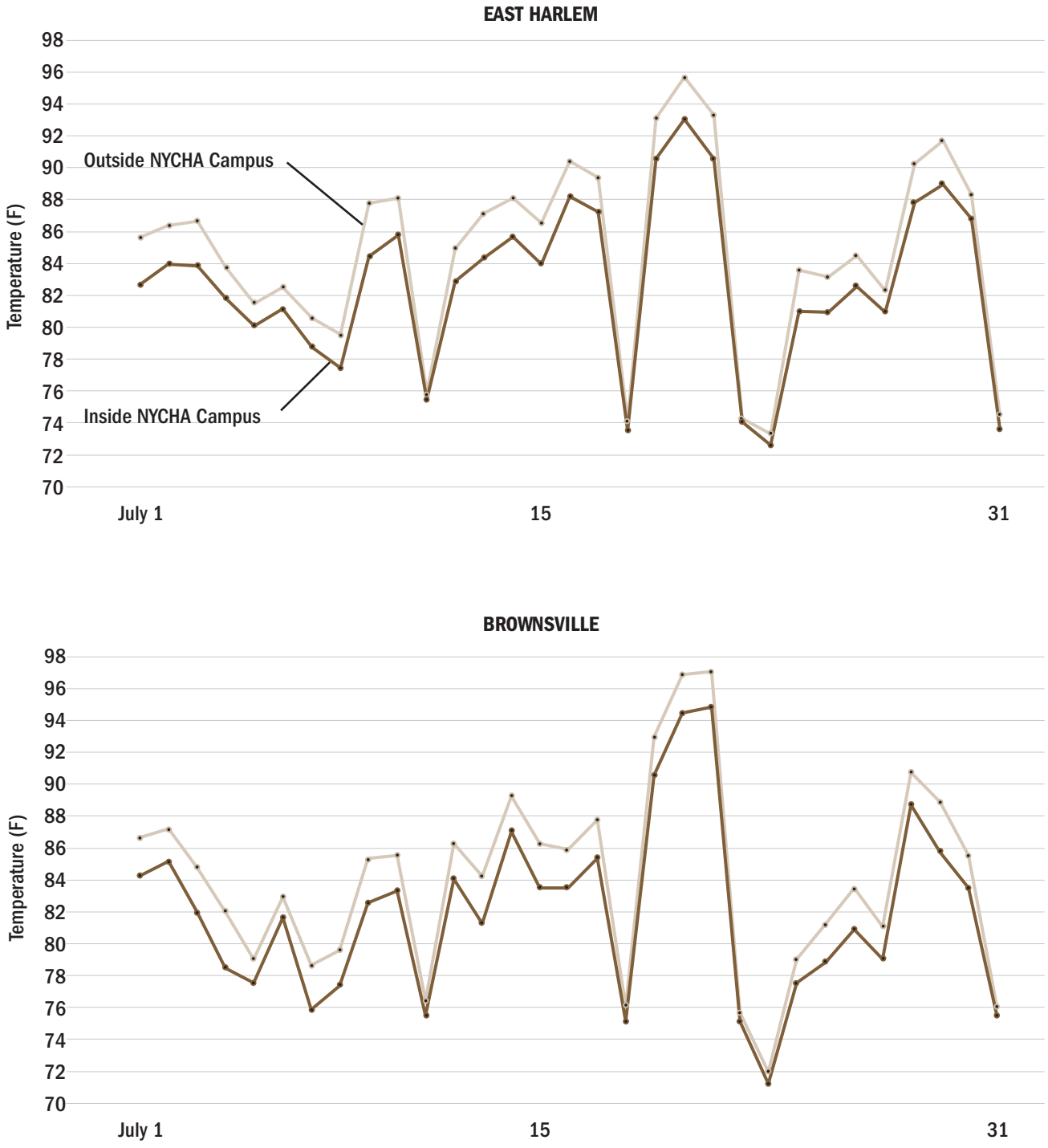
In general, NYCHA developments contain high levels of tree canopy cover relative to their surrounding areas. Campuses range widely in their canopy cover, however, with anywhere from 0% to 71% coverage, and an average of 34%. NYCHA worked with the Department of Health to monitor heat on NYCHA campuses and initial results show a 2-degree F difference between densely vegetated NYCHA campuses and their surrounding neighborhoods FIGURE 7.

A companion report to the Climate Adaptation Plan, "NYCHA's Urban Forest: A Vital Resource for New York City," provides more detail about the ecological and social value of NYCHA's trees and the reasoning behind the four strategies related to NYCHA's urban forest that are included in this plan.

FIGURE 7

Temperatures inside NYCHA campuses (brown line) were consistently about 2 degrees Fahrenheit cooler than temperatures in surrounding streets in July of 2019.

DATA: DOHMH Cool Neighborhoods Program



Heat sensors installed throughout several NYCHA campuses during the summer of 2020 helped NYCHA quantify the cooling value of its trees.

STRATEGY 1

Complete a comprehensive inventory of NYCHA trees.

NYCHA is working to further quantify the value of tree canopy and identify threats to trees' health by inventorying NYCHA trees. In the fall of 2020, with technical support from the US Forest Service and The Nature Conservancy, NYCHA worked with Green City Force alumni—NYCHA residents who have completed an AmeriCorps green jobs training program—to inventory trees at 18 NYCHA developments and check for symptoms of pests and diseases. The project took place across eighteen developments located in three distinct geographic clusters: The South Bronx, East Harlem, and Brownsville. Each of these neighborhoods contains large concentrations of NYCHA developments and, on a neighborhood scale, has a higher-than-average vulnerability to the effects of extreme heat.

The tree inventory showed that at those 18 developments alone, NYCHA trees remove over 2000 pounds of local air pollutants each year, sequester 44 tons of carbon, and retain over 100,000 cubic feet of stormwater.[15] The inventory served not only to move NYCHA toward a comprehensive inventory of trees, but to begin to identify needs for maintaining the health and benefits of NYCHA's tree canopy into the future. For example, over 1/3 of trees on the inventoried campuses are London Plane trees, a species that has proven not to be resilient to flooding. The Trees at NYCHA report includes much more detail on the findings from NYCHA's tree inventory to-date. NYCHA is continuing to work with Green City Force to move the tree inventory forward in the summer and fall of 2021, and aims to complete an inventory for all NYCHA developments within the next five years.

STRATEGY 2

Create and Implement Authority-Wide Tree Maintenance Plan

Based on NYCHA's tree inventory and assessment, it is clear that both preserving existing trees and planting new, more diverse tree species are essential to the long-term health of NYCHA's piece of the New York City Urban Forest. A comprehensive plan would allow NYCHA to align planting and tree management decisions with a long-term vision of a diverse, healthy, and resilient urban forest. NYCHA will work to develop a plan that incorporates the rich base of tree expertise available among partner agencies and organizations in New York City. The plan will include a target schedule for new plantings and priority locations for planting, concentrating on developments with lower levels of tree canopy cover, those with low species diversity, and those lacking young trees that will be able to replace NYCHA's large, mature shade trees as they reach the end of their lives. The plan should provide Integrated Pest Management (IPM) protocols to protect the health of NYCHA trees; and efforts to engage NYCHA residents in tree stewardship should be included.

Green City Force Field Staff work to inventory NYCHA's trees in the fall of 2021

Collecting information about the size and condition of NYCHA's trees will help NYCHA protect and enhance this important resource.

STRATEGY 3

Secure funding for arborist and community foresters devoted to NYCHA tree care

An arborist dedicated to NYCHA tree care would oversee the implementation of NYCHA's comprehensive tree care plan and would provide a central resource for development staff as they evaluate and manage tree-related problems.

NYCHA will seek funding to hire a full-time arborist within one year, either as part of NYCHA's staff or through an agreement with another agency or partner organization. A single arborist, however, is inadequate to oversee the execution of a maintenance plan for all NYCHA developments. To provide development staff with greater support for urban forestry needs, NYCHA will additionally advocate for community foresters assigned to work more closely with developments in each borough. Community foresters would develop a deeper understanding of the needs of a subset of NYCHA landscapes and develop targeted maintenance strategies for providing support to developments, including collaborating with GCF via the Trees at NYCHA program and leading resident tree stewardship events and programs. If these positions become available, NYCHA will seek to fill community forester positions with NYCHA residents who have gained urban forestry expertise through GCF urban forestry efforts.

STRATEGY 4

Build Partnerships Around Urban Forestry

NYCHA's tree care resources are limited; partnerships with agencies and organizations with deep expertise in tree care have been essential to NYCHA's tree inventory work. NYCHA will continue to build these partnerships as an essential means of staying up-to-date on tree care best practices and co-implementing urban forestry work.

NYCHA already has strong partnerships with several agencies and organizations. Green City Force is a valued partner because of its unique focus on creating green jobs opportunity for NYCHA residents. NYCHA will continue to expand its partnership with Green City Force, with the goal of creating urban forestry career pathways as additional options for participants in Green City Force programs. In parallel to the existing "Farms at NYCHA" program, NYCHA will seek to establish an ongoing "Trees at NYCHA" program that institutionalizes the urban forestry collaboration that NYCHA and GCF have begun together.

Additional partnerships that have been essential to building NYCHA's urban forestry work are those with the New York City Parks Department, The Nature Conservancy, the USDA Forest Service's Urban Field Station, and Trees New York. From 2020-2021, NYCHA participated in the Urban Forest Task Force, a group convened by The Nature Conservancy to develop an Urban Forest Agenda for New York City as a whole. Equity is central to the agenda and NYCHA will continue to participate in the Forest for All coalition that will work to implement the agenda. The USDA Forest Service and The Nature Conservancy have both provided essential technical and training support in completing NYCHA's tree assessment and planning for a healthier NYCHA forest. And in 2020, NYCHA was able to re-establish a lapsed license agreement with Trees New York that allows Trees New York to plant trees on NYCHA property as funding becomes available.

Planting new trees is essential for increasing species diversity and ensuring that NYCHA's tree canopy remains robust.

GOAL 3

Expand Access to Reliable, Efficient Cooling in NYCHA Apartments

NYCHA's approach to mitigating the risk of extreme heat is informed by research showing that most heat-related fatalities and hospitalizations happen after exposure to heat indoors.[18] In New York City, eighty-five percent of cases of heat-related illness and death result from exposure to extreme temperatures indoors. Based on this reality, lack of access to air conditioning creates the single greatest vulnerability to morbidity and mortality from extreme heat for NYCHA residents. New Yorkers living in high-poverty neighborhoods report much lower levels of air conditioning access than New Yorkers living in high-income neighborhoods, and past surveys of NYCHA residents' air conditioner prevalence have shown that residents are among those with lower levels of AC access. NYCHA knows that the most effective way to maintain safety from extreme heat for NYCHA residents is to provide reliable access to indoor cooling. At the same time, passive cooling strategies such as improved building insulation, use of cooler building materials, and enhanced tree canopy cover are important complementary strategies.

The 2019 report, Sheltering Seniors from Extreme Heat, details NYCHA's goal to find ways of providing cooling to NYCHA residents, particularly seniors, and NYCHA continues to expand efforts to do so at the same time decreasing the buildings' overall energy use. Retrofitting buildings with combined heating and cooling systems, continuation of cooling demonstration projects, and integrating cooling systems into NYCHA's Comprehensive modernization programs will increase passive survivability and reduce energy use.

The installation of smart, networked air conditioners at Meltzer Towers allowed NYCHA to test the feasibility of providing building-wide cooling while limiting the building's peak electricity demand.

STRATEGY 1

Continue to demonstrate ways to provide cooling to NYCHA residents & use results to inform future planning.

Public Housing Authorities historically have not provided residents with cooling. NYCHA has worked to find ways to provide cooling to residents that is efficient and cost-effective and will continue to find ways of increasing residents' safety during hot weather.

Cooling Demonstration Projects

NYCHA's Capital Projects Division, Energy Department launched two demonstration projects in 2019 to study the costs and benefits of providing cooling to NYCHA residents in senior buildings. NYCHA currently allows residents to install air conditioners at their own expense and requires that each air conditioner be registered. Each registered air conditioner is subject to a flat monthly fee to compensate NYCHA for the increased energy use, as required by HUD policy. In practice, unregistered air conditioners are common. Additionally, NYCHA Energy has found that the air conditioners that residents install are often improperly installed and poorly maintained, creating energy penalties and safety concerns. NYCHA Energy's air conditioning demonstration program provided WiFi enabled air conditioners to all residents of Meltzer

Tower who have opted into the program. The program consisted of replacing resident-owned air conditioners and providing energy-efficient, appropriate-sized WiFi air conditioners. For this program, residents' monthly air conditioning fee is waived. Because the air conditioners are WiFi enabled, compressors' energy use can be staggered during times of peak demand. NYCHA hopes to make the program cost-neutral by achieving energy savings through the increased efficiency of the air conditioner units, an improved installation process, and reductions in peak electric demand. NYCHA is also conducting an air source heat pump demonstration program in seven apartments at Fort Independence. The air source heat pumps will provide fully electric heating and cooling to these apartments, results of the program could lead to more opportunities for cooling. NYCHA's cooling demonstration projects have revealed the need for a heat pump unit that is tailored to NYCHA's specific retrofit needs.

As described in NYCHA's 2021 Sustainability Agenda, NYCHA has launched a Packaged Window Heat Pump Challenge in collaboration with NYSERDA. This challenge is expected to result in a heat pump unit that can be installed in existing window openings, allowing NYCHA to move toward efficient building electrification as well as providing full-building cooling. NYCHA sees these carbon reduction, electrification systems as the future for NYCHA developments.

BRIC Heat Mitigation Application

In 2020, NYCHA put forward an application to FEMA's Building Resilient Infrastructure and Communities (BRIC) program that aimed to mitigate extreme heat. The application argued that providing reliable in-unit cooling to NYCHA residents is the most effective way to mitigate residents' heat risk and proposed to replace the steam boiler plant at NYCHA's Lehman Village

Free air conditioners were available to residents through the Get Cool program in 2020, allowing recipients to stay cool while protecting themselves from COVID exposure.

Smart, networked air conditioners can increase AC access while allowing NYCHA to reduce energy peaks.

campus with in-unit Air Source Heat Pumps throughout the development. The application also proposed to complement the provision of in-unit cooling with the use of resilient plantings and cool surfaces throughout the development, as well as providing the community center—used as a cooling center during heat emergencies—with solar-powered battery backup power. Although NYCHA does not yet know the outcome of this application, this effort represents continued work to fund comprehensive heat mitigation work whenever possible and to find ways to demonstrate the benefits of integrating cooling into building heating plant renovations. NYCHA is continuing to apply for FEMA hazard mitigation funds aimed at protecting NYCHA residents from extreme heat, and is working to develop methodologies aimed at showing that cooling is an essential hazard mitigation strategy.

GetCool Program

As a result of the COVID-19 pandemic and the resulting restrictions on gatherings in public spaces, New Yorkers without air conditioning access faced a potentially dangerous summer in 2020, cut off from the usual sources of respite from summer heat such as community centers, libraries, and other facilities typically used as cooling centers during heat emergencies. NYCHA worked closely with the Mayor's Office of Resiliency to provide air conditioners, free of charge, to NYCHA residents who were 65 or over or had a qualifying underlying condition. NYCHA installed approximately 16,000 air conditioners through the program during the summer of 2020. NYCHA, in collaboration with the NYC Department of Health and Mental Hygiene, surveyed recipients of these air conditioners along with a control group of residents who just missed the age cutoff for eligibility for the program. Survey results indicate that those who received the air conditioners had a much greater ability to stay cool while adhering to social distancing recommendations, accomplishing the program's goal of providing those most vulnerable to extreme heat with a safe way to stay cool during the pandemic.

In addition, as a result of advocacy that NYCHA participated in during 2020, free air conditioners continue to be available to NYCHA residents with a qualifying condition through New York State's LIHEAP program. Prior to 2020, this program was not open to public housing residents.

STRATEGY 2

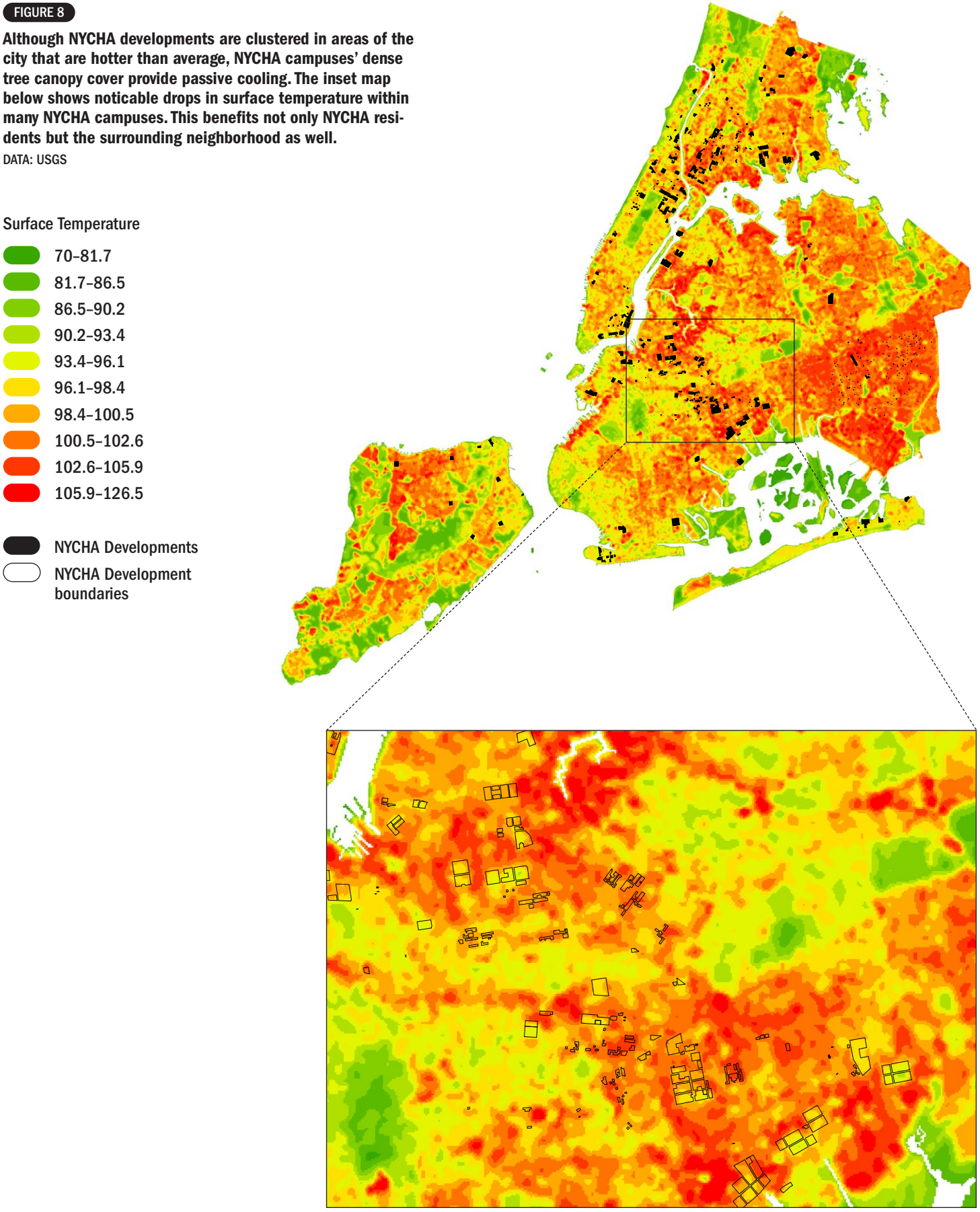
Integrate cooling into NYCHA's plans for comprehensive modernizations & heating plan replacements.

NYCHA is moving away from component-by-component replacement of systems and toward comprehensive modernizations to address the large backlog of deferred maintenance needs at developments. With comprehensive modernizations representing investment in NYCHA campuses at a scale not seen since their original construction, NYCHA recognizes the need to ensure that the modernizations create housing that will be appropriate for future conditions, including more extreme heat. NYCHA will prioritize the selection of comprehensive modernization plans that include cooling that is provided in an efficient and environmentally responsible manner. When heating plants are replaced outside of the comprehensive modernization process, NYCHA will modify its RFP scoring system to provide additional points to plans that include cooling in order to encourage holistic heating and cooling solutions.

FIGURE 8

Although NYCHA developments are clustered in areas of the city that are hotter than average, NYCHA campuses' dense tree canopy cover provide passive cooling. The inset map below shows noticable drops in surface temperature within many NYCHA campuses. This benefits not only NYCHA residents but the surrounding neighborhood as well.

DATA: USGS



STRATEGY 3

Install complementary measures that mitigate UHI where cooling is provided.

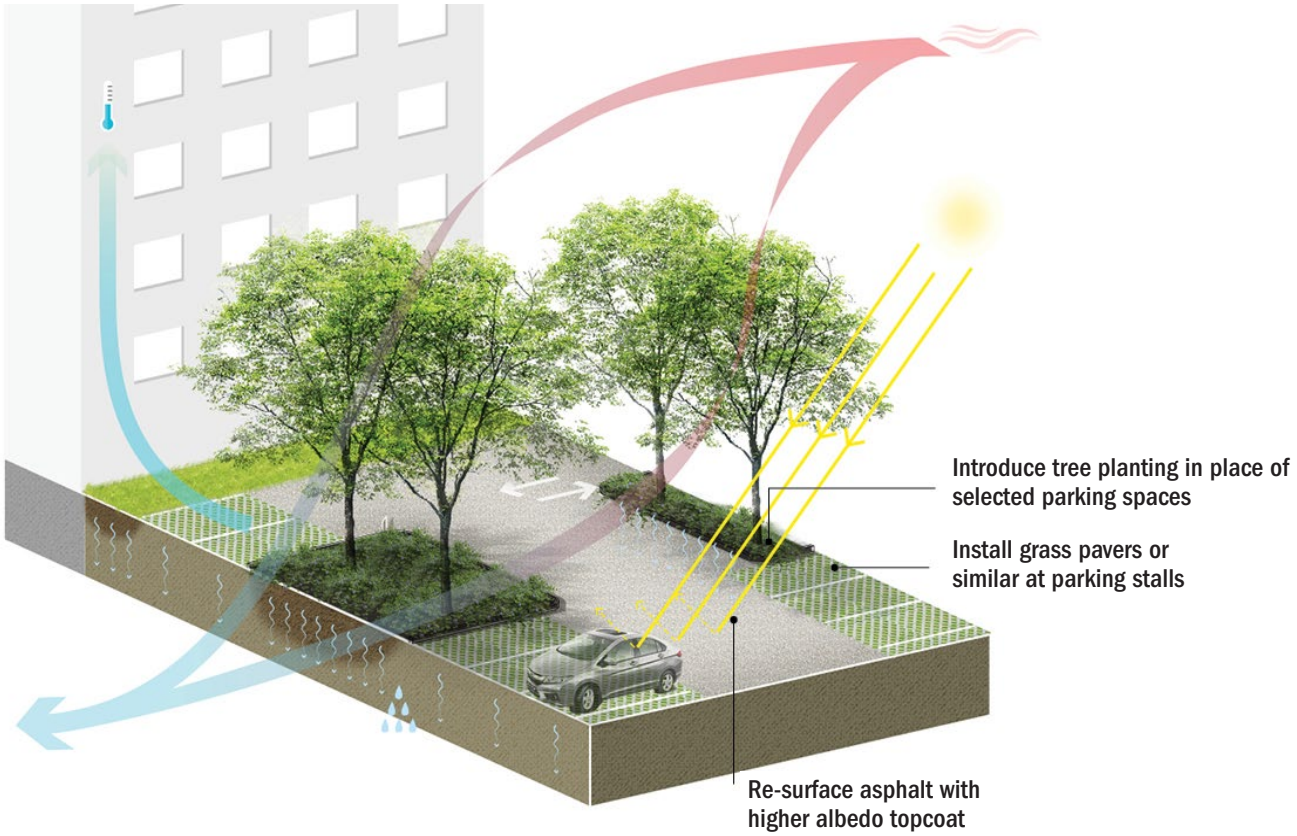
Dark, impervious surfaces absorb sunlight and retain it as heat, warming the urban environment. Dark surfaces are particularly problematic during multi-day heat waves, as they keep the environment warm for longer by preventing the outflow of hot air at night that creates a more comfortable environment. Dark roofs in particular absorb heat and keep upper floors of buildings hotter, increasing heat exposure. Roofs in New York City are now required to use light-colored surfaces that reflect solar radiation and prevent indoor heat gain; for roofs not slated to be replaced, white coatings can be added on top of existing roof materials, and NYCHA has participated in the mayoral Cool Roofs program to coat many of its roofs.

Beyond roofs, lighter-colored pavements and cool coatings on surfaces also mitigate heat build-up on NYCHA campuses. When installing cooling systems, NYCHA will seek opportunities to reduce the energy burden that cooling imposes via heat mitigation retrofits. FIGURE 9 shows a concept for a green parking lot, developed as a potential complementary measure to installing development-wide cooling. This type of strategy represents a small portion of the project cost but could increase the effectiveness and decrease the cost of mechanical cooling. Building insulation and air sealing are also essential improvements, both to improve passive survivability and to meet NYCHA's greenhouse gas emissions goals. NYCHA's 2021 Sustainability Agenda describes NYCHA's plans for upgrading building envelopes in more detail.

FIGURE 9

Green parking lots concept

AECOM FOR NYCHA



GOAL 4

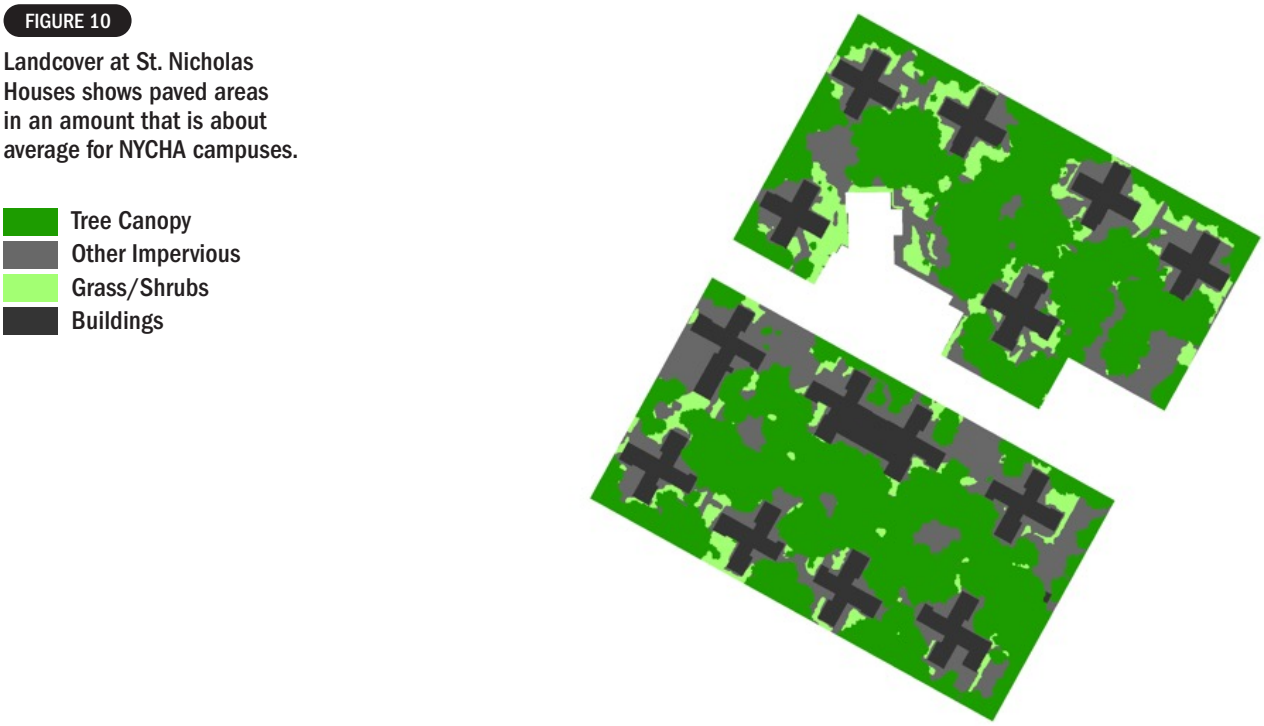
Prepare Developments to Manage Heavier, More Frequent Rainstorms

Today's 50-year rainstorm is expected to be the 5-year rainstorm of 2050. New York City's stormwater systems were not built to withstand such events, and citywide there is a need to find alternative ways of managing the larger volumes of rainwater that will become more frequent.

NYCHA campuses have generally high levels of tree canopy cover, but also tend to have a large amount of impervious surface, meaning that the rain that falls on those areas becomes runoff and contributes to the potential for stormwater-driven flooding. NYCHA campuses have an average of 27% cover of paved surfaces; the combination of buildings and paved surfaces makes up an average of 57% of campuses' landcover. As an example, FIGURE 10 shows the land cover at St. Nicholas Houses, which has a typical amount of impervious cover for a NYCHA development.

FIGURE 10

Landcover at St. Nicholas Houses shows paved areas in an amount that is about average for NYCHA campuses.



STRATEGY 1

Identify problems with existing stormwater infrastructure and work to address them.

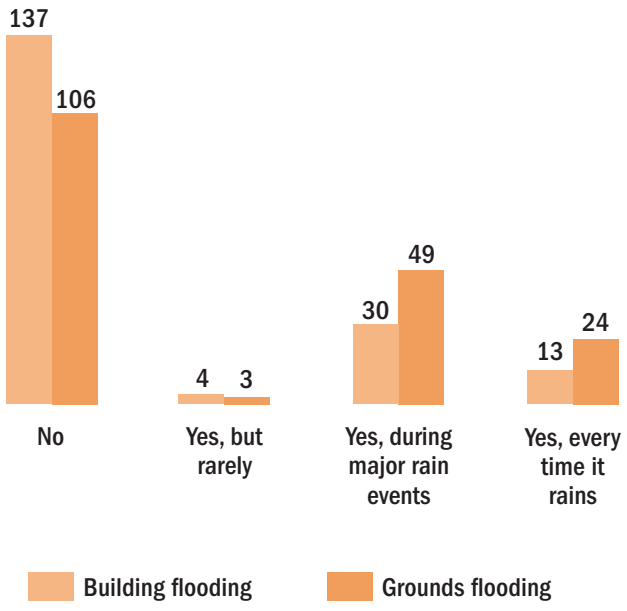
NYCHA's strategy to adapt to heavier and more frequent rains starts with ensuring that existing stormwater infrastructure is performing as designed; where existing infrastructure is inadequate to manage heavier rains, NYCHA will work to identify strategies and funding that can prevent damage to NYCHA equipment and keep NYCHA developments accessible during heavy rains.

NYCHA buildings are generally arranged within campus-style developments with large areas of open space between them. Because of this configuration, NYCHA properties contain stormwater drainpipes that are unusually long compared to other New York City properties. The longer length of these connections means that they become clogged more easily than shorter drain connections and must be cleared on a regular basis to maintain functionality. As NYCHA experiences more frequent heavy rains, it will become even more important to maintain stormwater drain functionality, especially in advance of predicted downpours.

NYCHA is engaged in an important effort to better catalogue which developments are already experiencing onsite flooding as a result of heavy rains. A survey of NYCHA property managers conducted in the summer of 2020 asked 186 developments' staff about the severity of rainwater-driven flooding, its effects on the developments' residents and staff, and what preventative practices were being pursued to mitigate it. Developments already experiencing these conditions are likely to suffer more as rains become heavier and more frequent in the future. Through this effort, NYCHA discovered that many developments are experiencing some level of ponding and/or flooding within buildings or on the grounds during rain, but effects are more significant for a smaller number of developments FIGURE 11. More recently, NYCHA closely tracked which developments experienced impacts related to Tropical Storm Ida. NYCHA will work to achieve a state of good repair for all of its stormwater systems, prioritizing developments where stormwater pipes have already proven to require upgrades. Additionally, NYCHA will work to develop procedures to ensure that storm drains are cleared when major rain events are expected.

FIGURE 11

NYCHA developments experiencing flooding during rain events
n=182



STRATEGY 2

Install stormwater management solutions at developments that are most vulnerable to rain-driven flooding

One tool for managing heavy downpours is **green infrastructure**, which absorbs stormwater using targeted plantings, landscape modifications, and

Signage at Edenwald Houses shows how green infrastructure absorbs stormwater.

subsurface retention systems. New York City's Department of Environmental Protection (DEP) uses green infrastructure to help meet New York City's Clean Water Act obligations to limit combined sewer overflows (CSOs) into surrounding waterbodies. DEP has funded green infrastructure on several NYCHA campuses as part of its CSO control program, taking advantage of the large amount of open space available on NYCHA campuses for these interventions. Green Infrastructure that includes plantings has a more natural look than typical NYCHA plantings and requires regular maintenance in order to continue providing stormwater mitigation benefits. This creates maintenance challenges for NYCHA developments due to the limited and physically spread-out locations of DEP-funded plantings.

NYCHA is working to increase capacity to maintain planted green infrastructure and identify partnerships and practices that would enable the development of more resilient landscapes at NYCHA. With additional resources, the wide-open green spaces of NYCHA campuses can be programmed in a more resilient manner.

Multi-functional infrastructure is not necessarily planted, but integrates the ability to manage heavy rains with amenities that provide residents with benefits on dry days. NYCHA is installing a sunken basketball court that will be able to hold water during heavy rains at South Jamaica Houses, and is studying the costs and benefits of installing a sunken water square at Clinton Houses in East Harlem. [These projects

Planted green infrastructure can provide a new visual appeal for green spaces at NYCHA; however, new landscape types also create maintenance challenges.

Resilient plantings such as native grasses do not need to be mowed and increase the amount of water that soils can absorb

are explained in greater detail in NYCHA's 2021 Sustainability Agenda]. These projects are appealing because they may be able to reduce the impacts of rainwater-driven flooding for NYCHA residents, while serving recreational purposes at times when NYCHA is not experiencing heavy rains. NYCHA will explore the expanded use of such spaces as NYCHA learn from the experience installing NYCHA's first two examples.

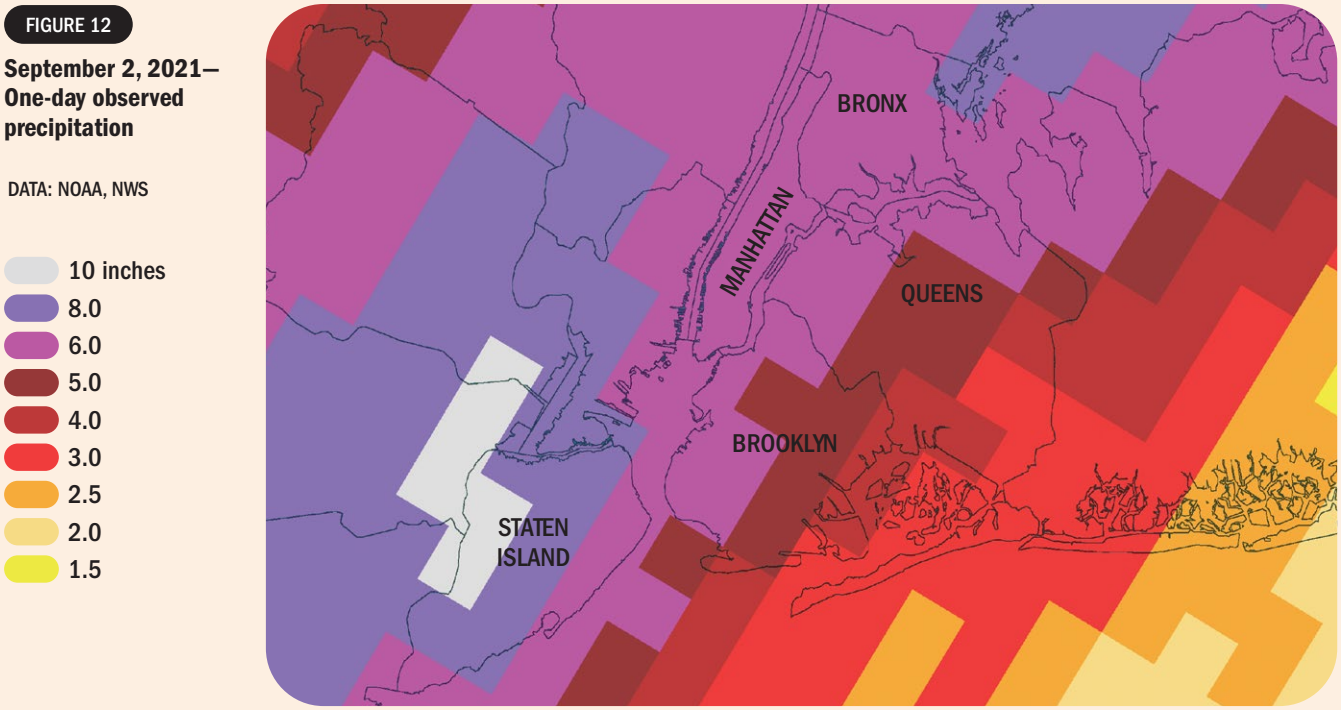
NYCHA will work with DEP and other partners to fund additional stormwater management solutions at developments that are most in need of stormwater mitigation. In addition, NYCHA will consider requiring that any outside funding to renovate outdoor spaces include adequate funds to integrate stormwater management best practices. If such a policy were instituted, NYCHA would ensure that each repaving of an outdoor space or renovation of an outdoor amenity made an incremental contribution to better management of heavy rainfall. This policy, however, must be developed with sensitivity to NYCHA's needs. Common features of stormwater management systems include porous materials, which let rainwater penetrate through concrete, pavers, or other materials and seep into the ground rather than running off; and resilient plantings such as native grasses that do not need to be mowed and increase the amount of water that soils can absorb. Materials that are new to NYCHA or require different maintenance protocols can create management challenges, and it is important to select materials and plantings that are durable and sited appropriately. NYCHA will work to understand how resilient materials can be incorporated into landscape work while maintaining the practice of installing durable materials. NYCHA will carefully study the cost of requiring that outdoor renovations include stormwater management best practices to ensure that such a policy does not limit the amenities provided to residents by external funding parties.

TROPICAL STORM IDA

FIGURE 12

September 2, 2021—One-day observed precipitation

DATA: NOAA, NWS



As this plan was being finalized, Tropical Storm Ida made its way through New York City, unleashing a historic amount of rain and causing devastation to property and lives. Ida's impacts were concentrated in neighborhoods that had not experienced heavy damages from Superstorm Sandy, such as Woodside, East Elmhurst, and the South Bronx, demonstrating that stormwater can have a very different geography of impact from coastal storms. Data from the National Weather Service shows that while the entire city experienced heavy rain, the specific path Ida took through the city concentrated rainfall in the eastern part of Staten Island, Western Brooklyn and Queens, and throughout Manhattan and the Bronx FIGURE 12.

NYCHA developments experiencing the worst impacts from Ida included Woodside Houses in Queens, Moore Houses and Sotomayor Houses in the Bronx, and Leavitt-34th Avenue in Queens, although other developments suffered impacts as well. The developments worst-impacted by Ida did not always match the developments projected to be most vulnerable to rainfall based on the future stormwater maps published by the New York City Department of Environmental Protection and Mayor's Office of Climate Resiliency; however, developments in Eastern Brooklyn and Queens could find themselves suffering greater impacts in a future storm with a slightly different path through the city.

In the wake of Tropical Storm Ida, NYCHA is redoubling its efforts to mitigate stormwater flooding by seeking funding to rebuild stormwater systems where they are inadequate to handle heavy rain, by working to expand the installation of onsite stormwater management systems, and by protecting existing and planned equipment. For example, pads for planned boiler replacements are being raised to elevate equipment above expected stormwater flood levels where needed. Ida demonstrates yet again the importance of building resilient design into all capital work at NYCHA.


CONEY ISLAND HOSPITAL

GOAL 5

Protect Critical Infrastructure at Developments Exposed to Coastal Flooding

NYCHA's strategies for adapting to sea level rise are rooted in a commitment to preserving public housing in New York City. Although planning for climate change in coastal cities inevitably raises the question of whether cities should retreat from their most vulnerable coastal areas, any discussion of managed retreat in New York City must acknowledge that public housing is a unique asset that is not easily replaced. Other cities that have chosen to demolish public housing in flood-vulnerable areas after a disaster have struggled to replace the lost housing units at scale.[16] After Hurricane Sandy, New York City chose to protect its existing public housing, taking sea level rise through 2050 into account in establishing the level of protection to provide. By the end of the century, over 1/3 of NYCHA's buildings will be located within the 100-year floodplain (Appendix). Managed retreat from NYCHA properties should be considered only as a last resort, and NYCHA will not propose retreat outside of a coordinated neighborhood-scale plan led by the City. Any consideration of such options must include detailed planning for one-for-one unit replacement, secured before NYCHA residents are asked to move.

NYCHA's current plans build on the $3.2 billion of investment that has taken place in the wake of Hurricane Sandy. About half of the disaster recovery funds NYCHA received after Sandy went into repairing damaged systems, with the other half going toward flood protection systems that will prevent damage from similar storms that may occur in the future. Implementing this work gives NYCHA a deep understanding of how to build flood resilience, which NYCHA will use to integrate flood protection measures into future capital work at sites with additional flood vulnerabilities.

STRATEGY 1

Institutionalize Knowledge Gained from the Sandy Recovery and Resilience Program

NYCHA's Recovery & Resilience program to recover from Hurricane Sandy and build resilience to future storms has been able to provide protection for critical infrastructure and buildings that were affected by Hurricane Sandy, as well as provide full-building backup power for 202 buildings. As the program nears the end stage of construction, NYCHA is working to ensure that it captures and publishes the lessons learned from installing flood protection at NYCHA for the first time—and in many cases from using technologies that had never before, or rarely before, been used in New York City.

TABLE 4 summarizes the overarching successes and challenges of the program as well as the benefits and challenges associated with the program's main components: protecting critical infrastructure, providing backup power to buildings, and protecting building structures from flooding.

TABLE 4 **Overview of Resiliency Strategies to recover from Hurricane Sandy**

INSTALL MORE SUSTAINABLE AND RESILIENT INFRASTRUCTURE			
Strategy	**How it was used**	**Benefits**	**Challenges**
New, more efficient boilers	Where boilers were severely damaged after Hurricane Sandy, the Recovery and Resilience program installed new heat and hot water systems and protected them from future flooding.	· New boilers are more efficient and emit less pollution than the boilers they replaced, improving environmental performance as well as resiliency	· When boilers are replaced without a full system replacement, the full benefit can be difficult to realize.
Provide resilient back-up power	NYCHA installed full back-up power generators at over 200 buildings that experienced power outages and flooding during Hurricane Sandy	· Back-up power allows buildings to be re-occupied quickly after a coastal storm and minimizes interruptions to daily life for residents · Generators can provide protection from outages that are unrelated to coastal storms as well, a co-benefit of full-building, permanent back-up generation · Back-up power ensures that sump pumps remain operational during a flooding event	· Generators require extensive new gas and electrical connections · Generators were an entirely new class of asset at NYCHA, that required new maintenance protocols · Extensive coordination with utilities is required for installation · No funding for controls to allow for revenue generation
PROTECT MECHANICAL , ELECTRICAL, AND PLUMBING INFRASTRUCTURE			
Build raised annexes to protect mechanical, electrical, and plumbing equipment	MEP annexes were built at 23 sites—this was often the most cost-effective way to provide ongoing, passive protection to MEP systems. Centralized generator enclosures were also installed at 15 sites.	· Critical equipment can more easily be protected in excess of the Design Flood Elevation and is protected without the need for flood walls or deployable barriers · Construction of new buildings can provide co-benefits by bringing new spaces to developments · Provides easier access to equipment on a day-to-day basis for service	· Increased cost · Requires installation of new site-wide distribution · Not all sites could accommodate new buildings given site constraints and zoning limitations

PROTECT MECHANICAL , ELECTRICAL, AND PLUMBING INFRASTRUCTURE (CONTINUED)			
Strategy	**How it was used**	**Benefits**	**Challenges**
Protect mechanical, electrical, and plumbing equipment inside buildings	Sometimes, it was most cost-effective to create protected zones within buildings by constructing flood doors and barriers around mechanical rooms or elevating equipment above the design flood elevation indoors.	· Often less expensive than constructing a new structure · Reduces impacts to open spaces and air and light in apartments	· Does not provide co-benefits like easier access for service & creation of new spaces · Space constraints can make the installation of flood doors inside buildings challenging, especially in narrow hallways · Elevating equipment inside buildings creates a considerable challenge servicing equipment for staff because it is so high off the ground
Locate mechanical equipment on the roofs of buildings	Generators were located on roofs at 21 developments, while boilers were relocated to building roofs at just one development, Bayside.	· When generators are installed on roofs, each building has an independent resilient power supply that is not at risk of flooding · When boilers are located on individual buildings' roofs, they can be more efficient because they minimize distribution losses	· Not all roofs were able to structurally support generators · Maintaining many individual buildings' generators is more costly and time-consuming than maintaining at a central location · Moving from a centralized to a distributed boiler system requires extensive in-building work, which is challenging outside of a comprehensive building renovation
PROTECT STRUCTURES			
Floodproof buildings, using deployable flood barriers for entrances and windows	Used at 22 developments, this strategy allowed NYCHA to create a continuous barrier to floodwaters around a building by reinforcing the buildings' walls and adding floodproof perimeter walls in some locations. Entrances and windows below the Design Flood Elevation are sealed with deployable elements when necessary.	· Protects entire building from flooding · Barriers can be deployed as needed prior to a storm · Costs are lower than passive barrier systems	· Storage and long-term maintenance of deployable elements is challenging · Ensuring that trained operators of deployable systems are available in the event of a storm is a challenge · Structural reinforcement of existing building walls is challenging and costly · Long-term maintenance and operations funding for deploying barriers prior to storm
Floodproof buildings, using passive barriers for entrances	This strategy, used at eleven (11) developments, creates a continuous barrier around the building. Elements at building entrances deploy automatically when water begins to rise around a building.	· No need to store or deploy flood barrier elements · Many interventions had secondary benefits such as building accessibility and enhanced landscaping	· Not feasible if there is not enough underground space for the installation of barriers · System must be maintained to ensure it functions during a storm event · Structural reinforcement of existing building walls is challenging and costly · More costly than deployable barriers

PROTECT STRUCTURES (CONTINUED)			
Strategy	**How it was used**	**Benefits**	**Challenges**
Install backwater prevention valves	Backwater prevention valves are required by code wherever plumbing is modified, but they are also an essential element in preventing sewage and storm-water from inundating buildings during a storm	· Necessary element of flood protection to prevent water from entering the building through sewer and stormwater systems	· New maintenance protocols are required for buildings with back-water prevention valves
Use "wet" floodproofing to protect buildings from floods without sealing water out	Used in six developments, wet floodproofing allows floodwaters to pass through a building without endangering a buildings' structural stability or critical systems. Critical infrastructure is relocated above the design flood elevation, and vents are installed to allow water to enter and exit the building. In some cases, certain rooms are dry floodproofed to protect critical spaces.	· Structural reinforcement of walls is not required · Cost is much lower than dry floodproofing strategies	· Requires acceptance that some degree of damage will result from a storm
Use floodwalls and changes in landscape grade to protect the site	At two developments—Baruch and Bayside—landscape based flood walls were used to pro-vide passive, consistent flood protection for large areas of the site. In Red Hook, an innovative "Lily Pad" design will raise the elevation of large areas between buildings and provide sitewide passive protection.	· Landscape-scale strategies provide protection beyond the buildings, keeping areas of the grounds protected during a flood event · These strategies can provide major co-benefits, such as the seating created by the flood wall at Baruch and the re-imagined community spaces that will be created at Red Hook	· This type of solution is only pos-sible at large developments and where the site's configuration allows · Construction of landscape-scale solutions can be extremely disruptive and often requires the removal of large numbers of trees · Unexpected locations of utilities and abandoned older infra-structure can create significant unanticipated costs

STRATEGY 2

Protect Storm Surge-Exposed Buildings and Developments that Were Not Eligible for Post-Sandy Funding.

The NYCHA buildings most exposed to the threat of storm surge are being protected through the Recovery & Resilience program. However, only buildings that were directly affected by Hurricane Sandy were eligible for disaster recovery funding; a larger storm, or a storm with a different path, could inundate additional buildings and campuses.

NYCHA will work to create plans to protect the developments most exposed to future storm surge that have not received post-Sandy investment. The form of protection NYCHA seeks at additional storm surge-exposed developments will vary based on site-specific needs, but NYCHA will focus on protecting critical infrastructure at the sites, ensuring that any new capital projects at these sites incorporate flood protection into their designs, and obtaining funding for flood protection retrofits wherever possible. At developments where storm surge risk lies further into the future, there is greater opportunity to achieve flood protection by integrating resiliency into capital work over time, while developments that are expected to be exposed to storm surge risk in the nearer term should be prioritized for stand-alone retrofits via pre-hazard mitigation funding.

Flood panels installed at Astoria Houses

For all buildings expected to be exposed to storm surge by 2050, NYCHA will create a plan for how the building will receive protection, with each falling into one of the following categories depending on the time scale at which risk is expected and renovation plans for the development:

- For buildings already protected through the Sandy recovery program, protections will be monitored and maintained to continue protection.
- For developments going through renovation via the PACT process, coastal flooding protection requirements will be integrated into the agreement with development partners.
- For developments that will go through comprehensive modernizations as part of NYCHA's Blueprint for Change, coastal flooding protection will be integrated into modernization plans.
- For buildings with the most immediate risks, NYCHA will develop retrofit scopes and prioritize them for near-term funding through FEMA or other resiliency funding streams, or by advocating for funding for these projects from the city or the state.

Achieving Flood Protection During Routine Capital Work: Raised Boiler Buildings

NYCHA received state funding to replace antiquated steam heating plants in 2020. For several sites slated to receive these funds, NYCHA recognized that replacing boilers in basements would expose new equipment to the threat of flooding in certain areas. At floor prone sites, NYCHA chose instead to build new above-grade heating facilities at four sites—Marcy Houses, Gowanus, Bay View, and Smith—implementing a best practice developed by NYCHA's Recovery & Resilience program. These above-grade boiler annexes were not funded by recovery or resiliency-specific funding, yet NYCHA recognizes the need to build protections proactively. Building new boilers at grade also provides the co-benefit of easier maintenance than basement-located boilers.

MARLBORO HOUSES

One site that has existing vulnerability to coastal flooding is Marlboro Houses. Marlboro Houses experienced damage as a result of Hurricane Sandy but was not eligible for FEMA funding because of its mixed-finance status and its LLC ownership structure. At this site, it is particularly important to find ways of incorporating flood protection into the scope of routine capital work at the development. NYCHA enlisted the help of the Urban Land Institute to develop strategies for protecting the site, and in February of 2021, a panel of experts came together to make recommendations for building resiliency at Marlboro Houses. The panel's recommendations reinforced NYCHA's plans to fine-tune understanding of which buildings and equipment are most vulnerable to flooding. The panel emphasized the importance of taking a comprehensive approach to building resiliency. They recommended addressing heat vulnerability and building energy resilience by increasing the insulation levels of buildings and reducing energy use, and recommended working with residents to identify strategies to reduce vulnerability. The ULI work will be integrated into RFPs for comprehensive modernization at the site.

STRATEGY 3

Maintain Long-Term Success of Flood Protection Measures Installed at Sandy-Affected Developments

NYCHA's resiliency investments after Hurricane Sandy provide crucial protections to the developments where they are located. NYCHA is committed to maintaining the success of these measures in the long term by ensuring that the flood protection systems that were installed are properly maintained and that staff stay aware of how to use them. Many of these developments' flood protection systems include deployable flood barriers, which in some cases comprise hundreds of elements that must be inventoried, stored, periodically checked, and correctly installed in advance of a storm. NYCHA has dedicated permanent staff to oversee the maintenance of the systems and is creating formal emergency action plans for developments that have flood protection systems. All parts for the systems are in the process of being labelled and cataloged in NYCHA's electronic inventory system, Maximo. NYCHA will continue to support maintenance and training to keep these essential flood protection systems in good working order. NYCHA's plans have been informed by best practices from private landlords and NYC Emergency Management's expertise.

A flood wall at Baruch Houses

STRATEGY 4

Monitor Emerging Information about Sea Level Rise and Citywide Flood Protection Initiatives

The study of sea level rise and the impacts it will exert in New York City is an active field of research. The likely impacts of tidal flooding, especially, are highly uncertain, and NYCHA does not have buildings that are expected to be affected by monthly tidal flooding until NYCHA have reached the levels of sea level rise expected in about the year 2050. The New York City Panel on Climate Change has released projected maps of Mean Monthly High Water that are intended to show areas that are likely to experience flooding at high tides at least twice a month in the coming decades. Based on NPCC projections, a few NYCHA developments are likely to experience tidal flooding somewhere on the development by the 2050's, with more projected to be in the tidal flooding zone by the 2080's TABLE 5. Developments are included on this list if any part of them is within areas projected to experience monthly tidal flooding in the future; this does not mean that buildings would necessarily be affected. Many of these developments have already received resiliency investments as part of the Hurricane Sandy Recovery & Resilience program. Measures such as elevation of mechanical equipment would protect developments from tidal impacts as well as storm surge; but additional measures may need to be considered in the future.

TABLE 5

NYCHA developments expected to experience monthly high-tide flooding by the 2080s.

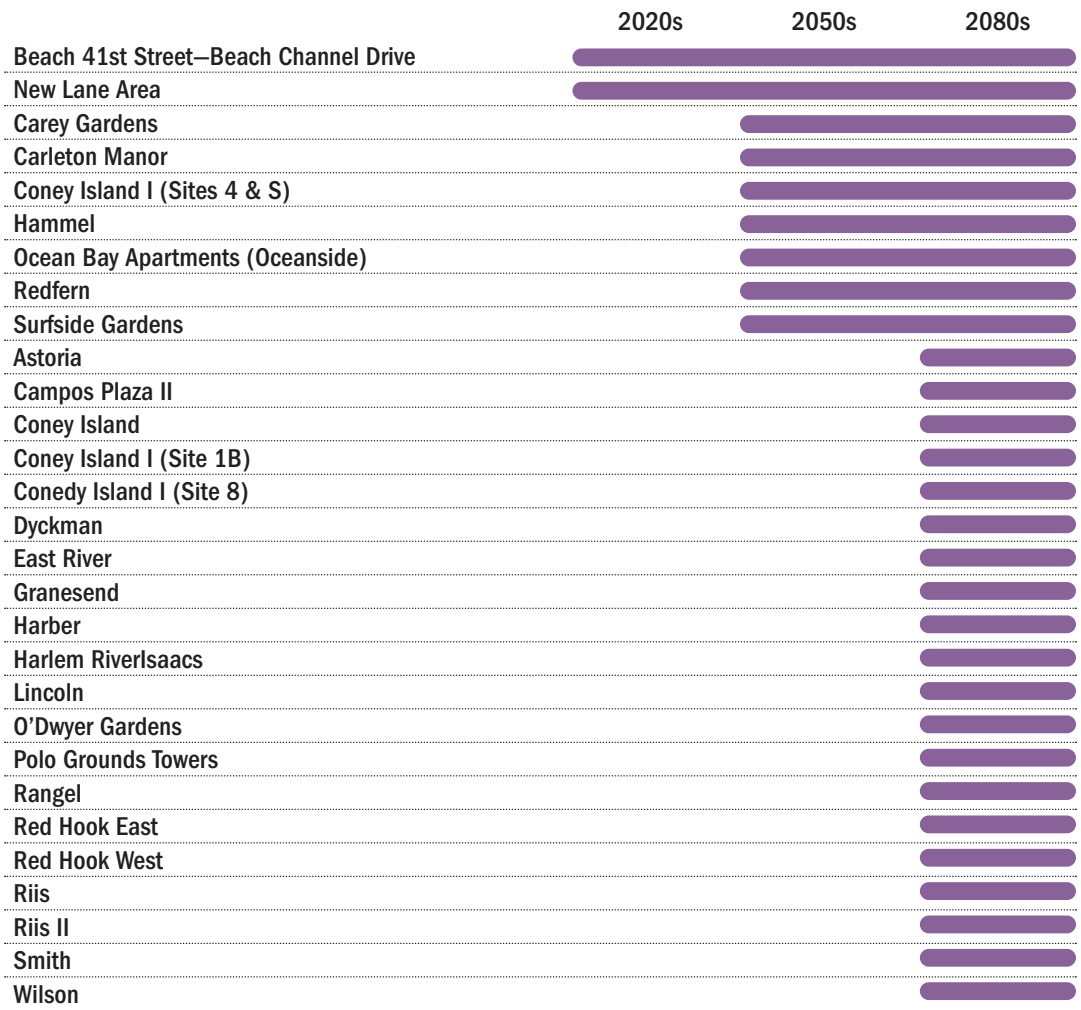


FIGURE 13

Although monthly high tide flooding is not expected to inundate buildings by the 2050's, nuisance flooding could make the development virtually inaccessible during high tide floods, as almost all surrounding streets will be flooded.

The reality of tidal flooding at these sites will depend not only on the trajectory of sea level rise that New York City experiences, but on the neighborhood-scale flood protection plans that are contemplated by New York City as well as New York State and the United States federal government. Beach 41st Street, for example, is the first development expected to experience tidal flooding; however, a US Army Corps of Engineers flood protection project is being planned that should provide continuous passive flood protection to Beach 41st Street Houses and the surrounding neighborhood.

For developments that do eventually experience nuisance flooding, these conditions will create new kinds of vulnerabilities for residents. Whether or not the buildings themselves are inundated, flooding can isolate residents living in flood-prone neighborhoods if nearby streets are untraversable. For example, if Beach 41st Street Houses begin to experience monthly tidal flooding, buildings themselves may not be inundated, but with all surrounding streets inundated, access to and from the development would effectively be blocked under high tide flood conditions FIGURE 13.

At developments where regular tidal flooding may occur in the future, NYCHA will consider retrofits designed to maintain access in and out of buildings and across NYCHA campuses in spite of these conditions. Where these conditions occur, NYCHA developments will not be the only properties affected, and the efforts to address tidal flooding conditions will prioritize coordination with neighborhood-scale plans led by the City.

GOAL 6

Prepare for Additional Hazards

Beyond the three primary climate-induced hazards of extreme heat, heavy downpours, and sea level rise, NYCHA will be monitoring the potential for additional hazards to affect NYCHA property and residents. Among these are groundwater rise, extreme winds, and cold snaps.

Snow is a well-known part of life in the Northeast; but in the context of warmer winters, heavy snows can have different impacts.

STRATEGY 1

Identify developments where projected groundwater rise will reach levels at which basement infiltration is likely and plan for protection of basement infrastructure at those developments.

Groundwater rise may eventually cause basement flooding in developments with high water tables and exacerbate the effects of rainwater-driven flooding. NYCHA will work to identify buildings where basements may be deeper than the projected level of groundwater rise in 2050 and develop strategies to limit damage that would result from flooding that is caused or exacerbated by rising levels of groundwater. In some developments, this is already taking place: the above-grade annex for the new heating plant to be built at Marcy Houses was prioritized for elevation due primarily to groundwater intrusion concerns.

STRATEGY 2

Identify likely impacts of continuing cold snaps in the context of a warmer climate and develop plans to protect against impacts.

Overall, cold weather is expected to decrease as climate conditions change in the coming decades. From a baseline average of 71 days with a minimum temperature at or below 32°F from 1971–2000, NYCHA expects to see a decrease of approximately 25% in the 2020s, more than 33% by the 2050s, and approximately 50% by the 2080s.[19] But cold snaps are expected to persist and may have different impacts in the context of an overall warmer winter. For example, snow followed by warm weather can result in heavy, wet snow that is more damaging to buildings and plants. Heavy rain following a cold snap can cause increased flooding because of the combined effects of melting snow and ice and heavy rain. And winter storms can cause storm surge during cold conditions, as was seen in Boston in January of 2018, when freezing floodwater inundated the city, creating the additional risk of cold exposure during a storm surge event.

The likelihood of warmer winters along with continuing occurrence of cold snaps means that NYCHA's plans for comprehensive modernizations that integrate modern heating systems will be all the more important. NYCHA's central steam boilers are designed for winters that remain consistently cold; steam boilers operate inefficiently if they must be turned on and off frequently. With increasing frequency of freeze-thaw cycles, steam lines and water pipes that are above the frost line could be more vulnerable to breaks that could cause heat outages and loss of potable water. Additionally, rapid freeze-thaw cycles could affect construction quality as well as the general durability of building materials. NYCHA will monitor changes in building and maintenance needs with changes in cold weather patterns.

STRATEGY 3

Mitigate impacts of extreme winds.

More extreme winds are expected in New York City in the future. The extent of changed conditions, and the resulting vulnerabilities, are the subject of current study, and NYCHA will continue to assess what additional vulnerabilities extreme wind conditions will present as more information becomes available. In the meantime, NYCHA is already proactively addressing potential hazards related to wind. Every roof replacement project includes the removal of antiquated incinerator stacks and other rooftop structures that pose potential hazards during high winds. NYCHA will also integrate façade and window improvements into its plans for comprehensive modernizations to reduce the potential for water and air pollution penetration of buildings during extreme wind conditions.

Roof replacements at NYCHA include the removal of antiquated equipment that could create hazards during high winds.

STRATEGY 4

Seek Opportunities to Mitigate Risks Related to Outside Services.

While transportation and utilities that residents rely on are not within NYCHA's direct control, NYCHA works to improve resiliency to outages of these services where possible. Backup power generation was installed at over 200 buildings through the Sandy recovery program because those sites are particularly vulnerable to outages, and NYCHA will actively seek additional opportunities to build resilience to service outages. One example of this is NYCHA's participation in a National Science Foundation-funded grant led by CUNY and Stantec looking at micromobility solutions for residents of NYCHA developments in the Rockaways. The grant seeks to provide NYCHA residents within the Rockaways with additional personal transportation options because of the unique vulnerability to transportation service outages in the neighborhood. NYCHA is participating in this study in an advisory capacity and will explore ways to partner in the implementation of the resulting recommendations.

FIGURE 14

A National Science Foundation-funded study led by CUNY and Stantec is investigating micromobility solutions that could provide resiliency in transportation services to NYCHA residents in the Rockaways. The study involves careful analysis of essential destinations, informed by NYCHA resident surveys.


3-5
I ♥ MY
BFF
MORE THAN
Shoes

GOAL 7

Invest in Social Resilience at NYCHA

Social Resilience refers to the ability of communities to recover from challenges. Research on social resilience has shown that strong community connections can actually reduce heat-related deaths, because those who know their neighbors and have safe, comfortable places to go are more likely to leave hot apartments during extreme heat or reach out to neighbors for help.[20] Hurricane Sandy demonstrated that many NYCHA residents rely heavily on each other to help stay informed and make decisions during challenging times.[21]

The way physical spaces are designed and maintained can support social resilience. For example, community gardens provide a space that encourages neighbors to forge stronger connections with each other, and green space that feels welcoming and safe promotes positive community interaction, improving health and mental health of those benefiting.[22] NYCHA's partnership with Green City Force via Farms at NYCHA is an example of a sustained effort to support outdoor spaces that promote community connections as well as pathways to green jobs for NYCHA residents. Community centers that are welcoming, active, and well-used during non-emergency times are more effective as centers of resources and emergency services during times of emergency. NYCHA will continue to seek opportunities to support social resiliency whenever possible.

NYCHA's Resident Engagement Department supports a number of initiatives that bring residents together, including Youth Councils.

STRATEGY 1

Recruit Climate Action Network composed of residents with an interest in climate-related topics that can advise on climate & sustainability plans.

Building community resilience to climate change means working with the resident community to shape strategies. Some of the information that is needed to plan for changing climate conditions is highly technical: NYCHA uses the projections of the New York City Panel on Climate Change (NPCC), along with other reports and analyses, to understand the impacts NYCHA may see in the future to come. But other information is more subjective: what should the top priorities be with respect to reducing vulnerabilities to a changing climate? When choosing among different possible strategies that are aimed at achieving the same goal, what factors should sway NYCHA's decisions? Prior to the release of this plan, NYCHA launched the Climate Action Network, jointly convened by NYCHA's Sustainability and Recovery and Resilience departments and made up of NYCHA residents with an interest in climate-related concerns. With this group, NYCHA held a series of workshops focused on the major climate hazards outlined here. Using these workshops and additional engagements that the network helps shape around specific challenges or opportunities, NYCHA will create a channel for two-way education: workshops will bring residents' knowledge, priorities, and preferences into the plan, and participation in the group will provide opportunities to learn about changing climate and its consequences.

STRATEGY 2

Integrate climate resiliency into community-driven outdoor space design

Outdoor spaces on NYCHA campuses can be important places of connection and community cohesion. NYCHA's Connected Communities initiative lays out an ambitious vision for how to re-shape outdoor spaces at NYCHA in a way that fosters connections within

Effective communication with residents is essential to building trust around capital projects

NYCHA campuses as well as with surrounding neighborhoods. The Open Space Master Plan to be released in the fall of 2021 details how landscapes can be re-designed to put that vision into practice and ensure that NYCHA's outdoor spaces better serve residents and build social resilience. NYCHA will continue to find ways to improve how outdoor spaces serve residents and support social resilience. For example, during increasingly hot summer weather, it is important to maintain residents' ability to be comfortable in outdoor spaces. Although children's playgrounds often provide cooling water features, NYCHA does not currently have cooling features geared toward adults. Older adults are an increasing proportion of NYCHA's population; NYCHA will seek opportunities to pilot the integration of features such as misting stations into outdoor spaces designed for adults.

STRATEGY 3

Retrofit Community Spaces to Serve as Resiliency Hubs During Times of Emergency.

A resiliency hub is a site that can serve as a resource during emergencies such as power outages, storms, and other disruptive events. The most effective resiliency hubs also serve residents well during non-emergencies and are therefore already a known resource that can effectively assist with emergency needs.[23] Community centers, senior centers, and day care centers located on NYCHA property already serve as gathering and learning spaces for their communities. NYCHA will build on this resource by retrofitting select community spaces as resiliency hubs, developing a suite of amenities, including permanently installed backup power generation, that each resiliency hub should have. The Climate Action Network provided important feedback about how resiliency hubs may most effectively serve NYCHA residents, and pointed out that the programming offered at community centers is just as important as the capital investments made in community center spaces. As a result, NYCHA is exploring how capital investments in resiliency hubs may effectively be paired with resiliency programming to best serve residents. NYCHA will work to ensure that each neighborhood has at least one resiliency hub outfitted with backup power and other amenities necessary for functioning as an emergency resource center.

Conclusion

NYCHA is committed to preserving and improving New York City's public housing. Building resilience to climate hazards into NYCHA's work is one crucial way to protect this important resource. This moment is a particularly important time at which to integrate resiliency into NYCHA's work: the Authority is currently undertaking an ambitious program to upgrade the quality of its housing throughout its portfolio.

NYCHA's Blueprint for Change details strategies to deliver much-needed capital improvements and to transform the way services are delivered to residents. Planning for current and future climate-induced vulnerabilities will help to ensure that investments made today continue to deliver for public housing residents into the future. As New York City adapts to changing climate conditions, new knowledge will continue to emerge about both climate vulnerabilities and effective ways to mitigate those vulnerabilities. This plan, therefore, will continue to evolve. As it does, NYCHA will continue to document findings about resiliency needs and the effectiveness of strategies that have been used to address them. Two companion documents presented with this plan illustrate NYCHA's commitment to this documentation: first, "NYCHA's Urban Forest: A Vital Resource for New York City" presents analysis performed in collaboration with several partner organizations of the value of NYCHA's trees and what the Authority must do to preserve those benefits. Second, "Flood Resilience at NYCHA: Memorializing Lessons Learned Through the Hurricane Sandy Disaster Recovery Program" looks at the benefits and challenges associated with various methods of protecting NYCHA buildings from coastal flooding, documenting design decisions and their consequences in order to benefit future flood protection efforts. Building public-facing analysis of resiliency strategies into NYCHA's work is important in advancing resilient practices within NYCHA and beyond.

As this plan is further developed and implemented, NYCHA will work in partnership with residents to build on successes and correct shortcomings. During the development of this plan, workshops with the Network for Climate Action as well as NYCHA's Citywide Council of Presidents (CCOP) helped to refine certain concepts, such as NYCHA's intention to develop resiliency hubs. During the implementation of the strategies outlined here, engagement with residents will continue to shape adaptation efforts.

New York City's changing climate will present challenges to every New Yorker; NYCHA will work hand in hand with residents, city agencies, funding partners, and other organizations to develop and continuously improve adaptation strategies.

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APPENDIX

Climate Variables

The Appendix provides key variables on a development-by-development basis that allow NYCHA to understand where specific climate hazards may be of relatively more concern. Analysis of the risk of a particular hazard to a specific development must be done using more detailed information about building configuration and infrastructure, the development's population, location, and other factors. However, these variables provide a starting point for developing priorities for resiliency interventions that should be considered in specific locations. Data sources and methodology for creating these variables is as follows:

Outdoor Temperature Rank is based on the relative summer surface temperature at each development. All developments were overlaid onto USGS Landsat Surface Temperature data from a summer day in 2018 (the date was selected by NYC DOHMH because it provided cloud-free imagery allowing for accurate surface temperature readings citywide). The average surface temperature for each development was calculated using GIS software and developments were assigned ranks of "Low," "Medium," or "High" based on the results. This variable is most useful for indicating the development's priority for outdoor cooling and UHI mitigation interventions.

AC Access Rank is based on NYCHA data on AC ownership for each development. NYCHA maintains data on AC ownership only for buildings where units are centrally metered, since NYCHA residents are required to register air conditioners and pay a fee to offset the energy use at those developments. Where available, developments are assigned a rank of "Lowest," "Average," or "Higher," to indicate relative AC access within the development. NYCHA buildings as a whole have lower rates of AC ownership than the city as a whole, however the relative prevalence of AC access provides an indication of where cooling interventions may be most needed.

Percent Tree Canopy Cover, 2017 is based on datasets derived from New York City's 2017 LiDAR imagery of New York City. Percent tree canopy cover at every NYCHA development was calculated by overlaying NYCHA development boundaries on the 8-class landcover dataset available at https://maps.nyc.gov/lidar/2017/.

Stormwater Flood Exposure Rank is based on developments' position relative to projected stormwater flooding extents published by the Mayor's Office of Climate Resiliency and the New York City Department of Environmental Protection. Developments were overlaid on maps of projected stormwater floods for both moderate and extreme rainfall scenarios and were assigned points for each scenario in which projected stormwater flooding intersected the development or was just adjacent. The ranks of "Low," "Medium," or "High" indicate the severity of expected stormwater-driven flooding at the development. *Note that these rankings do not account for which developments suffered impacts as a result of Tropical Storm Ida.

Development Received Resiliency Investments as part of Sandy Recovery & Resiliency Program. This variable is important because developments that received Sandy investments are better prepared for continued flooding threats. Many of these developments have elevated electrical and heating equipment and other measures that would protect services during stormwater-driven flooding as well as the coastal storms for which they were designed.

Minimum Depth to Groundwater less than 10', Current or Future. This variable provides a rough estimate of which developments in Brooklyn and Queens have shallow depth to groundwater or will have shallow groundwater by 2050. Variable is based on overlaying developments on USGS estimated current and projected future groundwater levels with NYCHA developments and indicating whether the estimated minimum depth to groundwater is 10' or less, either currently or projected by 2050. Data is only available for Brooklyn and Queens, and actual NYCHA building elevations are not considered; this variable is only a very rough approximation of potential for groundwater intrusion problems.

Number of Buildings is the total number of buildings within the development.

Number of Buildings Within the Current 100-year Floodplain is based on buildings' location with respect to A- and V-zones indicated in FEMA's Preliminary Flood Insurance Rate Maps published in 2015.

Number of Buildings within Future 100-year Floodplains indicates buildings position with respect to projected future floodplains according to the NPCC's 2019 maps available on OpenData NYC.

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
1010 EAST 178TH STREET	Medium	Average	Medium	58%		
104-14 TAPSCOTT STREET	High	Lowest	Low	1%		
1162-1176 WASHINGTON AVENUE	High	Lowest	Low	10%		
131 SAINT NICHOLAS AVENUE	Medium	Average	Low	41%		
1471 WATSON AVENUE	Medium	Average	High	16%		
154 WEST 84TH STREET	High		Low	20%		
303 VERNON AVENUE	Medium	Lowest	Low	45%		
335 EAST 111TH STREET	Medium		Medium	10%		
344 EAST 28TH STREET	Medium		Medium	48%		
45 ALLEN STREET	Medium	Higher	Medium	30%		
572 WARREN STREET	Medium		Medium	26%		by 2050
830 AMSTERDAM AVENUE	Medium	Average	Low	18%		
ADAMS	Low	Average	High	59%		
ALBANY	Low	Average	Medium	49%		
ALBANY II	Medium	Lowest	Medium	41%		
AMSTERDAM	Medium	Average	Medium	51%		
AMSTERDAM ADDITION	High	Lowest	High	36%		
ARMSTRONG I	Medium		Low	29%		
ARMSTRONG II	Medium		Low	26%		
ASTORIA	Low	Average	High	46%	Yes	current
ATLANTIC TERMINAL SITE 4B	High	Average	Medium	21%		
AUDUBON	Low	Average	Low	33%		
BAILEY AVENUE-WEST 193RD STREET	Low	Average	Low	51%		
BAISLEY PARK	Medium	Average	High	47%		current
BARUCH	Medium	Average	High	37%	Yes	
BARUCH HOUSES ADDITION	Low	Average	Medium	41%		
BAY VIEW	Low	Average	Medium	44%		current
BAYCHESTER	Medium		Medium	56%		
BEACH 41ST STREET-BEACH CHANNEL DRIVE	Low	Lowest	Medium	17%	Yes	current
BEDFORD-STUYVESANT REHAB	Medium		Low	7%		
BELMONT-SUTTER AREA	High		Medium	27%		
BERRY	Low	Higher	High	55%		
BERRY STREET-SOUTH 9TH STREET	High		Low	43%		
BETANCES I	Medium		Medium	55%		
BETANCES II, 13	High		Low	3%		

Development	7 Number of buildings within development	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when portions of the development may experience tidal flooding, if applicable
1010 EAST 178TH STREET	1						
104-14 TAPSCOTT STREET	1						
1162-1176 WASHINGTON AVENUE	1						
131 SAINT NICHOLAS AVENUE	1						
1471 WATSON AVENUE	1				1	1	
154 WEST 84TH STREET	1						
303 VERNON AVENUE	1						
335 EAST 111TH STREET	1	1	1	1	1	1	
344 EAST 28TH STREET	1						
45 ALLEN STREET	2						
572 WARREN STREET	2						
830 AMSTERDAM AVENUE	1						
ADAMS	8						
ALBANY	6						
ALBANY II	3						
AMSTERDAM	13						
AMSTERDAM ADDITION	1						
ARMSTRONG I	12						
ARMSTRONG II	6						
ASTORIA	23	13	14	18	19	20	2080s
ATLANTIC TERMINAL SITE 4B	1						
AUDUBON	1						
BAILEY AVENUE-WEST 193RD STREET	1						
BAISLEY PARK	7						
BARUCH	19	15	18	19	19	19	2100
BARUCH HOUSES ADDITION	1		1	1	1	1	
BAY VIEW	25			1	24	25	
BAYCHESTER	12						
BEACH 41ST STREET-BEACH CHANNEL	5	5	5	5	5	5	2020s
BEDFORD-STUYVESANT REHAB	3						
BELMONT-SUTTER AREA	3						
BERRY	9						
BERRY STREET-SOUTH 9TH STREET	4						
BETANCES I	13						
BETANCES II, 13	1						

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
BETANCES II, 18	Medium		Low	13%		
BETANCES II, 9A	Medium		Medium	15%		
BETANCES III, 13	High		Low	0%		
BETANCES III, 18	High		Low	6%		
BETANCES III, 9A	Medium		Low	19%		
BETANCES IV	High		Medium	20%		
BETANCES V	High		Medium	19%		
BETANCES VI	High		Medium	10%		
BETHUNE GARDENS		Average	Low	67%		
BLAND	Medium	Higher	High	52%		
BORINQUEN PLAZA I	High	Higher	High	34%		current
BORINQUEN PLAZA II	Medium	Higher	High	28%		
BOSTON ROAD PLAZA	High	Lowest	Low	38%		
BOSTON SECOR	Low	Lowest	High	55%		
BOULEVARD	Medium	Average	Medium	47%		current
BOYNTON AVENUE REHAB	Low		Low	3%		
BRACETTI PLAZA	Medium	Average	Low	14%		
BREUKELEN	High	Average	High	39%		current
BREVOORT	Medium	Average	High	45%		
BRONX RIVER	Low	Average	Medium	47%		
BRONX RIVER ADDITION	Medium	Lowest	Medium	45%		
BROWN	High		Low	32%		
BROWNSVILLE	Medium	Average	High	42%		
BRYANT AVENUE-EAST 174TH STREET	High	Lowest	Low	12%		
BUSHWICK	Medium	Average	Medium	50%		
BUSHWICK II (GROUPS A & C)	High		High	33%		
BUSHWICK II (GROUPS B & D)	High		High	23%		
BUSHWICK II CDA (GROUP E)	High		High	20%		
BUTLER	Medium	Average	High	40%		
CAMPOS PLAZA II	Medium		High	36%	Yes	
CAREY GARDENS	Low	Average	High	19%	Yes	current
CARLETON MANOR	Medium	Lowest	High	8%	Yes	current
CARVER	Low	Average	High	62%		
CASSIDY-LAFAYETTE	Low	Lowest	Medium	32%		
CASTLE HILL	Low	Average	Medium	39%		

Development	7 Number of buildings within development	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when portions of the development may experience tidal flooding, if applicable
BETANCES II, 18	2						
BETANCES II, 9A	1						
BETANCES III, 13	2						
BETANCES III, 18	1						
BETANCES III, 9A	2						
BETANCES IV	8						
BETANCES V	6						
BETANCES VI	5						
BETHUNE GARDENS	1						
BLAND	5						
BORINQUEN PLAZA I	10						
BORINQUEN PLAZA II	7						
BOSTON ROAD PLAZA	2						
BOSTON SECOR	6						
BOULEVARD	18				18	18	
BOYNTON AVENUE REHAB	3						
BRACETTI PLAZA	1				1	1	
BREUKELEN	33			25	33	33	
BREVOORT	15						
BRONX RIVER	11						
BRONX RIVER ADDITION	2					1	
BROWN	2						
BROWNSVILLE	27						
BRYANT AVENUE-EAST 174TH STREET	1						
BUSHWICK	8						
BUSHWICK II (GROUPS A & C)	25						
BUSHWICK II (GROUPS B & D)	26						
BUSHWICK II CDA (GROUP E)	6						
BUTLER	7						
CAMPOS PLAZA II	2		2	2	2	2	2080s
CAREY GARDENS	6		6	6	6	6	2050s
CARLETON MANOR	1		1	1	1	1	2050s
CARVER	13			1	4	4	
CASSIDY-LAFAYETTE	6						
CASTLE HILL	14				2	3	

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
CHELSEA	Medium	Average	Low	45%		
CHELSEA ADDITION	Medium	Average	Medium	38%		
CLAREMONT PARKWAY-FRANKLIN AVENUE	Medium		Low	35%		
CLAREMONT REHAB (GROUP 2)	High		Medium	4%		
CLAREMONT REHAB (GROUP 3)	Medium		High	13%		
CLAREMONT REHAB (GROUP 4)	High		High	12%		
CLAREMONT REHAB (GROUP 5)	Medium		Low	21%		
CLASON POINT GARDENS	Medium	Average	Medium	39%		
CLINTON	Medium	Average	High	40%		
COLLEGE AVENUE-EAST 165TH STREET	Medium	Lowest	Medium	27%		
CONEY ISLAND	Low	Average	High	17%	Yes	current
CONEY ISLAND I (SITE 1B)	Low	Average	Medium	27%	Yes	current
CONEY ISLAND I (SITE 8)	Low	Lowest	High	31%	Yes	current
CONEY ISLAND I (SITES 4 & 5)	Low	Lowest	High	19%	Yes	current
CONLON LIHFE TOWER	High	Average	High	35%		
COOPER PARK	Medium	Average	Low	56%		
CORSI HOUSES	High		Low	15%		
CROWN HEIGHTS	High		Low	6%		
CYPRESS HILLS	Medium	Average	High	46%		current
DAVIDSON	High	Lowest	Medium	27%		
DE HOSTOS APARTMENTS	Medium	Average	Low	19%		
DOUGLASS ADDITION	Medium	Average	High	33%		
DOUGLASS I	Low	Average	Medium	47%		
DOUGLASS II	Medium	Average	Medium	49%		
DREW-HAMILTON	Medium	Lowest	High	47%		
DYCKMAN	Low	Higher	High	60%		
EAGLE AVENUE-EAST 163RD STREET	Medium	Average	Low	12%		
EAST 152ND STREET-COURTLANDT AVENUE	High	Average	Low	19%		
EAST 165TH STREET-BRYANT AVENUE	Medium		Low	28%		
EAST 173RD STREET-VYSE AVENUE	Medium		Medium	20%		
EAST 180TH STREET-MONTEREY AVENUE	High	Average	Low	6%		
EAST NEW YORK CITY LINE	High	Average	High	25%		current
EAST RIVER	Low	Average	Medium	39%	Yes	
EASTCHESTER GARDENS	Low	Average	High	61%		
EDENWALD	Medium	Average	Medium	31%		

Development	7 Number of buildings within development	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when portions of the development may experience tidal flooding, if applicable
CHELSEA	2					1	
CHELSEA ADDITION	1				1	1	
CLAREMONT PARKWAY-FRANKLIN AVENUE	3						
CLAREMONT REHAB (GROUP 2)	6						
CLAREMONT REHAB (GROUP 3)	5						
CLAREMONT REHAB (GROUP 4)	9						
CLAREMONT REHAB (GROUP 5)	3						
CLASON POINT GARDENS	46			2	8	22	
CLINTON	8		3	7	8	8	
COLLEGE AVENUE-EAST 165TH STREET	1						
CONEY ISLAND	5	5	5	5	5	5	2080s
CONEY ISLAND I (SITE 1B)	1	1	1	1	1	1	2050s
CONEY ISLAND I (SITE 8)	1	1	1	1	1	1	2080s
CONEY ISLAND I (SITES 4 & 5)	2	2	2	2	2	2	2050s
CONLON LIHFE TOWER	1						
COOPER PARK	11						
CORSI HOUSES	1			1	1	1	
CROWN HEIGHTS	8				0	0	
CYPRESS HILLS	15				7	13	
DAVIDSON	1						
DE HOSTOS APARTMENTS	1						
DOUGLASS ADDITION	1						
DOUGLASS I	11						
DOUGLASS II	7						
DREW-HAMILTON	6						
DYCKMAN	8	1	2	6	7	7	2080s
EAGLE AVENUE-EAST 163RD STREET	1						
EAST 152ND STREET-COURTLANDT AVENUE	2						
EAST 165TH STREET-BRYANT AVENUE	5						
EAST 173RD STREET-VYSE AVENUE	8						
EAST 180TH STREET-MONTEREY AVENUE	2						
EAST NEW YORK CITY LINE	33				22	33	
EAST RIVER	11	11	11	11	11	11	2080s
EASTCHESTER GARDENS	11						
EDENWALD	43						

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
ELLIOTT	Medium	Average	Medium	52%		
FARRAGUT	Medium	Average	Medium	46%		current
FENIMORE-LEFFERTS	Medium	No Data	High	31%		
FIORENTINO PLAZA	High	Average	Medium	23%		
FIRST HOUSES	Medium	No Data	Medium	41%		
FOREST	Medium	Average	High	47%		
FORT INDEPENDENCE STREET-HEATH AVENUE	Low	Average	Medium	55%		
FORT WASHINGTON AVENUE REHAB	Low	No Data	Low	26%		
FRANKLIN AVENUE I CONVENTIONAL	Medium	No Data	Low	26%		
FRANKLIN AVENUE II CONVENTIONAL	Medium	No Data	Low	30%		
FRANKLIN AVENUE III CONVENTIONAL	Medium	No Data	Low	0%		
FULTON	Medium	Higher	Medium	39%		
GARVEY (GROUP A)	Medium	Lowest	Medium	31%		
GLEBE AVENUE-WESTCHESTER AVENUE	Medium	Lowest	Low	17%		
GLENMORE PLAZA	High	Lowest	Medium	21%		
GLENWOOD	Low	Average	Medium	47%		current
GOMPERS	Low	Average	Medium	52%		
GOWANUS	Medium	Average	High	47%	Yes	by 2050
GRAMPION	Medium	No Data	Low	35%		
GRANT	Medium	Average	High	57%		
GRAVESEND	Low	Average	High	24%	Yes	current
GUN HILL	Low	Average	Low	52%		
HABER	Low	Higher	Medium	26%	Yes	current
HAMMEL	Low	Lowest	High	16%	Yes	current
HARBORVIEW TERRACE	High	Average	Medium	26%		
HARLEM RIVER	Medium	Lowest	Medium	48%		
HARLEM RIVER II	Medium	Average	Medium	43%		
HARRISON AVENUE REHAB (GROUP A)	Medium	No Data	Low	11%		
HARRISON AVENUE REHAB (GROUP B)	Medium	No Data	Low	13%		
HERNANDEZ	Medium	Average	Medium	41%		
HIGHBRIDGE GARDENS	Low	Average	Medium	55%		
HIGHBRIDGE REHABS (ANDERSON AVENUE)	High	No Data	Low	4%		
HIGHBRIDGE REHABS (NELSON AVENUE)	High	No Data	Low	11%		
HOE AVENUE-EAST 173RD STREET	High	Lowest	Low	8%		
HOLMES TOWERS	Low	Average	Medium	46%		

Development	7 Number of buildings within develop-ment	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when por-tions of the development may experi-ence tidal flooding, if applicable
ELLIOTT	5			1	3	5	
FARRAGUT	10				2	3	
FENIMORE-LEFFERTS	18						
FIORENTINO PLAZA	8						
FIRST HOUSES	8						
FOREST	15						
FORT INDEPENDENCE STREET-HEATH AVENUE	1						
FORT WASHINGTON AVENUE REHAB	2						
FRANKLIN AVENUE I CONVENTIONAL	3						
FRANKLIN AVENUE II CONVENTIONAL	3						
FRANKLIN AVENUE III CONVENTIONAL	1						
FULTON	12			4	12	12	
GARVEY (GROUP A)	4						
GLEBE AVENUE-WESTCHESTER AVENUE	1						
GLENMORE PLAZA	5						
GLENWOOD	20				20	20	
GOMPERS	4					2	
GOWANUS	16		1	4	12	15	
GRAMPION	1						
GRANT	10						
GRAVESEND	15	15	15	15	15	15	2080s
GUN HILL	6						
HABER	3	3	3	3	3	3	2080s
HAMMEL	15	15	15	15	15	15	2050s
HARBORVIEW TERRACE	2						
HARLEM RIVER	7			1	1	2	2080s
HARLEM RIVER II	2						
HARRISON AVENUE REHAB (GROUP A)	1						
HARRISON AVENUE REHAB (GROUP B)	4						
HERNANDEZ	1						
HIGHBRIDGE GARDENS	6						
HIGHBRIDGE REHABS (ANDERSON AVENUE)	4						
HIGHBRIDGE REHABS (NELSON AVENUE)	3						
HOE AVENUE-EAST 173RD STREET	1						
HOLMES TOWERS	2	2	2	2	2	2	2100

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
HOPE GARDENS	High		High	37%		
HOWARD	Medium	Average	Medium	45%		
HOWARD AVENUE	High		Low	30%		
HOWARD AVENUE-PARK PLACE	High		Low	10%		
HUGHES APARTMENTS	Medium	Average	Medium	35%		
HUNTS POINT AVENUE REHAB	Medium		Low	2%		
HYLAN	Medium	Average	Medium	59%		
INDEPENDENCE	Medium		Low	56%		
INGERSOLL	Medium	Higher	High	45%		current
INTERNATIONAL TOWER	High		Low	23%		
ISAACS	Low	Average	High	35%	Yes	
JACKSON	Medium	Average	Low	47%		
JEFFERSON	Low	Average	Medium	48%		
JOHNSON	Low	Average	Medium	42%		
KING TOWERS	Low	Average	High	57%		
KINGSBOROUGH	Medium	Average	High	47%		
KINGSBOROUGH EXTENSION	Low	Lowest	Low	52%		
LA GUARDIA	Low	Average	Medium	67%	Yes	
LA GUARDIA ADDITION	Low	Average	Medium	56%		
LA PRECIOSA	High		Low	3%		
LAFAYETTE	Low	Average	Low	60%		
LATIMER GARDENS	High	Higher	High	41%		current
LAVANBURG HOMES	High		High	10%		
LEAVITT STREET-34TH AVENUE	High	Higher	High	13%		current
LEHMAN VILLAGE	Low	Average	High	55%		
LENOX ROAD-ROCKAWAY PARKWAY	Medium		Low	2%		
LEXINGTON	High	Higher	Low	48%		
LINCOLN	Medium	Average	Medium	50%	Yes	
LINDEN	Low	Average	High	59%		current
LONG ISLAND BAPTIST HOUSES	High		Medium	13%		
LONGFELLOW AVENUE REHAB	High		Low	2%		
LOW HOUSES	High	Average	High	43%		
LOWER EAST SIDE I INFILL	Medium		Medium	42%		
LOWER EAST SIDE II	Medium		High	42%		
LOWER EAST SIDE III	Medium		Medium	20%		

Development	7 Number of buildings within development	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when portions of the development may experience tidal flooding, if applicable
HOPE GARDENS	4						
HOWARD	11						
HOWARD AVENUE	7						
HOWARD AVENUE-PARK PLACE	8						
HUGHES APARTMENTS	4						
HUNTS POINT AVENUE REHAB	13						
HYLAN	1						
INDEPENDENCE	6						
INGERSOLL	22	1	1	1	5	6	
INTERNATIONAL TOWER	1						
ISAACS	4	4	4	4	4	4	2080s
JACKSON	8						
JEFFERSON	19	2	4	13	16	18	
JOHNSON	10				3	5	
KING TOWERS	10						
KINGSBOROUGH	16						
KINGSBOROUGH EXTENSION	2						
LA GUARDIA	10			1	2	3	
LA GUARDIA ADDITION	1				1	1	
LA PRECIOSA	1						
LAFAYETTE	7						
LATIMER GARDENS	4			4	4	4	
LAVANBURG HOMES	1	1	1	1	1	1	2100
LEAVITT STREET-34TH AVENUE	1			1	1	1	
LEHMAN VILLAGE	5		3	4	5	5	
LENOX ROAD-ROCKAWAY PARKWAY	3						
LEXINGTON	4						
LINCOLN	14	4	5	7	13	14	2080s
LINDEN	21				21	21	
LONG ISLAND BAPTIST HOUSES	4						
LONGFELLOW AVENUE REHAB	2						
LOW HOUSES	4						
LOWER EAST SIDE I INFILL	5						
LOWER EAST SIDE II	5	2	4	5	5	5	2100
LOWER EAST SIDE III	3	3	3	3	3	3	2100

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
LOWER EAST SIDE REHAB (GROUP 5)	Medium		High	17%	Yes	
MANHATTANVILLE	Low	Average	Medium	54%		
MANHATTANVILLE REHAB (GROUP 2)	High		Low	0%		
MANHATTANVILLE REHAB (GROUP 3)	Medium		Low	9%		
MARBLE HILL	Medium	Average	High	40%		
MARCY	Medium	Average	High	46%		current
MARCY AVENUE-GREENE AVENUE SITE A	High		Low	25%		
MARCY AVENUE-GREENE AVENUE SITE B	High		Low	34%		
MARINER'S HARBOR	Medium	Average	Low	31%		
MARLBORO	Low	Average	High	52%		current
MARSHALL PLAZA	Low		Low	6%		
MCKINLEY	Medium	Average	High	43%		
MELROSE	Medium	Average	Low	47%		
MELTZER TOWER	Medium	Full Access	Low	55%		
METRO NORTH PLAZA	High	Average	Medium	25%	Yes	
MIDDLETOWN PLAZA	High	Average	Medium	43%		
MILL BROOK	Medium	Lowest	Medium	53%		
MILL BROOK EXTENSION	Medium	Lowest	Low	16%		
MITCHEL	Medium	Average	Low	48%		
MONROE	Low	Average	Medium	54%		
MOORE	Medium	Average	Medium	52%		
MORRIS I	Low	Average	High	45%		
MORRIS II	Medium	Average	Low	48%		
MORRIS PARK SENIOR CITIZENS HOME	Medium		Low	11%		
MORRISANIA	Medium	Average	High	47%		
MORRISANIA AIR RIGHTS	High	Lowest	High	14%		
MOTT HAVEN	Low	Average	Medium	61%		
MURPHY	Medium		Low	40%		
NEW LANE AREA	Low		Low	25%	Yes	
NOSTRAND	Low	Average	High	55%		current
OCEAN BAY APARTMENTS (BAYSIDE)	Low		High	22%	Yes	current
OCEAN BAY APARTMENTS (OCEANSIDE)	Low	Lowest	High	17%	Yes	current
OCEAN HILL APARTMENTS	Medium	Higher	Medium	57%		
OCEAN HILL-BROWNSVILLE	High		Low	1%		
O'DWYER GARDENS	Low	Lowest	High	43%	Yes	current

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LOWER EAST SIDE REHAB (GROUP 5)	2	2	2	2	2	2	2100
MANHATTANVILLE	6						
MANHATTANVILLE REHAB (GROUP 2)	3						
MANHATTANVILLE REHAB (GROUP 3)	2						
MARBLE HILL	13				5	6	
MARCY	28			6	14	17	
MARCY AVENUE-GREENE AVENUE SITE A	2						
MARCY AVENUE-GREENE AVENUE SITE B	1						
MARINER'S HARBOR	23						
MARLBORO	30	9	12	15	23	27	2100
MARSHALL PLAZA	1						
MCKINLEY	7						
MELROSE	9						
MELTZER TOWER	1						
METRO NORTH PLAZA	3	3	3	3	3	3	2100
MIDDLETOWN PLAZA	1						
MILL BROOK	9					2	
MILL BROOK EXTENSION	1						
MITCHEL	12				2	2	
MONROE	13				5	7	
MOORE	2						
MORRIS I	10						
MORRIS II	8						
MORRIS PARK SENIOR CITIZENS HOME	1						
MORRISANIA	2						
MORRISANIA AIR RIGHTS	3						
MOTT HAVEN	10						
MURPHY	2						
NEW LANE AREA	1						2020s
NOSTRAND	17		1	10	17	17	
OCEAN BAY APARTMENTS (BAYSIDE)	25	24	24	25	25	25	2050s
OCEAN BAY APARTMENTS (OCEANSIDE)	8	8	8	8	8	8	2050s
OCEAN HILL APARTMENTS	4						
OCEAN HILL-BROWNSVILLE	5						
O'DWYER GARDENS	8	8	8	8	8	8	2080s

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
PALMETTO GARDENS	High		Low	17%		
PARK AVENUE-EAST 122ND, 123RD STREETS	High		Low	15%		
PARK ROCK REHAB	Medium		Low	5%		
PARKSIDE	Low	Average	Medium	49%		
PATTERSON	Medium	Higher	Medium	47%		
PELHAM PARKWAY	Medium	Average	Medium	58%		
PENNSYLVANIA AVENUE-WORTMAN AVENUE	Medium	Lowest	Medium	33%		current
PINK	Low	Average	High	63%		current
POLO GROUNDS TOWERS	Low	Average	High	45%		
POMONOK	Medium	Average	Medium	39%		
PROSPECT PLAZA PHASE I	High		Low	5%		
PROSPECT PLAZA PHASE II			Low	0%		
PROSPECT PLAZA PHASE III	High		Low	0%		
PSS GRANDPARENT FAMILY APARTMENTS	High		Low	12%		
PUBLIC SCHOOL 139 (CONVERSION)	Medium		Low	18%		
QUEENSBRIDGE NORTH	Low	Average	High	49%		current
QUEENSBRIDGE SOUTH	Low	Average	High	52%		current
RALPH AVENUE REHAB	High		Low	18%		
RANDALL AVENUE-BALCOM AVENUE	Low	Average	Medium	48%		
RANGEL	Low	Average	High	41%	Yes	
RAVENSWOOD	Low	Higher	Medium	52%		current
RED HOOK EAST	Medium	Average	High	31%	Yes	current
RED HOOK WEST	Medium	Average	High	26%	Yes	current
REDFERN	Low	Average	Medium	41%	Yes	current
REHAB PROGRAM (COLLEGE POINT)	High	Higher	Low	7%		
REHAB PROGRAM (DOUGLASS REHABS)	Medium	Lowest	Low	14%		
REHAB PROGRAM (TAFT REHABS)	Medium	Lowest	High	1%		
REHAB PROGRAM (WISE REHAB)	Medium	Lowest	Low	5%		
REID APARTMENTS	Medium	Lowest	Low	50%		
RICHMOND TERRACE	Low	Average	Medium	63%		
RIIS	Medium	Average	High	23%	Yes	
RIIS II	Medium	Average	High	43%	Yes	
ROBBINS PLAZA	Medium	Average	Low	12%		
ROBINSON	Medium	Lowest	Low	16%		
ROOSEVELT I	Medium	Average	Low	23%		

Development	7 Number of buildings within develop-ment	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when por-tions of the development may experi-ence tidal flooding, if applicable
PALMETTO GARDENS	1						
PARK AVENUE-EAST 122ND, 123RD STREETS	3						
PARK ROCK REHAB	9						
PARKSIDE	14						
PATTERSON	15			1	2	7	
PELHAM PARKWAY	23						
PENNSYLVANIA AVENUE-WORTMAN AVENUE	4				4	4	
PINK	25				25	25	
POLO GROUNDS TOWERS	8	2	3	4	8	8	2080s
POMONOK	35						
PROSPECT PLAZA PHASE I	2						
PROSPECT PLAZA PHASE II	2						
PROSPECT PLAZA PHASE III	1						
PSS GRANDPARENT FAMILY APARTMENTS	1						
PUBLIC SCHOOL 139 (CONVERSION)	1						
QUEENSBRIDGE NORTH	14		3	5	10	14	
QUEENSBRIDGE SOUTH	16			5	9	12	
RALPH AVENUE REHAB	5						
RANDALL AVENUE-BALCOM AVENUE	4					4	
RANGEL	8		1	1	3	3	2080s
RAVENSWOOD	31			11	21	22	
RED HOOK EAST	19	15	16	18	19	19	2100
RED HOOK WEST	15	15	15	15	15	15	2080s
REDFERN	9	9	9	9	9	9	2050s
REHAB PROGRAM (COLLEGE POINT)	1						
REHAB PROGRAM (DOUGLASS REHABS)	4						
REHAB PROGRAM (TAFT REHABS)	4						
REHAB PROGRAM (WISE REHAB)	1						
REID APARTMENTS	1						
RICHMOND TERRACE	7						
RIIS	14	14	14	14	14	14	2080s
RIIS II	6	6	6	6	6	6	2080s
ROBBINS PLAZA	1						
ROBINSON	1				1	1	
ROOSEVELT I	6						

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
ROOSEVELT II	High	Lowest	Low	31%		
RUTGERS	Low	Average	Low	57%		
RUTLAND TOWERS	High	Lowest	Medium	10%		
SACK WERN	Medium	Average	Low	14%		
SAINT MARY'S PARK	Low	Average	High	58%		
SAINT NICHOLAS	Medium	Average	High	53%		
SAMUEL (CITY)	High		Low	5%		
SAMUEL (MHOP) I	Medium		Low	3%		
SAMUEL (MHOP) II	Medium		Low	7%		
SAMUEL (MHOP) III	Medium		Low	54%		
SARATOGA VILLAGE	Medium	Average	High	42%		
SEDGWICK	Low	Average	Low	41%		
SEWARD PARK EXTENSION	Medium	Average	Medium	41%		
SHEEPSHEAD BAY	Low	Average	High	57%		current
SHELTON HOUSE	High		High	5%		
SMITH	Low	Average	High	40%	Yes	
SOTOMAYOR HOUSES	Low	Average	High	41%		
SOUNDVIEW	Low	Average	Medium	47%		
SOUTH BEACH	Low	Average	High	37%		
SOUTH BRONX AREA (SITE 402)	High		Low	28%		
SOUTH JAMAICA I	High	Average	Medium	50%		by 2050
SOUTH JAMAICA II	High	Average	Medium	41%		by 2050
STANTON STREET	Medium		Medium	12%		
STAPLETON	Low	Average	Medium	42%		
STEBBINS AVENUE-HEWITT PLACE	High		Low	25%		
STERLING PLACE REHABS (SAINT JOHNS-STERLING)	High		Low	20%		
STERLING PLACE REHABS (STERLING-BUFFALO)	High		Low	10%		
STRAUS	Medium	Average	Medium	41%		
STUYVESANT GARDENS I	High	Average	Low	25%		
STUYVESANT GARDENS II	Medium		Low	28%		
SUMNER	Low	Average	Low	56%		
SURFSIDE GARDENS	Low	Average	High	17%	Yes	current
SUTTER AVENUE-UNION STREET	High		Medium	23%		

Development	7 Number of buildings within development	8 Number of buildings within current 100-Year floodplain (2015 PFIRM)	9 Number of buildings within 100-year floodplain projected for 2020s (NPCC)	10 Number of buildings within 100-year floodplain projected for 2050s (NPCC)	11 Number of buildings within 100-year floodplain projected for 2080s (NPCC)	12 Number of buildings within 100-year floodplain projected by 2100 (NPCC)	13 Projected time period when portions of the development may experience tidal flooding, if applicable
ROOSEVELT II	3						
RUTGERS	5			2	2	2	
RUTLAND TOWERS	1						
SACK WERN	7						
SAINT MARY'S PARK	6						
SAINT NICHOLAS	14						
SAMUEL (CITY)	42			11	16	18	
SAMUEL (MHOP) I	5						
SAMUEL (MHOP) II	1					1	
SAMUEL (MHOP) III	1						
SARATOGA VILLAGE	1						
SEDGWICK	7						
SEWARD PARK EXTENSION	5						
SHEEPSHEAD BAY	19			18	19	19	
SHELTON HOUSE	1						
SMITH	13	6	7	9	13	13	2080s
SOTOMAYOR HOUSES	31			5	26	30	
SOUNDVIEW	15				1	8	
SOUTH BEACH	8						
SOUTH BRONX AREA (SITE 402)	5						
SOUTH JAMAICA I	12						
SOUTH JAMAICA II	16						
STANTON STREET	1						
STAPLETON	8						
STEBBINS AVENUE-HEWITT PLACE	2						
STERLING PLACE REHABS (SAINT JOHNS-STERLING)	5						
STERLING PLACE REHABS (STERLING-BUFFALO)	7						
STRAUS	2						
STUYVESANT GARDENS I	5						
STUYVESANT GARDENS II	1						
SUMNER	13						
SURFSIDE GARDENS	5	5	5	5	5	5	2050s
SUTTER AVENUE-UNION STREET	3						

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
TAFT	Low	Average	High	48%		
TAPSCOTT STREET REHAB	High		Medium	16%		
TAYLOR STREET-WYTHE AVENUE	Medium	Average	Low	21%		
TELLER AVENUE-EAST 166TH STREET	High	Average	High	13%		
THOMAS APARTMENTS	Medium		Low	25%		
THROGGS NECK	Low	Average	High	41%		
THROGGS NECK ADDITION	Medium	Average	Medium	18%		
TILDEN	Medium	Average	High	42%		
TODT HILL	Medium	Average	Medium	57%		
TOMPKINS	Low	Average	Low	57%		
TWIN PARKS EAST (SITE 9)	Medium		Low	42%		
TWIN PARKS WEST (SITES 1 & 2)	High		High	27%		
TWO BRIDGES URA (SITE 7)	Medium	Average	Low	21%	Yes	
UNION AVENUE-EAST 163RD STREET	High		Low	31%		
UNION AVENUE-EAST 166TH STREET	High		Medium	18%		
UNITY PLAZA (SITES 17,24,25A)	High	Average	Low	9%		
UNITY PLAZA (SITES 4-27)	High	Average	Medium	20%		
UNIVERSITY AVENUE REHAB	Medium		Medium	12%		
UPACA (SITE 5)	High		Low	31%		
UPACA (SITE 6)	High		Low	34%		
VAN DYKE I	Medium	Average	High	38%		
VAN DYKE II	Medium	Lowest	Medium	71%		
VANDALIA AVENUE	Medium		Medium	39%		
VLADECK	Medium	Average	Low	53%		
VLADECK II	Medium	Average	Low	44%		
WAGNER	Medium	Average	High	44%		
WALD	Medium	Higher	High	34%	Yes	
WASHINGTON	Medium	Higher	High	47%		
WASHINGTON HEIGHTS REHAB (GROUPS 1&2)	Medium		Low	0%		
WASHINGTON HEIGHTS REHAB PHASE III (FORT WASHINGTON)	Medium		Low	6%		
WASHINGTON HEIGHTS REHAB PHASE III (HARLEM RIVER)	Low		Low	3%		
WASHINGTON HEIGHTS REHAB PHASE IV (C)	Medium		Low	1%		
WASHINGTON HEIGHTS REHAB PHASE IV (D)	Low		Low	5%		

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TAFT	10				1	1	
TAPSCOTT STREET REHAB	8						
TAYLOR STREET-WYTHE AVENUE	6						
TELLER AVENUE-EAST 166TH STREET	1						
THOMAS APARTMENTS	1						
THROGGS NECK	32				1	22	
THROGGS NECK ADDITION	4					4	
TILDEN	9						
TODT HILL	7						
TOMPKINS	10						
TWIN PARKS EAST (SITE 9)	1						
TWIN PARKS WEST (SITES 1 & 2)	2						
TWO BRIDGES URA (SITE 7)	1	1	1	1	1	1	2100
UNION AVENUE-EAST 163RD STREET	2						
UNION AVENUE-EAST 166TH STREET	6						
UNITY PLAZA (SITES 17,24,25A)	3						
UNITY PLAZA (SITES 4-27)	5						
UNIVERSITY AVENUE REHAB	4						
UPACA (SITE 5)	1						
UPACA (SITE 6)	1						
VAN DYKE I	23						
VAN DYKE II	1						
VANDALIA AVENUE	3				1	3	
VLADECK	20				2	5	
VLADECK II	4						
WAGNER	24	9	15	18	24	24	2100
WALD	18	14	18	18	18	18	2100
WASHINGTON	16	1	2	7	12	14	
WASHINGTON HEIGHTS REHAB (GROUPS 1&2)	5						
WASHINGTON HEIGHTS REHAB PHASE III (FORT WASHINGTON)	7						
WASHINGTON HEIGHTS REHAB PHASE III (HARLEM RIVER)	1						
WASHINGTON HEIGHTS REHAB PHASE IV (C)	2						
WASHINGTON HEIGHTS REHAB PHASE IV (D)	2						

Development	1 Outdoor Temperature Rank	2 AC Access Rank	3 Stormwater Flood Exposure Rank	4 Percent Tree Canopy Cover, 2017	5 Development Received Resiliency Investments as Part of Sandy Recovery & Resiliency Program	6 Minimum Depth to Groundwater less than 10', current or future (data available only for Brooklyn and Queens)
WEBSTER	Medium	Average	Medium	45%		
WEEKSVILLE GARDENS	High		Medium	14%		
WEST BRIGHTON I	Medium	Average	Medium	49%		
WEST BRIGHTON II	Medium	Average	Medium	55%		
WEST FARMS ROAD REHAB	Medium		Medium	4%		
WEST FARMS SQUARE CONVENTIONAL	High		Low	8%		
WEST TREMONT AVENUE-SEDGWICK AVENUE AREA	Medium	Average	Low	31%		
WHITE	Medium	Average	Medium	29%		
WHITMAN	Medium	Average	Low	35%		
WILLIAMS PLAZA	Medium		Medium	70%		
WILLIAMSBURG	High	Average	Medium	43%		
WILSON	Low	Average	Low	39%		
WISE TOWERS	Medium		Low	45%		
WOODSIDE	Medium	Higher	High	50%		current
WOODSON	High	Lowest	Medium	51%		
WSUR (BROWNSTONES)	Low	Lowest	Low	26%		
WSUR (SITE A) 120 WEST 94TH STREET	Medium	Average	Low	48%		
WSUR (SITE B) 74 WEST 92ND STREET	Medium	Average	Medium	26%		
WSUR (SITE C) 589 AMSTERDAM AVENUE	Low	Average	Low	27%		
WYCKOFF GARDENS	Low	Average	High	52%		current

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WEBSTER	6						
WEEKSVILLE GARDENS	2						
WEST BRIGHTON I	9						
WEST BRIGHTON II	8						
WEST FARMS ROAD REHAB	4						
WEST FARMS SQUARE CONVENTIONAL	1						
WEST TREMONT AVENUE-SEDGWICK AVENUE AREA	1						
WHITE	1	1	1	1	1	1	
WHITMAN	19						
WILLIAMS PLAZA	5						
WILLIAMSBURG	22						
WILSON	3	3	3	3	3	3	2080s
WISE TOWERS	4						
WOODSIDE	20						
WOODSON	2						
WSUR (BROWNSTONES)	36						
WSUR (SITE A) 120 WEST 94TH STREET	1						
WSUR (SITE B) 74 WEST 92ND STREET	1						
WSUR (SITE C) 589 AMSTERDAM AVENUE	1						
WYCKOFF GARDENS	3						

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