

CLIMATE DISPLACEMENT IN NYC

MAKING SPACE
FOR OUR
NEIGHBORS



REBUILD
BY
DESIGN

 **Milliman**

CONTENTS

EXECUTIVE SUMMARY

7

INTRODUCTION

8

HOUSING IN THE NYC FLOODPLAIN

9

WHO IS AT RISK OF DISPLACEMENT?

11

METHODOLOGY

12-18

FINDINGS

19-20

DISPARATE IMPACTS

21

HURRICANE SANDY'S IMPACT

22-23

TIME FOR RETREAT?

24

THE ROAD AHEAD

25

EXECUTIVE SUMMARY

REBUILD BY DESIGN is reimagining the way communities find solutions for today's large-scale, complex problems by creating collaborations across communities and governments. Rebuild convenes global expertise, with regional leadership, and community stakeholders to gain a better understanding of how overlapping environmental and human-made vulnerabilities leave communities at risk. Rebuild's core belief is that through collaboration our communities can grow stronger and better prepared to stand up to whatever challenges tomorrow brings.

MILLIMAN is among the world's largest providers of actuarial and related products and services. The firm has consulting practices in healthcare, property & casualty insurance, life insurance and financial services, and employee benefits. Founded in 1947, Milliman is an independent firm with offices in major cities around the globe. For further information, visit milliman.com.

As severe flooding impacts low-lying communities, those who have financial means may move to higher ground, further gentrifying inland communities, and displacing long-term, lower-income residents. Others may leave New York City altogether, dramatically shrinking the tax base, leading to less funding for schools, transit, and of course, much needed resilient infrastructure. Those with the greatest needs will unfortunately have the least options. People who live paycheck to paycheck may face eviction or the destruction of their homes, exacerbating homelessness and mental health problems. The challenges brought on by this migration must be addressed and planned for early.

Rebuild by Design collaborated with Milliman to estimate how future coastal flooding in New York City could cause displacement of residents – both from the physical threats posed by flooding and the social and financial threats caused by people migrating to safer areas. Using data from the New York City Panel on Climate Change's (NPCC) 2019 report (NPCC3) we found that nearly 1.7 million people (20% of the city's population) currently live within or adjacent to the estimated 2050 coastal floodplain; nearly 400,000 of these people live in low-income neighborhoods where the median household income is about \$31,000. While most city residents (approximately 6.7 million people) live in areas at less risk to future coastal flooding, about 1.8 million of these people live in lower-income neighborhoods and could be displaced by residents moving inland from high risk coastal areas. Cumulatively, 40% of New York City's residents are at risk of displacement due to storm surge and rising sea levels, or from the movement of people inland to relocate out of harm's way. This data can help the City anticipate and plan for population shifts to help give all people across the economic spectrum the best options for adapting to a future climate.

INTRODUCTION

The increasing frequency and severity of acute climate events and the rising intensity of climate stressors are putting pressure on populations throughout the world to relocate. In 2021 alone, approximately 22 million people across 134 countries were internally displaced as a result of climate and weather-related disasters (IDMC, 2021). In the United States, entire communities, such as the islands of Isle de Jean Charles, Louisiana, and Shishmaref, Alaska, have already made difficult decisions of whether to leave their homes to escape rising seas and more frequent floods. More communities will likely be upended as climate change worsens.

Climate displacement – the relocation of peoples as a result of sudden and/or slow-onset climate and weather-related disasters – causes upheaval for those who stay and those who leave. Those who leave can have difficulty finding acceptable housing and employment. Those who remain after a disaster, as a result of an eroding tax base and less proximity to neighbors, can face diminished access to critical services, including police and fire, education, and healthcare. For all, social connections are lost. Those with scarce resources, language barriers, poor health, or differences in ability will fare the worst during and after a natural disaster and face the most difficulty relocating out of harm’s way (EPA, 2021; Flores et al., 2020; Rose et al., 2011). As the climate becomes more variable and more volatile, pressures to relocate will further reinforce underlying vulnerabilities and systemic inequality.

New York City, a coastal city with 520 miles of coastline and significant residential development along the water, is at risk to future coastal flooding from storm surge and sea level rise. When Hurricane Sandy hit New York City in 2012, nearly 800 buildings were damaged or destroyed, including 70,000 housing units, which took years to repair and rebuild. This event showed New York

City that the strength of one storm can wipe away neighborhoods, lives, and livelihoods.

Recent projections indicate that, with climate change, an event like Hurricane Sandy in the coming decades could have even more drastic consequences for New York City and its residents (Staletovich et al., 2022). As a part of the NPCC3 report, the panel released floodplain maps showing the estimated 100-year and 500-year (a flood that has a 1% and 0.2% chance of occurring in a given year, respectively) storm projections for the 2020s, 2050s, 2080s, and 2100. The estimates of the impacted areas from future storm surge events are stark – by mid-century, significant portions of the city’s waterfront could be inundated in a 100-year event. Even still, the gap between where adaptation measures have been implemented and where it is predicted to flood is significant and is only slowly being addressed.

To add to a growing body of knowledge on potential climate displacement in New York City, Rebuild by Design collaborated with Milliman to study the areas across New York City that could be impacted by coastal flooding in 2050 to better understand the economic and demographic makeup of these communities. Part of this work is to identify vulnerable populations at risk for displacement, and the compounding effects that displacement would have on the rest of the City. As past events have demonstrated, the most vulnerable communities in the city will face the greatest challenges in mitigating and retreating from rising waters (Calvan, 2022). By understanding which communities are at risk for displacement due to climate impacts, New York City can proactively implement programs and policies that will balance the need for migration from certain areas with ensuring that those who move, and the areas where they move, will not be further impacted by displacement or gentrification.

HOUSING IN THE NYC FLOODPLAIN

Currently, 14% of New Yorkers – 1.3 million people – live within or directly adjacent to the mapped 100-year floodplain (Rebuild by Design, 2020).¹ According to New York City’s report, “Retrofitting Buildings for Flood Risk,” the number of buildings in the floodplain in New York City is among the highest in any city in the United States, making the “population of New York City in the floodplain comparable to many mid-sized cities around the country” (NYC DCP, 2018). Furthermore, a substantial number of affordable housing units are located in high flood risk areas, including many buildings that are owned by the New York City Housing Authority (NYCHA) (Rush, 2014). The impact of climate change will be felt throughout New York City’s already tight housing market; in 2021, the city had a vacancy rate of 4.54%, which is considered to be a “housing emergency” (Smith, 2022).

When homeowners or tenants move to a new property, they may not understand their household’s risk of flooding. In 2021 alone, an estimated 7,645 newly purchased homes in New York State had previously flooded, totaling more than \$23 million in annual flood costs (Evans and Baeder, 2022). In 2022, the New York State legislature began to address this problem and passed legislation to require landlords to disclose the rental property’s flood risk and flooding history to prospective renters (NYS Assembly Bill A7876A, 2021). However, no such law exists for sellers and buyers. Instead, New York State law allows property owners to give buyers a \$500 credit toward their closing costs if they decline to be informed about their property’s flood history.

This planned loophole makes the flood history of a building opaque at best.

The New York City Comptroller’s Office has found that property values in the City’s 100-year floodplain total over \$176 billion in 2022. Left unabated, the 2050 floodplain could encompass an estimated \$242 billion in property values in current market value (ONYCC, 2022). Without proper mitigation, these properties stand to lose value due to flood damage. A 2018 study of the impact of Hurricane Sandy on property values in the floodplain revealed that both the properties that experienced damages and those adjacent to damaged properties experienced a decline in value, suggesting that even the perceived risk of flooding is enough to drive down property values (Ortega and Taspinar, 2018).



IMAGE: House in Staten Island, NY destroyed during Hurricane Sandy | DVIDSHUB

¹ These estimates consider the entire population of any block group intersecting any area of floodplain to be “within or adjacent to” the floodplain; other studies may only count census areas that are entirely in the floodplain or whose centroid is within the floodplain. Discrepancies in these population estimates highlight the challenges of comparing results based on census data due to the many potential methodological differences in how census geographies and demographic data are used.

WHO IS AT RISK OF DISPLACEMENT?

This collaboration sought to better understand which people could be displaced as a result of physical flooding hazards that would lead to increased pressure on housing availability and affordability throughout the city. This analysis combines the predicted floodplain for a 100-year event in 2050 with U.S. Census income and household data to segment the City based on potential future flood inundation and current economic conditions.



IMAGE: Home elevation in Meadowmere, Queens
SOURCE: Zachary Youngerman

METHODOLOGY

The study used the NPCC3's geospatial data layer delineating the estimated extent of the 2050 100-year event floodplain, which is based on a projected 30 inches of sea level rise by 2050 (Patrick et al., 2019) (Figure 1). We then spatially intersected the floodplain layer with the U.S. Census 2019 census block group boundaries. Census block groups are sets of one or more contiguous census blocks, which in urban areas such as New York City, are generally the equivalent of a city block bounded on all sides by streets.

If any portion of a block group overlapped with the floodplain layer, the block group was determined for the purposes of this study to be "flood impacted." Although a home may not be directly flooded, in New York City, census block groups are small and nearby flooding can impact people's ability to travel to get to work and services, and local utilities could be disrupted, cutting off power and other critical services to people's homes.

NEW YORK CITY 2050 100-YEAR FLOODPLAIN

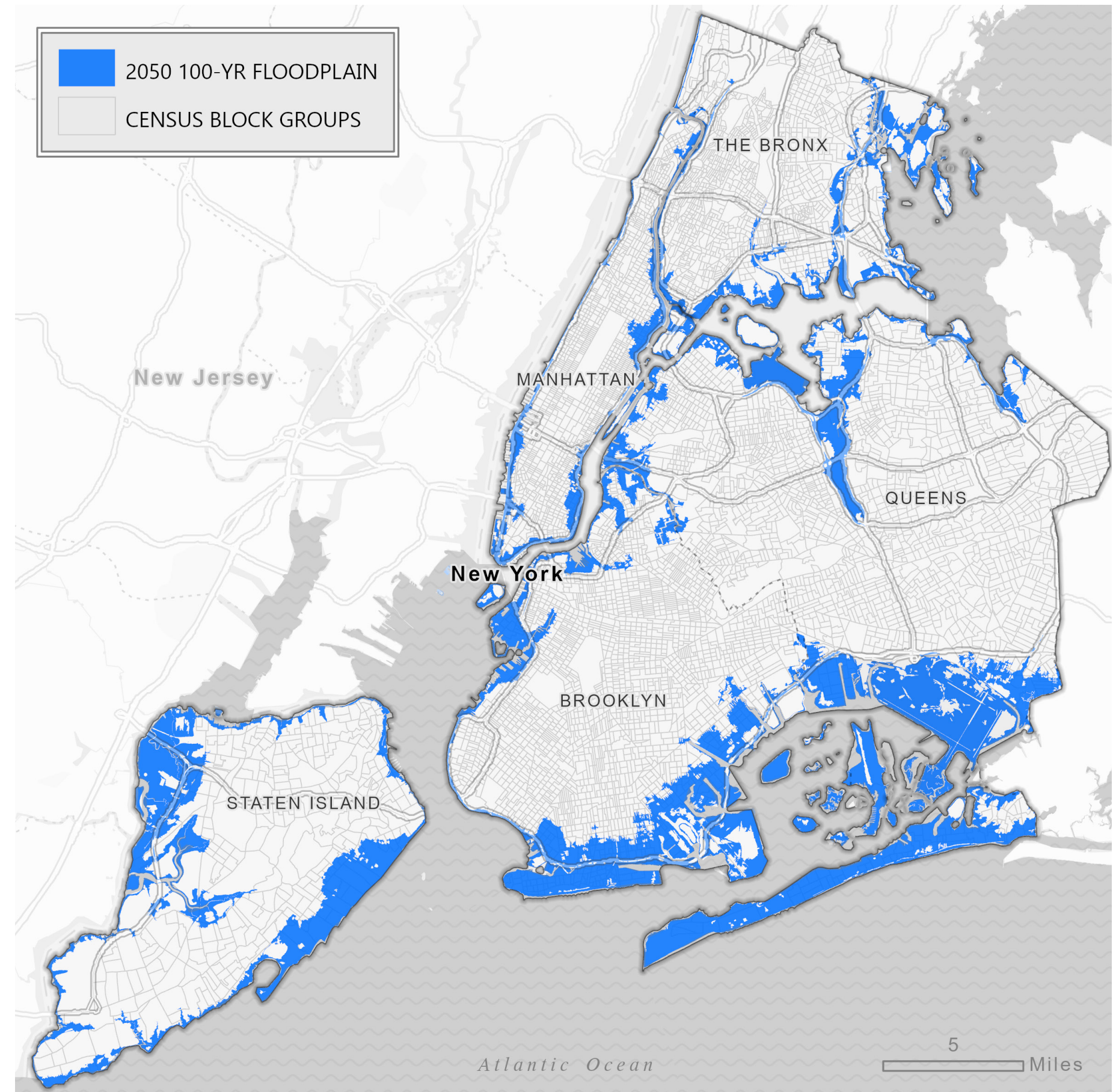
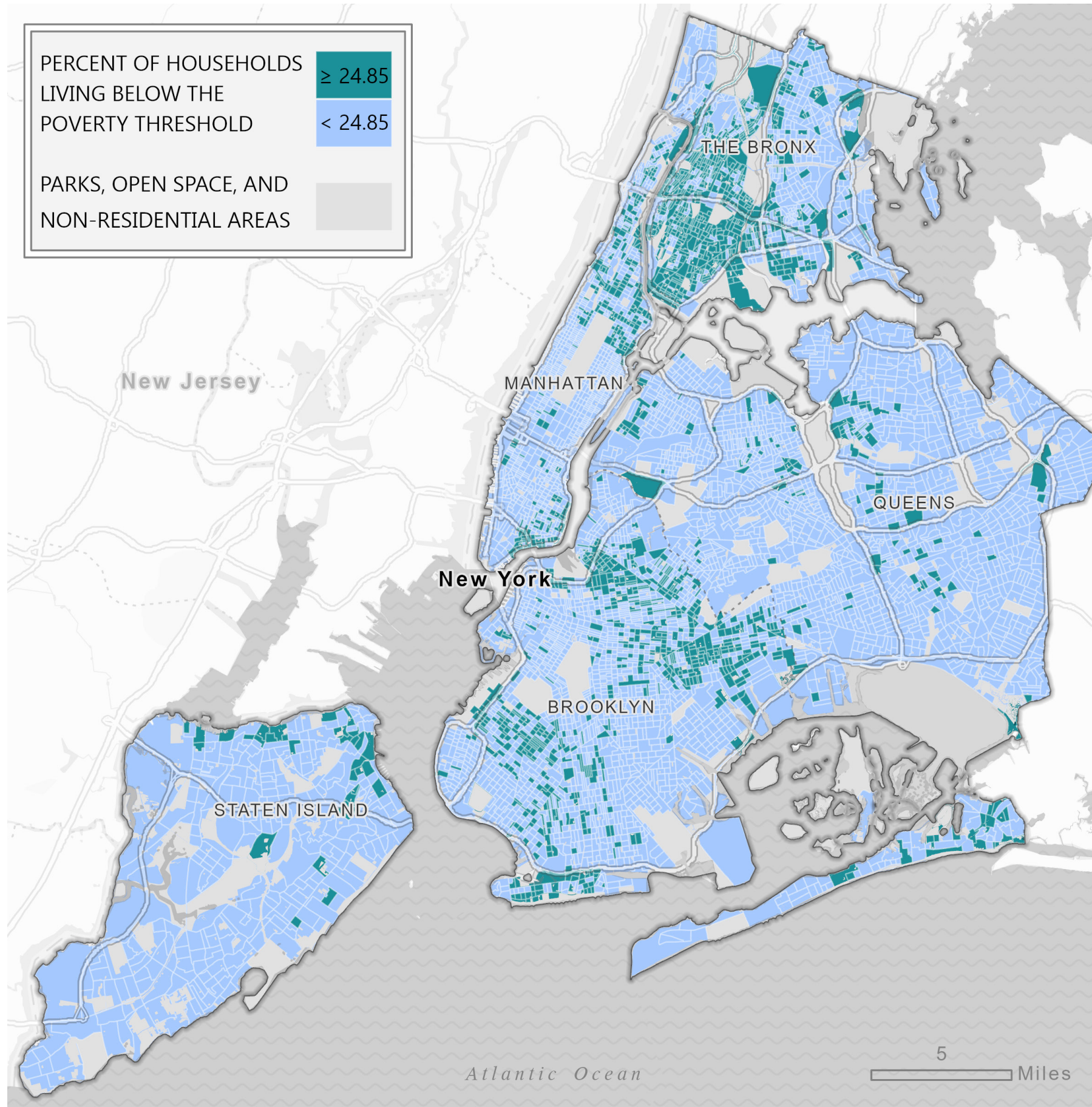


FIGURE 1. NPCC3 estimate of the 2050 100-year floodplain based on a projected 30" of sea level rise.

DATA SOURCE: 2050 floodplain data provided by the Mayor's Office of Climate and Environmental Justice (MOCEJ) on behalf of CUNY Institute for Sustainable Cities (CISC) and the New York Panel on Climate Change (NPCC). Service layer credits: NYC OpenData, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, EPA, NPS

NYC HOUSEHOLDS LIVING BELOW THE FEDERAL POVERTY LEVEL



Next, we used the U.S. Census 2019 American Community Survey (ACS) 5-year estimates of the number of households living below the poverty threshold by block group (ACS Table B17017) to identify the most impoverished block groups. Households were classified by the census as living below the poverty threshold when the total income of the householder's family in the prior year was below the poverty threshold; in 2019 the threshold for a family of four was \$26,172 (U.S. Census Bureau).

We calculated the percentage of households living below the poverty level by block group, then selected the upper quartile of this percentage (which corresponded to 24.85% of households) as the limit to isolate the most impoverished block groups. Any block groups where at least 24.85% of households had an income below the poverty threshold were labeled as "most impoverished" (Figure 2).

Block groups were then assigned into one of four "displacement quadrants" – CRISIS, DESTINATION, STABLE, OR EMIGRATING – based on the block group's future flood status (flood impacted yes/no) and current household poverty status (most impoverished yes/no) to create the New York City Displacement Map (Figure 3).

FIGURE 2. Census block groups with at least 24.85% of households living below the poverty threshold were flagged as "most impoverished," shown here in green.

DATA SOURCE: US Census, NYC OpenData, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, EPA, NPS

NYC CLIMATE DISPLACEMENT MAP

CRISIS areas include block groups within the 2050 floodplain extent where at least 24.85% of the households are currently living below the poverty threshold. These are low-lying areas with high future flood risk. People living in these areas are generally of lower-income and as waters rise, they will likely have limited options for retreat.

EMIGRATING areas include block groups within the 2050 floodplain where less than 24.85% of the households are currently living below the poverty threshold. These are low-lying areas with high future flood risk, currently occupied by higher-income residents who are more likely to have the financial stability to move elsewhere within the city.

DESTINATION areas include block groups outside of the 2050 floodplain where at least 24.85% of the households are currently living below the poverty threshold. These areas are on higher ground, have a relatively lower flood risk, and are currently occupied by lower-income people. Higher-income people retreating from riskier areas in the city could move into these areas.

STABLE areas include block groups outside of the 2050 flood extent where less than 24.85% of the households are currently living below the poverty threshold. These are areas of higher-ground and relatively lower flood risk. Since residents here have higher incomes, they are less susceptible to being displaced as people move from the riskier areas of the city.

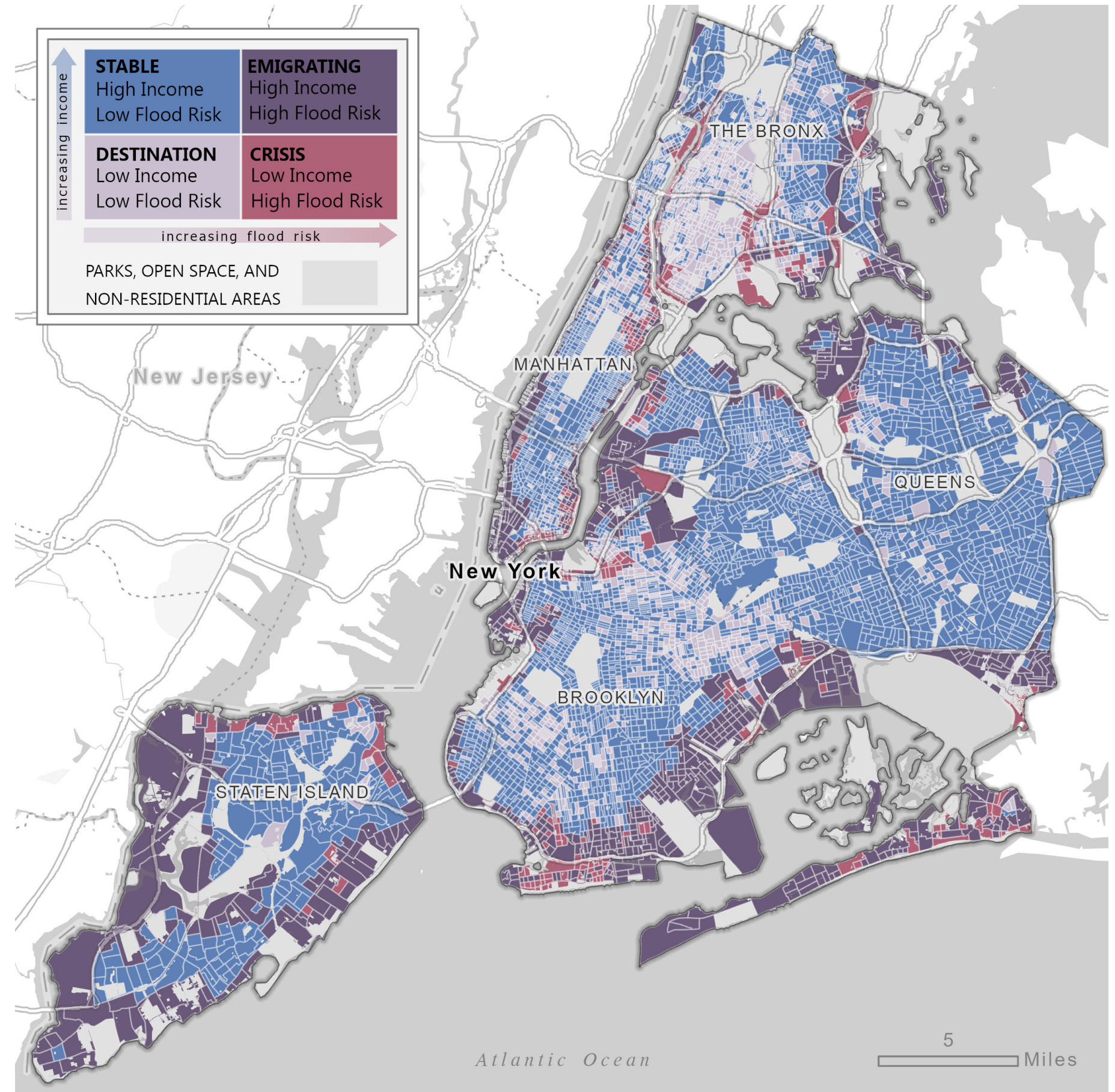


FIGURE 3. New York City Displacement Map. Census block groups were assigned to one of four displacement “quadrants.”

DATA SOURCE: US Census, NYC OpenData, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, EPA, NPS

Once block groups were assigned to a quadrant, additional census data were aggregated by quadrant to better understand the demographic and economic makeup of these areas, including data on housing types and home ownership (ACS Table B25032), rental costs (ACS Table B25064), income (ACS Table B19013), and race and ethnicity of residents (ACS Table B03002).

The goal of this study is to give the best approximation of potential migration patterns by New York City residents without adaptation interventions. Since all data has limitations, we would like to note that:

- Our assessment does not evaluate the impacts of flooding from precipitation or stormwater flooding, though these can have drastic effects on inland communities, as events like Hurricane Ida demonstrated (Maldonado, 2021). Areas which we have designated as the “lower risk” DESTINATION and STABLE areas could still experience substantial flooding due to heavy rain, which could impact housing availability and affordability.
- Our analysis does not account for people moving from or to nearby areas outside New York City (e.g., New Jersey) to escape future flood hazards, though it is likely that residents of other states could move to New York and vice-versa.
- The population estimates presented are based on static 2019 census data, while it is known that these numbers could change dramatically in the coming years given population growth.
- We recognize that the methodology described herein is a simplified way to assess both social vulnerability and flood risk. For example, although our analysis uses income to partition the city, many factors in addition to income contribute to an individual’s ability to adapt to the consequences of future flooding. Additionally, not all people living in block groups within CRISIS areas are low-income, just as not all people living in EMIGRATING areas will have the means to relocate on their own terms.

- There are existing capital projects that could change the flood risk to certain areas, such as the East Side Coastal Resilience Project in Lower Manhattan. However, since these projects are not yet built, the residents remain at high risk today.

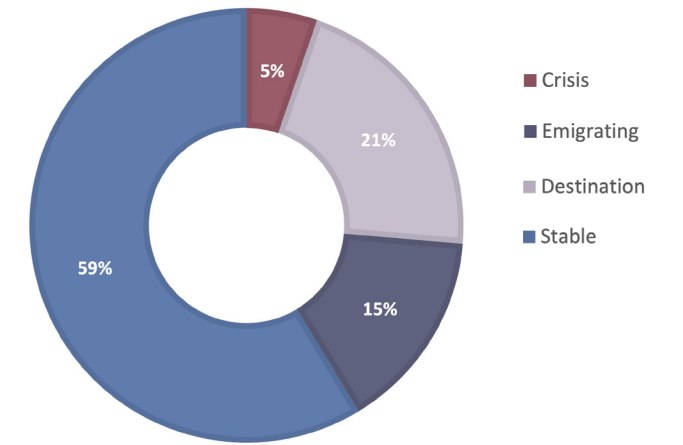
FININDINGS

Table 1 describes the socioeconomic make-up of each quadrant. Based on this analysis, approximately 1.7 million people (20% of the city’s population) currently live within block groups that could be impacted by coastal flood waters in 2050, with nearly 444,000 in CRISIS block groups and 1.3 million in EMIGRATING block groups. As sea level rise and storm surge flood these areas, without flood mitigation investments, residents will likely need to move elsewhere, yet, where they go will be highly dependent on their finances, social connections, and the available options. These shifts in population could have dramatic impacts on New York City’s communities and culture.

The EMIGRATING population (higher-income people living in higher flood risk areas) is predominantly white and about 43% live in owner-occupied housing units. EMIGRATING neighborhoods include coastal places such as Greenpoint, Battery Park City, parts of Red Hook, the Financial District, and the North Shore of Staten Island. Based on our analysis, likely migration locations for these people include DESTINATION areas such as Brownsville, parts of Harlem, East New York, Cypress Hills, Fordham, East Tremont, and Morrisania, which are currently mostly BIPOC communities of residents living in rented, multi-family dwellings. In DESTINATION areas, current median rental prices are at least \$500/month lower than EMIGRATING areas, indicating that the EMIGRATING population would likely have the economic means to move into these areas and put additional pressures on an already tight housing market, possibly displacing existing residents in DESTINATION areas.

The CRISIS population (lower-income people living in higher flood risk areas) is mostly comprised people of color living in multi-family rented units, in neighborhoods such as Coney Island, the Rockaway Ferry Area, other sections of East Harlem, and parts of Red Hook, where the current median rents are some of the lowest throughout the city due to the concentration of public housing. Those living in

PERCENT OF NYC RESIDENTS IN EACH QUADRANT



CRISIS areas will likely look to the City, FEMA, or charitable organizations for migration assistance as flood waters impede their ability to live in their homes. These residents could be forced to move out of New York City entirely if adequate, affordable housing in lower-risk areas is unavailable.

The majority of residents in New York City (roughly 5 million) are a part of the STABLE population (higher-income people living in lower flood risk areas). STABLE areas include inland neighborhoods on higher ground, such as Westchester, Northwest Bronx, Parkchester, and midtown Manhattan. These areas are likely to be less impacted by others moving from risky areas given the high rental costs and incomes of existing residents.

While this work is not the first to contemplate how New York City residents could be affected by future storm surge and sea level rise, it serves to further emphasize that lower-income communities of color could bear the brunt of climate change in New York City if the City government does not plan ahead and provide the policy changes and funding necessary to ensure equitable climate adaptation. As climate change continues to worsen flooding, the available housing stock will shift, creating rippling effects in both low lying and inland communities.

DEMOGRAPHICS OF DISPLACEMENT QUADRANTS

QUADRANT	CRISIS	EMIGRATING	DESTINATION	STABLE
TOTAL POPULATION	443,826	1,259,709	1,771,022	4,928,668
% OF NYC POPULATION	5%	15%	21%	59%
% HOUSEHOLDS LIVING BELOW POVERTY	40%	10%	38%	11%
MEDIAN HOUSEHOLD INCOME	\$30,975	\$92,814	\$32,020	\$80,897
% WHITE	35%	57%	26%	46%
% BLACK	32%	20%	33%	22%
% ASIAN	11%	12%	9%	16%
% OTHER RACE	22%	11%	32%	16%
% HISPANIC OR LATINO ²	37%	19%	46%	25%
TOTAL HOUSING UNITS	170,311	496,758	627,395	1,872,570
% RENTED HOUSING UNITS	90%	57%	88%	61%
MEDIAN RENT ³	\$898	\$1,672	\$1,157	\$1,596
% OF HOUSING UNITS THAT ARE SINGLE FAMILY HOMES	6%	22%	6%	20%

TABLE 1. Census data aggregated at the quadrant level.

DISPARATE IMPACTS

Natural disasters exacerbate many inequalities already present in our communities. As part of the 2019 NPCC3 report, the Community-Based Assessments of Adaptation and Equity Workgroup found that that “high levels of social vulnerability to climate change overlap with disproportionate exposure to environmental pollution, health stressors, and gentrification pressures” (Foster et al., 2019). Other studies also highlight the equity issues surrounding future flooding impacts on New York City’s vulnerable communities (Buchanan et al., 2020) and emphasize the importance of accounting for differing population vulnerabilities as the City plans for coastal flood resilience efforts (Herrerros-Cantis et al.2020).

The majority of communities in New York City currently at risk of flooding are low-income and predominantly Black, Latinx, or Asian (Rebuild by Design, 2020). As with other effects of climate change, increased flooding will disproportionately impact the most vulnerable populations, widening the gaps created by systemic inequalities (Islam, 2017). Stories from New York City’s previous coastal, tidal, and inland flood events, combined with future climate change scenarios, expose the harsh reality that while some communities may be able to adapt, others may have to relocate altogether (Cohen, 2020).

Wealth disparities are already a prevalent challenge in New York City (David, 2021) and are poised to increase community division under impacts of climate change. A 2018 report that looked at longitudinal impacts of natural disasters on wealth inequality in the United

States between 1999–2013 found that White residents of counties that experienced \$10 billion in damage from storms gained an average net worth of \$126,000 during that time period, while Black and Latino residents in the same areas lost an average of \$27,000 and \$29,000, respectively (Howell and Elliot, 2018). Similarly, homeowners and those with more education gained wealth while renters and those with less education lost wealth.

² The US Census considers “Hispanic or Latino” as an ethnicity, which is a distinct concept from race. Hispanic and Latinos may be of any race and percent Hispanic or Latino in a population should not be totaled along with race percentages.

³ Median rent by block group >\$3,500 is expressed as \$3,500+ in the census data, so we set values for block groups with a median rent “\$3,500+” to \$3,500. These values here should therefore be considered a “minimum” median rent by quadrant.

HURRICANE SANDY'S IMPACT

Hurricane Sandy is often used as a benchmark storm with which to compare potential future extreme flooding events in New York City, and the disproportionate impact it had on vulnerable populations raises the alarm for what could happen as flooding worsens with climate change. Roughly 33% of all housing units within the Sandy surge area were homes of low-income people, including 402 buildings containing 35,000 public housing units managed by the NYCHA, 248 buildings housing 24,500 rent subsidized units, and over 800 privately-owned buildings housing roughly 40,000 rent-stabilized units (Furman Center, 2013).

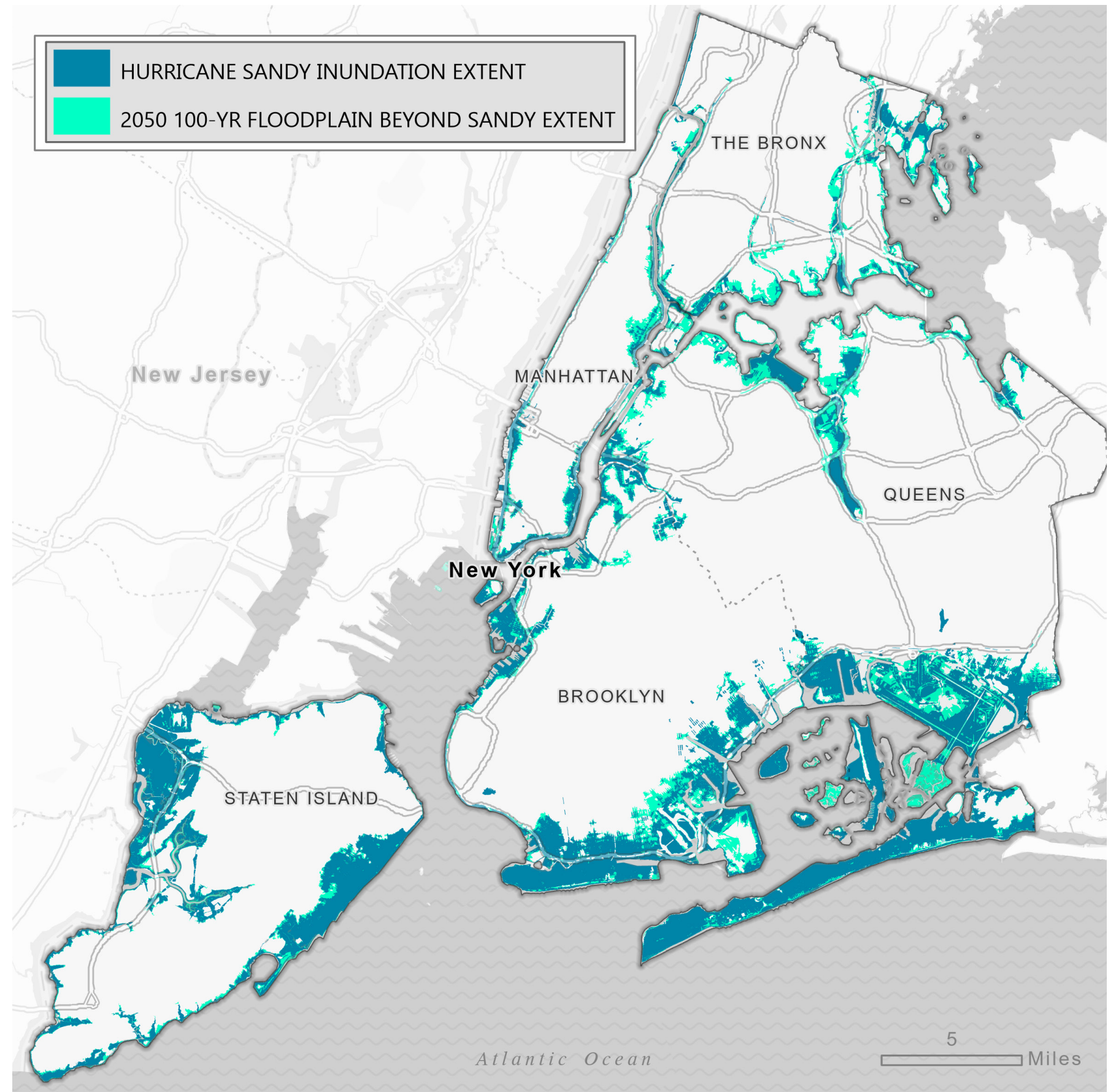
Reconstruction and improvements to the damaged NYCHA buildings was slow to begin and was far behind schedule by 2019 (Aponte and Smith, 2019). Of the roughly 150,000 households that registered for assistance from FEMA after the storm, 55.4% were renters, and two-thirds of these renters made less than \$30,000 a year (Furman Center, 2013). And while Sandy spurred the City into action – \$4 billion of seawalls and coastal barriers that were planned in the aftermath of the storm are now underway, or will begin soon (Kessinger, 2022) – many vulnerable Crisis areas remain unprotected.

Lessons learned from Hurricane Sandy can help the City map a road to adaptation for future, potentially more severe, events. Figure 4 shows how the NPCC3's estimate of the 2050 100-year floodplain used in our analysis compares to the inundation extent of Hurricane Sandy. The 2050 floodplain extends much further inland and affects even more residential areas. Given the lasting impacts Hurricane Sandy had on New York City, especially its vulnerable populations, an event affecting even more of the city could have irreversible consequences on the city's population.

FIGURE 4. Hurricane Sandy inundation extent compared to the NPCC3 2050 estimated 100-year floodplain.

DATA SOURCE: FEMA, NPCC, NYC OPENDATA, ESRI, HERE, GARMIN, SAFEGRAPH, FAO, METI/NASA, EPA, NPS

HURRICANE SANDY FLOOD INUNDATION



TIME TO RETREAT?

While disaster-related funding has been and remains focused on rebuilding and recovery, in recent years, particularly in the aftermath of Hurricanes Sandy and Ida, it has become clearer that communities will demand politicians use “retreat” as one of the tools to adapt to climate change (Feldman, 2022). Ideally, preparation for retreat is rooted in the needs of low-lying and waterfront communities and starts well in advance of the actual relocation so that decisions about investment and equity can be made with foresight. After Sandy, the New York State Governor’s Office of Storm Recovery (GOSR) facilitated coastal retreat by purchasing 612 flood-prone properties (Kashiwagi, 2019). The State further incentivized homeowners to work together in this decision by offering residents a 10% incentive above the pre-storm price if a large majority of their neighbors also participated, and an additional five percent if they were to relocate within New York City’s five boroughs (Spidalieri and Smith, 2020).

Ocean Breeze and Midland Beach who wanted to be bought out, but the government chose to instead repair and rebuild in the same location (Associated Press, 2013).

The lessons learned from the GOSR’s buyout program thus far can inform future buyout programs; however, due to the cost, the program as designed would be very difficult for the State to implement at large scale. Furthermore, since the program has involved relatively few buyouts thus far, it has not incorporated the creation of significant new housing opportunities inland for those who move, nor a way to ensure that the retreating residents do not displace

A majority of the homes purchased as a part of the buyouts program thus far were located in the low-lying Staten Island community of Oakwood Beach, classified as Emigrating in our analysis. After the total destruction of many of their homes during Hurricane Sandy, the residents of Oakwood Beach were finally ready for widespread buyouts. At least 185 homeowners in Oakwood Beach took advantage of the program to have their properties purchased from the State at their appraised pre-storm value.

While the Staten Island buyout program has been considered successful for most of the homeowners who participated, it did not provide funding for or create a long-term management plan for the post-buyout land, leaving that area vacant without a productive social or ecological use and some participants dissatisfied (Shailer, 2022). Furthermore, there were additional homeowners across Staten Island in neighborhoods such as

THE ROAD AHEAD

The New York City Displacement Map and analysis presented here illustrate a grave situation in the absence of intervention to help both coastal and inland communities adapt to a new climate future. How the City chooses to adapt could be a life or death situation for the most physically and socially vulnerable.

New York City must invest massively in infrastructure to protect shoreline communities to reduce the number of households that will be in CRISIS or EMIGRATING areas. In some places, coastal protection will not be feasible and communities will have to move. The City must therefore create a predictable, community-informed buyout program informed by the people most at risk with a prioritization for CRISIS community members. This program must be coupled with the input of inland communities, as well as the planning and creation

of new affordable housing in inland neighborhoods to ensure these Destination areas do not see widespread displacement.

The year 2023 brings an unprecedented opportunity. Grounded in the research and analysis Rebuild by Design published in 2019 highlighting the need for resilient infrastructure investments, New York State voters passed a \$4.2 billion Environmental Bond Act in the November 2022 election. This program includes \$250 million for voluntary buyouts, yet, New York State has no existing program to inform this work.

The design of a government-led retreat program must prioritize those who need financial and planning assistance, create affordable housing options so that all New Yorkers can continue to remain in the city, and include collaborations with



IMAGE: Understanding the impact of Hurricane sandy from NYCHA Leaders on the Lower East Side of Manhattan. | Rebuild by Design

local community organizations who understand the residents' specific needs the most. Land use decisions about where and how to accommodate moving populations and what to do with the abandoned land are critical to any government-led retreat program. To stem the risk of displacement, the program must include making space in inland communities to provide affordable options to those who have to move by investing in thousands of affordable units on higher ground. Additionally, the social implications of breaking up tightly knit communities must be considered and residents should be given a choice to relocate near one

another, maintaining community networks and social infrastructure. Lastly, more research is needed on the physical impact of the population movement on critical services and infrastructure, such as schools, medical facilities, transportation, the power grid, and the sewer system to ensure that inland communities are ready for the increased population. We must plan for climate migration, before it becomes a crisis. The time to begin making space for our neighbors is now.

RECOMMENDATIONS

The development of a voluntary, government-led, predictable retreat program that is informed by the people most at risk with a prioritization for CRISIS community members. This program must be coupled with the input of inland communities, as well as the planning and creation of new affordable housing in inland neighborhoods to ensure these DESTINATION areas do not see widespread displacement.

The planning and creation of affordable housing options focused in inland neighborhoods so that all New Yorkers can continue to remain in the city. Meaningful collaboration with local community organizations who understand the residents' specific needs and can act as a trustful partner when working with the local community.

Address the social implications of breaking up tightly knit communities and, where possible, give residents a choice to relocate near one another, maintaining community networks and social infrastructure.

Plan for the impact on critical services and physical infrastructure, such as schools, medical facilities, transportation, the power grid, and the sewer system for both the CRISIS and DESTINATION communities to ensure that government services are ready for increased populations and are ready for the increased and decreased populations.

WE

WANT

TO WORK

WITH YOU!

REBUILD BY DESIGN PARTNERS WITH COMMUNITIES TO DESIGN REGIONAL AND LOCAL PROCESSES THAT CREATE AND IMPLEMENT INFRASTRUCTURE POLICY AND PROJECTS TO PREPARE COMMUNITIES FOR THE WORLD'S MOST PRESSING PROBLEMS.

WE RESEARCH, DEVELOP POLICY, AND EDUCATE THE NEXT GENERATION OF RESILIENCE PRACTITIONERS. DO YOU HAVE A VEXING CHALLENGE THAT NEEDS CREATIVE PROBLEM SOLVING? CONTACT US AT INFO@REBUILDBYDESIGN.ORG CONTACT US AT INFO@REBUILDBYDESIGN.ORG

CITATIONS

Associated Press, "After Sandy, Only a Few Getting Buyouts," Oct. 2013, web. <https://www.nbcnewyork.com/news/local/sandy-buyouts-staten-island/1988854/>

Aponte, Claudia I. and Greg B. Smith, "NYCHA's Post-Sandy Rebuild Mired in Delays and Dubious Contracts," The City, Oct. 2019, web. <https://www.thecity.nyc/special-report/2019/10/29/21210733/nycha-s-post-sandy-rebuild-mired-in-delays-and-dubious-contracts>

Buchanan, M. K., S. Kulp, L. Cushing, R. Morello-Frosch, T. Nedwick, and B. Strauss, "Sea level rise and coastal flooding threaten affordable housing," Environment Research Letters, vol. 15, no. 12, 2020, <https://iopscience.iop.org/article/10.1088/1748-9326/abb266>

Calvan, Bobby C., "Supersorm Sandy legacy: Recovery far from equal on NY shore," AP News, Oct. 2022, web. <https://apnews.com/article/superstorm-sandy-disparities-042c69728c10e92837360b8b31704eac>

Cohen, Ilana, "In New York City, 'Managed Retreat' Has Become a Grim Reality," Inside Climate News, July 2020, web. <https://insideclimatenews.org/news/04072020/new-york-city-managed-retreat-sea-level-rise/>

David, Greg, "Jobs Grow – Along with the Pandemic Gap Between Rich and Poor New Yorkers," The City, Nov 2021, web. <http://www.thecity.nyc/2021/11/18/22790303/jobs-grow-in-nyc-but-widening-gap-between-rich-and-poor>

EPA, "Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts," Sept 2021, EPA 430-R-21-003. <http://www.epa.gov/cira/social-vulnerability-report>

Evans, David D. and Larry Baeder, "Estimating undisclosed flood risk in real estate transactions," Milliman, Aug. 2022, web. http://www.milliman.com/en/insight/Estimating-undisclosed-flood-risk-in-real-estate-transactions?mc_cid=f31ac23e15&mc_eid=c18049b784

Feldman, Ari Ephraim, "Conversations about coastal buyouts set to begin again – a decade after Sandy," NY1, Oct. 2022a, web. <https://www.ny1.com/nyc/all-boroughs/news/2022/10/27/conversations-about-coastal-buyouts-set-to-begin-again---a-decade-after-sandy>

Flores, A., T. Collins, S. Grineski, and J. Chakraborty, "Disparities in Health Effects and Access to Health Care Among Houston Area Residents After Hurricane Harvey," PubMed, vol. 135, no. 4, 2020, p. 511-523, doi. [org/10.1177/0033354920930133](https://doi.org/10.1177/0033354920930133)

Foster, S., R. Leichenk, K. H. Nguyen, R. Blake, H. Kunreuther, M. Madajewicz, E. Petkova, R. Zimmerman, C. Corbin-Mark, E. Yeampierre, A. Tovar, C. Herrera, D. Ravenborg, "Chapter 6: Community-Based Assessments of Adaptation and Equity," in New York City Panel on Climate Change 2019 Report, Annals of the New York Academy of Sciences, vol. 1439, is. 1, 2019, p. 126-173. doi. [org/10.1111/nyas.14009](https://doi.org/10.1111/nyas.14009)

Furman Center, "Sandy's Effects on Housing in New York City," March 2013, web. <https://furmancenter.org/files/publications/SandysEffectsOnHousingInNYC.pdf>

Herrerros-Cantis, P., V. Olivotto, Z. J. Grabowski, and T. McPhearson, "Shifting landscapes of coastal flood risk: environmental (in)justice of urban change, sea level rise, and differential vulnerability in New York City," Urban Transformations, vol. 2, no. 9, 2020, doi. [org/10.1186/s42854-020-00014-w](https://doi.org/10.1186/s42854-020-00014-w)

Howell, Junia and James Elliott, "Damages Done: The Longitudinal Impacts of Natural Hazards on Wealth Inequality in the United States," Social Problems, vol. 66, no. 3, Aug 2019, p. 448-467, doi. [org/10.1093/socpro/spy016](https://doi.org/10.1093/socpro/spy016).

Internal Displacement Monitoring Center "Disaster events 2008-2021 (internal displacement) per hazard type", web. https://api.idmcdb.org/api/disaster_data/xlsx?year=2008&year=2021&range=true&ci=IDMCWSHSOLO009&filename=IDMC_Internal_Displacement_Disasters_Events_2008_2021.xlsx

Islam, Nazrul and John Winkel, "Climate Change and Social Inequality," UN Department of Economic and Social Affairs, Oct. 2017, web. http://www.un.org/esa/desa/papers/2017/wp152_2017.pdf

Kashiwagi, Sydney, "State purchased hundreds of Sandy devastated homes on Island, but one homeowner still in limbo," SI Live, Oct. 2019, web. <http://www.silive.com/news/2019/10/state-purchased-hundreds-of-sandy-devastated-homes-on-island-but-one-homeowner-still-in-limbo.html>

Kessinger, Nathan, "Now and then: A photographic look at how Hurricane Sandy transformed New York City," Gothamist, Oct. 2022, web. <https://gothamist.com/news/now-and-then-a-photographic-look-at-how-hurricane-sandy-transformed-new-york-city>

Maldonado, Samantha, "Ida-Deluged NYC Drainage System All But Forgotten in Climate Battle," The City, Sep 21, web. <https://www.thecity.nyc/2021/9/3/22656414/ida-deluged-nyc-drainage-system-neglected-climate>

NYC Department of City Planning, "Chapter 2: Profile of NYC Buildings in the Floodplain," in Retrofitting Buildings for Flood Risk, Oct. 2018, web. www1.nyc.gov/assets/planning/download/pdf/plans-studies/retrofitting-buildings/retrofitting_chapter2.pdf

NYS Assembly Bill A7876A, 2021, <http://www.nysenate.gov/legislation/bills/2021/A7876>

Office of the New York City Comptroller Brad Lander, "Ten Years After Sandy: Barriers to Resilience," Bureau of Policy and Research, Oct. 2022, web. <https://comptroller.nyc.gov/reports/ten-years-after-sandy/>

Ortega, F. and S. Taspinar, "Rising Sea Levels and Sinking Property Values: The Effects of Hurricane Sandy on New York's Housing Market," SSRN, Oct. 2018, doi. [org/10.2139/ssrn.3074762](https://doi.org/10.2139/ssrn.3074762).

Patrick, L., W. Solecki, V. Gornitz, P. Orton, and A. Blumberg, "Chapter 5: Mapping Climate Risk" in New York City Panel on Climate Change 2019 Report, Annals of the New York Academy of Sciences, Mar 2019, p. 115-125, doi. [org/10.1111/nyas.14015](https://doi.org/10.1111/nyas.14015)

Rebuild by Design, "Who lives in NYC's floodplain?" 2020, web. rebuildbydesign.org/who-lives-in-nycs-floodplain/

Rose, D., J. N. Bodor, J. C. Rise, C. M. Swalm, and P. L. Hutchinson, "The Effects of Hurricane Katrina on Food Access Disparities in New Orleans," National Library of Medicine, vol. 101, no. 3, March 2011, p. 482-484, doi. [org/10.2105/AJPH.2010.196659](https://doi.org/10.2105/AJPH.2010.196659)

Rush, Elizabeth, "The Storm That Will Be: Protecting Public Housing in the New 100-Year Floodplain," Urban Omnibus, Oct. 2014, web. <https://urbanomnibus.net/2014/10/the-storm-that-will-be-protecting-public-housing-in-the-new-100-year-floodplain/>

Shailer, Leslie, "'They Lied to All of Us': Ten Years After Hurricane Sandy, Construction Begins on Staten Island's Promised Wetland", New York Focus, Oct. 2022, web. <https://www.nysfocus.com/2022/10/29/hurricane-sandy-oakwood-beach-buyout/>

Smith, Rachel H., "NYC Apartment Vacancy Rate Jumps Up, But 'Housing Emergency' Status Survives," The City, May 2022, web. <http://www.thecity.nyc/2022/5/17/23108792/nyc-apartment-vacancy-rate-housing-emergency>

Spidalieri, Katie and Isabelle Smith, "Managing the Retreat from Rising Seas," Georgetown Climate Center, 2020, web. http://www.georgetownclimate.org/files/MRT/GCC_20_Oakwood-4web.pdf

Staletovich, J., N. Underwood, J. Jeffrey-Wilensky, R. Misdary, J. Fenston, "These hurricane flood maps reveal the climate future for Miami, NYC and D.C.," NPR, July 2022, web. <http://www.npr.org/2022/07/28/1107518744/nyc-miami-dc-climate-change-flooding>

U.S. Census Bureau, "Poverty Thresholds by Size of Family and Number of Children," web. <https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html>