Hunts Point Resiliency

Feasibility Study

2016 – 2019

HDR · NYC Mayor's Office of Resiliency · NYC/EDC

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Chapter 1. **Introduction**

In October 2012, Hurricane Sandy hit New York City, flooding 17 percent of the city's land, claiming 44 lives, damaging over 69,000 residential units, and causing $19 billion in damages and lost economic activity. The hurricane caused power outages across the city that impacted over 2 million New Yorkers, with some experiencing outages that lasted for weeks or longer. While Hunts Point was largely spared during Hurricane Sandy due to the timing of the tides in this area of New York City, the storm highlighted the vulnerabilities of New York's waterfront neighborhoods to the growing impacts of climate change, especially for neighborhoods like Hunts Point with unique vulnerabilities. Hunts Point is home to a community of over 12,000 residents, as well as the Hunts Point Food Distribution Center (FDC), one of the largest wholesale food distribution centers in the world.

Following Hurricane Sandy, multiple levels of government worked collaboratively with the private sector and communities across the city to plan for a more resilient future. The federal government's *Rebuild by Design* competition brought together community groups and private sector engineers, designers, and architects to propose innovative resiliency solutions. Through this process, the Hunts Point community developed a proposal that recommended $1 billion worth of projects in the area, including a micro-grid for energy resiliency. After reviewing the proposal, the Department of Housing and Urban Development (HUD), through *Rebuild by Design*, subsequently allocated $20 million for the City to work with the local community to study and plan for climate risks in Hunts Point and to advance a pilot project into implementation. The City is supplementing this funding with additional Community Development Block Grant Disaster Recovery (CDGB-DR) and City Capital funds to bring the total project budget to $71 million.

After receiving the federal award, the New York City Economic Development Corporation (NYCEDC) and Mayor's Office of Resiliency (MOR) formed the Hunts Point Advisory Working Group (AWG) in 2015. Comprised of a diverse set of community and business stakeholders, the AWG recommended the City pursue a project focused on energy resiliency and flood risk reduction to achieve the following goals:

- Address critical vulnerabilities for both community and industry;
- Protect important citywide infrastructure during emergencies, such as a major flood;
- Protect existing and future industrial businesses and jobs;
- Support the community's social, economic, and environmental assets;
- Use sustainable, ecologically sensitive infrastructure.

The following year the Hunts Point Resiliency Feasibility Study (the Study or Feasibility Study) was launched to further assess energy resiliency and flood risk reduction options, and to select a preferred project to advance into conceptual design, environmental review, and permitting. To carry out this work, the City brought on a Consultant Team led by HDR (see Appendix C for a full list of the Consultant Team). The AWG continued to work closely with the City throughout the Feasibility Study to develop resiliency priorities, review consultant analysis and findings, and provide input on project design.

The Feasibility Study and conceptual design phase of the project concluded at the end of 2019. Based on community priorities identified by the advisory working group, the City put forth recommendations for energy resiliency and flood risk reduction and selected an energy resiliency project to advance into final design.

Climate resiliency requires a multi-layered approach. The City is committed to working closely with the community as final design advances for the energy resiliency project, and to continue to identify projects, programs, and approaches that can be used to better prepare Hunts Point for the impacts of climate change.

Study Area

The study area includes the Hunts Point peninsula, which is bounded by the Bruckner Expressway to the west and north, the Bronx River to the east, and the East River to the south (Figure 1). The peninsula includes three distinct areas: the residential core, the industrial area, and the Food Distribution Center (FDC).

Figure 1. **Hunts Point Study Area**

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The Hunts Point neighborhood is home to both a vibrant residential community and thriving industrial hub. There are over 12,000 residents and 18,000 workers in this 690-acre peninsula. The community is economically vulnerable as the poverty rate is more than double the rate of the New York City average[1] and the median household income is less than half[2]. The peninsula is also home to the Hunts Point FDC, one of the largest food distribution centers in the world. The FDC is an important food supplier for New

[1] Income in the Past 12 Months Below the Poverty Level, 2014-2018 American Community Survey, U.S. Census Bureau's American Community Survey Office

[2] Income and Benefits, 2014-2018 American Community Survey, U.S. Census Bureau's American Community Survey Office

York City and the region, distributing 4.5 billion pounds of food annually and employing over 8,500 workers. The FDC was established in the 1960s to transform the Hunts Point industrial area into a centralized food hub, taking advantage of the peninsula's accessibility to both the city and the region. Today, the FDC provides 12 percent of the city's overall food supply, according to the Five Borough Food Flow study conducted by NYCEDC in 2016 in response to Hurricane Sandy[3]. It is also an important economic center as it provides good paying jobs today and into the future.

Engagement Process

Hunts Point Resiliency engagement was designed and facilitated to ensure a transparent process that considered local stakeholder priorities and expertise in the decision-making process. Engagement strategies aimed to foster a shared understanding of the technical, legal, and financial aspects of the evaluation process and to ensure a diversity of voices were heard, including those who are usually marginalized from these processes.

To achieve the engagement goals as set forth above, a nested structure of teams was put into place. The teams, as well as the public process, were carried out as follows:

- **Advisory Working Group:** The AWG is composed of representatives from local elected officials, non-profit community groups, businesses, the New York City Economic Development Corporation, the Mayor's Office of Resiliency, and other city agencies. The AWG provided strategic input into key technical deliverables to inform the City's selection of a preferred resiliency project. The AWG also developed a set of Implementation Principles for the City to incorporate throughout the Hunts Point Resiliency process and project implementation. The AWG's Implementation Principles are:
    - Leadership Development – Embedded in any project there should be some intention around who will carry the work forward in the future, including considerations of leadership training opportunities.
    - Emergency Preparedness – Leverage these kinds of opportunities to build human capital and help people grow their skills along with the infrastructure in the direction of preparedness for future events.
    - Sustainability – Utilize sustainable, ecologically-sensitive materials, soft infrastructure over hard, and renewable, clean energy. The project should not increase the burden on the health and physical well-being of the Hunts Point community.
    - Leverageable – Prioritize projects that will draw additional investment from City, State, Federal, and other interested parties.
    - Stakeholder Participation in an Ongoing Way – AWG engagement should not end "when the shovel goes in the ground." There has to be an ongoing sense of accountability and participation from key stakeholders from the community and industry, including this AWG.

[3] Five Borough Food Flow – 2016 New York City Distribution and Resiliency Study Results (https://www1.nyc.gov/assets/foodpolicy/downloads/pdf/2016_food_supply_resiliency_study_results.pdf)

    - Transparency and Coordination – Keep AWG members aware of future capital investments on the horizon, making budgetary information as transparent as possible on an ongoing basis.
    - Local Procurement - Make sure money invested in these kinds of projects by the government circulates in the South Bronx (local goods, labor, and services).
    - Local Hiring and Training – Leverage this process and project to ensure that people who are ready to enter the workforce can learn and find jobs.
    - High Road Economic Development Project – Union jobs, prevailing wage, reward people for their efforts and the sweat of their brow. Any jobs related to these projects should be living wage jobs.
    - Multiple Benefits – Projects should be of broad benefit, for example serving needs and interests of both business and community and/or providing protection against major climate events, while also providing everyday benefit.
    - Ongoing Mechanism for Translation of Terms/Categories/Concepts – Everyone in the room should have enough information to participate. Make sure everyone understands what is being discussed.
- **Engagement Strategy Team:** The Engagement Strategy Team consisted of 12 individuals, including representatives of the AWG and a variety of community representatives with relationships to individuals and organizations in the Hunts Point community. Collectively they provided advice to ensure robust engagement throughout the Hunts Point Resiliency process, including ways to make public meetings more accessible to community members.
- **Neighborhood Outreach Team:** The Neighborhood Outreach Team was composed of 10 residents from the Hunts Point community who conducted extensive and targeted outreach and education activities to gather and amplify public voices at the neighborhood level. The Outreach Team considered which groups and residents were most marginalized or disengaged in the community and/or those who would most benefit from engagement, and then strategized on how to engage them and best practices for outreach. Collectively, the Outreach Team tabled at events, flyered within the neighborhood to advertise public meetings, and helped to construct and disseminate a survey around emergency preparedness. Individually, team members also completed media projects, including a series of podcasts and a video.
- **Public Meetings:** Open to any member of the public, and especially targeted to those who live and work in Hunts Point, a series of public meetings were convened to share project related information and gather public feedback relative to key decision points around project deliverables.

Hunts Point Resiliency went through several cycles of engagement, each focused on a different aspect of the technical analysis. Each cycle generally began with a meeting of the AWG, followed by on-the-ground engagement activities by the Neighborhood Outreach Team, and finally a public meeting. Throughout the project, the Engagement Strategy Team met with the Consultant Team to advise on the engagement process, and the Outreach Team met regularly to prepare for and debrief on their activities. Over the three-year duration of the project, 17 meetings were convened with different stakeholder teams and the public.

Extensive efforts were made to ensure that information provided at these meetings was accessible to the public and sufficient time was given for both clarifying discussion and gathering input. Regular updates to the project website also ensured that meeting presentations and summaries were available.
Through this process, the Hunts Point community was involved in every step of the analysis and recommendations, as well as the selection of the energy resiliency project for implementation.

Study Methodology

The approach used for the Feasibility Study was developed to understand the risks specific to Hunts Point, as well as the trade-offs of different resiliency approaches. It was developed based on the project goals, community engagement process, and HUD requirements for grant funded projects.

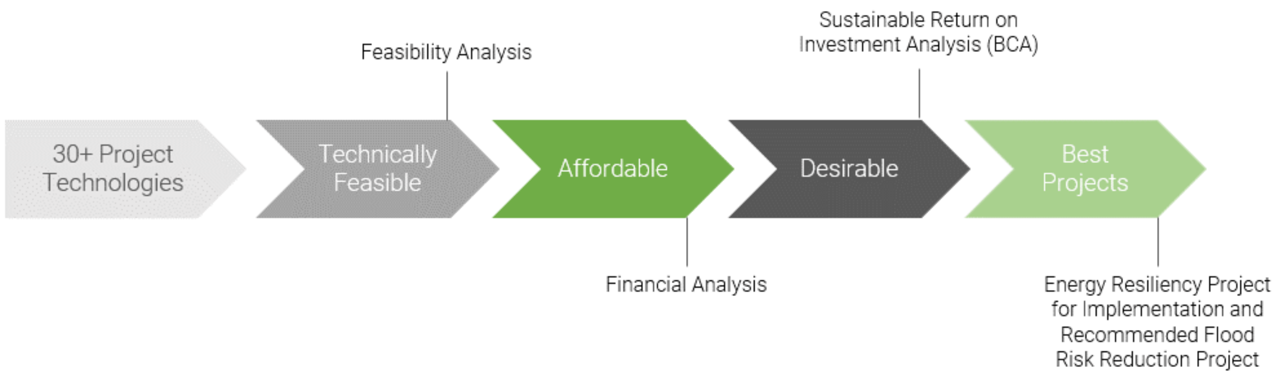
The Consultant Team began with a thorough study of existing conditions within the Hunts Point peninsula, including identifying a list of 36 critical facilities in the residential area, industrial area, and Food Distribution Center (see Appendix A for a full list of facilities). The team then conducted a comprehensive climate risk and vulnerability assessment for these critical facilities using the most recent New York City Panel on Climate Change (NPCC) data. Looking across a range of potential future events, the team assessed threats from sea level rise, coastal storm surge, extreme precipitation, extreme heat, and power outages.

To analyze the threat for each facility, the team assessed the likelihood of an event occurring, as well as the anticipated consequences of that event on each facility. Likelihood scores were identified based on the best available data on the probability of an event occurring, while consequence scores were developed considering factors such as facility operations and costs, direct community impacts, public health, and overall economic impacts. A more detailed description of the methodology for the risk and vulnerability assessment can be found in Chapter Two of this report.

After determining the most vulnerable facilities in Hunts Point, the team then analyzed a suite of technologies for potential energy resiliency and flood risk reduction projects. Project options were assessed through multiple lenses of engineering, environmental, regulatory, and financial feasibility, as well as consistency with the AWG's Implementation Principles. A key piece of the assessment was applying federal funding requirements, which included ensuring that any project advanced resiliency, had independent utility, and was financially feasible. The team also undertook a benefit-cost analysis following federal funding guidelines, to understand how resiliency, social, environmental, and economic benefits for different options compared to the total costs over the life of the project.

Lastly, the Consultant Team developed recommendations for an energy resiliency project to advance into implementation and flood risk reduction projects for future consideration. These projects aim to address Hunts Point's unique risks and vulnerabilities and were guided by the AWG's Implementation Principles, federal funding guidelines, and project feasibility.

Figure 2. **Project Selection Process**



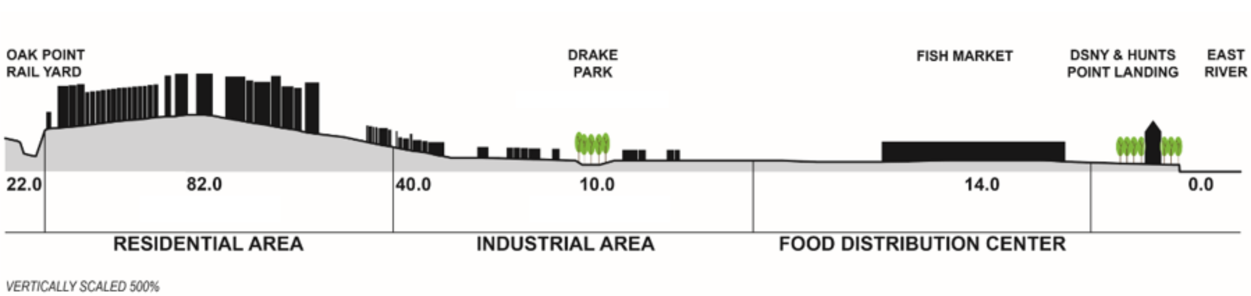
Study Findings & Recommendations

Driven by the robust climate risk and vulnerability assessment completed for Hunts Point, this Study found that different areas of the peninsula face different threats. The peninsula's residential areas are at a considerably higher elevation out of the floodplain and therefore not at risk from coastal storm surge (Figure 3). For this reason, the most acute risk for the residential portion of the neighborhood is from power outages at critical community facilities.

The low-lying industrial areas, where the Food Distribution Center is located, face risks from both storm surge and power outages. While the flood plain extends over most of the FDC, this Study found that many of the industrial buildings are already elevated and face limited vulnerability from a coastal storm surge. Three critical facilities in the FDC were found to be most vulnerable to coastal flooding – 355, 400 and 600 Food Center Drive — while the facilities most vulnerable to power outages were 100, 355, and 800 Food Center Drive.

Outside of the FDC, the Hunts Point Wastewater Treatment Plant and Hunts Point Railyard were found to be most vulnerable to storm surge, while the Vernon C. Bain Correctional Facility and certain roads and electrical infrastructure were found to be vulnerable to both storm surge and power outages.

Figure 3. **Elevations Across Different Areas of Hunts Point**



While the industrial and residential areas share threats from power outages, the consequences of any outages would be very different in each area. For facilities in the industrial area, power outages may mean employment disruptions and loss of revenue, as well as loss of critical food supply for refrigerated facilities in the FDC. In the residential area, power outages have the potential to cause a loss of refrigeration, home life support systems, air conditioning, and safe refuge during a heatwave, as well as disruptions to operations at schools and community facilities. A summary of the threats found to critical facilities is below in table one and described in further detail in Chapter Two of this report.

Table 1. **Summary of Threats to Critical Facilities**

Facility Threat	Future Threats
Food Distribution Center	
100 Food Center Drive	Outage, Heat
355 Food Center Drive	Outage, Surge, Heat
800 Food Center Drive	Outage, Heat
600 Food Center Drive	Surge
400 Food Center Drive	Surge
Community Facilities	
Hunts Point Recreation Center	Outage, Heat
Pio Mendez Housing for the Elderly	Outage
Primary School (PS) 48	Outage, Heat
Middle School (MS) 424	Outage, Heat
Infrastructure and Other Facilities	
Hunts Point Wastewater Treatment Plant	Surge
Oak Point Railyard	Surge
Vernon C. Bain Correctional Facility	Surge, Heat
Certain Road Intersections	Surge, Outage
Certain Electrical Transformers	Surge, Outage

Based on this comprehensive risk and vulnerability assessment and community priorities identified by the AWG, the City, in consultation with the community, recommended the HUD funding go towards advancing an energy resiliency project to address the vulnerability of both critical industrial and community facilities in Hunts Point.

The recommended energy resiliency project would provide substantial resiliency benefits by providing reliable, dispatchable, sustainable, and flood resilient power to Hunts Point through a combination of energy generation, solar, and storage solutions. Further, energy resiliency is uniquely able to mitigate against a broad range of climate threats from coastal storm flooding to heat waves and power outages.

To further address coastal storm flooding impacts, the Consultant Team recommended advocating for future funding for additional building-level resiliency measures to respond to the targeted flood risks at facilities vulnerable to storm surge. The City also carefully analyzed the potential for a floodwall given a strong community desire for this option. However, the City did not ultimately recommend this option as it was not found to best respond to the localized flood risks to Hunts Point facilities. Further, an areawide floodwall would face significant implementation challenges, which are further outlined in Chapter 5 of this report.

The City will continue to collaborate closely with the community, using the latest climate science, to understand the range of climate threats Hunts Point faces and how those risks can be mitigated over time.

Chapter 2. **Climate Risk and Vulnerability Assessment**

Climate Threat Definitions

This Study examined a wide range of climate hazards. Climate hazards include climate events, which are single and isolated occurrences, and chronic conditions, which happen on a continuing basis.

Chronic Conditions

Sea Level Rise – Refers to the increase in sea level caused by a change in the volume of the world's oceans due to temperature increase and the melting of glaciers.

Tidal Inundation – An impact of sea level rise. Tidal inundation refers to the regular, persistent impacts from a higher tide on a coastal area.

Acute Climate Events

Coastal Storm Surge – Refers to the temporary increase in the height of the sea at a location, due to extreme meteorological conditions, often a coastal storm such a hurricane or nor'easter. The storm surge is defined as being the excess above the level expected from tidal variation alone at that time and place.

Extreme Precipitation – Extreme precipitation is defined in this report as 10-year and 50-year storms today and in 2100. Extreme precipitation events can overwhelm stormwater management systems and lead to Combined Sewer Overflow (CSO) events. CSOs occur when the volume of water exceeds the combined sewer system's capacity, leading to the discharge of combined rainwater and sewer water into local waterways.

Heat Waves – A heat wave is a period of three consecutive days with maximum temperatures at or above 90º F. Heat waves are exacerbated by the urban heat island (UHI) effect, which is the tendency for higher air temperatures to persist in urban areas because of buildings and asphalt absorbing and emitting heat. A relative lack of vegetation, dark rooftops, dense human activity, and waste heat also contribute to the UHI effect. This effect tends to make cities hotter than surrounding suburban and rural areas.

Power Outages – Building-level infrastructure outages are caused by flood events, extreme heat, failure of local Con Edison feeder or equipment, local building-level equipment failures (transformers, switches, cabling) due to equipment condition, or local building-level equipment failures due to power quality variances. System-wide infrastructure outages are caused by generation facility failures, or network distribution system failures.

Risk & Vulnerability Assessment Methodology

The Study used projections from *Building the Knowledge Base for Climate Resiliency: New York City Panel on Climate Change (NPCC) 2015 Report*, which are reaffirmed in the 2019 NPCC report update, to assess Hunts Point's vulnerability to a range of climate threats. The NPCC is an independent body of climate experts that provides up-to-date scientific information and advises the City on climate risks and resilience. The NPCC provides projections for varying timeframes given available science for different risks. Due to the availability of data, the Study, used different timeframes for different risks.

The Study used the high-end 90th percentile 2050s projections for sea level rise and storm surge, which is higher than what is considered likely by mid-century. The 2050s 90th percentile projections are equivalent to the likely level of sea level rise for 2100. To assess extreme heat in the future, NPCC projections for 2080 were used. For extreme precipitation, the Study used NPCC projections for 10-year (10 percent chance of happening in a given year) and 50-year storms (2 percent chance of happening in a given year) for the present day and 2100.

Table 2. **Modeling and Data Source Used for Each Climate Threat Category**

Climate Threat Category	Modeling	Data Source
Sea Level Rise	2050s tidal inundation	NPCC, 2015*
Coastal Storm Surge	2050s 10-, 50-, 100-year coastal storm surge	FEMA; NPCC, 2015*
Extreme Precipitation	10-year Existing Storm, 10-year 2100 Storm, 50-year Existing Storm, 50-year 2100 Storm	NPCC, 2015*; Additional Modeling
Heat Waves	2080	NPCC, 2015*

* 90th percentile projections, reaffirmed in the 2019 NPCC Report

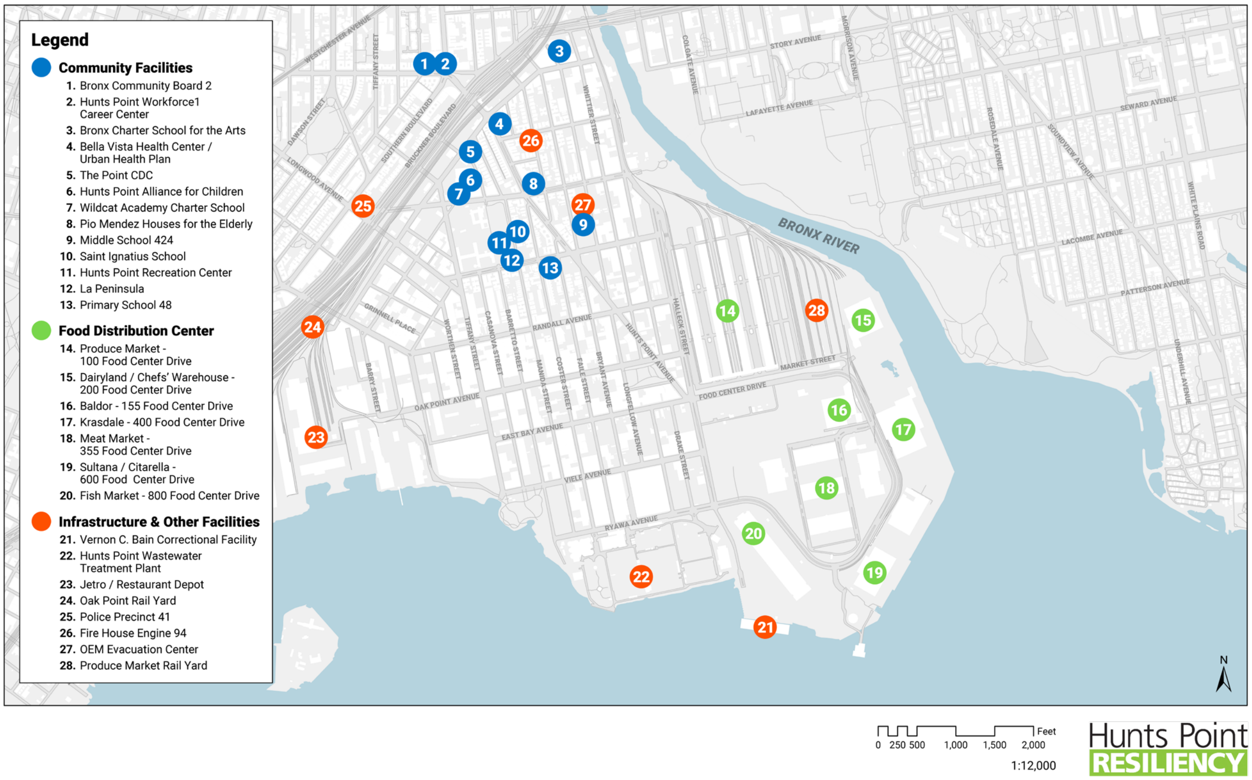
The likelihood of power outages were estimated by examining a range of causes and actual service disruptions experienced in the NYC region plus estimates for conditions in 2050. Assumptions for this analysis can be found in Appendix E.

For the Study, a multiple threat assessment was conducted using procedures established by the Federal Emergency Management Agency (FEMA) and building on the work of the United States National Institute of Standards and Technology. The Consultant Team's assessment process was also informed by Risk Informed Decision Making (RIDM) and Potential Failure Mode Analysis (PFMA) techniques.

The Study identified critical facilities in Hunts Point necessary to provide citywide and regional food distribution and community-level services, as displayed in Figure 4. A table of all critical facilities is also included in Appendix A of this study. Critical facilities include facilities related to:

- Food supply chain;
- Emergency response centers and communications systems;
- Emergency response access and transportation routes;
- Community-based organizations offering services, information capacity, and resiliency planning;
- Health service organizations;
- Workforce development services;
- Wastewater treatment plants; and
- Energy distribution systems.

Figure 4. **Map of Critical Facilities in Hunts Point**



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In order to determine the vulnerability of each critical facility to the range of threats, the Study determined the likelihood of a threat occurring (Table 3) and the consequences of that threat (Table 4), and then multiplied these two factors to come up with a vulnerability score. For coastal storm surge, the depth of flooding was also considered in determining a consequence score.

Table 3. **Likelihood Scale Descriptions (Threat-Specific)**

Score	Likelihood	Storm Surge	Precipitation	Heat	Outage
5	Almost Certain	**50% to 100%** chance of occurring within a given year	Maximum potential flooding due to rainfall that results in **some ponding** of runoff on site, typically on an annual basis	A prolonged heat wave will occur **several times a year**	Building level outage that occurs at least **once every year**, function of significant age, poor condition, or complexity of building equipment
4	Likely	**5% to 49%** chance of occurring within a given year	Maximum potential flooding due to rainfall that results in ponding depths **up to 1 foot**	A prolonged heat wave will occur once or **twice a year**	Building level outage that occurs every **1 to 2 years,** no backup generation, aged equipment, and complex electrical configuration
3	Possible	**2% to 4.9%** chance of occurring in a given year	Maximum potential flooding due to rainfall that results in ponding depths **between 1 to 2 feet**	A prolonged heat wave will occur **every other year**	Building level outage that occurs once every **2 to 5** years, no backup generation, moderately complex building level electrical infrastructure

2	Unlikely	**1% to 1.9%** chance of occurring in a given year	Maximum potential flooding due to rainfall that results in ponding depths **between 2 and 3 feet**	A prolonged heat wave will occur every **3-5 years**	Building level outage that occurs every **5 to 10 years**, limited backup generation, mildly complex building level electrical infrastructure
1	Rare	**<1%** chance of occurring in a given year	Maximum potential flooding due to rainfall that results in ponding depths **greater than 3 feet**	A prolonged heat wave will occur every **5 years or more**	Building level outage that occurs every **10 years or more**, simple building electrical infrastructure and/or backup generation

Table 4. **Consequence Scale Descriptions (Applicable to All Threats)**

Score	Consequence	Facility Operations / Costs	Community	Health	Economy
5	Significant	Significant building/content/ infrastructure damages that prevent re-occupation without major re-construction **(> 6 months)**	Significant portion of city / region affected, long-term displacement of significant number of people or entire communities **(> 6 months)**	**Significant** injuries or several fatalities, long term health impacts, widespread and significant hazardous waste releases with exposure	**Significant** impact on NYC's economy across many sectors and geographic areas
4	Substantial	Extensive building/content/ infrastructure damages, repair **(1-6 months)**	Substantial portion of city/region affected, medium to long term displacement of substantial number of people or portions of communities **(1-6 months)**	**Substantial** injuries or any fatalities, long term health impacts, substantial hazardous waste releases	**Substantial** impact on NYC's economy across several sectors and geographic areas
3	Moderate	Building cleanup and minor repairs necessary to building and equipment. Some replacement of contents **(2-4 weeks)**	Entire neighborhood affected, temporary displacement of moderate number of people or portion of a community **(2-4 weeks)**	**Moderate** injuries, short term health impacts, moderate hazardous waste releases with limited exposure	**Moderate** impact on NYC's economy across many sectors and geographic areas
2	Minor	Minor impacts to building, and equipment, some replacement of contents **(1 week)**	Minor number of people affected, temporary displacement of minor number of people, community intact **(1 week)**	**Minor** injuries, short term health impacts	**Minor** impact on NYC's economy in a few sectors or geographic areas

1	Insignificant	Minor impacts to structures, and equipment, no contents damage **(1 day)**	Insignificant number of people affected, community intact **(1 day)**	**Few** injuries	**Insignificant** impact on NYC's economy, limited to a few businesses
0	No Impact	**No** flood damage to structures, contents, or equipment	**No** community effects	**No** injuries / fatalities	**No** impact on NYC's economy or businesses

Summary of Findings

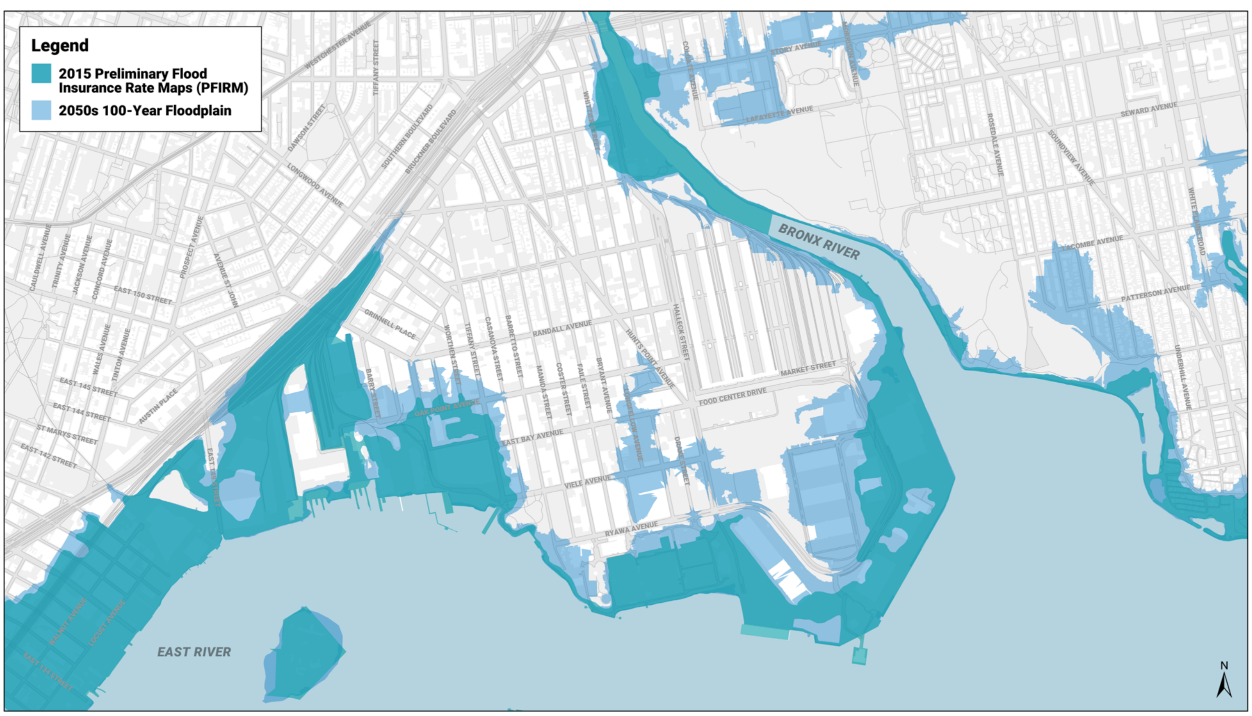
Sea Level Rise and Tidal Inundation

Consistent with other coastal flood risk management studies in the New York City region, the 90th percentile sea level projection in the 2050s, estimated at 2.5 feet, was adopted for this analysis. Sea level rise has minimal impact on the study area in the 2050s and will not result in any substantial daily tidal inundation. Sea level rise was also considered when assessing coastal storm surge in future years.

Coastal Storm Surge

Portions of the FDC and industrial area are vulnerable to coastal storm surge from a 100-year storm today, with risks increasing further in the 2050s. In contrast, the residential portion of the study area is on higher ground and is not vulnerable to storm surge now or in the 2050s (Figure 5).

Figure 5. **100-Year Floodplain in Current and Future Conditions**



0 250 500 1,000 1,500 2,000 Feet
1:12,000

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Sea level rise will increase storm surge heights, making low-lying parts of the industrial area and the FDC more vulnerable to coastal flooding in the future. Many of the buildings in the FDC are elevated and are therefore not vulnerable to flooding from storm surge. For facilities that are not elevated and are at risk of flooding, flood depths from a 100-year storm in current conditions would range between 0.4 and 3.5 feet in the FDC. For the 2050s 100-year storm, flood depths range from 1.5 to 6 feet, with most at-risk facilities in the FDC projected to be subject to less than 3 feet of inundation. Under current conditions, flood depths from a 100-year storm in the industrial area would be approximately 6 feet in targeted locations and reach 8.5 feet in those same locations in the 2050s.

The vulnerability of critical facilities to coastal storm surge was determined by multiplying the likelihood of a coastal storm surge (Table 5) by the consequences flooding would have on that facility. The consequence scores for coastal storm surge were determined by considering both the scale outlined in Table 3 and the depth of flooding (Table 6). Both likelihood and consequence were scored on a scale of 1-5 and vulnerability scores were out of 25.

Table 5. **Scale for Coastal Storm Surge Likelihood Scores**

Score	Likelihood	Quantitative Thresholds
5	Almost Certain	50% to 99% probability
4	Likely	5% to 49.9% probability
3	Possible	2% to 4.9% probability
2	Unlikely	1% to 1.9% probability
1	Rare	<1% probability

Table 6. **Quantitative Thresholds for Coastal Storm Surge Consequence Scores**

Score	Consequence	Quantitative Thresholds
5	Significant	15 feet flooding depth
4	Substantial	> 6 and < 15 feet flooding depth
3	Moderate	> 2 and < 6 feet flooding depth
2	Minor	> 0.5 and < 2 feet flooding depth
1	Insignificant	0.5 feet flooding depth
0	No Impact	No flooding

Of the 36 critical facilities studied, seven were identified as vulnerable to coastal storm surge today and in the future. Table 7 shows the vulnerability scores for these facilities: 355, 400 and 600 Food Center Drive in the Food Distribution Center, as well as Oak Point Railyard, Vernon C. Bain Correctional Facility, Hunts Point Wastewater Treatment Plant, and power distribution facilities in the industrial area.

Table 7. **Vulnerability Scores for Critical Facilities at Risk of Flooding from Coastal Storms**

Critical Facility	Existing (2020) Vulnerability Score			Future (2050) Vulnerability Score		
	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 25)	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 25)
Food Distribution Center						
355 Food Center Drive	3	4	12	4	4	16
400 Food Center Drive	3	3	9	3	3	9
600 Food Center Drive	3	3	9	3	3	9
Infrastructure and Other Facilities						
Hunts Point Wastewater Treatment Plant	3	3	9	3	4	12
Vernon C. Bain Correctional Center	3	3	9	3	3	9
Oak Point Railyard	3	3	9	3	3	9
Power distribution facilities (medium voltage facilities and transformer stations) (11); *several medium voltage facilities or transformers evaluated and determined to be most vulnerable; worst-case shown here with the scores for the Con Edison transformer near 500 Food Center Drive.*	3	3	9	3	4	12

Extreme Precipitation

Due to sloping topography and existing sewers, predicted increases in rainfall and extreme precipitation will have little effect on critical facilities within the study area. The vulnerability of critical facilities to extreme precipitation was determined by multiplying the likelihood of extreme precipitation impacting that facility (Table 8) and the consequence of extreme precipitation on that facility (Table 3). Due to the lack of probabilistic frequency data, the likelihood score is the same for both the existing and future conditions across the critical facilities. Both likelihood and consequence were scored on a scale of 1-5 and the vulnerability scores were scored out of 25.

Table 8. **Scale for Extreme Precipitation Likelihood Scores**

Score	Likelihood	Quantitative Thresholds
5	Almost Certain	Maximum potential flooding due to rainfall that results in some ponding or runoff on site, typically on an annual basis
4	Likely	Maximum potential flooding due to rainfall that results in ponding depths up to 1 foot
3	Possible	Maximum potential flooding due to rainfall that results in ponding depths between 1 to 2 feet

2	Unlikely	Maximum potential flooding due to rainfall that results in ponding depths between 2 and 3 feet
1	Rare	Maximum potential flooding due to rainfall that results in ponding depths greater than 3 feet

Of the 36 critical facilities studied, only Oak Point Railyard and some major roadways have limited vulnerability to extreme precipitation, as shown in the vulnerability scores in Table 9. Oak Point Railyard and certain roadway locations may flood during extreme precipitation events, which may impact access to pedestrian and vehicular bridges used to enter and exit the peninsula or local bus routes.

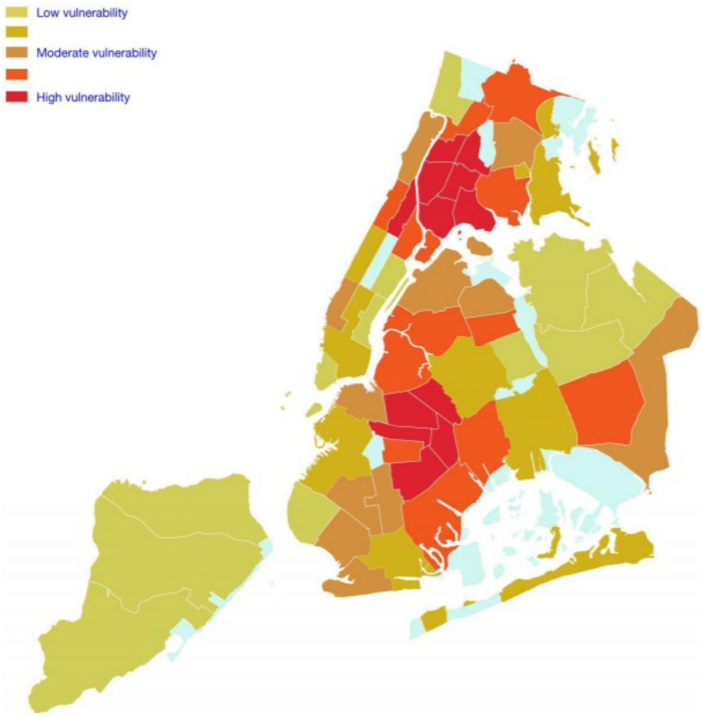
Table 9. **Critical Facilities Most Vulnerable to Extreme Precipitation (= Likelihood × Consequences)**

Critical Facility	Existing (2020) Vulnerability Score			Future (2100) Vulnerability Score		
	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 25)	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 25)
Infrastructure and Other Facilities						
Major roadways (leading to pedestrian and vehicular bridges); *several roadways evaluated and determined to be most vulnerable; worst-case shown here with the scores for the intersections of East Bay and Longfellow Avenues and Edgewater Road near Sims Metal Management*	3	1	3	3	1	3
Oak Point Railyard	1	2	2	1	2	2

Extreme Heat

Hunts Point today has a high Heat Vulnerability Index when compared to other parts of the city (Figure 6). Environmental factors, such as daytime summer surface temperature and green space, as well as social factors, such as poverty and race, are used to calculate the Heat Vulnerability Index. The land use and built environment in Hunts Point contributes to the community's vulnerability to extreme heat through the Urban Heat Island (UHI) Effect as Hunts Point is dominated by paved areas and structures.

Figure 6. **Heat Vulnerability Index (HVI) for New York City Community Districts (Source: NYC DOHMH)**



Predicted increases in overall temperature —and especially increases in the number and duration of heat waves, defined as three or more consecutive days over 90 degrees Fahrenheit (˚F)—will increase vulnerabilities across the study area. In the residential area, this could mean increased risk of heat-related emergency room visits, hospitalizations, or even death, especially for older residents. In the industrial area, worker health may be at risk due to heat waves. For the FDC, there are additional costs associated with heat waves for ensuring adequate refrigeration and compliance with cold chain regulations, as well as increased risks from energy outages and loss of stock as detailed further under the next section on power outages.

The vulnerability of critical facilities to extreme heat was determined by multiplying the likelihood of a heat wave in Hunts Point (Table 10) and the consequence that extreme heat would have on that facility, given its use and cooling needs. While individual days over 90˚F and 100˚F have consequences, this analysis considers the sustained impacts from heat waves projected by NPCC. Both likelihood and consequence were scored on a scale of 1-5 and the vulnerability scores were scored out of 25.

Table 10. **Scale for Extreme Heat Likelihood Scores**

Score	Likelihood	Quantitative Thresholds
5	Almost Certain	A prolonged heat wave will occur **several times a year**
4	Likely	A prolonged heat wave will occur **once or twice a year**
3	Possible	A prolonged heat wave will occur **every other year**
2	Unlikely	A prolonged heat wave will occur **every 3-5 years**
1	Rare	A prolonged heat wave will occur **every 5 years or more**

Existing and future vulnerability scores for extreme heat for the six most at risk facilities of the 36 critical facilities studied are provided in Table 11.

Table 11. **Critical Facilities Most Vulnerable to Extreme Heat (= Likelihood x Consequences)**

Critical Facility	Existing (2020) Vulnerability Score			Future (2080) Vulnerability Score		
	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 25)	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 25)
Food Distribution Center						
100 Food Center Drive	2	2	4	5	2	10
355 Food Center Drive	2	2	4	5	2	10
800 Food Center Drive	2	2	4	5	2	10
Community Facilities						
PS 48	2	2	4	5	2	10
MS 424	2	1	2	5	1	5
Infrastructure and Other Facilities						
Vernon C. Bain Correctional Center	2	2	4	5	2	10

Power Outages

Building-level power outages due to flooding or increased demand during extreme heat events pose a risk to several facilities in the FDC and industrial areas. Power outages in the FDC pose a significant risk due to the refrigeration needs of businesses critical to the city's food supply. In the residential areas, critical facilities, including schools and facilities providing social services or potentially serving as emergency centers, are also vulnerable to building-level outages. Some of these facilities currently have back-up generation capability and could withstand an outage of several hours or even days, while others have no back-up generation capability.

Blackouts and brownouts associated with system-wide outages or service disruptions pose less risk to the study area because the Con Edison electric distribution system is designed with a higher degree of redundancy than other systems in the United States. Similarly, the Con Edison gas system is robust. Historical system-level outages in the Bronx for both systems are low in terms of frequency and duration.

Table 12 summarizes the likelihood and consequence scores for the critical facilities most vulnerable to power outages in no rank order.

Table 12. **Critical Facilities Most Vulnerable to Building-level Outages (=Likelihood x Consequences)**

Critical Facility	Existing (2020) Vulnerability Score			Future (2100) Vulnerability Score		
	Likelihood (Scored out of 5)	Consequences (Scored out of 5)	Vulnerability (Scored out of 5)	Likelihood (Scored out of 5)	Consequences (Scored out 5)	Vulnerability (Scored out of 25)
Food Distribution Center						
355 Food Center Drive	3	4	12	4	4	16
800 Food Center Drive	4	2	8	5	2	10
100 Food Center Drive	4	4	16	5	4	20
Community Facilities						
PS 48	2	2	4	3	2	6
MS 424	2	2	4	3	2	6
Bella Vista Health Center/Urban Health Plan	3	2	6	4	2	8
Retail fueling stations (gas and/or diesel)	2	3	6	3	3	9
Pio Mendez Houses for the Elderly	1	4	4	2	4	8
Infrastructure and Other Facilities						
Jetro/Restaurant Depot	1	4	4	2	4	8
Con Edison gas compressor station	2	4	8	2	4	8
Power distribution facilities (medium voltage facilities and transformer stations); *several medium voltage facilities and transformers evaluated and determined to be most vulnerable; worst-case shown here.*	2	4	8	2	4	8

Summary

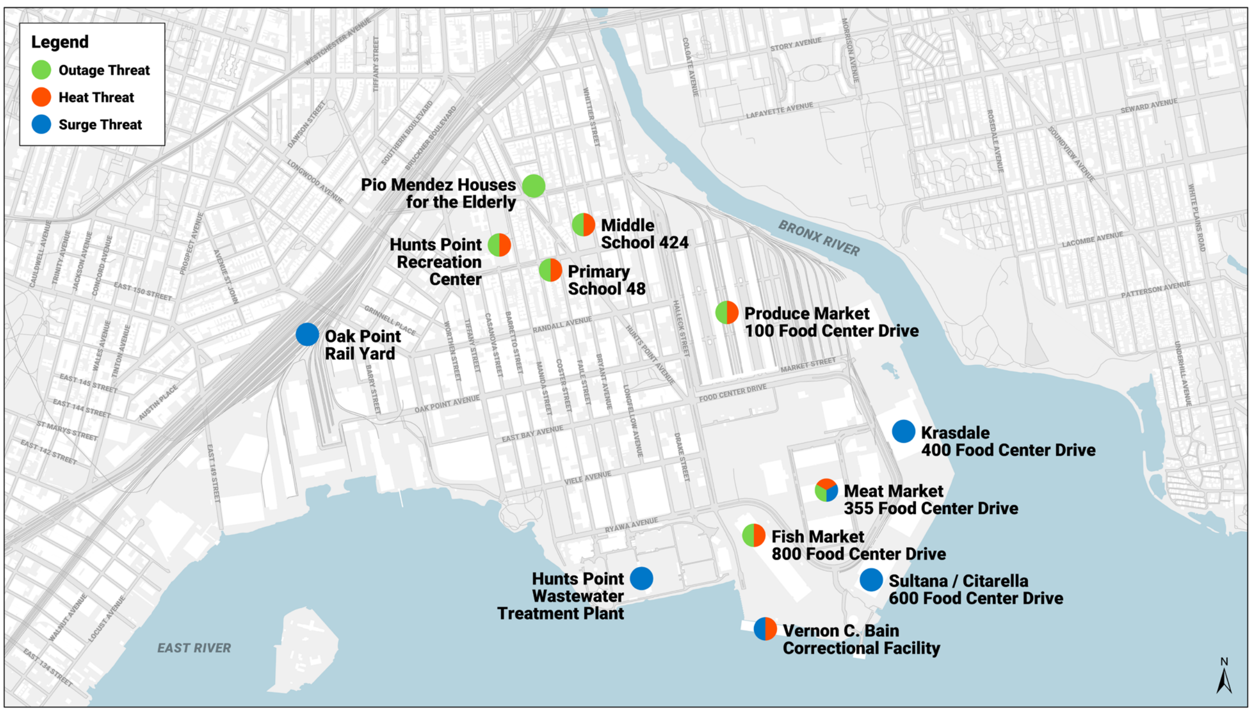
Overall, the climate risk and vulnerability assessment came to the following conclusions:

- Building- and system-level power outages are a significant and shared threat to residents and businesses in Hunts Point.
- Due to considerable elevation change, the low-lying industrial areas face threats from coastal flooding, while the upland residential area does not.
- Extreme rain/snowstorms are not a major threat in Hunts Point.
- The number of community organizations and history of organizing in Hunts Point can lay the foundation for strong social resiliency.

In total, twelve facilities (Figure 7) were identified as vulnerable based on the range of climate threats assessed. Heat and power outages pose a threat for facilities in both the residential community and in the Food Distribution Center, while only the FDC and industrial areas are at risk from coastal storm surge. Power outages pose a threat to 100, 355, and 800 Food Center Drive in the distribution center, as well as Pio Mendez Houses for the Elderly, Hunts Point Recreation Center, PS 48, and MS 424 in the residential area.

Seven facilities in the FDC and industrial area are vulnerable to storm surge. Of these facilities, the climate risk and vulnerability assessment identified the most vulnerable facilities to coastal storm flooding based on several factors, including elevation, number of people affected, potential mid- to long-term damage to electrical equipment and perishable goods, and cost of inventory that could be damaged. The facilities determined to be most vulnerable to coastal storm surge were 355, 400 and 600 Food Center Drive. Oak Point Railyard, Hunts Point Wastewater Treatment Plant, and Vernon C. Bain Correctional Facility are also vulnerable to storm surge, but these facilities have other existing mitigation measures.

Figure 7. **Climate Threats for Vulnerable Critical Facilities**



0 250 500 1,000 1,500 2,000 Feet
1:12,000

Hunts Point RESILIENCY

Chapter 3. **Assessment of Resiliency Options**

Building on the findings of the climate risk and vulnerability assessment, possible technologies and options to protect the most vulnerable critical facilities were studied. As daily tidal inundation and extreme precipitation pose limited threats to Hunts Point, the Study focused on options for protecting vulnerable critical facilities against coastal storm surge with future sea level rise, heat waves, and power outages.

Potential Options for Energy Resiliency

Several alternatives were identified and screened for their ability to protect vulnerable critical facilities from power outages caused by heat waves, coastal storm surge, or other energy system failures. Screening criteria included:

- Resiliency
    - Flood resilient
    - Proven technology
    - Operational during emergency conditions
- Sustainability
    - Level of emissions
- Community benefits
    - Workforce opportunity
    - Scalability
    - Multipurpose
- Constructability
    - Suitable space
    - Permitting
- Implementability
    - Schedule
    - Cost
    - Potential to secure funding
- Incorporation of the AWG Implementation Principles

Those alternatives that were retained after a screening process had a clear resiliency benefit, cleaner emissions, a range of uses in emergency and non-emergency conditions, and scalability. Alternatives that were not flood resilient, untested, or yielded higher emissions were screened out. For energy resiliency, the project selected must provide at least three days of reliable, flood resilient, and dispatchable power to vulnerable critical facilities during emergency events like Hurricane Sandy, power outages, and other threats.

The technologies screened were:

- Power generation
    - Combined cycle microgrid
    - Reciprocating engine microgrid
    - Emergency reciprocating engines
    - Simple cycle combustion turbine
    - Combined heat and power (CHP) reciprocating engine
    - Fuel cell applications
    - Tidal power
    - Anaerobic digestion
- Solar generation and storage
    - Solar photovoltaics (PV) and battery storage
    - Rooftop solar PV
    - Ground mounted solar PV
    - Power hub
- Other
    - Ice storage
    - Electrification of 100 Food Center Drive parking lot
    - 100 Food Center Drive switchgear replacement
    - Compressed natural gas vehicles

Definitions for each of these technologies are included in Appendix D of this report.

Of these options, the technologies that best achieved the screening criteria were developed into packages for costing and more detailed feasibility evaluations. Packages included:

- A pilot combined cycle engine generator with microgrid, solar and storage
- A large combined cycle engine generator with microgrid, solar and storage
- Individual generators

After developing initial packages for consideration, the City received additional community feedback on a strong desire for the team to explore more sustainable technologies that could reduce air quality emissions on the peninsula, as well as incorporate renewable energy technology, such as solar and battery storage. In response to this, the Consultant Team developed an updated conceptual design package that uses more sustainable technologies, improves air quality and emissions, electrifies a portion of diesel-powered refrigerated trucks, and replaces the need for existing boilers. This package includes a tri-generation micro-grid to service 100 and 355 Food Center Drive, rooftop solar PV and battery storage at two area schools, and mobile generators to service multiple businesses in the FDC. The final proposed package is detailed below:

Project Location	Energy Generation Type	Capacity (MW)
Food Distribution Center, Site D (Serving 100 and 355 Food Center Drive)	Tri-generation micro-grid	5.2
MS 424	Rooftop Solar PV	0.45
	Battery Storage	0.09
PS 48	Rooftop Solar PV	0.04
	Battery Storage	0.06
Multiple Businesses	Mobile Diesel Generators	1.1

Potential Options to Address Coastal Flood Risk

Several alternatives were identified and screened for their ability to protect the most vulnerable critical facilities from coastal storm surge. Screening criteria included:

- Resiliency
  - Protect against coastal storm surge
  - Proven technology
  - Operational during emergency conditions
- Sustainability
  - Ecological Improvements
  - Green infrastructure
  - Stormwater management
- Community benefits
  - Workforce opportunity
  - Scalability
  - Multi-purpose
- Constructability
  - Suitable space
  - Permitting
- Implementability
  - Schedule
  - Cost
  - Potential to secure funding

- Incorporation of the AWG Implementation Principles.

Those that were retained after a screening process were deemed reliable and scalable. The main reasons why alternatives were screened out included space availability constraints, unreasonably high elevation requirements, and low benefit-cost ratios.

The options screened were:

- Building level hardening
- Area-wide floodwall
- Facility-level floodwall
- Elevate buildings
- Elevate critical equipment
- Area-wide levees
- Deployable flood barriers
- Deployable pumps

Of these options, area-wide levees, deployable flood barriers, and deployable pumps were screened out due to the space needed to implement these options, the elevation to which these options would have to be designed to, and the cost of these options. Facility-level floodwalls and elevating critical equipment were also eliminated because of their low benefit-cost ratios. Area-wide floodwalls, elevating buildings, and building-level hardening at 355, 400, and 600 Food Center Drive were studied in more detail.

Area-Wide Floodwall

An area-wide floodwall is a permanent, hard structure along the waterfront to achieve a level of protection from flooding. A design for a 100-year storm in the 2050s with a 90th percentile sea level rise projection was developed, and preliminary costs were estimated at a conceptual level.

An area-wide floodwall is not recommended as it would not appropriately address the climate risks and would present significant design and construction challenges, as displayed in Table 13. Since the extent of flooding from coastal storm surge is limited to specific, localized parts of the low-lying industrial area and Food Distribution Center, risks can be mitigated more effectively with building-level options than an area-wide floodwall. As a result, it would be extremely difficult to obtain the necessary regulatory approvals and environmental permits for an area-wide floodwall, as it could negatively impact the ecology of surrounding waterways, limit waterfront access and views, and further cut the community off from the waterfront. It also presents significant design and maintenance challenges and would cost hundreds of millions of dollars. Lastly, an area-wide floodwall would require significant upgrades to drainage infrastructure. While today the topography allows water to drain by gravity, a floodwall would create a "bathtub" effect in which stormwater would be trapped on land and could not naturally flow from higher elevations down to lower-lying areas and into the river without significant additional infrastructure, such as pumping stations.

Table 13. **Evaluation for Area-Wide Floodwall**

Technical Difficulty
In-water construction requires a complex and lengthy permitting process with no guarantees and strong project justification requirements
Potential negative ecology impacts for in-water construction
Long term operational impacts on existing businesses' use of space and operations along the waterfront
Construction impacts on businesses
High cost and high level of uncertainty with costs related to the following factors: • Variability in subsurface soils creates uncertainty for foundation design, especially because much of the area has been remediated • Remediation related requirements, including sealing subsurface penetrations and disposal of materials • Siting and building multiple pump stations to facilitate drainage of interior stormwater • Property acquisitions
Responsibility by Sector
Implementation of this intervention, as well as long-term operation and maintenance of the floodwall, would likely be the public sector's responsibility
Potential Urban Co-Benefits
A floodwall would restrict waterfront access and views
It is difficult to incorporate greening into design of a floodwall

Elevating Buildings

The lowest occupied floor and equipment critical to building operations can be elevated to protect from coastal storm surge. Several elevation techniques are available, which generally consist of (1) jacking the structure up and building a new or extended foundation below it; (2) leaving the structure in place, retrofitting the first floor to accommodate floodwaters, and building an elevated floor within the structure or adding a new upper story; or (3) constructing a new building at a higher elevation to completely replace the lower elevation building. In Hunts Point, elevating buildings would be extremely challenging due to the age and layout of the buildings, significant disruptions to business operations during construction, and other impediments as further detailed in Table 14. Therefore, this is not a recommended resiliency strategy for Hunts Point.

Table 14. **Evaluation of Elevating Buildings**

Technical Difficulty
Elevating buildings would cause considerable disruption to operations during construction
Building permits and potential zoning conflicts may require one or more variances
For 355 Food Center Drive, one of the most vulnerable facilities, the operating floor already has a low ceiling and offices overhead
Responsibility by Sector
Implementation of this intervention would likely fall on building owners

Potential Urban Co-Benefits
Elevating buildings would maintain existing waterfront access and views

Building Hardening

Hardening focuses on strengthening the essential systems of an individual building (electrical, mechanical, fuel, communication, life-safety) to withstand water inundation, operate during a coastal storm surge, or return to service rapidly after a flood event subsides. Hardening can involve “wet floodproofing” or “dry floodproofing.” Wet floodproofing involves allowing water to enter a building without endangering structural stability or equipment integrity, while dry-floodproofing prevents water from entering a building or its equipment (Figure 8).

Figure 8. **Example of Dry-Floodproofing**

Hardening directly addresses the climate risks and vulnerabilities by protecting critical facilities and equipment from coastal storm flooding. Hardening presents less significant design and construction challenges than other options (Table 15) and has a much higher benefit-cost ratio. To address coastal flood risk, building hardening to protect critical facilities is the recommended strategy.

Table 15. **Evaluation of Building Hardening**

Technical Difficulty
Hardening presents minor challenges related to site preparation, adding sidewalls, and interferences with existing refrigeration sealing systems
Mechanical equipment can be damaged during routine facility operations, interfering with deployment
Deployable options present a risk in that all components must function to provide adequate protection
Responsibility by Sector
Implementation, maintenance, and deployment of this intervention would likely fall on building owners
Potential Urban Co-Benefits
Hardening would maintain existing waterfront access

Chapter 4. **Benefit-Cost Analysis**

A benefit-cost analysis was completed for the preferred projects consistent with federal guidelines. A benefit-cost analysis is a decision-making tool that looks at a project over its full lifecycle, quantifying all upfront capital and long-term maintenance costs, as well as all the benefits the project will have over time. For this analysis, resiliency, environmental, social, and economic benefits were considered. A benefit-cost ratio above one is the minimum standard to show that the benefits of a project over time outweigh both the upfront capital and long-term maintenance costs to implement the project. A BCA is a useful tool to ensure that a project meets the minimum standard of a BCA over one, while also helping to compare project options to one another.

Benefit-Cost Analysis of the Energy Resiliency Project

The benefit-cost analysis for the selected energy resiliency project shows that the resiliency, environmental, and social benefits of the project outweigh the costs of building and maintaining the project. The project meets the federal standard of a benefit-cost ratio above one and has a $27 million net present value, defined as the value of the project today against future costs and benefits. For the purpose of this analysis, it was assumed that the project would also create 55 construction jobs and 10 permanent jobs. The details of this benefit-cost analysis are represented in Table 16[4].

Table 16. **Benefit-Cost Analysis of Energy Resiliency Project (in 2016 Dollars)**

Total Lifecycle Costs (Capital, Operations and Maintenance, and Fuel)	$93 M
Total Benefits (Resiliency, Environmental, and Social)	$120 M
Net Present Value (NPV)	$27 M
Benefit-Cost Ratio (BCR)	**1.29**

Benefit-Cost Analysis of Coastal Flood Risk Reduction Options

Of the options studied, building hardening has a significantly higher benefit-cost ratio than an area-wide floodwall or elevating buildings (Table 17). The benefit-cost ratio of building hardening when considering resiliency and social benefits is 10.2 and 32.9 when considering resiliency, social, and economic benefits. The BCA in this instance is comparatively high due to the low-cost of implementing this measure against the high impact it is anticipated to have on mitigating climate risk, while providing additional social and economic benefits. The benefit-cost ratios for an area-wide floodwall and for elevating buildings are comparatively low. For an area-wide floodwall, the benefit-cost ratio is 0.5 when considering resiliency and social benefits and 2.1 when considering resiliency, social, and economic benefits. For elevating buildings, the benefit-cost ratio is only 0.2 when considering resiliency and social benefits and 2.9 when considering resiliency, social, and economic benefits. The costs used to determine the benefit-cost ratios for building hardening are estimates based on one commercially available system, and the estimates for elevating buildings and area-wide floodwalls are based on conceptual designs.

[4] The City of New York Proposed Substantial Action Plan Amendment 18 Rebuild by Design – Hunts Point Resiliency Project

Table 17. **Benefit-Cost Analysis of Coastal Flood Risk Reduction Options (in 2016 Dollars)**

	Option1	**Option 2**	**Option 3**
Metric	Building Hardening	Elevating Buildings	Area-wide Floodwall
Total Lifecycle Costs	$5.5 M	$45 M	$573 M
Benefits (Resiliency and Social)	$56 M	$6 M	$270 M
Net Present Value	$51 M	-$39 M	-$303 M
Benefit-Cost Ratio	**10.2**	**0.2**	**0.5**
Benefits (Resiliency, Social, and Economic)	$181 M	$130 M	$1.178 M
Net Present Value	$176 M	$85 M	$605 M
Benefit-Cost Ratio	**32.9**	**2.9**	**2.1**

Chapter 5. **Conclusions and Recommended Strategies**

Overall, the vulnerability of critical facilities to climate risks varies across the peninsula. Parts of the industrial area are at risk from coastal storm surge, which will become worse with sea level rise, while the residential area is at significantly higher elevation and is not at risk from coastal storm surge now or in the foreseeable future. Specifically, three critical facilities in the low-lying areas of the Food Distribution Center are vulnerable to flooding from a 100-year storm surge. Chronic flooding due to sea level rise will not have a significant impact on the peninsula in the 2050s, and flooding from extreme precipitation is limited. The most acute risks in Hunts Point are from power outages, which can be caused by a range of events from coastal flooding to extreme heat, and general power failures. Four critical community facilities and three critical FDC facilities are vulnerable to power outages.

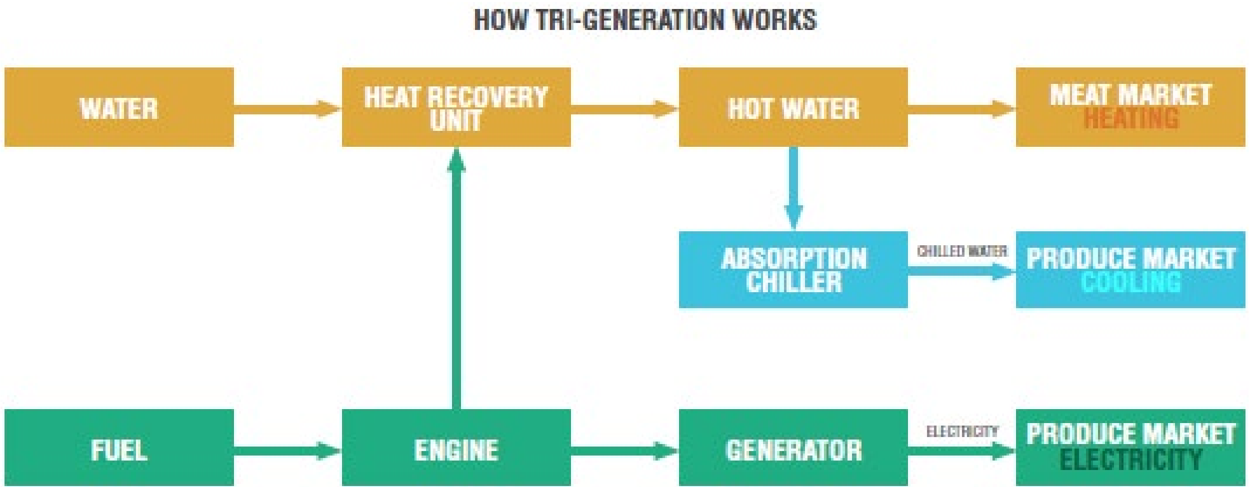
In response to these risks, the Study recommends a combination of energy solutions and building-level protections to ensure Hunts Point is resilient to current and future climate threats. The City is also advancing social resiliency programs to better protect vulnerable residents and small businesses.

Energy Resiliency

The Study identified an energy resiliency project, based on community priorities identified by the Advisory Working Group, to address the vulnerability of both critical industrial and community facilities in Hunts Point. The energy resiliency project aims to provide substantial resiliency benefits by providing reliable, dispatchable, and sustainable power to Hunts Point through a combination of energy generation and storage solutions. The project includes a suite of technologies that help secure the resiliency of our food distribution network, minimize threats to critical facilities in Hunts Point, achieve the highest sustainable return on investment, and maximize opportunities for sustainability and improved air quality:

- A flood resilient tri-generation facility with a microgrid that would ensure back-up power to food-related businesses in the Hunts Point Food Distribution Center (FDC) and protect a critical component of New York City's food supply system during emergency conditions, increasing the resiliency of the city and region as a whole. The tri-generation facility would also provide year-round energy benefits, supplying electricity and chilled water to 100 Food Center Drive and hot water to 355 Food Center Drive. As needed during emergency events, the microgrid would be able to supply a minimum of three days of electrical power separated from Con Edison's grid. A microgrid is a localized energy grid that can operate independently of a utility-operated or area-wide energy grid. A tri-generation system supplies three forms of energy in one process: electricity, heat, and chilled water. The natural gas generators produce electricity and heat as a by-product of the electrical generation. This exhaust heat is then used directly to produce hot water and feed to an absorption chiller to produce chilled water as part of the tri-generation system, as illustrated by the diagram in Figure 9.

Figure 9. **The Tri-Generation Microgrid would Provide Heating, Cooling and Electricity**



- Solar photovoltaic plus battery storage at two schools in the residential area of the peninsula (MS 424 and PS 48), providing year-round sustainable energy and backup energy during emergency conditions. At MS 424, the solar and storage installations would allow the facility to serve as a cooling or evacuation center, providing shelter, refuge, and gathering space for the public during extreme heat events or other emergency situations, and limit mobile diesel generators that may be necessary to operate for the full duration of an emergency event.
- Mobile diesel generators that provide resilient power supply intended to service multiple businesses in the FDC during emergency conditions. This energy resiliency project would reduce the vulnerability of the Hunts Point peninsula by providing at least three days of reliable, resilient, and dispatchable power to critical local and citywide facilities during emergency events like a coastal storm, power outage, or heat wave.

In addition to sustainable technologies such as solar and storage, the project aims to positively impact air quality by reducing air pollution and carbon emissions. The project includes electrifying a portion of the idling diesel-powered refrigerated trucks at 100 Food Center Drive and reducing usage of the existing boilers at 355 Food Center Drive.

Coastal Flood Risk

To address coastal flood risk, this process determined that building-level protections at 355, 400 and 600 Food Center Drive are the recommended solution. Building hardening mitigates the targeted risks Hunts Point facilities face, while maintaining existing access to the waterfront, minimizing design and construction challenges, and providing the highest benefit-cost ratio. It would provide a targeted and tailored approach to the most vulnerable critical facilities. An area-wide floodwall would be substantially more expensive and challenging to implement, without providing additional resiliency benefits. Elevating buildings also presents significant technical challenges and would disrupt operations of facilities. Therefore, building hardening is the most desirable, cost-effective, and feasible strategy to reduce coastal flood risk for vulnerable facilities in Hunts Point.

In addition, the City is advancing FEMA-funded resiliency projects for the Hunts Point Wastewater Treatment Plant and for the Vernon C. Bain Correction Center, both located in the industrial area.

Lastly, to address more near-term risk, the City is working to install emergency generators at 355 Food Center Drive, through funding from Council Member Rafael Salamanca; and New York City Emergency Management (NYCEM) has installed Interim Flood Protection Measures at the Hunts Point Wastewater Treatment Plant and 355 Food Center Drive to provide a temporary level of protection from coastal storms.

Social Resiliency

To increase social resiliency in Hunts Point, the City is implementing the RISE:NYC and Be A Buddy programs. Through CDBG-DR funding, the RISE: NYC program is improving the resiliency of small business in Hunts Point. The City worked with New America Foundation and the community to install decentralized mesh Wi-Fi networks that keep small businesses and the community connected during an outage. To protect Hunts Point's most vulnerable residents, the Point CDC in partnership with the Department of Mental Health and Hygiene (DOHMH), MOR, and the Fund for Public Health NY (FPHNYC) is leading the Hunts Point-Longwood Be A Buddy program. The Be A Buddy program increases resiliency by having local volunteers help the most at-risk residents during climate-related emergencies and by educating the broader community about climate preparedness.

Next Steps

Based upon community priorities identified through the AWG, the City recommends advancing implementation of the Hunts Point energy resiliency project in the residential and Food Distribution Center areas of Hunts Point, addressing the range of threats from power outages, coastal storms, and heat waves. The energy resiliency project is recommended to advance into final design and construction through a combination of HUD and City funding. The City will continue to work closely with the community throughout the final design process.

Based on the technical analysis of climate risks and vulnerabilities for the peninsula, the City will continue to coordinate with the tenants of the most vulnerable critical facilities to explore how to move forward with the recommendations of building hardening to protect from coastal flood risk.

Climate resiliency requires a multi-layered approach, and the City will continue to work with the community to identify projects, programs, and approaches that can be used to better prepare Hunts Point for the impacts of climate change.

Appendix A. **Table of Critical Facilities Assessed for Climate Risks and Vulnerabilities**

Category or Type	Facility (Unique Identifier)	In Study Area?
Emergency Services		
Governmental facilities are vital for the delivery of emergency services and immediate response before, during, and after an extreme weather event to both Hunts Point and a larger area in the Bronx, and must stay in continuous operation.	Fire House Engine 94	Y
	Police Precinct 41	N
Mobility*		
Transportation facilities that are vital for the delivery of emergency services and evacuation of residents or employees and must stay in continuous operation.	Pedestrian and vehicular bridges over rail yards separating Hunts Point from South Bronx	Y
	Major roadways leading to those bridges (no official evacuation routes)	Y
	Retail fueling stations (gas and/or diesel)	Y
	Oak Point Rail Yard	Y
	Produce Market Rail Yard	Y
Housing		
Immobile or vulnerable populations that would have to be either evacuated in the event of an extreme weather event or special provisions would have to be made for sheltering in place.	Pio Mendez Houses for the Elderly	Y
	Vernon C. Bain Correctional Center	Y
Utility Systems		
The continuous operation of these systems is vital to public health and safety, and to the provision of emergency response services.	Con Edison gas regulation/metering station	Y
	Power distribution facilities (medium voltage facilities or transformer stations)**	Y
	Hunts Point Wastewater Treatment Plant	Y
	Hunts Point Market Pump Station	Y
	Water supply lines and fire hydrants***	Y
	Major combined sewers, combined sewer outfall, and storm sewer outlets****	Y

	Telecommunications lines*****	Y
First Tier Citywide Economic Centers		
Based on overall product volumes, market segments served and/or NYC market share, these facilities are vital to regional food supply and their closure would result in meaningful regional impacts on food supply, as well as citywide impacts on employment and economic stability, such that it is important to ensure their continuous operation.	Hunts Point Terminal Produce Market (100 Food Center Drive)	Y
	Hunts Point Cooperative (Meat) Market (355 Food Center Drive)	Y
	New Fulton Fish Market (800 Food Center Drive)	Y
	Jetro/Restaurant Depot	Y
Second Tier Citywide Economic Centers		
Similarly, certain facilities may be closed temporarily without causing widespread disruptions, such as the regional food supply.	Baldor (155 Food Center Drive)	Y
	Krasdale (400 Food Center Drive)	Y
	Dairyland/Chef's Warehouse (200 Food Center Drive)	Y
	Citarella/Sultana (600 Food Center Drive)	Y
Social Services		
These facilities are important to the health and welfare of Hunts Point residents. Before or during a storm they could serve as evacuation or cooling centers. In addition, in the aftermath of a storm they could provide staging areas for recovery, gathering spots for the community, and/or serve as key distribution points for social and economic assistance. These spaces are flexible, adaptable and may cover for similar services that might be temporarily closed (unlike the essential governmental services in the first category).	Bella Vista Health Center/Urban Health Plan	Y
	Hunts Point Recreation Center	Y
	The Point CDC	Y
	La Peninsula	Y
	Hunts Point Alliance for Children	Y
	PS 48 Elementary School	Y
	Hyde Leadership Charter School / MS 424 Middle School (co-located at 730 Bryant Ave)******	Y
	Wildcat Second Opportunity School	Y
	Bronx Charter School for the Arts	Y
	Saint Ignatius School	Y
	Community Board 2 Offices	N
	Hunts Point Workforce 1 Center	N

* Important, but not critical, transportation systems include the NYCT Bx 6 and Bx 46 bus stops, the No. 6 Subway train, and the MTA infrastructure yard. It is our understanding that these facilities, while important for recovery, could be rerouted (e.g., buses) or be out of commission for a time without major loss of life, widespread economic impact, or long-term service disruption.

** This equipment is owned by Con Edison or unique facilities, and any disruption will be felt by specific critical facilities. Therefore, their vulnerability is scored similarly to the facility they serve. For example, the transformers at 355 Food Center Drive are critical and any flooding impact will also be reflected in the consequence and vulnerability rating for 355 Food Center Drive itself.

*** Water supply lines and fire hydrants are not rated for vulnerability, as there is redundancy that can be used in the event of fire.

**** Only large outfalls and drains are shown on the map; additional drainage pipes of various sizes exist along the study area shoreline.

***** Information about telecommunications lines is limited and are not considered.

****** Previously served as a New York City Emergency Management (EM) designated Hurricane Evacuation Center.

Appendix B. **Advisory Working Group Participants**

Group / Organization	Sector
Community Board 2	Community
The Point	Community
The BLK ProjeK	Community
Sustainable South Bronx	Community
Food Bank for New York City	Community
Youth Ministries for Peace & Justice	Community
Mothers on the Move	Community
Hunts Point Alliance for Children	Community
Rocking the Boat	Community
Hometown Security Labs	Community
Hyde Leadership	Community
Urban Health Plan	Community
Hunts Point EDC	Business
BOEDC	Business
355 Food Center Drive	Business
Fish Market	Business
Produce Market	Business
Baldor	Business
Jetro	Business
Oak Point Properties	Business
Teamster's 202	Business
Sims Metal Management	Business
Dairyland/Chef's Warehouse	Business
400 Food Center Drive	Business
500 Food Center Drive	Business
Sultana	Business
Citarella	Business
Baretto Bay Strategies	Business
Congressman José Serrano	Elected Official
Borough President's Rubén Díaz	Elected Official

Senator Rubén Díaz	Elected Official
Senator Jeff Klein	Elected Official
Assemblyman Marcos Crespo	Elected Official
Assemblywoman Carmen Arroyo	Elected Official
CM Rafael Salamanca	Elected Official
NYCEDC	Government
Mayor's Office of Resiliency	Government
NYC Department of Environmental Protection	Government
DOT	Advisory
DCP	Advisory
Parks	Advisory
SBS	Advisory
NYCEM	Advisory
DOHMH	Advisory
NYCEJA	Advisory
Con Edison	Advisory
NYPA	Advisory

Appendix C. **Consultant Team**

The Consultant Team was led by HDR with support from:

- Interaction Institute for Social Change
- The Point Community Development Center
- Mathews Nielson Landscape Architects
- Matrix New World
- Bright Power
- Smarter Grid Solutions
- Toscano Clements Taylor
- GEI
- HR&A
- Arcadis
- NYC Labor Market Information Service (CUNY-affiliated)

Appendix D. **Definitions of Technologies**

Technologies screened for energy resiliency included:

- Power generation
  - Combined cycle microgrid - Efficient, natural gas (or alternatively biogas or fuel oil) fired, energy generation technology that uses a combustion turbine to generate electricity and recover the waste heat to produce steam and supplemental electrical energy.
  - Reciprocating engine microgrid – Simple cycle, natural gas (or alternatively biogas or fuel oil) fired Reciprocating Internal Combustion Engine (RICE) generator, used to power a facility-scale microgrid.
  - Emergency reciprocating engines – Mobile RICE units, using natural gas (or alternatively biogas or fuel oil) to provide power to facilities.
  - Simple cycle combustion turbine – Natural gas (or biogas or fuel oil) fired Combustion Turbine Generator to provide power to facilities.
  - Reciprocating engine CHP – Reciprocating engine Combined Heat and Power (CHP), using RICE generators in a CHP arrangement to power facilities, while also providing waste heat for heating or chiller operation.
  - Fuel cell applications – Fuel cell technology for power generation alone and for power generation plus harvesting of waste heat for heating water or producing steam. Fuel cells work like batteries, but they do not run down or need recharging.
  - Tidal power – Also called tidal energy, a form of hydropower that converts the energy obtained from predictable tides into useful forms of power, mainly electricity.
  - Anaerobic digestion – Creates biogas as an alternative fuel source to natural gas, diesel, or other fuels. Microorganisms break down biodegradable material in the absence of oxygen to produce a biogas consisting of methane, carbon dioxide and traces of other gases that can then be used to provide fuel to combustion turbines, reciprocating engines, and fuel cells.
- Solar generation and storage
  - Solar PV and battery storage – Generate power during the day through Solar PV panels at varying degrees as a function of sunlight and cloud cover. Then stores electrical energy in batteries to reduce peak demands, supply backup power in the case of a power outage or maintain power quality during periods of frequency/voltage variations in the electrical grid.
  - Rooftop solar PV – Generates power during the day through rooftop Solar PV panels at varying degrees as a function of sunlight and cloud cover.
  - Ground mounted solar PV - Generates power during the day through ground-mounter Solar PV panels at varying degrees as a function of sunlight and cloud cover.
  - Power hub – Incorporates three main power generation devices: a micro CHP plant, a solar PV array, and an energy storage (ES) package of batteries.
- Other

    - Ice storage – Involves the generation and storage of ice, specifically the making of ice at off-peak demand times, storing it and using it to cool a facility during times of peak heat and/or electricity loads. Ice storage technology such as chillers requires a dedicated power source, whether electric or thermal, which in turn drives the costs, schedule, emissions, and other relevant characteristics of the technology.
    - Electrification of 100 Food Center Drive parking lot - Offsets the many diesel trailers that run frequently to provide refrigeration/freezing for the market by installing electrical interconnects throughout the parking lot and/or 100 Food Center Drive buildings for the truck trailers to run off of.
    - 100 Food Center Drive switchgear replacement – Ensures ongoing reliability and reduce potential downtime due to failure of aged equipment. This option is not an energy generation technology but rather a measure to maintain reliability.
    - Compressed natural gas vehicles – Compressed Natural Gas (CNG) vehicles are considered to be environmentally cleaner than typical gasoline or diesel fueled engines. Existing gasoline-powered vehicles may be converted to run on CNG and can be dedicated (running only on natural gas) or bi-fuel (running on either gasoline or natural gas). This is a community-wide solution that would require fueling stations within Hunts Point and truck modifications.

The options screened for flood risk reduction were:

- Building level hardening – Hardening focuses on strengthening the essential systems of an individual building (electrical, mechanical, fuel, communication, life-safety) to withstand water inundation, operate during storm surge or return to service rapidly after the event subsides.
- Area-wide floodwall – An area-wide floodwall is a permanent, hard structure along the waterfront, where feasible, to achieve a level of protection from flooding.
- Facility-level floodwall – Facility-level floodwalls are permanent, passive barriers that reduce the risk of flood damage for specific facilities.
- Elevate buildings – A building may be elevated so that the lowest occupied area will be above the target flood elevation.
- Elevate critical equipment – Elevating critical equipment is elevating essential systems like electrical, mechanical, communication, and life-safety equipment above projected flooding levels.
- Area-wide levees – A levee is an engineered berm or barrier comprised of soil and other earthen materials that can be sized to any elevation to keep floodwater out.
- Deployable flood barriers - Removable and temporary barriers comprise a set of structural systems that function like a levee or floodwall but may be rapidly deployed along the shoreline or flood pathways to prevent floodwaters from reaching the protected area.
- Deployable pumps – Slow or gradual flooding, such as through gaps in a foundation, may be counteracted with pumping

Appendix E. **Assumptions for Analysis**

The consequences rating scale applies equally to all threats assessed and is based on information assembled from multiple sources, including the narrative standards and scale used by New York City to rate consequences associated with risks to city-owned infrastructure. For the consequences of service or supply failures, the Consultant Team used a combination of stakeholder input and professional judgment about the impacts of different threats.

Coastal Storm Surge

Vulnerabilities associated with coastal storm surge are assessed using the risk methodology discussed in the Coastal Storm Surge section and the following additional assumptions to score likelihood and consequences:

- The likelihood rating scale specific to Coastal Surge is based on categories identified in FEMA Emergency Management Institute Training Document, "Hazard Risk Management, Session No. 14" (rare, unlikely, possible, likely, and almost certain). The categories show return frequencies and likelihood in a given year.
- The likelihood rating is a function of the chance of that event occurring 1 or more times within a 30-year period using a two-part or binomial distribution, following U.S. Army Corps of Engineers (USACE), EM 1110-2-1619, Chapter 3, Section 3 guidance. The 30-year time frame is a common assessment period since it applies to many financing arrangements and the anticipated life of many projects. With this period, it's possible to deter the likelihood of the threat occurring over the duration of a mortgage, for example, and compares flooding as a result of coastal storm surge to other threats such as a home fire.
- Following this approach, in each year a storm will either happen or not just like the flip of a coin. Using the 30-year time frame in a binomial distribution, a 10-year storm surge flood has a 10 percent likelihood every year and 96 percent chance over 30 years. A 25-year storm surge flood has a 4 percent likelihood every year and a 71 percent chance over 30 years. A 50-year storm surge flood has a 2 percent chance of occurring in a given year and a 45 percent chance over 30 years of occurring at least once. A 100-year storm surge flood has a 1 percent chance in a given year and only a 26 percent chance of occurring once over 30 years.
- Storm surge likelihood scores are based on the FEMA Preliminary Flood Insurance Rate Map (PFIRM) study for the NYC region (FEMA 2013). This condition is assumed to reflect existing conditions (2016) and those that can be reasonably expected in 2020. Because of the proximity of existing conditions (2016) to the future year, 2020, these two conditions are treated as the same. The condition is then modified with projections of sea level rise from NPCC for the 2050 90th percentile since that is the most extreme flood event identified for analysis.
- Likelihood of threat is then based on a desktop review of coastal storm surge flood boundaries. The Critical Facility locations are overlaid with the 10-, 25-, 50-, and 100-year storm surge flood boundaries to determine which storm surges they are impacted by. The likelihood is taken for the most frequently re-occurring storm surge flood. If, for example, a structure is not impacted by the 10-year storm surge flood but is inside the 25-year, the most frequent event is the 25-year storm surge flood.
- Consequences are based on the narrative standards and scale described in Table 4.

- Assigning consequence scores for coastal surge is also aided by quantitative USACE ratings, which typically presents depth of flooding in the following increments: less than 2 feet of flooding, 2 to 6 feet, 6 to 15 feet, and greater than 15 feet (Table 6). This rating scale is adjusted to create more bins or scoring possibilities that would align with the scoring scale and descriptions in Table 4 (i.e., less than 0.5 foot of flooding and 0.5 to 2 feet of flooding is included).
- This bin arrangement corresponds to different severities of damages which can be inferred from USACE and FEMA depth damage curves for residential and non-residential buildings (USACE EGM 04-01 and FEMA BCA Toolkit supplied functions). In the lowest bin, only minor impacts to structures and contents result with no loss of function to buildings and equipment. There is no effect on jobs, health or the community. In the highest bin (greater than 15 feet of flooding), there are significant impacts to critical facilities. The buildings contents and equipment are typically deemed a complete loss. There is significant down time in the operations usually lasting in excess of six months. The extents of the significant impacts may include long term impacts of jobs such as relocation or layoffs (if the company relocates or does not rebuild), permanent or near-permanent relocation of residents (for residential properties), and loss of life. Consequences are estimated by overlaying the surge elevations with the critical facilities and using the surge elevation for the most frequently recurring storm surge.
- Once the consequence score for facility operations/costs is assigned, then separate health, community, and economic consequences is scored based on the direct facility impacts.
- The consequences of flooding are significantly different for the critical facilities and multiple consequences may result for specific critical facilities. For example, flooding in the 355 Food Center Drive will have a direct effect on jobs and to a greater extent the regional food supply. Meanwhile, the consequence of a roadway with a bus stop being impacted is reduced access to mobility for people using public transit. Impacts to mobility can then have a range of indirect economic effects including worker absenteeism, health care access, and access to food. Direct impacts only are evaluated as part of the Study to develop relative vulnerability scores.

Extreme Precipitation

The assessment of risks associated with extreme precipitation events within the study area was conducted through two types of modeling: the New York City Department of Environmental Protection's InfoWorks model and a ponding analysis. DEP modeling assesses the capacity of their sewer networks that carry both sanitary sewage and stormwater (combined sewers). For the Study, a copy of the combined sewer model (InfoWorks) was obtained from DEP and used to simulate potential surface flooding that could result from existing sewer system capacity combined with extreme storm events predicted for the current-day and in the future under anticipated climate change conditions for 2100. The use of the InfoWorks model for this type of analysis has some limitations since it can only be used to simulate flows along major combined sewer pipes having diameters of 40 inches or greater. An additional limitation for the Hunts Point Peninsula is that only approximately 60 percent of the study area is served by combined sewers and the rest of the area is served by separate storm sewer systems that are not included in the InfoWorks model. The InfoWorks model also assumes that the sewer system is operating and built as designed, not taking into account parts that may be broken, clogged, or not built as specified that can result in isolated flooding. A second method is employed to overcome the above described limitations of the available sewer system model. This method is based on an analysis of the topography on the peninsula using LiDAR data as follows:

- If a Critical Facility is at a high point or the topography onsite is sloped in such a way that stormwater would not collect or pond onsite and would rather run off to a lower-lying area, these critical facilities are not evaluated for maximum potential flooding due to rainfall.
- If severe rainfall events overcome the capacity of the sewer system, or if the sewer system capacity is limited by clogged catch basins or pipe, rainfall runoff will collect in low-lying areas and create a flood threat.
- Once the low-lying areas are filled, the rainfall runoff will escape flowing overland through sloped streets to the East River. In essence, once the pooled area or the bathtub is filled, water will spill over the rim of the bathtub and limit the potential depth of the flood threat. The ponding analysis is a reasonable assessment of the maximum flood depths that may result from intense precipitation events. Ultimately, the ponded water will eventually dissipate through combined or storm sewers or pumping, and the flood threat will diminish.

Extreme Heat

Vulnerabilities associated with extreme heat are assessed using the risk methodology discussed in the Extreme Heat section and the following additional assumptions to score likelihood and consequences:

- There is little undeveloped space in the study area, which is comprised of 91 percent paved surfaces and 9 percent unpaved surfaces (approximately 91.75 acres). Of the existing unpaved surfaces, most are grass or shrub coverage, with little tree coverage.
- Based on near term development and remediation plans, the percentage of paved surfaces will increase and unpaved surfaces will decrease.
- The impact of these changes could be partially mitigated through street tree plantings and parkland development.
- There are few opportunities for mitigation. Approximately 188 acres of off-street parking area in Hunts Point are assumed to be fully used for parking or truck movement and could not be retrofitted in a significant way with green infrastructure. Any additional green infrastructure would have to be installed in limited areas in the right of way or on buildings. One of the few significant opportunities for mitigation of the Urban Heat Island Effect would be through the development of green roofs on over 75 acres of city-owned, large scale industrial roofs in the study area. However, much of that space is set aside for existing uses (e.g., rooftop HVAC) or planned uses (e.g., rooftop generators or solar PV). The NYC Cool Roof program and other initiatives to lower the albedo of existing surfaces could also be targeted to the study area to mitigate the Urban Heat Island Effect.
- According to NPCC, from a baseline of two heat waves of 4 days each (8 Heat Wave Days [HWD]), it is projected that there will be three to four heat waves of 5 days in duration by the 2020s (15-20 HWD), four to seven heat waves of 5 to 6 days in duration by the 2050s (20-42 HWD), and six to nine heat waves of 5 to 7 days duration by the 2080s (30-63 HWD).

Power Outages

Considering extreme weather events, Con Edison's past performance, as described in the 2013 power lines study performed by the New York Mayor's Office of Long-Term Planning and Sustainability can be summarized in the table below.

Major Storm	Areas Affected	Number of Customers, Average Duration (System-Wide)
July 18, 2012	Queens	3,366 customers for 3.38 hours
September 18 to 19, 2012	Bronx	1,822 customers for 6.94 hours
	Westchester	25,457 customers for 8.34 hours
October 29, 2012	All Areas	1,221,945 customers for 93.96 hours

Additional outage data regarding recent (2015) major event performance of the Bronx Electric Operations Service Area Network Distribution System Performance is summarized in the table below.

Date of Event	Areas Affected	Number of Customers, Average Duration (System-Wide)
May 14, 2015	Bronx	406 customers for 9 hours
July 30, 2015	Bronx	552 customers for 4 hours

Regarding system-wide infrastructure threats, the general considerations and assumptions for this assessment are as follows:

- Generation failures on the electric grid supplying Hunts Point could be caused by issues with power generation facilities in the region (e.g., equipment failures) or high demand due to extreme heat events. Another failure mode for generation and supply would be if there is a regional curtailment of natural gas, which would impact multiple generating units. Because a gas supply restriction would affect the power supply capability of the entire region, reserve margins could affect power delivery to Hunts Point either as load reductions, brownouts, or a blackout.
- Electrical grid or network system failures are considered to be the loss of power delivery to Hunts Point, whether through equipment failure or an extreme heat event. Similar to the Northeast Outage of 2003, these events could be caused by a cascading effect of grid system operations.
- Based upon the historical performance of the Bronx Electric Operations Service Area Network Distribution System, the 5-year averages from 2011 through 2015 for the System Average Interruption Frequency Index (SAIFI)[5] and Customer Average Interruption Duration Index (CAIDI)[6] are 16.6 and 6.41 hours, respectively. While these values are slightly higher than the Public Service Commission's standards of 15 and 3.25 hours, threats due to the failure of this network system can generally be considered as a low likelihood. Based on these values, the likelihood of a power interruption is 0.017 events per year per customer with an average length of an outage (not due to severe weather) being approximately 6.4 hours.

[5] SAIFI is expressed as the number of interruptions per year per 1,000 customers.
[6] CAIDI is the average length of the interruption experienced by a customer who loses service.

- For Hunts Point specifically during the years of 2012 to August 2016, Con Edison has provided SAIFI ratings ranging from 0.006 to 0.014 events per year per customer and CAIDI ratings ranging from 5.1 to 12.9 hours with averages of 0.011 and 7.0, respectively. Additionally, Con Edison has indicated that the power supply availability to Hunts Point has been 99.999 percent. They have also indicated that there have been no outages involving 250 or more customers in the Hunts Point area in the past 5 years.
- Therefore, the threat of network system failures can generally be viewed as a likelihood of "Unlikely," with a consequence that could be considered as "Minor." The reported causes of the above outages are approximately 90 percent attributable to service connections and street mains/cable.
- Because of the nature of power failures and their subsequent impacts on operations, heating/cooling, etc., the consequences of any power outage will ultimately be a function of the duration of the outage.

Regarding building-level infrastructure threats, outages are characterized based on available information in public sources and previous studies. Each of the Critical Facilities evaluated is subject to loss of power from a Con Edison power feed failure, transformer failure, or electrical equipment failure due to an extreme heat event, natural gas shortfall, power quality issues, flooding of equipment, or other potential outage condition. The following considerations and assumptions for scoring the vulnerability of Critical Facilities to building-level outages are noted:

- Scoring for the likelihood of an outage is based on professional judgment and available information about the reliability of facility-level switchgear and other equipment, including the availability and condition of backup generation. For example, the age (1964) and configuration of the 100 Food Center Drive switchgear made an outage more likely compared to a more modern facility.
- Regarding consequences, because of the nature of power failures and their subsequent impacts on operations, heating/cooling, etc., the severity of the outages are primarily a function of the duration of the outage as well as the size and criticality of the facility affected.
- For those that do have installed backup generation, the likelihood of power supply outages at the facility is reduced. For example, Baldor has sufficient backup power generation to maintain the majority of its operations. As a result, the likelihood of impacts to their operations is significantly reduced relative to the other industrial customers. DEP also has significant/excess backup power for its operations at the Hunts Point Wastewater Treatment Plant.
- Without backup generation, especially in the various markets and industrial facilities, outages from any number of failures can lead to loss of refrigeration and product, failure to supply food to New York City, loss of goods, personnel safety, loss of heating, and economic impact to vendors. In the residential and local services areas, outages without sufficient backup generation can lead to loss of air conditioning and heating, personnel safety concerns, loss of water supply, lost work time, sanitary impacts, general health and safety, and increased crime.
- The likelihood and consequences of an outage from Con Edison power feed events, transformer failures and electrical equipment failures are generally considered low, especially given the four transmission feeders that supply the Mott Haven substation, the looped power supply and fifteen primary power feeds to the peninsula as well as the installed level of equipment redundancy. In

the event that there is a failure, the duration of an outage event could be minutes, hours, or up to a few days to restore, but is expected to be relatively short based on the results of the 2013 Power Lines study and the Bronx network performance discussed above.

- Risk of outages due to natural gas shortfalls is also considered to be a low probability occurrence, though the severity of such an event varies considerably depending on if the outage happens in the summer or winter. Because most of the natural gas usage on Hunts Point is for heating, a winter outage could result in the inability to heat occupied areas and freezing of water infrastructure (pipes).
- Power quality issues, typically from transients in the electrical voltage and/or frequency, can also have impacts on electrical equipment. While this is likely a tenant-specific issue based upon the types of electronics used in their processes, there can be impacts to the performance and useful life of their equipment if power quality is erratic. This is often mitigated with uninterruptible power supplies, which are typically used to protect sensitive equipment (e.g., computers).
- 355 Food Center Drive is unique in the quantity of refrigeration equipment utilized which relies on the availability of power. These consequences are partially mitigated by the fact that this market is installing backup generation to maintain refrigeration capability (though not at full cooling capacity).
- In general, large industrial facilities with multiple tenants and more significant infrastructure are considered to be more vulnerable (due to a higher likelihood of occurrence) to energy supply outages because of the increased quantity of electrical equipment required to supply the tenants and the fact that the electrical infrastructure, beyond Con Edison's system, is managed and maintained independently.

For more information visit

edc.nyc/HuntsPointResiliency