City of Hoboken, New Jersey
Proposed Stormwater Management Plan
Health Impact Assessment (HIA)

Final Report

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DISCLAIMER

The authors of this report are solely responsible for the accuracy of the data, statements and interpretations contained in this document. The views expressed are those of the authors and do not necessarily reflect the views of Project Steering Committee, the City of Hoboken, the Health Impact Project, The Pew Charitable Trusts or the Robert Wood Johnson Foundation.

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EXECUTIVE SUMMARY

Hurricane Sandy made landfall near Atlantic City, New Jersey on October 29, 2012. The storm battered the State with hurricane force winds and record storm surge; resulting in 34 fatalities and damage in excess of an estimated $60 billion in property, infrastructure and related economic losses. A significant proportion of these damages were sustained in coastal areas in the northern and central parts of the State, including the City of Hoboken, located along the Hudson River in Hudson County, New Jersey. The human health impacts of Hurricane Sandy were significant and continue today, more than three years after the storm.

There are a multitude of decisions made by jurisdictions, government agencies, and individuals as part of disaster recovery efforts in the immediate aftermath of the storm and in the months and years that follow. Virtually every decision made in the disaster recovery process has the potential to impact human health. This Health Impact Assessment (HIA) examines the potential positive and negative health consequences of implementing green infrastructure-based stormwater management strategies to address chronic flooding and combined sewer system (CSS) back-ups and overflows in the City of Hoboken.

The geographic scope of the HIA included all neighborhoods in the city; however, special attention was given to the areas of the city most impacted by repetitive flooding and CSS back-ups and overflows. These areas include several neighborhoods in the low-lying western part of Hoboken. Although virtually every city resident is impacted by flooding in some way, within the parts of the city most frequently flooded, low-income individuals and families, older adults, and persons with disabilities were considered to be particularly vulnerable to the negative impacts of flooding and its associated health effects.

For the purposes of the HIA, the following health determinants/pathways were investigated:

1. Exposure to flooding and CSS back-ups/overflows
2. Access to natural features and greenspace
3. Changes in air quality
4. Changes in water quality
5. Changes in urban heat island
6. Exposure to standing water
7. Exposure to contaminated soil
8. Changes to economic conditions, including: access to “green” jobs, property values & rents, energy costs, municipal maintenance costs and taxes
9. Other exposure hazards, including: trip and fall incidents; pests/vermin, graffiti/crime and accumulation of trash/litter

The HIA was supported by a robust program of community and stakeholder engagement, including: an HIA advisory committee made up of Hoboken officials, non-profit leaders and residents; structured interviews with local officials and other stakeholders; resident focus groups; a community-wide resident survey; a pop-up kiosk at a local supermarket; and briefings at public meetings of the Hoboken Planning Board and City Council. Other research methods included a comprehensive literature review and analysis of secondary data.

Key Findings:

- According to the U.S. Census Bureau, Hoboken is home to more than 53,000 residents. The city's population is younger than that of Hudson County or New Jersey as a whole and Hoboken residents are also wealthier, with household incomes well above the average for Hudson County and New Jersey. Approximately 12 percent of the city's residents live in poverty.
- The overall health status of Hoboken residents that completed the community-wide survey conducted as part of the HIA assessment phase is higher than that of Hudson County and New Jersey residents. With the exception of two conditions–asthma and depression–Hoboken residents that completed the survey report lower rates of most chronic disease when compared to Hudson County and New Jersey. These results are consistent with research that shows that younger people and people with higher incomes generally report being in better overall health.
- The State of New Jersey has experienced a statistically significant increase in total precipitation over the past several decades. In addition, the northeast region of the United States has seen a 71 percent increase in heavy precipitation events over the past 40 years. On average, the City of Hoboken receives more than 45 inches of precipitation annually. As a result of these conditions, combined with the city's elevation and topography, parts of Hoboken flood regularly, especially during periods of heavy rainfall and high tide.
- Empirical data on flood frequency in Hoboken was confirmed and supported by data collected in 2015 by a community-wide resident survey conducted as part of the HIA assessment phase. When asked how often regular flooding occurs in the city, 75 percent of survey respondents reported experiencing flooding more than three times per year on average. Another 17 percent reported experiencing flooding 2-3 times per year. When asked how often they were personally impacted by flooding in the city, nearly one quarter (22 percent) reported every time it rains, while 50 percent reported being impacted only during heavy rainstorms. Twenty percent of survey respondents reported being personally impacted by flooding more than three times in the past two years.
- The majority of residents living in poverty and other lower-income Hoboken residents live in low-lying areas which are more susceptible to frequent flooding and CSS back-ups. This includes a significant portion of Hoboken Housing Authority facilities and other HUD-subsidized housing units. Based on data from the community-wide survey, these groups are disproportionately impacted by repetitive flooding in the city.
- The potential impacts of flooding on human health include: infectious disease, respiratory conditions, injury and death by drowning.
- Flooding in Hoboken is often accompanied by CSS back-ups and overflows. As such, the potential exists for Hoboken residents to come in contact with untreated human and industrial waste, toxic materials, and debris found in stormwater runoff. Exposure to the pollution caused by CSS back-ups and overflows can have significant direct impacts on human health. Such impacts can include symptoms such as vomiting, diarrhea, dehydration, respiratory illness, fever, dysentery or even death associated with exposure to pathogens such as bacteria, protozoans and viruses.
- Among the Hoboken residents that completed the HIA community-wide survey, the most frequently cited impact of flooding was sewer back-ups near residents' homes. Sixty percent of survey respondents listed sewer back-ups as a problem when it floods. As a consequence of coming in contact with

contaminated flood waters or sewer back-ups, nearly one third of survey respondents (28 percent) reported experiencing one or more of the following symptoms: headaches; vomiting; abdominal cramping, nausea, or diarrhea; muscle aches; eye irritation/infection; asthma or other respiratory condition; or skin rash. Fifteen percent of respondents reporting seeking medical attention as a result of experiencing one or more of the symptoms.

- A significant number of survey respondents reported an increase in unhealthy personal behaviors immediately before, during and/or immediately after flooding events. Half or more of survey respondents reported engaging in unhealthy behaviors such as eating more junk food, consuming more alcohol, and exercising less. In addition, nearly two-thirds of survey respondents (65 percent) reported experiencing flooding-related stress or anxiety and nearly half (49 percent) reported problems sleeping.

- Several groups living in the city were identified as potentially more vulnerable to the impacts of flooding. These groups include low-income residents, people with disabilities, and older residents. Data from the community-wide survey indicates that these populations experience disparate impacts from flooding. Thirty-six percent of survey respondents in these groups reported being impacted every time it floods compared to 20 percent of the general population. Of those that were impacted by flooding at least one time in the past two years, 24 percent of vulnerable populations reported that their apartment/house was damaged. This compares to 13 percent of the general population. In terms of disruption, vulnerable populations were consistently more likely to report having difficulty attending to activities of daily life such as picking up prescriptions, getting to doctor/medical appointments, picking up food and groceries, and getting to work or school.

- The primary goal of Hoboken's proposed stormwater management plan and ordinance amendments is to reduce flooding and CSS back-ups and overflows in the city. There is a growing body of research that suggests installing green infrastructure best management practices (BMPs) can be an effective way to reduce flooding and stormwater flows entering CSSs during wet weather. In fact, data reviewed for this HIA confirms that the volume of stormwater flow reduction feasible if green infrastructure BMPs were deployed in a manner consistent with the Hoboken Green Infrastructure Strategic Plan exceeds that necessary to mitigate flooding events that have recently occurred in Hoboken.

- The evidence that green infrastructure BMPs can substantially reduce flooding and the volume and flow of stormwater entering the CSS and thereby reduce or eliminate CSS back-ups and overflows is strong. It is very likely that adoption and implementation of Hoboken's proposed stormwater management plan and ordinance will help to significantly reduce flooding and CSS back-ups and overflows. The magnitude of the potential health benefits that may result from fewer flooding and CSS events is high. With proper construction, management and maintenance of the green infrastructure BMPs deployed in the city, the duration of flood mitigation, improved CSS performance and associated health benefits can be long-lasting.

- In addition, given the fact that the some of the areas most affected by flooding and CSS events are where lower-income residents live, the potential distribution of benefits derived from less flooding and improved CSS performance has the potential to be restorative, addressing long-standing disparate impacts from flooding in the city.

- In addition to helping to reduce flooding and CSS back-ups and overflows, there is evidence that implementation of green infrastructure BMPs may result in various changes to the natural, built and social environment that can have positive health consequences. At the same time, some of these changes may also pose minor health risks.

Table ES-1 characterizes the potential health effects that may result from implementing green infrastructure BMPs in Hoboken.

Table ES-1. Assessment and Characterization of the Potential Health Consequences/Outcomes Of Implementing Green Infrastructure BMPs in Hoboken

Health Determinant	Likelihood Health Effect Will Occur	Direction of Health Effect	Magnitude of Health Effect	Duration	Distribution of Health Effects	Evidence Strength
Flood management	Very likely	Positive	High	Long	Restorative effects	Strong
Management of CSOs	Very likely	Positive	High	Long	Restorative effects	Strong
Management of CSS back-ups	Very likely	Positive	High	Long	Restorative effects	Strong
Access to green space	Very likely	Positive	Moderate	Long	Even	Limited
Standing water	Likely	Positive & Negative	Moderate	Long	Disprop. harm	Limited
Air quality	Likely	Positive & Negative	Moderate	Long	Even	Limited
Urban heat island	Very likely	Positive	Moderate	Long	Even	Strong
Water quality	Very likely	Positive	Low	Long	Even	Strong
Soil Quality	Possible	Negative	Moderate	Long	Even	Mixed
Economic conditions:						
- **Access to "green" jobs**	Possible	Positive	Moderate	Medium	Restorative effects	Limited
- **Property values/Rents**	Possible	Positive & Negative	Low	Long	Even/Disprop. harm	Limited
- **Energy costs**	Possible	Positive	Low	Long	Even	Limited
- **Taxes**	Possible	Positive & Negative	Low	Long	Disprop. harm	Limited
Other exposure hazards:						
- **Trip and fall**	Possible	Negative	Low	Long	Even	Limited*
- **Pests/vermin**	Likely	Negative	Low	Long	Even	Limited*
- **Graffiti/crime**	Possible	Negative	Low	Long	Disprop. harm	Limited*
- **Trash/litter**	Likely	Negative	Low	Long	Even	Limited*

Notes: *Evidence is based primarily on resident and stakeholder input related to past experiences with parks and recreational facilities in the city and personal concerns about green infrastructure implementation. There was very limited or no evidence found in the literature regarding these potential exposure hazards.

Conclusion and Recommendations:

It is clear from the HIA that implementation of Hoboken's proposed stormwater management plan and ordinance amendments may have a variety of positive health outcomes. Most importantly, implementation of green infrastructure BMPs, when combined with the NHSA's construction of wet weather pump stations, has the potential to substantially reduce flooding and CSS back-ups and overflows in the city. Fewer flooding and CSS events can have a range of positive health effects. Implementation of green infrastructure BMPs may also have a number of health-related co-benefits and some minor risks.

The recommendations developed as part of the HIA process are aimed at maximizing the potential health benefits and minimizing/mitigating the potential health risks associated with the decision to implement green infrastructure city-wide. The recommendations are based on the findings of the HIA impact analysis, current effective practices and local knowledge. Every effort was made to ensure that the recommended actions are: specific; responsive to predicted impacts; technically feasible; and within the authority of Hoboken officials, representatives from the NHSA and other implementation partners. The recommendations are as follows:

1. **Ensure the longevity of potential BMP benefits as well as public safety/enjoyment with careful design, monitoring and a robust program of on-going maintenance.**
    a) Incorporate clear and consistent green infrastructure inspection and maintenance requirements in city's stormwater management plan and ordinance.
    b) Develop a checklist of design and siting considerations for each type of BMP being considered for implementation. The checklist should be informed by the potential health benefits and risks highlighted in the HIA.
    c) Require owners of green infrastructure BMPs to prepare and implement a green infrastructure operations and maintenance plans that includes regular monitoring and inspections; vegetation management, cleaning; soil testing (where appropriate), and vermin/insect control procedures. The plans should have specific standards, procedures and maintenance schedules for each type of BMP constructed.
    d) Provide funding to support adequate operations and maintenance. Funding and implementation of operations and maintenance should take advantage of public-private partnerships where feasible.
    e) If green infrastructure BMPs are to be implemented by entities other than the city, city officials should put in place an appropriate oversight mechanism to ensure green infrastructure BMPs are properly designed, constructed, and maintained.
    f) Develop and implement a training and education program for the city's public works personnel on the proper care and maintenance of green infrastructure BMPs. The findings of the HIA should be incorporated in the training curriculum. Where feasible, utilize existing training programs and resources.
    g) If contractors are used to construct, operate and maintain green infrastructure on public property, ensure that workers are specifically trained and certified in green infrastructure construction, operations and maintenance and give preference to those companies that employ Hoboken residents.
    h) Require the hiring of trained and certified contractors to install and maintain publically-funded green infrastructure on private property.

2. **Ensure that the co-benefits of green infrastructure BMPs accrue equitably throughout the city.**
    a) Locate green infrastructure BMPs where they can provide the most significant stormwater management/flood reduction benefit, while remaining aware of the distribution of co-benefits to be derived from specific BMPs.
    b) Use GIS software and mapping to analyze the "benefit buffers" associated with each BMP in relation to where it is to be constructed. Overlay the benefit buffers with population data to ensure that potential co-benefits and risks are shared across neighborhoods and sub-populations.
    c) To the extent feasible given engineering and fiscal constraints, use green infrastructure BMPs to improve neighborhood conditions and minimize potential risks in areas where vulnerable populations live, especially in lower income neighborhoods.

3. **Leverage investment in green infrastructure construction, operations and maintenance to grow jobs and provide career pathways for city residents, especially low-income populations.**
    a) Generate opportunities for local workers and local businesses to participate in green infrastructure implementation by inserting community benefit strategies into green infrastructure installation and maintenance contracts.

b) If green infrastructure operations and maintenance responsibilities will be outsourced, consider partnering with local workforce development programs and/or giving preferences to local companies or those that hire local workers.

4. **Magnify the benefits of green infrastructure BMPs by expanding implementation throughout North Hudson Sewerage Authority (NHSA) service area and beyond.**
    a) NHSA should include a robust program of green infrastructure implementation as part of its Long Term Control Plan to manage CSS overflows. This should include construction, operations and maintenance of green infrastructure BMPs throughout the NHSA service area.
    b) Share and present the findings and recommendations of the HIA to elected officials, planning board members, local health officials and the public in Union City, Weehawken and West New York as well as Hudson County government. This can help to build support for green infrastructure implementation in communities outside of Hoboken.
    c) Create opportunities for peer-to-peer exchange between elected and appointed officials from Hoboken, Union City, Weehawken and West New York to explore opportunities for green infrastructure collaboration.
    d) Work with Hudson County officials to promote green infrastructure implementation county-wide. Toward this end, Hudson County should incorporate green infrastructure implementation as a strategy in the Hudson County Multi-jurisdiction Hazard Mitigation Plan.

5. **Expand public outreach and engagement to ensure more residents are aware of the city's efforts to implement green infrastructure and understand potential benefits and risks.**
    a) Use the HIA final report and executive-level briefing materials as a platform to expand public outreach and engagement related to the pending decision on adopting the proposed stormwater management plan amendments and ordinance.
    b) Develop a traveling booth display that can be used during community events, fairs, etc.
    c) Work with the Hoboken Board of Education to sponsor a poster or video contest on green infrastructure benefits and risks. The HIA final report and briefing materials can be used to develop a short curriculum for students on flooding and CSS events and how green infrastructure is being used to improve stormwater management in Hoboken and make the city more resilient.
    d) Partner with the Hoboken Housing Authority to foster greater awareness regarding green infrastructure benefits and risks among housing authority residents.
    e) Partner with community-based organizations working in Hoboken to increase green infrastructure awareness among other vulnerable populations, including seniors and people with disabilities.

6. **Develop and implement a monitoring and evaluation program to track green infrastructure performance and health outcomes over time.**
    a) Create and maintain a GIS inventory and database of public and private green infrastructure BMPs. The inventory should include: basic information regarding the BMP such as: type, ownership, geographic location, materials used, and other relevant descriptive characteristics; information regarding the expected performance characteristics such as stormwater storage/removal capacity and anticipated co-benefits, inspection and maintenance requirements; and actual performance monitoring data.
    b) Establish a green infrastructure implementation advisory committee to develop consensus on a manageable set of performance indicators and metrics. The selection of indicators should be informed by the findings of the HIA and include metrics in the following categories: stormwater

management/flood reduction; exposure and access to green space/natural features; water quality; soil quality; air quality/heat island; change in household and community economic conditions; exposure to other hazards.

c) Utilize the NHSA Long Term Control Plan process to support green infrastructure monitoring and evaluation. This should include data collection and reporting consistent with the green infrastructure monitoring and evaluation program.
d) Partner with Hoboken University Medical Center and North Hudson Community Action Corporation Health Center to collect and report data consistent with the green infrastructure monitoring and evaluation program.
e) Conduct a bi-annual community-wide resident survey to track resident experiences, perceptions and opinions of green infrastructure implementation and performance and associated health-related effects.

CHAPTER 1: BACKGROUND AND INTRODUCTION

Background

Hurricane Sandy made landfall near Atlantic City, New Jersey on October 29, 2012. The storm battered the State with hurricane force winds and record storm surge; resulting in 34 fatalities and damage in excess of an estimated $60 billion in property, infrastructure and related economic losses. A significant proportion of these damages were sustained in coastal areas in the northern and central parts of the State. The human health impacts of Hurricane Sandy were significant and continue today, more than three years after the storm.

In the aftermath of the storm, national tracking surveys used to gauge the health and well-being of U.S. residents found that people residing in areas most impacted by Sandy showed a decrease twice the national average, in exercise activities for the fall and winter seasons immediately following the storm. Other healthy behavior indicators also showed differences, including a decrease in healthy eating and an increase in unhealthy habits such as smoking (1). In Hudson County, data collected by the Hudson Regional Health Commission found a combined 15 percent drop in people reporting that they were in "good" or "very good" health (2). The data also showed a combined 29 percent decrease in respondents reporting "good" or "very good" emotional health (2).

There are a multitude of decisions made by jurisdictions, government agencies, and individuals as part of disaster recovery efforts in the immediate aftermath of the storm and in the months and years that follow. Examples include: where and how to build back housing and infrastructure; what social services are needed to assist disaster victims; how can and should ecosystems be best restored? Virtually every decision made in the disaster recovery process has the potential to impact human health.

The Health Impact Project, a collaboration of the Robert Wood Johnson Foundation (RWJF) and The Pew Charitable Trusts (Pew), promotes the use of Health Impact Assessments (HIAs) and related approaches to help policy-makers in a wide range of fields incorporate health considerations into new policies, programs, plans, and projects, and make decisions that reduce unnecessary health risks, improve health, and decrease costs (3). In 2014, a research team led by the Edward J. Bloustein School of Planning and Public Policy at Rutgers University received funding from The Health Impact Project to explore how HIA could be used as a tool to inform disaster planning and recovery decision-making.

The project, which is one of the first times that HIA was applied to disaster recovery decision-making in the United States, included two HIAs[1]. One examined the potential health-related impacts associated with voluntary property buy-out scenarios in a flood prone neighborhood in Little Egg Harbor, Ocean County, New Jersey. The second–which is the subject of this HIA final report–assessed the potential health impacts of implementing green infrastructure-based stormwater management strategies to address chronic flooding in Hoboken, Hudson County, New Jersey. Both communities were severely impacted by Hurricane Sandy. The project also developed a toolkit that municipalities can use to integrate HIA into local decision-making as part of the Sustainable Jersey™ municipal certification program and made overarching recommendations for how the practice of HIA can be integrated into post-disaster planning and decision-making in the United States.

[1] The U.S. Environmental Protection Agency is also conducting an HIA in the context of Sandy-related recovery and resiliency planning in Suffolk County, NY. The HIA will evaluate potential beneficial and adverse impacts to health that may result from the proposed code changes regarding onsite sewage disposal systems (OSDS) for residential properties.

Flooding in Hoboken

The City of Hoboken is located along the Hudson River, just a few nautical miles from the Atlantic Ocean. When Hurricane Sandy impacted New Jersey in October of 2012, coastal storm surge flooded more than 75 percent of the city's land area. However, due to the city's topography, flooding is not only a concern during catastrophic storms; it is also a chronic problem. Flooding is a common occurrence in the city.

Hoboken was once an island surrounded by the Hudson River to the east and tidal marsh on its western edge. The tidal marsh was drained and filled in the mid-1800s. Today, parts of western Hoboken still lie near or below sea level. During periods of heavy rain and high tide in the Hudson River, water cannot drain into the river, causing some streets and neighborhoods to flood (4). The topography of the city is depicted in Figure 1 with arrows showing the directional flow of stormwater runoff. The areas in light blue show the lowest-lying, most flood prone parts of the city. Streets marked in blue are those most frequently inundated with floodwaters.

According to a recently completed study, "between July 2002 and July 2012 the city recorded 26 dates with greater than 2 inches of precipitation and tides of 4 feet or higher (5). Figure 2 shows just a handful of recent flooding events in the city. A recent severe flooding event occurred in May of 2015. As shown in Figure 3, low-lying areas of western Hoboken were inundated with flood waters.

Source: Hoboken Green Infrastructure Strategic Plan

Figure 1. Hoboken Topography Overlaid with Water Flow & Recurring Flooded Streets

Source: City of Hoboken

Figure 2. Recent Flooding Events in Hoboken

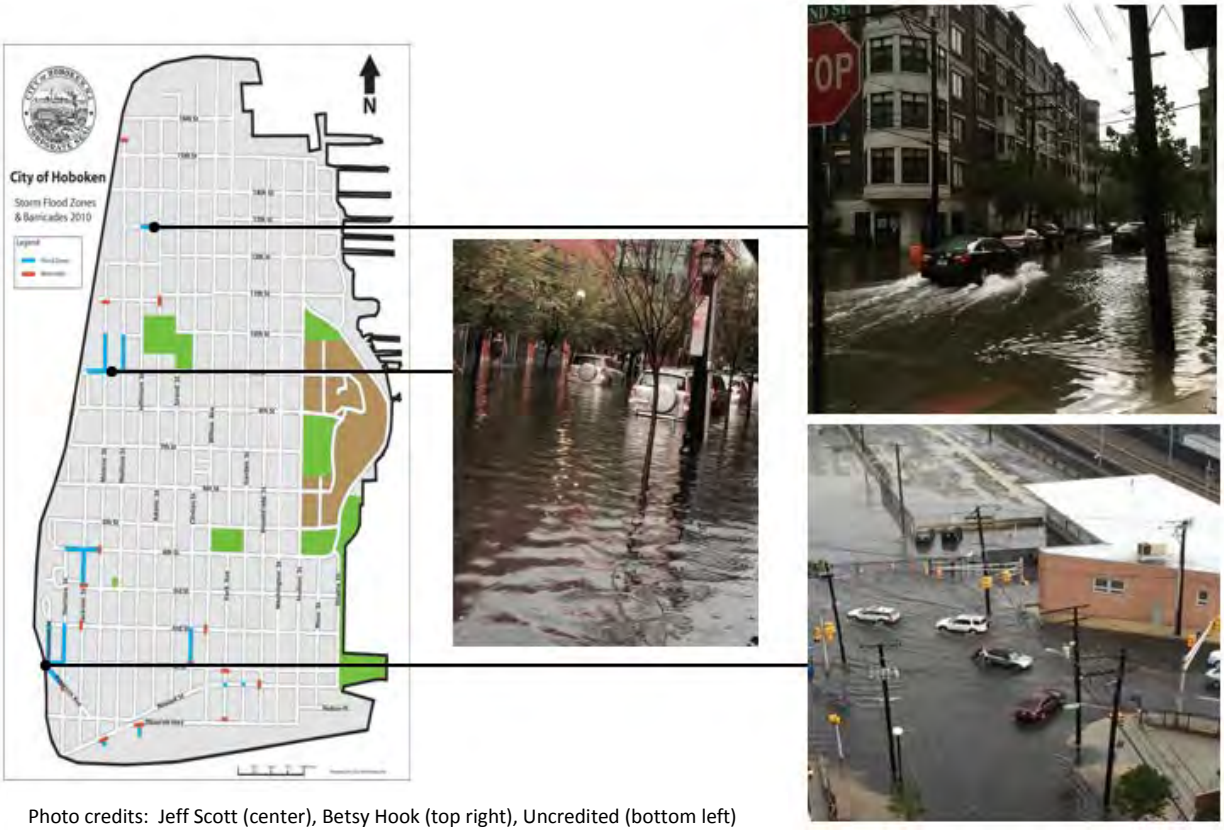
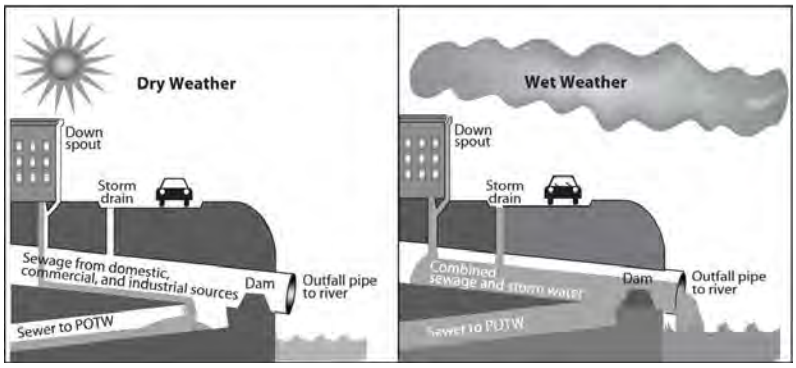


Photo credits: Jeff Scott (center), Betsy Hook (top right), Uncredited (bottom left)

Figure 3. Flooding in Hoboken, May 31, 2015

Hoboken's Combined Sewer System

Wastewater treatment for the City of Hoboken is provided by North Hudson Sewerage Authority (NHSA), which also serves the communities of Union City, Weehawken and West New York. The NHSA operates a Combined Sewer System (CSS). As illustrated in Figure 4, Combined Sewer Systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. During periods of heavy rainfall and high tides in Hoboken, the volume of water flows entering the combined sewer system exceeds the capacity of the NHSA's treatment plant. This results in CSS back-ups that overflow into city streets and the basements of private property and discharge untreated wastewater directly to the Hudson River. These back-ups and overflows contain not only stormwater but may also contain untreated human waste, toxic materials, and debris from runoff. In October of 2015, the New Jersey Department of Environmental Protection issued a final renewal permit to the NHSA that requires the Authority to submit monthly discharge monitoring reports and develop a Long Term Control Plan (LTCP) that will result in a substantial reduction or the elimination of combined sewer overflows. The LTCP must be submitted for State approval by June 1, 2020 (6).



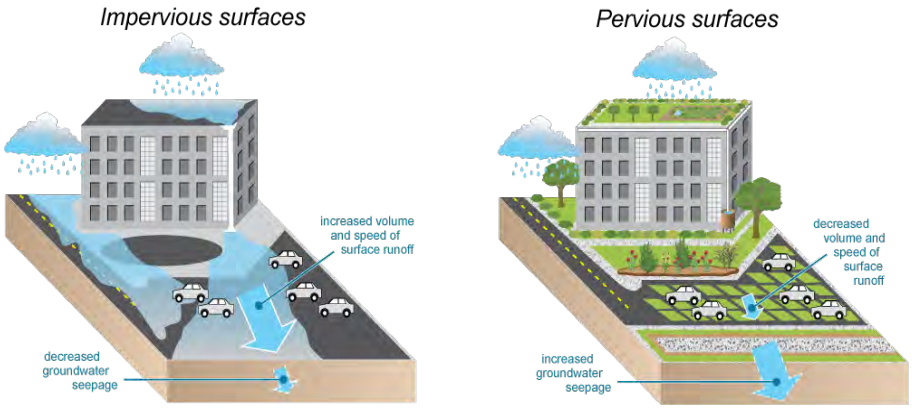
Source: U.S. Environmental Protection Agency

Figure 4. Combined Sewer Systems

Managing Stormwater with Green Infrastructure

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, the water is absorbed and filtered by soil and plants. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems, including combined sewer systems, and/or discharged directly into nearby water bodies. Stormwater runoff often carries trash, bacteria, heavy metals, and other pollutants from the urban landscape into the combined sewer system or other collection system. When the polluted stormwater is discharged, it can degrade the quality of the receiving waters. Higher amounts of rainfall can also cause erosion and flooding in streets and urban streams, damaging habitat, property, and infrastructure.

As shown in Figure 5, green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments.

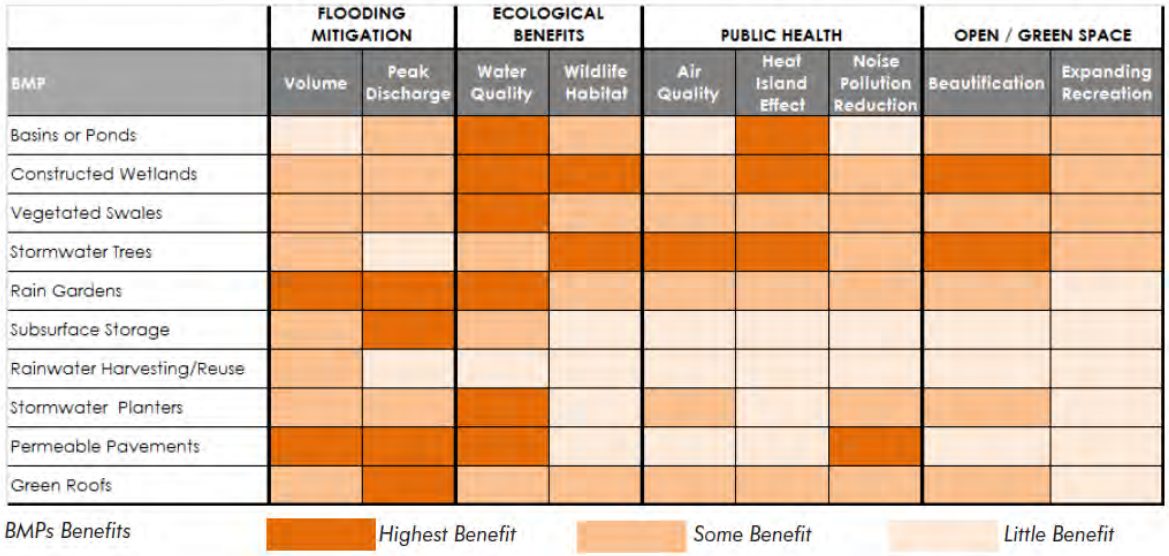


Conceptual diagram illustrating impervious and pervious surfaces. Impervious surfaces are hard and increase stormwater runoff, causing pollutant and sediment delivery in downstream waters. Pervious surfaces are soft and decrease stromwater runoff, which filters out pollutants and sediments before they arrive in downstream waters.
Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Chesapeake and Atlantic Coastal Bays Trust Fund, 2013. Stormwater Management: Reducing Water Quantity and Improving Water Quality. IAN press, newsletter publication.

Source: U.S. Department of Environmental Protection

Figure 5. How Green Infrastructure Works

At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water. (7) Green Infrastructure Best Management Practices (BMPs) can help reduce flooding, provide ecological benefits, improve public health and increase the amount of open/green space in a community (See Figure 6).



Source: Hoboken Green Infrastructure Strategic Plan Final Report, 2013

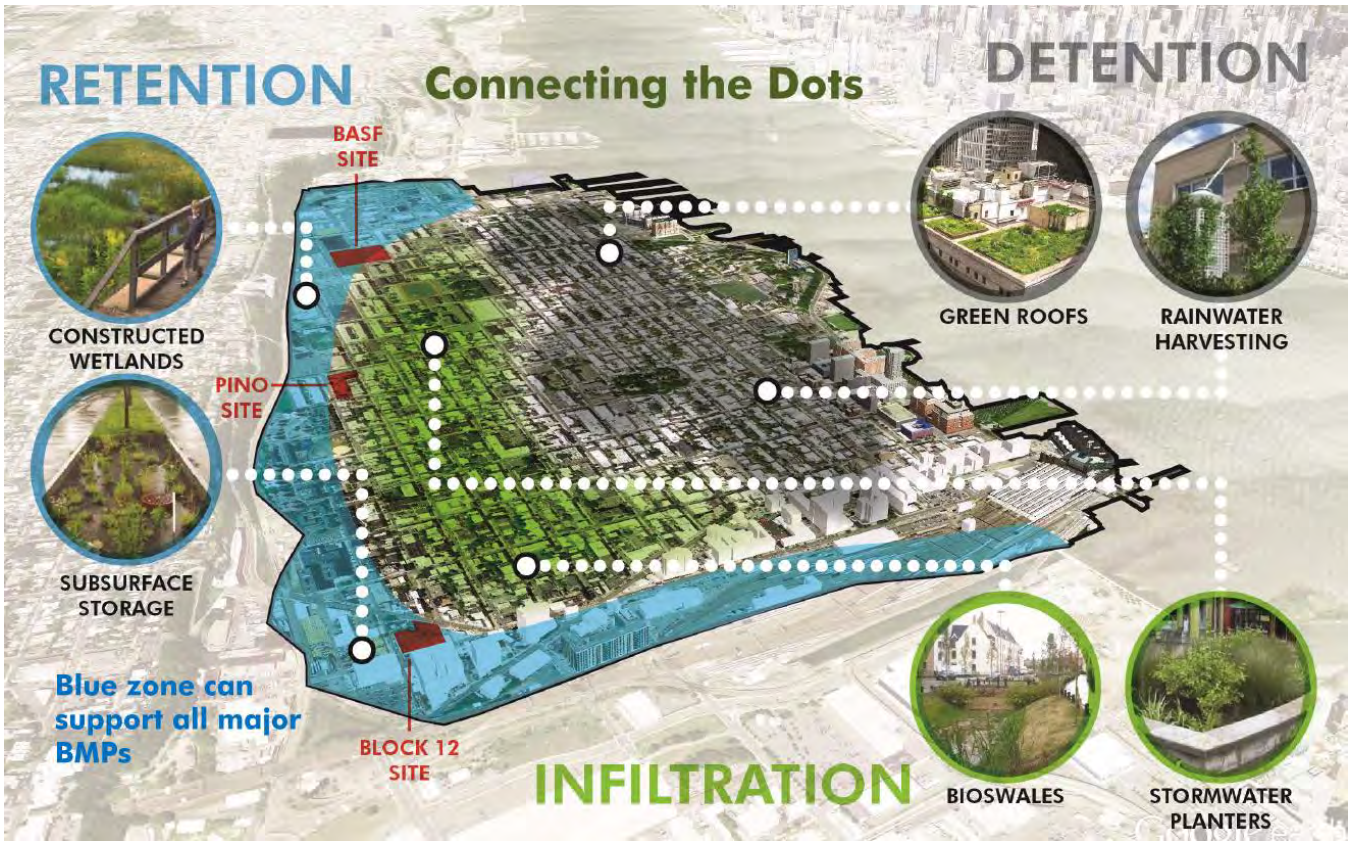
Figure 6. Potential Benefits of Green Infrastructure BMPs

Hoboken's Proposed Stormwater Management Plan and Ordinance Amendments

In 2013, Hoboken received a technical assistance grant from Together North Jersey–a U.S. Department of Housing and Urban Development (HUD)-funded regional planning partnership–to develop the ***Hoboken Green Infrastructure Strategic Plan.*** The plan:

- Creates a framework for green infrastructure implementation on both a city-wide and district by district basis;
- Identifies a suite of cost-effective, place-based stormwater best management practices (BMP) the city can employ to address stormwater management and the anticipated increase in frequency of future flooding events;
- Locates and prioritizes infrastructure assets most in need of protection; and
- Recommends a set of strategies the city can employ to implement the Plan.

The green infrastructure strategy proposed in the plan focuses on implementation of a variety of green infrastructure best management practices to reduce and manage stormwater runoff. The strategy organizes the city into three zone with recommendations regarding the appropriateness of different green infrastructure BMPS for each zone (See Figure 7 and Table 1).



Source: Hoboken Green Infrastructure Strategic Plan Final Report, 2013

Figure 7. Hoboken Green Infrastructure Strategy

Table 1. Hoboken Green Infrastructure Strategy BMPs by Zone

Green Infrastructure BMP	Gray Zone: Detention	Green Zone: Infiltration	Blue Zone: Retention
Rainwater harvesting	✓		
Green roofs	✓		
Bio-swales		✓	
Permeable Pavement		✓	
Rain gardens		✓	
Stormwater infiltration planter/Tree pits		✓	
Basins or Ponds		✓	✓
Subsurface storage		✓	✓
Constructed wetlands			✓

The Green Infrastructure Strategic Plan recommends that the city develop and adopt an amended stormwater management element to the city's Master Plan and a new stormwater management ordinance designed to facilitate implementation of green infrastructure BMPs city-wide as a way to mitigate flooding and reduce CSS events. Amendments to the city's current stormwater management plan element and stormwater ordinance are now pending before the Planning Board and City Council and are the subject of this HIA.

About Health Impact Assessment

Health Impact Assessment (HIA) is a fast-growing practice in the United States that provides practitioners and policymakers with a tool to consider the health outcomes of decisions. The National Research Council of the National Academies defines HIA as "… a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects."

According to the Health Impact Project, HIAs:

- Look at health from a broad perspective that considers social, economic and environmental influences;
- Bring community members, business interests and other stakeholders together, which can help build consensus;
- Acknowledge the trade-offs of choices under consideration and offers decision makers comprehensive information and practical recommendations to maximize health gains and minimize adverse effects;
- Put health concerns in the context of other important factors when making a decision; and
- Consider whether certain impacts may affect vulnerable groups of people in different ways.

As shown in Figure 8, HIAs typically include six steps: Screening, Scoping, Assessment, Recommendations, Reporting and Evaluation.

Rebuild By Design

Hoboken's green infrastructure initiatives are being undertaken within the context and in support of other concurrent and complementary resiliency planning activities, including ***Rebuild by Design***, which began as a design competition run by the U.S. Department of Housing and Urban Development (HUD) in the aftermath of Hurricane Sandy. The competition has transformed into "an innovative process that places local communities and civic leaders at the heart of a robust, interdisciplinary, creative process to generate implementable solutions for a more resilient region." With Hurricane Sandy recovery funding provided by HUD, regional partners are pursuing implementation of a comprehensive urban water strategy designed to make the Hoboken, Jersey City and Weehawken more resilient to flooding, coastal storm surge and sea-level rise. The strategy– which is known as "Resist, Delay, Store, Discharge"– will "deploy programmed hard infrastructure and soft landscape for coastal defense (resist); policy recommendations, guidelines, and urban infrastructure to slow rainwater runoff (delay); a circuit of interconnected green infrastructure to store and direct excess rainwater (store); and water pumps and alternative routes to support drainage (discharge)."

Source: http://www.rebuildbydesign.org/

Figure 8. The Six Steps of Health Impact Assessment

About this Report

The purpose of this HIA is to inform the stormwater management planning process as well as the decision-making of the Hoboken City Council as it considers a comprehensive stormwater management ordinance. The HIA considers the possible health effects of flooding and potential exposure to polluted stormwater from combined sewer system back-ups and overflows, as well as the potential effects associated with implementing green infrastructure solutions to address these problems.

This report presents the findings and recommendations of the HIA organized generally around the steps of the HIA process. ***Chapter 2*** presents the results of the HIA screening phase. ***Chapter 3*** describes the scope of the HIA in terms of study area, temporal boundaries, potentially impacted populations, and the potential health effects of implementing green infrastructure best management practices to reduce flooding in the city. ***Chapter 4*** provides an overview of the stakeholder engagement activities conducted throughout the HIA process. ***Chapter 5*** presents the methods used and findings from the HIA assessment phase. ***Chapter 6*** presents a series of recommendations aimed at maximizing the beneficial health effects of implementing green infrastructure BMPs in Hoboken as well as ways to minimize any potentially negative effects. ***Chapter 7*** describes the how the results of the HIA were disseminated and finally ***Chapter 8*** lays out a plan for monitoring and evaluating the short and longer term effects of implementing the proposed stormwater management plan over time.

CHAPTER 2: HIA SCREENING AND PRE-SCOPING PHASE RESULTS

The screening/pre-scoping process for this HIA included consultations with city officials and representatives from Princeton Hydro, the consultant team hired to prepare the city's stormwater management plan amendments. Princeton Hydro's contract covered several elements designed to address flooding issues including continuity of operations, all hazards planning, and development of a stormwater management plan and associated ordinance amendments. As noted previously, this HIA focused only on the proposed stormwater management plan.

As described in more detail in Chapter 3, the purpose of the stormwater management plan amendments is to facilitate implementation of green infrastructure BMPs city-wide. According to city officials, potential health impacts of implementing green infrastructure strategies were not being considered as part of Princeton Hydro's consultant work or the city's deliberations regarding adoption of a stormwater management plan and ordinance.

Adoption of a city-wide stormwater management plan will be accomplished by amending the city's current Master Plan to incorporate this new element and adoption of a new stormwater management ordinance. The first action will require approval by the City Planning Board. Subsequently, the City Council will need to take action to replace the city's current ineffective stormwater management ordinance with a new ordinance intended to implement the recommendations set for in the Master Plan Stormwater Management element.

HIA screening seeks to answer a number of threshold questions to determine the feasibility and efficacy of completing an HIA. These questions and answers are reported below.

- ***What project or decision will the HIA address or inform?*** The primary decision to be addressed by the HIA is adoption of stormwater management plan element to the city's Master Plan, and subsequently, adoption of an updated stormwater management ordinance.
- ***Who are the decision-makers?*** The Hoboken Planning Board is the decision-making body that will take action on adoption of the Stormwater Management Plan. The Hoboken Mayor and City Council are the decision-makers that will take action regarding the adoption of a stormwater management ordinance.
- ***How important to health is the project or decision?*** The combined effects of frequent and persistent flooding and associated Combined Sewer System (CSS) back-ups and overflows are significant hazards in Hoboken. The health risks associated with both are also significant as are the potential health benefits of mitigating flood hazards and less frequent CSS events.
- ***Will the HIA provide new and important information to inform decision-makers?*** Currently, health impacts are not specifically identified for investigation as part of the stormwater management planning process in Hoboken. The HIA has the potential to provide new and important information to inform decision-makers about both the health risks/impacts of flooding and associated CSS back-ups and overflows on city residents and the potential health benefits and risks of green infrastructure approaches to flood mitigation as part of the planning process.
- ***Under what time frame will the decisions be made?*** The Hoboken Stormwater Management Plan will be completed by fall 2015. Decisions related to which mitigation strategies to recommend in the plan are on-going. The Hoboken Planning Board and other stakeholders will consider whether to accept the recommendations, adopt the plan and move forward with implementation in late 2015 or early 2016.

- ***What data or evidence is available to support the HIA analysis?*** A number of past studies have documented the extent and nature of flooding in Hoboken as well as potential mitigation strategies that can be used to address flooding city-wide. Past studies include a variety analyses completed by the North Hudson Sewerage Authority, the Hoboken Green Infrastructure Strategic Plan, the Rebuild By Design disaster recovery design competition, the Hudson County Multijurisdictional Hazard Mitigation Plan and the on-going work of the Princeton Hydro consultant team. There is also a significant body of literature that explores the potential impacts of flooding on human health. Health data for Hudson County is available from a variety of sources; however city/neighborhood level data is not currently available.

- ***Is an HIA feasible given available resources?*** An HIA is feasible given available resources. The decision process spans approximately 12-18 months. This HIA is supported by grant funding from the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts. A team of researchers with expertise in planning, public engagement, public health and health impact assessment has been assembled to undertake the HIA. The City of Hoboken is a committed partner and has made the Princeton Hydro consultant team available to support the HIA.

Based on the above, the decision was made to proceed with the HIA.

CHAPTER 3: HIA SCOPING PHASE RESULTS

The second step in the HIA process is scoping. Scoping is intended to: identify the range of health effects that will be considered in the HIA; the populations potentially affected by the pending decision; the strategies to be used to engage stakeholders and the public in the HIA process; and the sources of data and the methods to be used to assess potential health risks and benefits.

The Hoboken Proposed Stormwater Management Plan HIA focuses on the problems of repetitive flooding and CSS events (back-ups and overflows). As part of the HIA scoping process, the research team conducted a preliminary review of literature on flood risks and impacts of CSS events on the natural environment and human health to identify the health pathways likely present in the Hoboken context. The research team also met with the HIA advisory committee of local stakeholders to: seek input regarding the specific research questions that can/should to be investigated as part of the HIA; identify the health risks and benefits that may be associated with implementing the stormwater management techniques under consideration; discuss what methods can/should be used to for assessing impacts; and what demographic, geographic and temporal boundaries should be set to help define the scope of the HIA analysis. The sections that follow summarize the results of the HIA scoping phase.

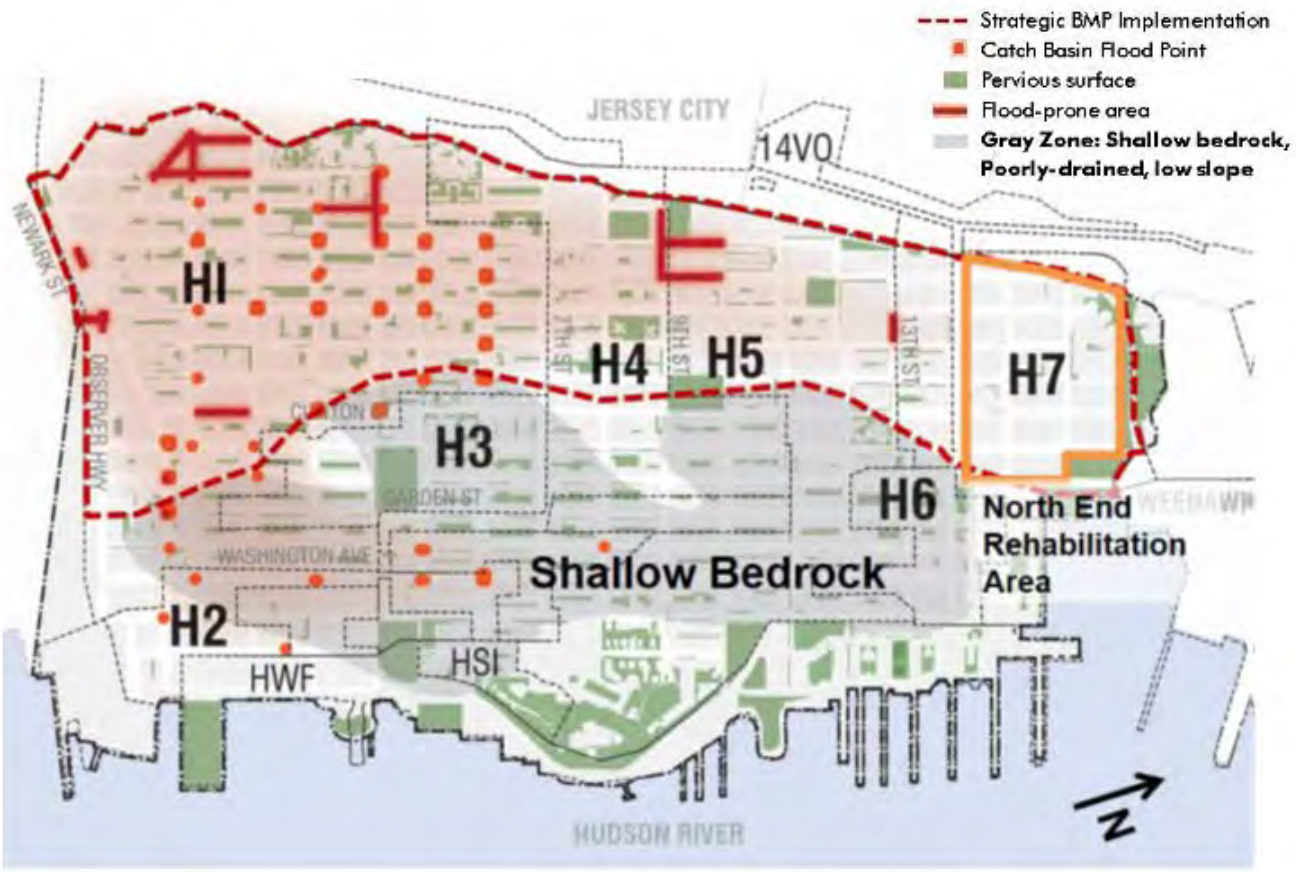
Goals of the HIA

The following goals for the Hoboken Proposed Stormwater Management Plan HIA were developed with input from the HIA advisory committee:

- Understand better the health impacts of flooding and CSS events in Hoboken;
- Understand better the potential health risks and benefits of stormwater management and flood mitigation strategies under consideration;
- Identify the distribution of health impacts related to flooding and CSS events to assess potential inequities in terms of how heath risks and benefits accrue;
- Identify opportunities to maximize benefits and minimize risks associated with implementing proposed green infrastructure approaches to stormwater management;
- Engage with city officials regarding health impact assessment;
- Connect housing authority residents to resiliency planning efforts in the city;
- Influence decision-making related to stormwater management planning in Hoboken and in other jurisdictions;
- Inform the broader context of existing efforts related to hazard mitigation and resiliency planning; and
- Identify opportunities to transfer knowledge and lessons learned during the HIA process to other jurisdictions.

Geography and Focus of HIA

As already described, this HIA focuses on the problem of repetitive flooding and regular inundation from high tides. The geography of the HIA includes the jurisdiction of the City of Hoboken. However, special attention was given to the areas of the city most impacted by repetitive flooding and the impacts of CSOs. These areas include the H1-Southwest Sewershed, the western portions of the H4-Midtown Sewershed, the western portion of the H5-Northwest Sewershed and the H7-Northwest Sewershed. See Figure 9.



Source: Hoboken Green Infrastructure Strategic Plan Final Report, 2013

Figure 9: City of Hoboken Flood Prone Areas

Temporal Scope of the HIA

Full implementation of green infrastructure BMPs in Hoboken will likely take several decades. As such, the potential health benefits and detriments of implementing green infrastructure in the city will be incremental and not fully realized for many years. The HIA will consider both short and longer term impacts from green infrastructure implementation.

Potentially Affected Population

Although virtually every city resident is impacted by flooding in some way, within the parts of the city most frequently flooded, there are a number of groups that may be disproportionately impacted by flooding and its associated effects. These groups include low-income individuals and families, older adults, and persons with disabilities.

Potential Health Determinants

The proposed Hoboken Stormwater Management Plan Amendments Health Impact Assessment (HIA) was conducted to examine the potential positive and negative health effects if the City of Hoboken decides to adopt amendments to the city's stormwater management plan and ordinances that would implement the recommendations of the Hoboken Green Infrastructure Strategic Plan. Implementation of "green infrastructure" BMPs is intended to mitigate chronic flooding in the city and to help reduce the sanitary sewer back-ups and CSS events that often occur along with the flooding. The following is a summary of the potential health effects and outcomes that could result from the decision to move ahead with the stormwater management plan changes as proposed. The health determinants were identified in the literature and by stakeholders participating in the HIA planning process. They include:

1. Exposure to flooding
2. Exposure to Combined Sewer System back-ups and overflows
3. Access to natural features and green landscape
4. Changes in air quality
5. Changes in water quality
6. Changes in urban heat island
7. Exposure to standing water
8. Exposure to contaminated soil
9. Changes to economic conditions:
    a) Access to "green" jobs
    b) Property values
    c) Rents
    d) Taxes
10. Other exposure hazards:
    a) Trip and fall incidents
    b) Pests/vermin
    c) Graffiti/crime
    d) Accumulation of trash/litter

As part of the scoping process the HIA research team developed two health pathway diagrams to guide inquiry during the assessment phase. These are included at the end of the report as Appendix 2: Flooding/CSO health pathways Diagram; and Appendix 2a: Green Infrastructure BMPs Health Pathways Diagram.

CHAPTER 4. STAKEHOLDER ENGAGEMENT

A variety of methods aimed at facilitating public participation in the HIA process were employed in each phase of the HIA. Following is a description of the methods used, the phase of the HIA in which they were employed, and their purposes.

Scoping Phase

During the HIA scoping phase, the project team established and convened an *HIA Advisory Committee*. Advisory committee members were selected for: their knowledge of the community, representation of community interests, understanding of the city's management and administration, emergency preparedness, local business and development interests, provision of essential services, or their experience with community health issues. The advisory committee met one time during this phase for a HIA kick-off workshop. At the meeting, the group identified specific populations for the project team to focus on, including residents in the areas that experience chronic flooding, low-income individuals and families, older adults, and people with Limited English Proficiency. The group also participated in an exercise to identify key health determinants and pathways related to flooding and then added new pathways based on the proposed green infrastructure solutions being contemplated by the city.

Assessment Phase

Focus Groups

During the HIA Assessment Phase, the project team conducted two resident focus groups– one with low-income residents living in Hoboken Housing Authority properties and one with senior citizens aged 65 and over living throughout the city. The purpose of the focus groups was to collect primary data related to flooding experience and its effects on individual health and mental health as well as to solicit community input on potential flood mitigation strategies. The focus groups were intended to ensure for potentially vulnerable populations to provide input into the HIA process.

Community-wide Resident Survey

In addition to the focus groups, the project team also designed and administered a community-wide resident survey. The survey included up to 58 questions addressing respondent's experiences dealing with chronic flooding in Hoboken, the impacts of flooding on their health and well-being, their opinions on green infrastructure, and their general health status. Surveys were available in both English and Spanish. They were delivered in electronic format through the internet and via hard copy surveys distributed through various outlets. These outlets included outreach through project partners and the steering committee as well as media and the delivery of hard copy surveys via government offices, senior housing facilities and private businesses.

Additional outreach was also conducted at the kiosk set up at Shop Rite either directing individuals to the survey website, or providing hard copy surveys in person. The hard copy surveys included an envelope and paid postage for ease of returning the survey. To encourage participation, respondents were provided the opportunity to enter into a random drawing to win a gift card at the end of the survey. The survey opened June 14, 2015 and the last response included in the data analysis was received on August 30, 2015. In total, 395 surveys were completed.

Structured interviews

The project team conducted structured interviews to collect pertinent background information and data related to health and flooding in Hoboken. Individuals that were interviewed included: Frank Sasso from the Hoboken

Health Department; Christina Butieb Bianco from the Hudson Regional Health Commission; Fred Pocci from the North Hudson Sewerage Authority; Vito Veneruso from the North Hudson Community Action Corporation; and Marisa Mustachio Gerke from HOPES CAP.

Advisory Committee Meetings

The advisory committee met three times during the assessment phase (both in-person and web-based formats were used for these meetings). At the meetings, the committee reviewed relevant documents, provided input and came to agreement on items such as the: goals for the HIA; strategy for community outreach, including specific contacts and methods; online survey protocol, questionnaire; and key findings from the survey. The committee members were invaluable in helping the project team recruit individuals for the survey and the focus groups. Individuals with technical expertise on planning and designing green infrastructure recommended specific studies that contributed to the literature review and the draft recommendations.

Hoboken Planning Board Briefing

Also at the beginning of the assessment phase, the project team made a short presentation before the Hoboken Planning Board to brief them on the HIA project and solicit input. Planning board members contributed ideas regarding potentially vulnerable populations to be included in the HIA and suggested health impacts of greatest concern.

Kiosk at Shop Rite

At the recommendation of the advisory committee, the project team set up a kiosk at the ShopRite located on Madison Street in Hoboken on Sunday, June 14. The group selected that location as it attracts a wide array of residents and it is also itself in a highly flood prone part of the city. The kiosk was setup from 10am until 2pm at which time all flyers were distributed. While at the kiosk, the project team members encouraged Shop Rite patrons to participate in the survey handing out hard copy surveys as well as flyers. Flyers were provided in both English and Spanish directing individuals to the web-based survey. In addition to survey outreach, the project team answered questions and received feedback about the project.

Recommendations and Reporting Phase

The advisory committee met twice during the Recommendations Phase. Both meetings were held to review the results of the assessment phase and to discuss preliminary recommendations. The first meeting was in-person and the second was web-based to accommodate the schedules of several committee members. In both cases, the advisory committee provided critical guidance on how to make the information easier to understand and provided a ground-truthing of the scope of the recommendations. The committee met again on February 23, 2016 to review and provide input on the final draft of the HIA report. After incorporating the committee's input, in August 2016, the project team presented the report and recommendations at two public meetings, one before the Hoboken Planning Board and the other before Hoboken City Council. In addition, the HIA final report was disseminated to a range of Hoboken stakeholders and made available to the public on the New Jersey Future and Rutgers University websites. Hard copies were placed at document repositories located at City Hall and the Hoboken Public Library.

CHAPTER 5: HIA ASSESSMENT PHASE FINDINGS

The potential impacts of flooding on human health, including infectious disease, respiratory conditions, injury and death are well documented in the literature (8) (9) (10) (11) (12) (13) (14). In addition, as noted above, flooding in Hoboken is often accompanied by CSS events such as sanitary sewer back-ups and CSOs. During CSS events, the potential exists for humans to come in contact with untreated human and industrial waste, toxic materials, and debris. Exposure to the pollution caused by CSS events can have significant direct impacts on human health. According to the USEPA, such impacts can include symptoms such as vomiting, diarrhea, dehydration, respiratory illness, fever, dysentery or even death associated with exposure to pathogens such as bacteria, protozoans and viruses (8).

In addition to polluted runoff and sewer system back-ups and overflows, flooding creates significant disruptions to community life in the city, including: stranded residents and dislocation; power failure; disruptions of transportation services; disruptions to social services; disruption of police and fire services; and loss of business activity. Such disruptions can have significant negative impacts to physical and mental health (8) (15) (16) (17) (18) (19) (20). On the positive side, green infrastructure solutions to stormwater management problems can improve air quality, reduce heat island effects and improve water quality (21) (22) (23) (24) (25) (26) (27) (28) (29). All of these things can have positive health effects.

As part of the scoping process the HIA research team identified two sets of questions to guide the assessment phase. The first was intended to help the research team understand baseline conditions and foundational relationships related to flooding and flooding/CSS impacts in the City of Hoboken. The second set was more specifically related to how flood mitigation and green infrastructure BMPs may positively and negatively impact human health over time. See Figure 10.

HIA ASSESSMENT QUESTIONS

I. Understanding Baseline Conditions

a. What is the current health status of residents and vulnerable sub-populations?

b. What is the extent of the recurrent flooding problem in Hoboken?

   i. How frequently do flooding events occur and how severe are those events?

   ii. What parts of the city are most impacted and are any populations more acutely impacted than others?

c. How frequently do CSS events occur in Hoboken?

   i. What causes these events to occur?

   ii. Where are CSO discharge outfalls located?

   iii. What is the typical volume of effluent discharged to the Hudson River?

   iv. To what extent do CSS events result in backups in city streets as well as residential and commercial properties?

   v. What contact do residents have with potentially polluted water (e.g., do they swim, boat etc. in areas proximate to the outfalls?

   vi. Does sewage effluent include industrial waste? If yes, what is the nature of the waste?

d. How much are green infrastructure BMPs expected to reduce flooding and CSO events?

   i. In what parts of the city are the benefits mostly likely to accrue?

II. Assessing Potential Health Impacts

a. What are the potential health/mental health impacts of flooding?

b. What are the potential health impacts of CSS events?

c. What are the potential health risks and benefits of green infrastructure BMPs and to whom will the benefits/risks most likely accrue?

Figure 10. Assessment Questions

Research Methods

HIA standards of practice recommend that the assessment of potential health impacts associated with a plan, program or project be based on a synthesis of the best available evidence, including: existing data, empirical research, professional expertise and local knowledge as well as the products of original investigations (30). For this HIA, the research team utilized the several methods to assess the potential positive and negative health effects that may derive from implementation of the proposed Hoboken stormwater management plan amendments and revised ordinance.

- Review and analysis of secondary data – The research team compiled, analyzed and/or mapped data from a variety of secondary data sources including but not limited to: U.S. Census Bureau; National Oceanic and Atmospheric Administration; NJ Department of Health; NJ Department of Environmental Protection; Hudson County Regional Health Commission; City of Hoboken; North Hudson Sewerage Authority; Together North Jersey; Community Collaborative Rain, Hail and Snow Network; and Intellicast among others to create an appropriate understanding of existing conditions in the city and its various neighborhoods.
- Structured interviews – The research team conducted a series of structured interviews with key stakeholders including representatives from: City of Hoboken Office of Community Development, Department of Health and Human Services, City of Hoboken Planning Board, North Hudson Sewerage Authority, Hoboken Housing Authority, Hoboken public health officials, Hudson County health officials, representatives from the North Hudson Community Action Corporation. These individuals brought important subject matter expertise and local knowledge to the HIA assessment process.

- Literature review and knowledge scan – The research team conducted a detailed review of available empirical research regarding the health pathways and likely health outcomes associated with chronic flooding in the city and the proposed solutions to the flooding problem. This included evidence related to reductions in impervious cover, implementation of stormwater BMPs, increased access to green space, and other areas defined as part of the scoping process. Weight was given to peer-reviewed studies; however, local knowledge and stakeholder expertise was also included.

- Resident surveys and focus groups – The research team conducted a community-wide resident survey to collect data on the current health status of Hoboken residents, residents experience with flooding in Hoboken and resident knowledge of and opinions about green infrastructure BMPs. The survey included a battery of demographic questions that were used to help document existing health disparities and any disparities related to flooding impacts. The team also conducted two focus groups, one each with senior citizens and housing authority residents. The focus groups provided insights into the range of flooding impacts experienced by Hoboken residents, the extent to which conditions have changed over time, and the degree to which residents are aware of Hoboken's stormwater management approach, and more specifically if they understand what green infrastructure is and how it may reduce flooding in the city. A copy of the survey methods and results report, including the survey questionnaire can is provided in Appendix 3.

Baseline Conditions

As part of any HIA process, it is important to understand existing conditions within the study area and in relation to the populations potentially impacted by the decision being considered. As noted in Figure 10, the research team developed a series of key questions to guide documentation of baseline conditions in the city. These questions included:

a. Who lives in Hoboken and where, including socially vulnerable populations such as low-income residents, older adults and people with disabilities?
b. What is the current health status of Hoboken residents?
c. What is the extent of the recurrent flooding problem in Hoboken?
d. How frequently do CSS events occur in Hoboken?

The following subsections present the best available information data in relation to these key questions.

Table 2. City of Hoboken Quick Facts

	Hoboken	Hudson County	New Jersey
Population Characteristics			
Total Population, 2014 estimate	53,312	669,115	8,938,175
Persons under 18 years, percent, 2010	12.2%	20.7%	23.5%
Persons 65 years and over, percent, 2010	6.3%	10.4%	13.5%
Female persons, percent, 2010	49.5%	50.5%	51.3%
Race/Ethnicity			
White alone, percent, 2010 (a)	82.2%	57.2%	68.6%
Black or African American alone, percent, 2010 (a)	3.5%	14.7%	13.7%
Asian alone, percent, 2010 (a)	7.1%	14.5%	8.3%
Two or More Races, percent, 2010	2.6%	4.4%	2.7%
Hispanic or Latino, percent, 2010 (b)	15.2%	42.2%	17.7%
White alone, not Hispanic or Latino, percent, 2010	73.2%	30.8%	59.3%
Language/Education			
Foreign born persons, percent, 2009-2013	14.8%	41.2%	21.2%
Language other than English spoken at home, pct age 5+, 2009-2013	20.3%	59.2%	30.0%
High school graduate or higher, percent of persons age 25+, 2009-2013	92.6%	81.9%	88.1%
Bachelor's degree or higher, percent of persons age 25+, 2009-2013	73.5%	36.3%	35.8%
Income and Poverty			
Median Household Income, 2009-2013	$107,366	$58,442	$71,629
Employment percent of population 16 years old and over, 2009-2013	75.6%	61.7%	59.7%
Persons below poverty level, percent, 2009-2013	11.7%	16.8%	10.4%
Housing Characteristics			
Housing units, 2010	26,855	270,335	3,553,562
Homeownership rate, 2009-2013	32.7%	32.6%	65.6%
Housing units in multi-unit structures, percent, 2009-2013	94.7%	83.5%	36.0%
Median value of owner-occupied housing units, 2009-2013	$550,700	$347,200	$327,100
Households, 2009-2013	23,997	243,875	3,186,418
Persons per household, 2009-2013	2.06	2.61	2.71
Geography			
Land area in square miles, 2010	1.28	46.19	7,354.22
Persons per square mile, 2010	39,219.6	13,731.4	1,195.5

Notes: (a) Includes persons reporting only one race; (b) Hispanics may be of any race, so also are included in applicable race categories.
Source: US Census Bureau State & County QuickFacts

Hoboken Population Characteristics

The City of Hoboken, located in Hudson County, New Jersey is home to more than 53,000 residents. As shown in Table 2, the city's population is younger than that of Hudson County or New Jersey as a whole, with only 6.3 percent of the population over the age of 65. In terms of race and ethnicity, Hoboken's population is significantly less diverse than Hudson County and the State. More than 82 percent of Hoboken's population is White. Hoboken residents are highly educated, with 74 percent of the population having a Bachelor's degree or higher. Rates of employment in the city are notably higher than the Hudson County or the State, with 76 percent of working age Hoboken residents employed. Average household income in Hoboken is $107,366, well above the average in Hudson County ($58,442) and New Jersey ($71,629). At the same time, approximately 12 percent of the city's residents live in poverty.

The majority of residents living in poverty and other lower-income Hoboken residents live in Hoboken's lower-lying neighborhoods which are most susceptible to frequent flooding and CSS back-ups (Sewersheds H1 and H4). Figures 11-13 show Census block groups with the highest rates of poverty, the location of Hoboken Housing Authority facilities and the location of HUD-subsidized housing units in the city. As shown in Figures 14 and 15, Hoboken residents with disabilities and minority residents are also concentrated in more flood prone areas. Because of individual and family resource constraints, these groups are likely to be more vulnerable to negative consequence of flooding and CSS back-ups and stand to gain the most benefit from actions that may reduce flooding in the city.

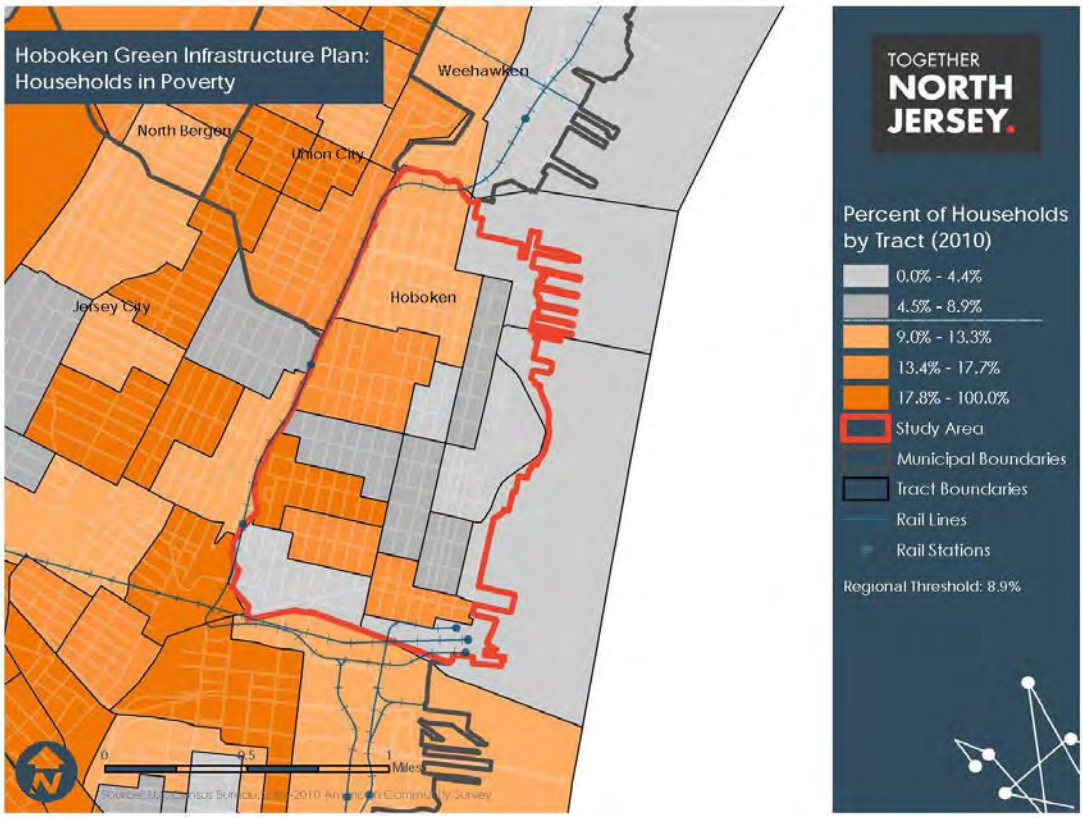


Figure 11. People living in poverty in Hoboken

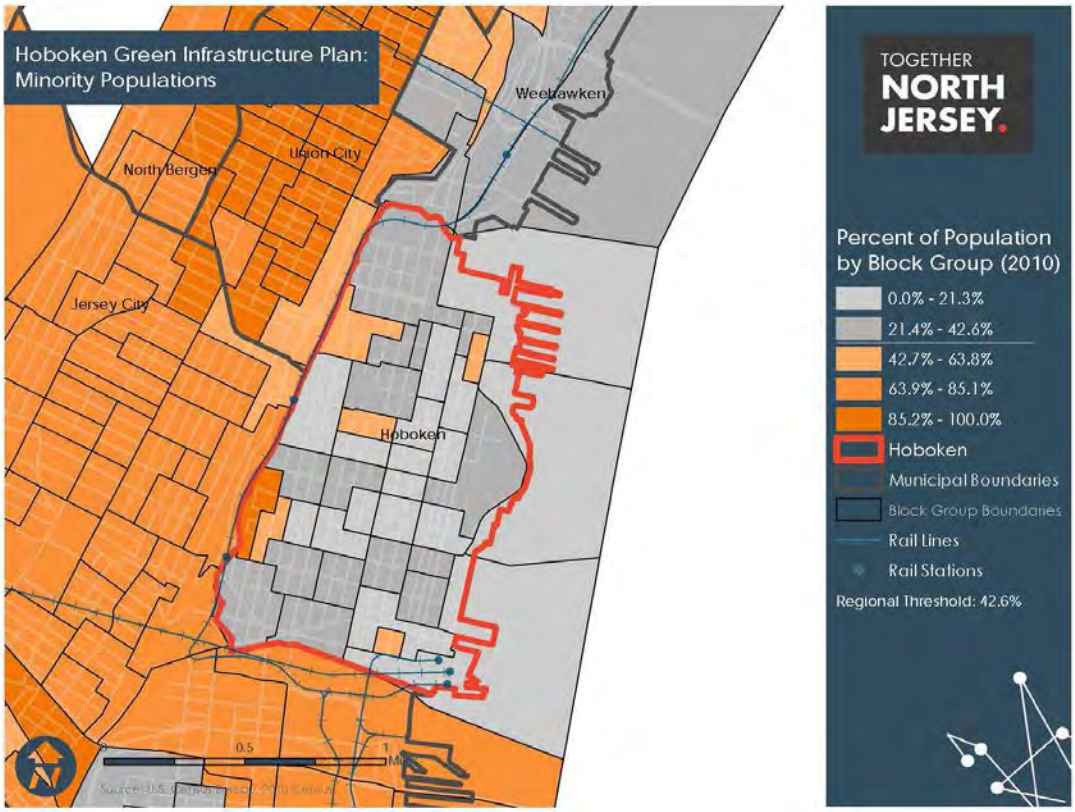


Figure 12. Minority populations in Hoboken

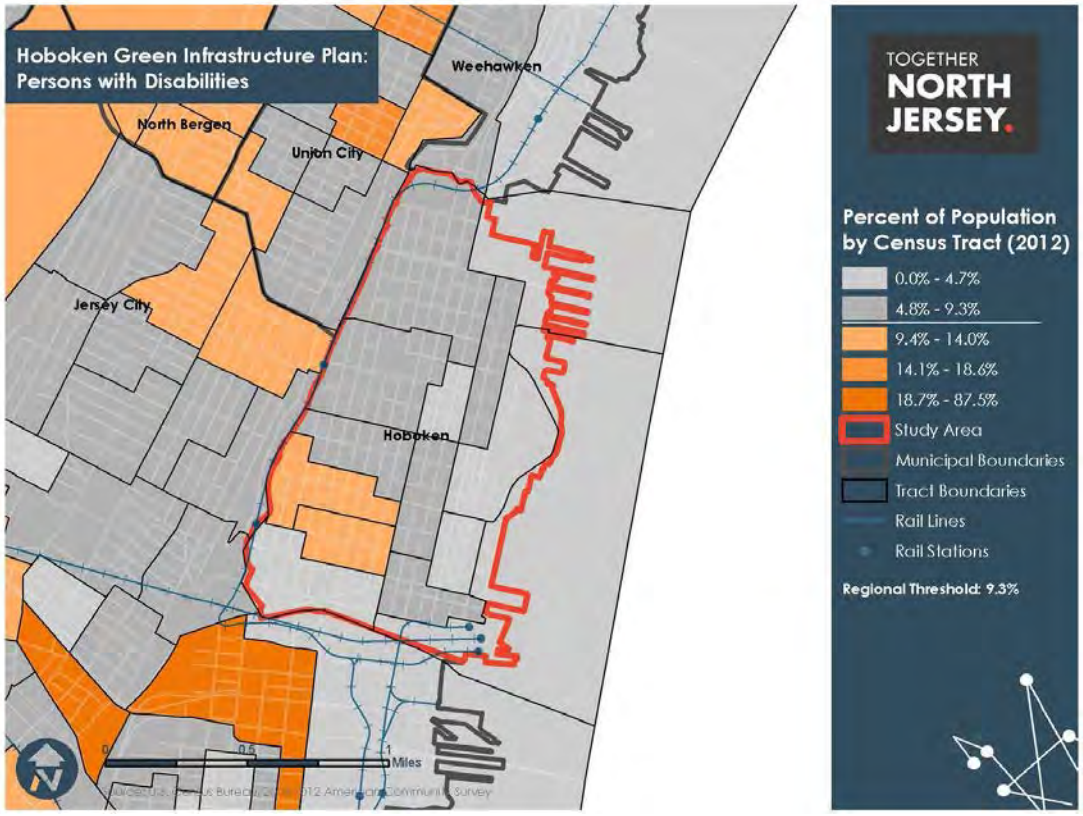


Figure 13. People with disabilities living in Hoboken

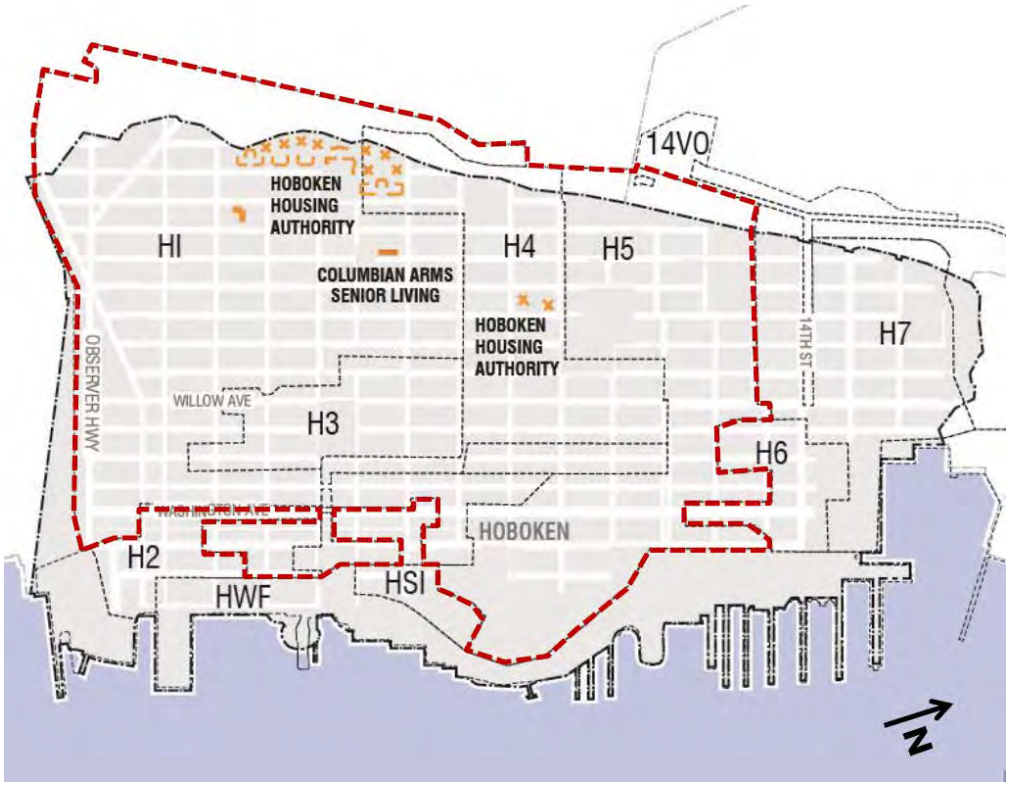


Figure 14. Location of Hoboken Housing Authority Properties

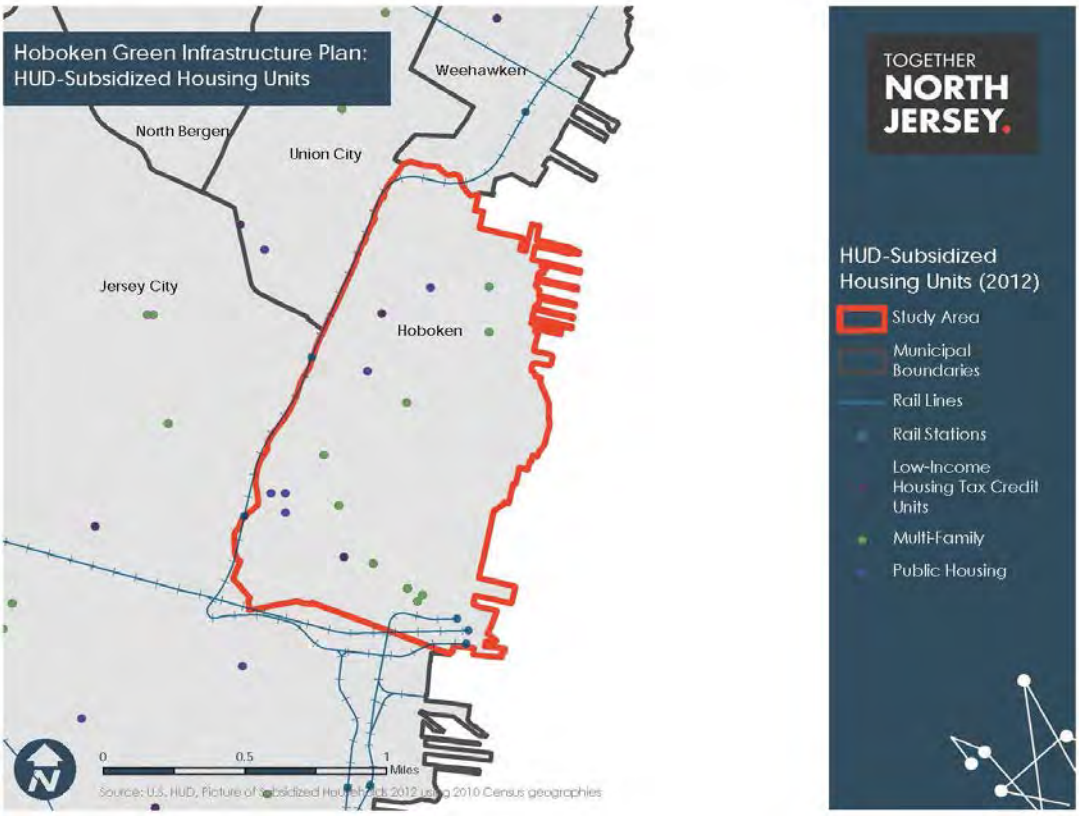


Figure 15. HUD subsidized housing in Hoboken

Current Health Status of Hoboken Residents

The most comprehensive data available on individual and community health status is from the Behavioral Risk Factor Surveillance System (BRFSS), a nation-wide health survey partially funded by the Centers for Disease Control and Prevention (CDC). The BRFSS monitors major behavioral risk factors and chronic conditions associated with disability and death among adults, aged 18 and over who live at home (i.e., not in dormitories, jails, hospitals, nursing homes, or other similar group quarters). BRFSS results are used to monitor selected health conditions and behaviors as reported by survey participants. According to the NJ Department of Health, the NJ-BRFSS has been in operation since 1991 and includes statistics through the year 2013, the latest year for which data is available.

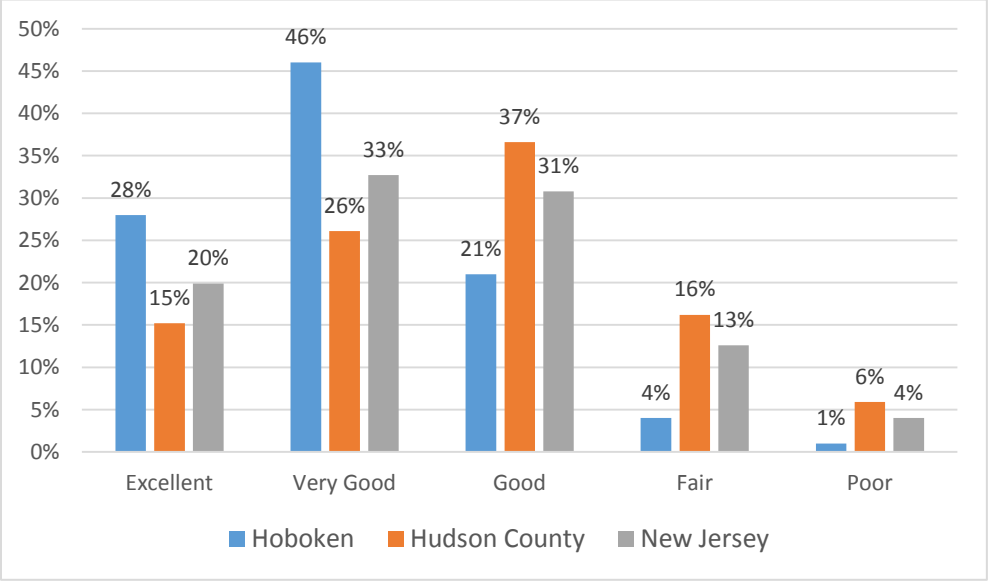
Unfortunately, with the exception of data for the cities of Newark and Jersey City, only county- and State-level data are available in New Jersey. No Hoboken-specific health data was identified from available data sources. Given this constraint, the research team included a battery of health status questions in the community-wide resident survey conducted for the HIA in 2015. The health-related questions included in the resident survey mirrored the BRFSS questionnaire to facilitate data comparisons.

The health status characterization contained in this section includes data from the NJ-BRFSS database and data collected via the Hoboken HIA resident survey. It should be noted that the data collected for Hoboken was derived from a convenience sample of residents that completed the community-wide survey on-line. The individual characteristics of residents that completed the survey in terms of age, gender, race and income were broadly representative of Hoboken's overall population but the pool of survey respondents does not represent a randomly selected sample of residents. Consequently, the survey results may contain biases that make it inappropriate to generalize the results to Hoboken's overall population. The survey methods report contained in Appendix 3 includes a more detailed explanation of data constraints and presents weighted data for a number of key health-related indicators. The process of weighting the data to correct for difference in population characteristics and make the results more generalizable resulted in some minor adjustments to the survey results.

As shown in Figure 16, the overall health status of Hoboken residents that completed the survey is higher than that of Hudson County and New Jersey residents. Ninety-five percent of Hoboken survey participants report being in excellent, very good or good health. This compares to 78 percent of Hudson County residents and 83 percent of New Jersey residents. Only 5 percent of Hoboken residents that completed the survey reported their health status to be fair or poor. This compared to 22 percent of Hudson County residents and 17 percent of New Jersey residents. There are a number of possible demographic reasons that could help to explain these differences. In particular, age and income are leading indicators of reported health status. Hoboken's population is younger and tends to be higher income than Hudson County and State residents overall (see Table 1). This was true of Hoboken survey respondents as well. Research shows that younger people and people with higher incomes generally report being in better overall health (31) (32) (33)

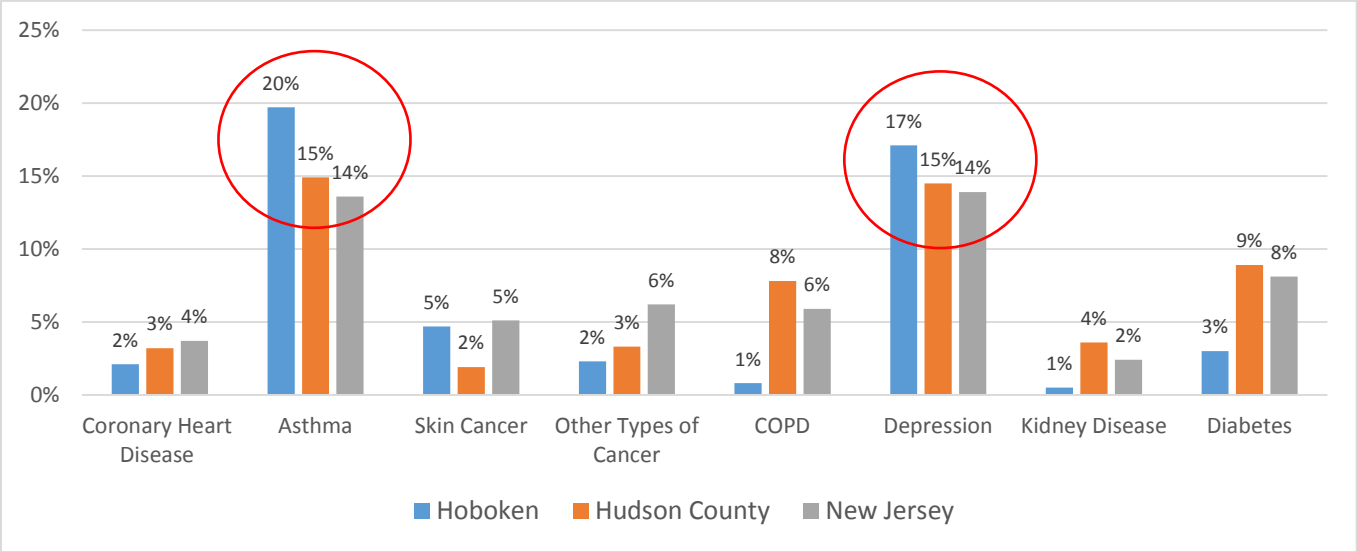
In addition to overall health status, BRFSS tracks prevalence of chronic health conditions in the general population. A sampling of tracked conditions include: asthma, chronic obstructive pulmonary disease (COPD), diabetes, depression, kidney disease, skin cancer and other types of cancer. As shown in Figure 17, health data indicate that there is a lower prevalence of coronary heart disease, COPD, kidney disease and diabetes among Hoboken residents that completed the survey when compared to the population of Hudson County and New Jersey. In addition, the incidence of skin cancer diagnoses among Hoboken residents completing the survey is on par with the State and somewhat higher than that of Hudson County residents. However, the prevalence of two conditions–asthma and depression–are notably higher among Hoboken residents that completed the survey

than in Hudson County and New Jersey. As discussed, later in this chapter, flooding and exposure to contaminated flood waters has the potential to exacerbate asthma. In addition, for the chronically ill, flooding can disrupt access to healthcare services such as medical appointments and dialysis as well as limit access to prescription medications. Frequent flooding can also cause stress and anxiety which can result in or worsen symptoms associated with depression.



Sources: Hoboken Stormwater HIA Community-wide Survey, 2015; New Jersey Behavioral Risk Factor Survey (NJBRFS). New Jersey Department of Health, Center for Health Statistics, New Jersey State Health Assessment Data (NJSHAD) [online], 2013. Accessed at http://nj.gov/health/shad on 8/10/15.

Figure 16. General Health Status of Hoboken Residents vs. Hudson County and New Jersey

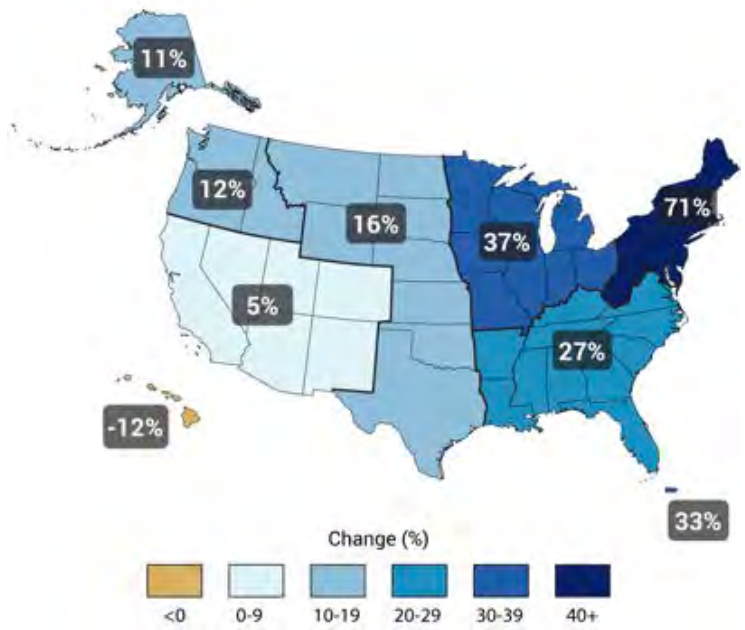


Sources: Hoboken Stormwater HIA Community-wide Survey, 2015; New Jersey Behavioral Risk Factor Survey (NJBRFS). New Jersey Department of Health, Center for Health Statistics, New Jersey State Health Assessment Data (NJSHAD) [online], 2013. Accessed at http://nj.gov/health/shad on 2/15/16

Figure 17. Prevalence of Chronic Health Conditions in Hoboken vs. Hudson County and New Jersey

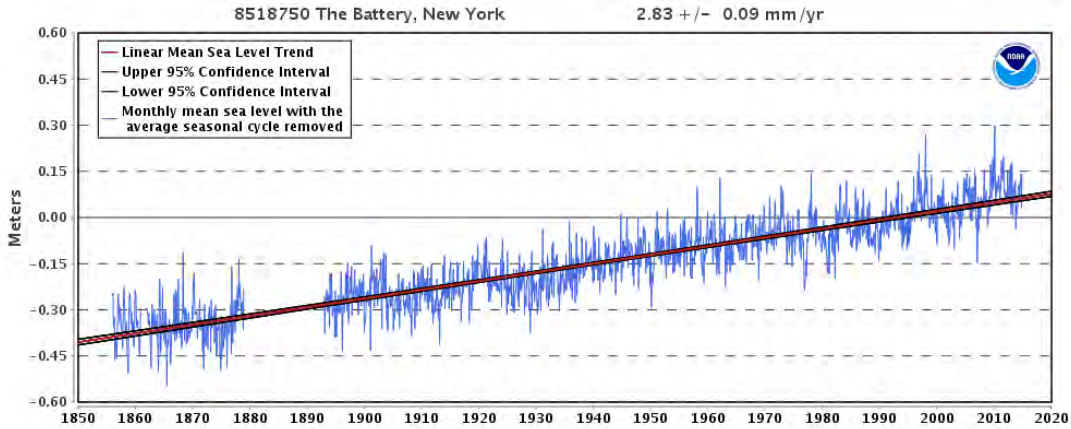
Environmental and Climate Conditions

On average, the City of Hoboken receives more than 45 inches of precipitation annually (34). According to the State Department of Environmental Protection, New Jersey has experienced a statistically significant increase in total precipitation over the past several decades. (35) In addition, as shown in Figure 18, over the past 40 years, the Northeast region of the United states has experienced a 71 percent increase in very heavy precipitation events (add citation http://climatenexus.org/learn/regional-impacts/northeast). To make matters worse, tide gauge data (see Figure 19) collected by the National Oceanic and Atmospheric Administration shows that tide levels at Battery Park, NY and Sandy Hook, NJ have increased the equivalent of 1 inch and 1.33 feet respectively over the past 100 years (36). These conditions and trends result in frequent and recurring flooding in Hoboken.



Source: http://climatenexus.org/learn/regional-impacts/northeast

Figure 18. Observed Change in Heavy Precipitation (1958-2012)



Source: National Oceanic and Atmospheric Administration, http://co-ops.nos.noaa.gov/sltrends/sltrends.shtml

Figure 19. Mean Sea Level Rise, Battery Park, New York

Frequency of Recurrent Flooding in Hoboken

The City of Hoboken is broken into seven drainage basins as shown in Figure 20. The conditions vary from basin to basin in terms of elevation, flood frequency and flood severity. Historically, minor to moderate flooding in Hoboken occurred multiple times per year, with the most frequent flooding occurring in the H1 drainage basin and more occasional flooding occurring in H4, H5 and H7 basins.

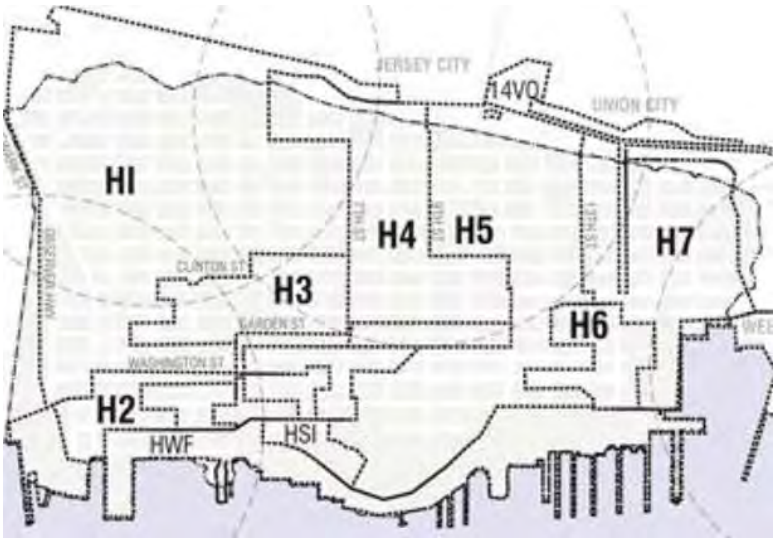
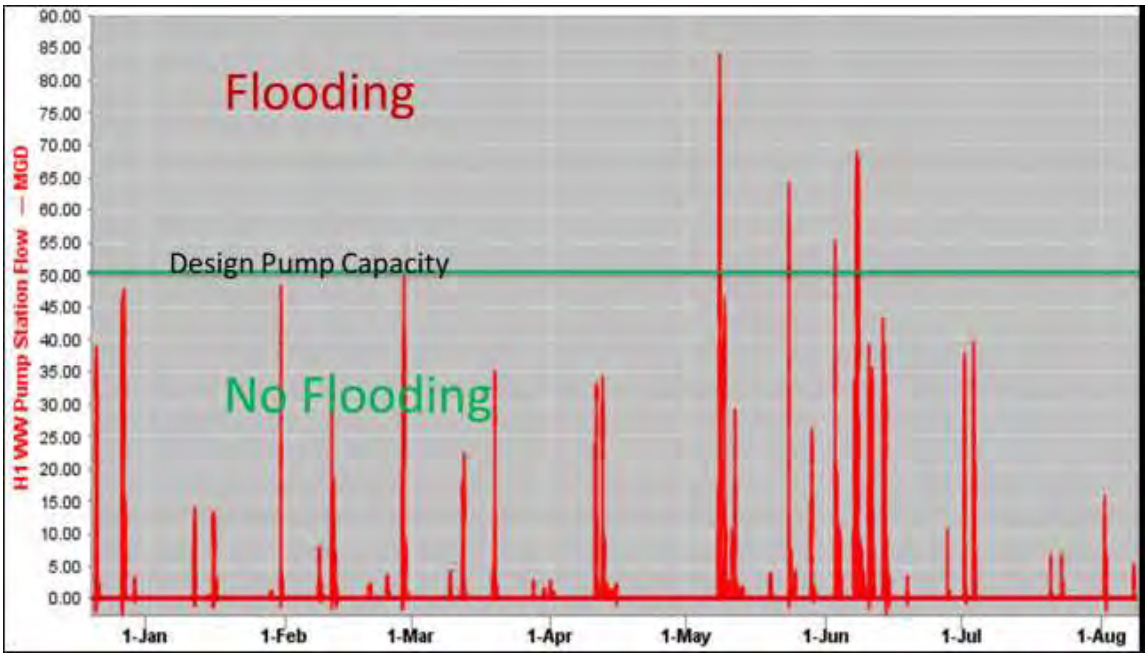


Figure 20. Hoboken Drainage Basins/Sewersheds

The best available empirical data on historic patterns of flooding in the city can be found in a 2002 study conducted by the NHSA and a follow up study conducted in 2012. The 2002 study concluded that "significant" flooding–which was defined as flooding depths of 1.5 feet or more–regularly occurs more than once per year in the H1 drainage basin (37). The study further concluded that flooding can be anticipated in the city's H1 drainage basin each time a 3-month, 1 year, 2-year and 5-year storm occurs. This is largely due to the fact that parts of basin–mainly along Marshall and Harrison Streets, between 1st and 2nd Streets– are only 2.0 feet above mean sea level (37). Based on these findings, the NHSA installed a wet weather pump station (WWPS) to alleviate at least some of the recurrent flooding in the H1 drainage basin.

In late 2012, the NHSA deployed a "real time decision support system (RT-DSS) throughout Hoboken." (38) The purpose of the deployment was to evaluate the performance of the H1 WWPS. Based on the collected data through the RT-DSS, the NHSA found that "The H1 WWPS was utilized 36 times between December 20, 2012 and August 1, 2013. In all but 4 storm events, the pump station was able to prevent flooding city-wide. Flooding only occurred when the flows to the pump station exceeded 50 MGD." (38) As shown in Figure 21, all four flood events that exceeded the pump station capacity occurred between May and July of 2013. Detailed data on the characteristics of these four events in shown in Table 3. It should also be noted that flooding occurred twice during the month of June 2013 in areas not protected by the H1 WWPS, including parts of the H4, H5 and H7 drainage basins.



Source: EmNet, 2013

Figure 21. Flood frequency from Dec 20, 2012 through Aug 10, 2013

Table 3. Description of Storm Events Resulting in Flooding (Dec 20, 2012 to Aug 10, 2013)

Storm	Total Rain (inches)	Duration (hour)	Max Intensity (in/hr)	Storm Designation
May 8, 2013	2.44	11.3	2.28	1 year, 12 hr. 1 year, 1 hr. peak
May 23, 2013	1.19	1.5	2.64	1 year, 1 hr. peak
June 2-3, 2013	1.22	19.2	2.40	Almost 1 year
June 6-8, 2013	3.99	31.5	1.08	Tropical Storm Andrea 4 year, 12 hr.

Source: Adapted from EmNet, 2013

This empirical data on flood frequency is confirmed and supported by data collected in 2015 as part of a community-wide resident survey conducted for this HIA. The survey asked residents about their individual experiences with flooding in Hoboken and the impacts of flooding they most often experienced. Three hundred and ninety-five Hoboken residents responded to the survey.

When asked how often regular flooding occurs in the city, 75 percent of survey respondents reported experiencing flooding more than three times per year on average. Another 17 percent reported experiencing flooding 2-3 times per year. When asked how often they were personally impacted by flooding in the city, nearly one quarter (22 percent) reported every time it rains, while 50 percent reported being impacted only during heavy rainstorms. Twenty percent of survey respondents reported being personally impacted by flooding more than three times in the past two years. Another 14 percent reported being personally impacted three times. Nineteen percent were impacted twice and another 20 percent reported being impacted just one time.

How often are you personally impacted by flooding in Hoboken?		
	Vulnerable Population	General Population
Every time it floods	36%	20%
Only during very heavy rainstorm	44%	50%
Almost never	17%	23%
I am not affected by flooding in Hoboken	3%	7%

In the past two years, how many times were you personally impacted by flooding?		
	Vulnerable Population	General Population
Never	18%	27%
Just one time	16%	20%
Two times	17%	19%
Three times	19%	14%
More than three times	29%	20%

Figure 22. Impact of flooding on vulnerable populations

The survey data showed that vulnerable populations, including low-income residents, people over the age of 65 and individuals with physical, mental or emotional limitations were disproportionately impacted by flooding. Vulnerable populations were more likely to report being personally impacted by flooding every time it rains and being more frequently impacted by flooding over the past two years. See Figure 22.

Health Impacts of Flooding and CSS Back-ups and Overflows

There is significant epidemiological evidence that severe flooding and flood disasters cause health impacts. (12) The CDC recognizes a serious health risk to individuals can result from flood waters and even standing water. These include infectious disease, injuries and even death (10). Though many of these health effects result from major flooding disasters, negative health effects have also been associated with routine flood events. For example, the CDC points to the risks associated with children playing and/or swallowing contaminated flood waters, or even just planning with toys that have been in contact with flood waters. They further note that even in shallow standing water, drowning is a risk for people–especially children–that cannot swim (10).

However, due to variability in the intensity and severity of flood events–from routine to catastrophic–health authorities are cautioned to characterize potential health-related impacts of flooding on an event by event basis. Such an approach would take into account contamination sources and the uses of areas inundated with flood waters (9). The CDC therefore recommends cautioning the public "to avoid standing water, areas saturated with floodwater, and areas with visible debris." These areas create the most risk for injury and microbial exposure and may also cause other public safety concerns (9).

Standing water can pose many health risks (13), including exposure to microbial pathogens in flood waters, especially when mixed with stormwater discharged from combined sewer systems (8) (9). These pathogens, which are often found in CSS back-ups and overflows, may cause a number of health conditions and symptoms, including: rashes, respiratory issues such as asthma, eye irritation, gastrointestinal conditions such as vomiting and abdominal pain, muscle aches, and headaches (8) (10) (11) (39) (40) (41) (42). Standing water also encourages mosquito growth (43) (44) (45). Mosquito can transmit vector-borne diseases include protozoan diseases and a range of viruses (46).

Other potential contaminants often found in floodwaters include a variety of toxics typically found in roadway runoff (8). Sources include: motor fuels (Lead, Nickel), tires (Zinc, Cadmium), and moving engine parts (Copper, Iron, Chromium, Manganese); as well as road salt, pesticides, preservatives and other day-to-day materials (9). In addition, some heavy metals, chemicals and organic compounds may bio-accumulate in aquatic life and in humans through ingestion or absorption into the skin (8).

When combined sewer systems discharge effluent into to nearby waterways, water quality may be degraded to the point where swimming, boating and fishing become hazardous. Swimming has been shown to have a direct link to illness caused by microbial pathogens (8). Exposure to pathogens occurs through all human orifices, including: eyes, ears, nose, anus, genitourinary tract, mouth and open cuts/abrasions (8). Exposure to pathogens in contaminated waters has been associated with a number of health impacts to swimmers respiratory system, gastroenteritis, eyes, ears and more. In addition, pollutants causing beach closures extend beyond pathogens and include floatables which create aesthetic and safety issues. Some debris includes medical and personal hygiene products including syringes, condoms and tampon applicators (8). Appendix 4 presents a summary table of possible floodwater contaminants and their associated health risks and potential impacts.

The populations most at risk from exposure to pollutants are the elderly, children, and pregnant women (8) (41). The elderly are at risk as a result of a weakened immune system that comes with age. Children and infants have immature immune systems and are also likely to participate in activities that raise exposure risk. For example, playing in contaminated water puts children at risk for ingesting contaminated flood water. Women who are pregnant may or may not experience illness after contracting a virus but regardless may transmit illness to their fetus, during birth or shortly thereafter (8). Other individuals with compromised immune system such as those with AIDS, cancer and individuals that have undergone organ transplants are also at higher risk (8). These populations are most likely to suffer from diarrhea resulting from waterborne or foodborne illness (8). It should be noted however that, overall, research is mixed on drawing direct causal relationships between the source of exposures and the resulting health impacts.

Repeated flooding that enters building structures, saturating carpets, insulation and sheetrock in homes can lead to mold growth. “People with asthma, allergies or other respiratory conditions may be more sensitive to mold. People with weakened immune systems or with chronic lung diseases can develop mold infections in their lungs.” (11) A meta-analysis that reviewed 33 studies determined that “dampness and mold are associated with approximately 30–50% increases in a variety of respiratory and asthma-related health outcomes.” (47)

There is considerable evidence that flooding causes mental health impacts. Severe flooding events, in particular, have been widely studied and have been found to cause an array of mental health issues including but not limited to: stress, depression, anxiety disorders and sleeplessness (12) (15) (16) (48) (49) (50). One study also found that social effects of flooding can include the trauma associated with the loss and damage to possessions and property, disruption and deterioration in the quality of individual, family and community life, time off work and the financial consequences, and fears of future flooding events (16).

Studies also show that mental health impacts, especially stress, can result from routine flooding not just catastrophic events such as Hurricane Sandy (17) (51) (52) (53) (54). Flooding can damage cars, homes and businesses alike even in routine instances (17) (55) (56) (57) (58). Impacts to transportation and utility infrastructure can also occur (55) (58) (59) (60) (61). Businesses may be disrupted and health impacts can lead some to miss work and lose the financial benefits of working (15) (17).

This type of economic impact is well known and widespread the City of Hoboken. "The flood hazard areas of the City of Hoboken are subject to periodic inundation which can result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare." (18) Further, the New Jersey Department of Environmental Protection has documented that "flooding causes major social disruptions." (18) This includes the simple movement of people to work, school or even the grocery store (19) (20). Further, studies have shown that flooding may also exacerbate unhealthy lifestyle choices such as a decrease in exercise and an increase in the consumption of junk food (62) and increases substance (alcohol, tobacco and drugs) use and abuse (49). These findings are supported by data collected as part of the community-wide resident survey conducted for this HIA.

Impacts of Flooding and CSS events on Hoboken Residents

As shown in Figure 23, the most frequently cited impact of flooding was sewer back-ups near residents' homes, which likely exposes residents to a range of health risks. Sixty percent of survey respondents listed sewer back-ups as a problem when it floods. As a consequence of coming in contact with contaminated flood waters or sewer back-ups, nearly one third of survey respondents (28 percent) reported experiencing one or more of the following symptoms: headaches; vomiting; abdominal cramping, nausea, or diarrhea; muscle aches; eye irritation/infection; asthma or other respiratory condition; or skin rash. Twenty-three percent of respondents reporting seeking medical attention as a result of experiencing one or more of the symptoms. See Figure 24.

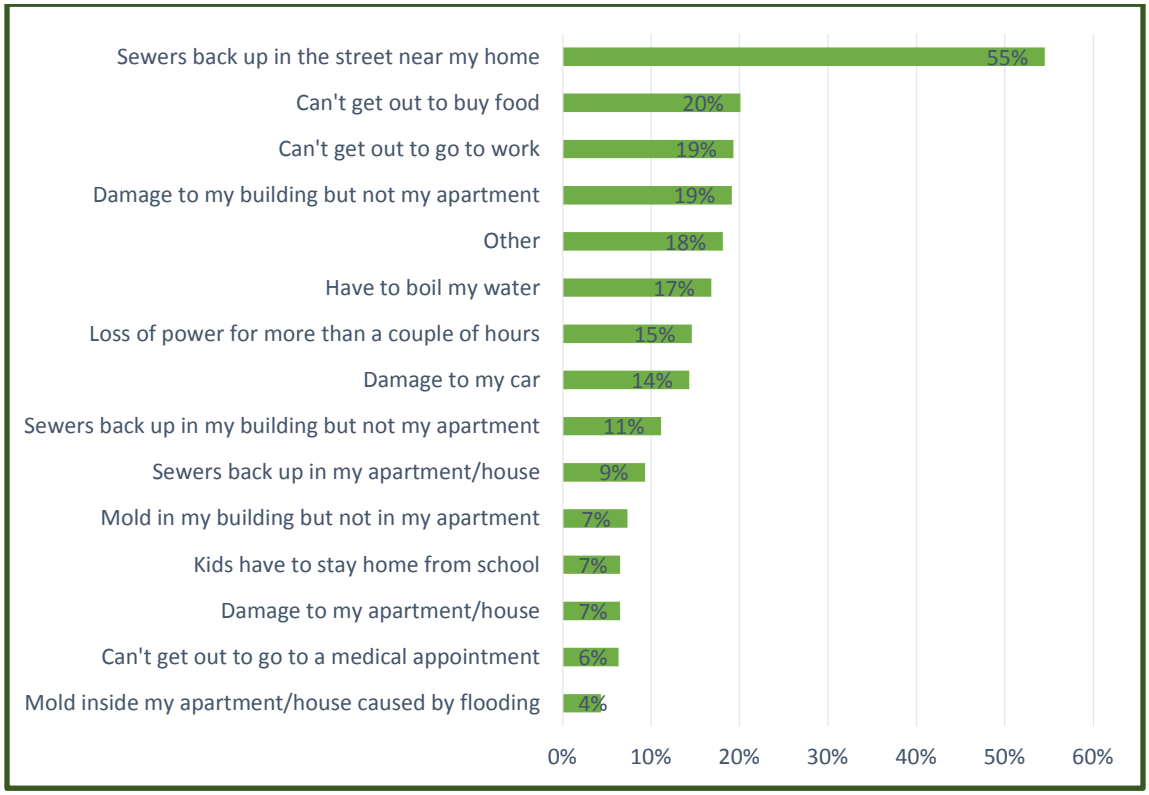


Figure 23. Most frequently cited impacts of flooding in Hoboken

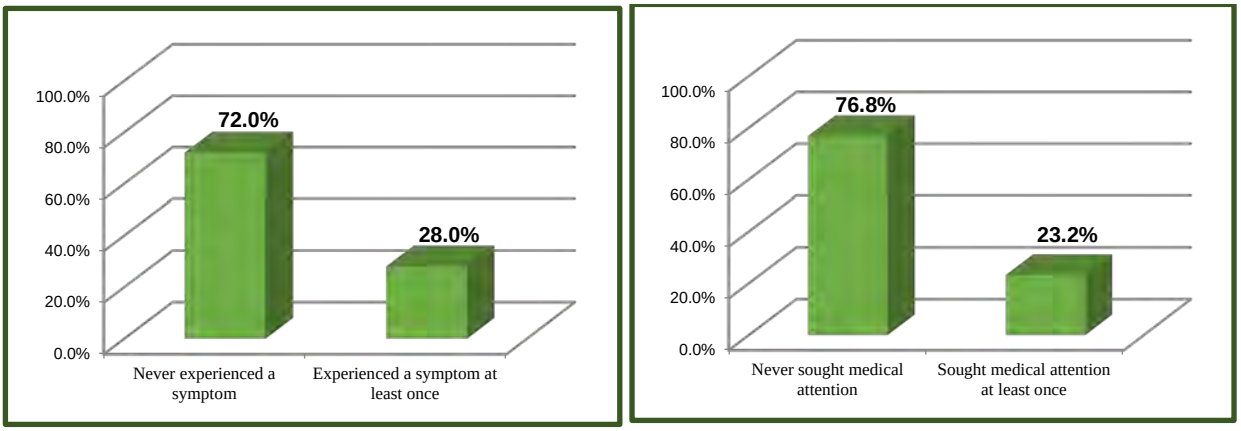


Figure 24. Percent of survey respondents experiencing flooding-related illness symptoms

Only a small percentage of Hoboken residents reported experiencing an injury requiring medical attention because of regular flooding (3 percent) and a similarly small percentage (2 percent) reported seeking counseling or other mental health services to help them cope with regular flooding. However, a significant number of survey respondents reported engaging in unhealthy personal behaviors immediately before, during and/or immediately after flooding events. As shown in Figure 25, with the exception of smoking more cigarettes and using illegal drugs, half or more of survey respondents reported engaging in unhealthy behaviors such as eating more junk food, consuming more alcohol, and exercising less. In addition, nearly two-thirds of survey respondents (65 percent) reported experiencing flooding-related stress or anxiety and nearly half (48 percent) reported problems sleeping.

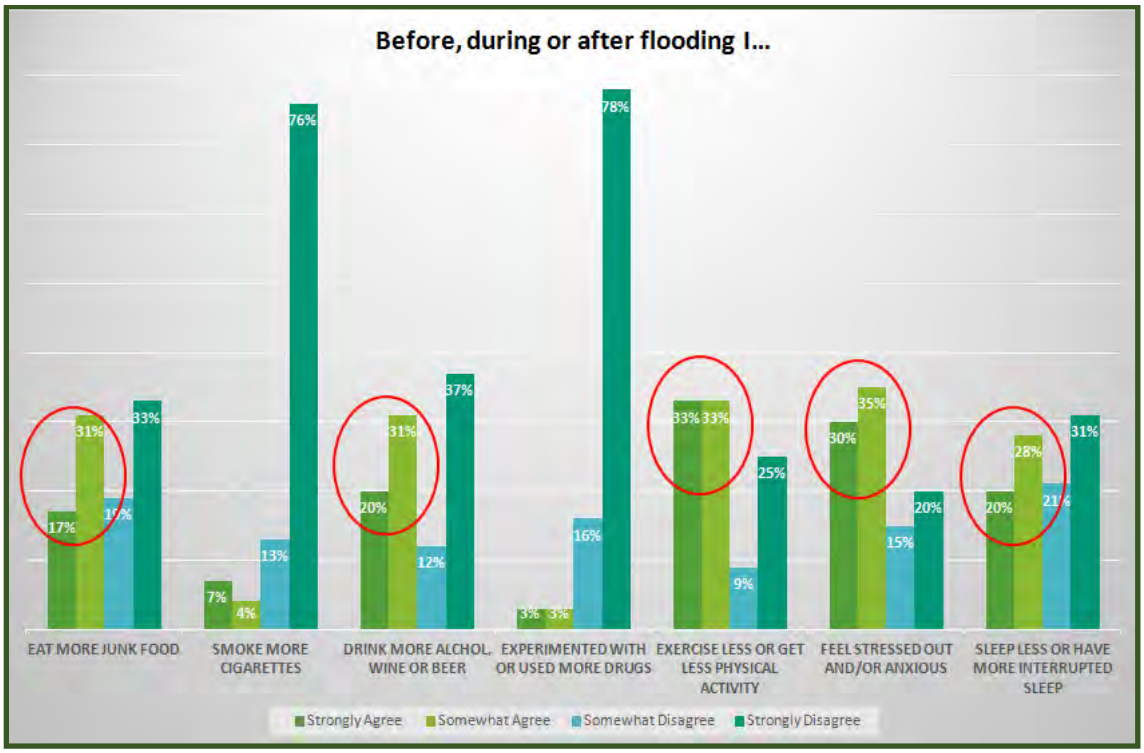


Figure 25. Association between unhealthy personal behaviors and flooding

Impacts of Flooding on Vulnerable Groups

As noted in Chapter 3, several groups living in the city were identified as potentially more vulnerable to the impacts of flooding. These groups include low-income residents, people with disabilities, and older residents. To understand whether the flooding experiences of these population groups are different from the general population, the research team conducted a more detailed analysis of the survey data. To support this analysis, survey respondents were divided into two groups. Group 1, identified as vulnerable populations, included survey respondents with household incomes of $25,000 or less; individuals that reported having activity limitations deriving from physical, mental and emotional problems; and residents aged 65 and over. Group two, identified as the general population, included all other survey respondents. In total, 72 individuals or 18 percent of the survey population reported having one or more of vulnerable population characteristics.

It is clear from the analysis that vulnerable populations experience disparate impacts from flooding. As shown in Table 4, 36 percent of vulnerable populations reported being impacted every time it floods compares to 20 percent of the general population. Of those that were impacted by flooding at least one time in the past two years, 24 percent of vulnerable populations reported that their apartment/house was damaged. This compares to 13 percent of the general population. In terms of disruption, vulnerable populations were consistently more likely to report having difficulty attending to activities of daily life such as picking up prescriptions, getting to doctor/medical appointments, picking up food and groceries, and getting to work or school.

Table 4. Flooding impacts on Vulnerable Populations vs. the General Population

Survey Question	Vulnerable Population	General Population
How often are you personally impacted by flooding in Hoboken?		
Every time is floods	36%	20%
Only during very heavy rainstorms	44%	50%
Almost never	17%	23%
I am not affected by flooding in Hoboken	3%	7%
In the past two years, how many times were you personally impacted by flooding?		
Never	18%	27%
Just one time	17%	21%
Two times	17%	19%
Three times	19%	13%
More than three times	29%	20%
If you were impacted by flooding in the past two years, was your apartment/house damaged?		
Yes	24%	13%
No	76%	87%
When it floods in Hoboken, it is at least somewhat difficult to do the following things[1]:		
Pick up prescriptions	51%	31%
Get to my doctor or other medical appointment	54%	30%
Pick up food/groceries	70%	57%
Get to work	61%	58%
Get to school	30%	19%

Notes: 1 – Percent includes response options very difficult, difficult and somewhat difficult. Survey respondents were permitted to select all that apply. As a result percentages will not sum to 100%.

Predicted Health Impacts Associated with Adopting and Implementing Hoboken's Proposed Stormwater Management Plan and Ordinance Amendments

The primary purpose of any HIA is to predict the potential positive and negative health consequences/outcomes of a particular policy, program or project and assess the base of evidence by which potential health impacts will be evaluated. To accomplish this purpose, the research team conducted a comprehensive review of available literature and collected qualitative data and information through structured interviews with subject matter experts, HIA advisory committee meetings, resident focus groups and a community-wide resident survey.

In the case of this HIA, the principal decision being examined is the adoption of changes to Hoboken's stormwater management plan and ordinance to encourage the implementation of green infrastructure BMPs in order to address chronic, repetitive flooding and CSS back-ups and overflows. The ***decision*** to adopt changes to Hoboken's stormwater management plan and ordinance may have primary, secondary and tertiary effects that impact human health. ***Primary effects*** are those that result directly from the decision. These may include direct health consequences or changes in the natural, built or social environment that eventually lead to positive and negative health consequences or outcomes. If primary effects lead to further changes to the natural, built or social environment, these subsequent changes can be thought of as ***secondary and tertiary effects***. Figure 26 presents a simple flow diagram that illustrates the relationship between a decision and the eventual health consequences or outcomes associated with that decision.

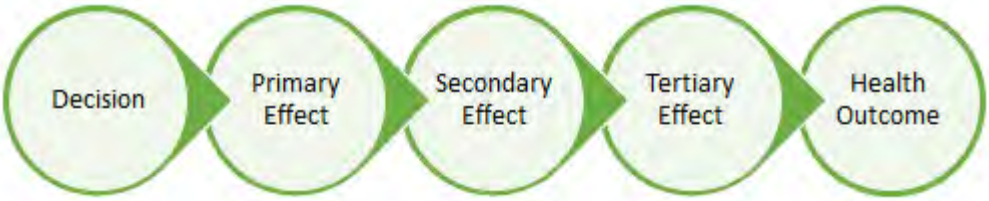


Figure 26. Decision effects lead to health outcomes

Implementation of green infrastructure BMPs in Hoboken are expected to have a number of primary, secondary and tertiary effects that result in positive and negative health consequences/outcomes. For example, the most significant primary effect of green infrastructure implementation is expected to be reduced flooding. A direct health consequence/outcome of reduced flooding may be lower risk of flooding-related injuries and deaths due to drowning. Reduced flooding could also have a number of potential secondary effects, such as reduced exposure to microbial pathogens and other contaminants often found in flood waters; reduced exposure to mold after flooding occurs; and fewer community disruptions like lost power or closed roadways that prevent residents from getting to work, going doctor appointments or buying groceries. The potential health outcomes of these secondary effects include: fewer incidents of exposure-related illness due to residents coming into contact with contaminated flood waters; improved respiratory health because there is less flood-related mold, dust and debris; and improved mental health because there is less flood-induced stress affecting residents.

Table 5 presents a summary of predicted health outcomes associated with implementing green infrastructure BMPs. The table is organized around the health determinants/pathways identified during the HIA scoping process. Health determinants include a range of personal, social, economic, and environmental factors that influence health status and outcomes. The health determinants deemed important for this HIA are presented in column 1, followed by potential primary, secondary and tertiary effects in columns 2 through 4 and finally, potential positive and negative health consequences/outcomes in column 5.

Table 5. Potential Health Pathways and Outcomes Related to Implementing Green Infrastructure BMPs in Hoboken

Health Determinant	Primary Effect	Secondary Effect	Tertiary Effect	Health Consequence/Outcome
Flood management	• Fewer flooding events	• Reduced exposure to microbial pathogens and other contaminants • Reduced exposure to mold • Reduced community disruption		• Fewer injuries/deaths due to drowning • Fewer incidents of exposure-related illness • Improved respiratory health • Improved mental health
Management of CSOs	• Fewer CSO events	• Reduced risk of exposure to microbial pathogens and other contaminants, especially recreational water users		• Fewer incidents of exposure-related illness
Management of CSS Back-ups	• Fewer sewer back-ups	• Reduced exposure to microbial pathogens and other contaminants • Reduced exposure to mold		• Fewer incidents of exposure-related illness • Improved respiratory health • Improved mental health
Access to greenspace	• Increased opportunities for recreation • Improved streetscape/ walking environment • Increase in wildlife habitat • Increased access to open water	• Improved community aesthetics and quality of life • Increase in physical activity • Increased exposure to nature, flora and fauna	• Decrease in crime • Decrease in rates of obesity • Increase risk of exposure to animal and insect bites	• Improved mental health • Decrease rates of chronic disease • Improved life expectancy • Increased risk of exposure to vector-borne disease • Increase risk of drowning
Air quality / Urban Heat-Island Effect	• Increased vegetative cover	• Reduced airborne pollutants • Reduced GHG emissions • Increase in shade coverage • Increased biogenic emissions • Increased exposure to allergens such as pollen	• Reduced ambient air temperature • Reduced exposure to UV rays.	• Improved respiratory health • Reduced heat-related illness and mortality • Fewer incidents of UV ray exposure related illness • Reduced respiratory health

Water/soil quality	• Increased opportunity for infiltration and absorption of rain water	• Reduced surface puddling and standing water where insects breed • Reduced pollution in runoff • Trapping/bio-magnification of toxins and pathogens in soil, detention facilities, and harvested rainwater	• Reduced risk of exposure to insect bites • Increased risk of exposure to toxins and pathogens	• Reduced risk of exposure to vector-borne disease • Increase in toxics exposure-related illness • Increase in pathogen exposure-related illness
Changes in Economic conditions	• Improved access to "green jobs" • Increase in property values • Increase in costs to build and/or meet building requirements • Increase of municipal maintenance cost • Increase in building energy efficiency	• Higher wages • Reduced heating/cooling energy costs • Increase in municipal tax revenue • Increase in housing costs (rents/purchase prices) • Higher taxes (owners)	• Greater financial stability • More disposable income available to purchase healthcare services, healthier food, better housing • Less disposable income available to purchase healthcare services, healthier food, etc.	• Decrease in rates of chronic disease • Improved life expectancy • Improved mental health • Reduced mental health • Increase in rates of chronic disease • Reduced life expectancy
Other Exposure Hazards:	• Increased risk of trips and falls • Increase opportunity for loitering/graffiti • Accumulation of trash and litter	• Increase in real/perceived crime • Reduced quality of life		• Increase in rates of injury • Reduced mental health • Increase in rates of chronic disease • Decreased life expectancy

Note: Items listed in red represent potential negative effects/health risks.

The subsections that follow present the best available evidence regarding the benefits and risks associated with implementing green infrastructure BMPs. The evidence base includes information found in academic articles and manuscripts; government reports and guidance documents; other gray literature resources; as well as qualitative data and information provided by subject matter experts, local officials, and Hoboken residents. Each subsection also includes an assessment of the evidence base in the context of implementing green infrastructure BMPs in the City of Hoboken. The evidence was evaluated against six criteria:

- Likelihood – How certain is it that the decision will effect health determinants or outcomes?
- Direction – Will the decision have a positive or negative effect on health outcomes?
- Magnitude – How much may health outcomes change as a result of the decision?
- Duration – For how long will the positive or negative health effects or outcomes last?
- Distribution – How will the positive and negative effects be distributed across populations?
- Evidence – How strong is the body of evidence supporting the effect characterization?

Table 6 provides a summary assessment potential health consequences/outcomes based on the six criteria presented above. A more detailed description of the criteria is provided in Appendix 5. It should be noted that the six criteria listed in Table 6 refer to potential health consequences/outcomes rather than the primary, secondary or tertiary effects of implementing green infrastructure BMPs. Table 5 and Table 6 are best interpreted together. Table 5 summarizes the anticipated health-related effects of implementing green infrastructure BMPs, while Table 6 describes the characteristics of the potential health consequences/outcomes.

Table 6. Assessment and Characterization of the Potential Health Consequences/Outcomes Of Implementing Green Infrastructure BMPs in Hoboken

Health Determinant	Likelihood Health Effect Will Occur	Direction of Health Effect	Magnitude of Health Effect	Duration	Distribution of Health Effects	Evidence Strength
Flood management	Very likely	Positive	High	Long	Restorative effects	Strong
Management of CSOs	Very likely	Positive	High	Long	Restorative effects	Strong
Management of CSS back-ups	Very likely	Positive	High	Long	Restorative effects	Strong
Access to green space	Very likely	Positive	Moderate	Long	Even	Limited
Standing water	Likely	Positive & Negative	Moderate	Long	Disprop. harm	Limited
Air quality	Likely	Positive & Negative	Moderate	Long	Even	Limited
Urban heat island	Very likely	Positive	Moderate	Long	Even	Strong
Water quality	Very likely	Positive	Low	Long	Even	Strong
Soil Quality	Possible	Negative	Moderate	Long	Even	Mixed
Economic conditions:						
- **Access to "green" jobs**	Possible	Positive	Moderate	Medium	Restorative effects	Limited
- **Property values/Rents**	Possible	Positive & Negative	Low	Long	Even/Disprop. harm	Limited
- **Energy costs**	Possible	Positive	Low	Long	Even	Limited
- **Taxes**	Possible	Positive & Negative	Low	Long	Disprop. harm	Limited
Other exposure hazards:						
- **Trip and fall**	Possible	Negative	Low	Long	Even	Limited*
- **Pests/vermin**	Likely	Negative	Low	Long	Even	Limited*
- **Graffiti/crime**	Possible	Negative	Low	Long	Disprop. harm	Limited*
- **Trash/litter**	Likely	Negative	Low	Long	Even	Limited*

Notes: *Evidence is based primarily on resident and stakeholder input related to past experiences with parks and recreational facilities in the city and personal concerns about green infrastructure implementation. There was very limited or no evidence found in the literature regarding these potential exposure hazards.

Management of Flooding and CSS back-ups and Overflows

The primary goal of Hoboken's proposed stormwater management plan amendments is to reduce flooding and CSS events in the city. There is a growing body of research, including studies conducted in other jurisdictions, that suggests installing green infrastructure BMPs can be an effective way to reduce flooding and stormwater flows entering CSSs during wet weather (5) (22) (63) (64). In some studies, implementation of green infrastructure such as swales, porous pavement and other infiltration strategies has completely mitigated localized chronic flooding from large rainfall events (64).

Another study conducted by American Rivers, the Water Environment Federation, the American Society of Landscape Architects and ECONorthwest examined a range of green infrastructure systems in a variety of locations. The investigators concluded that green infrastructure BMPS have the potential to "target the capture and infiltration of runoff associated with 90 to 95% of storm events that occur annually in most U.S. communities." (22) At the same time, the authors noted that while green infrastructure systems can significantly reduce flooding impacts and peak flow rates they may not fully mitigate high volume rainfall events (22). At least two studies found that reduced flooding and lower peak flow rates attributable to green infrastructure BMPs also reduced health impacts associated with flooding (22) (63).

The City of Hoboken Green Infrastructure Strategic Plan estimated that green infrastructure BMPs, if implemented city-wide, have the potential to capture as much as 4.2 million cubic feet of stormwater during a typical 1 year storm event (5). As shown in Table 7, this equates to eliminating or storing more than 31 million gallons of stormwater that contributes to flooding during rainstorm events. This level of reduction has the potential to significantly reduce the frequency and severity of flooding events in Hoboken.

Table 7. Estimated Stormwater Flow Reduction from Green Infrastructure by Sewershed

Drainage Area	Cubic Feet Captured in 1 Year Storm Event	Gallons	MGD
H1	**2,319,133**	**17,348,274**	**17.3**
H2	41,284	308,825	0.3
H3	26,284	196,617	0.2
H4	**440,472**	**3,294,951**	**3.3**
H5	**351,404**	**2,628,678**	**2.6**
H6	10,944	81,867	0.08
H7	**1,011,581**	**7,567,132**	**7.6**
Citywide Total	4,201,102	31,426,344	31.4
Northern Area Total (Sum of H4, H5, H7)	**1,803,457**	**13,490,760**	**13.5**

Source: Hoboken Green Infrastructure Strategic Plan, 2013;
Conversion note: 1 cubic foot = 7.4805 US gallons

The most flood prone areas of the city include the H1, H4, H5 and H7 drainage basins. According to a flood mitigation study conducted in 2013 by EmNet, LLC, four flooding events occurred in Hoboken between December 20, 2012 and August 1, 2013. In each of these events the volume of wastewater and stormwater entering the city's CSS exceeded the capacity of the system, including the wet weather pump station located in the H1 drainage basin. The study concluded that an additional flood volume storage capacity of 4.2 MG in the H1 drainage basin and 4.3 MG in the Northern Area of the city, which includes the H4, H5 and H7 drainage

basins, could have mitigated all four of the flooding events that occurred during the six month analysis period (38). As shown in Table 7, the volume of stormwater flow reduction feasible if green infrastructure BMPs were to be deployed in a manner consistent with the Hoboken Green Infrastructure Strategic Plan exceeds that necessary to mitigate the four flooding events that occurred between December 20, 2012 and August 1, 2013.

Table 8. Additional Flood Storage Needed to Mitigate Flooding vs. Stormwater Flow Reductions Possible with Green Infrastructure BMPs

Storm Event	H1 Peak Flood Storage Volume Required to Mitigate Flooding	H1 Potential Stormwater Volume Captured by Green Infrastructure	Northern Area (Sum of H4, H5, H7) Peak Flood Volume Required to Mitigate Flooding	Northern Area (Sum of H4, H5, H7) Potential Stormwater Volume Captured by Green Infrastructure
May 8, 2013	4.2 MG	17.3 MG	4.3 MG	13.5 MG
May 23, 2013	1.7 MG		0.1 MG	
June 2-3, 2013	1.0 MG		0.6 MG	
June 6-8, 2013	1.4 MG		1.0 MG	

Sources: Hoboken Green Infrastructure Strategic Plan, 2013; Final Report: An Evaluation of I/I and Illicit Flow in West New York, NJ and Flood Mitigation in Hoboken, NJ, 2013

Based on this analysis, which is supported by the literature and documented in several reports prepared on behalf of the city, the likelihood that implementation of green infrastructure citywide as intended in the proposed stormwater management plan amendments and ordinances can significantly reduce the frequency and severity of flooding in Hoboken over time appears very high. This level of flood mitigation has the potential to eliminate nearly all the negative health impacts associated with flooding in the city. The magnitude of the potential health benefits to be derived from the decision is therefore also high. With proper management and maintenance, the duration of flood reduction and the associated health benefits provided by the decision can be long-lasting.

It is clear from the results of the community-wide resident survey that repetitive flooding in the Hoboken has a significant negative impact on the lives and health of Hoboken residents, especially vulnerable populations including low-income residents, seniors and people with disabilities. These individuals experience a disproportionate burden in terms of flooding impacts. More than one-third of survey respondents (36 percent) indicated that in the past two years, they have been impacted three or more times by flooding. Twenty-two percent of survey respondents and 32 percent of socially vulnerable respondents reported being personally impacted by flooding every time it rains. While the impacts of flooding varied, the most frequently cited impact was sewer back-up near residences, disruptions in residents' ability to buy food and groceries or get to work and damage to residential structures. As such, the potential distribution of flood reduction benefits has the potential to be restorative in nature. Finally, the evidence that green infrastructure BMPs have the potential to deliver these results is strong.

The likelihood that adoption and implementation of Hoboken's proposed stormwater management plan and ordinance will result in less frequent combined sewer system back-ups and overflows is similarly high. Again, the magnitude of the potential health benefits to be derived from the decision is high. With proper management and maintenance of the green infrastructure BMPs deployed in the city, the duration of improved CSS performance and associated health benefits will be long-lasting. And like with flood reduction, given the

fact that the some of the areas most affected by CSS events are where lower income residents live, the potential distribution of benefits derived from improved CSS conditions has the potential to be restorative. Finally, the evidence that green infrastructure BMPs can substantially reduce the flow of stormwater entering the CSS and thereby reduce or eliminate CSS events is strong. As noted above, the volume of stormwater flow reduction feasible if green infrastructure BMPs were to be deployed in a manner consistent with the Hoboken Green Infrastructure Strategic Plan exceeds that necessary to mitigate most, if not all, of routine flooding events that have occurred over the past several years.

Potential Health-related Co-benefits and Risks Associated with Green Infrastructure BMPs

To identify and document the potential health-related co-benefits and risks associated with Hoboken's proposed stormwater management plan amendments and ordinance, the research team investigated each green infrastructure BMP being considered for implementation. These included: rainwater harvesting, green roofs, bio-swales, permeable pavement, rain gardens, stormwater infiltration planters, stormwater tree pits, basins/ponds, subsurface storage, and constructed wetlands.

Access to Green Landscape and Natural Areas

A number of green infrastructure BMP's have the potential to increase residents' access to natural areas and greenspace. Whether in the form of raingardens, new street trees, stormwater infiltration planters, basins/ponds, constructed wetlands, or a new park on top of a subsurface stormwater detention facility, access to natural features and vegetation can have a positive impact on human health. Even green roofs have the potential to increase access to green space if only visually and/or for the residents/tenants of the building on which the green roof is construction.

A literature review conducted by Tzoulas, et. al. found empirical evidence that natural features and open space can provide important health benefits to communities and individuals (65). Well maintained green space and the presence of street trees have been shown to reduce crime in neighborhoods (24) (66). Use of tree pits and practices increase landscaping along streets can enhance pedestrian safety by providing a buffer between the sidewalks and the street and calming traffic (67). Green space and natural elements are amenities that bring beauty to a community which can increase a person sense of community and well-being (24) (25) (65).

Although it is difficult to demonstrate direct causality, the relationship between well-being, health and green space has been shown in a number of studies in a number of disciplines. For example, green space has been linked to longevity amongst senior citizens (23) (65). Individuals that use parks and experience open space on a regular basis have perceived higher levels of overall health (65). This may be in part due to increased levels of physical activity. There are a growing number of studies that highlight the role a high quality physical environment plays in the activity levels of neighborhood residents (65).

The mental health benefits of greening an urban environment is also evident in the literature. Simply having views of natural environments and elements such as trees and vegetation reduces stress levels and improves mental health in general (22) (23) (65). Reduced stress can even lead to lowered blood pressure (22) (65). A green landscape has been shown to have a calming effect on and increase the focus of children with attention deficit disorder (22) (24) (65).

Constructed wetlands provide an opportunity to create larger green spaces and natural areas in an urban environment such as Hoboken. Wetland areas not only provide a location to divert stormwater, they provide wildlife habitat and, if designed well, they can serve as a destination for physical activity, passive recreation such as bird watching, personal respite, education, and community programming which can all have positive health

effects (23) (26) (68) (69) (70). Simply walking regularly can reduce risk of cardiovascular risks, diabetes, cancer, mental health among others (22) (23).

At the same time, green infrastructure BMPs, including constructed wetlands and others must be well maintained. Overgrown vegetation and accumulation of trash and litter can lead to resident anxiety as perception of crime increases (65) and in some cases public access can result in real public safety concerns (68). For example, wetlands and open water basins and ponds can increase the chance of drowning (69), especially among children and others that cannot swim. Such risks can be mitigated with proper design (e.g., handrails along walkways) and public education (69).

Street trees may create the increased chance that branches may fall on power lines. The immediate safety hazards from downed wires are obvious but secondary impacts such as loss of power can cause additional negative effects (71). Over time, tree roots can raise sidewalks and create trip and fall hazards. Furthermore, use of vegetation adjacent to buildings can increase the risk of fire. Such concerns can be mitigated through proper selection of tree and plant species (71).

Trees, landscaping and constructed wetlands can expand and/or enhance habitat for birds, small mammals and insects. This may result in both positive and negative health impacts. On the positive side, increased access to wildlife, flora and fauna can improve quality of life and mental health (27). On the negative side, wildlife may be perceived as a nuisance and can create public health concerns such as exposing the public to insect- and rodent-spread diseases (8) (45) (65). Again, proper design and maintenance can help to mitigate these concerns. For example, properly designed and cared for wetlands, basins and ponds can support fish and other wildlife that can be used to control insects such as mosquitoes. Other mitigation options include pre-treatment and maintenance of the water entering wetlands and waterbodies (69).

The <u>likelihood</u> that the decision to adopt and implement Hoboken's proposed stormwater management plan and ordinance will result in increased access to green space and natural features for Hoboken residents is very high. As described above, the <u>magnitude</u> of potential health benefits to be derived from increased access to greenspace can be considered moderate. With proper management and maintenance, green infrastructure can provide an important amenity that increases community quality of life, encourages physical activity and provides opportunities for respite and passive enjoyment. The <u>duration</u> of these likely benefits is expected to be long. The potential health benefits associated with these positive effects include: improved mental health, a decrease in chronic disease and increased life expectancy. It is anticipated that the <u>distribution</u> of these benefits will largely be even throughout the population; although, individuals living more proximate to the green infrastructure amenities may experience somewhat higher benefit. Finally, while intuitive, the <u>evidence</u> that green infrastructure BMPs have the potential to deliver these results is somewhat limited. Drawing direct causal relationships between increased access to greenspace and positive health outcomes is difficult.

In addition to the potential benefits described above, there was some evidence found in the literature and concern expressed by Hoboken residents that increased access to green space and natural features could have some negative effects. For example, increased risk of exposure to animal and insect bites which may spread disease and increased risk of drowning if BMPs create situations where the public has access to open water. These risks, while real, can largely be mitigated through careful design, proper management and maintenance and through public education.

<u>Air Quality and Urban Heat Island</u>

Vegetation, especially trees, used in green infrastructure BMPs help to clean the air we breathe by filtering out airborne pollutants such as nitrogen dioxide, ozone, sulfur dioxide, dust and other particulate matter (22) (23)

(24) (25) (26) (28) (71). These pollutants exacerbate respiratory ailments such as asthma (72) (73), bronchitis, emphysema (22) (23) and other infections and wheezing (73). Additionally, research has demonstrated an association between these pollutants and lung cancer and cardiopulmonary mortality in children (23) (74). Cleaner air can result in improved respiratory health (29).

Green roofs provide similar benefits. "A 2008 study of green roofs in the City of Portland, Oregon found that each square foot of green roof removed 0.04 pounds of dust and particulate matter out of the air. Their analysis found that one 40,000 square foot green roof would remove 1,600 pounds of particulate matter from the air every year." (22) Another source indicates that "5.5 million square feet of green roofs [is] estimated to capture 1,300 lbs. of PM10 each year - equivalent to the emissions of more than 10,000 cars." (67) In studies conducted in Toronto and Florida respectively, summertime green roof temperatures were found to be about 35°F and 39°F cooler than conventional roofs (22).

The benefits of vegetation and trees also include their ability absorb heat and provide shade, which can reduce ambient air temperatures (22) (24) (25) (26) (27) (28). Exposure to excessive temperatures can result in heat stress, heat stroke and death (75). A study conducted by the CDC found that between 1979 and 2003, an estimated 8,000 deaths were attributed to excessive heat (76). Children and the elderly, along with those with respiratory illnesses are more vulnerable to the impacts of high heat days (75).

Shaded areas may help reduce surface temperatures by 20–40°F (22). By reducing the surface level temperatures, a reduction in heat related illness and mortality may also be expected (66) (75) (77). In addition, trees can provide relief from exposure to UV rays. Those susceptible to UV health impacts such as skin cancer and eye damage may derive relief from shade trees and tree canopies (71).

The likelihood that the decision to adopt and implement Hoboken's proposed stormwater management plan and ordinance will increase vegetative cover in the city, which can reduce airborne pollutants and greenhouse gas emissions, as well as reduce ambient air temperatures and exposure to UV rays is high. The magnitude of the potential health benefits to be derived from these effects can be considered moderate and, with proper management and maintenance, the duration of benefits can be long. The potential positive health benefits associated with cleaner air and lower ambient air temperatures include: improved respiratory health; reduced heat-related illness and mortality; and fewer incidents of UV ray exposure related illness, such as skin cancer.

It is anticipated that the distribution of these benefits will once again be evenly distributed; however, individuals living more proximate to the green infrastructure amenities may experience somewhat higher benefit. It is important to note though that the evidence that green infrastructure BMPs have the potential to deliver these results is somewhat mixed, except in the case of the potential for green infrastructure, especially street trees, to reduce the effects of urban heat island. In this case the evidence is strong. In addition, as was the case with access to natural features and green space, green infrastructure BMPs present some potential for negative air quality-related health effects. For example, vegetation can result in biogenic emissions and increased exposure to allergens such as pollen. These can reduce respiratory health, especially for those with asthma.

Water and Soil Quality

As described briefly in Chapter 1, impervious land cover such as roads, buildings, parking lots and sidewalks reduce or eliminate the ability for rain to infiltrate the ground. When it rains, stormwater travels across these surfaces and captures various types of pollutants from multiple sources, including: oil and fluids from vehicles on roadways; fertilizers and lawn care chemicals from yards; metals and other materials from gutters and built infrastructure; and other sources that give off residual pollution. The stormwater then is collected by

stormwater conveyance systems. As a result, many of these pollutants end up in nearby water bodies as the untreated stormwater is discharged (21) (78).

Green infrastructure BMPs can help reduce stormwater runoff and associated pollution by increasing the amount of permeable area and restoring some of the natural functions performed by vegetation and trees. An increase in permeable surfaces reduces the volume of polluted runoff and thereby reducing the risk of human exposure to the contaminants in the runoff (21) (78). Properly maintained permeable pavement can promote infiltration which allows soils to reduce trace amounts of biodegradable pollutants (24). Permeable pavements also allows snow melt to drain faster reducing icing during freeze-thaw cycles (22), and can minimize puddling and standing water that provide breeding grounds for mosquitoes and other insects (24).

Street trees also reduce stormwater runoff and associated pollution (25). Tree pits can enhance the stormwater reduction provided by trees by allowing pits to act like "mini-reservoirs" which can collect runoff and begin the infiltration process, which provides trees with a source of water over a longer period of time (24). As a result, tree pits may enhance bioremediation of runoff breaking down pollutants such as "metals, organic compounds, fuels, and solvents." (24) Tree leaves also absorb rainwater and provide an added benefit of minimizing the rain that actually reaches the ground (22).

Vegetated swales provide similar run-off relief. Through infiltration, swales have the ability to absorb and breakdown many runoff pollutants, which can reduce the flow of pollutants into the CSS. In some instances smaller storms may create flows through swales in which infiltration completely removes runoff during conveyance (21). These benefits can be enhanced through the use of check dams which slow the flow of runoff, providing additional time for infiltration and evapotranspiration to take place (24).

Constructed wetlands, basins and/or ponds, and subsurface storage are designed to retain or detain stormwater and slowly release it back into the environment and/or CSS at times of lower flow rates. These BMPs can provide benefits similar to permeable pavements, swales and trees in that pollution may be absorbed naturally into vegetated areas. In addition, they provide the benefit of trapping suspended sediments (79).

Unfortunately, constructed wetlands, basins/ponds and subsurface storage facilities can also trap pathogens, some of which may have prolonged survival in sediment such as bacteria and viruses (79). Additional pathogens that can result in the transmission of disease include fungi and parasites (69). Additionally, retention basins and wet ponds provide permanent pools of water. These pools and permanent structures may enhance breeding and natural habitats for insects such as mosquitoes (21) (69).

Another concern is the potential accumulation of toxic chemicals collected and retained over time in sediment. Constructed wetland and other vegetation can incorporate some toxins into biological tissue; however, "if chemical levels exceed the normal tolerance limits of the wetland or other biota, problems such as chronic or acute toxic effects may result. Some toxic chemicals are prone to bio-magnification in ecological food chains and, when present in elevated concentrations in wastewaters entering a wetland, they may result in effects at higher trophic levels." (69)

Pollution which can bio-magnify includes heavy metals (e.g. copper, chromium, lead, nickel, zinc, tin) many of which collect in stormwater runoff (80). The resulting bio-magnification can negatively impact human health (81). A notable example of the human health impacts is the direct linkages of metals entering fish muscle tissue. Humans absorb lead through food but children may be more likely to absorb a high percentage and can take years to be released by the body. Lead poisoning attacks nervous systems resulting in headaches, irritability, abdominal pain, sleeplessness and restlessness (82). As a result children may experience behavioral issues such as learning and concentration difficulties. In severe cases, mental health deteriorates as acute psychosis and

confusion may set in and memory begins to become affected (82). With appropriate mitigation measures, these risks can be managed. Technology solutions and proper maintenance and management can help control, though not eliminate, toxicity in wetlands (76).

Water quality may also be a concern when harvesting rainwater. Harvested rainwater may be used indoors to supply toilets or provide exterior irrigation. Health concerns are mostly focused on cross contamination of potable water and the harvested rain water when used indoors (83). "When rainwater is integrated as a significant supply source for a non-potable indoor use, a potable make-up supply line is needed for dry periods and when the collected rainwater supply is unable to meet water demands. The make-up supply to the cistern is the point of greatest risk for cross-contamination of the potable supply." (83) However, this risk can be managed by "limiting rainwater reuse to water closets, urinals and hose bibs." (83)

Many of the best management practices being considered for implementation in Hoboken use green infrastructure to allow stormwater to be absorbed by plant materials, infiltrate into surrounding soils and or evaporate. As noted previously, the process of stormwater infiltration and uptake by plant materials and trees effectively clean pollutants out of the stormwater. As a result, collection and capturing of pollutants can over time result in contaminated soils and sediment (21). Pollutants such as heavy metals which are element based do not naturally breakdown in soil and can have negative health effects. (82) (84) (85)

Captured bacteria can also be a potential problem. "Typically, it takes 2–3 months for enteric bacteria to significantly reduce in soil, with certain exceptions. Environmental factors including temperature, soil desiccation, pH, soil characteristics, and sunlight influence microbial survival and persistence. Microbial survival in soil and the resulting potential for human exposure is difficult to predict because of natural variability in those environmental factors and varying microbial susceptibilities. For example, shigella has survived in soil at room temperature for 9–12 days and cryptosporidium oocysts may survive in a moist environment for 60 –180 days. Spore-forming microbes such anthrax spores can survive in soil for many years. Aside from the microbe's ability to survive, availability is another important factor to consider. Certain microbes can sorb to stable soil, which may lengthen their survival time." (9)

Although soil contamination over time is a potential risk to human health, mitigation techniques are available to reduce soil contamination. Simple maintenance of vegetation through pruning may reduce contamination found in plant matter. Other management techniques include the use of mulch and mediums which can catch pollutants and be removed on a regular basis and replaced (9) (21). "Small areas of gross contamination (i.e., sewage with visible solid material) should be cleaned, and treatment with hydrated lime maybe considered. Hydrated lime can be applied to increase pH to a level that kills microbes." (9) Other remedial and control options such as depositing new soil on top of the affected soil and compacting, planting new grass, watering to flush organisms out of the upper soil layers and applying dust-suppressant products where air dispersion is a concern can also be considered (9). Some research suggests that plants can be used for phytoremediation which suggests having the plants take in the soil contaminants which cannot be broken down naturally in the soil and then removing and disposing of the plan material (21) (84) (86).

As noted above, a co-benefit of green infrastructure is known to be the ability of green infrastructure BMPs to filter some but not all pollutants out of stormwater before the water enters the ground water supplies. This is particularly important in places where stormwater infiltration helps to replenish underground aquifers that supply the public with drinking water. This is not the case in Hoboken where drinking water supplies come from source unrelated to nearby ground and surface waters. As such, both the benefit of cleaner water entering groundwater supplies and the potential risk of some pollutants found in stormwater not being filtered out entering drinking water supplies is low.

Nonetheless, the likelihood that green infrastructure BMPs deployed in Hoboken will filter pollutants from stormwater runoff is high. The magnitude of the potential health benefits to be derived from stormwater filtering, in the case of Hoboken, is generally low because residents do not receive their drinking water from aquifers or surface waters proximate to the city. Despite the low level of benefit likely to be derived, with proper management and maintenance, the duration of stormwater filtering benefits provided by green infrastructure BMPs is likely to be long. It anticipated distribution of benefits is neutral. Finally, the evidence that green infrastructure BMPs have the potential to filter pollutants from stormwater is strong.

As noted above, there is some evidence that suggests pollutants, including some toxics, heavy metals and resilient bacteria can be retained in the soil and plant matter used in green infrastructure BMPs. Without careful planning and proper maintenance, contaminants can build-up in the soil and plant matter causing potential risk of exposure to contaminants that can impact human health. This risk is largely dependent on the mix and concentration of contaminants found in the stormwater being filtered through the BMPs. Data on the contaminants contained in Hoboken stormwater were not available at the time that this HIA was prepared. Given the limited nature of the evidence in this regard it appears that the other benefits of green infrastructure BMPs outweigh this potential risk.

Changes in Economic Conditions – Green Jobs, Energy Costs and Maintenance Costs

Green Infrastructure construction and maintenance can provide a platform for improving labor market conditions for local workers and connecting urban residents with needed jobs. Installation, inspection and maintenance of many improvements require a range of skilled and unskilled labor categories. These range from landscapers to LEED-certified professionals. These jobs can provide immediate employment-related social benefits to low-income households and a career pathway to higher wages (66). In 2009, the U.S. Environmental Protection Agency published a catalog of training opportunities for green infrastructure technologies. In the publication, EPA notes that "(t)he implementation of green infrastructure in wet weather management programs across the country is creating the potential for a new wave of jobs. The potential is notable, not just for initial design and installation of practices such as bio-retention and permeable pavements, but also for long-term operation and maintenance." (87)

In 2013, the organization Green for All–a national organization working to build an inclusive green economy strong enough to lift people out of poverty– in partnership with American Rivers–a leading organization working to protect and restore the nation's rivers and streams–published *Staying Green and Growing Jobs*. The authors note that "the operations and maintenance of green infrastructure represents a significant opportunity to create entry-level jobs in the green sector for individuals from disadvantaged communities." (88)

Regardless of who is hired for constructing and implementing green infrastructure, simply having a job and additional income provides a series of potential health benefits. Financial insecurity causes stress which can negatively impact mental and physical health (51) (52) (53). Stress can lead to psychological effects which tend to affect lower wage earners more (51) (52). Stress has been associated with sleep deprivation which can in turn result in changes in blood pressure, eating habits, and Cortisol, insulin, and leptin levels among other many other human body effects (54). Other studies show that reducing stress has physical health benefits such as lower rates of coronary heart disease (89).

As outlined above, green infrastructure BMPs, especially street trees can reduce urban heat islands by reducing ambient air temperatures (22) (24) (25) (26) (27). Trees have an innate ability to reduce air temperatures. In a study conducted by the USDA Forest Service, a series of trees were planted around homes in the City of Sacramento. An average of 3 trees were planted within 10 feet resulting in one percent cooling energy savings and two percent heating energy savings per tree (71). Other studies show high savings with total savings ranging

from 8-18 percent in cooling savings and 2- 8 percent in heating savings (71). The heat savings result primarily from wind shielding (22) (71). Furthermore, the use of green roofs also improves energy efficiency results in energy cost savings. Studies have found green roofs absorb less energy/heat than traditional roofs and as a result are 39-60 percent cooler than traditional roofs (22). Energy use savings results in lower utility costs which can increase disposable income for residents to spend on healthcare services, healthy food and other items that contribute to positive health outcomes.

As noted on several occasions, many green infrastructure BMPs require ongoing management and maintenance. For example, the collection of stormwater may require pruning of vegetation and removal of soil and/or mulch regularly to prevent the build-up of contaminated soils and sediment. If constructed wetlands, basins or ponds permit public access, there will be costs to maintain those areas. Other maintenance costs associated with green infrastructure includes watering vegetation, pest and vermin control, vegetation removal and the potential for the need to repair infrastructure from roots and fallen branches (71). Roots may crack and damage sidewalks while more trees may affect power lines during storms and high wind days (71). Overgrown vegetation and poorly maintained and patrolled green space can lead to public perceptions of and real opportunities for crime, which can cause physical harm and emotional stress (65). Finally, some practices such as permeable pavements require special maintenance techniques and sometimes equipment to maintain their beneficial function (21) (5). Increases in municipal maintenance costs could result in higher taxes. Unlike with energy savings if taxes rise, residents may have less disposable income available for residents to spend on healthcare services, healthy food and other items that contribute to positive health outcomes.

The evidence related to these benefits and risks is generally limited. The likelihood of these benefits and risks materializing, while possible is uncertain at best. In addition, the magnitude of potential health benefit/risk associated with these outcomes ranges from moderate to low. The duration of the benefits/risks would likely be long and the distribution might range from restorative to disproportionate harm, depending on the risk/benefit being considered.

Other Exposure Hazards

It should be noted that local stakeholders and residents raised a number of concerns about green infrastructure implementation. Some were confirmed in the literature. Others were more localized concerns not found in the literature but deserving of acknowledgement nonetheless.

First, residents that participated in the low-income resident focus group expressed the concern that new green spaces will invite graffiti and loitering which will negatively impact quality of life in those areas. They observed that there are a number of examples, where existing nearby parks are not well patrolled by police. The parks attract drug dealers and others “up to no good.” They suggested that if large cisterns are used to capture and store rainwater, they could become “eyesores” and magnets for graffiti. Low income residents were also concerned that without active maintenance, trash and litter would undoubtedly accumulate in rain gardens, swales, ponds, tree pits, etc. They expressed skepticism that the green infrastructure, once installed would be properly maintained. As evidence, they observed that streets near their residences are not even cleaned following flooding events. As a result, the sewage and other contaminants in the flood waters dry on the streets, become dusty and airborne when cars drive by and ultimately contribute to people becoming sick. Finally, low-income residents expressed suspicion that the more attractive green infrastructure such as rain gardens would be installed in wealthier parts of the city, not in their neighborhoods.

Participants in the senior citizens focus group expressed similar concerns regarding potential public safety issues; however, they were more worried that on-going maintenance and upkeep of green infrastructure BMPs would increase property taxes. Residents that participated in the community-wide survey were also concerned

about the costs of implementation and on-going maintenance; loitering and crime; as well as higher taxes. They raised additional concerns about: potential smells from standing water; being more bothered by mosquitoes and vermin; more opportunities for pet refuse to go uncleaned; increased problems with allergies caused by an increase in vegetation and loss of parking.

The evidence related to these risks is mostly limited to the past experiences and concerns of residents that participated in the HIA focus groups and community-wide resident survey. The likelihood of these risks materializing was deemed to range from likely to possible but all are uncertain. In addition, the magnitude of potential health risk associated with these outcomes was deemed to be low. The duration of the risks would likely be long and the distribution would range from evenly distributed to disproportionate harm for those living most proximate to the BMPs once constructed.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

It is clear from the HIA that implementation of Hoboken's proposed stormwater management plan and ordinance amendments may have a variety of positive health outcomes. Most importantly, implementation of green infrastructure BMPs, when combined with the NHSA's construction of wet weather pump stations, has the potential to substantially reduce flooding and CSS back-ups and overflows in the city. Fewer flooding and CSS events can have range of positive health effects. Implementation of green infrastructure BMPs may also have a number of health-related co-benefits and some minor risks.

The HIA research team worked with the HIA advisory committee to develop short and longer term recommendations to inform stormwater management planning in Hoboken. The recommendations developed as part of the HIA process are aimed at maximizing the potential health benefits and minimizing/mitigating the potential health risks associated with the decision to implement green infrastructure city-wide. The recommendations are based on the findings of the HIA impact analysis, current effective practices and local knowledge. Every effort was made to ensure that the recommended actions are: specific; responsive to predicted impacts; technically feasible; and within the authority of Hoboken officials, representatives from the NHSA and other implementation partners. The recommendations are as follows:

1. **Ensure the longevity of potential BMP benefits as well as public safety/enjoyment with careful design, monitoring and a robust program of on-going maintenance.**
   Several recurring themes emerged from the HIA analysis. One was how important it is to carefully design and construct BMPs to ensure their proper function. Two was the need to regularly monitor BMP performance; and a three was the need to manage and maintain BMPs on an on-going basis. Green infrastructure BMPs are essentially mini-environmental systems that need to be thoughtfully engineered, appropriately installed and properly maintained to ensure their efficient and safe functioning over time. The following actions can/should be taken to maximize the potential health benefits and manage the potential risks associated with implementing green infrastructure BMPs in Hoboken:

   a) Incorporate clear and consistent green infrastructure inspection and maintenance requirements in city's stormwater management plan and ordinance.
   b) Develop a checklist of design and siting considerations for each type of BMP being considered for implementation. The checklist should be informed by the potential health benefits and risks highlighted in the HIA and should seek to minimize the risks and maximize the potential health benefits.
   c) Require owners of green infrastructure BMPs to prepare and implement a green infrastructure operations and maintenance plans that includes regular monitoring and inspections; vegetation management, cleaning; soil testing (where appropriate), and vermin/insect control procedures. The plans should have specific standards, procedures and maintenance schedules for each type of BMP constructed.
   d) Provide funding to support adequate operations and maintenance. Funding and implementation of operations and maintenance should take advantage of public-private partnerships where feasible.
   e) If green infrastructure BMPs are to be implemented by entities other than the city, city officials should put in place an appropriate oversight mechanism to ensure green infrastructure BMPs are properly designed, constructed, and maintained.
   f) Develop and implement a training and education program for the city's public works personnel on the proper care and maintenance of green infrastructure BMPs. The findings of the HIA should be

incorporated in the training curriculum. Where feasible, utilize existing training programs and resources.

g) If contractors are used construct, operate and maintain green infrastructure on public property, ensure that workers are specifically trained and certified in green infrastructure construction, operations and maintenance and give preference to those companies that employ Hoboken residents.
h) Require the hiring of trained and certified contractors to install and maintain publically-funded green infrastructure on private property.

2. Ensure that the co-benefits of green infrastructure BMPs accrue equitably throughout the city.

The HIA impact analysis highlighted the fact that some neighborhoods and populations in Hoboken are more burdened by the impacts of flooding than others. In particular, those living in the lowest-lying areas on the western edge of the city, including low-income residents living in these neighborhoods, people with disabilities and older Hoboken residents. Residents living in the lowest-lying, most frequently flooded neighborhoods in the city will likely experience the biggest benefits of green infrastructure BMPs in terms of flood reduction and the health benefits associated with less frequent flooding and fewer CSS events. However, it is important to recognize that many of the co-benefits of green infrastructure BMPs are likely to accrue to residents that live proximate to where the BMPs are installed. With this in mind, decision-makers in Hoboken can help to ensure that the full benefits of green infrastructure implementation accrue evenly throughout the city by taking the following actions:

a) Locate green infrastructure BMPs where they can provide the most significant stormwater management/flood reduction benefit, while remaining aware of the distribution of co-benefits to be derived from specific BMPs.
b) Use GIS software and mapping to analyze the "benefit buffers" associated with each BMP in relation to where it is to be constructed. Overlay the benefit buffers with population data to ensure that potential co-benefits and risks are shared across neighborhoods and sub-populations.
c) To the extent feasible given engineering and fiscal constraints, use green infrastructure BMPs to improve neighborhood conditions and minimize potential risks in areas where vulnerable populations live, especially in lower income neighborhoods.

3. Leverage investment in green infrastructure construction, operations and maintenance to grow jobs and provide career pathways for city residents, especially low-income populations.

The HIA analysis regarding potential economic co-benefits of green infrastructure BMPs revealed an interesting and potentially impactful approach to green infrastructure implementation. There are several guidance documents and case study examples that demonstrate how to connect green infrastructure construction, operations and maintenance with workforce development initiatives in order to maximize the potential positive benefits of "green job" growth, especially the benefits that accrue to low-income and other disadvantaged workers. In that regard, decision-makers in Hoboken responsible for advancing green infrastructure implementation can/should take the following actions:

a) Generate opportunities for local workers and local businesses to participate in green infrastructure implementation by inserting community benefit strategies into green infrastructure installation and maintenance contracts.

b) If green infrastructure operations and maintenance responsibilities will be outsourced, consider partnering with local workforce development programs and/or giving preferences to local companies or those that hire local workers.

4. **Magnify the benefits of green infrastructure BMPs by expanding implementation throughout North Hudson Sewerage Authority (NHSA) service area and beyond.**
The HIA impact analysis highlights the potential for green infrastructure implementation to significantly reduce the flow of stormwater entering Hoboken's combined sewer system. However, the sewage treatment plant in Hoboken operated by the NHSA receives wastewater and stormwater flows from other nearby communities, including Union City. The potential benefits of green infrastructure deployment in Hoboken could be magnified by expanding implementation of green infrastructure BMPs throughout the NHSA service area. Toward that end, the following specific actions can/should be undertaken:

a) NHSA should include a robust program of green infrastructure implementation as part of its Long Term Control Plan to manage CSS overflows. This should include construction, operations and maintenance of green infrastructure BMPs throughout the NHSA service area.
b) Share and present the findings and recommendations of the HIA to elected officials, planning board members, local health officials and the public in Union City, Weehawken and West New York as well as Hudson County government. This can help to build support for green infrastructure implementation in communities outside of Hoboken.
c) Create opportunities for peer-to-peer exchange between elected and appointed officials from Hoboken, Union City, Weehawken and West New York to explore opportunities for green infrastructure collaboration.
d) Work with Hudson County officials to promote green infrastructure implementation county-wide. Toward this end, Hudson County should incorporate green infrastructure implementation as a strategy in the Hudson County Multi-jurisdiction Hazard Mitigation Plan.

5. **Expand public outreach and engagement to ensure more residents are aware of the city's efforts to implement green infrastructure and understand potential benefits and risks.**
The community-wide resident survey conducted during the HIA assessment phase revealed that approximately 65 percent of resident respondents had heard about green infrastructure before taking the survey. Of those, about 84 percent were aware of Hoboken's efforts to use green infrastructure to address chronic flooding and to make the city more resilient. Awareness among low-income residents, seniors and people with disabilities was somewhat lower, with just about 50 percent reporting they were familiar with green infrastructure and the city's effort in that regard. Based on these results, it would appear that about one third to a half of city residents could benefit from expanded outreach and engagement to educate all city residents about the potential benefits and risks of green infrastructure as city decision-makers move ahead with plans to adopt a new approach to stormwater management. To ensure Hoboken residents are well informed, the following actions can/should be undertaken:

a) Use the HIA final report and executive-level briefing materials as a platform to expand public outreach and engagement related to the pending decision on adopting the proposed stormwater management plan amendments and ordinance.
b) Develop a traveling booth display that can be used during community events, fairs, etc.

c) Work with the Hoboken Board of Education to sponsor a poster or video contest on green infrastructure benefits and risks. The HIA final report and briefing materials can be used to develop a short curriculum for students on flooding and CSS events and how green infrastructure is being used to improve stormwater management in Hoboken and make the city more resilient.
d) Partner with the Hoboken Housing Authority to foster greater awareness regarding green infrastructure benefits and risks among housing authority residents.
e) Partner with community-based organizations working in Hoboken to increase green infrastructure awareness among other vulnerable populations, including seniors and people with disabilities.

6. Develop and implement a monitoring and evaluation program to track green infrastructure performance and health outcomes over time.

Implementation of green infrastructure BMPs in Hoboken is expected to be incremental, will likely take many years and will involve a range of implementation partners, including the city, NHSA, community-based organizations and private property owners. Monitoring and evaluating the performance of green infrastructure BMPs and their associated health impacts will require a collaborative partnership and sustained effort. The frequency and rigor of monitoring and evaluation activities will be determined by available resources, but should include on-going periodic performance assessments. The following actions can/should be undertaken:

a) Create and maintain a GIS inventory and database of public and private green infrastructure BMPs. The inventory should include: basic information regarding the BMP such as: type, ownership, geographic location, materials used, and other relevant descriptive characteristics; information regarding the expected performance characteristics such as stormwater storage/removal capacity and anticipated co-benefits, inspection and maintenance requirements; and actual performance monitoring data.
b) Establish a green infrastructure implementation advisory committee to develop consensus on a manageable set of performance indicators and metrics. The selection of indicators should be informed by the findings of the HIA and include metrics in the following categories: stormwater management/flood reduction; exposure and access to green space/natural features; water quality; soil quality; air quality/heat island; change in household and community economic conditions; exposure to other hazards.
c) Utilize the NHSA Long Term Control Plan process to support green infrastructure monitoring and evaluation. This should include data collection and reporting consistent with the green infrastructure monitoring and evaluation program.
d) Partner with Hoboken University Medical Center and North Hudson Community Action Corporation Health Center to collect and report data consistent with the green infrastructure monitoring and evaluation program.
e) Conduct a bi-annual community-wide resident survey to track resident experiences, perceptions and opinions of green infrastructure implementation and performance and associated health-related effects.

Appendix 1: References

1. **Witters, Dan and Andre, Steve.** Healthy Behaviors Not Fully Regained in Areas Hit by Sandy. *Gallup.* [Online] Novermber 26, 2013. http://www.gallup.com/poll/166013/healthy-behaviors-not-fully-regained-areas-hit-sandy.aspx.

2. **Hudson Regional Health Commission.** Superstorm Sandy Health & Wellbeing Assessment Report. *Hudson Regional Health Commission.* [Online] April 30, 2014. http://www.hudsonregional.org/Resources/Superstorm_Sandy/3%20Hudson%20Superstorm%20Sandy%20Assessment%20Report%20Final.pdf.

3. **The Pew Charitable Trusts.** Health Impact Project Announces 2014 Call for Proposals. *The Pew Charitable Trusts.* [Online] February 12, 2014. http://www.pewtrusts.org/en/about/news-room/press-releases/0001/01/01/health-impact-project-announces-2014-call-for-proposals.

4. **Bailin, Deborah.** Hoboken's Post-Sandy Resilience. *Center for Science and Democracy.* [Online] February 2014. [Cited: February 11, 2015.] http://www.ucsusa.org/sites/default/files/legacy/assets/documents/center-for-science-and-democracy/hoboken-post-sandy-resilience.pdf.

5. **Together North Jersey.** *Hoboken Green Infrastructure Strategic Plan.* 2013.

6. **Mannick, Joseph.** Final Surface Water Minor Mod. Permit Action; Category:A - Sanitary Wasterwater; CSM - Combined Sewer Management; NJPDES Permit No. NJ0025321; North Hudson Sewerage Authority; River Road Sewerage Treatment Plant; West New York Town, Hudson County. *New Jersey Department of Environmental Protection.* [Online] October 7, 2015. www.nj.gov/dep/dwq/pdf/cso-nj0025321-final.pdf.

7. **United States Environmental Protection Agency.** What is Green Infrastructure. *United States Environmental Protection Agency.* [Online] November 2, 2015. https://www.epa.gov/green-infrastructure/what-green-infrastructure.

8. —. *Report to Congress: Impacts and Control of CSOs and SSOs.* Washington D.C. : s.n., 2004.

9. **Centers for Disease Control and Prevention.** Guidance on Microvial Contamination in Previosuly Flooded Outdoor Areas. *Centers for Disease Control and Prevention.* [Online] March 2011. [Cited: June 19, 2015.] http://www.cdc.gov/nceh/ehs/docs/guidance_contamination_of_flooded_areas.pdf.

10. —. Water-Related Emergencies & Outbreaks. *Centers for Disease Control and Prevention.* [Online] Centers for Disease Control and Prevention, December 4, 2014. [Cited: June 19, 2015.] http://www.cdc.gov/healthywater/emergency/flood/buildings.html.

11. —. Mold After a Disaster. *Centers for Disease Control and Prevention.* [Online] Centers for Disease Control and Prevention, April 22, 2015. [Cited: June 19, 2015.] http://emergency.cdc.gov/disasters/mold/index.asp.

12. *Global Health Impacts of Floods: Epidemiologic Evidence.* **Ahern, Mike, et al.** s.l. : Epidemiologic Reviews, 2005, Vol. 27.

13. **Centers for Disease Control and Prevention.** Flood Waters or Standing Waters. *Centers for Disease Control and Prevention.* [Online] January 23, 2013. [Cited: February 1, 2016.] http://www.cdc.gov/healthywater/emergency/extreme-weather/floods-standingwater.html.

14. *Public health impacts of floods and chemical contamination.* **Euripidou, Euripides and Murray, Virginia.** 4, s.l. : Jounrnal of Public Health, 2004, Vol. 26.

15. *"I wish I'd never heard of Banbury": The relationship between 'place' and the health impacts from flooding.* **Tapsell, S. M. and Tunstall, S. M.** Queensway : Health & Place, 2008, Vol. 14.

16. *Vulnerability to flooding: health and social dimensions.* **Tapsell, S. M., et al.** 1796, London : Philosophical Transactions of the Royal Society A, 2002, Vol. 360.

17. **CBS New York/Associated Press.** Deluge Of Rain Causes Flooding Across Parts Of Tri-State Area. *CBS New York.* [Online] CBS Radio Inc., May 31, 2015. [Cited: June 19, 2015.] http://newyork.cbslocal.com/2015/05/31/heavy-rain-flooding-tri-state-area/.

18. **City of Hoboken.** AN ORDINANCE AMENDING CHAPTER §104 (FLOOD DAMAGE PREVENTION) TO REFLECT UPDATES RECOMMENDED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION'S LATEST REVISED MODEL ORDINANCE. *City of Hoboken.* [Online] November 6, 2013. [Cited: June 19, 2015.] http://www.hobokennj.org/docs/council/respack13/revised-respac-11-06-13.pdf.

19. **The JerseyJournal.** Rains create flooding nightmare in Hoboken. *NJ.com.* [Online] New Jersey On-Line LLC, March 14, 2010. [Cited: June 19, 2015.] http://www.nj.com/hobokennow/index.ssf/2010/03/rains_create_flooding_nightmar.html.

20. **North Hudson Sewearge Autority.** H-5 Wet Weather Pump Station Additional Frequently Asked Questions. *City of Hoboken.* [Online] February 23, 2015. [Cited: June 19, 2015.] http://www.hobokennj.org/docs/mayor/2-23-15-Memo-Zimmer-Council.pdf.

21. *Green Engineering Promote Low-impact Development.* **Davis, Allen P.** 16, s.l. : Environmental Science and Technology, 2005, Vol. 39.

22. **Odefey, Jeffrey, et al.** *Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide.* 2012.

23. *Green infrastructure and Public Health in the Florida Communities Trust Public Land Acquisition Program.* **Coutts, Christopher.** 4, s.l. : Planning Practice and Research, 2010, Vol. 25.

24. **United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds.** Water: Low Impact Development. *United States Environmental Protection Agency.* [Online] September 2013. [Cited: February 18, 2015.] http://water.epa.gov/polwaste/green/upload/stormwater2streettrees.pdf.

25. **Uyterhoeven, Sonia.** Home Gardening Center Tip Sheet: Caring for Urban Street Trees. *The New York Botanical Garden.* [Online] [Cited: February 18, 2015.] http://www.nybg.org/gardens/home-gardening/tips/street-trees.php.

26. **United States Environmental Protection Agency.** Case Studies Analyzing the Economic Benefits of Low Impact Development and Green infrastructure Programs. *United States Environmental Protection Agency.* [Online] August 2013. [Cited: February 18, 2015.] http://water.epa.gov/polwaste/green/upload/lid-gi-programs_report_8-6-13_combined.pdf.

27. —. Aesthetics of Low Impact Development. *United States Environmental Protection Agency.* [Online] March 2012. [Cited: February 18, 2015.] http://water.epa.gov/polwaste/green/upload/bbfs4aesthetics.pdf.

28. —. Benefits of Low Impact Development. *United States Environmental Protection Agency.* [Online] [Cited: February 2015, 2015.] http://water.epa.gov/polwaste/green/upload/bbfs1benefits.pdf.

29. —. Case Studies Analyzing the Economic Benefits of Low Impact Development and Green infrastructure Programs. *United States Environmental Protection Agency.* [Online] August 2013. [Cited: February 18, 2015.] http://water.epa.gov/polwaste/green/upload/lid-gi-programs_report_8-6-13_combined.pdf.

30. **Bhatia, R, et al.** Minimum Elements and Practice Standards for Health Impact Assessment, Version 3. *Society of Practioners of Health Impact Assessment.* [Online] September 2014. [Cited: July 20, 2016.] hiasociety.org/wp-content/uploads/2013/11/HIA-Practice-Standards-September-2014.pdf.

31. *The Relationship between Socioeconomic Status and Health: A Review of the Literature.* **Feinstein, Jonathan S.** 2, 1993, The Milbank Quarterly, Vol. 71, pp. 279-322.

32. *Age, Socioeconomic Status, and Health.* **House, James S., Kessler, Ronald C. and Herzog, A. Regula.** 3, 1990, The Milbank Quarterly, Vol. 68, pp. 383-411.

33. *Understanding the association between socioeconomic status and physical health.* **Gallo, Linda C. and Matthews, Karen A.** 1, 2003, Psychological Bulletin, Vol. 129, pp. 10-51.

34. **Intellicast.** Historic Average. *intellicast.* [Online] February 24, 2015. http://www.intellicast.com/Local/History.aspx?location=USNJ0221.

35. **New Jersey Department of Environmental Protection.** Climate Change in New Jersey: Temperature, Precipitaion, Extreme Events and Sea Level. *New Jersey Department of Environmental Protection Office of Science.* [Online] June 2013. [Cited: February 24, 2015.] http://www.nj.gov/dep/dsr/trends/pdfs/climate-change.pdf.

36. **National Oceanic and Atmospheric Administration.** Sea Level Trends. *National Oceanic and Atmospheric Administration, Tides & Currents.* [Online] October 15, 2013. [Cited: February 24, 2015.] http://co-ops.nos.noaa.gov/sltrends/sltrends.shtml.

37. **CH2M HILL.** Southwest Hoboken Flooding Analysis. *North Hudson Sewerage Authority.* [Online] 2002. [Cited: February 11, 2015.] http://www.nhudsonsa.com/images_subpages/SW_Hoboken_Flooding_2002.pdf.

38. **EmNet, LLC.** Final Report: An Evaluation of I/I and Illicit Flow in West New York, NJ and Flood Mitigiation in Hoboken, NJ. *North Hudson Sewerage Authority.* [Online] 2013. [Cited: February 11, 2015.] http://www.nhudsonsa.com/docs/Hoboken_Flooding_Analysis_and_WNY_Illicit_Flow_Analysis_2013.pdf.

39. **United States Department of Labor, Occupational Safety & Health Administration.** Fact Sheets on Natural Disaster Recovery: Flood Cleanup. *United States Department of Labor.* [Online] [Cited: January 20, 2016.] https://www.osha.gov/OshDoc/floodCleanup.html.

40. **Burton, Jr., G. Allen and Pitt, Robert E.** *Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists, and Engineers.* Boca Raton, FL : Taylor and Francis Group, LLC, 2002.

41. *Pathogenic Human Viruses in Coastal Waters.* **Griffin, Dale W., et al.** 1, s.l. : Clinical Microbiology Reviews, 2003, Vol. 16.

42. *Epidemiological investigation of an outbreak of hepatitis A in rural China.* **Yu, Ping, et al.** s.l. : International Journal of Infectious Disease, 2015, Vol. 33.

43. *A Field Evaluation of Rain Garden Flow and Pollutant Treatment.* **Dietz, Michael E. and Clausen, John C.** 1-4, s.l. : Water, Air, and Soil Pollution, 2005, Vol. 167, pp. 123-138.

44. *Impact of Anthropogenic Environmental Alterations on Vector-Borne Diseases.* **Vora, Neil.** 10, s.l. : The Medscape Journal of Medicine, 2008, Vol. 10.

45. *Factors in the emergence of infectious diseases.* **Morse, S. S.** 1, s.l. : Emerging Infectious Disease, 1995, Vol. 1, pp. 7-15.

46. **American Mosquito Control Association.** Mosquito-Borne Diseases. *American Mosquito Control Association.* [Online] American Mosquito Control Association, 2014. [Cited: June 19, 2015.] http://www.mosquito.org/mosquito-borne-diseases.

47. *Meta-analyses of the associations of respiratory health effects with dampness and mold in homes.* **Fisk, W. J., Lei-Gomez, Q. and Mendell, M. J.** Singapore : Indoor Air, 2007, Vol. 17.

48. *Indoor environmental problems and health status in water-damaged homes due to tsunami disaster in Japan.* **Hasegawa, Kenichi, et al.** s.l. : Building and Environment , 2015, Vols. (In Press - Corrected Proof).

49. *The Effects of Flooding on Mental Health: Outcomes and Recommendations from a Review of the Literature.* **Stanke, Carla, et al.** 1, s.l. : PLOS Currents Disasters, 2012.

50. **National Council on Alcholism and Drug Dependence, Inc.** National Council on Alcholism and Drug Dependence, Inc. *Experts Say mental Health Effects of Hurricane Sandy Could be Powerful.* [Online] November 4, 2012. [Cited: February 11, 2015.] https://ncadd.org/blogs/in-the-news/entry/experts-say-mental-health-effects-of-hurricane-sandy-could-be-powerful.

51. *Intervening processess in the relationship between unemployment and health.* **Kessler, Ronald C, Turner, J. Blake and House, James S.** 4, Great Britain : Psychological Medicine, 1987, Vol. 17.

52. *Stress, Life Events, and Socioeconomic Disparities in Health: Results from the Americans' Changing Lives Study.* **Lantz, Paula M., et al.** 3, s.l. : Journal of Health and Social Behavior, 2005, Vol. 46.

53. *Financial strain is associated with increased oxidative stress levels: The Woman's Health and Aging Studies.* **Palat, Priya, et al.** TBD - In Press, s.l. : Geriatric Nursing, 2015, Vols. TBD - In Press.

54. *Protective and damaging effects of stress mediators: central role of the brain.* **McEwen, Bruce S.** 4, s.l. : Dialogues in Clinical NueroSciences, 2006, Vol. 8.

55. **City of Hoboken.** Flooding Information. *Hoboken.* [Online] City of Hobken, June 19, 2015. [Cited: June 19, 2015.] http://www.hobokennj.org/departments/environmental-services/storm-flood-zones/.

56. **News 12 New Jersey.** Heavy rain floods streets, homes in Hoboken. *News 12 New Jersey.* [Online] News 12 Interactive LLC, May 8, 2015. [Cited: June 19, 2015.] http://newjersey.news12.com/news/heavy-rain-floods-streets-homes-in-hoboken-1.5224542?pts=794280.

57. **HOBOKEN411.** Spring rain = Hoboken flooding. *Hoboken 411.* [Online] Hoboken411.com, May 8, 2013. [Cited: June 19, 2015.] http://hoboken411.com/archives/93318.

58. **Duffy, Christie.** Heavy Rain Floods NJ Streets, Homes and Businesses. *NJTVNEWS.* [Online] WNET, May 1, 2014. [Cited: June 19, 2015.] http://www.njtvonline.org/news/video/heavy-rain-floods-nj-streets-homes-and-businesses/.

59. **Maurer, Mark.** Flooding causes Hoboken street closings, North Hudson fire officials preparing for worst. *NJ.com.* [Online] New Jersey On-Line LLC, September 30, 2010. [Cited: June 19, 2015.] http://www.nj.com/hobokennow/index.ssf/2010/09/flooding_causes_street_closing.html.

60. **Hack, Charles.** Flooding causes traffic jams in Hoboken and Jersey City. *NJ.com.* [Online] New-Jersey On-Line, February 27, 2013. [Cited: June 19, 20145.] http://www.nj.com/hudson/index.ssf/2013/02/flooding_causes_traffic_jams_i.html.

61. *The Long Road to Recovery: Environmental Health Impacts of Hurricane Sandy.* **Manuel, John.** 5, s.l. : Environmental Health Perspective, May 1, 2013, Vol. 121.

62. **Ander, Steve and Witters, Dan.** Healthy Behaviors Fall in Areas Hit by Superstorm Sandy. [Online] February 8, 2013. [Cited: February 19, 2015.] http://www.gallup.com/poll/160364/healthy-behaviors-fall-areas-hit-superstorm-sandy.

63. **Philadelphia Water Department.** Green City Clean Water: The City of Philadelphia's Program for COmbined Sewer Overflow Control. *Philadelphia Water Department.* [Online] September 1, 2009. [Cited: February 27, 2015.] http://www.phillywatersheds.org/ltcpu/LTCPU_Complete.pdf.

64. **Garrison, Noah, et al.** Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows. *Natural Resources Defense Council.* [Online] October 2013. [Cited: February 27, 2015.] http://www.nrdc.org/water/pollution/rooftopsII/default.asp.

65. *Promoting ecosystem and human health in urban areas.* **Tzoulas, Konstantinos, et al.** s.l. : Landscape and Urban Planning, 2007, Vol. 81.

66. **Stratus Consulting, Inc.** *A Triple Bottom Line Assessment of Traditional and Green infrastructure Options for Controlling CSO Events in Philadelphias Watershed.* Boulder : s.n., 2009.

67. **Kloss, Chris.** Opportunities to Introduce Green infrastructure into CSO Plans. *New Jersey Department of Environmental Protection.* [Online] January 2015. [Cited: February 16, 2015.] http://www.nj.gov/dep/dwq/cso.htm.

68. **United States Environmental Protection Agency Office of Wetlands, Oceans and Watersheds.** *Guiding Principles for Constructed Treatment Wetlands.* Washington, D.C. : U.S Environmental Protection Agency, 2000.

69. *Wildlife Habitat and Public Use Benefits of Treatment Wetlands.* **Knight, Robert L.** 5, Great Britain : Water Science and Technology, 1997, Vol. 35.

70. *Relationship of Activity and Social Support to the Functional Health of Older Adults.* **Everard, Kelly M., et al.** 4, s.l. : Journal of Gerantology, 2000, Vol. 55B.

71. **United States Environmental Protection Agency.** Reducing Urban Heat Islands: Compendium of Strategies. *United States Environmental Protection Agency.* [Online] August 29, 2013. [Cited: March 16, 2015.] http://www.epa.gov/heatislands/resources/pdf/TreesandVegCompendium.pdf.

72. *Particulate air pollutants and asthma: A paradigm for the role of oxidative stress in PM-induced adverse health effects.* **Li, Ning, et al.** 3, s.l. : Clinical Immunology, 2003, Vol. 109.

73. *Health effects of air pollution.* **Bernstein, Jonathan A., et al.** 5, s.l. : Journal of Allergy and Clinical Immunology, 2004, Vol. 114.

74. *Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution.* **Pope, CA III, Burnett, R T and Thun, M J.** 2002, Journal of the American Medical Association, pp. 1132-1141.

75. *Intra-urban vulnerability to heat-related mortality in New York City, 1997-2006.* **Rosenthall, Joyce Klein, Kinney, Patrick L. and Metzger, Kristina B.** s.l. : Health & Place, 2014, Vol. 30.

76. **United States Environmental Protection Agency.** Heat Island Effect. *United State Environmental Protection Agency.* [Online] August 29, 2013. [Cited: March 5, 2015.] http://www.epa.gov/heatislands/impacts/index.htm.

77. *Variation of daily warm season mortality as a function of micro-urban heat islands.* **Smargiassi, A., et al.** 8, s.l. : Journal of Epidemiology & Community Health, 2009, Vol. 63.

78. *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator.* **Arnold, Chester Jr. L. and Gibbons, C. James.** 2, s.l. : Jounral of the American Planning Association, 1996, Vol. 62.

79. *The persistance and removal of enteric pathogens in constructed wetlands.* **Karim, Mohammad R., et al.** 2004, s.l. : Water Research, 2004, Vol. 38.

80. **Unknown.** Bioaccumulation & Biomagnification. *Marietta College.* [Online] April 3, 2002. [Cited: March 6, 2015.] http://www.marietta.edu/~biol/102/2bioma95.html.

81. **Naidu, Haripriya.** heavy metal phytoremeditation by water hyacinth at constructed wetlands. *academia.edu.* [Online] [Cited: March 6, 2015.] http://www.academia.edu/2134220/heavy_metal_phytoremediation_by_water_hyacinth_at_constructed_wetlands.

82. *Hazards of heavy metal contamination.* **Jarup, Lars.** 1, London : British Medical Bulletin, 2003, Vol. 68.

83. **Kloss, Christopher.** Managing Wet Weather with Green Infrastructure: Municipal Handbook. *United States Environmental Protection Agency.* [Online] 2008. [Cited: Marc 6, 2015.] http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_harvesting.pdf.

84. *Phytoremediation of toxic elemental and organic pollutants.* **Meagher, Richard B.** 2, s.l. : Current Opinion in Plant Biology, 2000, Vol. 3.

85. *Heavy Metal Contamination in Soils of Urban Highways Comparison Between Runoff and Soil Cocnentrations at Cincinnati, Ohio.* **Turer, Dilek, Maynard, Barry J. and Sansalone, John J.** 3-4, s.l. : Water, Air and Soil Pollution, 2001, Vol. 132.

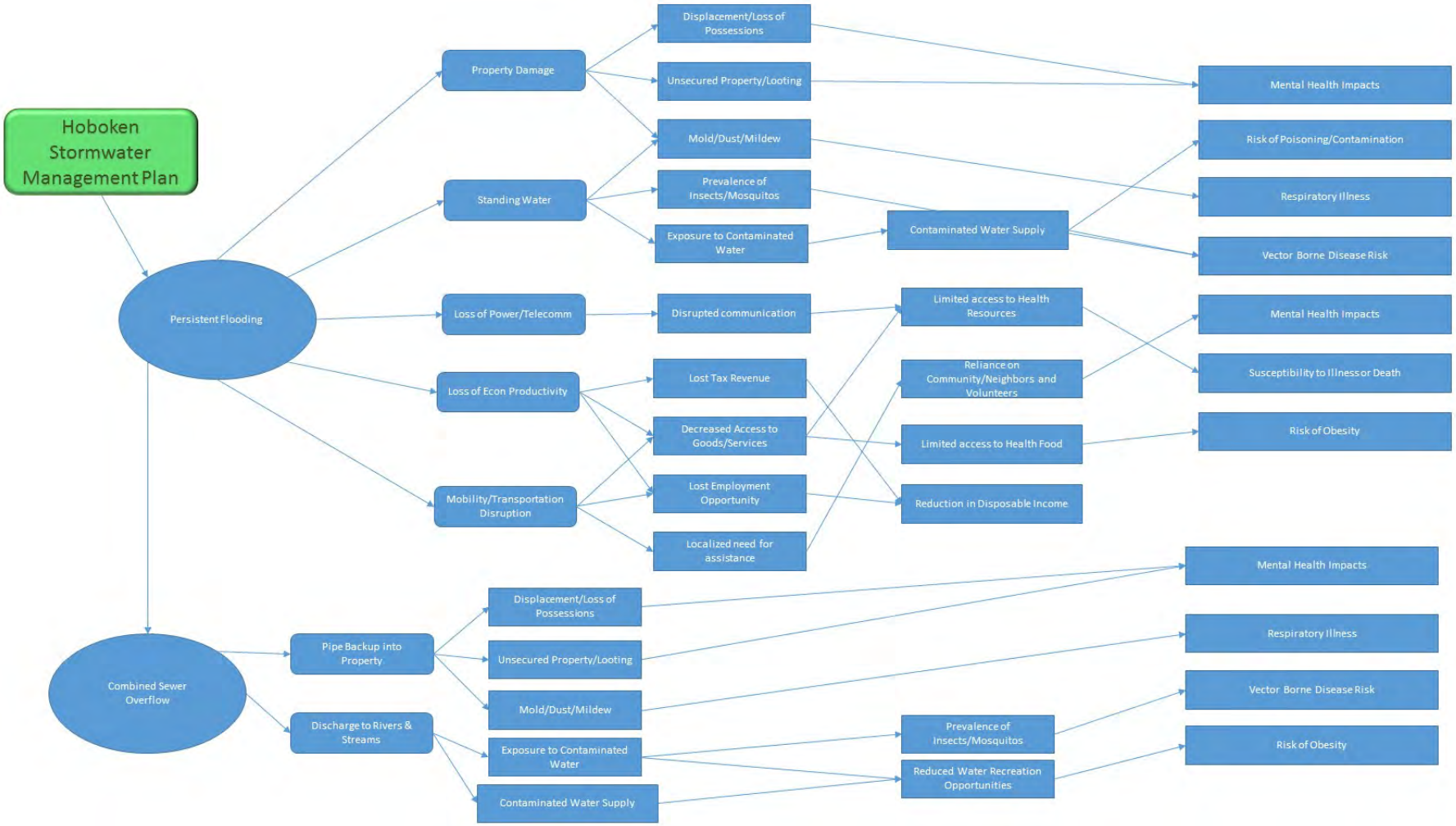
86. *Phytoremediation of metals: using plants to remove pollutants from the environment.* **Raskin, Ilya, Smith, Robert D. and Salt, David E.** 2, s.l. : Current Opinion in Biotechnology, 1997, Vol. 8.

87. **United States Environmental Protection Agency.** Green Jobs Training: A Catalog of Training Opportunities for Green Infrastructure Technologies. *United States Environmental Protection Agency.* [Online] February 2009. https://www.epa.gov/npdes/pubs/gi_greenjobs_feb09.pdf.

88. **Green For All.** Staying Green and Growing Jobs: Green Infrastructure Operations and Maintenance as Career Pathway Stepping Stones. *Green For All.* [Online] April 2013. http://www.greenforall.org/staying_green_and_growing_jobs_green_infrastructure_operations_and_maintenance_as_career_pathway_stepping_stones.

89. *Self-reported economic difficulties and coronary events in men: evidence from the Whitehall II study.* **Ferrie, J. E., et al.** 3, s.l. : International Journal of Epidemiology, 2005, Vol. 34.

Appendix 2a: Preliminary Flooding/CSO health pathways Diagram (Developed as part of Scoping Phase)



Appendix 2b: Preliminary Green Infrastructure BMPs Health Pathways Diagram (Developed during Scoping Phase)

Appendix 3

City of Hoboken, New Jersey
Proposed Stormwater Management Plan
Health Impact Assessment (HIA)

Community-wide Survey Methods and Results Report

BACKGROUND AND OBJECTIVES

The stakeholder engagement plan for the Hoboken, NJ Proposed Stormwater Management Plan and Ordinance Amendments HIA included a community-wide resident survey. The purpose of the survey was to collect data to help the HIA research team to better understand resident experiences with chronic flooding in Hoboken, the impacts of flooding on their health and well-being, their opinions on green infrastructure, and their general health status. These data were used to document the current health status of residents and document the health effects of flooding in Hoboken residents. These data were also used to predict the potential health benefits and risks of implementing green infrastructure best management practices to reduce flooding and combined sewer system back-ups and overflows in the city.

SURVEY METHODS

The survey included a total of 58 questions and was administered on-line using Qualtrics on-line survey software. Survey responses were collected using a convenience sampling approach that included email recruitment, social media announcements, word-of-mouth, traditional media outreach, flyers, community outreach via area non-profits and a public kiosk set up at a local grocery store. Surveys were available in both English and Spanish. In addition to being administered on-line, hard copies of the survey were distributed through various outlets including Hoboken City Hall, Hoboken Housing Authority properties, senior housing facilities and private businesses. The hard copy surveys included an envelope and paid postage for ease of returning the survey. To encourage participation, respondents were provided the opportunity to enter into a random drawing to win a $100 gift card at the end of the survey. The survey was open June 14, 2015 through August 30, 2015.

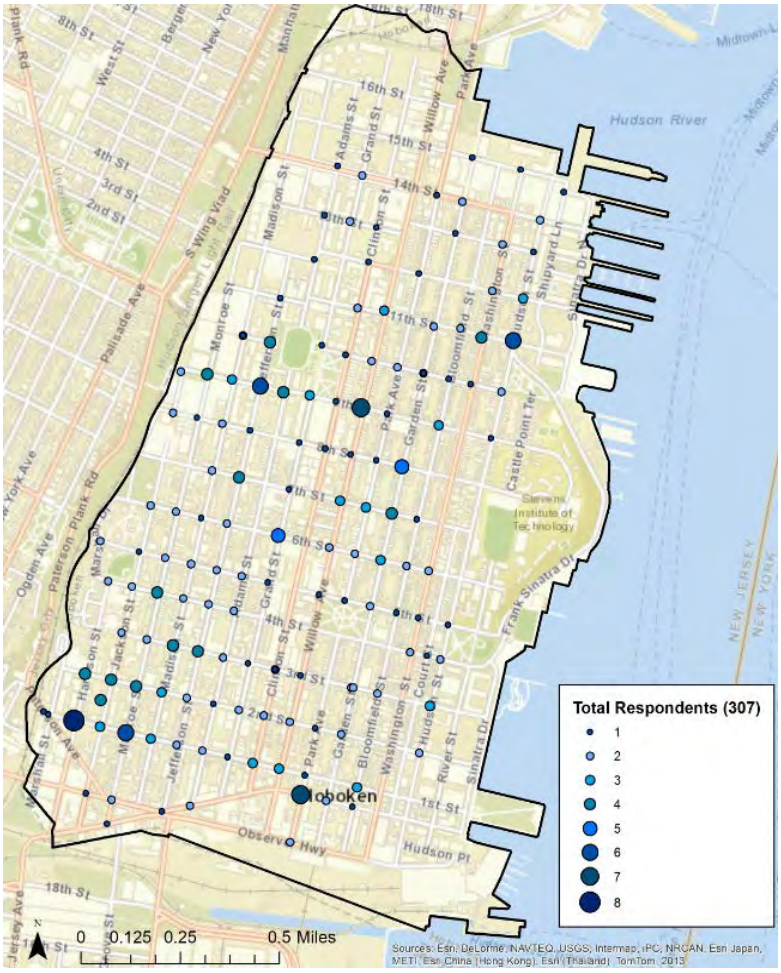


Figure AP3-1: Location of Hoboken HIA Survey Respondents by Nearest Intersection

SURVEY RESULTS - Demographic Comparison

In total 654 individuals visited the survey site. A total of 398 completed survey responses were received. This represents a 60 percent completion rate. Figure 1 shows the geographic distribution of survey participants based on the information they provided for the nearest intersection to their place of residence. In addition to mapping the distribution of survey responses, the research team compared the demographic data provided by survey participants to population and demographic data from the U. S. Census Bureau. Tables 1 through 4 summarize the findings of this comparative analysis:

Table AP3-1. Age – Survey Sample vs. Census

	Survey	Census*
Under 18	0%	0%
18-35	53%	56%
36-50	28%	26%
51-65	17%	11%
66-75	2%	4%
Over 75	0%	3%
* Percentage of those over 18		

Source: U.S. Census American Community Survey 2014 – Raw Data

Table AP3-2. Race/Ethnicity – Survey Sample vs. Census

	Survey	Census
White	87%	85%
Black/African American	2%	3%
Asian	3%	8%
Multiracial	3%	3%
Other	5%	1%

Hispanic	12%	17%

Source: U.S. Census American Community Survey 2014 – Raw Data

Table AP3-3. Household Income – Survey Sample vs. Census

	Survey	Census
Less than $25,000	7%	14%
$25,000-50,000	9%	9%
$50,001-$75,000	16%	10%
$75,001-$100,000	16%	13%
Over $100,000	52%	54%

Source: U.S. Census American Community Survey 2014 – Raw Data

Table AP3-4. Gender – Survey Sample vs. Census

	Survey	Census
Male	37%	50%
Female	63%	50%

Source: U.S. Census American Community Survey 2014 – Raw Data

DATA WEIGHTING & ANALYSIS

The survey sample for this survey was not drawn from a random population of Hoboken residents. As such, statistical adjustments must be made to make the results generalizable to the overall population of the city. The following data weighting procedures were applied and are presented below for key data points:

- Gender: weights the data to be representative of the gender population distribution of Hoboken.
- Income: weights the data to be representative of the income population distribution of Hoboken.
- Hispanic: weights the data to be representative of the Hispanic population distribution of Hoboken.
- Race: weights the data to be representative of the race population distribution of Hoboken.
- Age: weights the data to be representative of the age population distribution of Hoboken.
- Combined: weights the data to be representative of the population distribution of Hoboken based on gender, Hispanic population, race, and income.[2]

The following script was developed within the statistical analysis software used to weight the survey data:

```
data test1;
set HobokenHIADD;

/* Population weights: Hobo has 51979 people and survey has 398 respondents
*/
   popwght=51979/398;

/* Sex weight: Q56=Sex */
if Q56=1 then sexwght=(49.5/37.5);
if Q56=2 then sexwght=(37.5/49.5); else sexwght=sexwght;
if Q56=. then sexwght=1; else sexwght=sexwght;

/* Population times sex weight */
popsexwght=popwght*sexwght;

/* Hispanic weight */
if Q47=1 then Hispwght=17.0/11.7;
if Q47=2 then Hispwght=83.0/88.3; else Hispwght=Hispwght;
if Q47=. then Hispwght=1; else Hispwght=Hispwght;

/* Population times Hispanic weight */
PopHiswght=Hispwght*popwght;

/* AGE WEIGHT: Q46=AGE */
IF Q46=1 THEN AGEWGHT=(55.6/52.8);
IF Q46=2 THEN AGEWGHT=(25.7/27.8); ELSE AGEWGHT=AGEWGHT;
IF Q46=3 THEN AGEWGHT=(11.4/17.5); ELSE AGEWGHT=AGEWGHT;
```

[2] Age was not included in the combined weighting due to the limited survey sample for those aged between "66 and 75" and "Over 75".

```
IF Q46=4 THEN AGEWGHT=(4.0/1.5); ELSE AGEWGHT=AGEWGHT;
IF Q46=5 THEN AGEWGHT=(3.3/0.3); ELSE AGEWGHT=AGEWGHT;
IF Q46=. THEN AGEWGHT=1; ELSE AGEWGHT=AGEWGHT;


/* Race weight */
if Q48=1 then Racewght=84.7/86.6; else racewght=racewght;
if Q48=2 then Racewght=3.0/2.1; else racewght=racewght;
if Q48=4 then Racewght=8.0/2.6; else racewght=racewght;
if Q48=3 or Q48=5 or Q48=6 then Racewght=4.2/8.8; else racewght=racewght;
if Q48=. then Racewght=1; else racewght=racewght;

/* Population times Race weight */
PopRacewght=racewght*popwght;

/* Income weight */
if Q51=1 then Incwght=14.1/6.8; else incwght=incwght;
if Q51=2 then Incwght=8.9/9.0; else incwght=incwght;
if Q51=3 then Incwght=10.5/16.1; else incwght=incwght;
if Q51=4 then Incwght=12.6/15.8; else incwght=incwght;
if Q51=5 then Incwght=53.9/52.3; else incwght=incwght;
if Q51=. then Incwght=1; else incwght=incwght;

/* Population times Income weight */
PopIncwght=Incwght*popwght;

/* Now try two comprehensive weight, the first without population weight, the
second with population weight */

AllWght1=sexwght*Hispwght*Racewght*Incwght;
AllWght2=popwght*sexwght*Hispwght*Racewght*Incwght;

data test2;
set test1;
keep id popwght sexwght popsexwght Hispwght PopHiswght Racewght PopRacewght
Incwght PopIncWght
AllWght1 Allwght2;
proc print data=test2 (obs=100);
run;
```

For the purposes of the Health Impact Assessment, the research team also utilized survey data to determine the extent to which the impacts of flooding in Hoboken might be disparately impacting vulnerable subgroups. The groups identified as “vulnerable populations” included survey respondents that self-reported in one or more of the following categories: people over the age of 65, low-income residents (those residing in households with less than $25,000 in annual household income) and individuals with physical, mental or emotional limitations.

ANALYSIS RESULTS FOR KEY SURVEY QUESTIONS

Utilizing the various weights developed, the research team analyzed the data using each weight. The results of the analysis utilizing the weights as well as an "unweighted" data for key survey questions are summarized below.

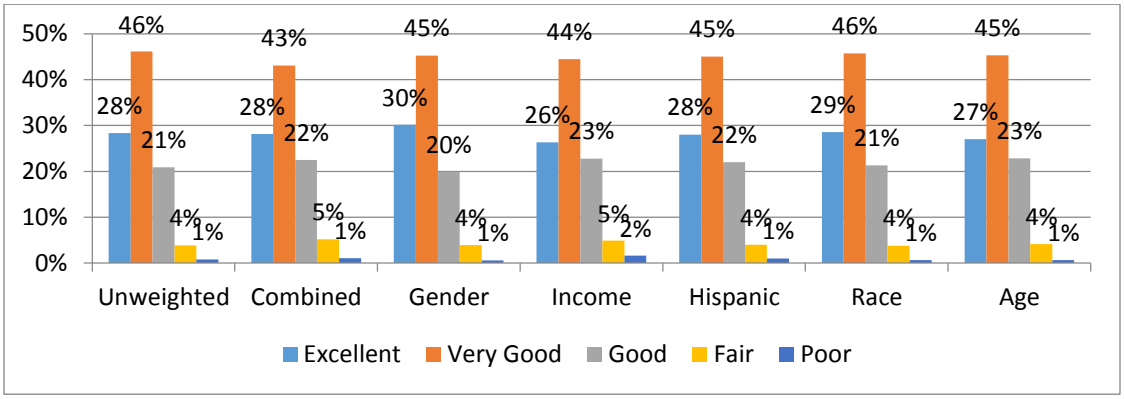


Figure AP3-2. General Health Status – Would you say that your health in general is…

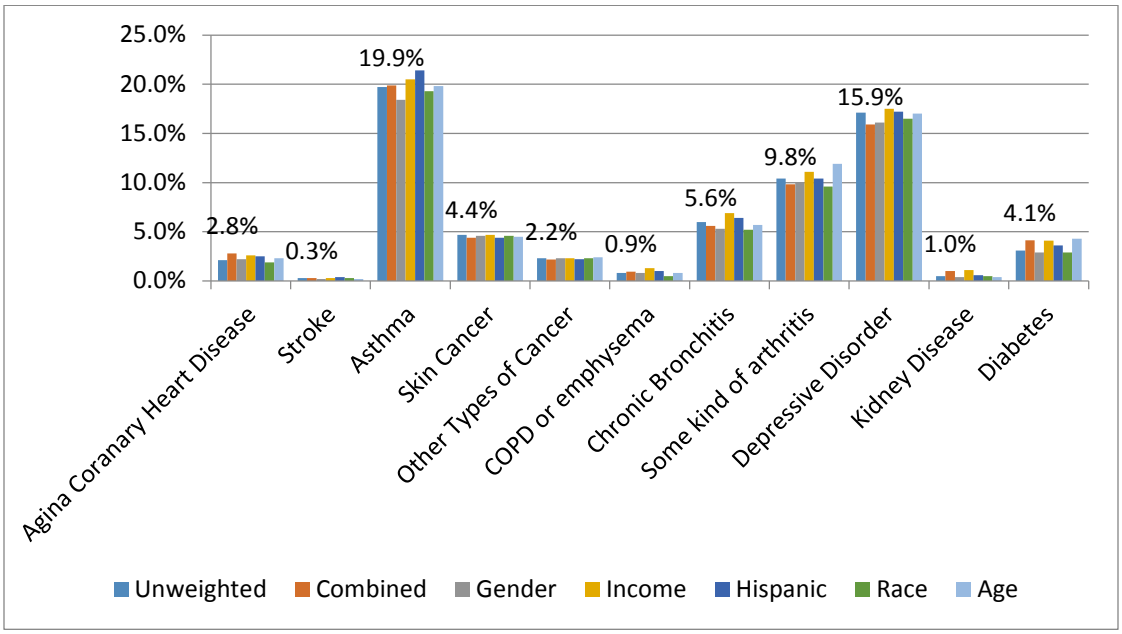


Figure AP3-3. Chronic Health Conditions – Has a doctor, nurse or other health professional EVER told you that you had any of the following…[3]

[3] Displayed data points represent the "combined" weighted data.

Table AP3-5. How often are you personally impacted by flooding in Hoboken?

	Vulnerable Population							General Population						
	Unweighted	Combined	Gender	Income	Hispanic	Race	Age	Unweighted	Combined	Gender	Income	Hispanic	Race	Age
Every time it floods	36%	37%	34%	39%	37%	36%	38%	20%	19%	20%	20%	20%	18%	19%
Only during very heavy rainstorms	44%	43%	43%	44%	44%	45%	60%	50%	52%	51%	50%	51%	52%	49%
Almost never	17%	16%	18%	15%	17%	16%	21%	23%	23%	23%	23%	23%	23%	21%
I am not affected by flooding in Hoboken.	3%	3%	4%	6%	3%	3%	6%	7%	6%	6%	6%	7%	7%	7%

Table AP3-6. In the past two years, how many times were you personally impacted by flooding?

	Vulnerable Population							General Population						
	Unweighted	Combined	Gender	Income	Hispanic	Race	Age	Unweighted	Combined	Gender	Income	Hispanic	Race	Age
Never	18%	16%	20%	16%	17%	18%	16%	27%	26%	27%	27%	26%	28%	26%
Just one time	16%	18%	18%	18%	17%	15%	28%	20%	21%	21%	21%	22%	20%	22%
Two times	17%	21%	15%	16%	17%	21%	16%	19%	19%	19%	18%	19%	20%	19%
Three times	19%	16%	20%	19%	19%	19%	16%	14%	13%	14%	14%	13%	13%	14%
More than three times	29%	28%	27%	32%	31%	27%	24%	20%	21%	20%	20%	20%	20%	20%

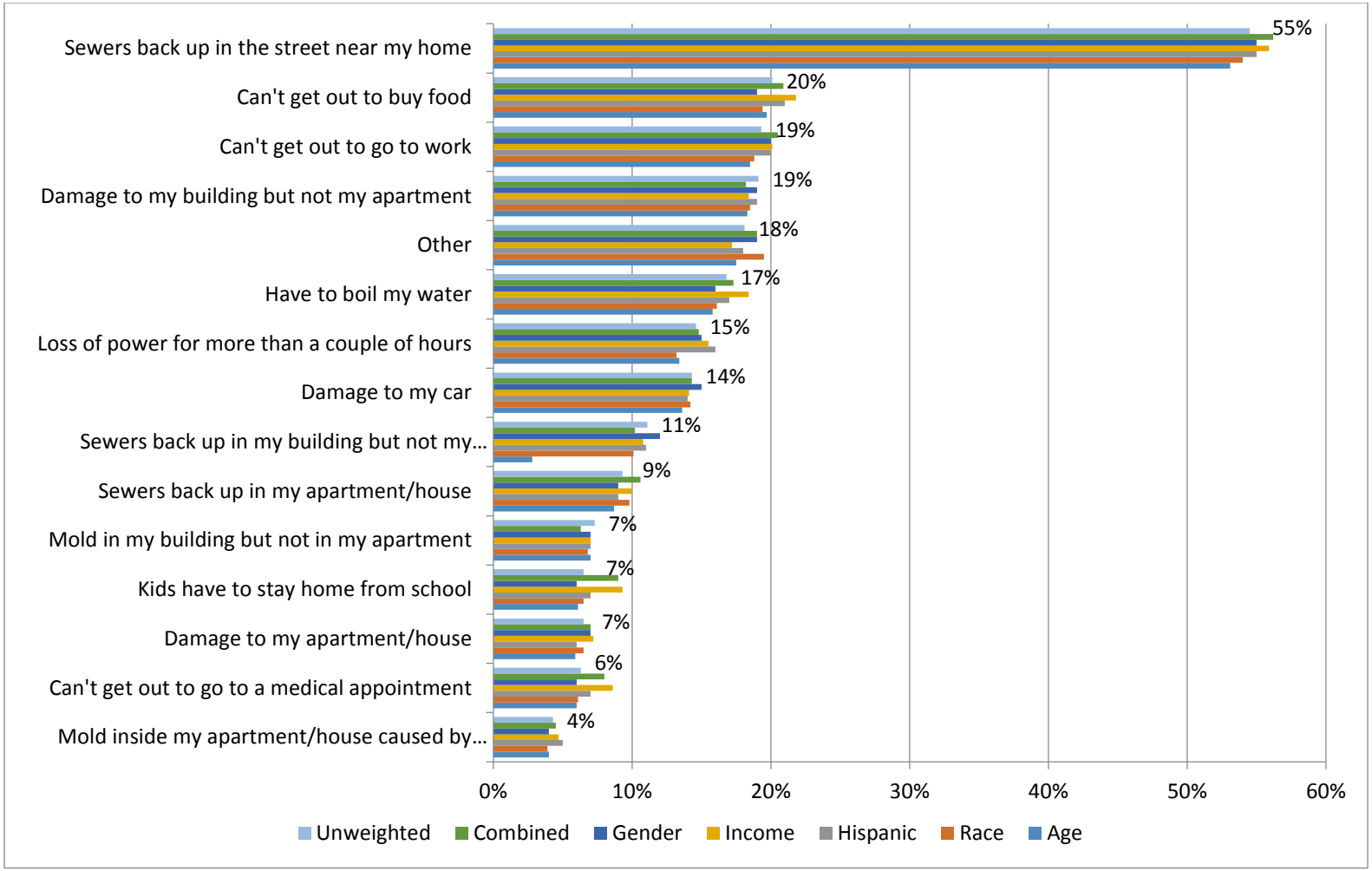


Figure AP3-4. What types of impacts do you regularly experience?[4]

[4] Displayed data points represent the unweighted data.

Table AP3-7. In the past two years, how many times have you experienced a one of the following medical conditions? (Skin rash; Asthma or other respiratory condition; Eye irritation/infection; Muscle aches; Abdominal cramping, nausea or diarrhea; Vomiting; Headaches)

	Unweighted	Combined	Gender	Income	Hispanic	Race	Age
Never experienced a Symptom	72.0%	71.1%	72.7%	69.3%	70.7%	73.2%	73.9%
Experienced a symptom at least once	28.0%	28.9%	27.3%	30.7%	29.3%	26.8%	26.1%

Table AP3-8. In the past two years, how many times have you sought medical attention for one of the following medical conditions? (Skin rash; Asthma or other respiratory condition; Eye irritation/infection; Muscle aches; Abdominal cramping, nausea or diarrhea; Vomiting; Headaches)

	Unweighted	Combined	Gender	Income	Hispanic	Race	Age
Never sought medical attention	76.8%	75.5%	77.0%	75.1%	74.3%	77.5%	78.6%
Sought medical attention at least once	23.2%	24.5%	23.0%	24.9%	24.2%	22.5%	21.4%

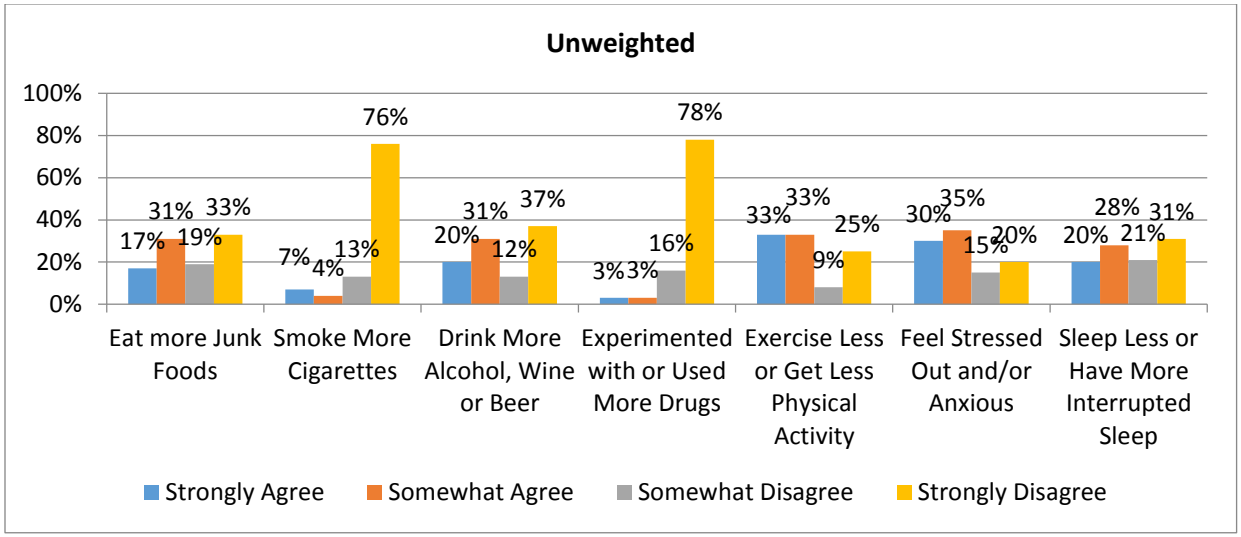


Figure AP3-5a. How much do you agree with the following statements?

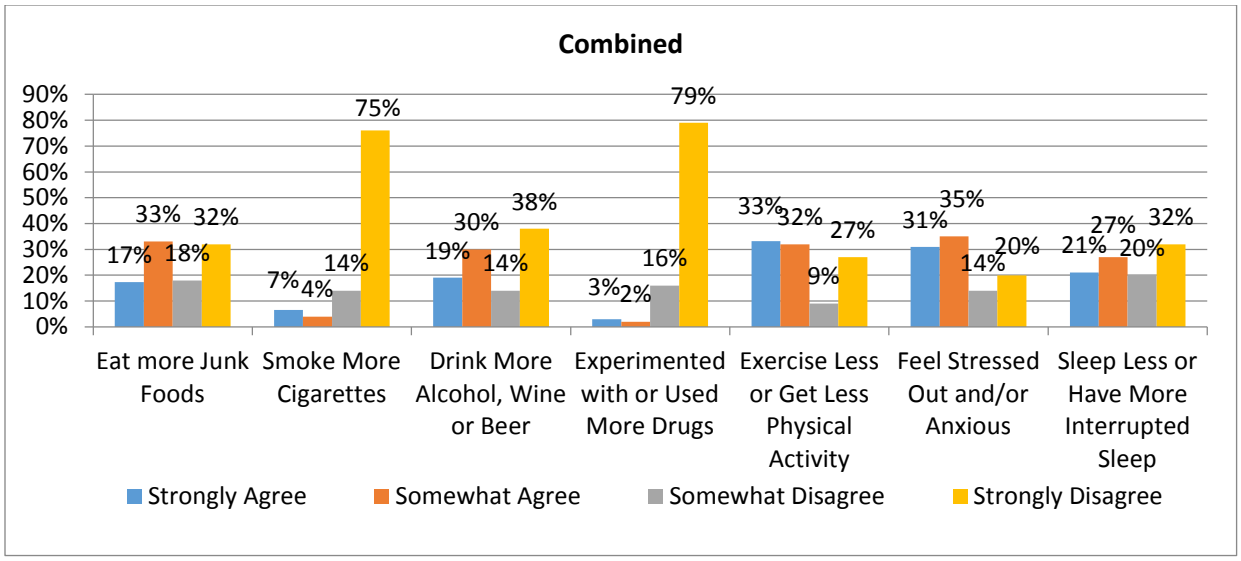


Figure AP3-5b. How much do you agree with the following statements?

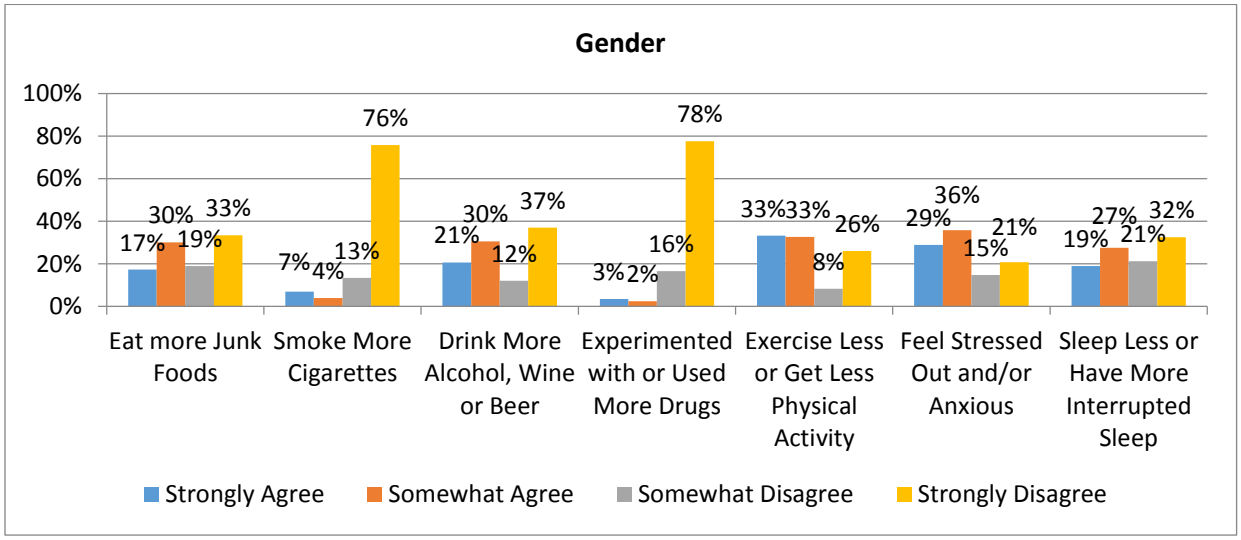


Figure AP3-5c. How much do you agree with the following statements?

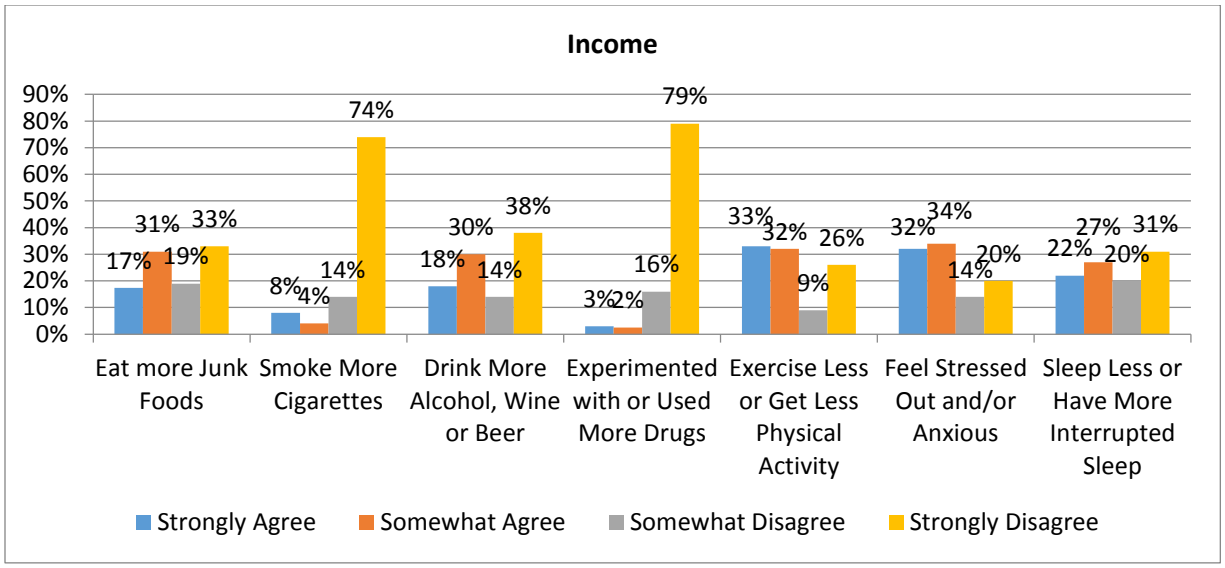


Figure AP3-5d. How much do you agree with the following statements?

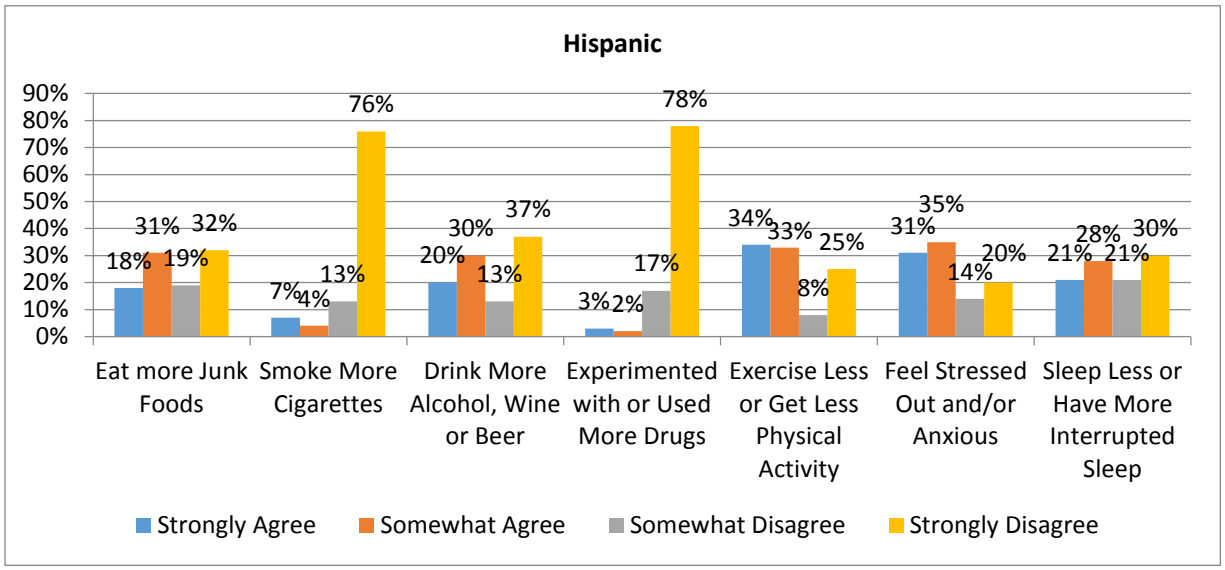


Figure AP3-5e. How much do you agree with the following statements?

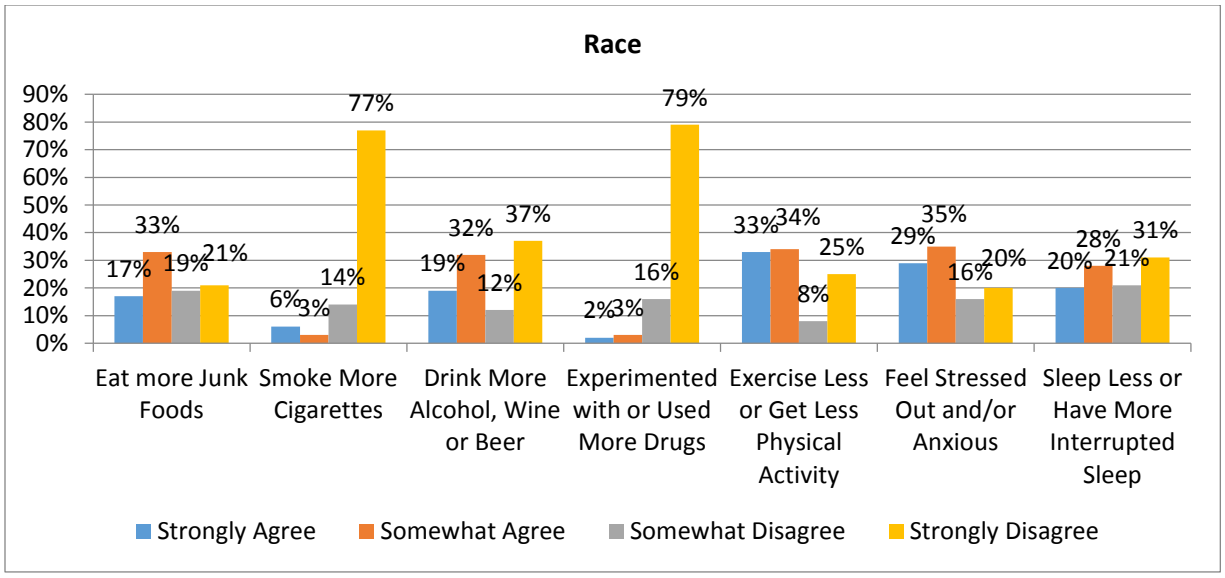


Figure AP3-5f. How much do you agree with the following statements?

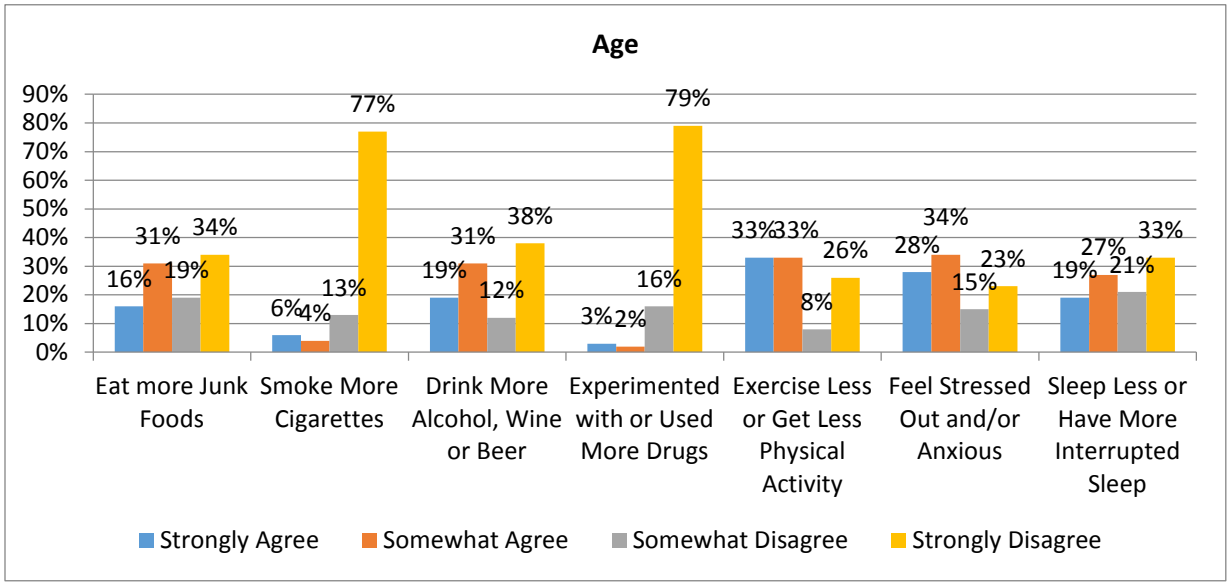


Figure AP3-5g. How much do you agree with the following statements?

Table AP3-9. Was your apartment/house damaged by flooding in the past two years?

	Vulnerable Population							General Population						
	Unweighted	Combined	Gender	Income	Hispanic	Race	Age	Unweighted	Combined	Gender	Income	Hispanic	Race	Age
Yes	23.7%	25.4%	22.2%	23.8%	24.2%	25.5%	17.6%	13.4%	12.4%	13.2%	13.1%	13.2%	12.9%	12.7%
No	76.3%	74.6%	77.8%	76.3%	75.8%	74.5%	82.4%	86.6%	87.6%	86.8%	86.9%	86.8%	87.1%	87.3%

Table AP3-10. When it floods in Hoboken, it is at least somewhat difficult to do the following things:

	Vulnerable Population							General Population						
	Unweighted	Combined	Gender	Income	Hispanic	Race	Age	Unweighted	Combined	Gender	Income	Hispanic	Race	Age
Pick up prescriptions	51%	52%	45%	57%	52%	50%	43%	31%	31%	31%	30%	31%	31%	31%
Get to my doctor or other medical appointment	54%	52%	48%	57%	57%	51%	45%	30%	30%	30%	29%	30%	30%	30%
Pick up food/groceries	70%	69%	67%	72%	72%	72%	59%	57%	59%	58%	57%	57%	58%	58%
Get to work	61%	58%	58%	59%	62%	60%	49%	58%	58%	58%	57%	58%	58%	59%
Get to school	30%	31%	26%	33%	32%	28%	24%	19%	22%	19%	19%	19%	19%	18%

Attachment A: Hoboken Resident Community Health and Resilience Survey

INFORMED CONSENT

You are being invited to participate in a research study that is being conducted by the New Jersey Health Impact Collaborative at Rutgers University's Bloustein School for Planning and Public Policy. The study is being funded by the Health Impact Project in collaboration with the Pew Charitable Trusts and the Robert Wood Johnson Foundation to investigate how to include public health considerations in decisions made before and after natural disasters. Although you will not receive any direct benefit from participating in this survey, your answers will help the research team understand better how community decision-making around disaster preparedness and recovery can be changed to improve public health outcomes.

This survey is anonymous. Anonymous means that no personal information about you will be recorded when you take the survey. There will be no way to link your responses back to you. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see your responses, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only summarized results will be stated. All study data will be kept for three years.

The survey should take about 15 minutes to complete. Your participation is completely voluntary. You may choose not to answer any questions you are not comfortable answering and if at any time you wish to stop taking the survey, you are completely free to do so. As part of the survey you will be asked to remember back to how past flooding events in Hoboken–including Hurricane Sandy–may have impacted you and your family. Depending on how these events impacted you and your family it may be stressful to think about these things. If after taking the survey you for any reason feel like you could benefit from assistance, counseling or other storm-recovery services, resources are available from the Hudson County Long-term Recovery Committee and NJ Mental Health Cares. You may access these resources by calling 211. There are no other foreseeable risks to participation in this study.

This survey is anonymous. Anonymous means that no personal information about you will be recorded when you take the survey. There will be no way to link your responses back to you. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see your responses, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only summarized results will be stated. All study data will be kept for three years.

At the end of the survey you will be asked if you want to be entered to win a $100 Visa gift cards. Gift cards will be awarded to two randomly selected individuals that complete the survey. We estimate that your chances of winning a gift card will be 1 in 250. If you choose to enter, you will be asked to provide us with your contact information. This information will be kept confidential.

If you have any questions about the study or study procedures, you may contact Jon Carnegie at Voorhees Transportation Center, 33 Livingston Ave., New Brunswick, NJ, 08901, 848-932-2840, carnegie@ejb.rutgers.edu.

If you have any questions about your rights as a research subject, you may contact the IRB Administrator at Rutgers University, Arts and Sciences IRB at:

Institutional Review Board
Rutgers University, the State University of New Jersey
Liberty Plaza / Suite 3200
335 George Street, 3rd Floor
New Brunswick, NJ 08901
Phone: 732-235-9806
Email: humansubjects@orsp.rutgers.edu

If you are 18 years of age or older, understand the statements above, and agree to participate in the study, check "Yes" If not, please check "No".

- ❍ Yes
- ❍ No (Not eligible to participate. Stop.)

EXPERIENCES WITH CHRONIC FLOODING IN HOBOKEN

This section is about your experiences with chronic flooding in Hoboken. This means flooding that occurs regularly when it rains hard. For the purpose of this study, we are NOT talking about big storms like Hurricane Sandy that had a storm surge from the ocean that caused massive flooding in Hoboken. When answering questions in this section, we want you to think about the problems and impacts you experience from regular flooding that occurs during and after heavy rain storms.

1. About how often would you say regular flooding occurs in Hoboken after periods of heavy rain?
   - ☐ Once per year
   - ☐ 2-3 times per year
   - ☐ More than 3 times per year.

2. How often are you personally impacted by flooding in Hoboken?
   - ☐ Every time it floods
   - ☐ Only during very heavy rainstorms
   - ☐ Almost never
   - ☐ I am not affected by flooding in Hoboken

3. What type of impacts do you regularly experience? (Check all that apply).
   - ☐ Damage to my apartment/house
   - ☐ Damage to my building but not my apartment
   - ☐ Mold inside my apartment/house caused by flooding
   - ☐ Mold in my building but not in my apartment caused by flooding
   - ☐ Sewers back up in my apartment/house
   - ☐ Sewers back up in my building but not my apartment
   - ☐ Sewers back up in the street near my home
   - ☐ Loss of power for more than a couple of hours
   - ☐ Have to boil my water
   - ☐ Damage to my car
   - ☐ Can't get out to go to work
   - ☐ Can't get to out to buy food
   - ☐ Can't get out to go to a medical appointment
   - ☐ Kids have to stay home from school
   - ☐ Other

4. In the past two years how many times were you personally impacted by flooding? Remember, the period we are interested in is the past two year **AFTER** Hurricane Sandy.
   - ☐ Never (Skip to question 10)
   - ☐ One time
   - ☐ Two times
   - ☐ Three times
   - ☐ More than three times

5. Was your apartment/house damaged by flooding in the **past two years**?
   - ☐ Yes
   - ☐ No (Skip to question 10)

6. If your apartment/house was damaged by flooding, what was the approximate total cost to make all repairs and/or replace household/personal items that were destroyed by all the flooding events during the **past two years, not including Hurricane Sandy**?
   - ☐ $500 or less
   - ☐ $501 to $1,000
   - ☐ $1,001 to $3,000
   - ☐ $3,001 to $5,000
   - ☐ $5,001 to $7,500
   - ☐ $7,501 to $10,000
   - ☐ $10,001 to $20,000
   - ☐ $20,001 to $30,000
   - ☐ More than $30,000

7. If your apartment/house was damaged in the **past two years**, did you have renters/homeowners or flood insurance that covered the costs of making repairs or and/or replacing household/personal items?
   - ☐ Yes
   - ☐ No (Skip to question 10)
   - ☐ Don't know / Not sure

8. If your apartment/home was damaged did/does insurance cover the cost of making repairs and/or replacing household/personal items?
   - ☐ Insurance covered all costs
   - ☐ Insurance covered some of the costs
   - ☐ Insurance did not cover the costs
   - ☐ Don't know / Not sure

9. If insurance covered all or part of the costs, what was the total cost of the insurance deductible(s) you paid for all insurance claims?
   - ☐ I did not pay a deductible
   - ☐ Less than $500
   - ☐ $500 to $999
   - ☐ $1,000 to $1,499
   - ☐ $1,500 to $2,000
   - ☐ More than $2,000, specify amount _____
   - ☐ Don't know / Not sure

10. When flooding is expected, do you regularly evacuate from your home? Remember, we're talking about regular flooding not during a big storm like Hurricane Sandy.
    - ☐ Yes
    - ☐ No (Skip to question 13)
    - ☐ Don't know / Not Sure

11. Where do you go?
    - ☐ Stayed with a friend or family member in Hoboken
    - ☐ Stayed with a friend or family member outside of Hoboken
    - ☐ An emergency shelter in Hoboken
    - ☐ An emergency shelter outside of Hoboken
    - ☐ A hotel/motel
    - ☐ Other _____

12. When you evacuate, how long do you usually stay at some other location?
    - ☐ 24 hours or less
    - ☐ 1-2 days
    - ☐ 3-4 days
    - ☐ More than 5 days

IMPACTS OF FLOODING ON HEALTH/WELL-BEING

This section is about how chronic flooding in Hoboken affects the lives of you and your family. Remember, for the purpose of this study, we are NOT talking about big storms like Hurricane Sandy that had a storm surge from the ocean that caused massive flooding in Hoboken. When answering questions in this section, we want you to think about the problems you experience from regular flooding that occurs during and after heavy rain storms.

13. When it floods in Hoboken, how difficult do you find it to do the following things:

Activity	Very difficult	Difficult	Somewhat Difficult	Neutral	Somewhat Easy	Easy	Very Easy	Not Applicable
Pick up prescriptions								
Get to my doctor or other medical appointment								
Pick up food/groceries								
Get to work								
Get to school								

14. In the **past two years**, how many times have you missed a medical appointment because of flooding?
    - ☐ I did not miss a medical appointment
    - ☐ One time
    - ☐ Two times
    - ☐ Three times
    - ☐ More than three times
    - ☐ Don't know / Not sure

15. How much do you agree with the following statements? Before, during or after flooding I …….

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
Eat more junk foods				
Smoke more cigarettes				
Drink more alcohol, wine or beer				
Experimented with or used more drugs				
Exercise less or get less physical activity				
Feel stressed out and/or anxious				
Sleep less or have more interrupted sleep				

16. Have you ever experienced an injury requiring medical attention because of **regular flooding** in Hoboken? For example, slipping and falling.
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Not sure

17. Have you ever sought counseling or other mental health services to help you cope with **regular flooding** in Hoboken?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know/Not Sure

18. **In the past two years**, have you ever come in physical contact with flood waters or sewer back-ups caused by flooding in Hoboken?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know/Not Sure

19. **In the past two years**, have you ever had to clean-up after flooding or sewer back-ups caused by flooding?
    - ☐ Yes
    - ☐ No (Skip to question 21)
    - ☐ Don't know/Not Sure

20. If you had to clean up after flooding or sewer back-ups, what precautions did you take to protect your health when cleaning up?
    - ☐ None / I took no precautions
    - ☐ Wore rubber gloves
    - ☐ Wore a face mask
    - ☐ Wore protective clothing
    - ☐ Other: Specify_____

21. In the **past two years**, how many times have you sought medical attention for any of the following conditions after you came in contact with flood waters, sewer back-ups, had to clean up after flooding or came in contact with the mud, sludge or dry residue after flooding or a sewer back-up caused by flooding?

	Never	1 time	2 or more times
Skin rash			
Asthma or other respiratory condition			
Eye irritation/infection			
Muscle aches			
Abdominal cramping, nausea or diarrhea			
Vomiting			
Headaches			

22. In the **past two years** how many times have you personally experienced but did not seek medical attention for any of the following conditions after you came in contact with flood waters, sewer back-ups, had to clean up after flooding or came in contact with the mud, sludge or dry residue after flooding or a sewer back-up caused by flooding?

	Never	1 time	2 or more times
Skin rash			
Asthma or other respiratory condition			
Eye irritation/infection			
Muscle aches			
Abdominal cramping, nausea or diarrhea			
Vomiting			
Headaches			

23. In the **past two years**, have any of your family members, friends, neighbors or others you know experienced any of the following conditions after they came in contact with flood waters, sewer back-ups, had to clean up after flooding or came in contact with the mud, sludge or dry residue after flooding or a sewer back-up caused by flooding?

	Yes	No	No Sure / Don't Know
Skin rash			
Asthma or other respiratory condition			
Eye irritation/infection			
Muscle aches			
Abdominal cramping, nausea or diarrhea			
Vomiting			
Headaches			

24. Do you actively participate in any of the following water-based recreational activities in and around Hoboken? Select all that apply.
    - ☐ Swimming
    - ☐ Kayaking/canoeing
    - ☐ Fishing
    - ☐ Other: Specify _____

25. How long do you wait after flooding events to take part in these activities?
    - ☐ I do not wait
    - ☐ 1-2 days
    - ☐ 3-4 days
    - ☐ 5-7 days
    - ☐ More than a week

26. Are you currently...?
    - ☐ Employed for wages
    - ☐ Self-employed
    - ☐ Out of work for 1 year or more
    - ☐ Out of work for less than 1 year
    - ☐ A Homemaker (Skip to question 28)
    - ☐ A Student not working (Skip to question 28)
    - ☐ Retired (Skip to question 28)
    - ☐ Unable to work (Skip to question 28)

27. At your main job or business, how are you generally paid for the work you do. Are you–
    - ☐ Paid by salary
    - ☐ Paid by the hour
    - ☐ Paid by the job/task (e.g. commission, piecework)
    - ☐ Paid some other way
    - ☐ Don't know / Not sure

28. If you were employed in the past two years, how many days have you missed work because of **regular flooding** in Hoboken?
    - ☐ I have not been employed for the past two years (Skip to question 30)
    - ☐ I did not miss work because of flooding (Skip to question 30)
    - ☐ 1 day/shift
    - ☐ 2 days/shifts
    - ☐ 3 days/shifts
    - ☐ More than 3 days/shifts, please specify _____

29. What was the main reason you missed work because of **regular flooding** in Hoboken?
    - ☐ Got sick
    - ☐ Had to clean-up damage
    - ☐ Could not get to work because I lacked transportation
    - ☐ My place of work was closed due to flooding or the threat of flooding
    - ☐ School or childcare was closed and I had to care for me children
    - ☐ Other, please specify _____

30. In the **past two years**, how often have you restricted the outdoor play activities of your children because of flooding, sewer back-ups caused by flooding or because you were worried that your children might come in contact with the mud, sludge or dry residue left after flooding or a sewer back-up caused by flooding?
    - ☐ Never
    - ☐ One time
    - ☐ 2-3 times
    - ☐ 4-5 times
    - ☐ More than 5 times

OPINIONS ABOUT "GREEN INFRASTRUCTURE"

This set of questions is about something called "Green Infrastructure." Stormwater running off of roofs, streets and parking lots when it rains is a major cause of water pollution and flooding in urban areas. When rain falls in undeveloped areas, the water is absorbed and filtered by soil and plants. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground.

In most urban areas, stormwater is drained through storm drains and pipes and discharged into nearby waterbodies. The stormwater carries with it trash, bacteria, heavy metals, and other pollution, degrading the quality of the receiving waters. Higher amounts of rainfall can also cause flooding in streets and urban streams, damaging habitat, property, transportation, power supplies and other community assets.

Green infrastructure uses vegetation, trees, soils, and natural processes to manage storm water and create healthier urban environments. The City of Hoboken is considering how they can use green infrastructure to help reduce stormwater runoff, flooding and sewer back-ups. The following pictures show the types of green infrastructure city officials are considering. After you have looked at these pictures, please click CONTINUE.

Note: Please see attachment at back of survey to view images.

31. Before taking this survey, had you ever heard about green infrastructure?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know/Not Sure

32. Were you aware that the City of Hoboken was considering how to use green infrastructure to reduce stormwater runoff, flooding and sewer back-ups.
    - ☐ Yes
    - ☐ No
    - ☐ Don't know/Not Sure

33. How much do you agree with the following statements? Using green infrastructure in Hoboken can/will…..

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
Help to reduce stormwater runoff				
Help to reduce flooding in my neighborhood				
Help to reduce sewer-back ups				
Provide more green space in the City				
Help to improve air quality				
Reduce temperatures in the summertime				
Improve quality of life in the city by providing more greenery, parks and natural areas				
Make me more likely to be active because it will be more pleasant to walk or improve my access parks and natural places to enjoy.				
Improve the health of city residents				
Take money away from other needed services				

34. How do you think the City of Hoboken should pay for installing and maintaining green infrastructure? Select all that apply.
    - ☐ Apply for and use state and federal grant money
    - ☐ Use some of the City's tax dollars
    - ☐ Make developers pay for it when they build/renovate buildings
    - ☐ Other, please specify: _____

35. What other benefits do you think green infrastructure can provide in Hoboken?

    _____

36. What concerns do you have about using green infrastructure in Hoboken to reduce stormwater runoff, flooding and sewer back-ups?

    _____

GENERAL HEALTH STATUS

This set of questions is about your general state of health. Your answers to these questions will give the research team a better idea about the current health of Hoboken residents in general. Remember, your answers to ALL the questions in this survey are anonymous. There will be no way to connect you with your answers.

37. Would you say that in general your health is?
    - ☐ Excellent
    - ☐ Very good
    - ☐ Good
    - ☐ Fair
    - ☐ Poor
    - ☐ Don't know/Not sure

38. During the past month, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?
    - ☐ 0 days
    - ☐ 1-3 days
    - ☐ 4-6 days
    - ☐ 7-10 days
    - ☐ More than 10 days
    - ☐ Don't Know/Not sure

39. Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, government plans such as Medicare, or Indian Health Service?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Not sure

40. How often in the past 12 months would you say you were worried or stressed about having enough money to pay your rent/mortgage? Would you say
    - ☐ Always
    - ☐ Usually
    - ☐ Sometimes
    - ☐ Rarely
    - ☐ Never
    - ☐ Don't know / Not sure

41. How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals? Would you say
    - ☐ Always
    - ☐ Usually
    - ☐ Sometimes
    - ☐ Rarely
    - ☐ Never
    - ☐ Don't know / Not sure

42. Has a doctor, nurse, or other health professional EVER told you that you had any of the following?:

	Yes	No	Don't Know / Not Sure
Myocardial infarction?			
Angina or coronary heart disease?			
Stroke?			
Asthma?			
Skin cancer?			
Other types of cancer?			
Chronic Obstructive Pulmonary Disease or COPD, emphysema or			
Chronic bronchitis?			
Some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?			
Depressive disorder, including depression, major depression, dysthymia, or minor depression?			
Kidney disease? Do NOT include kidney stones, bladder infection or incontinence.			
Diabetes?			

43. Are you limited in any way in any activities because of physical, mental, or emotional problems?
    - ☐ Yes
    - ☐ No
    - ☐ Don't know / Not Sure

44. During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?
    - ☐ Yes
    - ☐ No (Skip to question 46)
    - ☐ Don't know / Not sure (Skip to question 46)

45. If yes, how many times did you take part in this activity during the past month?
    - ☐ Once
    - ☐ Twice
    - ☐ 3-4 Times
    - ☐ More than 4 times

TELL US ABOUT YOURSELF

The last set of questions are about you as an individual. Your answers to these questions will help the research team understand the range of people that filled out the survey and whether the answers to the questions were different depending on the individual characteristics of survey participants.

46. What is your age?
    - ☐ 18 – 35
    - ☐ 36 – 50
    - ☐ 51 – 65
    - ☐ 66 - 75
    - ☐ Over 75

47. Are you Hispanic, Latino/a, or Spanish origin?
    - ☐ Yes
    - ☐ No

48. Which one or more of the following would you say is your race? Select all that apply.
    - ☐ White
    - ☐ Black or African American
    - ☐ American Indian or Alaska Native
    - ☐ Asian
    - ☐ Multiracial
    - ☐ Other, please specify:

49. How many children less than 18 years of age live in your household?
    - ☐ Zero
    - ☐ 1-2
    - ☐ 3-4
    - ☐ 5 or more

50. What is the highest grade or year of school you completed?
    - ☐ Never attended school or only attended kindergarten
    - ☐ Grades 1 through 8 (Elementary)
    - ☐ Grades 9 through 11 (Some high school)
    - ☐ Grade 12 or GED (High school graduate)
    - ☐ College 1 year to 3 years (Some college or technical school)
    - ☐ College 4 years or more (College graduate)

51. What is your annual household income from all sources?
    - ☐ Less than $25,000
    - ☐ 25,000 – 50,000
    - ☐ 50,001 – 75,000
    - ☐ 75,001 – 100,000
    - ☐ 100,001 +

52. What town do you live in? _____

53. What is the zip code where you live? _____

54. What is the nearest street intersection to where you live?
    Street #1 _____ / Street#2_____

55. Do you own or rent your home?
    - ☐ Own
    - ☐ Rent
    - ☐ Other arrangement
    - ☐ Don't know / Not sure

56. What is your sex?
    - ☐ Male
    - ☐ Female
    - ☐ Transgender/Other

57. Do you want to enter to win a $100 Visa Gift Card?
    - ☐ Yes
    - ☐ No (Skip to end of survey)

58. What is your contact information?
    - ☐ Last Name _____
    - ☐ First Name _____
    - ☐ Phone Number _____
    - ☐ Email address _____

Thank you for participating!

Appendix 4: Summary Table of Possible Floodwater Contaminants and Their Associated Potential Health Risks and Impacts

Pollutant	Pollutant Sub-Types	Sub-Type Examples	Human Exposure Health Impact Examples
Microbial Pathogens	Bacteria	• Fecal coliform (1) • E. coli (1) (2) • Enterococcus (1) (3) • Adenoviruses (3) • Citrobacter freundii (3) • Aeromonas ichtiosmia (3) • Actinomycetes (3) • Fecal Streptococci (3) • Coliphage (3) • Tetanus (2)	• Gastrointestinal Illnesses (1) (2)(4) (5) (6) -abdominal cramps -diarrhea -fever -vomiting • Dysentery (4) • Pneumonia (1) • Bronchitis (1) • Swimmer's Ear (1) (6) • Headache (2) • Muscle Aches & Spasms (7)
	Viruses[5]	• Picornaviridae -Poliovirus (1) (8) -Coxsackie (1) (8) -Hepatitis A (1) (2) (4) (5) (8) • Adenoviridae (8) -Adenovirus Strains • Caliciviridae (8) -Norwalk • Reoviridae -Rotoviruses	• Vomiting (1) (2) (8) (9) • Diarrhea (1) (2) (4) (8) (9) • Skin Rash (1) (10) • Muscle Aches (2) • Headache (9) • Abdominal Pain (4) (9) • Fever (1)(8)(9)(10) • Respiratory Infection (1) (8) • Liver Infection (1) • Diabetes (8) (11) • Mouth Sores/Blisters (10) • Intestinal Inflammation (4)
	Parasites	• Parasitic Protozoa (1) (4) -Giardia -Cryptosporidium -Entameoba • Helminths (1) (4) • Ectoparasites (2)	• Gastrointestinal Illnesses (4) (12) -Acute & Chronic Diarrhea (1) (12) -Abdominal Pain (4) (12) -Vomiting (12) • Giardiasis (1) • Infections (1) • Round-, Tape, Hook-, & Whip-worms (1) • Ectoparasite diseases (2)
Oxygen Depleting Substances (BOD5)	In/Organic Matter	• Human Excrement (1) • Kitchen Waste (1) • Industrial Waste (1)	• Gastrointestinal Illnesses (13) -Acute & Chronic Diarrhea (1) (12) -Abdominal Pain (4) (12) -Vomiting (12)
Total Suspended Solids (TSS)	Surface & Suspended in Water Particles/Solids	• Decaying Plant Matter (1) • Decaying Animal Matter (1) • Industrial Wastes (1) -Chemicals (15) • Bacteria (15) • Silt (1)	• Health impacts may be considered the same as those found with microbial pathogens and toxics. (14) (15)

[5] More than 120 viruses may be found in sewage. (1)

Toxics	Metals (16)	• Arsenic (1)(17) • Cadmium (1) • Chromium (1) (17) • Copper (17) • Lead (1)(17) • Manganese (17) • Mercury (1) • Nickle (17) • Silver (17) • Zinc (17)	• Brain, Liver, Fat & Kidney Damage (1) • Dermatitis (1) (18) (19) (20) • Hair Loss (1) • Gastrointestinal Illness (1) (18) (19) • Bone Disease (1) • Developmental Illnesses (1)
	Synthetic Organic Chemicals	• Chlorinated Aromatic Hydrocarbons (21) -polychlorinated biphenyls (PCBs) (1) (16) • Chlorinated Hydrocarbons -pesticides (1) (16) • Polycyclic Aromatic Hydrocarbons (1) (16) • Bis(2-ethylhexyl) phthalate (17) • Pharmaceuticals[6] -Antibiotics (22) (23) -Non-prescription Drugs (23) -Steroids & Hormones (23)	• Skin Rash (1) (2) • Anemia (1) • Nervous System Effects (1) • Blood Effects (1) • Liver & Kidney Effects (1) • Reproductive Difficulties (1) • Increased Risk of Cancer (1) • Fetus Reproductive System Effects (24) • Headaches (2) • Dizziness, Nausea, Fatigue, Weakness, Excitability (2) • Respiratory Illness (24) -Asthma -Eczema -Rhinitis
Nutrients	Nitrogen	• N/A	• Rashes (25) • Stomach Illness (25) • Liver Illness (25) • Respiratory Effects (25) -Blue Baby Syndrome (25) • Neurological Effects (25) • Death (25) • Reproductive Effects (25) • Development Effects (25) • Cancer (25)
	Phosphorus	• N/A	
Floatables	Debris/Trash	• Litter (1) • Sanitary Waste (from toilets) (1)	

[6] Additional research is needed to determine what, if any, health impacts may result in humans from exposure.

Attachment A: Appendix 4 References

1. **United States Environmental Protection Agency.** *Report to Congress: Impacts and Control of CSOs and SSOs.* Washington D.C. : s.n., 2004.

2. **United States Department of Labor, Occupational Safety & Health Administration.** Fact Sheets on Natural Disaster Recovery: Flood Cleanup. *United States Department of Labor.* [Online] [Cited: January 20, 2016.] https://www.osha.gov/OshDoc/floodCleanup.html.

3. *Temporal variability of combined sewer overflow contaminants: Evaluation of wastewater micropollutants as tracers of fecal contamination.* **Madoux-Humery, Anne-Sophie, et al.** 13, s.l. : Water Research, 2013, Vol. 47.

4. **Centers for Disease Control and Prevention.** Guidance on Microvial Contamination in Previosuly Flooded Outdoor Areas. *Centers for Disease Control and Prevention.* [Online] March 2011. [Cited: June 19, 2015.] http://www.cdc.gov/nceh/ehs/docs/guidance_contamination_of_flooded_areas.pdf.

5. **Foodsafety.gov.** Causes of Food Poisoning. *Foodsafety.gov.* [Online] [Cited: March 18, 2015.] http://www.foodsafety.gov/poisoning/causes/index.html.

6. **Burton, Jr., G. Allen and Pitt, Robert E.** *Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists, and Engineers.* Boca Raton, FL : Taylor and Francis Group, LLC, 2002.

7. **United States Environmental Protection Agency Office of Wetlands, Oceans and Watersheds.** *Guiding Principles for Constructed Treatment Wetlands.* Washington, D.C. : U.S Environmental Protection Agency, 2000.

8. *Pathogenic Human Viruses in Coastal Waters.* **Griffin, Dale W., et al.** 1, s.l. : Clinical Microbiology Reviews, 2003, Vol. 16.

9. *Epidemiological investigation of an outbreak of hepatitis A in rural China.* **Yu, Ping, et al.** s.l. : International Journal of Infectious Disease, 2015, Vol. 33.

10. **Centers for Disease Control and Prevention.** Non-Polio Enterovirus. *Centers for Disease Control and Prevention.* [Online] May 10, 2013. [Cited: March 18, 2015.] http://www.cdc.gov/non-polio-enterovirus/about/symptoms.html.

11. *Diabetes induced by Coxsackie virus: Initiation by bystander damage and not molecular mimicry.* **Horwitz, Marc S., et al.** s.l. : Nature Medicine, 1998, Vol. 4.

12. **Centers for Disease Control and Prevention.** Parasites. *Centers for Disease Control and Prevention.* [Online] March 10, 2014. [Cited: March 18, 2015.] http://www.cdc.gov/parasites/food.html.

13. *Estimated human health risks from exposure to recreational waters impacted by human and non-human sources of faecal contamination.* **Soller, Jeffrey A, et al.** 16, s.l. : Water Research, 2010, Vol. 44.

14. *Isolation of enteroviruses from water, suspended solids, and sediments from Galveston Bay: survival of poliovirus and rotavirus adsorbed to sediments.* **Rao, V C, et al.** 2, s.l. : Applied and Environmental Microbiology, 1984, Vol. 48.

15. **Fondriest Environmental.** Fundamentals of Environmental Measurements. *Fondriest Environmental.* [Online] [Cited: November 17, 2014.] http://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/.

16. *Evaluation of the factors relating combined sewer overflows with sediment contamination of the lower Passaic River.* **Shear, N. M., et al.** 3, s.l. : Marine Pollution Bulletin, 1996, Vol. 32.

17. **New Jersey Department of Environmental Protection.** Bureau of Surface Water Permitting. *New Jersey Department of Environmental Protection.* [Online] January 23, 2015. [Cited: February 11, 2015.] http://www.state.nj.us/dep/dwq/pdf/cso-adamsst-draft.pdf.

18. **United States Environmental Protection Agency.** Chromium Compounds. *United States Environmental Protection Agency.* [Online] October 18, 2003. [Cited: 18 2015, March.] http://www.epa.gov/airtoxics/hlthef/chromium.html.

19. **U.S. Department of Health and Human Services.** Toxicology Profile For Chromium. *Agency for Toxic Substances & Disease Registry.* [Online] September 2012. [Cited: March 2015, 2015.] http://www.atsdr.cdc.gov/toxprofiles/tp7.pdf.

20. —. Toxicology Profile For Copper. *Agency for Toxic Substances & Disease Registry.* [Online] September 2004. [Cited: March 18, 2015.] http://www.atsdr.cdc.gov/ToxProfiles/tp132.pdf.

21. *ORGANIC EXTRACTABLES IN MUNICIPAL WASTEWATER VANCOUVER, BRITISH COLUMBIA.* **Rogers, Ian H., Birtwell, Ian K. and Kruzynski, George M.** 2, s.l. : Water Pollution Research journal of Canada, 1986, Vol. 21.

22. *Detection of a wide variety of human and veterinary fluoroquinolone antibiotics in municipal wastewater and wastewater-impacted surface water.* **He, Ka, et al.** s.l. : Journal of Pharmaceutical and Biomedical Analysis, 2015, Vol. 106.

23. *Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999–2000: a national reconnaissance.* **Kolpin, Dana W., et al.** s.l. : Environment Science & Technology, 2002, Vol. 36.

24. *Environmental phthalate exposure in relation to reproductive outcomes and other health endpoints in humans.* **Swan, Shanna H.** 2, s.l. : Environmental Research, 2008, Vol. 108.

25. **United States Environmental Protection Agency.** Nutrient Pollution. *United States Environmental Protection Agency.* [Online] March 17, 2015. [Cited: March 18, 2015.] http://www2.epa.gov/nutrientpollution.

Appendix 5: Health Effects Evaluation Criteria

Table AP5-1. Health Effects Evaluation Criteria

Direction	What type of health effects may occur if the decision is made to move ahead with the proposal?	Likelihood	How certain is it that the decision will effect health determinants or outcomes, irrespective of the frequency, severity or magnitude?
Positive	The decision could have positive health effects.	**Unlikely/Implausible**	Logically implausible effect; substantial evidence against mechanism of effect
Negative	The decision could have negative health effects.	**Possible**	Logically plausible effect with limited or uncertain supporting evidence
Positive & Negative	The decision could have both positive and negative health effects.	**Likely**	Logically plausible effect with substantial and consistent supporting evidence, however there is some uncertainty
Insufficient Evidence / Not Evaluated	–	**Very likely / Certain**	Adequate evidence exists for a causal and generalizable effect
		Insufficient Evidence / Not Evaluated	–

Table AP5-2. Health Effects Evaluation Criteria

Magnitude	How much will health outcomes change as a result of the decision? (i.e., what is the expected change in the population frequency of the symptoms, disease, illness, injury, disability, or mortality)?	Duration	For how long are the positive/negative health effects or outcomes expected to last?
Low	Logically implausible effect; substantial evidence against mechanism of effect	**Short**	The effects are expected to be short-term (less than one month) and/or occur with low frequency
Moderate	Logically plausible effect with limited or uncertain supporting evidence	**Medium**	The effects are expected to last more than one month but less than one year or occur with intermediate frequency

High	Logically plausible effect with substantial and consistent supporting evidence, however there may be some uncertainty	**Long**	The effects are expected to last longer than one year or occur with consistent frequency
Insufficient Evidence / Not Evaluated	-	**Insufficient Evidence / Not Evaluated**	-

Table AP5-3. Health Effects Evaluation Criteria

Distribution	Will the effects, whether adverse or beneficial, be distributed equitably across populations. Will the decision reverse or undo baseline or historical inequities?	Evidence	How strong is the body of evidence (literature, stakeholder input, local data) supporting the effect characterization?
Disproportionate Harm	The decision may result in disproportionate adverse effects to populations defined by demographics, culture, or geography	**Limited**	There is some evidence found in academic and grey literature but the evidence is not overwhelming; and/or the effect characterization is based on local expert knowledge and/or data
Even	The benefits and burdens of the decision are likely to distribute near evenly across the affected population	**Mixed**	The evidence found in the academic and grey literature shows mixed results and or there are conflicting local expert opinion and/or contradictory data
Disproportionate Benefits	The decision may result in disproportionate beneficial effects to populations defined by demographics, culture, or geography	**Strong**	The evidence found in academic and grey literature appears to be conclusive with little or no evidence to the contrary; the opinions of local expert and the public are nearly unanimous.
Restorative Equity Effects	The decision has the potential to reverse or undo existing or historical inequitable health-relevant conditions or health disparities	**None found / Not Evaluated**	-
Insufficient Evidence / Not Evaluated	-		

Appendix 6

City of Hoboken, New Jersey
Proposed Stormwater Management Plan
Health Impact Assessment (HIA)

Focus Group Topic Guide and Summary Notes

INTRODUCTION

During the HIA Assessment Phase, the project team conducted two resident focus groups– one with low-income residents living in Hoboken Housing Authority properties and one with senior citizens aged 65 and over living throughout the city. The purpose of the focus groups was to collect primary data related to flooding experience and its effects on individual health and mental health as well as to solicit community input on potential flood mitigation strategies. The focus groups were intended to ensure for potentially vulnerable populations to provide input into the HIA process.

FOCUS GROUP TOPIC GUIDE

[Focus Group Runtime = 90 minutes]

I. INTRODUCTION (5 minutes)

1. Moderator introduces self and identifies Rutgers University and NJ Future as the research facilitators.

2. Explain what focus groups are for and how they work:
   - Groups have common denominators; focus closely on a topic.
   - We use a "Topic Guide," but it is primarily an open discussion.
   - Observers/recording; only one person speaks at a time, and please start your comments by saying your name first.
   - We are interested in everyone's opinion; no right or wrong answers to the questions.

3. Time Limit – we'll be done and you'll be on your way home around 8:30.
   - Incentives – you'll receive the incentive when we're finished with the discussion, just as you leave.

4. Provide brief overview of the HIA process and the Hoboken project

5. <u>Our purpose tonight</u>: To discuss how chronic flooding in Hoboken affects the lives of City residents and their health and how proposed changes to the City's stormwater management plan may affect health over the long term.

II. STATEMENT OF CONFIDENTIALITY (5 min)

Moderator: Before we begin, I want to make three points.
First, your participation is in this focus group is completely voluntary; however, your opinions are highly valued and will be a critical part of our success. You may choose not to answer any questions you are not comfortable answering. If at any time during our conversation you wish to stop participating, you are completely free to do so.

Second, your participation is confidential. Confidential means that the research records will include some information about you, such as your name and your contact information. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated.

Finally, as part of the focus group discussion I will be asking you to remember back to how past flooding events in Hoboken–including Hurricane Sandy–may have impacted you and your family. Depending on how much these events impacted you and your family it may be stressful to think about these things. If after today's discussion or for any reason you feel like you could benefit from mental health counseling or other storm-recovery services, there are resources available from the ***Hudson County Long-term Recovery Committee*** and the ***NJ Mental Health Cares***. I have a flyer with me tonight that provides information and contact information on how to access services.

III. BASIC INFORMATION (10 min)

Assistant moderator flips page on easel to show the following items pre-listed on the next page:

1. To get to know each other a little, let's go around the room and share with each other this basic information.
    a. Your first name or nickname?
    b. In what part of Hoboken do you live?
    c. How long have you lived in Hoboken?

Now please write your first name on the tent card in front of you.
Now that we all know each other a little better, let's begin our discussion.

IV. INITIAL WRITTEN SCRIPTS (2.5 min)

Assistant Moderator: Hand out one large index card to each participant.

I'd like each of you to jot down up to three "bullet points" that tell us anything you want us to know about your experience with flooding in Hoboken. That could be about the number of times you have been flooded, how the flooding impacted you personally, or anything else that you would like us to discuss this evening.

[Runtime to this point = 22.5 minutes]

V. EXPERIENCES DURING HURRICANE SANDY (5 min)

1. How many of you lived in Hoboken during Hurricane Sandy?
2. What were some of your experiences during and after Hurricane Sandy?
    a. Did you evacuate?
    b. Were you without power?
    c. Was your home or apartment damaged?
    d. How was it damaged?
    e. Have there been any lasting effects of the damage to your home?
    f. What other impacts did you experience?

VI. EXPERIENCES WITH CHRONIC FLOODING IN HOBOKEN (10 min)

1. How often do you witness flooding in Hoboken?
2. How often are you personally impacted by flooding in Hoboken?
    a. Would you say you have become accustomed to the flooding?
    b. What adjustments do you make when you expect flooding to occur?
3. Do any of you regularly evacuate when you expect flooding?
    a. Where do you go?
    b. How long do you stay?
    g. What was your experience like staying were you stayed?
4. Do you have own a car/truck or other vehicle that you keep in the City?
    a. Do you have to move your vehicle because of chronic flooding?
    b. How would you describe the impacts of having to do this?

VII. IMPACTS OF CHRONIC FLOODING ON HOUSE/HOME (10 min)

1. Has your home/apartment ever been impacted by flooding?
    a. What type of impacts do you experience?
    b. About how often?
    c. Do you have renters/homeowners insurance?
    d. Did/does insurance cover the damage?
2. What do you do to limit damage from chronic flooding?

VIII. IMPACTS OF CHRONIC FLOODING ON WORK/WAGES (5 min)

1. Have you missed work because of flooding in Hoboken?
    a. About how often?
    b. Why did you miss work?
        i. Got sick
        ii. Had to clean-up damage
        iii. Could not get to work because I lacked transportation
        iv. My place of work was closed due to flooding or the threat of flooding

IX. IMPACTS OF FLOODING ON HEALTH/WELL-BEING (15 min)

1. Does regular flooding impact your health in anyway?
    a. Were you or members of your family injured in any way by passed flooding events?
    b. Is it difficult to get prescriptions and or other needed medical care after flooding events?
    c. Is it difficult to access healthy food options during and after flooding events?
    d. Do you regularly have any restrictions on the use of drinking water?
    e. Are your toilets/bathroom facilities functioning during and after flooding events?

    f. When you anticipate or experience flooding would you say you smoke more?
    g. When you anticipate or experience flooding do you consume more alcohol?
    h. Does flooding cause you to be stressed, depressed or anxious?
    i. Have you ever sought counseling or other services to help you cope with flooding?
2. Have you ever come in contact with flood waters?
    a. What were the circumstances?
    b. Do you believe you became sick as a result?
3. Have you ever experienced sewers backing up during or after flooding events?
    a. How frequently?
    b. Did you come in contact with materials from sewer-back-ups?
    c. Do you believe you became sick as a result?
4. Are you responsible for or have you ever had to clean up after being flooded or experience sewer back-ups?
    a. Did you take precautions to protect your health when cleaning up flood waters or sewer backups?
    b. What kind of precautions do you take?
    c. Do you think you have the information you need to clean up safely?
5. Do you feel flooding has impacted your health in any other way?
6. Do you actively participate in water-based recreational activities in and around Hoboken?
    a. What kind of activities?
    b. How long do you wait after flooding events to take part in these activities?
    c. Do you ever recall any warning about the safety of water quality in the Hudson River during or after flooding events?

X. GREEN INFRASTRUCTURE BENEFITS AND RISKS (20 min)

[INTRODUCTION: Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, the water is absorbed and filtered by soil and plants. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems and discharged into nearby waterbodies. The stormwater carries trash, bacteria, heavy metals, and other pollutants from the urban landscape, degrading the quality of the receiving waters. Higher amounts of rainfall can also cause erosion and flooding in streets and urban streams, damaging habitat, property, and infrastructure.]

1. Have you ever heard the term "Green Infrastructure"

    [Recite DEFINITION of GI: *Green infrastructure uses vegetation, soils, and natural processes to manage storm water and create healthier urban environments.*

    Distribute print-outs of Green Infrastructure strategies: *We are now going to look at a series of pictures and briefly discuss different types of Green Infrastructure strategies that the City of Hoboken is considering to help reduce chronic flooding and sewer back-ups and overflows during periods of heavy rain.]*

2. What are your reactions to these strategies?
    a. Do you think implementing these strategies will make a positive contribution to the city?
        i. What benefits to you think they might provide?

1. Would having more trees, plants and green space be positive for you and your family?
2. Would you utilize new parks and walking/biking trails?
    a. How do you think you would use them and how often?

b. Do you have any concerns about implementing any of these strategies?
    i. What are your concerns?

c. How do you think implementing these strategies might impact your health?
    i. What positive impacts might there be?
    ii. What about negative impacts?

XI. WRITTEN POST-SCRIPTS (2.5 min)

Assistant Moderator: Hand out one large index card to each participant.

Finally, I'd like each of you to jot down up to three "bullet points" that tell us w about your experiences with chronic flooding in Hoboken and what the City is doing to address flooding. These could be the most important things you think were mentioned tonight, or it could be things we did not mention but you would like us to know about, or anything you'd like.

XII. ADJOURN FOCUS GROUPS

Thank you for participating. Your help and input is extremely valuable to us. Now, please leave the index card at your seat, and move into the next room where we will distribute the incentives. Again, thank you for your help.

Hoboken Housing Authority Residents Focus Group

Meeting Notes

Date/Time/Location:
Tuesday, March 10, 2015
7 PM – 8:30 PM
Adams Street Residence Meeting Room

Facilitator: Jon Carnegie, Rutgers University
Staff support: Teri Jover, New Jersey Future; Ryan Whytlaw, Rutgers University

Participants:
Eight (8) individuals participated as part of this focus group.

I. Introduction

The focus group facilitator introduced himself and the project staff and provided an overview of the HIA project, emphasizing that the analysis will focus on chronic flooding and how it relates to health and the city's proposed stormwater management plan. He explained what focus groups are and how they work, including a few meeting ground rules.

II. Statement of Confidentiality

Participants were instructed regarding the need for them to provide consent to participate in the focus group. The facilitator highlighted that participation is voluntary and confidential. He also acknowledged that talking about past flooding experiences can bring up stressful memories and offered referrals for mental-health counseling or other storm-recovery services. Participants were then asked to review and sign the informed consent form and received a hand-out with information on how to access mental-health and other services if needed.

III. Experiences During Hurricane Sandy

Participants were asked to describe their experiences during Hurricane Sandy. Among the comments:

Extent of the flooding:

- Looking out window on 9th St between Jefferson and Adams, looking east to Washington Street: assumption was that the water would come from east, but saw man running from Jefferson to 9th and a wave of water came around the corner and within seconds cars were underwater.
- Water came down 2nd St like a whistle (live on Harrison by light rail).
- Generators did not kick-in because the water overwhelmed the area.
- Harrison and Jackson Streets always had flooding.
- Flooding worse because of the increased construction. Building on the water is part of the problem.

Aftermath conditions:

- For two weeks: without electricity; smell of gasoline; "mysterious green ooze" in the water; smell of sewage; and standing water.

- Fish in the water.
- Didn't pump out the water, had to wait for it to recede.
- Kids were running through the water.
- NY police and military assisted during weeks after the storm.
- Hospital was flooded and closed.
- Residents were able to boil water using gas stoves (manually lit).
- Community came together to help each other out and share resources.

Evacuation:

- Toward the end of the storm, residents were advised to evacuate building, but not before. They had the buses beforehand, but it was not clear where people were going to be taken. Buses left before the storm.
- First evacuees were ground floor apartments.
- National Guard came a few days after with boats to get people out.
- This group decided to stay in their apartments – did not expect it to be "that bad."
- City provided buses to Wallace Elementary School, but they flood too. Felt more comfortable in own homes and the buildings are very strong.
- Would not want to go through this experience again. Life stood still for two weeks.
- What would you do if another Sandy type of storm came?
    - Initially, most people indicated they would likely stay in the event of another storm, except for one person whose husband has a pacemaker.
    - Upon revisiting the question, several more people said they would go to family in Bellville, Union City and Secaucus, which do not flood.
    - One participant indicated that for Irene his family had to split up and stay with different grandparents.

Impact on mobility:

- After the storm, could not get to work. Eventually took down the NJ TRANSIT fence behind the light rail stop and then people could walk to Franklin/Palisade Ave to go to work in Jersey City.
- One participant could not reach mother, who was stranded in another building in a wheelchair. Daughter had to push policy/emergency workers to get her out.
- A few participants lost their cars during Sandy.

Other observations:

- Harrison and Jackson Streets always had flooding, but now that there is new development in the area it seems that people are paying more attention to the problem.
- Flooding worse because of the increased construction. Building on the waterfront is perceived to be part of the problem.
- Historically, downtown did not flood, but now it is starting to flood when there is a heavy rain.

Equity considerations:

- Now that there is new development in the area it seems that people are paying more attention to the problem.
- Housing Authority residents were forgotten in the aftermath. City Hall ignored them.
- HHA areas were the last to be emptied and were given fewer supplies. This did include the residents of the new condo developments.
- Eventually food trucks and donations did arrive.

IV. Experiences with chronic flooding in Hoboken

Participants were asked to shift their focus from Sandy recollections to their experiences with everyday flooding in Hoboken.

Extent of flooding:

- A heavy rain will cause flooding up to and over the curb, often into the middle of the street.
- Living in Hoboken for 62 years and have seen floods for 62 years.
- Floods quickly on Harrison Street – will have to walk through water to get home in a heavy rain.
- Have to go out of the way to reach delis, etc. because of regular flooding. Laundromat, super food and liquor store gets flooded every year.
- Heavy rain, water from Wash Street and water from hills runs off into this area.
- From Harrison to Jackson is a mess after a flood.

Damage due to regular flooding:

- Foundation of some HHA buildings falling apart after Sandy.
- Construction of new condos on empty lots and old factories – new residents now getting lawyers because of the frequent flooding.
- Wise to put something on the roofs of these new buildings to absorb water.
- Black "gunk" left behind after a storm; condos pay someone to wash it off the sidewalks, but not the HHA buildings and other residences.

Sewage:

- Since 2006, there have seen people cleaning out the sewer drains and pipes, but water still pushes through and backs up into the streets.
    - The facilitator explained what a combined sewer system is and noted that Hoboken is served by a combined sewer system. Participants were not aware of the problem but recognized the impacts (e.g., smell, contaminants in water, etc.)
- Participants acknowledged the heavy sewer smell during storms, noting that toilet paper is often seen floating in the street.

Mobility issues:

- Residents do not typically evacuate due to regular flooding.
- One participant reported he was not able to get to work several times. Another reported she could not get to a job interview because of flooding.

- Kids often have trouble getting to school, and if they do go, they play in the water and arrive at school soaking wet and smelly.

Health impacts:

- Some reported feeling sick due to strong smell. Like a toilet bowl and in the summer it is terrible.
- 4th and Jackson – sewer smell is very strong; "sewage heaven"; also Harrison.
- In summer, after a flood there are a lot of mosquitos and flies. Repellants do not work. Conditions seem worse than in previous years.
- Street sweepers after a flood raise dust and put kids with asthma at risk.
- Often there are rashes – person that works at Boys and Girls Club corroborated this.
- Some parents limit the time kids play in the park because of the residue left behind after a strong rain.
- Injuries experienced during floods:
    - One person fell over a manhole cover when it came loose.
    - Another person fell into a storm drain as a child.
- Concerned about contaminants in the flood waters, including the impacts of the "green gunk" post-Sandy. Grass doesn't grow in these areas.

Coping strategies:

- Leave shoes in hallway to avoid bringing in dust/dirt.
- Rubber boots – everyone has them. Sometimes the flood goes over the top of the boots.
- There was some concerned about odor in the running water and as a result they don't use it to brush their teeth. It was suggested that the odor might be due to reservoir levels.

Wildlife:

- Increase in the number of wildlife seen post-flood. One theory is that they were scattered into "upper areas" after Sandy and are coming down.
    - Rabbits – have not seen in many years and they have re-emerged.
    - Skunks – in particular on Jackson Street.
    - Squirrels – in particular on Harrison Street, very aggressive.

V. Green Infrastructure Benefits and Risks

The facilitator provided an overview of green infrastructure best management practices and the City's stormwater management plan update that is underway. He walked participants through a handout called "What is Green Infrastructure?" with visuals to illustrate the concepts and also talked through a packet called "City of Hoboken Proposed Stormwater Management Plan Amendments Health Impact Assessment," which included a collection of photographs illustrating the range of different green infrastructure best management practices being considered as part of the Hoboken Storm Water Management Plan update.

Positive responses

- Permeable pavement is definitely needed on the west side of Hoboken.
- Some support the BASF proposal because of the incorporation of parking, which is in high demand.
- It was suggested that the plan will lessen the blow, but there was acknowledgement that the flood will still happen.
- One participant suggested starting with swales on outer edge of Hoboken.

Concerns about implementation

- There was concern about installing giant tanks/cisterns to collect rainwater because it might attract mosquitoes, flies and gnats, which are already a problem. Participants mentioned a previous proposal to install storage along western edge of city near HHA property.
- It was suggested that green infrastructure is not being installed in much of the new condo development, which is a missed opportunity.
    - One participant noted that there is a rain garden installed at 7th and Jackson.
- Concerned about the cost of maintaining the green infrastructure, especially since the city can't stay on top of pot holes.
- There was skepticism about the BASF project helping the HHA neighborhoods.
- Concern about storage tanks because of vandalism, mosquitoes, flies, gnats. Already have a lot of these.

Equity concerns

- Participants asked if the green infrastructure like rain gardens, stormwater tree pits and infiltration planters being considered will be installed at any of the housing authority properties.
    - The facilitator suggested pervious pavement might be an option for some of the areas.
- Does this study include the housing authority residents/properties?
    - The facilitator replied that this is one of the reasons for the focus group. Findings from this meeting and the HIA will be shared with the city council and planning board.
- BASF is good for the east side, but the west side has to worry about flooding from all directions.
- Seems like the city only cares about 9th St by the ShopRite.
- City has installed new pipes across the city, but not in the HHA areas. Worried they may be funneling water into their neighborhood.
- Participants encouraged city to have an open forum where residents can come voice opinions, with visuals and an opportunity to comment.

General questions

- Can existing buildings be retrofitted for green roofs, etc.?
    - The facilitator replied that it depends on the buildings' structural engineering.
- If all this done in Hoboken, and none of surrounding towns participate, what is the point?

VI. Adjournment

The facilitator thanked participants for their time and valuable input. He asked them to fill out forms in order to receive cash incentive payments.

Senior Residents Focus Group

Meeting Notes

Date/Time/Location:
Tuesday, April 28, 2015
10:30 AM to 1 PM
HOPES CAP, Rue School
301 Garden Street, Hoboken

Facilitator: Jon Carnegie, Rutgers University
Staff support: Teri Jover, New Jersey Future; Ryan Whytlaw, Rutgers University

Participants:
Six (6) individuals participated as part of this focus group.

I. Introduction

The focus group facilitator introduced himself and the project staff and provided an overview of the HIA project, emphasizing that the analysis will focus on chronic flooding and how it relates to health and the city's proposed stormwater management plan. He explained what focus groups are and how they work, including a few meeting ground rules.

II. Statement of Confidentiality

Participants were instructed regarding the need for them to provide consent to participate in the focus group. The facilitator highlighted that participation is voluntary and confidential. He also acknowledged that talking about past flooding experiences can bring up stressful memories and offered referrals for mental-health counseling or other storm-recovery services. Participants were then asked to review and sign the informed consent form and received a hand-out with information on how to access mental-health and other services if needed.

III. Experiences During Hurricane Sandy

Participants were asked to describe their experiences during Hurricane Sandy. Among the comments:

History of flooding:

- Prior to Sandy, streets/neighborhoods had little to no history of flooding. One participant reported no cases of flooding in 58 years.
- There were reports of storm sewers backing up into streets, but not flooding of homes.
- One participant who lives in a housing authority residence reported that the new pumps are helping with chronic flooding, but there is still stagnant water after heavy rain.
- Hoboken is a "hole" where water runs downhill from Union City and into the projects.

Sandy flooding/damages:

- Cars were flooded and destroyed (parked in the church parking lot).
- Street level apartment of home flooded up to the top kitchen cabinets, which were not damaged.

- Five feet of flood waters surrounded apartment building (housing authority).
- Clinton/4th to Willow/6th was completely flooded.
- After the storm there was furniture and all sorts of belongings on the street, damaged by flood water. All items that were flooded had to be destroyed because of sewer contamination.
- The senior housing building went 10 days without electricity. No power for medical equipment, no elevator, etc. Supplies were provided regularly.
- Sand was found throughout the home.

Evacuation:

- Several participants related a reluctance/unwillingness to evacuate:
    - Evacuation to Holmdel during Hurricane Irene proved unnecessary as there was no flooding in her neighborhood. This made evacuation for Sandy seem less urgent.
    - Did not evacuate apartment building even after rescue boats arrived. Eventually was helped by the National Guard after the storm and then stayed at son's home in Hoboken.
    -
- Several participants did evacuate during storm:
    - Evacuated to daughter's home on Garden Street during Sandy.
    - Mayor called one participant and encouraged evacuation; moved to daughter's home in Hoboken to wait out storm.

Mobility issues:

- There were no subways available for three months after the storm.

Health observations:

- There was an oil scent pervasive after the storm.
- Mold grew in houses. Construction debris stored in crawl space caused mold damage.
- Nervousness/anxiety was rampant among residents. One participant reported her friend taking Xanax to help with the mental strain.

Other observations:

- The city is fixing the corners on Jackson Street.
- Pump station on Observer Highway not in the right place.
- How are new buildings impacting the sewer system?
- Sandy could happen again; is Hoboken ready?

IV. Experiences with chronic flooding in Hoboken

Participants were asked to shift their focus from Sandy recollections to their experiences with everyday flooding in Hoboken.

- Jackson Street is affected by chronic flooding, particularly near 4th and at the ShopRite.
- There are stagnant water spots at 2nd and Harrison St and the stagnant water smells.

- The water comes down to Hoboken from Union City.
- The larger buildings that are being built are making flooding problems worse.
- When the ShopRite area floods, grocery shopping is difficult. People have to go to the A&P or Jersey City, which can be very expensive.
- In addition to Shop Rite, local shopping center with grocery store gets flooded regularly.
- Corners need to be dealt with because the storm sewers back up a lot, maybe they need cleaning. There is always water at the corner, making it hard to walk.
- Storm drain repairs have helped with chronic flooding.
- Before the boom in new residential development, Hoboken was a big family where everyone knew everyone else.

V. Green Infrastructure Benefits and Risks

The facilitator provided an overview of green infrastructure best management practices and the City's stormwater management plan update that is underway. He walked participants through a handout called "What is Green Infrastructure?" with visuals to illustrate the concepts and also talked through a packet called "City of Hoboken Proposed Stormwater Management Plan Amendments Health Impact Assessment," which included a collection of photographs illustrating the range of different green infrastructure best management practices being considered as part of the Hoboken Storm Water Management Plan update.

Positive responses:

- Less concrete, more gardens a good thing as it looks pretty.
- Permeable pavement good because it takes water away.

Thoughts about implementation:

- Trees on Jackson St. are dying as-is. Facilitator indicated need for special design of pit to allow for water to permeate.
- New condos have some rain barrels to help manage stormwater.
- There is regularly stagnant water near the housing authority buildings and the city is not addressing it; will they be able to maintain new green infrastructure that might bring with it some stagnant water?
- Permeable pavers that allow grass to grow might take more to maintain and could be slippery. It would look nicer though.
- Is the BASF site that is proposed for storm water storage contaminated?
- What about putting storm water storage sites throughout the town to collect water?
- What are they doing about run-off from Jersey City and Union City?

Other observations:

- Could they dig a hole into the mountain to give a place for the water to go? Facilitator mentioned a proposal to design an underground parking garage to serve as storm water storage during heavy rain as well as plans to install infrastructure to absorb water before it enters Hoboken.

- Jackson St/Harrison St. used to be a marshy area.
- City does not fix things on Harrison St.; they just patch them up.

VI. Adjournment

The facilitator thanked participants for their time and valuable input. He asked them to fill out forms in order to receive cash incentive payments.

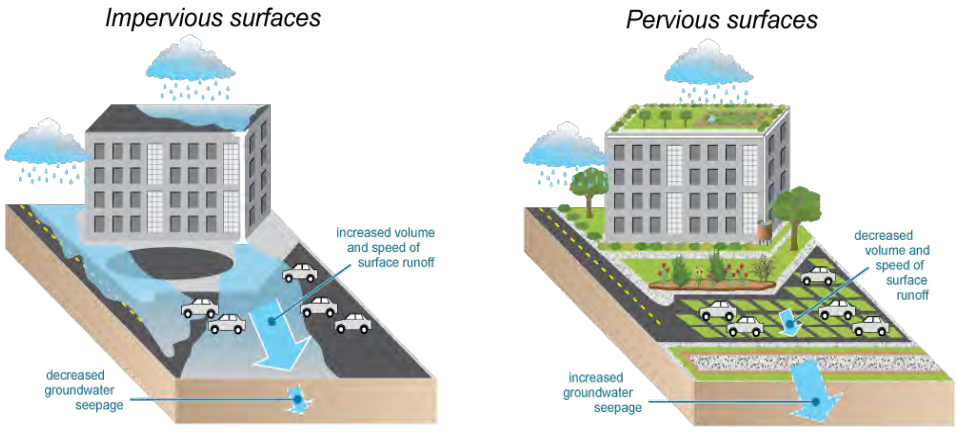
Appendix 6; Attachment A

“What is Green Infrastructure” Handout

What is Green Infrastructure?

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, the water is absorbed and filtered by soil and plants. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems and discharged into nearby waterbodies. The stormwater carries trash, bacteria, heavy metals, and other pollutants from the urban landscape, degrading the quality of the receiving waters. Higher amounts of rainfall can also cause erosion and flooding in streets and urban streams, damaging habitat, property, and infrastructure.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water. (Source: USEPA)



Impervious 'hard' surfaces (roofs, roads, large areas of pavement, and asphalt parking lots) increase the volume and speed of stormwater runoff. This swift surge of water erodes streambeds, reduces groundwater infiltration, and delivers many pollutants and sediment to downstream waters.

Pervious 'soft' surfaces (green roofs, rain gardens, grass paver parking lots, and infiltration trenches) decrease volume and speed of stormwater runoff. The slowed water seeps into the ground, recharges the water table, and filters out many pollutants and sediment before they arrive in downstream waters.

Conceptual diagram illustrating impervious and pervious surfaces. Impervious surfaces are hard and increase stormwater runoff, causing pollutant and sediment delivery in downstream waters. Pervious surfaces are soft and decrease stromwater runoff, which filters out pollutants and sediments before they arrive in downstream waters.
Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Chesapeake and Atlantic Coastal Bays Trust Fund, 2013. Stormwater Management: Reducing Water Quantity and Improving Water Quality. IAN press, newsletter publication.

Potential Benefits of Green Infrastructure

Green Infrastructure Best Management Practices can help reduce flooding, provide ecological benefits, improve public health and increase the amount of open/green space in a community.

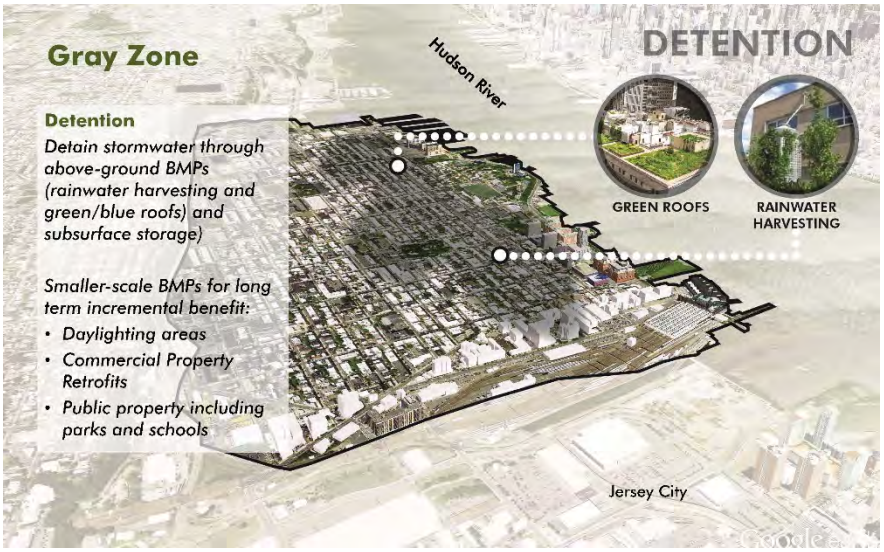
	FLOODING MITIGATION		ECOLOGICAL BENEFITS		PUBLIC HEALTH			OPEN / GREEN SPACE	
BMP	Volume	Peak Discharge	Water Quality	Wildlife Habitat	Air Quality	Heat Island Effect	Noise Pollution Reduction	Beautification	Expanding Recreation
Basins or Ponds									
Constructed Wetlands									
Vegetated Swales									
Stormwater Trees									
Rain Gardens									
Subsurface Storage									
Rainwater Harvesting/Reuse									
Stormwater Planters									
Permeable Pavements									
Green Roofs									

Source: Hoboken Green Infrastructure Strategic Plan Final Report, 2013

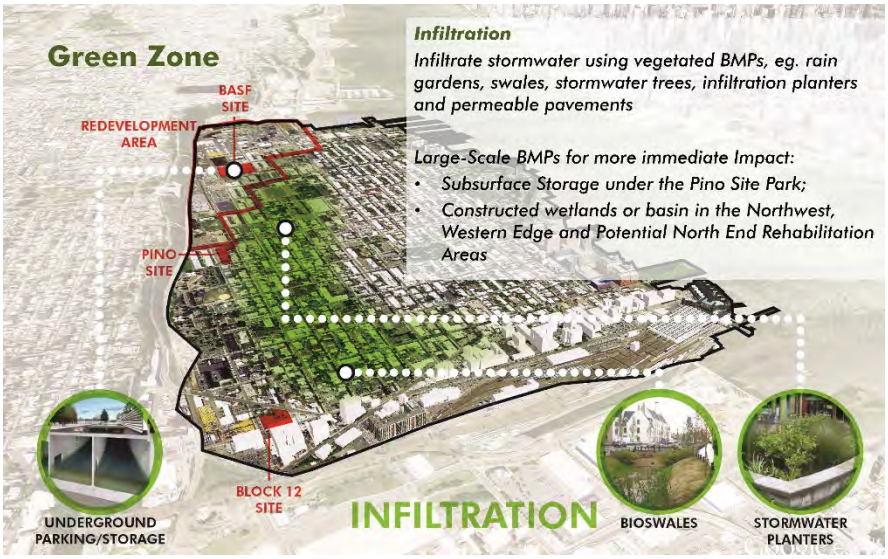
City of Hoboken Green Infrastructure Strategy

The City of Hoboken Green Infrastructure strategy proposes implementation of a variety of green infrastructure best management practices to reduce and manage stormwater runoff. The strategy organizes the city into three zones:

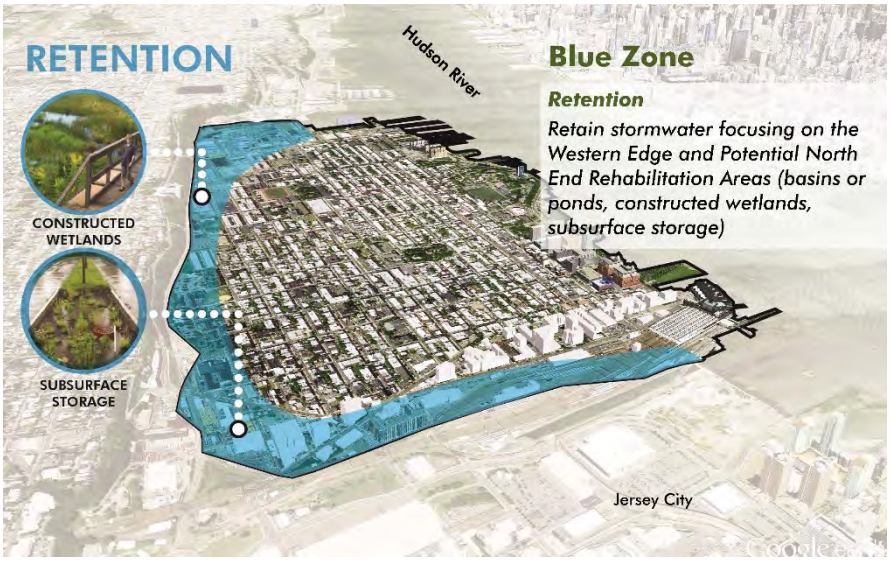
The Gray Zone, which contains a shallow depth to bedrock and therefore cannot infiltrate stormwater efficiently, is most appropriate for above-ground BMPs such as rainwater harvesting and green roofs.



The Green Zone, which has a greater depth to bedrock and soils that are capable of accepting and infiltrating stormwater, is most appropriate for vegetated BMPs like rain gardens, swales, and stormwater trees.



The Blue Zone, which contains the lowest elevations in the City is most appropriate for the detention of stormwater using constructed wetlands and subsurface storage.



Source: Hoboken Green Infrastructure Strategic Plan Final Report, 2013

Appendix 6; Attachment B

Visuals Handout

City of Hoboken Proposed Stormwater Management Plan Amendments Health Impact Assessment

Resident Focus Groups

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

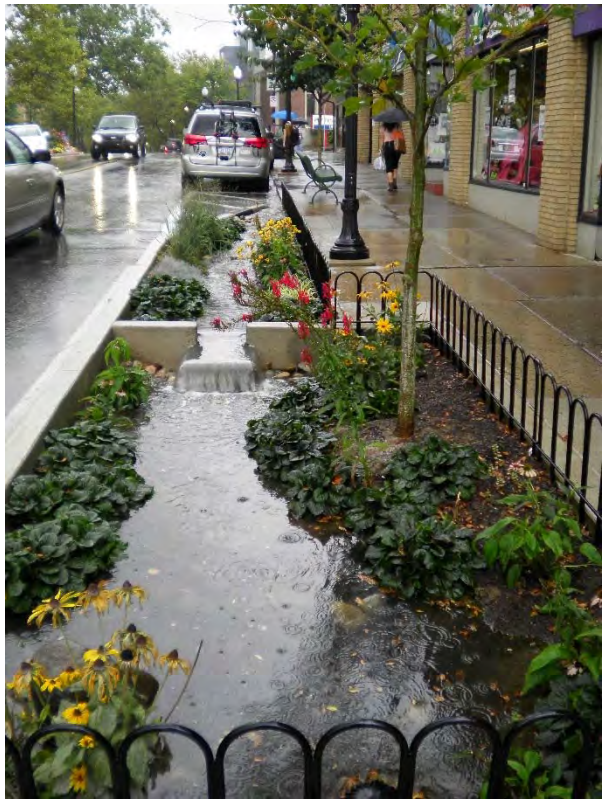
NEW JERSEY FUTURE

Hoboken Floods Regularly
(before and after Sandy)

Green Infrastructure Strategies Proposed for Hoboken

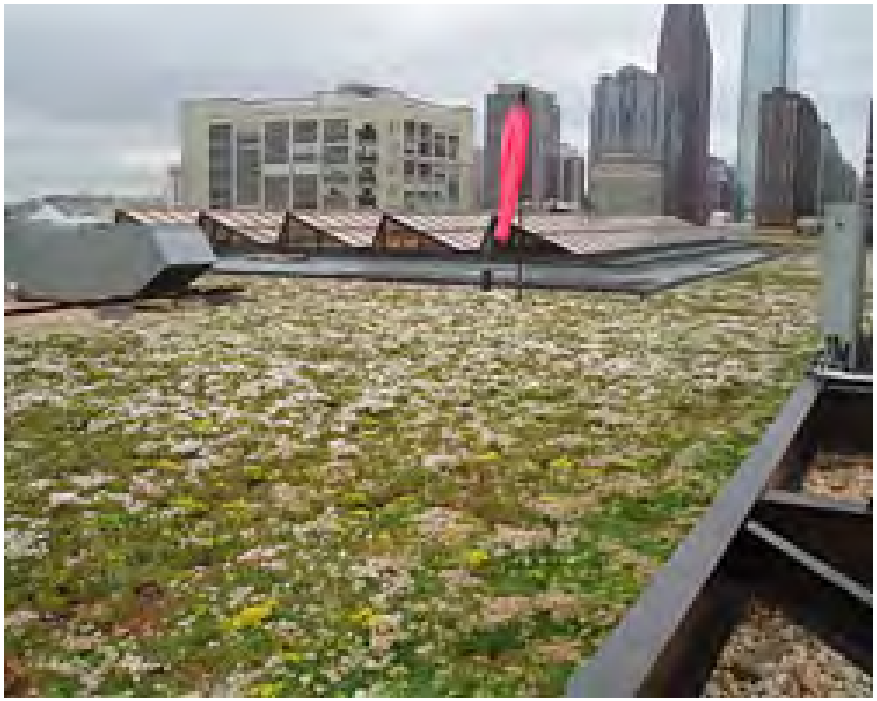
- Constructed Wetlands
- Permeable Pavements
- Stormwater Tree Pits
- Vegetated Swales
- Rainwater Harvesting
- Basins or Ponds
- Raingardens
- Stormwater Infiltration Planters
- Subsurface Storage
- Green Roofs
- Other??

Rain Gardens, Stormwater Tree Pits, and Stormwater Infiltration Planters



Constructed wetlands and vegetated swales

Rainwater Harvesting and Green Roofs



Permeable Pavement

Underground Storage, Basins and Ponds

Appendix 7

Hoboken Stormwater Management Plan Amendments

-City of Hoboken, New Jersey: Guide for Flood and Stormwater Municipal Improvement Projects with Economic Incentives (August 26, 2015)

- City of Hoboken, New Jersey: Codes, Ordinances and Standards (August 26, 2015)

CITY OF HOBOKEN

NEW JERSEY

Guide for Flood and Stormwater Municipal Improvement Projects with Economic Incentives

August 26, 2015

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Introduction

The City of Hoboken is proactively tacking its vulnerability to flood risk. Due to the historic filling of wetlands and lowlands coupled with the legacy of a combined sewer system and increasing rainstorm intensity, the City experiences chronic flooding due to excessive runoff water volume. Municipal and wastewater utility permits issued in 2004 and 2015, along with aggressive planning and local regulations are catalysts in addressing water quality and quantity, with corresponding multiple project initiatives by the City to address stormwater flow from existing and future development and flood risk. A number of funding options exist to incentivize the implementation of Green Infrastructure, flood control and maintain those systems once installed.

Localized Flooding

Chronic Urban Flooding of Streets

City of Hoboken, as a water dependent community, was founded on a high point along a river, nestled within surrounding riverine wetlands. Like many cities of its kind, as Hoboken's population grew, the boundary of the City's development expanded to include low lying areas and, as a result, these areas increasingly experiences chronic urban flooding of streets. Development on filled wetlands presents numerous modern challenges that include a high water table, settling soils and low elevations – these all contribute to the repetitive flooding experienced in the low lying neighborhoods of the City. The flooding is more than a nuisance – it requires City resources, it interrupts traffic, causes inundation of homes – it affects the quality of life for residents.

Hoboken has a map and information provided on its website:
http://www.hobokennj.org/departments/environmental-services/storm-flood-zones/

Inadequate Conveyance and Backflows Through Combined Sewer System

Compounding the challenges created by development in wetland and low lying lands is Hoboken's combined sewer system (owns and operated by the North Hudson Sewerage Authority), also common to early urban development, where storm and sanitary sewer flows are routed through the same underground pipe system. During heavy rain events, stormwater overwhelms the sewer system and leads to sanitary sewer overflows and flooding. Street closures are frequently experienced along with residents needing to move cars to higher ground and City parking garages. People have witnessed wakes created by moving vehicles in flooded roads that overtop curbs and lap against buildings. Overwhelmed combined sewer systems back up through sanitary laterals into basements and lowest floors of buildings. The North Hudson Sewerage Authority has information on its webpage and currently includes

information on how it and Hoboken are advancing steps to address the inadequate conveyance and backflows through pump stations: http://www.nhudsonsa.com/

Volume is the Issue

While Hoboken's landscape position and aging infrastructure are not unusual for a city its age, its small size and dominance of ultra-urban land use (94% impervious) cover are afflicting the City. This predominantly impervious land prevents local rainfall from infiltrating the ground and with little vegetation, uptake and transpiration by plants is currently absent. The City is suffering from an excessive volume of runoff and coupled with filled wetlands and an undersized conveyance system, the water has no place to go during and immediately following a storm.

Context of Stormwater and Floodplain Management Policy

Municipal Tier A NJPDES Permit

As required by the New Jersey Municipal Stormwater Regulation Program (N.J.A.C. 7:14A-25), the City of Hoboken City Council adopted a Municipal Stormwater Management Plan (SWM Plan) to document the strategy for the City to address stormwater related impacts for the very limited area, described by the North Hudson Sewerage Authority as two (2) inlets, with separate storm sewer infrastructure. If future storm sewer installation is isolated from the combined sewer system, the City's permit and SWM Plan applicability will expand. The Plan, entitled "Stormwater Management Plan for the City of Hoboken" and prepared by Schoor DePalma, Inc., January 2006, was adopted on January 17, 2007 by ordinance number DR-289. The Plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts by incorporating stormwater design and performance standards for new major development, defined as projects that disturb one or more acres of land, in the section of the City of Hoboken that is not serviced by "Combined Sewers Overflow" and therefore not under the jurisdiction of the North Hudson Sewerage Authority.

Green Infrastructure Strategic Plan

In March 2014, the City of Hoboken Green Infrastructure Strategic Plan (GISP) was created to develop place-based stormwater management and flood control strategies and identify implementable climate adaptation action steps for the City. The underlying goals of the project were to demonstrate how such strategies can help create a more resilient transit system and transit-oriented community; to develop implementable place-based stormwater management strategies in support of climate adaptation action steps; and to develop a framework for green infrastructure, including cost-effective, long-term solutions to update the aging system and integrate source controls into the design and construction of public improvement, private development, open space and right-of-way projects. Key issues addressed by the plan include climate adaptation, flood control strategies, resilience of transit and the surrounding

community, and the use of green infrastructure. The GISP, as discussed below, was integrated into the Stormwater Management Plan Amendment

Stormwater Management Plan Amendment

As part of Post Sandy Resiliency Planning and Engineering work completed in August 2015, a Stormwater Management Plan Amendment supplements the City of Hoboken's January 2006 Stormwater Management Plan and GISP to tie the stormwater management planning documents together. The Amendment also enables a replacement to the City's Chapter 166 Stormwater Management Ordinance coming from the same grant effort. This ordinance has a retention standard that will require all new development, redevelopment and projects that disturb 3,000 square feet or greater to hold runoff from 1.25-inches of rain over 2-hours. This standard will initiate private lands to be contributing to the solution of excess volume of runoff.

Green Plan Element

The City has developed the Green Buildings and Environmental Sustainability Plan Master Plan Element (Green Plan Element). The purpose of the Green Plan Element is to establish goals, policies and strategies to encourage energy efficient buildings, protect natural resources and to create a healthy and sustainable economy and society. Stormwater management is an integral part of the Green Plan Element. The stormwater management section of the draft document promotes strategies to mitigate the impact of stormwater on the existing combined sewer system and alleviate widespread flooding.

Rebuild by Design

Integral to the City's future stormwater and floodplain management planning and implementation is the proposed "Resist, Delay, Store, Discharge: a comprehensive strategy for Hoboken" completed through the Rebuild by Design initiative of President Obama's Hurricane Sandy Rebuilding Task Force. The Rebuild by Design project's goal is to create a comprehensive flood strategy, addressing both flash flooding and tidal surge. Project elements include coastal defense (Resist), policies that delay stormwater volume (Delay), greenbelt for stormwater management (Store), and water pumps to promote drainage (Discharge). The City's existing Stormwater Management Plan and Amendment, and Green Infrastructure Strategic Plan support the Rebuild by Design policies to delay stormwater volume. The City has prioritized the Resist element with the award of $230 million from the competition to account for risk from events like Hurricane Sandy but acknowledges that the localized events cause more frequent flooding, and in cooperation with the North Hudson Sewerage Authority, need equal attention.

North Hudson Sewerage Authority

Storm Sewer Network and Combined Sewer Overflow Permit

Other than the limited separate storm sewer mentioned in the above section called "Municipal Tier A NJPDES Permit" a combined system and treatment plan serves the City of Hoboken. This system is owned and operated by the North Hudson Sewerage Authority and is now covered under a Combined Sewer Overflow (CSO) permit effective July 1, 2015. Information on this program is found here: http://www.nj.gov/dep/dwq/cso.htm

The City of Hoboken's is ahead of North Hudson Sewerage Authority with retention standards of its new Chapter 166 Stormwater Management Ordinance; this is independent of the North Hudson Sewerage Authority's regulations found on the website: http://www.nhudsonsa.com/Sewer/sewer.html The Authority requires only detention standards at this point, meaning that they require a delay in releasing runoff from new applicant. This has much less benefit to the overflow and ponding of streets observed in urban flooding.

The new CSO permit will require North Hudson to develop a Long Term Control Plan that will take three to five years to develop and implementation of the plan, likely to be a combination of structural and non-structural (Green Infrastructure) measure will be extraordinarily expensive; it cannot be over emphasized that large expenditures are head for many urban communities in New Jersey including the City of Hoboken. There are great uncertainties in coming North Hudson Sewerage Authority regulations and techniques. Excellent information on what is ahead is found on New Jersey Future's Urban Water Infrastructure website here: http://www.njfuture.org/issues/environment-and-agriculture/water-sewer/urban-water-infrastructure/

Green infrastructure uses vegetation and soil to manage rainwater where it falls. As stated in the GISP, green infrastructure has many advantages over traditional or gray infrastructure and the City of Hoboken is committed to promoting the use of green infrastructure practices. The GISP provides Geographic Information Systems (GIS) analyses of the City to provide general guidance on which areas of the City that may be best suited for specific green infrastructure practices. While these analyses are a useful starting point for development, it is necessary that each site be properly studied in order to ensure that the appropriate stormwater management practices are used.

> "Green infrastructure refers to an array of technologies, approaches, and practices that protect and use natural systems or systems engineered to mimic natural processes, to manage rain water as a resource."
>
> EPA

While it can be assumed that the North Hudson Sewerage Authority will call on green infrastructure in its Long Term Control Plan the contributing densely developed urban area, in conjunction with high

ground water and shallow bedrock constraints, may limit the utility of some green infrastructure techniques. The City will have to stay abreast of the policymaking of the North Hudson Sewerage Authority as it proceeds in addressing its permit. Should North Hudson Sewerage Authority not meet the conditions of its permit, the New Jersey Department of Environmental and the Environmental Protection Agency will seek court action to come into compliance with the federal Clean Water Act through a Consent Decree as other municipalities have done nationwide. Importantly, whatever happens, the CSO Permit infrastructure upgrades will take time to be realized, so Hoboken's aggressive stance is deserving of recognition.

Hoboken Aggressive with Projects Addressing Runoff Volume

As well described in Hoboken's Community Resilience Plan (http://www.hobokennj.org/resiliency/) the City has worked with the North Hudson Sewerage Authority in implementing wet weather pump stations. These were ahead of, but integrated into the concept of the Rebuild by Design plan. The first installed H-1 Wet Weather Pump Station has already been tested as it was installed in 2011 along Observer Highway. Details on the second wet weather pump station on Eleventh Street is found here: http://www.nhudsonsa.com/Public/H-5_WWPS.html

The City of Hoboken looks to integrating Stormwater infrastructure and community parks. As with the wet weather pumping stations, Hoboken has been proactive in advancing projects such as the Southwest Park (http://www.hobokennj.org/2014/06/hoboken-awarded-250000-grant-for-southwest-park/) and the "BASF site" covered in the REinvest Feasibility Study 2015 found here: http://www.reinvestinitiative.org/reports/RE.invest_Hoboken-City-Report.pdf Both of these project use underground detention systems to delay stormwater discharge into the combined sewer system. In addition, Hoboken is implementing Green Infrastructure in its Complete Streets Policy; this policy is being implemented for Washington Street with great explanation found on the website: http://www.hobokennj.org/washingtonstreet/ Further, the City is realizing demonstration projects rain garden curb extensions and tree pits to compliment retrofits at City Hall that incorporates a cistern for rainwater reuse and rain gardens on the City Hall property.

This variety of storm and flood management initiatives couple with the retention standard in the new stormwater ordinance applicable for development and redevelopment and the Resilient Building Design Guidelines developed during the Post Sandy Resiliency Planning and Engineering collective effort.

Incentivizing Flood and Stormwater Municipal Improvement Projects

Hoboken has demonstrated a proactive in utilizing state programs such as the New Jersey Environmental Infrastructure Trust (NJEIT). The NJEIT is available for the City to qualify for low interest loans to implement Green Infrastructure. While Hoboken is most interested in solving runoff volume issues, water quality

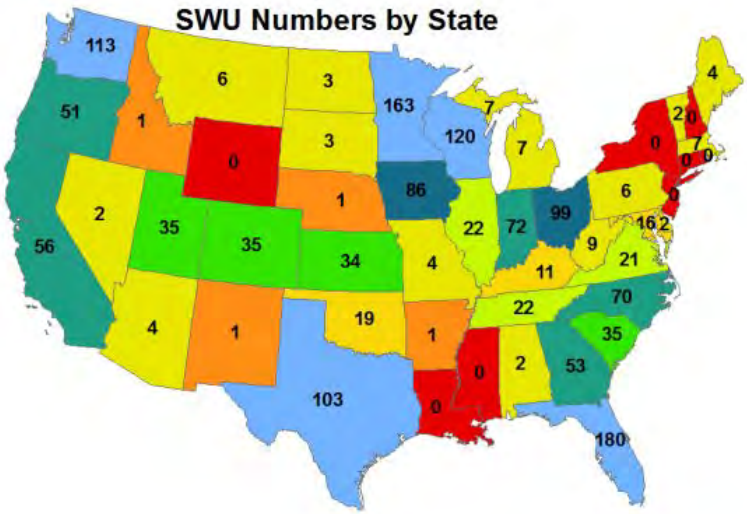
improvements are also realized in the process. Eliminating flows to the combined sewer system will not only improve Hoboken's localized flooding but reduce water treatment by North Hudson Sewerage Authority. According to the NJEIT website, Green Projects such as "replacing existing paving with porous pavement, utilizing bioretention, constructing green roofs, creating rain gardens, and other practices that mimic natural hydrology and increase effective perviousness" are eligible under the Clean Water (CWSRF) program. NJEIT funding is not only available to utilities but to municipal government as Hoboken has exhibited.

Other potential sources of funding are covered below:

Expansion of Open Space Funding Program

The City collects fees for open space acquisition. In discussions with City staff, that program could be expanded to implement and maintain Green Infrastructure on public open space in accordance with the Recreation and Open Space Inventory. This may be another way to get expedient demonstration projects in service prior to the North Hudson Sewerage Authority's Long Term Control Plan implementation.

Stormwater Utilities



The collection of funds through a stormwater utility could alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4) for Hoboken as combined sewer systems are separated or managed through other mechanisms through North Hudson Sewerage Authority's Long Term Control Plan. The costs of stormwater programs, increased by regulatory requirements (stormwater Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be offset through a stormwater utility or various other methods. More than 1,500 communities or districts across the country have adopted a stormwater utility to help fund the costs of stormwater programs, including the costs of regulatory compliance, planning, maintenance, capital improvements, and repair or replacement of infrastructure. Western Kentucky University tracks stormwater utilities in the United States and Canada and provides its findings on this website: https://www.wku.edu/engineering/civil/fpm/swusurvey/ (figure above from Western Kentucky University's Stormwater Utility Survey 2014). It is important to note that there are no stormwater utilities in New Jersey and the neighboring states of New York and this may be due to a combination of

lateness in CSO Permits, EPA Region 2, lack of familiarity and aversion to additional fee collection and taxes. The below sections called New Jersey Legislative Activity and Newark Legal Opinion touch on the context of Stormwater Utilities in New Jersey.

Some communities include stormwater management costs within their water or sanitary sewer system budgets, often basing fees on metered water flow. However, a property's metered water flow often bears no relationship to the stormwater runoff it generates. For example, the stormwater runoff from the impervious area of a shopping center's buildings and parking lots is significant, but its use of metered water is relatively small. Stormwater fees, which are typically based on property type or area, provide for regulatory compliance and operation and maintenance costs, and are charged to both tax-paying and tax-exempt properties. The average quarterly fee for a single-family home is $11, though some communities charge as little as $2 or as much as $40 per quarter to a single family home.

As commercial, industrial and parking lots have larger lot and impervious areas they pay more under a Stormwater Utility for the use of the combined sewer system conveyance and treatment. They are incentivized to perform stormwater mitigation, a retrofit, on the property to reduce stormwater fees. A particular good example of this is in the City of Philadelphia, the District of Columbia and the City of Lancaster, Lancaster County, PA. Weblinks are provided as follows:

http://www.phillywatersheds.org/whats_in_it_for_you/reduce-your-stormwater-fees

http://green.dc.gov/src

http://saveitlancaster.com/resources/stormwaterfee/

Hoboken's stormwater management and flood control efforts on public lands are commendable. With the retention standard in the new Stormwater Management Ordinance will over time address private property. Hoboken should encourage North Hudson Sewerage Authority to implement a Stormwater Utility as part of its Long Term Control Plan where the biggest users of the Combined Sewer System pay fair share for the use (large lots with high impervious cover).

New Jersey Legislative activity

There have been several attempts in the New Jersey Legislature to pass enabling law to establish stormwater utilities. These included a pilot in Ocean County, statewide allowance and most recently, permission for Combined Sewer System utilities and municipalities. All efforts have failed to date, with the closest attempt vetoed by Governor Christie. With the implementation of Combined Sewer Overflow Permits in July 2015, there absolutely will be further emphasis to have enabling statue.

Newark Legal Opinion

The legal opinion on the City of Newark's ability to assess stormwater fees under, issued by The Environmental Law Clinic of the Columbia University School of Law, is of great interest to Hoboken, and

one would expect ultimately to the North Hudson Sewerage Authority. The basis of the fee is on quantifiable contributions to the combined sewer systems. The opinion states that the money collected would have to be used for the costs in constructing, reconstructing and maintaining the system – this is one inherent benefit to forming a stormwater utility to keep from mixing with other expenditures. The legal opinion was shared in confidence with the Princeton Hydro team and Hoboken and the North Hudson Sewerage Authority would have to ask for that document directly from the City of Newark.

User fees

A review of the stormwater management plans and ordinances of cities in the forefront of sustainable stormwater management, including New York, Philadelphia, Chicago, and Washington DC, was conducted in support of this document. In its stormwater rule, Chicago regulates developments of 7,500 square feet or greater, and Philadelphia and Washington DC regulates disturbances of 5,000 square feet or greater. The median lot in Hoboken is 6,672 square feet, with 26% of the City's lots between 500 and 5,000 square feet. With its small land area and density of small lots, it would be necessary for the City of Hoboken to establish a fee structure that is applicable to all exiting development and redevelopment.

The Philadelphia Water Department (PWD) developed the Green City, Clean Waters program for Combined Sewer Overflow Control to "protect and enhance our watersheds by managing stormwater with innovative green infrastructure." Green City, Clean Waters, Philadelphia's plan to reduce combined sewer overflows, calls for an investment of $2.4 billion over the next 25 years in public infrastructure. This money will fund treatment plant upgrades and the installation of green stormwater infrastructure in streets, parks, schools and other public spaces.

In conjunction with this program, it was announced that the PWD would collect a Stormwater Management Service charge (SWMS). As of July 1, 2010, the method of SWMS charge calculation changed from a meter size-based charge to a parcel area based-charge. Additionally, the SWMS charge is presented as a separate line item on Water/Sewer/Stormwater Bills. The SWMS charge is based on two parameters: the Gross Area square footage and Impervious Area square footage determined for a property.

Credits Aggregated Projects

The City of Philadelphia, through the Philadelphia Water Department (PWD) and Philadelphia Industrial Development Corporation (PIDC), has also created the Stormwater Management Incentives Program (SMIP) to offer incentives and assistance to non-residential PWD customers. These programs aim to stimulate investment in and utilization of stormwater best management practices, which reduce a parcel's contribution of stormwater to the City's sewer and surrounding waterways.

Individual property owners and developers of Stormwater Credits are not limited in the method and mean by which they can fulfill regulatory requirements. Rather, innovation is fostered. The City of Hoboken could work with the North Hudson Sewerage Authority to develop and implement a

stormwater utility similar to the City of Philadelphia's, including billing structure and allocation of funds for stormwater management projects within the City and other flood-effected sewer service areas with the important addition of maintenance of the projects realized through the Rebuild by Design initiative. The Princeton Hydro team encourages Hoboken and the North Hudson Sewerage Authority to meet with the Philadelphia Water Department to learn more about successes and failures – there is no reason to reinvent the wheel.

Flood Control District

What sets the City of Hoboken apart from other cities is the magnitude of flood risk. While flooding is obviously an important consideration in cities that have implemented Stormwater Utilities, and while the City of Hoboken is sensitive to concerns regarding environmental quality of life and the health of the Hudson River, control of flooding during most stormwater events is the priority for the City of Hoboken. While Flood Control Districts are prolific in the United States, mainly for operation and maintenance of levees, according to the legal opinion of the Environmental Law Clinic of the Columbia University School of Law, the New Jersey Flood Control Act does not give the right to a utility or municipality to collect fees. However, according to the opinion, the Act allows the issuance of bonds offset by taxes paid by those that receive a benefit. Since about three quarters of Hoboken would be advantaged by Green Infrastructure's volume reduction improvements, and since Hoboken does not own or operate the combined sewer system, this may be an attractive option for the City. A Flood Control District may be well matched with the implementation of the Rebuild by Design implementation and maintenance will be required for each element, including the first phase "Resist." As stated earlier, the legal opinion was shared in confidence with the Princeton Hydro team, and Hoboken and the North Hudson Sewerage Authority would have to ask for that document directly from the City of Newark.

Green Bonds

Public infrastructure needs and changing environmental conditions have spurred innovation in financing called "Green Bonds" since 2007. Climate Change Mitigation and Adaptation is one of the leading uses of Green Bonds. With Hoboken's growing value and real estate demand lowering financial risk, investors should be attracted to this mechanism for Hoboken's adaptation projects. The multitude of resiliency efforts well publicized by Hoboken should be able to draw the attention of investors.

Public-Private Partnerships

While not being covered here, Public-Private Partnerships may be an option for Hoboken to explore. These will require a sophisticated and experienced practitioner to establish demand, contractual agreements, creating a credit marketplace. As an example, the Hudson Bergen Light Rail Project was a Public-Private Partnership success and this should be familiar to the City of Hoboken.

CITY OF HOBOKEN

NEW JERSEY

Codes, Ordinances and Standards

August 26, 2015

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HOBOKEN

August 24, 2015

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I. RESOURCES

[Draft] **Green Buildings & Environmental Sustainability Plan Element** (Green Plan Element)

Hoboken Green Infrastructure Strategic Plan October 2013 (GISP)

Memorandum by Brandy Forbes, Community Development Director dated November 12, 2014

Draft amendments to Chapter 196 (Zoning) "To Include a New Article IV (General Regulations Applicable to All Uses and Structures)…" provided by Ann Holtzman, CFM, Zoning Officer

Draft Amendments to Chapter 196 (Zoning) New Article II, "Definitions" provided by Ann Holtzman, CFM, Zoning Officer

II. ROOF TREATMENTS

(a) Green Roofs

Objective

Remove barriers to green roof installation

See: Green Plan Element, Land Use and Green Building Design, Goals F & H, p.50

See: GISP, Green Roofs, p. 42

Existing Problem

Current zoning regulations (§196-23 Height Regulations, cited below) for roof-top equipment impose a coverage limit of 10 percent in the Residential districts and within the CBD. Industrial zones are permitted coverage up to 50 percent.

Response

B. Forbes 11-12-14 Memorandum:

> Similar to what the ordinance provides with solar arrays, the ordinance should be amended to exempt green roofs and possibly roof decks from the rooftop coverage calculation.

B. Forbes 11-12-14 Memorandum and Draft amendments to Article IV General Regulations Applicable to All Uses and Structures in Chapter 196 (Zoning) provided by A. Holtzman:

> Green Roofs. Green roofs are encouraged on all projects with roof surface area of 5,000 square feet or more where other alternative energy applications are not being used. Green roofs shall be installed in accordance with the following criteria:
>
> 1. A green roof shall consist of four layers: a waterproof membrane, a layer of insulation, a drainage layer, and the growing medium (substrate). Additionally, a protective layer of PVC or other suitable material may be

placed beneath the growing medium to protect against roots penetrating the waterproofing layer.

2. The growing medium shall be a thin, lightweight medium suitable for planting green roof vegetation; for example, a mix of expanded shale and/or sand with 10 percent humus.

3. Plantings on green roofs shall be shallow-rooted, drought-tolerant species that thrive in thin, nutrient-poor soils and will not require irrigation; for example, mosses, grasses and sedum.

4. If a green roof is provided on at least 50 percent of the roof surface, there shall be no limitation on the materials used on the remaining 50 percent.

5. Green roofs are subject to approval by the city Engineer and may be subject to periodic inspection. (Or: An application for a green roof installation shall include an engineer's report confirming the structural integrity and load capacity of the proposed roof.)

6. If all of the above criteria are met, review and approval of the application will be processed by the Zoning Officer; no Board review shall be required.

Consider adding a definition in §196-6 for Green Roof, e.g. "Green Roof – A roof covered with vegetation, designed for its aesthetic value and to optimize energy conservation."

Consider amending §196-23 Height Regulations, subsection A, General application and permitted exceptions, as follows:

No building or structure shall be higher than the height permitted in the district where such building is located. Such limitations shall not apply to roof appurtenances such as flagpoles, radio or television antennas other than satellite dishes, wireless telecommunications antennas, chimneys, elevator or stair bulkheads, mechanical penthouses, parapets or railings up to five feet in height above the roof slab, water tanks or cooling towers or any similar structures, provided that:

(1) In PUD's and redevelopment areas (where regulations in the Plan are more restrictive, the Plan will control) and in the R and CBD districts, such roof appurtenances in their aggregate coverage may occupy no more than 10% of the roof area of the building and may not exceed a height of 15 feet above the roof on which they are located **except for green roofs as defined in this Chapter and in accordance with the specifications set forth in Article IV General Regulations Applicable to All Uses and Structures**; and

(2) In I-1 and I-2 districts, such roof appurtenances in their aggregate coverage may occupy no more than 50% of the roof area of the building and may not exceed a height of 15 feet above the roof on which they are located **except for green roofs as defined in this Chapter and in accordance with the specifications set forth in Article IV General Regulations Applicable to All Uses and Structures**.

(b) Cool Roof Standards

Objective
Use light-colored and green roof surfaces to reflect light and heat back into the atmosphere, reducing the urban heat island effect and improving energy efficiency. Adopt cool-roof standards that require the use of light-colored roof surfaces for both flat and pitched roofs.
See: Green Plan Element, Land Use and Green Building Design, Goals H, p.50

Response
B. Forbes 11-12-14 Memorandum and Draft amendments to Article IV General Regulations Applicable to All Uses and Structures in Chapter 196 (Zoning) provided by A. Holtzman:

> § 196-4xx. Roofs.
> Cool roofs. All projects with roof surface area of 1,000 square feet or more shall utilize a material that has a solar reflectivity of 40 percent or greater as certified by the Cool Roof Rating Council.

A definition should be added to Chapter 196.

Question
Would a Green Roof qualify? If so, the proposed definition for Green Roof, above, should be modified.

III. ROOF-MOUNTED EQUIPMENT & SOLAR/COGENERATION

(a) Roof-Mounted Equipment

Objective
Protect building systems by relocating them above design flood elevation. Remove barriers to roof-top equipment installation.
See: Green Plan Element, Land Use and Green Building Design, Goal B, p. 48

Potential Problem
Current zoning regulations (§196-23 Height Regulations) appears to exempt roof-mounted mechanical equipment up to a height of 15 feet. As with the issue of green roofs, the issue may be the coverage limitation of 10 percent in the Residential districts and in the CBD.

> No building or structure shall be higher than the height permitted in the district where such building is located. Such limitations shall not apply to roof appurtenances such as flagpoles, radio or television antennas other than satellite dishes, wireless telecommunications antennas, chimneys, elevator or stair bulkheads, mechanical penthouses, parapets or railings up to five feet in height above the roof slab, water tanks or cooling towers or any similar structures, provided that:
>
> (1) In PUD's and redevelopment areas (where regulations in the Plan are more restrictive, the Plan will control) and in the R and CBD districts, such roof appurtenances in their aggregate coverage may occupy no more than

> 10% of the roof area of the building and may not exceed a height of 15 feet above the roof on which they are located and
>
> (2) In I-1 and I-2 districts, such roof appurtenances in their aggregate coverage may occupy no more than 50% of the roof area of the building and may not exceed a height of 15 feet above the roof on which they are located.

Response
B. Forbes 11-12-14 Memorandum proposes increasing coverage to 20 percent, as follows:

> Other rooftop appurtenances. Other rooftop appurtenances (combined), including but not limited to flagpoles, antennas, chimneys, elevator or stair bulkheads, mechanical equipment, water tanks and cooling towers, shall not exceed 20 percent of the roof surface or exceed a height of 15 feet above the roof slab on which they are located.

Question
Is it correct to assume that the current Ordinance standard allowing up to 50 percent coverage for the Industrial zone districts will not be changed? If so, the proposed Ordinance amendment should be revised to make this clear.

(b). Solar & Cogeneration

Objective
Remove barriers to cogenerations, solar and other alternative energy installations. Remove technical and regulatory barriers that inhibit installation of cogeneration and solar energy systems.
See: Green Plan Element, Land Use and Green Building Design, Goal J, p. 51

Comment
§196-35.1 *Solar Installation*, does not impose a coverage limitation for roof-mounted solar equipment. It does limit the height on flat roofs to 6 feet. Solar installation is permitted in the Historic Districts and for a designated historic site or structure subject to approval from the Hoboken Historic Preservation Commission.

Response
Consider adding a definition for "cogeneration" and evaluate if the ground-mounted provisions currently in place have presented an obstacle for proposed facilities.

IV. BUILDING HEIGHT

Objective
Provide zoning incentives especially in areas with highest contribution to flooding. Modify FAR, **height**, density requirements for impervious surface area reduction.
See: GISP, Planning and Implementation Agenda

Prerequisite to Establishing Incentive
Clarity regarding the current zoning standards in measuring building height, particularly in the Residential zone districts is needed. Before determining what type of incentive would be appropriate in the various residential and nonresidential zone districts, and within the existing Historic Districts and the proposed expansion of same as proposed in the City's

2004 Master Plan, agreement and consistency on standards must be established. Some questions for consideration:

- Should "base flood elevation" continue as the key point of measurement or should it be replaced with "design flood elevation"?

- Should "stories" be eliminated as a co-determinate in setting building height as recently proposed?

Current Standard

Chapter 196 defines "Building Height" as:

> The vertical distance measured from the mean level of the ground around the foundation to the highest point of the finished roof.

Article VIII, *Supplemental Lot, Height and yard Regulations*, building height in the Residential zone districts is measured in relation to the base flood elevation, as follows:

> §196-23 *Height Regulations*
> B. Measurement and specific application.
> (1) Building height. Building height shall be **measured from the average grade computed by averaging the grade obtained at the four corners of a principal structure** or the four most extreme points on the north, south, east and west sides of a principal structure, or at four points 90° apart for a circular structure.
>
> §196-14 **R-1**
> E(6) (a) R-1 District: Principal buildings, a maximum of three stories **but in no event more than 40 feet above base flood elevation**, whichever is less.
>
> [1] **Where front sidewalk grade is already above base flood elevation, maximum height of 40 feet shall be measured from said sidewalk grade**. Where front sidewalk grade is below the natural grade of the building site as of the date of adoption of this ordinance, such as Hudson Street, the point of measurement for maximum building height shall be determined by the average elevation of the final grade adjoining such building.
>
> §196-15 **R-2**
> E(5) Building height, maximum: For principal buildings: a maximum of four stories which may consist of three stories, or not more than 30 feet, whichever is less, above an on-site parking facility for a total height not to exceed 40 feet.
> (a) **Where a principal building is constructed without parking, its maximum height may be more than three stories or not more than 40 feet above base flood elevation**, whichever is less.
> (b) **Where front sidewalk grade is already above base flood elevation**, maximum height shall be measured from said sidewalk grade.
>
> §196-16 **R-3**
> E(5) Building height maximum: For principal buildings: a maximum of four stories which may consist of three stories, or not more than 30 feet,

whichever is less, above an on-site parking facility for a total height not to exceed 40 feet.

(a) Where a principal building is constructed without parking, its maximum height may be no more than three stories **or not more than 40 feet above base flood elevation, whichever is less.**
(b) **Where front sidewalk grade is already above base flood elevation**, maximum height shall be measured from said sidewalk grade.

Response
Chapter 196, (Zoning), does not define Base Flood Elevation however, Chapter 104, (Flood Damage Prevention) does include the following definition:

> BASE FLOOD – The flood having a one-percent chance of being equaled or exceeded in any given year.

A revised definition for "story" along with new definitions for "half-story", "base flood elevation", and "design flood elevation", are proposed for Chapter 196 in Draft Amendments to Chapter 196 (Zoning) New Article II, "Definitions" provided by A. Holtzman, as follows:

> BASE FLOOD ELEVATION (BFE) – The highest point expressed in feet above sea level of the level of floodwaters occurring in the regulatory base flood as established by the Federal Emergency Management Agency (FEMA).
>
> DESIGN FLOOD ELEVATION – The elevation in vertical feet above sea level plus Freeboard adopted by the City of Hoboken to guide design and construction practices that reduce the likelihood of flood damage in the event that flood levels exceed the Base Flood Elevation (BFE).
>
> STORY – That portion of a building included between the surface of any floor and the surface of the floor or roof next above it. [**Existing: Chapter 196 Zoning**]
>
> STORY -- That portion of a building included between the surface of any floor and the surface of the floor next above it, or if there is no floor above it, then the space between the floor and the ceiling next above it and including basements used for the principal use. [**Proposed**]
>
> STORY, HALF – A space under a sloping roof that has a line of intersection of the roof and wall face not more than three (3) feet above the floor level and in which space the possible floor area with headroom of five (5) feet or less occupies at least 40 percent of the total floor area of the story directly beneath. Basements as defined herein may also be counted as a half-story.

B. Forbes 11-12-14 Memorandum recommends the following revision using the **Design Flood Elevation** as the starting point (subsection A) and removes "**stories**" as a determining factor in establishing building height (subsection C) in the Residential districts.

Number of Stories Recommended Changes:

§ 196-__. Building Height

A. Building height for residential zones R-1, R-2 and R-3 is hereby amended to allow up to 40 feet above Design Flood Elevation as adopted by the City of Hoboken and amended from time to time per Chapter 104, Flood Damage Prevention, of the municipal code. Where adjacent grade is above Design Flood Elevation, building height shall be permitted up to 40 feet above the average elevation of finished grade surrounding the structure.

B. In residential zones R-1, R-2 and R-3 where a new building occupies no more than 50 feet of frontage between two existing adjacent buildings which are higher than 40 feet, the new structure may match the height of the lower of the two buildings. Final height in such a case shall include any front parapet.

C. Number of stories will not be applied to determine building height; however a minimum floor-to-floor height of 10 feet shall be required of all stories above Design Flood Elevation on new construction.

D. In all areas of special flood hazard, enclosed areas below Design Flood Elevation of a new or substantially improved building are usable only for vehicle parking (where permitted), building access, and storage; or where permitted, a commercial use may occupy the ground floor provided the floor meets the floodproofing standards set forth in Chapter 104, Flood Damage Prevention, of the municipal code.

The memorandum also cites a recommendation from the Zoning Board of Adjustment annual reports dealing with this issue, although with the concept of "story" still in place, as follows:

> Allow a fourth story in the flood hazard areas (3 stories are permitted) or provide an exception for first floors in a flood hazard area not to be counted as a story, as long as the ground floor is only used for storage (equipment, bicycles, strollers, waste disposal, etc.).

Incentives to reduce impervious coverage and remove existing residential units below the base flood elevation (or design flood elevation) would include allowing additional building height equal at least to another habitable level (10-15 ft.) and/or an addition story unless the latter is removed from the calculation, as recommended above.

Issues for Further Discussion

(a) Should this incentive apply only to buildings within critical flood areas i.e. Sewersheds H1, H3, H4, and H5 per GISP or in any zone district?

(b) Historic Districts, both existing and areas proposed for designation per the 2004 Master Plan, and individual Historic structures should be included and therefore the Historic Preservation Commission should be included in discussion on best approach in this regard.

V. IMPERVIOUS COVERAGE

Objective

Increase the amount of pervious surfaces city wide.

- Adopt minimum design standards for new development and yard alterations that incorporate limitations on impervious surfaces; encourage voluntary compliance from homeowners with existing impervious cover.
- Remove barriers to at grade planted courtyards along the public right of way.
- Consider incentives for replacing blacktop and concrete paved surfaces on existing parking lots with permeable paving.

See: Green Plan Element, Land Use and Green Building Design, Goal G, p.50

See: GISP, Planning and Implementation Agenda

Problem

Building coverage is synonymous with lot coverage, (see definitions, below). Permitted lot coverage is generally 60 percent in the residential zones, between 60 to 80 percent in the CBD and 30 percent in the waterfront districts (see Tables I-IV, below). It appears that portion of property not covered by a building is thus not regulated with regard to impervious coverage. The applicable definition in Chapter 196 (Zoning) is as follows:

> Building Coverage – The percentage of area of a lot which is occupied by the physical limits of all buildings. In the case of a planned unit development, "building coverage" is calculated as the percentage of area of a development block occupied by the physical limits of all buildings, subject to the exclusions identified in § 196-27.1B(3)(b), the same as lot coverage.
>
> Lot Coverage – Same as building coverage.

Response

Consider adopting separate standards for building and/or structure coverage and other impervious coverage.

Three new definitions and a modification to Lot Coverage are proposed in Draft Amendments to Chapter 196 (Zoning) New Article II, "Definitions" provided by A. Holtzman, as follows:

- Building Coverage – The ratio of the horizontal area, measured from the exterior surface of the exterior walls of the ground floor, of all principal and accessory buildings on a lot to the total lot area.

- Impervious Surface – A surface that has been covered with a layer of inorganic material; such as a structure or pavement, so that it is highly resistant to infiltration by water.

- Pervious Surface – Any material that permits full or partial absorption of storm water into the underlying land.

- Lot Coverage – That part of the lot that is covered by impervious surfaces.

Issues for Further Discussion

(a) Patios: B. Forbes 11-12-14 Memorandum provides recommended standards for patios and terraces which need to be reconciled with the above-stated objectives in that patios will not be considered lot or building coverage and may consist of impervious material subject to certain limitations, as follows:

§ 196-__.3 Patios and Terraces.

A. A patio or terrace, located in the rear or side yard of a principal building, shall be a landscaped or surfaced area at a height not more than 18 inches above finished grade.

B. Patios and terraces without roof cover will not be considered lot or building coverage or rear yard or side yard encroachments. A patio or terrace with any form of cover including but not limited to a pergola, fabric canopy or fixed plant material will be considered lot coverage and must meet the specification of an accessory structure.

C. If made of impervious material such as but not limited to concrete pavement or pavers with mortared joints, no more than one-third of the yard area may be covered. The area of impervious cover must be graded to a drain and drywell or detention tank with a capacity sufficient to capture runoff from the impervious surface equal to or exceeding a 50-year rain event.

D. A patio or terrace made of pervious materials such as but not limited to wood planks, pervious pavers, wood chips, chipped stone or gravel, up to two-thirds of the yard area may be covered.

E. If located in an area of special flood hazard, a constructed patio or terrace must be securely anchored with footings or tie downs in accordance with Flood Damage Prevention Chapter 104.

(b) Porous Pavement. §196-40 *Design Standards for Off-Street Parking Areas* requires, in part the following standards:

> D. General standards for parking area.
> (1) Design. Parking areas for six or more vehicles and access to this parking shall be designed and planned in accordance with accepted engineering and parking design principles, such as contained in the 1978 Eno Foundation publication, Parking Garage Planning and Operation.
>
> (2) Review. All plans may be reviewed by the City Engineer and/or the Parking Authority and recommendations forwarded to the Planning Board for their use in accordance with § 196-26, Site plan review.
>
> (3) Paving and drainage. Where parking areas are paved with asphalt, they shall be paved and drained in accordance with good engineering and construction practices, such as defined in the Construction Code of the City of Hoboken. Where other surfacing materials are used, standard practice yielding corresponding performance standards shall be followed.

The question is if the above requirements preclude porous paving design, such as provided at 380 Newark St. (photo, right). Consultation with the City Engineer is recommended.

(c) Planted Courtyards. Proposed amendments to Chapter 168 Streets and Sidewalks" provided by A. Holtzman appear to address the current obstacles or absence of regulations permitting to providing planted courtyards along the public right-of-way, in particular the proposed section on landscaping which reads as follows:

1. Landscaping of the space between the lot line and the fence line is encouraged.
2. At grade planting beds are preferred as they capture, filter and infiltrate stormwater and contribute to groundwater recharge. At

grade beds are best suited to capture runoff from roof downspouts and sheet flow from the adjacent sidewalk.

3. Raised planting beds are permitted. The maximum height of any retaining wall for such a planting bed shall be eighteen (18) inches. Beds with curbing of six (6) inches or more must be setback from the fence line one (1) inch for each additional inch in height.
4. Hedges or other buffer plantings may be used in lieu of a fence. The height shall not exceed forty-eight (48) inches and no plant material may project beyond the fence line of the block.
5. "Native Landscaping" and indigenous plants are hardy, drought tolerant and low maintenance while benefiting the environment by reducing the need for fertilizer, pesticides and water. Native landscaping techniques should be employed wherever possible.
6. Where paving materials such as blue stone or pavers are used to create a visual courtyard, whether recessed or not, that paving must be dry-laid so stormwater may permeate.
7. Landscaped areas must be maintained, kept free of weeds, litter and other impediments that may affect the adjacent public right-of-way.

The draft Ordinance amendments should be discussed with the City Engineer and with the County Engineer for County streets within Hoboken to allow for the type of streetscape improvements (stormwater planters, rain gardens, etc.) identified in the GISP and proposed by the City for the First Street Streetscape Revitalization Project.

VI. FLOOR AREA RATIO & DENSITY

Objective

Provide zoning incentives especially in areas with highest contribution to flooding. Modify **FAR**, height, **density** requirements for impervious surface area reduction.
See: GISP, Planning and Implementation Agenda

Current Standards

The City's zoning regulations establish residential density by dividing the "site area" by 660. "Site area" is not defined in Chapter 196. It is not clear why this approach is used rather than establishing a permitted number of units per acre although it may easier to apply where nonconforming lots predominate. Floor Area Ratio (FAR) is determined, at least in the Residential zones and within the CBD as part of the residential calculation, as follows: "…*the percentage of total permitted floor area occupied by the nonresidential use shall be applied against the maximum number of dwelling units and the residential units shall be reduced thereby*…"

District standards for density and FAR are presented below. See Tables I-IV for minimum lot area requirements.

R-1, R-1 (CS) Site area ÷ 660 = maximum dwelling units

R-1(H)(CPT) Sub-district: one & two-family homes only

R-2 Site area ÷ 660 = maximum dwelling units

R-3 Site area ÷ 660 = maximum dwelling units

CBD; CBD(H) sub-district; CBD(H)(CS) sub-district
Site area ÷ 500 = maximum dwelling units
Where an accessory apartment is added to an existing accessory garage on Court Street, the total number of units on site may exceed the permitted maximum by one unit so long as the proposed accessory apartment meets the other bulk requirements of the district.

R-1, R-1 (CS) Zones
Where principal uses in addition to residential are proposed for the subject building (such as retail or office), the percentage of total permitted floor area occupied by the nonresidential use shall be applied against the maximum number of dwelling units and the residential units shall be reduced thereby, except as specified below. Any fraction shall be equivalent to a whole dwelling unit. On **Washington Street, First Street** and **Fourteenth Street**, nonresidential principal uses located on the ground floor and basement (as permitted elsewhere in this chapter) shall no be deducted from the maximum permitted number of residential units."

R-2 Zone
Where principal uses in addition to residential are proposed for the subject building (such as retail or office), the percentage of total permitted floor area occupied by the nonresidential use shall be applied against the maximum number of dwelling units and the residential units shall be reduced thereby except as specified below. Any fraction shall be equivalent to a whole dwelling unit. On **Fourteenth Street**, nonresidential principal uses located on the ground floor and basement (as permitted elsewhere in this chapter) shall no be deducted from the maximum permitted number of residential units.

R-3 Zone
Where principal uses in addition to residential are proposed for the subject building (such as retail or office), the percentage of total permitted floor area occupied by the nonresidential use shall be applied against the maximum number of dwelling units and the residential units shall be reduced thereby except as specified below. Any fraction shall be equivalent to a whole dwelling unit. On **First Street**, **Newark Street** and **Observer Highway**, nonresidential principal uses located on the ground floor and basement (as permitted elsewhere in this chapter) shall no be deducted from the maximum permitted number of residential units.

CBD; CBD(H) sub-district; CBD(H)(CS) sub-district zones
Where principal uses in addition to residential are proposed for the subject building (such as retail or office), the percentage of total permitted floor area occupied by the nonresidential use shall be applied against the maximum number of dwelling units and the residential units shall be reduced thereby. Any fraction shall be equivalent to a whole dwelling unit. Where an accessory apartment is added to an existing accessory garage on Court Street, the total number of units on site may exceed the permitted maximum by one unit so long as the proposed accessory apartment meets the other bulk requirements of the district.

I-2 Zone
FAR: 1.25

Prerequisite to Establishing Incentive
It may be useful to select a target residential street, a street with mixed-use buildings and a commercial/retail street to conduct a build-out analysis under current zoning and potential density and FAR bonus incentives.

Issue for Further Discussion
(a) Consider revising Ordinance standards to base density on unit per acre basis and FAR as a separate calculation based upon the required lot area and clarify the percentage of gross floor area to be permitted for nonresidential use within mixed-use buildings.

VII. BASEMENTS

Current Standard
Chapter 196 (Zoning) defines a basement as follows:

> Basement – A space having at least 1/2 of its floor-to-ceiling height above the average level of the adjoining exterior grade. A "basement" shall be counted as a story if used for business, industrial, office or residential purposes.

Chapter 104 (Flood Damage Prevention) provides this definition:

> Basement – Any area of the building having its floor subgrade (below ground level) on all sides.

Response
Draft Amendments to Chapter 196 (Zoning) New Article II, "Definitions" provided by A. Holtzman, proposes a revised definition for Chapter 196. Can same be applied to Chapter 104 as well? The proposed definition is as follows:

> Basement – Any area of a building having its floor below the average height of finished grade of the adjoining exterior ground or any area of a building below Design Flood Elevation that is not used for habitation. Basements shall not be counted as a story unless the floor is above Design Flood Elevation or used as principal dwelling space.

Draft amendments to Article IV General Regulations Applicable to All Uses and Structures in Chapter 196 (Zoning) provided by A. Holtzman provide the following regulations for basements:

> Basements.
> A. Any basement which is not at least two (2) feet above Base Flood Elevation (BFE+2), shall not be used as a primary residence. A basement below BFE+2 may be used for accessory purposes to the principal structure, but shall not contain sleeping quarters or the primary kitchen of any dwelling. A basement unit may be used for commercial use, subject to approval, provided all requirements for such use may be met.

B. A basement dwelling unit lawfully in existence at the effective date of this chapter, which shall be made nonconforming at the passage of this chapter, shall continue as a dwelling units, may change ownership and continue to function as a dwelling unit, provided the following conditions are met:

1. A legally-nonconforming basement dwelling unit shall not be enlarged, extended, or structurally altered, except when changing the unit to a conforming use.
2. A legally-nonconforming basement dwelling may be restored or renovated pursuant to Uniform Construction Code (UCC) Rehabilitation Law, but shall not be altered in any way which increases the nonconformity.
3. A legally-nonconforming basement dwelling damaged by fire or act of nature may be repaired and used as before, provided there is no expansion of the use. All repairs shall be completed within one (1) year after damages occur or the dwelling shall not be restored.
4. When a basement dwelling unit is destroyed or damaged beyond repair, or is not repaired within one (1) year after damages occur, or the owner of the dwelling unit desires to rebuild for any reason, the Board of Adjustment, may authorize such rebuilding, provided the owner has received approval to rebuild from New Jersey Department of Environmental Protection (NJDEP) and any other such government agency having jurisdiction over construction within a flood zone.

VIII. DEFINITIONS

Draft Amendments to Chapter 196 (Zoning) New Article II, "Definitions" provided by A. Holtzman proposes a number of revisions to existing definitions and new definitions. In addition to those cited above, the following are important to this project:

1. GRADE – (1) The average elevation of the land around a building; (2) the percent of rise or descent of a sloping surface.

2. GRADE, FINISHED – The final elevation of the average ground level adjoining a building at all exterior walls after development.

3. INCENTIVE ZONING – The granting by the approving authority of additional development capacity in exchange for the developer's provision of a public benefit or amenity.

4. SPECIAL FLOOD HAZARD AREA (SFHA) – The land in the flood plain within city boundaries subject to a 1% or greater chance of flooding in any given year

5. STORMWATER -- Water that originates from a precipitation event such as rain or snow.

6. STORMWATER DETENTION -- Any storm drainage technique that retards or detains runoff, such as a detention or retention basin, parking lot or rooftop detention, porous pavement, dry wells or any combination thereof.

7. STORMWATER MANAGEMENT -- The control and management of stormwater to minimize the detrimental effects of surface water runoff.

TABLE I
RESIDENTIAL

Zone District	Lot Coverage (Principal Building)	Lot Coverage (Accessory Building)	Minimum Lot Area	Density FAR	Building height principal	Building height accessory
R-1 / Residence District (Conservation)	60%		2,000 sq. ft.		Maximum of three stories but in no event more than 40 feet above base flood elevation, whichever is less.*	
R-1-E / Higher Education District	50%		2,000 sq. ft.		4 stories or 40 ft within 200 ft. of any residential district; otherwise maximum of 10 stories or 100 ft.	
R-1-CS / Court Street Sub-district	60%	20% or 400 sq. ft.	2,000 sq. ft.		Same as R-1 (3 stories no more than 40 ft.)	One residential story over accessory garage, total height not to exceed 30 ft.
R-1-H-CPT / Castle Point Historic Sub-district	60%		2,000 sq. ft. – 1 family 3,000 sq. ft. – 2 family		No addition shall be constructed on the front, side or top of an existing building so as to change the architectural style of the front facade; additions may be made to the rear portions of existing structures so long as the addition complies with other bulk requirements and does not exceed 40 feet in height above the grade of the rear yard as measured at the two rear building corners existing at the time of the adoption of this section. New construction shall not exceed the prevailing height as established on the subject blockfront as measured from the average grade of the two front corners of all principal building[s]?	
R-2 / Residence District	60%		2,000 sq. ft.		Building height, maximum: For principal buildings: a maximum of four stories which may consist of three stories, or not more than 30 feet, whichever is less, above an on-site parking facility for a total height not to exceed 40 feet. Where a principal building is constructed without parking, its maximum height may be more than three stories or not more than 40 feet above base flood elevation, whichever is less.	
R-3 / Residence District	60%		2,500 sq. ft.		Maximum of 4 stories – may consist of 3 stories or not more than 30 ft. whichever is less above on-site parking facility for total height not to exceed 40 ft. Principal building without parking - maximum height no more than 3 stories or not more than 40 ft. above base flood elevation, whichever is less. Where a new building occupies no more	

					than 50 feet of frontage between two existing adjacent buildings which are higher than the maximum allowed (as measured in feet), the new structure may match the height of the lower of the two buildings. Final height in such a case includes any front parapet.	

* [1] Where front sidewalk grade is already above base flood elevation, maximum height of 40 feet shall be measured from said sidewalk grade. Where front sidewalk grade is below the natural grade of the building site as of the date of adoption of this ordinance, such as Hudson Street, the point of measurement for maximum building height shall be determined by the average elevation of the final grade adjoining such building.

[2] Where a new building occupies no more than 50 feet of frontage between two existing adjacent principal buildings whose height (as measured in feet) is lower than the maximum permitted for the district, the new structure may match the height of the higher of the two buildings. Where the adjacent buildings are higher than the maximum permitted for the district, the new structure may match the lower of the two buildings. Final height in such a case includes any front parapet.

TABLE II
CENTRAL BUSINESS DISTRICT

Zone District	Lot Coverage (Principal Building)	Lot Coverage (Accessory Building)	Minimum Lot Area	Density /FAR	Building height principal	Building height accessory
CBD / Central Business District	80%-commercial 60%-residential or residential portion of mixed-use	n/a	5,000 sq. ft.		16 stories or 160 ft.	
CBD-H / Historic Sub-district	60%	10%	2,000 sq. ft.		Prevailing but not to exceed 5 stories	
CBD-H-CS / Court Street Sub-district	None indicated*	20%	2,000 sq. ft.		Same as CBD-(H) (Prevailing but not to exceed 5 stories)	Accessory apartments: 20 ft. above accessory garage for total of 30 ft.

TABLE III
WATERFRONT

Zone District	Lot Coverage (Principal Building)	Lot Coverage (Accessory Building)	Minimum Lot Area	Density /FAR	Building height principal	Building height accessory
W-RDV / Waterfront Redevelopment Sub-district (Special Review)	Development in the W(RDV) Sub-district is subject to the special use, bulk and parking regulations of the South Waterfront Redevelopment Plan adopted November 17, 1989, as amended					
W-H / Historic Sub-district (Waterfront)*	30%	10%	40,000 sq. ft.		2 stories, not more than 35 ft.	
W-N / Castle Point Sub-district	30%	10%	40,000 sq. ft.		2 stories, not more than 35 ft.	

* W(H) Historic Sub-district is subject to review procedures of the Historic Commission

TABLE IV
INDUSTRIAL

Zone District	Lot Coverage (Principal Building)	Lot Coverage (Accessory Building)	Minimum Lot Area	Density /FAR	Building height principal	Building height accessory
I-1 / Industrial District (Light Manufacturing)	65%	10%	20,000 sq. ft.		4 stories but not more than 80 ft.	1½ stories but not more than 30 ft.
I-1-W / Waterfront Sub-district	65%	10%	20,000 sq. ft.		Manufacturing bldg: 4 stories no more than 80 ft. Office and research: 8 stories; no more than 80 ft. Marinas & other retail: 2 stories no more than 30 ft.	
I-1(W) Planned Unit Development		**Subject to §196.27.1 Note A**	10 acres	**Note B**	Manufacturing bldg: 4 stories no more than 80 ft. Office and research: 8 stories; no more than 85 ft. Marinas: 2 stories no more than 30 ft. Retail: 2 floors maximum up to 30 ft. ***** Residential: 8 stories no more than 85 ft Residential in planned unit development******: 125 ft. subject to § 196-17E(2)(b)[4]*** Parking structures Not located within a principal building: 8 stories no more than 80 ft. Building height includes floors devoted to off-street parking when located within the principal building	
1-2 / Industrial District (Mixed Use)	60%	10%	5,000 sq. ft.	1.25	2 stories no more than 40 ft.	1½ stories no more than 30 ft.

Note A §196-27.1 Urban Design Review
(3) That the following bulk controls have been applied:
(a) Rear walls of residential buildings shall not be more than 70 feet from the street line of any public or private street [except in the case of residential buildings located within 150 feet of the intersection of two streets, which buildings may have rear walls located not more than 125 feet from the street line].
(b) Building coverage for any one development block shall not exceed 75%, so long as average building coverage for all development blocks does not exceed 65%; provided, however, that where a parking structure is created under the principal building, up to four stories may cover up to 100% of

the development block. Such stories of the building shall be excluded from the calculation of building coverage so long as the following conditions are met:

[1] The roofstop of the parking structure shall be landscaped and designed for the use and enjoyment of occupants of the building; and

[2]The stories of the building containing the parking levels fully comply with the requirements of § 196-27.1B(2)(d).

(c) Any development block within a planned development containing one or more residential buildings shall contain an open area for light and air [having no dimension less than 30% of the block width] commencing no higher than the level of the lowest residential floor facing the interior of the block. Open areas above buildings or structures, on-grade parking lots, driveways, sidewalks and other surfaces may satisfy this requirement.

Note B: §196-17E(2)(b)[5].
Permissible ranges of ratios of residential and nonresidential uses measured on the basis of gross use area:
[a] Permissible range of gross use area devoted to residential use: 25% minimum to 85% maximum.
[b]Permissible range of gross use area devoted to the total of all commercial, industrial, public or quasi-public uses: 15% minimum to 75% maximum.

*** Need to clarify the following**: "Freestanding retail building: maximum two floors of retail use, up to 30 feet in height; rooftop parking is permitted so long as the total building does not exceed 80 feet in height."

****** Residential buildings in planned unit development (at least 51% of gross use area devoted to residential)
Question: So there are two types of residential buildings in the I-1 (W) Planned Unit Development?

******* §196-17E(2)(b)[4].
In order to promote flexibility in the design of planned unit developments, residential buildings in any development block may be constructed to a height of up to 125 feet, provided that the total gross use area for residential uses in the planned unit development does not exceed the gross use area which would be permitted (at the eight-story height limitation) in the planned unit development under the following formula: the sum total area of all development blocks in the planned unit development multiplied by eight {representing the number of stories of residential use permitted under § 197.17E(2)(b)[3][e]} multiplied by 51%.

Master Plan Update Recommendations

Resilient Master Plan Recommendations

Hoboken, N.J.

August 24, 2015

Introduction

The changing fortunes of the Hoboken's waterfront have long been emblematic of the City's ability to endure difficulties and rise above adversity. From its early regional prominence as a center of shipping and trade, Hoboken endured a long period of decline as its waterfront, ruled by manpower, was replaced elsewhere by containerized shipping.\

Neighborhoods once in deep decline have seen a decades-long resurgence of interest and reinvestment and Hoboken has endured to rebuild itself into the pre-eminent urban village in the region. Hoboken's post-industrial waterfront, with its expansive waterside park and pedestrian network, puts City residents and visitors in an intimate juxtaposition to the City that never sleeps, making it an extraordinary people place.

Despite the City's unprecedented success in reestablishing itself as a highly desirable place to live, work, socialize and play, significant flood hazards affect most of Hoboken's residential neighborhoods. Hurricane Sandy brought Hoboken's exposure to flood risks from major storms into clear focus. But the City also remains vulnerable to flooding from more frequent storm events, including normal meteorological conditions. As a result, much attention has been focused on the role of local flood damage mitigation policies and regulations promoting resilient design.

Hoboken's Vulnerability to Flood Damage

Hoboken is the fourth most densely settled city in New Jersey, the Nation's most densely populated State. While the Washington Street business district and nearby commercial areas at the higher elevations are generally outside the flood hazard area, Hoboken's most densely settled neighborhoods are highly vulnerable to flood risks.

The threat of continued flood damage from future storms has prompted Hoboken to develop a multi-pronged Recovery and Resiliency Plan to address vulnerabilities and mitigate against future flooding and disaster events. The elements of this plan include

- Energy Resiliency ("Micro-grid")
- Shoreline Protection (seawalls and flood barriers)
- Flood Mitigation (wet weather pump stations)
- Stormwater Management (purchase land in the flood hazard area for parks and open space with stormwater retention facilities)
- Critical Facilities/Infrastructure (Municipal Hazard Mitigation, Open Space, Recreation and Historic Preservation PlanUpdates)
- Emergency Notification (programmable, solar-powered, mobile message boards)
- Public Information (public information campaign)
- Resilient Building Codes (reconcile city code with state and federal regulations to permit "wet floodproofing" and "dry flood proofing on the street level of buildings in the flood hazard area below the BFE)
- Resiliency Task Force: (develop community recovery and resiliency ideas, policies, projects and programs and assist with implementation of a Community Rating System ("CRS"))

Hoboken's 2004 Master Plan ("2004 Plan"), the most recent comprehensive plan, continued many of the city's long-standing land use policies, which were generally designed to conserve and capitalize upon the desirable character of the City's historic neighborhoods and business districts. The 2004 Plan also called for significant changes to local policies and land use regulations, although many, if not most, recommendations for changes have not been implemented. Nonetheless, many of the unimplemented changes recommended in 2004 appear to have continuing merit and should be further reviewed. They are not the subject of the current analysis, however, except to the extent that flood hazard mitigation is concerned.

Resilient design is the focus of several new or updated elements of the City's Master Plan, including a new Stormwater Management Plan, an Open Space and Recreation Plan Update and a Historic Preservation Plan Update, all contained in separate documents. Resilient Urban Design Guidelines have also been developed to assist those seeking to expand, adapt or construct buildings in the flood hazard area.

In addition to these three (3) updated plan elements, Hoboken's Master Plan includes a wide range of policies that merit updating from the perspective of resiliency and flood damage prevention and mitigation. The affected plan elements from the 2004 Master Plan are discussed below, along with relevant recommendations from the 2010 Master Plan Reexamination Report and current recommendations for a more resilient master plan.

Apart from the updated Stormwater Management Plan, Open Space and Recreation Plan and Historic Preservation Plan, flood resilient design has implications for a number of other plan elements that were not updated through this review process, but where additions or modifications are appropriate, including:

- Land Use Plan
- Community Facilities Plan
- Utility Plan
- Circulation Plan

- Economic Development Plan

Table 1 examines the implications of land use and other master plan policies on flood hazard mitigation in Hoboken.

TABLE 1 - Master Plan Recommendations from 2004, 2010 and 2015

Plan Element	**2004 Plan Finding or Policy (page #)**	**2010 Reexam Finding or Policy (page #)**	**Resiliency Issue**	**2015 Comment or Recommendation**
Land Use Part 1	"essentially fully developed"(23)	(No Change)	Resilient retrofitting requires incentives	Develop incentives to encourage voluntary flood resiliency improvements
	"in love with this paradigm" regarding stoops in front, large windows and a ground floor halfway below grade (25)	(No Change)	Community character impacts	Utilize design guidelines in Historic Preservation Plan
	Maximum residential building height limited to 40' and 3 stories (28)	(No Change)	Incentivize	Allow additional height when needed to incentivize removal of a residential occupancy below the BFE
Building and Site Design	"require buildings to be oriented to the street"(34)	(No Change)	Elevated first floors	Use design guidelines
	"continue to promote stoops" (34)	(No Change)	Elevated first floors	New forms of vertical access may be required
	"encourage ground	(No Change)	ground floor and basement	Prohibit new ground floor or basement

	floor and basement apartments where possible” (34)		apartments should not be allowed below BFE	apartments below BFE
	Retain “open space on the interior of blocks” by protecting rear yards (34)	(No Change)	Prevent increase in impervious coverage	Require stormwater management improvements to more than compensate for any increase in impervious surfaces
	“refine existing façade regulations” including fenestration at ground level (35)	(No Change)	Resilient building modifications like flood openings can alter fqcade appearance	Refer to design guidelines
	“enact ‘green architecture’ requirements for new construction (35)	(No Change)	Stormwater management	encourage ‘green architecture’ requirements for new construction
Community Facilities	City government facilities (50)		Building and site management	Highlight current program to improve stormwater capture at City Hall as a model for other sites
	Emergency services (58, 59)	Consolidate emergency services in modern facilities in the center of town (13)	Flood avoidance maximizing flood free routes	Highlight need to relocate or flood proof critical facilities
	Medical facilities (60)		Flood avoidance maximizing flood free routes	Highlight need to flood proof critical facilities
	Utilities (60)		Elevate above BFE	Highlight need to flood proof critical facilities
	Combined Sewers (61)		Eliminate sanitary effluent from stormwater system	Highlight health and safety concerns related to flooding
	Possibly relocate emergency services and Police HQ to a		Flood avoidance maximizing flood free routes	Assure flood free location with easiest access across less flooded routes

	central part of city (66)			
	School roof greening (66)	Consider garden/ landscape/green roof retrofits for school roofs	Stormwater management	Work with BOE to develop coordinatesd approach
	Drainage problems in flood areas (67)	(No Change)	Stormwater management	Reduce impervious coverage and increase infiltration
Utility Services	Improve city utility systems (67)	(No Change)		
	Enforce coverage limitations (67)	(No Change)		
	Develop stormwater policies for new development (67)	(No Change)		See updated stormwater management plan and ordinance
	Replace combined sewers with separate storm and sanitary systems (67)	(No Change)	Discharge of untreated sewage	Work with the North Hudson Regional Sewerage Authority to prioritize improvements to the system
Circulation	Only ten access points into Hoboken and complicated intersections and traffic patterns(78)	(No Change)	Flood Safety	Avoid land uses at these locations that will further complicate access in times of emergency
Economic Development	Mandate street level retail in retail cores (95)	No zoning change adopted	Elimination of residential occupancy blow the BFE	Replacing residential uses with non-residential uses in flood-prone areas can retain an active streetscape
Retail Districts	Technical assistance for storefront	(No Change)		See Resilient Design Guidelines

	improvements (97)			
	Schematic user-friendly illustrations (97)	(No Change)	Need for design guidance	See Resilient Design Guidelines
	Promote storefront design variety (97)	(No Change)		See Resilient Design Guidelines
Land Use Part 2				
		Develop a Green Plan Element	Various resilieincy benefits	See Green Infrastructure Strategic Plan
		Consider arts and industry overlay and “area in need of rehabilitation” designtaion	Ability to incentivize resilient building modifications	Area in Need designation can be applied city wide and could allow tax incentives for repairs
Business Districts	Require commercial buildings to be built up to the front lot line (148)		Access	Could complicate the provision of necessary access and other design features needed to connect new or adapted buildings with the street level.
	Mandate street level retail (148)	No zoning change adopted	Access	Good for corner locations where residential uses can be replaced with non-res. at ground level
	Encourage additional neighborhood retail on secondary retail streets (149)	No zoning change adopted	Retail conversions can make productive use of areas below BFE and maintain an active streetscape	Good for corner locations where residential uses can be replaced with non-res. at ground level
	Encourage additional office space in appropriate locations (149)	No zoning change adopted	Office conversions can make productive use of areas below BFE and maintain an active streetscape	Good for mid-block locations where residential uses should be eliminated from ground level

Central City Neighborhoods	Maintain the lower densities and heights in residential zones (150)	(No Change)	Incentives needed to inspire voluntary resiliency improvements	Allow increased density and height when residential occupancy below the BFE is converted to a FEMA compliant use
	Permit mixed uses but continue to remain predominantly residential (150)	(No Change)	Provides alternate use for areas below BFE	Residential first floors below the BFE, which pose serious risks to residents, are best converted to other uses wherever an activated streetscape is desired
	Permit bed and breakfast inns and home occupations (150)	(No Change)	Provides alternate use for areas below BFE	Alternatives to residential use of flood prone ground floors can enrich neighborhood opportunities and retain active first floor uses
Zoning		Control impervious and increase pervious coverage	Stormwater management	Provide incentives to owners to limit and reduce impervious coverage
		Reconsider retail in residential zones and limit retail to corner locations here	Retail conversions can make productive use of areas below BFE and maintain an active streetscape	Examine loations where commercial conversions are appropriate and develop standards to encourage such conversions where it will prevent loss of neighborhood character
		Develop a bonus system to incentivize green improvements	Stormwater management	Develop a bonus system to incentivize green building and site improvements

Stormwater Management Plan Amendment

CITY OF HOBOKEN

NEW JERSEY

Stormwater Management Plan Amendment

August 24, 2015

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Introduction

As required by the New Jersey Municipal Stormwater Regulation Program (N.J.A.C. 7:14A-25), the City of Hoboken City Council adopted a Municipal Stormwater Management Plan (SWM Plan) to document the strategy for the City to address stormwater related impacts for the limited areas with separate storm sewer infrastructure. The Plan, entitled "Stormwater Management Plan for the City of Hoboken" and prepared by Schoor DePalma, Inc., January 2006, was adopted on January 17, 2007 by ordinance number DR-289. The Plan addresses groundwater recharge, stormwater quantity, and stormwater quality impacts by incorporating stormwater design and performance standards for new major development, defined as projects that disturb one or more acres of land, in the section of the City of Hoboken that is not serviced by "Combined Sewers Overflow" and therefore not under the jurisdiction of the North Hudson Sewerage Authority. These standards, implemented through Hoboken's Stormwater Management Ordinance (Chapter 166), are intended to minimize negative adverse impacts of stormwater runoff.

In March 2014, the City of Hoboken Green Infrastructure Strategic Plan (GISP) was created, funded through Together North Jersey who was awarded a $5 million Sustainable Communities Regional Planning Grant by the U.S. Department of Housing and Urban Development (HUD), to develop place-based stormwater management and flood control strategies and identify implementable climate adaptation action steps for the City. The underlying goal of the project is to demonstrate how such strategies can help create a more resilient transit system and transit-oriented community, and the project is also focused on the following objectives:

- To develop implementable place-based stormwater management strategies in support of climate adaptation action steps.
- To develop a framework for green infrastructure, including cost-effective, long-term solutions to update the aging system and integrate source controls into the design and construction of public improvement, private development, open space and right-of-way projects, including a focus on how these measures can improve the resilience of Hoboken's transit infrastructure.[1]

Key issues addressed by the plan include climate adaptation, flood control strategies, resilience of transit and the surrounding community, and the use of green infrastructure. The GISP project team included NJ Transit; EE&K, a Perkins Eastman Company; Louis Berger Group; and Clarke Caton Hintz and the project was completed with guidance provided by Together North Jersey with funding originating with the U.S. Department of Housing and Urban Development (HUD).

Integral to the City's future stormwater management planning is the proposed "Resist, Delay, Store, Discharge: a comprehensive strategy for Hoboken" completed through the Rebuild by Design initiative of President Obama's

[1] Hoboken Green Infrastructure Strategic Plan

Hurricane Sandy Rebulding Task Force. The Rebuild by Design project's goal is to create a comprehensive flood strategy, addressing both flash flooding and tidal surge. Project elements include coastal defense (Resist), policies that delay stormwater volume (Delay), greenbelt for stormwater management (Store), and water pumps to promote drainage (Discharge).[2] The City's existing Plan and GISP, in conjunction with this Amendment, supply the above-suggested policies to delay stormwater volume. The City has prioritized the Resist element with the award of $230 million from the competition to account for risk from events like Hurricane Sandy but acknowledges that the localized events cause more frequent flooding and with the North Hudson Sewerage Authority need equal attention.

The City is currently developing the Green Buildings and Environmental Sustainability Plan Master Plan Element (Green Plan Element). The purpose of the Green Plan Element is to establish goals, policies and strategies to encourage energy efficient buildings, protect natural resources and to create a healthy and sustainable economy and society; stormwater management is an integral part of the Green Plan Element. The stormwater management section of the draft document promotes strategies to mitigate the impact of stormwater on the existing combined sewer system and alleviate widespread flooding.

The purpose of this Stormwater Management Plan Amendment (Amendment) is to supplement the City of Hoboken's Stormwater Management Plan and GISP and to tie stormwater management planning documents together. The changes herein are intended only to supplement those documents, to enable amendments to the City's Chapter 166 Stormwater Management Ordinance; this document does not replace the existing Plan or GISP. The City of Hoboken's stormwater management regulations are independent of the North Hudson Sewerage Authority's regulations.

Background

An early industrial maritime center, the City of Hoboken was founded on a high point along a river, nestled within surrounding riverine wetlands. Like many cities of its kind, as Hoboken's population grew, the fabric of the City expanded to include development in low lying areas and, as a result, is now facing special challenges in stormwater management. Compounding this challenge is Hoboken's combined sewer system, also common to early city development, where storm and sanitary sewer flows are routed through the same underground pipe system. During heavy rain events, stormwater overwhelms the sewer system and leads to sanitary sewer overflows and flooding. While Hoboken's landscape position and aging infrastructure are not unusual for a city its age, its small size and dominance of ultra-urban land use cover are. Looking forward, it is imperative that new development and redevelopment within Hoboken incorporate alternative stormwater management practices in order to assure both the safety and health of the community's residents.

[2] http://www.rebuildbydesign.org/project/comprehensive-strategy/

Green infrastructure uses vegetation and soil to manage rainwater where it falls.[3] As stated in the GISP, green infrastructure has many advantages over traditional or gray infrastructure and the City of Hoboken is committed to promoting the use of green infrastructure practices. The GISP provides Geographic Information Systems (GIS) analyses of the City to provide general guidance on which areas of the City that may be best suited for specific green infrastructure practices. While these analyses are a useful starting point for development, it is necessary that each site be properly studied in order to ensure that the appropriate stormwater management practices are used.

This Amendment sets broad performance standards applicable across the entire City to ensure that individual property owners are not limited in the method and mean by which they can fulfill regulatory requirements. Rather, innovation is fostered. In addition, while green infrastructure practices are strongly encouraged by the City's GISP and Green Buildings and Environmental Sustainability Plan Master Plan Element, the techniques addressed in this document are not limited to green infrastructure, as the densely developed urban fabric of the city, in conjunction with high ground water and shallow bedrock constraints, may limit the utility of some green infrastructure techniques in some areas.

A review of the stormwater management plans and ordinances of many cities in the forefront of sustainable stormwater management, including New York, Philadelphia, Chicago, and Washington DC, was conducted in support of this Amendment. In their stormwater rule, Chicago regulates developments of 7,500 square feet or greater, and Philadelphia and Washington DC regulates disturbances of 5,000 square feet or greater. The City of Hoboken is 1.28 miles square and, in contrast and as an example, the City of New York (NYC) is 301 miles square, with Central Park alone totaling 1.32 miles square. The median lot in Hoboken is 6,672 square feet, with 26% of the City's lots between 500 and 5,000 square feet. With its small land area and density of small lots, it is necessary for the city of Hoboken to establish stormwater regulations that are applicable to all development and redevelopment of both small and large scale.

Significant difference in scale is not the only factor that sets the City of Hoboken apart from the other cities examined. While flooding is obviously an important driver in those Cities, and while the City of Hoboken is sensitive to concerns regarding environmental quality of life and the health of the Hudson River, control of flooding during most stormwater events is the priority for the City of Hoboken and, as such, the stormwater ordinance is specifically tailored to meet this goal.

In common with the City of Hoboken's goals, the New York City Department of Environmental Protection (NYCDEP) states in their NYC Green Infrastructure Plan, a Sustainable Strategies For Clean Water Ways (2010) that the "new performance standard is intended to reduce the peak charges to the city's sewer system during rain events by requiring greater on-site storage of stormwater runoff and slower release to the sewer system." To achieve this, the city seeks to manage the equivalent of an inch of rainfall on 10% of the impervious areas in

[3] http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm

combined sewer watersheds by year 2030. It is notable that in their plan is their commitment of over five billion dollars for targeted green infrastructure installation gray infrastructure upgrades.

The NYCDEP is also deeply committed public outreach and engagement regarding their green infrastructure program. As with any new policy initiative, it is important to educate citizens regarding proposed changes early in the process, both to benefit from local knowledge of existing issues and understand possible conflicts, but also to better ensure proposed practices are both undertaken and maintained properly. As such, while this document makes revisions to existing the stormwater management plan and ordinance, it is strongly suggested that this document be used as a tool to initiate discussion and collaboration for future initiatives, including possible tax incentives and stormwater utility to fund community projects.

While a tailored Stormwater Management Plan Amendment and Ordinance was written for the City of Hoboken, the NYDEP Guidelines for the Design and Construction of Stormwater Management Systems (Guidelines) are an excellent, existing resource to the City because the types of systems suggested are highly compatible with the land use density of Hoboken. Suggested stormwater management techniques include underground storage and rooftop systems, which is in line with a recommendations made by the GISP. The NYCDEP Guidelines also provide comprehensive calculation and design information and details, all of which are valuable resources to the potential users. As such, the NYDEP Guidelines are referenced in the Stormwater Ordinance.

While precipitation is the most common cause of flooding in the city, an important differentiation must be made between flooding due to minor or average storm events and flooding due to major storm events, i.e. Hurricane Sandy. Flooding due to minor storm events is the purview of this document while flooding due to major storm events, particularly including wide scale flooding from the Hudson River, is addressed through the City's section of the Hudson County all natural Hazard Mitigation Plan and that conceptualized by the Rebuild by Design project.

Stormwater Ordinance

Suggested edits to the City of Hoboken’s existing stormwater ordinance are provided as part of this Amendment. The suggested ordinance updates reference the North Hudson Sewerage Authority (NHSA) Technical Requirements for Stormwater Management, with select language in the ordinance superseding the NHSA Technical Requirements in that the City wishes to control runoff volume (retention) and not runoff rate (detention). The City’s proposed amended ordinance does not distinguish an application based on sanitary sewerage flows and is triggered by disturbance of 3,000 square feet; the City also wants to promote the reduction of runoff in concert with the NHSA that gives credit for removal of 25% of the properties impervious cover. Superseding the NHSA Technical Requirements include the Quantity Volume method of calculation.

While the NHSA Technical Requirements provide information regarding stormwater management, the information is limited. The New York Department of Environmental Protection Guidelines for the Design and Construction of Stormwater Management Systems is referenced for water quality, quantity and groundwater calculation methods and green infrastructure measure design. The New Jersey Stormwater Best Management Practices Manual is referenced for structural stormwater management measure design.

Future Planning

Stormwater Utility

The collection of funds through a stormwater utility could alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4) as combined sewer systems are separated. The costs of stormwater programs, increased by regulatory requirements (stormwater Phase I or Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be offset through a stormwater utility or various other methods. More than 1,400 communities or districts across the country have adopted a stormwater utility to help fund the costs of stormwater programs, including the costs of regulatory compliance, planning, maintenance, capital improvements, and repair or replacement of infrastructure.[4]

Some communities include stormwater management costs within their water or sanitary sewer system budgets, often basing fees on metered water flow. However, a property's metered water flow often bears no relationship to the stormwater runoff it generates. For example, the stormwater runoff from the impervious area of a shopping center's buildings and parking lots is significant, but its use of metered water is relatively small. Stormwater fees, which are typically based on property type or area, provide for regulatory compliance and operation and maintenance costs, and are charged to both tax-paying and tax-exempt properties. The average quarterly fee for a single-family home is $11, though some communities charge as little as $2 or as much as $40 per quarter to a single family home. [5]

The Philadelphia Water Department (PWD) developed the Green City, Clean Waters program for Combined Sewer Overflow Control to "protect and enhance our watersheds by managing stormwater with innovative green infrastructure." Green City, Clean Waters, Philadelphia's plan to reduce combined sewer overflows, calls for an investment of $2.4 billion over the next 25 years in public infrastructure. This money will fund treatment plant upgrades and the installation of green stormwater infrastructure in streets, parks, schools and other public spaces.[6]

In conjunction with this program, it was announced that the PWD would collect a Stormwater Management Service charge (SWMS). As of July 1, 2010, the method of SWMS charge calculation changed from a meter size-based charge to a parcel area based-charge. Additionally, the SWMS charge is presented as a separate line item on Water/Sewer/Stormwater Bills. The SWMS charge is based on two parameters: the Gross Area square footage and Impervious Area square footage determined for a property.

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[4] http://www.wku.edu/engineering/civil/fpm/swusurvey/
[5] http://water.epa.gov/infrastructure/greeninfrastructure/upload/FundingStormwater.pdf
[6] http://www.phila.gov/water/wu/stormwater/Pages/StormwaterManagement.aspx

The City of Philadelphia, through the Philadelphia Water Department (PWD) and Philadelphia Industrial Development Corporation (PIDC), has also created the Stormwater Management Incentives Program (SMIP) to offer incentives and assistance to non-residential PWD customers. These programs aim to stimulate investment in and utilization of stormwater best management practices, which reduce a parcel's contribution of stormwater to the City's sewer and surrounding waterways.[7]

The City of Hoboken is expecting to work with the North Hudson Sewerage Authority to them develop and implement a stormwater utility identical to the City of Philadelphia's, including billing structure and allocation of funds for stormwater management projects within the City and other flood-effected sewer service areas.

Mitigation

Requiring mitigation when either a variance or exemption from the stormwater management requirements of the City ordinance is necessary due to specific and proven site constraints, including shallow groundwater and elevated bedrock.

Any mitigation project must provide groundwater recharge benefits, or protection of stormwater runoff quantity and quality from previously developed properties that do not currently meet the requirements of the ordinance. The applicant must follow the requirements outlined in the City's stormwater ordinance, including operations and maintenance requirements.

The City may allow an applicant to provide funding or partial funding for an environmental enhancement project that is identified by the City. The funding must be equal to or greater than the cost to design and implement the required mitigation, and include the cost associated with the operations and maintenance requirements for the mitigation measure. The Draft Green Plan Element strongly advocates that open space acquisition is coupled with stormwater management projects to maximize the utility of these areas, including the "Parks as Defense" concept which incorporates coastal flood prevention, underground stormwater retention, or on-grade green infrastructure in open space areas.

Other recommendations include:

- Promote subsurface storage wherever feasible.
- Fortify the City's waterfront with constructed wetlands, as proposed by Resist, Delay, Store, Discharge and the Green Infrastructure Strategic Plan. Consider re-introducing marshes with native plants and utilizing other creative storm water and flooding mitigation strategies.

[7] http://www.phila.gov/water/wu/stormwater/Pages/ResidentialSWBilling.aspx

- Use Constructed wetlands, consistent with the Rebuild By Design strategy, to serve as part of the "Resist" strategy.
- The Green Infrastructure Strategic Plan recommends constructed wetlands within the Blue Zone. Utilize existing public property along the NJ Transit Hudson-Bergen Light Rail and potential redevelopment sites to form a contiguous corridor for stormwater management, without affecting the transit system.
- Where applicable, consider basins and/or ponds on Hoboken's western and northern edge, as Hoboken's topography results in stormwater running toward the west.

Burden of proof must be provided to ensure that the project was completed as agreed upon, with as-built documents with an accompanying report and photographic log of the work provided to the City. Construction inspection may be required during the project implementation and that requirement is to be determined by the City on a project-by-project basis.

Stormwater Management Ordinance

CITY OF HOBOKEN

NEW JERSEY

Stormwater Management Ordinance

August 24, 2015

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166.1 Severability

If the provisions of any section, subsection, paragraph, subdivision, or clause of this ordinance shall be judged invalid by a court of competent jurisdiction, such order of judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, subdivision, or clause of this ordinance.

166.2 Preamble

A Municipal Stormwater Management Plan (the "SWM Plan") has been developed to address the key issues of flooding, water pollution and public safety related to the impacts of stormwater on the City of Hoboken; and the SWM Plan conforms to all relevant federal and state statutes and rules to include local rainfall intensity curves used in stormwater management design criteria in accordance with the Residential Site Improvement Standards (RSIS) and/or substituted by published local frequency data, when available which address stormwater management, dam safety, water pollution and flood control. An additional goal of the SWM Plan is to ensure it is consistent with any other plans which deal with stormwater issues as well as with the goals and strategies of the State Development and Redevelopment Plan. The specific goals of this Plan are to:

A. Reduce flood damage, including damage to life and property;

B. Minimize stormwater runoff and new development projects where such runoff will increase flood damage;

C. Reduce soil erosion from any development or construction project;

D. Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures;

E. Induce water recharge into the ground where practical and permissible;

F. Prevent to the greatest extent feasible, an increase in nonpoint source pollution;

G. Maintain the integrity of stream channels for their biological functions, as well as for drainage;

H. Minimize pollutant in stormwater runoff from new and existing developments in order to restore, enhance and maintain the chemical, physical and biological integrity of the waters of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values and to enhance the domestic, municipal, recreational; industrial and other use of water;

I. Protect public safety through the proper design and operation of stormwater management facilities; and

J. Ensure adequate maintenance procedures have been established and implemented to ensure that the stormwater management measures fulfill their intended functions.

The Hoboken Planning Board has adopted the Stormwater Management Plan on January 17, 2007. The Hoboken Planning Board has adopted the Stormwater Management Plan Amendment on [insert date].

Once both the Stormwater Management Plan and Stormwater Control Ordinance is adopted, same will be submitted to Hudson County for review and approval.

166.3 Policy Statement

Flood control, groundwater recharge, and pollutant reduction through nonstructural or low impact techniques shall be explored before relying on structural BMPs. Structural BMPs should be integrated with nonstructural stormwater management strategies and proper maintenance plans. Nonstructural strategies include both environmentally sensitive site design and source controls that prevent pollutants from being placed on the site or from being exposed to stormwater. Source control plans should be developed based upon physical site conditions and the origin, nature, and the anticipated quantity or amount of potential pollutants. Multiple stormwater management BMPs may be necessary to achieve the established performance standards for water quality, quantity, and groundwater recharge.[1]

166.4 Approving Agency

The Hoboken Planning Board and Zoning Board of Adjustment are the final approving land use board agencies for applications that come before those boards. The City will also use this ordinance in building permit approvals overseen by the Construction Official and/or Zoning Officer; in those cases, Stormwater Management approval rests with these officials. These requirements are proposed as a supplement to the current North Hudson Sewage Authority (NHSA) Technical Requirements for Stormwater Management. Where two different requirements are referenced in this ordinance and the NHSA Technical Requirements, the more conservative of the two shall be observed.

166.5 Applicability

1. This ordinance shall be applicable to:
    a. New development
    b. Redevelopment
    c. Disturbance greater than or equal to 3,000 square feet
2. These regulations apply to entire development sites, even if development of that site is to take place in phases.

[1] New Jersey Stormwater BMP Manual (2004, with revisions); http://www.state.nj.us/dep/stormwater/bmp_manual2.htm

3. This ordinance does not apply to activities of Hudson County, the State of New Jersey and the government of the United States of America when those activities are specifically exempted from municipal regulation by relevant State or Federal law.

166.6 Compatibility with Other Permit and Ordinance Requirements

Development approvals issued for subdivisions and site plans pursuant to this ordinance are to be considered an integral part of development approvals under the subdivision and site plan review process and do not relieve the applicant of the responsibility to secure required permits or approvals, such as building permits, for activities regulated by any other applicable code, rule, act, or ordinance. In their interpretation and application, the provisions of this ordinance shall be held to be the minimum requirements for the promotion of the public health, safety, and general welfare. This ordinance shall be construed to assure consistency with the requirements of New Jersey laws and acts amendatory thereof or supplementary thereto, applicable implementing regulations, and any existing or future municipal NJPDES Permits and any amendments or revisions thereto or reissuance thereof. This ordinance is not intended to interfere with, abrogate, or annul any other ordinance, rule or regulation, statute, or other provision of law. Where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, whichever provisions are more restrictive or impose higher standards shall control.

166.7 Definitions

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application. The definitions below are the same as or based on the corresponding definitions in the Stormwater Management Rules at N.J.A.C. 7:8-1.2; references have been provided for definitions not found in the Stormwater Management Rules at N.J.A.C. 7:8-1.2.

BMP - Best Management Practices as contained in the New Jersey Stormwater Best Management Practices Manual dated April 2004 and as updated, available from www.njstormwater.com.

Compaction - the increase in soil bulk density.

Core - a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

County review agency - an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

1. A county planning agency; or

2. A county water resource association created under N.J.S.A 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

Department - the New Jersey Department of Environmental Protection.

Design engineer - a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

Development - means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any clearing, grading, or excavation or any other activity that results in land disturbance, and any use or change in the use of any building or other structure, or land or extension of use of land, by any person, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq.

Disturbance – means the addition of impervious surface (e.g. pavement); exposure or movement of soil or bedrock (e.g. grading, excavation); or clearing, cutting, or removing vegetation.

Drainage area - means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Erosion - the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

Flood Hazard Area – An area of water ponding that may be influenced by stormwater runoff from inland areas and/or by tidal overflow, tailwater or backflow through the sewer system.

Green infrastructure - stormwater management practices that use vegetation and soil to manage rainwater where it falls. (http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm)

Groundwater - a body of water below the surface of the land in a zone of saturation where the spaces between the soil or geological materials are fully saturated with water.

Impervious surface - a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

Infiltration - the process by which water seeps into the soil from precipitation.

Maintenance Plan - a document required for all major development projects for stormwater management maintenance. The document shall contain specific preventive maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventive and corrective maintenance (including replacement).

Major development – development or redevelopment, as defined by this section, that adds or replaces (alone or in combination) 2,000 square feet or more of impervious surface, or that provides for ultimately disturbing

2,000 square feet or more of land. Major development includes both private and public projects or activities. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation.

Maximum Extent Practicable - compliance with the specific objective to the greatest extent possible taking into account equitable considerations and competing factors, including but not limited to, environmental benefits, pollutant removal effectiveness, regulatory compliance, ability to implement given site-specific environmental conditions, cost and technical or engineering feasibility.

Mitigation - an action by an applicant -providing compensation or offset actions for onsite stormwater management requirements where the applicant has demonstrated the inability or impracticality of strict compliance with the stormwater management requirements set forth in NJAC 7:8, in an adopted regional stormwater management plan, or in this local ordinance, and has received a waiver from strict compliance from the municipality. Mitigation, for the purposes of this ordinance, includes both the mitigation plan detailing how the project's failure to strictly comply will be compensated, and the implementation of the approved mitigation plan within the same HUC-14 within which the subject project is proposed (if possible and practical), or a contribution of funding toward a regional stormwater control project, or provision for equivalent treatment at an alternate location, or other equivalent water quality benefit.

Municipality - the City of Hoboken or any city, borough, town, township, or village.

Nutrient - a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

Nutrient load - the total amount of a nutrient such as nitrogen or phosphorus entering the water during a given time, such as "tons of nitrogen per year", or "pounds of phosphorus per day." Nutrients may enter the water from runoff, groundwater recharge, point source discharges, or the air (in the form of wet deposition such as rain or snow as well as dry deposition).

Nutrient concentration - the amount of a nutrient in a defined volume of water (such as milligrams of nitrogen per liter). The relationship between nutrient concentration and nutrient load can vary and depends on the surface water flow, the volume of water in the water body or aquifer, and watershed characteristics.
"Permeable" means a surface or land cover capable of transmitting or percolating a significant amount of precipitation into the underlying soils.

Person - any individual, corporation, company, partnership, firm, association, City of Hoboken, or political subdivision of New Jersey that is subject to municipal jurisdiction pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. .

Pollutant -any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and

construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. “Pollutant” includes both hazardous and nonhazardous pollutants.

Pollution - the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water to the extent that the pollutant concentration or level violates either the Groundwater Quality Standards (N.J.A.C. 7:9-6) or the Surface Water Quality Standards (N.J.A.C. 7:9B) of New Jersey.

Recharge - the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

Redevelopment - land-disturbing activity that results in the creation, addition, or replacement of impervious surface area on an already developed or disturbed site. Redevelopment includes, but is not limited to: the expansion of a building footprint; addition or replacement of a structure; replacement of impervious surface area that is not part of a routine maintenance activity; and land disturbing activities related to structural or impervious surfaces. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety.

Review agency (municipal) - the municipal land use body or official that is responsible for the review of a major development project for compliance with the stormwater management requirements.

Sediment - solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

Site - the lot or lots upon which a major development is to occur or has occurred.

Soil - all unconsolidated mineral and organic material of any origin.

Solid and floatable materials - sediment, debris, trash, and other floating, suspended, or settleable solids.

Source material - any material(s) or machinery, located at an industrial facility that is directly or indirectly related to process, manufacturing, or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to ground or surface water. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

Stormwater - water resulting from precipitation (including rain and snow) that runs off the land’s surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities, or conveyed by snow removal equipment.

Stormwater runoff - water flow on the surface of the ground or in storm sewers, resulting from precipitation.

Stormwater management measure - any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal non-stormwater discharges into stormwater conveyances.

Structural Stormwater Techniques - a stormwater management measure that involves control of concentrated stormwater runoff or infiltration such as stormwater basins, piped conveyance systems and manufactured stormwater devices, and can include various types of basins, filters, surfaces, and devices located on individual lots in a residential development or throughout a commercial, industrial, or institutional development site in areas not typically suited for larger, centralized structural facilities. This includes blue roofs.

Time of concentration - defined as the time it takes for stormwater runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed.

Waters of the State - the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or ground water, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

Wetlands or wetland - an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

166.8 Administration

These rules, regulations and standards shall be considered the minimum requirements for the protection of the public health, safety and welfare of the citizens of the City of Hoboken. Any action taken by the governing body, Planning Board or Zoning Board of Adjustment under the terms of this chapter shall have primary consideration to the above-mentioned matters and to the welfare of the entire community. However, if the property owner or his agent can clearly demonstrate that, because of peculiar conditions pertaining to their land, a literal enforcement of one or more of these regulations is impracticable or will exact undue hardship, the Planning Board, Zoning Board of Adjustment and governing body may permit such variance or variances as may be reasonable and within the general purpose and intent of the rules, regulations and standards established by this chapter. The City of Hoboken shall require mitigation in all cases where a variance or variances are issued. Mitigation procedures are covered in Section 166.15 below.

166.9 General Standards

The following General Standards supplement the current North Hudson Sewage Authority (NHSA) Technical Requirements for Stormwater Management. All language in this document supersedes the NHSA Technical Requirements for Stormwater Management.

1. Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater retention, stormwater runoff quantity, and stormwater

runoff quality standards in this ordinance. To the maximum extent practicable, these standards shall be met by incorporating nonstructural or green infrastructure stormwater management strategies into the design. If these strategies alone are not sufficient to meet these standards, structural stormwater management measures necessary to meet these standards shall be incorporated into the design.

2. The standards in this ordinance are intended to minimize the impact of stormwater runoff on flash flooding, water quality and water quantity in receiving water bodies, and promote groundwater recharge. These standards do not replace the applicant's requirement to confer with the North Hudson Sewerage Authority and meet that agency's rules.

3. Where redevelopment that adds, replaces, or disturbs (alone or in combination) greater than 2,000 square feet of impervious surface results in an alteration to more than fifty percent of impervious surfaces of a previously existing development, the entire existing development shall meet the requirements of this ordinance.

166.10 Stormwater Management Requirements

The following requirements supplement the current North Hudson Sewage Authority (NHSA) Technical Requirements for Stormwater Management.

A. Water Quality Volume and Groundwater Recharge

1. The design engineer shall, using the below assumptions and factors for stormwater runoff and groundwater recharge calculations , demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures will result in retention on-site, with no discharge, of runoff from the 1.25-inch, 2-hour rainfall event.

2. The Water Quality Volume may be infiltrated onsite. A list of acceptable infiltration and retention practices is provided in the New Jersey Stormwater Best Management Practices Manual[2] and the New York Department of Environmental Protection Guidelines for the Design and Construction of Stormwater Management Systems[3]. Some examples follow:

   a. Rain gardens;

   b. Green roofs;

[2] http://www.state.nj.us/dep/stormwater/bmp_manual2.htm
[3] Guidelines for the Design and Construction of Stormwater Management Systems (July 2012) http://www.nyc.gov/html/dep/pdf/green_infrastructure/stormwater_guidelines_2012_final.pdf (note: there are techniques in these guidelines that are not covered in the NJDEP BMP Manual for more urban areas, such as: Rain Gardens, Green Roofs, Tree Boxes and Rainfall Harvesting)

c. Permeable pavement;

d. Bioinfiltration;

e. Vegetated swales;

f. Trees and tree boxes;

g. Rainwater harvesting systems;

h. Downspout disconnection;

i. Constructed stormwater wetlands;

j. Disconnected low flow channels; and

k. Drywells.

3. The following conditions exempt a project from the groundwater recharge requirement:

a. Depth to groundwater is less than three (3) feet

b. An infiltration rate below 0.5 inches per hour or greater

c. Soil investigation report certified by a professional engineer that soils are unsuitable for infiltration

d. Infiltration techniques must not be used in the following locations:

(1) Industrial and commercial areas where solvents and/or petroleum products are loaded, unloaded, stored, or applied or pesticides are loaded, unloaded, or stored.

(2) Areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the U.S. Environmental Protection Agency in the Code of Federal Regulations at 40 CFR 302.4.

(3) Areas where infiltration basin use would be inconsistent with an NJDEP-approved remedial action work plan or landfill closure plan.

(4) Areas with high risks for spills of toxic materials such as gas stations and vehicle maintenance facilities.

(5) Areas where industrial stormwater runoff is exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process,

manufacturing, or other industrial activities, that could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to raw materials, intermediate products, final products, waste materials, by-products, industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

(6) The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or downgradient of the groundwater recharge area.

B. The following linear development projects are exempt from Stormwater Management Requirements of Section 166.10:

1. The construction of an underground utility line provided that the disturbed areas are revegetated or paved with pervious materials upon completion;

2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

3. The construction of a public pedestrian access, such as a sidewalk or trail, provided that the access is made of pervious material.

C. A waiver from strict compliance Stormwater Management Requirements of Section 166.10 may be obtained for the enlargement of an existing public roadway or railroad; or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

2. The applicant demonstrates in writing through an alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of Section 166.10 to the maximum extent practicable; For road or highway projects, the applicant shall, at minimum, follow USEPA guidance regarding Managing Wet Weather with Green Infrastructure: Green Streets (December 2008 EPA-833-F-08-009);

3. The applicant demonstrates that, in order to meet the requirements of Section 166.10, existing structures currently in use, such as homes and buildings, would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under 166.10 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate the requirements of Section 166.10 that were not achievable on-site.

D. Green Infrastructure and Nonstructural Stormwater Management Strategies

1. To the maximum extent practicable, the standards in Section 166.10 shall be met by incorporating into the design green infrastructure and non-structural stormwater management strategies. The applicant shall identify the green infrastructure and nonstructural measures incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any green infrastructure or nonstructural stormwater management measures into the design of a particular project, the applicant shall identify the strategy considered and provide a basis for the contention of infeasibility for each practice that is not used. The applicant bears the burden of proving infeasibility as described in 166.15 below. The requirements of this section apply notwithstanding any provisions of any other local law that allows for site designs that conflict with such requirements, including but not limited to other local laws authorizing disturbance of a certain percentage of a development site.

2. Green Infrastructure and nonstructural stormwater management strategies incorporated into site design shall:

    a. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

    b. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

    c. Maximize the protection of natural drainage features and vegetation;

    d. Minimize the decrease in the "time of concentration” from pre- construction to post construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed;

    e. Minimize land disturbance including clearing and grading;

    f. Minimize soil compaction;

g. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

h. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas;

i. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site, in order to prevent or minimize the release of those pollutants into stormwater runoff. Such source controls include, but are not limited to:

(1) Site design features that help to prevent accumulation of trash and debris in drainage systems;

(2) Site design features that help to prevent discharge of trash and debris from drainage systems;

(3) Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

(4) When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

3. Site design features shall comply with the following standard to control passage of solid and floatable materials. For purposes of this paragraph, “solid and floatable materials” means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard see below.

a. Design engineers shall use either grates where individual clear space in that grate has an area of no more than seven (7.0) square inches, or is no greater than one half (0.5) inch across the smallest dimension.

b. Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

c. Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear

spaces) shall have an area of no more than seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

d. This standard does not apply:

(1) Where the review agency determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet these standards;

(2) Where flows from the water quality design storm as specified are conveyed through any device (e.g., bioinfiltration system, cistern, or manufactured treatment device) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

(a) A rectangular space four and five-eighths inches long and one and one-half inches wide (this option does not apply for outfall netting facilities); or

(b) A bar screen having a bar spacing of 0.5 inches.

(3) Where flows are conveyed through a trash rack that has parallel bars with one-inch (1”) spacing between the bars, to the elevation of the water quality design storm as specified in Section 4.G.1; or

(4) Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

4. Any land area used as a green infrastructure or nonstructural stormwater management measure to meet the performance standards in Sections 166.10 shall be dedicated to a government agency, subjected to a conservation restriction filed with the appropriate County Clerk’s office, or subject to an approved equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.

5. Guidance for green infrastructure stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual and New York Department of Environmental Protection Guidelines for the Design and Construction of Stormwater Management Systems previously referenced in this Section.

6. Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual.

166.11 Calculation of Stormwater Runoff and Groundwater Recharge

Refer to the New Jersey Stormwater Best Management Practices Manual dated April 2004, and as updated, for the method to calculate the Stormwater Management Requirements in Section 166.10.

166.12 Standards for Green Infrastructure Stormwater Management Measures

Refer to the New Jersey Stormwater Best Management Practices Manual and New York Department of Environmental Protection Guidelines for the Design and Construction of Stormwater Management Systems, as referenced in Section 166.10, for the standards for green infrastructure stormwater management measures.

166.13 Standards for Structural and Nonstructural Stormwater Management Measures

Refer to the New Jersey Stormwater Best Management Practices Manual for the standards for structural stormwater management measures, as referenced in Section 166.10.

166.14 Operation and Maintenance

A. Applicability

1. Projects subject to review as in Section 116.11:A of this ordinance shall comply with the requirements of Sections 116.15 of this document.

B. General Maintenance

1. Applicant must submit an Operation and Maintenance Plan for stormwater management system contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

2. The maintenance plan shall specifically provide a municipal right of access, which may include stormwater easements or covenants. The maintenance access shall be provided by the property

owner(s) for access regarding facility inspections and maintenance, as required. Easements and covenants shall be recorded prior to issuance of any permit or approval.

3. Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project.

4. If the person responsible for maintenance identified under Section 116.15:B.1 above is not a public agency, the maintenance plan and any future revisions based on Section 116.15:B.6 below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

5. Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

6. The person responsible for maintenance identified under Section 116.15:B.1 above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

7. The person responsible for maintenance identified under Section 116.15:B.1 above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

8. The person responsible for maintenance identified under Section 116.15:B.1 above shall retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, the maintenance plan and the documentation required by 116.15:B.1 above.

9. On or before February 1 of each year, the person responsible for maintenance shall submit to the City a certification of compliance during the prior year, which shall include a summary of inspection and maintenance activities and any proposed changes to the maintenance plan.

10. The requirements of Sections 116.15:B.1-7 above do not apply to stormwater management facilities that are dedicated to and accepted by the municipality or another governmental agency.

11. In the event that the stormwater management facility becomes a danger to public safety or public health, or if it is in need of maintenance or repair, the municipality shall so notify the responsible person in writing. Upon receipt of that notice, the responsible person shall have fourteen (14) days to effect maintenance and repair of the facility in a manner that is approved

by the municipal engineer or his designee. The municipality, in its discretion, may extend the time allowed for effecting maintenance and repair for good cause. If the responsible person fails or refuses to perform such maintenance and repair, the municipality or County may immediately proceed to do so and shall bill the cost thereof to the responsible person.

12. Nothing in this section shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

13. Planting plans must be submitted for green roofs and rain gardens

14. The following must be included in the maintenance plan for green roofs and rain gardens:

a. Watering plans for periods of excessively long dry weather

b. Weeding plans

c. Replanting requirements

d. Inspections

15. Maintenance records must be kept on-site for a period of three years by the owner of the stormwater management system. These records shall be made available to the City within 72 hours upon the City's request to review these records.

16. The City reserves the right to inspect all stormwater management systems. The owner of the stormwater management system shall provide access for inspection to the City within 72 hours of the City's request to inspect the stormwater management systems.

17. Failure to maintain adequate maintenance records, perform maintenance, and/or deny the City access to maintenance records or inspection without cause is subject to fines by the City as detailed in the Sewer Connection: Application Procedures and Fee Schedule document.

166.15 Mitigation

A. The Board having jurisdiction over an application requiring a stormwater management design shall have the jurisdiction to grant a waiver from strict compliance with the performance requirements of this Ordinance or the Stormwater Management Plan. The waiver may be granted where an applicant has demonstrated the inability or impracticality of strict compliance with this Ordinance, and/or the Stormwater Management Plan upon the following conditions. The applicant must demonstrate one of the following: (1) an inability to apply any of the Best Management Practices and methodologies as defined and approved herein and in the Stormwater Management Plan or reference documents, due to an extraordinary and exceptional situation uniquely affecting the subject property or the structures thereon, resulting in a peculiar and exceptional practical difficulty or undue hardship; or (2) that the purposes of this Ordinance and Stormwater Management Plan can be advanced by a deviation from the

Best Management Practices and methodologies as defined and approved herein and in the Stormwater Management Plan, where the benefits of such deviation substantially outweigh any detriment.

B. In requesting a waiver as to any application, the applicant may submit as reasons for the waiver the site conditions of the proposed project, including soils types; thin soil cover; low permeability soils, and/or shallow depths to groundwater (high groundwater levels), unique conditions which would create an unsafe design, or conditions which would provide a detrimental impact to public health, welfare or safety

C. The waiver cannot be granted due to conditions created by the applicant. If the applicant can comply with the requirements of the Ordinance and Stormwater Management Plan through reduction of the size of the project, the hardship is self-imposed and the Board lacks jurisdiction to grant any waiver under this Section.

D. The applicant must propose a suitable mitigation method through submission of a mitigation plan which will conform as closely as possible to the design and performance standards of this Ordinance, through structural or non-structural stormwater management measures, governing stormwater quality, quantity, and groundwater recharge.

E. The mitigation plan shall include sufficient data and analyses, including an alternatives analysis, which demonstrate how on-site compliance is to be maximized.

F. The project may provide additional groundwater recharge benefits, or other mechanism to reduce stormwater runoff volume from previously developed property that does not currently meet the design and performance standards set in this ordinance and outlined in the Municipal Stormwater Management Plan. The developer must ensure the long-term maintenance of the project, including the maintenance requirements under Section 116.14.

G. The applicant shall be responsible for locating an appropriate site for mitigation of the performance section for which the waiver is sought.

H. Contribution to a regional, municipal or offsite mitigation plan shall be allowed. When approved by the Board, receipt of the financial contribution shall be deemed to satisfy the mitigation requirement for that application.

I. The Board having jurisdiction over the individual application may determine that, due to the size of the project necessary to mitigate for the waiver, it is not practical to require a mitigation project.

J. In all instances the Board having jurisdiction over the application shall have the power to impose additional conditions as may be appropriate under the circumstances of the application. The Board shall make specific findings of fact and conclusions consistent with this Section (1) showing the inability or impracticality of strict compliance with the Ordinance and Stormwater Management Plan and (2) justifying the approval of the applicant's mitigation plan, in order to satisfy the reporting requirements of the municipality's NJPDES permit and other applicable state law requiring the submission of reports

to any state or county review agency. The Board shall also have the power to require mitigation as to applications which have received waivers from the New Jersey Department of Environmental Protection.

K. For purposes of this Section, "Mitigation" shall incorporate the definition set forth in Section 2 of this Ordinance and shall include situations where the applicant has demonstrated the inability or impracticality of strict compliance with the stormwater management requirements set forth in this Ordinance.

166.16 Enforcement

An [Administrative Officer] will review the implementation of the Stormwater Management approval and take any necessary follow-up action regarding inspection and enforcement of maintenance plans and/or approval of proposed changes to maintenance plans.

166.17 Violations and Penalties

Any person who erects, constructs, alters, repairs, converts, maintains, or uses any building, structure or land in violation of this ordinance shall be subject to the following penalties not to exceed Ten Thousand Dollars ($10,000.00) and/or imprisonment for a time not to exceed sixty (60) days. After notified of violation, each day of continuance thereof may, in the discretion of the court, be treated as a separate and distinctive violation hereof.

Any person who erects, constructs, alters, repairs, converts, or maintains, or uses any building, structure or land in violation of this ordinance, shall be subject to the following penalties:

A. Failure to complete a stormwater management facility that fulfills the standards required herein: $500 for every day past the citation date until the violation is remedied.

B. Failure to maintain a stormwater management facility as required by the City: $100 for each day past the citation date until the violation is remedied.

166.18 Adoption of Stormwater Management Plan

The City of Hoboken does here by adopt the Stormwater Management Plan Amendment dated _____ and Ordinance prepared by Princeton Hydro, LLC of which 10 copies are on file with the City Clerk. This Amendment incorporates the Green Infrastructure Strategic Plan prepared by the team of New Jersey Transit; EE&K, a Perkins Eastman Company; Louis Berger Group; and Clarke Caton Hintz.

166.19 Effective date

This ordinance shall take effect immediately upon the approval by the county review agency, or sixty (60) days from the receipt of the ordinance by the county review agency if the county review agency should fail to act.

UCC-Coordinated Floodplain Management Ordinance

UCC-Coordinated FPM Ordinance, Annotated for Hoboken, NJ

Comment [RCQ1]: This file dated <081915 ReorganizedAccepted> accepts the changes shown in <081915_FullNotes>, deletes the comment bubbles, retains the cross refs to 104, and reorganizes and renumbers as shown in file named <Renumbered>.

There remain a few things to resolve. Acceptance of <tracked changes> and the removal of notes does not imply resolution/acceptance of those notes

Look t 96 later

ORDINANCE FOR ADOPTION OF THE FLOOD DAMAGE PREVENTION REGULATIONS OF THE CITY OF HOBOKEN, NEW JERSEY

ORDINANCE NO. XX-XX

AN ORDINANCE BY THE CITY COUNCIL OF THE CITY OF HOBOKEN AMENDING THE CITY OF HOBOKEN CODE OF ORDINANCES TO REPEAL AND REPLACE CHAPTER 104 FLOOD DAMAGE PREVENTION; TO ADOPT FLOOD HAZARD MAPS; TO DESIGNATE A FLOODPLAIN ADMINISTRATOR; [*ADD PER STANDARD PROTOCOL…….*] AND PROVIDING FOR SEVERABILITY AND AN EFFECTIVE DATE.

Comment [RCQ2]:

WHEREAS, the Legislature of the State of New Jersey has, in N.J.S.A. 40:48-1 et seq., delegated to local governments the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Federal Emergency Management Agency has identified special flood hazard areas within the boundaries of City of Hoboken, and the City has identified flood hazard areas on the Hoboken Flood Hazard Map, and such areas may be subject to periodic inundation which may result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety and general welfare, and

Comment [RCQ3]: 104-2.A

WHEREAS, the City of Hoboken was accepted for participation in the National Flood Insurance Program on November 17, 1982 and the City Council of the City of Hoboken desires to continue to meet the requirements of Title 44 Code of Federal Regulations, Sections 59 and 60, necessary for such participation; and

WHEREAS, the City of Hoboken is required, pursuant to N.J.A.C 5:23, to administer and enforce the State building codes, and such building codes contain certain provisions that apply to the design and construction of buildings and structures in flood hazard areas.

NOW, THEREFORE, be it ordained by the City Council of the City of Hoboken that the following floodplain management regulations are hereby adopted.

SECTION ONE. REPEAL AND REPLACEMENT

Chapter 104, Flood Damage Prevention, of the Code of the City of Hoboken is hereby repealed and replaced as follows. All text is new.

Article I. Administration

§ 104-101. Purpose, Objectives, Scope and Other General Provisions.

A. Title. This chapter, in combination with the flood provisions of the New Jersey Uniform

Construction Code (hereinafter "building codes," consisting of the Building Subcode, Residential Subcode, Rehabilitation Subcode, and related codes), shall be known as the *Flood Damage Prevention Regulations* of City of Hoboken.

B. Purpose. The purposes of this chapter and the flood load and flood resistant construction requirements of the building codes are to promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific flood hazard areas through the establishment of comprehensive regulations for management of flood hazard areas, designed to:

Comment [RCQ4]: 104-3 & -4

(1) Prevent unnecessary disruption of commerce, access and public service during times of flooding;

(2) Manage the alteration of natural floodplains, stream channels and shorelines;

(3) Manage filling, grading, dredging and other development which may reduce flood storage capacity and increase flood damage, drainage problems, or erosion potential;

(4) Prevent or regulate the construction of flood barriers which will divert floodwaters or which can increase flood hazards; and

(5) Contribute to improved construction techniques in the floodplain.

C. Objectives. The objectives of this chapter is to protect human life, minimize the expenditure of public money for flood control projects, minimize the need for rescue and relief efforts associated with flooding, minimize prolonged business interruption, minimize damage to public facilities and utilities, help maintain a stable tax base by providing for the sound use and development of flood-prone areas, contribute to improved construction techniques in the floodplain and ensure that potential owners and occupants are notified that property is within flood hazard areas.

Comment [RCQ5]: 104-3

D. Scope. The provisions of this chapter, in combination with the flood provisions of the building codes shall apply to all proposed development in flood hazard areas established in §104-102B.

E. Coordination with Building Codes. Pursuant to the requirement established in State statute that the City of Hoboken administer and enforce the State building codes, the City Council of the City of Hoboken does hereby acknowledge that the building codes contain certain provisions that apply to the design and construction of buildings and structures in flood hazard areas. Therefore, this chapter is intended to be administered and enforced in conjunction with the building codes.

F. Warning. The degree of flood protection required by this chapter and the building codes is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur. Flood heights may be increased by man-made or natural causes. Enforcement of this chapter and the building codes does not imply that land outside flood hazard areas, or that uses permitted within such flood hazard areas, will be free from flooding or flood damage.

Comment [RCQ6]: 104-11.A

G. Other Laws. The provisions of this chapter shall not be deemed to nullify any provisions of local, State or federal law.

H. Violations. Any violation of a provision of this chapter, or failure to comply with a permit or variance issued pursuant to this chapter or any requirement of this chapter, shall be handled in accordance with the requirements of **{insert citation to applicable local code}**.

I. Abrogation and greater restrictions. This chapter supersedes any regulation in effect in flood hazard areas. However, this chapter is not intended to repeal or abrogate any existing ordinances including land development regulations, subdivision regulations, zoning ordinances, stormwater management regulations, or building codes. In the event of a conflict between this chapter and any other ordinance, code, or regulation, the more restrictive shall govern.

Comment [RCQ7]: 104-9

J. Interpretation. In the interpretation of this chapter, all provisions shall be:

Comment [RCQ8]: 104-10

(1) Considered as minimum requirements;

(2) Liberally construed in favor of the governing body; and

(3) Deemed neither to limit nor repeal any other powers granted under state statutes.

K. Disclaimer of Liability. This chapter shall not create liability on the part of the City of Hoboken or any officer for any flood damage that results from reliance on this chapter.The Floodplain Administrator and any employee charged with the enforcement of this chapter, while acting for the jurisdiction in good faith and without malice in the discharge of the duties required by this chapter or other pertinent law or ordinance, shall not thereby be rendered liable personally and is hereby relieved from personal liability for any damage accruing to persons or property as a result of any act or by reason of an act or omission in the discharge of official duties. Any suit instituted against an officer or employee because of an act performed by that officer or employee in the lawful discharge of duties and under the provisions of this chapter shall be defended by legal representative of the jurisdiction until the final termination of the proceedings. The Floodplain Administrator and any subordinate shall not be liable for cost in any action, suit or proceeding that is instituted in pursuance of the provisions of this chapter.

Comment [RCQ9]: 104-11.B

§ 104-102. Applicability.

A. General. This chapter, in conjunction with the building codes, provides minimum requirements for development located in flood hazard areas, including the subdivision of land; site improvements and installation of utilities; new construction and repair, reconstruction, rehabilitation or additions to new construction; substantial improvement of existing buildings and structures, including restoration after damage; installation of tanks; temporary structures and temporary or permanent storage; utility and miscellaneous buildings and structures; and certain building work exempt from permit under the building codes; and other buildings and development activities.

Comment [RCQ10]: 104-6

B. Establishment of flood hazard areas. Flood hazard area boundaries and design flood elevations in the City of Hoboken are established as the more restrictive of:

Comment [RCQ11]: 104-7

(1) The boundaries of flood hazard areas and flood elevation are hereby established as shown on the Flood Hazard Map of the City of Hoboken, which is attached hereto and is hereby made a part of this chapter. Said map, together with everything shown thereon, and all amendments thereto, shall be a part of this chapter as if the same were fully described and set forth herein.

(2) The boundaries of special flood hazard areas and flood elevations are hereby established as shown on the Flood Insurance Study, Hudson County, New Jersey (All Jurisdictions) dated August 16, 2006 and the accompanying Flood Insurance Rate Maps (FIRM) identified in Table 102.2(1) are hereby adopted by reference.

Table 102.2(1). Effective Flood Insurance Rate Map Panel Numbers and Dates	
Map Panel #	Panel Date
0043	August 16, 2006
0044	August 16, 2006
0106	August 16, 2006
0107	August 16, 2006

C. Prevailing Flood Hazard Areas and Flood Elevations. Where there are differences in the delineation of flood hazard area boundaries or differences in the flood elevations shown on the Flood Hazard Map of the City of Hoboken and the Flood Insurance Rate Maps cited in § 104-102B, the more extensive flood hazard area or the higher flood elevation shall be used.

§ 104-103. Duties and powers of the Floodplain Adminstrator.

A. Designation. The Floodplain Administrator is a position in the Community Development Department. The Floodplain Administrator may delegate performance of certain duties to other employees.

Comment [RCQ12]: 104-13

B. General. The Floodplain Administrator is authorized and directed to administer the provisions of this chapter. The Floodplain Administrator shall have the authority to render interpretations of this chapter, to grant or deny permit applications, and to establish policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be consistent with the intent and purpose of this chapter and the flood provisions of the building code.

Comment [RCQ13]: 104-13

C. Coordination. The Floodplain Administrator shall coordinate with the Building Inspector to administer and enforce the flood provisions of the building code.

D. Duties. The duties of the Floodplain Administrator shall include but are not limited to:

Comment [RCQ14]: 104-14

(1) Review all permit applications to determine whether proposed development is located in flood hazard areas established in § 104-102B.

(2) Require development in flood hazard areas to be reasonably safe from flooding and to be designed and constructed with methods, practices and materials that minimize flood damage.

Comment [RCQ15]: 104-16B

(3) Interpret flood hazard area boundaries, provide available flood elevation and flood hazard information.

Comment [RCQ16]: 104-14E

(4) Determine whether additional flood hazard data shall be obtained or developed.

(5) Establish, in coordination with the Building Inspector, written procedures for administering and documenting determinations of substantial improvement and substantial damage made pursuant to § 104-103G.

(6) Review requests submitted to the Building Inspector that seek approval to modify the strict application of the flood load and flood resistant construction requirements of the building code, to determine whether such requests require consideration as a variance pursuant to § 104-106.

(7) Require applicants who submit hydrologic and hydraulic engineering analyses as part of permit applications to submit to FEMA the data and information necessary to maintain the Flood Insurance Rate Maps if the analyses propose to change base

flood elevations or flood hazard area boundaries; such submissions shall be made within 6 months of such data becoming available.

(8) Notify FEMA when the corporate boundaries of City of Hoboken have been modified.

E. Other permits. It shall be the responsibility of the Floodplain Administrator to assure that approval of a proposed development shall not be given until proof that necessary permits have been granted by federal or State agencies having jurisdiction over such development from which prior approval is required.

Comment [RCQ17]: 104-14.A(2)

F. Alterations of the natural coastline. Prior to issuing a permit for any alteration of the coastline in coastal high hazard areas and Coastal A Zones, the Floodplain Administrator shall require submission of an engineering analysis, prepared by a registered design professional, demonstrating that the proposed alteration will not increase the potential for flood damage.

Comment [RCQ18]: 104-4.A(4)

G. Substantial improvement and substantial damage determinations. For applications for building permits to improve buildings and structures, including alterations, movement, enlargement, replacement, repair, change of occupancy, additions, rehabilitations, renovations, substantial improvements, repairs of substantial damage, and any other improvement of or work on such buildings and structures, the Floodplain Administrator, in coordination with the Building Inspector, shall:

(1) Estimate the market value, or require the applicant to obtain a professional appraisal prepared by a qualified independent appraiser, of the market value of the building or structure before the start of construction of the proposed work; in the case of repair, the market value of the building or structure shall be the market value before the damage occurred and before any repairs are made;

(2) Compare the cost to perform the improvement, the cost to repair the damaged building to its pre-damaged condition, or the combined costs of improvements and repairs, if applicable, to the market value of the building or structure;

(3) Determine and document whether the proposed work constitutes substantial improvement or repair of substantial damage; and

(4) Notify the applicant if it is determined that the work constitutes substantial improvement or repair of substantial damage and that compliance with the flood resistant construction requirements of the building code is required.

H. Department records. In addition to the requirements of the building code and this chapter, and regardless of any limitation on the period required for retention of public records, the Floodplain Administrator shall maintain and permanently keep and make available for public inspection all records that are necessary for the administration of this chapter and the flood provisions of the building codes, including Flood Insurance Rate Maps; documents from FEMA that amend or revise FIRMs; records of issuance of permits and denial of permits; determinations of whether proposed work constitutes substantial improvement or repair of substantial damage; required certifications and documentation specified by the building codes and this chapter; notifications to adjacent communities, FEMA, and the State related to alterations of watercourses; assurance that the flood carrying capacity of altered waterways will be maintained; documentation related to variances, including justification for their issuance; and records of enforcement actions taken pursuant to this chapter and the flood resistant provisions of the building codes.

Comment [RCQ19]: 104-14.C, the “maintain” part (for the rest, see UCC)

§ 104-104. Permits.

A. Permits Required. Any person, owner or authorized agent who intends to conduct any development in a flood hazard area shall first make application to the Floodplain Administrator and shall obtain the required permit.

Comment [RCQ20]: 104-12

B. Application for permit. The applicant shall file an application in writing on a form furnished by the Floodplain Administrator. Such application shall:

Comment [RCQ21]: 104-12.A (also see Chapter 44, Appendix A)

(1) Identify and describe the development to be covered by the permit.

(2) Describe the land on which the proposed development is to be conducted by legal description, street address or similar description that will readily identify and definitely locate the site.

(3) Include a site plan, in duplicate and drawn to scale, showing the delineation of flood hazard areas, design flood elevations, ground elevations, proposed fill and excavation and drainage patterns and facilities.

(4) Indicate the use and occupancy for which the proposed development is intended.

(5) Be accompanied by construction documents, grading and filling plans and other information deemed appropriate by the Floodplain Administrator.

(6) State the cost estimate of the proposed work.

(7) Be signed by the applicant or the applicant's authorized agent.

C. Fees. Fees for development in flood hazard areas shall be:

(1) For new construction:

(a) One- and two-family dwellings; $

(b) All other buildings, elevated; $

(c) All other buildings, dry floodproofed; $

(2) For work on existing buildings and structures:

(a) One- and two-family dwellings; $

(b) All other buildings; $

(3) Other development; $

D. Validity of permit. The issuance of a permit under this chapter or the building codes shall not be construed to be a permit for, or approval of, any violation of this appendix or any other ordinance of the jurisdiction. The issuance of a permit based on submitted documents and information shall not prevent the Floodplain Administrator from requiring the correction of errors. The Floodplain Administrator is authorized to prevent occupancy or use of a structure or site which is in violation of this chapter or other ordinances of this jurisdiction.

E. Expiration. A permit shall become invalid if the proposed development is not commenced within 180 days after its issuance, or if the work authorized is suspended or abandoned for a period of 180 days after the work commences. Extensions shall be requested in writing and justifiable cause demonstrated. The Floodplain Administrator is authorized to grant, in writing, one or more extensions of time, for periods not more than 180 days each.

F. Suspension or revocation. The Floodplain Administrator is authorized to suspend or revoke a permit issued under this chapter wherever the permit is issued in error or on the basis of incorrect, inaccurate or incomplete information, or in violation of any ordinance or code of this jurisdiction.

§ 104-105. Inspections.

A. General. Development for which a permit is required shall be subject to inspection. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this chapter or the building code. Inspections presuming to give authority to violate or cancel the provisions of this chapter or the building code or other ordinances shall not be valid.

B. Inspections of development. The Floodplain Administrator shall make or cause to be made, inspections of all development in flood hazard areas authorized by issuance of a permit under this chapter.

C. Inspection of buildings and structures. The Building Inspector shall make or cause to be made, inspections for buildings and structures in flood hazard areas authorized by permit in accordance with the building codes:

Comment [RCQ22]: 104-14.C (see UCC 5:23-2.18)

(1) **Lowest floor elevation**. Upon placement of the lowest floor, including the basement, and prior to further vertical construction, certification of the elevation required in the building code shall be submitted to the Building Inspector.

(2) Final inspection. Prior to the final inspection, certification of the elevation required in the building code shall be submitted to the Building Inspector.

§ 104-106. Appeals and variances.

Comment [RCQ23]: 104-15

A. Authority. The Planning Board established by the City Council shall hear and decide appeals when it Is alleged there is an error in any requirement, decision, or determination made by the Floodplain Administrator in the administration or enforcement of this chapter. The Planning Board shall hear and decide requests for variances from the requirements of this chapter and the flood provisions of the Building Code. The Planning Board shall base its determination on variances on technical justifications and has the right to attach such conditions to variances as it deems necessary to further the purposes and objectives of this chapter and the flood provisions of the Building Code. Those aggrieved by the decision of the Planning Board, or any taxpayer, may appeal such decision to the Superior Court of New Jersey, N.J.S.A. 52:27D-127 et seq.

Comment [RCQ24]: 104-15.A(5)

B. Records. The Floodplain Administrator shall maintain a permanent record of all variance actions, including justifications for issuance.

C. Historic structures. A variance is authorized to be issued for the repair or rehabilitation of a historic structure upon a determination that the proposed repair or rehabilitation will not preclude the structure's continued designation as a historic structure, and the variance is the minimum necessary to preserve the historic character and design of the structure.

Comment [RCQ25]: 104-15.B(2)

Exception: Within flood hazard areas, historic structures that are not:

(1) Listed or preliminarily determined to be eligible for listing in the National Register of Historic Places; or

(2) Determined by the Secretary of the U.S. Department of Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined to qualify as an historic district; or

(3) Designated as historic under a State or local historic preservation program that is approved by the Department of Interior.

D. Functionally dependent uses. A variance is authorized to be issued for the construction or substantial improvement of a functionally dependent use provided the criteria in Section 1612.1 of the Building Code are met and the variance is the minimum necessary to allow the construction or substantial improvement, and that all due consideration has been given to methods and materials that minimize flood damages during the design flood and create no additional threats to public safety.

Comment [RCQ26]: 104-19.A(1)

E. Considerations. In reviewing applications for variances, all technical evaluations, all relevant factors, all other portions of this chapter and the following shall be considered:

Comment [RCQ27]: 104-15.A(4) and 104-15.B

(1) The danger that materials and debris may be swept onto other lands resulting in further injury or damage;

(2) The danger to life and property due to flooding or erosion damage;

(3) The susceptibility of the proposed development, including contents, to flood damage and the effect of such damage on current and future owners;

(4) The importance of the services provided by the proposed development to the community;

(5) The availability of alternate locations for the proposed development that are not subject to flooding or erosion;

(6) The compatibility of the proposed development with existing and anticipated development;

(7) The relationship of the proposed development to the comprehensive plan and floodplain management program for that area;

(8) The safety of access to the property in times of flood for ordinary and emergency vehicles;

(9) The expected heights, velocity, duration, rate of rise and debris and sediment transport of the floodwaters and the effects of wave action, if applicable, expected at the site, and;

(10) The costs of providing governmental services during and after flood conditions including maintenance and repair of public utilities and facilities such as sewer, gas, electrical and water systems, streets and bridges.

F. Conditions for issuance. Variances shall only be issued upon:

Comment [RCQ28]: 104-15.B(5) and (6)

(1) A technical showing of good and sufficient cause that the unique characteristics of the size, configuration or topography of the site renders the elevation standards inappropriate;

(2) A determination that failure to grant the variance would result in exceptional hardship by rendering the lot undevelopable;

(3) A determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, nor create nuisances,

cause fraud on or victimization of the public or conflict with existing local laws or ordinances;

(4) A determination that the variance is the minimum necessary, considering the flood hazard, to afford relief; and

(5) Notification to the applicant in writing over the signature of the Floodplain Administrator that the issuance of a variance to construct a structure below the base flood elevation will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage, and that such construction below the base flood elevation increases risks to life and property.

Comment [RCQ29]: 104-15.B(4)

§ 104-107. Penalties for noncompliance.

Comment [RCQ30]: 104-8

A. Violations. No or land within the flood hazard area shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this chapter and other applicable regulations. Violations of this chapter by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor.

B. Authority. The Floodplain Administrator is authorized to serve notices of violation or stop work orders to owners of property involved, to the owner's agent, or to the person or persons doing the work for development that is not within the scope of the building codes, but is regulated by this chapter and that is determined to be a violation.

C. Unlawful continuance. Any person who violates this chapter, fails to comply with any of its requirements, or continues any work after having been served with a notice of violation or a stop work order, except such work as that person is directed to perform to remove or remedy a violation or unsafe condition, shall be fined $2,000 or imprisoned for not more than 30 days, or both, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the City of Hoboken from taking such other lawful action as is necessary to prevent or remedy any violation.

ARTICLE II. Definitions

§ 104-201. General. The following words and terms shall, for the purposes of this chapter, have the meanings shown herein. Other terms are defined in the UCC Building Subcode and used in the Residential Subcode.

§ 104-202. Definitions

500-YEAR FLOOD HAZARD AREA. Area subject to flooding having a 0.2% chance of being equaled or exceeded in any given year. The area is shown on the Hoboken Flood Hazard Map.

APPEAL. A request for review of the Floodplain Administrator's interpretation of the provisions of this chapter.

ASCE 24. The standard *Flood Resistant Design and Construction*, referenced by the building code, developed and published by the American Society of Civil Engineers, Reston, VA.

BASE FLOOD ELEVATON. The elevation of the base flood, including wave height, relative to the datum specified on the Flood Insurance Rate Map.

BASEMENT. For the application of this chapter and the building codes, the portion of a building having its floor subgrade (below ground level) on all sides.

BUILDING CODE. The family of building codes specifically adopted by the State of New Jersey and composed of:

(1) The Building Subcode (N.J.A.C. 5:23-3.14), applicable to buildings and structures other than dwellings within the scope of the Residential Subcode.
(2) The Residential Subcode (N.J.A.C. 5:23-3.21), applicable to one- and two-family dwellings and townhouses not more than three stories, and accessory structures.
(3) The Rehabilitation Subcode (N.J.A.C 5:23-6), applicable to existing buildings (as defined in that code).
(4) Other specified codes.

COASTAL A ZONE. Area within a special flood hazard area, landward of a V zone or landward of an open coast without mapped coastal high hazard areas. In a coastal A zone, the principal source of flooding must be astronomical tides, storm surges, seiches or tsunamis, not riverine flooding. During design flood conditions, the potential for breaking wave height shall be greater than or equal to 1 ½ feet (457 mm). The inland limit of the coastal A zone is (a) the Limit of Moderate Wave Action if delineated on a FIRM, or (b) designated by the authority having jurisdiction. The area is shown on the Hoboken Flood Hazard Area Map.

COASTAL HIGH HAZARD AREA. Area within the special flood hazard area extending from offshore to the inland limit of a primary dune along an open coast and any other area that is subject to high-velocity wave action from storms or seismic sources, and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as velocity Zone V, VO, VE or V1-30. The area is shown on the Hoboken Flood Hazard Map.

DESIGN FLOOD. The flood associated with the greater of the following two areas:

1. Area with a flood plain subject to a 1-percent or greater chance of flooding in any year.
2. Area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

DESIGN FLOOD ELEVATION. The elevation of the "design flood," including wave height, relative to the datum specified on the community's legally designated flood hazard map. In areas designated as Zone AO, the design flood elevation shall be the elevation of the highest existing grade of the building's perimeter plus the depth number (in feet) specified on the flood hazard map. In areas designated as Zone AO where a depth number is not specified on the map, the depth number shall be taken as being equal to 2 feet (610 mm).

DEVELOPMENT. Any manmade change to improved or unimproved real estate, including but not limited to, buildings or other structures, temporary structures, temporary or permanent storage of materials, mining, dredging, filling, grading, paving, excavations, operations and other land-disturbing activities.

FLOOD DAMAGE-RESISTANT MATERIALS. See the building code.

Comment [RCQ31]: Used only once, 1001.5

FLOOD HAZARD AREA. Area subject to flooding shown on the Hoboken Flood Hazard Map, composed of the Coastal High Hazard Area, Coastal A Zone, Flood Hazard Areas, and the 500-year flood hazard area.

FLOOD INSURANCE RATE MAP. See § 104-102B.

FLOOD INSURANCE STUDY. See § 104-102B.

FREEBOARD. An additional height to which buildings and structures must be elevated or protected in accordance with the New Jersey Uniform Construction Code and this chapter. Freeboard is a margin of safety to account for sea level rise, waves, debris, miscalculations, lack of data, drainage obstructions, or other environmental changes.

Comment [RCQ32]: used once 102.2 (adopting), 103.4 (about changing FIRM); 103.12 (records), and dfn CHHA

Comment [RCQ33]: need to verify, especially if additional + 1 ft added to water surface elevaiton

FUNCTIONALLY DEPENDENT USE. A use that cannot be used for its intended purpose unless it is located or carried out in close proximity to water, such as a docking or port facility necessary for the loading or unloading of cargo or passengers, shipbuilding or ship repair. The term does not include long-term storage, manufacture, sales or service facilities.

HISTORIC STRUCTURE. Any structure that is:

1. Listed individually on the National Register of Historic Places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
2. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district preliminarily determined by the Secretary to qualify as a registered historic district;
3. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or
4. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
    a. By an approved state program as determined by the Secretary of the Interior; or
    b. Directly by the Secretary of the Interior in states without approved programs.

LIMIT OF MODERATE WAVE ACTION. Line shown on flood hazard maps to indicate the inland limit of the 1.5 foot break wave height during the base flood.

LOWEST FLOOR. The lowest floor of the lowest enclosed area, including basement, but excluding any unfinished or flood-resistant enclosure, usable solely for vehicle parking, building access or limited storage provided that such enclosure is not built to render the structure in violation of the applicable requirements of the building codes.

MANUFACTURED HOME. A structure that is transportable in one or more sections, built on a permanent chassis, designed for use with or without a permanent foundation when attached to the required utilities, and constructed to the Federal Mobile Home Construction and Safety Standards and rules and regulations promulgated by the U.S. Department of Housing and Urban Development. The term also includes mobile homes, park trailers, travel trailers and similar transportable structures that are placed on a site for 180 consecutive days or longer.

MARKET VALUE. The price at which a property will change hands between a willing buyer and a willing seller, neither party being under compulsion to buy or sell and both having reasonable knowledge of relevant facts. As used in this chapter, the term refers to the market value of buildings and structures, excluding the land and other improvements on the parcel. Market value may be established by a qualified independent appraiser, Actual Cash Value (replacement cost depreciated for age and quality of construction), or tax assessment value

adjusted to approximate market value by a factor provided by the Property Appraiser.

NFPA 70. The *National Electric Code,* referenced by the building code, developed and published by the National Fire Protection Association, Quincy, MA.

RECREATIONAL VEHICLE. A vehicle that is built on a single chassis, 400 square feet (37.16 m^2) or less when measured at the largest horizontal projection, designed to be self-propelled or permanently towable by a light-duty truck, and designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel or seasonal use. A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices and has no permanently attached additions.

SPECIAL FLOOD HAZARD AREA. The land area subject to flood hazads and shown on a Flood Insurance Rate Map or other flood hazard map as Zone A, AE, A1-30, A99, AR, AO, AH, V, VO, VE or V1-30.

START OF CONSTRUCTION. See the building code.

SUBSTANTIAL DAMAGE. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

SUBSTANTIAL IMPROVEMENT. Any repair, reconstruction, rehabilitation, alteration, addition or other improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The term does not, however, include aAny project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the Building Official and that are the minimum necessary to assure safe living conditions.

UTILITY AND MISCELLANEOUS GROUP G. Buildings and structures of an accessory character and miscellaneous structure not classified in any special occupancy, as described in the Building Code.

VARIANCE. A grant of relief from the requirements of this section which permits construction in a manner otherwise prohibited by this section where specific enforcement would result in unnecessary hardship.

VIOLATION. A development that is not fully compliant with these regulations or the flood provisions of the building code, as applicable.

Article III. Development Requirements

§ 104-301. Subdivisions and development.

A. General. Subdivision proposals or other proposed new development in a flood hazard area shall be reviewed to assure that:

Comment [RCQ34]: 104-16.D

(1) All such proposals are consistent with the need to minimize flood damage;

(2) All public utilities and facilities, such as sewer, gas, electric and water systems are located and constructed to minimize or eliminate flood damage; and

(3) Adequate drainage is provided to reduce exposure to flood hazards.

B. Subdivision requirements. The following requirements shall apply in the case of any proposed subdivision, any portion of which lies within a flood hazard area:

(1) The flood hazard area, including coastal high hazard areas, and Coastal A Zones, as appropriate, shall be delineated on tentative subdivision plats;

(2) Design flood elevations shall be shown on tentative and final subdivision plats;

(3) The design criteria for utilities and facilities set forth in these regulations and appropriate codes shall be met.

§ 104-302. Site improvement.

A. Coastal high hazard areas and Coastal A Zones. In coastal high hazard areas and Coastal A Zones:

(1) New buildings shall only be authorized landward of the reach of mean high tide established and updated from time to time by the governmental agency with jurisdiction over same.

(2) Open space and outdoor passive and active recreational uses may be permitted seaward of the reach of mean high tide provided such uses create no additional threat to public safety and otherwise conforms to the requirements of this chapter.

(3) The use of fill for structural support of buildings is prohibited.

B. Sewer facilities. All new or replaced sanitary sewer facilities and waste lines shall be designed in accordance with Chapter 7, ASCE 24, to minimize or eliminate infiltration of floodwaters into the facilities and discharge from the facilities into flood waters, or impairment of the facilities and systems, by installation of check valves and backflow preventers.

C. Water facilities. All new or replacement water facilities shall be designed in accordance with the provisions of Chapter 7, ASCE 24, to minimize or eliminate infiltration of floodwaters into the systems.

D. Storm drainage. Storm drainage shall be designed to convey the flow of surface waters to minimize or eliminate damage to persons or property.

E. Streets and sidewalks. Streets and sidewalks shall be designed to minimize potential for increasing or aggravating flood levels.

§ 104-303. Protection of flood storage and drainage.

A. Limitation on use of fill. Fill shall not be used for structural support of buildings. Applications to use fill for any other purpose shall include evidence fill is necessary and the amount of fill is the minimum necessary.

B. Limitation on obstruction of flood storage capacity. Buildings and building foundations shall, to the extent feasible, not obstruct or displace flood storage capacity.

Comment [RCQ35]: 104-19.A
Also see 196-5.I

Comment [RCQ36]: Also see 196-5.I

Comment [RCQ37]: 104-19.A(1),

Comment [RCQ38]: 104-16.C(2) & (3)
STATE REQMTS specify to installation in SFHA? (guess I need to search DEP rules…

Comment [RCQ39]: 104-16.C(1)

STATE REQMTS specify to installation in SFHA? (guess I need to search DEP rules…

Comment [RCQ40]: 104-16.F

§ 104-304. Freeboard and building elevations.

In all flood hazard areas, the bottom of the lowest horizontal structural member of the lowest floor of buildings and structures shall be at or above the elevations based on the freeboard requirements specified in Table 104-304(1).

Table 104-304(1) Freeboard and Building Elevation Requirements

Flood Design Class (see UCC Building Subcode referenced standard ASCE 24)	500-year flood hazard area	Flood hazard area	Coastal high hazard area and Coastal A Zone
FDC 1	N/A	1 foot	??***
FDC 2 and Dwellings within the scope of UCC Residential Subcode	1 foot	1 foot	2 feet
FDC 3	1 foot	2 feet	3 feet
FDC 4	1 foot	2 feet or 500-year elevation + 1 foot, whichever is higher	3 feet or 500-year elevation + 1 foot, whichever is higher

§ 104-305. Temporary structures and temporary storage.

A. Temporary structures. Temporary structures shall be erected for a period of less than 180 days. Temporary structures shall be anchored to prevent flotation, collapse or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the design flood. Fully enclosed temporary structures shall have flood openings that are in accordance with ASCE 24 to allow for the automatic entry and exit of flood waters.

B. Temporary storage. Temporary storage includes storage of goods and materials for a period of less than 180 days. Stored materials shall not include hazardous materials.

§ 104-306. Utility and miscellaneous structures.

A. Utility and miscellaneous structures. Utility and miscellaneous structures include buildings that are accessory in character and miscellaneous structures not classified in any specific occupancy in the Building Code, including, but not limited to, agricultural buildings, aircraft hangars (accessory to a one- or two-family residence), barns, carports, fences more than 6 feet (1829 mm) high, grain silos (accessory to a residential occupancy), greenhouses, livestock shelters, private garages, retaining walls, sheds, stables, and towers.

B. Flood loads. Utility and miscellaneous buildings and structures, including substantial improvement of such buildings and structures, shall be anchored to prevent flotation, collapse or lateral movement resulting from flood loads, including the effects of buoyancy, during conditions of the design flood.

C. Elevation. Utility and miscellaneous buildings and structures that are enclosed by walls and roofs, including substantial improvement of such buildings and structures, shall be elevated

Comment [RCQ41]: 104-16.E, Table 1

Comment [RCQ42]: format per how Chpt 44, when a section has only one para, it's not lettered

Comment [RCQ43]: see working document on freeboard for footnotes

Comment [RCQ44]: 104-16.A(2)

such that the lowest floor, including basement, is elevated to or above the design flood elevation in accordance with ASCE 24.

D. Enclosures below design flood elevation. Fully enclosed areas below the design flood elevation shall be constructed in accordance with ASCE 24.

E. Flood-damage resistant materials. Flood-damage-resistant materials shall be used below the design flood elevation.

F. Protection of mechanical, plumbing and electrical systems. Mechanical, plumbing and electrical systems, including plumbing fixtures, shall be elevated to or above the design flood elevation.

> **Exception:** Electrical systems, equipment and components, and heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall be permitted to be located below the design flood elevation provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistant construction requirements of this code. Electrical wiring systems shall be permitted to be located below the design flood elevation provided they conform to the provisions of NFPA 70.

§ 104-307. Other development activities.

A. Garages and accessory structures. Garages and accessory structures shall be designed and constructed in accordance with ASCE 24.

B. Fences and privacy walls. Fences and privacy walls shall not block the passage and drainage of floodwaters.

C. Retaining walls, sidewalks and driveways. Retaining walls, sidewalks and driveways shall meet the requirements for site grading in Chapter 18 of the Building Code.

D. Swimming pools. Swimming pools shall be designed and constructed in accordance with ASCE 24. .

E. Decks, porches, and patios. Decks, porches and patios shall be designed and constructed in accordance with ASCE 24.

Comment [RCQ45]: 104-16.A(2)

F. Non-structural concrete slabs in coastal high hazard areas and Coastal A Zones. In coastal high hazard areas and Coastal A Zones, non-structural concrete slabs used as parking pads, enclosure floors, landings, decks, walkways, patios and similar non-structural uses are permitted beneath or adjacent to buildings and structures provided the concrete slabs shall be constructed in accordance with ASCE 24.

§ 104-308. Tanks.

Comment [RCQ46]: format per how Chpt 44, when a section has only one para, it's not lettered

Underground and above-ground tanks shall be designed, constructed, installed and anchored in accordance with ASCE 24.

§ 104-309. Manufactured homes and recreational vehicles.

Manufactured homes and recreational vehicles are not permitted in the City of Hoboken.

SECTION TWO. SEVERABILITY

Comment [RCQ47]: patterned after ordinance that modified 196

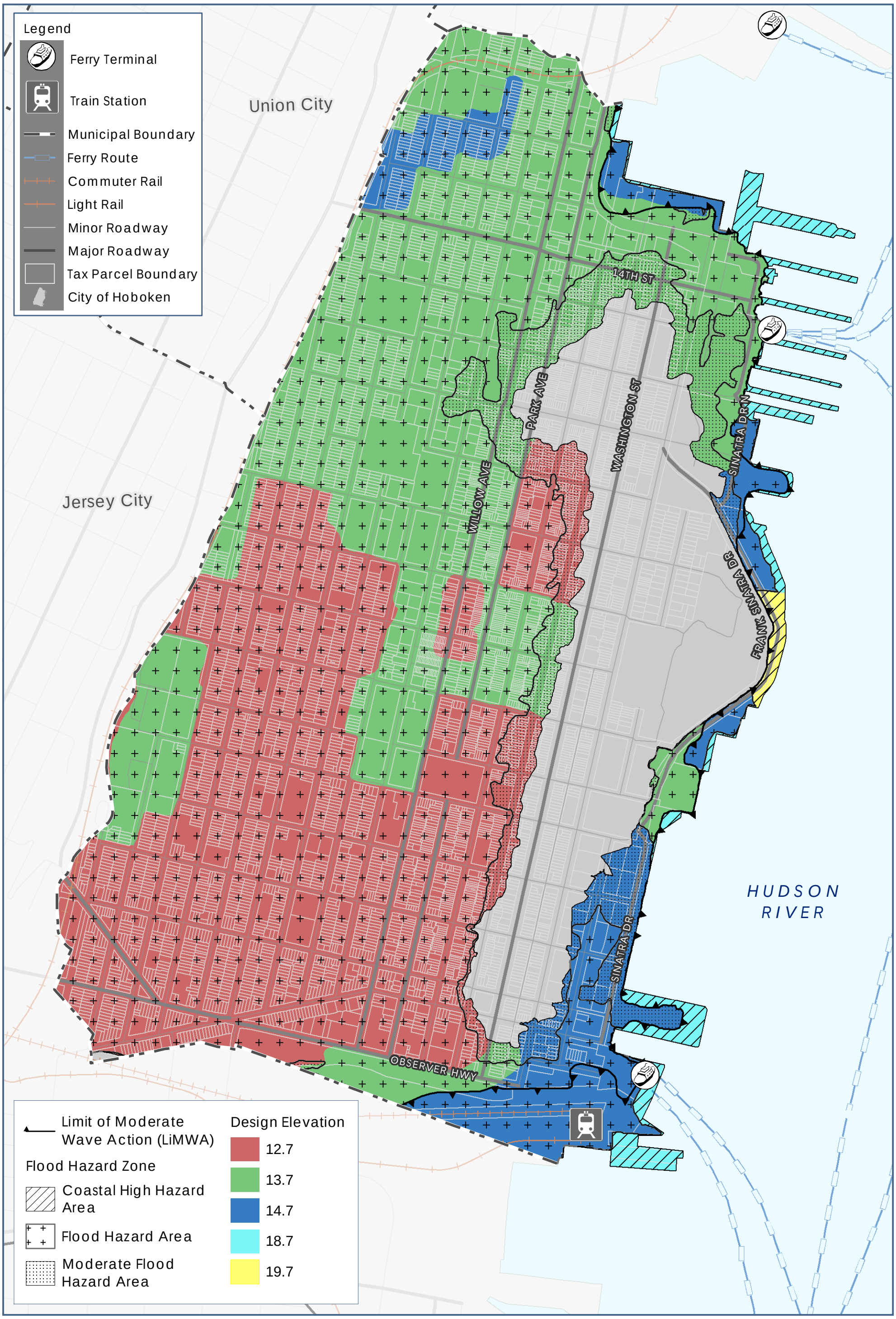
The provisions of this Ordinance are declared to be severable and if any section, subsection, sentence, clause, or phrase thereof for any reason be held to be invalid or unconstitutional by a court of competent jurisdiction, such decision shall not affect the validity of the remaining sections, subsections, sentences, clauses and phrases of this Ordinance, but shall remain in effect, it being the legislative intent that this Ordinance shall stand notwithstanding the invalidity of any part.

SECTION THREE. EFFECTIVE DATE

This Ordinance shall take effect upon passage and publication as provided by law **.**

[Jurisdiction to add signature blocks.]

Flood Hazard Map – City of Hoboken



File: P:\1409\Projects\14090021\GIS\MXD\FloodHazardMap.mxd, 8/21/2015, Drawn by cpollack, Copyright Princeton Hydro, LLC.

August 2015

DRAFT

Flood Hazard Map
City of Hoboken

0 500 1,000 Feet

Map Projection:
NAD 1983 StatePlane New Jersey FIPS 2900

Princeton Hydro

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