VULNERABILITIES

ENTRY POINT

UNPROTECTED WATERFRONT

100 YEAR FLOOD (2013)

94% IMPERVIOUS SURFACE

LOWLYING WATERFRONT

LOWLYING AREA

ENTRY POINT
Observed Change in Very Heavy Precipitation
[1958-2012]
GLOBAL WARMING IS REAL
Hurricane Sandy
FEMA (IA) Program: $100 million+
FEMA (PA) Program: $25 million+
Flooded Homes + Businesses = >1,750
Automobiles Destroyed = >1,000
Heavy rain events = Flooded Streets
Islands of protection will not work
WHY DO WE NEED THE PROJECT?

The project area is at risk from storm surge events and heavy rainfall that results in flooding.
ALTERNATIVE 3

*For more information on Alternative 3, please see the project boards

- Resist - Alternative 3
- Existing Structures
- Delay, Store, Discharge
Zone 1 — Weehawken Tie In
Alternative 1 @ Waterfront to Lincoln Tunnel
Alternative 2, 3 @ Inland to 19th Street

Zone 2 — Weehawken Cove
Alternative 1, 2, 3 @ Boathouse to Park Space

Zone 3 — Residential
Alternative 1 @ Waterfront along Tea Building
Alternative 2 @ 15th St to Washington St.
Alternative 3 @ Alleyway to Washington St.

Zone 4 — North Waterfront
Alternative 1 Only

BASF Site
DSD - Alternative 1, 2, 3

Block 10 Site
DSD - Alternative 1, 2, 3

Zone 5 — South Waterfront
Alternative 1 Only

Zone 6 — Observer Highway
Alternative 1, 2, 3 @ Street or along rails

Zone 7 — Jersey Avenue Underpass
Alternative 1, 2, 3 @ Underpass
Urban Lawn

Dolores Park, San Francisco
Playscape
Blaxland Riverside Park, Sydney, Australia
Cove Park
East Alleyway

Parking: 41 Spaces

14th St.

Bloomfield St.

Washington St.
Urban Stormwater Management in Hoboken, NJ

NYMTC

December 12, 2018
Flood Risk

Landmass within Flood Zone (A): 63.85%
Landmass within Flood Zone (V): 7.41%
Landmass within Flood Zone (X): 7.66%
Hoboken NFIP Total Liability: $1,922,187,500
Hoboken NFIP Annual Premiums: $5,984,720

Existing Rainfall Flooding “Hotspots”

2015 Preliminary 1% Annual Chance (100-Year) FEMA
Combined Sewer System
Combined Sewer Overflows

**Dry Weather**
- Sewage inflow
- Stormwater inflow

**Stormy Weather**
- Combined Sewer Overflow

Flow to wastewater treatment plant

---

[Image of a cityscape with people kayaking on the water]
Green Infrastructure in Planning and Policy
HOBOKEN GREEN INFRASTRUCTURE STRATEGIC PLAN
HOBOKE, NJ

FINAL REPORT

OCTOBER 2013
City-wide Green Infrastructure Strategy

RETENTION

CONSTRUCTED WETLANDS

PINO SITE

SUBSURFACE STORAGE

BASF SITE

DETENTION

GREEN ROOFS

RAINWATER HARVESTING

INfiltration

BLOCK 12 SITE

BIOSWALEs

STORMWATER PLANTERS
Green Infrastructure
Measures and Benefits

1. Subsurface Storage
2. Greenroofs
3. Rainwater Harvesting (cisterns, rain barrels)
4. Stormwater Tree pits
5. Vegetated Swales (right-of-way bioswales)
6. Permeable Pavements
7. Raingardens
8. Stormwater Infiltration Planters
9. Constructed Wetlands
10. Basins or Ponds

- Increase Open Space
- Reduce CSOs and Improve Water Quality
- Mitigate Flooding
- Improve Public Health and Local Economy
• Legalized use of rain barrels in 2011
• Rain barrels were previously considered a nuisance
• Any container maintained for the short-term collection of rainwater must have a properly fitting lid, be access-resistant to insects and rodents and must be maintained in good working order at all times and must be kept in a clean and sanitary way

Rainwater Harvesting

Code §136-2
Green Roofs

Incentivized use of green roofs in 2015
Green roofs are encouraged wherever possible (especially on roofs with surface area of ≥ 5,000 SF)
If a green roof is provided on at least 50% of the roof surface, the remainder may be utilized for a roof deck
Rooftop gardens are considered a green roof and may cover up to 90% of a roof’s surface area
7th & Jackson Park
Green Infrastructure in Capital Projects
City Hall Green
Infrastructure
Washington Street Redesign
H1 and H5
Pump Stations
Southwest Park

BIOSWALE BUMP-OUTS

INTERACTIVE SCULPTURE IN LAWN

SHADED SEATING

RAIN GARDEN

POPP-UP MARKET ZONE

TEMPORARY CLOSING ON MARKET/EVENT DAY

DOG RUN

EVENT SPACE

RAIN GARDEN
STORM EVENT
1.24 ACRE SITE | .58 IMPERVIOUS, .27 PERMEABLE PAVERS AND .39 PERVIOUS AREA

RAIN GARDENS
1,405 CUBIC FEET OF STORAGE

DETENTION CHAMBERS
9,534 CUBIC FEET OF STORAGE
NORTHWEST ENTRANCE VIEW
STREETS BIOSWALE

FARMERS MARKET

MOBILE LIBRARY

MOBILE FOOD CART

TEMPORARY EVENT/VENDOR PROGRAM

MOBILE LIBRARY
BLOCK 10
POTENTIAL PARK EXPANSION

BLOCK 12
SW PARK UNDER CONSTRUCTION

VACANT LOT
Northwest Park
- Integrated flood management solutions to complement RBD
- Proposed a combined surface and subsurface plan to utilize 4 contiguous acres of the 6-acre BASF site that would include:
  - Stormwater detention facility
  - Underground parking garage
  - Surface park space
  - Integrated green infrastructure
Northwest Park Design Goals

• Use green infrastructure and other resilient design solutions
• Maximize stormwater management and water quality benefits
• Consider treatment and reuse of stormwater
• Engage the Hoboken community in an iterative and collaborative design process
• Coordinate with Rebuild by Design – Hudson River and NHSA
• Create a destination park that provides safe and unique open space and recreation amenities for the Hoboken community
• Use context sensitive urban design and landscape architecture
• Meet NJEIFP eligibility requirements to save taxpayers >30%
• Consider industry certification standards (LEED, Envision)
Coordination with NHSA CSO Reduction Project

- Create an “ecological zone” in part of the H6 and H7 drainage areas
- Install new storm sewer infrastructure to separate the currently combined system
- Stormwater could flow to the Northwest Park where solids and floatables would be removed
- Stormwater could be detained under the Northwest Park until the detention facility is at capacity
- Detained stormwater could either:
  - Be pumped to a new outfall in Weehawken Cove where engineered wetlands would filter stormwater, AND/OR
  - Be treated for reuse (City is exploring its engineering options)
Proposed underground detention facilities with green/open space on ground surface with discharge features such as pumps to manage rainfall runoff volume

**Block 10 site**
- Manages rainfall runoff for approx. 8 acres

**BASF site**
- Manages rainfall runoff for approx. 55 acres

**NJ Transit site**
- Manages rainfall runoff for approx. 15 acres

**ROW Green/Grey Infrastructure Practices**
- Total of 61 sites to manage street drainage for approx. 13 acres
AFTER
SURVIVING
HELL

EVEN HOBOKEN WAS
A WELCOME
SIGHT
NO TO NYWW @ UDD - WE DON’T WANT TO GO BACKWARDS IN TIME
2018 Alternatives Analysis Project

Reviewed 5 potential Sites

Recommends 3 Better Alternatives

Highlights Characteristics to serve function

Highlights Context to influence form
<table>
<thead>
<tr>
<th>Site ID</th>
<th>Name of Potential Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hoboken South</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Site Characteristics</th>
<th>Ranking (1-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Hoboken South is currently utilized for ferry berthing and maintenance operations. Although the site cannot immediately provide the required berthing capacity or upland capacity, the installation of a barge and redevelopment of site could accommodate the FMOF.</td>
<td>8</td>
</tr>
<tr>
<td>Zoning/Use Compatibility</td>
<td>The existing site is zoned in the I-2 Industrial District and the W (H) Waterfront Historic District. Hoboken South is a transportation hub that houses commuter rails, light rails and the Hoboken Ferry Terminal. Bus and taxi service are also directly accessible at the site. The FMOF would be a compatible use at this site, however, nearby property owners have voiced opposition to a maintenance facility in such close proximity to the Jersey City waterfront.</td>
<td>8</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Hoboken South is highly accessible by mass transit, as well as, by car or shuttle service.</td>
<td>9</td>
</tr>
<tr>
<td>Public Safety</td>
<td>Hoboken Terminal is a high volume transportation hub that will not be significantly impacted by additional vessel traffic or diesel engine fumes. Minor impacts from additional staff and fuel/parts deliveries may occur.</td>
<td>8</td>
</tr>
<tr>
<td>Development Timing</td>
<td>Installation of a barge at this location and development of an adequate upland area would require local and environmental approvals. Preparation of engineering plans, acquisition of approvals and construction of the required improvements are estimated to take 18-24 months.</td>
<td>6</td>
</tr>
<tr>
<td>Environmental Constraints</td>
<td>Since the site is accustomed to heavy vessel traffic and boat wake, the FMOF will not noticeably increase turbidity. This location is not known for high occurrences of threatened and endangered species.</td>
<td>8</td>
</tr>
<tr>
<td>Future Expansion</td>
<td>Although the accommodation of a ferry maintenance facility at this location is feasible, additional berthing or landward capacity is unlikely due to the limited available space at Hoboken Terminal.</td>
<td>4</td>
</tr>
<tr>
<td>Cost</td>
<td>Utilization of this site requires a lease agreement with NJ Transit. The cost to construct the required improvements is estimated at $3-5MM.</td>
<td>7</td>
</tr>
<tr>
<td>Evaluation Criteria</td>
<td>Site Characteristics</td>
<td>Ranking (1-10)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>Bayonne Peninsula is an existing waterfront pier consisting of various industrial, commercial and residential uses. The site has access to a large portion of the waterfront and can adequately accommodate the FMOF through installation of a barge or raised dock platform.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Zoning/Use Compatibility</strong></td>
<td>The property is zoned as a Metropolitan Harbor District — Redevelopment Area. The surrounding properties consists of water dependent industrial uses, including a boat repair dock, retail establishments, the Bayonne Golf Course and a multi-family residential development. Current zoning allows for the development of a ferry maintenance facility.</td>
<td>9</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>The site is located along NJ-440 and can be access by car, bus or the Hudson Bergen Light Rail (34 Street Light Rail Station). Direct access to the waterward end of the pier is limited and lack of proximity to NY Waterway ferry terminals is a disadvantage to this location.</td>
<td>4</td>
</tr>
<tr>
<td><strong>Public Safety</strong></td>
<td>The pier currently experiences daily vessel traffic and is located several thousand feet from the shoreline. Other than disturbances associated with construction activities, safety will not be impacted.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Development Timeline</strong></td>
<td>The preparation of a comprehensive engineering design and the acquisition of regulatory and local approvals would require 18 months since less public opposition is anticipated at this industrial location.</td>
<td>7</td>
</tr>
<tr>
<td><strong>Environmental Constraints</strong></td>
<td>Deeper waters at this location reduce the need for frequent maintenance dredging minimizing habitat disturbances. The FMOF will have little to no impact on finfish migratory pathways.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Future Expansion</strong></td>
<td>The Bayonne Peninsula provides an opportunity for future expansion and has the potential to accommodate an additional ferry terminal as the area continues to be redeveloped with mixed use residential housing and retail establishments.</td>
<td>7</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>A portion of the pier can be leased at market rate, however, the distance from NY Waterway facilities will increase operational costs.</td>
<td>4</td>
</tr>
<tr>
<td>Evaluation Criteria</td>
<td>Site Characteristics</td>
<td>Ranking (1-10)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>The property was formerly the site of the Binghamton Ferryboat which operated as a restaurant from 1975 to 2007 and most recently dismantled in 2017. The site can accommodate the required berthing capacity through the installation of a barge or fixed pier. The existing parking area would require modification to incorporate an adequately sized upland facility.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Zoning/Use Compatibility</strong></td>
<td>The site is located in the Waterfront Commercial Business District. The site is currently zoned for commercial port use. Adjacent land uses include a hotel, several large retailers and their associated parking lots.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>The site can be directly accessed along River Road by car or bus. Rail service is not available at this location.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Public Safety</strong></td>
<td>The site is located adjacent to large parking areas that are congested during the hours of 1am to 5pm. The inclusion of a FMOF at this location would increase congestion and limit fuel/parts deliveries. Safety measures would be required to protect users of the Hudson River Waterfront Walkway during ferry maintenance operations.</td>
<td>7</td>
</tr>
<tr>
<td><strong>Development Timing</strong></td>
<td>The construction of a pier and an adjacent upland maintenance facility would require engineering plans, as well as, Federal, State and local approvals including a parking variance. (Estimated timeframe 18-24 months)</td>
<td>6</td>
</tr>
<tr>
<td><strong>Environmental Constraints</strong></td>
<td>Dredging is not anticipated since the Binghamton site formerly moored a stationary ferryboat at the terminus of a fixed pier. However, the installation of a FMOF will significantly increase boat wake and propeller induced turbidity.</td>
<td>7</td>
</tr>
<tr>
<td><strong>Future Expansion</strong></td>
<td>Development of a FMOF at this heavily built-out site would not provide additional expansion opportunities</td>
<td>3</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>A sub-lease with the current tenant is required for the FMOF. The cost to construct the required improvements are estimated at $3-4 MM.</td>
<td>6</td>
</tr>
</tbody>
</table>
### Site ID: 4  
### Name of Potential Site: Union Dry Dock

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Site Characteristics</th>
<th>Ranking (1-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>According to a site plan prepared by Bowman Engineering, the site contains berthing capacity for up to 20 ferries. The upland area is adequate with parking for 70+ employees.</td>
<td>9</td>
</tr>
<tr>
<td>Zoning/Use Compatibility</td>
<td>The site, which was a former dry dock and boat repair facility, is zoned as a WN Waterfront-Castle Point Subdistrict. Surrounding land uses include high density residential buildings, student housing, passive/active recreation and water dependent sporting (kayaking, paddle boarding). The plans to redevelop this highly visible site as a FMOF has been met with significant public opposition from surrounding property owners, residents and interest groups.</td>
<td>4</td>
</tr>
<tr>
<td>Accessibility</td>
<td>The site is located along Frank Sinatra Drive and can be accessed by car or bus. Frank Sinatra Drive is a low speed/low volume roadway and direct access by train or light rail is not available.</td>
<td>5</td>
</tr>
<tr>
<td>Public Safety</td>
<td>High-volume vessel traffic is a major safety concern at Hudson Cove Community Boathouse servicing over 6,000 paddlers each year. Residents are also concerned with constant fumes from diesel engines.</td>
<td>4</td>
</tr>
<tr>
<td>Development Timeline</td>
<td>NY Waterway is awaiting authorization from the Army Corps of Engineers to move forward with their current redevelopment plan. If an approval is issued, occupation can occur in the fall of 2018.</td>
<td>8</td>
</tr>
<tr>
<td>Environmental Constraints</td>
<td>The recent biodiversity report (Thurlow, 2018) identified the Hudson Cove area as a habitat for over 70 aquatic species. Shallow channel depths along the shoreline increase the need for periodic dredging and are more susceptible to propeller induced turbidity.</td>
<td>4</td>
</tr>
<tr>
<td>Future Expansion</td>
<td>Although the site can accommodate the current FMOF, there is limited opportunity to increase berthing capacity and expansion of the upland area beyond the site limits is not possible.</td>
<td>3</td>
</tr>
<tr>
<td>Cost</td>
<td>NY Waterway recently purchased the property for $11MM+. Minor improvements are required to make the site operational, however, additional improvements are anticipated.</td>
<td>8</td>
</tr>
<tr>
<td>Site</td>
<td>Capacity</td>
<td>Zoning/Compatibility</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Hoboken South</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Bayonne Peninsula</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Binghamton Ferry Site</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Union Dry Dock</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Port Imperial Ferry Terminal</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>
RAVINDER S. BHALLA
MAYOR

CALEB D. STRATTON, AICP, CFM
CHIEF RESILIENCE OFFICER
PSEG is the electrical company that services Hudson County. They own, operate and maintain the circuits, substations and distribution assets within their respective territory that supply residential, commercial and industrial costumers energy from the PJM RTO.
A city microgrid can separate itself from the main grid “island” and operate in parallel. Microgrids provide additional reliability for critical electrical and sometimes thermal loads.
City of Hoboken Energy Surety Analysis: Preliminary Design Summary

Jason Ump, Michael Bock, John Eddy, Ross Guffens, Jordan Henry, Richard Jensen, Krista McComas, Daniel Schomer, and Matt Smith
Sandia National Laboratories

<table>
<thead>
<tr>
<th>Design Parameter</th>
<th>UBS</th>
<th>LBS</th>
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<tbody>
<tr>
<td>Buildings</td>
<td>55</td>
<td>34</td>
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<tr>
<td>Critical Load (kW)</td>
<td>9232.5</td>
<td>6360.0</td>
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<tr>
<td>New NG Generators</td>
<td>56</td>
<td>37</td>
</tr>
<tr>
<td>New NG Generation (kW)</td>
<td>12340.0</td>
<td>7327.5</td>
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<tr>
<td>Building Retrofit Sites</td>
<td>37</td>
<td>19</td>
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<tr>
<td>Microgrids</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Isolated Buildings</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Cost</th>
<th>UBS</th>
<th>LBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Retrofits</td>
<td>$6.5M</td>
<td>$2.7M</td>
</tr>
<tr>
<td>Control and Communications</td>
<td>$5.6M</td>
<td>$3.7M</td>
</tr>
<tr>
<td>Microgrid Infrastructure</td>
<td>$21.7M</td>
<td>$12.1M</td>
</tr>
<tr>
<td>Combined Heat and Power</td>
<td>$0.9M</td>
<td>$0.8M</td>
</tr>
<tr>
<td>Design and Engineering</td>
<td>$8.6M</td>
<td>$4.8M</td>
</tr>
<tr>
<td>Contingency</td>
<td>$5.2M</td>
<td>$2.9M</td>
</tr>
<tr>
<td>Totals</td>
<td>$48.4M</td>
<td>$26.9M</td>
</tr>
</tbody>
</table>
The Hoboken Microgrid Business Model

While at e-Lab Accelerator, the team developed a microgrid business model for Hoboken that could be feasible within the current regulatory environment, and creates various opportunities for PSE&G to play a role in the development and operation of the microgrid. (Note: Several assumptions about this business model will need to be validated by PSE&G and/or the NJ BPU).

4 PROJECT FOCUS AREAS
Our data hierarchy
THE ICEBERG
A Tool for Guiding Systemic Thinking

EVENTS
What just happened?

PATTERNS/TRENDS
What trends have there been over time?

UNDERLYING STRUCTURES
What has influenced the patterns?
What are the relationships between the parts?

MENTAL MODELS
What assumptions, beliefs and values do people hold about the system? What beliefs keep the system in place?

React
Anticipate
Design
Transform
3.4 Stormwater utility fee calculations (under working)

Table 2: the summary of stormwater billing unit calculation

<table>
<thead>
<tr>
<th>Unit area (ft²)</th>
<th>EHA</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600</td>
<td>1580</td>
<td>To be discussed</td>
</tr>
<tr>
<td>13,625</td>
<td>14,507</td>
<td>To be discussed</td>
</tr>
<tr>
<td>30.58</td>
<td>28.72</td>
<td>To be discussed</td>
</tr>
</tbody>
</table>

Figure 13: the parcel layer with assigned imperviousness

Figure 9: the dimensions of common residential parcel, and the calculated ratio of B, PY, and IPY within the parcel.

The BRavg is calculated using total shape area of buildings in typical blocks (Btot) divided by total area of parcels in typical blocks (TPAvg):

$$BR_{avg} (\%) = \frac{B_{tot} \ (ft^2)}{TP_{avg} \ (ft^2)} \times 100\% = \frac{5611835.05 \ ft^2}{9140448.03 \ ft^2} \times 100\% = 61.40\%$$

The values in equation above is derived from geometry calculation in ArcMap.

With the BRavg and TBYIavg determined, the IRPavg and ERU can be calculated:

$$IRP_{avg} (\%) = BR_{avg} (\%) + \left(1 - \frac{BR_{avg} (\%)}{100}\right) \times TBYI_{avg} (\%)$$

$$= 61.40\% + \left(1 - \frac{61.40\%}{100}\right) \times 49\% = 80.314\% \approx 80\%$$

$$ERU (ft^2) = RPA_{avg} (ft^2) \times IRP_{avg} (\%) = 2000 \ ft^2 \times 80\% = 1600 \ ft^2$$

2.3.2 Equivalent Hydraulic Unit (EHA)

Equivalent hydraulic unit is based on combined impact of impervious and pervious surfaces of a parcel. This one requires more input from administrators but considers both pervious and impervious areas. More cost is associated with impervious area. Equation below shows the equation for EHA from the Michigan document:

$$EHA (ft^2) = IRP_{avg} (\%) \times RPA_{avg} (ft^2) \times 0.95 + \left(1 - IRP_{avg} (\%)ight) \times RPA_{avg} (ft^2) \times 0.15$$

$$= 80\% \times 2000 \ ft^2 \times 0.95 + (1 - 80\%) \times 2000 \ ft^2 \times 0.15 = 1580 \ ft^2$$

$$EHA = \left(\text{impervious area in sq. ft.} \times 0.95\right) + \left(\text{pervious area in sq. ft.} \times 0.15\right)$$
Thank you!

Caleb D. Stratton AICP, CFM
Chief Resilience Officer

cstratton@hobokennj.gov
201-744-9602