Combating Extreme Weather with Smarter Solutions

July 15, 2024

NYC DDC TOWN +GOWN: NYC

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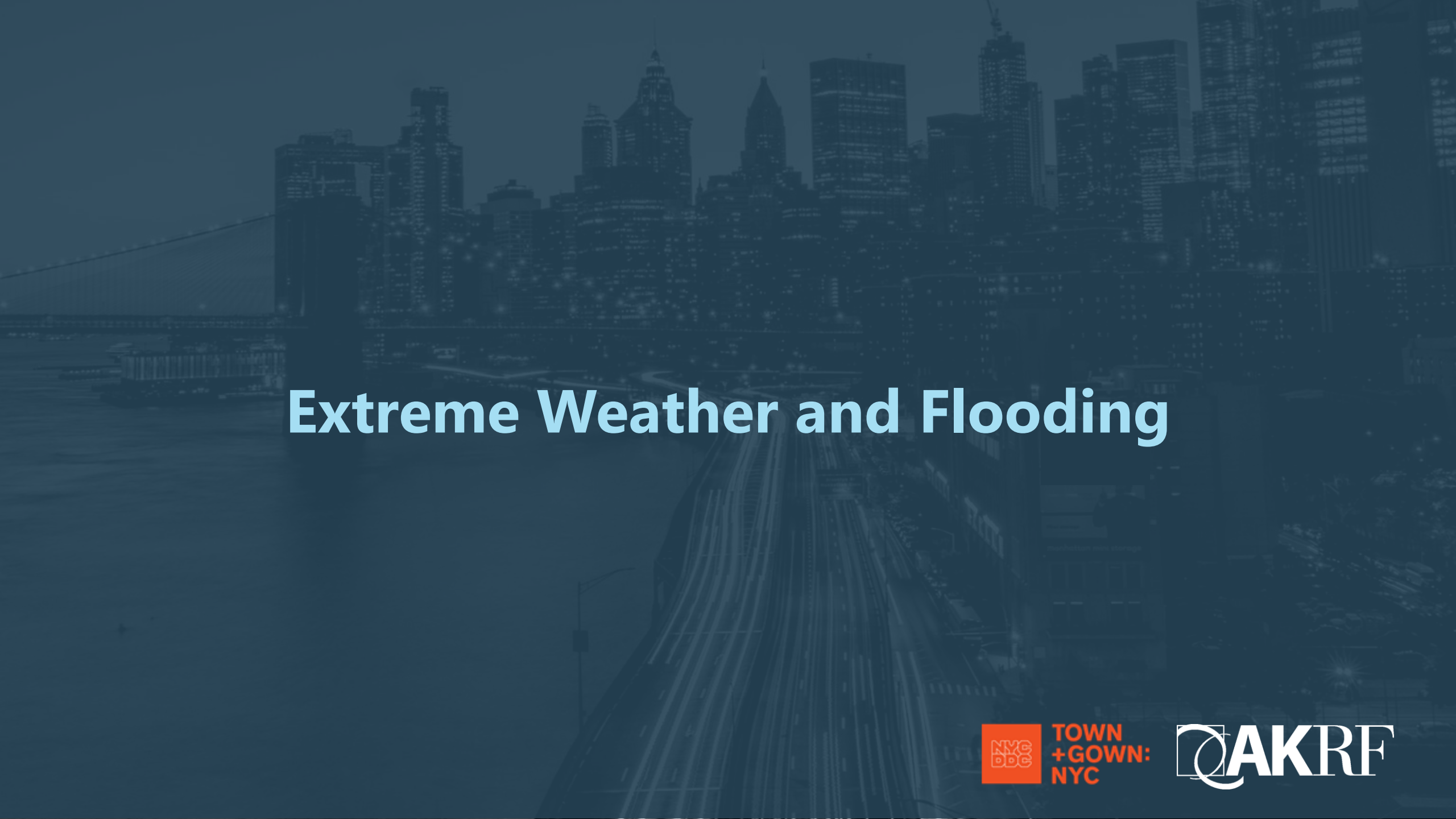
Overview

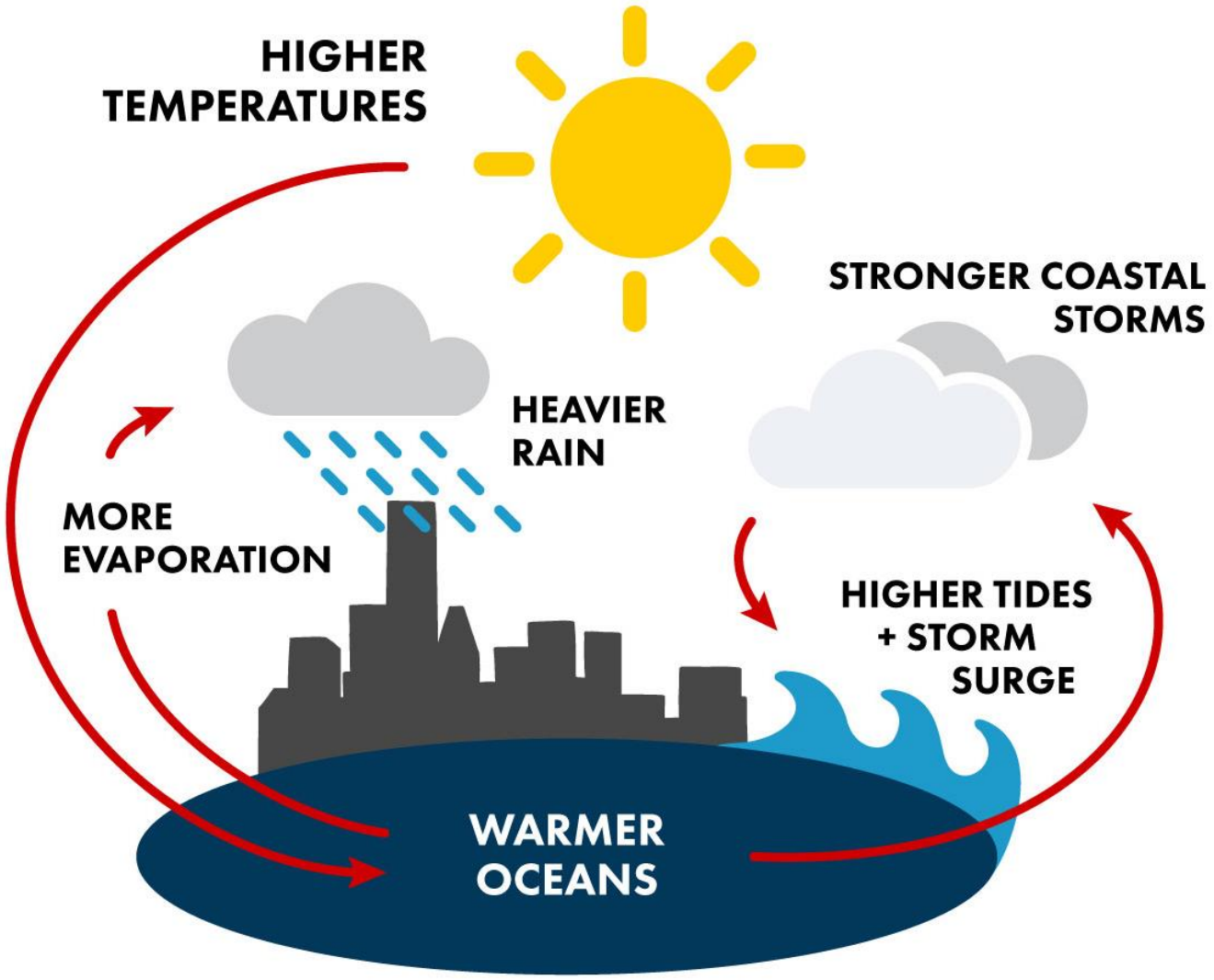
- Extreme Weather and Flooding
- NYC's Toolkit of Solutions
- Tools for Smarter Solutions
  - Monitoring
  - Modeling
- Case Study: Cloudburst Management
- Key Takeaways

Storm clouds over Lower Manhattan
Source: John Angelillo/UPI/Shutterstock

Extreme Weather and Flooding



Extreme weather results in flooding



- Our Warming Planet[1]
  - Average temperatures in NYC have increased approximately 1.7 to 3.0 degrees since mid-1900s
  - Temperatures are projected to increase an additional 4 to 6 degrees by 2050
- Leads to Extreme Weather
  - Stronger coastal storms
  - Heavier downpours
- Leads to Greater Flooding
  - Vulnerable waterfront areas
  - Low-lying areas
  - Urban areas not suited to handle large storms

1: New York City Panel on Climate Change 4th Assessment

2021 Tropical Storm Henri

1.94 inches of rain in 1 hour

2021 Hurricane Ida

3.15 inches of rain in 1 hour

Source: Anthony Behar/Sipa USA

2023 Tropical Storm Ophelia

2.5 inches of rain in 1 hour

NYC's Toolkit of Solutions

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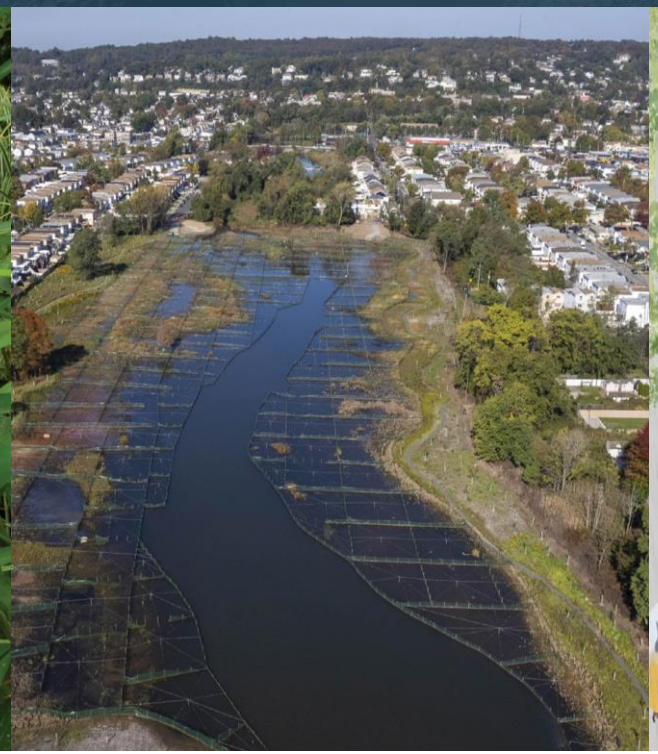
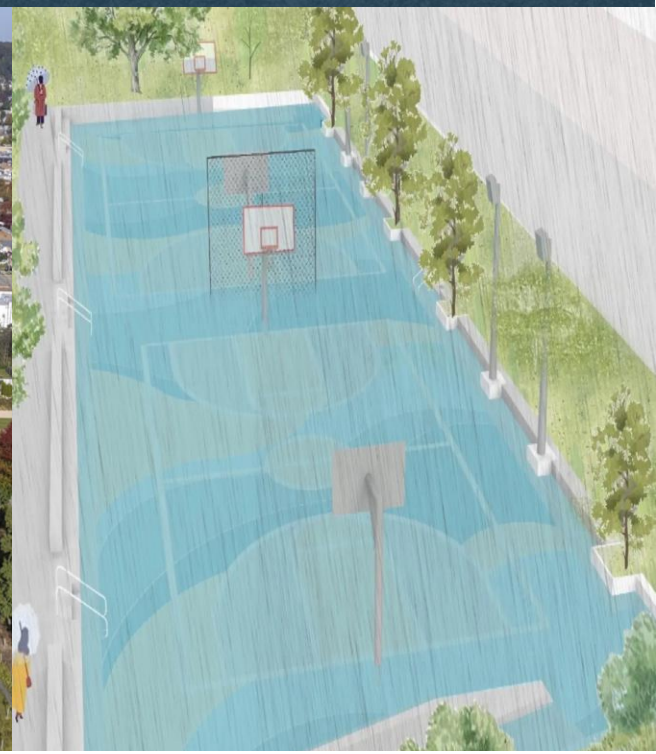
The City has a toolkit of solutions to strategically combat flooding from intense rainfall

- Grey Infrastructure
- Green Infrastructure
- Bluebelts
- Cloudburst Management

Toolkit of Solutions





Grey Infrastructure

- Pipes and tanks
- First line of defense
- Protects against 98% of storms
- Can get overwhelmed during large events

Green Infrastructure

- Rain gardens and porous pavement
- Infiltrates water into soils
- Reduces stormwater volumes entering grey infrastructure

Bluebelts

- Large areas to store and treat stormwater
- Ecological areas to preserve or restore natural drainage pathways

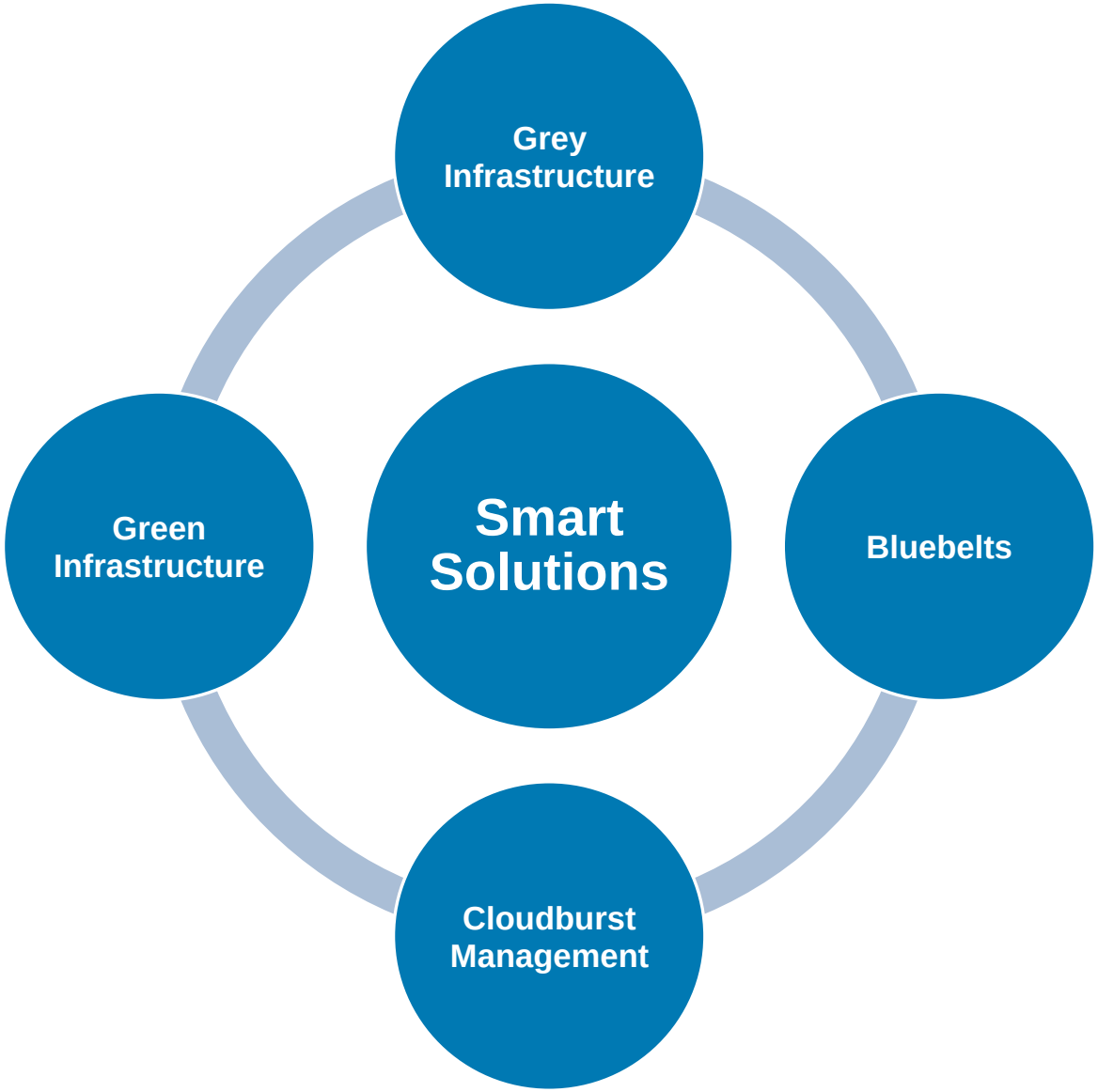
Cloudburst Management

- Combination of grey and green infrastructure
- Captures, conveys, and stores stormwater
- Designed for larger and more intense downpours

Source: NYC DEP

Selecting Smart Solutions

- Managing larger rainfall events requires a structured and defendable approach to select a smart solution:
  - Identify priority areas
  - Develop options using the toolkit
  - Evaluate the options
  - Execute the preferred alternative




Tools for Smarter Solutions
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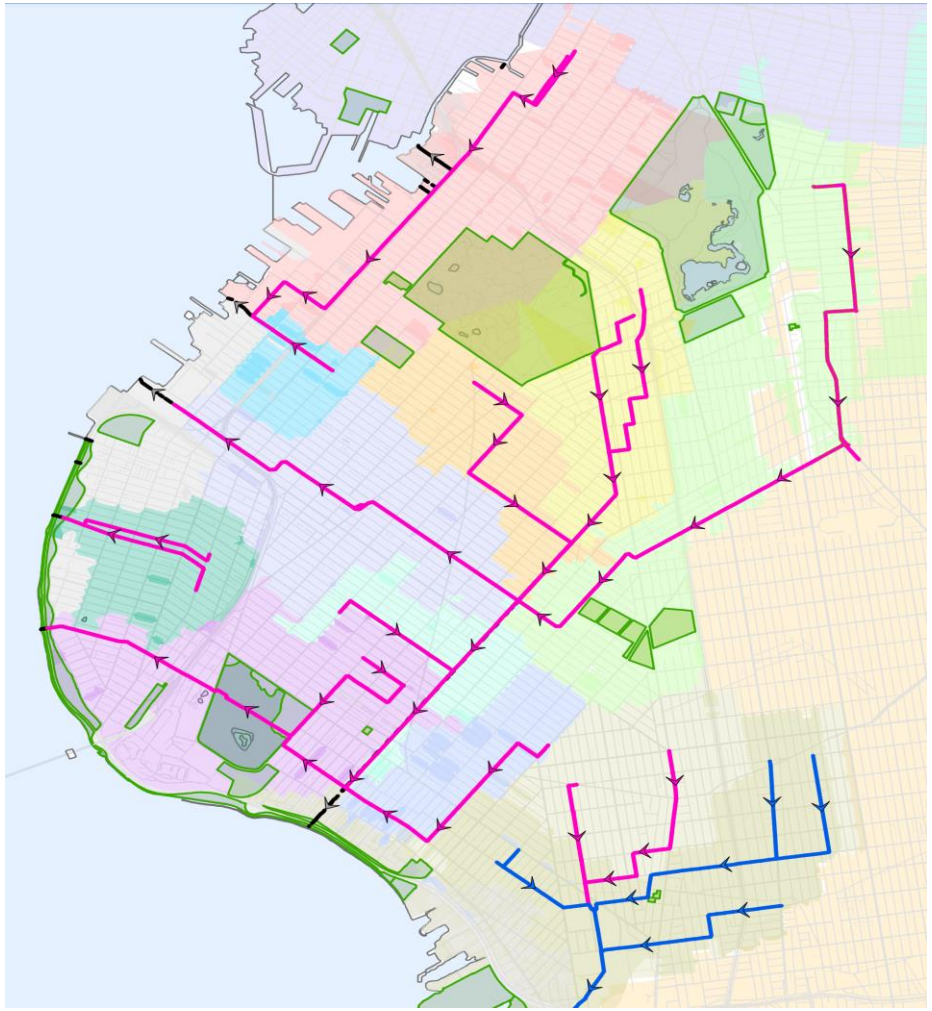
How do we lead to smarter solutions?

Monitoring

Source: www.floodnet.nyc

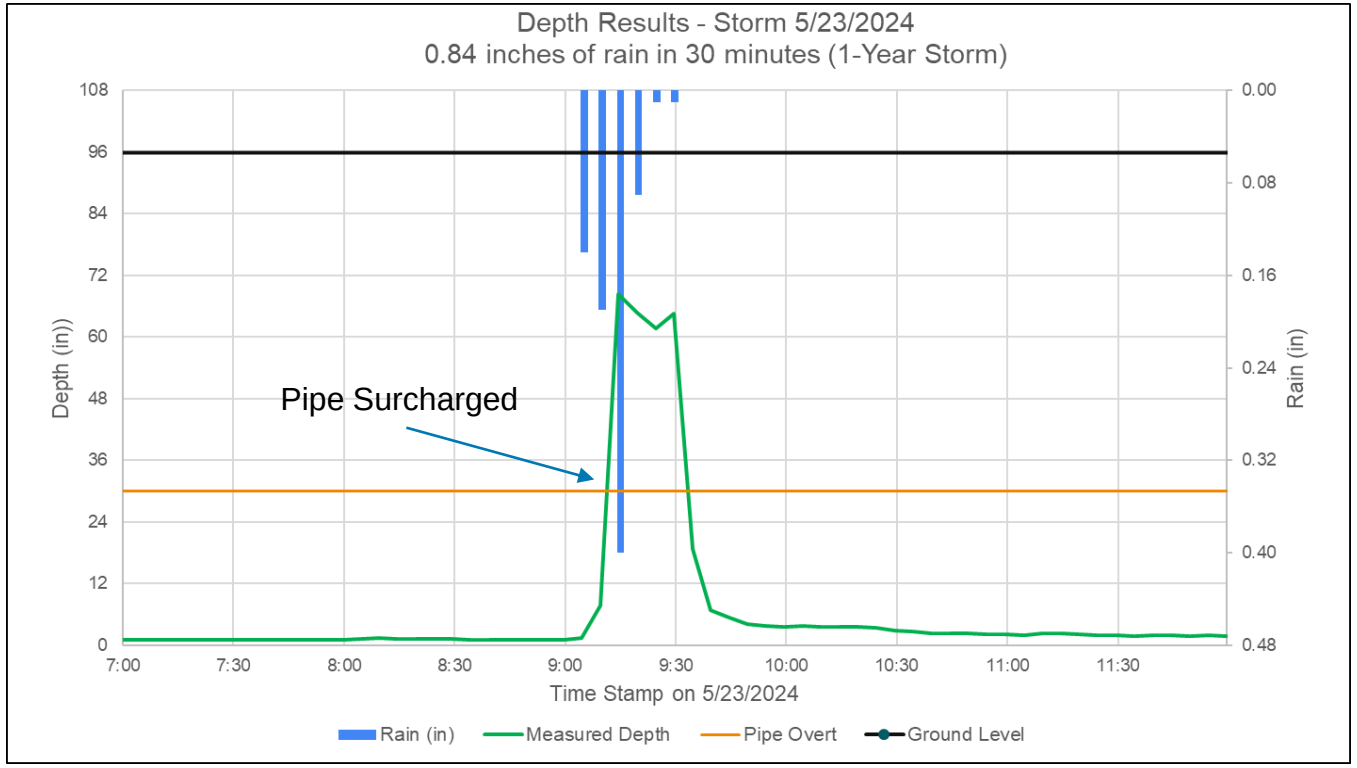
Modeling



Source: NYC DEP 2024 Stormwater Analysis

Monitoring

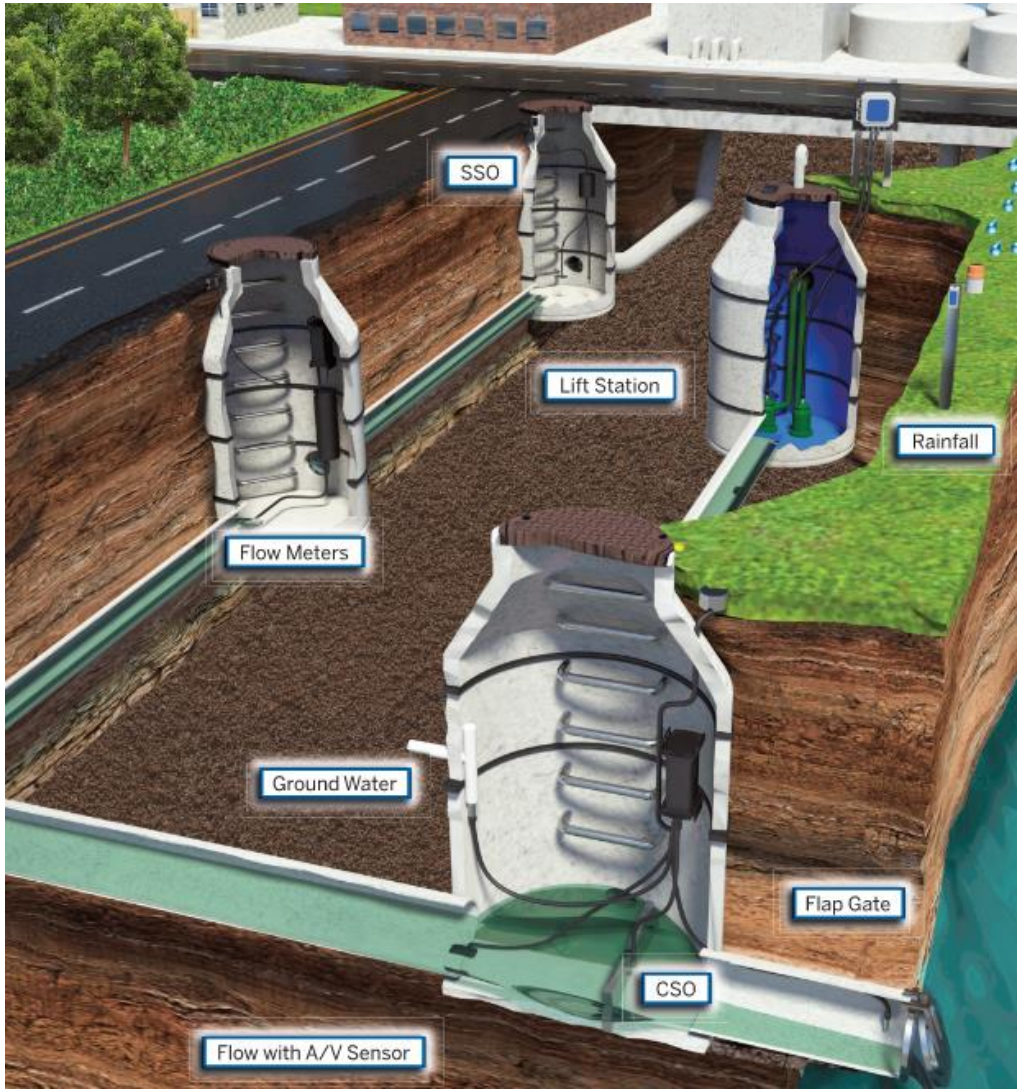
- Monitors that help us
  - Understand flows during dry weather vs rainfall conditions
  - Determine capacity needs or challenges
  - Confirm complaints
  - Support development of solutions
  - Help validate or calibrate models
- Types
  - Sewer Monitoring
  - Surface Flood Monitoring



Recorded rainfall and storm sewer depth

Sewer Monitoring

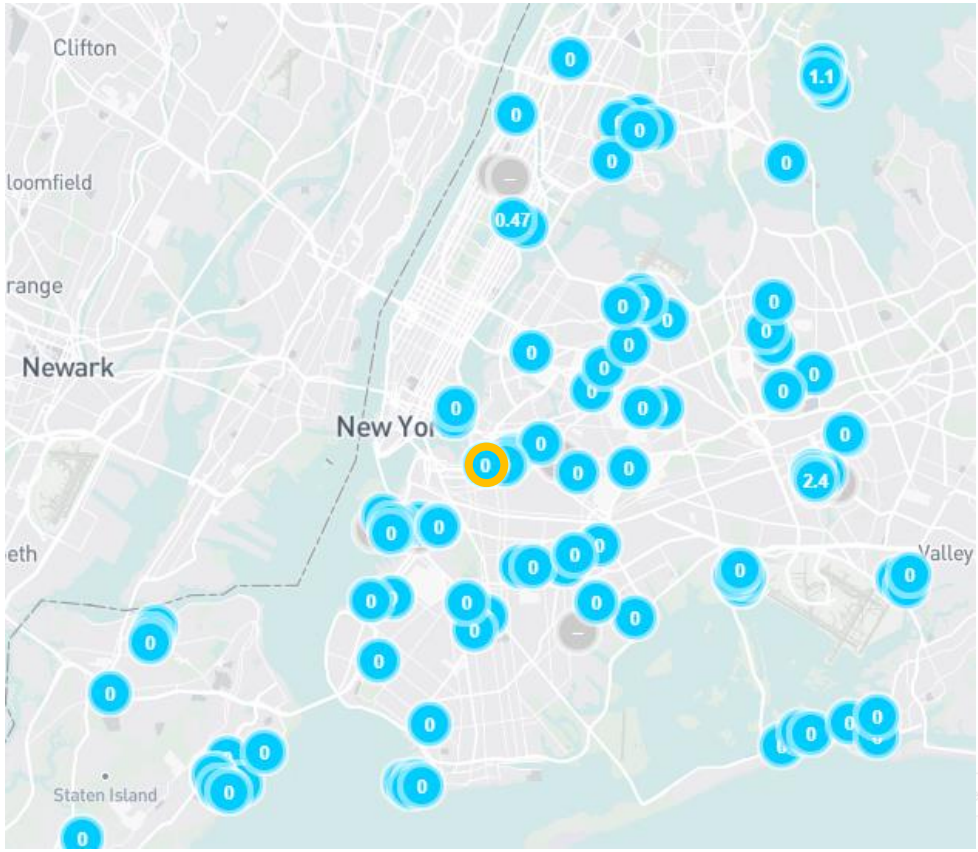
- Temporary Monitors
  - Sewer level and flow data to support drainage analyses and model calibration
  - Considerations for time of year (e.g., rainy seasons) are important
- Permanent Monitors
  - Commonly at facilities (e.g., pump stations, water recovery facilities) and at outfalls for Combined Sewer Overflow (CSO) compliance
  - City considering permanent real-time monitoring to support a “smart sewer” network

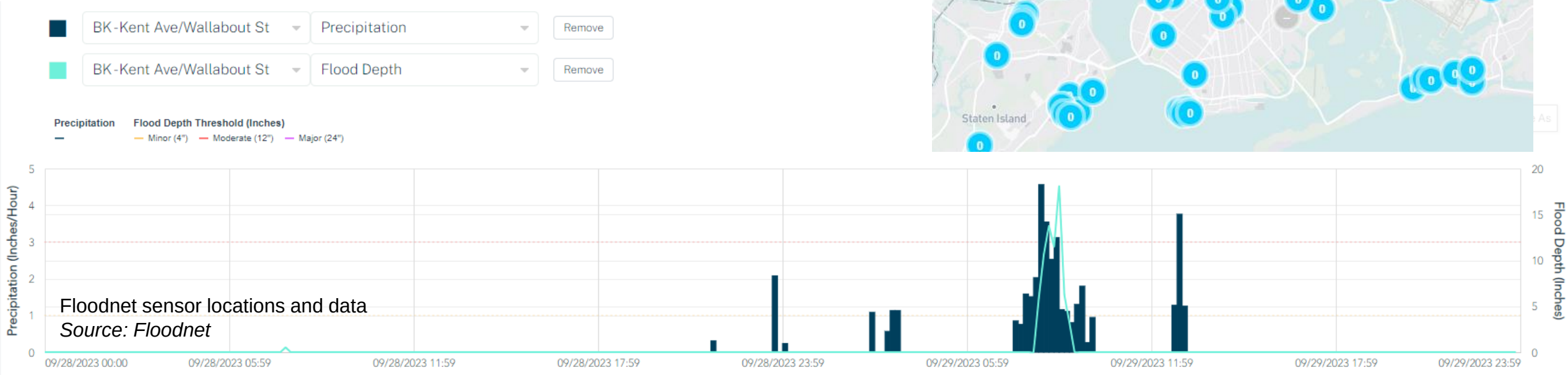


Sewer monitoring technologies
Source: Telog

Surface Flood Monitoring

- FloodNet
  - Permanent real-time sensors
  - Developed by the FloodSense project (NYU/CUNY)
  - Ultrasonic sensors detect water at the surface
  - Relatively low cost to install, easy to construct, open-source design

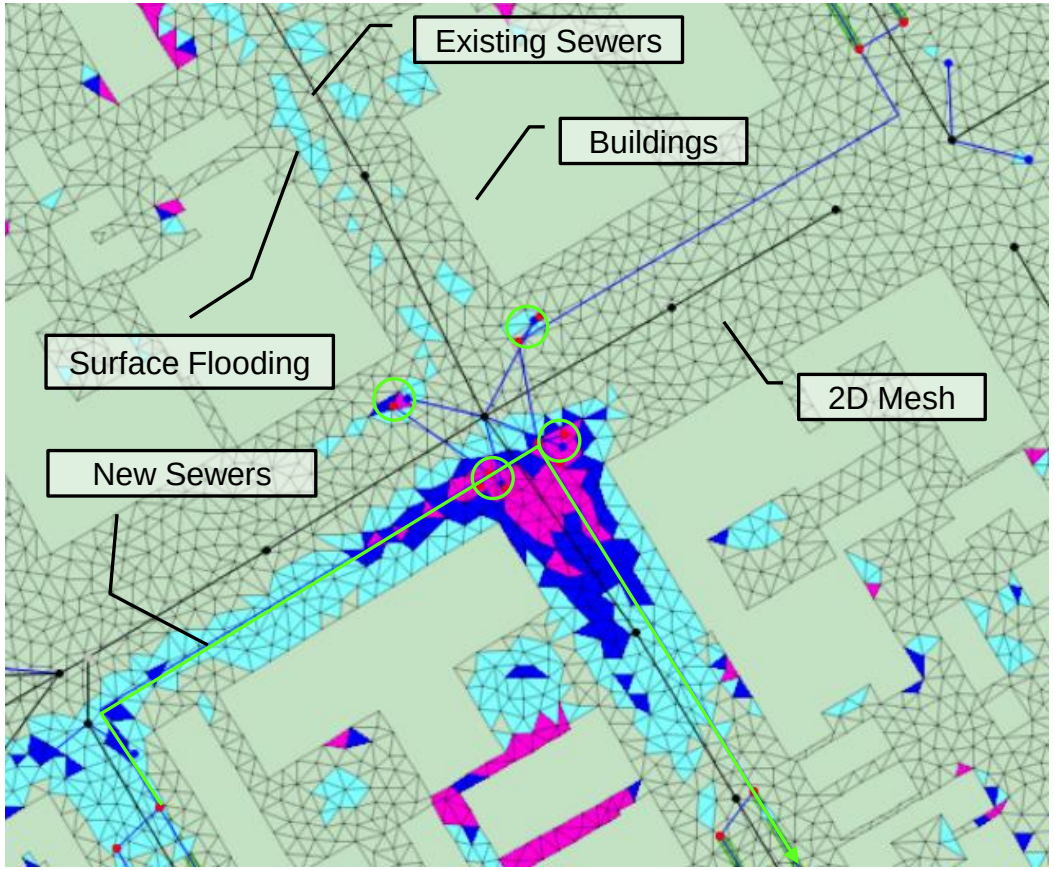




Floodnet sensor locations and data
Source: Floodnet

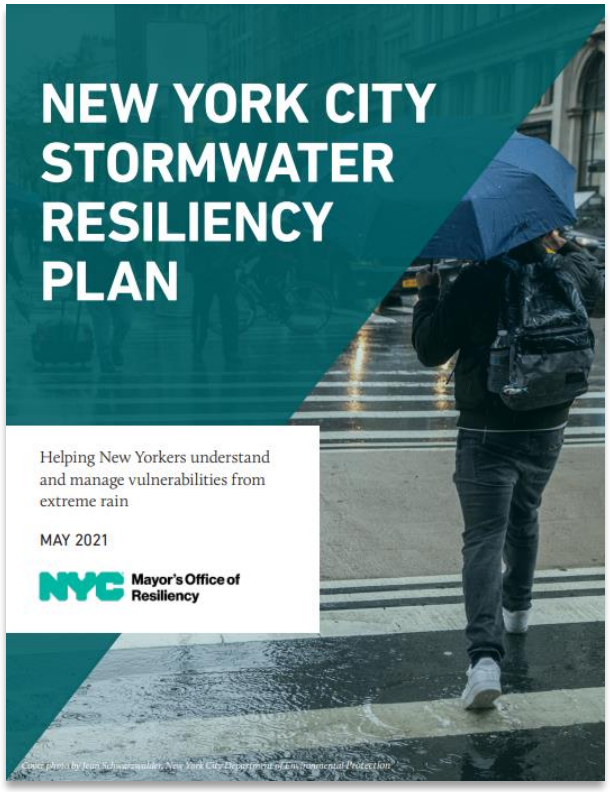
Modeling - Hydrologic & Hydraulic Models

- Computer tools that help us
  - Represent how water enters our sewers (hydrology), moves through sewers (hydraulics), and floods our streets
  - Predict how the existing sewer system performs
  - Prioritize areas to focus improvements
  - Predict how an improved system would perform
  - Inform benefit-cost analyses (BCA) that support improvements
- Types
  - 1-dimensional
  - 2-dimensional

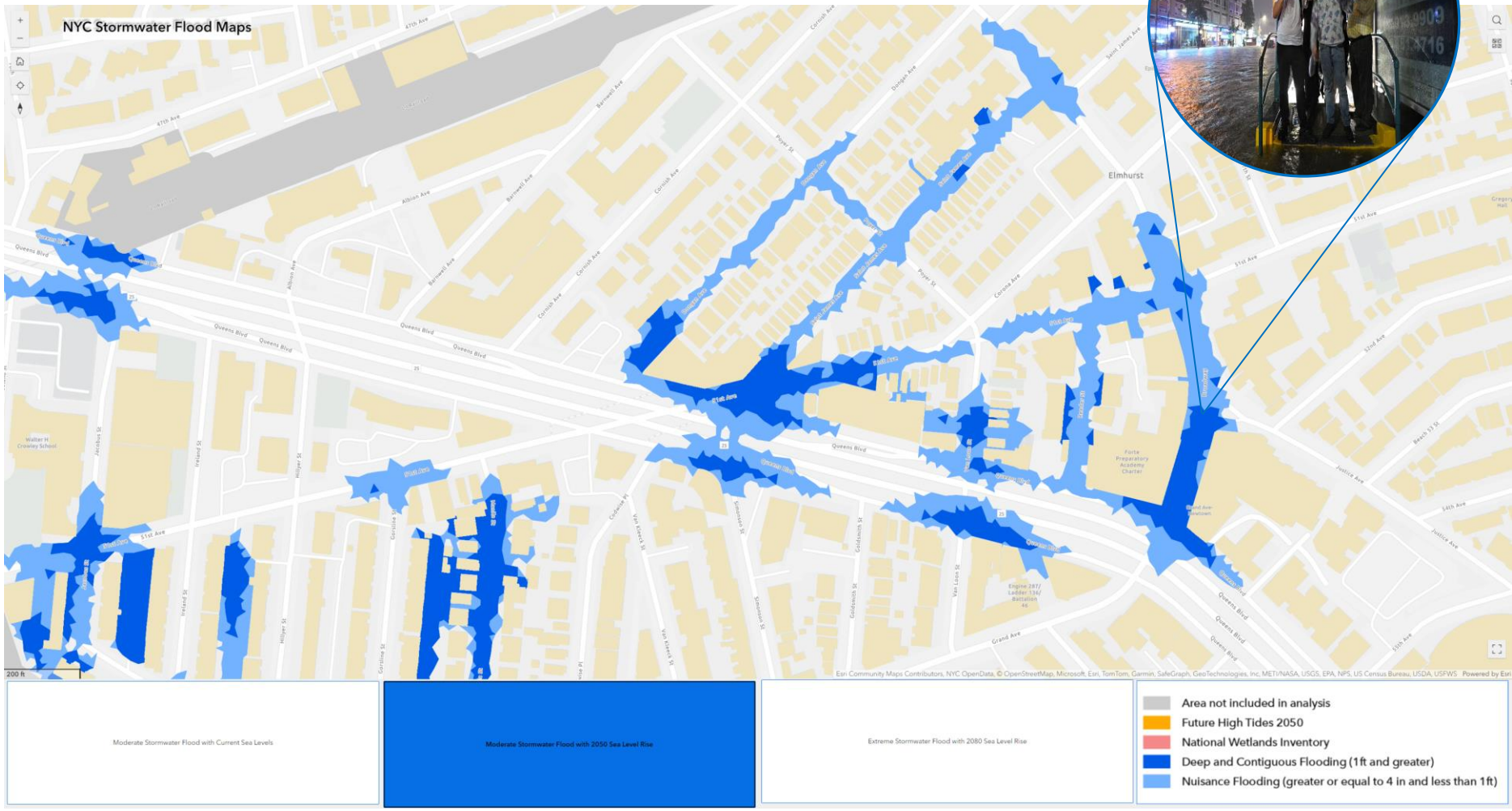


2-dimensional hydrologic and hydraulic (H&H) model used to explore options that reduce flooding

Modeling-Supported Flood Vulnerability Maps

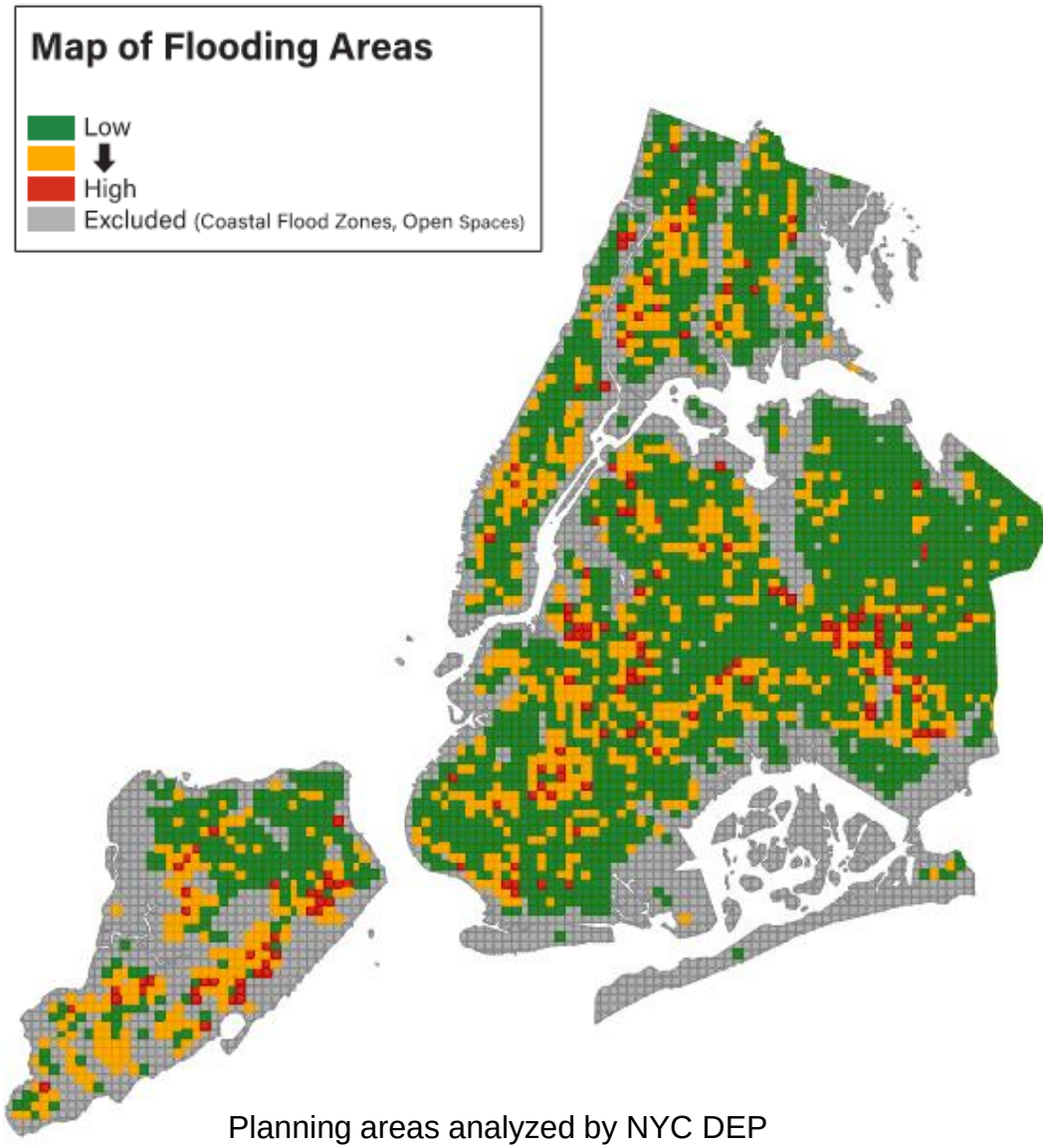


Rainfall represented as 2.1 in/hr
(Similar to a 10-yr 1-hr event)



Map interface indicating flood vulnerability from rainfall events under future climate conditions
Source: NYC Stormwater Flood Maps

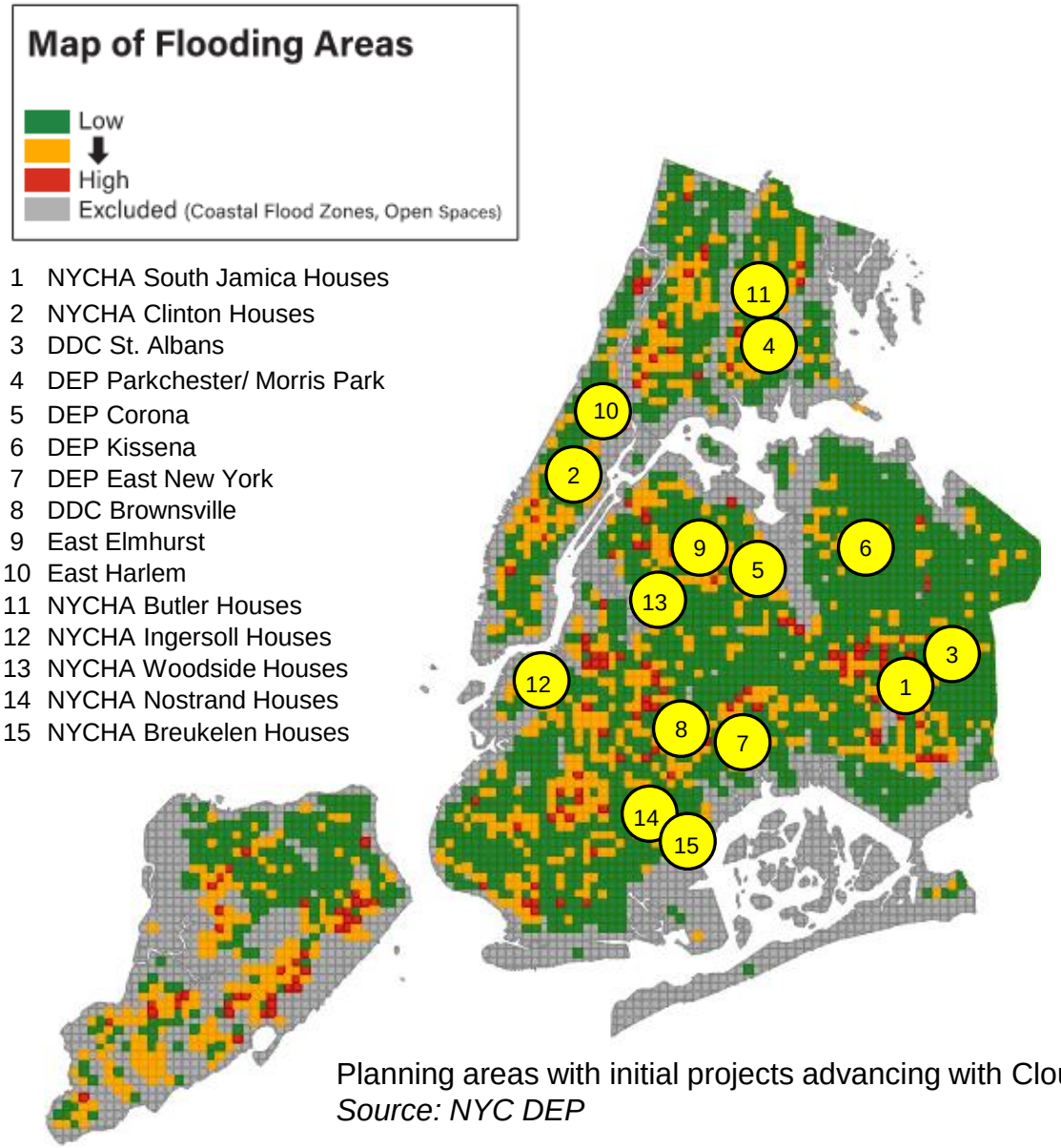
Modeling-Supported Prioritization



Planning areas analyzed by NYC DEP
Source: NYC DEP

- NYC DEP evaluated flooding city-wide to identify areas in greatest need for improvement
- Rain Event: 2.1 in/hr (10-yr 1-hr)
- Result
  - 100+ areas identified with chronic flooding (of 5,600 total areas)
  - 30+ areas identified to be addressed by Cloudburst Management

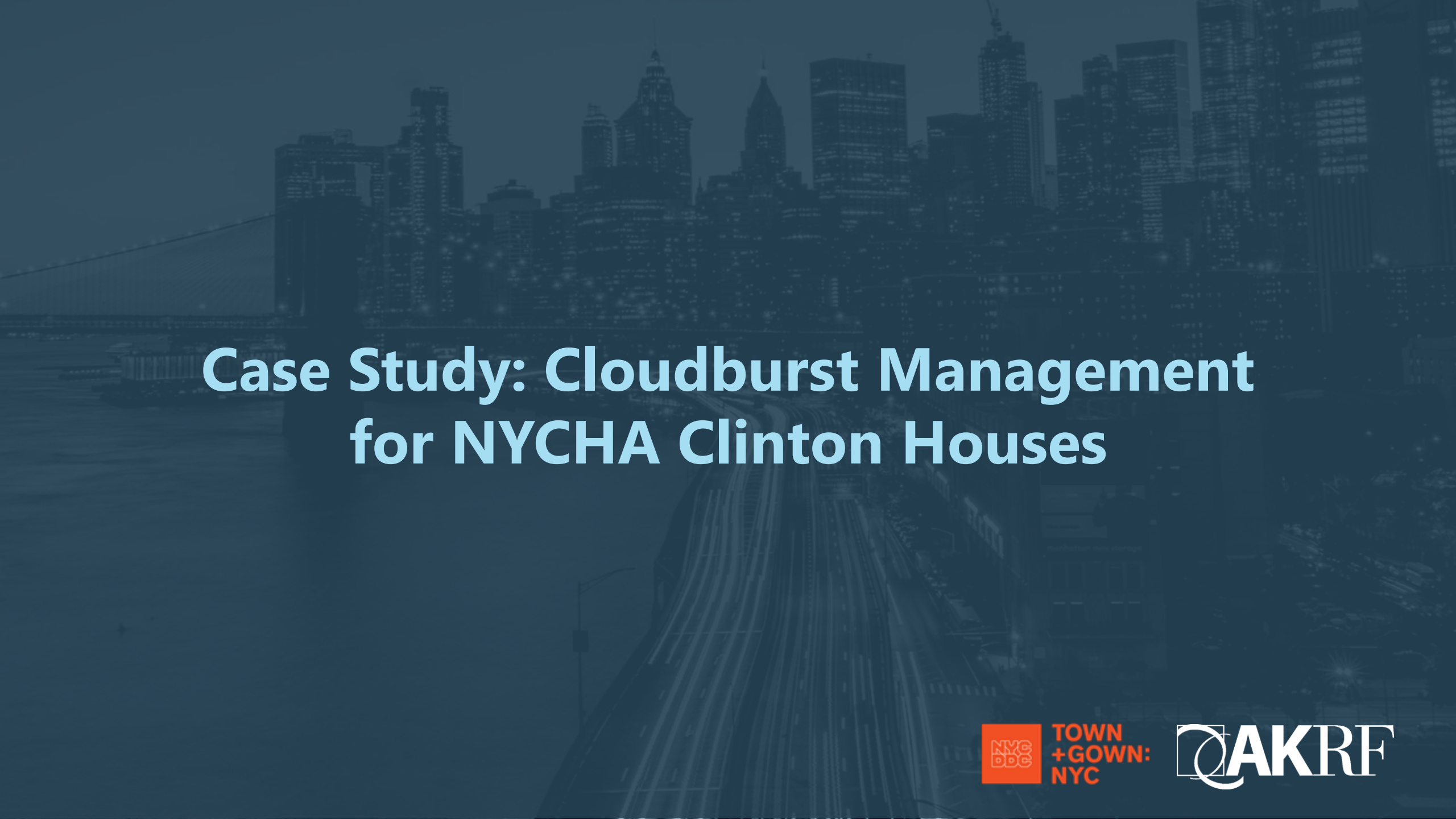
Identifying Cloudburst Management Areas



Planning areas with initial projects advancing with Cloudburst Management
Source: NYC DEP

- NYC DEP in collaboration with NYC Parks, Schools, and NYCHA identified areas to implement Cloudburst Management
- Cloudburst Management projects are advancing:
  - 5 in design through DEP/DDC with 3 additional awaiting funding
  - 7 in design/construction through NYCHA

Case Study: Cloudburst Management for NYCHA Clinton Houses

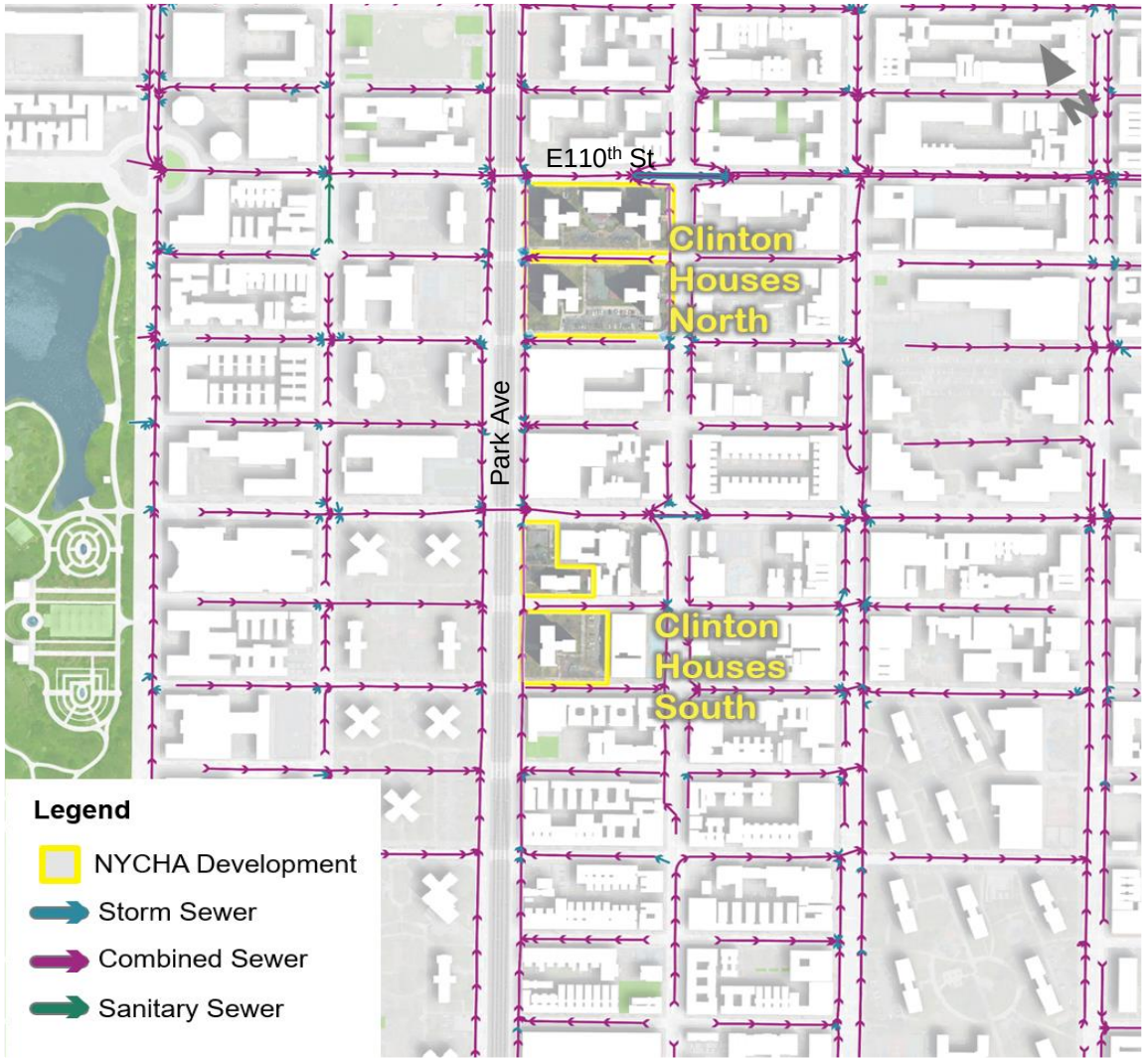


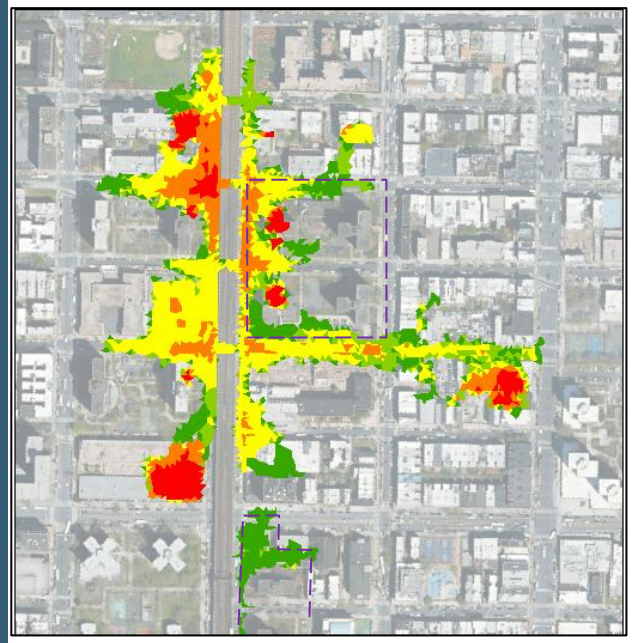
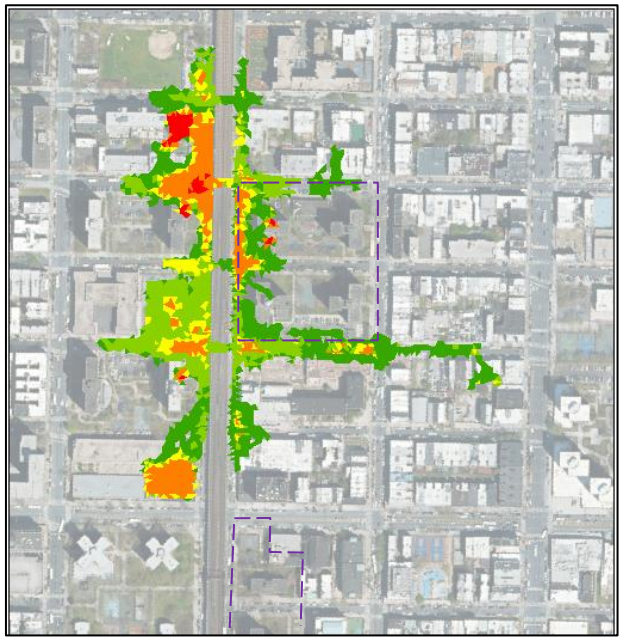
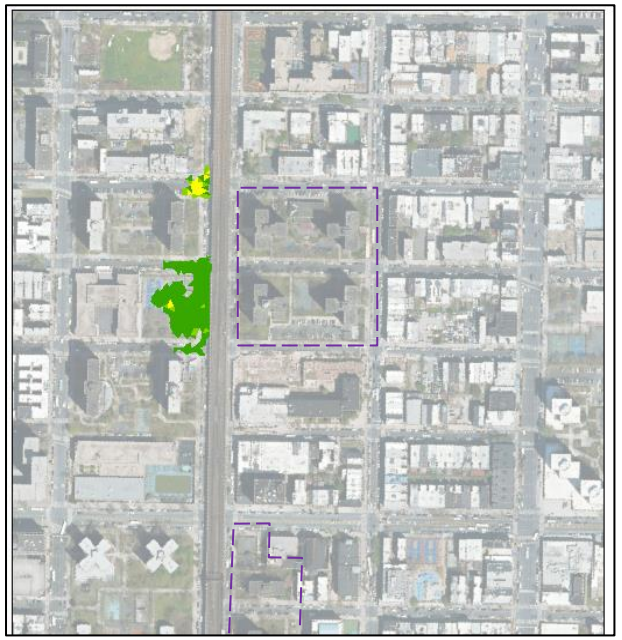
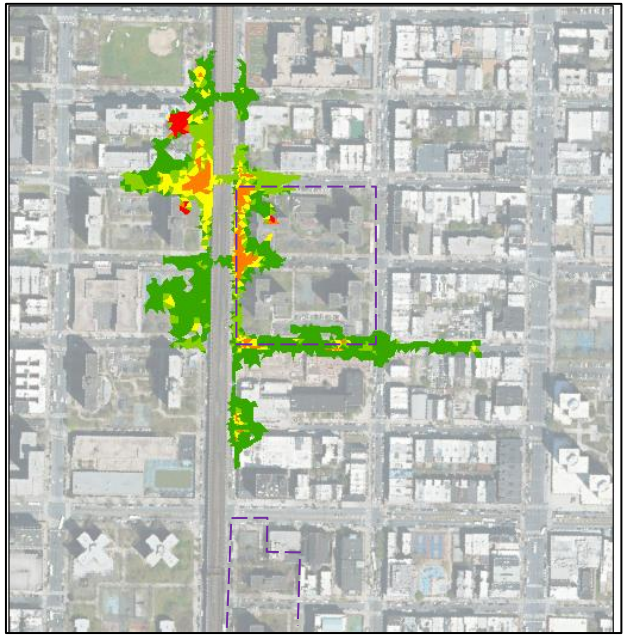
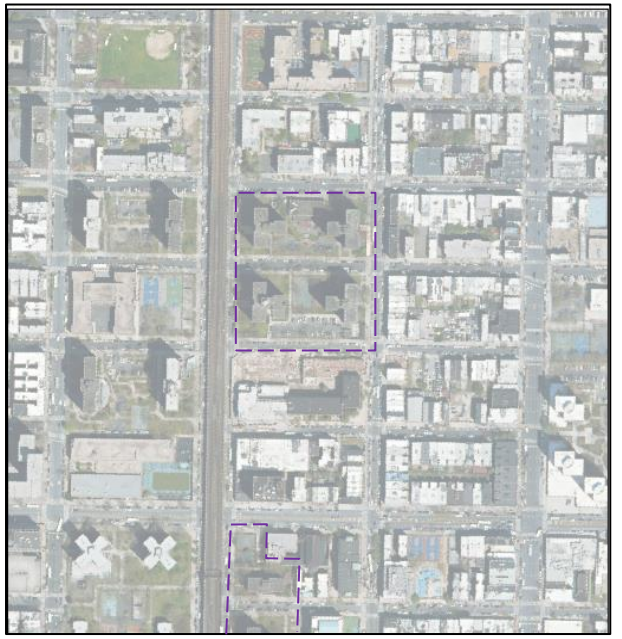
Overview of NYCHA Clinton Houses

- The largest public housing authority in North America, New York City Housing Authority (NYCHA) is home to roughly 1 in 16 New Yorkers
- Clinton Houses is a 5.6-acre campus comprised of 6 residential buildings and community center for ~1,800 residents
- The area is low-lying with a historic buried stream that through a portion of the campus
- The buildings and surrounding area routinely flood during heavy downpours
- NYCHA, in collaboration w/ DEP, advanced planning and design of innovative solutions to mitigate flooding for the campus

Proposed Cloudburst Management & Analysis

- Cloudburst Management
  - Proposed solutions included networks of subsurface storage, nature-based surface storage and channels, and grey infrastructure
  - Total Volume: 1.78 MG
  - Proposed solutions were tested using H&H modeling
  - Multiple rainfall events were represented to develop the preferred design and quantify flood reduction:
    - 2-yr, 5-yr, and 10-yr 1-hr



	10 year - 1 hour	5 year - 1 hour	2 year - 1 hour
Existing Flood Conditions			
Conditions with Improvements			

Improvements will protect from some rainfall events, but will not eliminate all flooding

Key Takeaways

Takeaways to a Smarter Future

- **More Rain is Coming** - Heavier downpours are our new normal
- **Understanding Risk** - Not all flooding can be managed
- **The Right Tools** - Monitoring and modeling will be critical to support solutions that address flooding
- **Smarter Solutions** - System improvements that account for anticipated climate change are underway
- **Evolving System Needs** - Priorities and solutions will evolve as we complete system improvements
- **Evolving Public Needs** - Social vulnerability and equity will be important considerations as we explore future improvements to protect communities

Thank you!

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