Water Infrastructure Resilience

Planning for Climate Resiliency

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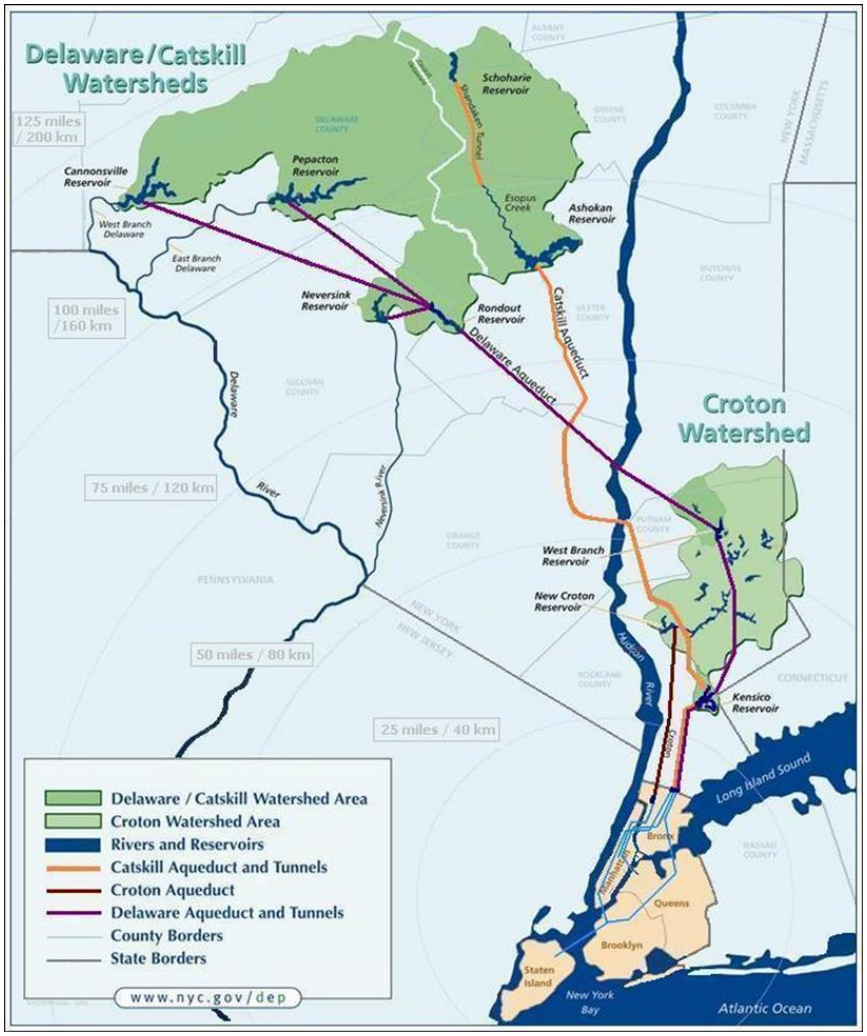
OVERVIEW

- New York City's Water Infrastructure
- Climate Change Planning
- Impacts and Response to Climatic Events
- Adaptation Strategies
- Challenges
- Closing Thoughts

NYC Water Supply



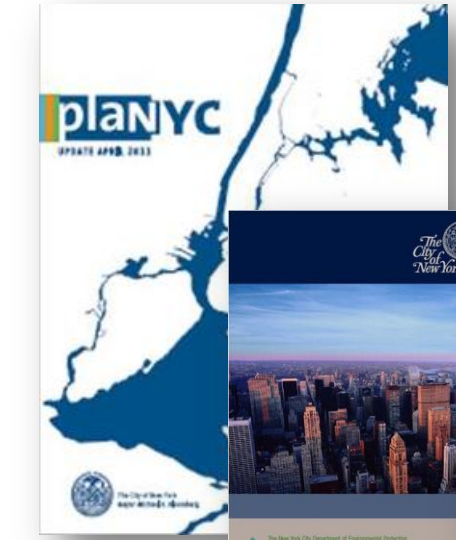
- NYC watershed extends more than 125 miles (200 km) from the city, and comprises 19 reservoirs, and 3 aqueducts
- Supply more than 1 billion gallons of water/day for 9 million residents
- NYC remains one of only five large cities in the United States that is not required to filter its drinking water

NYC Wastewater Treatment

- Treat 1.3 billion gallons of wastewater per day
- ~7,400 miles of sewer lines convey waste water and storm water to 14 treatment plants
- Treatment capacity is twice normal flow to handle storm water volume

CLIMATE CHANGE PLANNING

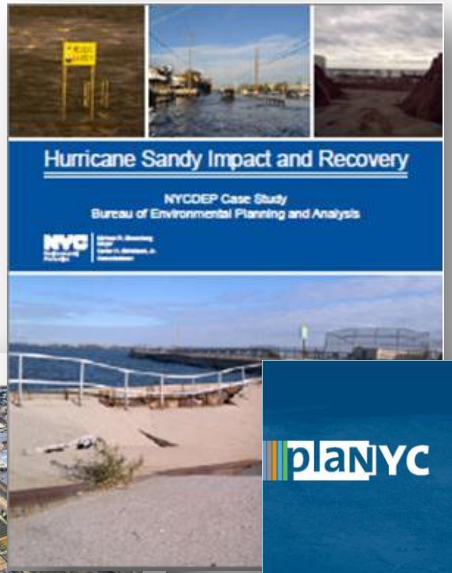
Since 2007, NYCDEP has been proactively investigating the impacts of climate change on its infrastructure…



Apr. 2007

May 2008

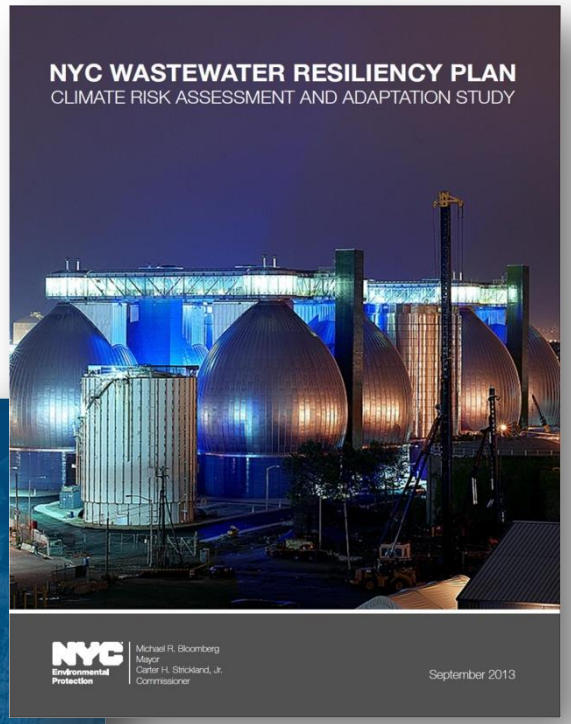
Oct. 2012



Feb. 2011

Jun. 2013

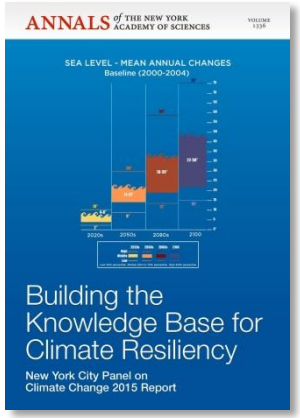
Oct. 2013



Climate Change / 21st Century Threats

…And grapple with the impacts of climate change on our city.

The NYC Panel on Climate Change (NPCC) projects increased chronic climate hazards…



By the 2050s:

- 4.1°F to 5.7°F increase in average temperature
- 4% to 11% increase in average annual precipitation
- Sea levels likely to rise 1-2 ft.; maybe 2½ ft.

By 2100:

- High-end projections ***may*** reach 6 ft.

…and increased impact from extreme weather events.

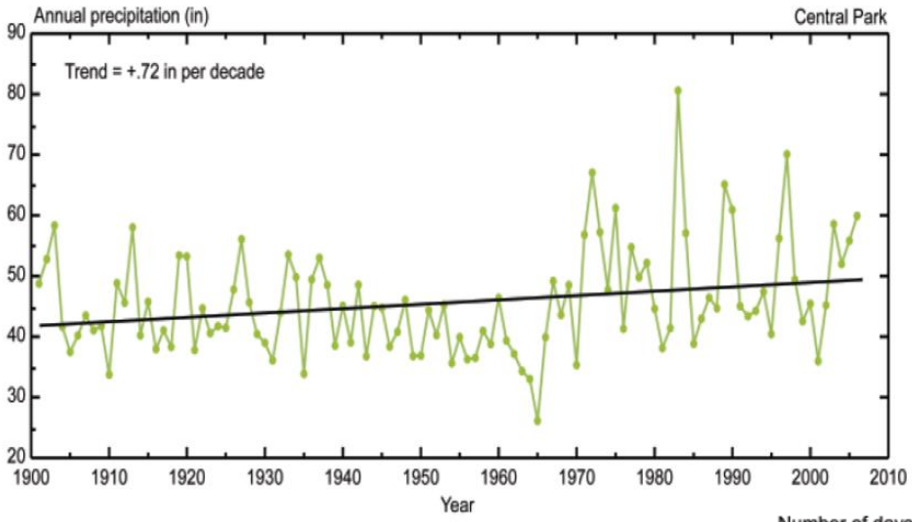
By the 2050s:

- Number of days in NYC above 90° could triple

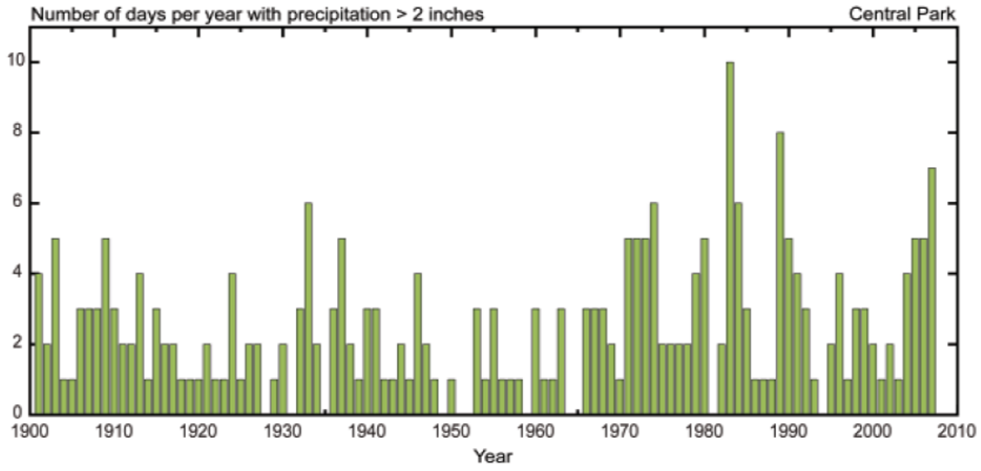
Even today:

- 100-year floodplain expanded by 17 square miles (51%) citywide; 2.3 ft. average increase in 100-year flood elevations; will increase with further sea level rise; now encompasses 71,500 structures

NYC Precipitation Trends



- Variability of precipitation has become more pronounced
- Precipitation seems to be coming in the form of more intense storms



Source: New York City Panel on Climate Change

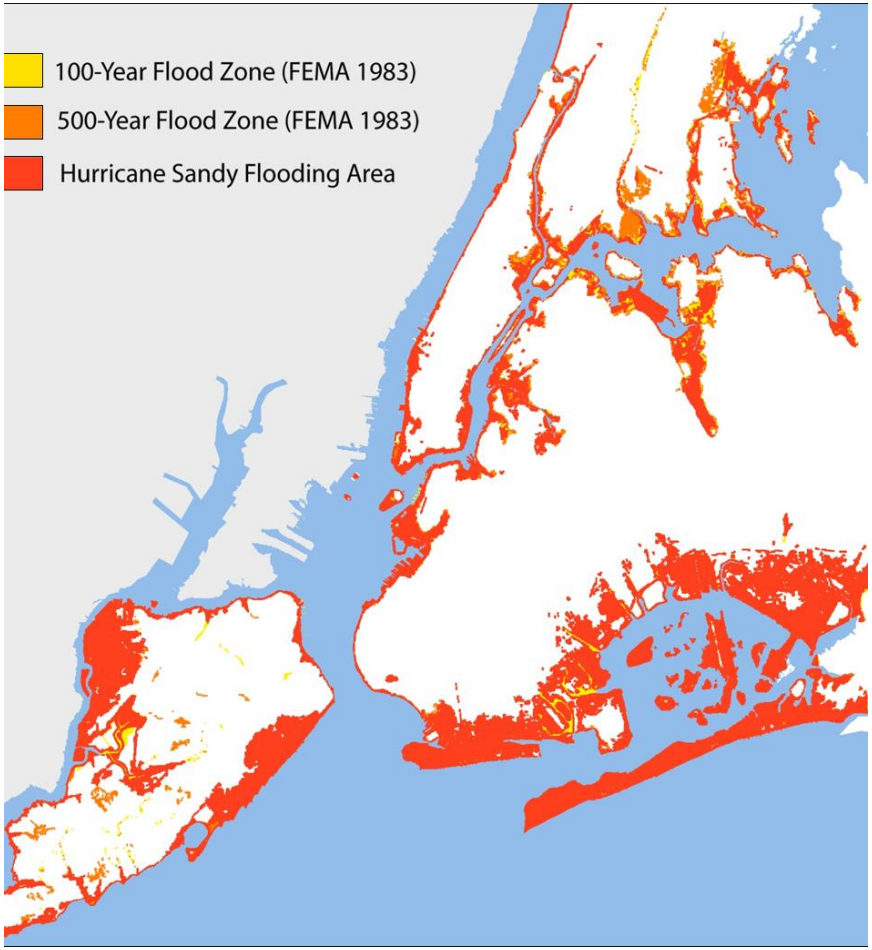
First Came Irene and Lee…

- In 2011, all-time rainfall records were broken.
  - Tropical Storm Irene: 16 inches of rain < 24 hours.
  - Tropical Storm Lee - 2 weeks later the Catskill watershed received another 8 inches of intense rain

- Millions of dollars in reconstruction, repairs and debris removal, with millions of dollars committed to future studies.

Water spills over the Gilboa Dam in Gilboa, NY. Aug. 29, 2011.

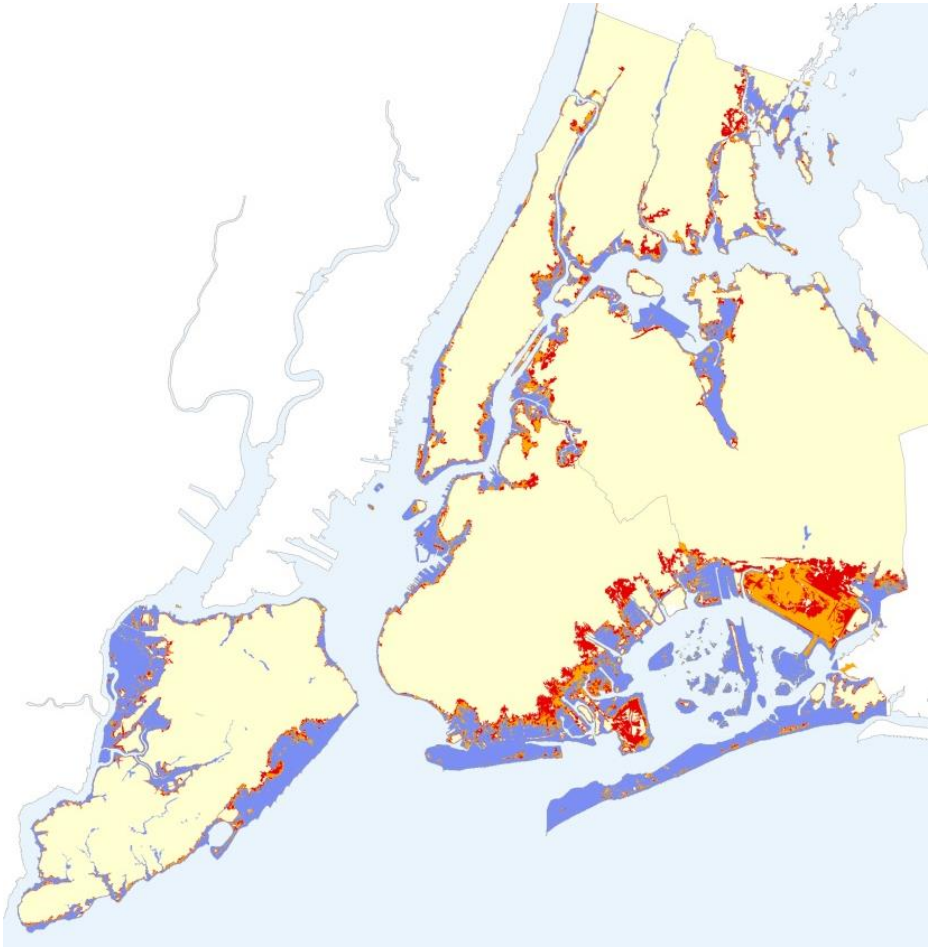
… And Then Sandy



- Record high water level- 14.06 ft above Mean Low Water at the Battery
- Extensive flooding, beyond the boundaries of the 500-year floodplain

Future Flood Risk

FEMA Preliminary FIRMs with 2020s and 2050s Floodplain Growth



- Developed maps showing how the floodplains will expand by the 2050s.

100-Year Floodplain (FEMA 2013 Preliminary FIRMs)

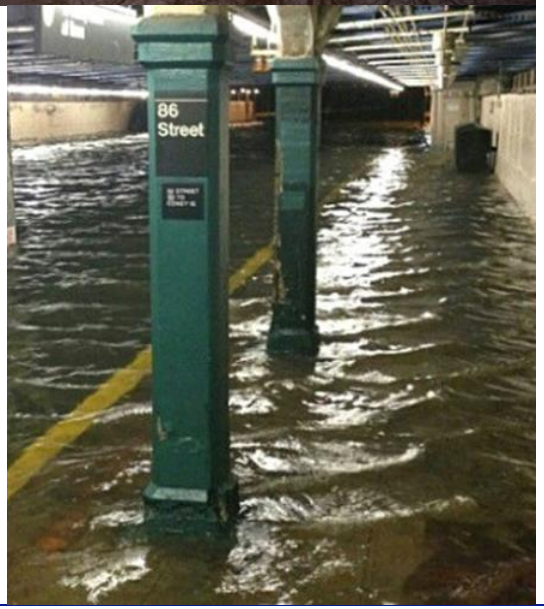
100-Year Floodplain (Projected 2020s)

100-Year Floodplain (Projected 2050s)

Preparations

- Hardening of critical infrastructure
- Topped off chemical and fuel supplies
- Ran plant shutdown drills
- Moved water out of reservoirs
- Expedited operation of Gilboa Dam crest gates
- Activated Incident Command Center

Major Citywide Impacts

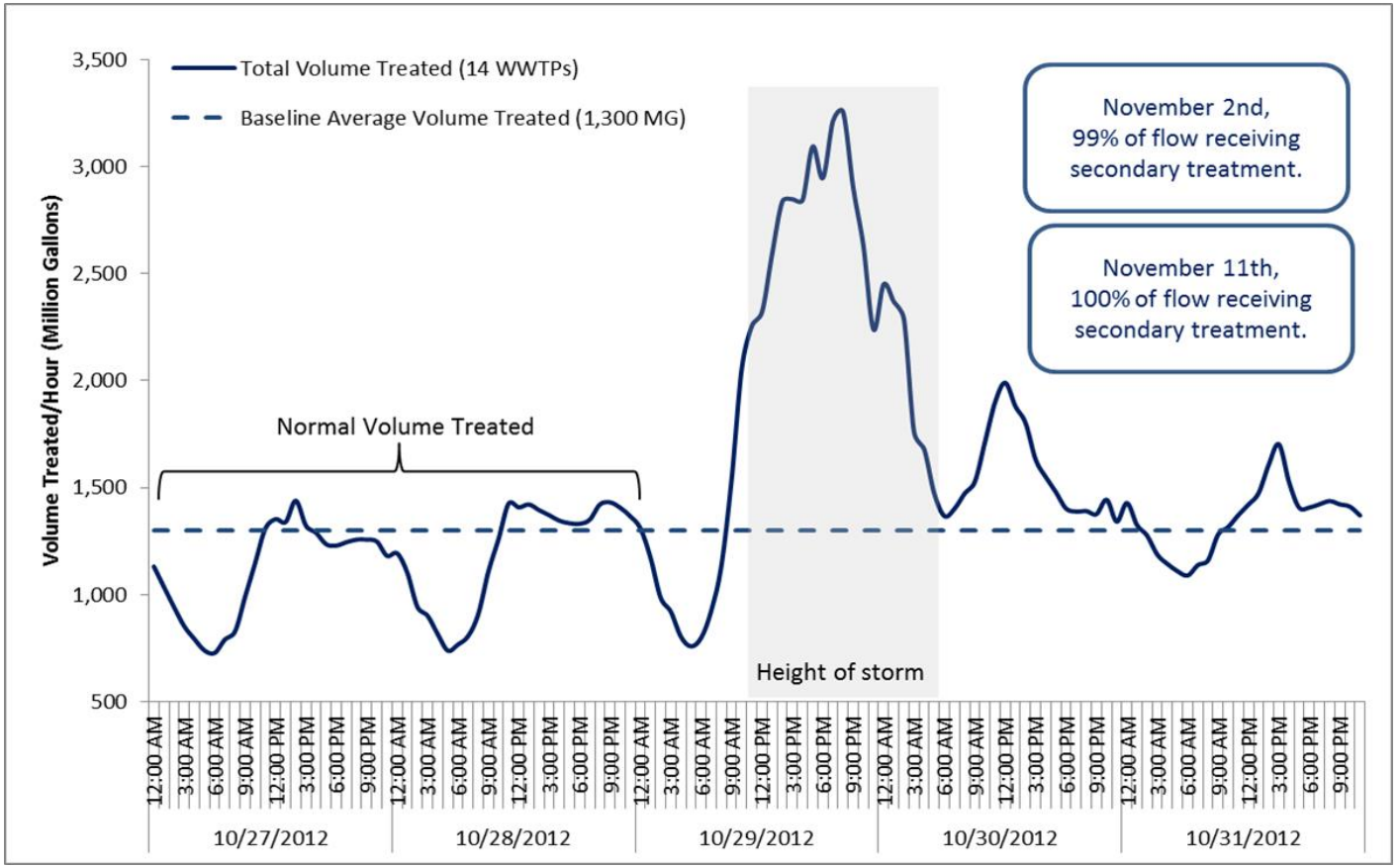


Wastewater Impacts

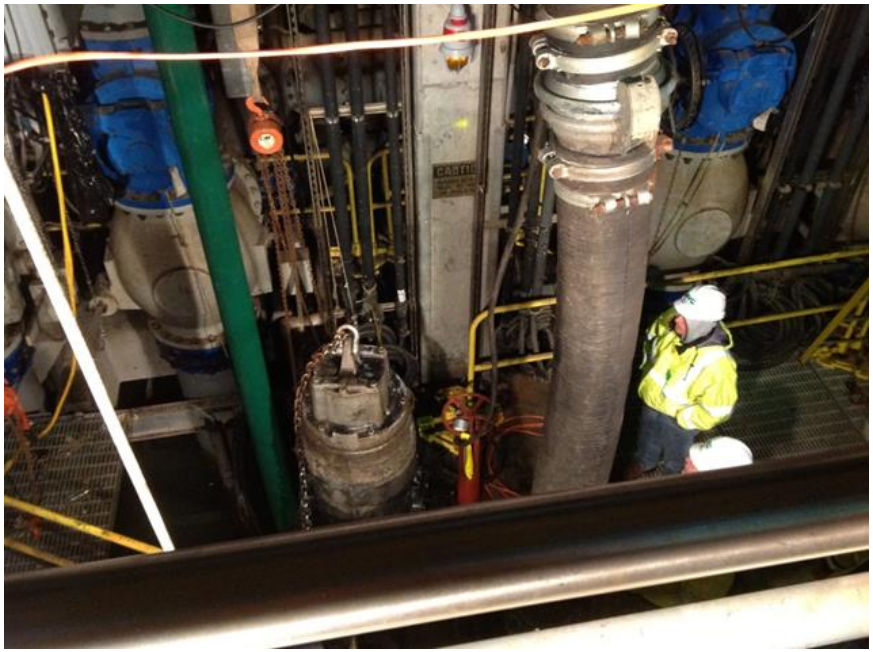
- Three plants lose ability to treat wastewater for some duration
- 10 of 14 plants experience some flooding or process issues
- 42 of 96 wastewater pumping stations flooded or without utility power
- Damage to tide gates and interceptors
- Debris and sand pushed into catch basins and sewers

Wastewater Impacts

Wastewater Treated: During the height of the storm 10 of the 14 WWTPs were treating 2xDDWF



Rockaway WWTP Response



Loss of Main Sewage Pumps

By-Pass Pumping from Wet well

Structural Damage at Rockaway WWTP

Abandoned Pipe – conduit to flooding of galleries

Subsidence at Sludge Storage Bldg

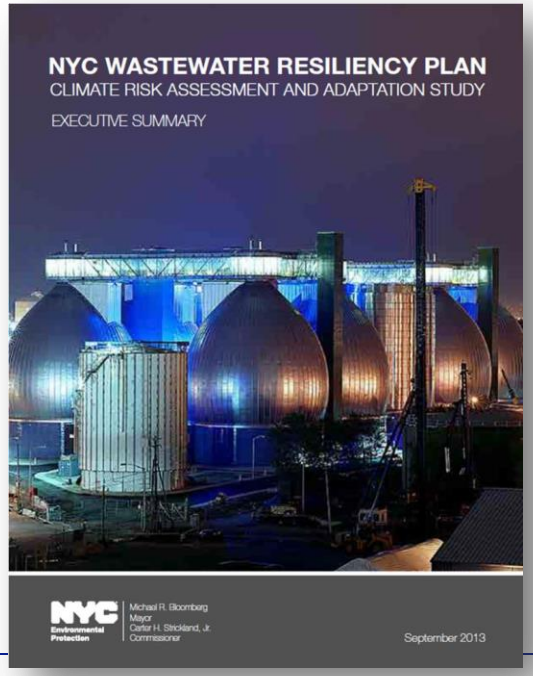
WASTEWATER RESILIENCY

Provide a roadmap to

enhance the flood resiliency of wastewater infrastructure

considering existing vulnerabilities, cost, and level of protection

- Give a sense of the options and level of effort
- Support funding applications
- Provide preliminary analysis for future design projects

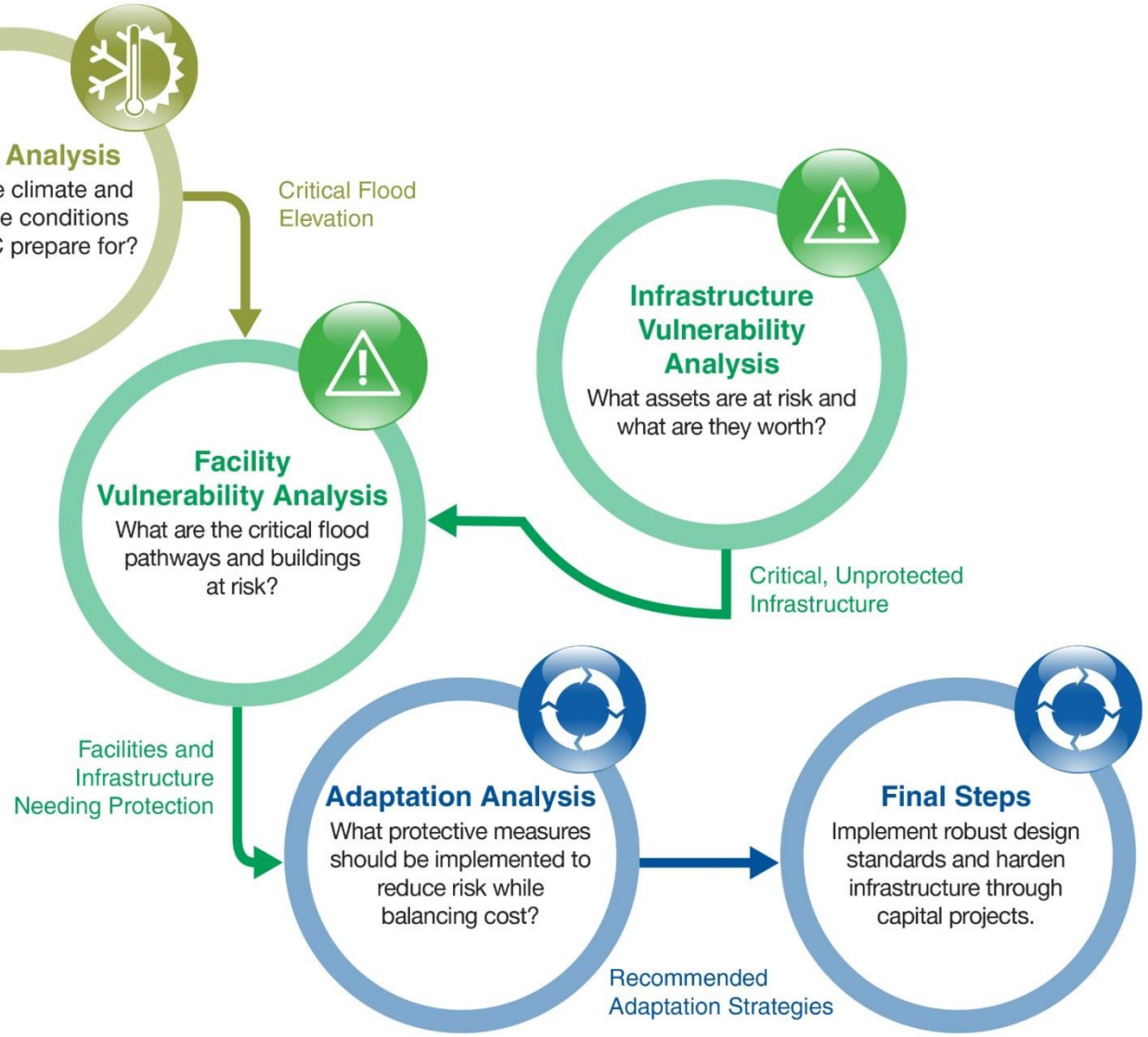


STUDY FRAMEWORK

Phase 1
Climate Analysis

Phase 2
Vulnerability Analysis

Phase 3
Adaptation Analysis



PHASE 1: CLIMATE ANALYSIS

Establish the Design Flood Elevation

Design Flood Elevation = **Current Surge Projections** + **Future Sea Level Rise**

- We chose 100 year ABFE + 30” Sea Level Rise (from NPCC) as a conservative level

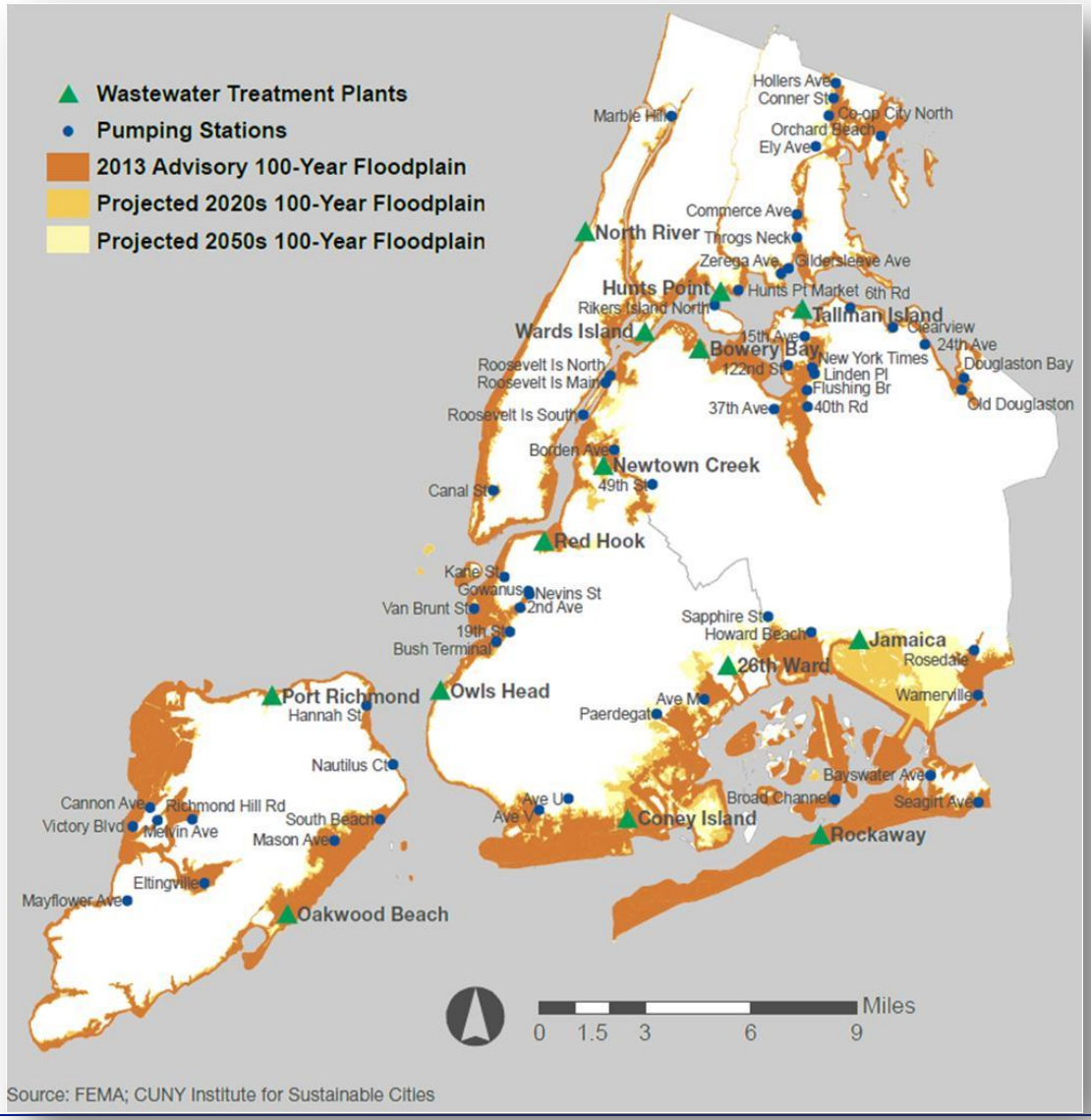
- FEMA
- USGS
- State and Municipal

- IPCC
- NPCC
- Local research institutions

NPCC Seal Level Rise Projections:

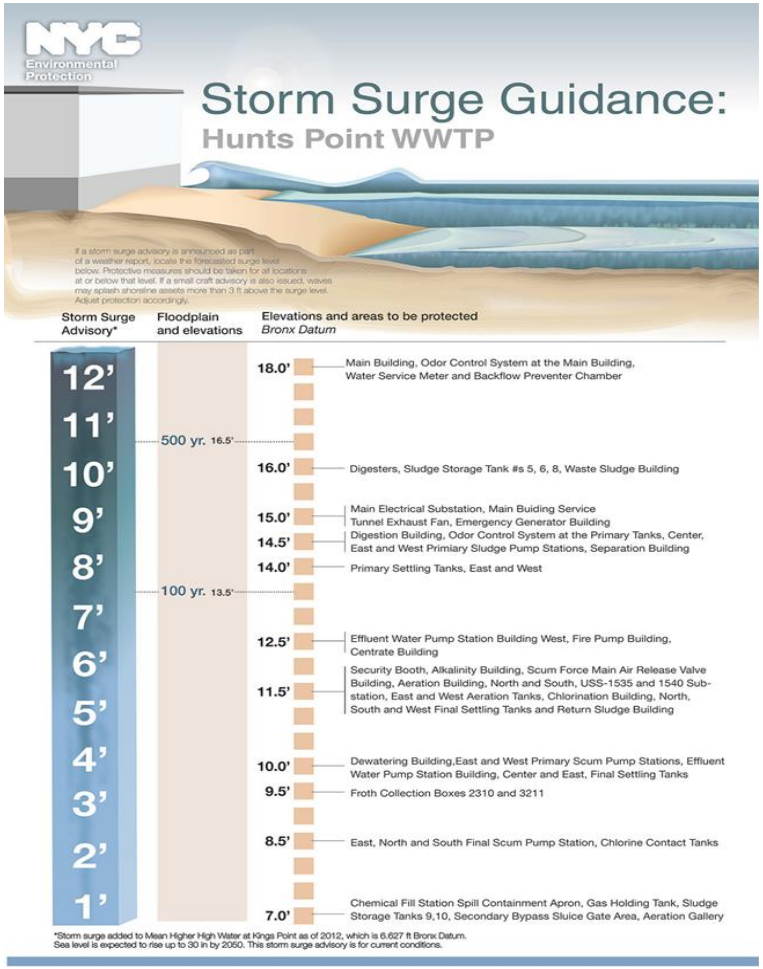
Sea Level Rise Baseline (2000 – 2004)	Low-estimate (10th percentile)	Middle range (25th to 75th percentile)	High-estimate (90th percentile)
2020s	+ 2 in	+ 4 in to 8 in	**+ 10 in**
2050s	**+ 8 in**	+ 11 in to **21 in**	**+ 30 in**
2080s	+ 13 in	+ 18 in to 39 in	+ 58 in
2100	+ 15 in	+ 22 in to 50 in	+ 75 in

PHASE 2: VULNERABILITY RESULTS



- All 14 wastewater treatment plants and 60% of pumping stations are at risk.

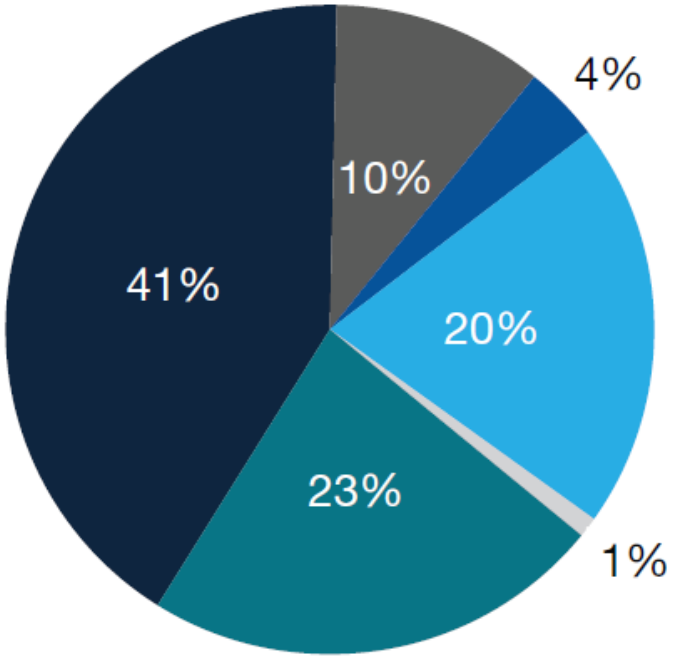
Hunt Point WWTP Vulnerability Analysis



- Almost 2,000 assets reviewed for Hunts Point WWTP
- Prioritization based on criticality of equipment, vulnerability to flooding, and cost of 'do nothing' scenario versus benefits and costs of protective measures
- Number of vulnerable, critical assets increases with sea level rise
- Final adaptation portfolio is likely a mix of emergency response, hardening assets and operational measures

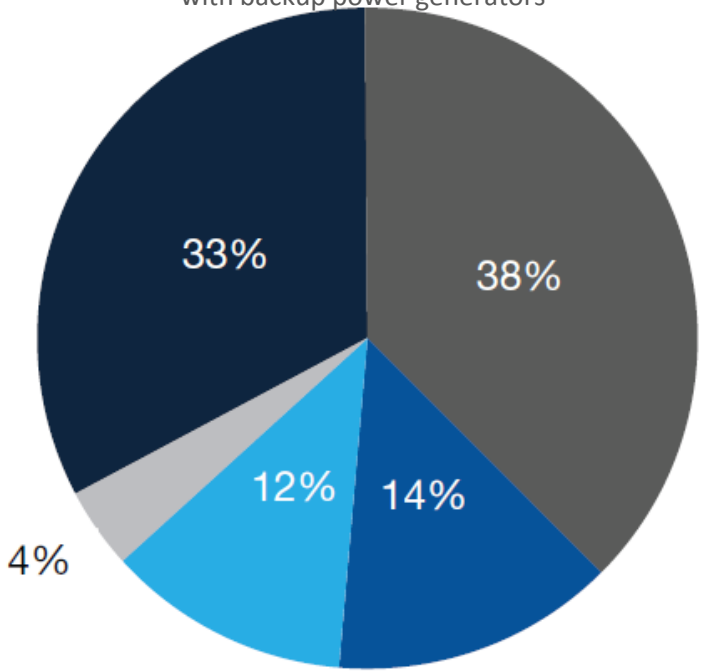
PHASE 3: ADAPTATION STRATEGY

Pumping Stations



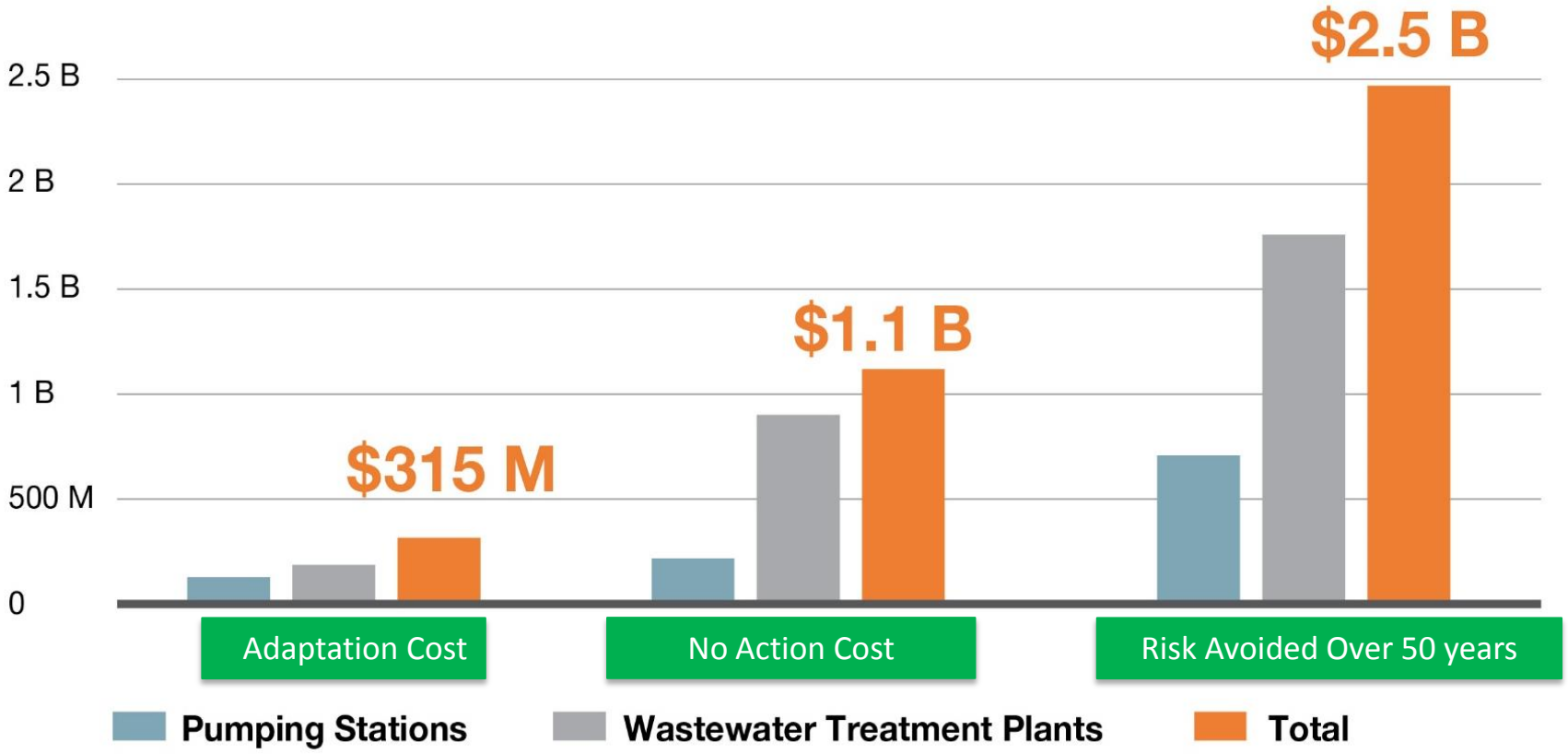
Wastewater Treatment Plants

Note: All facilities are already equipped with backup power generators



- Elevate Equipment
- Flood-Proof Equipment
- Seal Building
- Construct Barrier
- Sandbag Temporarily
- Install Backup Power

SUMMARY OF COSTS



Investing **$315 Million** in strategic fortification can safeguard **$1.1 Billion** of vital infrastructure and save the city **$2.5 Billion** in emergency response costs over the next 50 years.

CHALLENGES

- Climate Resiliency must compete with other demands for Capital Funding
  - State-of-Good-Repair Projects in an aging infrastructure
  - Increases in new Regulatory Programs/Requirements
- Public Perceptions of the “Risks” from Climate Change
  - Growing consensus of reality of Climate Change
  - Still a majority do not believe immediate action is required
- Resistance of other entities to adopt less expensive mitigation strategies
- Fiscal Pressures = resistance to rate increases

Financing America's Infrastructure Needs

- Between now and 2020, America's underinvestment gap will grow from:

  $1.7T to **$2.75T**

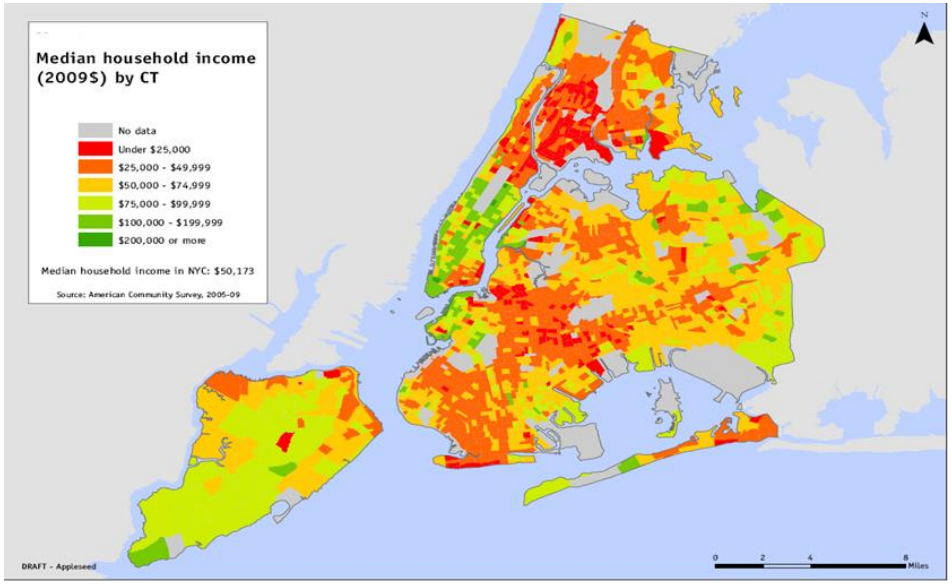
- Expanding, operating and maintaining America's core asset base in order to increase overall economic productivity will require an additional investment of **$157 billion a year** between now and 2020.

- By investing an additional $84 billion in water and wastewater infrastructure through 2020, businesses and households could prevent increased costs of over: **$200 billion**

(Source: American Society of Civil Engineers)

Taking Into Account Affordability Concerns

- By 2020, family budgets will be squeezed by $900 as water rates rise and personal income falls.
- EPA's current affordability criteria for wastewater considers:



Average total wastewater cost per household > 2%
Median household income

- 25% of households pay 2% or more on wastewater bills.
- So, how to allocate investments and drive capital planning with an affordability perspective and additionally address the impacts of climate change?

Getting it right requires…

- Investing in water and wastewater infrastructure .
- Prioritizing capital investments with an affordability perspective.
- Coordination among three levels of government and a national framework to efficiently invest in water infrastructure.
- Integrating climate change science into planning and design with consistent guidance from federal agencies.
- Sustainable drinking water and wastewater management.
- Citywide coordination: One NYC, new long-term strategic plan

… set course for an improved climate-resiliency water resource framework for New York City

Thank You!

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