Lessons Learned and a Framework for Wastewater Vulnerability and Resilience Assessment

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Primary Treatment

Raw sewage enters here

Disinfection

Secondary Treatment: Clarification

Secondary Treatment: Aeration Tanks

GLASTONBURY Water Pollution Control Facility

Outfall to Connecticut River

Figure: S. Pappano, CT DEEP Municipal Facilities Section
Past Storm Impacts

• Milford WWTP within 12 inches of *flooding* and Bridgeport to within 2 inches of *power loss*
  – Regionally 5 WWTP flooded
• Norwalk a pump station was *submerged* by salt water requiring complete rebuilding.
  – Regionally 17 PS submerged
• WWTPs were *inaccessible* in Greenwich and Stratford.
  – Regionally 5 inaccessible
How much is vulnerable?

- 1,000+ pump stations
- 10,000 miles of sewers

Figure: S. Pappano, CT DEEP Municipal Facilities Section
Vulnerability is a function of...

• The hazard itself
  – E.g., Sea level rise, storm surge, wave action, extreme events, climate change

• The physical system
  – E.g., Location, protective measures, back-up systems
Typically vulnerability assessment...

- F[Haz, Exp]

This approach largely ignores the broader social system (e.g., policy, political, management)

- Climate Modeling
  - Historical/future precip/extremes

- Hydrologic and Hydraulic Modeling
  - Stream flows; water surface profiles

- Infrastructure Vulnerability
  - Maps showing locations of high risk areas; process for prioritization

Figure: Bowering et al. 2013. Flood risk assessment for municipal infrastructure...
Why is this problematic?

• No or limited buy-in = no or limited implementation
• Little attention to policy/management = limited opportunity to integrate new information
• Little opportunity for long-term change
• Ignores other social/policy/management factors that can mitigate vulnerability
“Resilience is the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a potentially hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures.” IPCC 2012
Resilience Approach to Vulnerability

Hazard: Natural variability & climate change

Risk

Sensitivity

Adaptive Capacity

Exposure

Adaptation

Figure: adapted from IPCC SREX Report
Resilience Approaches Promote Learning

Should the berm height be increased by 6 inches?

How do we integrate flood resilience in WW with other infrastructure resilience planning?

Should critical assets be relocated or abandoned once established risk thresholds are crossed?
Resilience Framework

Planning/Scoping/Data

Modeling
Climate, hydrologic, hydraulic

Infrastructure Vulnerability
Co-produced maps of asset risks and prioritization

Adaptive Capacity
Co-produced indices

Response Options
Plan and Execution

Stakeholder Process

Evaluation
Thank You

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