Connecticut Utilities - Building Resilience

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What is resilience?

Resilience is the ability of system to prepare for, withstand, recover from, and adapt to a range of climate-related (or other) threats.

A long-term process that balances risk and resources, to flexibly prepare for, cope with, respond to, recover from, and transform in anticipation of or in response to events.

– (Comfort et al. 2010)
Earliest Motivation: Sandy, Irene, & other storms
Recent Motivation: Drought, water quality, etc.

Other stresses:
Demand reduction, Aging infrastructure, Workforce issues, etc.
Flood Risk
• Two times (up to 4x) more extreme precipitation
• Current 1 in 20 yr flood may occur once in every 5 yrs

Drought Risk
• More frequent and more extreme summer droughts likely
• Current 1 in 20 yr drought may occur once every every 3-10 years by mid-century

Seth et al. 2019. Connecticut Physical Climate Assessment
Overview

Wastewater VA
- Sea level rise analysis
- Hydrologic / flooding analysis
- Legal analysis
- Spatial data gathering
- Surveys and interviews

Output: Pilot town resiliency plans and WW guide available at:
https://kirchhofflg.weebly.com/research.html

Water System V & Resilience
- Climate change analysis
- Private wells flood susceptibility
- Policy Analysis
- Spatial data analysis
- Surveys and interviews

Output: State DW resiliency plan
Approach

• Started with literature review (resilience, vulnerability, and adaptive capacity) as foundation for interrogating resilience, especially the human dimensions
  – Eakin et al. (2014) define two types of adaptive capacities: generic (e.g., funding, knowledge, leadership) and specific (e.g., specific interventions and capacity for intervention)

• Use social science research methods (surveys & interviews) to understand W&WW managers’:
  – Experience with extreme events; changes; factors that influence learning and change; resilience perspectives and thinking
Methods

- Surveys (n=173) & interviews (n=53) of CT wastewater (WW) and water (W) systems
- WW surveys and interviews were conducted in 2015-2016
- Interviews with water managers were conducted from 2017-2018 followed by a survey in 2018
IMPACTS OF PAST EXTREME EVENTS
Most WW Systems Impacted

- 72% of respondents experienced impacts from past extreme storm events
- Large and small systems and inland and coastal systems impacted
Impacts Experienced by WW

- Lost power: 68.6% experienced, 31.4% did not
- Experienced flooding: 57.0% experienced, 43.0% did not
- Bypassed: 51.2% experienced, 48.8% did not
- Lost access: 26.7% experienced, 73.3% did not

Percent of Systems

Experienced impact
Did not experience impact
Storm Impacts for CWS

• Most systems experienced some kind of storm impact; but, storm impacts generally less severe than drought impacts

- Used a generator/Lost power
- Implemented emergency response
- Staff had difficulty getting to work
- Experienced flooding

Chart showing percentages of respondents who experienced each impact.
Drought Impacts for CWS
(e.g., from 2015 – 2016 drought)

- Most systems experienced some kind of drought impact; but few experienced really severe impacts

- Voluntary water restrictions
- Experienced reduced supply
- Used an interconnection
- Boil water advisory
RESILIENCE ACTIONS
Most WW Systems (>75%) Made Changes

- Some changes low cost, temporary
  “…our local machine shop made up stop gates. …we just drop them in and it holds back the water” (S24).

- Some are permanent & more costly
  “[W]ith the flooding …, we lost a few generators. When we replaced them, … we [built them up] on a cement pier using the high water mark from that [flood] event” (S09).

- Not only equipment but managerial and operational changes too
CWS Actions to Prepare, Cope, Recover

• Permanent Equipment/Technology
  – Backup generator
  – Remote Sensing / SCADA
  – Establish an interconnection
  – Invest in the watershed

• Managerial and operational changes
  – Revise response plans
  – Educate staff
  – Raise rates
MOTIVATION FOR CHANGE
WW Drivers of Change

• Experience with multiple disruptive, damaging impacts (median 3 vs. 1, U = 297.5, p<0.001)

• Organizational leadership including being entrusted and empowered to make decisions & creating a culture of continuous improvement

• Some (but mixed) evidence concern for future climate-related risks helps drive change
W System Drivers of Change

• Regulatory compliance is the biggest motivator as is availability of funds (e.g., for generators)

• Climate change is not a huge driver or concern

“In all honesty, that [climate change] really doesn't affect us. ... As much as you know you want to say you're concerned about the environment or climate change, it's not affecting my water system.”

--Public utility manager
RESILIENCE & RESILIENCE GAPS
“Our focus has been ... hardening facilities” to increase “...survivability due to extreme weather events. I think we basically call it, the new buzz term is, resiliency" (S23).
But, mostly resilience to the past

- Elevating equipment to at or just above past flood levels
- Incremental, reactive changes based on improving coping, recoverability of past storms
- Can get stuck – complacent, if perceived threat risk is sufficiently reduced
Resilience to future change

- Driven mostly by new regulations requiring that CWSRF monies address expected climate change impacts

“Our upgrade that is in the planning stages and includes one hundred plus three is driven by state requirements” (S16).
Resilience to future change

• Most CWS aware that climate change will bring more frequent or severe droughts and storms but only high capacity systems are thinking about these changes and only in terms of strategic (very high level) planning
Resilience is a Human-Driven Process

- High amounts of generic adaptive capacity (e.g., leadership, experienced staff, funding, knowledge) is crucial for:
  - Fostering good day-to-day and emergency operations
  - Facilitating a culture of ongoing change & adaptive management
  - Build and deploy more and more diverse types of adaptive changes (specific adaptive capacities); ideally, within an adaptive management framework
  - Seek and use information to inform ongoing risk assessment, anticipation and proactive response
Questions and Resources

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Resources
https://kirchhofflg.weebly.com/research.html

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