Resilience of Wastewater and Drinking Water Systems

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Contributors:

CT Water and Wastewater Systems









Resilience

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

Motivation: Sandy, Irene, & other storms



Drought, water quality, other stresses





10/28/2016

Gov. Malloy: After State's First-Ever Drought Watch Issued, Residents Asked to Voluntarily Reduce Water Use When Possible

Drought Watched Issued for the First Time Ever in Six of Connecticut's Eight Counties

Other stresses:

Demand reduction, Aging infrastructure, Workforce issues, etc.

Climate change will likely worsen flood and drought risks

Flood Risk

- Current 1 in 20 yr flood may occur once in every 5 yrs
- Two times (up to 4x) more extreme precipitation

Drought Risk

 More frequent and more extreme summer droughts likely

Wang, G. 2018. "Future Changes of Extreme Precipitation and Drought in CT." Presented at Workshop: Implementing a Drinking Water Resilience Plan for Connecticut. April 6, 2018. See presentation recap at: https://circa.uconn.edu/2018/03/19/workshop-drinking-water/

Resilience

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Often resilience efforts often focus on physical infrastructure

Resilience

A long-term **process** that is a balancing act between risk and resources, that results in the means to be flexibly innovative in **preparing** for, **coping** with, **responding** to, **recovering** from, and **transforming** in anticipation of or in response to events.

- (Comfort et al. 2010)

RESEARCH APPROACH

Approach

- Use social science research methods (surveys & interviews) to understand W&WW managers:
 - Experience with extreme events (prepare, cope, recover, change)
 - Perspectives and thoughts about resilience and improving resilience

Approach

 Use this understanding to derive broader lessons about what helps (or hinders) building resilience and identify strategies to help address resiliency gaps

Survey & Interview Data

 Thank you (!) to all the water and wastewater managers who participated in surveys and/or interviews

	Wastewater	Water
Surveys	86 (65.6%)	60+ (ongoing)
Interviews	29	23

Survey Methods

Wastewater

- 20 to 60 minute online & paper survey
- WW superintendents & operators



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STORM RESPONSE SURVEY

The following is a survey for the Department of Energy and Environmental Protection (DEEP) to assemble data regarding past experiences with storm and flood events, the status of flood response plans, and relevant structure and function in municipal wastewater treatment plants and pump stations in Connecticut.

Survey Methods



Welcome!

The University of Connecticut Department of Civil and Environmental Engineering is conducting a survey of drinking water systems in Connecticut. You have been contacted because of your work with community water systems.

Water

- ~15 minute online survey
- CWS managers or owners

Interview Methods (Ex. Water)

- 1 hour semi-structured phone interviews with CWS managers
 - System overview
 - Storm and drought preparation, experience, and response
 - Climate change & resilience
- Aimed for representativeness
 - Across all four coastal counties
 - Diverse sources (SW, GW, PW), sizes (20 to 400,000 served), ownership (public, private, institutional)

RESULTS

Experience with extreme events (prepare, cope, recover, change) Full results: Kirchhoff and Watson (in review) JAWRA

Most Wastewater Systems Impacted by Past Storms

- 72% of respondents experienced impacts from past storms
- Large and small sytems and inland and coastal systems impacted



Types of Impacts Experienced



Actions to Prepare & Cope

• Some are low cost, temporary

"...our local machine shop made up stop gates. ...we just drop them in and it holds back the water" (S24).

"We'll fill up all the fuel tanks and make sure all the vehicles are fueled up" (S14).





Actions to Prepare & Cope

 Not only equipment but managerial and operational changes

"...if there's going to a hurricane ... or nor'easter. What we do is typically we'll leave guys here at the facility rather than risking not being able to get to work" (S14) in advance of a storm.

Conduct more trainings (S16 and O20) and save more money to fund emergency repairs (DE18).

Actions to Prepare & Cope & Recover

• Some are permanent & more costly

"[W]ith the flooding ..., we lost a few generators. When we replaced them, ... one we put up on a cement pier using the high water mark from that [flood] event" (S09).



Stafford Springs UV

Norwalk pump station Photo: Kirchhoff



Many systems made changes

- Changes driven by:
 - Experience with multiple disruptive, damaging impacts (median 3 vs. 1, U = 297.5, p<0.001)

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- Changes driven by:
 - Experience with multiple disruptive, damaging impacts (median 3 vs. 1, U = 297.5, p<0.001)
 - Organizational leadership including being entrusted/empowered to make decisions & creating a culture of continuous improvement

Many systems made changes

- Changes driven by:
 - Some (but mixed) evidence concern for future climate-related risks helps drive change

"I. mean global yarmiggnoites alving ostant iof the big sohe we're things thet (jtgislade [are the] nationmy plantp" (12/1051) and the plant here. So we're hoping that'll help us" (S32).

RESULTS

Perspectives and thoughts about resilience and improving resilience

Full results:Kirchhoff and Watson (in review) JAWRAMullin and Kirchhoff (in review) JAWRA

WW Managers Aim to Improve Resilience

"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

Few resilient to climate 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).

"the state ...requiring to put in resilience flood measures. ...that's kind of the driving force behind it (S12)."

Lessons: Resilience a Human-Driven Process

- Effective leadership coupled with experienced staff are crucial for:
 - Fostering good day-to-day and emergency operations
 - Facilitating a culture of ongoing change & adaptive management
- More resilient systems:
 - Employ a greater diversity of adaptive changes (temporary and permanent, hard and soft)
 - Monitor and track change and response over time (support adaptive management)

Thank you!

- Thank you to all interview & survey participants!
- Co-authors: Treuer, Mullin & Watson
- Co-Investigators: Dr. Wang, Dr. Burnicki
- Collaborators/partners: CIRCA, CTDEEP, CTDPH, MMI





Questions?



