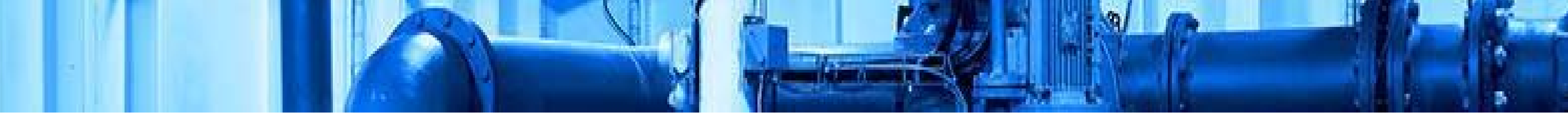


Smart Management for
Small Water Systems

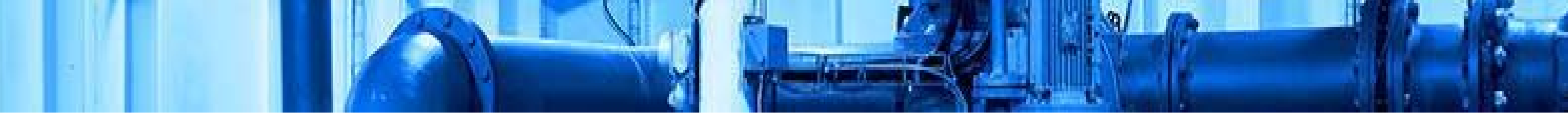
Resiliency Planning for Small Water Systems: How to Weather the Storm

Tuesday, February 13, 2018

www.efcnetwork.org

EFCN
environmental finance center network

This program is made possible under a cooperative agreement with the U.S. EPA.



Logistics

Opening the control panel

Show your control panel

All phones/microphones are muted
for the duration of the webinar

Toggle between full screen/window screen view

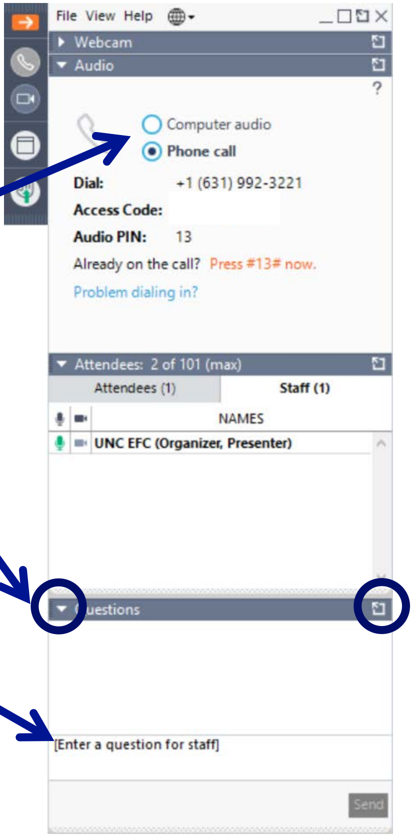
Using the control panel

Audio: please choose between computer audio or phone call

If you do not hear audio right now, please check your speaker volume or enter #[your Audio PIN]# if using phone

Click [▸] to open in Control Panel

Submit **questions** in the Questions box at any time, and press [Send]



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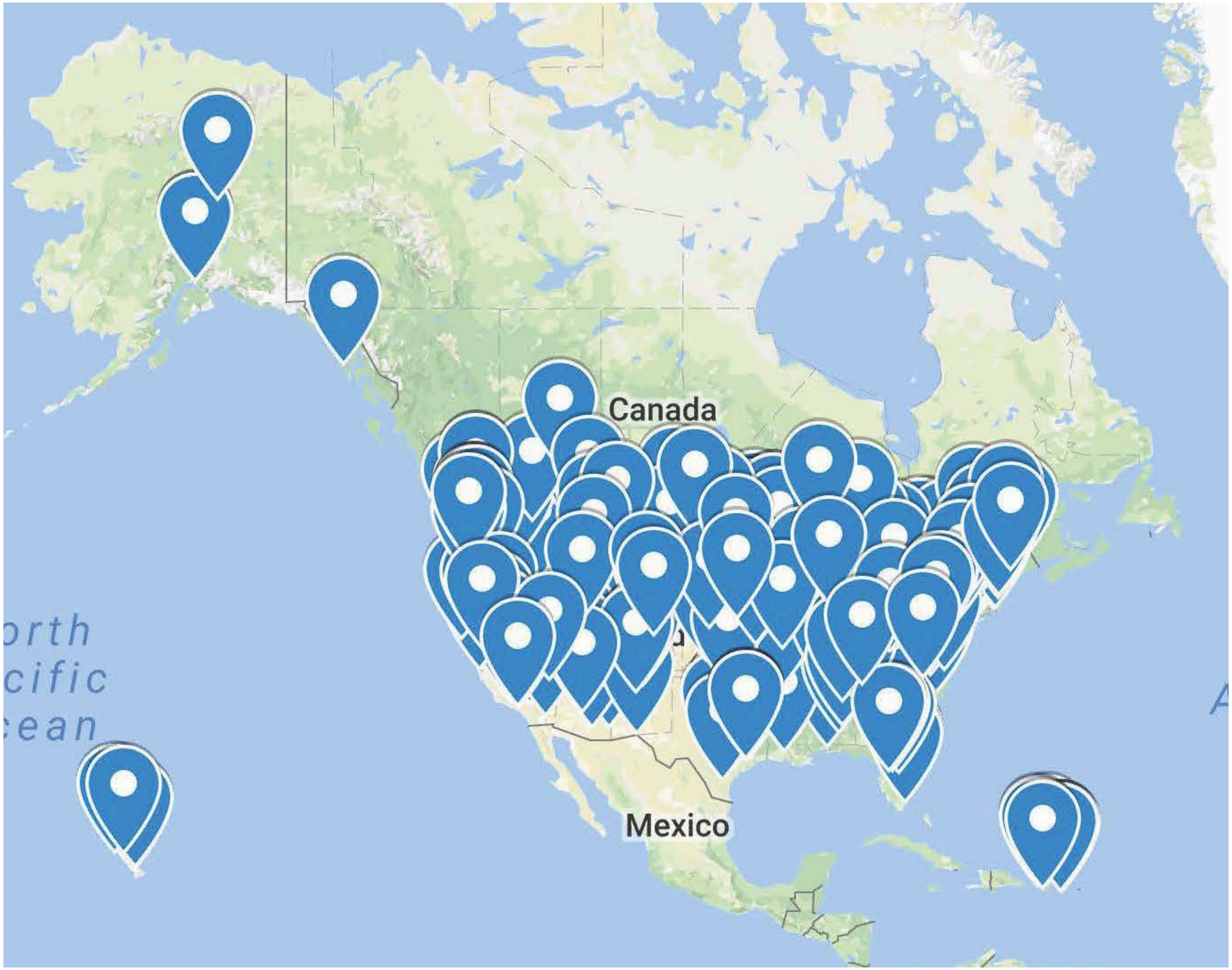
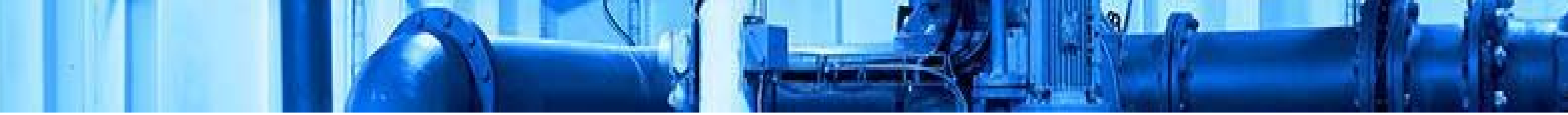
Registrants of this Webinar





About the Environmental Finance Center Network (EFCN)

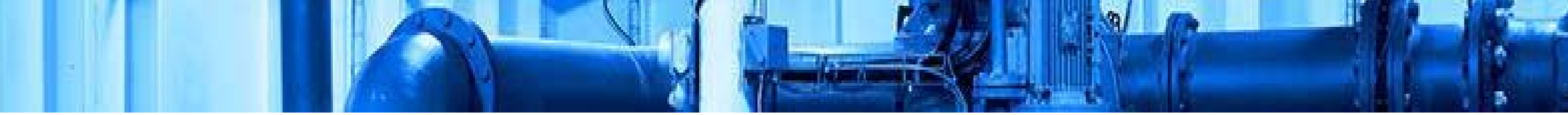
The Environmental Finance Center Network (EFCN) is a university-based organization creating innovative solutions to the difficult how-to-pay issues of environmental protection and improvement. The EFCN works with the public and private sectors to promote sustainable environmental solutions while bolstering efforts to manage costs.

The Smart Management for Small Water Systems Program

This program is offered free of charge to all who are interested. The Program Team will conduct activities in every state, territory, and the Navajo Nation. All small drinking water systems are eligible to receive free training and technical assistance.

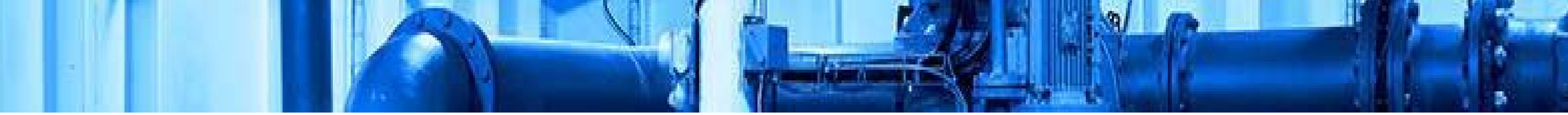
What We Offer

Individualized technical assistance, workshops, small group support, webinars, eLearning, online tools & resources, blogs



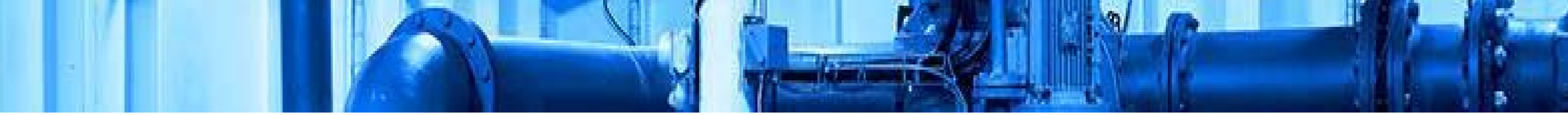
The Small Systems Program Team

- Environmental Finance Center at The University of North Carolina at Chapel Hill
- Environmental Finance Center at Wichita State University
- EFC West
- New England Environmental Finance Center at the University of Southern Maine
- Southwest Environmental Finance Center at the University of New Mexico
- Syracuse University Environmental Finance Center
- Environmental Finance Center at the University of Maryland
- American Water Works Association (AWWA)



Areas of Expertise

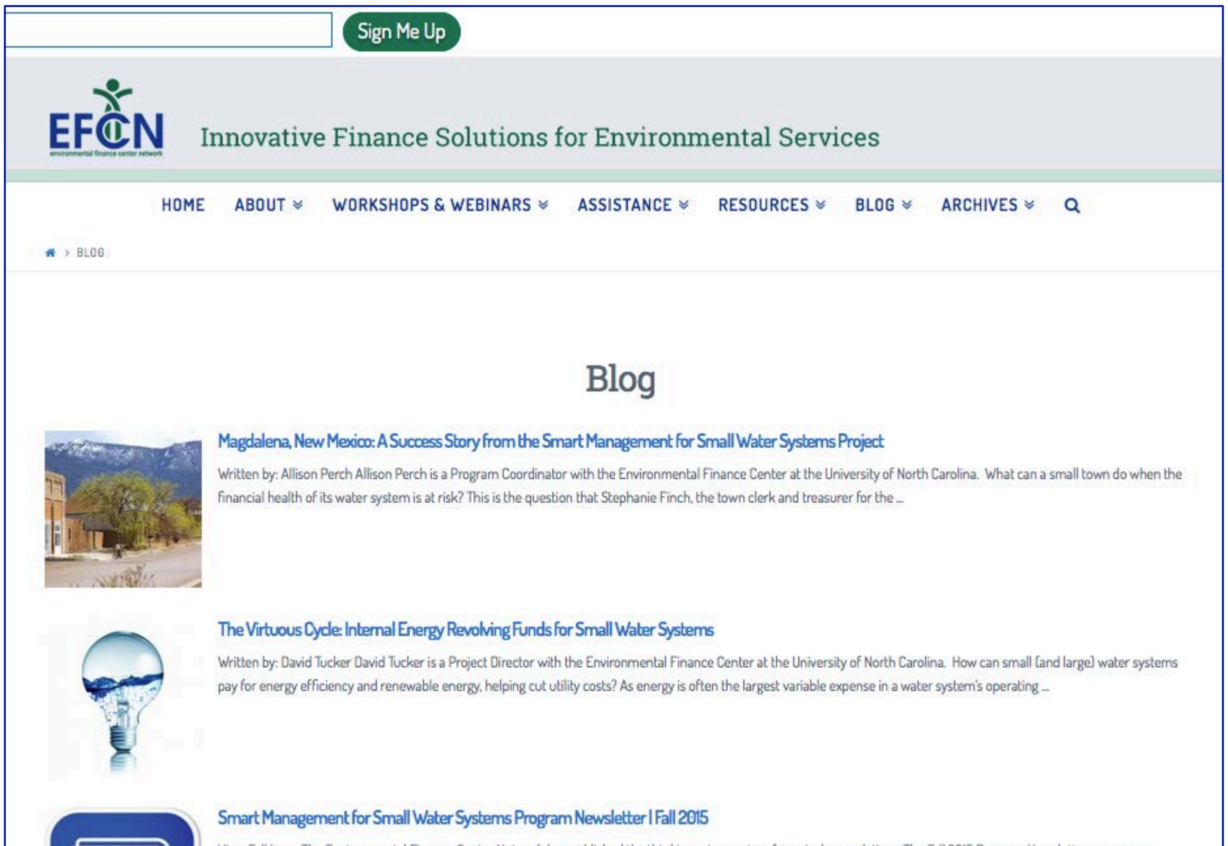
- Asset Management
- Rate Setting and Fiscal Planning
- Leadership Through Decision-making and Communication
- Water Loss Reduction
- Energy Management Planning
- Accessing Infrastructure Financing Programs
- Workforce Development
- Water Conservation Finance and Management
- Collaborating with Other Water Systems
- Resiliency Planning
- Managing Drought

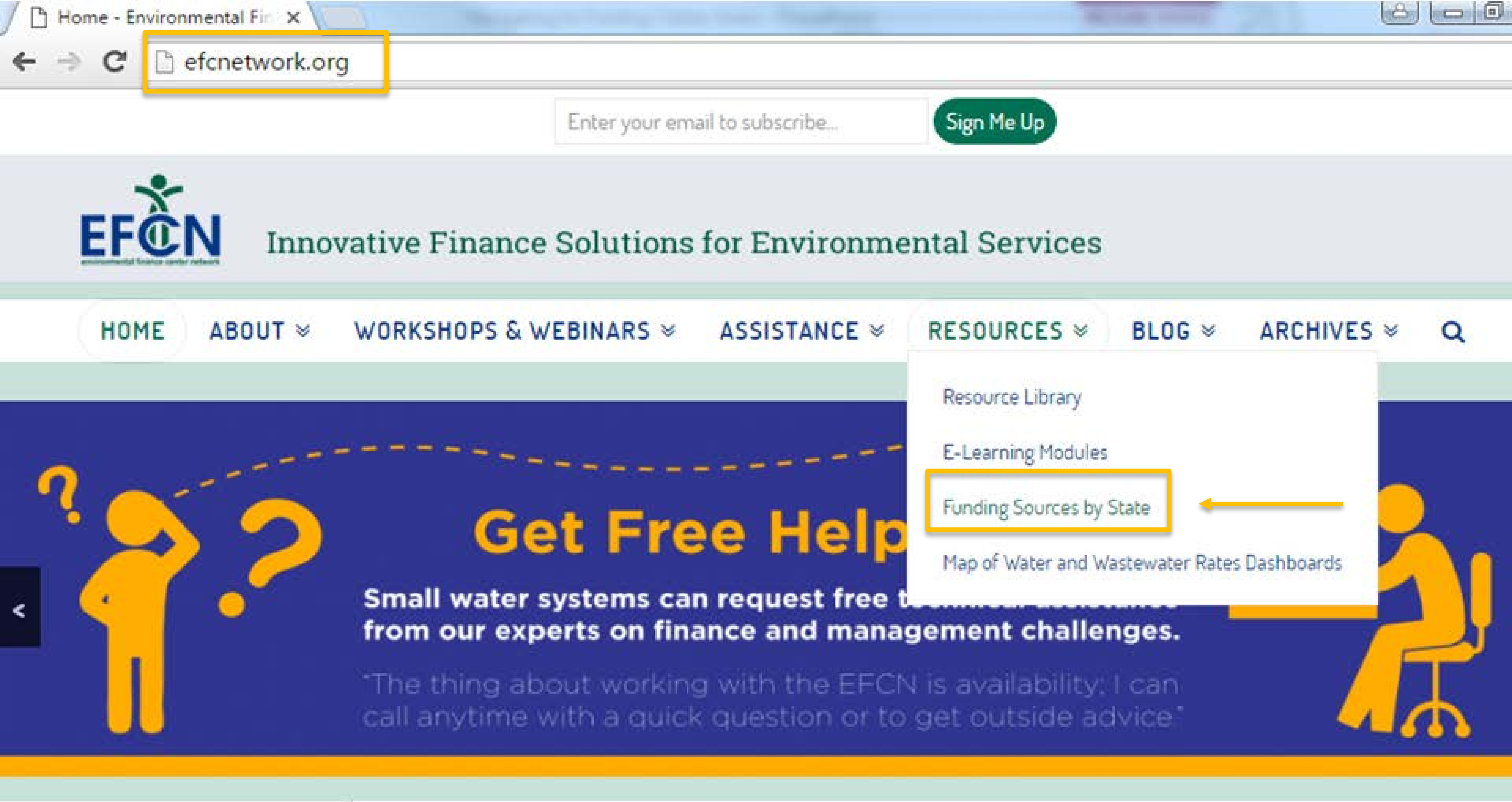


Small Systems Blog

Learn more about water finance and management through our Small Systems Blog! Blog posts feature lessons learned from our training and technical assistance, descriptions of available tools, and small systems “success stories.”

efcnetwork.org/small_systems_blog/





Navigating to Funding Tables

Step 1: efcnetwork.org

Step 2: Select "Funding Sources by State" under the Resources Tab

Funding Sources by State

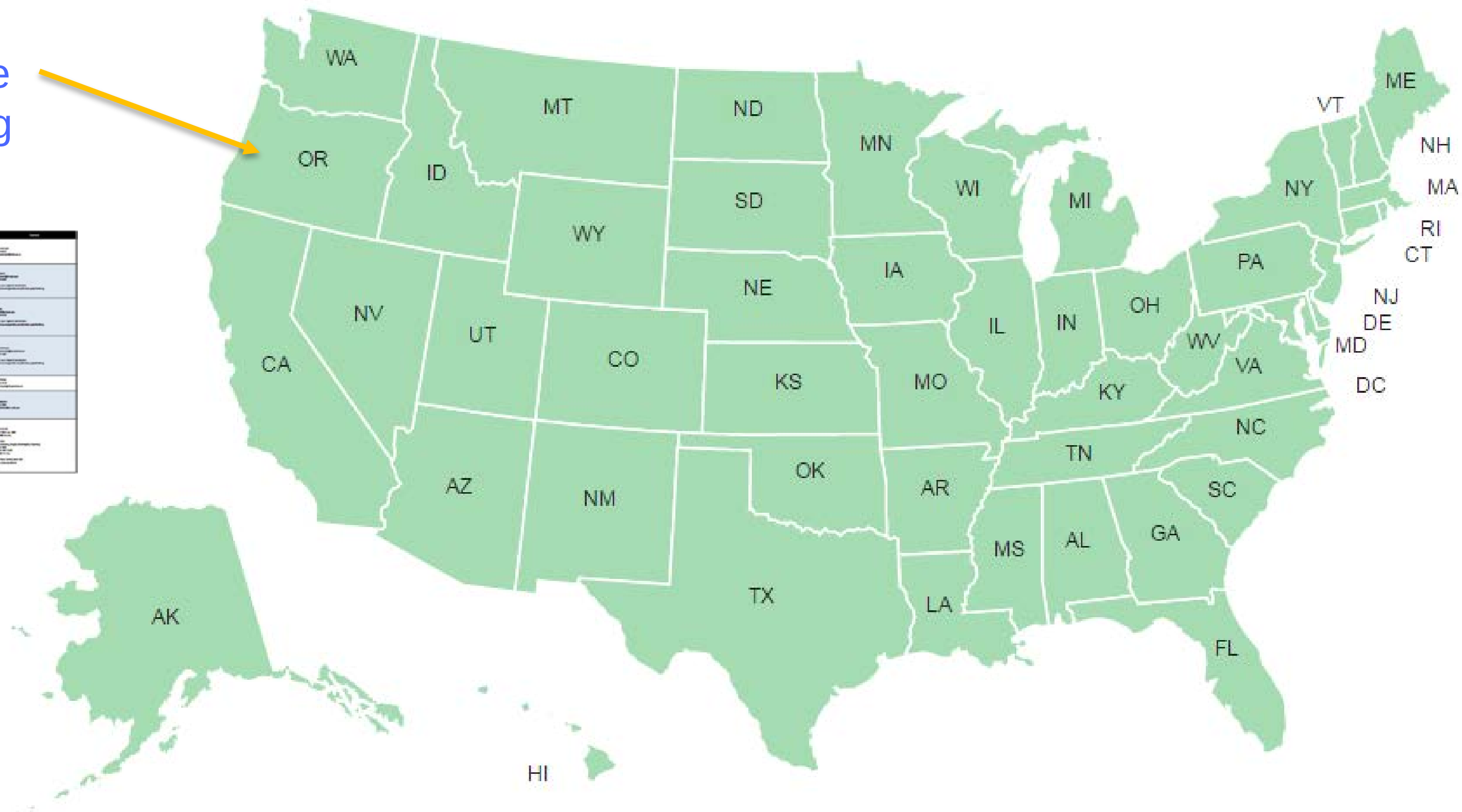
efcnetwork.org/funding-sources-by-state/

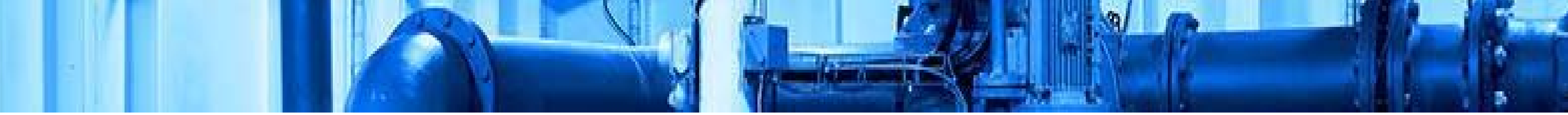
Funding Sources by State

Note: Some states may have additional resources listed below the map.

Click on the map below to view funding sources for each state:

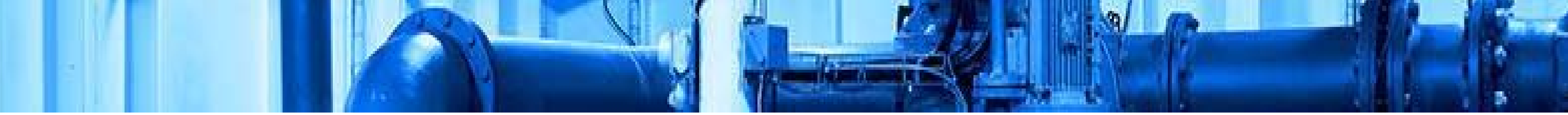
Click on an individual state to view funding table.





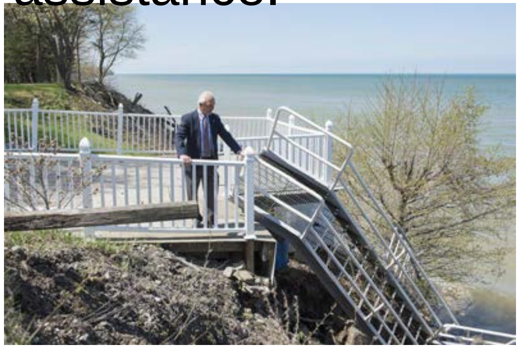
Agenda

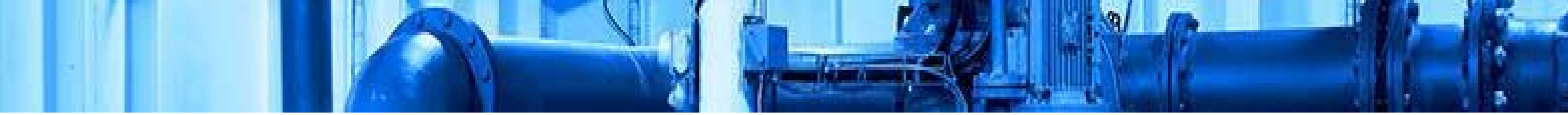
- Defining Resilience
- Trends in risks and threats for water systems
- Establishing a framework for planning ahead
- Implementing resilience strategies
- Resources and tools available to assist water system decision-makers



What is resiliency?

A resilient community is one in which residents and institutions have the capacity to prepare for, respond to, and recover from events and trends with minimal outside assistance.

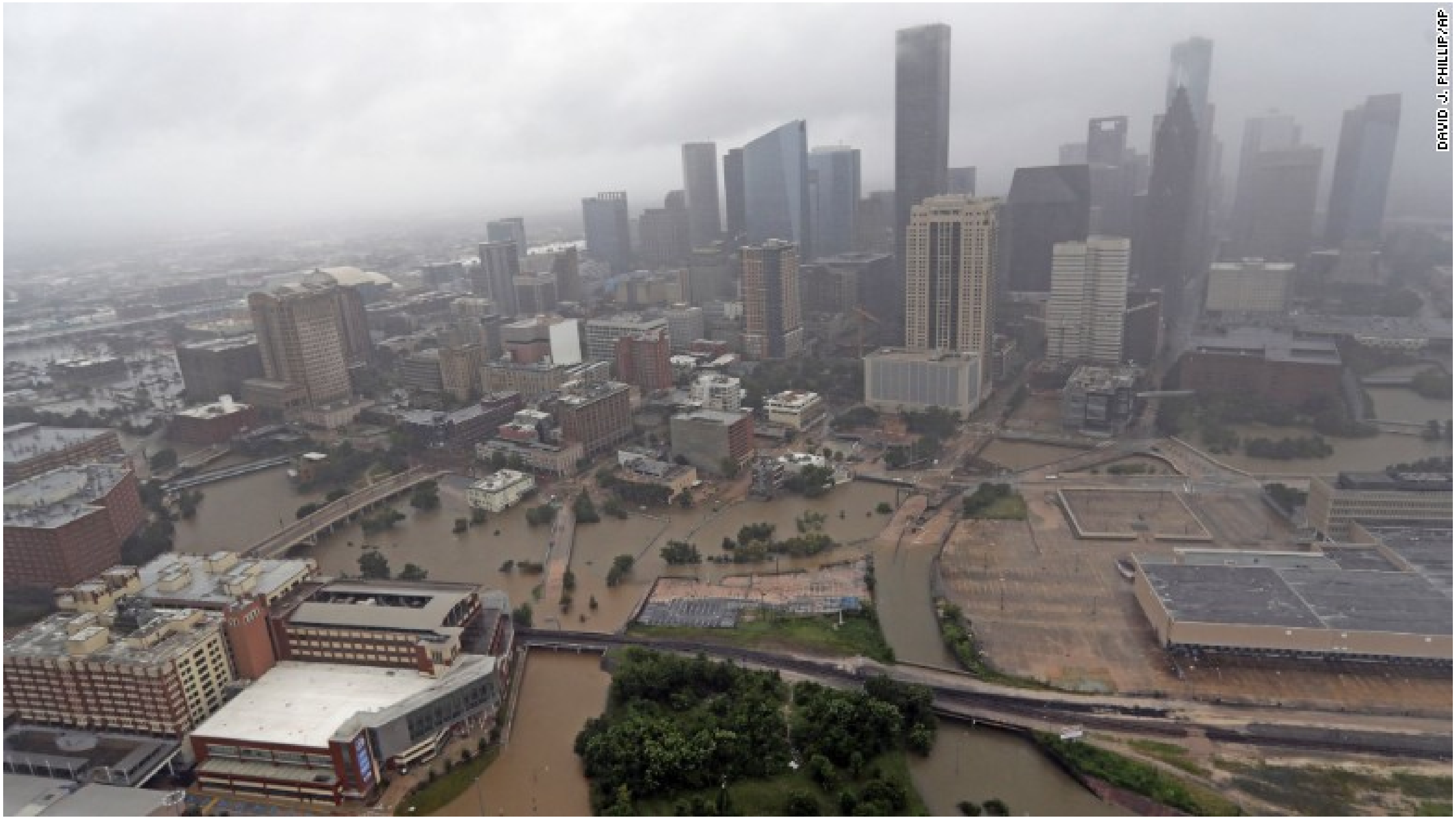




Resiliency Considerations

Community resiliency can include:

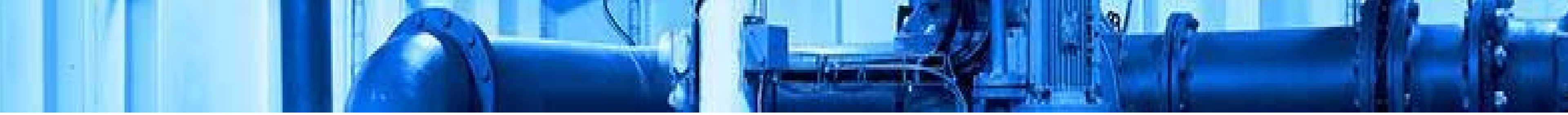
- Municipal financial health
- Community financial health
  - Is your portfolio diversified? Consider:
    - community demographics
    - Commerce
    - relation to neighboring communities
- Environment:
  - water supply,
  - impacts from storms,
  - drought,
  - social, cultural, and economic changes
- Adaptation to ~~{Climate}~~ Change
- Social, cultural, and economic changes



Sometimes we don’t know we’re not resilient

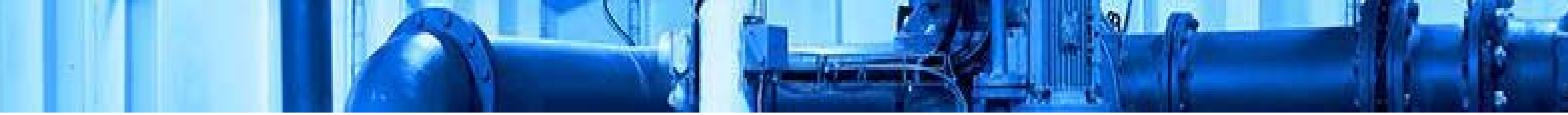
How, if and where do we rebuild?

Proactive Resiliency Planning vs. Reactive Disaster Response



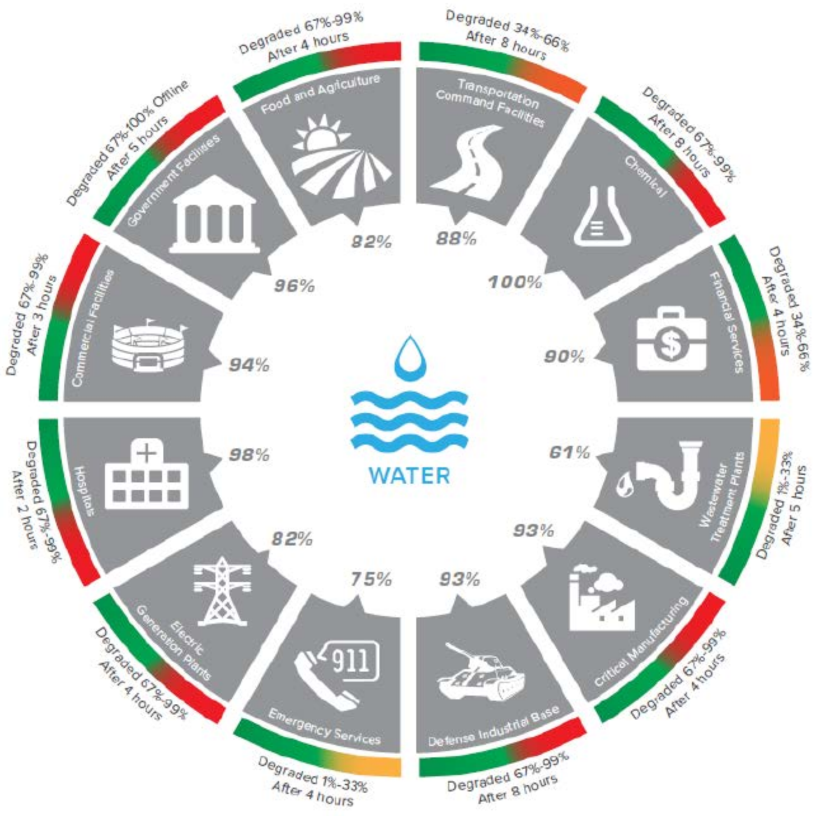
Waiting is Costly

Katrina · Oroville Dam · Flint · UCLA



Impacts to Critical Infrastructure

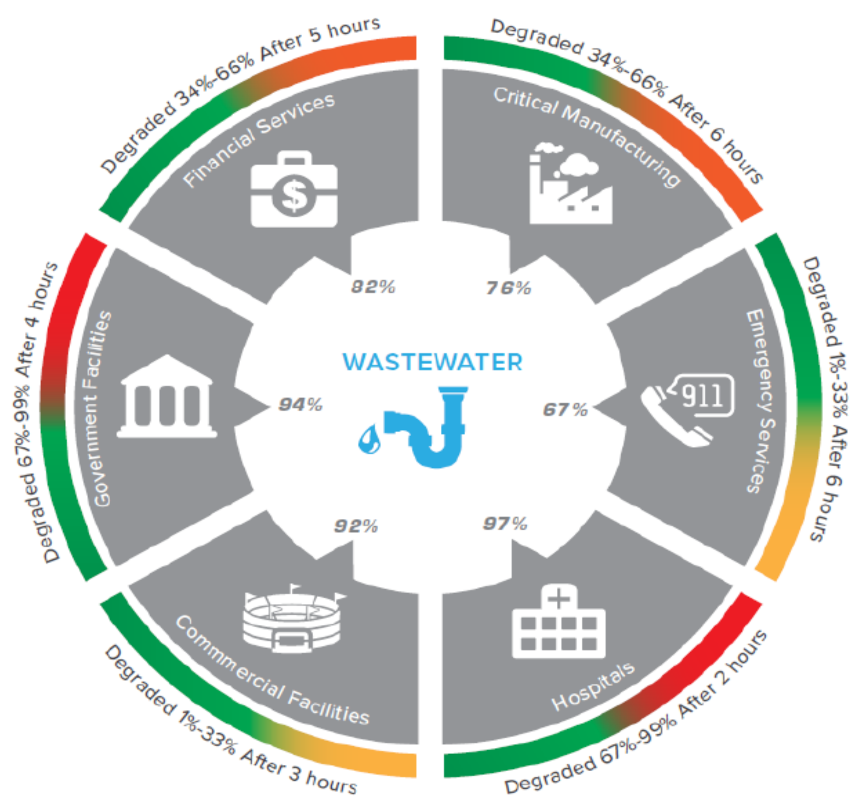
LOSS OF WATER SERVICES



Note: This data represents a majority (60 percent or greater) dependence on water.

FIGURE 3.—Critical Infrastructure Dependent on Water and Potential Functional Degradation Following a Loss of Water Services (Courtesy of DHS and Argonne National Laboratory).

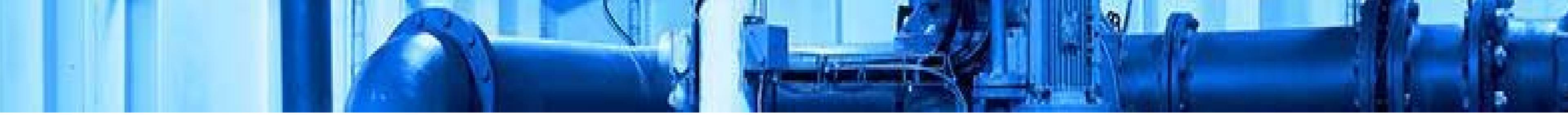
LOSS OF WASTEWATER SERVICES



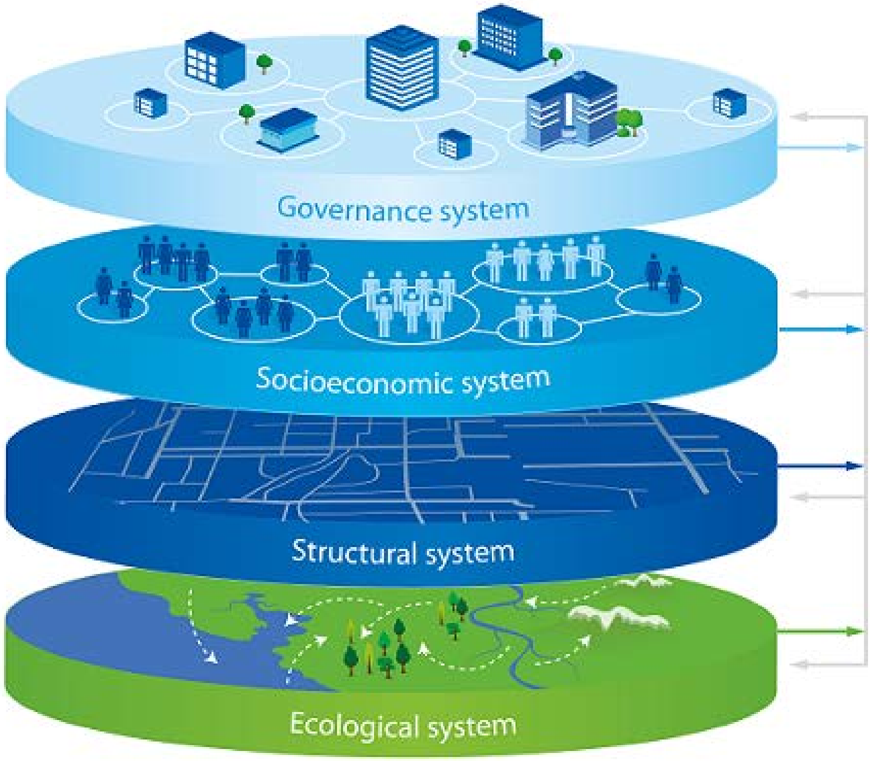
Note: This data represents a majority (60 percent or greater) dependence on wastewater services.

FIGURE 4.—Critical Infrastructure Dependent on Wastewater and Potential Functional Degradation Following a Loss of Wastewater Services (Courtesy of DHS and Argonne National Laboratory).

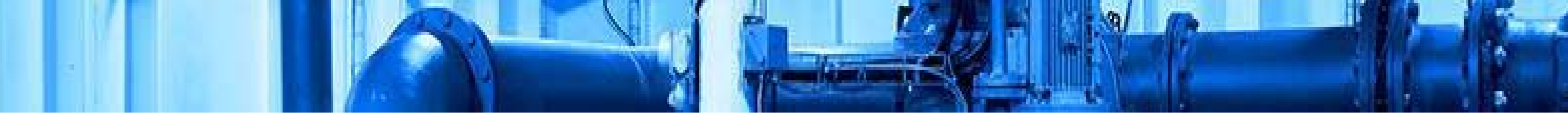
https://www.massport.com/media/266269/Report_Sector-Resilience-Report-Water-and-Wastewater.pdf



Multi-layered Systems Mindset



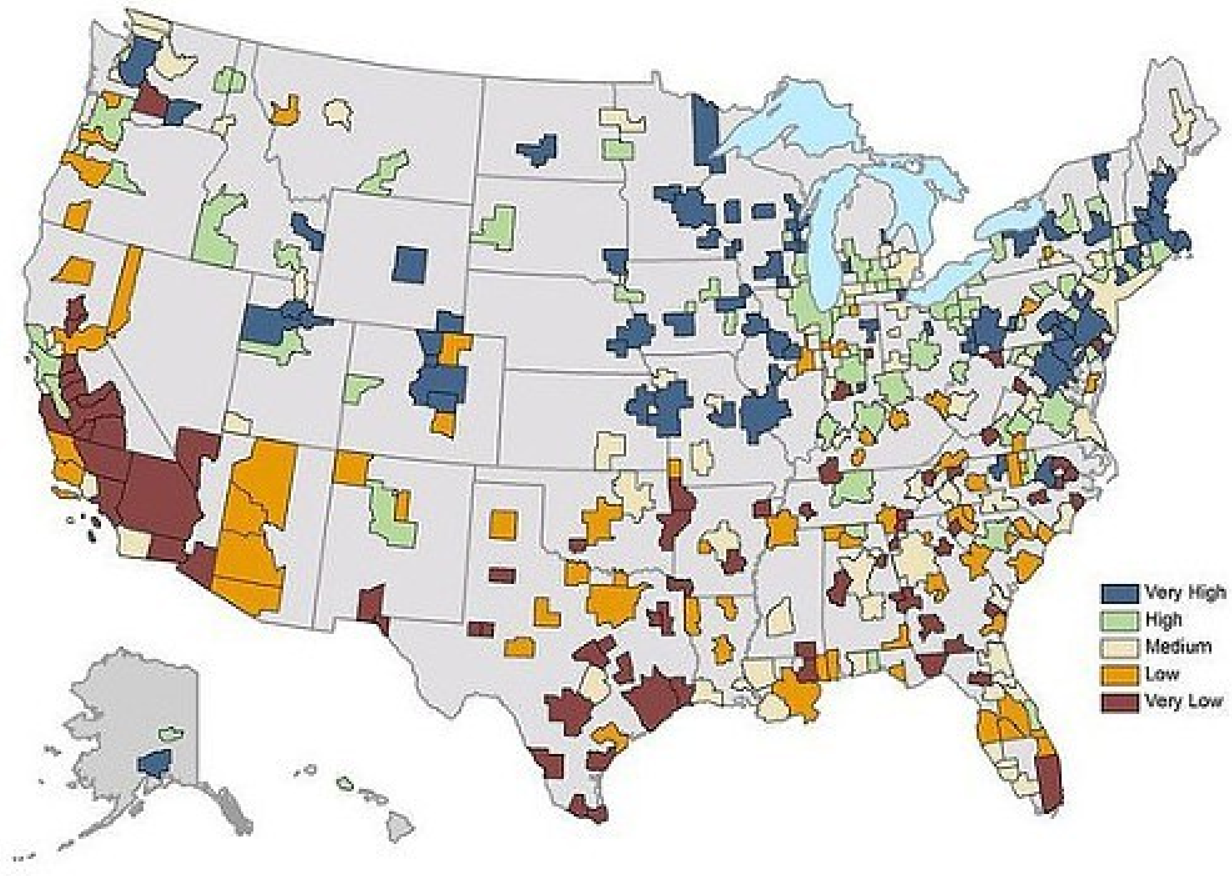
The multi-layered systems mindset in DNV GL's Systems & Urban Resilience Framework (SURF) model.
The model views urban areas as systems with a unique profiles of mutually interconnected ecological, structural, socioeconomic, and governance systems.




Water Stress in the U.S.
Water Supply Stress Index
0.0
0.1–0.2
0.3–0.4
0.5–0.6
0.7–0.8
0.9–1.0
1.1–6.4
Low
High

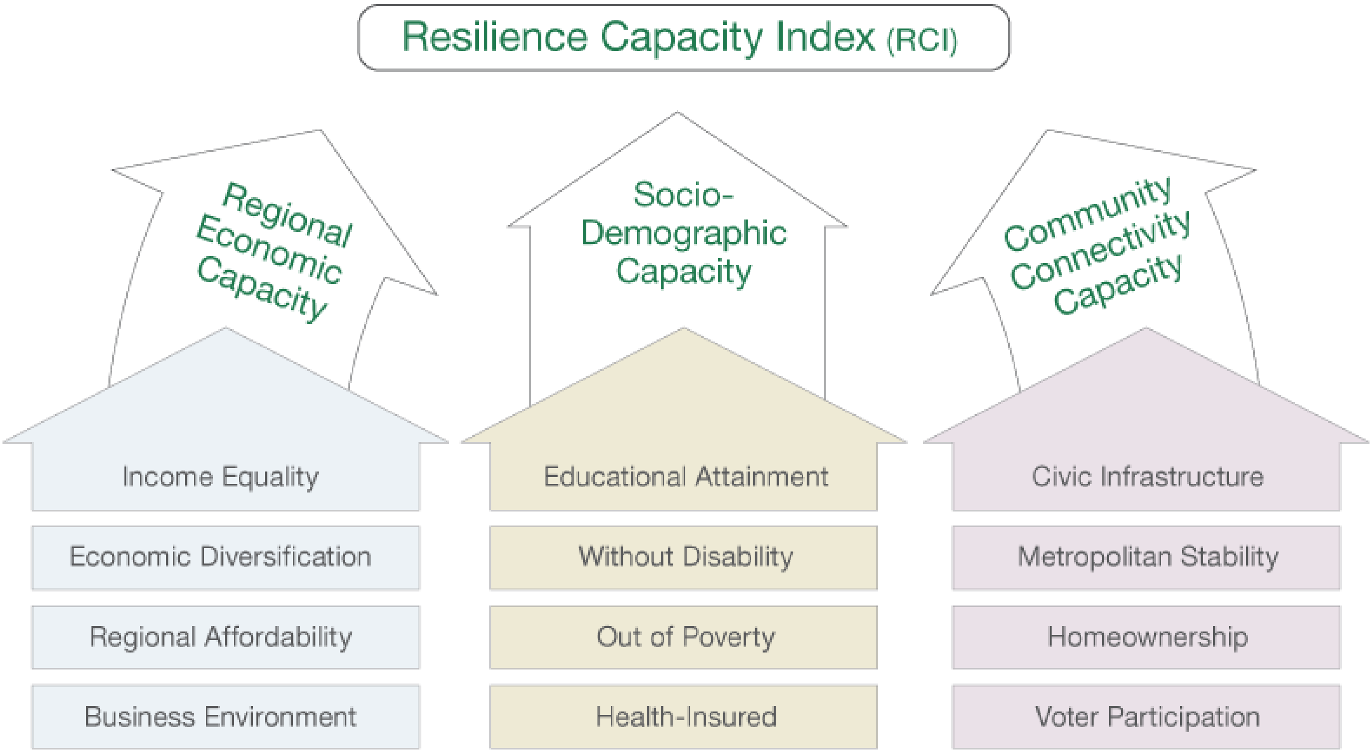

OIL SPILL
AREA CLOSED
NO WATER CONTACT
East Bay Regional Park District

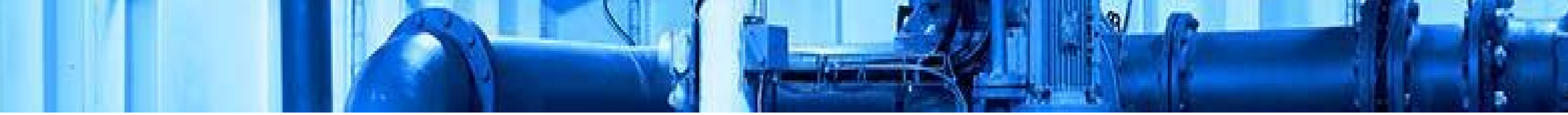
Who is Resilient?



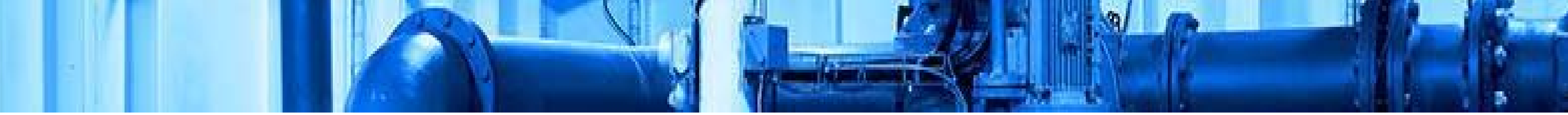
By what measure...?

University of California Berkeley





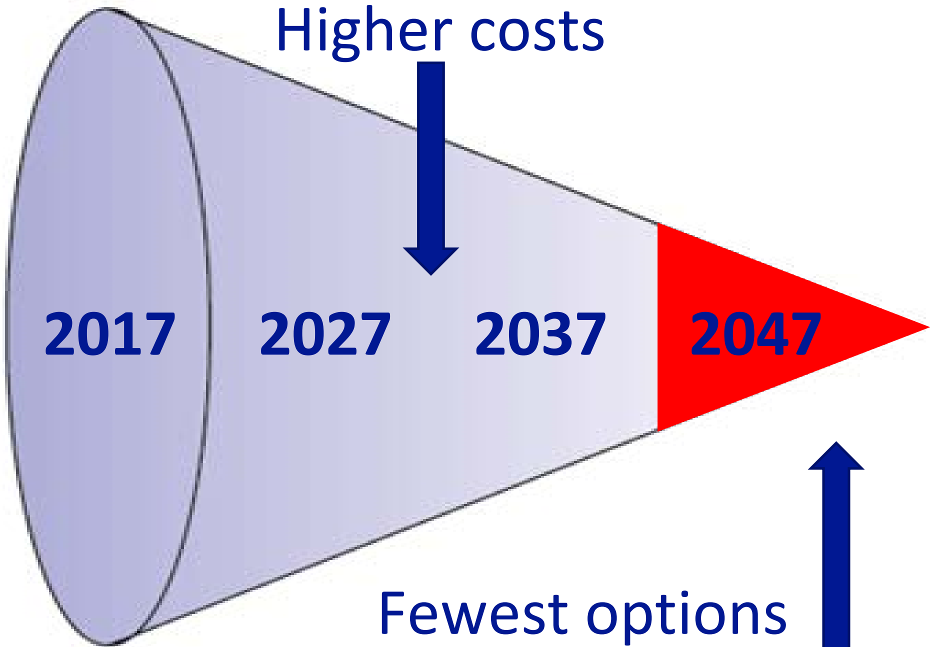
How can you become resilient?



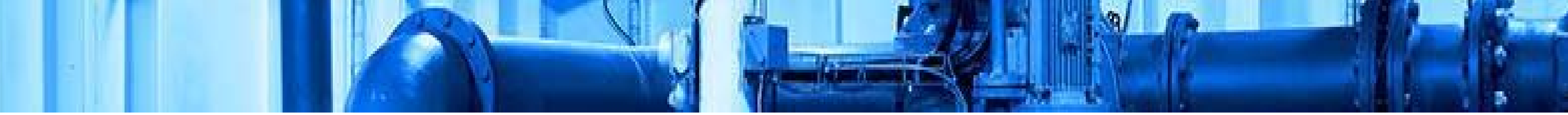
The Hard Sell

Fewer options
Higher costs

Multiple options
Lower costs



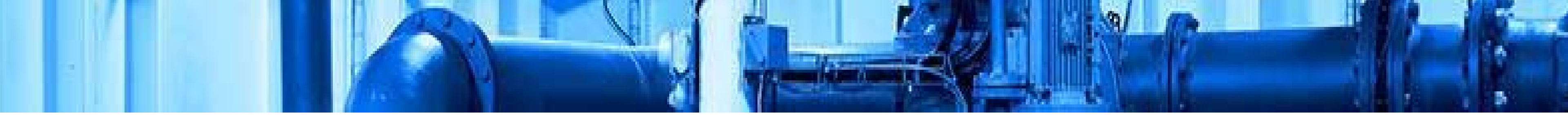
Fewest options
Highest costs
Including damage and recovery costs



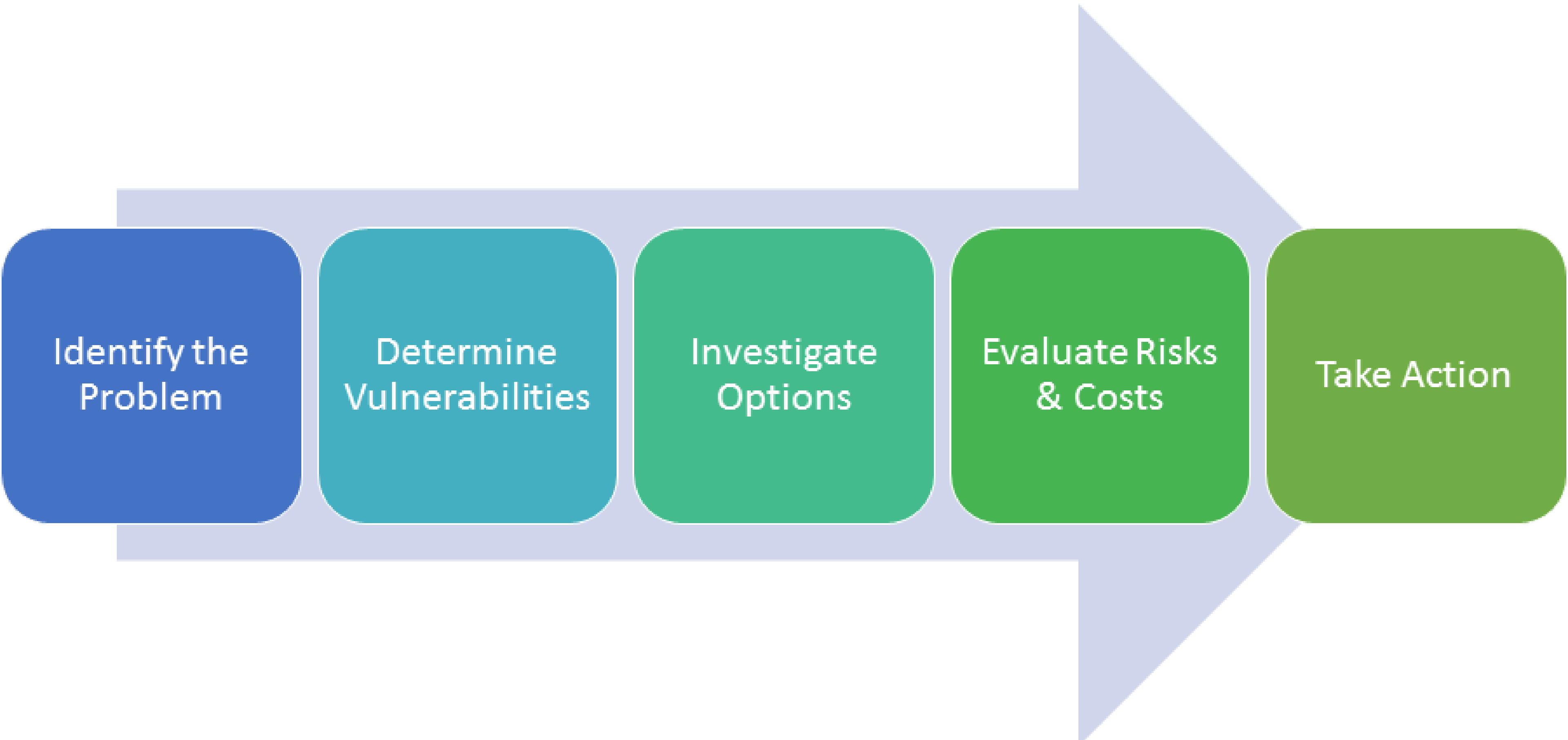
Planning for Resiliency

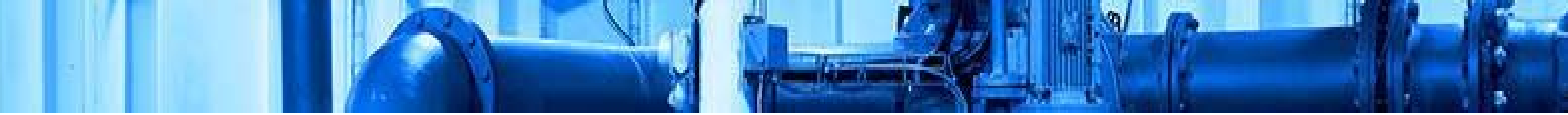
- ✓ Comprehensive Plans
- ✓ Zoning
- ✓ Asset Management Planning
- ✓ Capital
- ✓ Land-Use Planning

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			



Steps toward Resiliency





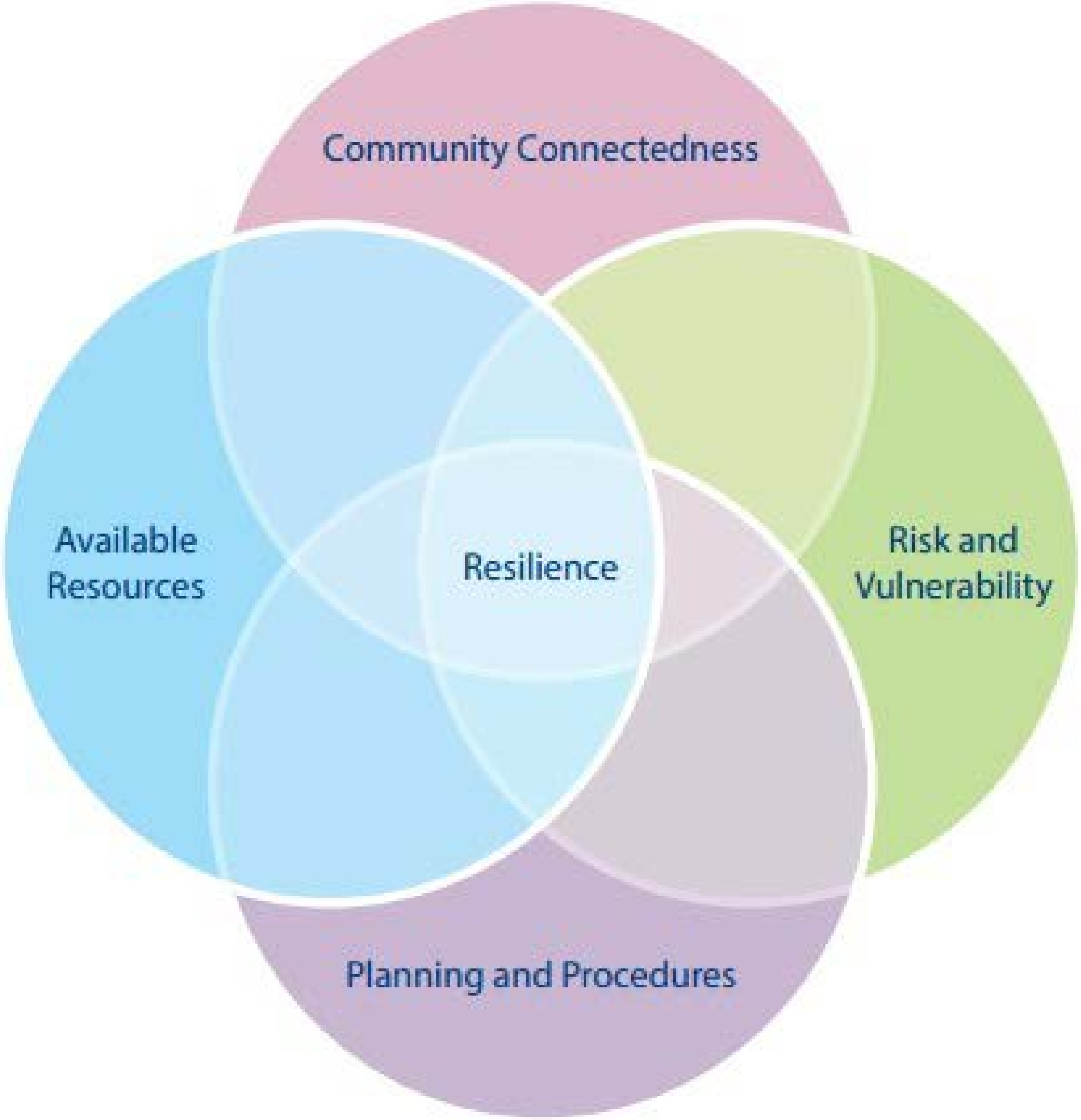
4 Rs of Resiliency

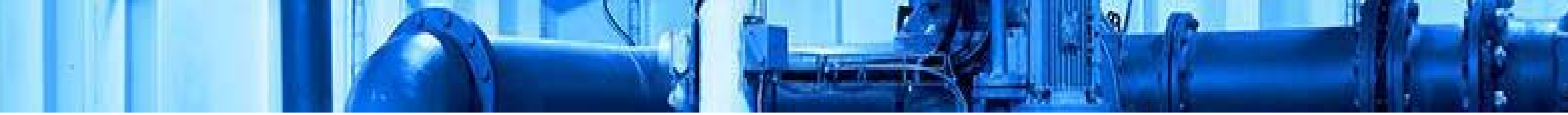
Redundancy

Robust

Resources

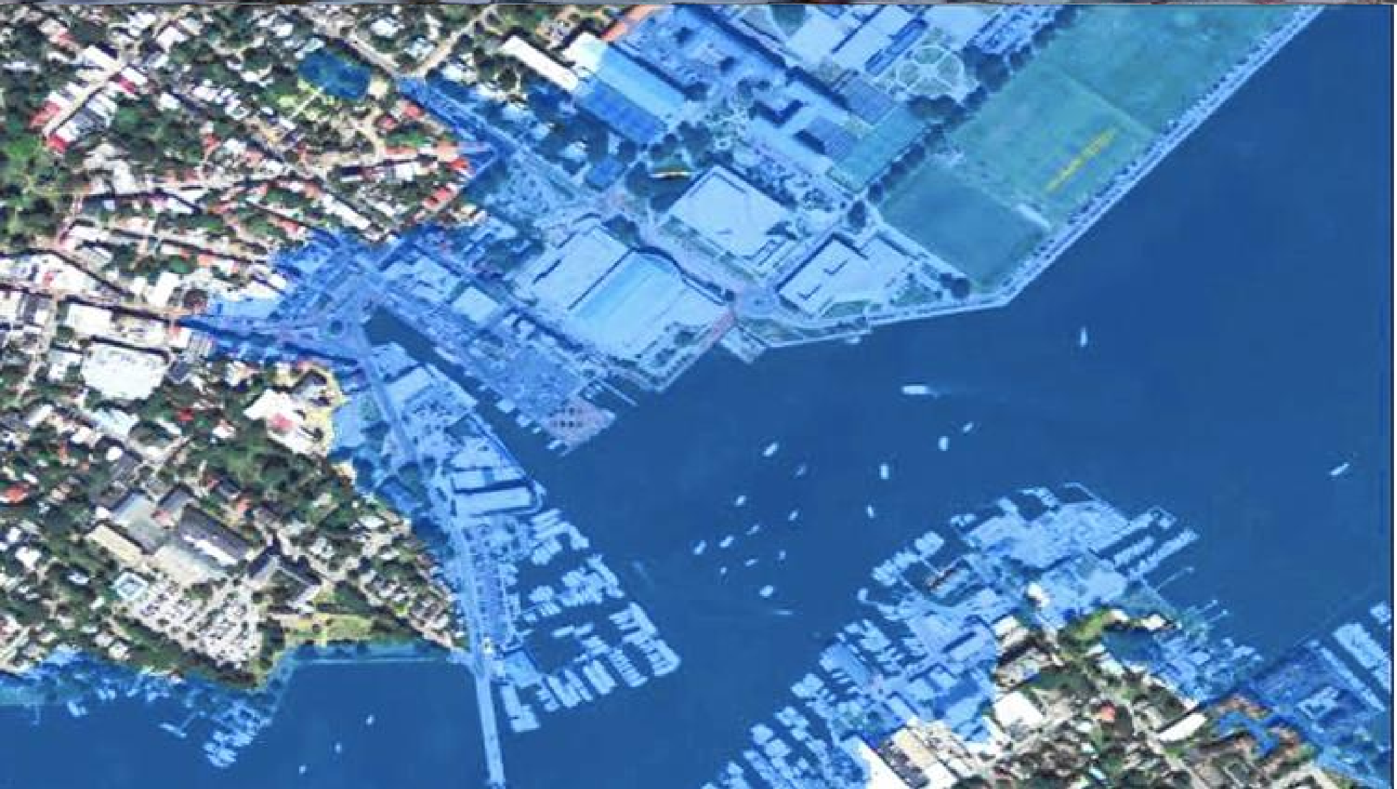
Rapid Response





Community Experience Snapshots

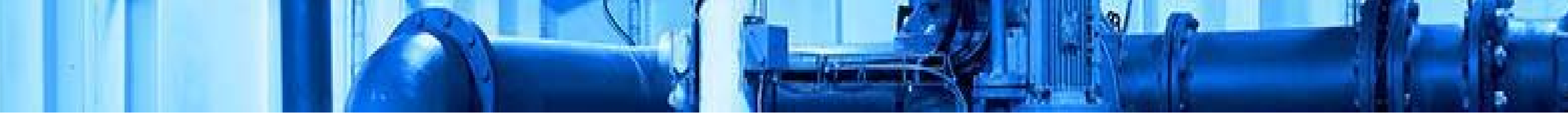
Annapolis, MD



40 tidal flooding events per year, when there used to be very few

Venice Italy: Today

2011: Lourdes Hospital, Binghamton



What building resiliency looks like: Binghamton-Johnson City Joint STP Case Study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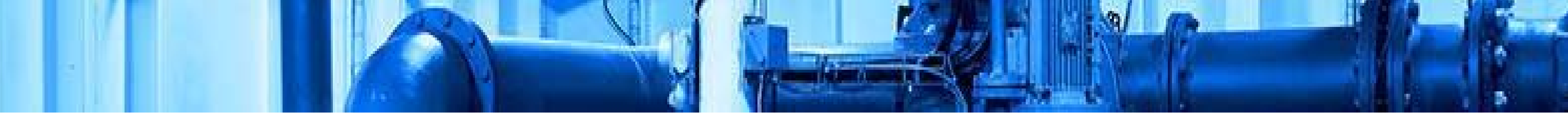
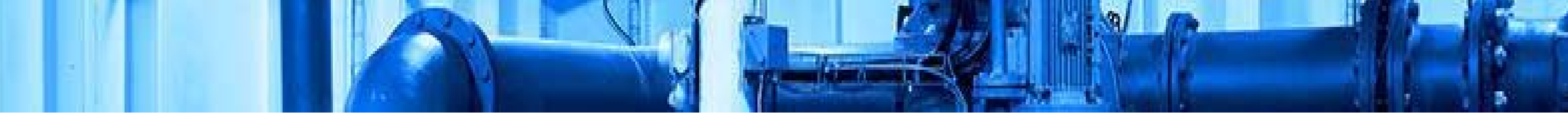
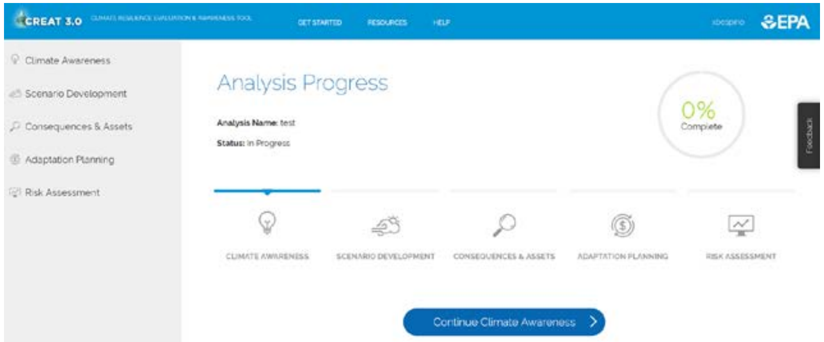


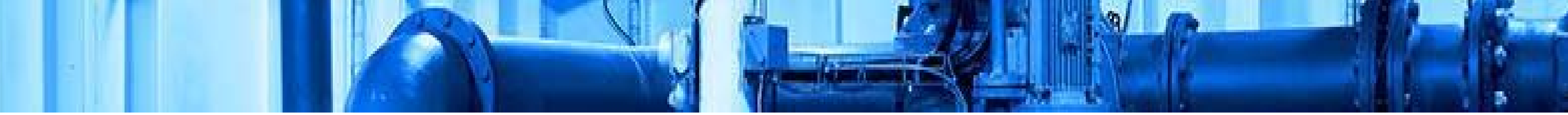


Climate Resilience Evaluation and Awareness Tool (CREAT)

- Risk assessment tool
- Helps utilities in adapting to extreme weather events through a better understanding of current and future climate conditions.

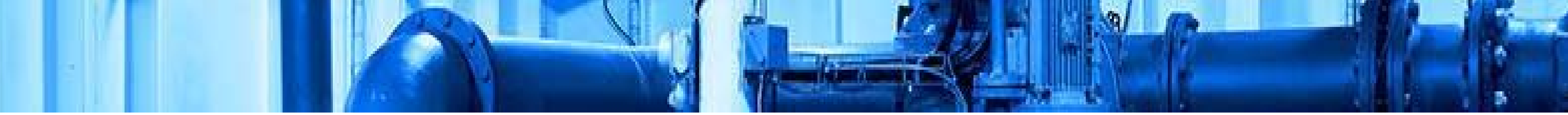


https://www.epa.gov/crwu/build-resilience-your-utility https://youtu.be/fa0oK_jE8Zw



BJCJSTP’s existing measures to protect the plant from high flow events:

- Sand bags as temporary flood barriers
- System performance models
- Weather forecast monitoring
- Emergency Response Plan for flooding events



Potential Adaptive Measures for Binghamton-Johnson City Joint Sewage Treatment Plant

ADAPTIVE MEASURE	DESCRIPTION	ESTIMATED COST
Back-up generators	Three (3) back-up generators and diesel storage tanks to provide power for the entire plant and related processes during future power outages.	$50,000 - $150,000
Alternate wastewater capabilities	Develop redundant treatment processes. Development or replacement could include entire facility or just critical portions to support operations when damage or loss occurs.	$3,000,000 - $10,000,000
Hydrologic barrier	Develop hydrologic barriers to counter flooding. Manipulating natural landscapes to absorb or redirect flooding is often more aesthetic than building structures. Construction and design must consider projected flood magnitudes and local hydrography.	$750,000 - $1,250,000
Flood wall	Construct a flood wall for protection against high flow events. Construction and design is 1.5 feet of freeboard above the 2011 storm event level.	$1,750,000 - $4,000,000
Submersible pumps	Install submersible pumps that will not be significantly impacted by flood waters entering the plant.	$1,500,000 - $3,000,000
Raise electrical equipment	Raise electrical equipment above the 2011 flood level.	$50,000 - $100,000
Raise VFDs	Raise the Variable Frequency Drives (VFDs) at least one foot above the 2011 flood level.	$50,000 - $100,000
Flood risk management plan	Develop phased, adaptive risk management plan for urban flood risks and treatment requirements that will prioritize the ability to limit or prevent damage to the facility during floods. Integrating observations, process models and decision frameworks provides a powerful suite of tools to anticipate potential flood scenarios and deal with flood damage.	$7,500 - $10,000
Water tight doors	Install water tight doors at critical infiltration points to mitigate impacts of flood waters on plant and equipment.	$200,000 - $500,000
Permeable pavement	Install permeable pavement at the facility to allow for infiltration of stormwater through the pavement surface reducing runoff (and localized flooding). Could be constructed from porous asphalt, porous concrete, and interlocking pavers.	$100,000 - $350,000
Flood models	Build integrated flood models for catchments and urban drainage. Beyond many current hydrologic and flood models, these new models should ensure that changing climate conditions can be accommodated in models and that these models include topographic information (GIS) and risk assessment components.	$35,000 - $75,000
Quick disassembly pumps	Retrofit existing pumps to make it easier to disassemble them and remove them in advance of a flooding event. Costs include the retrofitting and the cost to remove them for one event.	$50,000 - $100,000

Significant Risks to Consider

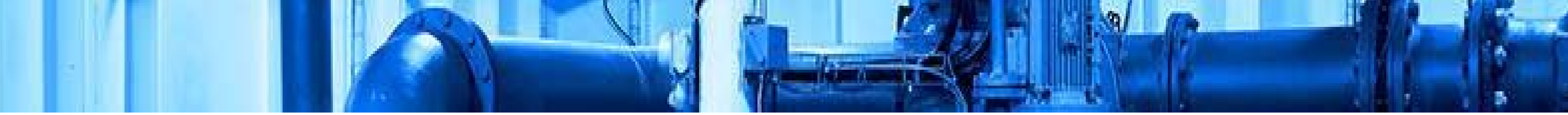
Aging Infrastructure

Infiltration and Inflow (I/I) Issues

Changing Regulations

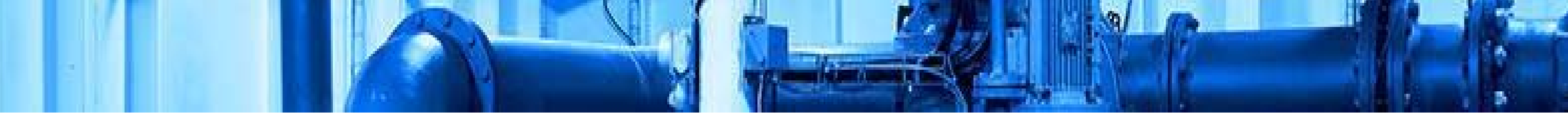
Population Growth/ Development

Structural Concerns – Site flooding



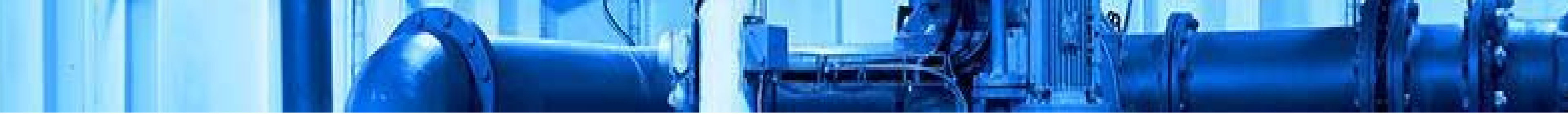
Consider these components in vulnerability assessment

- Distribution systems including pipes and constructed conveyances
- Physical barriers
- Water collection, pretreatment, and treatment facilities
- Use, storage, and handling of various chemicals
- Storage and distribution facilities
- Electronic, computer or other automated or cyber systems

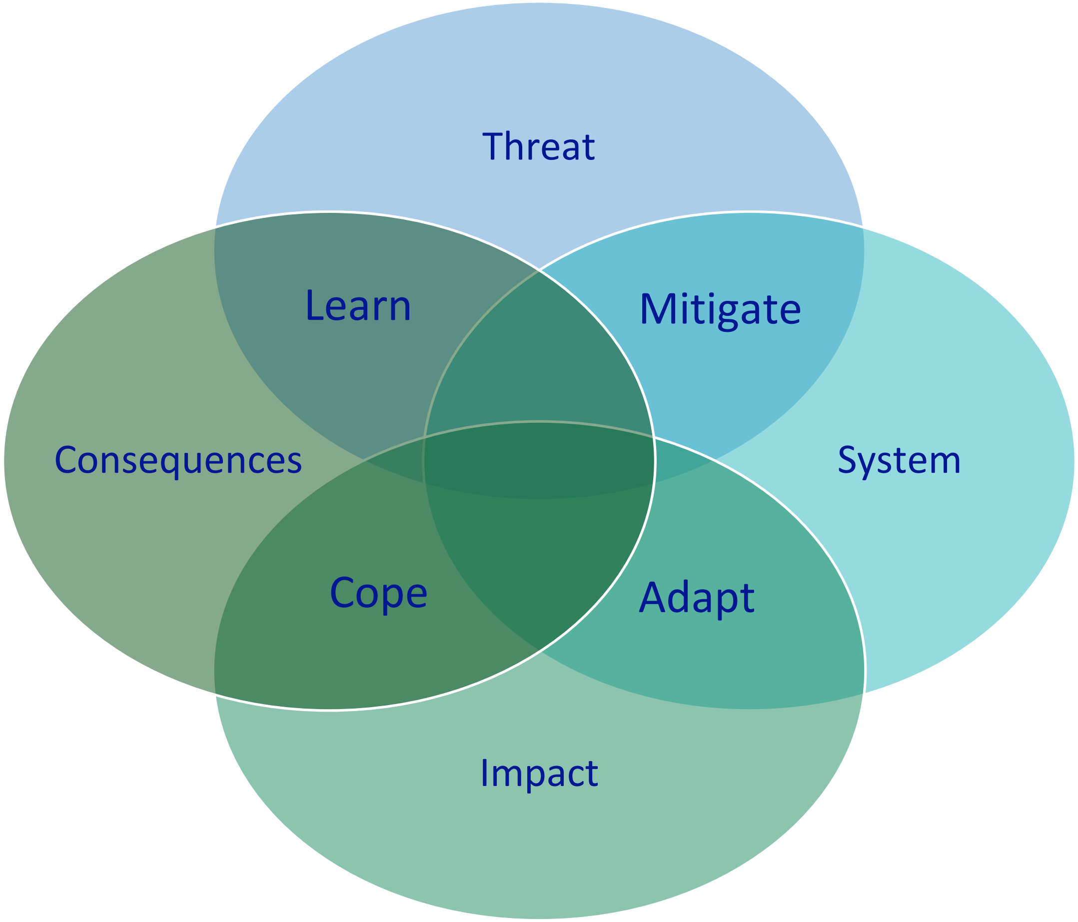


Frameworks and resources for planning ahead

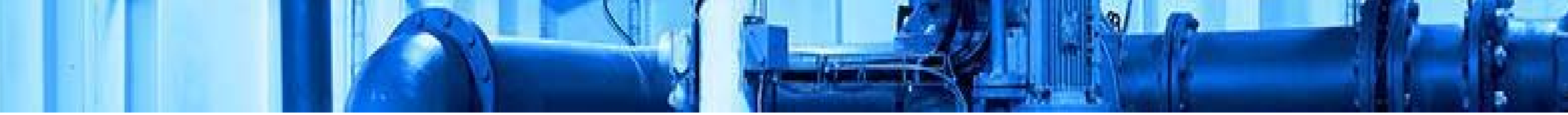
U.S. Small Water Utility Builds Flood Resilience – US Climate Resilience Toolkit



Safe and SuRe Approach



(Butler, D., Ward, S. et. al., March 2016)



Threat Categorization

Chronic

Internal

- Insufficient rehabilitation
- Resource depletion/degradation
- Loss of collective skills and knowledge
- Incremental innovation
- Lack of investment

External

- Climate change
- Urban creep
- Population growth
- Demographic change
- Stringent regulation
- Increasing affluence

Internal

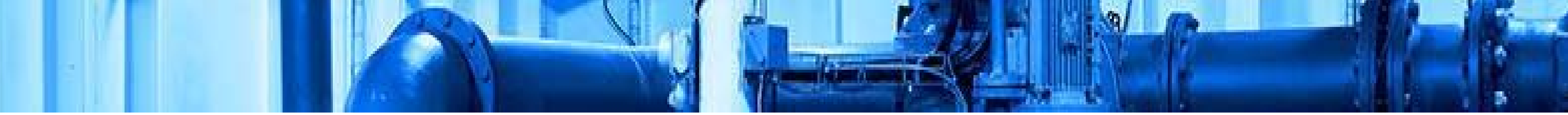
- Insufficient maintenance
- Accident
- Human error
- Strike action
- Poor management

External

- Extreme weather
- Natural Disaster
- Power outage
- Sabotage
- Riot/war
- Political pressures

Acute

(Butler, D., Ward, S. et. al., March 2016)



System Impacts

Functional

Internal / **External**

Structural

Internal – Functional:

- Pressure increase (e.g. due to water hammer)
- Sludge bulking in wastewater treatment plant
- Contamination

External – Functional:

- Increased demand
- Changing wastewater composition/characteristics

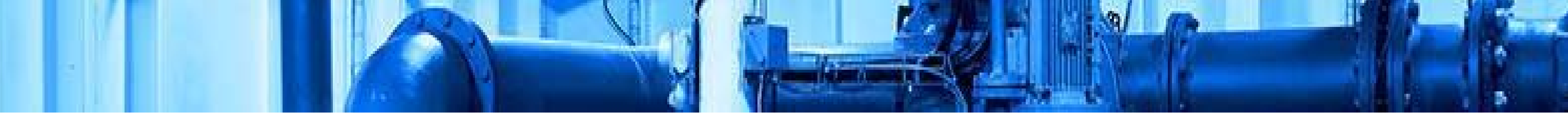
Internal – Structural:

- Pipe failure
- Pump failure
- Billing System failure

External – Structural:

- Power system failure
- Other critical infrastructure failure

(Butler, D., Ward, S. et. al., March 2016)



Service Impacts

Chronic

Internal – Chronic

- Recurrent low supply pressure
- Frequent drain blockage or slow running

External – Chronic

- Recurrent surface water flooding from sewers
- Wastewater treatment permit non-compliance
- Non-point source pollution

Internal ⟷ **External**

Internal – Acute

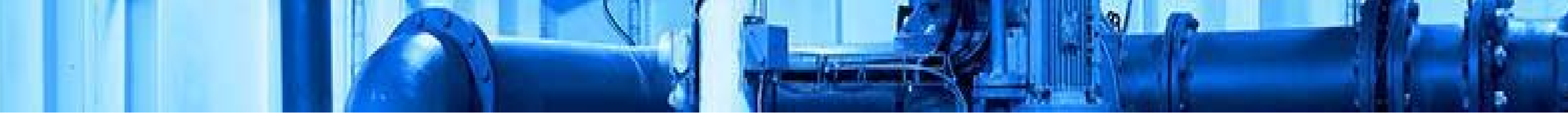
- Water supply interruption
- Contaminated water supply
- Discolored water supply

External – Acute

- Water use restrictions
- Property flooding from sewers
- Point source pollution

Acute

(Butler, D., Ward, S. et. al., March 2016)



Consequences

Tangible

Direct

- Property damage
- Infrastructure damage
- Loss of agricultural produce
- Injury and loss of life

Indirect

- Response and recovery costs
- Traffic disruption
- Loss of industrial production
- Loss of earnings

Intangible

Direct

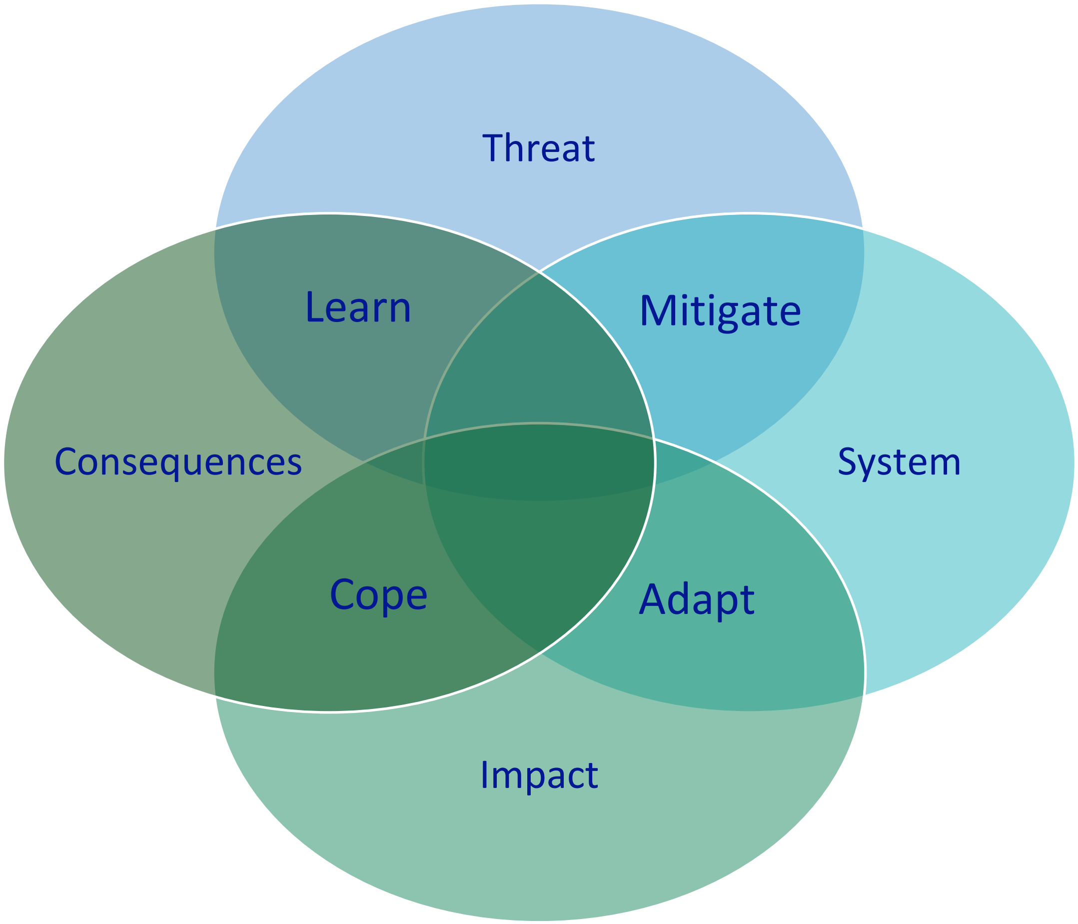
- Loss of ecosystem services
- Disease
- Loss of amenities
- Damage to cultural heritage

Indirect

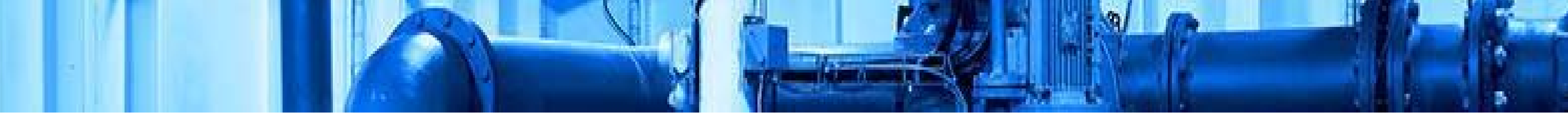
- Inconvenience
- Psychological damage
- Disease
- Societal disruption
- Increased inequity (e.g. relative poverty levels)
- Reduced biodiversity

(Butler, D., Ward, S. et. al., March 2016)

Interventions to Consider



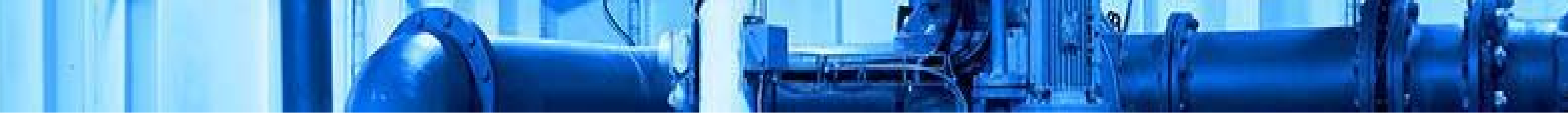
(Butler, D., Ward, S. et. al., March 2016)



Example of Mitigation

Quadrant	Threat	Action
Internal-chronic	Insufficient rehabilitation	Accelerate asset replacement strategy
Internal- acute	Accidents	Develop safety culture
External-chronic	Urban creep	Enforce planning controls
External- acute	Extreme weather	Reduce greenhouse gas emissions of operations

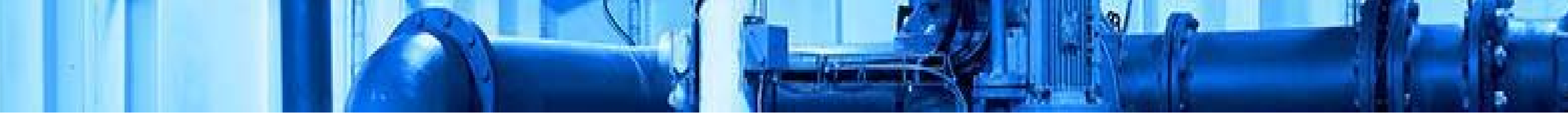
(Butler, D., Ward, S. et. al., March 2016)



Example of Adaptation

Quadrant	Threat	Action
Internal-functional	Sludge bulking	Operational modifications
Internal- structural	Pump failure	Provision backup pumps
External-functional	Increased demand	Promotion of water saving technologies and use of reclaimed water
External- structural	Changing regulations	Provision of additional treatment/new technologies, for example nutrient recovery

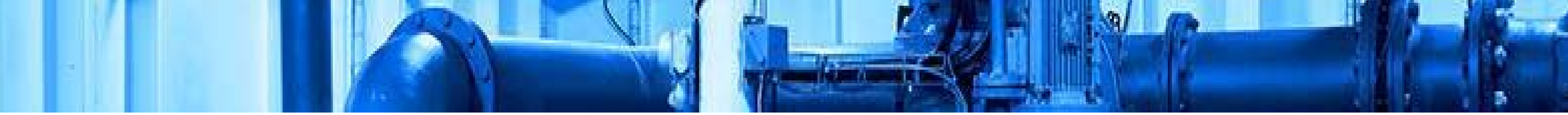
(Butler, D., Ward, S. et. al., March 2016)



Example of Coping

Quadrant	Threat	Action
Direct- tangible	Property damage	Temporarily relocate
Direct- intangible	Spread of disease	Boil water
Indirect- tangible	Response and recovery	Purchase building insurance
Indirect- intangible	Reduced biodiversity	Re-introduce species

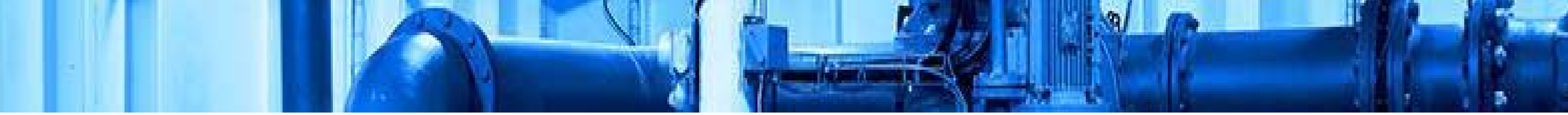
(Butler, D., Ward, S. et. al., March 2016)



Ideas for Implementing Resilience Strategies

Flooding Impacts

- Regional interconnections
- Alternative power supplies
- Monitor and inspect infrastructure
- Elevate or flood-proof assets
- Join a mutual aid network



Changes in Seasonal Runoff

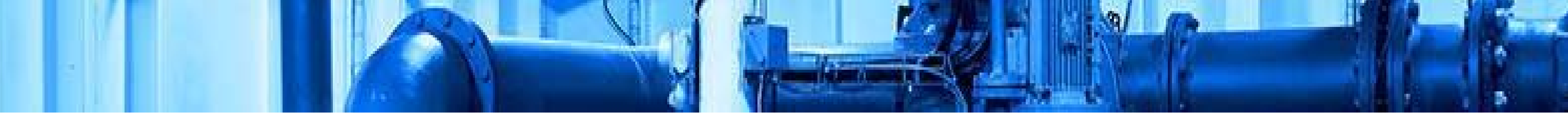
- Monitor
- Incorporate predictions of snowpack and runoff changes into models
- Update drought contingency plans
- Diversify water supplies
- Increase storage capacity
- Establish regional interconnections

Increased Runoff

- Green infrastructure
- Distributed systems
- Invest in watershed management
- Model potential stormwater impacts to your service area
- Monitor runoff, vegetation and land use changes

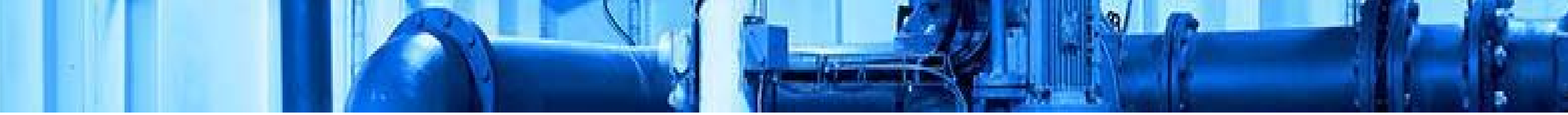
Stressed Sewer Systems

- Green infrastructure
- Acquire and manage existing ecosystems
- Reduce infiltration and inflow by managing assets
- Increase capacity or capabilities of wastewater treatment system and facilities
- Model potential stormwater impacts to your service area

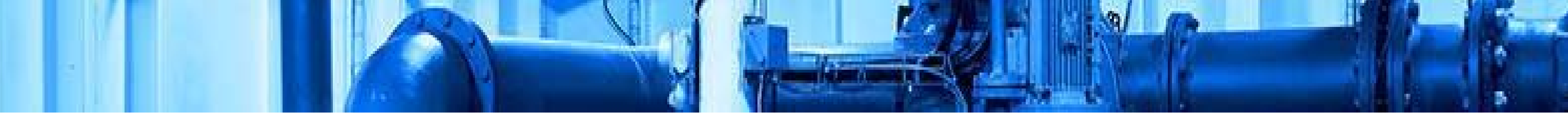


Community and Economic Impacts

- Collaborate Discuss adaptation options with local businesses
- Communicate adaptation activities and plans to customers
- Become marketers
- Raise rates in an affordable and responsible way



Other Resources for Planning



Adaptation Strategies Guide for Water Utilities

GROUP		DW	WW
Drought	Reduced groundwater recharge	💧	
	Lower lake & reservoir levels	💧	
	Changes in seasonal runoff & loss of snowpack	💧💧	
Water Quality Degradation	Low flow conditions & altered water quality		💧💧
	Saltwater intrusion into aquifers	💧	
	Altered surface water quality	💧	💧
Floods	High flow events & flooding	💧💧	💧💧
	Flooding from coastal storm surges	💧💧	💧💧
Ecosystem Changes	Loss of coastal landforms / wetlands	💧💧	💧💧
	Increased fire risk & altered vegetation	💧	💧
Service Demand & Use	Volume & temperature challenges	💧💧	💧💧
	Changes in agricultural water demand	💧	
	Changes in energy sector needs	💧	
	Changes in energy needs of utilities	💧💧	💧💧

EPA United States Environmental Protection Agency

CLIMATE READY WATER UTILITIES EPA

HIGH FLOW EVENTS AND FLOODING (DW)

Return to Introduction

Intense precipitation events may occur more frequently, concentrating the annual total rainfall into episodes that may challenge current infrastructure for water management and flood control. When these protections fail, inundation may disrupt service and damage infrastructure such as treatment plants, intake facilities and water conveyance and distribution systems. Episodic peak flows into reservoirs will strain the capacity of these systems. Furthermore, inflow will be of lesser quality due to soil erosion and contaminants from overland flows, leading to treatment challenges and degraded conditions in reservoirs.

CLIMATE INFORMATION

- Since 1991, the amount of rain falling in very heavy precipitation events has been above average across most of the United States (USGCRP 2014). This observed trend has been greatest in the Northeast, Midwest and Great Plains – projections for these regions indicate that 30% more precipitation will fall in very heavy rain events relative to the 1901-1960 average (Karl et al. 2009).
- Heavy downpours are increasing nationally, with especially large increases in the Midwest and Northeast (Kunkel et al. 2012, USGCRP 2014). Precipitation intensity (e.g., precipitation per rainy day) is projected to continue to increase by mid-century for most of the U.S. This change is expected even for regions that are projected to experience decreases in mean annual precipitation, such as the Southwest (Kunkel et al. 2012, Wehner 2013, USGCRP 2014).
- The increasing intensity of precipitation events can be expected to lead to more flooding and high flow events in rivers. For example, by the end of the century, New York City is projected to experience almost twice as many days of extreme precipitation that cause flood damage (Ntelekos et al. 2010). For the U.S. overall, a recent assessment of flood risks found that the odds of experiencing a 100-year flood are expected to double by 2030 (USGCRP 2014).
- The intensity, frequency and duration of North Atlantic hurricanes has increased in recent decades, and the intensity of these storms is likely to increase in this century (USGCRP 2014).

ADAPTATION OPTIONS

Click to left of name to check off options for consideration; $'s (**$-$$$**) indicate relative costs
Click name of any option to review more information in the Glossary
No Regrets options - actions that would provide benefits to the utility under current climate conditions as well as any future changes in climate. For more information on No Regrets options, see Page 11 in the Introduction.
Click on the , or icon to review the relevant Sustainability Brief.

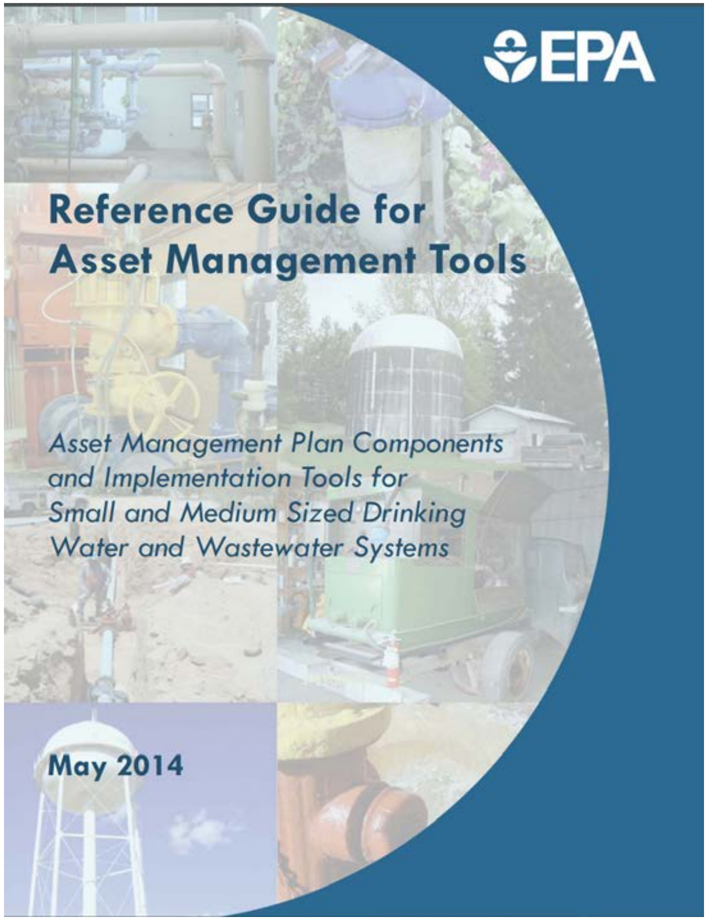
✓	PLANNING	COST
	Integrate flood management and modeling into land use planning.	$
	Develop models to understand potential water quality changes (e.g., increased turbidity) and costs of resultant changes in treatment.	$
	Expand current resources by developing regional water connections to allow for water trading in times of service disruption or shortage.	$$-$$$
	Plan for alternative power supplies to support operations in case of loss of power.	$
	Adopt insurance mechanisms and other financial instruments, such as catastrophe bonds, to protect against financial losses associated with infrastructure losses.	$
	Conduct training for personnel in climate change impacts and adaptation.	$
	Ensure that emergency response plans deal with flooding contingencies and include stakeholder engagement and communication.	$
	Establish mutual aid agreements with neighboring utilities.	$

ADAPTATION STRATEGIES GUIDE FOR WATER UTILITIES

Continued on page 2

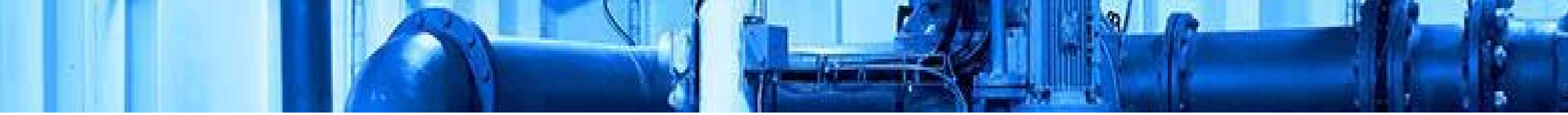
https://www.epa.gov/sites/production/files/2015-04/documents/updated_adaptation_strategies_guide_for_water_utilities.pdf

Asset Management Resources



https://www.epa.gov/sites/production/files/2015-04/documents/epa816k03002.pdf

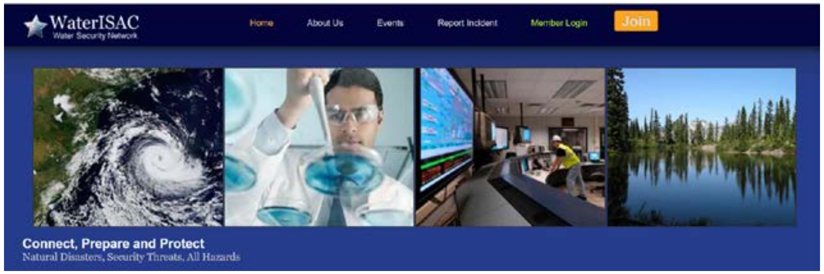
https://www.epa.gov/sites/production/files/2016-04/documents/am_tools_guide_may_2014.pdf



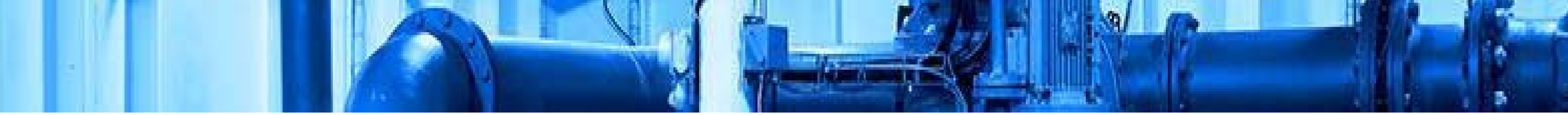
Information Sharing to Support Resilience

Water/Wastewater Agency Response Network (WARN)

Water Information Sharing and Analysis Center (WaterISAC)



https://www.awwa.org/resources-tools/water-knowledge/emergency-preparedness/water-wastewater-agency-response-network.aspx https://www.waterisac.org/



Smart Management for
Small Water Systems

Thank you for participating in today's webinar!

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