Dealing with Disruption:

Operationalizing Resilience in the Water Sector

Building Disaster Resilience

February 26, 2020 | 2:00 PM – 3:30 PM ET

Co-hosted by: NACWA THE VOICE FOR A CLEAN WATER FUTURE ASSOCIATION OF METROPOLITAN WATER AGENCIES

Eileen White
Director of Wastewater
East Bay Municipal Utility District
Oakland, CA

Chair, NACWA Climate & Resiliency Committee

ASSOCIATION OF METROPOLITAN WATER AGENCIES

NACWA
THE VOICE FOR A CLEAN WATER FUTURE

National Association of Clean Water Agencies Resilience Webinar Series: Building Disaster Resilience

February 26, 2020

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EAST BAY MUNICIPAL UTILITY DISTRICT

NACWA

2019 HIGHLIGHTS

U.S. Weather & Climate Disasters in 2019

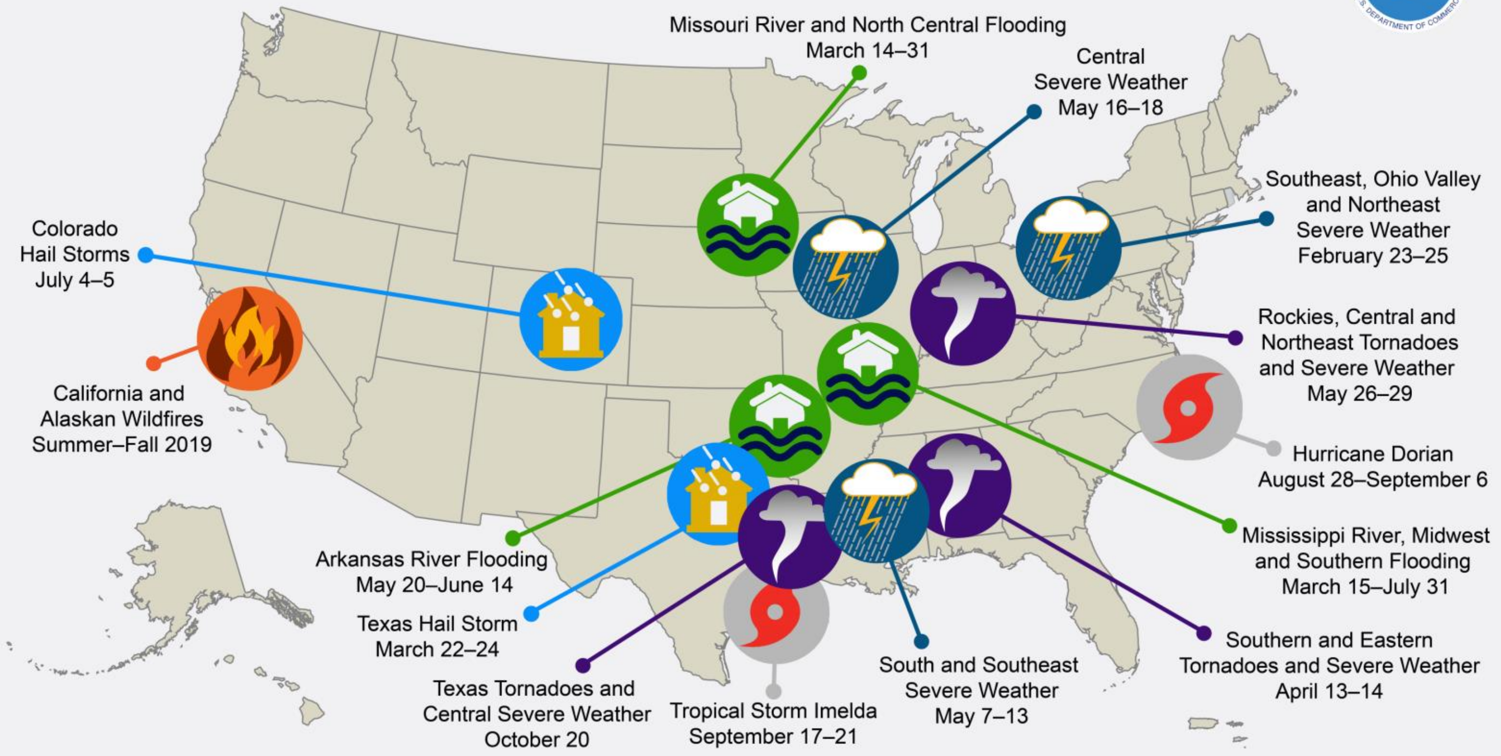
BY THE NUMBERS

$45 Billion Total *in* Damages

14 Climate Disaster Events *in* 2019

- **3** Floods
- **8** Severe Storms
- **2** Tropical Cyclones
- **1** Wildfire

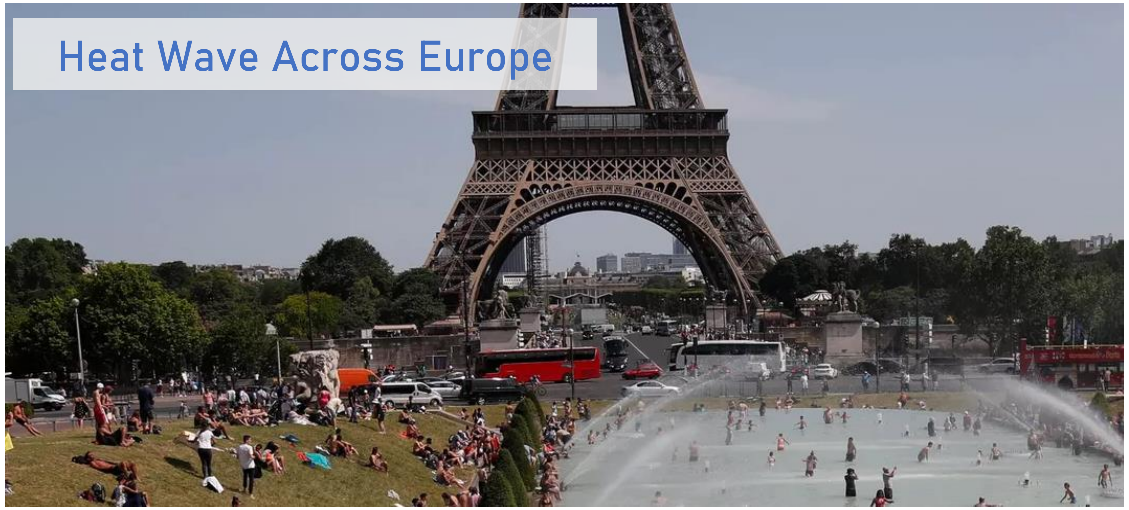
6.5 Average No. of Events *per* Year *from* 1980-2019



*This map denotes the approximate location for each of the **14 separate billion-dollar weather and climate disasters** that impacted the United States **during 2019**.*

2019 HIGHLIGHTS

International Weather & Climate Disasters in 2019


Heat Wave Across Europe

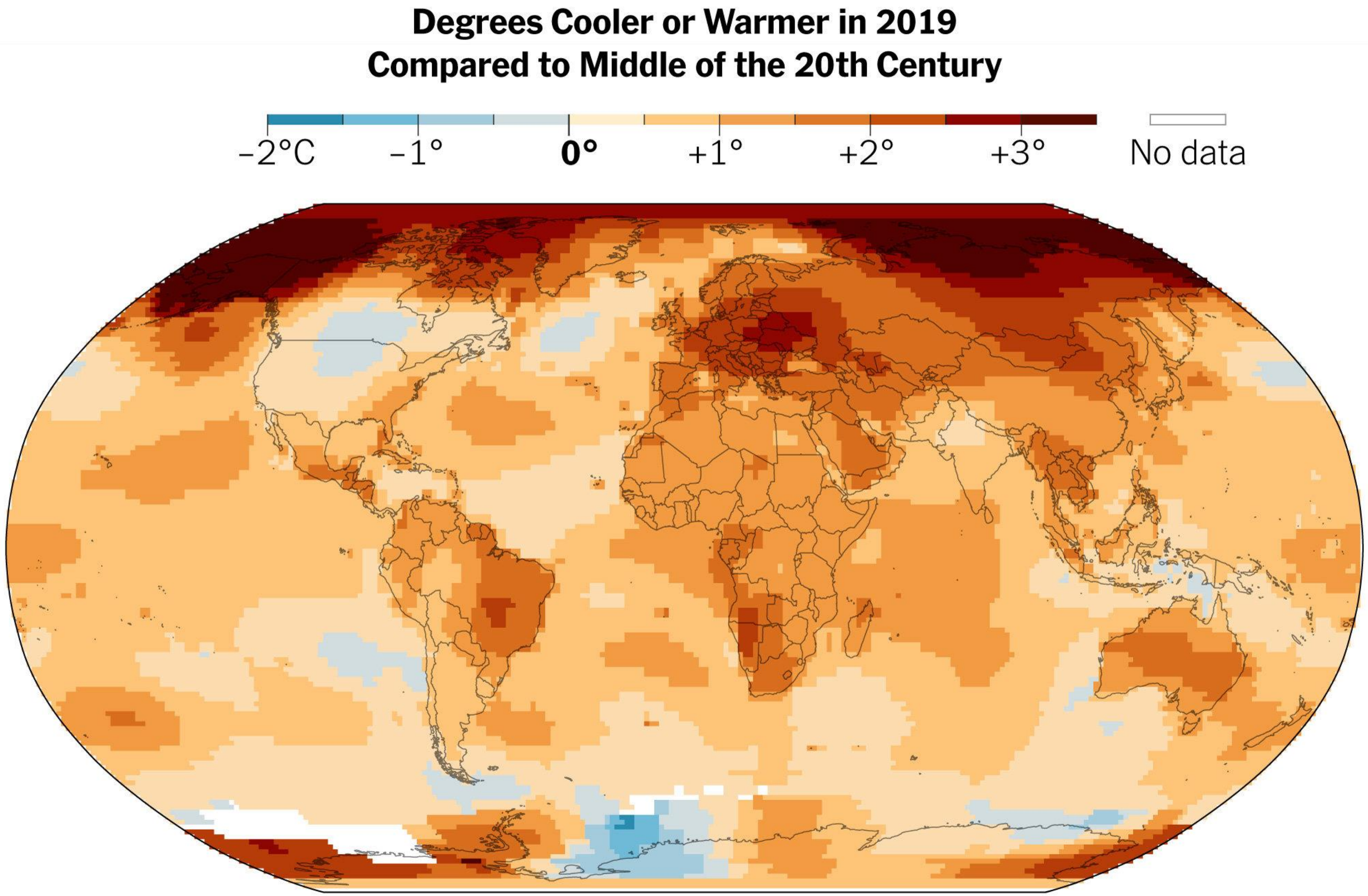

Wildfires in the Amazon…


Flooding in Venice


…and Australia

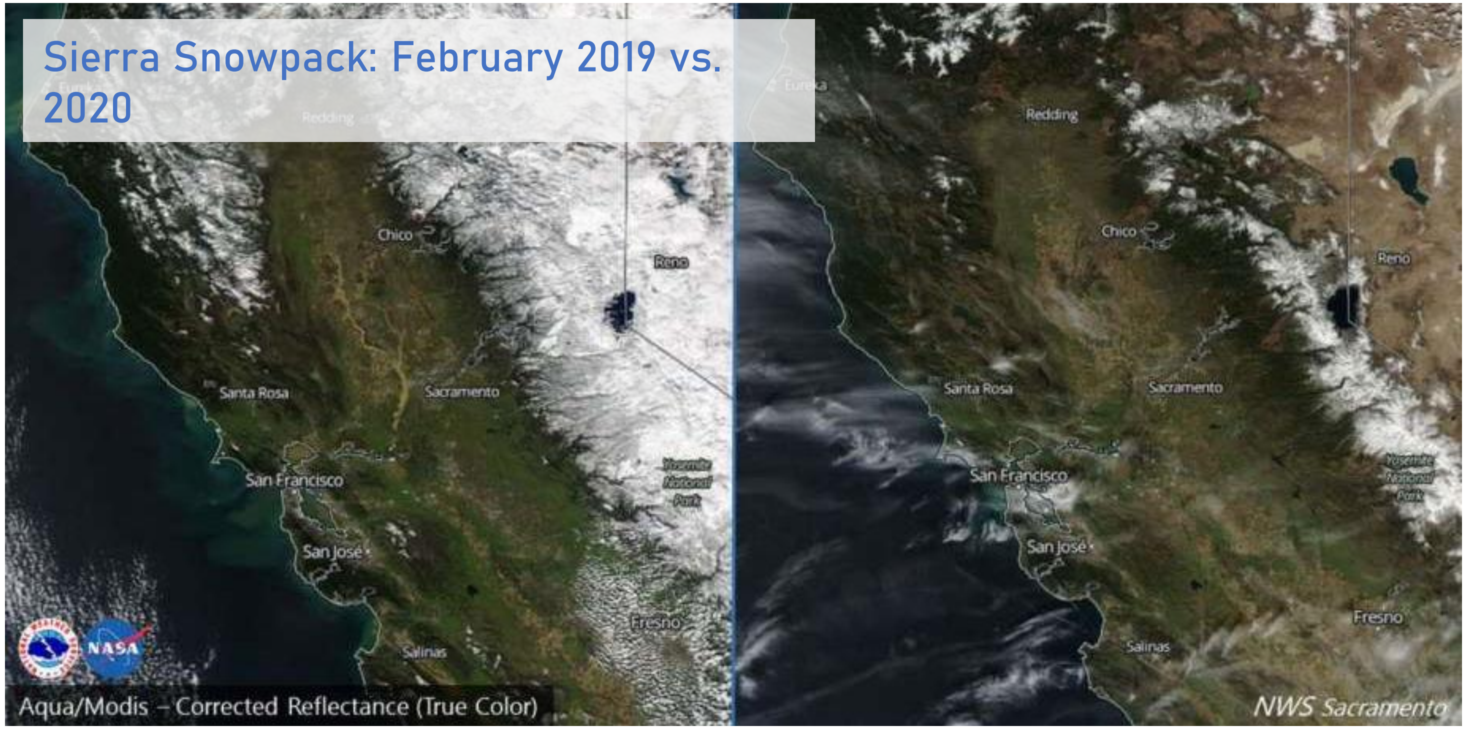
2019 HIGHLIGHTS

2019 Was Second-Hottest Year Ever



How is 2020 Looking So Far?

Sierra Snowpack: February 2019 vs. 2020



Catastrophic Flooding of the Mississippi River

Webinar Speakers

WEBINAR SPEAKERS

1 Curt Baranowski and Steve Fries, EPA

2 Lindsey Hallock, Cape Fear Public Utility Authority

3 Travis Block, City of Faribault

4 Peggy Nguyen, LA Sanitation & Environment

Let's kick off the webinar!

EILEEN M. WHITE, PE
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Curt Baranowski
Environmental Scientist
Creating Resilient Water Utilities
U.S. Environmental Protection Agency
Washington, DC

U.S. EPA's Creating Resilient Water Utilities (CRWU) initiative: Mission Statement

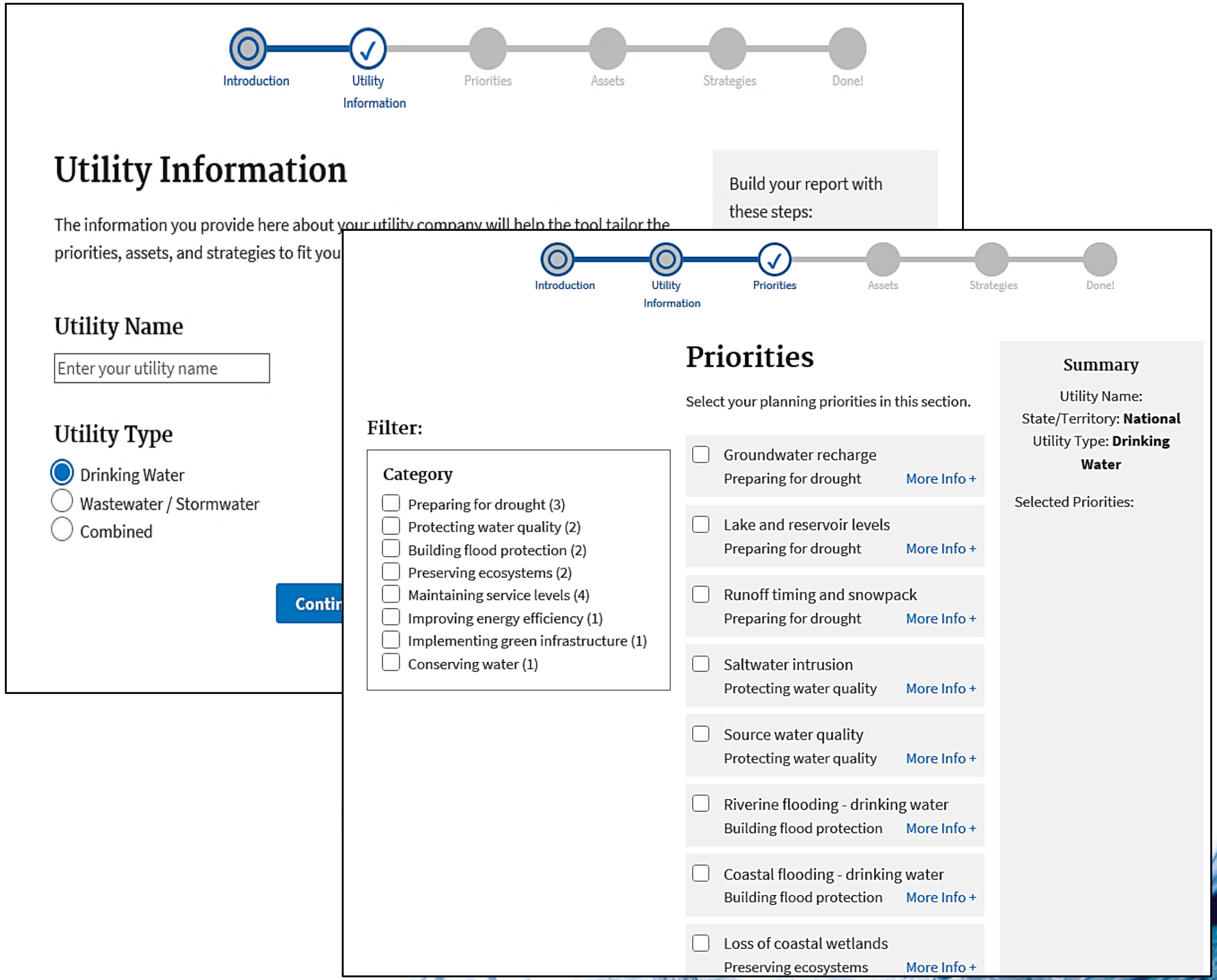
- Provides drinking water, wastewater, and stormwater utilities with the practical tools, training, and technical assistance needed to increase resilience to extreme weather events.

- Through a comprehensive planning process, CRWU assists water sector utilities by promoting a clear understanding of potential long-term adaptation options.

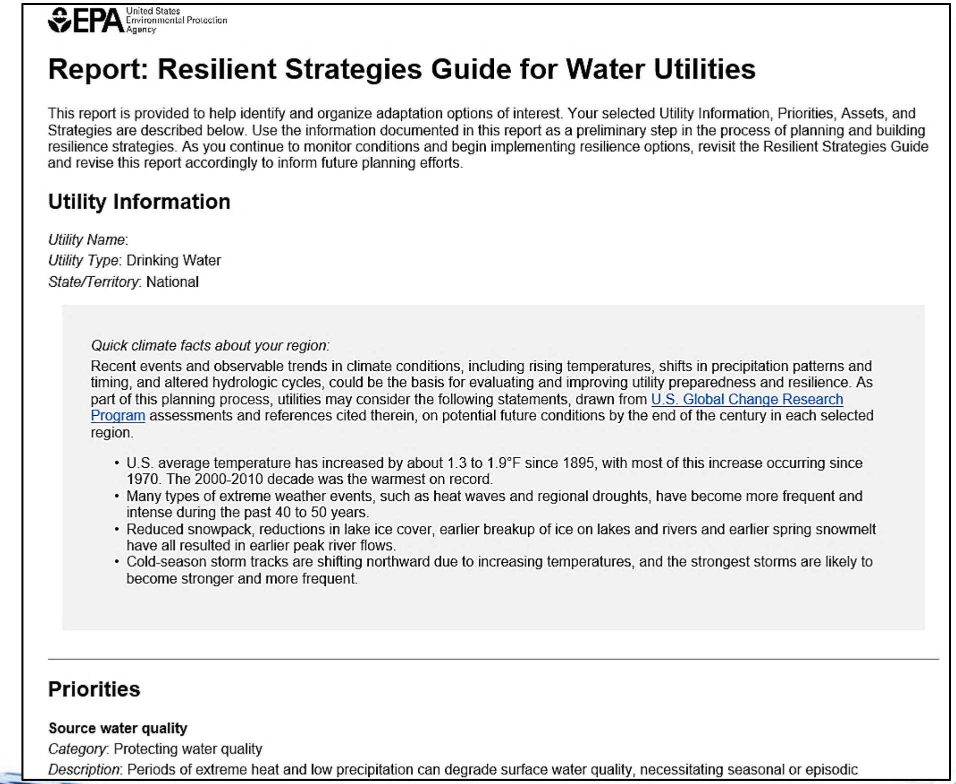
Resilience Building Process

Resilient Strategies Guide

- Web-based tool, based on previous Adaptation Strategies Guide publication, for reviewing resilient strategies being used by water utilities
- Guided process to review and select priorities, vulnerable assets, and relevant strategies
- Final report documents selected strategies to explore during adaptation planning



Resilient Strategies Guide - Outputs



United States Environmental Protection Agency

Report: Resilient Strategies Guide for Water Utilities

This report is provided to help identify and organize adaptation options of interest. Your selected Utility Information, Priorities, Assets, and Strategies are described below. Use the information documented in this report as a preliminary step in the process of planning and building resilience strategies. As you continue to monitor conditions and begin implementing resilience options, revisit the Resilient Strategies Guide and revise this report accordingly to inform future planning efforts.

Utility Information

Utility Name:
Utility Type: Drinking Water
State/Territory: National

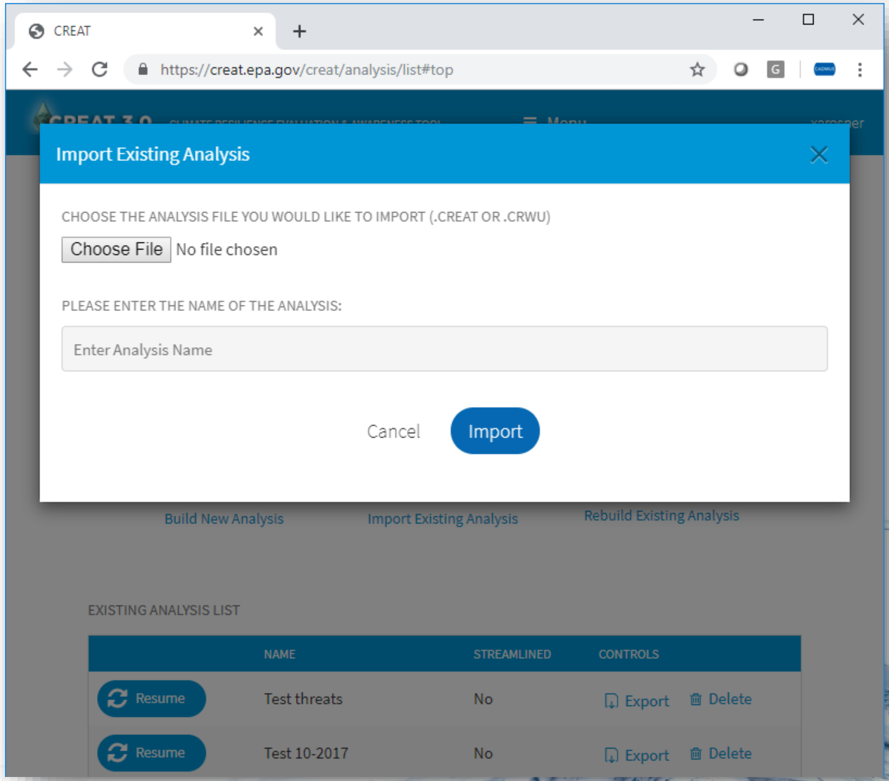
Quick climate facts about your region:

Recent events and observable trends in climate conditions, including rising temperatures, shifts in precipitation patterns and timing, and altered hydrologic cycles, could be the basis for evaluating and improving utility preparedness and resilience. As part of this planning process, utilities may consider the following statements, drawn from U.S. Global Change Research Program assessments and references cited therein, on potential future conditions by the end of the century in each selected region.

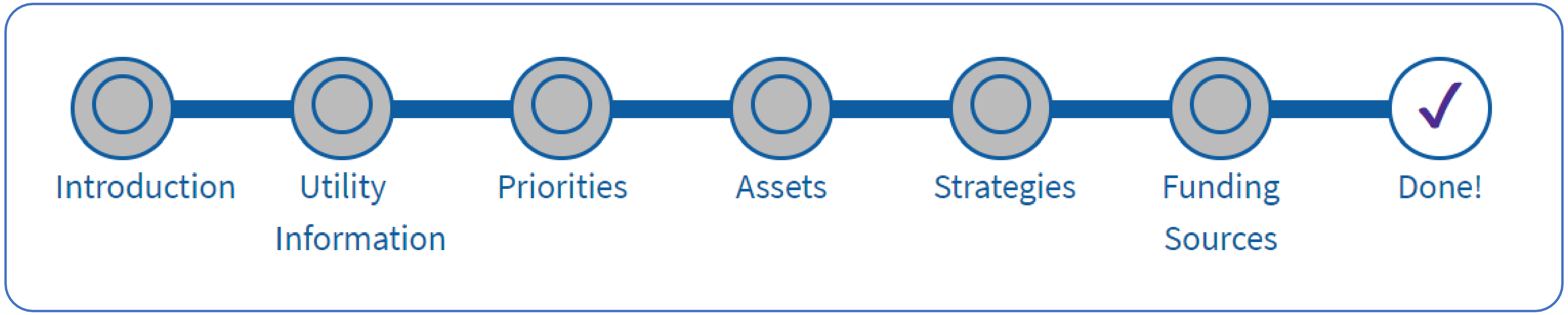
- U.S. average temperature has increased by about 1.3 to 1.9°F since 1895, with most of this increase occurring since 1970. The 2000-2010 decade was the warmest on record.
- Many types of extreme weather events, such as heat waves and regional droughts, have become more frequent and intense during the past 40 to 50 years.
- Reduced snowpack, reductions in lake ice cover, earlier breakup of ice on lakes and rivers and earlier spring snowmelt have all resulted in earlier peak river flows.
- Cold-season storm tracks are shifting northward due to increasing temperatures, and the strongest storms are likely to become stronger and more frequent.

Priorities

Source water quality
Category: Protecting water quality
Description: Periods of extreme heat and low precipitation can degrade surface water quality, necessitating seasonal or episodic



Resilient Strategies Guide - Update

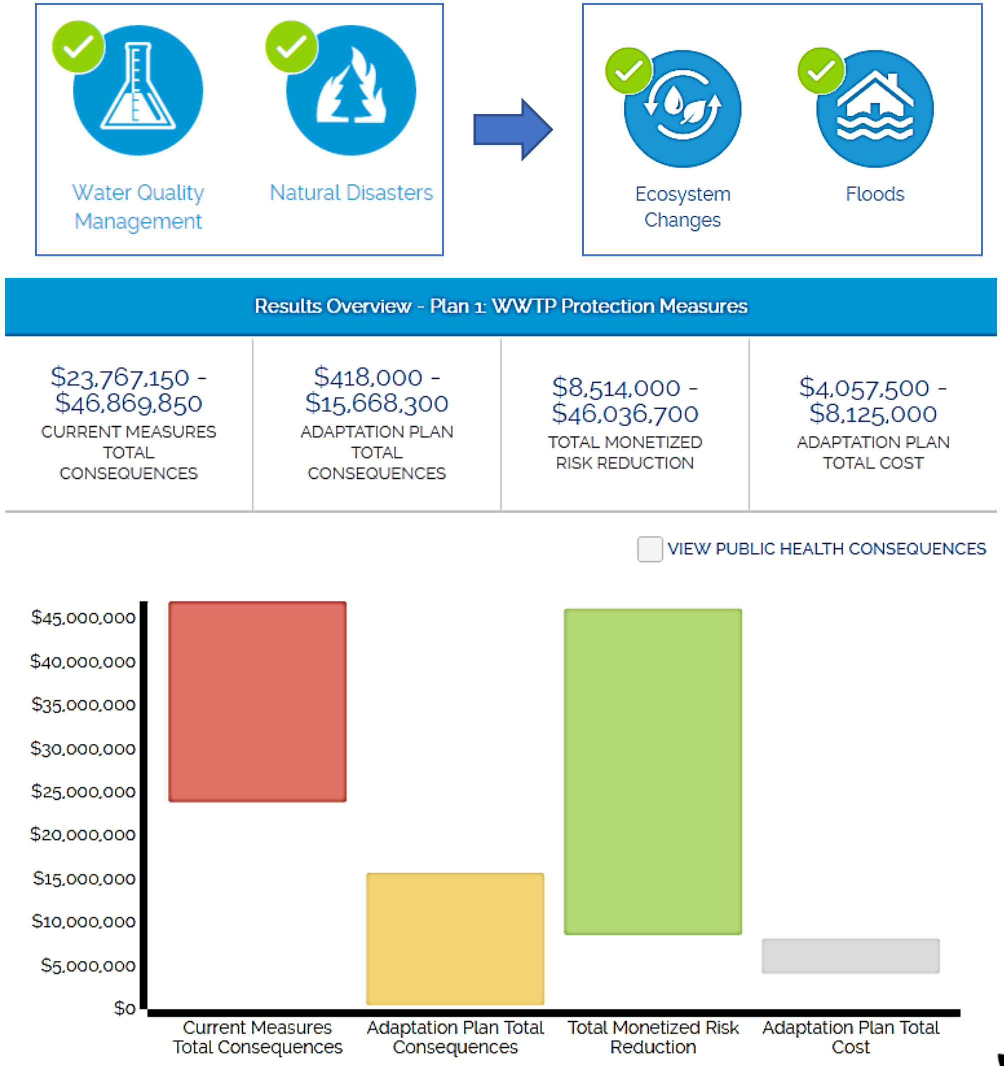


- Adding new step, Funding Sources, that draws information from EPA's Water Finance Clearinghouse
- Funding sources are filtered to those most relevant to the utility location (state/territory) and selected strategies

Climate Resilience Evaluation and Awareness Tool (CREAT)

- **Web-based tool** for assessing risk of potential extreme weather impacts
- **Module-based process** with clearly defined goals and reports
- Multiple scenarios provided to help **capture uncertainty**
- **Assessment of current resilience** will help inform adaptation planning
- Results help utilities compare **risk reduction** and **implementation costs**

CREAT 3.0



EPA

CREAT Assessment Process

CLIMATE AWARENESS

Provide basic utility information

Increase awareness of climate impacts

SCENARIO DEVELOPMENT

Understand utility risk

Design scenarios of threats based on climate data

CONSEQUENCES & ASSETS

Outline potential consequences

Catalog critical assets

ADAPTATION PLANNING

Inventory current actions that provide resilience

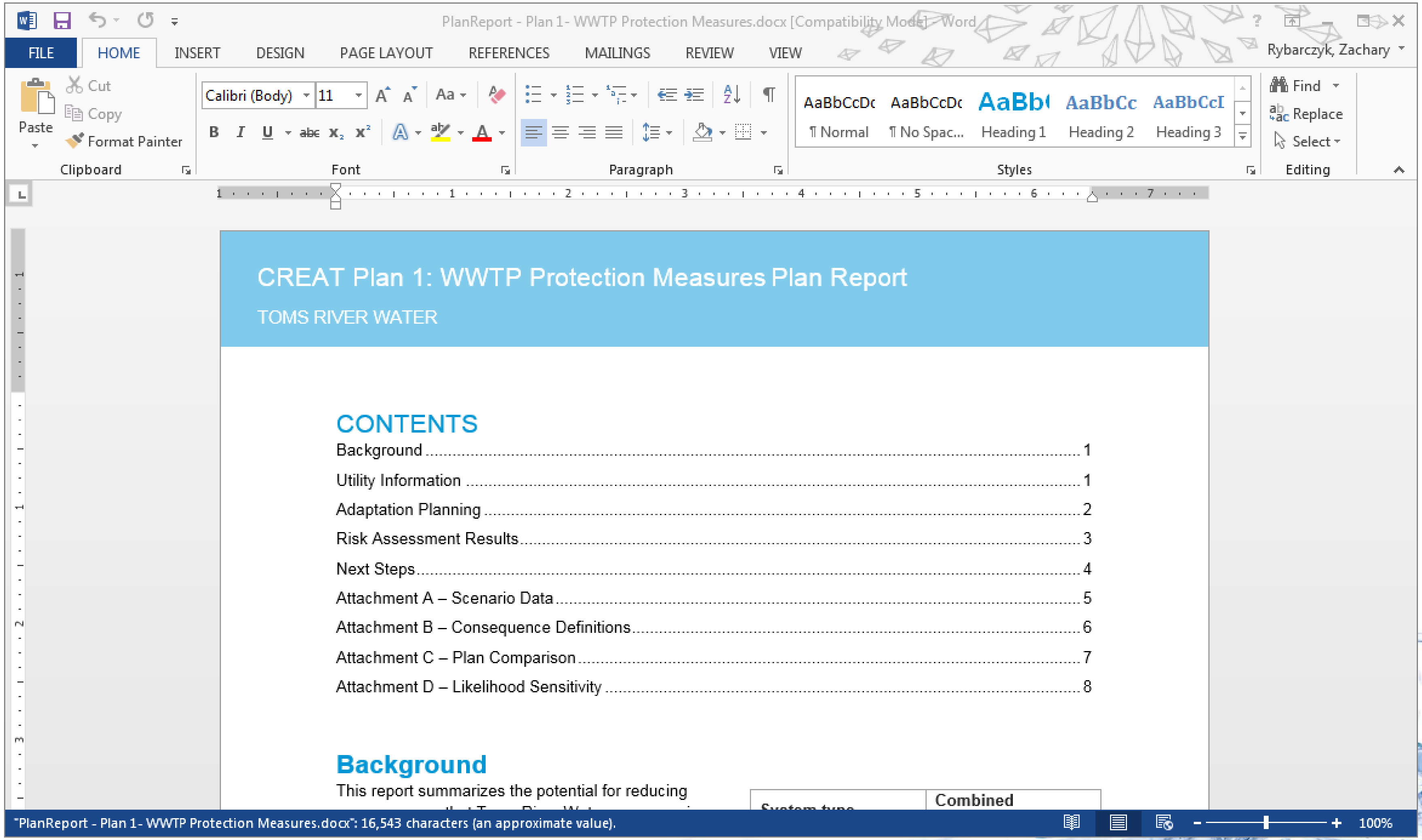
Design adaptation plans

RISK ASSESSMENT

Assess risk from a changing climate

Evaluate adaptation plans

CREAT Outputs: Final Report



CREAT Plan 1: WWTP Protection Measures Plan Report

TOMS RIVER WATER

CONTENTS

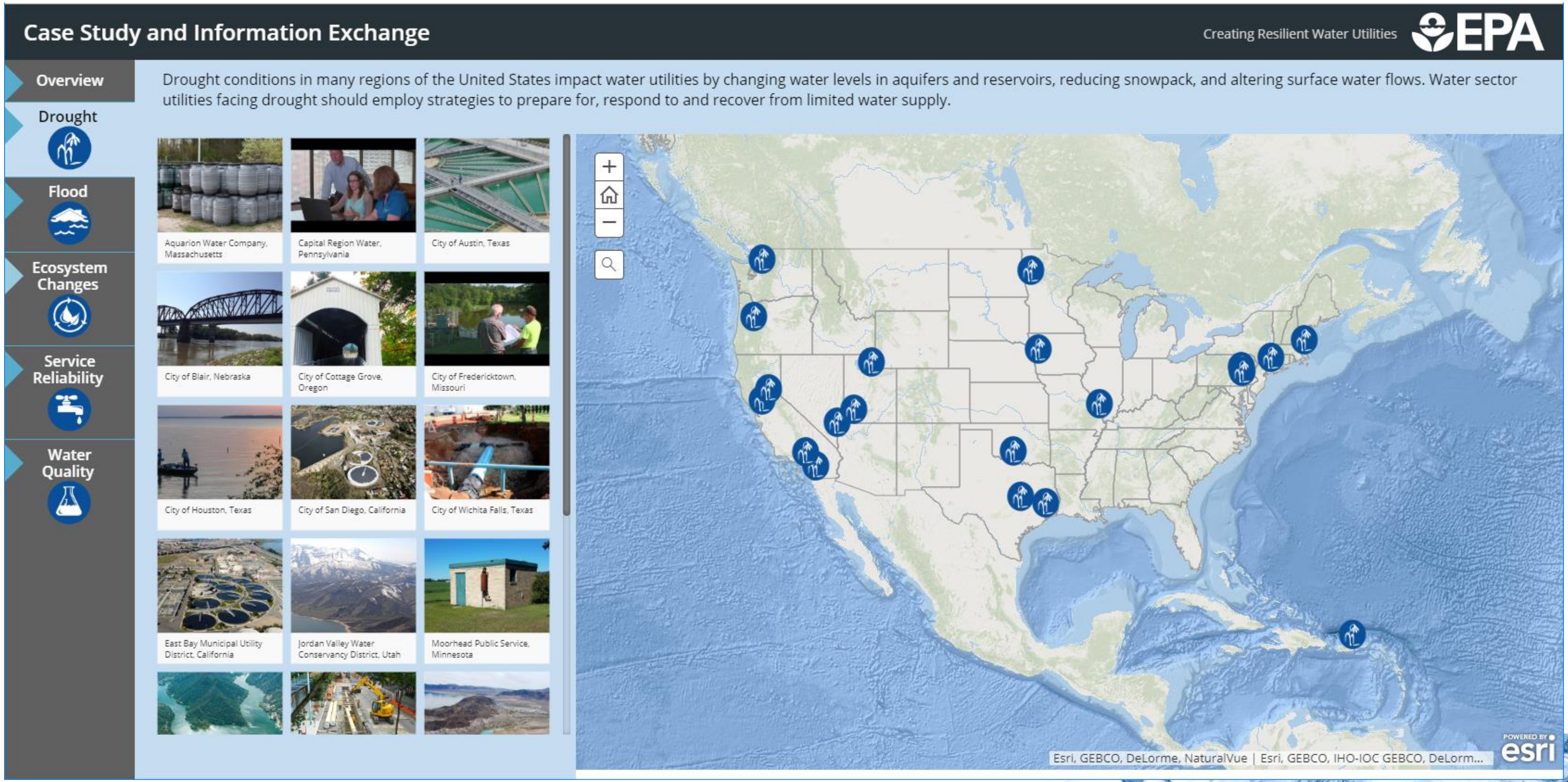
Background

This report summarizes the potential for reducing

	Combined

Case Study and Information Exchange

Stories from 44 utilities/communities (so far) addressing these climate-related concerns



Adaptation Case Study and Information Exchange

**Case Study:
Water and Wastewater Utilities
Planning for Resilience**

EPA

WASHINGTON COUNTY WATER CONSERVANCY DISTRICT (WCWCD) WASHINGTON COUNTY, UTAH

Background

The Washington County Water Conservancy District (WCWCD) provides drinking water services to 175,000 customers in the southwest region of Utah. WCWCD's current water supply comes from a combination of surface and ground water sources in the Virgin River watershed, which relies heavily on snowmelt from nearby mountains. The majority of the district's water is sold wholesale to its local municipal partners. The district also operates small retail culinary water, secondary irrigation water, and wastewater systems.

The not-for-profit agency has been operating for over 50 years and is responsible for conserving, developing, managing, and stabilizing water supplies for the county. Since its start, WCWCD has significantly expanded its infrastructure, services, and capabilities in an ongoing effort to serve the county's growing population. The district predicts water conservation will play an increasingly critical role in water resource planning and management to meet future demand and adapt to climate impacts.

Challenges

WCWCD identified sole water source reliance, water supply/quality management, meeting projected water demands with limited local supplies, and natural disasters as leading concerns for the county. They are particularly concerned that potential flood events could affect their water quality and that drought events may reduce the amount of snow pack in the region. Recently, WCWCD has been seeing decreased river flow due to less precipitation and more frequent warm spells during the winter. If a predicted hotter and drier future were to occur, WCWCD would expect severe business impacts to the utility due to service disruption.

Planning Process

To evaluate the resilience of their water system to extreme drought, WCWCD used the U.S. Environmental Protection Agency's (EPA's) CREAT. CREAT assists water utilities in identifying future extreme weather and other environmental threats, assessing risks from these threats, and evaluating and comparing measures to adapt to these threats. The assessment brought together individuals from WCWCD, state agencies, and EPA to think critically about potential vulnerabilities, priority assets, and strategies for strengthening infrastructure and operational resilience.

Resilience Strategies and Priorities

Based on experiences from prior threats to their water supply, WCWCD has already taken measures to protect their water supply from drought and to improve their overall resilience. For example, they offer landscape water audits to help residents better understand their water use and provide rebates to users who upgrade their irrigation equipment (e.g., use smart timers). Using the results of the CREAT assessment, the county was able to evaluate the performance and costs of different potential adaptation measures that, if implemented, could further strengthen the physical and operational resilience of the

**Case Study:
Water and Wastewater Utilities
Planning for Resilience**

EPA

CITY OF BLAIR, NEBRASKA

Background

The city of Blair, Nebraska provides drinking water and wastewater services to residential, industrial and commercial customers. The city of Blair owns and operates the entire municipal water system, including a 20 million gallons per day (MGD) water treatment plant that draws from the Missouri River. Drinking water demand for residential, commercial and industrial customers is described in Table 1. The city of Blair has an interconnection with Omaha through a rural system that can provide up to 1 MGD in case of an emergency.

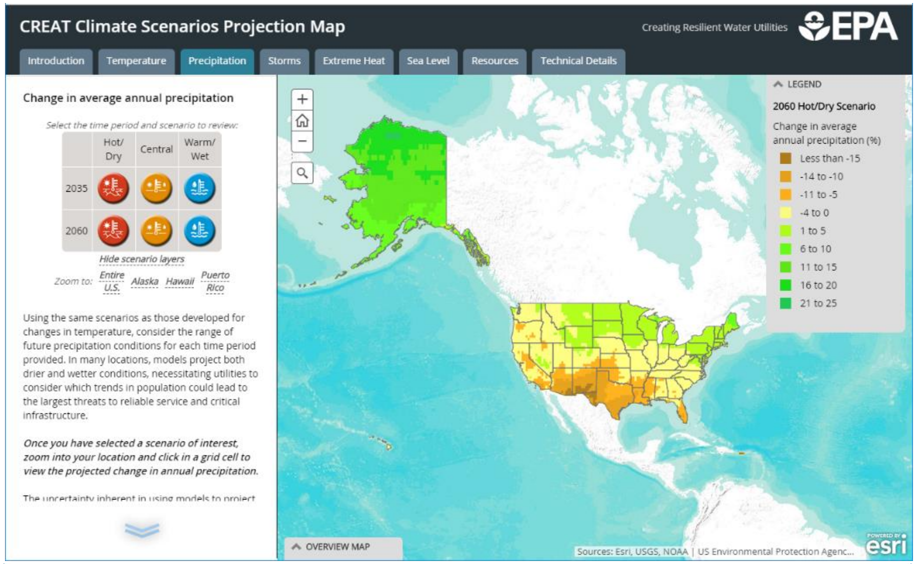
Table 1. City of Blair Drinking Water Demand

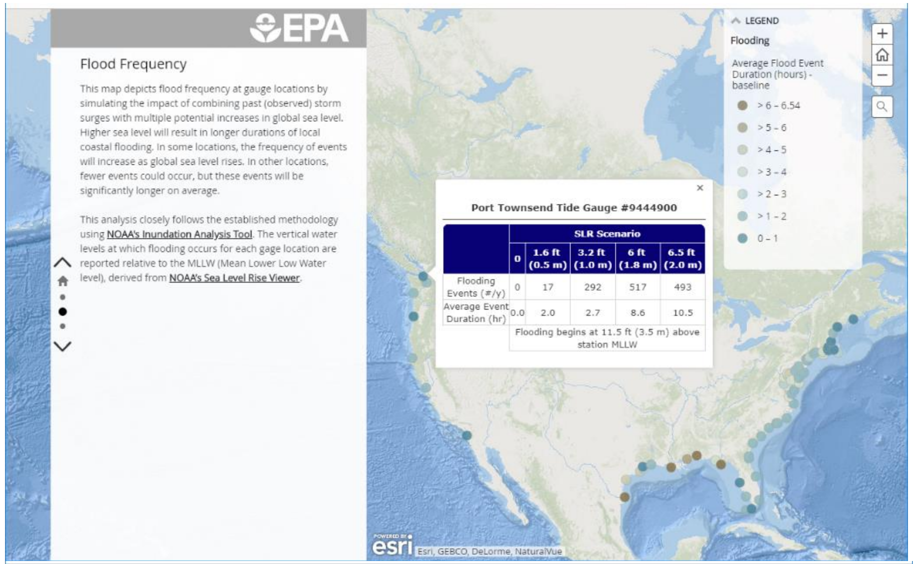
CUSTOMER	WATER DEMAND
Residential	Average: 1 MGD; Peak demand: 4 MGD City of Blair: population 8,000 Additional small rural systems outside the city: population of 2,000 – 4,000
Industrial – Cargill biocampus	10-15 MGD; higher demand in summer months
Industrial – Omaha Public Power Plant (OPPD) nuclear power plant	0.4 MGD OPPD switches over to the city of Blair's water source in warmer months when the temperature in their usual source water is too high and could cause the nuclear plant to violate their National Pollution Discharge Elimination System thermal discharge criteria
Additional commercial and industrial customers	2 MGD

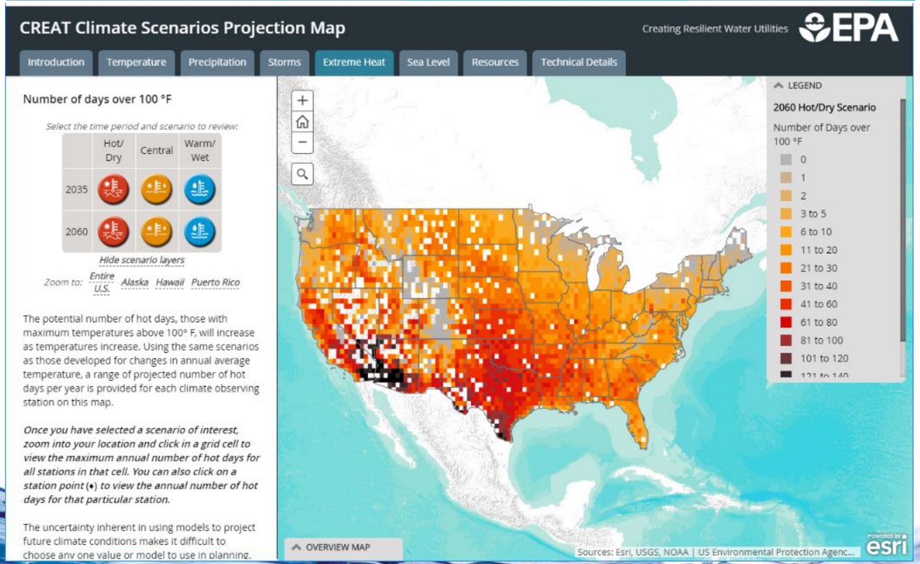
Challenges

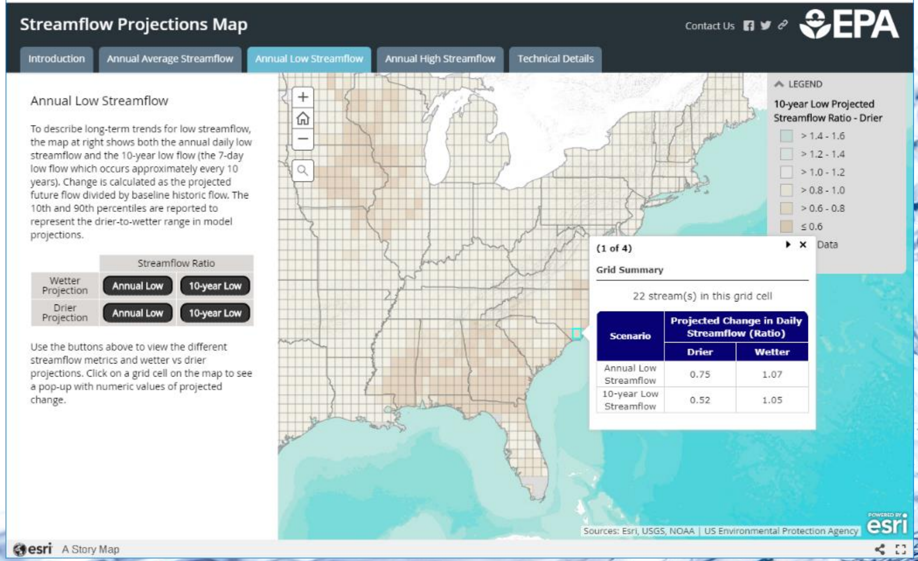
EPA

CRWU Data Services and Maps

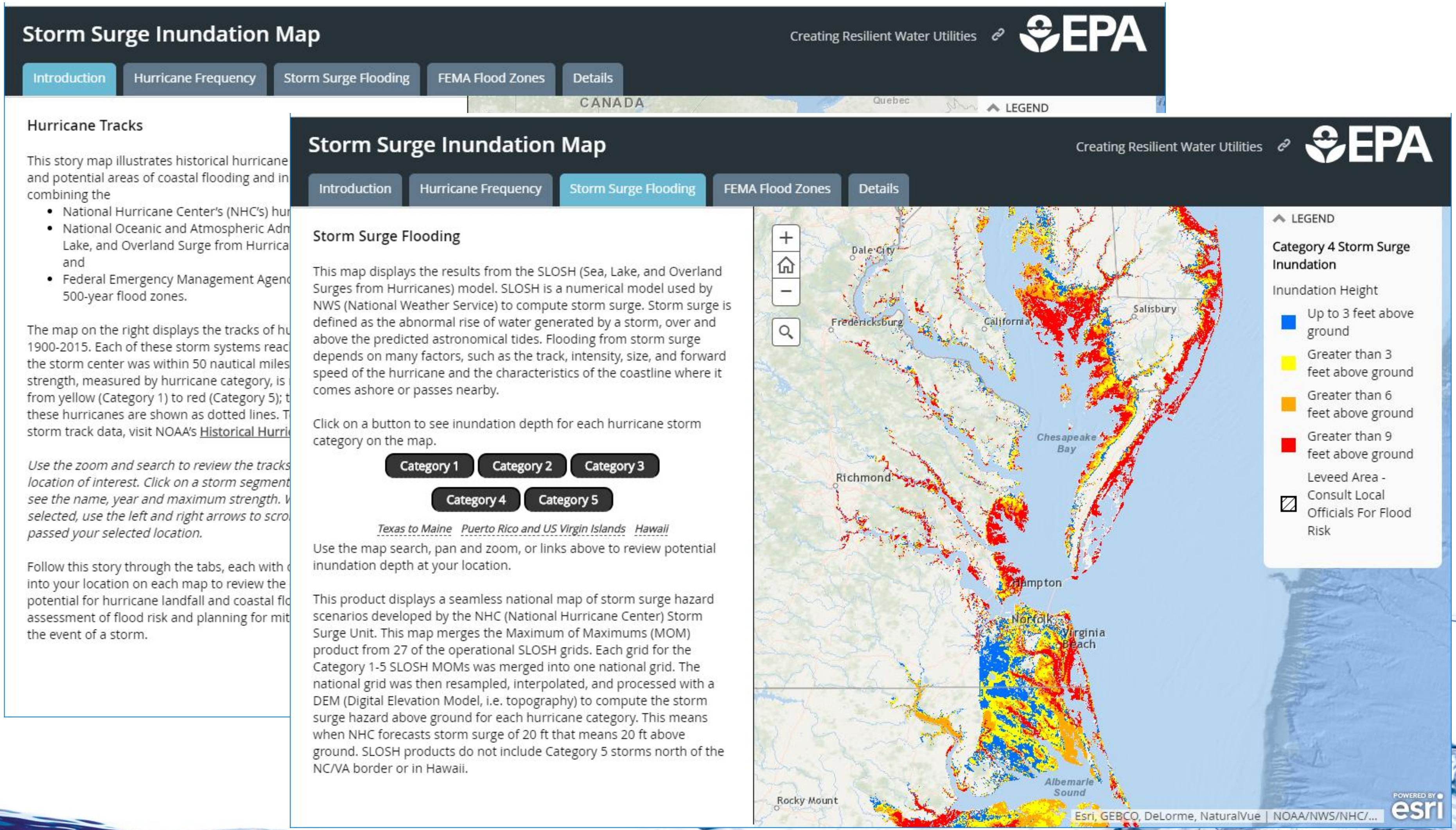






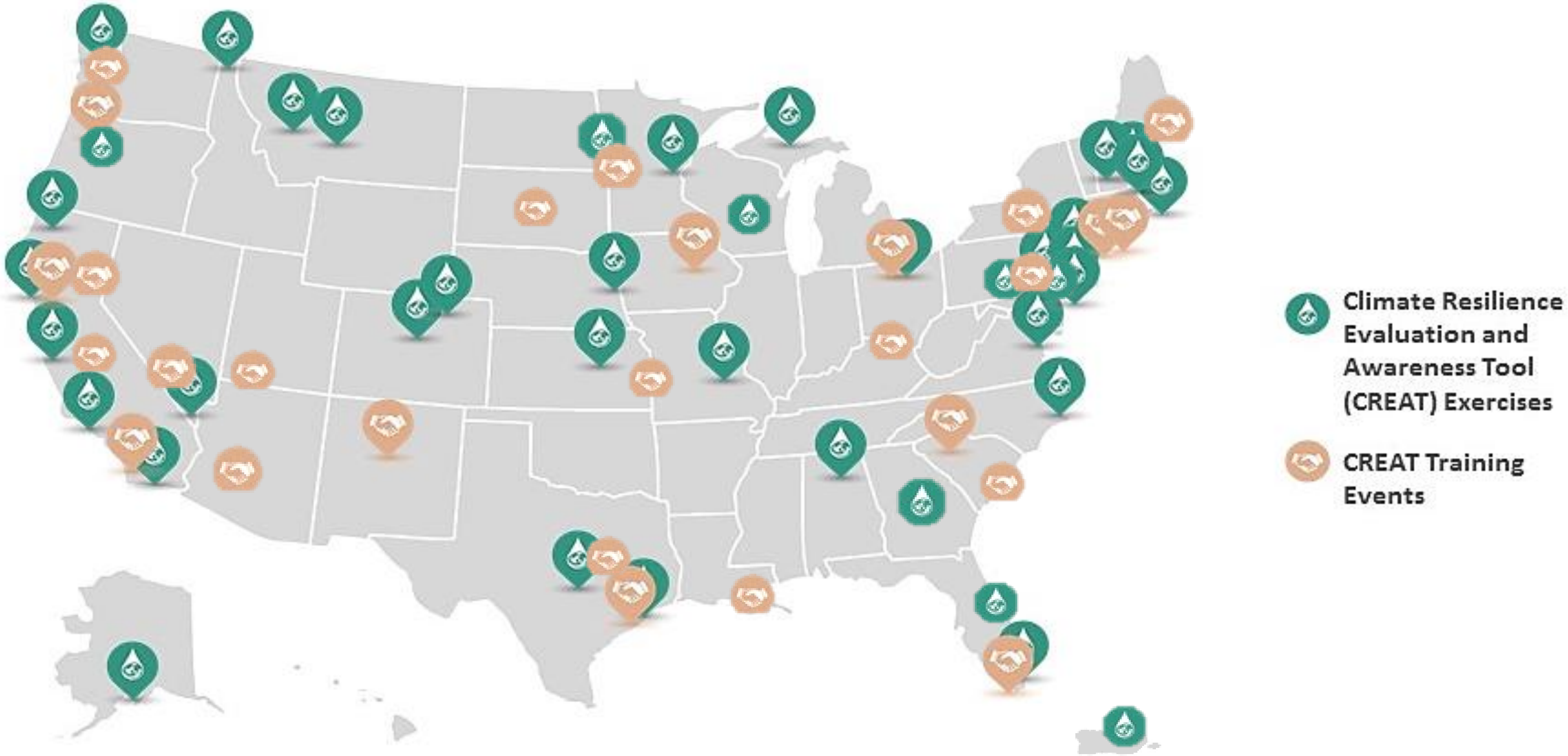


Storm Surge Inundation Map



EPA

CRWU Water Utility Resilience Support Projects: Outreach and Training



Contact Us

- Email: crwuhelp@epa.gov
- Curt Baranowski: Baranowski.curt@epa.gov
- Steve Fries: fries.steve@epa.gov
- CRWU website: www.epa.gov/crwu

Lindsey Hallock
Director of Public and Environmental Policy
Cape Fear Public Utility Authority
Wilmington, NC

ASSOCIATION OF METROPOLITAN WATER AGENCIES

NACWA
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Resiliency in the Water Sector

February 26, 2020

Lindsey Hallock
Director of Public and Environmental Policy
Cape Fear Public Utility Authority

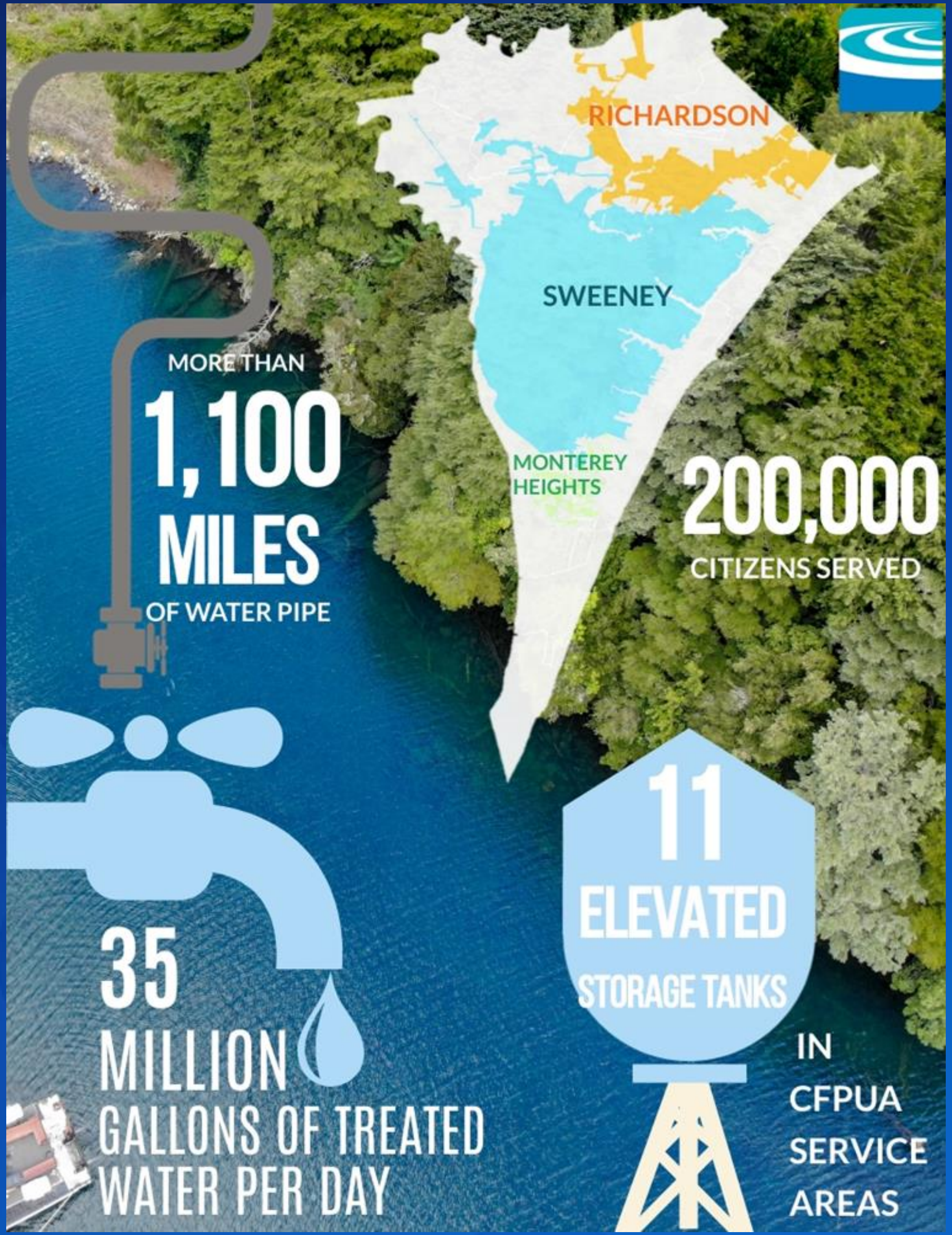
CFPUA: Who Are We?

July 2008:

- Cape Fear Public Utility Authority opened its doors with a mission of infrastructure improvement.
- Located in Southeastern North Carolina, with the Atlantic Ocean to our east and the Cape Fear River to our west.

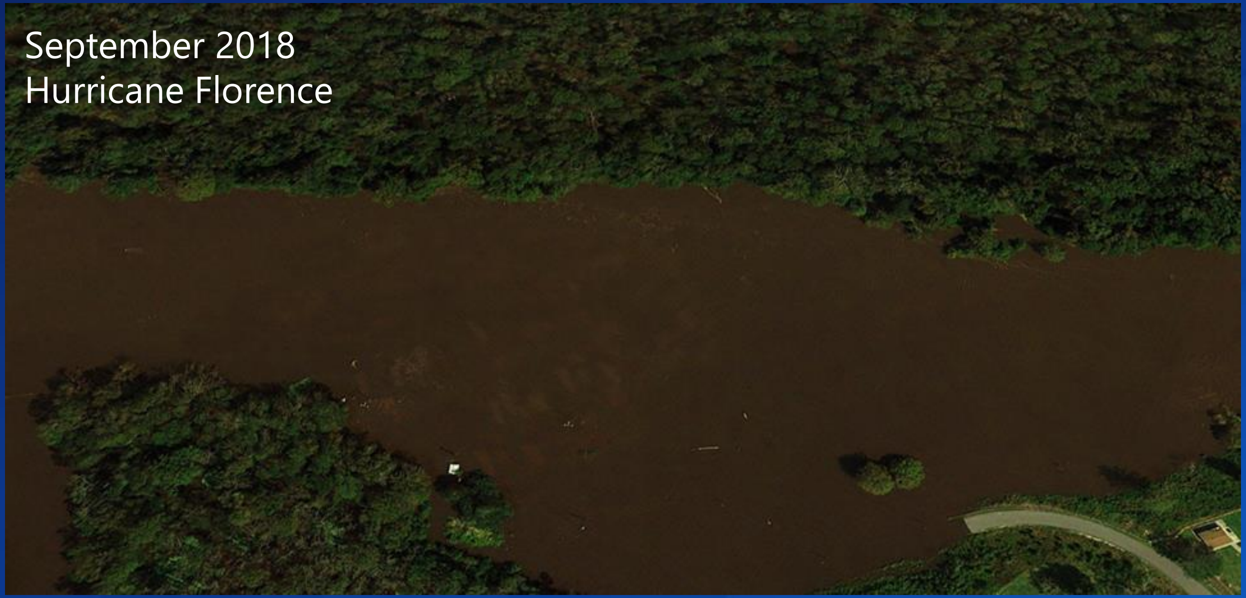
Today:

- Operate three drinking water systems- two groundwater systems and one surface water system on the Cape Fear River.
- Operate two wastewater plants.
- Serve approximately 200,000 people throughout City of Wilmington and New Hanover County, NC.
- Rely on rate revenue for majority of our funding—do not receive tax dollars.



Environmental Hazards We Face

- Sea-Level Rise and Flooding
  - Recent report found sea level rise of 0.9 inches per decade at Wilmington
- Drought
  - Implemented emergency water conservation plan in May of this year after we saw record-breaking rain the year before
- Increasing Temperatures
  - More instances of heat illness for employees working in the field are possible
- Hurricanes
  - Affected by three in the past four years



Hurricane Florence: How Did We Do?

- Maintained water and sewer service to customers throughout event
  - Only one home lost water service

- Pre-planning by Communications Unit resulted in no loss of network, voice, or business communications

- Areas of Improvement:
  - SSOs
  - Energy procurement during extended rain events
  - Raw water redundancy
  - Targeted customer notifications

Partnering With EPA

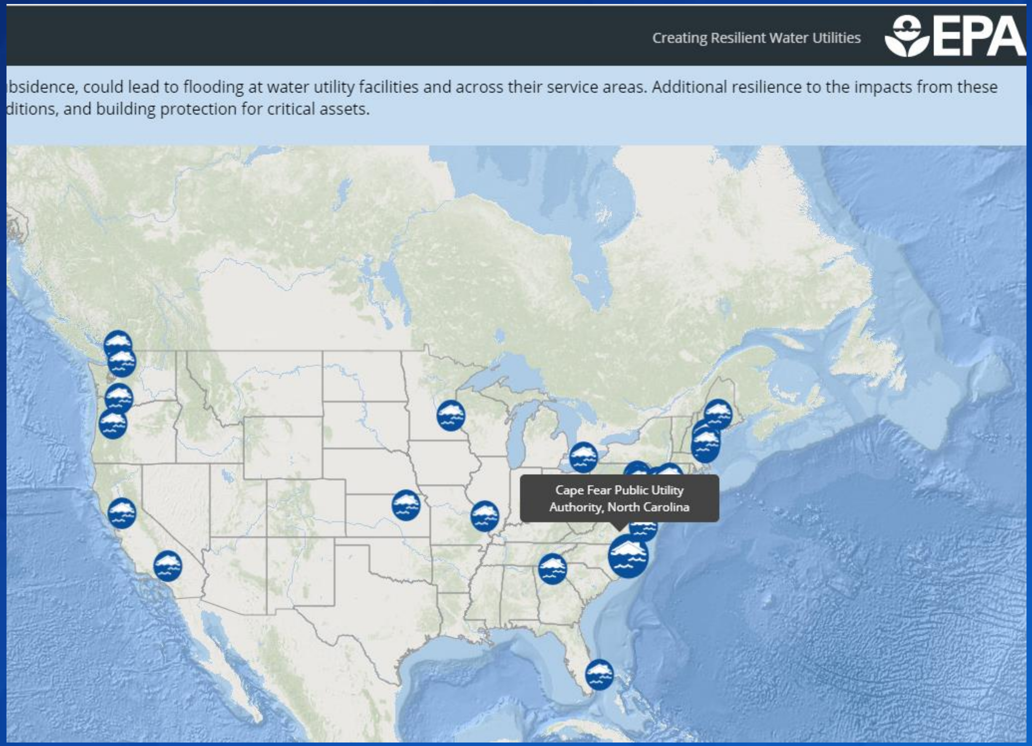
- EPA assisted Cape Fear Public Utility Authority (CFPUA) with a vulnerability and climate risk assessment using the VSAT and CREAT tools.

- This process helped CFPUA to:
  - Understand their vulnerabilities to natural hazards and climate change impacts
  - Calculate the costs and benefits of a variety of adaptation strategies
  - Satisfy AWIA risk assessment certification requirement

Using the Tools: Our Experience

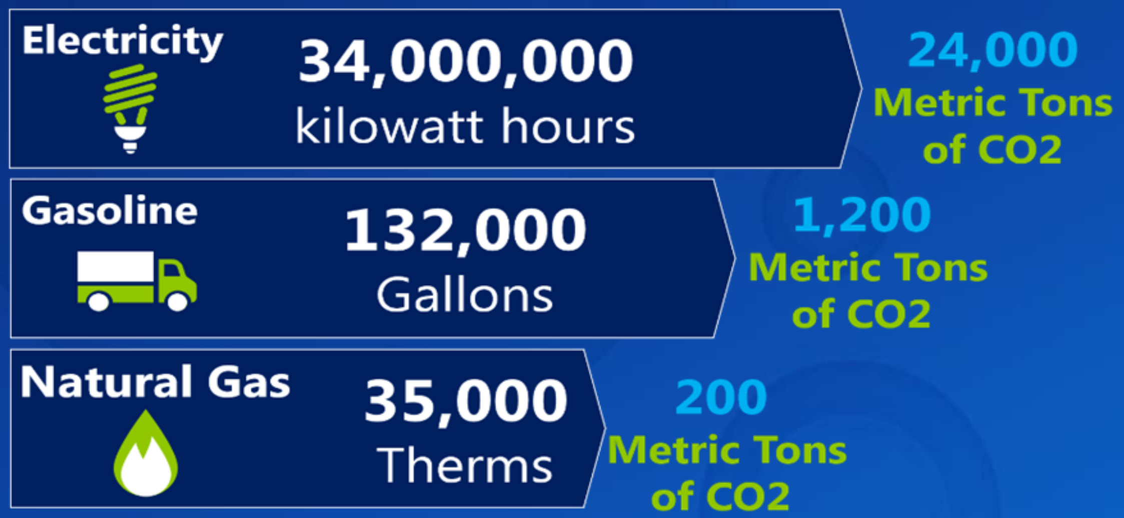
- **Resilient Strategies Guide (RSG)**
  - Sample of CFPUA employees surveyed on risks, vulnerable assets and resolutions:
  - Used Survey Monkey
  - 34 total responses received
  - Questions based on EPA Resilient Strategies Guide

- **Vulnerability Self Assessment Tool (VSAT) and CREAT**
  - Flood and drought scenarios
  - Acute vs. Chronic Threats
  - Cost-Benefit Analysis of Adaptation Strategies
  - Environmental Projection Data



Resiliency Initiatives In the Works

- CFPUA Energy Team designed to find efficiencies and reduce dependence on fuel
- Incorporating resiliency efforts and climate change data into our CIP
- Conducting elevation study on pump stations in areas vulnerable to flooding



Consumption numbers are approximate and are from Fiscal Year 2018 (July 2017-June 2018
Carbon Dioxide (CO2) equivalencies are approximated from the EPA Greenhouse Gas Equivalencies Calculator

THANK YOU

Lindsey Hallock

Director of Public and Environmental Policy

Cape Fear Public Utility Authority

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Travis Block
Public Utilities Director
City of Faribault
Faribault, MN

ASSOCIATION OF METROPOLITAN WATER AGENCIES

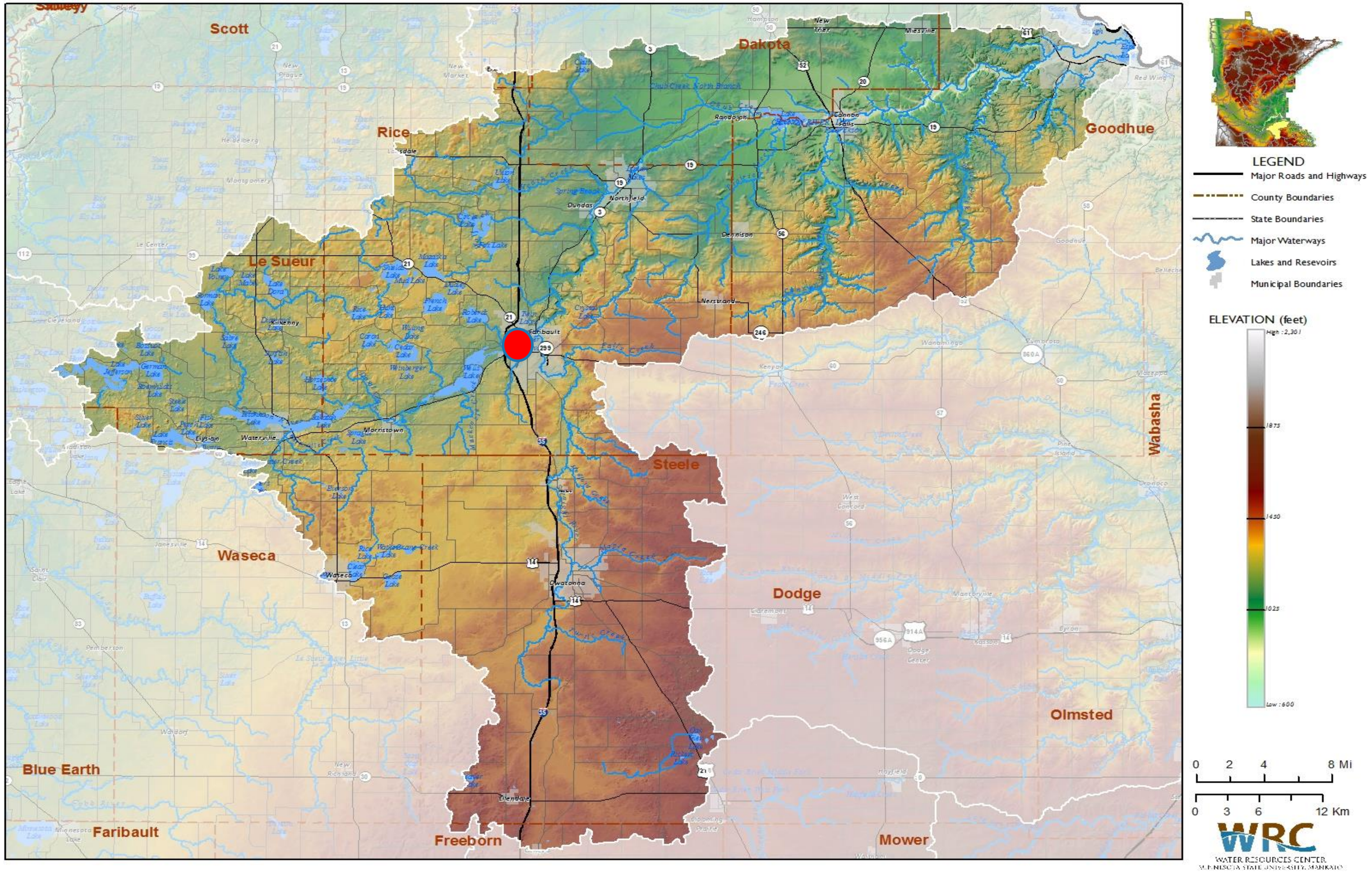
NACWA
THE VOICE FOR A CLEAN WATER FUTURE

City Of Faribault

FLOOD MITIGATION AND BANK STABILIZATION MEASURES

FACILITY OVERVIEW

- UTILITY BACKGROUND
  - AVERAGE FLOW: 4 MGD
  - 50-60% FLOW IS INDUSTRIAL
  - POPULATION SERVED: 23,352
- CONCERNED WITH FLOODING
  - PREVIOUS PERIODS OF OVERFLOW/BYPASS
  - INFILTRATION & INFLOW
- 2010 FLOOD IMPACTS
  - FACILITY LOCATED ON THE RIVER AND EXPERIENCED 6.17 INCHES OF RAIN IN FOUR DAYS. 8.56 INCHES FELL IN THE SAME TIME PERIOD UPSTREAM.
  - PLANT TAKEN OFF-LINE; SIPHON ON INTERCEPTORS ACROSS RIVER KNOCKED OFF-LINE FOR OVER ONE MONTH
  - STRUCTURE RELOCATED AWAY FROM THE RIVER



CANNON RIVER MAJOR WATERSHED

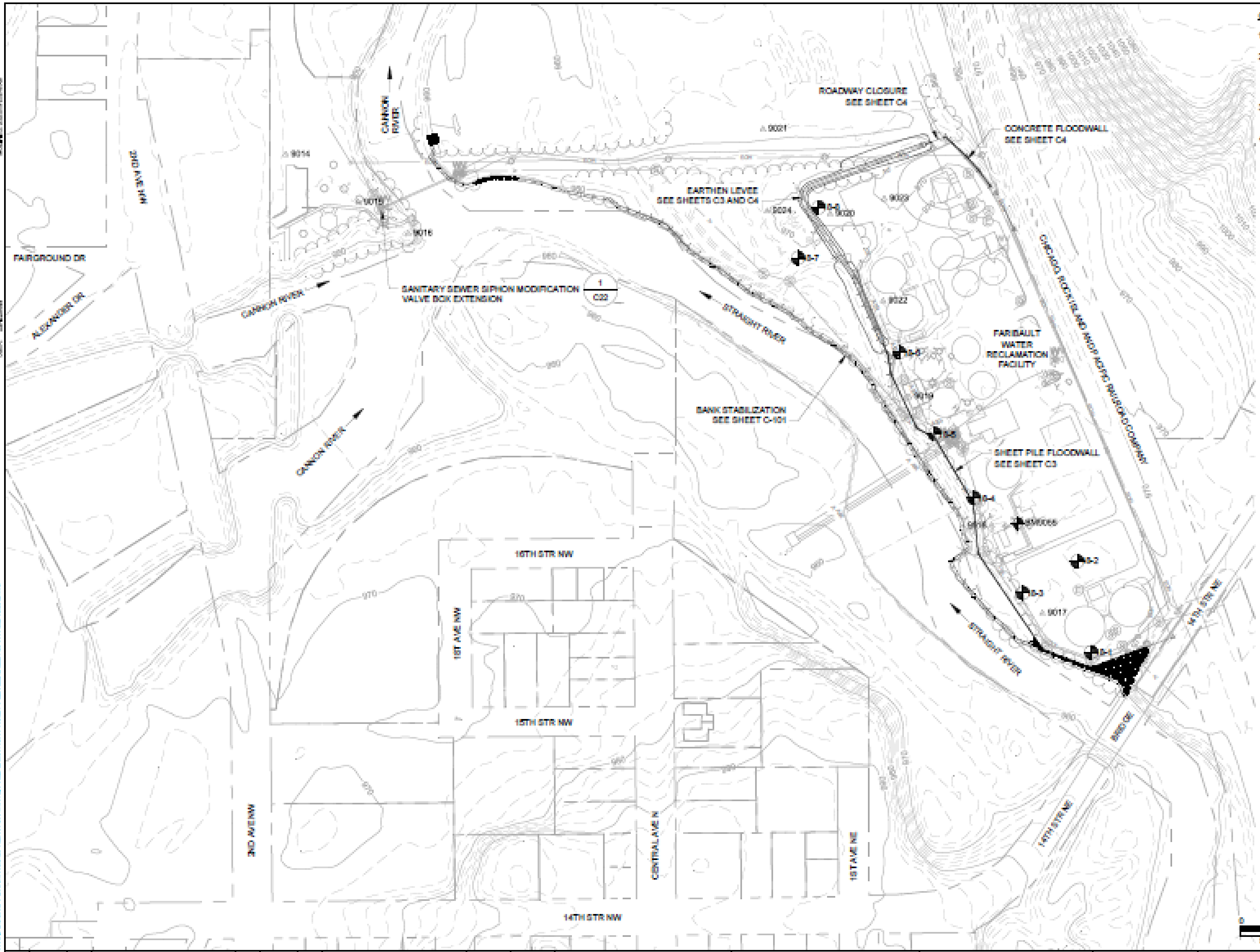

CITY OF FARIBAULT
WATER
RECLAMATION
FACILITY
214 NE 14th


WATER POLLUTION
CONTROL PLANT
FARIBAULT
AMERICAN


FARIBAULT
40

FLOOD MITIGATION MEASURES

- CONSTRUCTION OF APPROXIMATELY 1,715 FEET OF FLOOD BARRIER
- 995 FEET OF FLOODWALL AND 720 FEET OF LEVEE ALONG THE WEST SIDE OF THE WRF.
- THE CONSTRUCTION OF AN EASTERN FLOODWALL TIEBACK AND ROAD CLOSURE SYSTEM.
- THE CONSTRUCTION OF 1,900 FEET OF STREAMBANK STABILIZATION ALONG THE EAST BANK OF THE STRAIGHT RIVER.
- MAKE IMPROVEMENTS (ELEVATING TO ALLOW ACCESS UNDER FLOODING CONDITIONS) TO A KEY SANITARY SEWER STRUCTURE THAT COLLECTS WASTEWATER FROM THE NORTHERN AND INDUSTRIAL PARK SERVICE AREAS OF THE COMMUNITY.



GENERAL NOTES:

1. CONTOUR INTERVAL IS 2-FOOT (UNO).
2. EXISTING SITE TOPOGRAPHY AND SITE BASEMAP IS A COMPILATION OF MNTOPO LIDAR DATA AND SITE SURVEYS OF THE FARIBAULT WATER RECLAMATION FACILITY AREA BY SEH, INC. IN AUGUST AND SEPTEMBER 2018.
3. HORIZONTAL CONTROL IS BASE ON HARN 83 (96) RICE COUNTY MINNESOTA COORDINATE SYSTEM.
4. VERTICAL DATUM IS NAVD88.

VERTICAL BENCHMARK TABLE		
BM #	ELEVATION	DESCRIPTION
BM9055	969.47	BMK : X NW CORNER CONC

HORIZONTAL CONTROL POINT TABLE				
POINT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
9014	142204.78	463841.52	967.60	CPT 3/4 IP
9015	142107.72	463989.46	967.99	CPT 3/4 IP
9016	142044.52	464089.35	966.34	CPT 3/4 IP
9017	141273.41	465378.69	967.10	CPT 60D NAIL
9018	141452.29	465275.19	968.17	CPT 60D NAIL
9019	141713.16	465107.21	966.18	CPT 60D NAIL
9020	142084.09	464947.15	970.44	CPT 3/4 IP
9021	142256.68	464810.62	964.22	CPT 3/4 IP
9022	141908.35	465054.76	976.40	CPT : 60D NAIL
9023	142115.06	465057.14	969.73	CPT : 60D NAIL
9024	142089.78	464819.45	969.77	CPT : 60D NAIL

PLANS PREPARED BY:

SEH
3535 VADNAIS CENTER DRIVE
ST. PAUL, MINNESOTA 55110
PHONE: 1.800.325.2055
www.sehinc.com

PLANS PREPARED FOR:

City of Faribault

FARIBAULT
FARIT 146924
FA146924G03

FARIBAULT WATER RECLAMATION FACILITY
FLOOD MITIGATION AND BANK STABILIZATION PROJECT
FARIBAULT, MINNESOTA

SITE PLAN AND EXISTING CONDITIONS

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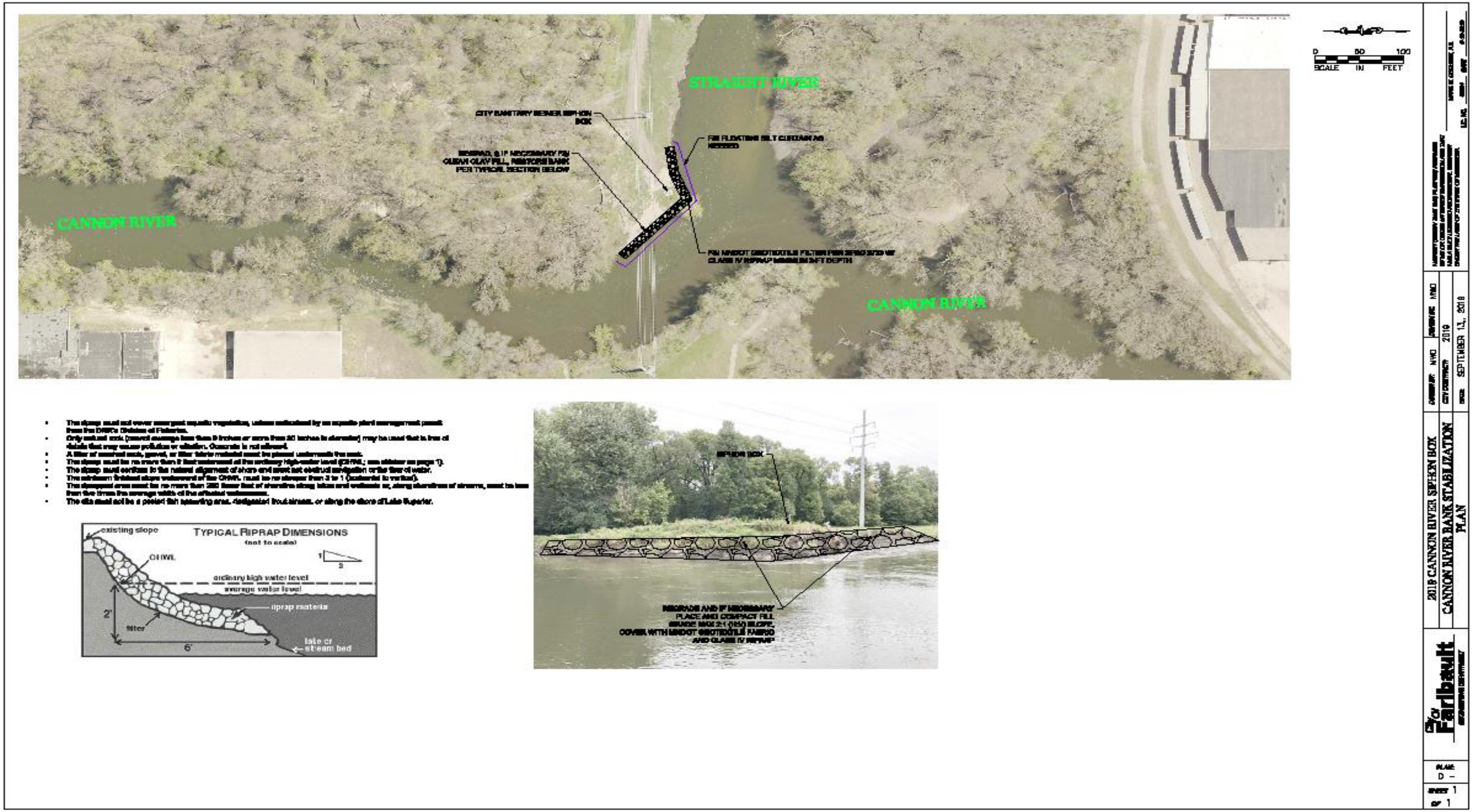
STRAIGHT RIVER
CANNON RIVER
CANNON RIVER
CITY SANITARY SEWER SIPHON BOX
0 50 100
SCALE IN FEET
TYPICAL RIPRAP DIMENSIONS
(not to scale)
existing slope
OHWL
ordinary high water level
average water level
riprap material
filter
2'
6'
lake or stream bed
1
3
SIPHON BOX
2019 CANNON RIVER SIPHON BOX
CANNON RIVER BANK STABILIZATION
PLAN
SEPTEMBER 13, 2019
Faribault
D -
1
1

PROJECT FUNDING

- PRELIMINARY COST ESTIMATE OF $3.8M
- PROPOSED FUNDING SPLIT OF 50/50 STATE & LOCAL
- AN APPLICATION WAS SUBMITTED TO THE MN DEPARTMENT OF NATURAL RESOURCES FLOOD DAMAGE REDUCTION PROGRAM
- A CAPITAL BONDING PROJECT APPLICATION WAS SUBMITTED TO THE MN MANAGEMENT & BUDGET OFFICE
- PROJECT IS CURRENTLY ON THE DNR’S ELIGIBLE LIST AND PENDING FUNDING FROM THE STATE LEGISLATURE

QUESTIONS ?

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Environmental Supervisor
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Regulatory Affairs Division
LA Sanitation and Environment
Los Angeles, CA

ASSOCIATION OF METROPOLITAN WATER AGENCIES

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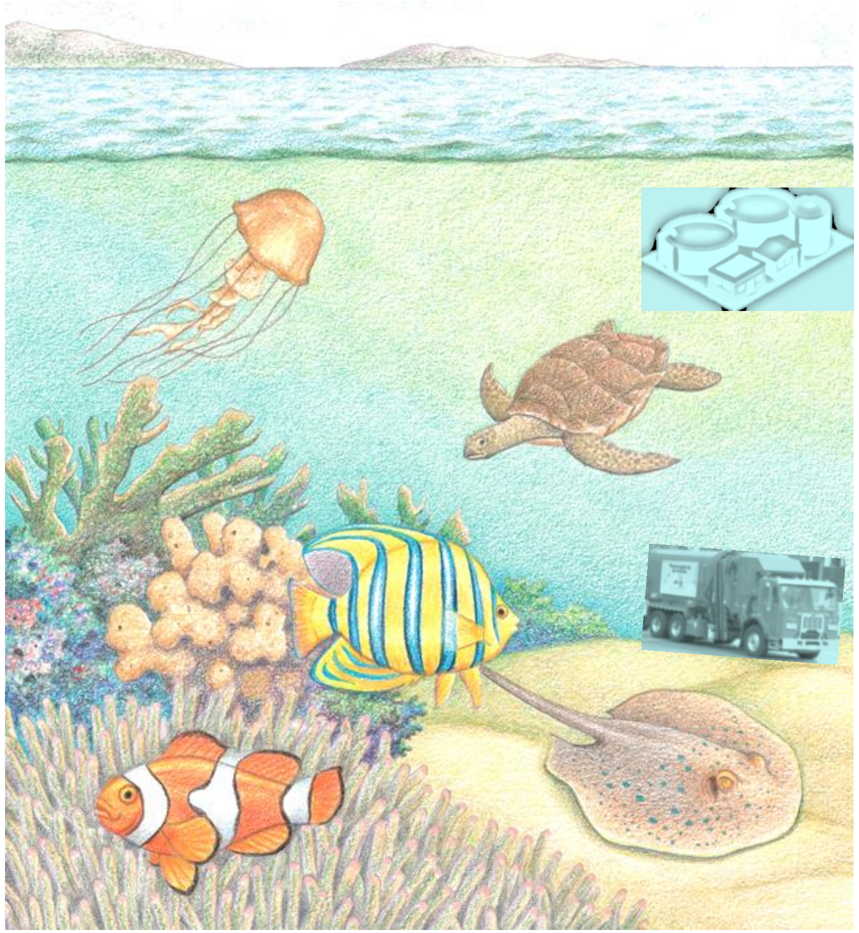
"Planning for climate change is not necessarily about being green. It really is about managing risk." - *Lara Whitely Binder, Climate Impacts Group*



Artwork by Russell Farrell (modified by staff)

CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION MEASURES FOR LA SANITATION AND ENVIRONMENT

City of Los Angeles Sanitation (LASAN) Facilities and Infrastructure

Presented in the AMWA/NACWA Building Resilience in the Water Sector Webinar
February 26, 2020

Mayor Eric Garcetti

environment LA SANITATION CITY OF LOS ANGELES
REGULATORY AFFAIRS DIVISION
Hassan Rad, Division Manager

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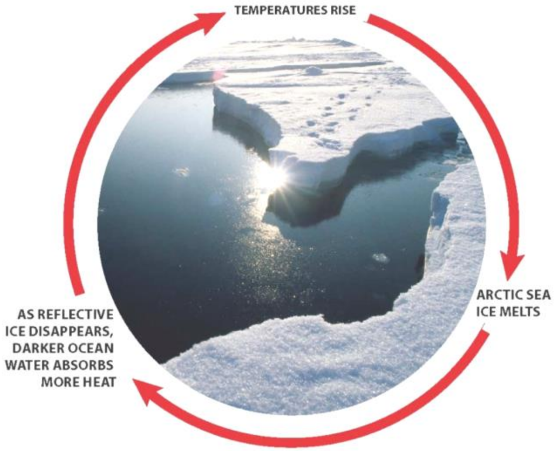
Source: Climate.NASA.gov



Source: National Academies of Sciences (http://nas-sites.org/americasclimatechoices//)

environment LA SANITATION
CITY OF LOS ANGELES
REGULATORY AFFAIRS DIVISION

PLANNING FOR CLIMATE RESILIENCY

We must prepare Los Angeles for future earthquakes and increasing climate disruptions facing our city, including bigger wildfires, longer and hotter heat waves, and rising sea levels. Whether in the form of distributed water solutions to help increase local water supplies and fight fires post-earthquake, or the integration of grid-tied solar powered backup systems to keep fire stations running, it is immediately necessary to have proactive solutions to prepare the City.

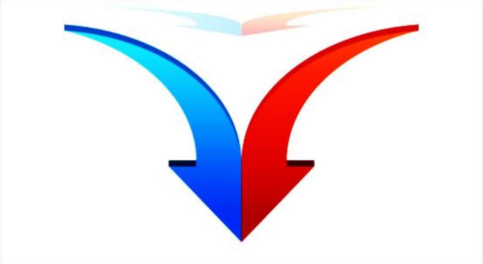
pLAn
TRANSFORMING LOS ANGELES
ENVIRONMENT | ECONOMY | EQUITY

PLANNING FOR CLIMATE RESILIENCY

LASAN Strategic Plan Goal No. 8

- Complete a Climate Change Adaptation Plan
- Identify Projects for LASAN's 10-Yr CIP for 2016-17

Initial Risk Screening



Climate Resilience Evaluation and Awareness Tool (CREAT)

↓

LASAN Climate Change Resiliency Assessment and Recommendations

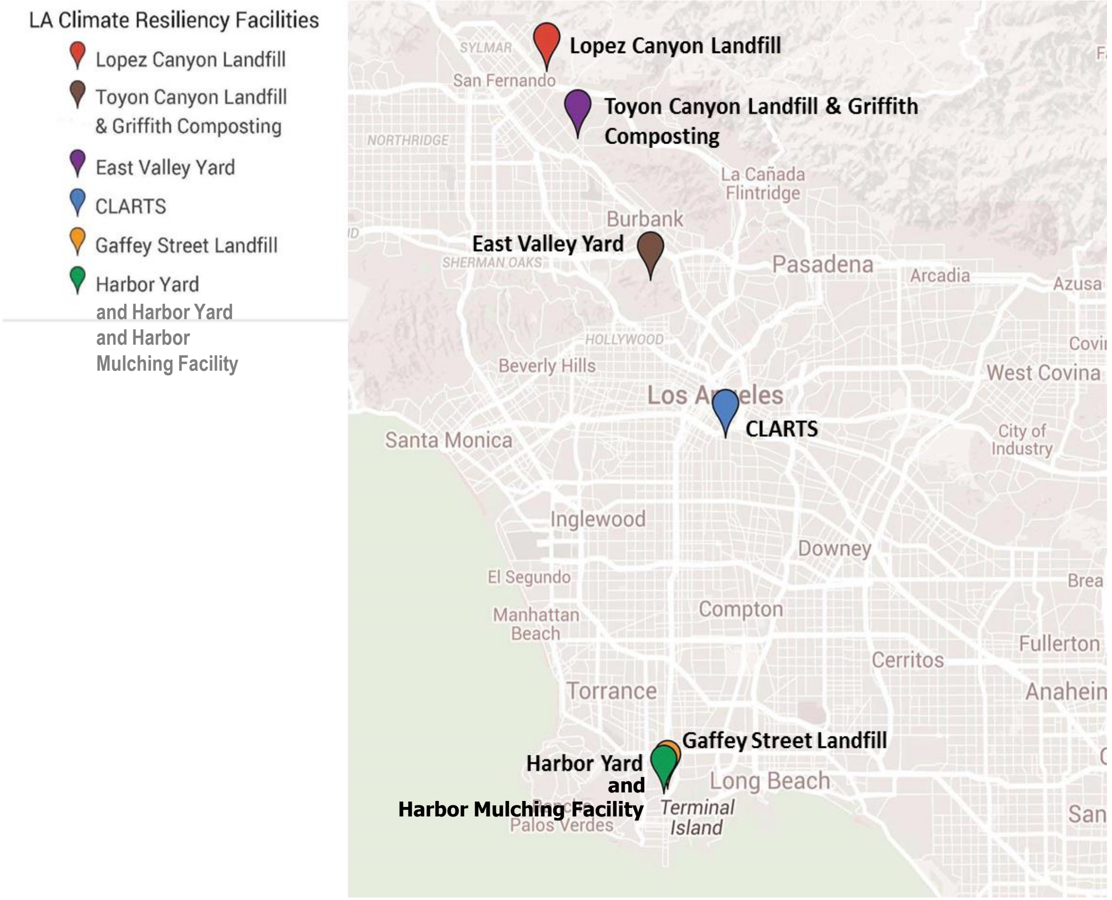
↓

Climate Change Adaptation and Resiliency Plan / CIP Projects

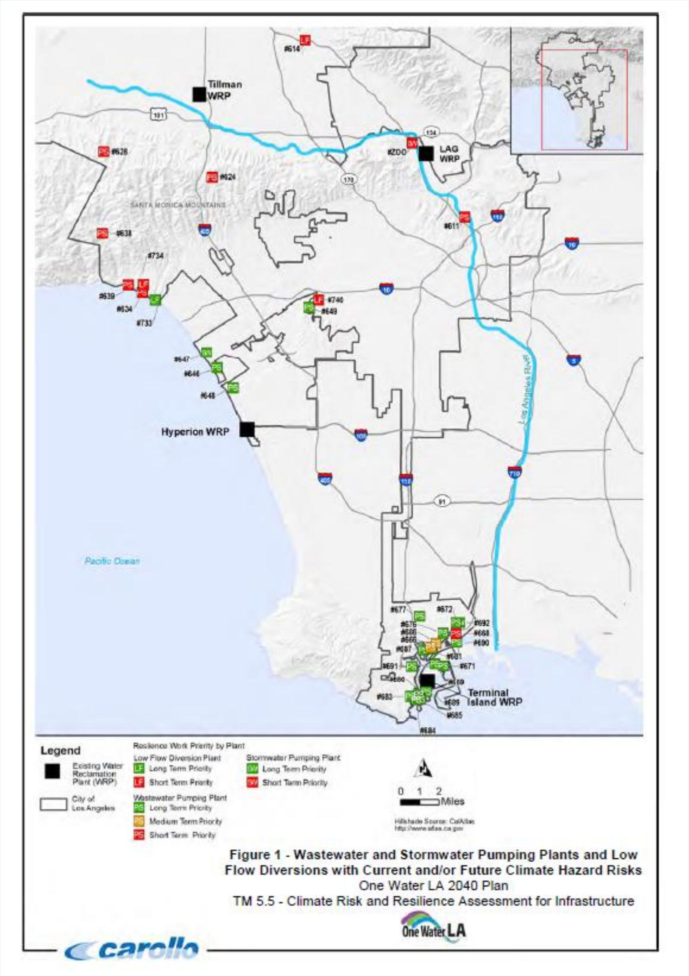
Mayor's Sustainability pLAn

- Integrate natural disaster resiliency strategy with climate action and adaptation plans by 2017
- Prepare for future earthquakes and increasing climate disruptions

PHASE 1
SOLID RESOURCES ASSESSMENTS



PHASE 1 AND 2
CLEAN WATER RESOURCES ASSESSMENTS



PHASE 1 PROJECT CHRONOLOGY

Initial Meetings

- EPA Extreme Events and Climate Adaptation Planning Workshop, April 2015
- Review of New York City Reports & USEPA Guidance
- Partnership: Project Planning and Coordination & Teleconferences with USEPA and CH2M
- Coordination with Affected LASAN Divisions

Facility Tours

- TIWRP
- 5 Wastewater Pumping Plants
- 1 Low-Flow Diversion Pumping Plant
- 7 Solid Resources Facilities

Asset Vulnerability Reports

- Wastewater and Stormwater
- Solid Resources
- Climate Change and Resiliency Adaptation Cost Analysis and Recommendations

Completed in March 2016

PHASE 2 PROJECT CHRONOLOGY

Initial Meetings

- Project Coordination Meetings Beginning January 2016
- Coordination with LASAN Divisions and Stakeholders
- Partnerships, Collaboration, and Innovation Special Topic Groups

Facility Tours

- 3 Water Reclamation Plants (WRP)
- 43 Wastewater Pumping Plants (WWPP)
- 11 Stormwater Pumping Plants (SWPP)
- 22 Low Flow Diversions (LFD)
- 3 Facilities in Design

Asset Vulnerability Reports

- 17 WWPPs, 9 SWPPs, and 16 LFDs had no impact.
- Remaining Facilities and Facilities in Design Assessed and Adaptation Measures Were Identified
- Climate Change and Resiliency Adaptation Cost Analysis and Recommendations

Completed in 2018

PHASE 3 IMPLEMENTATION

Business Process Updates

- Climate Resilience
- Environmental Justice
- Project Rating/Approval and Prioritization
- Project Pre-Design Analysis
- Board Reports

Design Standards

- Design Guidelines
- Plan Check Process Updates

Implementation

- Funding research and advocacy
- Climate adaptation project implementation training for project, operations and maintenance, and support services managers

Follow-Through

- Action planning
- Progress reporting/Trouble-shooting

In Progress

CLIMATE IMPACTS TO LOS ANGELES REGION

No. of Hot Days	6-22 days/year by 2060 Health, Safety, Power Outage, Transmission Problems
Flooding	• More extreme precipitation events, river flows, flooding, depths • Increase in spatial extent and depth of coastal storm surges
Landslide/ Liquefaction/Wildfire	• More extreme variations in weather patterns (intense precipitation and temperatures, more hot days)
Tsunami	• Submarine earthquakes and landslides, coastal inundation risks • Amplified with coastal storms and sea level rise
Sea Level Rise	• CoSMoS 3.0 (2016) 0.5 meters mid-century, 1.5 meters in 2100

REPRESENTATIVE CLIMATE INFORMATION

LOCATION	CLIMATE VARIABLE	HISTORICAL VALUE (OBSERVED)	PROJECTED VALUE FOR 2060 (OBSERVED + CHANGES)
Santa Monica Bay	Average Annual Temperature	62.9°F	66.0°F
	Total Annual Precipitation	18.5 inches	22.4 inches
	100-Year Storm Event	5.4 inches in 24 hours	7.0 inches in 24 hours
	Hot days (over 95°F)	6 days (1981-2000)[3]	22 days
	Sea-Level Rise	2 mm/year[4]	>0.5 meters (1.64 feet)
Los Angeles Harbor	Average Annual Temperature	63.2°F	66.1°F
	Total Annual Precipitation	13.7 inches	15.2 inches
	100-Year Storm Event	7.3 inches in 24 hours	9.5 inches in 24 hours
	Hot days (over 95°F)	6 days (1981-2000)[3]	22 days[3]
	Sea-Level Rise	2 mm/year[4]	>0.5 meters (1.64 feet)

3 Dr. Alex Hall, UCLA Study on Climate Change in the Los Angeles Region: Temperature Results, Business As Usual Scenario

4 Historical global sea-level rise observations, used by CoSMoS 1.0

5 Projected sea-level rise data from – SLR from CoSMoS 1.0 for the year 2050, CoSMoS 3.0 model calculations used at 100-year storm plus 0.5m sea-level rise scenario

RISK ANALYSIS

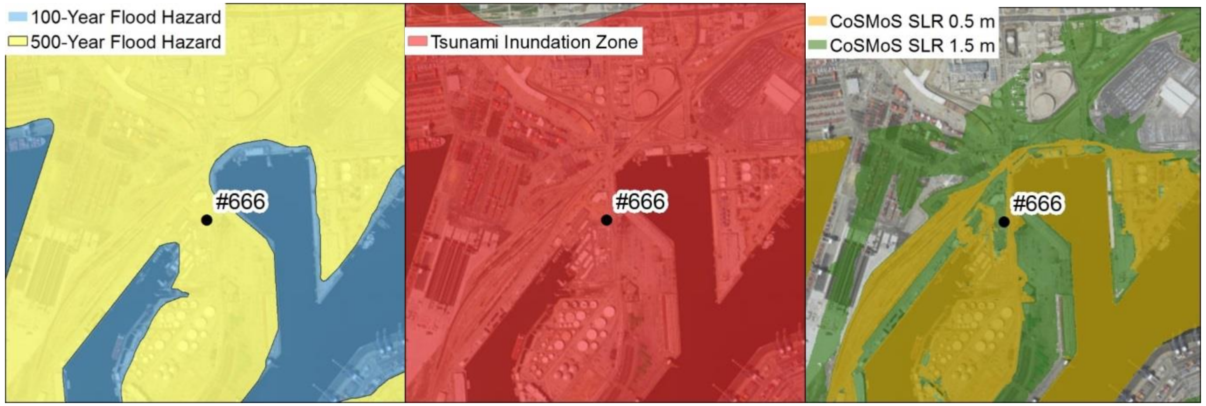
Terminal Island Water Reclamation Plant

Flood Zones/ Sea-Level Rise

Landslide, Liquefaction, Wildfire, and Tsunami Zones

WASTEWATER PUMPING PLANT #666 FRIES

- **Hazards**
  - 500-yr Flood Zone (Elev 12.25)
  - Tsunami (Elev. ~20)
  - 0.5-1.5m CoSMoS (Elev 11.64 – 14.92)
- **Damage Threshold Elevations**
  - Door Elev 11.17
  - Generator Pad Elev 11.89



*Elevations shown are in NAVD88 and 1' include freeboard

VENICE BEACH LOW-FLOW DIVERSION PUMPING PLANT NO. 647

Climate change risks

- Located in the 500-year flood zone and tsunami zone
- Coastal flooding, additional risk with sea-level rise
- Liquefaction*

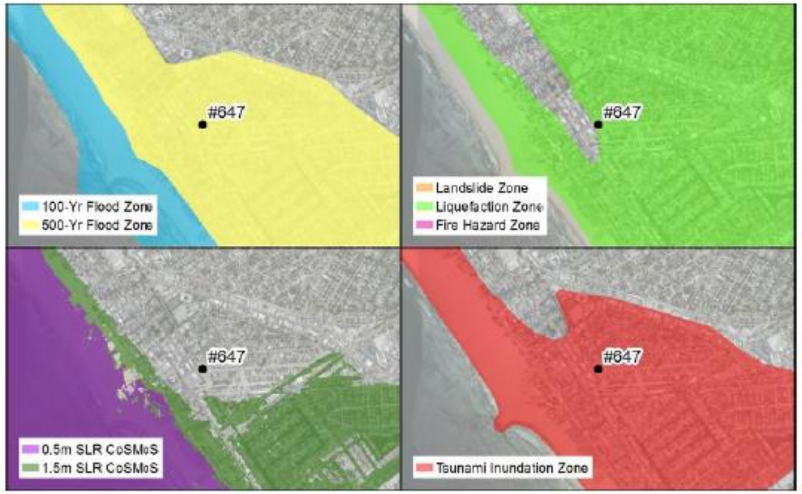


Figure 1. Hazard Zones for Kinney Circle Pumping Plant No. 647

* Minimized by flat terrain and development

Adaptation options

- Waterproof hatches
- Raise vents to elevations above future design flood elevation
- Use watertight enclosures on electrical, instrumentation and controls and MCCs
- Resize green infrastructure and other drainage enhancements for design storms
- Capture and re-use stormwater for irrigation or other non-potable uses

For planning purposes the estimated cost of the recommended adaptations is $610,000. The estimated damage replacement costs of the facility is $3,750,000.

HAWAIIAN & B PUMPING PLANT NO. 677

Climate change risks

- Located in the 500-year flood zone and tsunami zone
- Coastal flooding from tsunami
- Liquefaction*

Figure 1. Hazard Zones for Hawaiian & "B" Pumping Plant No. 677

* Minimized by flat terrain and development

Adaptation options

- Install watertight connections and protect the motor control center
- Waterproof instrumentation and controls
- Waterproof hatches and raise vents
- Install submarine doors to control room
- Raise generator pad
- Install bollards to protect above- ground structures from tsunami wave debris

For planning purposes, the estimated cost of the recommended adaptations is $870,000. The replace-in-kind cost estimate is $4,071,600.

CAPITAL COST ESTIMATES
(SOLID RESOURCES FACILITIES ONLY)

Facility/Operation	Estimated Replacement Costs	Estimated Resilience Improvement Cost
CLARTS	$1,100,000	$0
Harbor Collection Yard	$6,300,000	$230,000
Harbor Mulching Facility	$8,500,000	$0
Gaffey Street Landfill	$530,000	$0
Toyon Canyon Landfill	$500,000	$220,000
Griffith Park Composting Facility	$2,200,000	$220,000
East Valley Yard	$108,900,000	$1,540,000
Lopez Canyon Landfill	$29,500,000	$0
Alternative Fueling Systems	n/a	$7,040,000
Totals	**$157,530,000**	**$9,250,000**

CAPITAL COST ESTIMATES
(CLEAN WATER AND WATERSHED PROGRAMS)

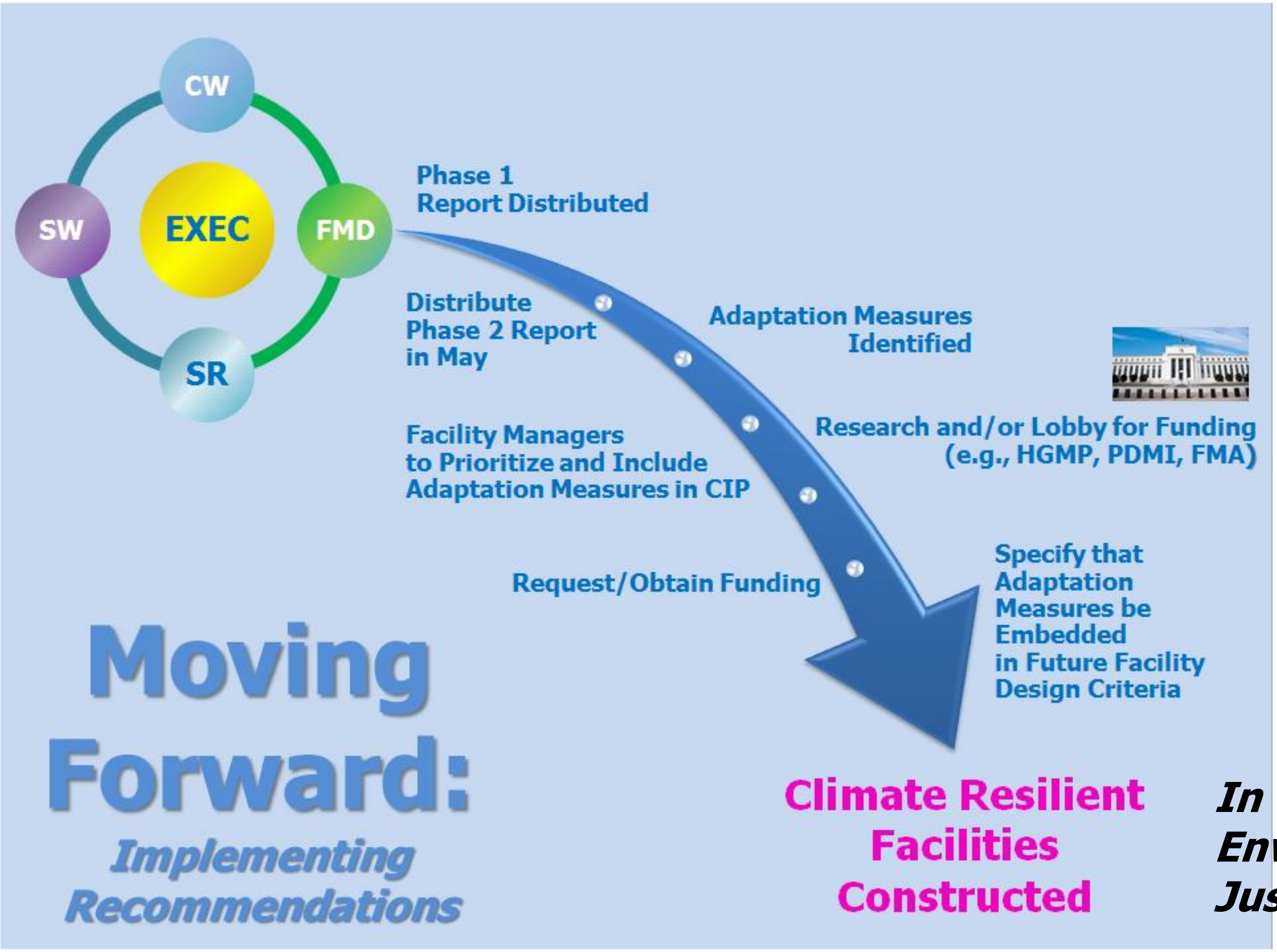
Assets	Estimated Replacement Costs	Estimated Resilience Improvement Costs
Water Reclamation Plants	$300,000,000	$33,212,900
Wastewater Pumping Plants	$92,474,800	$12,946,000
Stormwater Pumping Plants	$23,166,000	$1,860,000
Low-Flow Diversions	$3,250,000	$380,000
Low-Flow Diversion/Stormwater	$12,174,000	$1,570,000
Total Estimates	**$431,064,800**	**$49,968,900**

DETERMINING THE RISK LEVEL AND PRIORITIZING PROJECTS

Level	Utility Business Impacts	Utility Equipment Damage	Source/Receiving Water Impacts	Environmental Impacts
Very High	Long-term or significant loss of revenue or operating income	Complete loss of asset	Long-term compromise of source water quality or quantity	Significant environmental damage – may incur regulatory action
High	Seasonal or episodic compromise of revenue or operating income	Significant damage to equipment	Seasonal or episodic compromise of source water quality or quantity	Persistent environmental damage – may incur regulatory action
Medium	Minor and short-term reductions in expected revenue	Minor damage to equipment	Temporary impact on source water quality or quantity	Short-term environmental damage, compliance can be quickly restored
Low	Minimal potential for loss of revenue or operating income	Minimal damage to equipment	No more than minimal changes to water quality	No impact or environmental damage

Source: EPA Climate Resilience Evaluation and Awareness Tool Version 3.0 Methodology Guide

NEXT STEPS



In Environmentally Just ways

IMPLEMENTATION OF CLIMATE CHANGE ADAPTATION MEASURES

Concept and Design

- Update project approval processes to include climate change and environmental justice considerations
- Raise awareness
- Improve collaboration among project managers, operations staff and environmental review and compliance staff
- Reduce negative impacts to schedule and budget

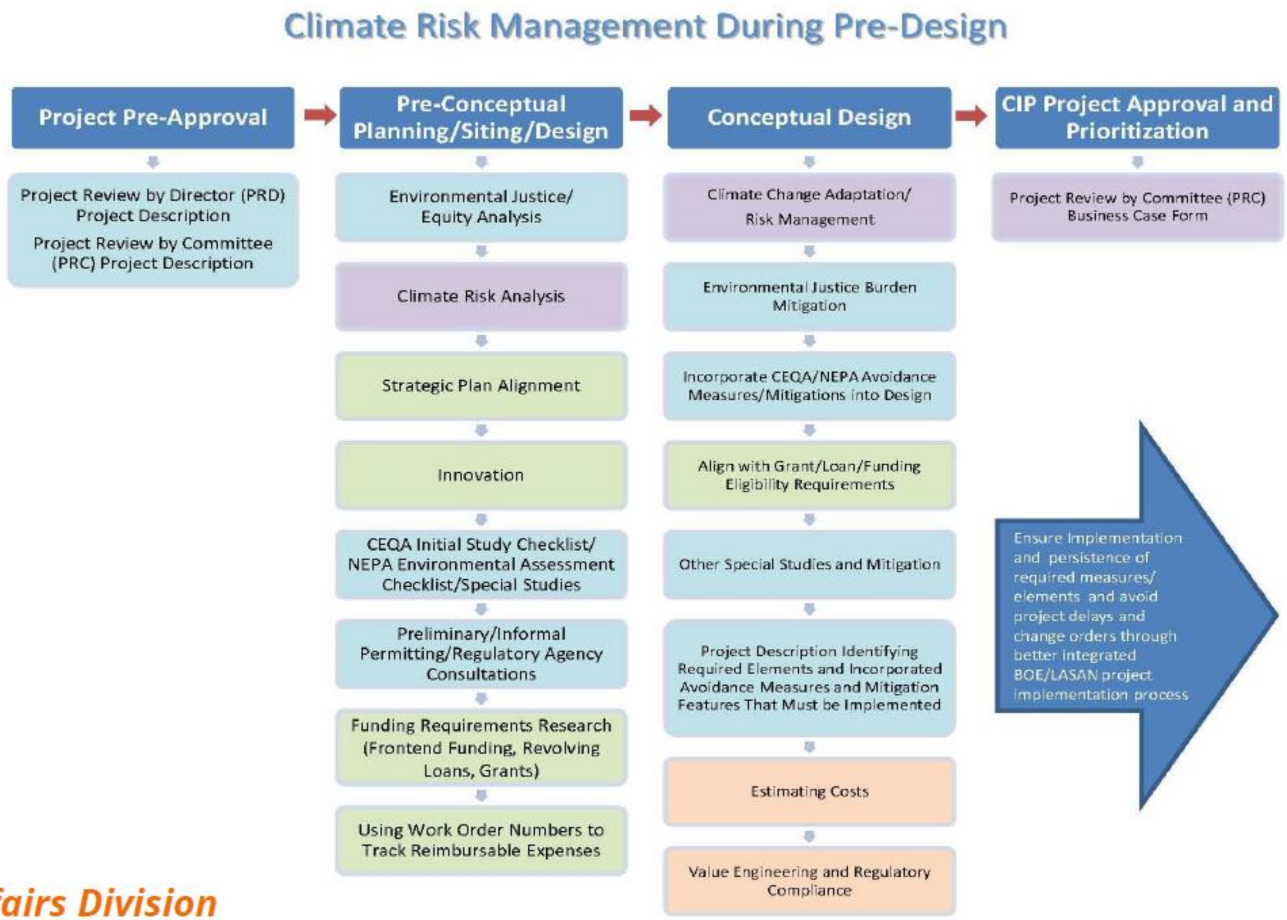
IMPLEMENTATION OF CLIMATE CHANGE ADAPTATION MEASURES

Institutionalization - Process Improvements

- Updating Project Approval Process to Consider Climate Risk and Environmental Justice Risk Impacts
- Updating Design Standards
- Conduct Funding Research
- Conduct Outreach
- Prepare Training Modules
- Train Project Managers and Asset Owners

IMPLEMENTATION OF CLIMATE CHANGE ADAPTATION MEASURES

environment
SANITATION
CITY OF LOS ANGELES
REGULATORY AFFAIRS DIVISION



Regulatory Affairs Division

IMPLEMENTATION OF CLIMATE CHANGE ADAPTATION MEASURES

Updating Climate Resilience Standards

New types of standards and procedural mechanisms provide opportunities for increased climate resiliency.

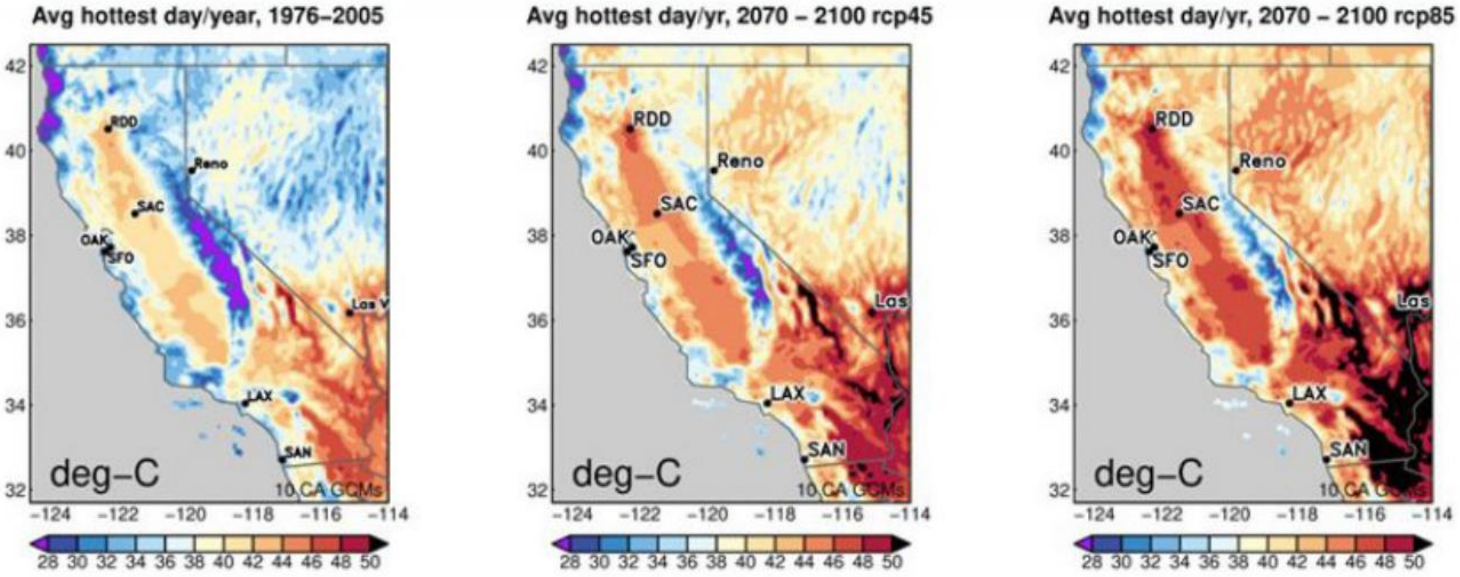
- Performance-based standards;
- Standards for professional practice;
- Standards of care;
- Different procurement approaches for various types of climate-safe infrastructure projects; and
- ASCE's Manual of Practice (MOP) that recommends an adaptive design approach.

Voluntary Climate Resilience Standards

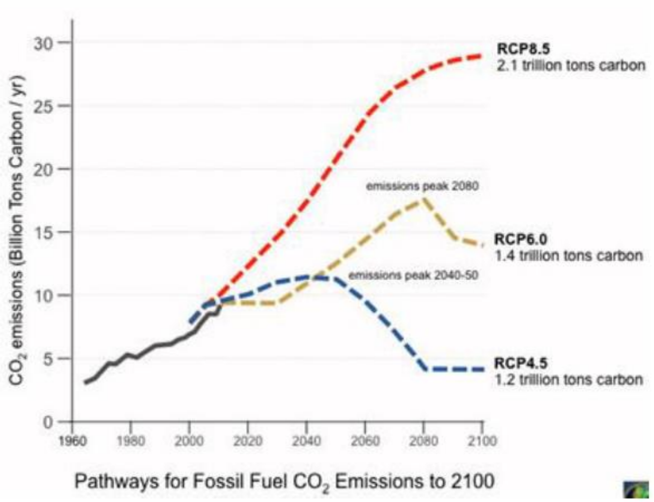
- The US Green Building Council's Building Resilience—Los Angeles Project (BRLA)
- The Insurance Council of Australia's Building Resilience Rating Tool (BRRT)
- The Institute for Sustainable Infrastructure's Envision Rating System
- The Insurance Institute for Business and Home Safety's FORTIFIED Standards
- The US Green Building Council's LEED program
- The US Green Building Council's Performance Excellence in Electricity Renewal (PEER) program
- The RELi Resilience Collaborative's RELi Resiliency Action List & Credit Catalog
- Arup's The Resilience Based Earthquake Design Initiative (REDi)
- Sustainable Sites Initiative (SITES)
- Enterprise Community Partners' Enterprise Green Communities Certification
- Alliance for National and Community Resilience (ANCR) (and its resilience benchmarking system, currently under development
- The Department of Homeland Security's Interagency Concept for Community Resilience (ICCR)
- The National Institute of Building Sciences' Unified Facilities Criteria (UFC)
- The National Institute of Standards and Technology (NIST) Community Resilience Assessment Methodology (CRAM)
- Cal Green Tiers 1 and 2

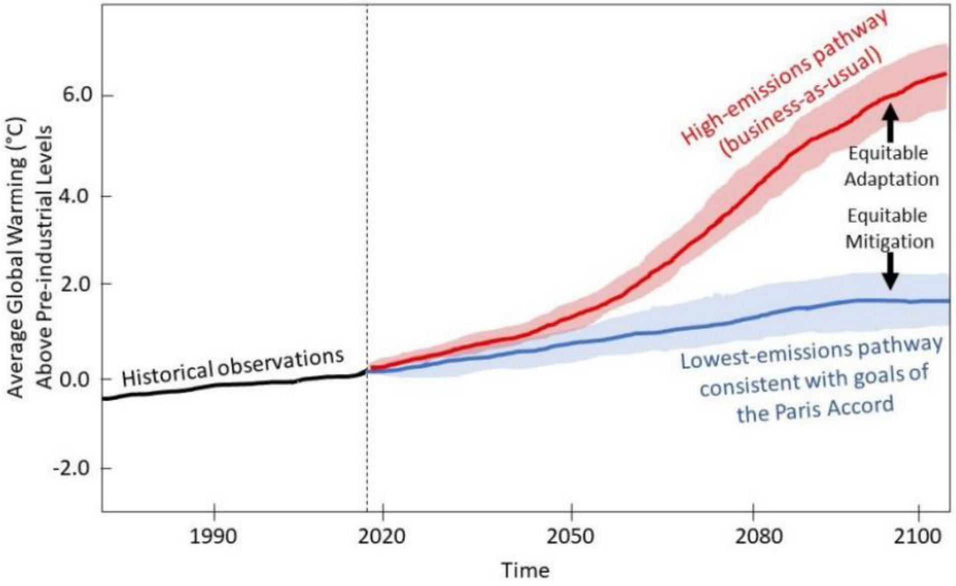
Deciding How to Time and Plan Investments With Scenario Planning

Temperature Increases in Different Scenarios



Scenario Planning with Representative Concentration Pathways (RCPs)





Retrieved from: https://architecture2030.org/ipcc_analysis/
Source: CSIWG (2018), *Paying It Forward*

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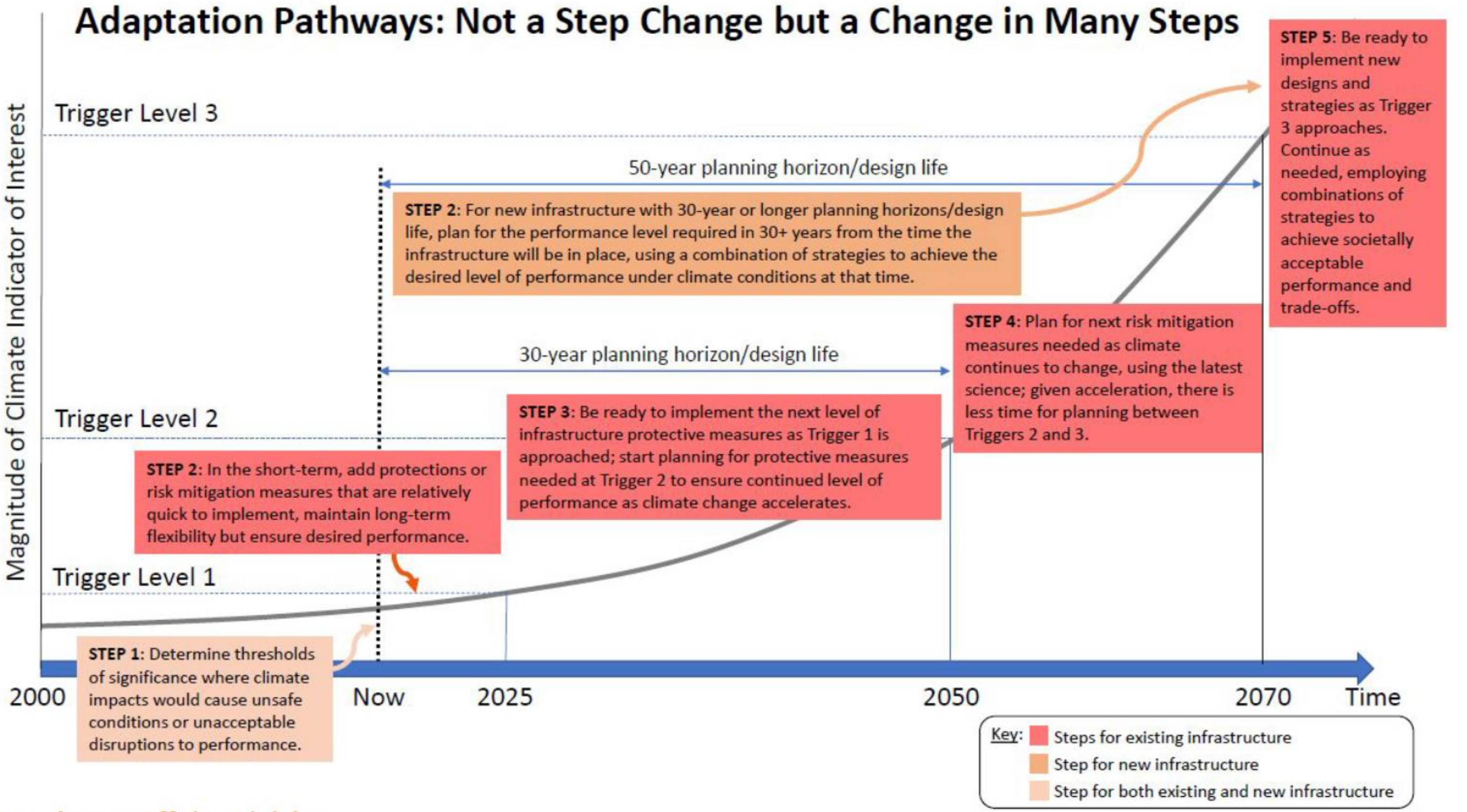

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Source: CSIWG (2018), *Paying It Forward*

LASAN CONTACTS

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REFERENCE INFORMATION

FREEBOARD

Freeboard is a **factor of safety** usually **expressed in feet above a flood level** for purposes of floodplain management.

"Freeboard" tends to **compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions**, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.

Freeboard is not required by National Flood Insurance Program (NFIP) standards, but communities are encouraged to adopt at least a one-foot freeboard to account for the **one-foot rise built into the concept of designating a floodway and the encroachment requirements** where floodways have not been designated. Freeboard results in significantly lower flood insurance rates due to lower flood risk.

Source: FEMA (https://www.fema.gov/freeboard)

DESIGN FLOOD ELEVATION (DFE) CALCULATION METHODOLOGY

The ASCE-recommended design flood elevation (DFE) in Standard 24-14 is calculated using the base flood elevation (BFE) plus a freeboard of 1 foot for inland areas or 2 feet for coastal areas. The BFE is the 100-year flood elevation as shown on a FEMA FIRM.

In the risk assessment, the DFE was compared to actual threshold elevations at facilities for determining risks and needed improvements. DFEs can be summarized as follows:

- **Short Term Risk DFEs** were identified by comparing the threshold elevations to the BFE plus the relevant freeboard (inland vs. coastal) as the DFE as follows:

  100-year Flood DFE = BFE + Freeboard

- **Medium-Term Risk DFEs** used the BFE plus freeboard plus 1.64 feet (0.5 meter) of sea level rise (SLR) for mid-century conditions as follows:

  0.5 meter SLR DFE = BFE + Freeboard + 0.5 meter

- **Long-Term Risk DFEs** used either the 500-year (0.2 percent chance of annual occurrence) flood elevation plus freeboard, the BFE plus freeboard plus 4.92 feet (1.5 meters) of SLR, or a tsunami depth of 20 feet as follows:

  500-year Flood DFE = BFE*1.25 + Freeboard

  1.5 meter SLR DFE = BFE + Freeboard + 1.5 meters

  Tsunami DFE = 20 foot estimated tsunami wave height

COASTAL STORM MODELING SYSTEM (CoSMoS)

- A dynamic modeling approach that has been developed by the United States Geological Survey in order to allow more detailed predictions of coastal flooding due to both future sea level rise and storms integrated with long-term coastal evolution (i.e., beach changes and cliff/bluff retreat) over large geographic areas (100s of kilometers).

- CoSMoS models all the relevant physics of a coastal storm (e.g.,tides, waves, and storm surge), which are then scaled down to local flood projections for use in community-level coastal planning and decision-making.

- Rather than relying on historic storm records, CoSMoS uses wind and pressure from global climate models to project coastal storms under changing climatic conditions during the 21st century.

- Projections of multiple storm scenarios (daily conditions, annual storm, 20-year- and 100-year-return intervals) are provided under a suite of sea-level rise scenarios ranging from 0 to 2 meters (0 to 6.6 feet), along with an extreme 5-meter (16-foot) scenario. This allows users to manage and meet their own planning horizons and specify degrees of risk tolerance.

Source: USGS, https://walrus.wr.usgs.gov/coastal_processes/cosmos/index.html

CoSMoS VERSIONS

Version 1.0 **Southern California**
Version 2.0 **Northern California (outer coast)**
Version 3.0 **Southern California** Model enhancements for southern California include: • Improved system methodology from CoSMoS 1.0 for more accurate flood projections in high-interest embayments and estuaries • Long-term coastal evolution projections for sandy beaches and cliffs produced from a collection of state-of-the-art models and historical data • Downscaled winds from Global Climate Model (GCM) data for locally-generated seas and surge • Discharge from rivers for event response and long-term sediment supply • An improved baseline elevation DEM that incorporates recent LIDAR survey

Source: USGS, https://walrus.wr.usgs.gov/coastal_processes/cosmos/socal3.0/index.html

Questions

&

Discussion

ASSOCIATION OF METROPOLITAN WATER AGENCIES

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Additional Resources

- Funding programs for resilience and adaption – List compiled by EPA
- "Federal financial resources for disaster mitigation and resilience in the U.S. water sector" – article in *Utilities Policy*

ASSOCIATION OF METROPOLITAN WATER AGENCIES

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THE VOICE FOR A CLEAN WATER FUTURE

Upcoming Webinar

Dealing with Disruption: Operationalizing Resilience in the Water Sector

Part 4: June 3, 2020 | 2:00 PM - 3:30 PM ET

Learn more by visiting **nacwa.org/19rw**

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