

U.S. EPA's Creating Resilient Water Utilities 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
- Take complex climate science data and put it into usable formats

Resilient Strategies Guide

- Introduction or “On-Ramp” to climate change for those with no or limited knowledge of climate change
- Guided process to review and select priorities, vulnerable assets, and relevant strategies
- Final report documents selected strategies to explore during adaptation planning

The screenshot displays two sequential steps of a guided process. The top step, 'Utility Information', features a progress bar with 'Introduction' and 'Utility Information' highlighted. Below the progress bar, there is a heading 'Utility Information' and a sub-heading 'Utility Name' with a text input field. Underneath, 'Utility Type' is shown with three radio button options: 'Drinking Water' (selected), 'Wastewater / Stormwater', and 'Combined'. To the right, a 'States and Territories' dropdown menu is set to 'National'. A blue button labeled 'Continue to Priorities' is positioned below the 'Utility Type' section. A grey box on the right side of the 'Utility Information' step provides instructions: 'Build your report with these steps: 1 Enter **Utility Information** for your system 2 Review and select your **Priorities**'. The bottom step, 'Priorities', has a progress bar with 'Introduction', 'Utility Information', and 'Priorities' highlighted. It includes a 'Filter:' section with a 'Category' list containing items like 'Preparing for drought (3)', 'Protecting water quality (2)', 'Building flood protection (2)', 'Preserving ecosystems (2)', 'Maintaining service levels (4)', 'Improving energy efficiency (1)', 'Implementing green infrastructure (1)', and 'Conserving water (1)'. To the right of the filter is a list of priority options, each with a checkbox and a 'More Info +' link. The 'Summary' section on the far right of the 'Priorities' step shows 'Utility Name:' (blank), 'State/Territory: **National**', and 'Utility Type: **Drinking Water**'. Below this, it says 'Selected Priorities:'.

Resilient Strategies Guide

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Resilient Strategies Guide for Water Utilities

Introduction Utility Information **Priorities** Assets Strategies Done!

Priorities

Select your planning priorities in this section.

Filter:

Category

- Preparing for drought (3)
- Protecting water quality (2)
- Building flood protection (2)
- Preserving ecosystems (2)
- Maintaining service levels (4)
- Improving energy efficiency (1)
- Implementing green infrastructure (1)
- Conserving water (1)

- Groundwater recharge
Preparing for drought [More Info +](#)
- Lake and reservoir levels
Preparing for drought [More Info +](#)
- Runoff timing and snowpack
Preparing for drought [More Info +](#)
- Saltwater intrusion
Protecting water quality [More Info +](#)
- Source water quality
Protecting water quality [More Info +](#)
- Riverine flooding - drinking water
Building flood protection [More Info +](#)
- Coastal flooding - drinking water
Building flood protection [More Info +](#)
- Loss of coastal wetlands
Preserving ecosystems [More Info +](#)

Summary

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

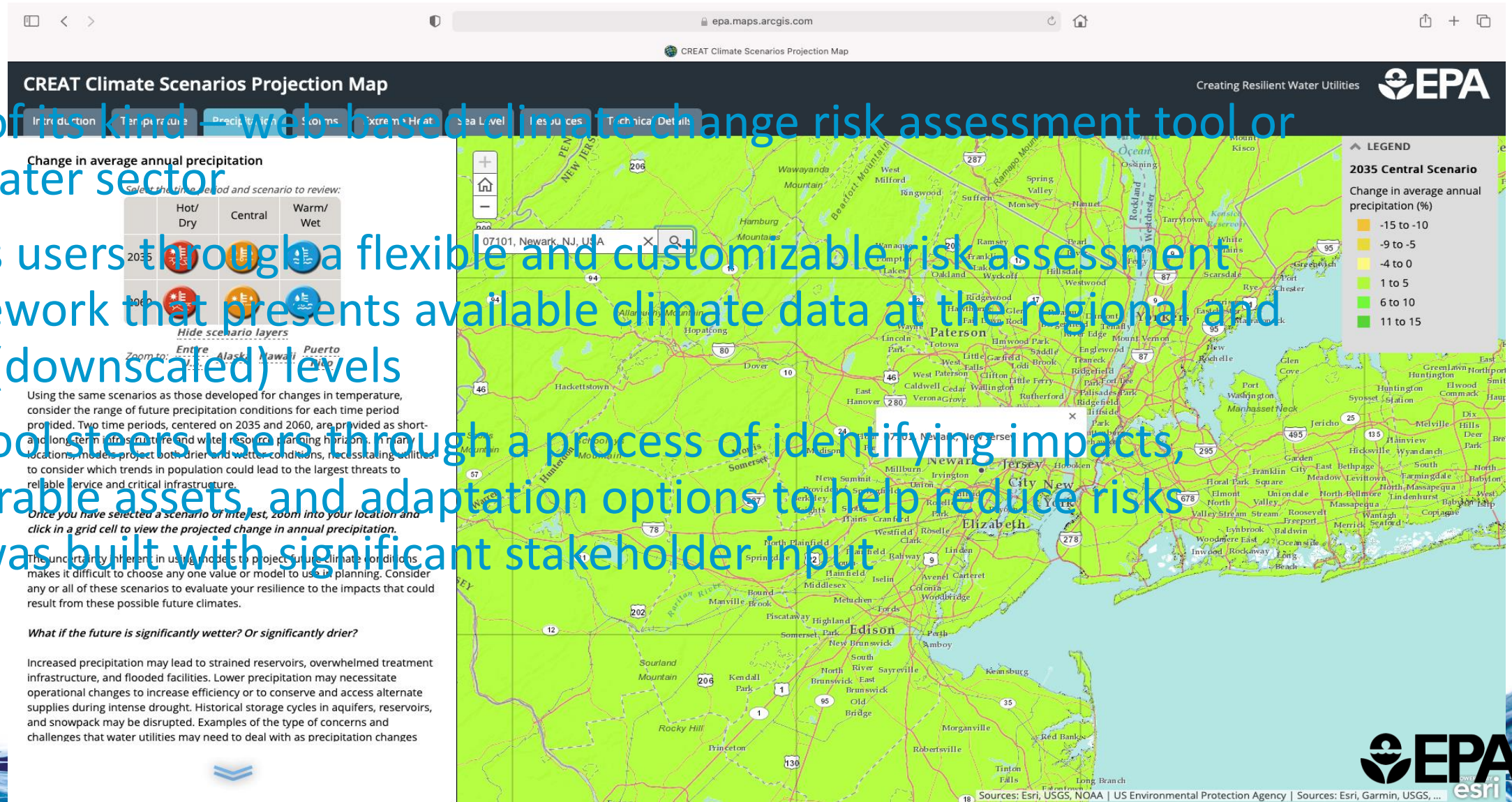
Selected Priorities:

Assets 2 selected +

Climate Resilience Evaluation and Awareness Tool

- First of its kind – web-based climate change risk assessment tool for the water sector
- Walks users through a flexible and customizable risk assessment framework that presents available climate data at the regional and local (downscaled) levels
- The tool steers users through a process of identifying impacts, vulnerable assets, and adaptation options to help reduce risks and was built with significant stakeholder input

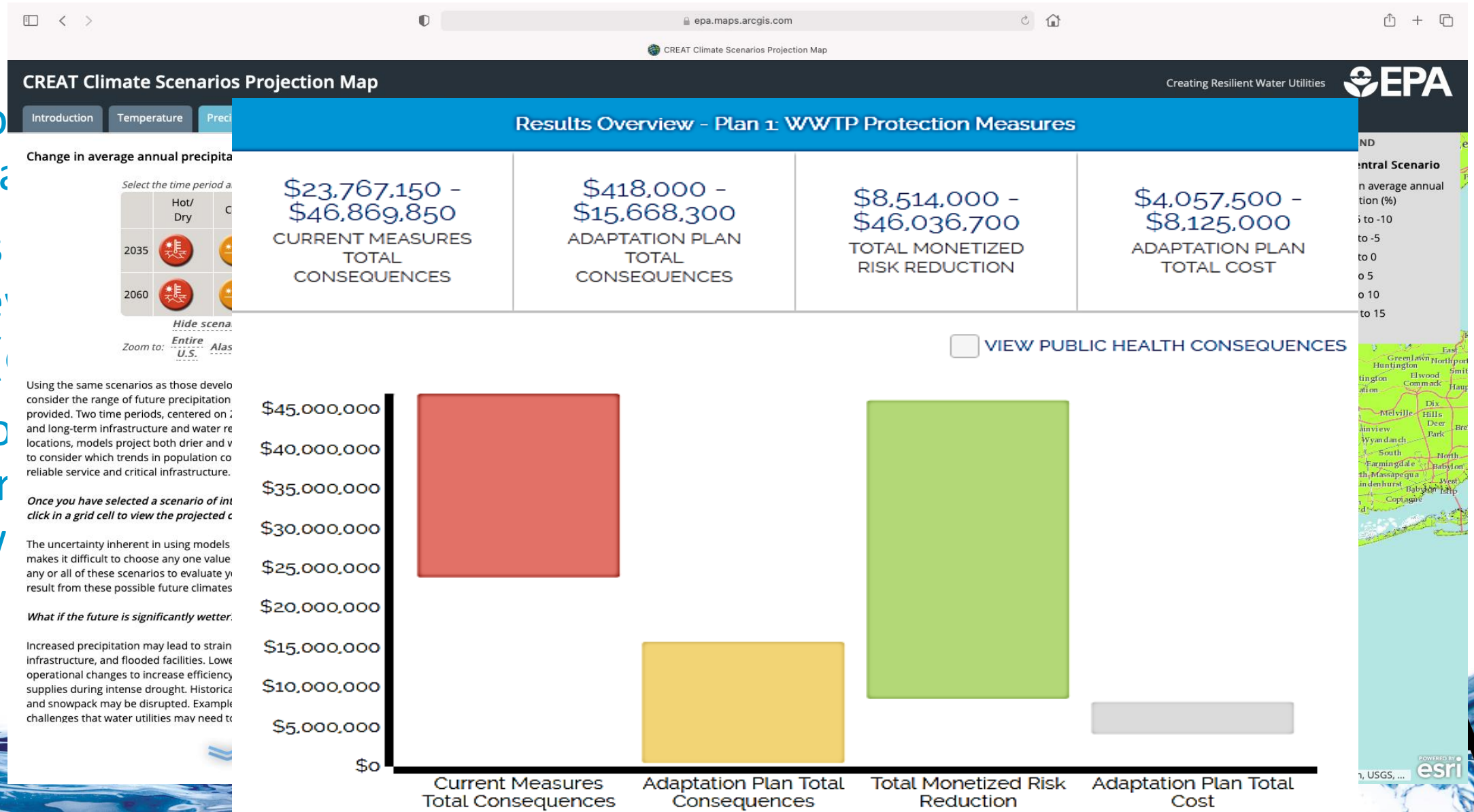
Climate Resilience Evaluation and Awareness Tool



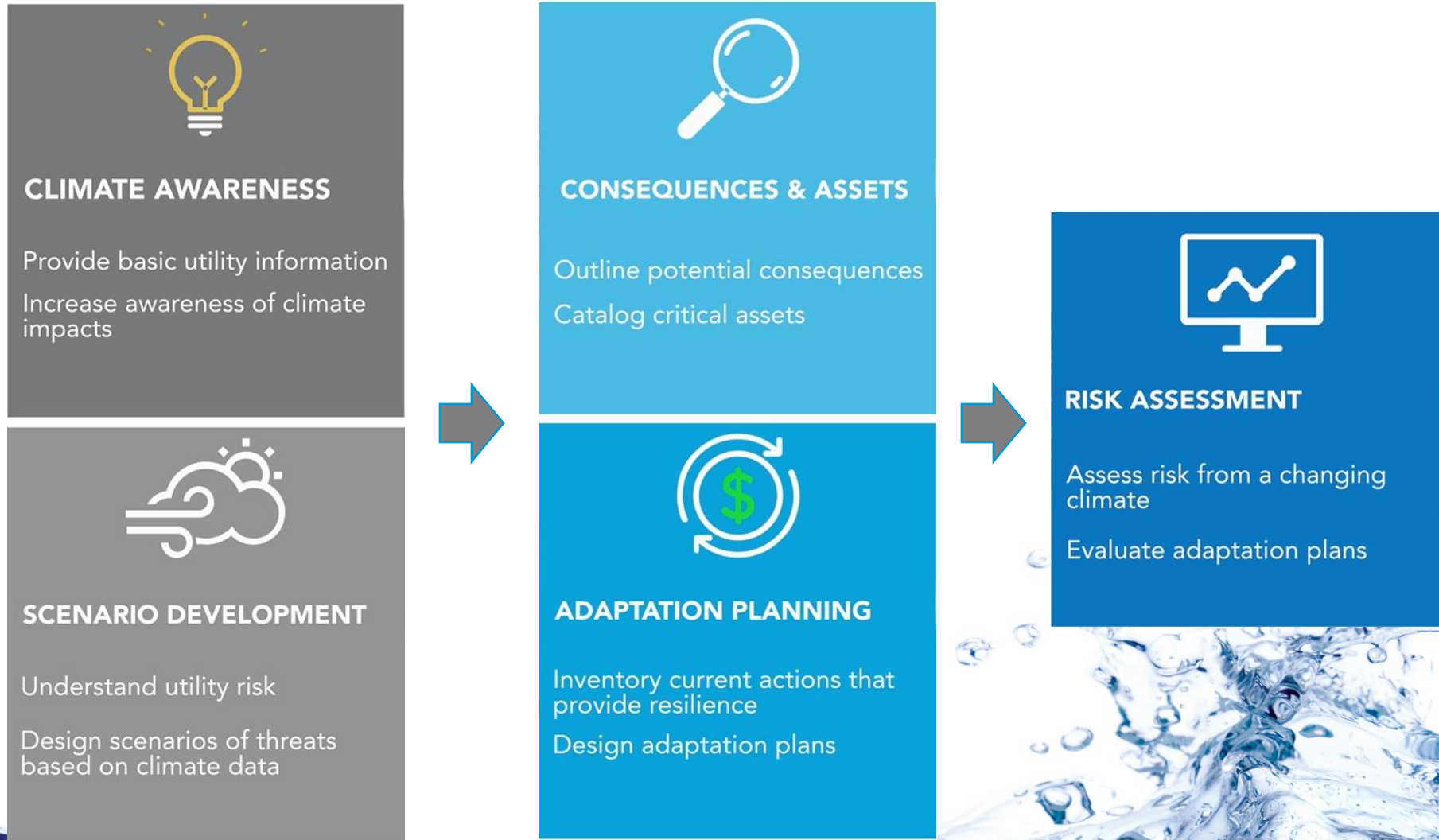
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Climate Resilience Evaluation and Awareness Tool

- First of the water framework local (
- Walks through the framework local (
- The tool evaluates vulnerability and water




CREAT Assessment Process



Potential future climate conditions for Metro Utility (Newark) NJ

Climate change presents challenges to water, wastewater and stormwater utilities and the communities they serve. Those utilities that adapt to these changes may need to raise rates to develop new water supplies and adjust their treatment and operations. Without adaptation, infrastructure and operations designed for historical climate conditions could be overwhelmed or damaged. Main breaks, overflows, and service outages would



CLIMATE AWARENESS

Provide basic utility information
Increase awareness of climate impacts



CONSEQUENCES & ASSETS

Outline potential consequences
Catalog critical assets



RISK ASSESSMENT

Assess risk from a changing climate
Evaluate adaptation plans



SCENARIO DEVELOPMENT

Understand utility risk
Design scenarios of threats based on climate data



ADAPTATION PLANNING

Inventory current actions that provide resilience
Design adaptation plans

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...ark, New Jerse

...if the climate w

...ment processes t...
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...s and equipment s

...if the climate w

...ervoirs, overwhe...
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...changes to incre...
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...will rising sea l

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...storm surges
...uifers more vulner...
...level

...Climate Conditions in 2000 for Metro Utility No

...se in average annual temperature

...easonal demand during hotter...
...exceeding supply leads to outages
...health risks
...fires and damage to infrastructure and
...res under hotter conditions

...ange in annual...
...rise in 100-y

...ets and basen...
...following heavy...
...from Combined...
...Sanitary Sewe

...0.20% change i...al p

...istorical storage...
...nd snowpack
...fires and damag...
...res under hot


... inches high

...mage and stre...
...mmunities
...of outfalls and facilities to
...ate moving shoreline


Case Study and Information Exchange Map


More than fifty (50) utilities/communities addressing these climate-related concerns


Case Study and Information Exchange


Creating Resilient Water Utilities 


Overview
Drought conditions in many regions of the United States impact water utilities by changing water levels in aquifers and reservoirs, reducing snowpack, and altering surface water flows. Water sector utilities facing drought should employ strategies to prepare for, respond to and recover from limited water supply.
















Drought



Flood



Ecosystem Changes


Service Reliability


Water Quality


 Aquarion Water Company, Massachusetts	 Capital Region Water, Pennsylvania	 City of Austin, Texas
 City of Blair, Nebraska	 City of Cottage Grove, Oregon	 City of Fredericktown, Missouri
 City of Houston, Texas	 City of San Diego, California	 City of Wichita Falls, Texas
 East Bay Municipal Utility District, California	 Jordan Valley Water Conservancy District, Utah	 Moorhead Public Service, Minnesota
		



Esri, GEBCO, DeLorme, NaturalVue | Esri, GEBCO, IHO-IOC GEBCO, DeLorme... 

Case Study and Information Exchange Map

More than fifty (50) utilities

Case Study and Information Exchange

- Overview
- Drought
 - Aquarion Water Company, Massachusetts
 - Capital Region Water, Pennsylvania
- Flood
- Ecosystem Changes
- Service Reliability
 - City of Blair, Nebraska
 - City of Cottage Grove, Oregon
- Water Quality
 - City of Houston, Texas
 - City of San Diego, California

Case Study: Water and Wastewater Utilities Planning for Resilience



cerns

CITY OF FARIBAULT, MINNESOTA

Background

The City of Faribault provides wastewater services to residential and industrial customers in Faribault, Minnesota, which is located about one hour south of Minneapolis, Minnesota. About 50 to 60% of all wastewater flow is from industrial customers, including a laundry facility and a food packaging plant. The water reclamation facility (WRF) is designed to treat an average flow of approximately 3.5 million gallons per day (MGD) and a peak wet weather flow of 7 MGD.

Challenges

The WRF is located near the confluence of the Straight River and Cannon River and is at risk of flooding. The City previously experienced issues related to overflows and bypass as well as infiltration and inflow (I&I) from heavy precipitation events. The WRF was impacted by previous flooding events due to high river levels. During a flooding event in 2010, the WRF was inundated and taken completely offline for approximately two weeks due to a damaged siphon box through which all flows are conveyed under the Straight River to the WRF. During that time, a temporary above-ground collection system had to be constructed to convey the wastewater from the City to the WRF for treatment. Following that flooding event, WRF assets were relocated away from the river, however flooding concerns still exist if the river re-channels within the floodway. It is expected that floodwaters could still damage infrastructure assets at their new locations.

Planning Process

To better understand the resilience of their wastewater infrastructure and operations to extreme flooding, the City of Faribault assessed potential impacts of environmental change and extreme weather events using the U.S. Environmental Protection Agency's (EPA's) [CREAT](#) and enhanced resilience through long-term planning using EPA's *Planning for Sustainability Handbook*. The assessment brought together individuals from the City of Faribault, state agencies and EPA staff to think critically about potential impacts, priority assets, and possible resilience strategies.

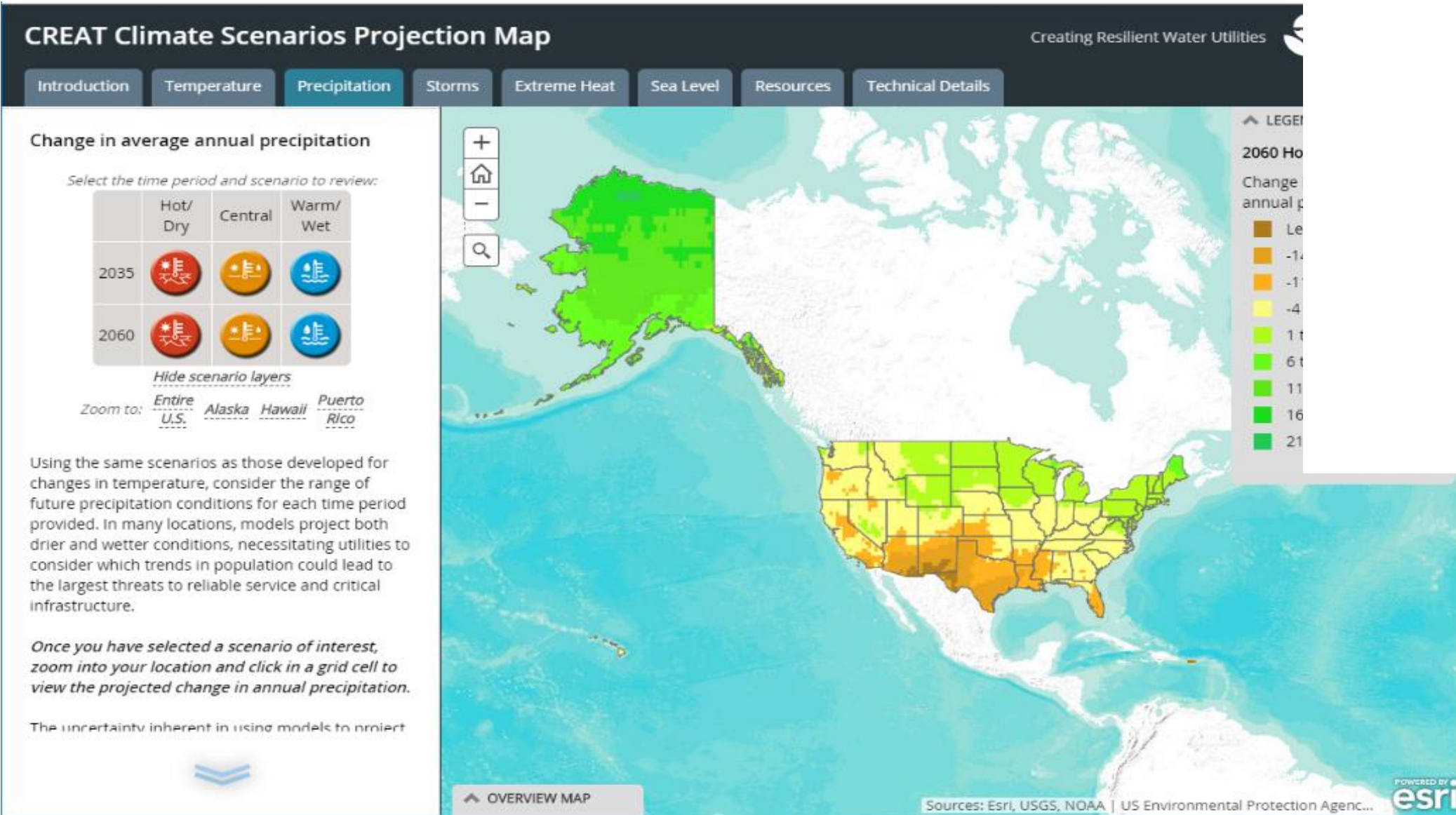
Resilience Strategies and Priorities

Based on experience with prior intense precipitation events, the City of Faribault has already taken action to protect their WRF from flooding and improve their overall resilience to extreme weather impacts. Using CREAT results, the City was able to evaluate the performance and costs of two priority actions that, if implemented, will provide additional protection to the facility: constructing a berm and building streambank stabilization. The City will continue to use the CREAT results and the information from EPA's *Planning for Sustainability Handbook* to conduct additional long-term infrastructure and financial planning. See the table below for all potential measures that were considered.

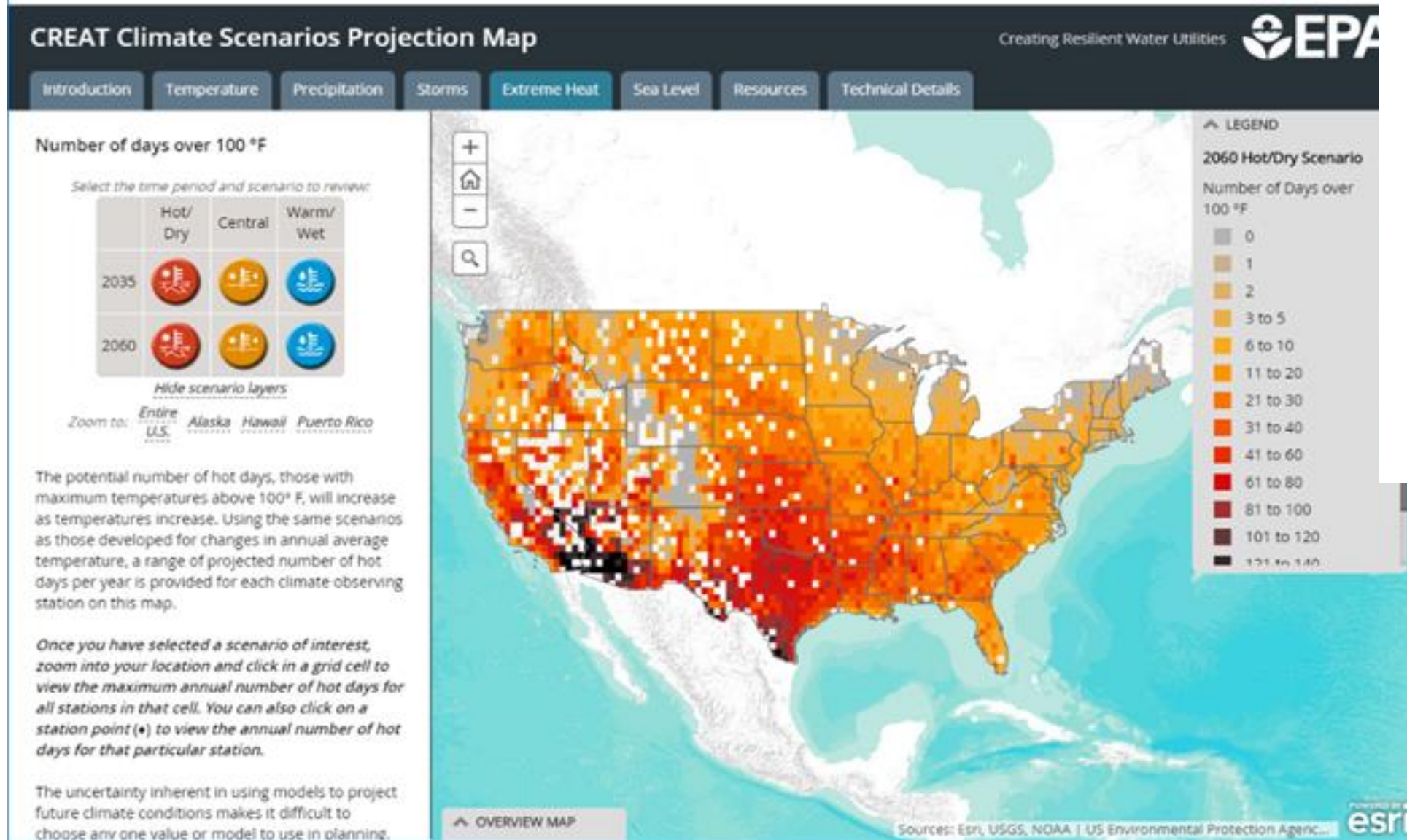
Water Utilities
EPA
Water flows. Water sector
POWERED BY
esri



CRWU Data Services and Maps: Climate Projections



Hot Days / Streamflow Map



Hot Days / Streamflow Map



Number of days over 100 °F

Select the time period and scenario to review:

	Hot/ Dry	Central	Warm/ Wet
2035			
2060			

Hide scenario layers

Zoom to:

The potential number of hot days, those with maximum temperatures above 100° F, will increase as temperatures increase. Using the same scenarios as those developed for changes in annual average temperature, a range of projected number of hot days per year is provided for each climate observing station on this map.

Once you have selected a scenario of interest, zoom into your location and click in a grid cell to view the maximum annual number of hot days for all stations in that cell. You can also click on a station point (•) to view the annual number of hot days for that particular station.

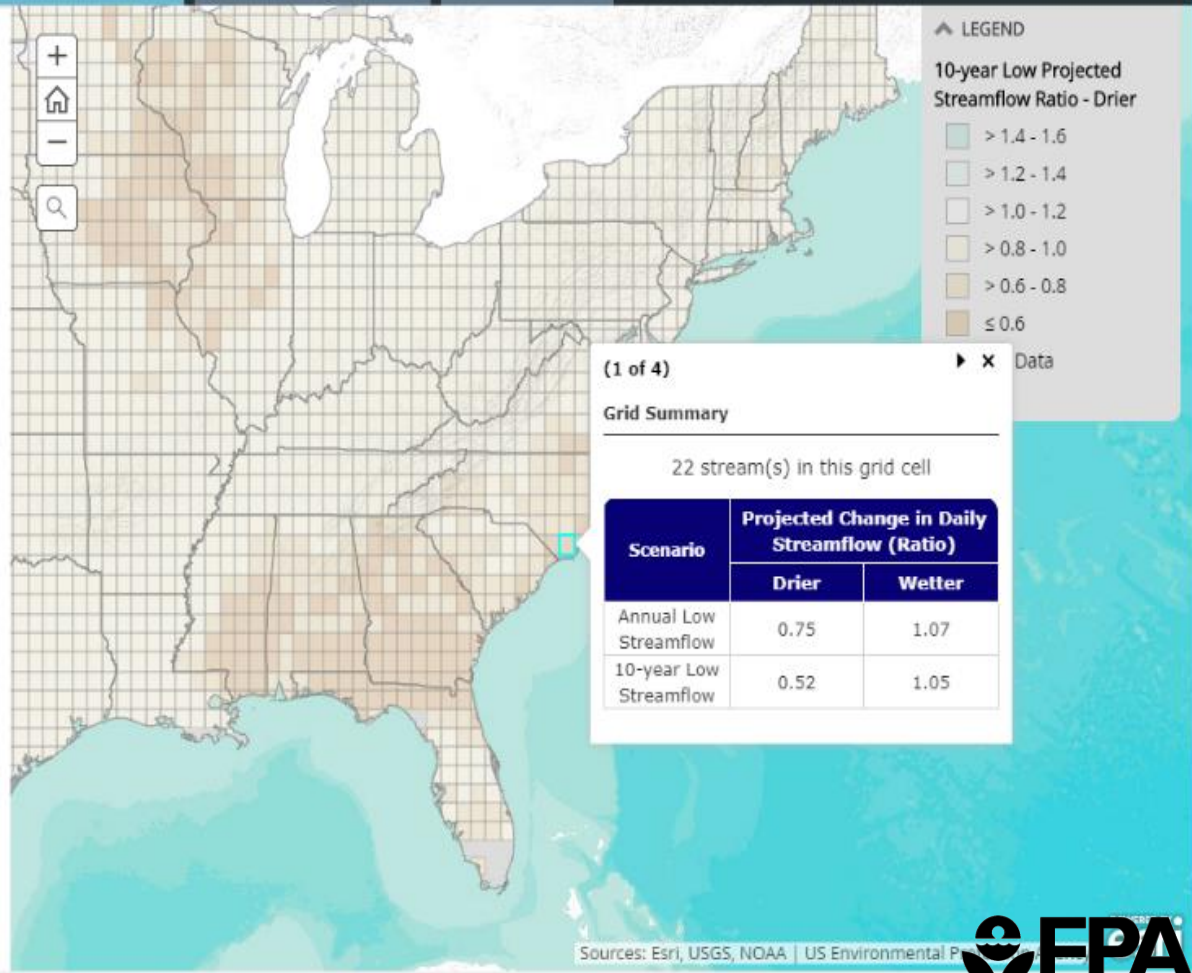
The uncertainty inherent in using models to project future climate conditions makes it difficult to choose any one value or model to use in planning.

Annual Low Streamflow

To describe long-term trends for low streamflow, the map at right shows both the annual daily low streamflow and the 10-year low flow (the 7-day low flow which occurs approximately every 10 years). Change is calculated as the projected future flow divided by baseline historic flow. The 10th and 90th percentiles are reported to represent the drier-to-wetter range in model projections.

	Streamflow Ratio	
Wetter Projection	Annual Low	10-year Low
Drier Projection	Annual Low	10-year Low

Use the buttons above to view the different streamflow metrics and wetter vs drier projections. Click on a grid cell on the map to see a pop-up with numeric values of projected change.



Sources: Esri, USGS, NOAA | US Environmental Protection Agency

Storm Surge Inundation Map



Storm Surge Inundation Map

Creating Resilient Water Utilities

Introduction

Hurricane Frequency

Storm Surge Flooding

FEMA Flood Zones

Details

Hurricane Tracks

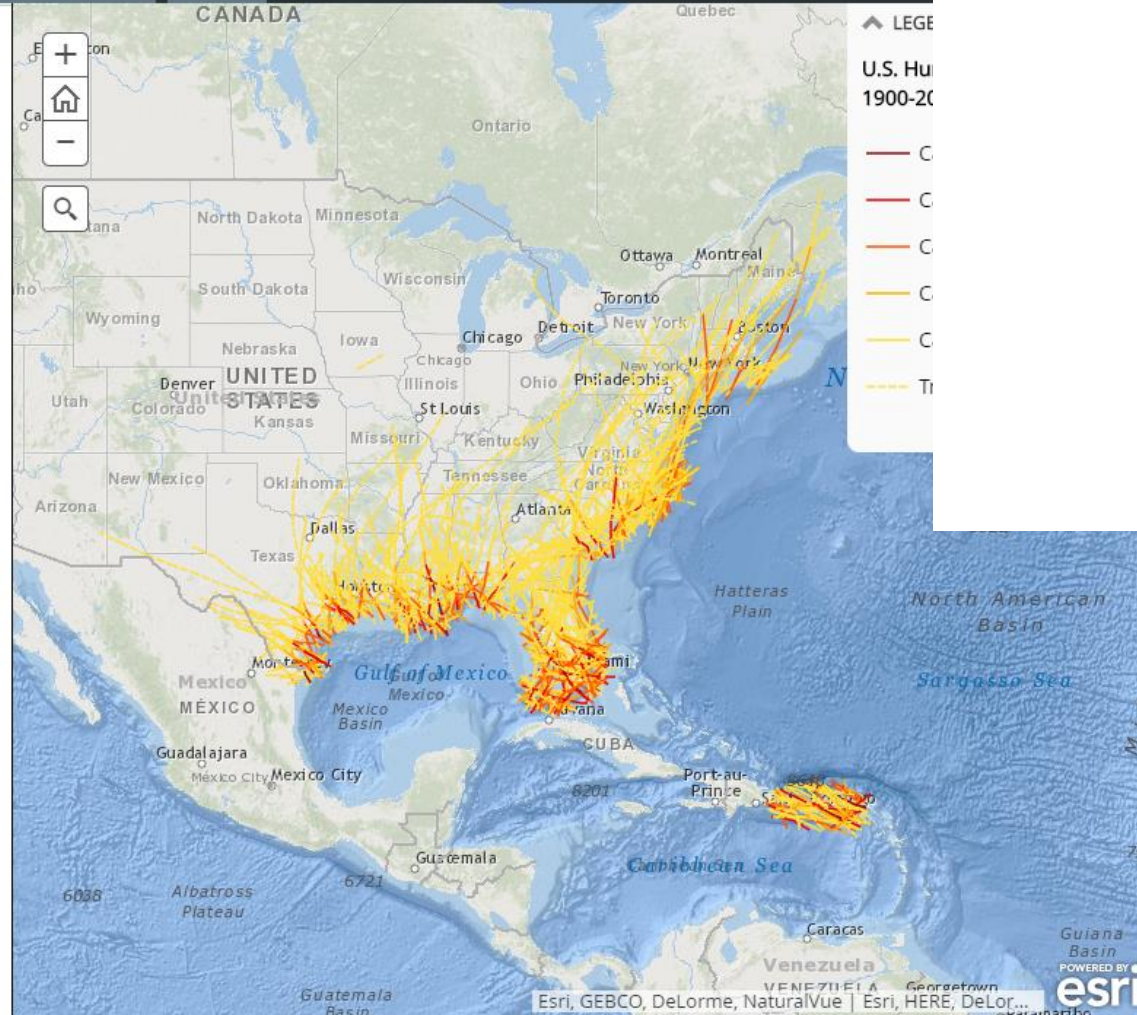
This story map illustrates historical hurricane tracks, strike frequency, and potential areas of coastal flooding and inundation from storms by combining the

- National Hurricane Center's (NHC's) hurricane strike dataset,
- National Oceanic and Atmospheric Administration's (NOAA's) Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model results, and
- Federal Emergency Management Agency's (FEMA's) 100-year and 500-year flood zones.

The map on the right displays the tracks of hurricane systems from 1900-2015. Each of these storm systems reached hurricane strength as the storm center was within 50 nautical miles of the U.S. coastline. The strength, measured by hurricane category, is represented with colors from yellow (Category 1) to red (Category 5); tropical storm segments of these hurricanes are shown as dotted lines. To access more detailed storm track data, visit NOAA's [Historical Hurricane Tracks Tool](#).

Use the zoom and search to review the tracks that pass close to any location of interest. Click on a storm segment to highlight the track and see the name, year and maximum strength. When multiple tracks are selected, use the left and right arrows to scroll through the storms that passed your selected location.


Follow this story through the tabs, each with different data layers. Zoom into your location on each map to review the data to identify the potential for hurricane landfall and coastal flooding for use in your assessment of flood risk and planning for mitigating flood damage in the event of a storm.



Storm Surge Inundation Map



Storm Surge Inundation Map

Creating Resilient Water Utilities 

[Introduction](#) [Hurricane Frequency](#) [Storm Surge Flooding](#) [FEMA Flood Zones](#) [Details](#)

Storm Surge Flooding

This map displays the results from the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model. SLOSH is a numerical model used by NWS (National Weather Service) to compute storm surge. Storm surge is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tides. Flooding from storm surge depends on many factors, such as the track, intensity, size, and forward speed of the hurricane and the characteristics of the coastline where it comes ashore or passes nearby.

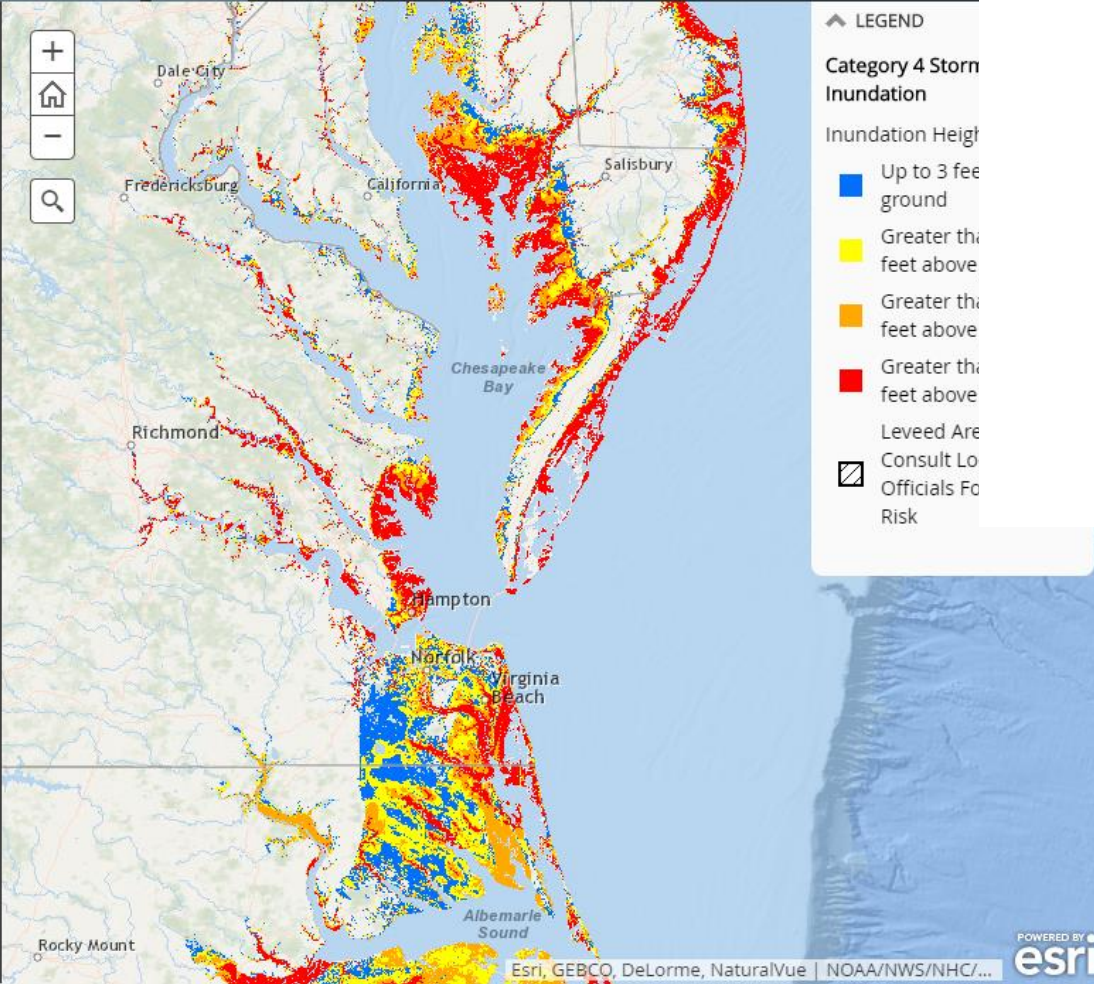
Click on a button to see inundation depth for each hurricane storm category on the map.

[Category 1](#) [Category 2](#) [Category 3](#)
[Category 4](#) [Category 5](#)

[Texas to Maine](#) [Puerto Rico and US Virgin Islands](#) [Hawaii](#)

Use the map search, pan and zoom, or links above to review potential inundation depth at your location.

This product displays a seamless national map of storm surge hazard scenarios developed by the NHC (National Hurricane Center) Storm Surge Unit. This map merges the Maximum of Maximums (MOM) product from 27 of the operational SLOSH grids. Each grid for the Category 1-5 SLOSH MOMs was merged into one national grid. The national grid was then resampled, interpolated, and processed with a DEM (Digital Elevation Model, i.e. topography) to compute the storm surge hazard above ground for each hurricane category. This means when NHC forecasts storm surge of 20 ft that means 20 ft above ground. SLOSH products do not include Category 5 storms north of the NC/VA border or in Hawaii.




LEGEND

Category 4 Storm Inundation

Inundation Height

- Up to 3 feet above ground
- Greater than 3 feet above ground
- Greater than 4 feet above ground
- Greater than 5 feet above ground

Leveed Area Consult Local Officials For Risk

POWERED BY 

Esri, GEBCO, DeLorme, NaturalVue | NOAA/NWS/NHC/...



Outreach and Training

- Training website
- Workshops
- Onsite technical assistance
- Website
- Newsletter



Contact Us

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- Klara Zimmerman: zimmerman.klara@epa.gov



Poarch Band of Creek Indians Utilities Authority

Southeast Climate Region
Shaun Livermore
Utilities Operations Manager

Poarch Band of Creek Indians

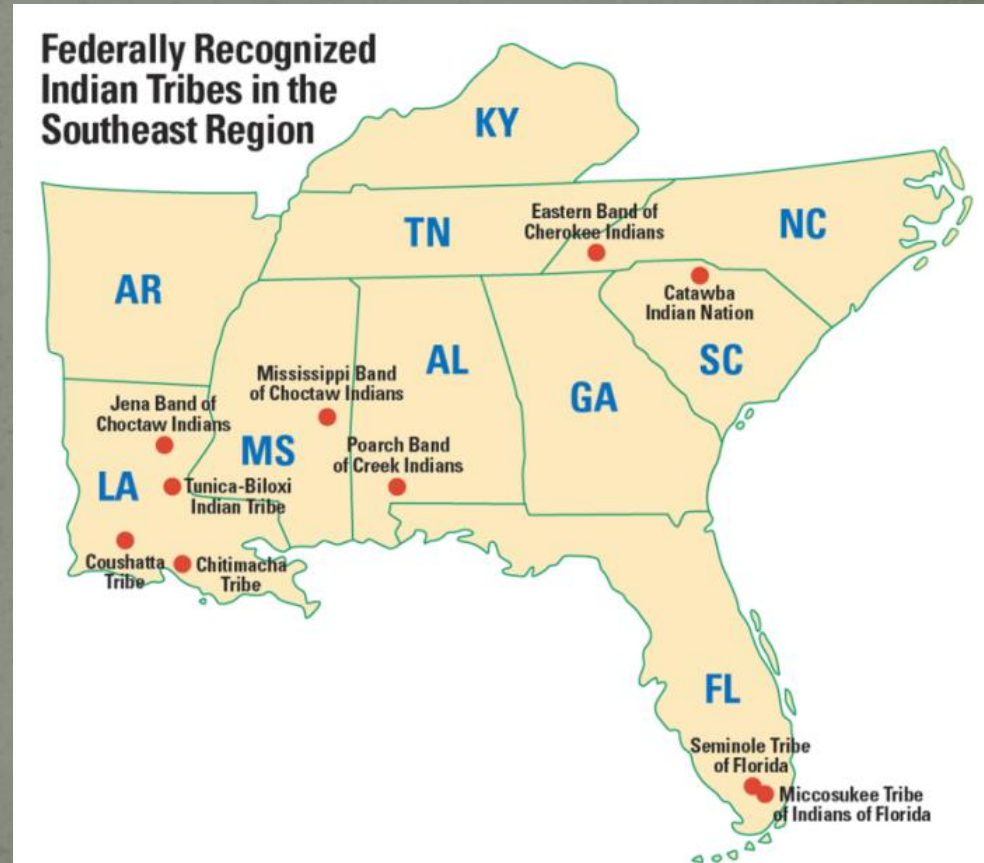
- The Poarch Creek Indians are descendants of a segment of the original Creek Nation that once covered almost all of Alabama and Georgia.
- Unlike many eastern Indian tribes, the Poarch Creeks were not removed from their tribal lands and have lived together for almost 200 years in and around the reservation in Poarch, Alabama.
- The reservation is located eight miles northwest of Atmore, Alabama in rural Escambia County, about 57 miles east of Mobile.

First Formal Leader



Federal Recognition

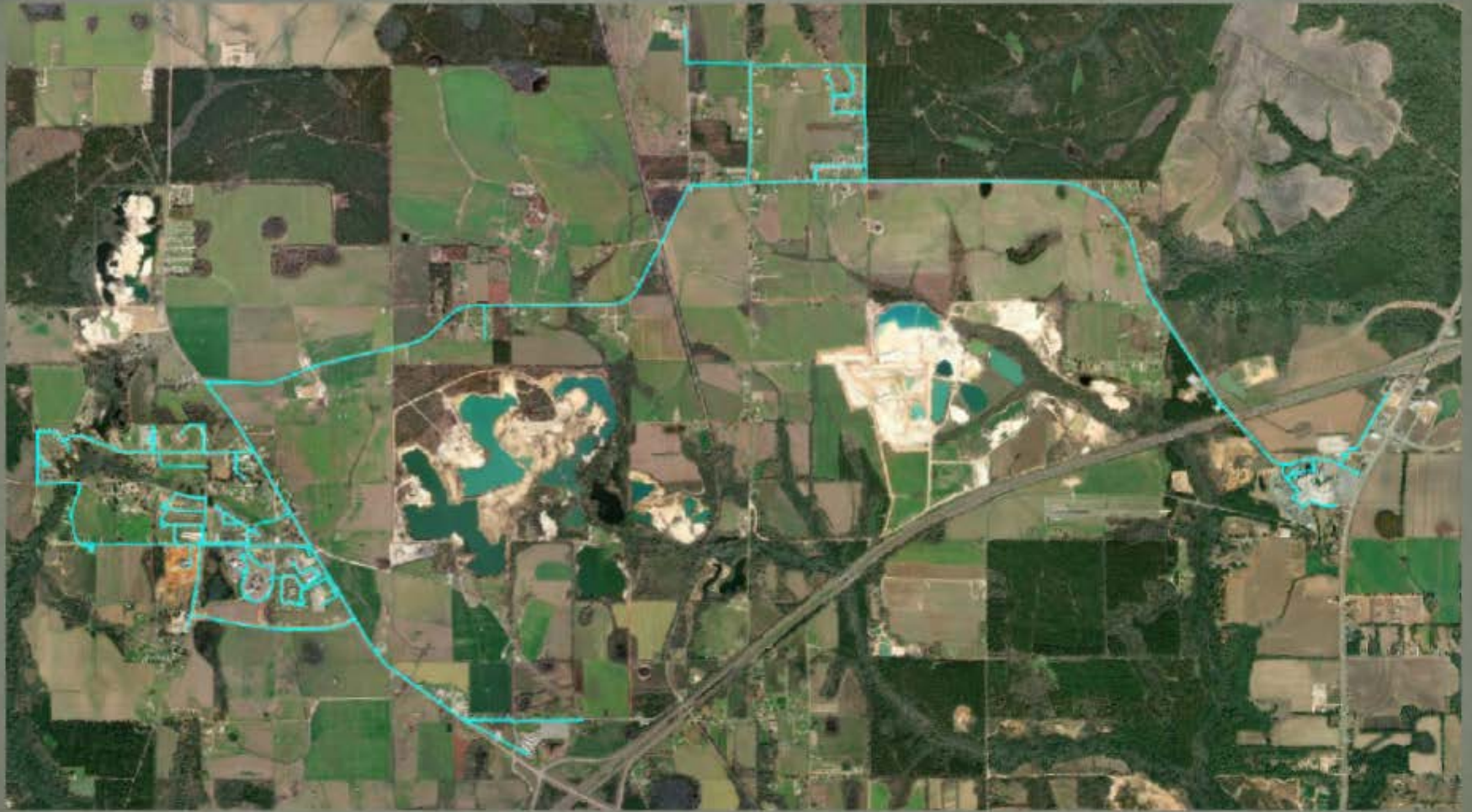
- On August 11, 1984, the U.S. formally acknowledged that the Poarch Creek Indians officially exists as an “Indian Tribe.” A segment of the original reservation land of Lynn McGhee became the center of Tribal operations. It is the only land within the original domain of the Creek Confederacy to still be occupied by Creek people.



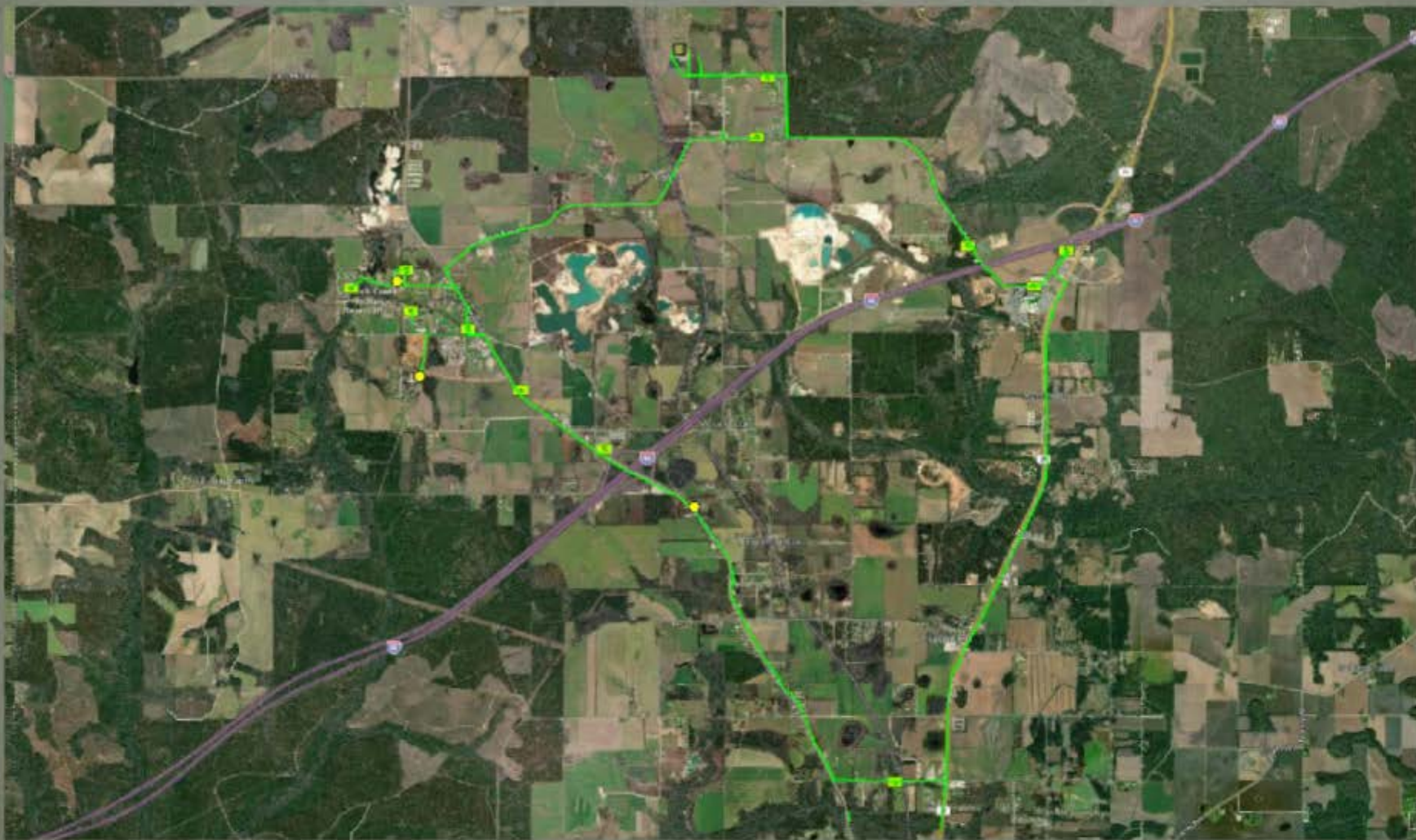
Utilities Authority

- The original Utilities Charter was signed on October 13th 1994.
- It was later revised on November 20th 2007
- Poarch Band of Creek Indians Utilities Authority (PCIUA) currently employs 14 people.
- PCIUA serves approximately 300 water/sewer connections in and around the reservation.
- PCIUA formed Escambia Community Utilities (ECU) to manage and own utility systems off reservation.
- ECU currently serves about 500 water connections.

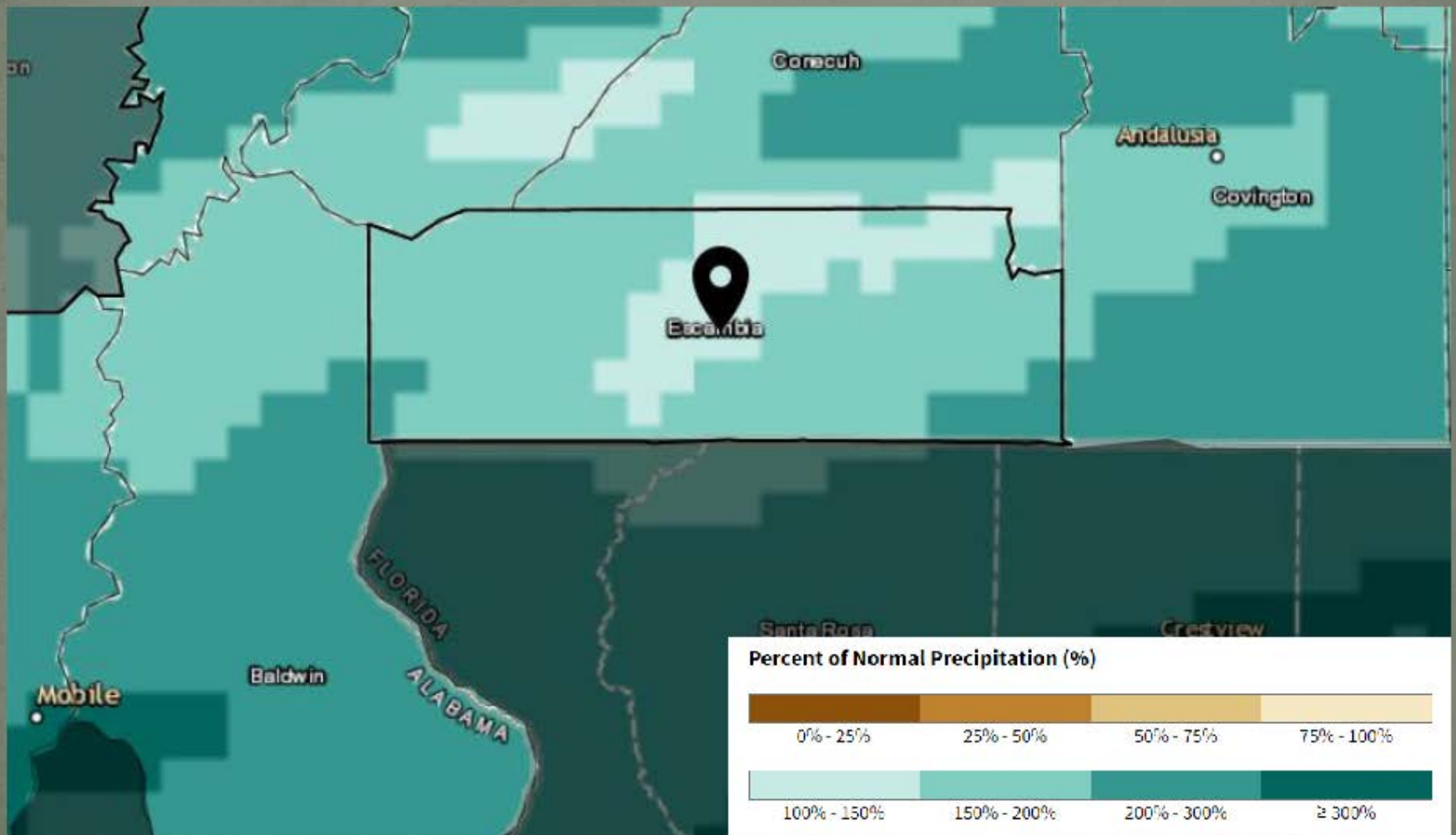
PCIUA Water System



PCIUA Sanitary Sewer System



Escambia County 30 Day Rainfall



Drought versus Flood Risk

- Drought has been an issue in the region recently
- Rainfall patterns have changed
- Totals do not reflect the intensity of the rain events
- Floods are a higher risk to operations



DON'T BE A FAILURE

The screenshot shows the EPA CREAT website. At the top, the navigation bar includes the CREAT logo, the text "TO WATER RESILIENCE EVALUATION & AWARENESS TOOL", and links for "GET STARTED", "RESOURCES", and "HELP". The EPA logo is in the top right corner. The main header area features a background image of waves crashing on a beach. On the left, the text "Build Climate Resilience at Your Utility" is displayed. On the right, two white text boxes contain the following information:

- The Climate Resilience Evaluation and Awareness Tool (CREAT)** is a climate change risk assessment and planning application for water, wastewater and stormwater utilities.
- CREAT** helps water sector utilities understand and adapt to climate change.

Below the header, there are three sections of text:

- Discover:** This online tool helps you assess the risks of climate change events, understand their significance, and build scenarios to help you prepare for them.
- Assess:** Use the tool to assess the risks of climate change events to your utility and understand the impacts of climate change on utility operations.
- Share:** Generate reports describing the costs and benefits of your risk reduction strategies for decision-makers and stakeholders.

Below these sections, there is a paragraph: "To see what other utilities have done to increase climate change resilience using CREAT, visit EPA's **Case Study and Information Exchange Map**. This tool provides links to case studies of training events being conducted by water utilities across the United States. Utilities have shared their experiences and lessons learned with the goal of assisting other utilities that are currently developing the plans or responding to recent events."

At the bottom of this section, it says: "EPA encourages utilities that have their own stories to share to contact us at CRWUhelp@epa.gov."

A large red arrow points from the text above down to a blue button labeled "Get Started", which is circled in red. The word "Click It" is written in large red letters over the arrow.

On the right side of the page, there is a video player. The video is currently paused. The player interface includes "Watch later" and "Share" buttons at the top right, and "Watch on YouTube" at the bottom left.

At the bottom of the page, the footer contains "EPA Home | Disclaimer" on the left and "Creating Resilient Water Utilities | Contact Us" on the right.



Climate Resiliency at MWRA

David W. Coppes, P.E.
Chief Operating Officer

July 29, 2021



Changing Precipitation Quantity and Patterns

- Currently, we average 104 rain events per year with an average of 44 inches of rainfall
- Models suggest we'll see longer dry spells with shorter, heavier rain
- An overall modest increase in total rainfall
- Examples:
 - 2016/2017 drought affects water supply of many in Massachusetts
 - Flooding during the January and March Nor'easters in 2018 impeded access to several MWRA facilities



No Longer A Theory: State Street, Boston – March 2018



AP/CityLab





Eastern Avenue, Chelsea – March 2018





Shirley Street, Winthrop – March 2018





Nut Island, Quincy – March 2018





Preparing for Climate Change: Drinking Water System Is In Good Shape

- Quabbin Reservoir, Belchertown
 - 65 miles west of Boston
 - Elevation 528 feet
- Wachusett Reservoir, Clinton
 - 35 miles west of Boston
 - Elevation 395 feet
- Water treatment plant is in Marlborough
- 85% of water delivered by gravity
- Lowest elevation of a water tank is 192 feet above sea level





Significant Investment in Dams

- All MWRA dams, dikes, spillways and appurtenances are inspected routinely by licensed dam safety engineers and are in good condition
- MWRA has spent over \$22 million on dam safety projects
- Quabbin and Wachusett spillways have been improved to be able to discharge the probable maximum flood



Quabbin Spillway Rehab





Wachusett Crest Gate





Adaptation for Sea Level Rise In The Design of Deer Island Treatment Plant

- Deer Island plant fully protected
 - 100-year flood
 - 1.9-foot (0.6 meter) sea level rise
 - Wave run-up of 14 feet (4.3 meters) on east side and 2 feet (0.6 meter) on west side
 - Nut Island headworks in Quincy similarly designed for sea level rise





Deer Island On-Site Power Plant

- On-site power plant ensures uninterrupted power supply to keep the plant operating for up to 90 days





MWRA Coastal Facilities





MWRA's Chelsea Facility

- Most of our staff and equipment is at our Chelsea Facility off of Eastern Avenue, across from the Chelsea Creek





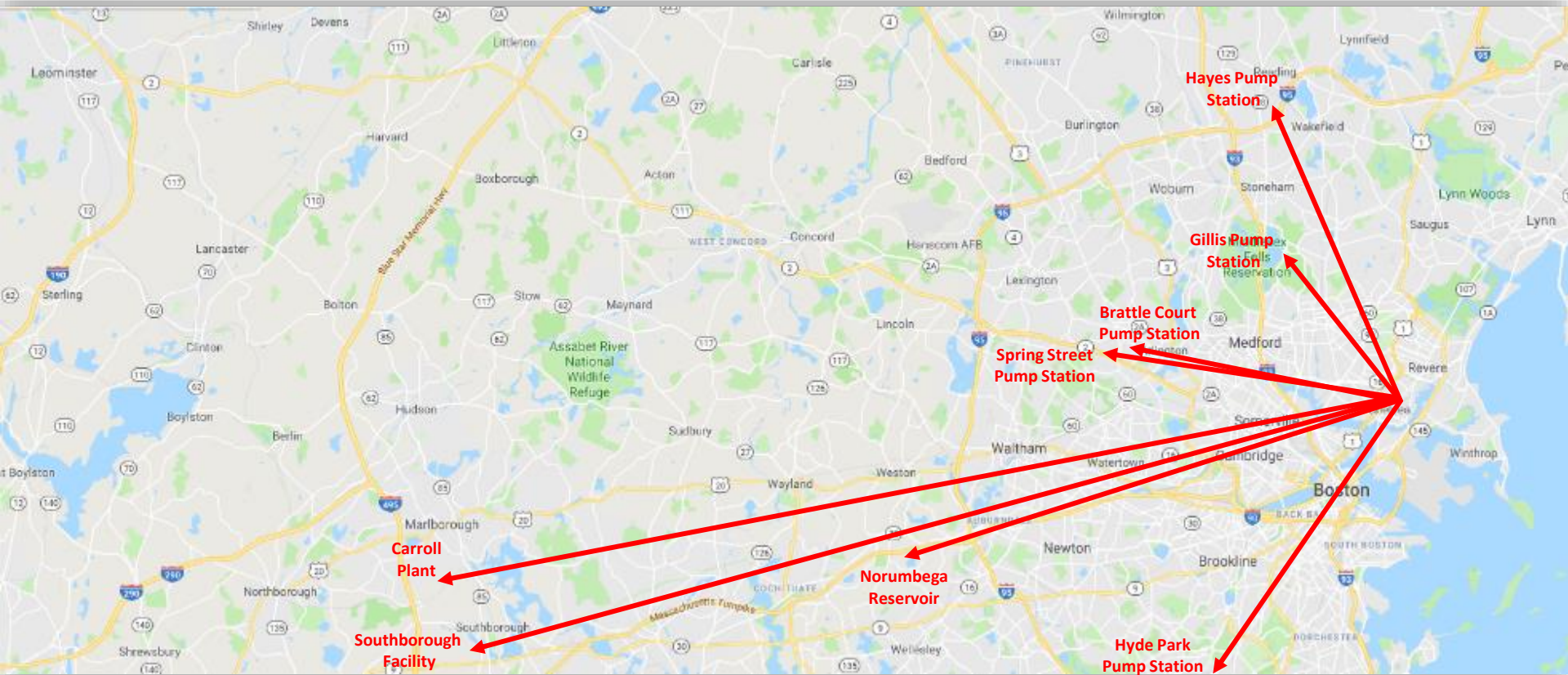
Plans in Place to Pre-deploy Staff to Higher Ground

- Back-up water and wastewater operations control center created at Carroll Treatment Plant in Marlborough





Plans to Pre-deploy Staff and Equipment to Higher Ground





Benchmarks For Evaluating Facilities

- 100 year flood as determined by FEMA
- 100 year flood + 2.5 feet (NYC DEP, BHA)
- Hurricane flooding levels as determined by FEMA's SLOSH model (current evacuation planning recommendation) were reviewed
- Wave action (for facilities adjacent to FEMA Hazard Zone VE) was reviewed



MWRA's Approach

- Short-term
 - At-risk buildings are being fitted with temporary flood barriers
 - Expanding fuel storage at wastewater stations
- Long-term
 - Facility rehabilitation on a 20-year cycle
 - Future rehabilitation contracts will include protection measures
- May have to speed things up



Flood Elevations At Chelsea Creek Headworks





Flood Elevations At Chelsea Creek



Southwest Facility View



Backup Generator



New Flood Control Measures Are Being Added





Chelsea Headworks



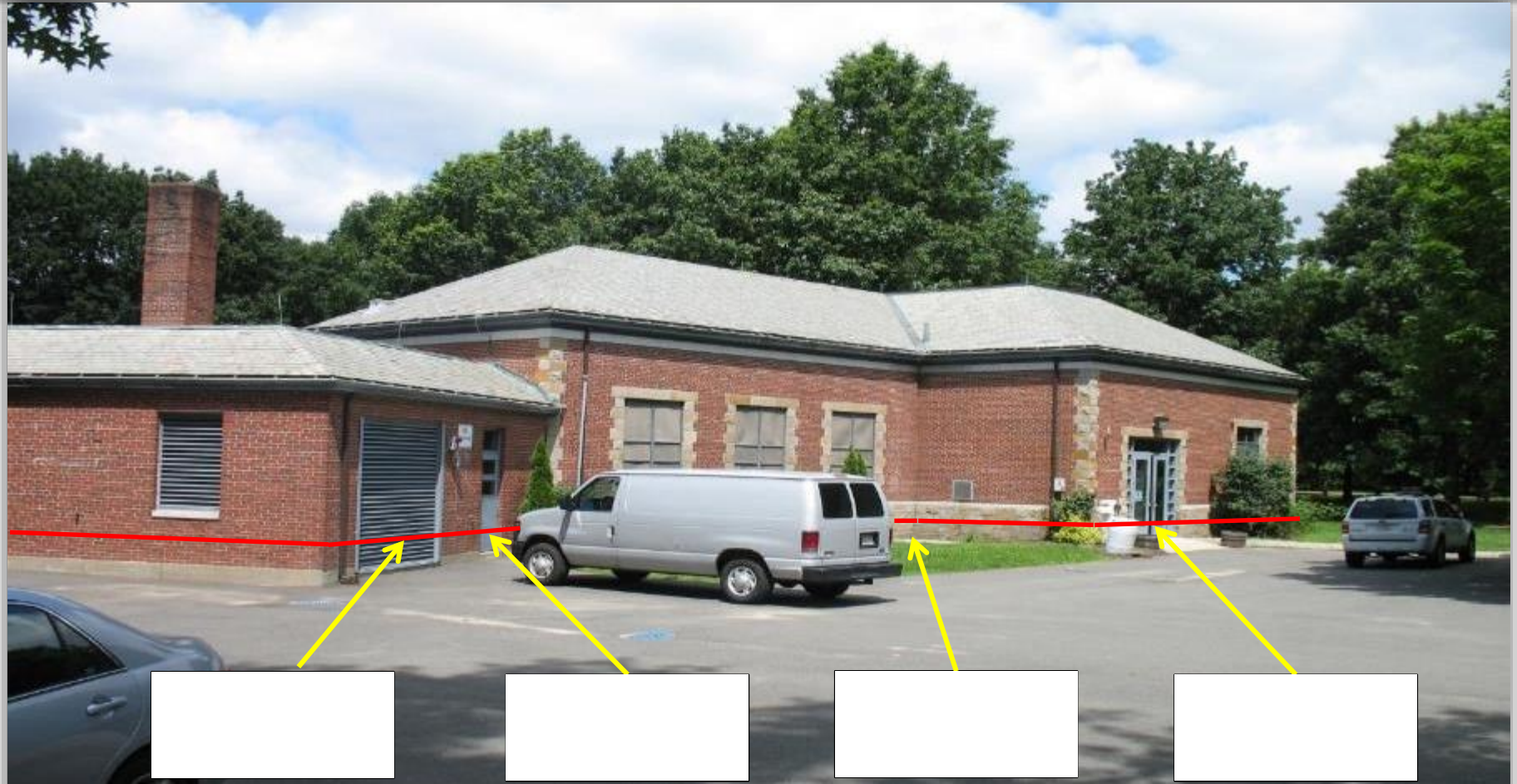


Chelsea Headworks





Alewife Brook Pump Station





Alewife Brook Pump Station





Alewife Brook Pump Station





Working With Our Customer Communities

- MWRA works closely with its customer communities, providing training on Emergency Action Plans and guidance assistance with vulnerability assessments

