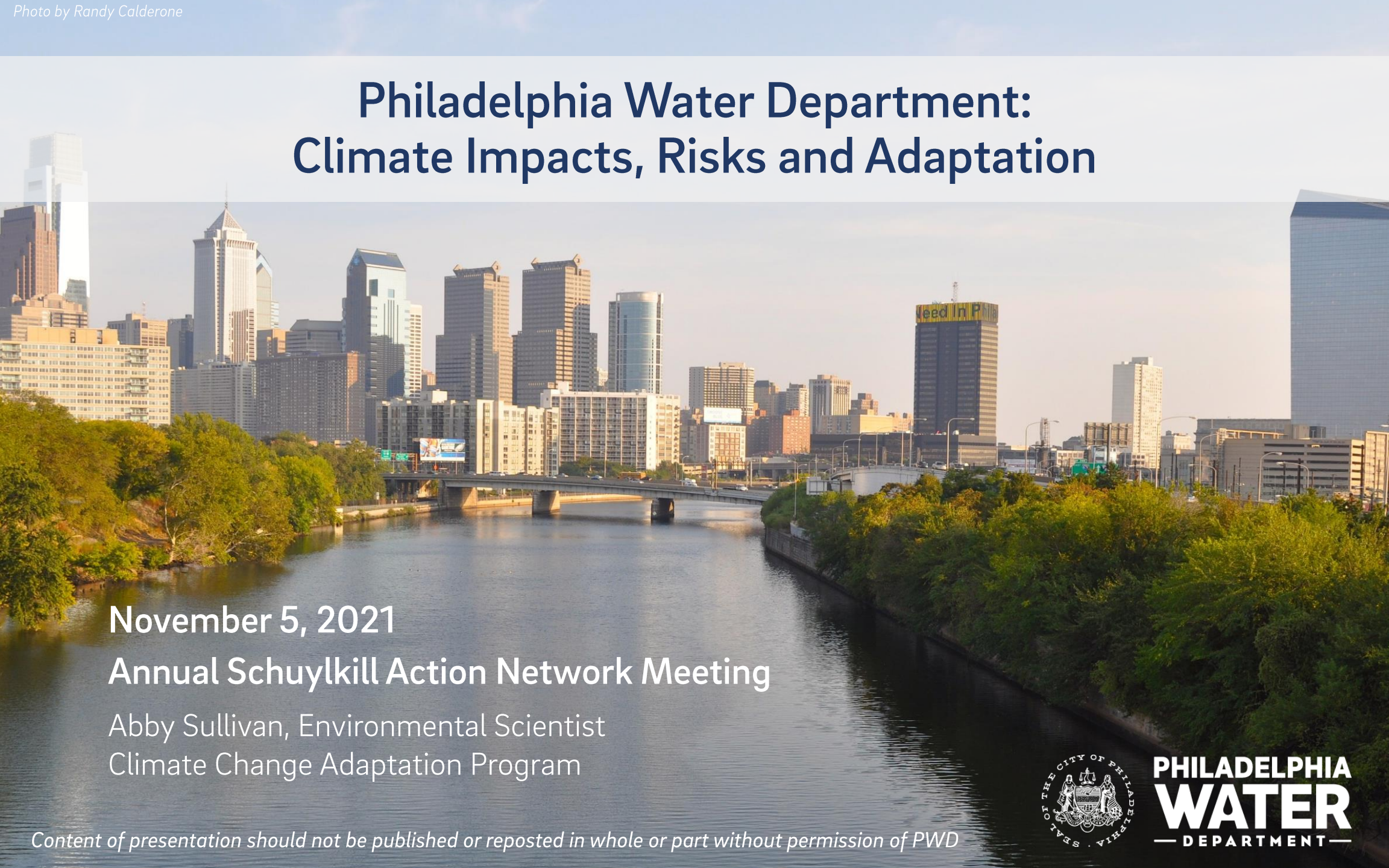


Philadelphia Water Department: Climate Impacts, Risks and Adaptation

November 5, 2021

Annual Schuylkill Action Network Meeting

Abby Sullivan, Environmental Scientist
Climate Change Adaptation Program

PHILADELPHIA WATER DEPARTMENT

Philadelphia Water Department

One Water Utility

Drinking Water

- Source: Delaware and Schuylkill Rivers
- 1.6 million drinking water customers
- Three Water Treatment Facilities
- Up to 300 million gallons treated per day
- 3,000 miles of water mains, 25+ pumping stations

Wastewater

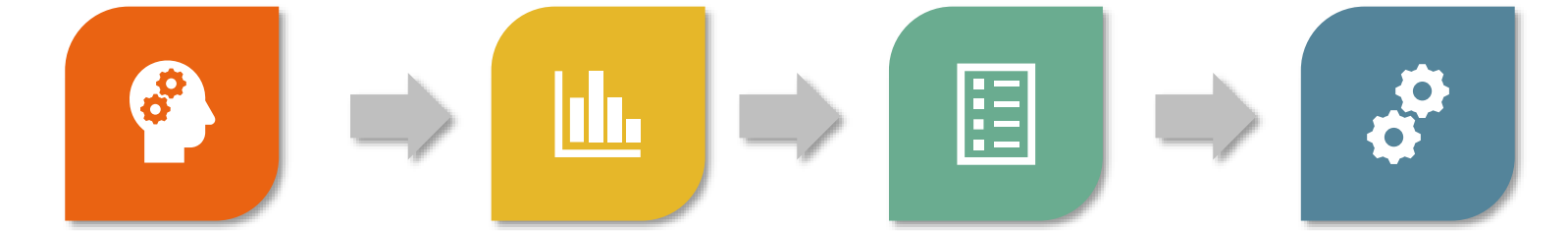
- 2.2 million wastewater customers
- 3 Water Pollution Control Plants
- Over 522 million gallons treated per day
- 3,716 miles of sewers, 19 pumping stations
- Biosolids handling facility

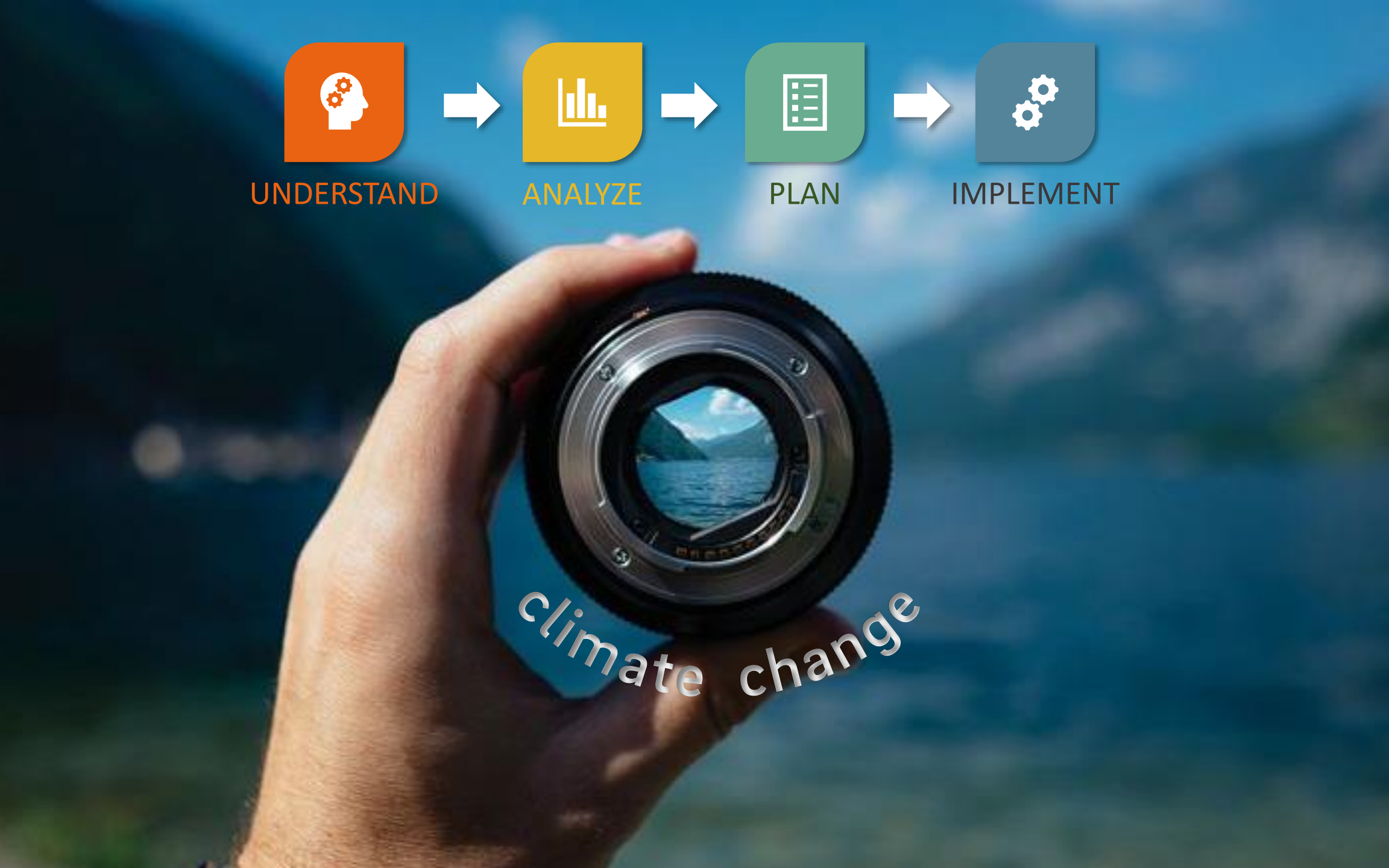
Stormwater

- Roughly 60% Combined Sewer, 40% Separate Sewer
- Green City, Clean Waters - Large-scale green stormwater infrastructure program to reduce combined sewer overflows (CSOs)

The work we do to achieve our mission is…

- DRIVEN BY DATA AND BEST AVAILABLE SCIENCE
  - Understand existing conditions and potential future conditions
- BASED ON SOPHISTICATED TOOLS
  - Analyze how our systems and infrastructure perform under a range of conditions
- FOUNDED ON COMPREHENSIVE, WATERSHED-WIDE PLANNING
  - Evaluate risks and develop short and long-term strategies to reduce risks
- IMPLEMENTED USING INNOVATIVE APPROACHES
  - Adaptive management, policy changes, advanced technologies, networks & partnerships




UNDERSTAND
ANALYZE
PLAN
IMPLEMENT
climate change

Climate Change Adaptation Program (CCAP)

Est. 2014

PHILADELPHIA WATER DEPARTMENT

Program Goal

Reduce the risks and associated expenses PWD will face from the impacts of climate change by identifying and implementing effective and feasible adaptation strategies

Precipitation ↑

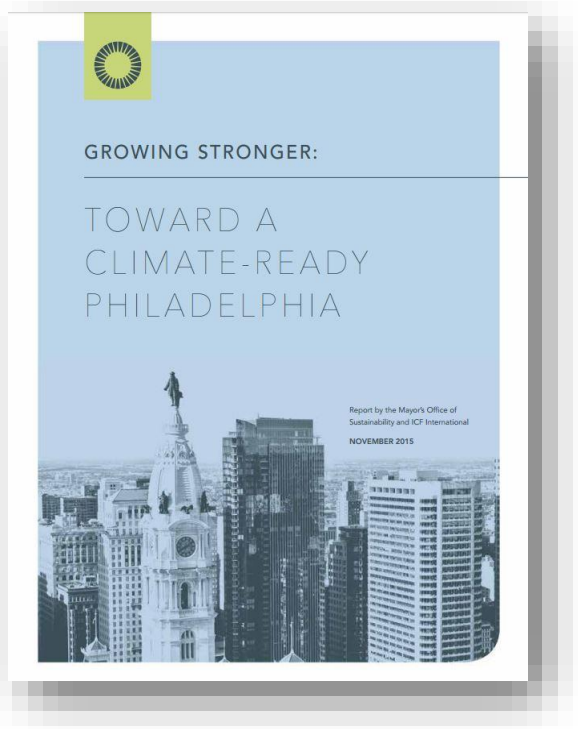
Sea level ↑

Air temperature ↑

Extreme storm events* ↑

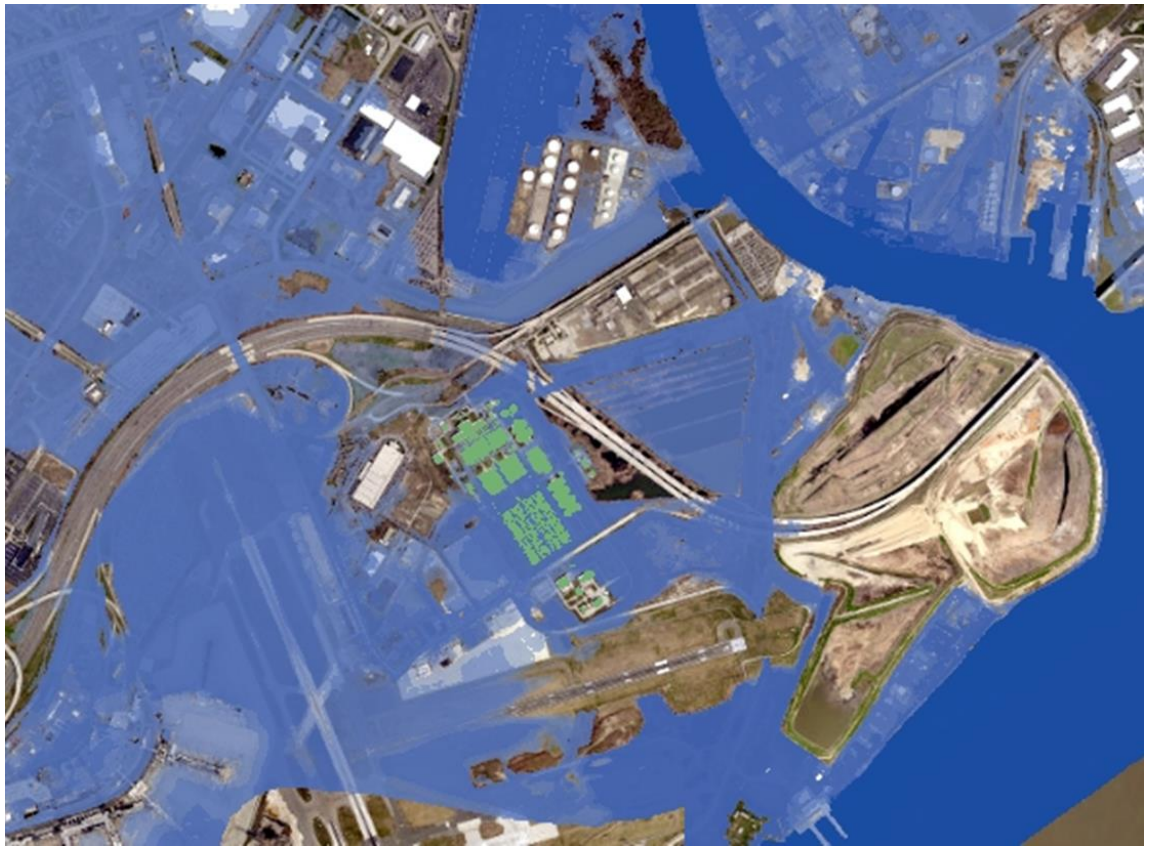
Droughts ↑ ↓ —

*the **number of heavy & extremely heavy precipitation events per year** only

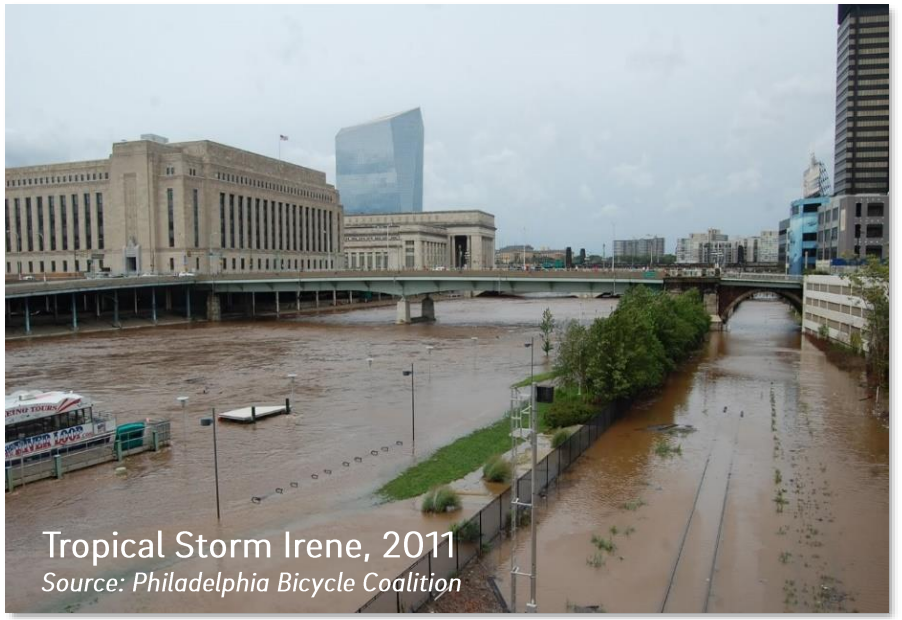


Priority Risks to Address

Coastal, riverine and infrastructure-based flooding

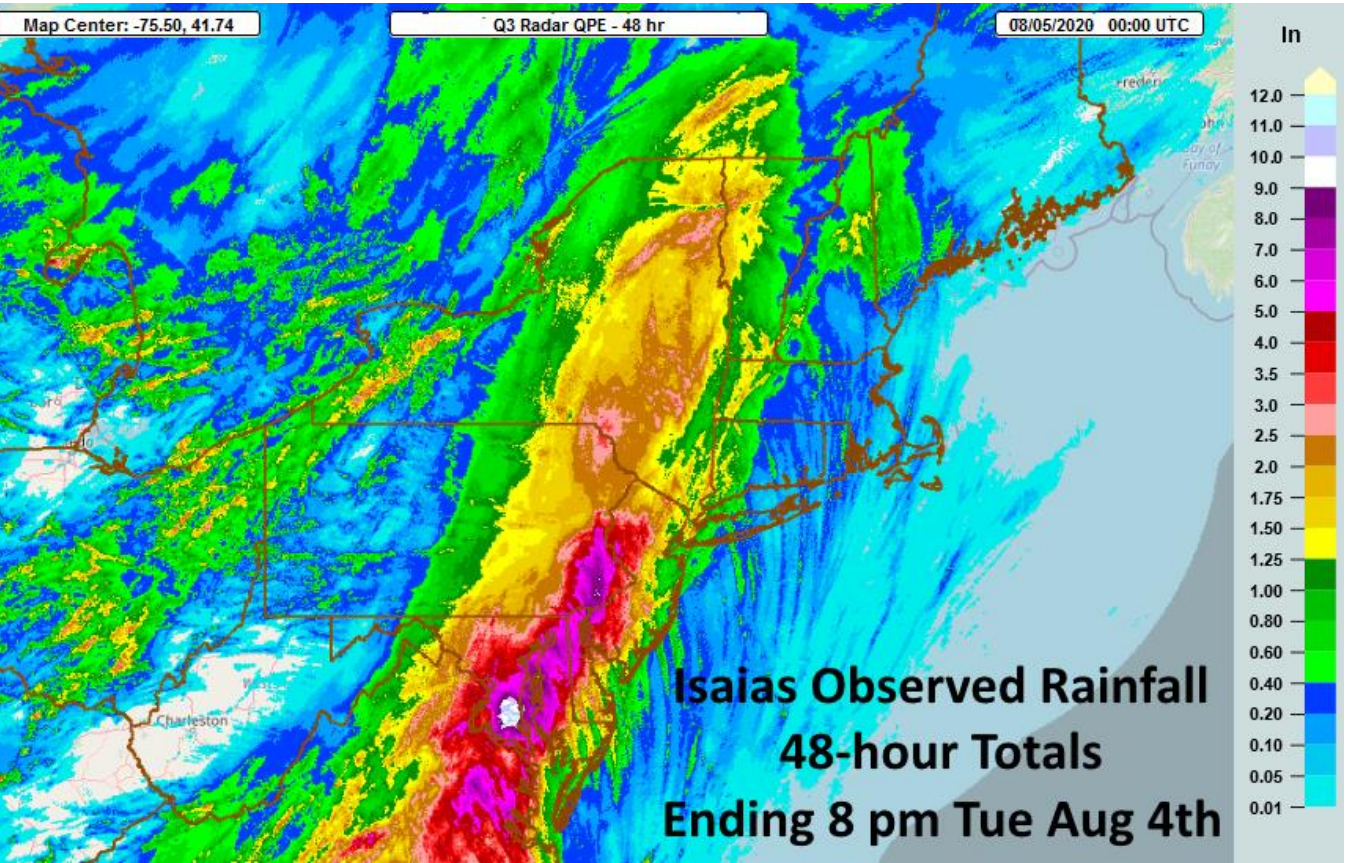


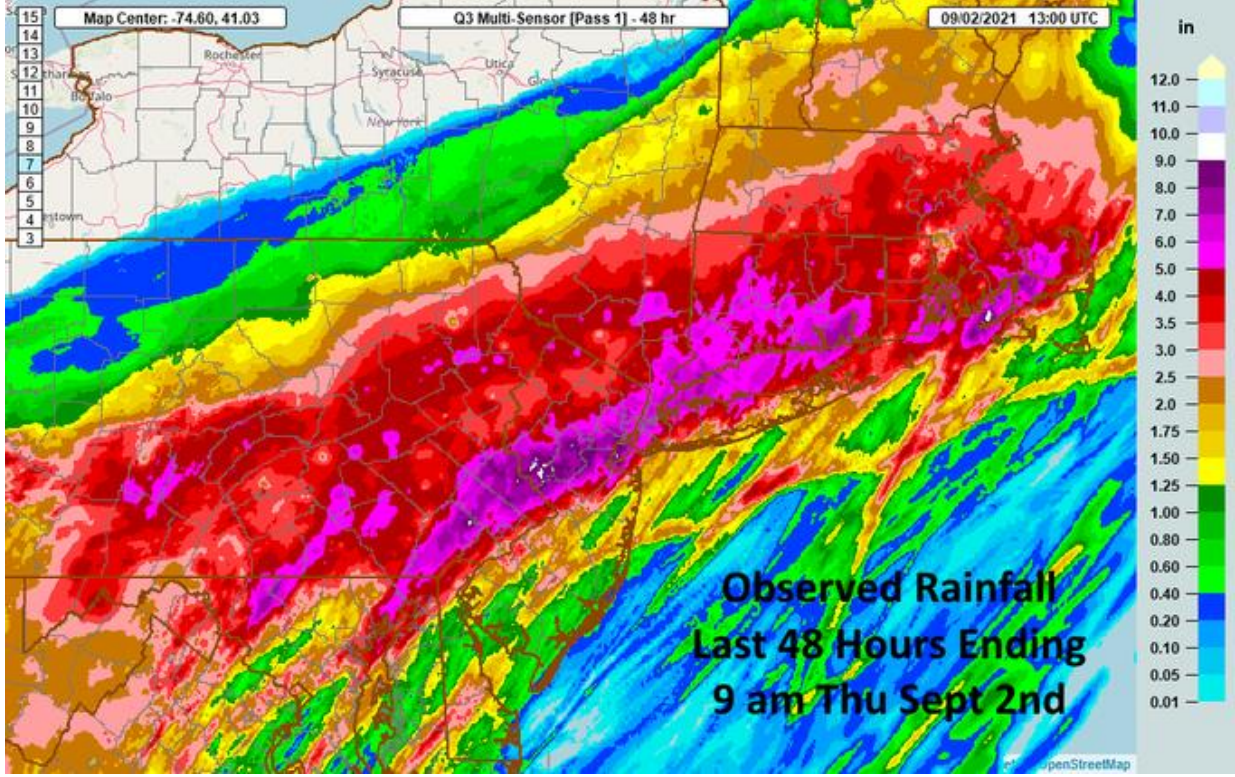
Tropical Storm Ida, 2021
Source: AP/Matt Rourke



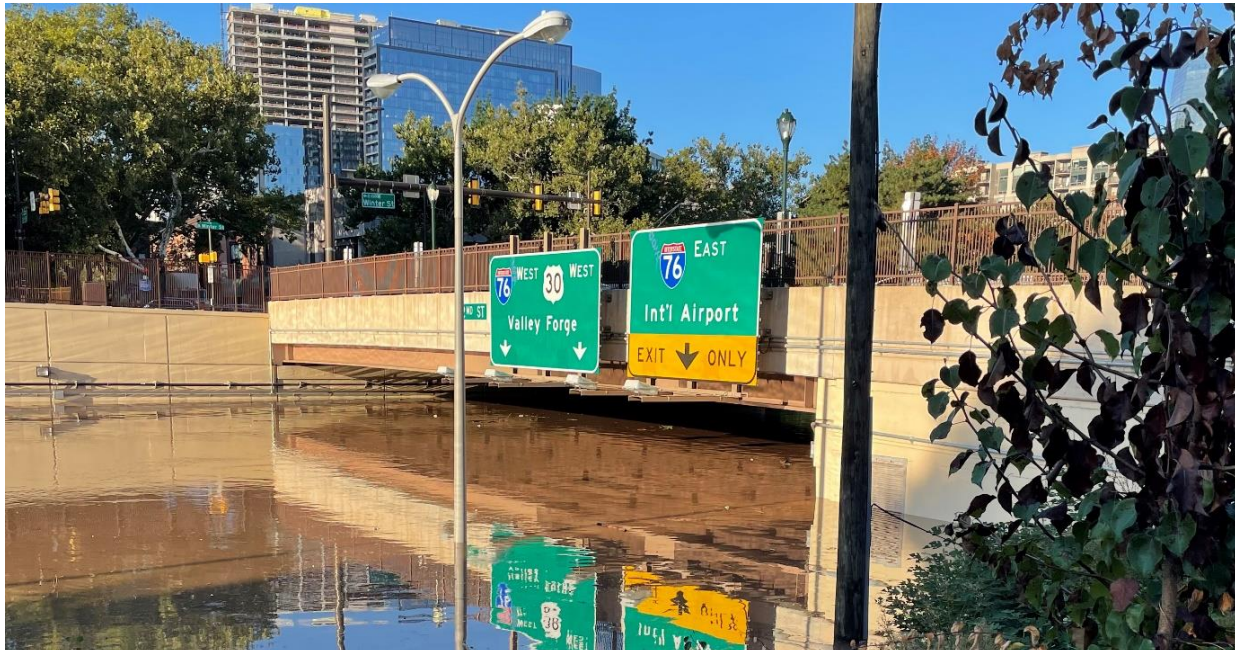
Tropical Storm Irene, 2011
Source: Philadelphia Bicycle Coalition

Tropical Storm Isaias





Tropical Storm Ida



Priority Risks to Address

Water quality impacts

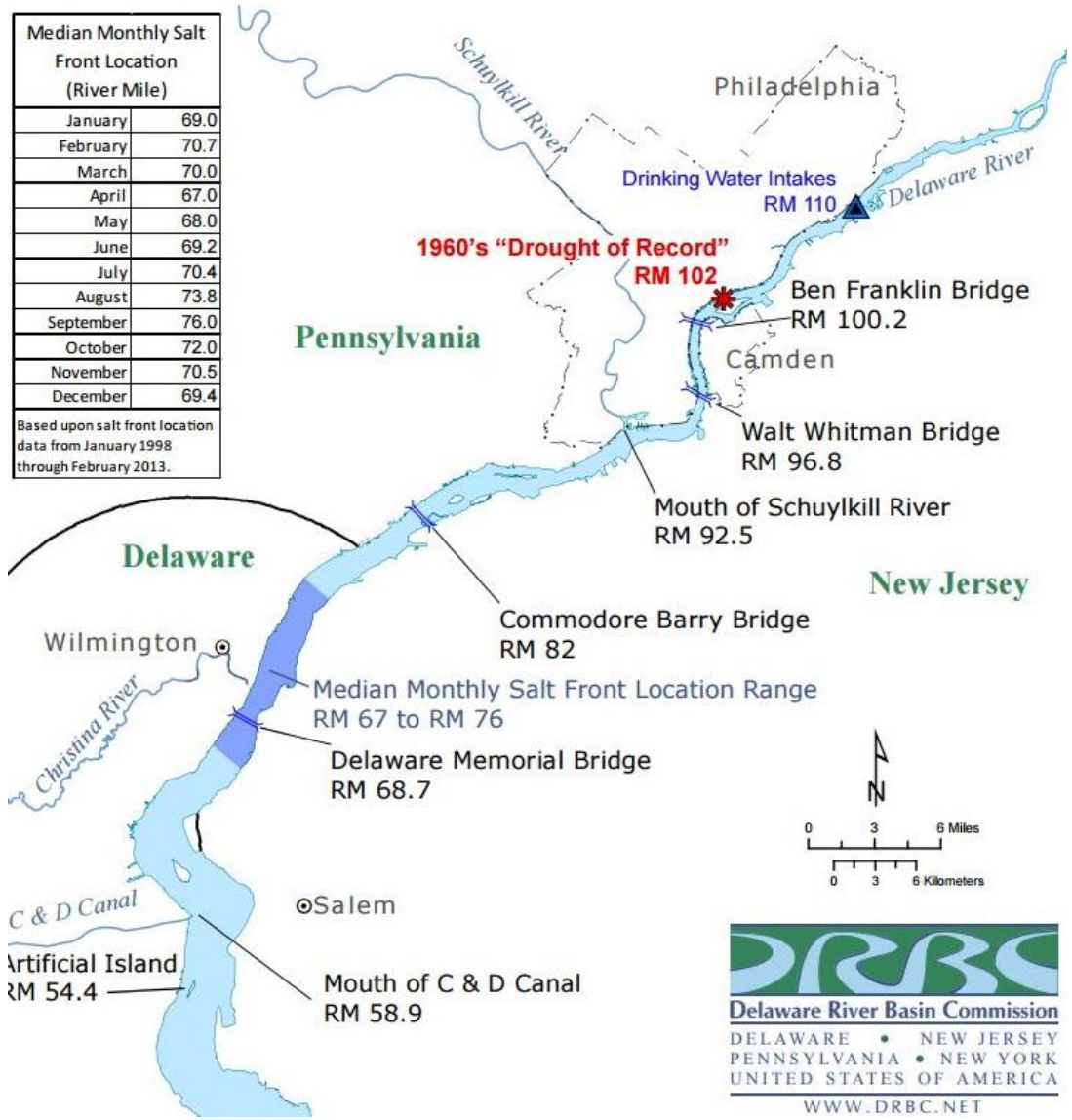
Higher temperatures could lead to decreased dissolved oxygen levels, increased algal growth, and changes to treatment processes

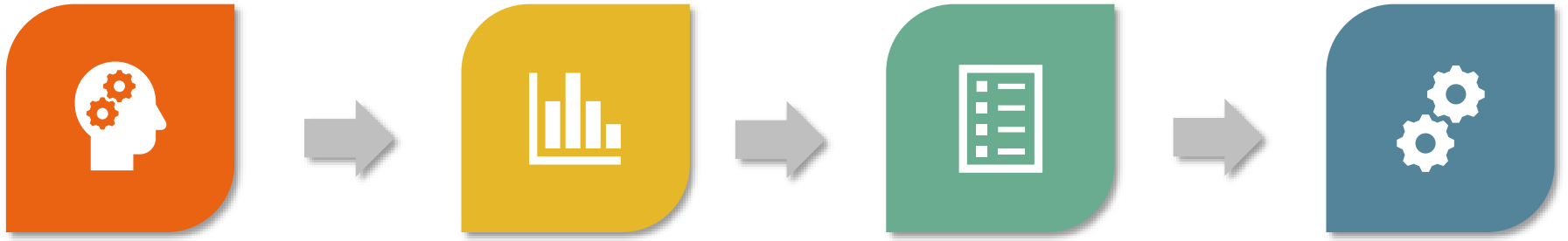
Sea level rise intensified salinity intrusion

Intrusion of ocean salt upstream during drought conditions is a natural process anticipated to become more frequent and severe later this century due to sea level rise

Median Monthly Salt Front Location (River Mile)	
January	69.0
February	70.7
March	70.0
April	67.0
May	68.0
June	69.2
July	70.4
August	73.8
September	76.0
October	72.0
November	70.5
December	69.4

Based upon salt front location data from January 1998 through February 2013.





UNDERSTAND ANALYZE PLAN IMPLEMENT

How and when will these impacts affect the operations and management of our systems?
What strategies can we employ to reduce risks and maintain current levels of service?

ACTIONABLE SCIENCE IS REQUIRED

"...data, analyses, projections, or tools that can support decisions regarding the management of the risks and impacts of climate change." *(ACCCNRS, 2015)*

Sea Level Rise and Storm Surge

Philadelphia's two main rivers are tidal – we will be impacted by sea level rise

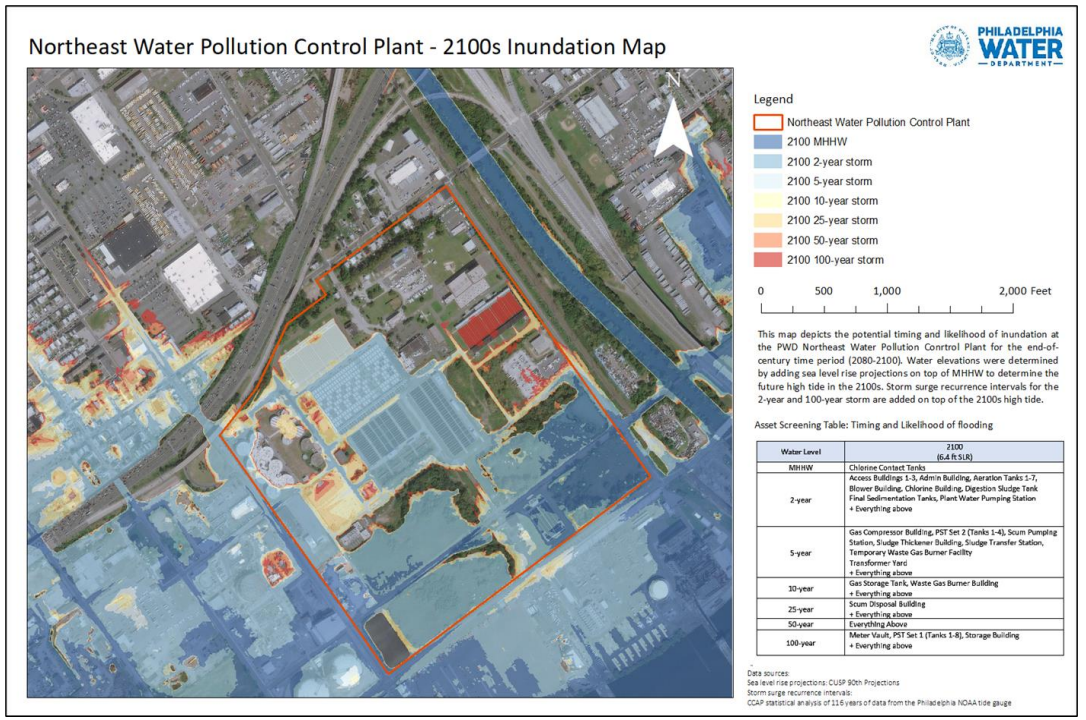
Potential risks include:

- Flooding of PWD assets
  - Surface and below-grade
  - Treatment plants and pump stations
- Increased energy demand (pumping and treatment)
- Degraded source water quality (salinity)

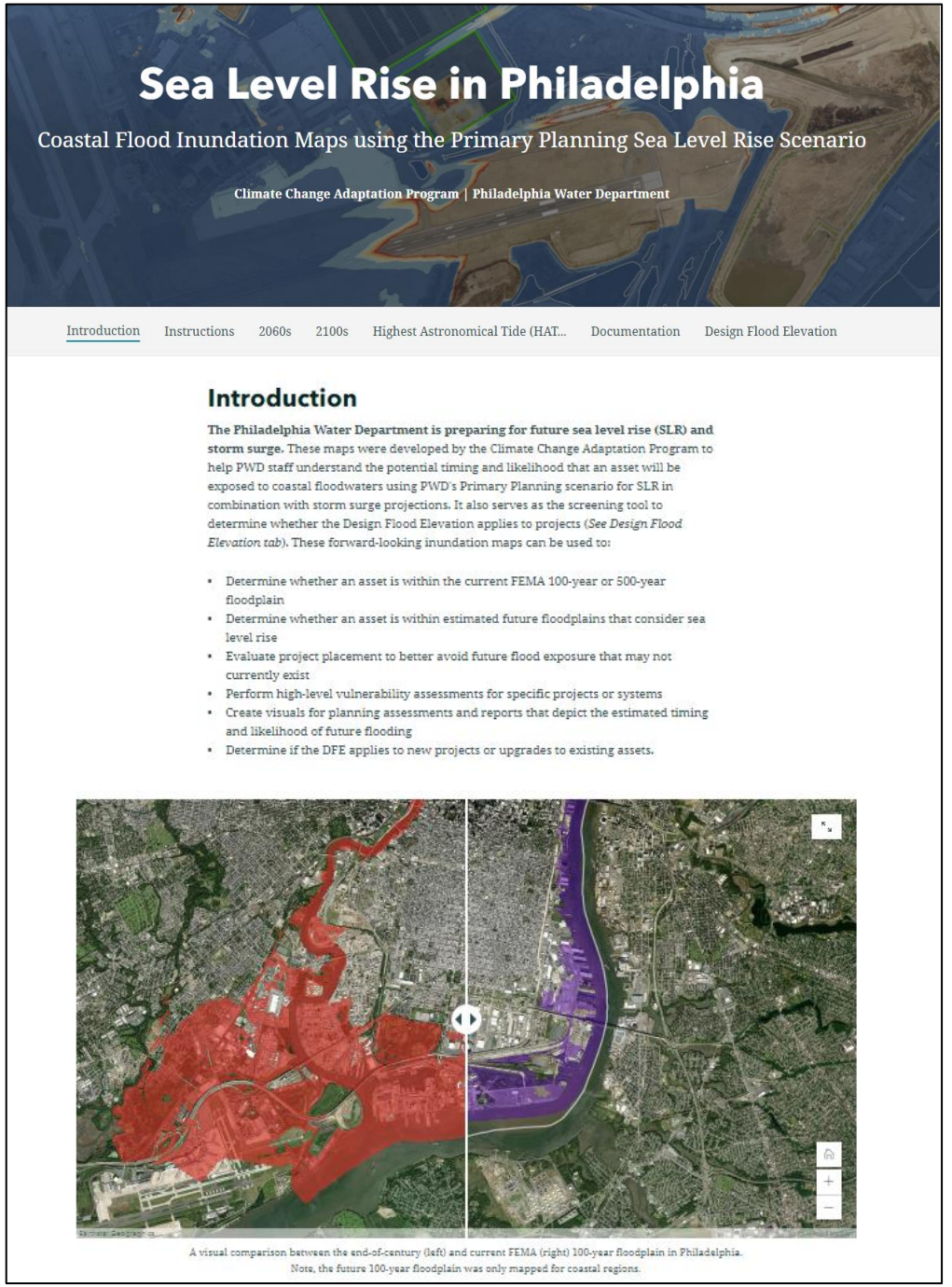
Actionable science developed includes:

- Analysis of SLR projections and storm surge elevations on Delaware River
- Customized GIS screening tool for PWD assets
- Proposed design flood elevation (DFE) based on flooding risks
- Analysis with PWD 3-D model of salinity intrusion under current and future sea level conditions

PWD Inundation Model



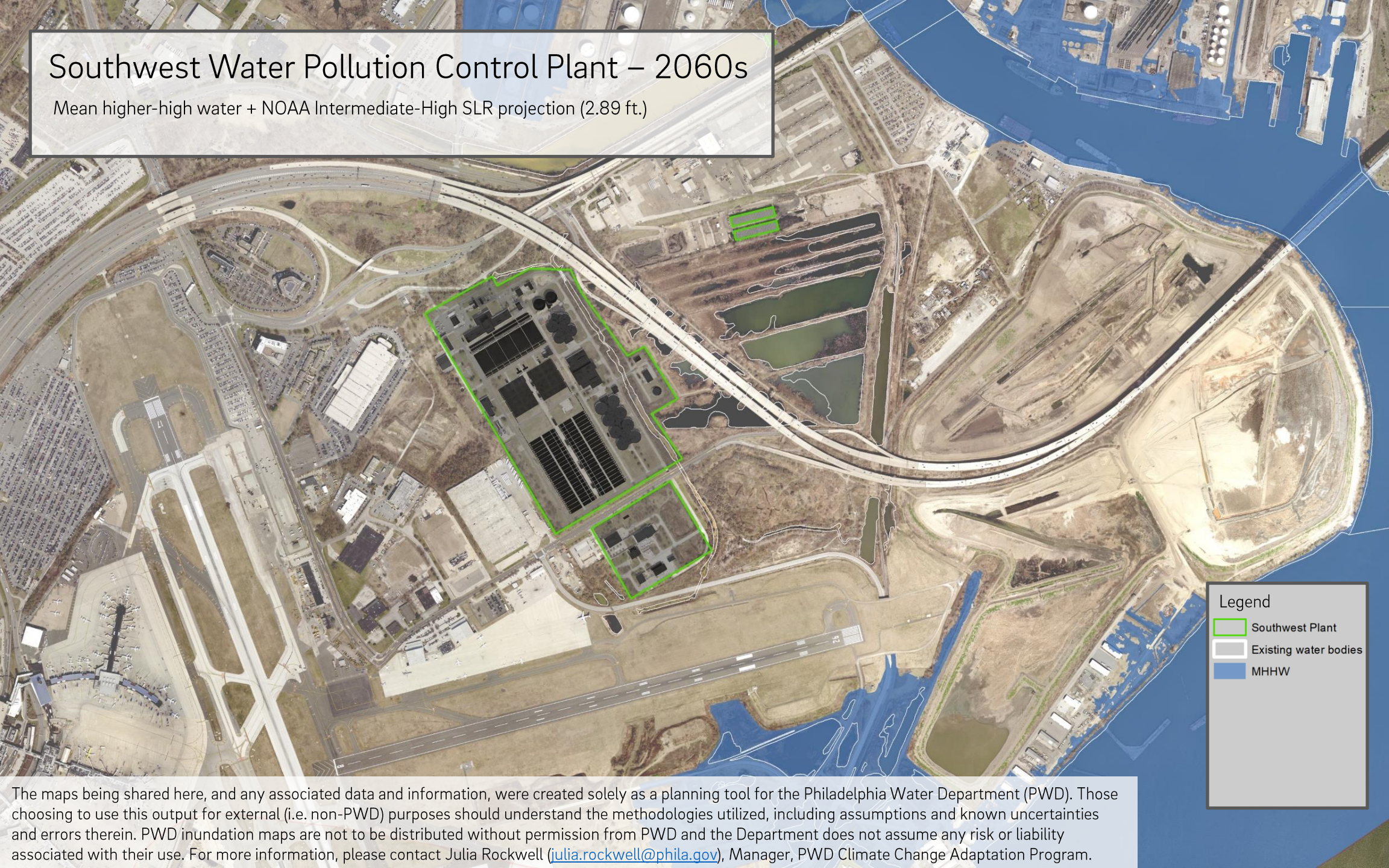
Disclaimer: *The maps being shared here, and any associated data and information, were created solely as a planning tool for the Philadelphia Water Department (PWD). Those choosing to use this output for external (i.e. non-PWD) purposes should understand the methodologies utilized, including assumptions and known uncertainties and errors therein. PWD inundation maps are not to be distributed without permission from PWD and the Department does not assume any risk or liability associated with their use. For more information, please contact Julia Rockwell (julia.rockwell@phila.gov), Manager, PWD Climate Change Adaptation Program.*



Southwest Water Pollution Control Plant
Mid-century, 2060s

Southwest Water Pollution Control Plant – 2060s

Mean higher-high water + NOAA Intermediate-High SLR projection (2.89 ft.)



Southwest Water Pollution Control Plant – 2060s

Mean higher-high water + NOAA Intermediate-High SLR projection (2.89 ft.)
+ 2 through 100-year storm tides

Southwest Water Pollution Control Plant
End-of-century, 2100s

Southwest Water Pollution Control Plant – 2100s

Mean higher-high water + NOAA Intermediate-High SLR projection (6.4 ft.)

Southwest Water Pollution Control Plant – 2100s

Mean higher-high water + NOAA Intermediate-High SLR projection (6.4 ft.)
+ 2 through 100-year storm tides

Increasing Precipitation

In Philadelphia, rainfall is expected to increase in intensity, with the largest increases occurring for the biggest storms

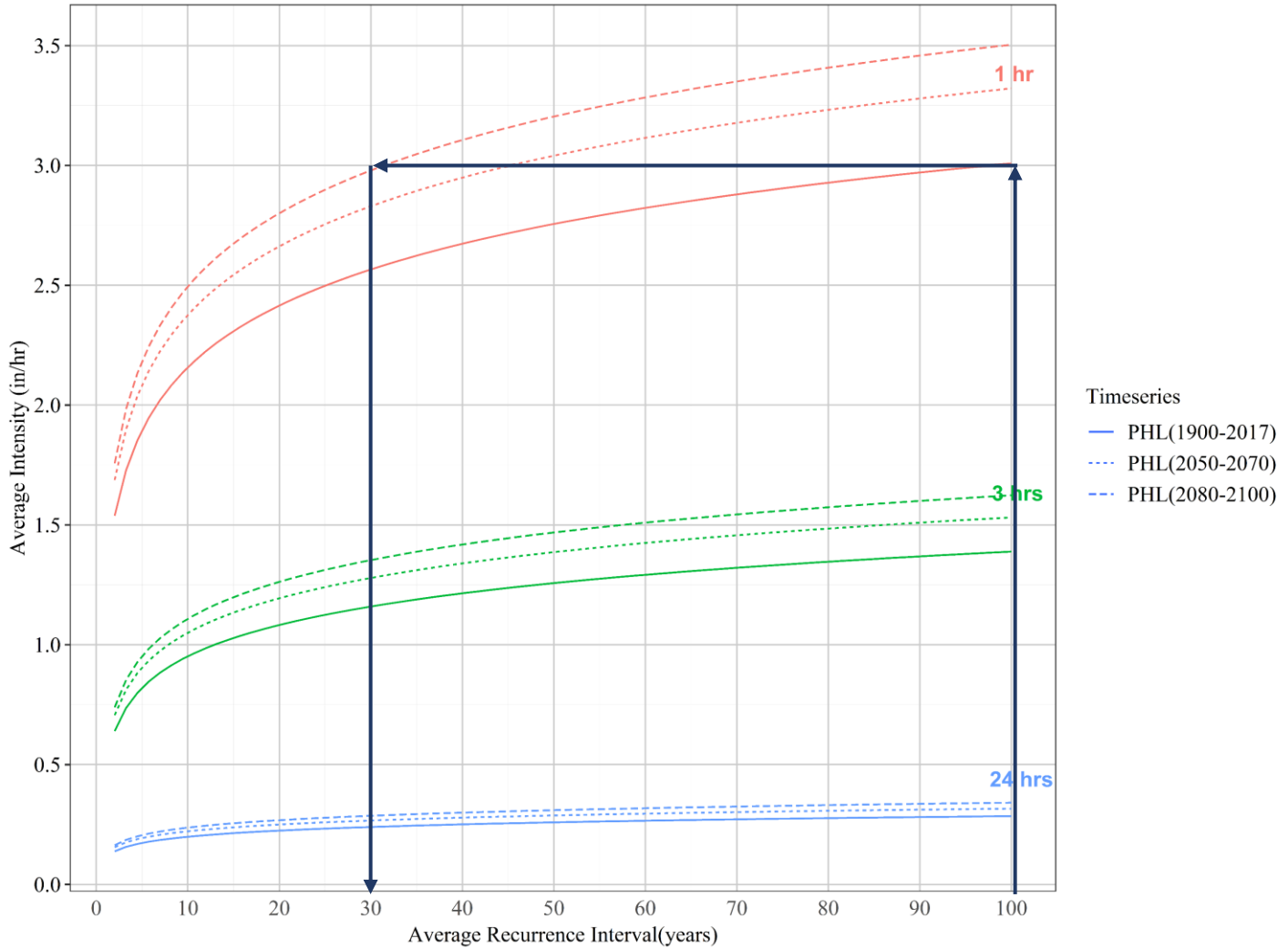
Potential risks include:

- More frequent combined sewer overflows (CSOs)
- Increased erosion and sediment transport
- Increased riverine flooding
- Increased infrastructure-based flooding (basement/sewer back-ups)

Actionable science developed includes:

- High resolution precipitation projections for use in modeling applications
- Future design storm events (common tool in infrastructure design)
- Stochastic rainfall generator to evaluate current and future precipitation variability

Intensity-Duration-Frequency Curves



Comparison of IDF curves generated by fitting GEV Type II distribution on AMS using PHL data (1900-2017) with future PHL time series based on the 2050-2070 and 2080-2100 storm sets for RCP8.5

Journal of Water Resources Planning and Management / Volume 145 Issue 6 - June 2019

Technical Papers

Transforming Global Climate Model Precipitation Output for Use in Urban Stormwater Applications

M. Maimone, Ph.D., P.E., D.WRE, M.ASCE; S. Malter; J. Rockwell; and V. Raj

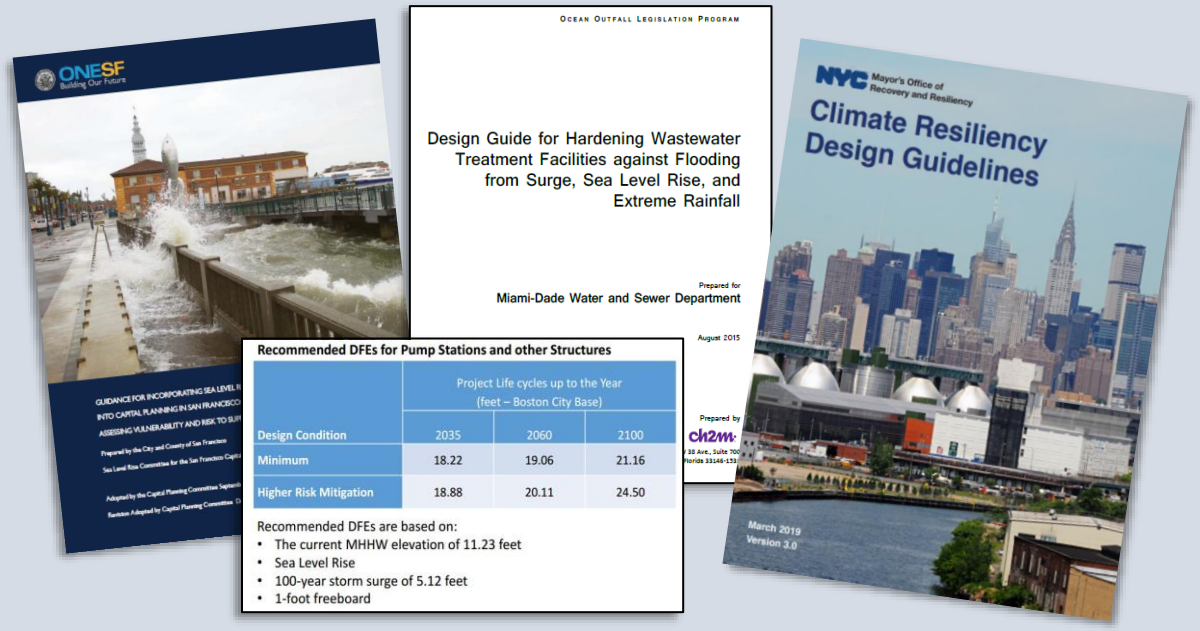
How do we adapt?

Adaptation Requires Mainstreaming the Use of Climate Information

Existing assets: Consider short and long-term adaptation strategies

New Assets: Ensure climate change is considered in the planning and design of new projects

- Perform **on-the-ground risk assessments** to identify strategies & investments to protect existing assets
- Inform **long-term infrastructure plans** (Water & Wastewater Master Plans)
- Integrate climate information into the **capital planning** process
- Developing & implement **Climate Change Planning & Design Guidance** for PWD
- **Coordinate with local and regional partners** to scale adaptation solutions



Policy changes
Updated Design standards
New management approaches

Building Resiliency

Green City, Clean Waters Program

Green City, Clean Waters continues to make tremendous progress since launching in 2011. We exceeded our 10-year pollution reduction goal, with new infrastructure investments now keeping nearly **three billion gallons** of stormwater runoff and sewer overflow out of local waterways.

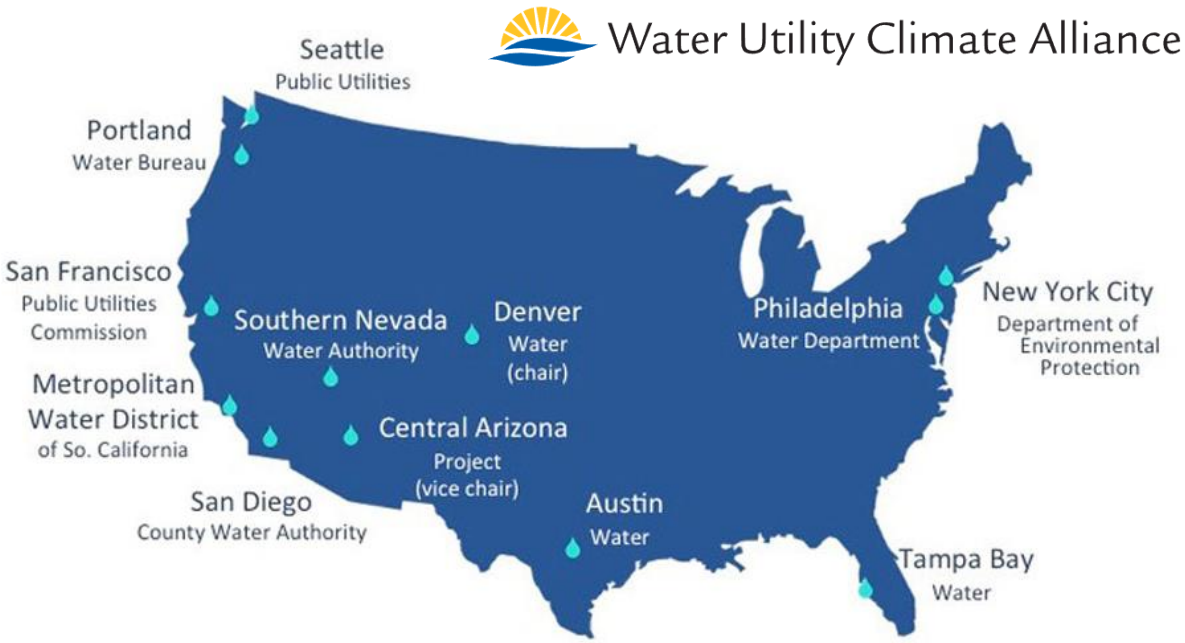
We've installed more than
2,800 green tools...

...at nearly
800 sites
throughout the city...

...keeping more than
2.7 billion gallons
of polluted water out of our rivers.

Where we're headed

- Continue work on priority initiatives that will help mainstream the use of climate information (risk assessments, climate planning & design guidance)
- Move from planning to implementation of adaptation strategies
- Continue building internal capacity and engaging with city and regional partners
- Continue partnering with and leveraging knowledge from peer cities/utilities



Additional Resources

- PWD Climate Change Adaptation Program website:
https://www.phila.gov/water/sustainability/Pages/ClimateChange.aspx

- ASCE Article on PWD Time Series Method:
https://ascelibrary.org/doi/abs/10.1061/%28ASCE%29WR.1943-5452.0001071

- Green City, Clean Waters Information:
https://www.phila.gov/water/sustainability/greencitycleanwaters/Pages/default.aspx

- Water Utility Climate Alliance (WUCA) website:
https://www.wucaonline.org/

Thank You!

Abby Sullivan
Abby.sullivan@phila.gov

PHILADELPHIA WATER DEPARTMENT