

CLIMATE CHANGED:

What will you do when
your project floods?

BUILDINGENERGY BOSTON

MARCH 19-20, 2024 • WESTIN BOSTON SEAPORT DISTRICT • [NESEA.ORG/BE24](https://www.nesea.org/be24)

Conference + Trade Show of the Northeast Sustainable Energy Association (NESEA)



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VANDERWEIL 

“Water is the primary medium through which we will feel the effects of climate change.”

– UN Secretary General Antonio Guterres

ecosystem degradation water scarcity
water quality subsidence
heat island effect social conflict seepage
famine
changes to ocean circulation increased runoff pollution catastrophic flooding
freshwater availability soil erosion inundation intrusion sea level rise
groundwater recharge ecological resilience acidification wildfires
aquifer depletion stormwater management displacement infrastructure damage
biodiversity loss drought extreme precipitation desertification
eutrophication humidity levels
depletion

Flash Flooding in New Hampshire's White Mountains



What summer flooding means for Lake Champlain water quality and cyanobacteria blooms

By [Mikaela Iefrak](#), [Andrea Laurion](#)

Published August 5, 2023 at 5:29 PM EDT

As temperatures rise, toxic bacteria blooms in Mass. ponds prompt 'stay away' notices

Updated July 26, 2023 | By [Paula Moore](#)



Courtney Marie
[@CourtMarie211](#) · Follow



What a wild summer! Flooding near the Walpole commuter train. One car stalled police have shut down the road while crews clear the drains [@NECN](#) [@NBC10Boston](#)

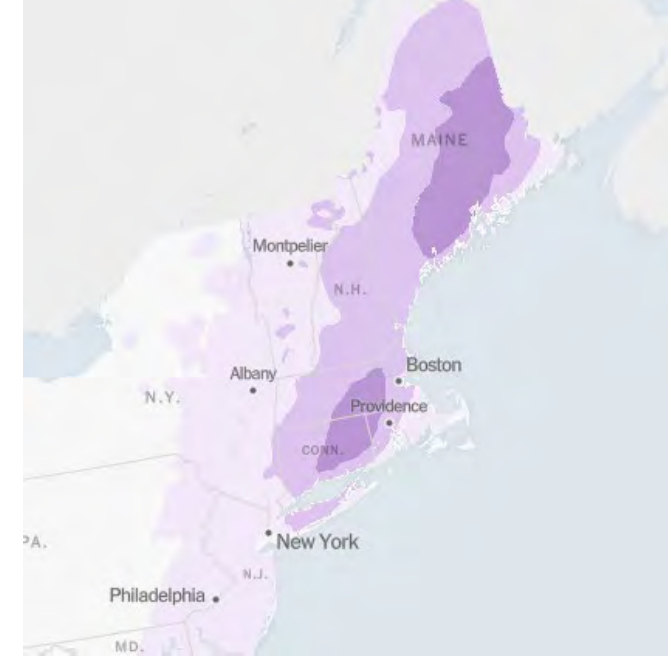


9:55 AM · Aug 18, 2023



Record-setting storm wallops East Coast with flooding, high winds

Over 800,000 customers had no power in the Northeast on Monday afternoon while major coastal flooding pushed water levels up to 4 feet above normal



Sewage overflows in Boston and Cambridge prompt warnings

A number of sewers in Boston and Cambridge overflowed late Saturday and early Sunday due to heavy rains.



Vermont Floods Show Limits of America's Efforts to Adapt to Climate Change

The lack of a comprehensive national rainfall database and current flood maps hampers the ability to prepare for storms intensified by climate change.

Floodwaters inundate Maine, New Hampshire for fourth time since December

Story by [Ian Livingston](#) · 1h · 3 min read



In Cities and Small Towns, Vermonters Reckon With the Devastation of Flooding

Calls for search and rescue missions continued, as residents and business owners started assessing damage, fueling an anxious, unsettled mood.

Local & State News Kennebec Journal

Flooding Kennebec River leaves wake of destruction as thousands remain without power in central Maine



America Is Using Up Its Groundwater Like There's No Tomorrow

Overuse is draining and damaging aquifers nationwide, a New York Times data investigation revealed.

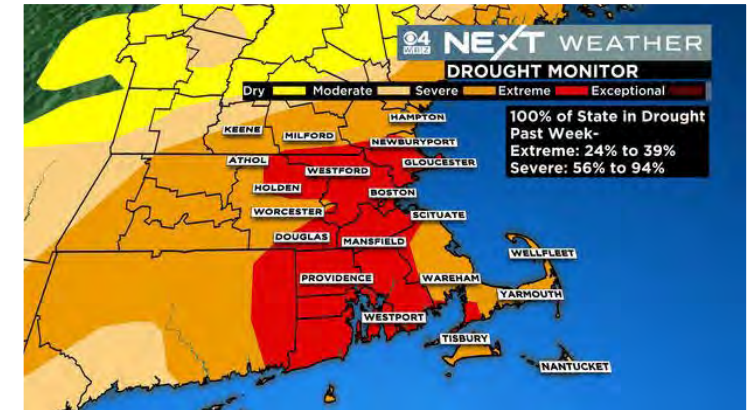
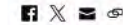
Environment

87 Percent of Connecticut in 'Severe' Drought According to Federal Data

— Angela Corrett, 8/26/2022

All of Massachusetts now in drought amid alarming expansion of dry conditions in Northeast

By Brandon Miller, Judson Jones and Rachel Ramirez, CNN
6 minute read · Updated 12:12 PM EDT, Thu August 18, 2022



Parts of Rhode Island and Massachusetts deteriorate to Extreme Drought

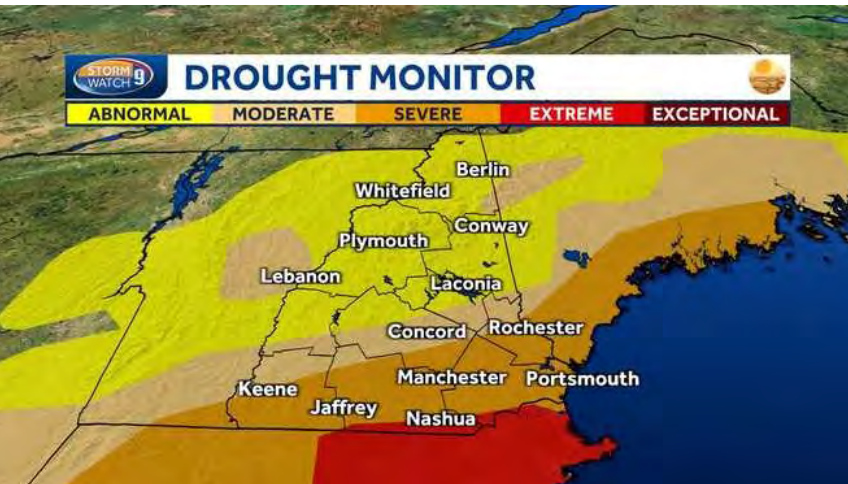
by ANTHONY MACARI, STORM TEAM 10 | Thu, August 11th 2022 at 12:55 PM
Updated Thu, August 11th 2022 at 6:48 PM



NEWS

Record Low Water Levels Outlined in 2022 New England Drought Report

By [New England Water Science Center](#) March 22, 2023



Weeds grow through the cracked soil on what would usually be on the bottom of the Hopkin Hill Reservoir in North Attleboro, Massachusetts. Charles Krupa/AP

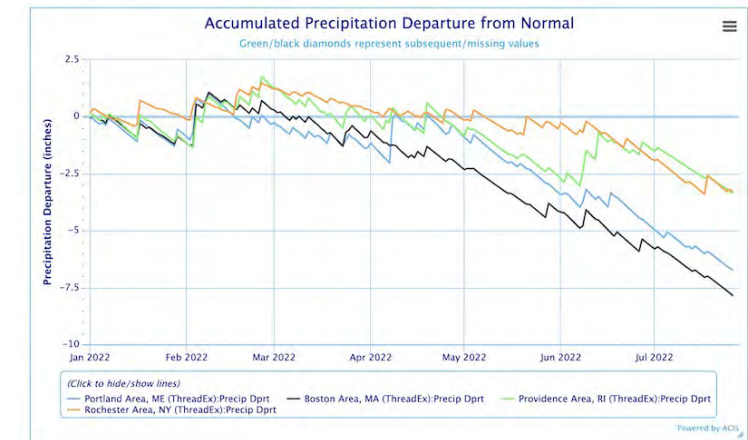
Local & State Business

Drought persists as Maine has another month of well below average rainfall

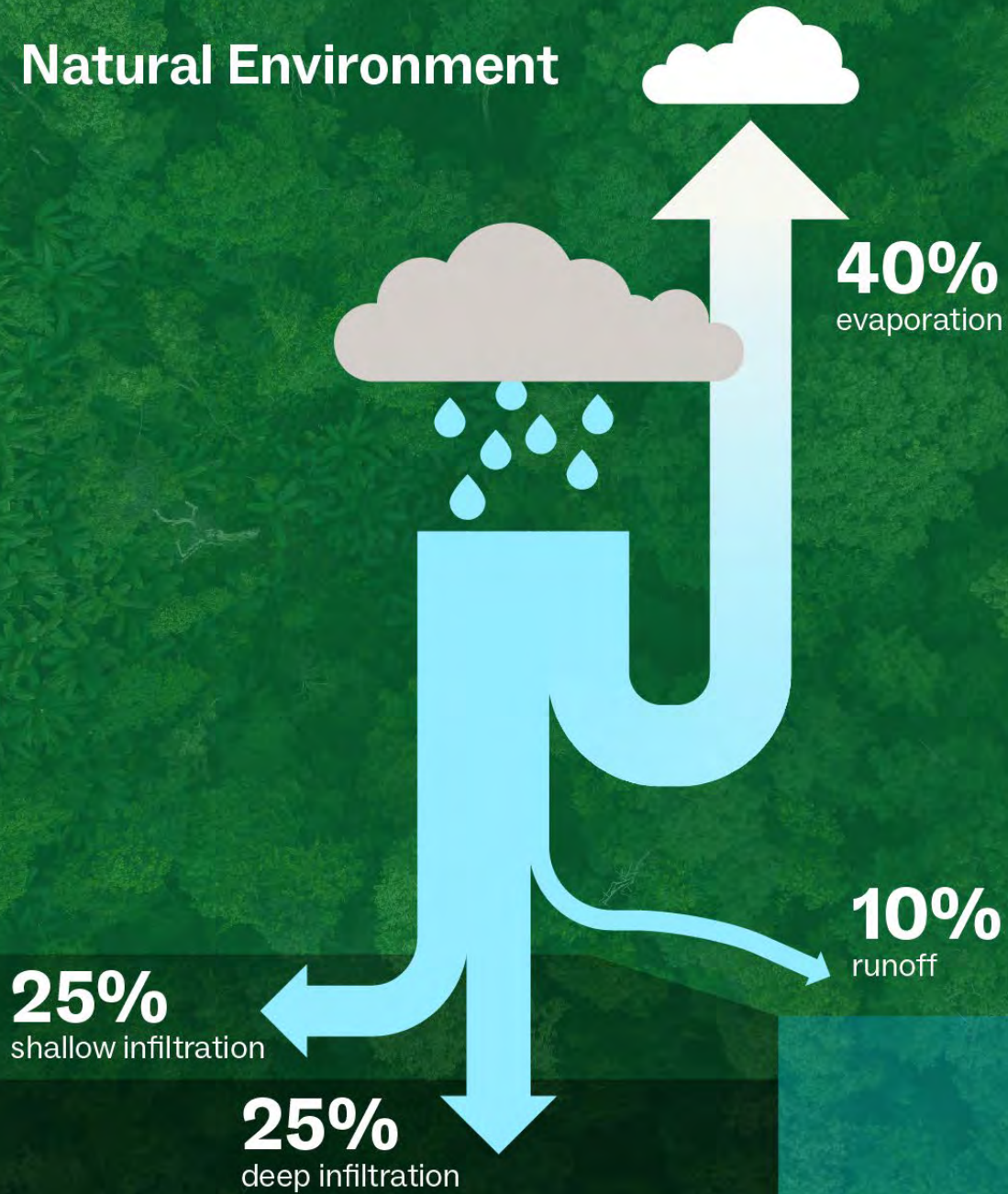
Quick-hitting storms do little to change conditions on the ground, and more heat is in the forecast.

Published July 15, 2022 Updated July 31, 2022
Bonnie Washuk Press Herald

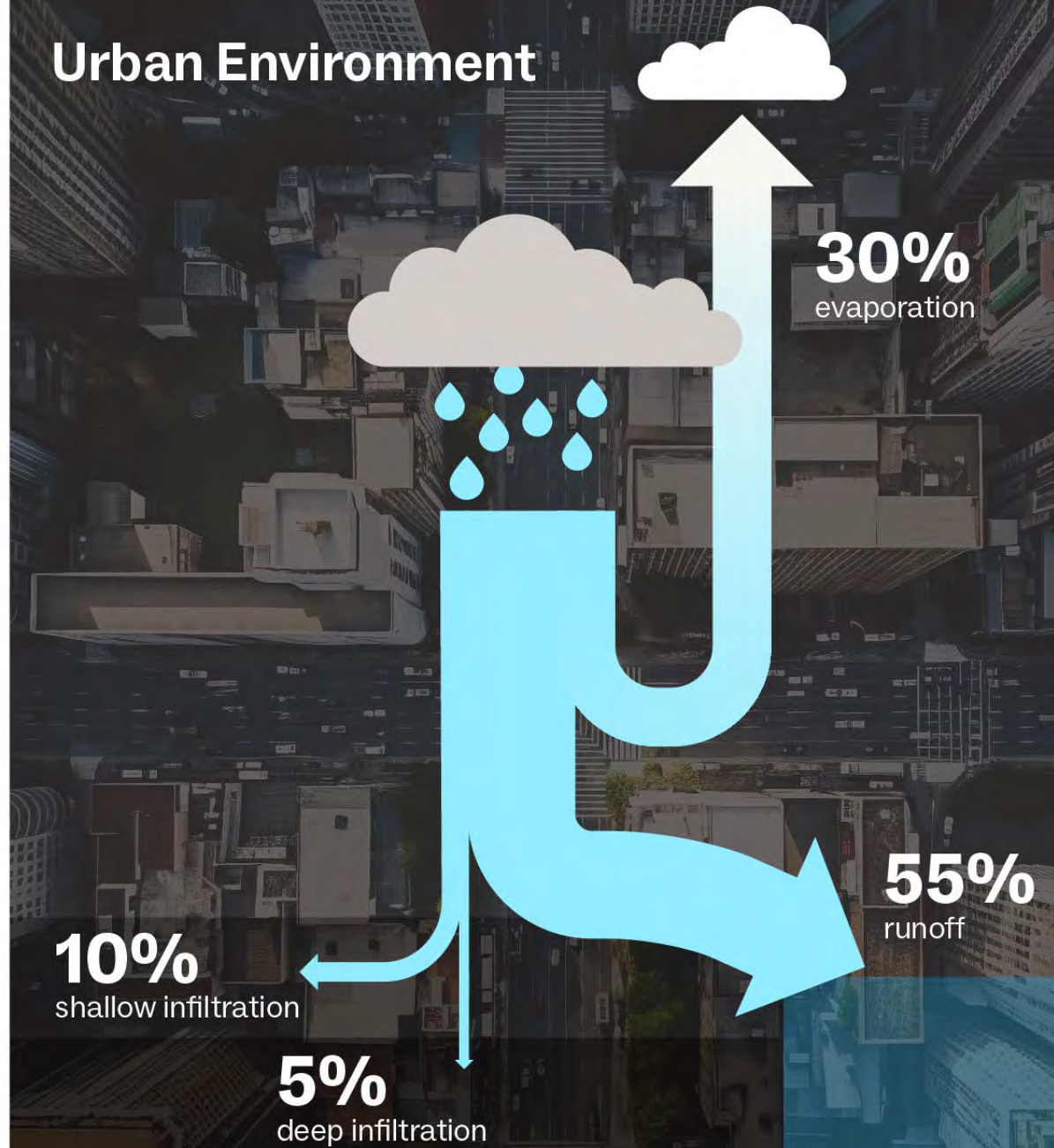
Accumulated Precipitation Departure from Normal



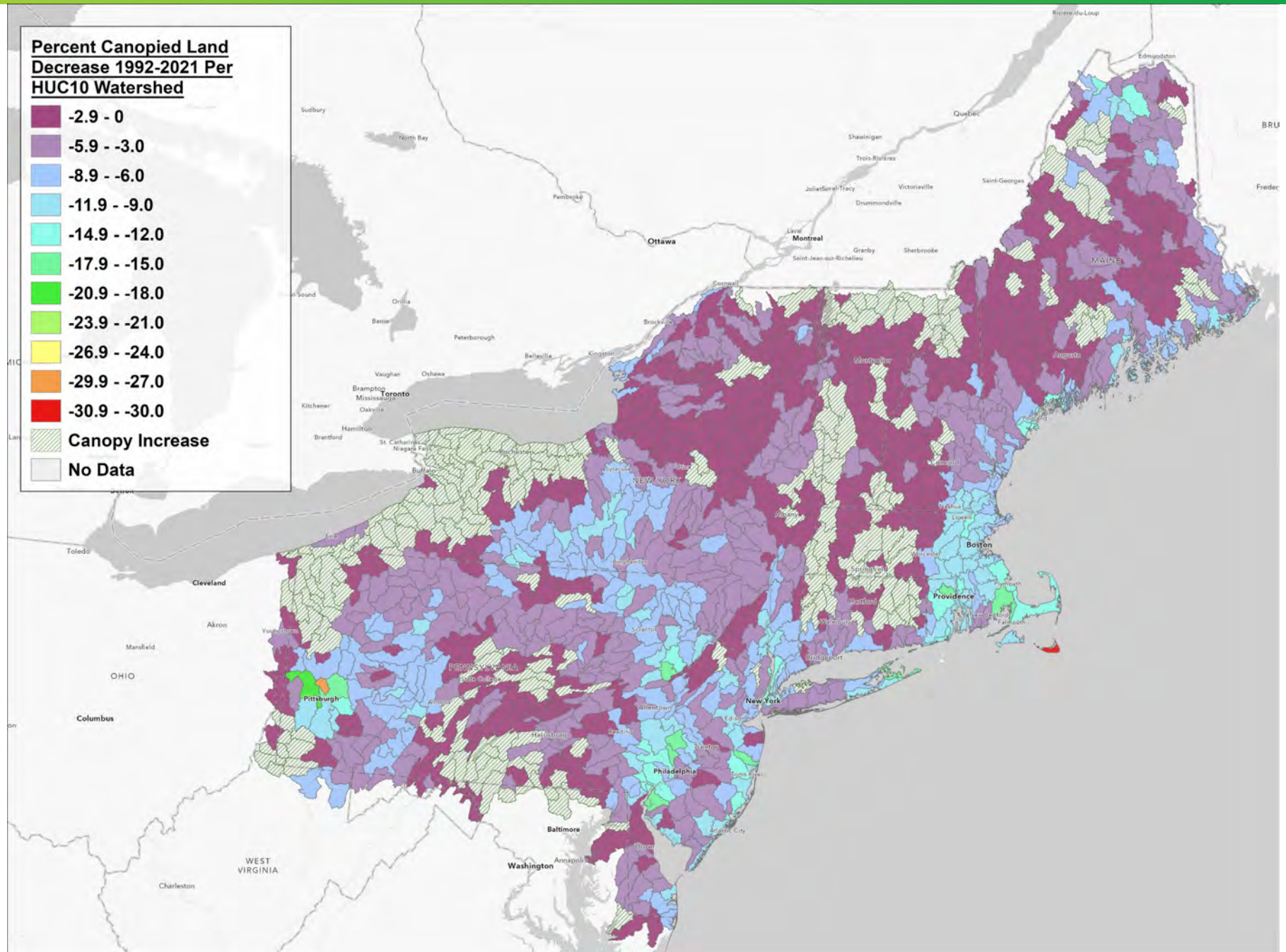
Natural Environment



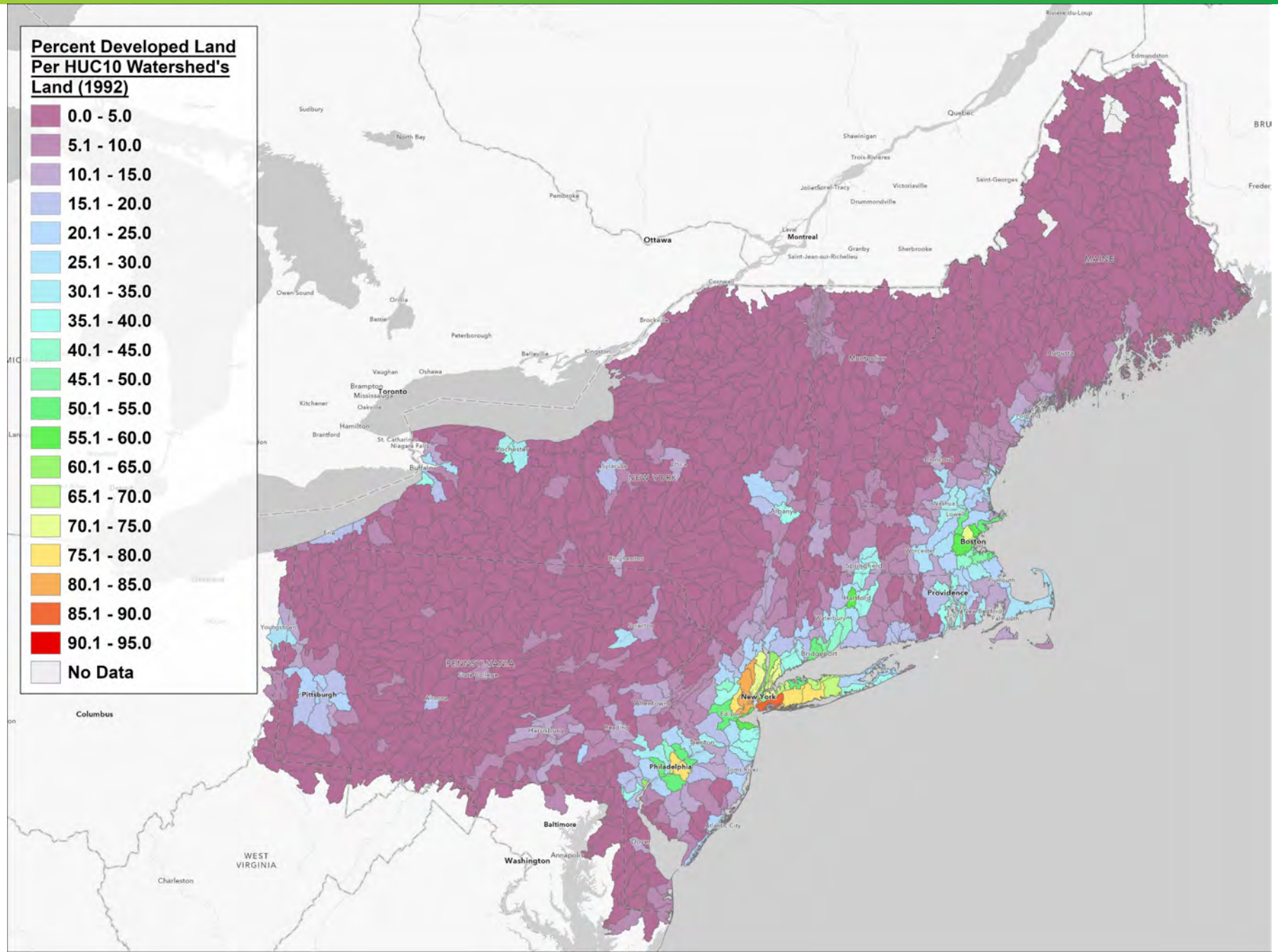
Urban Environment



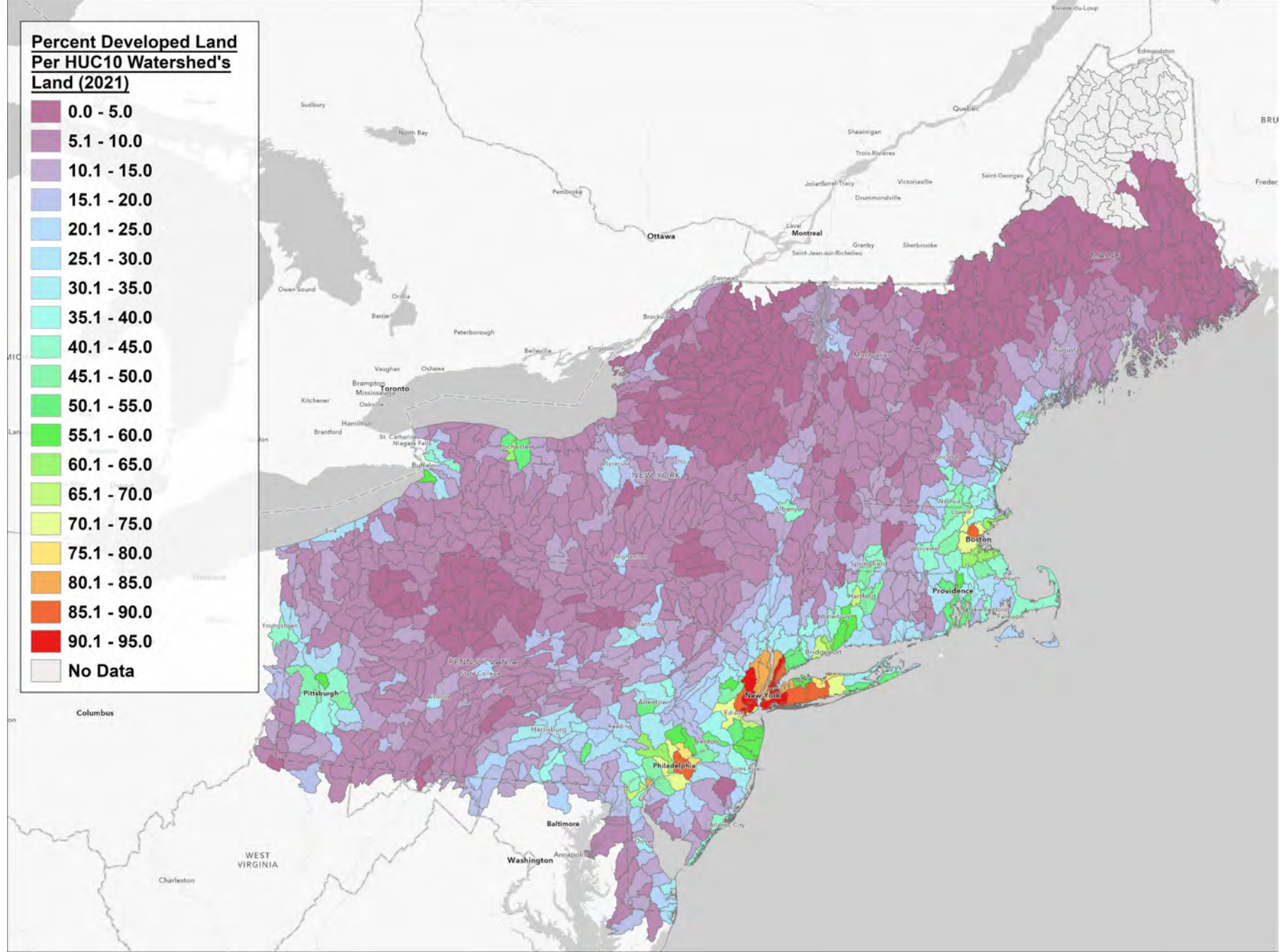
% Canopied Land Change - 1992-2021



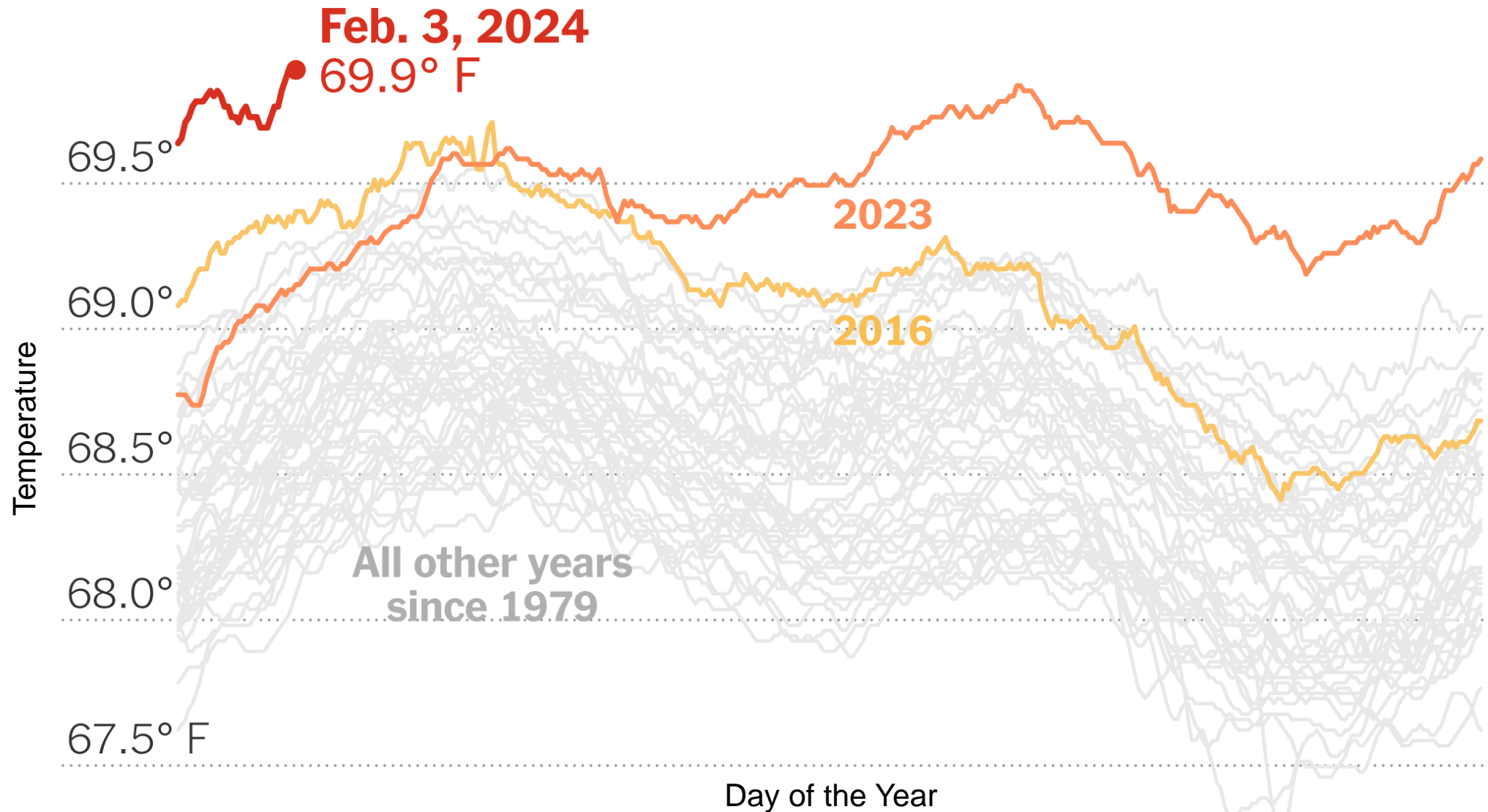
1992 - % Developed Land by Watershed



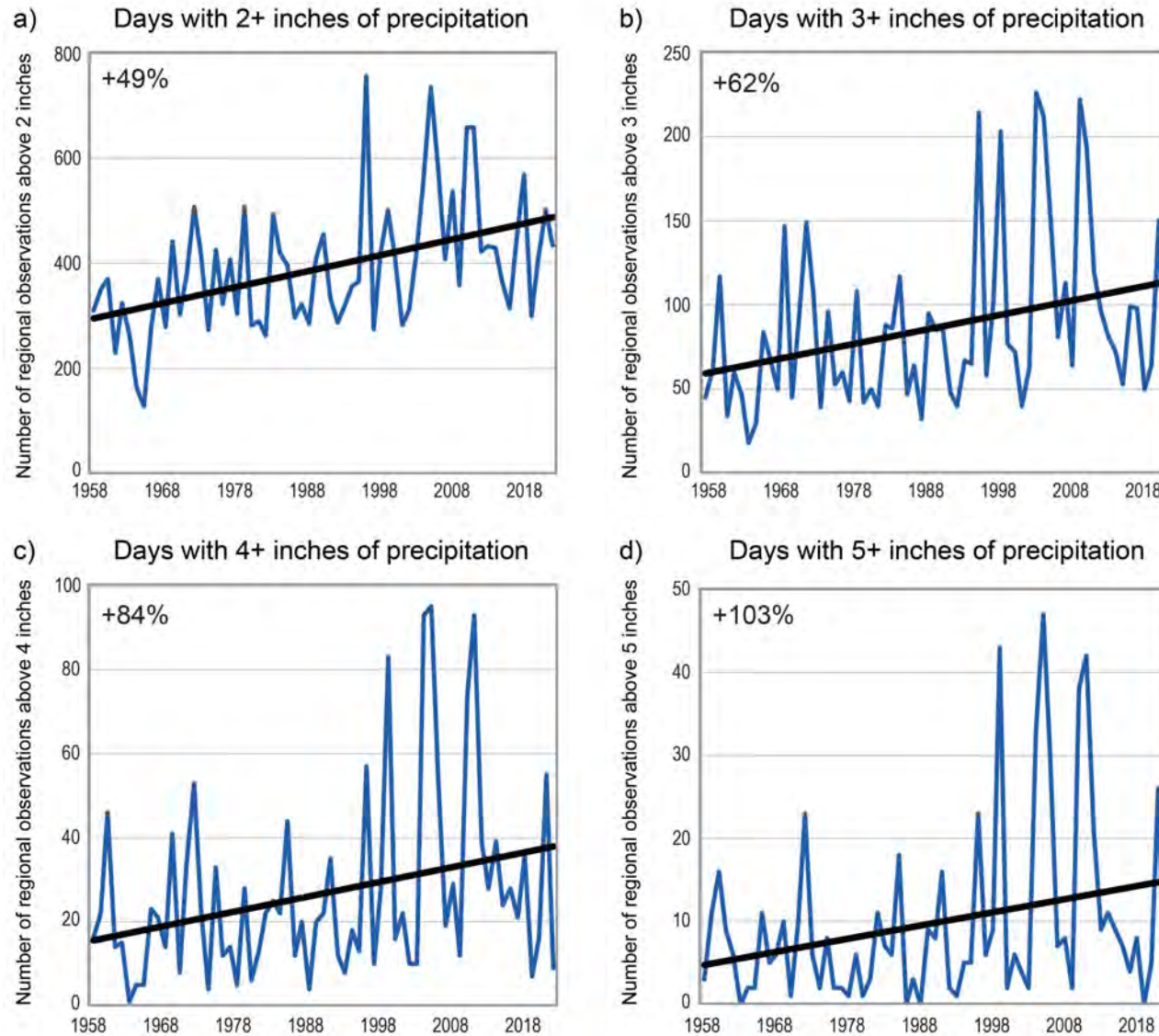
2021 - % Developed Land by Watershed



Daily Sea Surface Temperatures

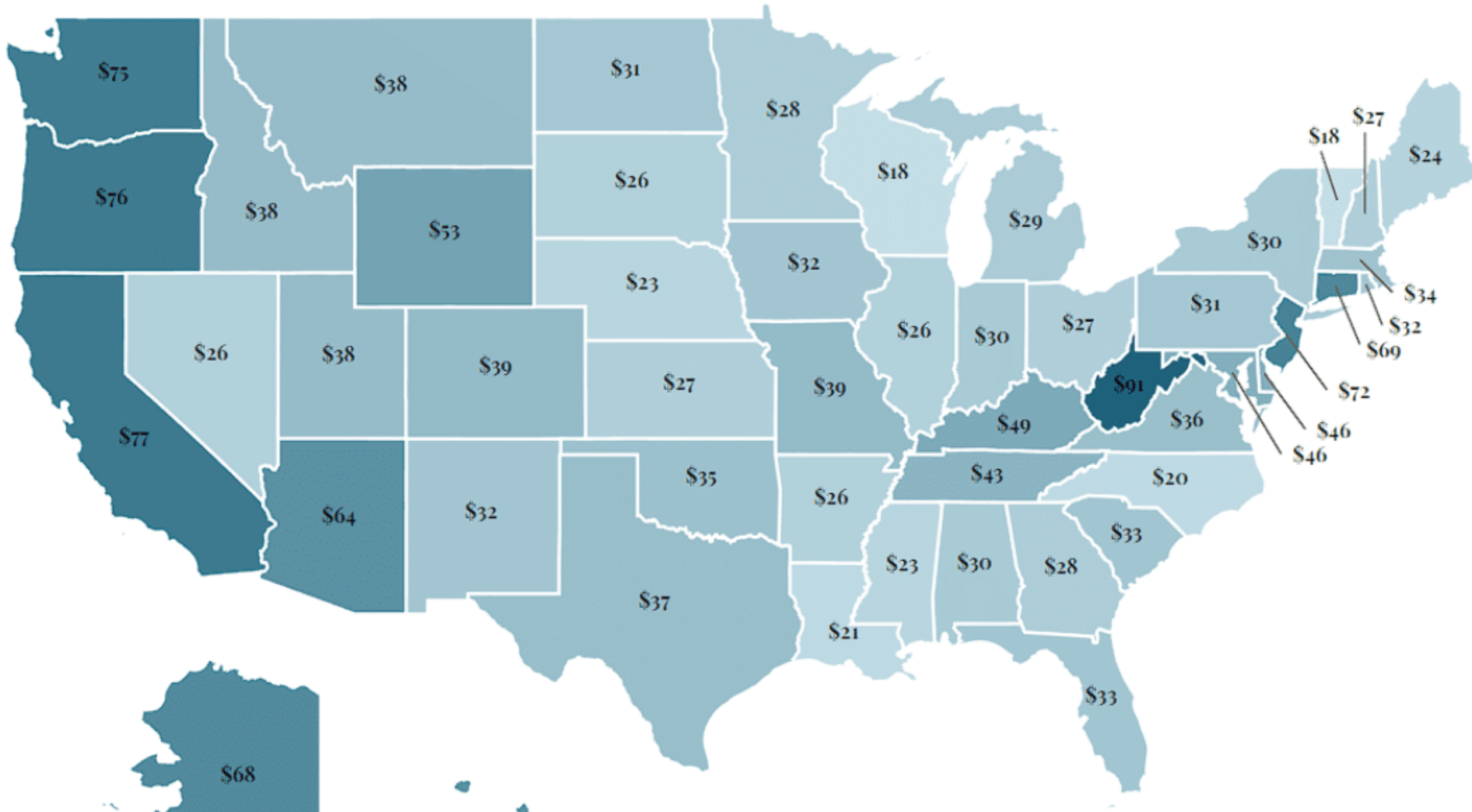


Trends in Extreme Precipitation in the Northeast



Source: Boston Globe • Trends in extreme precipitation in the Northeast •
USDA Forest Service, Drexel University, NOAA NCEI, and CISS NC

Monthly Cost of Water Per Household by State



ONE WATER

“One Water is a transformative way of viewing, valuing, and managing water.”

-US Water Alliance





CHART HOUSE
SEAFOOD • STEAKS • PRIME RIB

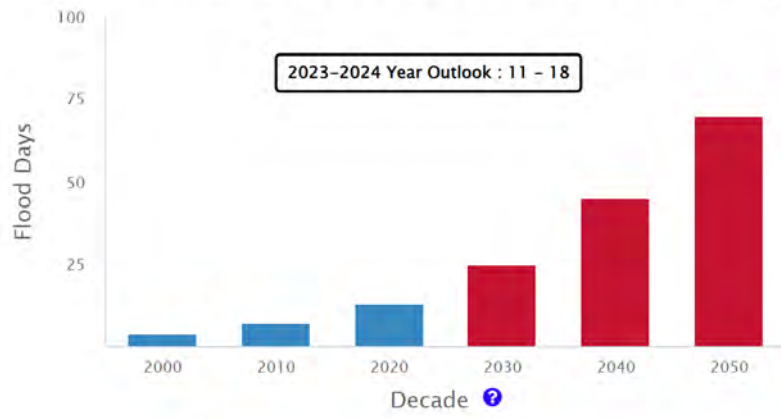
CHART HOUSE

NO PARKING
IN THIS ZONE
EXCEPT FOR
LOADING AND UNLOADING
PASSENGERS
OR MERCHANDISE
FOR THE BUSINESS
OPERATING IN THIS
ZONE

12345



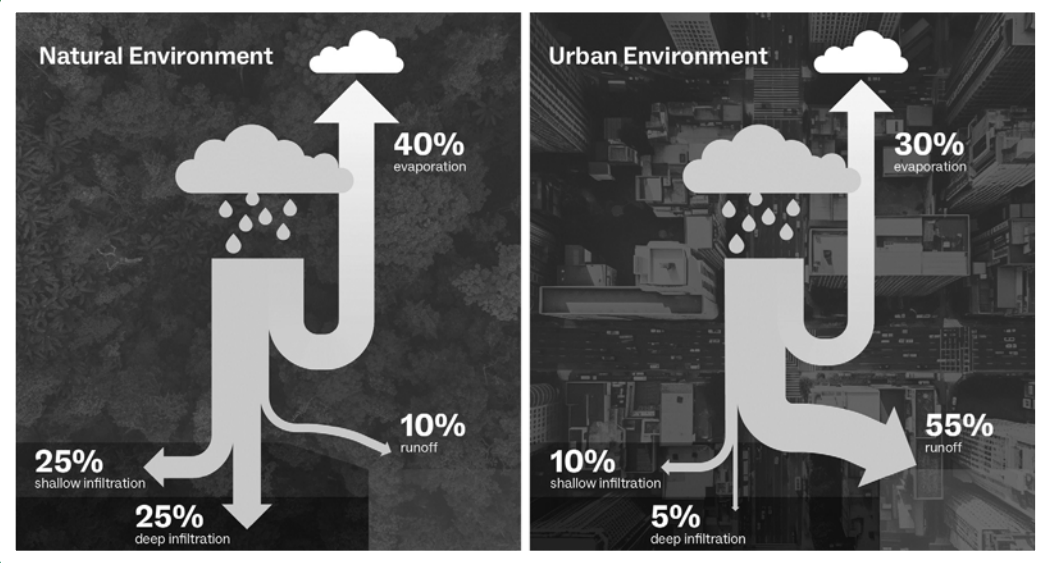
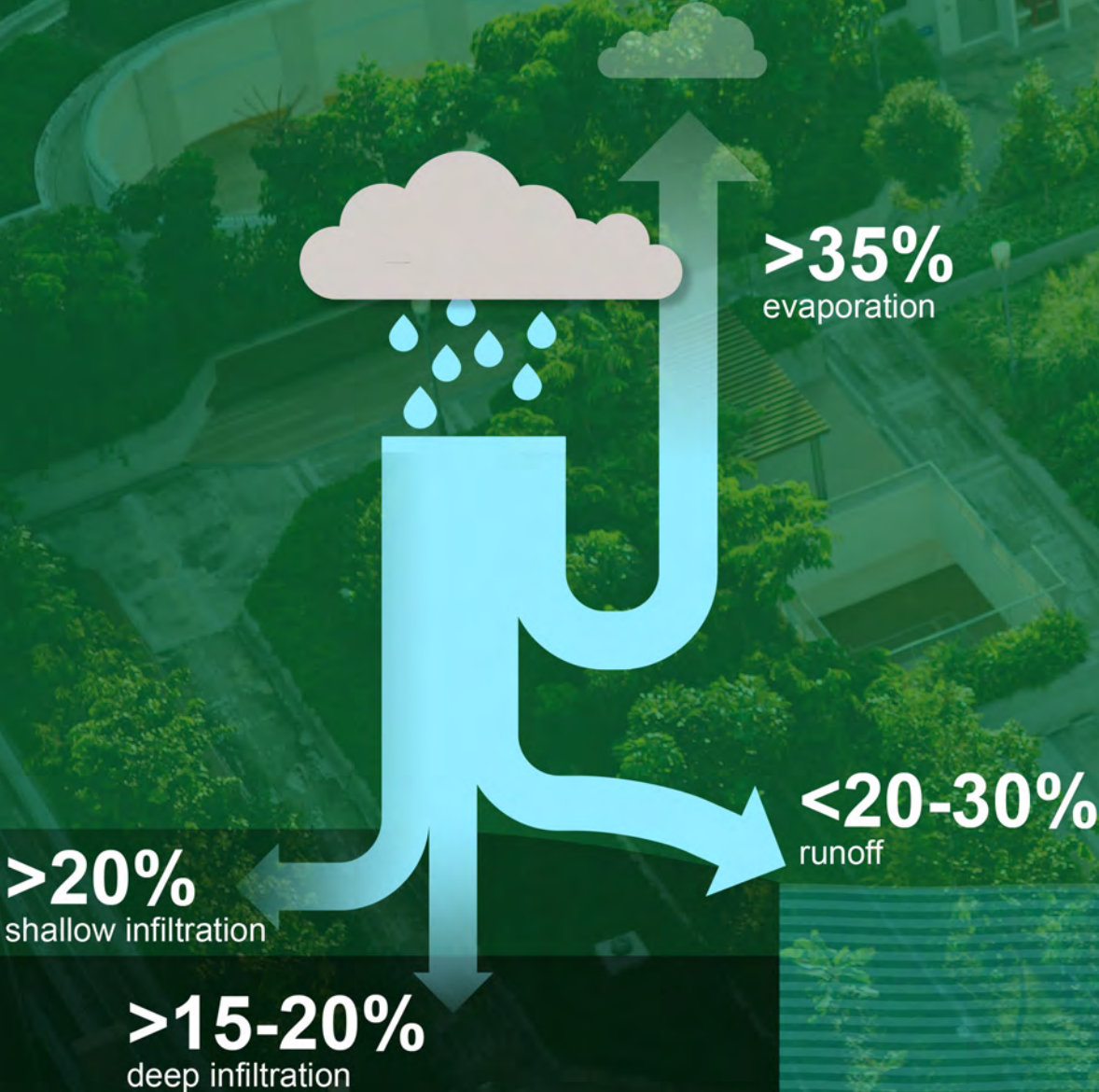
Observed / Projected HTF Days at 8443970, Boston MA



■ Average annual observed flood days per decade

■ Projected *Intermediate* HTF days through 2050 (based on selected scenario)

One Water Approach



Waterbury State Office Complex Restoration, Renovation and Reuse

Vermont Department of Buildings & General
Services | Waterbury, VT

Project Team:

Vermont Department of Buildings and
General Services

Vermont Division for Historic
Preservation

Waterbury State Office Complex

Town and Village of Waterbury

Architect: Freeman French Freeman

Preservation Architect: Goody Clancy

Civil & Structural Engineering:
Engineering Ventures

MEP Engineering: Rist-Frost Shumway

Landscape Design: S.E. Group

Code Consulting: Rolf Jensen &
Associates

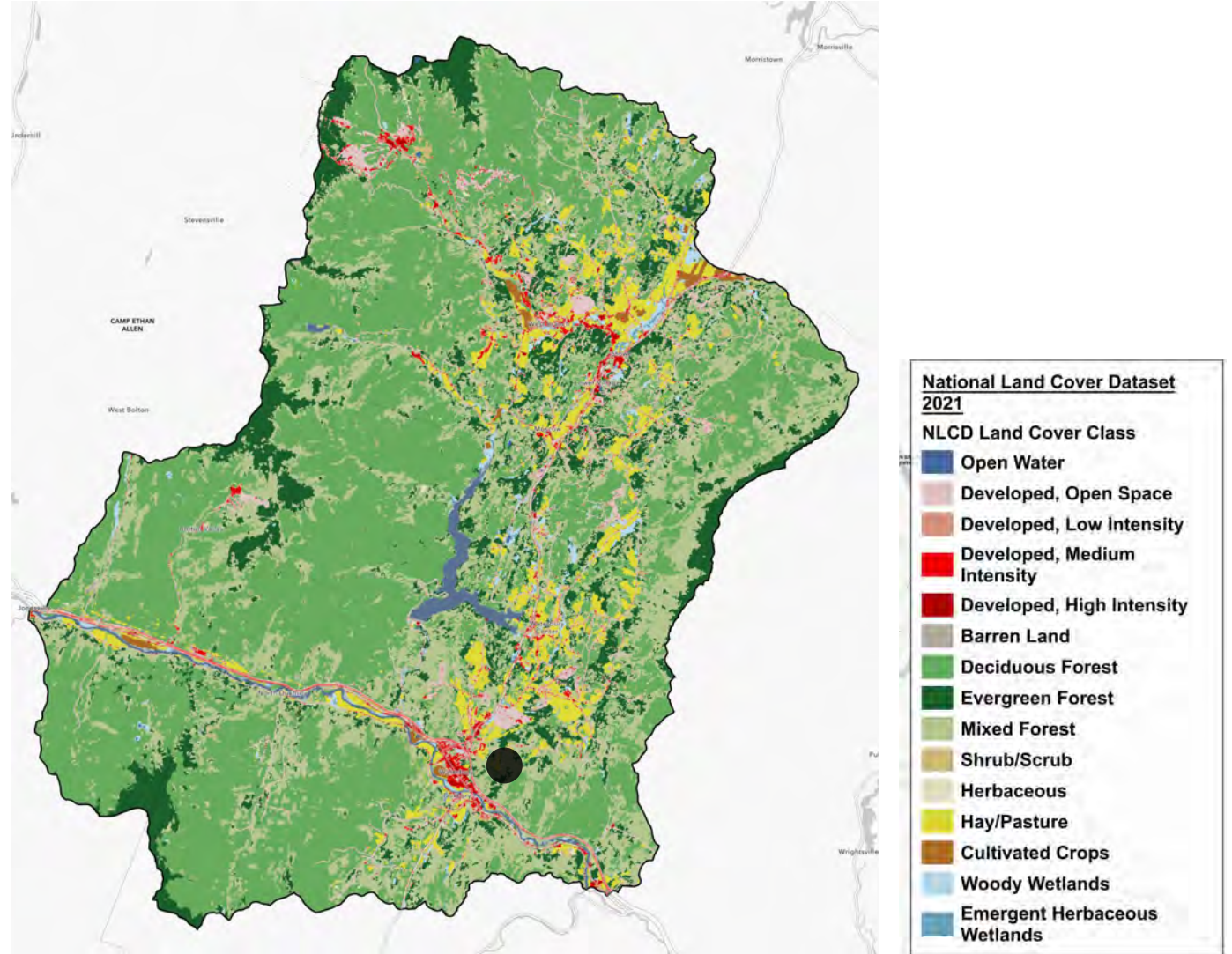
Cost Consulting: Vermeulens

Floodway Consulting: VHB floodways

Construction Manager: PC Construction

Little River-Winooski River Watershed

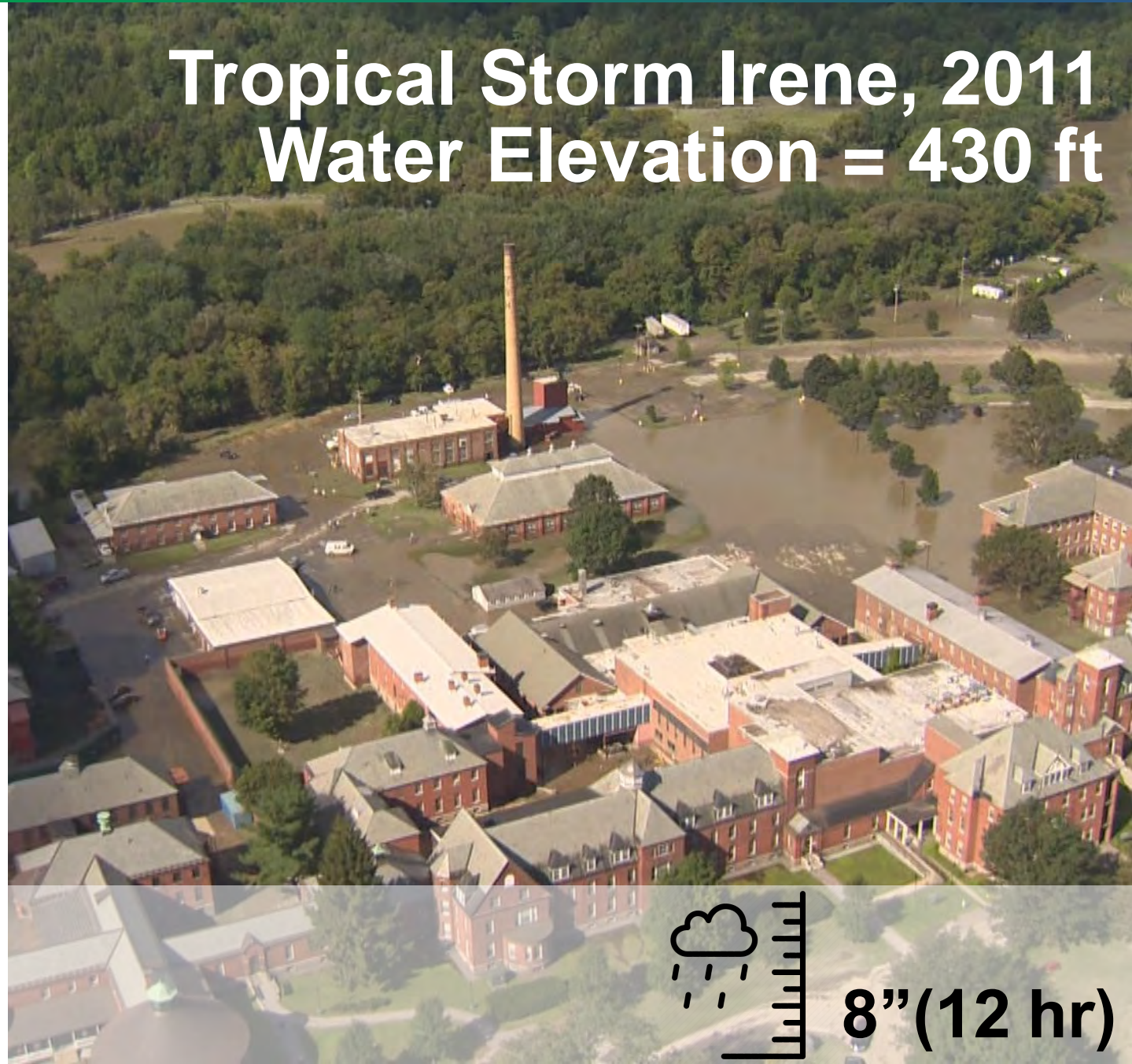
- Headwaters for Lake Champlain basin
- Over 70% forested
- Developed land tripled (2.7% to 6.7%) over the last 30 years
- Tree canopy coverage decreased by 643 acres
- Impaired with phosphorus and nitrogen



Waterbury State Office Complex

- Catastrophic flooding across site
- 40+ buildings flooded
- Up to 8 feet of water in buildings
- 1200+ state workers displaced

Tropical Storm Irene, 2011
Water Elevation = 430 ft



8" (12 hr)



Demolished over 20
buildings across site





Added Dry-Flood
Proofing at Existing
Buildings

New Power Plant

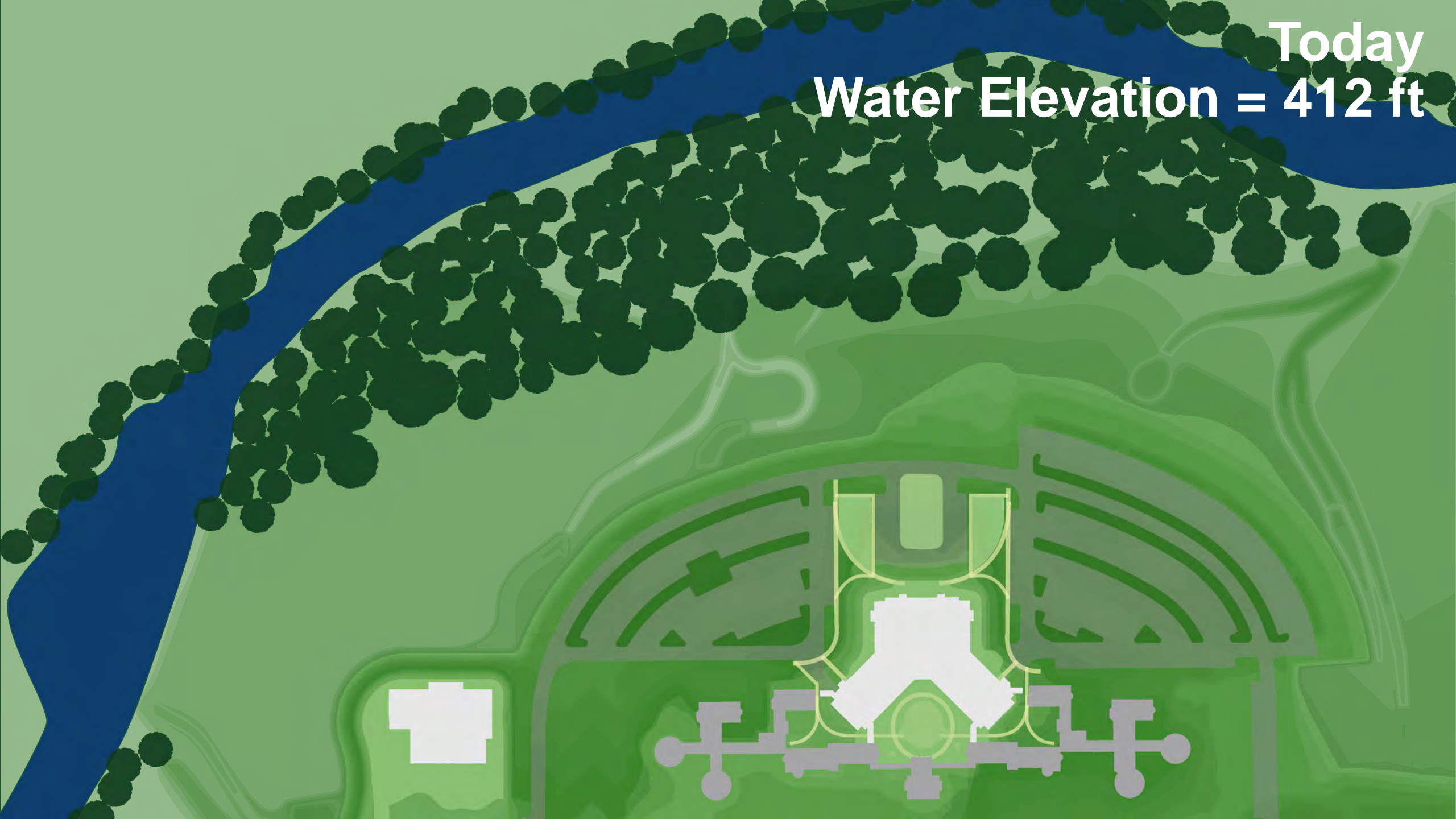
New Center Building



Lowered grades
across remainder
of site



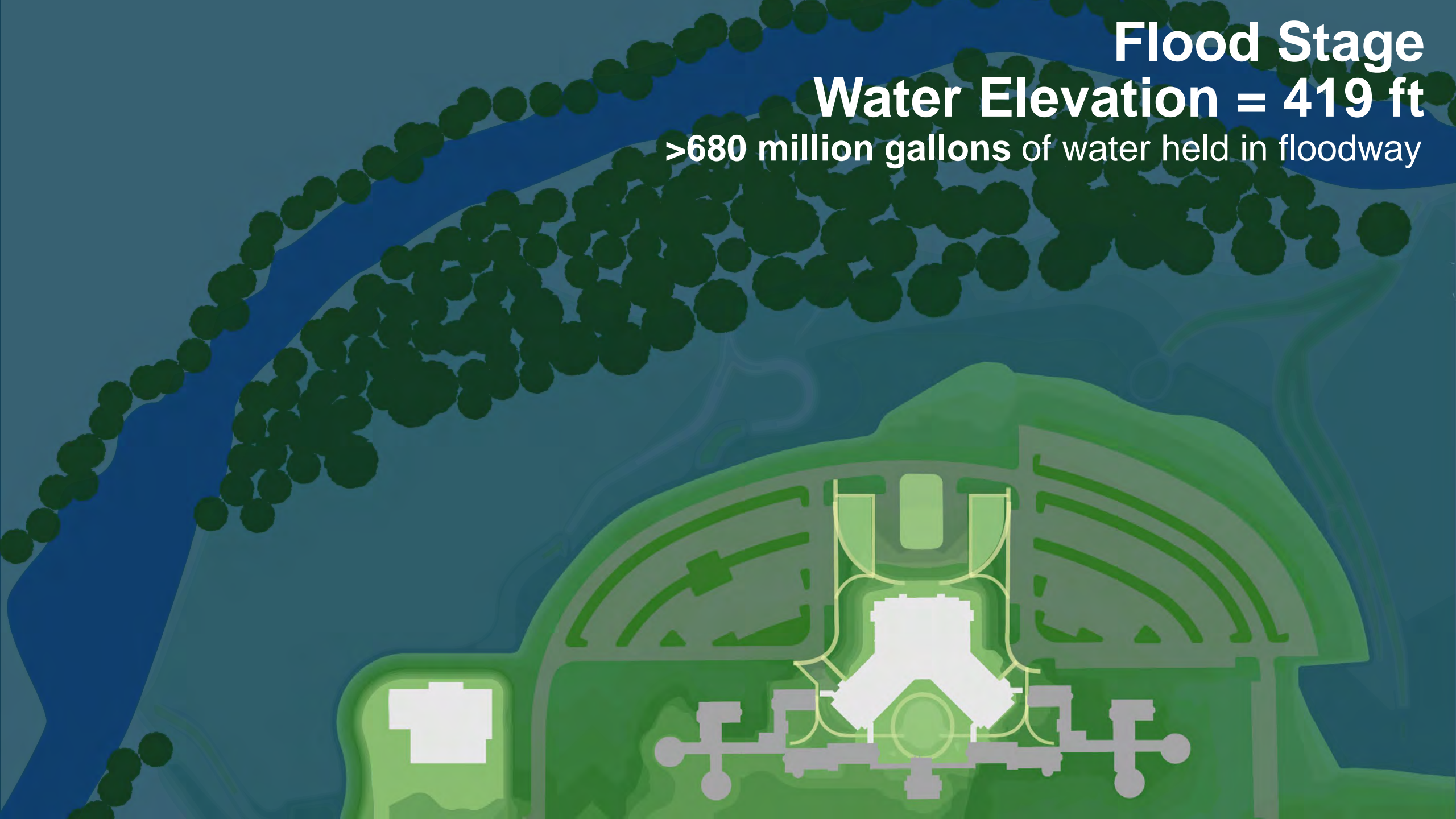
Today
Water Elevation = 412 ft



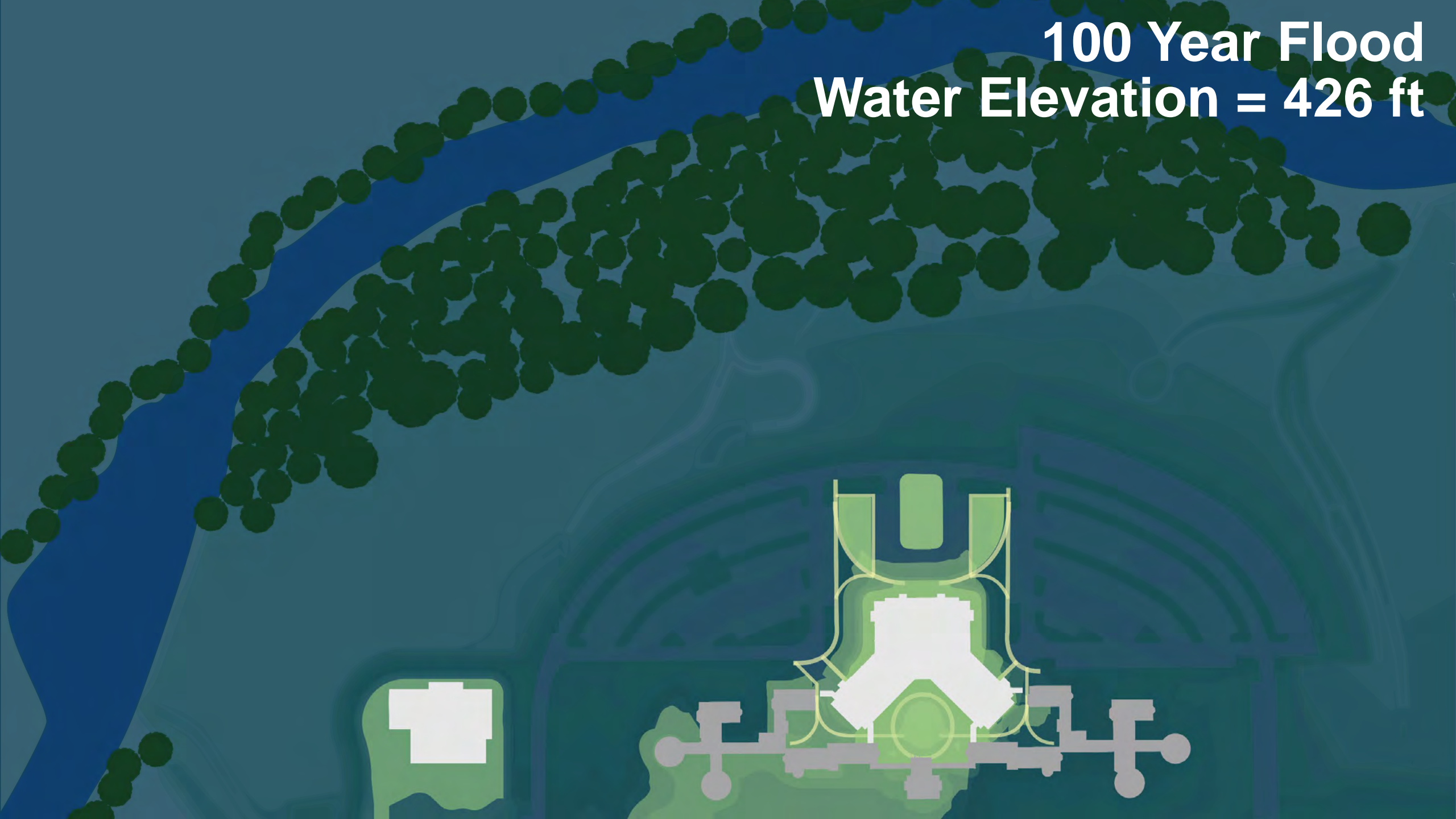
Flood Stage

Water Elevation = 419 ft

>680 million gallons of water held in floodway



**100 Year Flood
Water Elevation = 426 ft**



**500 Year Flood
Water Elevation = 431 ft**



**July 2023 Flood
Water Elevation = 426.7 ft**



Waterbury, Vermont on July 10, 2023 (photo by Vermont Air National Guard)



Waterbury State Office Complex Parking Lot, the morning of July 11, 2023 (photo by VT Digger)

<12 hours later



Waterbury State Office Complex Parking Lot, the evening of July 11, 2023

Impacts by Scale

Project Site:

Mitigate flood risk within the site



Watershed:

Reduce flood potential at immediate downstream areas



Drainage Basin:

Minimize pollution impact to downstream water bodies

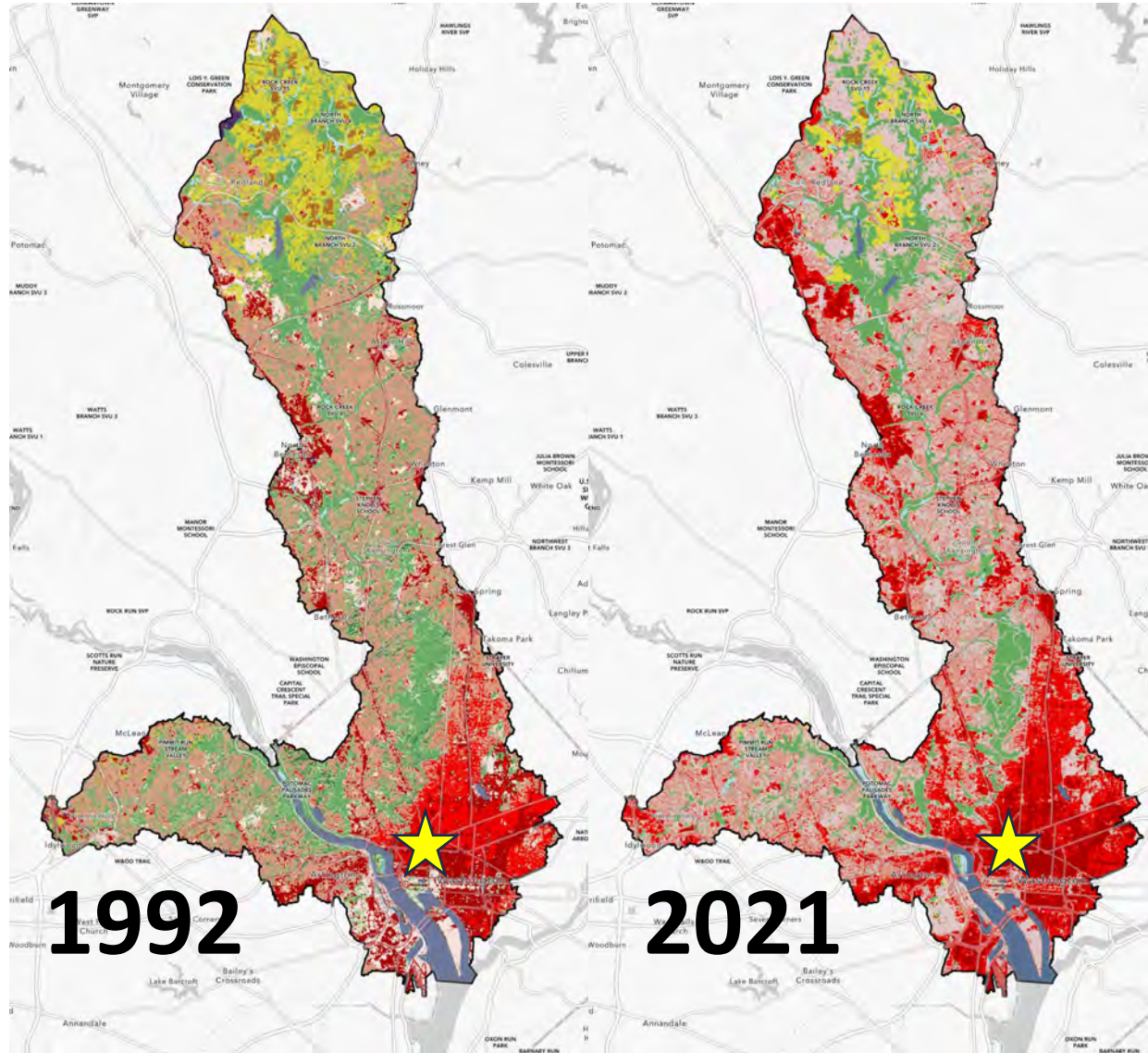
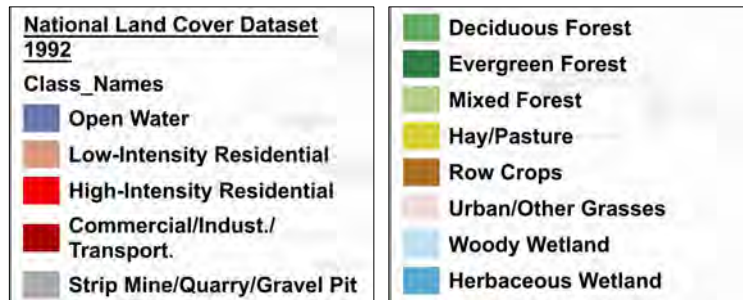


Historic Federal Office Building

Washington, DC

Rock Creek-Potomac River Watershed

- Developed land increased from 53% to 79% over the last 30 years
- Tree canopy coverage decreased from 29% to 17% or 1379 acres
- Pollutants of concern: pathogens, metals, and organic chemicals



The Washington Post
Democracy Dies in Darkness

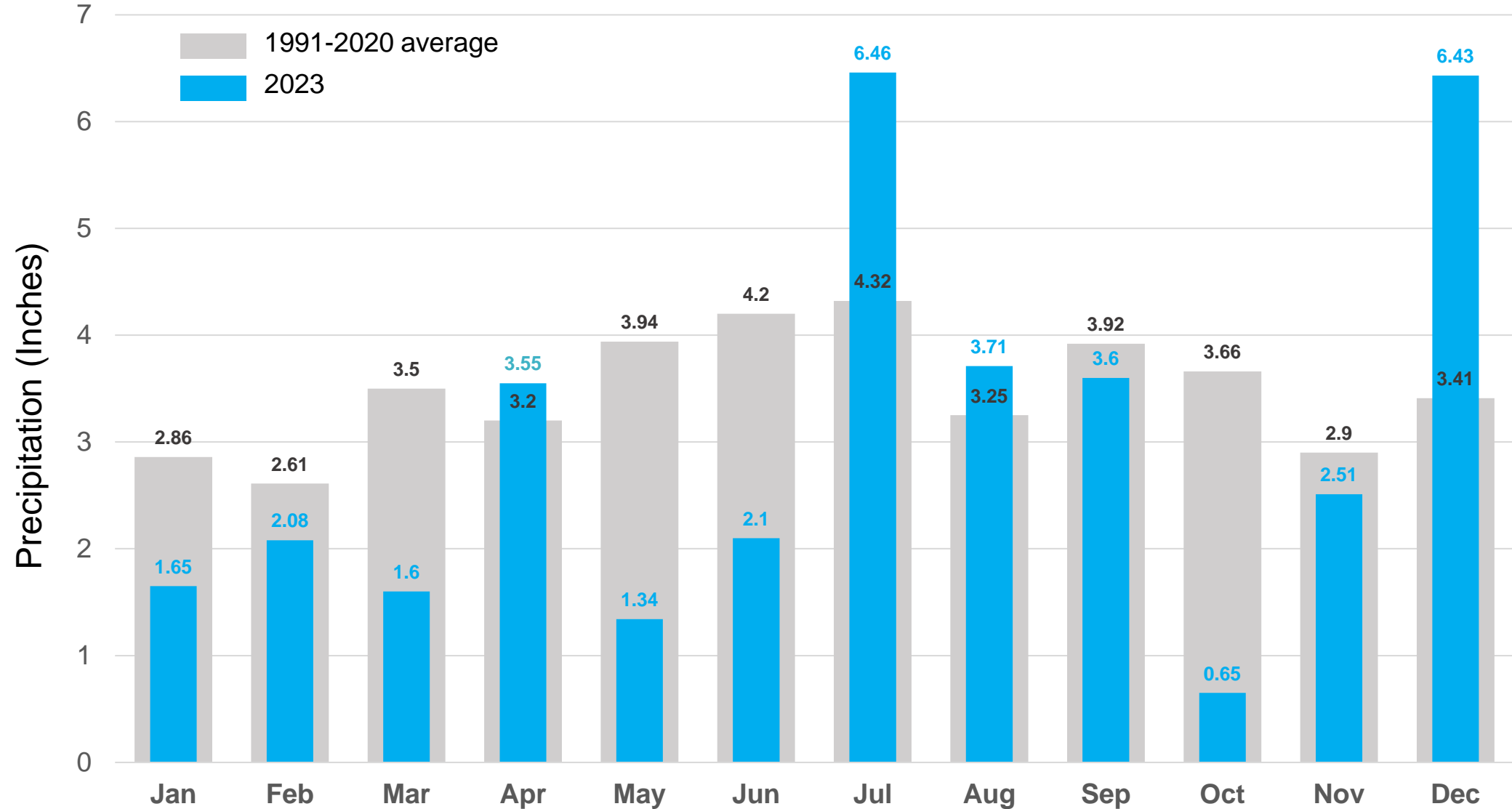
The nation's capital, built on water, struggles to keep from drowning



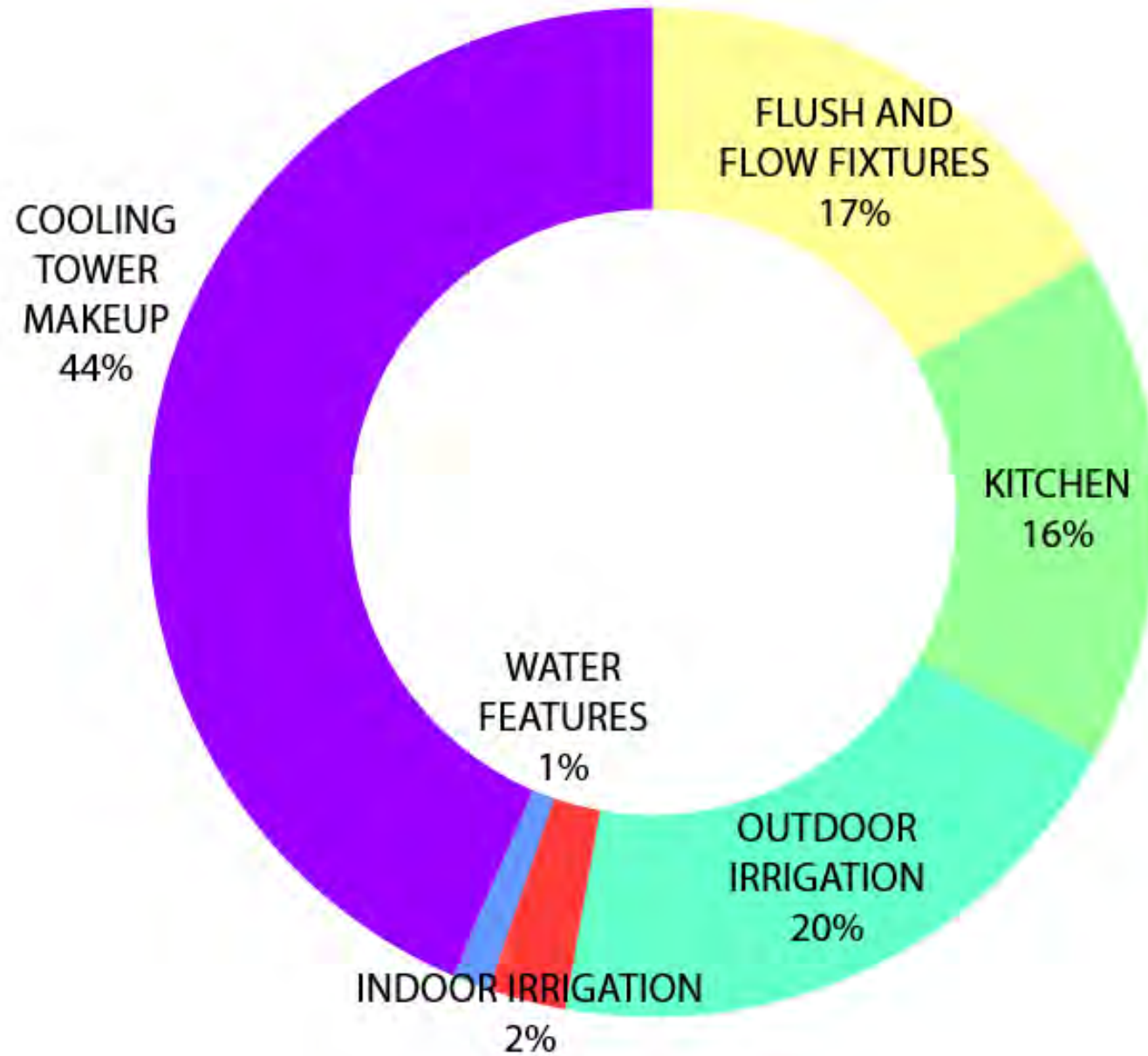
By Dana Priest and John Muyskens

Dec. 19 at 6:00 a.m.

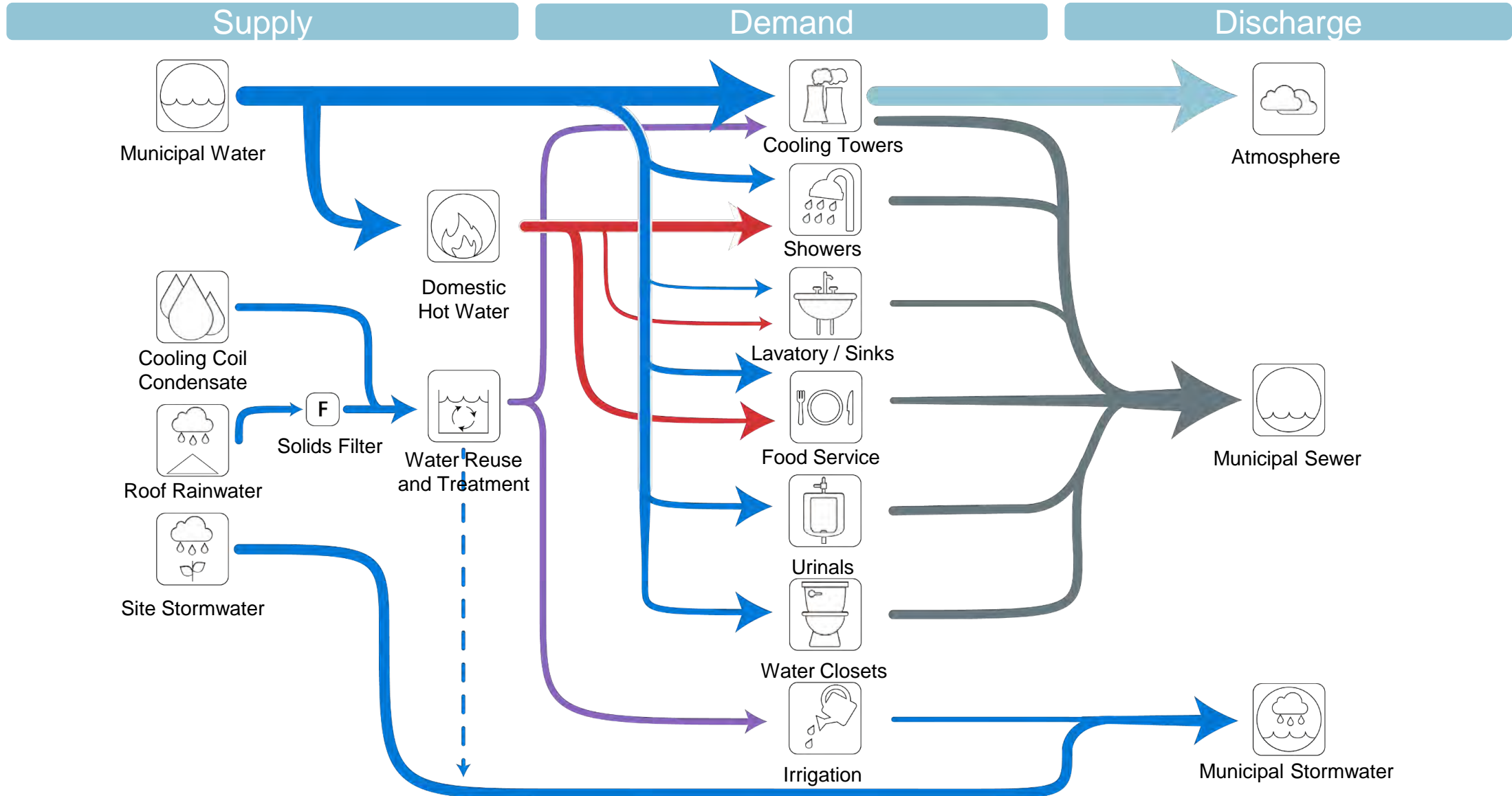
Monthly Precipitation in Washington D.C.

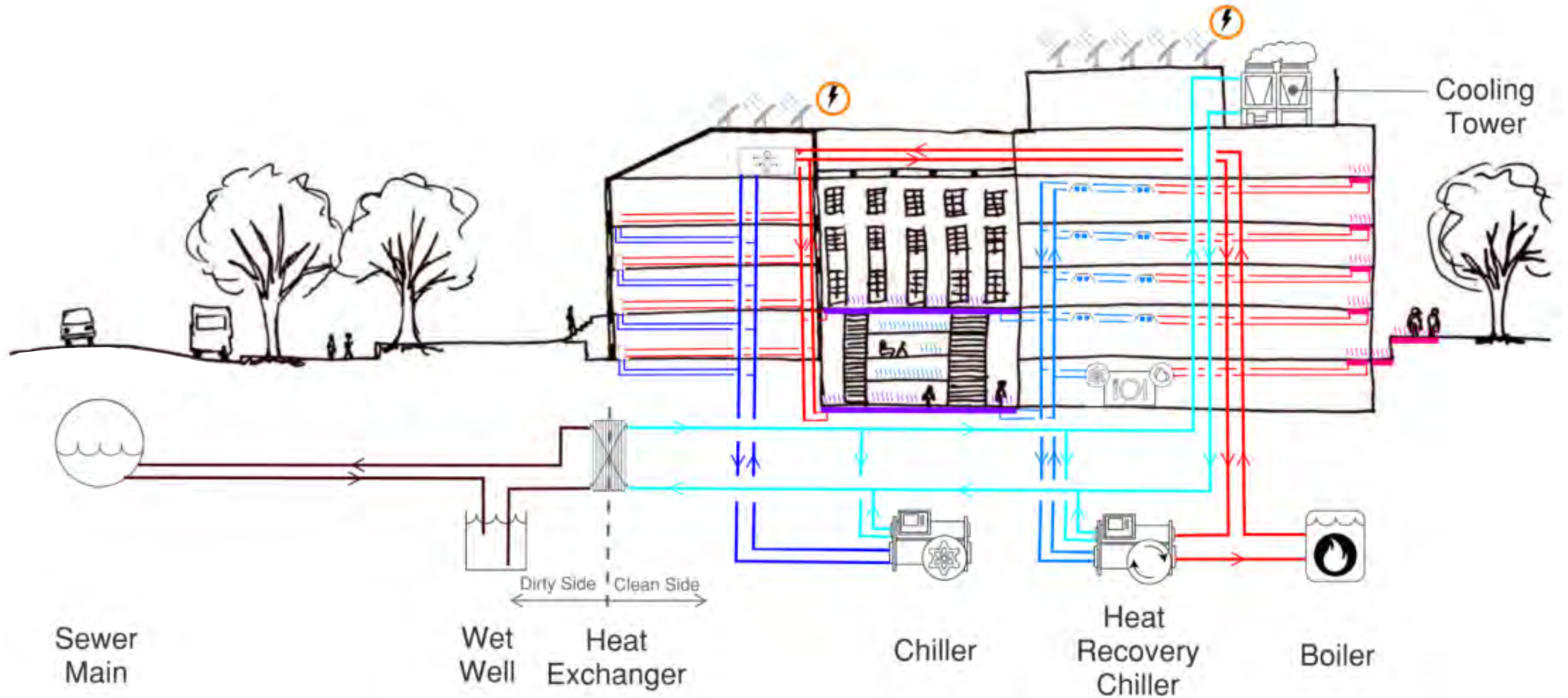


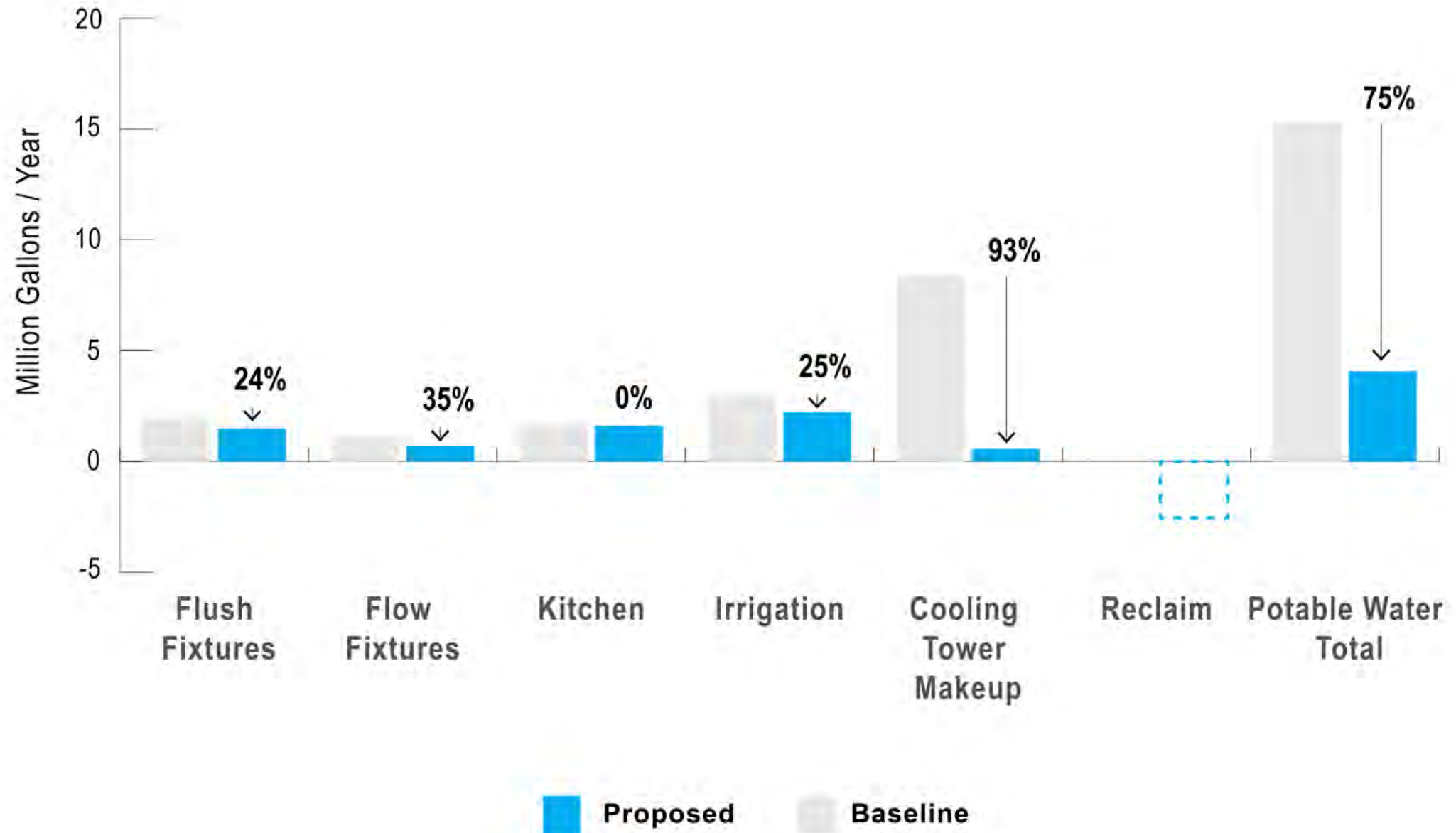
Source: ACIS • Adapted from Image by Ian Livingston/Capital Weather Gang



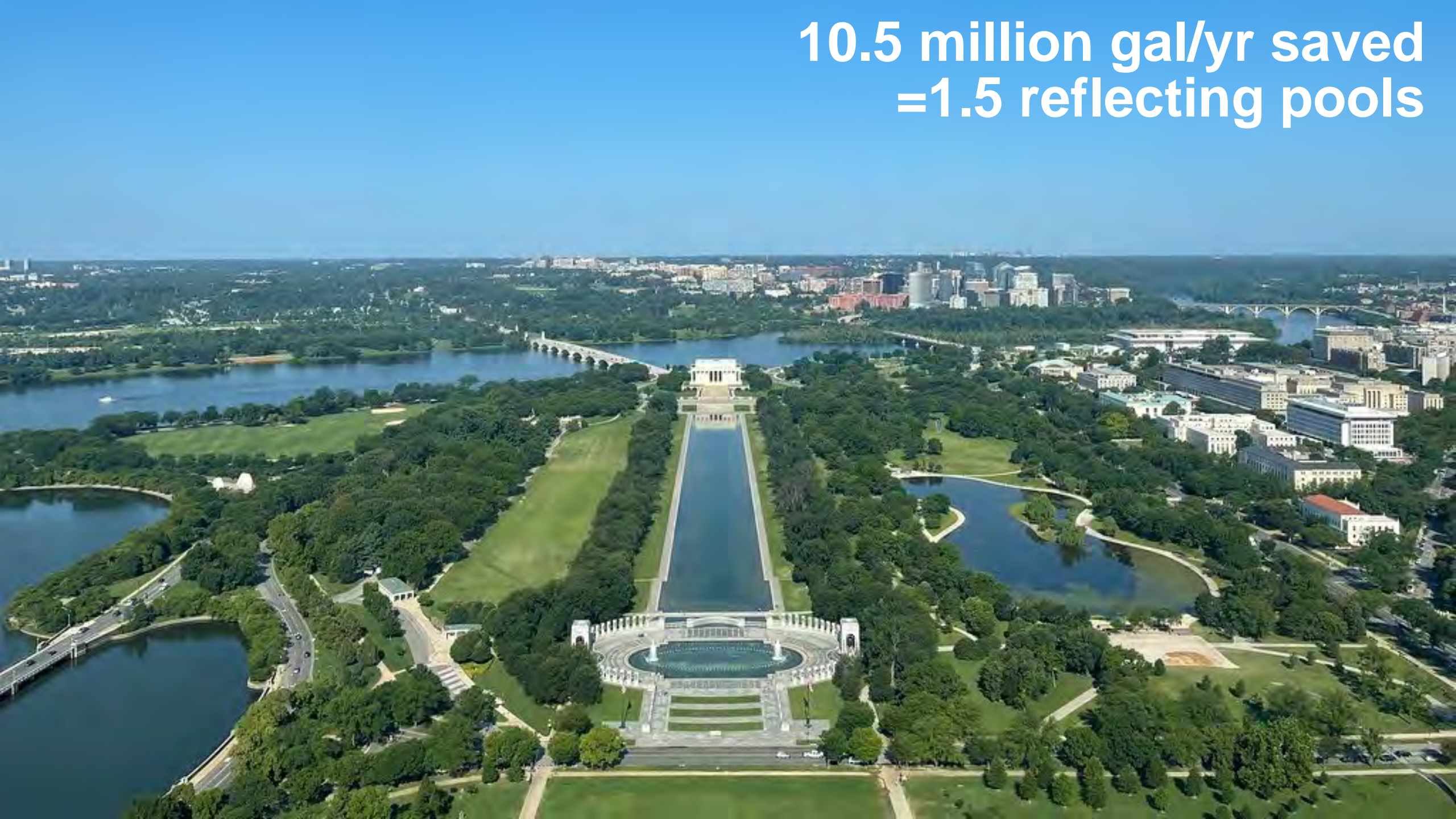
One Water Approach







**10.5 million gal/yr saved
=1.5 reflecting pools**



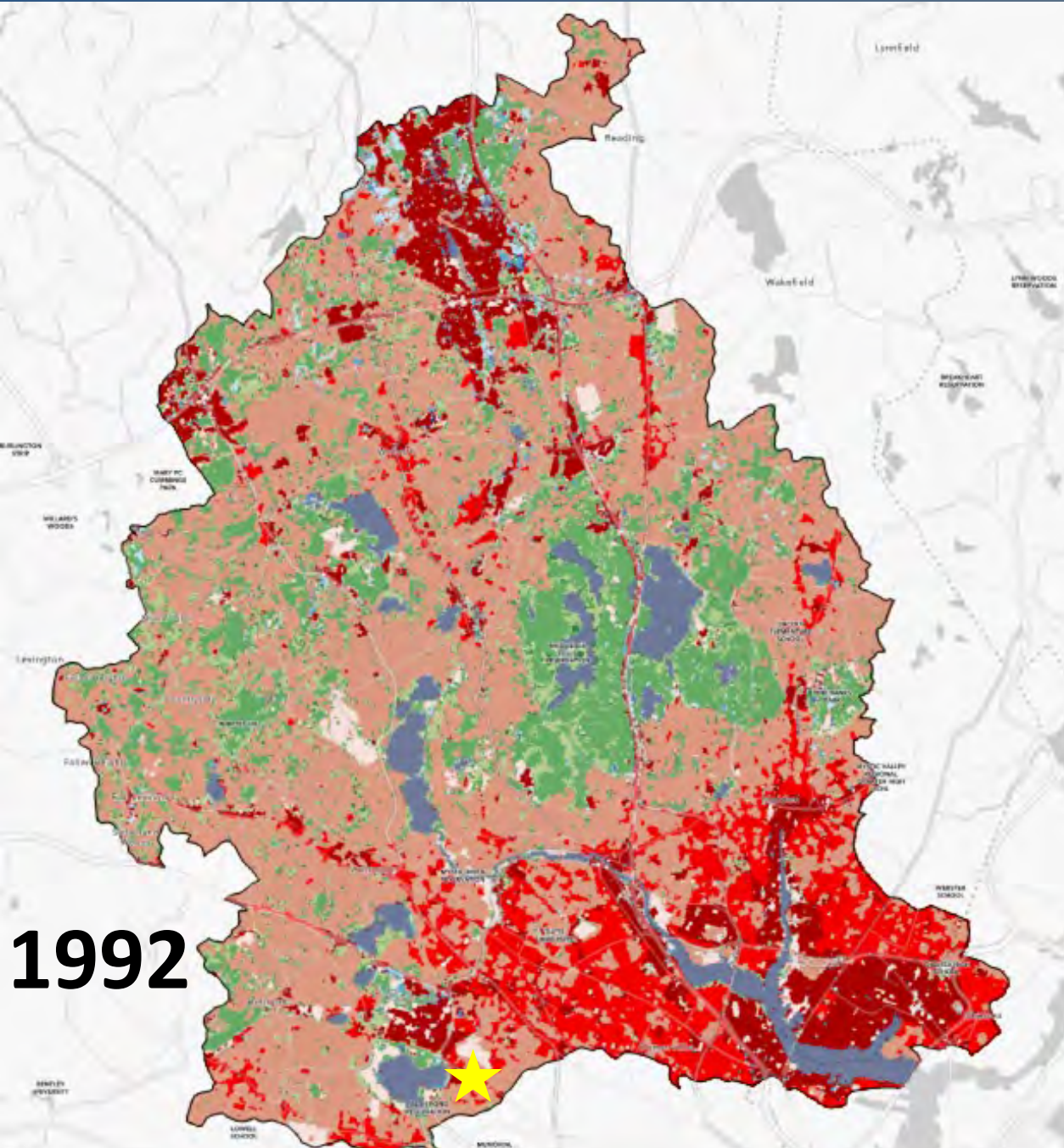
Tobin Montessori & Vassal Lane Upper School

Cambridge, MA

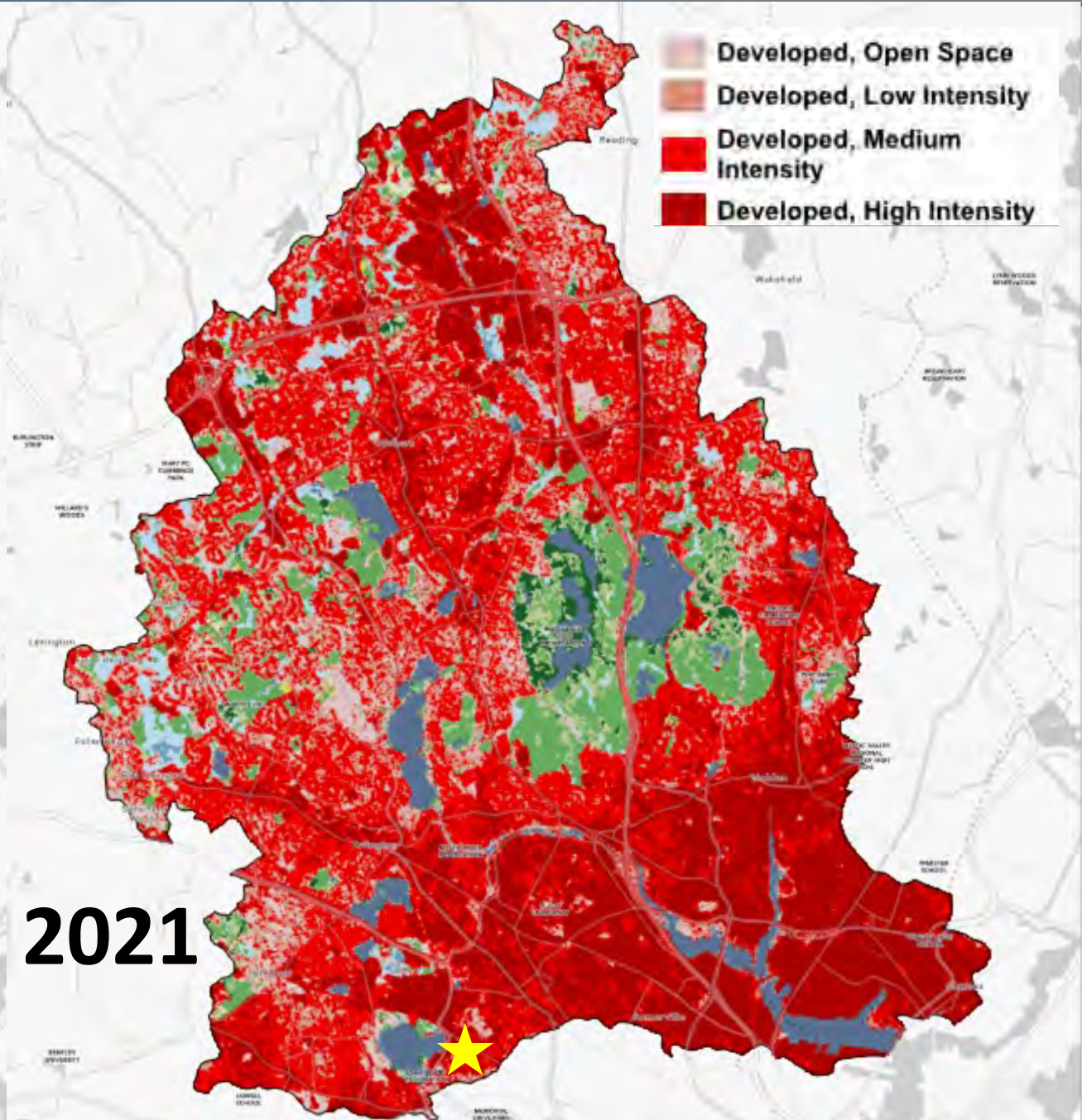
Architect: Perkins Eastman
MEP / FP: Rist Frost Shumway
Landscape Architect: Traverse
Irrigation: Aqueous
**Hazardous Materials: Fuss &
O'Neill**
Structural: Foley Buhl Roberts
Traffic: VHB
Sustainability: Soden
**Embodied Energy/Resiliency:
Linnean**
Energy: AKF / InPosse

City of Cambridge Consultants
Stormwater Tank: Stantec
**Environmental/Geotechnical:
CDM**

Mystic River Watershed

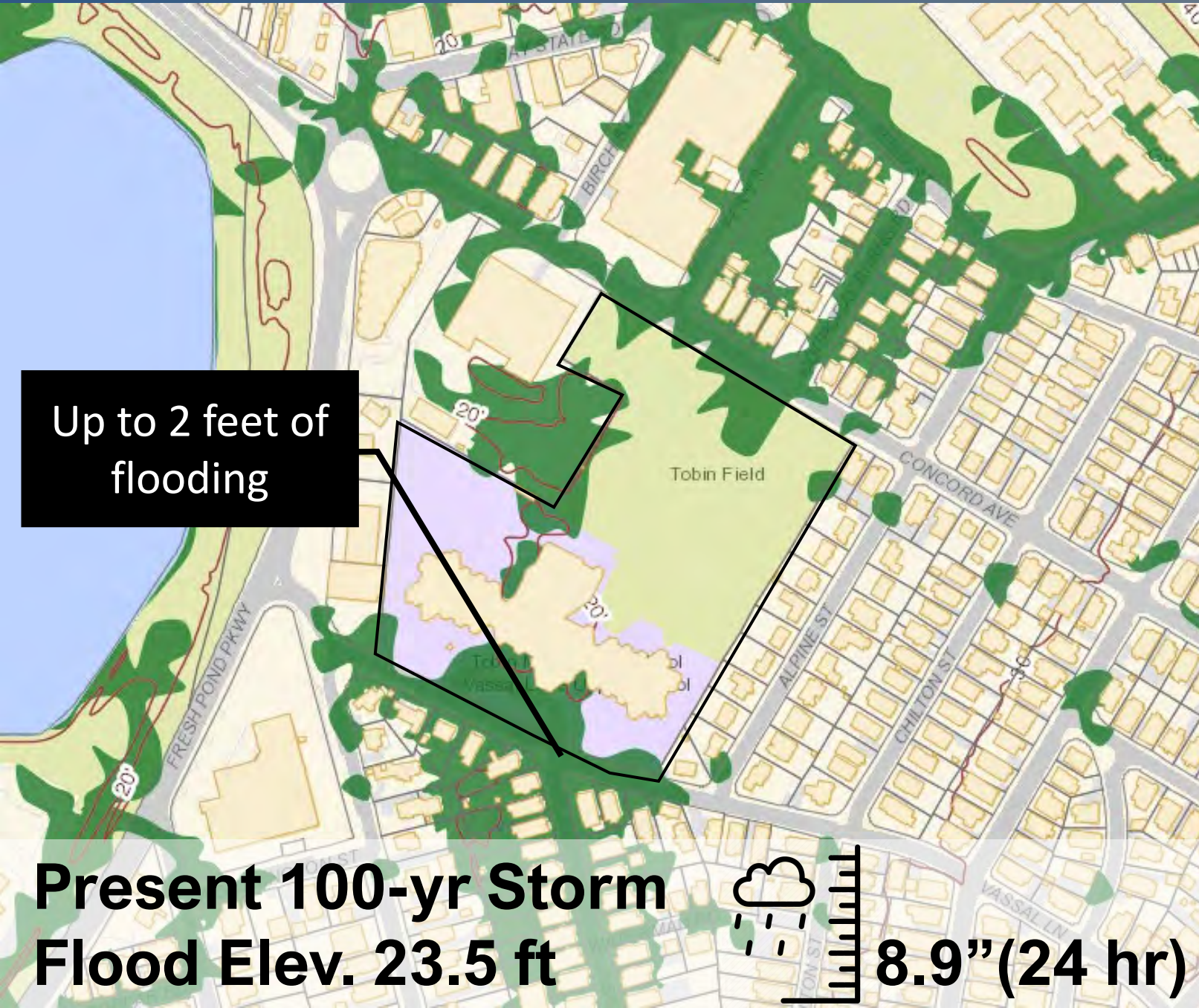


1992



2021

- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity



Up to 2 feet of flooding

**Present 100-yr Storm
Flood Elev. 23.5 ft**



8.9" (24 hr)



Doorway Elev =
23.8 ft



**Present 100-yr Storm
Flood Elev. 23.5 ft**



8.9" (24 hr)



Integrated Green Stormwater Infrastructure

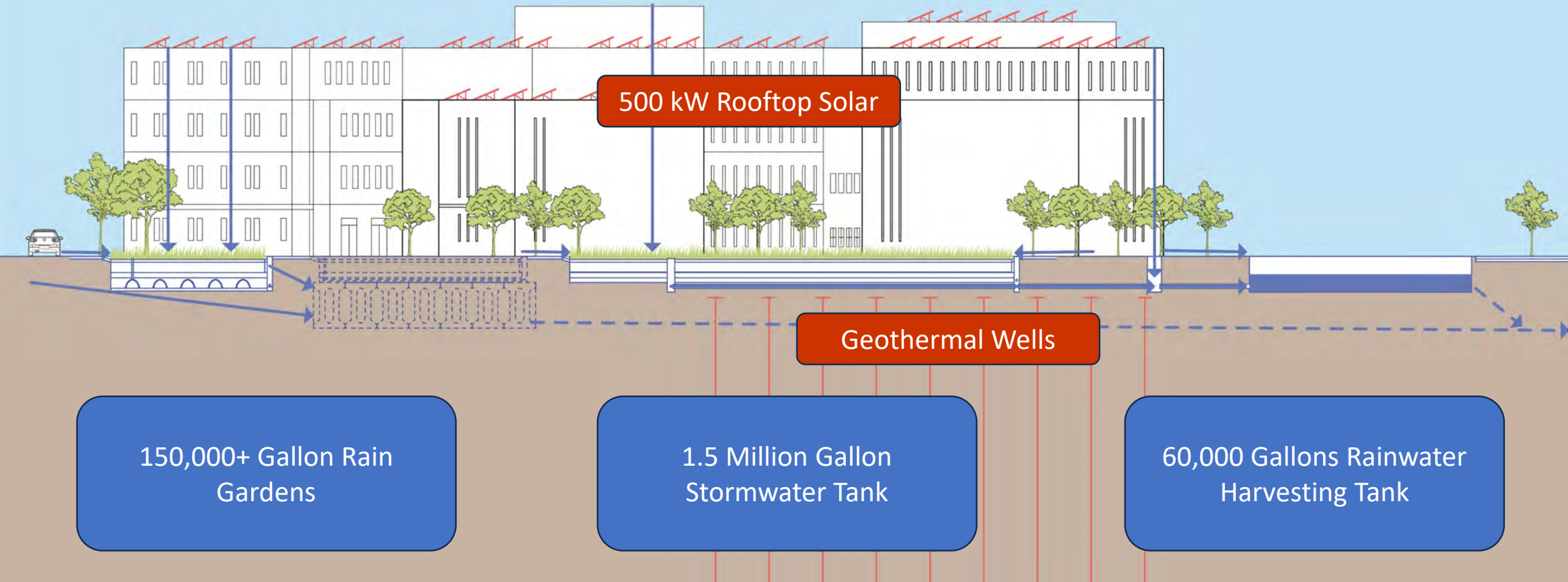
500 kW Rooftop Solar

Geothermal Wells

150,000+ Gallon Rain Gardens

1.5 Million Gallon Stormwater Tank

60,000 Gallons Rainwater Harvesting Tank



58% Existing Canopy Preserved

374 New Trees Increase Mature Canopy by 1.8 acres

0.5 Acres More Green Space – Reduced Heat Island Effect

1.74 Million Gallons of
Stormwater Storage

~ 7 Olympic Swimming Pools

4.4 Acres of Impervious
Area Treated with Green
Infrastructure

70% Reduction in
Phosphorus Load from
Stormwater

70% Less Energy
Usage than a Typical
School

(Further offset by solar +
geothermal renewables!)



Address in Cambridge MA

10"
Decrease
in 100-yr
Storm
Flood
Depth
(Tank only)



Partial Project Update to
Cambridge Flood Viewer



“One Water is a transformative way of viewing, valuing, and managing water. The One Water approach manages all water...in a collaborative, integrated, inclusive, and holistic manner.”

-US Water Alliance

ONE WATER MINDSET

1. The site is the watershed.

ONE WATER MINDSET

1. The site is the watershed.
2. Critically integrate the data.

ONE WATER MINDSET

1. The site is the watershed.
2. Critically integrate the data.
3. Initiate the ripple effect.

ONE WATER

ONE TEAM