

Building Energy Benchmarking

Energy benchmarking is the process of measuring whole building energy and water use over time to understand performance relative to a portfolio of properties or to a set of buildings defined by use class or groupings. Many organizations use benchmarking voluntarily.

Building attributes + energy usage

- Floor area
- Space usage
- Other building attributes
- Occupancy
- Operational hours
- Computers
- Energy consumption
 - Electricity
 - Natural gas
 - Fuel oil
 - Steam

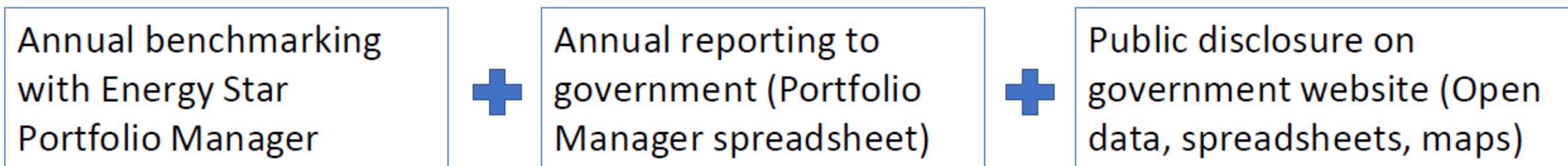


Energy Indicators

- Energy use intensity (MMBTU/square foot)
- Site EUI
- Source EUI
- GHG intensity (lbs CO₂e/square foot)
- Total energy use (MMBTU)
- Fuel use (MMBTU, kwh, therms, etc)
- Total water use
- Water use intensity
- Energy performance scores (e.g., Energy Star rating)

Energy Benchmarking Laws

Regulations mandating annual energy benchmarking, reporting, and transparency



Why require energy benchmarking

- Building energy use is invisible
- Many property owners do not actively manage their energy use (not major cost relative to other costs; retrofits can be disruptive; split incentive; lack of financing; debt limits)

Benefits

- Provide energy performance data to marketplace to allow informed property transactions; foster market competition and support consumer choice
- Support energy cost savings and reduce GHG emissions
- Provide municipalities with energy and emissions data for planning and policymaking, including trends

Local Governments Enacting Building Energy Benchmarking Laws

History:

- Initiative of the Institute for Market Transformation
- Washington, DC established the first local building energy benchmarking law in 2008
- New York City implemented its ordinance first, starting in 2010

33 cities as of April 2021

Small cities

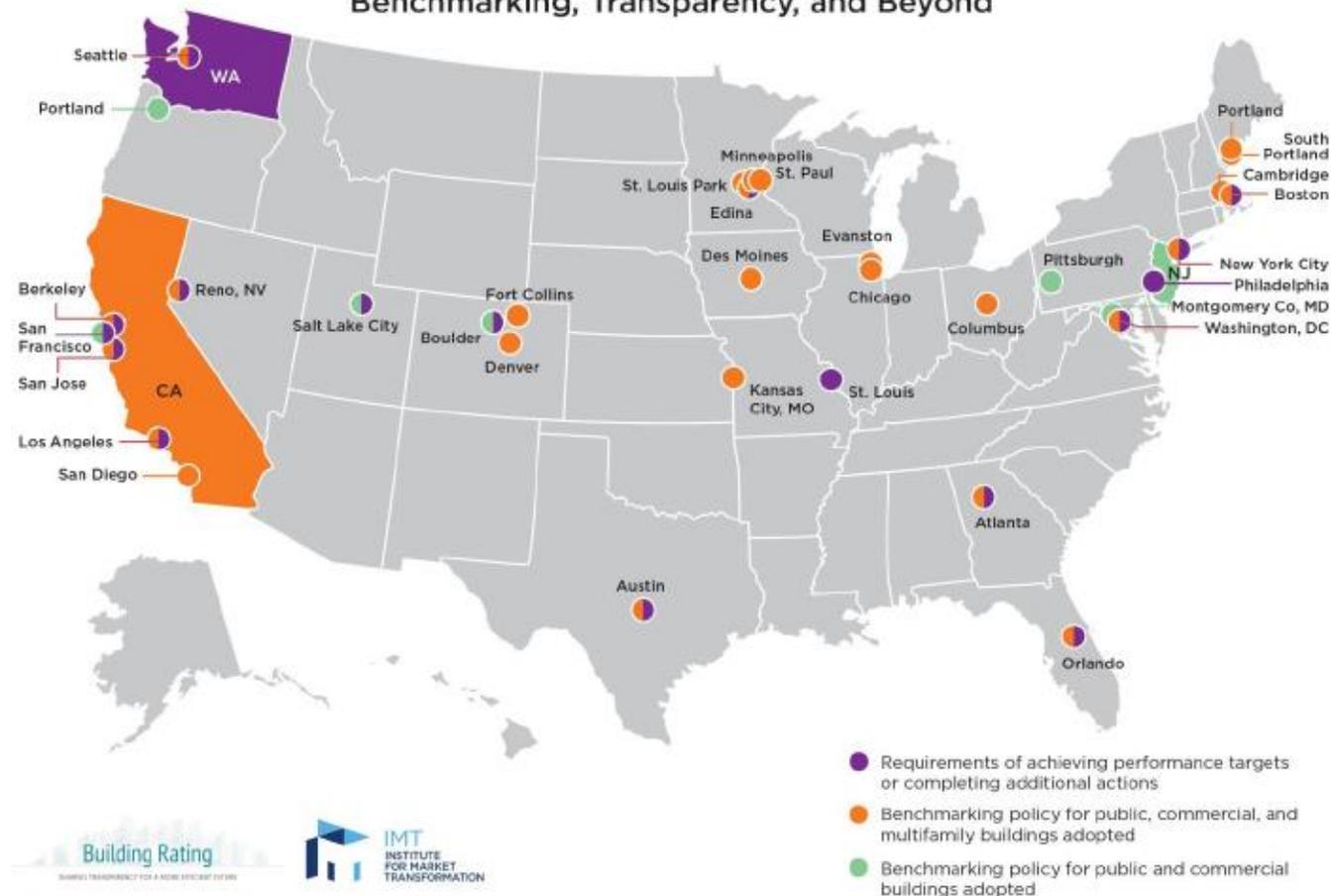
Edina, MN (51,746)

St. Louis Park, MN (48,677)

South Portland, ME (25,548)

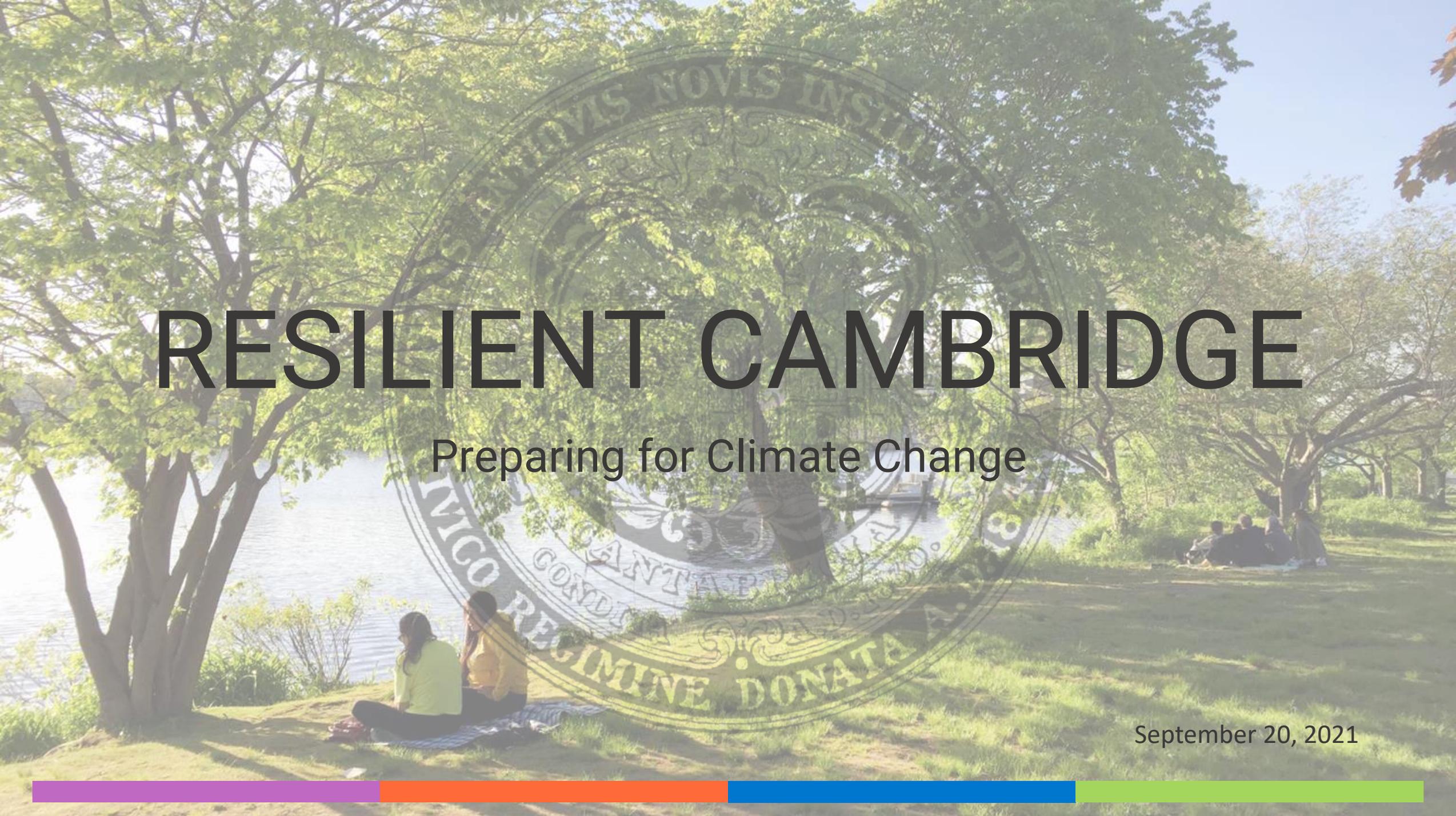
West Chester, PA (20,034)

U.S. City, County, and State Policies for Existing Buildings:
Benchmarking, Transparency, and Beyond



Cambridge Building Energy Use Disclosure Ordinance (BEUDO)

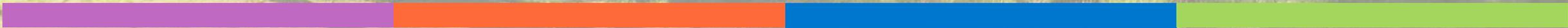
- Thresholds: *Municipal*: 10,000 sf; *Non-Residential*: 25,000 sf; *Residential*: 50 units
- Ordinance applies to parcels but reporting required at building scale
- Approximately 1,100 buildings covered accounting for about 70% of building energy use
- Build covered property database in October/November
- Notification letters sent to property owners in December; emails to agents; covered property lists sorted by address and map/lot number are posted
- Provide site for owners to acknowledge notification, challenge jurisdiction & provide contact info
- May 1 reporting deadline
- Eversource provides energy data portal for aggregated whole building data on gas and electricity; Vicinity Energy provides district steam data; data becomes available in January
- Data quality is screened with Portfolio Manager checks and assessing for EUI outliers; help desk follows up to address issues
- City selects 250 Portfolio Manager fields for energy data reporting template and provides link
- Consultant provides help desk services, data analysis, preparation of disclosure data, data distillation and communications
- Annual compliance is about 80-85% by buildings and 90% by floor area; no fines
- GHG reducing about 1% per year, need to be reducing at 3-4% per year
- Cambridge developing performance requirements



RESILIENT CAMBRIDGE

Preparing for Climate Change

September 20, 2021



Resilient Cambridge Timeline

2010: CPAC recommended to City Manager that City begin preparing for unavoidable impacts and conduct a vulnerability assessment

2012: Consultant team hired and project kicked off

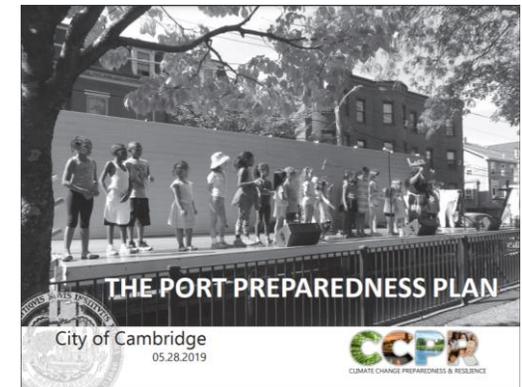
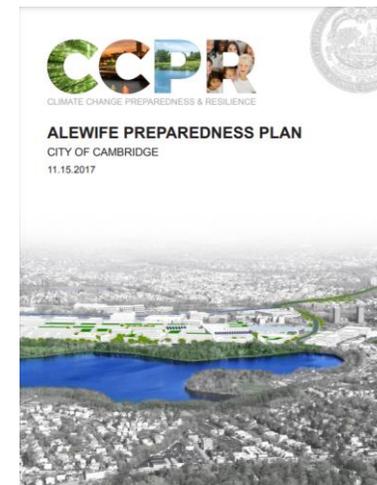
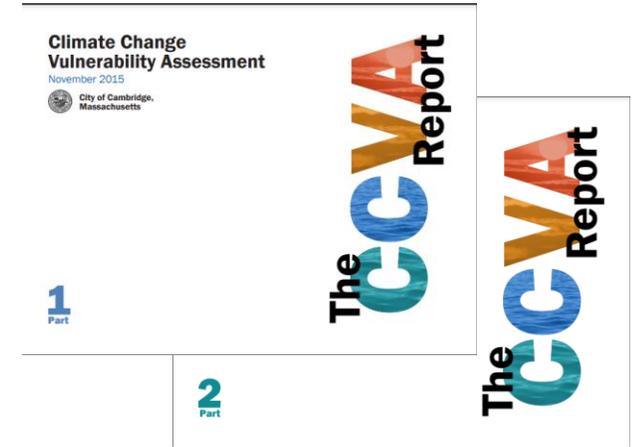
2015-2017: Climate Change Vulnerability Assessment (CCVA)

2017-2021: Climate Change Preparedness & Resiliency Plan (CCPR)

2017: Alewife Preparedness Plan

2019: The Port Preparedness Plan

2021: Resilient Cambridge



Climate Change: Shifting Risks

Extreme Heat



Days over 90°F to triple by 2030. By 2070, there could be more than 2 months in a year over 90°F.

Extreme Rain



Flooding from rain more frequent and more severe

Sea Level Rise/ Storm Surge

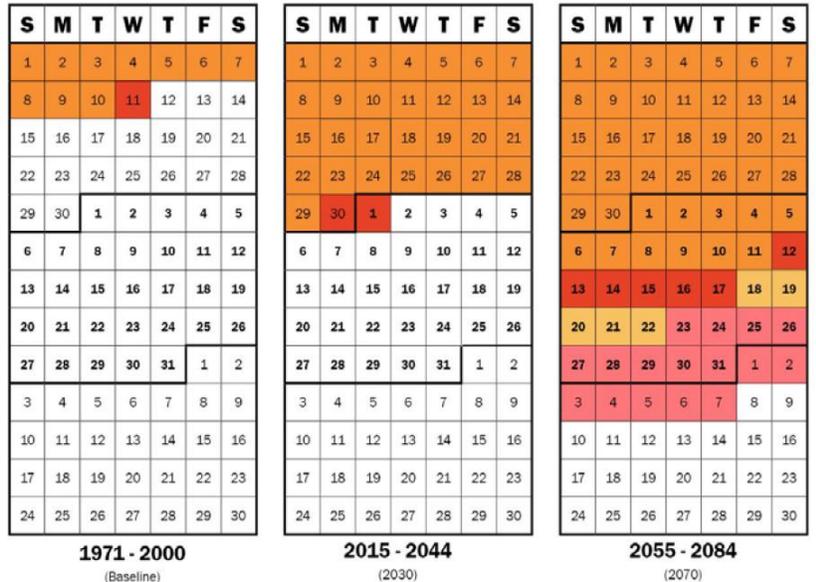


Sea level rise and larger storm surge in Boston Harbor will overtop and flank the Mystic and Charles River dams



Increasing Heat

Warm Averages, Higher Temps, More Heat Waves



■ Above 90°F - Low Scenario
 ■ Above 90°F - High Scenario
 ■ Above 100°F - Low Scenario
 ■ High 100°F - High Scenario

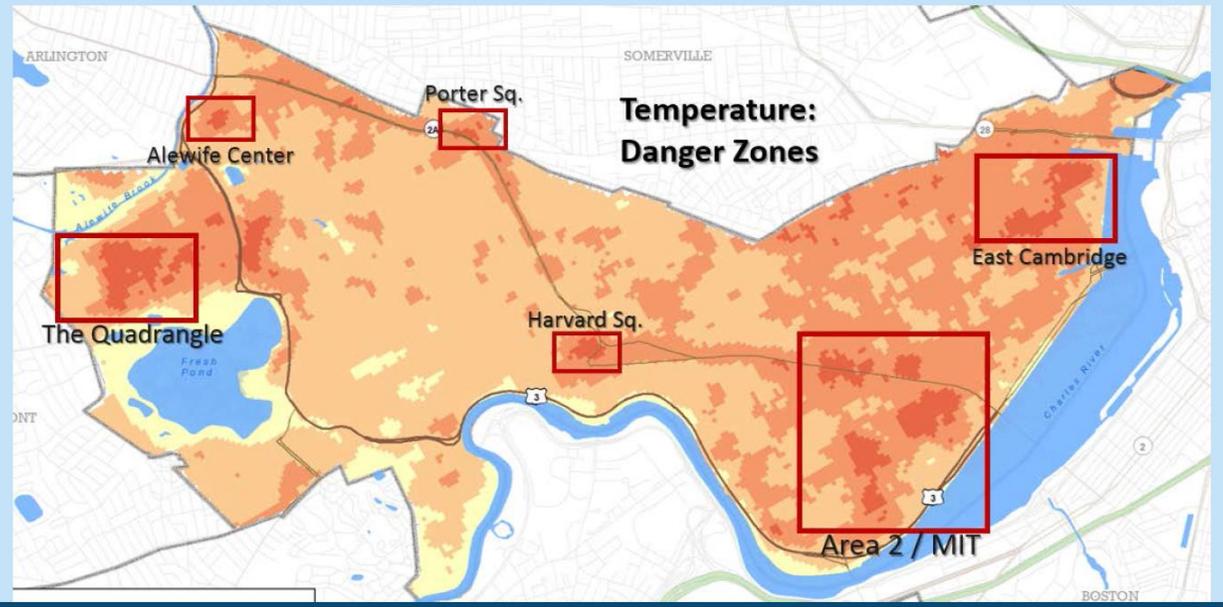
*Summer is considered to be the 91 days of June through August

By 2030, the number of days above 90° F could triple

- Stress on human health
- Stress on infrastructure

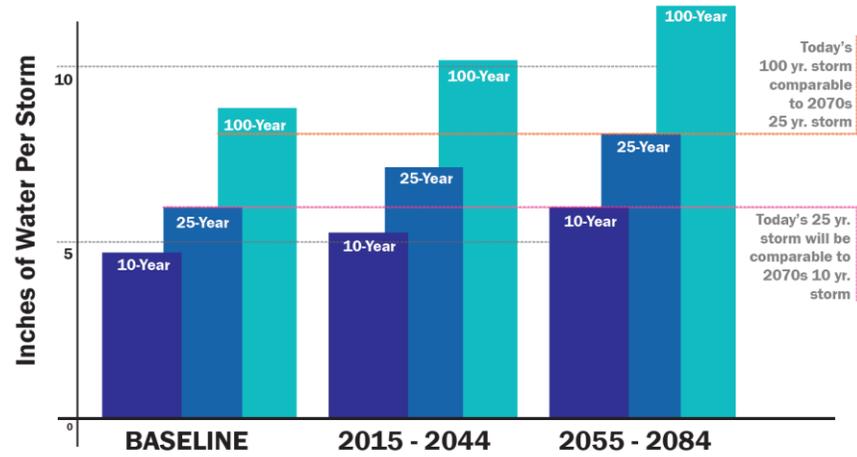
Urban Heat Island Effect Magnifies Ambient Temperature

- Darker impervious surfaces – pavement & roofs -- absorb heat
- Areas with large amounts of impervious surface and lacking tree canopy tend to be heat islands

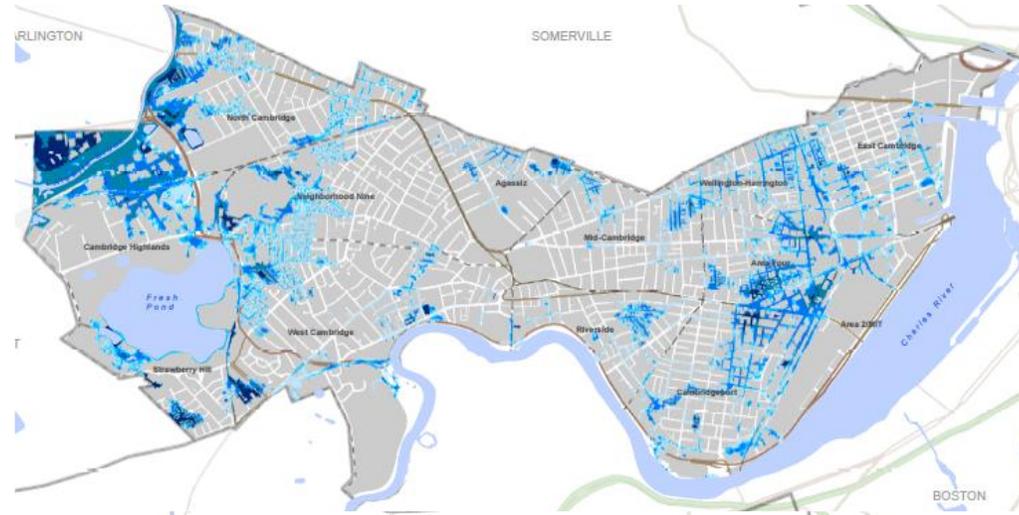


Increasing Precipitation

Extreme rates, Increasing frequency



(per 24 hr. event)



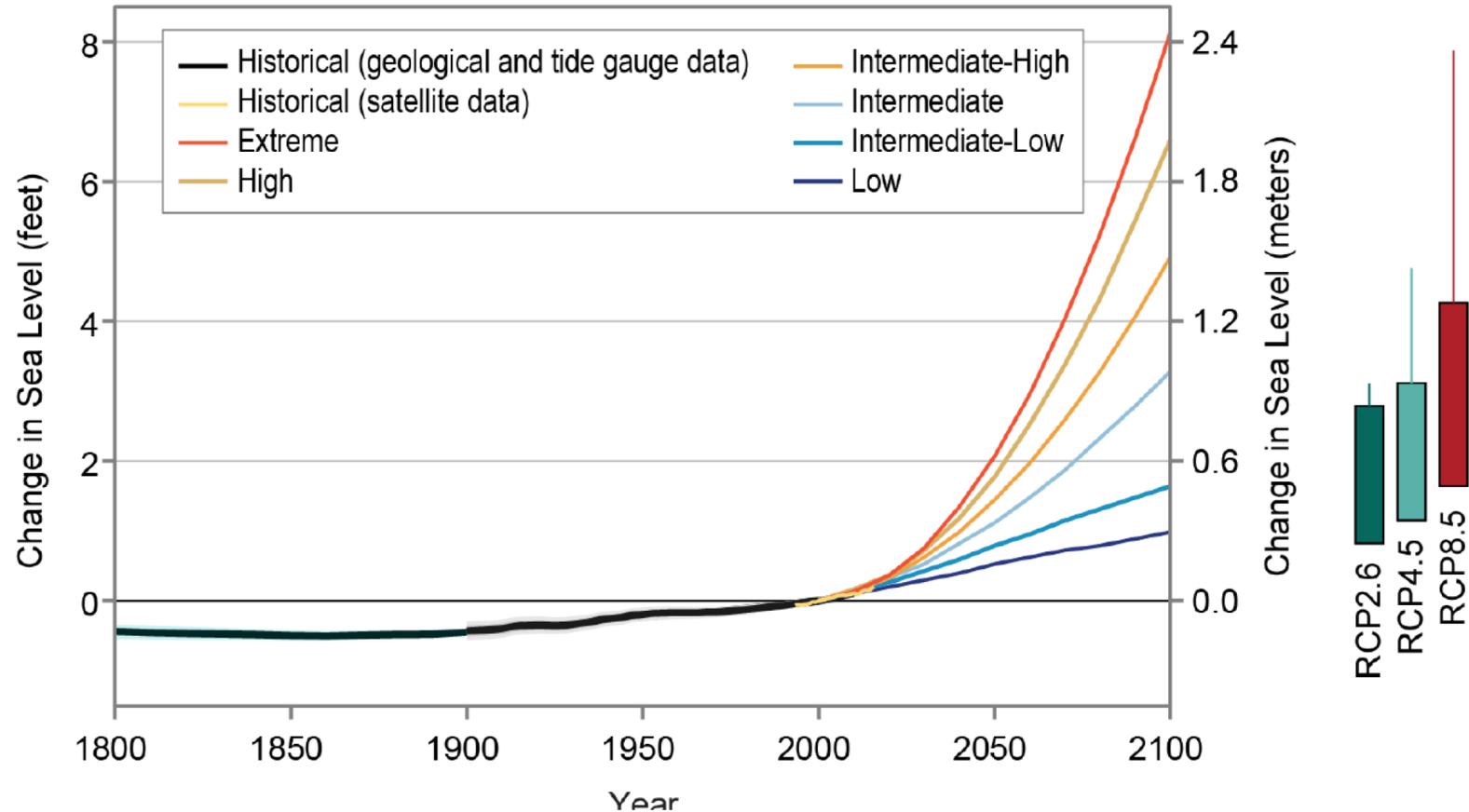
(per 24 hr. event)



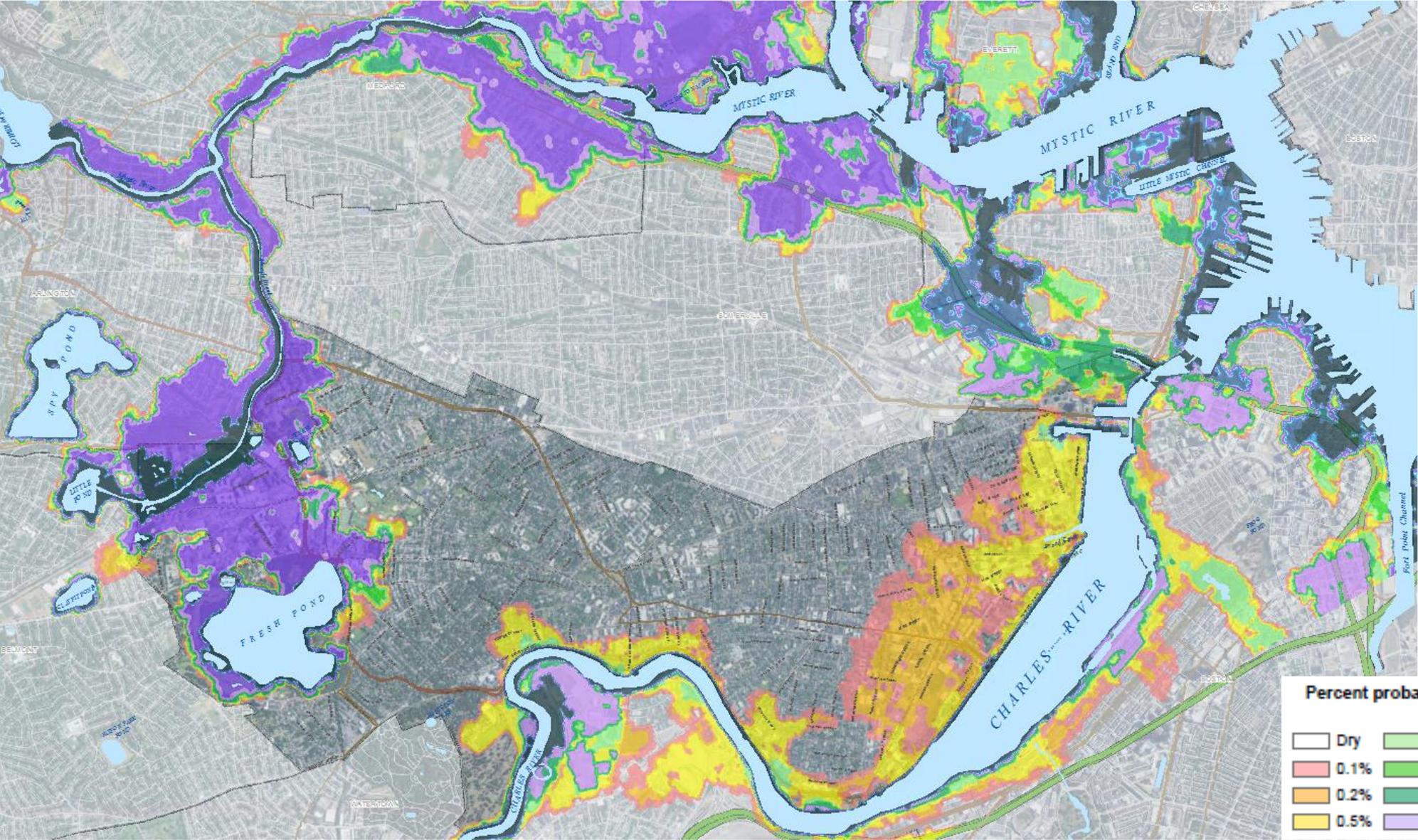
Rising Sea Levels

Higher Tides and Storm Surges

Historical and Projected Global Average Sea Level Rise



Rising Sea Level: Emergence of storm surge flooding risk by 2070



Based on Boston Harbor Flood Risk Model (BHFRM)
MassDOT & Woods Hole Group
• ADCIRC & SWAN

Climate Stress Test: What Happens If No Action Taken

Water

Fresh Pond Reservoir
New St Pump Station

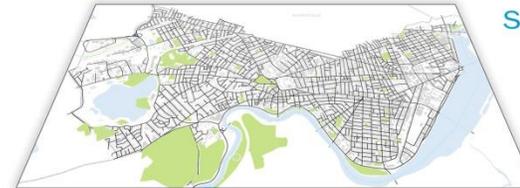


Storm Water

Separated Stormwater
CAM 400 (Alewife)
CAM 004 (Alewife)
Western Flagg (Charles)
Lechmere (Charles)
D46 (Alewife)

Combined Sewer
CAM 017 (Charles)
Cam 001

Water



Storm Water

Roadway

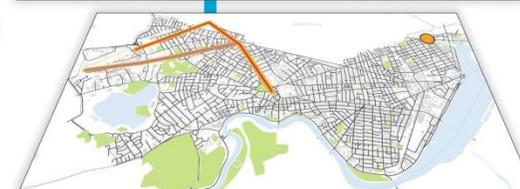
Concord Tpke, Broadway
Memorial Drive, Land Blvd
BU Rotary / Reid Overpass
Cambridge St Underpass
Monsignor O'Brien Hwy
Alewife Brook Pkwy
Massachusetts Ave
Lars Anderson Bridge
Longfellow Bridge
Eliot Bridge
Fresh Pond Pkwy



Transit

Alewife-Davis-Porter Rail Line
Fitchburg Commuter Rail
Central-Kendall Rail Line
Central Square Bus Hub
MBTA #66 Bus Route
Lechmere T & Rail Line
Central Square T Station
Kendall T Station
Alewife T Station
Porter Square Station

Roadway

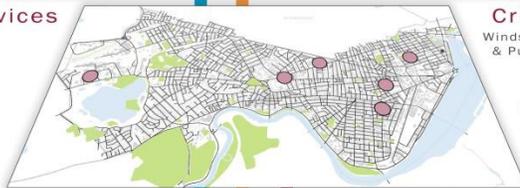


Transit

Porter-Harvard Rail Line
Lechmere-Science
Park Rail Line
Alewife-Davis-Porter
Rail Line
Fitchburg Commuter
Rail Line

Critical Services

Youville Hospital
Fire Company 2
Fire Department
Headquarters



Critical Services

Windsor Street Health Center
& Public Health Department
Police Headquarters
Professional Ambulance
Services Office

Critical Services

Cambridge Water
Department building
(the City's Emergency
Operations Center)

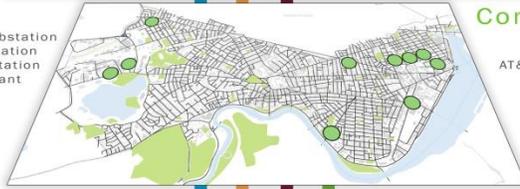


Critical Services

Public Health Department
building on Windsor Street
Police Headquarters
Professional Ambulance
Services office
Fire Department
headquarters

Energy

North Cambridge Substation
Brookford St Take Station
Third St. Regulator Station
MIT Cogeneration Plant
Putnam Substation
Prospect Substation

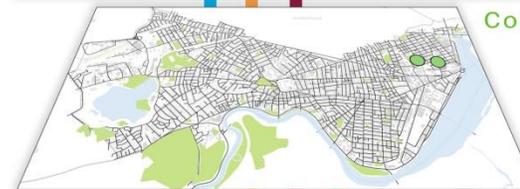


Communication

City Emergency Com
Center (Police HQ)
AT&T Data Hub/300 Bent St
BBN Data Hub/CO-LOC:
10-12 Moulton St
AT&T Office/Long Line
Switch: 250 Bent St

Energy

Third Street
Regulator Station

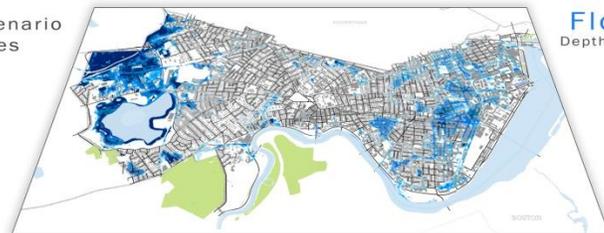


Communication

City Emergency
Communications
Center (Police HQ)



2070s Scenario
11.7 inches
rainfall in
24 hours



Flood Risk

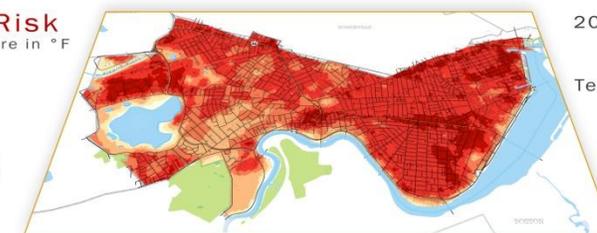
Depth of flooding (ft)

0 - 0.5	Lightest Blue
0.5 - 1.0	Light Blue
1.0 - 2.0	Medium Blue
2.0 - 3.0	Dark Blue
> 3.0	Darkest Blue

Heat Risk

Temperature in °F

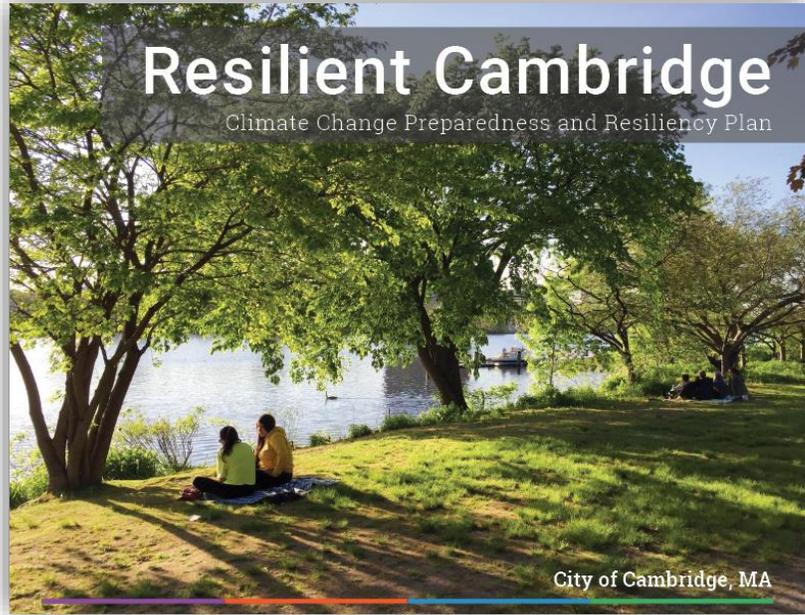
<80	Lightest Yellow
80-85	Light Yellow
85-90	Yellow
90-95	Orange
95-100	Red-Orange
100-110	Red
>110	Darkest Red



2070s Scenario
Estimated
Ambient
Temperature on
100 °F Day



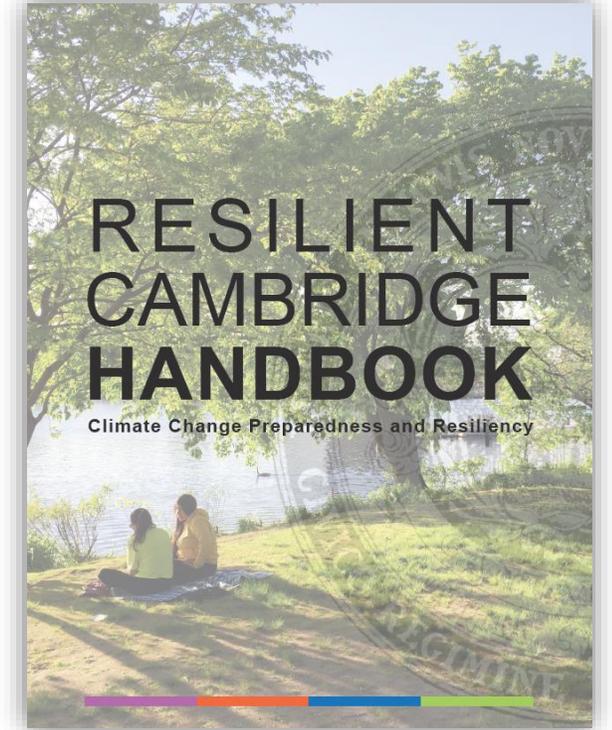
What we produced: Resilient Cambridge



Plan



Technical reports



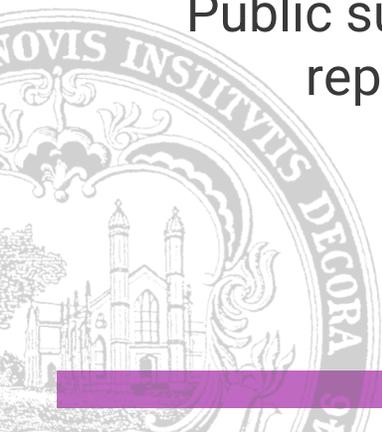
Handbook



What we produced: Additional materials



Public summary report



Story Maps



Flood Risk



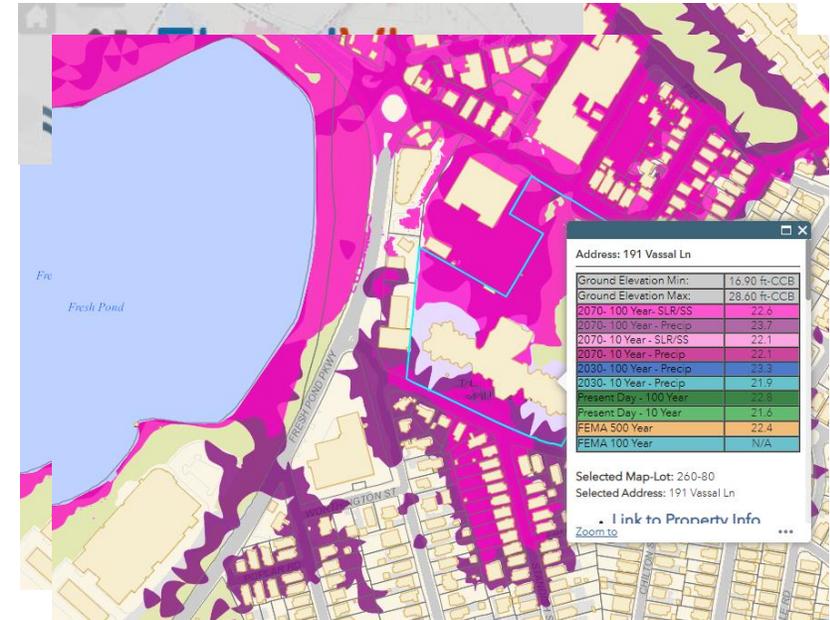
Heat Risk



Flood Strategies



Heat Strategies



FloodViewer:
potential flooding
by parcel

What we recommend

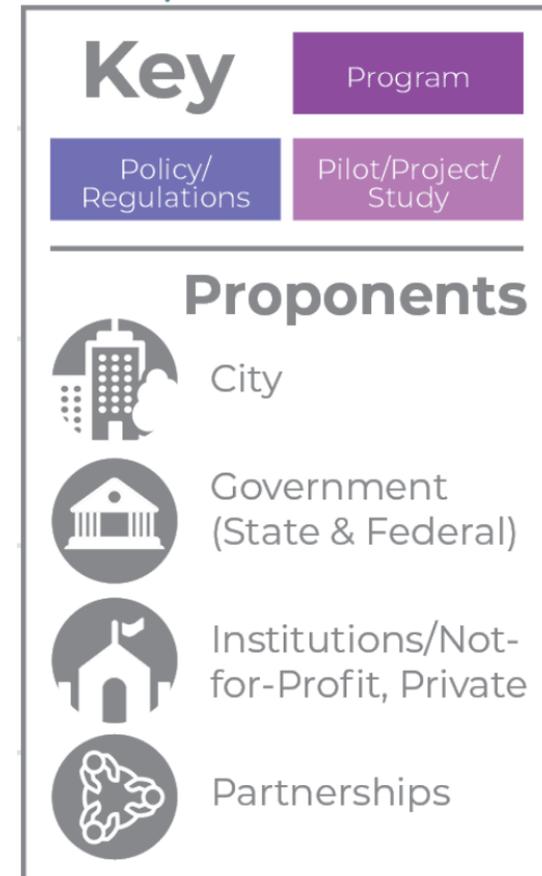
Specific actions to prepare for climate change and enhance people's lives in the process of becoming resilient.

- Programs
- Policy/regulations changes
- Pilots/projects/studies

Undertaken by:

- The City
- State/Federal Government
- Institutions/non-profit, Private
- Partnerships

Completed over 10 years (2020-2030), with a 5-year review by the City



Approach to climate change preparedness & resilience

Reduce Risk



Prepare for Unavoidable Risks

- Reduce urban heat islands
- Increase flood storage & conveyance
- Install storm surge barriers
- Elevate structures

- Be transparent and open about risks, share data
- Plan for extremes and new normals
- Coordinate planning initiatives
- Engage stakeholders & community
- Develop strategies for people, buildings, infrastructure, and ecosystem
- Implement at different scales
- Coordinate and engage regionally

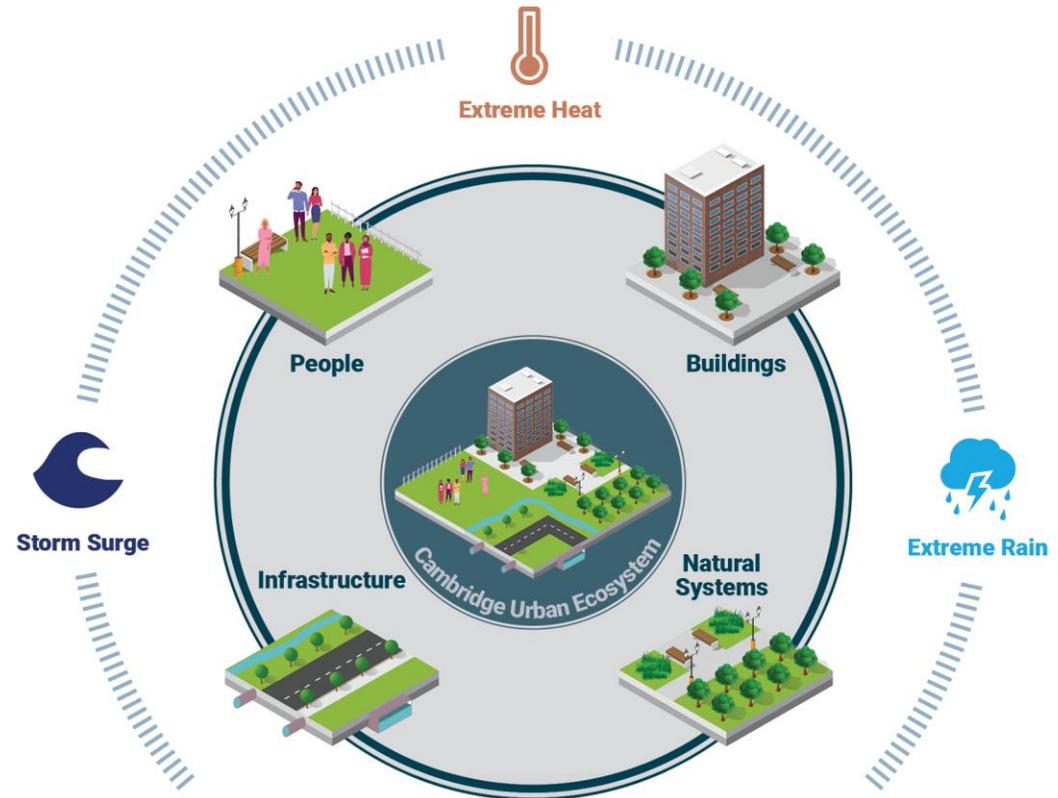


What we recommend

Organized around four categories:

- Closer Neighborhoods
- Better Buildings
- Stronger Infrastructure
- Greener City

Discusses regional considerations



Closer Neighborhoods

- 11 total
- Proponents:
City and
partnerships

Key

Proponents



City



Government
(State & Federal)



Institutions/Not-
for-Profit, Private



Partnerships



A1 Provide Neighborhood Resilience Hubs



A2 Enhance Resilient Public Amenities



A3 Create Support Systems For Populations At Risk



A4 Strengthen Emergency Communication Systems



A5 Support Business And Organizational Preparedness



A6 Protect Community Resource Buildings



A7 Enhance Emergency Response Plans



A8 Provide For Healthcare Continuity And Access



A9 Encourage Stronger Social Network



A10 Continue Climate Education



A11 Support Renter Preparedness



Better Buildings

- 10 total
- Proponents: City, government, and partnerships

Key

Proponents



City



Government
(State & Federal)



Institutions/Not-
for-Profit, Private



Partnerships



B1 Regulate Flood Protection For New Buildings



B2 Regulate Heat Protection For New Buildings



B3 Encourage Flood Protection For Existing Buildings



B4 Encourage Heat Protection For Existing Buildings



B5 Support Building Management For Flood And Heat Protection



B6 Promote Site Green Infrastructure



B7 Establish Adapted Zoning Policies And Regulations



B8 Study Adapted Planning For Resilient Urban Blocks



B9 Encourage Resiliency of Building Scale Energy



B10 Develop Flood Protection And Operations Planning For Historic And Critical Facilities



Stronger Infrastructure

- 8 total
- Proponents: City, private, government, and partnerships

Key

Proponents



City



Government
(State & Federal)



Institutions/Not-
for-Profit, Private



Partnerships



C1 Protect Fresh Pond Reservoir



C2 Encourage the Resiliency of the Electrical Distribution System



C3 Encourage the Resiliency of the Transportation System



C4 Continue Combined Sewer Separation



C5 Upgrade Stormwater Storage



C6 Support Sustainable Energy Infrastructure



C7 Implement Green Infrastructure For Stormwater Management



C8 Support A Resilient Telecommunication Network



Greener City

- 5 total
- Proponents: City and partnerships

Key

Proponents



City



Government
(State & Federal)



Institutions/Not-
for-Profit, Private



Partnerships



D1 Provide For A Resilient Urban Forest



D2 Enhance Outdoor Thermal Comfort



D3 Reduce Impervious Area



D4 Seek Green Infrastructure Opportunities



D5 Expand And Improve Open Spaces



Before

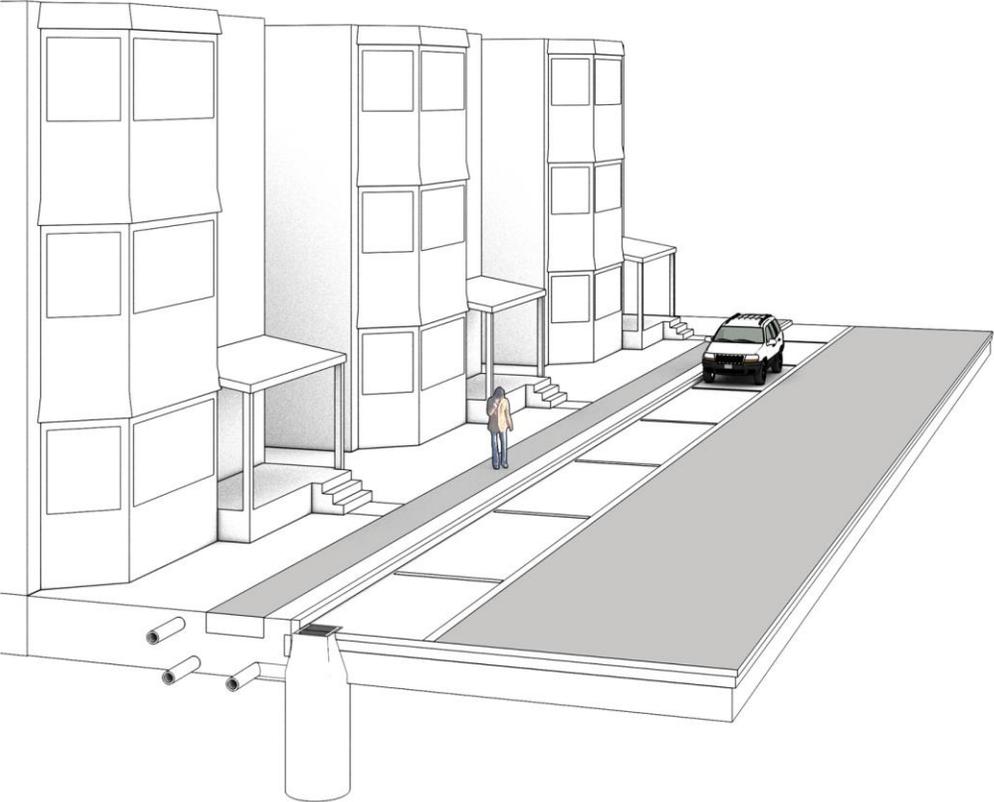
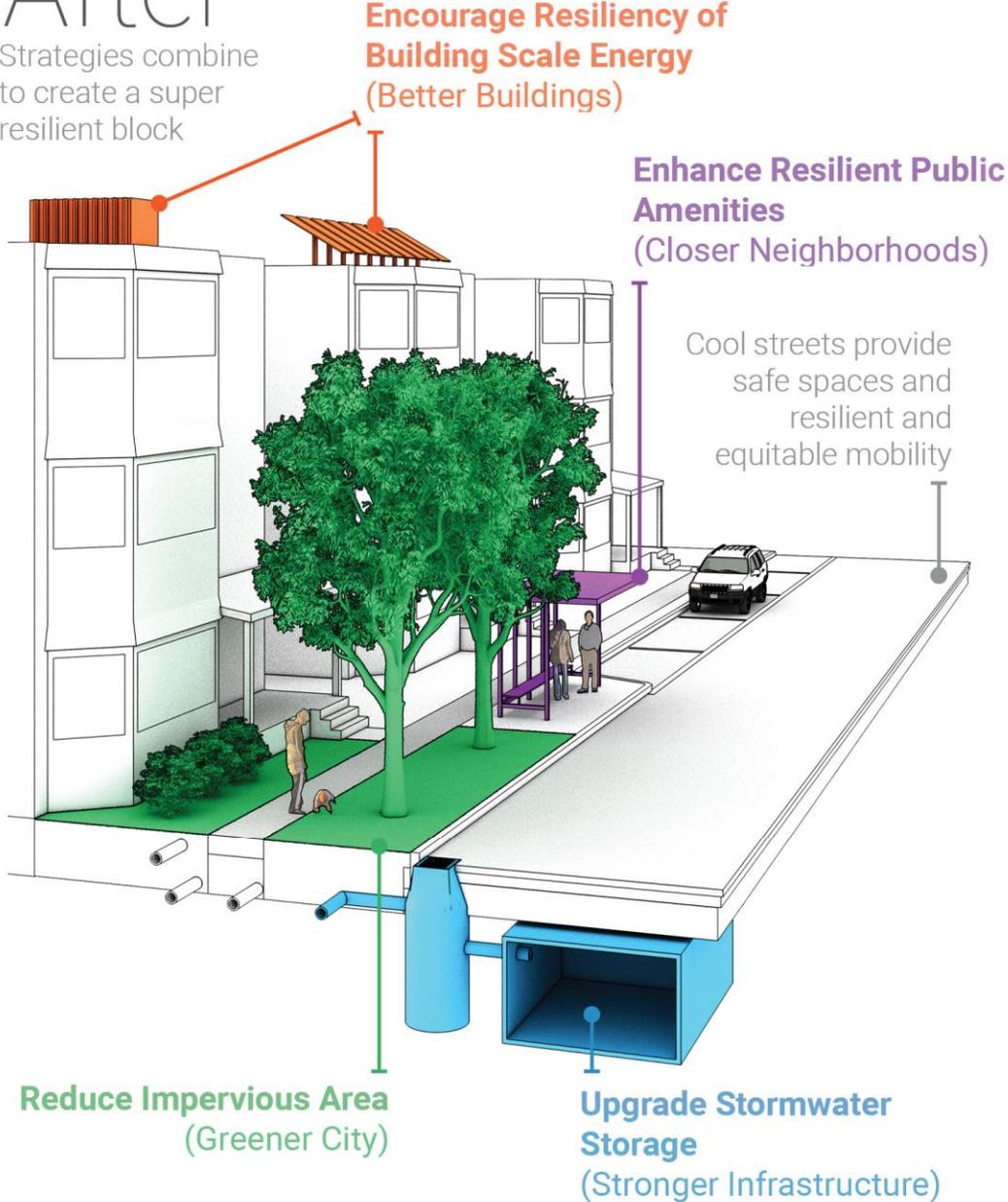


Illustration not to scale

After

Strategies combine to create a super resilient block



Visions for a Transformed City



A climate-prepared community with neighbors who connect, live in better buildings, benefit from stronger infrastructure, and enjoy a Greener City

Coastal flooding – regional is key

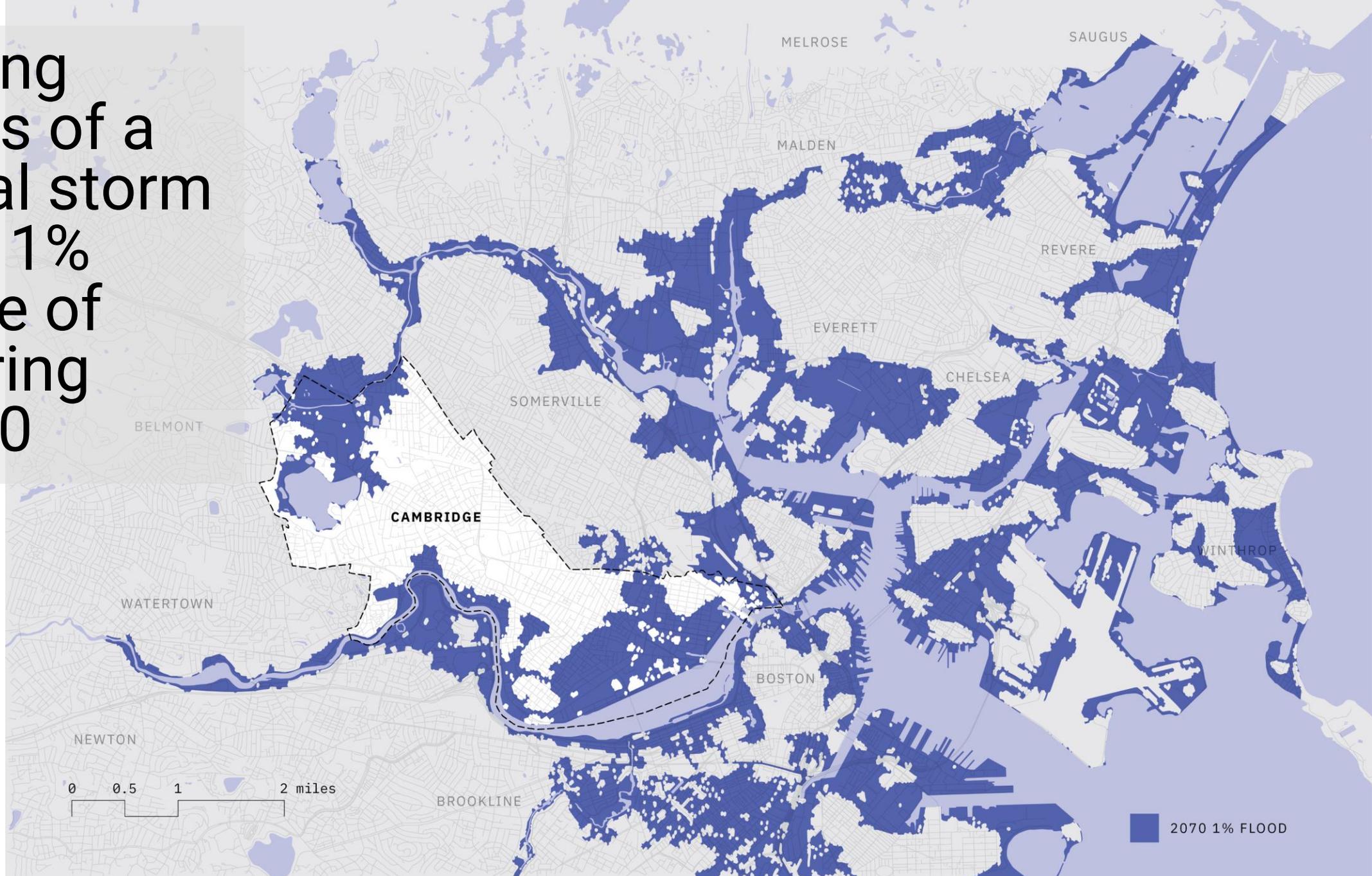
Larger than any individual community



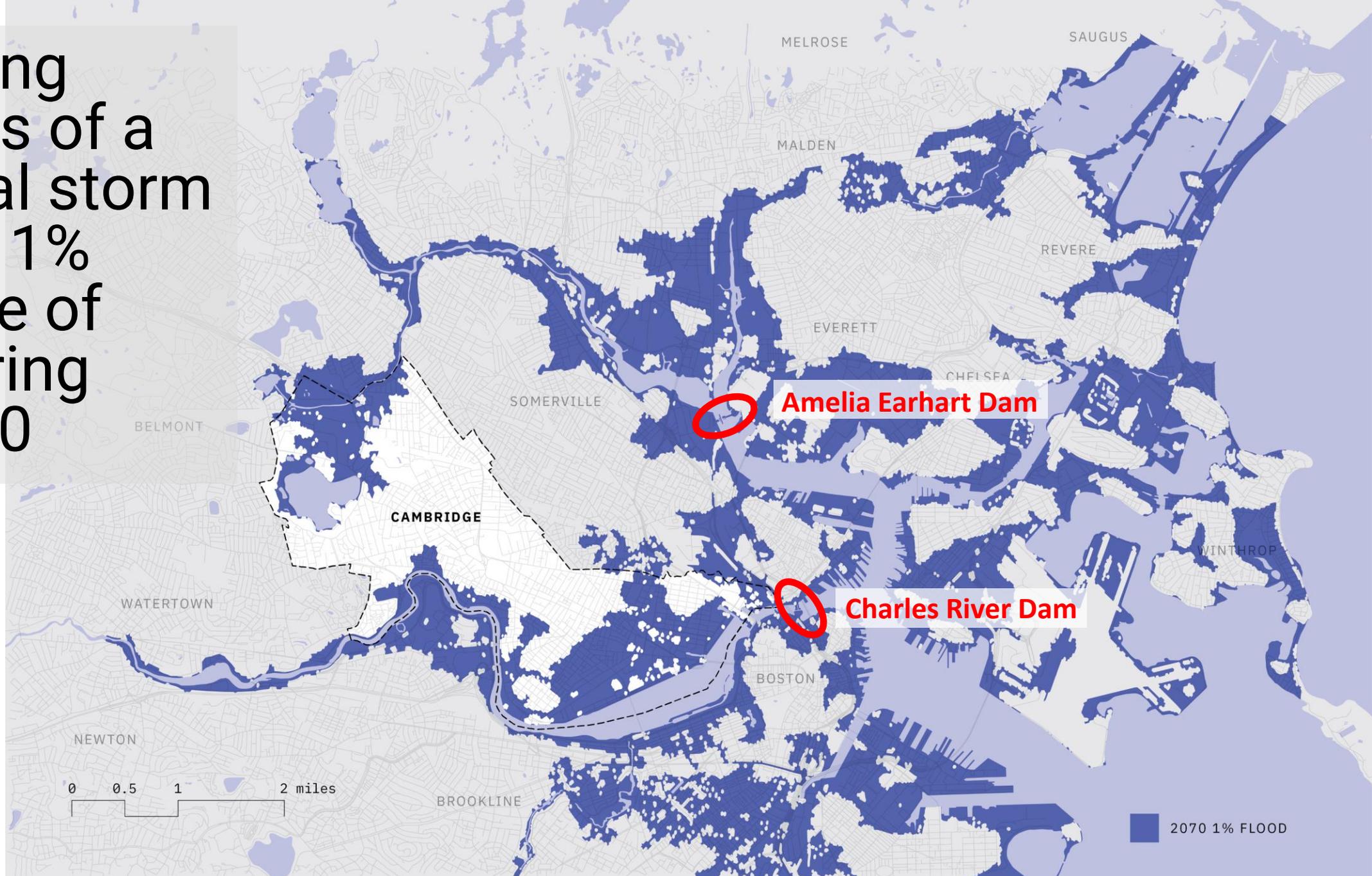
Photo credit: Bryan Gammond



Flooding extents of a coastal storm with a 1% chance of occurring in 2070



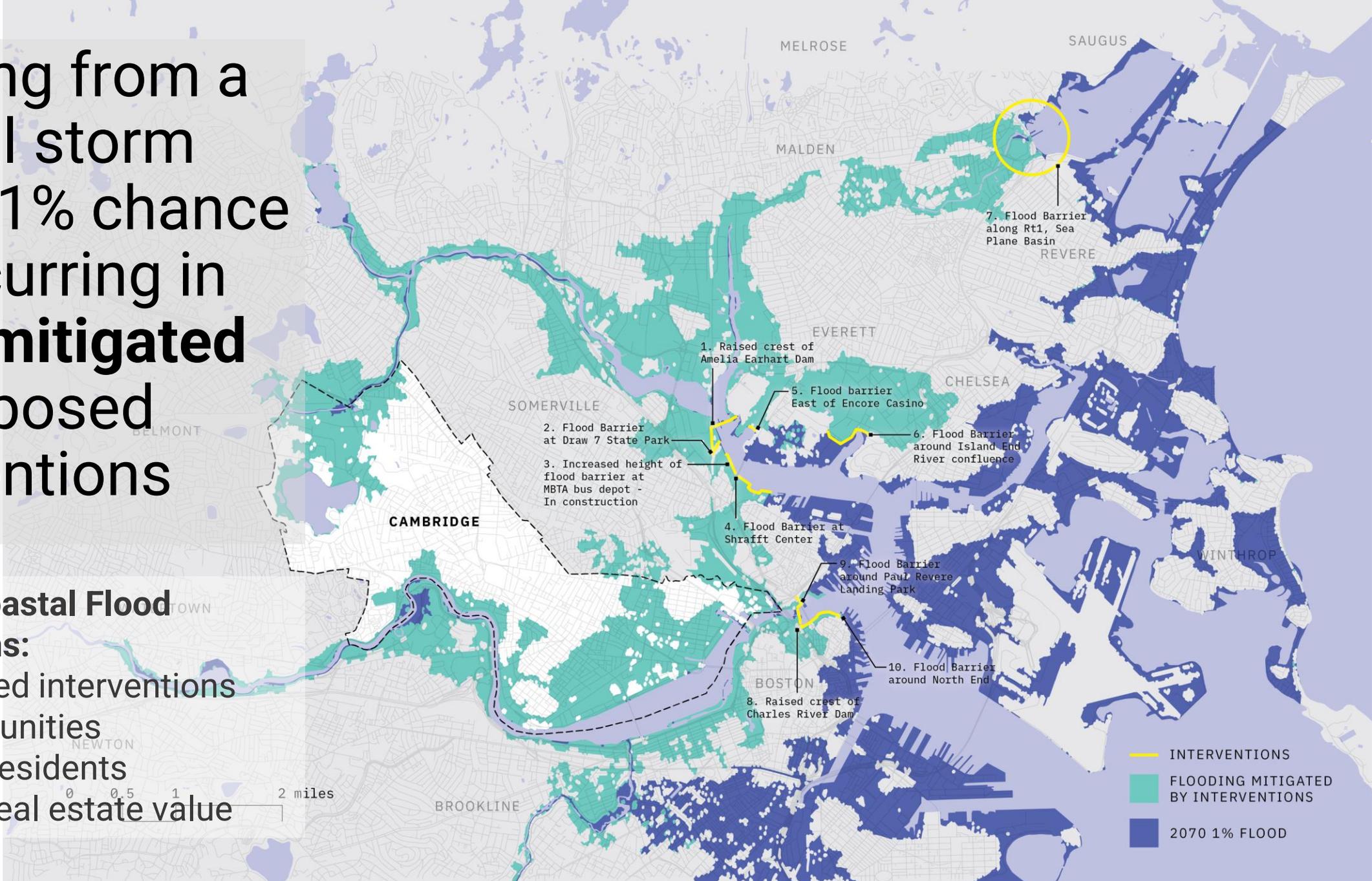
Flooding extents of a coastal storm with a 1% chance of occurring in 2070



Flooding from a coastal storm with a 1% chance of occurring in 2070, mitigated by proposed interventions

Regional Coastal Flood Interventions:

- 10 targeted interventions
- 12 communities
- 108,000 residents
- \$60B of real estate value



Related Processes

Envision Cambridge – Community Development Department

- Climate Resilience Zoning Task Force
 - Proposing codification of 2070 flood risk standards and Cool Factor
- Cambridge Street Planning Study

Urban Forest Master Plan – Public Works Department

- Expanded urban forest staff and budget
- Update to Tree Protection Ordinance
- Increased tree plantings
- Witness Tree project with Harvard Forest
- Miyawaki micro-forests
- Ongoing urban forest assessments

Community Health Improvement Plan – Public Health Department

- Community social resilience priority
 - Community Resilience Manager
- 

Current initiatives



Cambridge Community Corps



Finch Cambridge

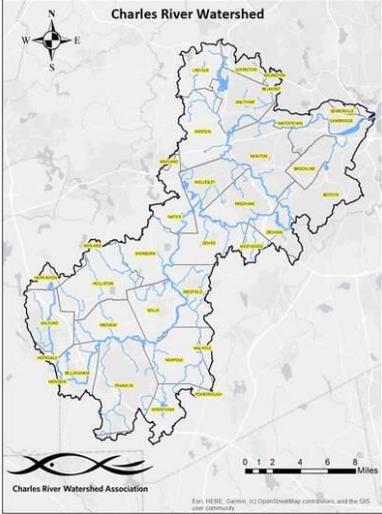
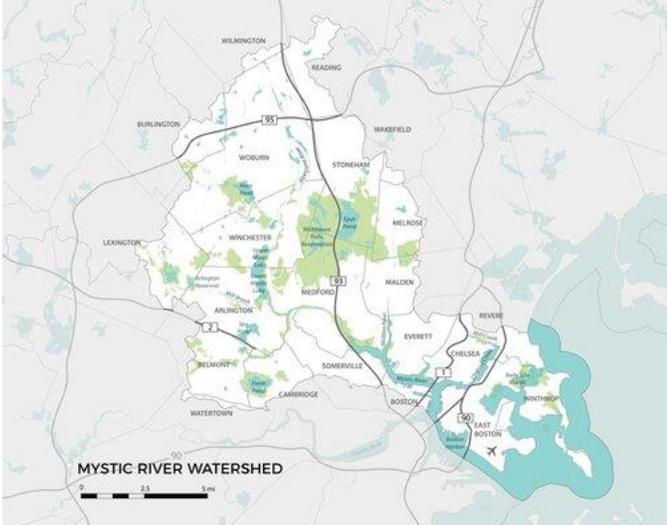
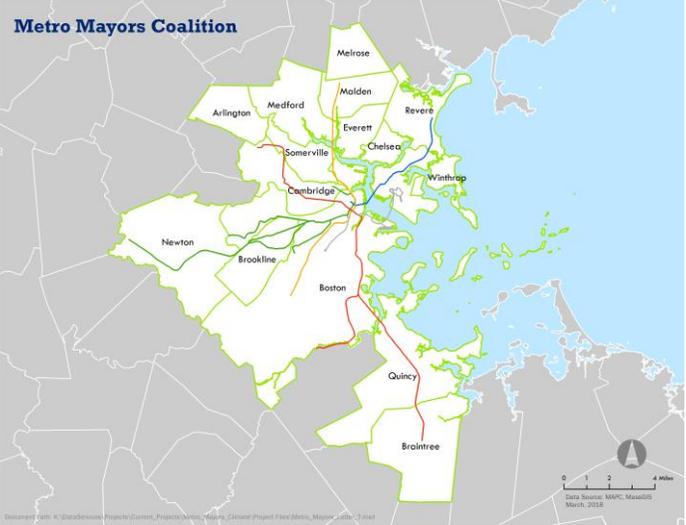


The Port Infrastructure Project/PL-6 Tank



Springfield Street Parking Lot

Regional Climate Collaborations



Metro Mayors Climate Task Force

- 15 inner core communities
- Coordinated by MAPC
- Building Resilience to Climate-driven Heat in Metro Boston

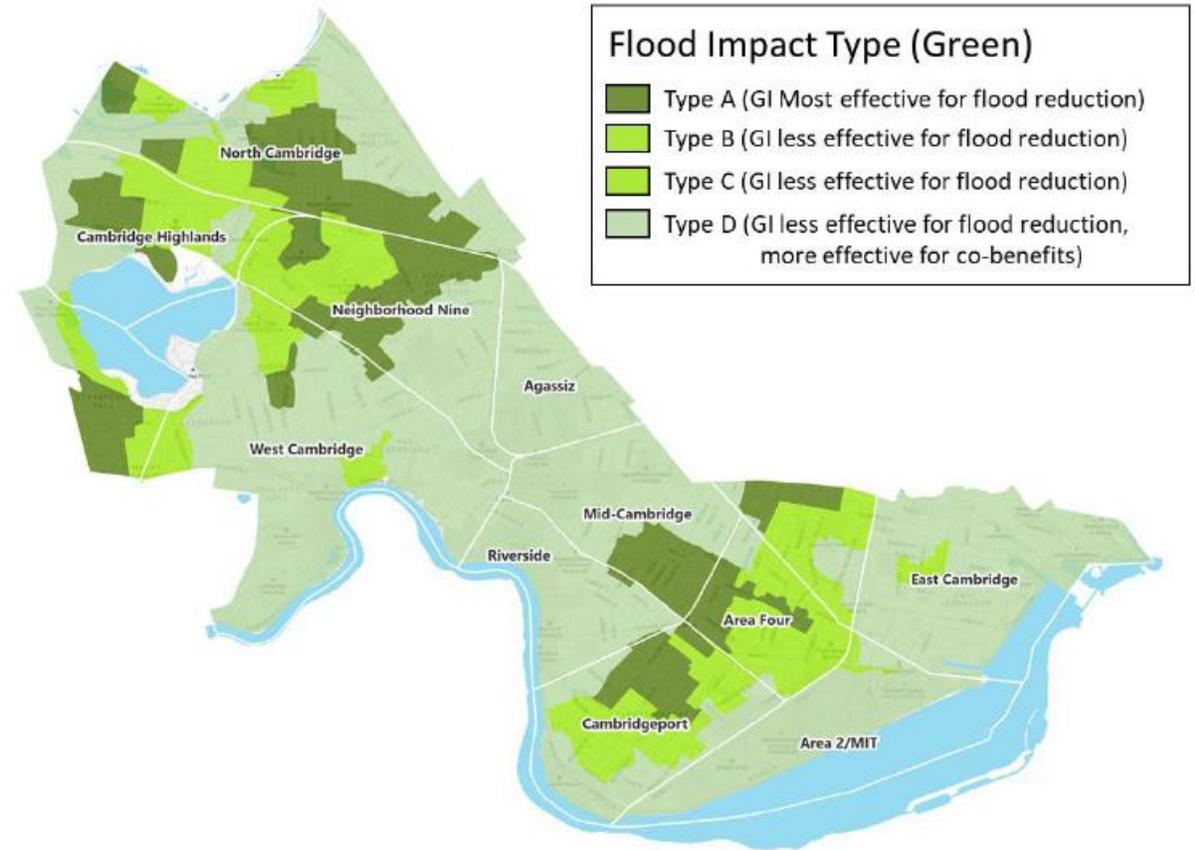
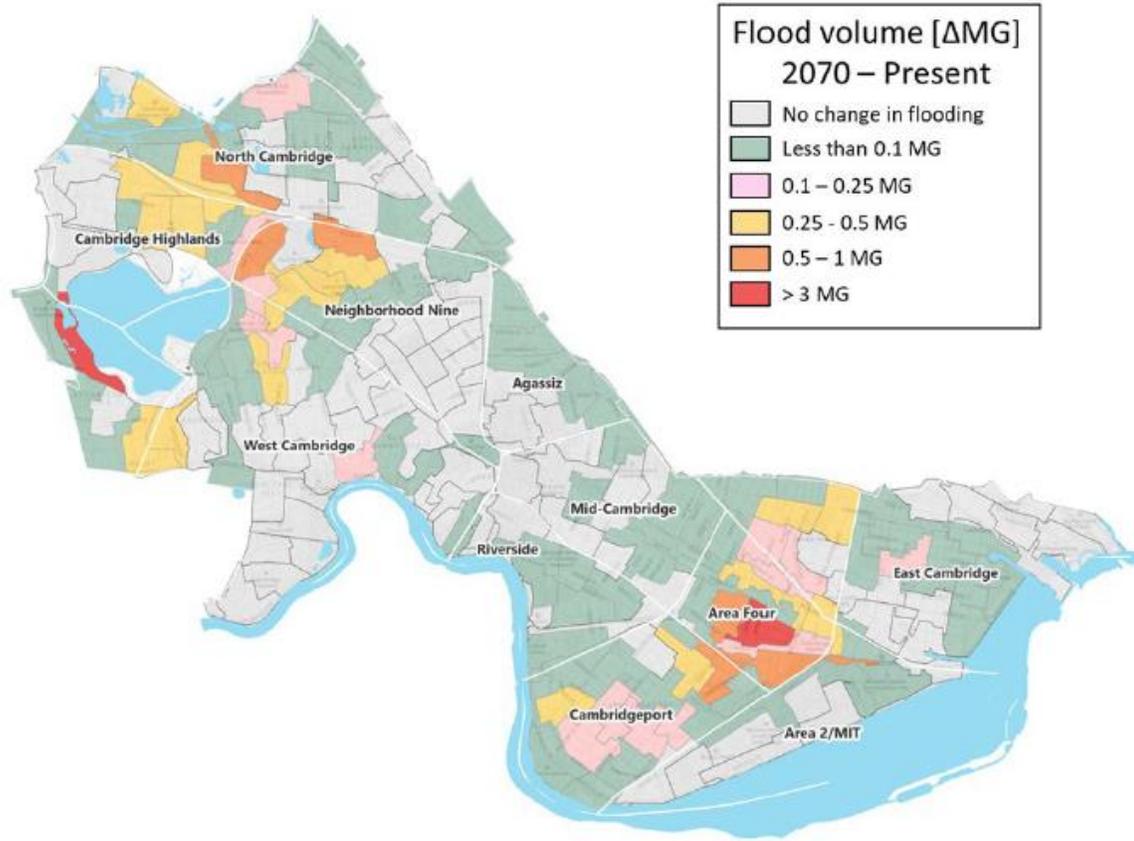
Resilient Mystic Collaborative

- 21 watershed communities
- Coordinated by MyRWA
- Upper Mystic Stormwater Project
- Social resilience work group
- Lower Mystic Storm proofing critical infrastructure
- Regional storm surge protection

Charles River Climate Compact

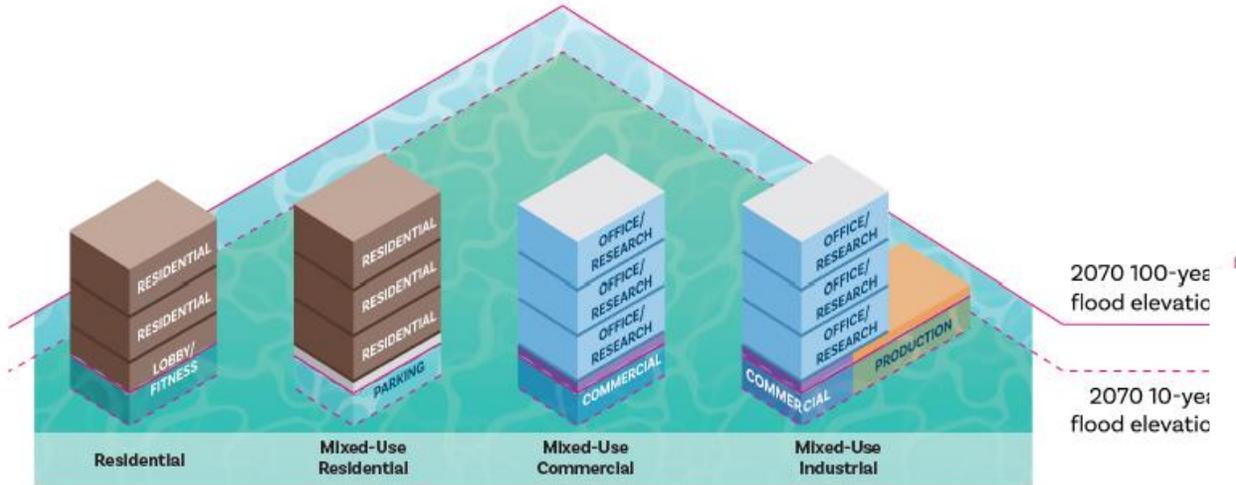
- 23 communities
- Coordinated by CRWA
- Current focus is on upper watershed stormwater management

Green Infrastructure Suitability



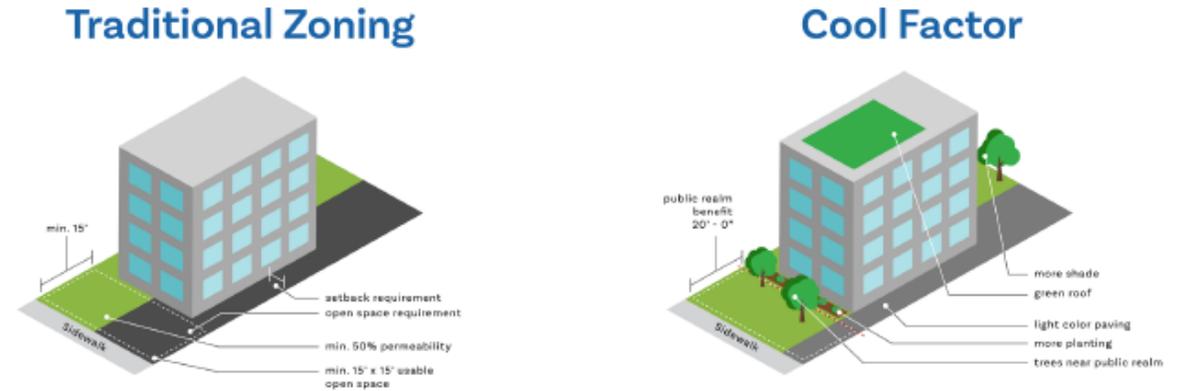
Climate Resilience Zoning

Residential		Non-Residential		Envision Prototypes
Residential	Mixed-Use Residential	Mixed-Use Commercial	Mixed-Use Industrial	
<ul style="list-style-type: none"> Housing must be elevated or floodproofed Garage levels can be floodproofed or floodable Elevate or protect utilities and major equipment 	<ul style="list-style-type: none"> Housing must be elevated Commercial or retail uses can be floodproofed Elevate or protect utilities and major equipment 	<ul style="list-style-type: none"> Office uses can be floodproofed Commercial or retail uses can be floodproofed Elevate or protect utilities and major equipment 	<ul style="list-style-type: none"> Office uses can be floodproofed Commercial, industrial, or retail uses can be floodproofed Elevate or protect utilities, major equipment, and chemical storage 	



Codify Future Flood Elevations

Cool Factor Site Rating System



✓ Open Space ✓ Permeability + ✓ Shade ✓ Cool Surfaces ✓ Planting



Resilient City Resilient People



We must all work together to ensure a resilient future for Cambridge.



Thank you for coming!

To learn more, visit:

www.cambridgema.gov/ResilientCambridge

