Onwards from Climate Change Assessment to Implementation – City of Cambridge

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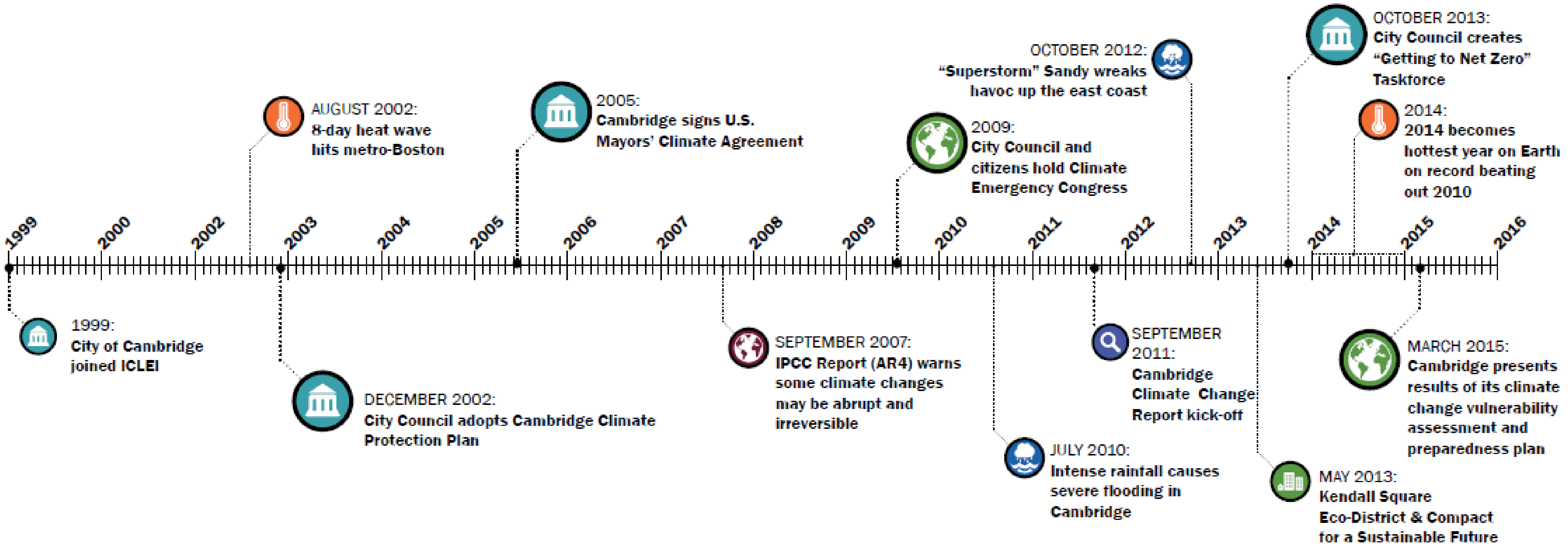
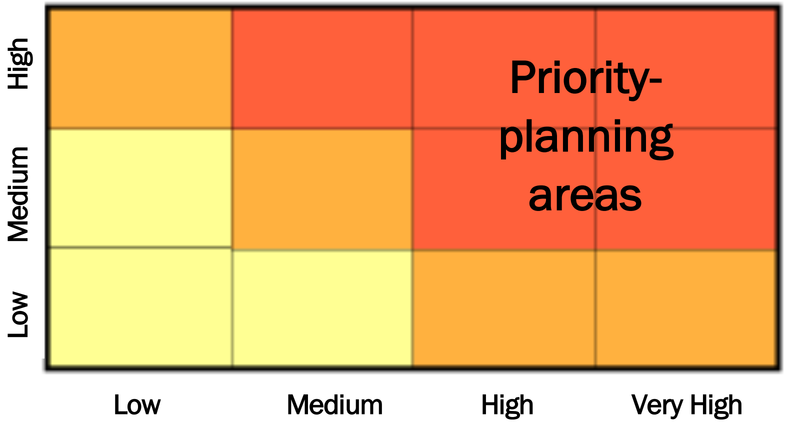
Cambridge Sustainability & Resiliency Timeline



Project's Framework

Phase I: Vulnerability Assessment



Step 1

Climate Scenarios

Step 2

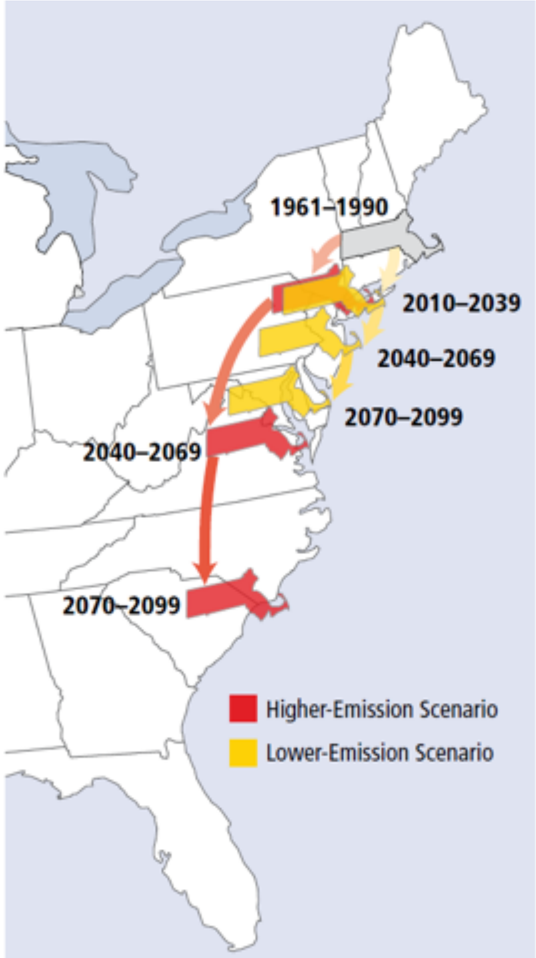
Vulnerability & Risk Assessment

Step 3

Preparedness Plan

Climate Scenarios

Temperature



Precipitation

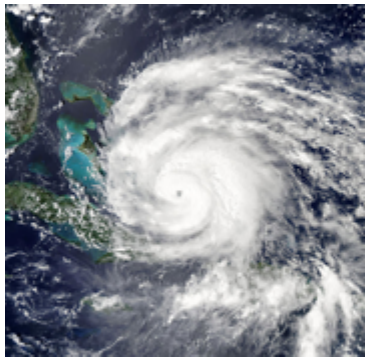
More extreme events

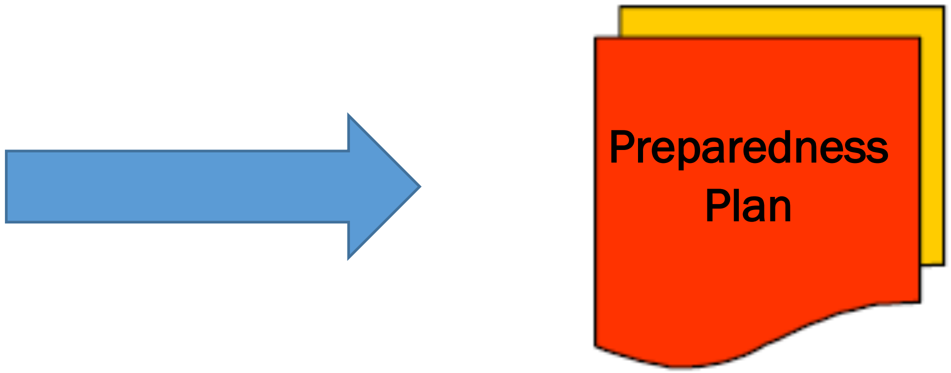
Sea level rise

The Challenge

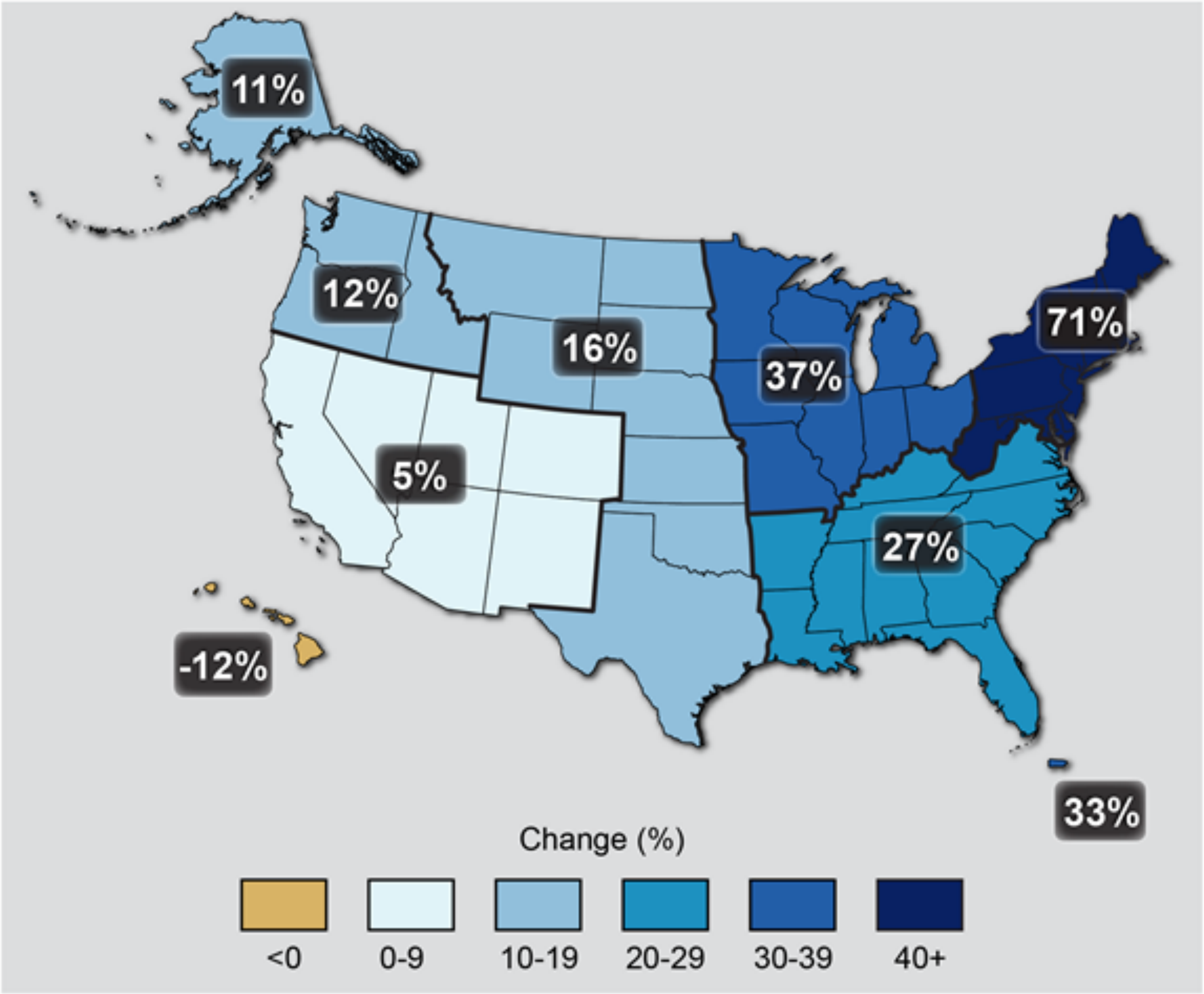
- Design criteria based on past events.
- Past is no longer a reliable indicator of present or future conditions.

How do you translate climate risk into planning and design?



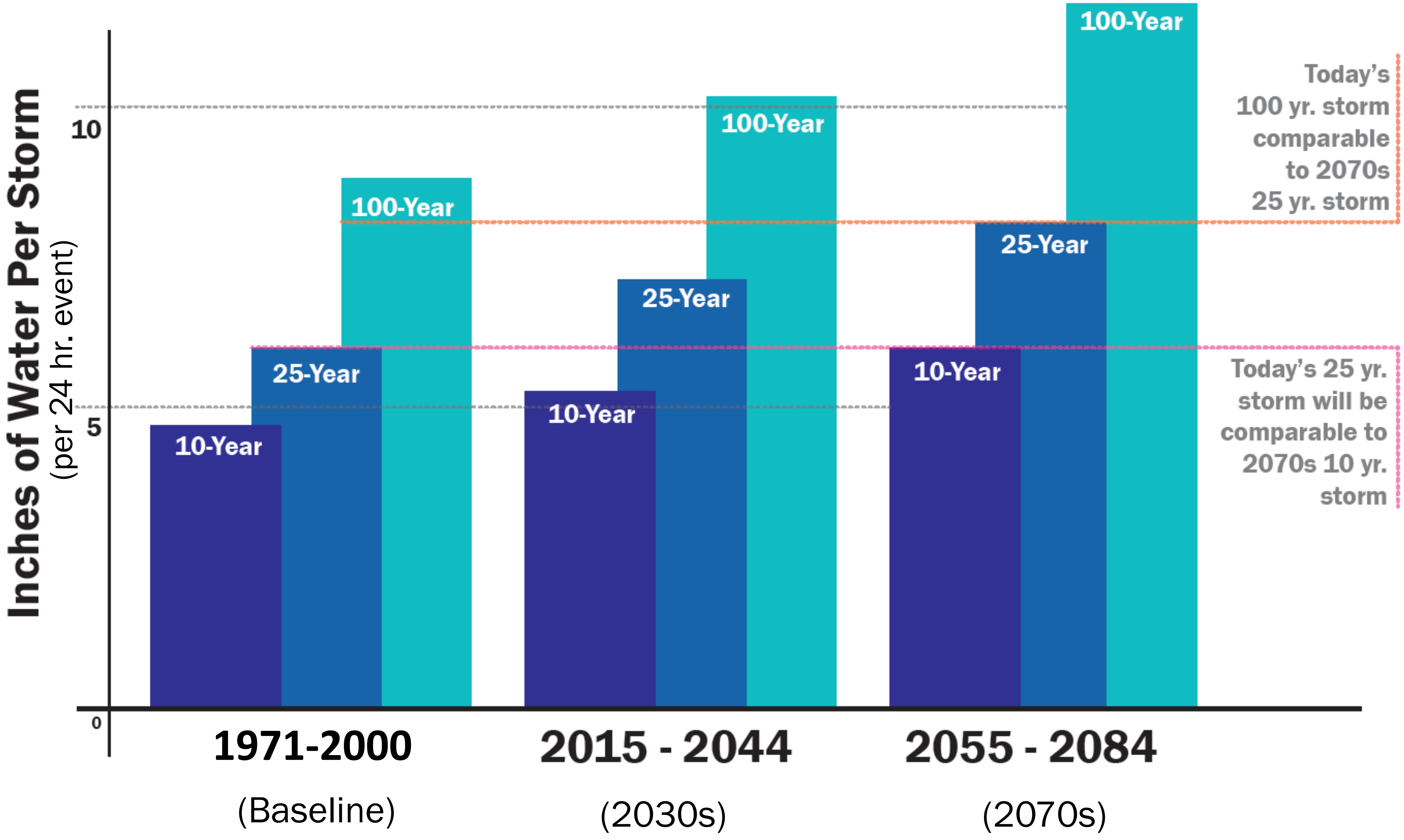


Precipitation Change



Observed change in very heavy precipitation events (defined as the heaviest 1% of all daily events) from 1958 to 2012.
Source: Walsh et al. 2014a

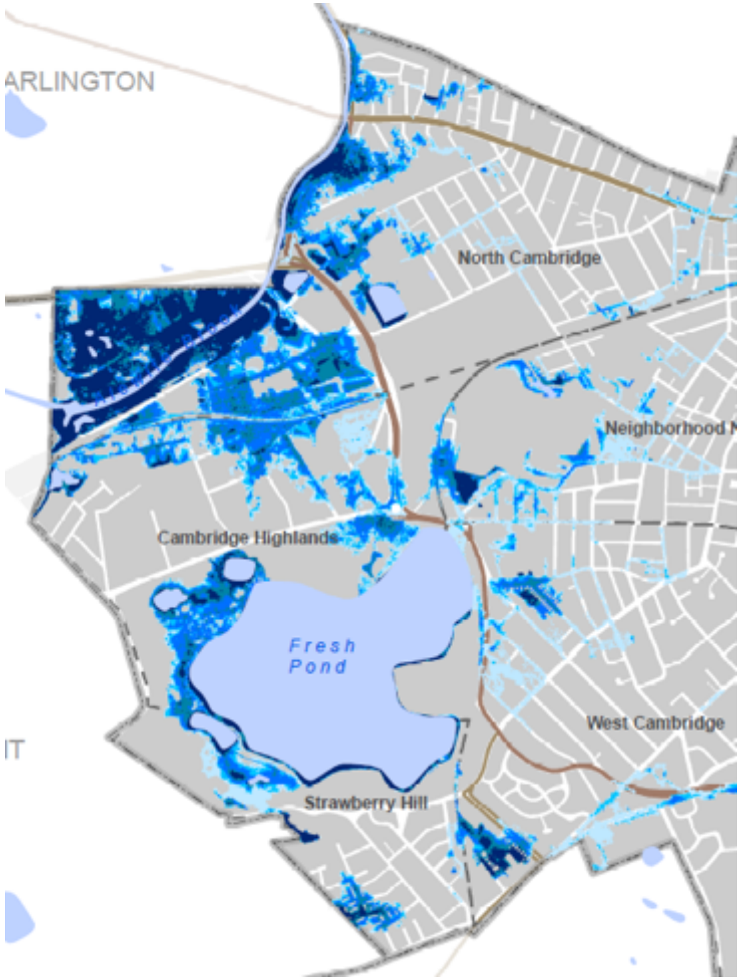
Precipitation Projections



Expected Flooding Volume

Present 10-yr storm

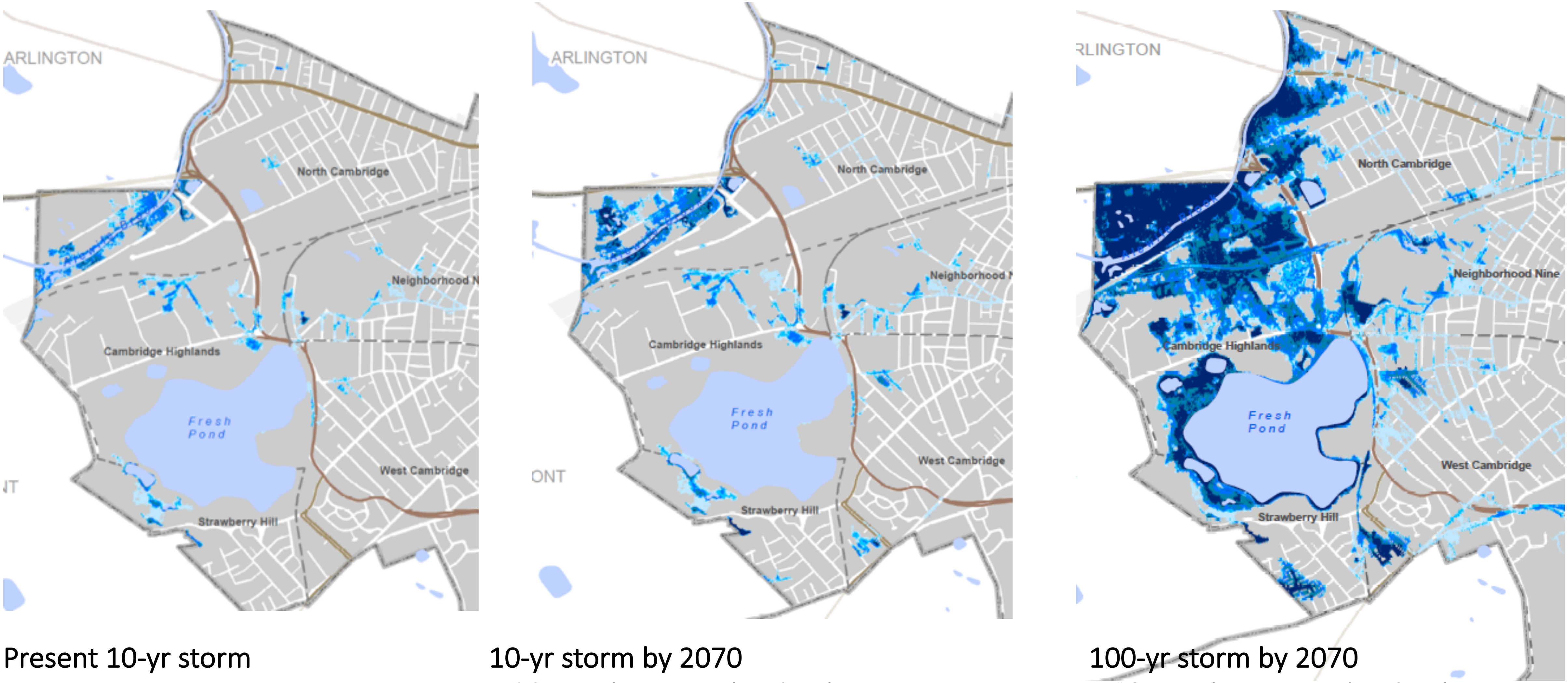
10-yr storm by 2030
Additional 17 MG Flood Volume



100-yr storm by 2030
Additional 200 MG Flood Volume

Source: Kleinfelder, City of Cambridge Climate Change Preparedness & Resiliency (CCPR) Plan, November 2016

Expected Flooding Volume



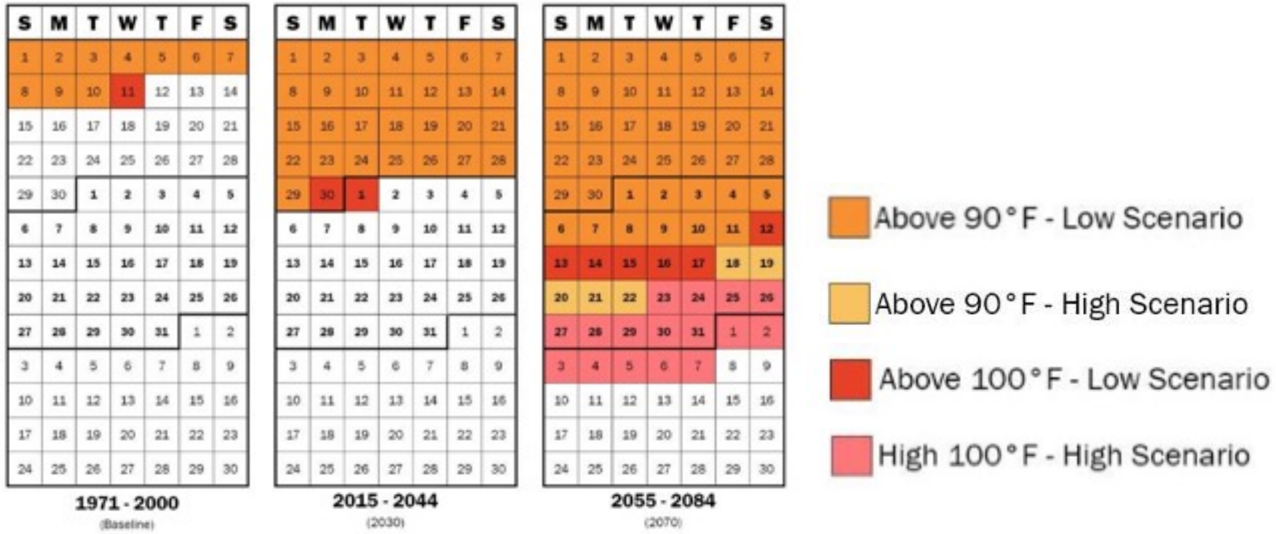
Present 10-yr storm

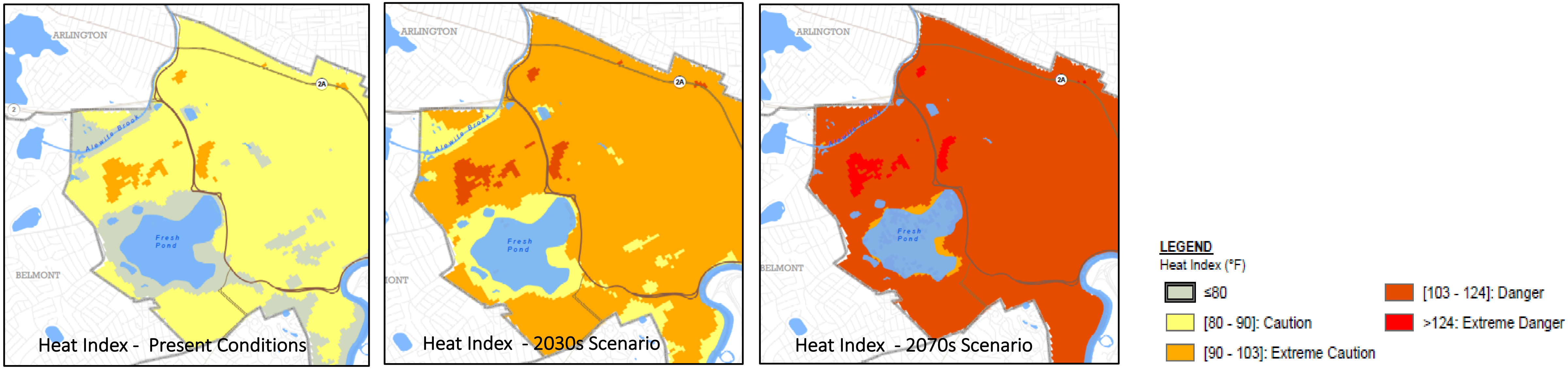
10-yr storm by 2070
Additional 35 MG Flood Volume

100-yr storm by 2070
Additional 290 MG Flood Volume

Source: Kleinfelder, City of Cambridge Climate Change Preparedness & Resiliency (CCPR) Plan, November 2016

Increased Temperature and Urban Heat Island





Identifying Critical Assets & Resources

The Built Environment

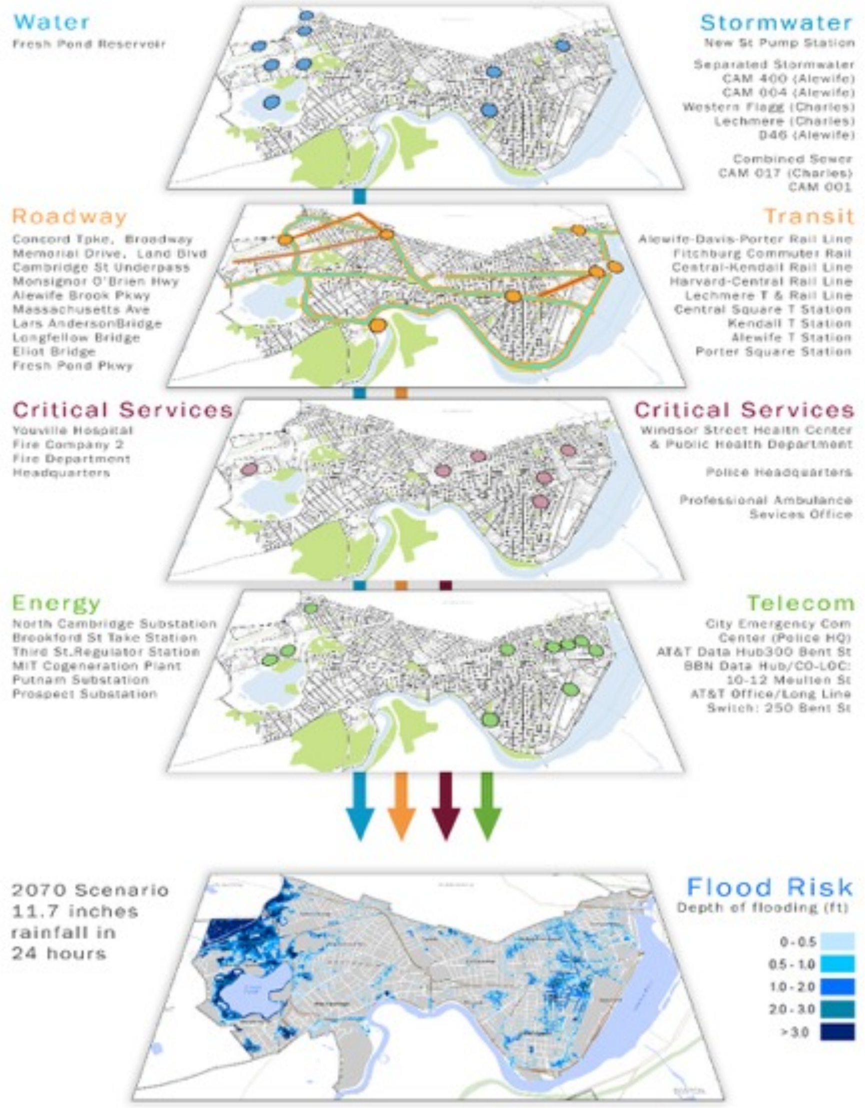
- Energy
- Transportation
- Water
- Telecommunication
- Critical Services
- The Urban Forest

The Social Environment

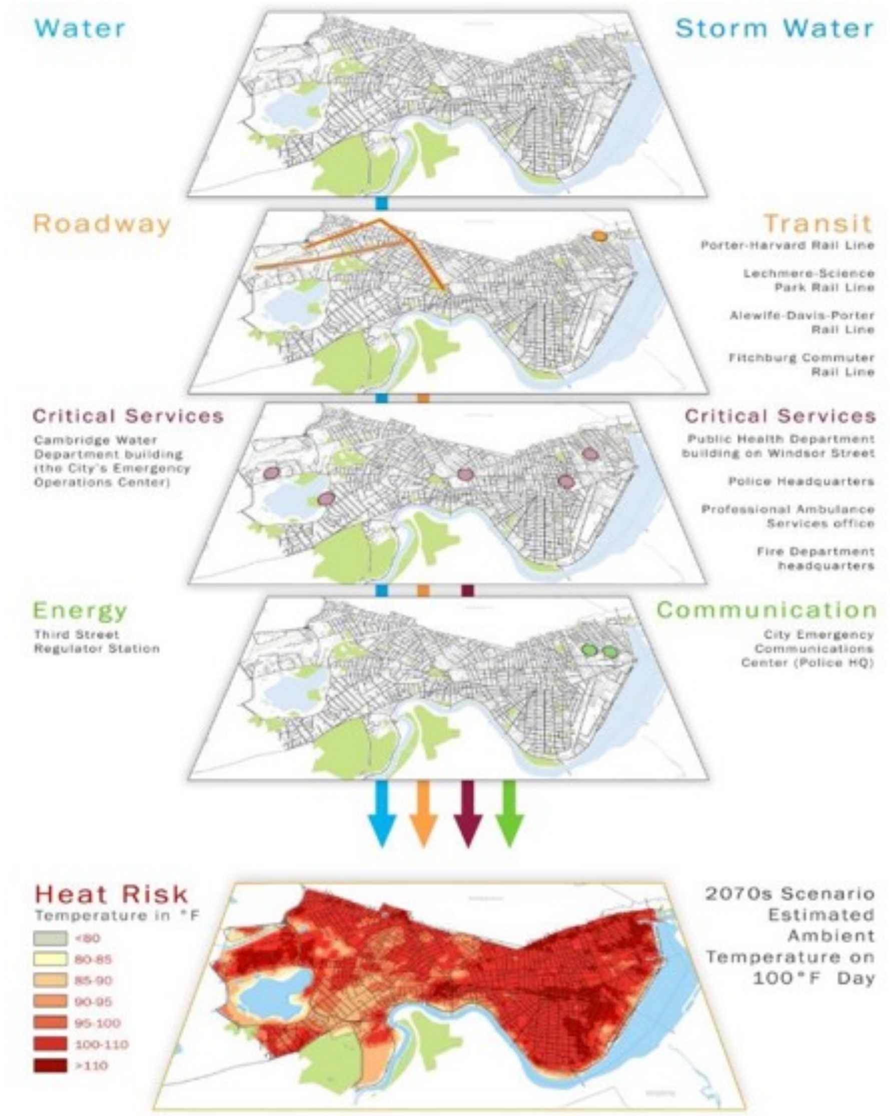
- Public Health
- Community Resources
- Vulnerable Population
- Economic Impact

Vulnerability and Risk of Urban Infrastructure & Services

Flooding Stress Test



Heat Stress Test



Climate Change Priority Planning Areas

Key Findings of CCVA Part 1

- **Heat vulnerability** and **inland flooding** are more imminent.
- **Social vulnerability** is not evenly distributed among neighborhoods or households
  - Heat stress, heat-sensitive disease, critical services, indoor air, food safety, housing/shelter, communications
- **Key infrastructure assets** are vulnerable in the near-term.
- **Economic losses** from a flood event or an area-wide power loss would be significant.
  - Disruption of **economic** activity could be greater than property damage.
- **Adaptation** will require coordination with other entities

Climate Change
Vulnerability Assessment

November 2015

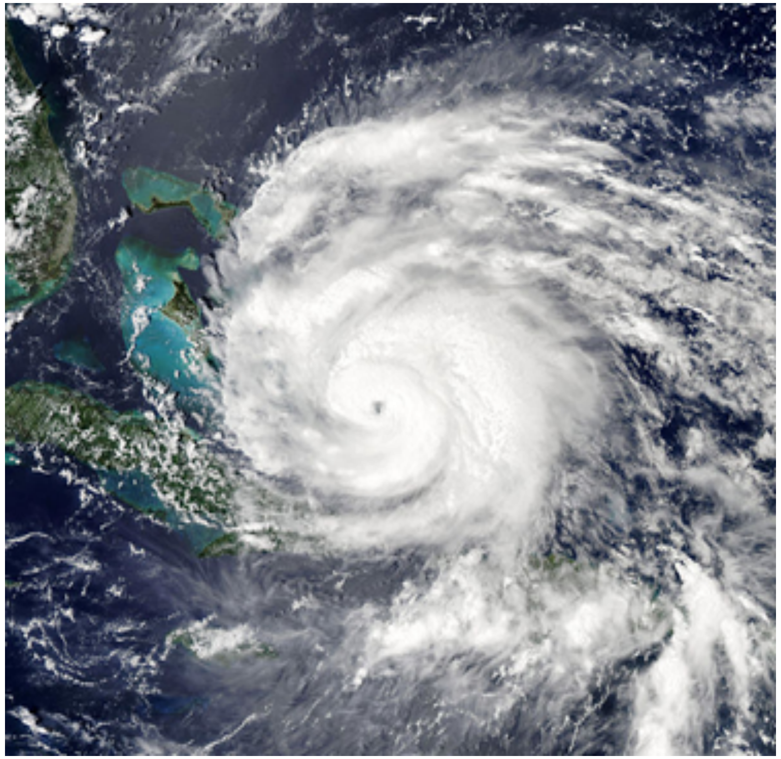
City of Cambridge, Massachusetts

1
Part

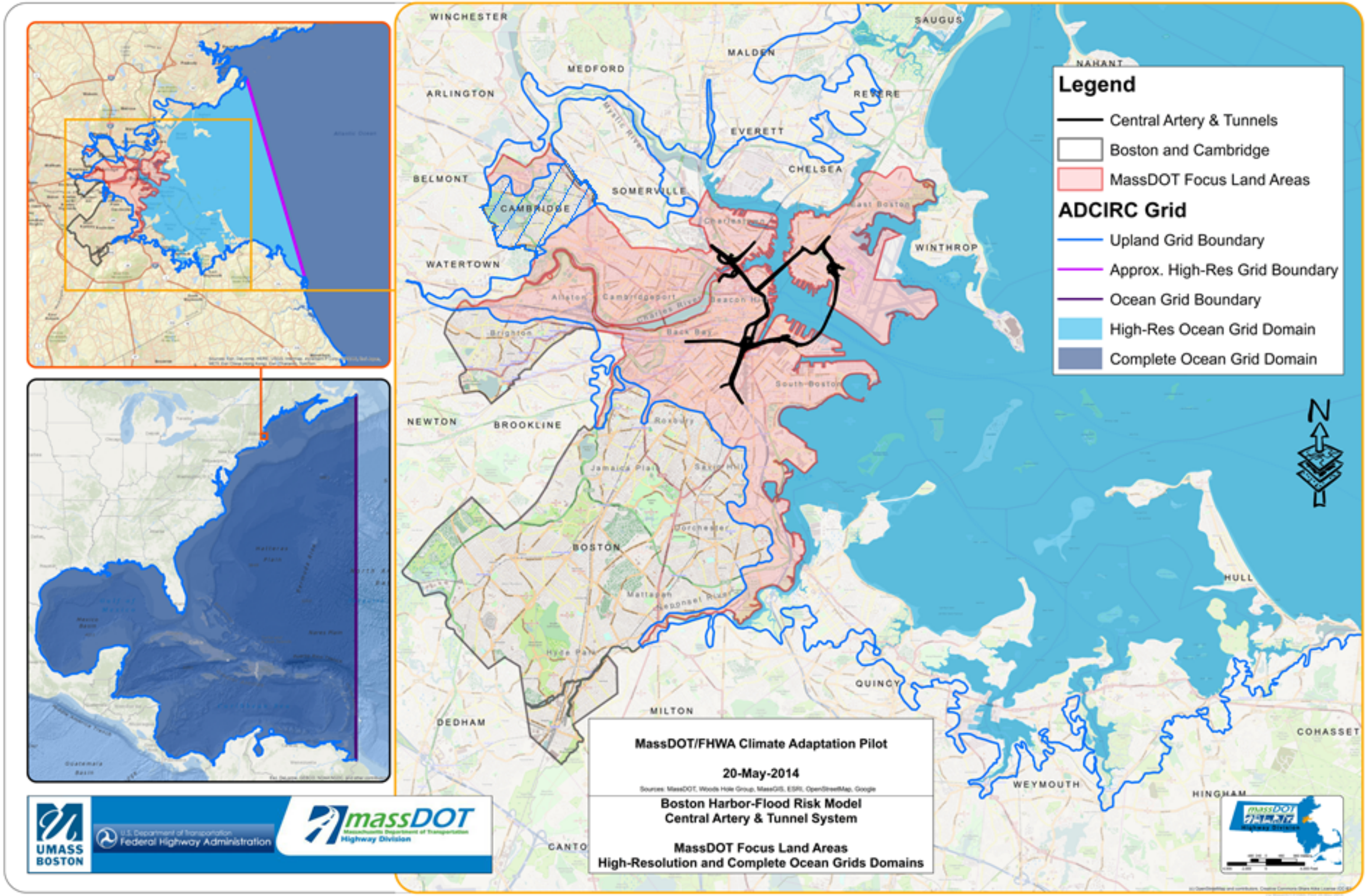
The CCVA Report

The Report and Technical Appendices online at www.cambridgema.gov/climateprep

Sea Level Rise and Storm Surge

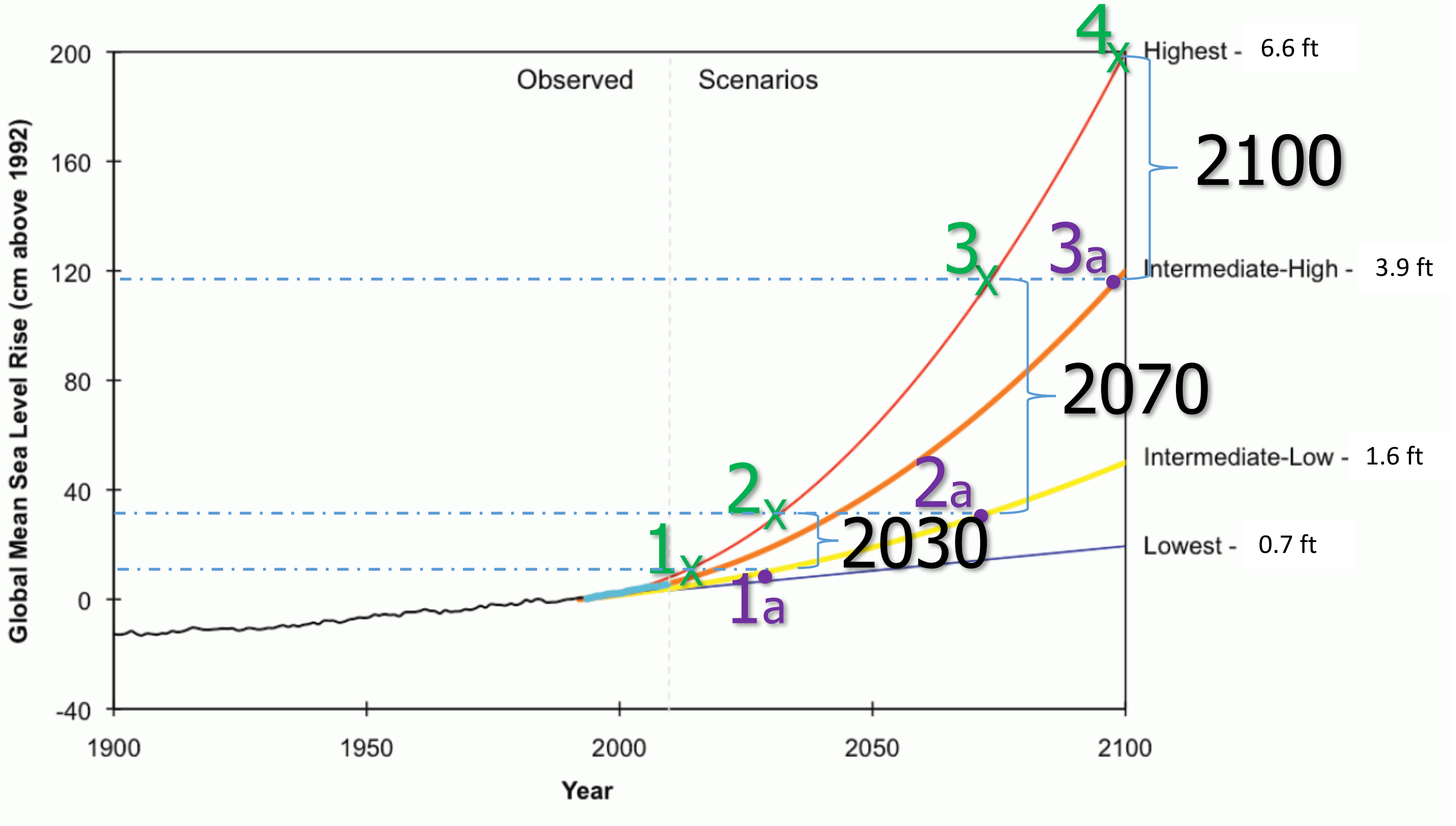


Boston Harbor Flood Risk Model

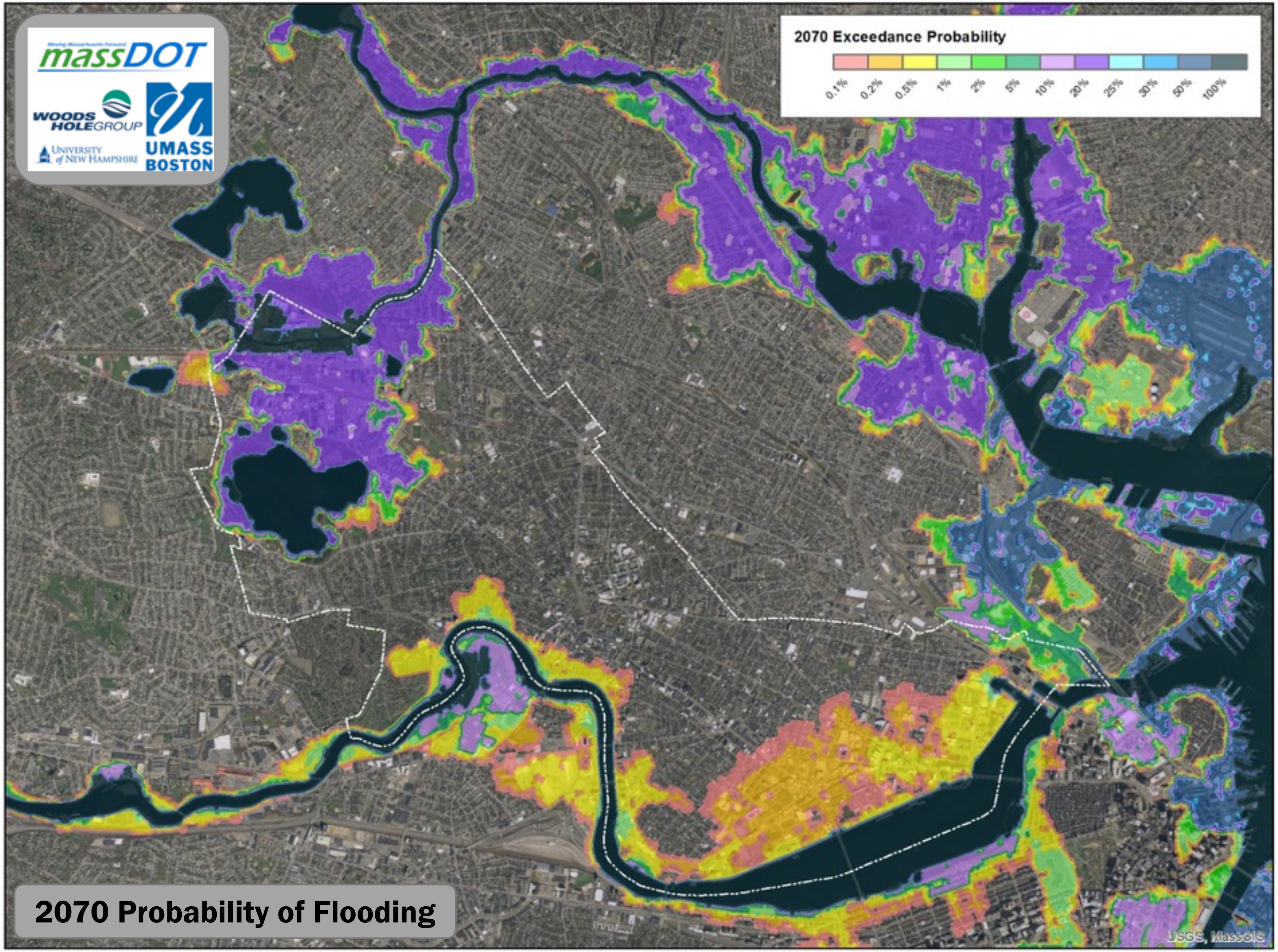


Sea Level Rise Projections

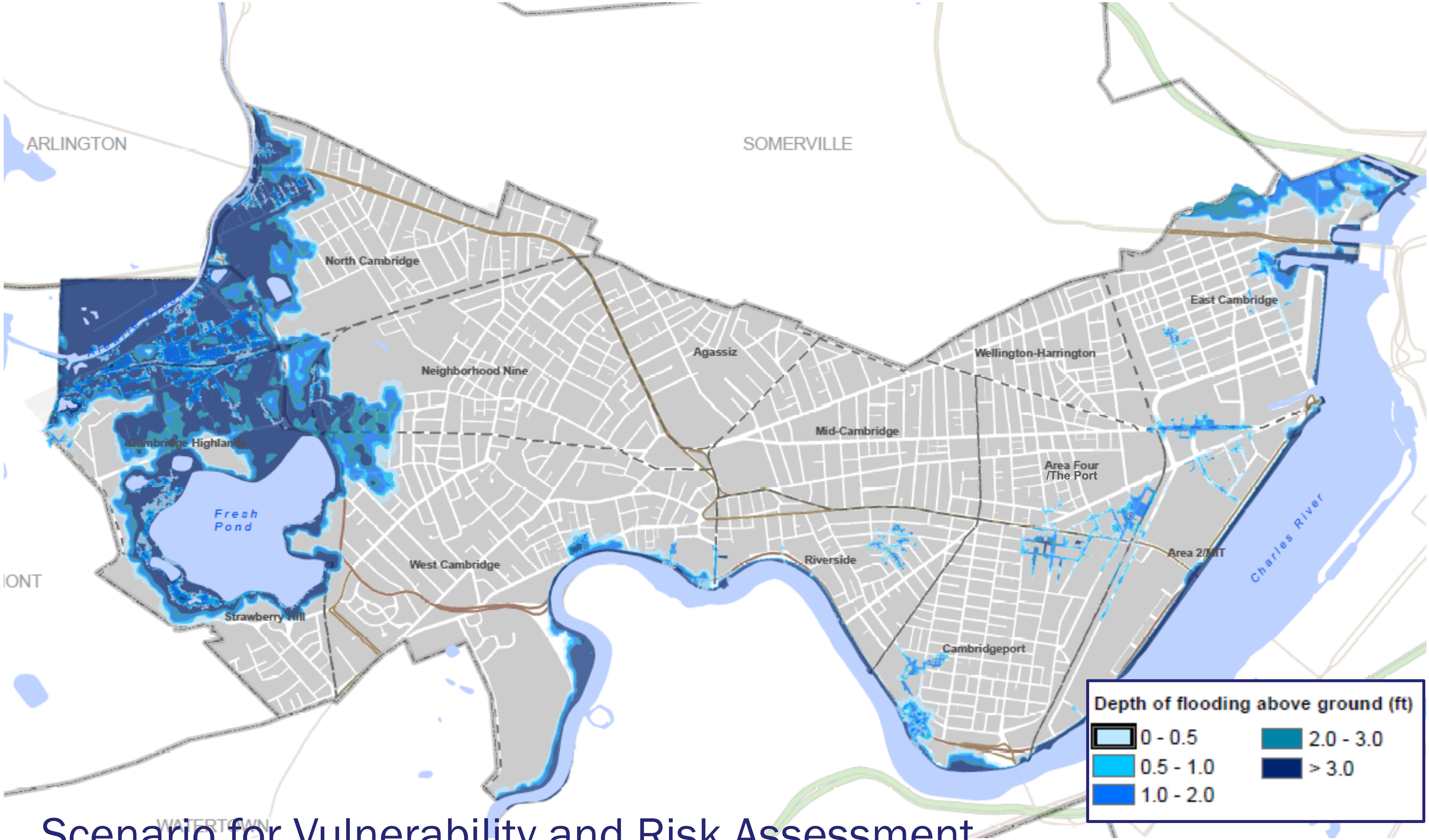
Scenarios	2020	2030	2040	2050	2060	2070	2080	2090	2100
"Highest" Global SLR (from 2013-2020) (feet)	0.21	0.61	1.10	1.70	2.40	3.21	4.11	5.12	6.23
Land subsidence (feet) @ 0.003 ft/yr	0.02	0.06	0.09	0.12	0.15	0.19	0.22	0.25	0.29
"Highest" Relative SLR (from 2013-2020) - (feet)	**0.24**	**0.66**	**1.19**	**1.82**	**2.56**	**3.39**	**4.33**	**5.37**	**6.52**



NOAA (2012). Global Sea Level Rise Scenarios for the United States National Climate Assessment


massDOT
WOODS HOLE GROUP
UNIVERSITY of NEW HAMPSHIRE
UMASS BOSTON
2070 Exceedance Probability
0.1%
0.2%
0.5%
1%
2%
5%
10%
20%
25%
30%
50%
100%
2070 Probability of Flooding
USGS, MassGIS

2070 Depth of Flooding for 1% Probability

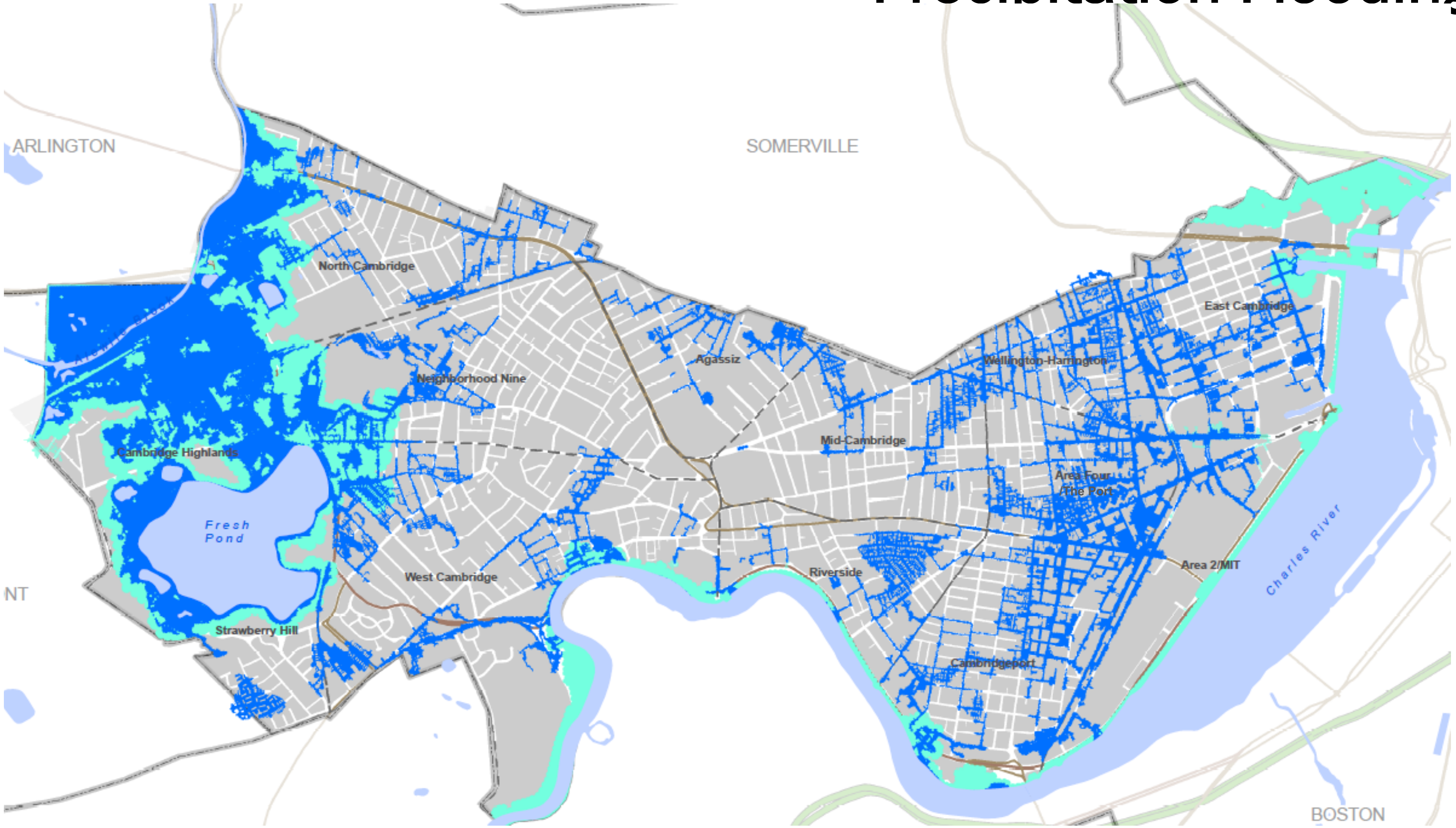


Scenario for Vulnerability and Risk Assessment

SLR/ Storm Surge + propagation through piped infrastructure

Source: Kleinfelder based on WHG & MWH analyses, October 2015

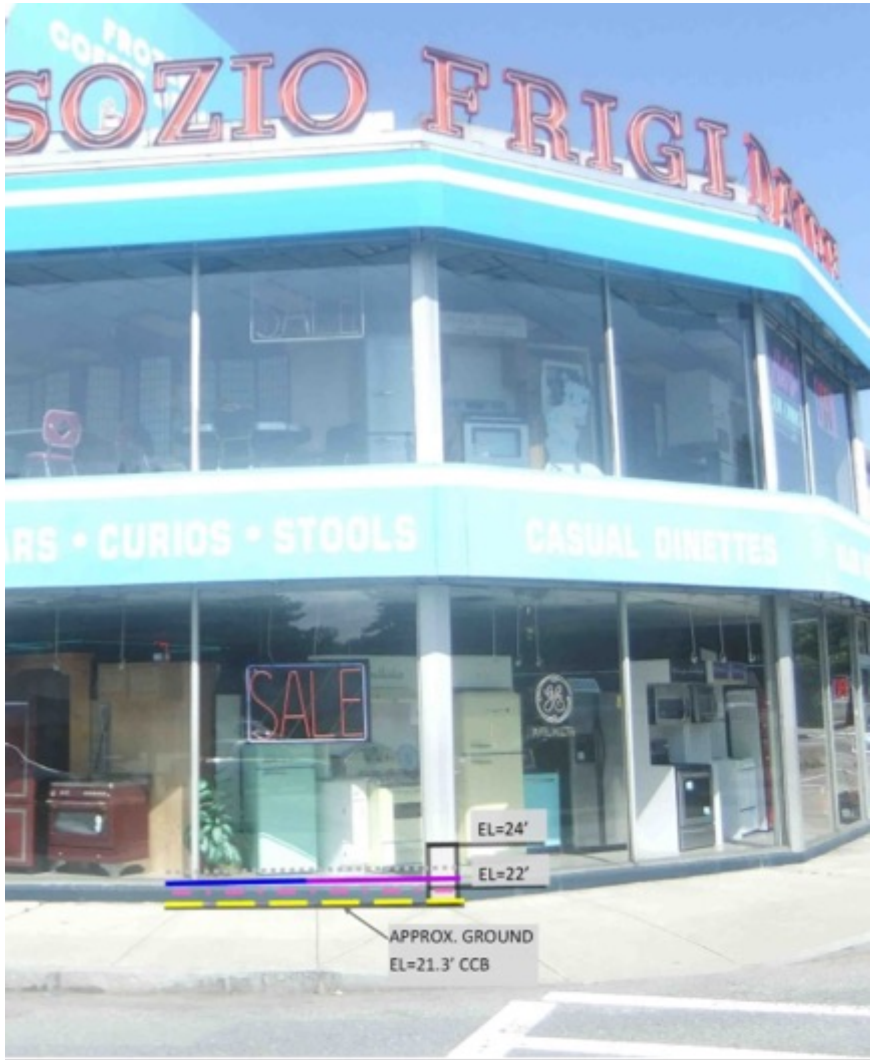
Comparison of Storm Surge and Precipitation Flooding

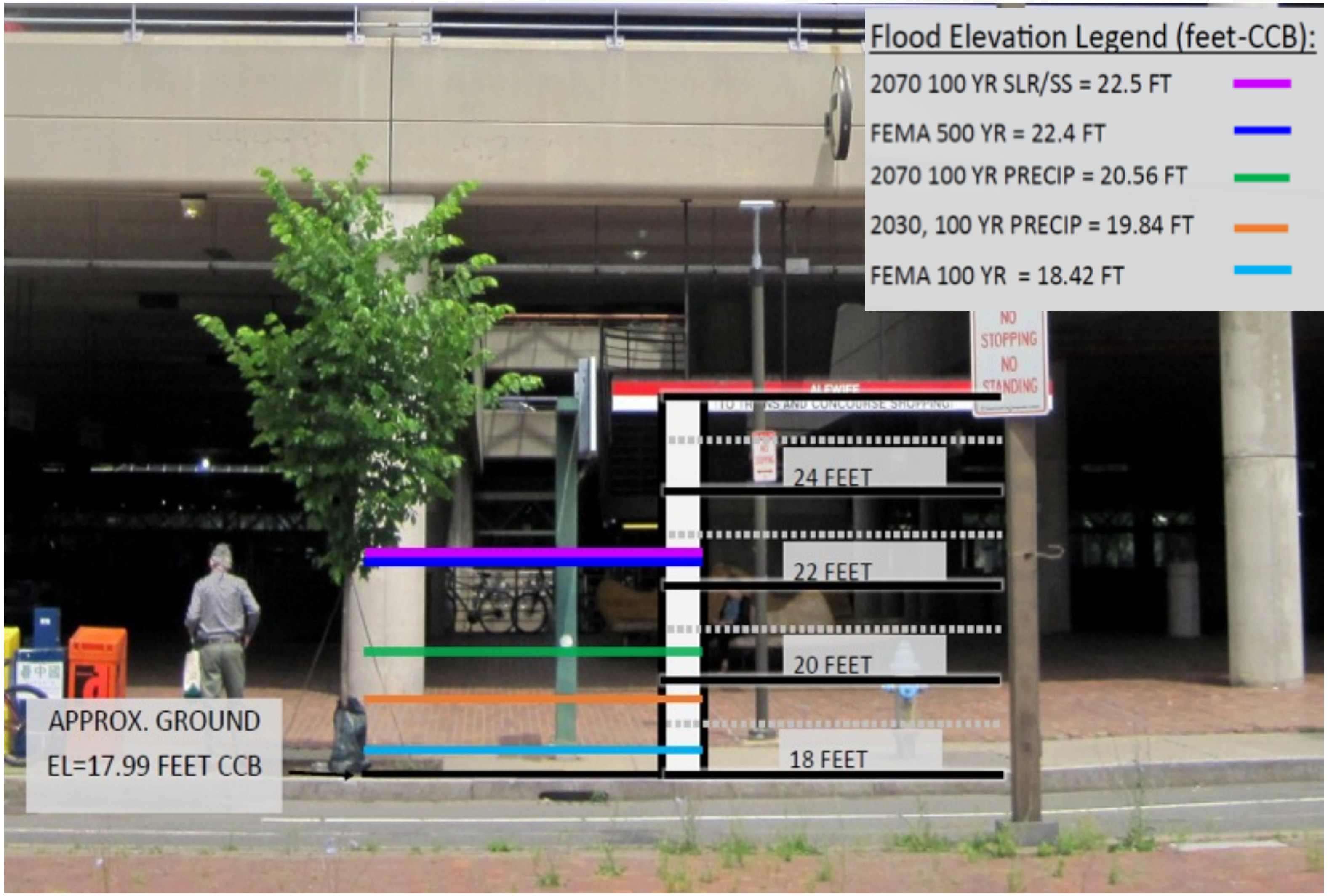


Extent of flooding from 1% flood by 2070 with SLR and storm surge and propagation through piped infrastructure (no rain)

Extent of flooding from 100-yr 24 hr rain storm by 2070

Flood Elevations





What We Learned About SLR/ Storm Surge

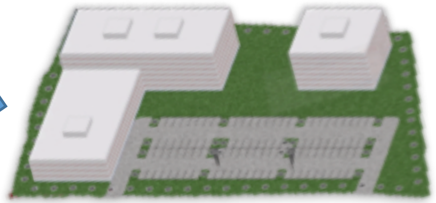
- Dams effectively protect Cambridge until at least 2030
- Both dams would be flanked before they are overtopped. For the 1% probability level (100-yr flood) by 2070, both dams are overtopped.
- Ability of the dams to pump after an event will affect the duration of flooding in the City
- Storm surge risks more significant in
  - Alewife/Fresh Pond area by 2050
  - North Point area by 2070
- Storm surge flooding would be a new experience for Cambridge

Goals and Objectives [CC Preparedness & Resiliency Plan]

- Provide a **vision for a climate-resilient Cambridge**
- Propose a **realistic set of strategies and recommended actions** to guide the City, stakeholders and community in implementing the goals of the Plan.
- **Engage the community** to help understand the strategies and the level of effort needed to create a climate-resilient and prepared community that engages stakeholders and residents in the development of recommended actions.
- **Program early actions for area(s) of focus**: Alewife Area by conducting pilot study early in the process.

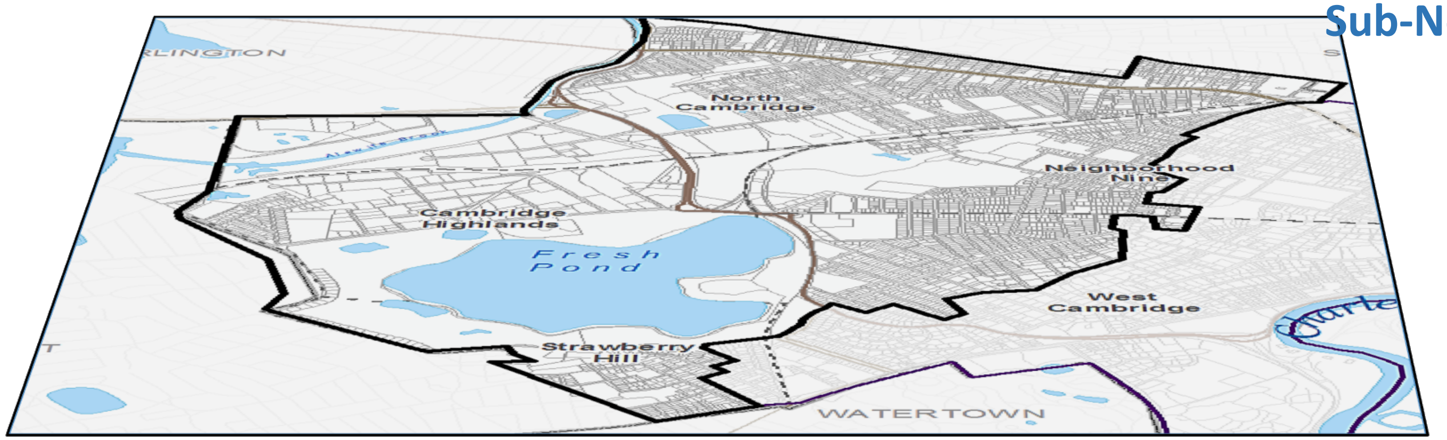
Scale of Interventions

Regional [R], Neighborhood [N], Sub-neighborhood [SN] & Parcel [P]



Parcel [P]

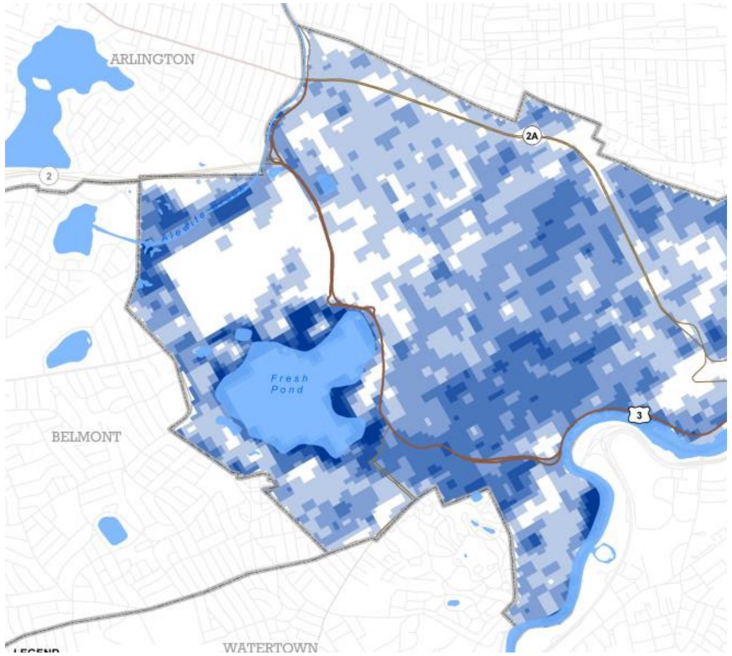
Sub-Neighborhood [SN] =Alewife / Concord



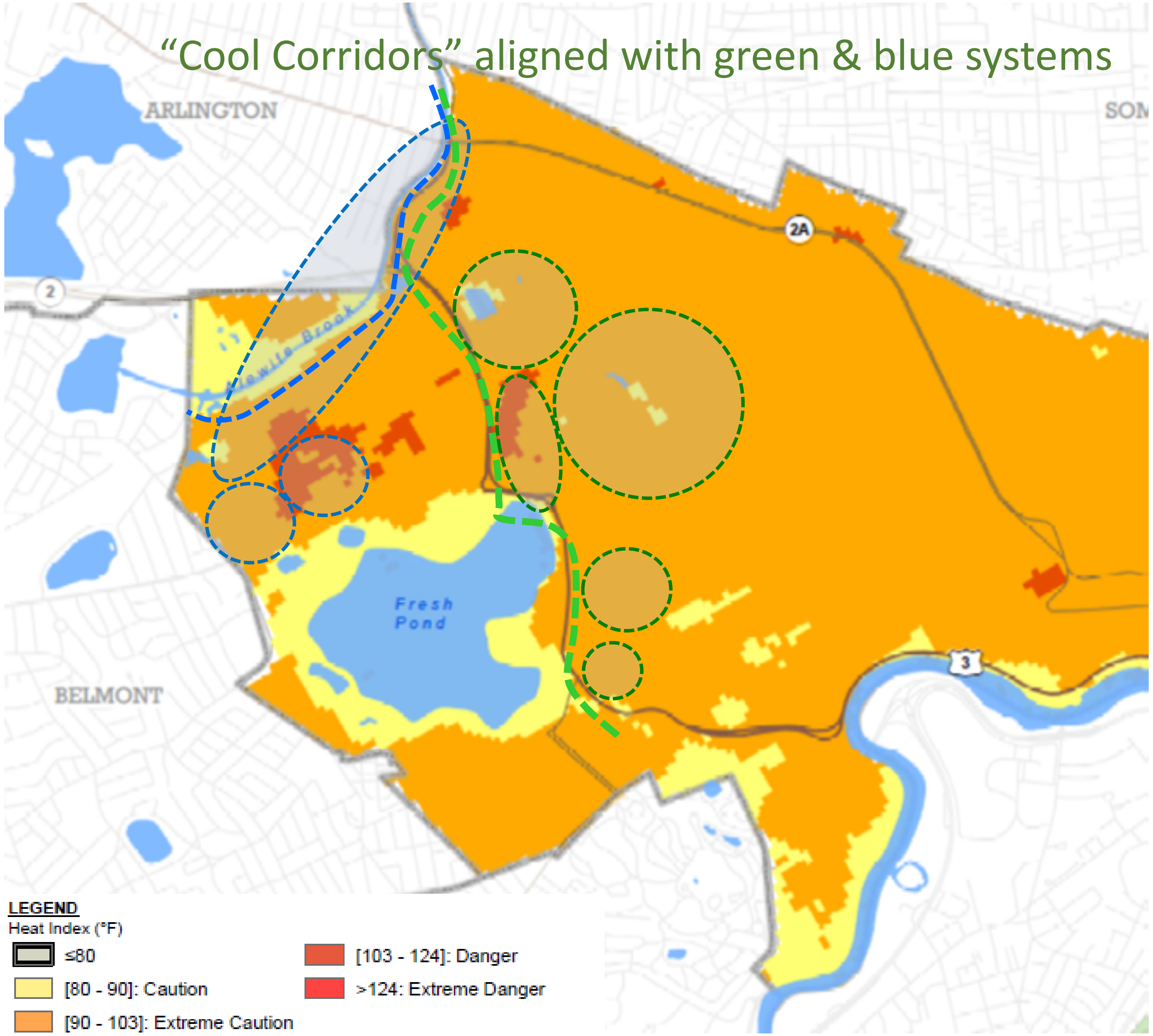
Neighborhood [N] = Alewife

Neighborhood [N] Scale: Alewife

N1:Reduce Urban Heat Island (UHI) effect by increasing tree canopy in Alewife areas deprived of vegetation. This will also improve stormwater management.

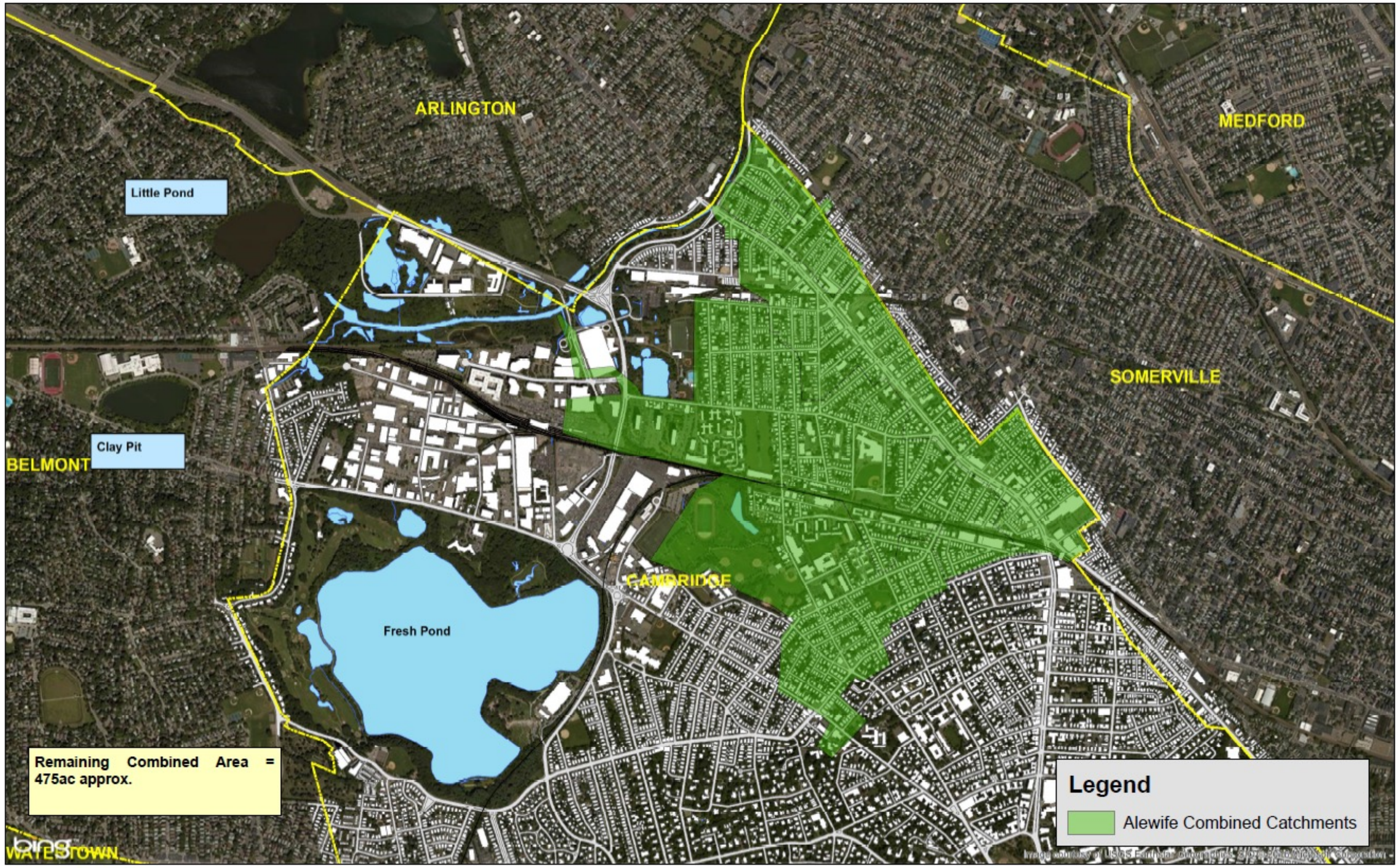


Cooling impact of tree canopy (Existing)

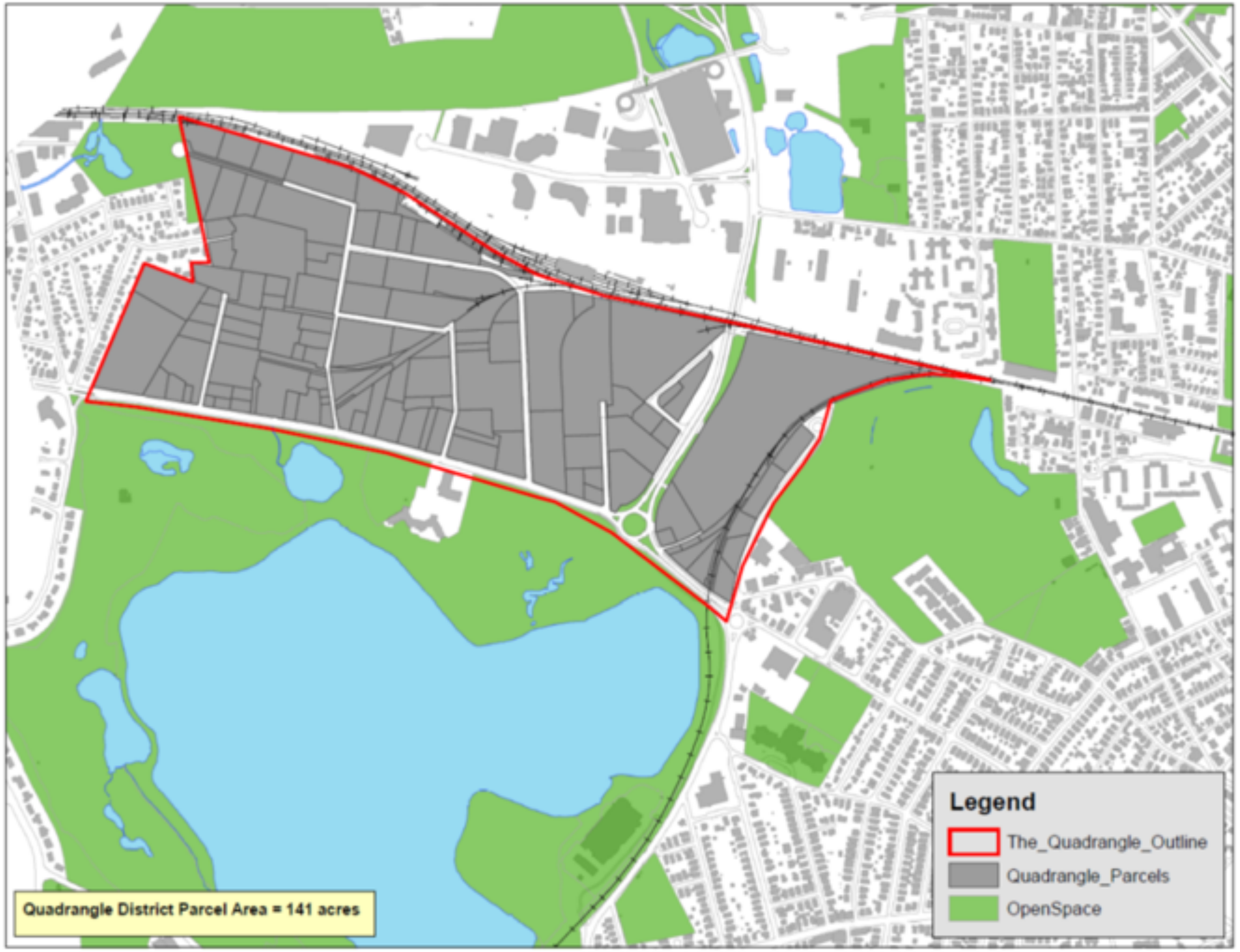


2030 heat projections

N2: Continue Sewer Separation in Alewife Area to Reduce Flooding and Adverse Public Health Impacts



SN1: Apply the "2030 25:2" Compensatory Flood Storage Requirement at the Sub-Neighborhood Scale



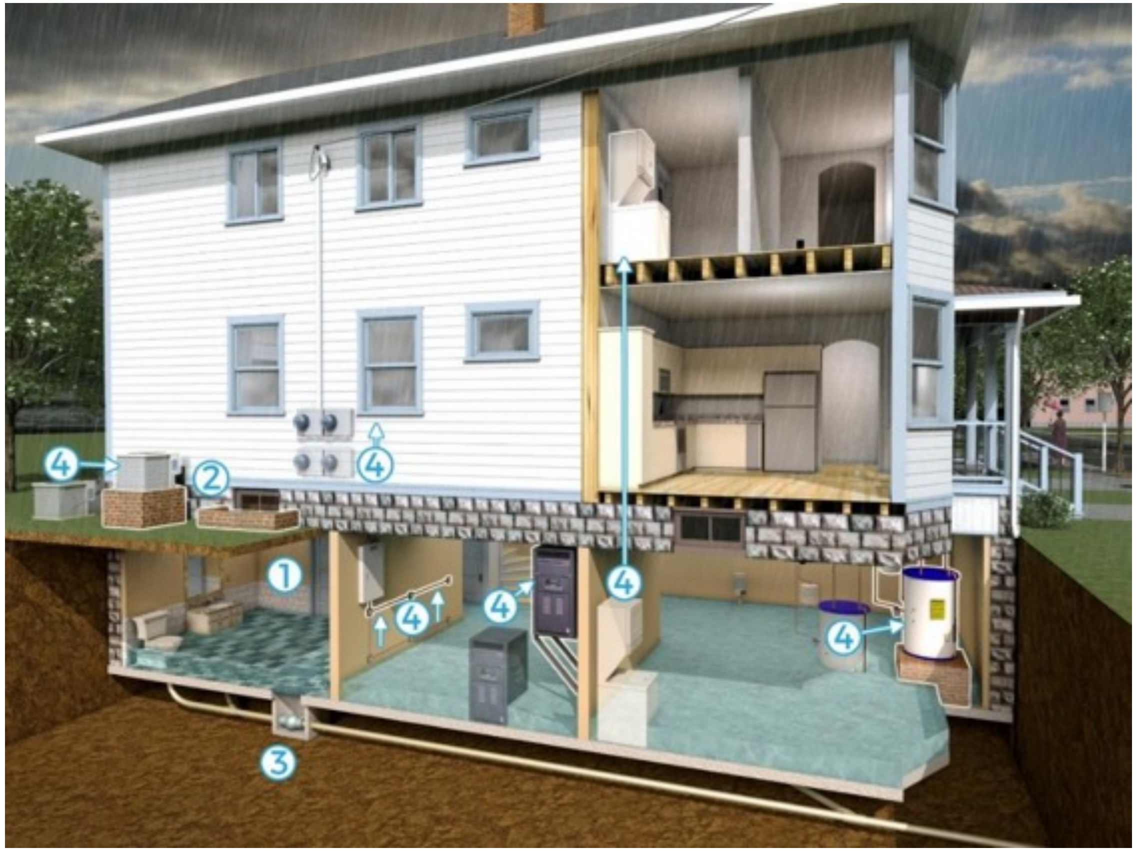
The peak flow from the site for the 2030 25-year storm under post-development conditions should be less than or equal to the present 2-year storm under pre-development conditions.

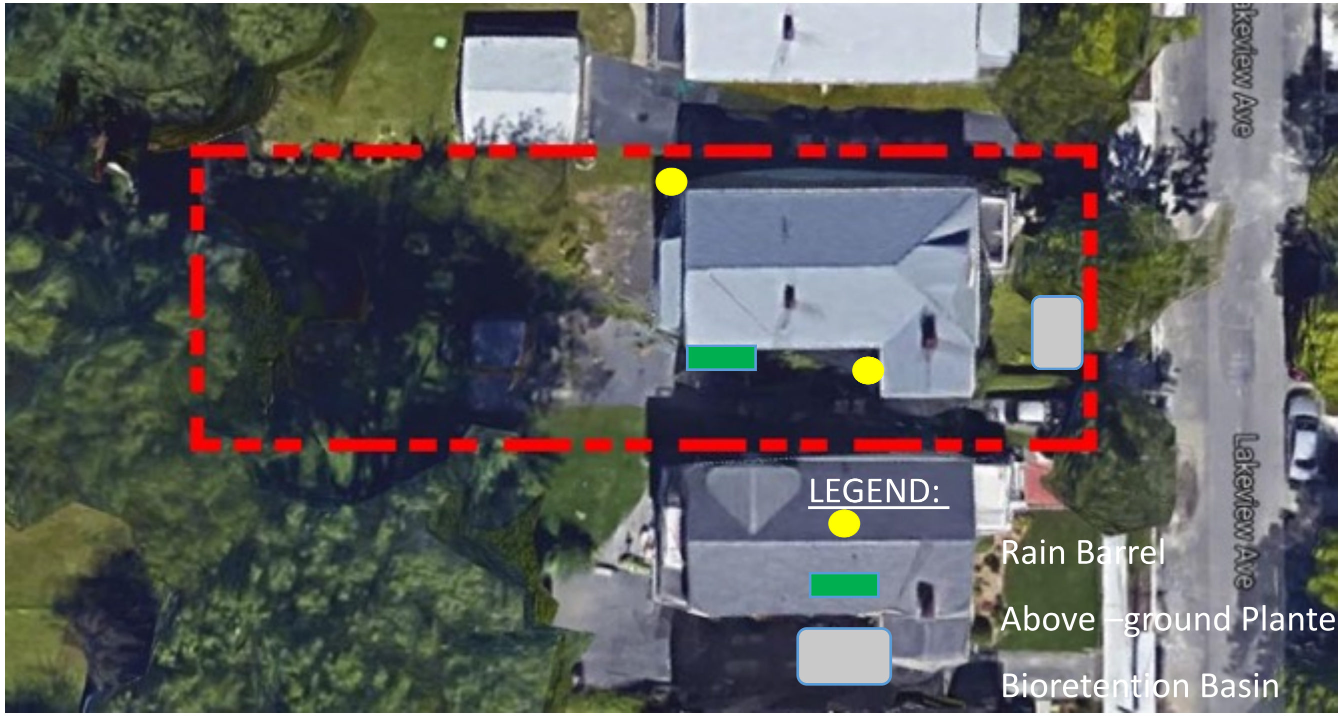
SAMPLE QUADRANGLE PARCEL:
EXISTING COMMERCIAL PARCEL

SAMPLE QUADRANGLE PARCEL:
NEW DEVELOPMENT UNDER CURRENT CODE

SAMPLE QUADRANGLE PARCEL:
NEW DEVELOPMENT WITH INTEGRATED RESILIENCY STRATEGIES

Parcel [P] Scale: Retrofit Existing Development





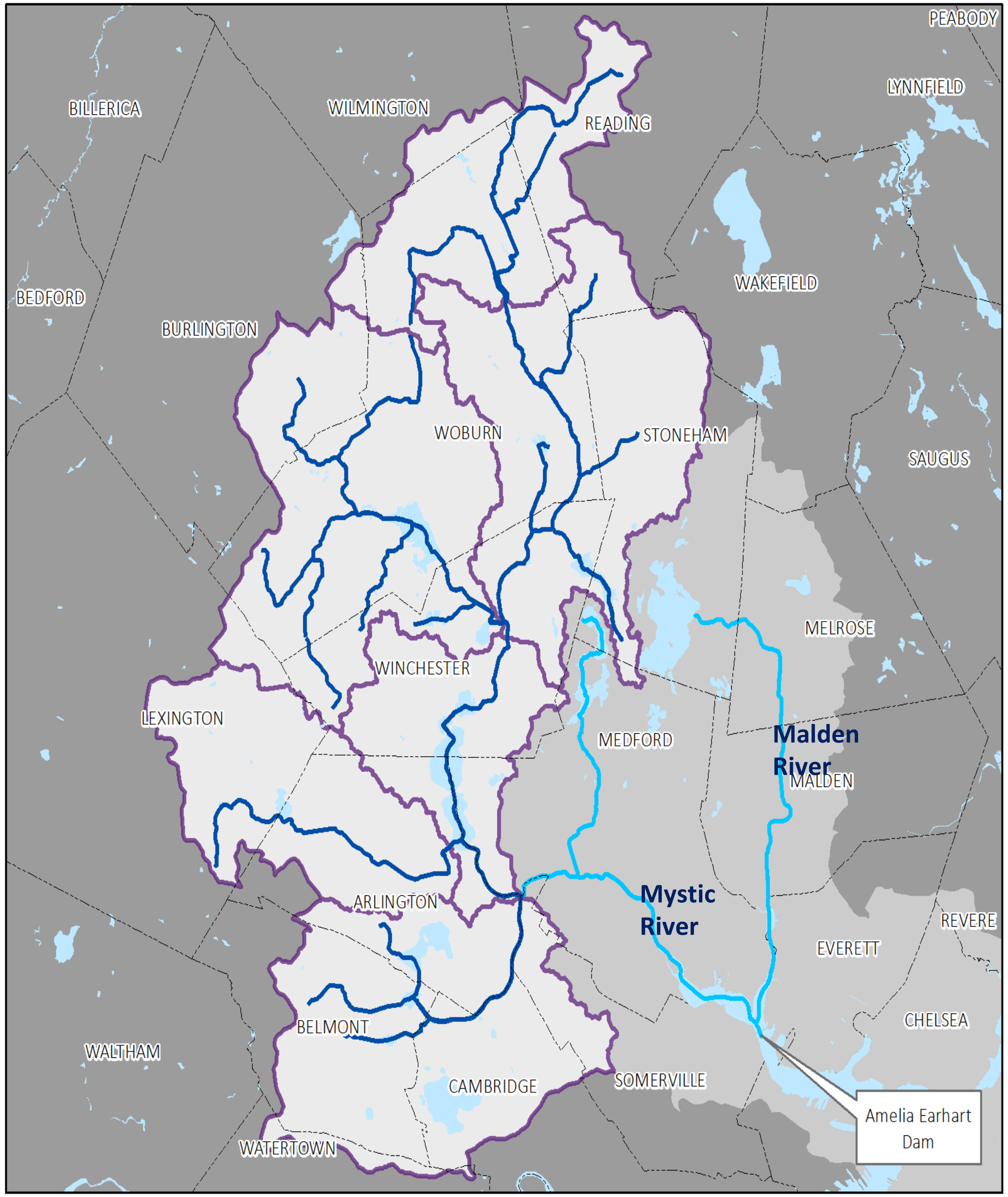
1. Use flood resilient materials
2. 2. Build exterior floodwalls
3. 3. Install backwater valves
4. 4. Elevate / relocate utilities

Revised requirements (larger storage)

Volume Requirement	Volume (gallons)
25:2 Present	564
25:2 2030	880

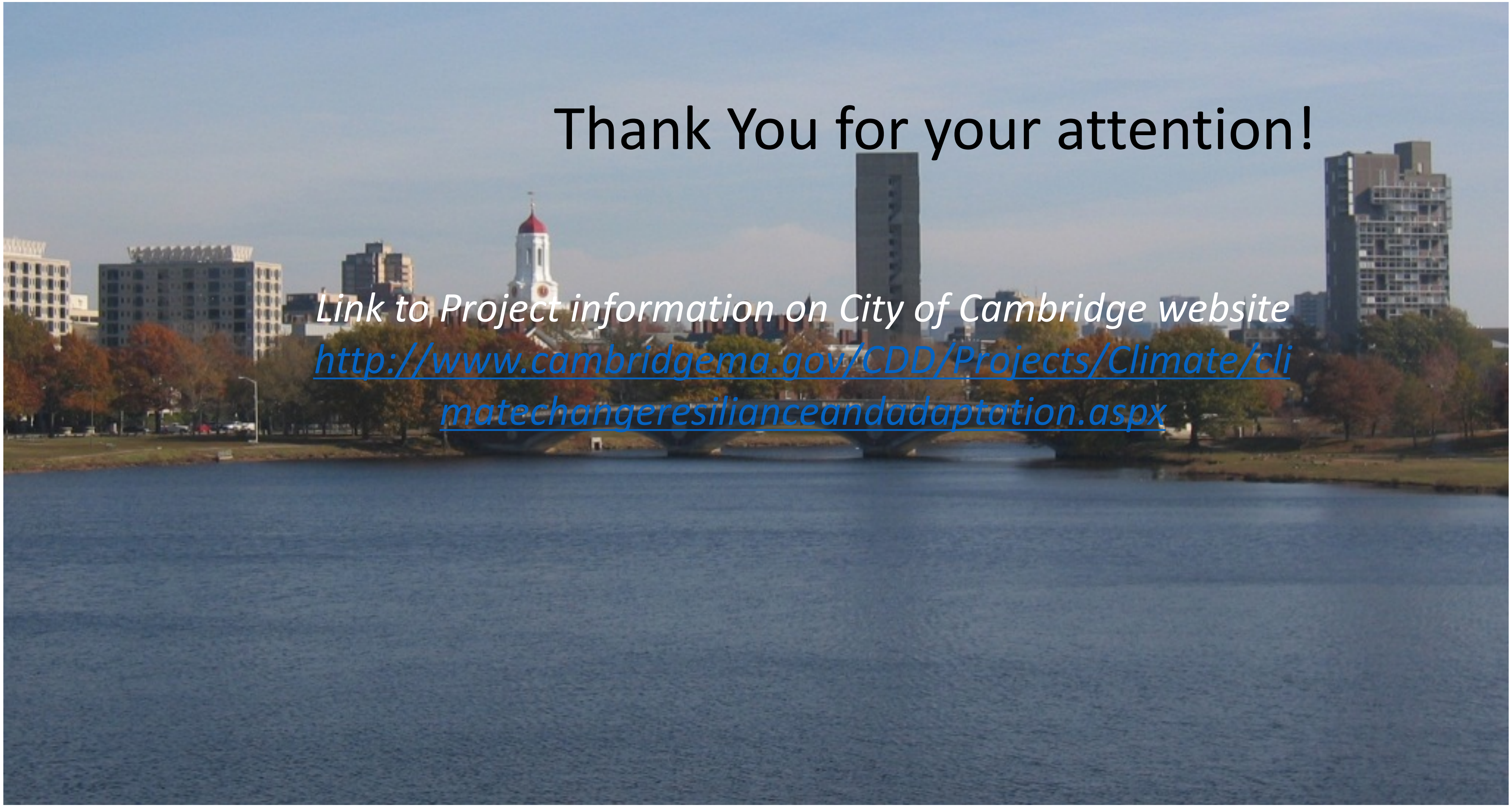
How it can be achieved

POSSIBLE GI BMP	Volume Stored (gallons)
Rain Barrel - 2	100
Above-ground Planter	75
Bioretention Basin	1,047
Total Stored	1,222



Continue coordination on regional climate resiliency efforts:

- Dam operations (DCR)
- Reducing runoff across community boundaries (ABC Flood Group)
- Explore shared responses to sea level rise and storm surge (Metro Boston Climate Preparedness Task Force)
- Ongoing flooding analyses (e.g., concurrent studies of the Mystic River, such as Senator Brownsberger's Project)



Thank You for your attention!

Link to Project information on City of Cambridge website

http://www.cambridgema.gov/CDD/Projects/Climate/climatechangeresilienceandadaptation.aspx

How to assess vulnerability & risk for assets?

- **Exposure:** Direct contact with hazard (flood/heat)

- **Vulnerability:** function of asset *Sensitivity* and *Adaptive Capacity* in relation to E*xposure*

- **Risk:** function of *Probability of Occurrence* and *Consequence of Failure*

Flood elevations