Massachusetts Department of Environmental Protection Stormwater Advisory Committee

Meeting 3: September 22, 2020

Agenda

Time for Q&A

• Welcome, Agenda, Objectives, Meeting Protocols	DEP /RVA
• MassDEP: Updating Wetlands Regulations with Current Precipitation Data	DEP
• EEA: Resilient MA Action Team (RMAT) Climate Resilience for Public Assets	EEA
• City of Cambridge Case Study / Resilient Mystic Collaborative	City of Cambridge
• Facilitated AC Discussion w/ DEP-EEA-Camb. Panel	Panel/RVA
• Facilitated Q&A with Public	Panel/RVA
• Wrap up	DEP/RVA

Increasing Precipitation: Updating MassDEP Wetlands Regulations & Stormwater Handbook

Executive Order 569: Establishing an Integrated Climate Change Strategy for the Commonwealth

September 16, 2016

"…WHEREAS, extreme weather events associated with climate change present a serious threat to public safety, and the lives and property of our residents…"

"…within two years of this Order … that includes a statewide adaptation strategy incorporating: (i) observed and projected climate trends based on the best available data, including but not limited to, extreme weather events, drought, coastal and inland flooding…"

State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) September 17, 2018

- Advance Priority Actions - EEA Resilient Massachusetts Action Team (RMAT)

- Action Item – SHMCAP Chapter 7: MassDEP Update precipitation data used by Wetlands Program

CLIMATE RESILIENCE STANDARDS, GUIDELINES, AND CAPITAL PLANNING TOOL

Resilient Massachusetts Action Team (RMAT) Technical Support

PROJECT GOALS

Mission Statement

Advance priority actions from the State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) and develop:

- Consistent standards for using climate projection data in projects with physical assets
- Guidelines and best practices for implementing climate resilient standards
- Resilient benefit evaluation web-tool for capital planning

What's the end product?

The project deliverables will be focused on supporting climate resilience in projects with physical assets owned and maintained by state agencies but can also apply to MVP Action Projects and other climate resilience projects throughout the Commonwealth. These deliverables will include downloadable materials hosted on ResilientMA.org.

KEY THEMES

Integration	Action Oriented	Science Based	Adaptable
Incorporate existing practices and procedures to promote consistent climate resilience strategy throughout the Commonwealth	Establish clear, pragmatic guidance and standards that can be applied to diverse set of project types with physical assets	Produce objective, replicable results grounded in scientific methodology and using best available data	Develop deliverables that work for current and future projects across state agencies and multiple climate hazards

PROJECT DELIVERABLES

STANDARDS

Climate Resilience Standards

The standards will provide a risk-based process that identifies climate design adjustments to be used for planning efforts. The standards will be developed using case studies that represent different asset types, geographic locations, and criticality levels.

The standards will be uploaded to ResilientMA.org with downloadable materials, including case study examples and excel templates.

GUIDELINES

Guidelines on Best Practices and Applying Standards

The guidelines will use case studies to explain how to incorporate the standards into projects. The guidelines will include checklists and forms to document the use of climate resilient standards in procedures such as procurement and project review.

The guidelines will be uploaded to ResilientMA.org with downloadable materials, including checklists, forms, and case studies.

TOOL

Web-based Capital Planning Tool

The web-based tool will be an interactive application that enables users to quantify the resilience benefits of a project for capital planning purposes. The tool will include metrics for climate resilience along with social, environmental, and governance considerations.

The tool will be an online application hosted on ResilientMA.org, with a downloadable user's manual that includes example projects from capital planning.

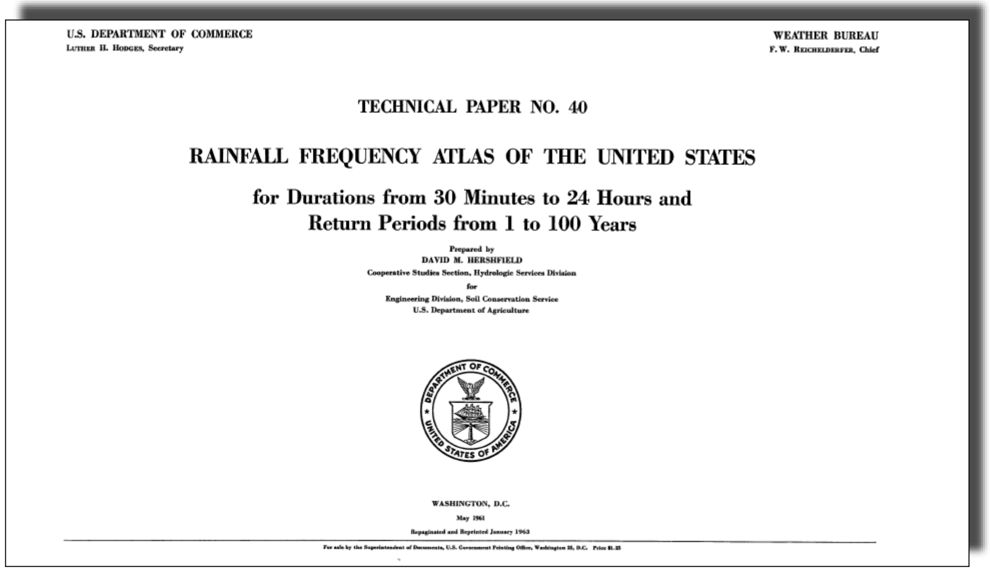
Why Change the Precipitation Amounts in the Wetland Regulations?

To protect interests of the Wetlands Protection Act, including:

- Storm Damage Prevention;
- Flood Control;
- Prevention of Pollution; and
- Protection of Ground Water Supply

Design Storms Required by Wetland Regulations Are Out-Of-Date

- Wetland regulation design storms rely on the precipitation estimates from TP40
- TP40 Published in 1961
- TP40 compared to more current precipitation estimates
- TP40 does not reflect current or future precipitation estimates



U.S. DEPARTMENT OF COMMERCE
LUTHER H. HODGES, Secretary

WEATHER BUREAU
F. W. REICHELDERFER, Chief

TECHNICAL PAPER NO. 40

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and
Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

WASHINGTON, D.C.
May 1961
Repaginated and Reprinted January 1963

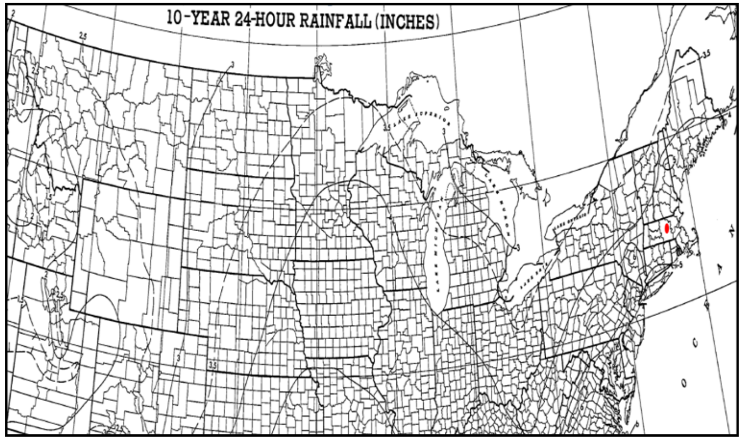
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $1.25

Wetland Design Storms Rely on Precipitation Estimates

RESOURCE	DESIGN STORM
EXTREME PRECIPITATION (TOP 1% STORMS)	
Vernal Pool boundary	2.6-inch storm in 24-hours (310 CMR 10.57(2)(a)6.). Approximates TP40 Statewide 1-year 24-hour storm.
BLSF	Wildlife Habitat: 4.8-inch storm in 24-hours in absence of FEMA profile data (310 CMR 10.57(2)(a)4.). Approximates the TP40 Statewide 10-year 24-hour storm. Outer Boundary: 7.0-inch storm in 24-hours in absence of FEMA profile data (310 CMR 10.57(2)(a)3.a.) Approximates the TP40 Statewide 100-year 24-hour storm
ILSF	Volume: 1-year 24-hour design storm (Wetlands Policy 85-2). Outer Boundary: 7.0-in. storm in 24-hours (310 CMR 10.57(2)(b)3.). Approximates the TP40 Statewide 100-year 24-hour storm.
Peak Runoff Rate	2-, 10-, and 100-year 24-hour storms from TP40
Stream Crossings	Maintain channel carrying capacity, Meet Stream Crossing Standards
ANNUAL PRECIPITATION AND FIRST FLUSH STORM	
Stormwater Recharge	0.1-inch to 0.6-inches, depending on Hydrologic Soil Group
Stormwater Water Quality Volume	First ½-inch or 1-inch of runoff, depending if the stormwater is directed to or near a critical area, soil with rapid infiltration rate, or land use with higher potential pollutant load.

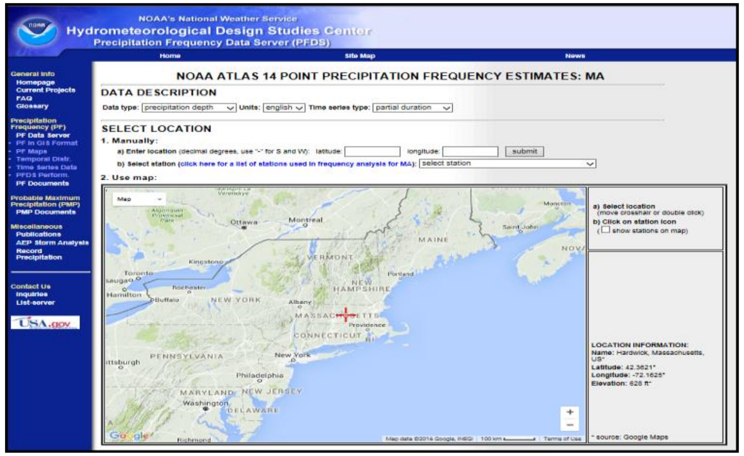
MassDEP

Which Precipitation Estimates Did We Consider?

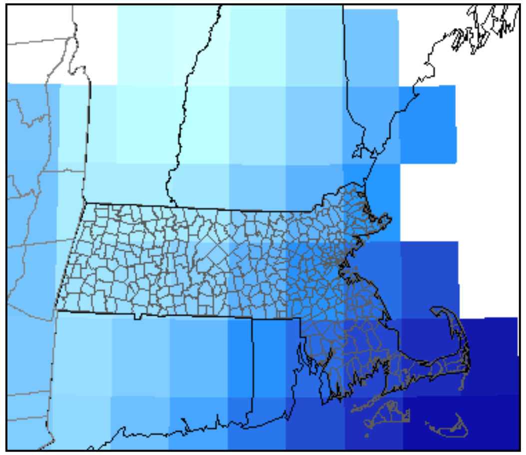


1961 TP40

2008 NRCC at Cornell:
Current Conditions



2015/2019 NOAA 14:
Current Conditions



Downscaled GCM:
Future Conditions

MassDEP Considers NOAA14 Most Robust Atlas

	Year Published	# of Mass. Stations	# of Mass. Stations >100-years	Date Range (Earliest Date to Latest Date)	Mass. Average Record Length (Years)
TP40	1961	12*	Unknown	Unknown - 1958	Unknown
NRCC (Cornell)	Circa 2009	116	10	1872-2008	59
NOAA14	2015/2019	265	51	1816-2014	59

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QUIZ 1

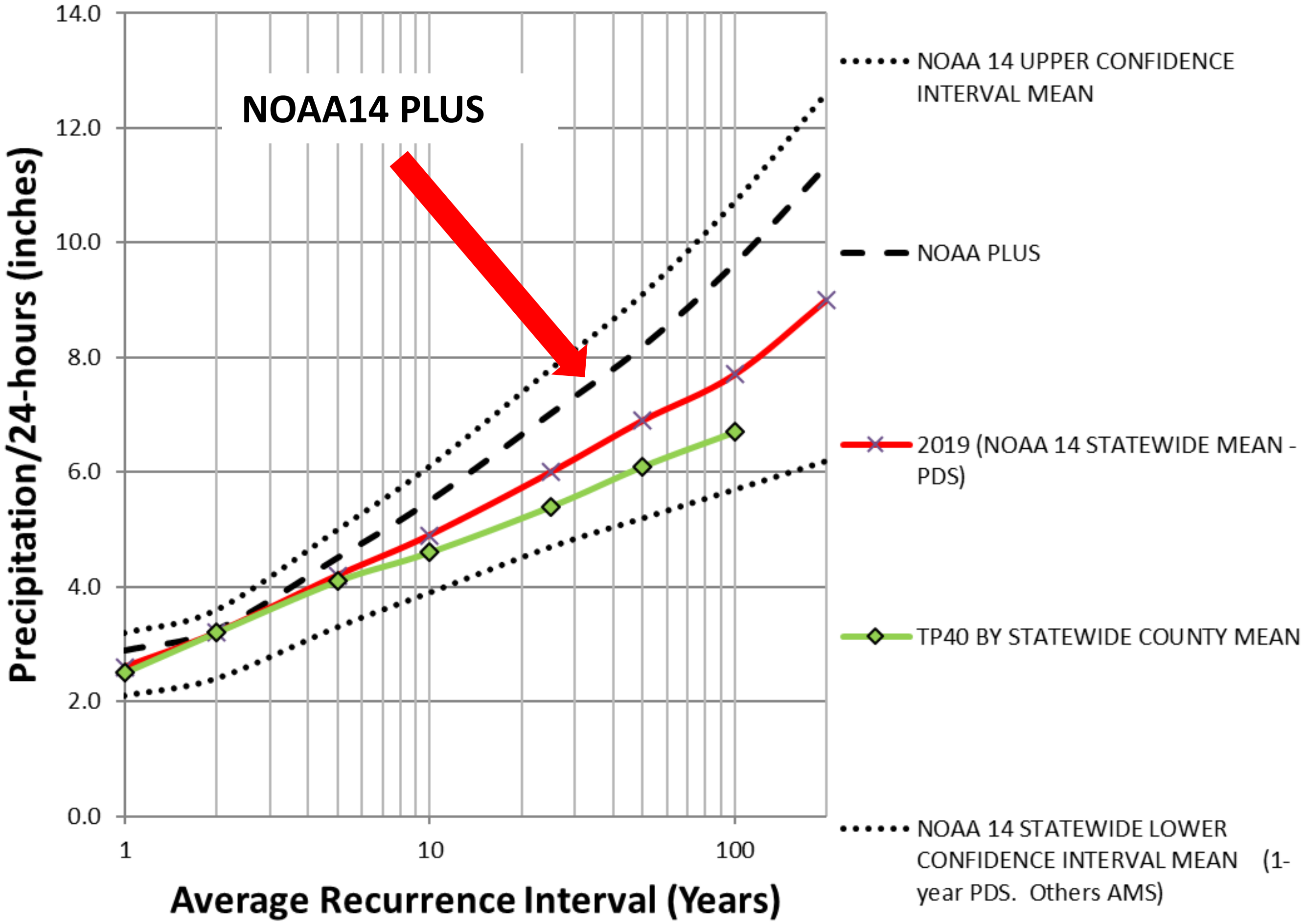
LOCATION	OBSERVATION DATE	1-day OBSERVED MAX (inches), Constrained	24-hour MAX (inches), Unconstrained
WESTFIELD, MA	8/19/1955	18.15	20.14
SPRINGFIELD, MA	8/19/1955	11.47	12.73
MILFORD, MA	10/15/2005	7.69	8.53
BOSTON LOGAN INTL AP, MA	8/19/1955	7.52	8.35

QUIZ 2

LOCATION	24-hour MAX (inches)	NOAA 14 Precipitation Frequency
WESTFIELD, MA	20.14	8.74
SPRINGFIELD, MA	12.73	8.12
MILFORD, MA	8.53	8.21
BOSTON LOGAN INTL AP, MA	8.35	7.88

MassDEP Preferred Option: NOAA 14 PLUS

- **Incorporates risk observed in the <u>current</u> data to reflect range of larger storms.**



How Do You Get NOAA14 PLUS?

- Navigate to NOAA14 Web site (https://hdsc.nws.noaa.gov/hdsc/pfds/)
- Click Massachusetts map on the desired location
- Navigate to "point-of-interest," Tabular results will pop-up
- Multiple 0.9 by the NOAA Upper Confidence
- Example: 10.7 x 0.9 = 9.63-inches, use 9.63-inches for 100-year 24-hour storm instead of 7.88-inches

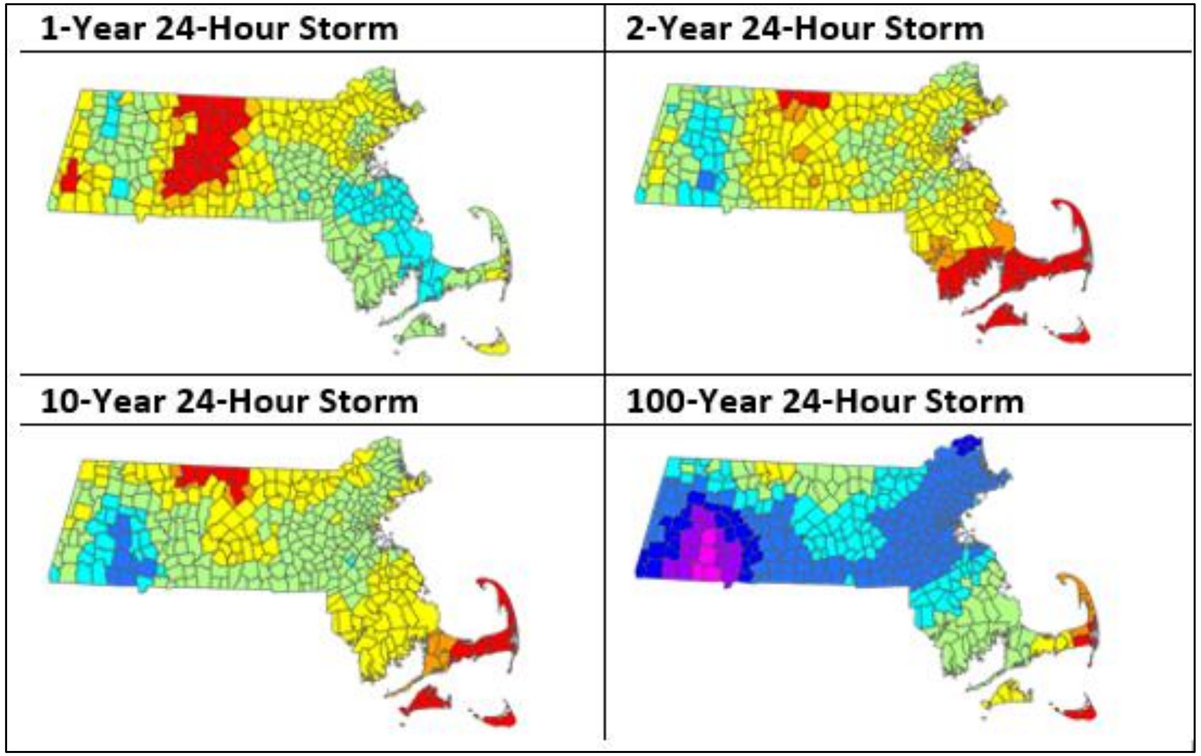
PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.296** (0.243-0.361)	**0.366** (0.300-0.446)	**0.480** (0.392-0.587)	**0.574** (0.465-0.708)	**0.704** (0.549-0.919)	**0.801** (0.610-1.07)	**0.905** (0.665-1.27)	**1.03** (0.703-1.48)	**1.22** (0.792-1.82)	**1.38** (0.870-2.10)
10-min	**0.420** (0.345-0.511)	**0.518** (0.425-0.632)	**0.679** (0.554-0.831)	**0.813** (0.659-1.00)	**0.998** (0.777-1.30)	**1.14** (0.863-1.52)	**1.28** (0.942-1.80)	**1.46** (0.994-2.09)	**1.72** (1.12-2.57)	**1.95** (1.23-2.97)
15-min	**0.494** (0.405-0.601)	**0.610** (0.500-0.743)	**0.800** (0.653-0.979)	**0.957** (0.776-1.18)	**1.17** (0.915-1.53)	**1.34** (1.01-1.79)	**1.51** (1.11-2.12)	**1.72** (1.17-2.46)	**2.03** (1.32-3.02)	**2.29** (1.45-3.50)
30-min	**0.659** (0.541-0.802)	**0.815** (0.668-0.993)	**1.07** (0.873-1.31)	**1.28** (1.04-1.58)	**1.57** (1.23-2.05)	**1.79** (1.36-2.40)	**2.02** (1.49-2.84)	**2.30** (1.57-3.30)	**2.72** (1.77-4.06)	**3.08** (1.95-4.70)
60-min	**0.824** (0.677-1.00)	**1.02** (0.836-1.24)	**1.34** (1.09-1.64)	**1.61** (1.30-1.98)	**1.97** (1.54-2.57)	**2.24** (1.71-3.00)	**2.53** (1.86-3.56)	**2.88** (1.97-4.13)	**3.42** (2.22-5.10)	**3.87** (2.45-5.91)
2-hr	**1.07** (0.882-1.29)	**1.34** (1.10-1.62)	**1.78** (1.46-2.16)	**2.14** (1.75-2.62)	**2.64** (2.08-3.43)	**3.01** (2.31-4.02)	**3.42** (2.54-4.80)	**3.92** (2.68-5.57)	**4.70** (3.07-6.94)	**5.38** (3.41-8.11)
3-hr	**1.25** (1.03-1.50)	**1.56** (1.30-1.89)	**2.08** (1.72-2.52)	**2.51** (2.06-3.06)	**3.11** (2.45-4.02)	**3.54** (2.73-4.71)	**4.02** (3.00-5.62)	**4.62** (3.17-6.52)	**5.55** (3.63-8.15)	**6.36** (4.05-9.54)
6-hr	**1.63** (1.36-1.95)	**2.03** (1.69-2.44)	**2.69** (2.23-3.24)	**3.24** (2.67-3.92)	**3.99** (3.16-5.12)	**4.54** (3.51-5.99)	**5.15** (3.85-7.12)	**5.90** (4.07-8.25)	**7.08** (4.65-10.3)	**8.10** (5.17-12.0)
12-hr	**2.10** (1.77-2.50)	**2.59** (2.18-3.09)	**3.40** (2.84-4.06)	**4.06** (3.37-4.88)	**4.98** (3.96-6.32)	**5.65** (4.39-7.37)	**6.39** (4.80-8.7[illegible])	**7.30** (5.05-10.1)	**8.69** (5.73-12.5)	**9.90** (6.34-14.5)
24-hr	**2.53** (2.14-2.99)	**3.14** (2.65-3.71)	**4.14** (3.48-4.92)	**4.97** (4.15-5.94)	**6.12** (4.91-7.72)	**6.96** (5.45-9.02)	**7.88** (5.96-10.7)	**9.04** (6.28-12.4)	**10.9** (7.17-15.4)	**12.4** (7.98-18.0)

Metrics MassDEP Studied To Determine Effects on Wetlands

METRICS	AFFECTS
• TP40, NRCC, NOAA, NOAA+, GCM (CAVA) differences • Annual Maximum Daily Precipitation Trend • Annual Number of Storms ≥ 2-inches (Top 1% Daily Storms)	• Peak Runoff Rate • BLSF Boundaries • ILSF Boundaries • Vernal Pools Boundaries
• Annual Precipitation Trend	• Stormwater Recharge
• Trend in Daily Storms that cause the "First Flush" runoff	• Water Quality Volume

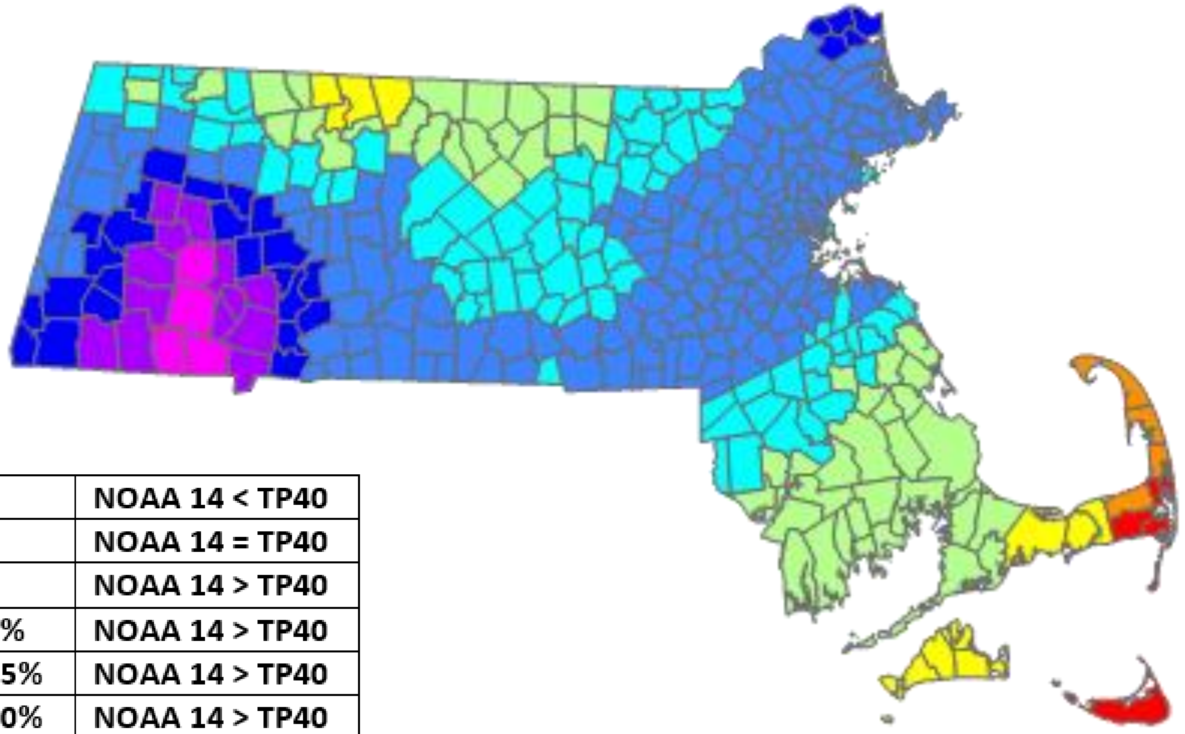
Current NOAA 14 Intensity Is Greater In Many Locations Than 1961 TP40



LEGEND

(red)	<0%	NOAA 14 < TP40
(orange)	0	NOAA 14 = TP40
(yellow)	>0 to 5%	NOAA 14 > TP40
(green)	>5% to 10%	NOAA 14 > TP40
(cyan)	>10% to 15%	NOAA 14 > TP40
(light blue)	>15% to 20%	NOAA 14 > TP40
(blue)	>20% to 25%	NOAA 14 > TP40
(purple)	>25% to 30%	NOAA 14 > TP40
(pink)	>30 to 35%	NOAA 14 > TP40

NOAA14 100-year 24-Hour Storm Intensity is Greater Than TP40 in Many Locations



LEGEND

(red)	<0%	NOAA 14 < TP40
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(cyan)	>10% to 15%	NOAA 14 > TP40
(light blue)	>15% to 20%	NOAA 14 > TP40
(blue)	>20% to 25%	NOAA 14 > TP40
(purple)	>25% to 30%	NOAA 14 > TP40
(pink)	>30 to 35%	NOAA 14 > TP40

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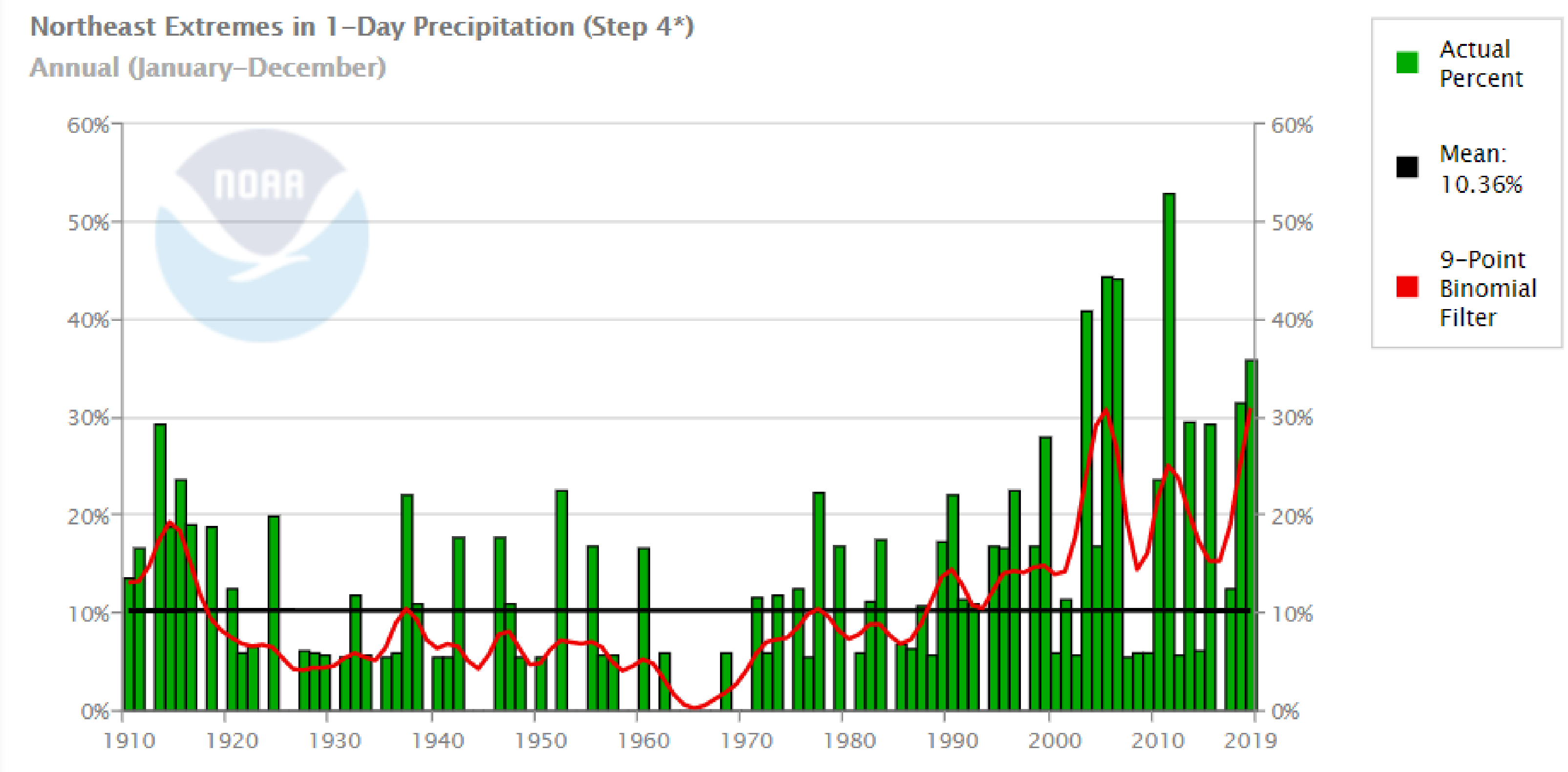
Top 1% Daily Storms: Increasing Trend (Peak Runoff Rate, BLSF, ILSF, Vernal Pools)

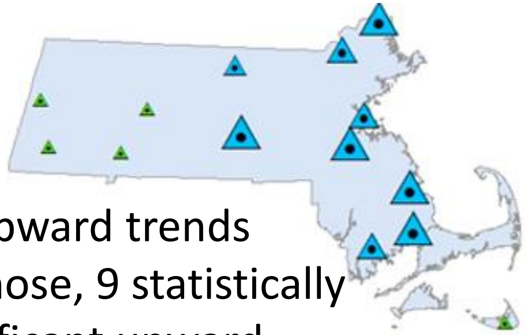


NOAA, U.S. Climate Extremes Index, Northeast Extremes in 1-Day Precipitation, https://www.ncdc.noaa.gov/extremes/cei/graph

Data from the GHCN Northeast Network: Approximately 1600 Stations

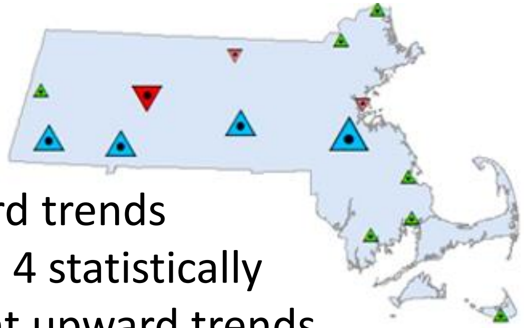
Top 1% Daily Storms: Trend is Significant

Top 1% Storms
(Daily Storms/year ≥ 2-inches)



- 14 upward trends
- Of those, 9 statistically significant upward trends
- No downward trends

Annual Maximum Daily Precipitation



- 11 upward trends
- Of those: 4 statistically significant upward trends
- 1 statistically significant downward trend

LEGEND

	Positive Trend, Not Significant at $\alpha = 0.1$
	Positive Trend, Significant at $\alpha = 0.1$
	Negative Trend, Not Significant at $\alpha = 0.1$
	Negative Trend, Significant at $\alpha = 0.1$

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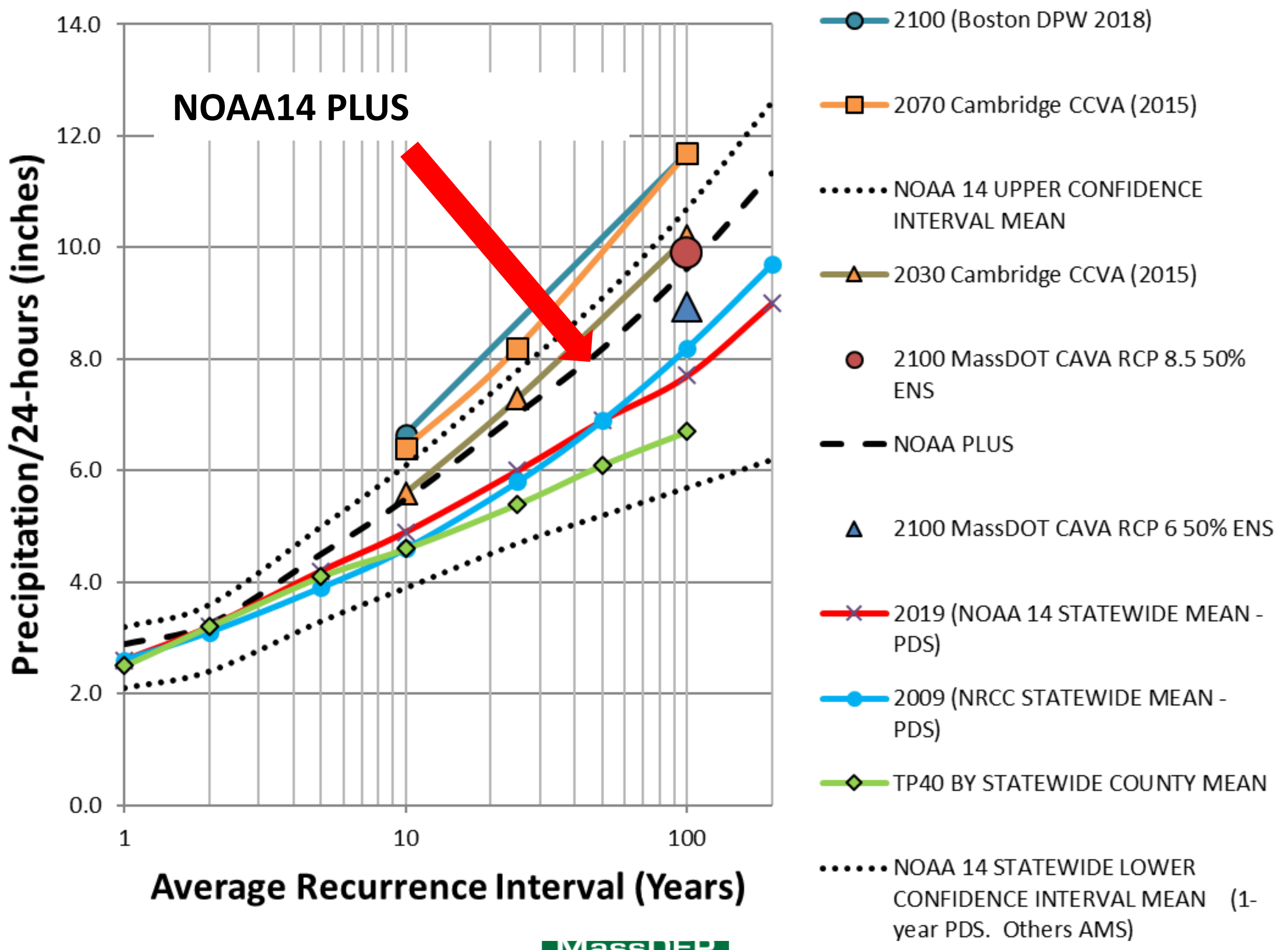
Top 1% Storms: Expansion of *Flood Prone Areas*

NOAA PLUS Better Accounts for Larger Observed Storms



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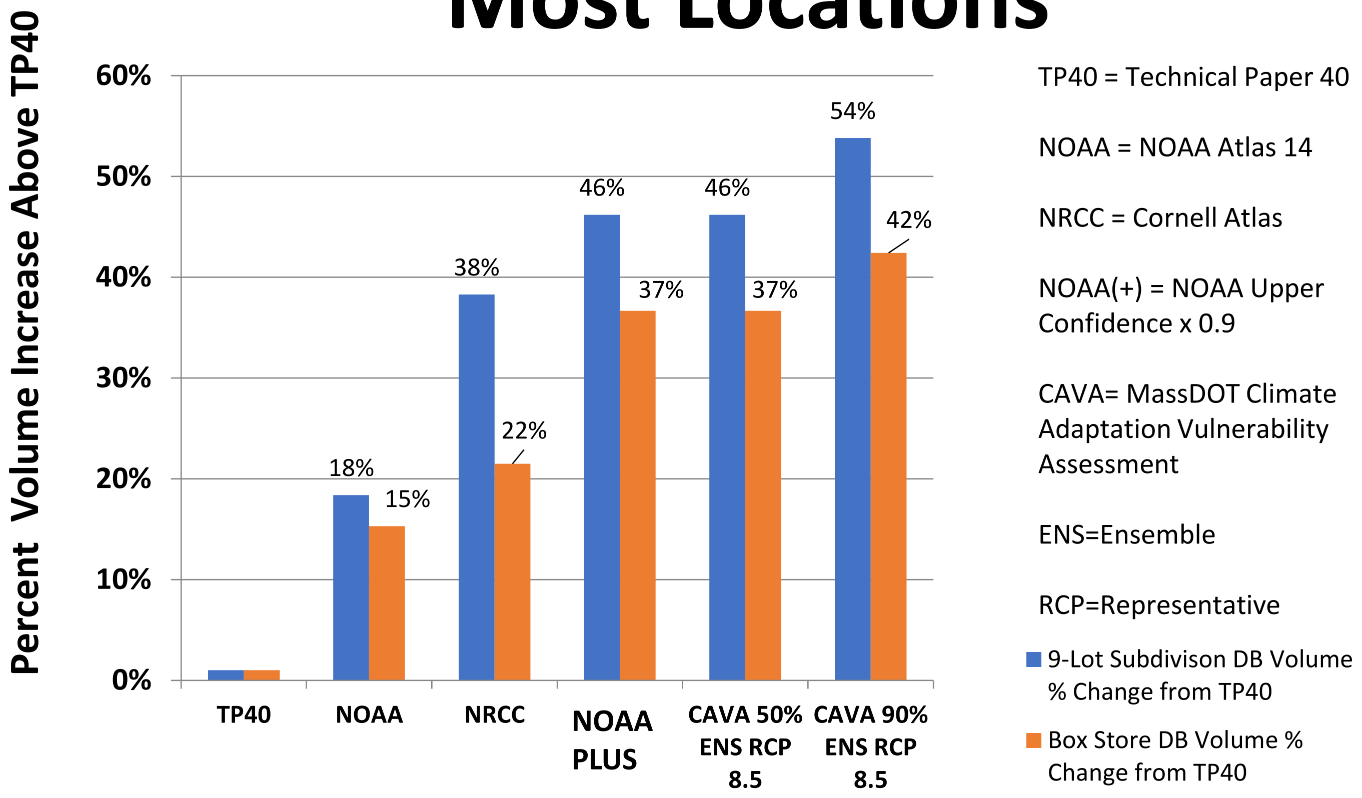
Stormwater Basin Size Will Increase In Most Locations



TP40 = Technical Paper 40

NOAA = NOAA Atlas 14

NRCC = Cornell Atlas

NOAA(+) = NOAA Upper Confidence x 0.9

CAVA= MassDOT Climate Adaptation Vulnerability Assessment

ENS=Ensemble

RCP=Representative

CAVA (MassDOT) 50% Ensemble (Akin to Median) Year 2100
CAVA (MassDOT) 90% Ensemble (Akin to Upper Confidence) Year 2100

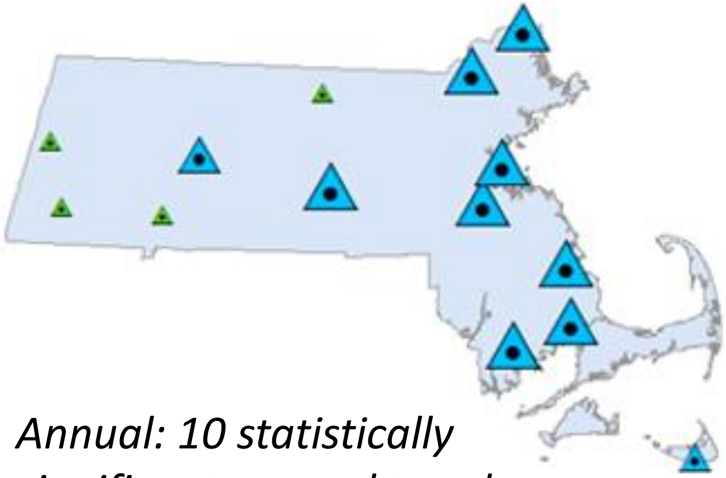
MassDEP

MassDEP Is Recommending NOAA 14 PLUS

- Provides an off-the-shelf method that can be implemented without complex downscaling
- Incorporates risk observed in the current data to reflect range of larger observed storms.
- Provides greater resiliency for infrastructure than NOAA14
- Larger stormwater controls better able to accommodate runoff from larger storms, less localized urban flooding
- Requires design to address upper range of current expected storms
- Allows for construction of Intensity-Duration-Frequency Curves
- Expands BLSF/ILSF boundaries that are regulated, reducing flood risk

Precipitation Effects - Increased Recharge & Water Quality Volume Needed: To Be Discussed At Next AC Meeting

Annual Precipitation Trend: Affects Recharge Target

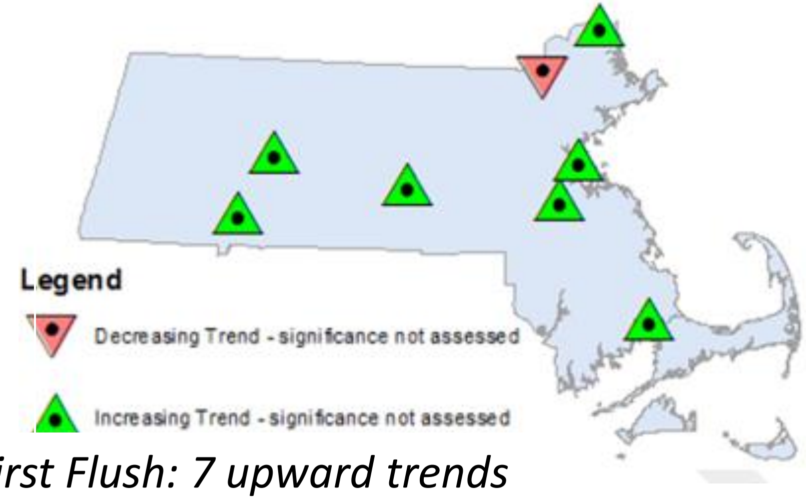


Annual: 10 statistically significant upward trends

LEGEND

	Positive Trend, Not Significant at $\alpha = 0.1$
	Positive Trend, Significant at $\alpha = 0.1$
	Negative Trend, Not Significant at $\alpha = 0.1$
	Negative Trend, Significant at $\alpha = 0.1$

First Flush Trend: Affects WQV.



First Flush: 7 upward trends

Recommendations

RESOURCE	CURRENT DESIGN STORM	RECOMMENDED
EXTREME PRECIPITATION (TOP 1% STORMS)		
Vernal Pool	2.6-inch storm in 24-hours	Eliminate use of Design Storms. Rely on observable physical boundary
BLSF	Wildlife Habitat: 4.8-inch storm in 24-hours. Outer Boundary: 7.0-inch storm in 24-hours	Eliminate use of Design Storms. Use USGS StreamStats 10-year and 100-year streamflow
ILSF	Volume: 1-year 24-hour design storm Outer Boundary: 7.0-inch storm in 24-hours	NOAA PLUS year 24-hour storm NOAA PLUS 100-year 24-hour storm
Stormwater Peak Rate	2-, 10-, and 100-year 24-hour storms from TP40	NOAA PLUS 2-, 10- , & 100-year 24-hour storms
Stream Crossings	Maintain channel carrying capacity	Emphasize sizing using Stream Crossing Standards and not design storms.
ANNUAL PRECIPITATION AND FIRST FLUSH STORM		
Stormwater Recharge	0.1-inch to 0.6-inches	1-inch for all hydrologic soil groups with exceptions
Stormwater Water Quality Volume	First ½-inch or 1-inch of runoff	Included in Recharge Volume, Eliminate WQV as sizing measure in most situations

MassDEP

NEXT ON AGENDA

Resilient Massachusetts Action Team (RMAT)

Resilient Mystic Collaborative

QUESTIONS?

Resilient MA Action Team:

CLIMATE RESILIENT DESIGN STANDARDS & GUIDELINES

for State Agencies

Mia Mansfield,
Director of Climate Adaptation and Resilience
MA Executive Office of Energy and Environmental Affairs

Resilient MA Action Team (RMAT)

Responsible for the State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) implementation, monitoring, and maintenance, with representatives from each Secretariat and key state agencies

2020 Focus

- Climate resilience design standards and guidance for state agencies
- Resilient capital planning screening tool
- SHMCAP Action Tracker

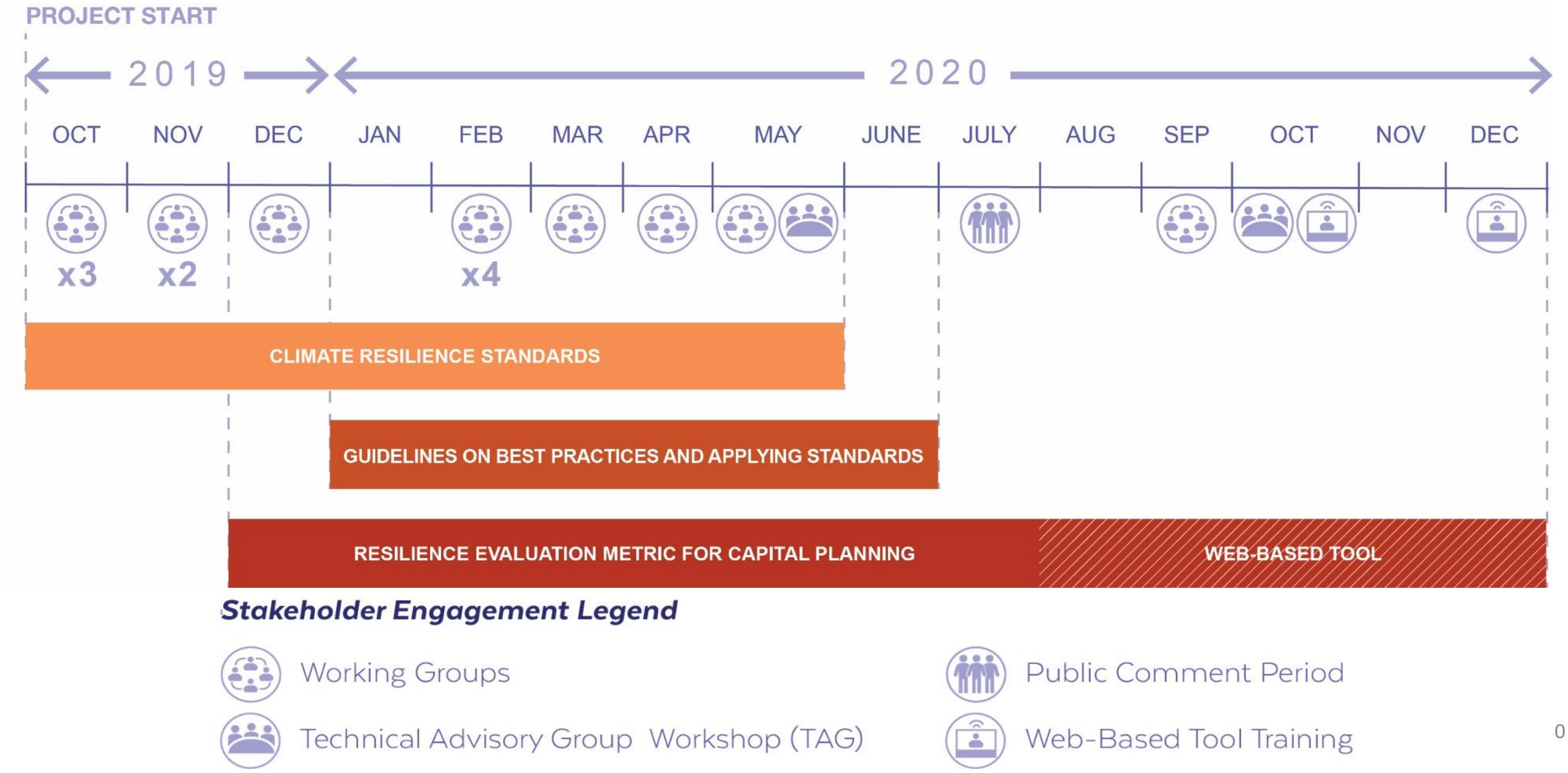
Climate Resilience Standards for State Agencies

STANDARDS	GUIDELINES	TOOL
Climate Resilience Standards	*Guidelines on Best Practices and Applying Standards*	*Web-based Capital Planning Tool*
Basis of design (what you design to)	**How you design or plan to meet standard**	**Project screening and assessment**

KEY THEMES

Integration	Action Oriented	Science Based	Adaptable
Incorporate existing practices and procedures to promote consistent climate resilience strategy throughout the Commonwealth	Establish clear, pragmatic guidance and standards that can be applied to diverse set of project types with physical assets	Produce objective, replicable results grounded in scientific methodology and using best available data	Develop deliverables that work for current and future projects across State Agencies and multiple climate hazards

PROJECT TIMELINE



DRAFT

Intended users of version 1:

- Decision support for:
  - State capital budget and program managers investing state funds in physical projects
  - State infrastructure grant managers (e.g. MVP) scoring municipal applications for state funding

WHAT DO WE MEAN BY STANDARDS?

Team Working Definition:

"A climate resilience standard is a **process or method**, that when conducted repeatedly, across sectors, adapted over time, and/or modified with data, **produces a consistent outcome**, which uniformly guides in the scientifically-based selection of **planning horizons, climate parameters, and flexible design criteria**."

DRAFT

Weston & Sampson

WHAT DO WE MEAN BY STANDARDS?

Planning horizons:

Present (2030), Mid-Century (2050), Mid-late Century (2070), End of Century (2100)

Primary climate parameters:

Extreme precipitation, extreme heat, sea level rise/storm surge

Design criteria:

Base flood elevation, cooling degree days, rainfall depth, and more

Recurrence Intervals:

10-year (10%) or 100-year (1%), etc.

Weston & Sampson

DRAFT

RMAT Climate Standards Overview
Tier Classification

	< 10 years	10 to 50 years	50 years +
High Criticality	TIER 2	TIER 3	TIER 3 *Ex. Amelia Earhart Dam*
Medium Criticality	TIER 1 *Ex. Dam emergency repairs*	TIER 2 *Ex. Moakley Park*	TIER 3
Low Criticality	TIER 1	TIER 2 *Ex. Salt shed*	TIER 2

INTENDED USEFUL LIFE

The RMAT is working to establish Tier 3 data for the Commonwealth, and several studies are already in progress.

Criticality =

SCOPE

- The geographic area and population that would be affected by the loss or inoperability of an asset.

TIME

- The length of time an asset can be inoperable without consequences.

SEVERITY

- The consequences associated from the loss and/or inoperability of an asset.

Doubled *if project located in EJ community or provides services to vulnerable populations.*

Final criticality score *is the average of the scope, time, and severity scores and normalized on a scale of 10 (low) to 100 (high).*

+70= HIGH
-40= LOW

Weston

Table 3.15. Data Sources & Methodologies Recommended from the Tool for the Extreme Precipitation Design Criteria

E PRECIPITATION	Design Criteria	Data Sources & Methodologies		
		Tier 3 - High Level of Effort	**Tier 2 - Average Level of Effort**	**Tier 1 - Low Level of Effort**
	Total Precipitation Depth for 24-hour Design Storms	Downscaled GCMs (from ResilientMA.org or LOCA dataset) and extreme value distribution analysis	NCA4 CSSR values and increase the NOAA Atlas 14 values by the change percentage as indicated	Atlas-14 90% of the upper 90% C.I (DEP proposed approach)
		Type III distribution to		Type III distribution

*Tiers 2 and 3 incorporate climate change data that reflect **future** conditions*

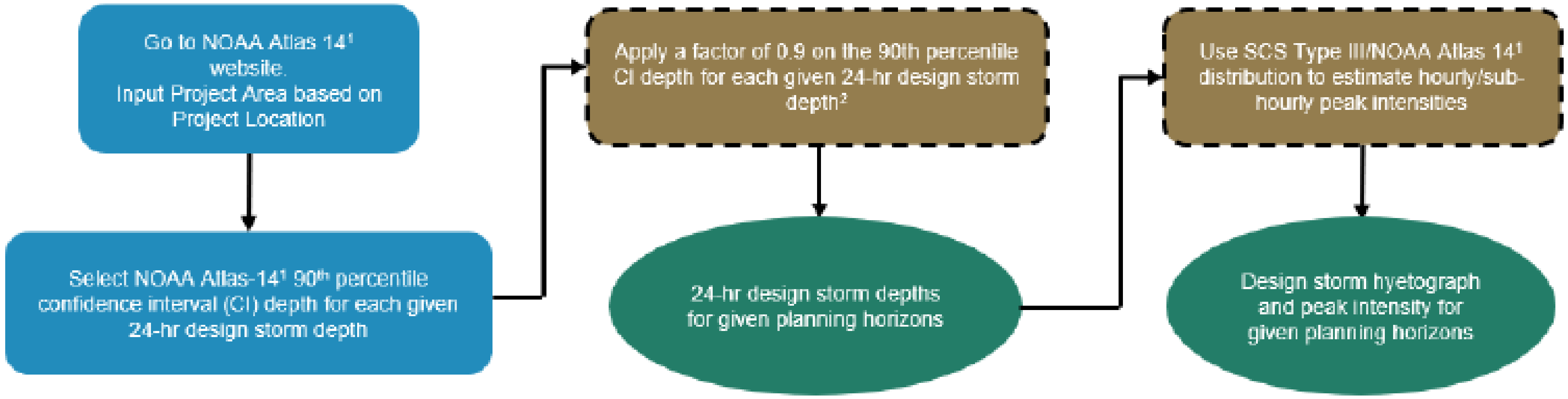
*Tier 1 is the NOAA+ approach that reflects high **historic** conditions*

3.3.6.4 Draft Tiered Methodology for Extreme Precipitation Depth and Intensity – Tier 1

RMAT Tiered Methodology to Assess 24-hr Precipitation Storm Depth and Peak Intensity - Tier 1 Projects (Low Level of Effort)

Given Standards Output from Tool: Planning Horizon (2030, 2050, 2070, 2090); Recurrence Interval (5-yr, 10-yr, 25-yr, 50-yr, 100-yr, 500-yr)

NOAA+ approach is the baseline



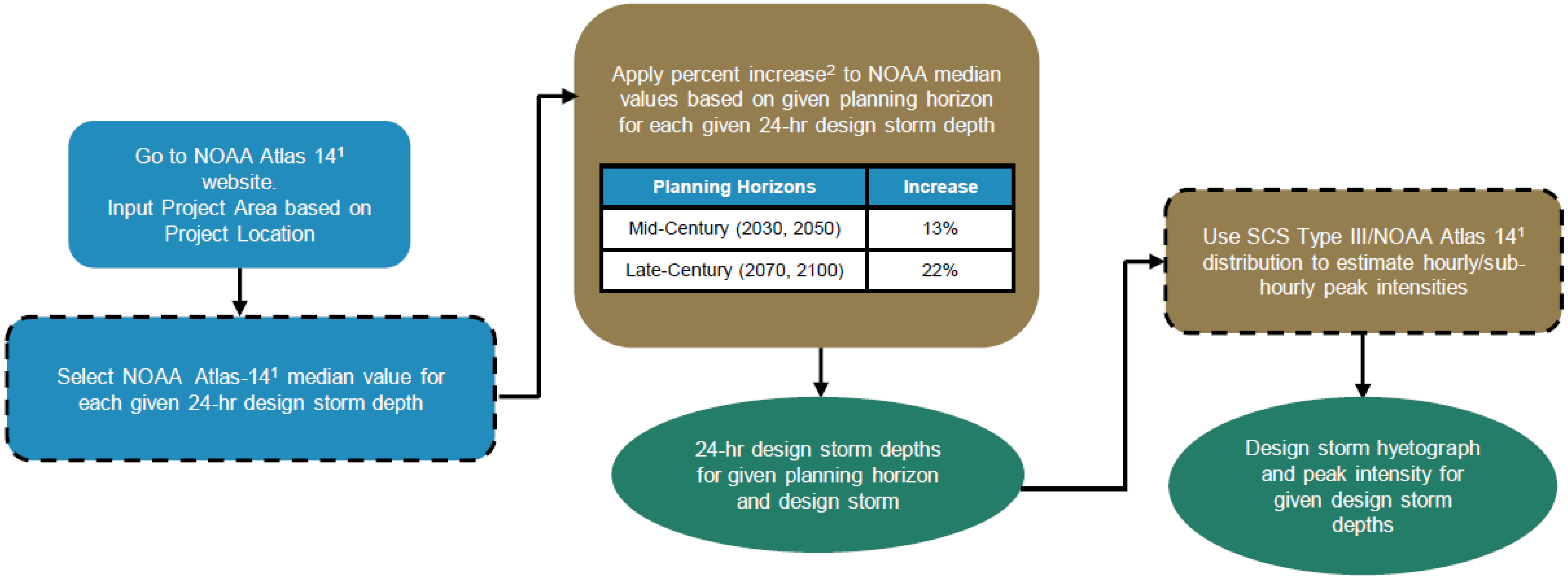
DRAFT

1. NOAA Atlas 14 Point Precipitation Frequency Estimates: Northeastern States; NOAA Atlas 14, Volume 10, Version 3
2. A Comparison of Precipitation Frequency Atlases in Massachusetts: Considerations in Regulating Inland Wetland Resource Areas Affected by Climate Change, Internal Draft, October 22, 2017.

Figure 3.8. *Draft Tier 1 Methodology to Assess Extreme Precipitation Design Criteria Values as Recommended by the Climate Resilience Design Standards Tool*

RMAT SOPs to Assess 24-hr Precipitation Storm Depth and Peak Intensity Tier 2 Projects (Medium Level of Effort)

Given Standards Output from Tool: Planning Horizon (2030, 2050, 2070, 2090); Recurrence Interval (5-yr, 10-yr, 25-yr, 50-yr, 100-yr, 500-yr)



Planning Horizons	Increase
Mid-Century (2030, 2050)	13%
Late-Century (2070, 2100)	22%

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Additional analysis underway to further downscale Tier 2 methodology for multiple design storms, planning horizons, and regions utilizing LOCA GCMs (global climate models)

Therefore, the primary objectives of this proposed scope of work are the following:

- Develop Statewide percent increase estimates for different Annual Exceedance Probability (AEP) design storms for each planning horizon for the Eastern and Western parts of the Commonwealth using industry-accepted standard methodology
- Receive consensus from the different State entities, academic and scientific experts on the percent increase estimates developed from this methodology
- Incorporate this tiered methodology as “Tier 2” methodology for the Draft Climate Resilience Design Standards Tool (the Tool)

3.3.6.2 Draft Tiered Methodology for Extreme Precipitation Depth and Intensity – Tier 3

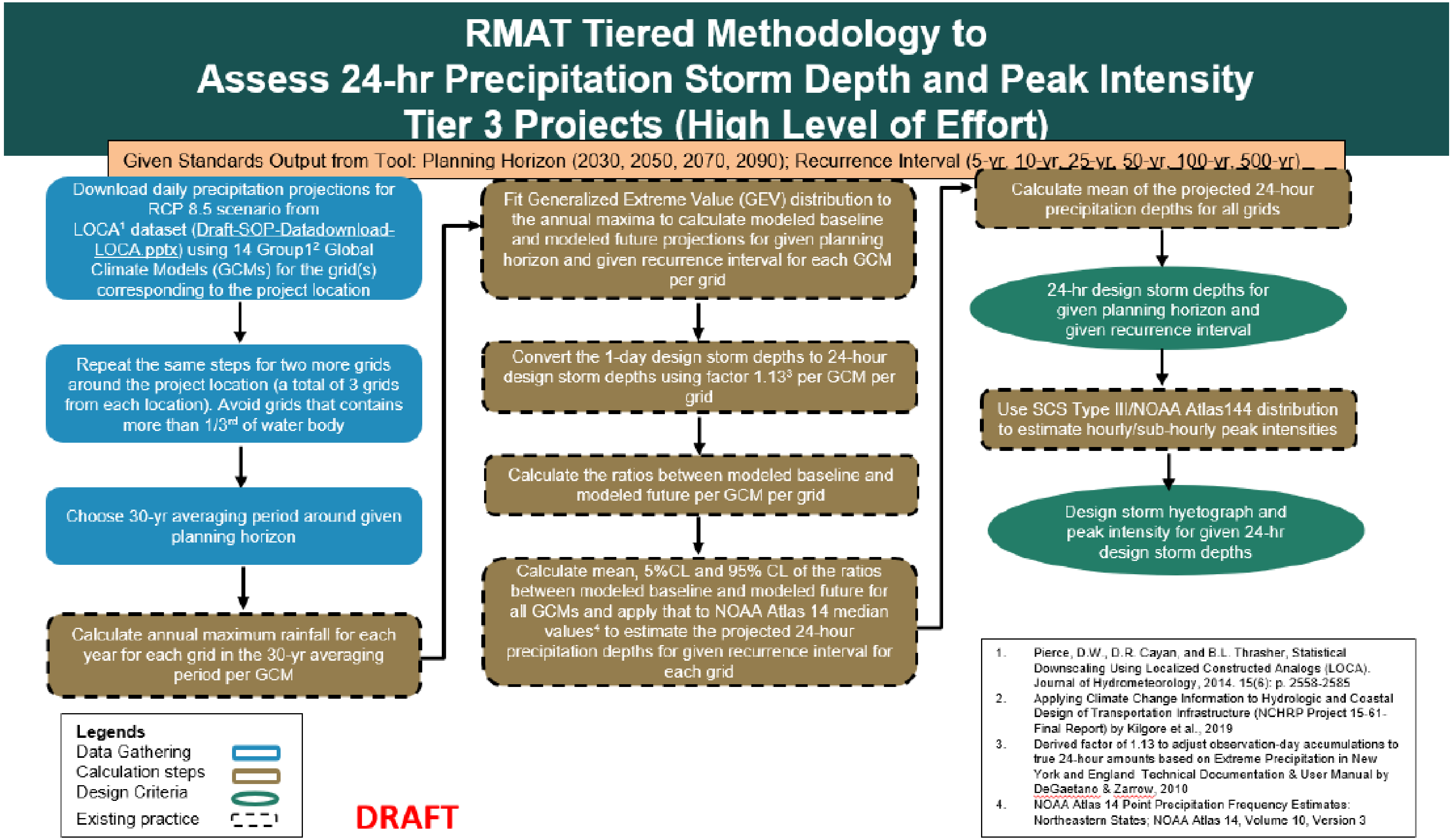


Figure 3.6. *Draft Tier 3 Methodology to Assess Extreme Precipitation Design Criteria Values as Recommended by the Climate Resilience Design Standards Tool*

Next steps

- RMAT Climate Resilience Design Standards & Guidelines currently in revision following public review period
- Will transition framework to web-based tool in Fall/Winter 2020
- Estimated launch **early 2021** on ResilientMA.org for State projects and as resource for MVP and other grants

Executive Office of Energy and Environmental Affairs

Mia.mansfield@mass.gov
https://www.mass.gov/municipal-vulnerability-preparedness-program

NEXT ON AGENDA

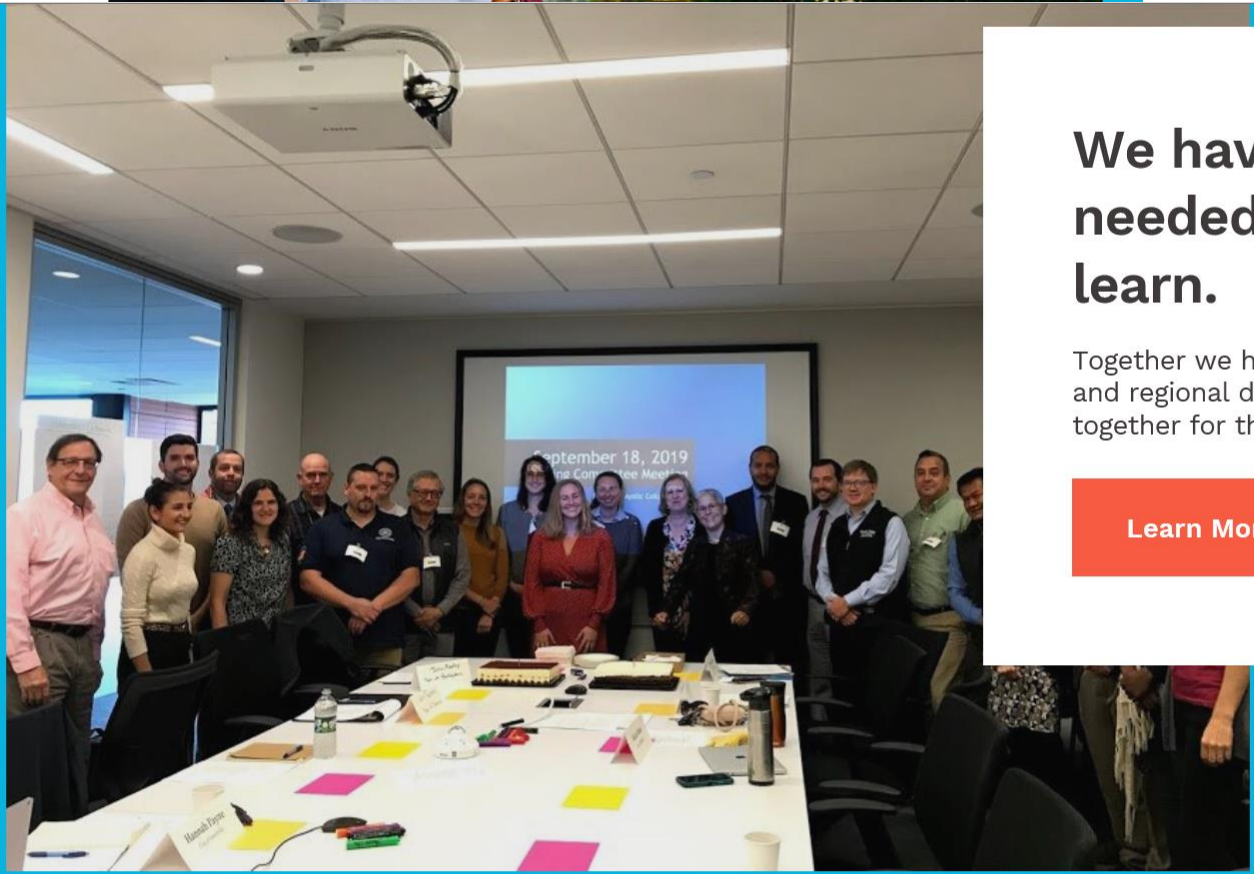
Resilient Mystic Collaborative

Katherine F. Watkins, PE
Assistant Commissioner / City Engineer
City of Cambridge, DPW

We are mutually supportive.

We share knowledge, resources, and a love of place. The 21 communities that make up the Mystic River Watershed together are the size of Brooklyn, NY. We come together to not come apart.

Learn More



We have the structure needed to succeed and learn.

Together we have crafted the vision, capacity, and regional decision-making needed to stay together for the long run.

Learn More

RMC supporting RMAT's effort to increase resiliency

Mia G. Mansfield
Director of Climate Adaptation and Resilience
MA Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900, Boston MA 02114
617-626-1162 (w) 857-338-4392 (c)
Via email: Mia.mansfield@mass.gov

September 9, 2020

Dear Ms. Mansfield,

Thank you for the opportunity to comment on the Resilient MA Action Team's Climate Resilience Design Standards & Guidelines project. We are commenting as senior agency staff from among the 20 municipalities that comprise the Resilient Mystic Collaborative (RMC). The RMC is a voluntary partnership among cities and towns within Greater Boston's Mystic River Watershed. We work on regional climate preparedness projects and policies that no one community can undertake alone. Mass EOEEA's climate resilience efforts—including the MVP grants program, and now RMAT—are essential to our success.

General comments
We very much support RMAT's efforts to increase resiliency throughout the state and provide clear guidance to be used for state infrastructure and grant funded projects. This is a critical undertaking and we applaud both your efforts and your progress. Having clear guidance for project designers is critical to getting climate change incorporated into projects early and consistently.

We also strongly encourage you to ensure that the final tool provides clear, straightforward guidance and information without becoming too much of a black box. It's important to clarify (and keep updated) the best available climate projections, and separately apply criticality and/or risk factors to recognize the relative socioeconomic cost of a structure being damaged. Ultimately, it should be clear to project developers and managers what external environmental conditions (flooding, wind, heat) will cause their project to fail or require retrofits, and approximately when they should begin to expect such conditions.

Note: as climate change accelerates, our ability to project future conditions throughout the lifespan of projects will worsen. Our standards and guidelines will need to move from its current framework of "predict and prevent" to something more adaptive. As you work to establish these initial guidelines and any subsequent regulations, please take advantage of the wealth of academic and practitioner expertise in this region to develop a next-generation framework based on adaptive management (not that we know what that looks like right now, either!).

Sincerely,

Kathy Watkins, PE
City Engineer, Cambridge

John Livsey, PE
Town Engineer, Lexington

Alicia Hunt
Director Energy & Environment, Medford

Oliver Sellers-Garcia
Director Sustainability and Env., Somerville

Jay Corey, PE
City Engineer, Woburn

Emily Sullivan,
Environmental Planner, Arlington

Yem Lip, PE
City Engineer, Malden

Alexander Rozycki, PE
Senior Civil Engineer, Reading

Gregory M. St. Louis, PE
ED Public Works & Engineering, Everett

Alexander Train
Director Housing and Comm. Dev., Chelsea

RMC supporting DEP's effort to increase resiliency

Kathy Baskin
Assistant Commissioner, Bureau of Water Resources
Massachusetts DEP
1 Winter St, Boston, MA 02108

Re: Stormwater Advisory Committee

April 2, 2020

Dear Assistant Commissioner Baskin,

Thank you for the opportunity to contribute to discussions on updating rainfall data in the Stormwater Handbook to represent current and future projections. In order to contribute to this process, engineers from ten municipalities (Arlington, Cambridge, Chelsea, Everett, Lexington, Malden, Medford, Melrose, Winchester, and Woburn) participating in the Resilient Mystic Collaborative have developed recommendations to improve state data and policies. Recommendations are summarized below.

1. **MassDEP needs to develop statewide downscaled rainfall projections based on global climate models.** We strongly support Mass DEP's efforts to develop statewide downscaled future projections of extreme precipitation based on global climate models. This would be the best science to use for stormwater management and modelling efforts.

2. **Until statewide downscaled rainfall projections can be completed, using the upper bound of NOAA 14 90% confidence interval could be used as a proxy for 2070 rainfall projections. Using 90% of the upper bound of NOAA 14 90% confidence interval could be used as a proxy for 2030 rainfall projections.** Mass DEP staff have floated using 90% of the upper bound of NOAA Atlas 14 (NOAA14) 90% confidence interval values as a "safety factor" to take into account climate change-enhanced rainfall intensity.

Working with climate scientist Dr. Katharine Hayhoe, Cambridge has completed a downscale model.[1] Figure 1 and Table 1 compare downscaled precipitation projections (in inches) with TP-40, NOAA14 and other measures of rainfall intensity.

Sincerely,

Kathy Watkins, PE
City Engineer, Cambridge

John Livsey, PE
Town Engineer, Lexington

Tim McGivern, PE
City Engineer, Medford

Beth Rudolph, PE
Town Engineer, Winchester

Jay Corey, PE
City Engineer, Woburn

Wayne Chouinard, PE
Town Engineer, Arlington

Yem Lip, PE
City Engineer, Malden

Elena Proakis Ellis, PE
City Engineer/Ass't DPW Director, Melrose

Gregory M. St. Louis, PE
ED Public Works & Engineering, Everett

Louis V. Mammolette, PE
DPW Deputy Comm./City Engineer, Chelsea

William J. Renault, Jr., PE
Town Engineer, Wakefield

<u>Beth Rudolph, Town Engineer, Winchester</u>

Winchester supports the proposed change, and has been officially **<u>requiring applicants to use the Cornell rainfall data</u>** since the FEMA maps became effective in June 2010.

Flooding is occurring now and is increasing

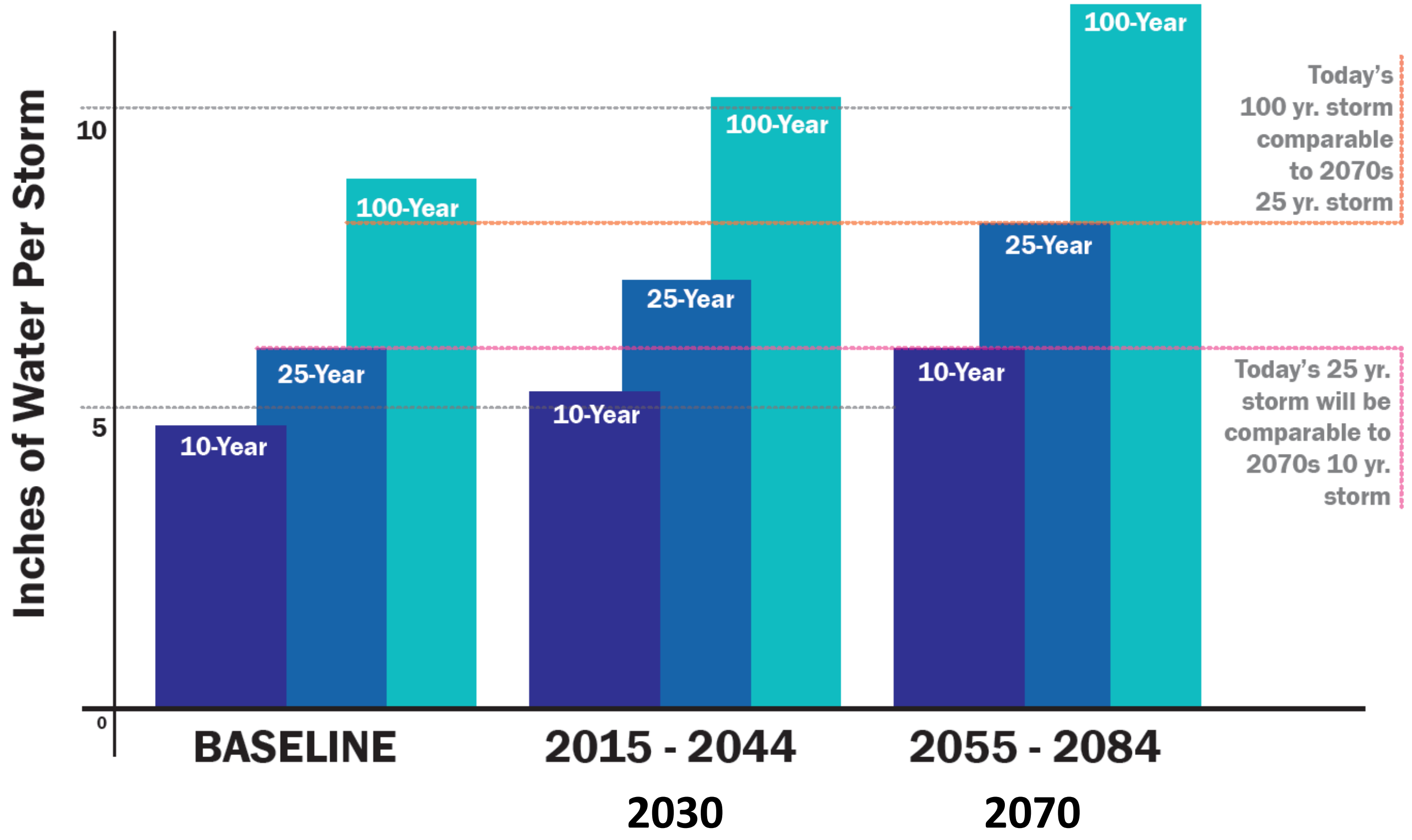

Cambridge

Somerville


Winchester

Future Projections: Increasing Rates of Precipitation & Frequency of Larger Storms

Climate scientist Dr. Katharine Hayhoe completed a downscale model for Cambridge.
2030 and 2070 Projections. Advocate for statewide downscale model.



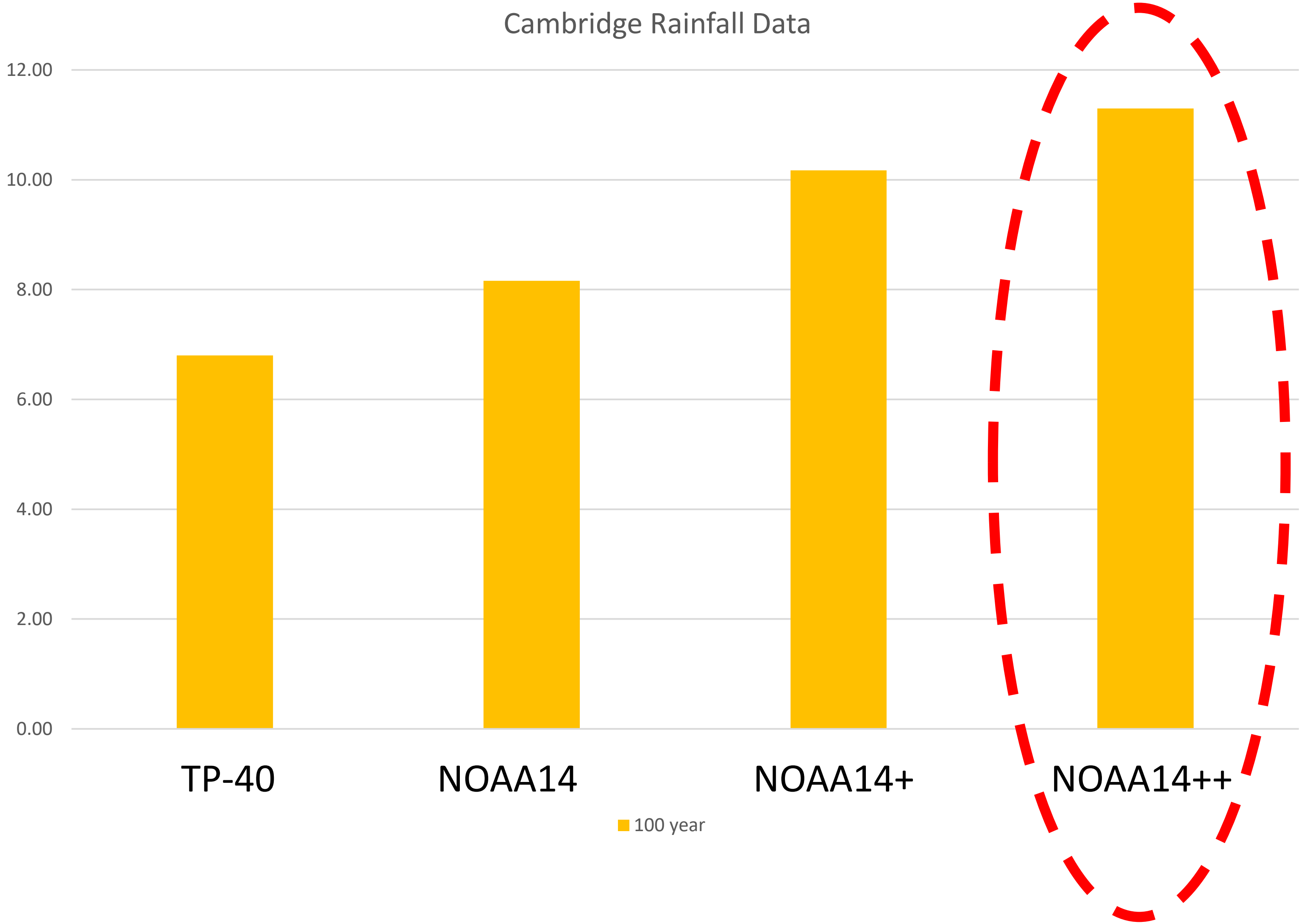
<u>Greg St. Louis, Executive Director Public Works, Everett</u>

The Commonwealth needs to **<u>protect its constituents</u>** from these effects by providing more accurate criterion for permitting agencies to uphold and for designers to adhere to; **<u>so that tax payers do not bear the burden of resultant flooding.</u>**

Source: Kleinfelder based on ATMOS projections (November 2015)

Recommend Full NOAA 90%ile

Go beyond NOAA Atlas 14+ to NOAA14++. Based on current data but provides increased level of protection and factor of safety.

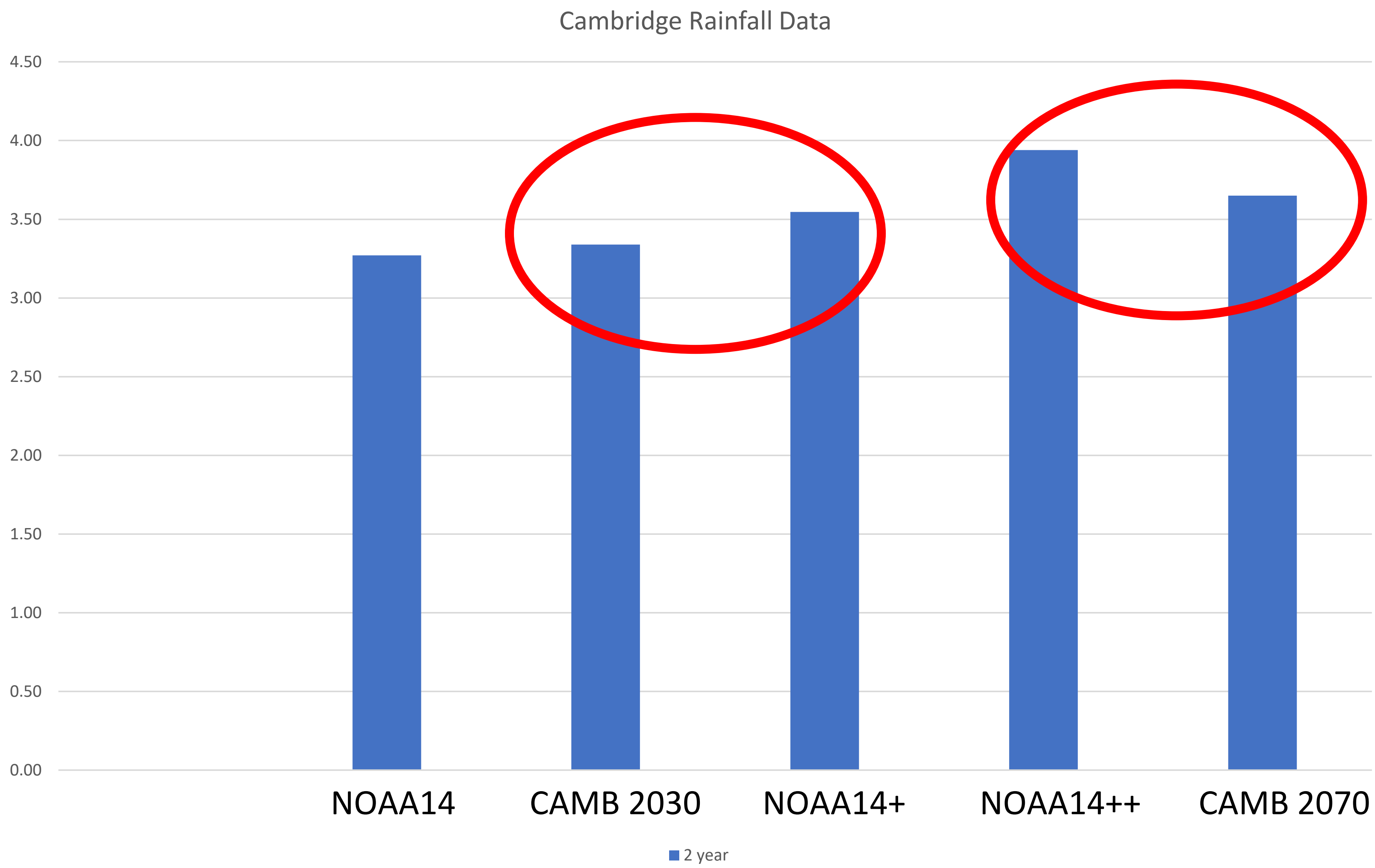


NOAA14
mid-range of 90% Confidence Interval

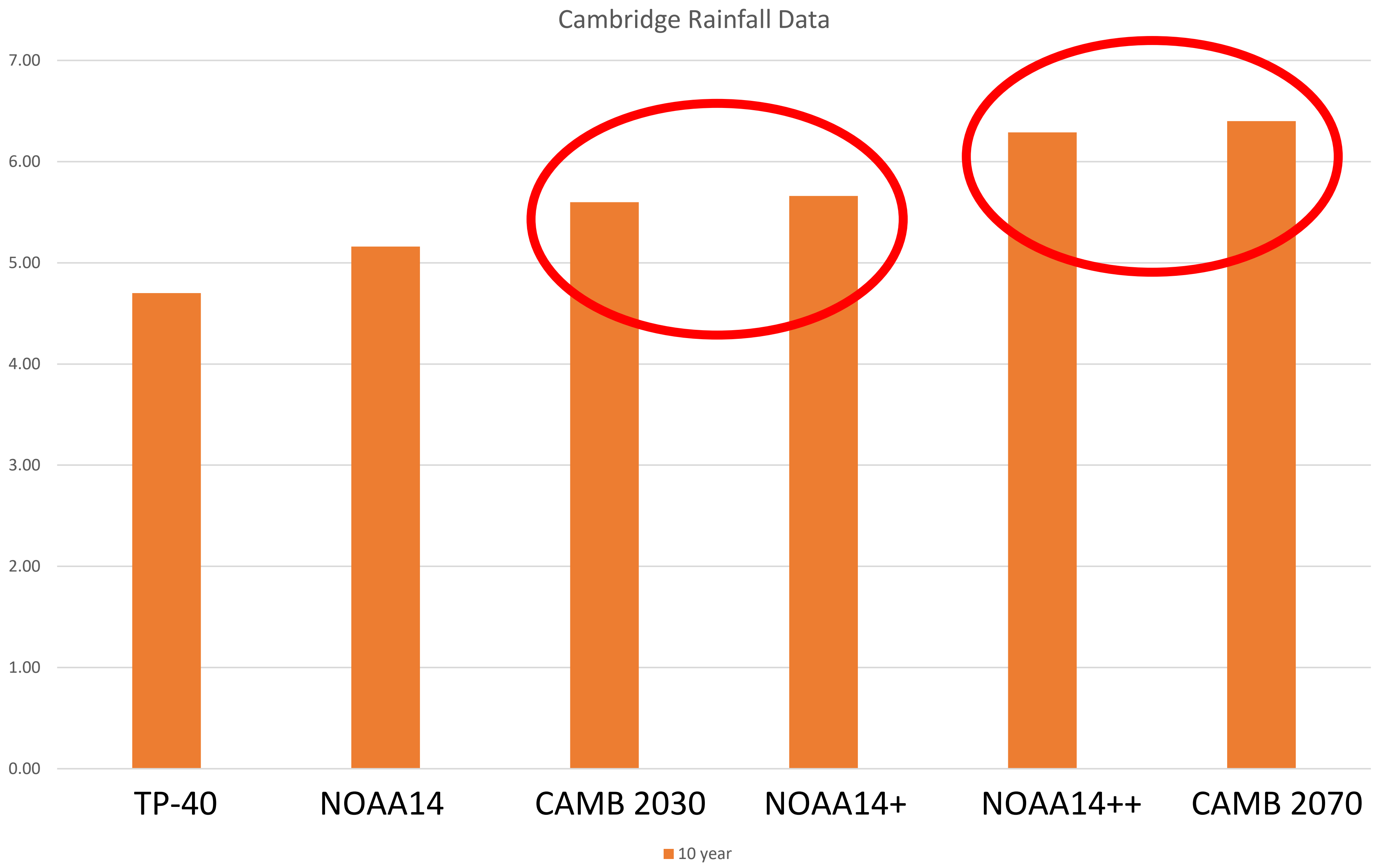
NOAA14+
90% of Upper Bound of 90%ile Confidence Interval

NOAA14++
Upper Bound of 90%ile Confidence Interval

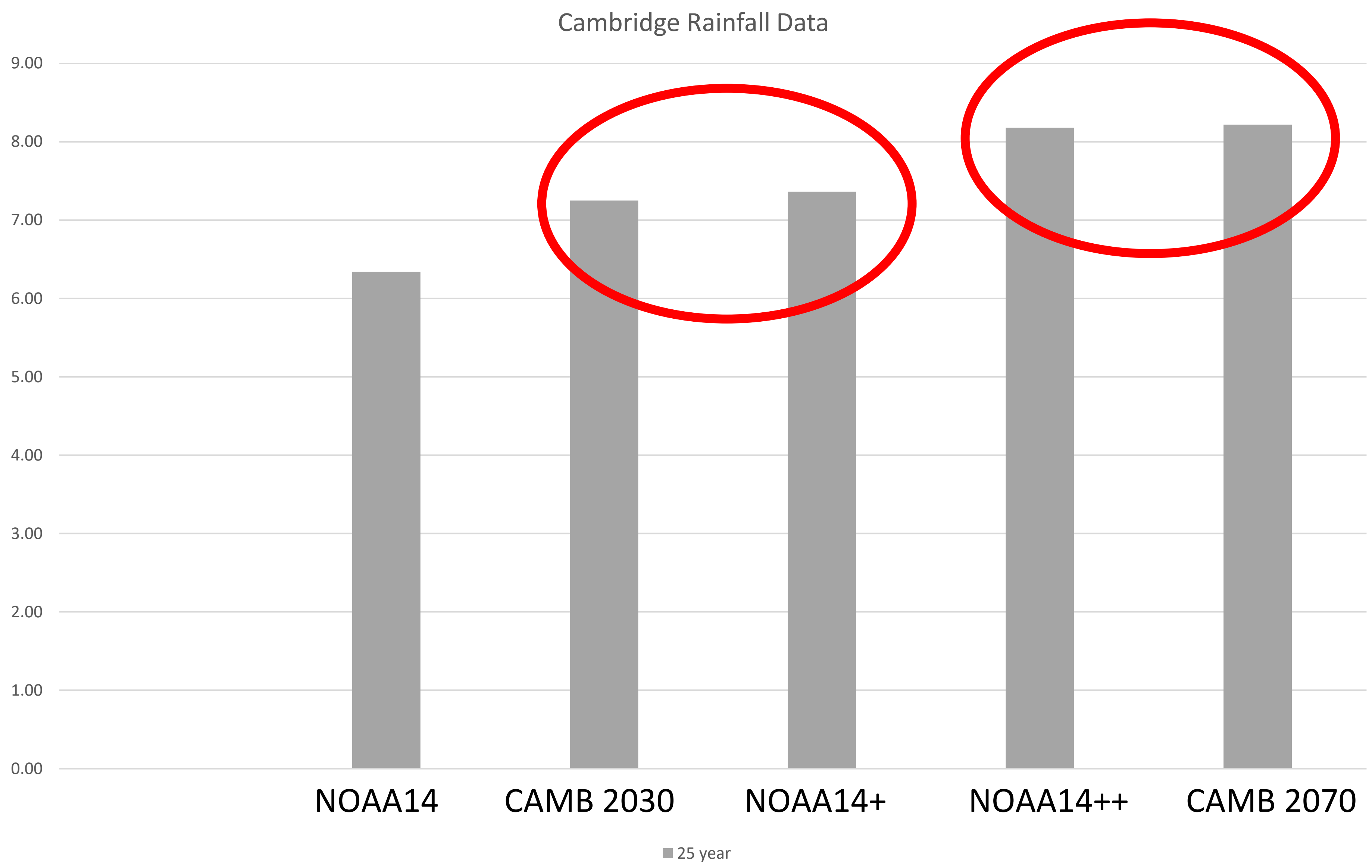
Cambridge Specific Data – 2 Year Storm



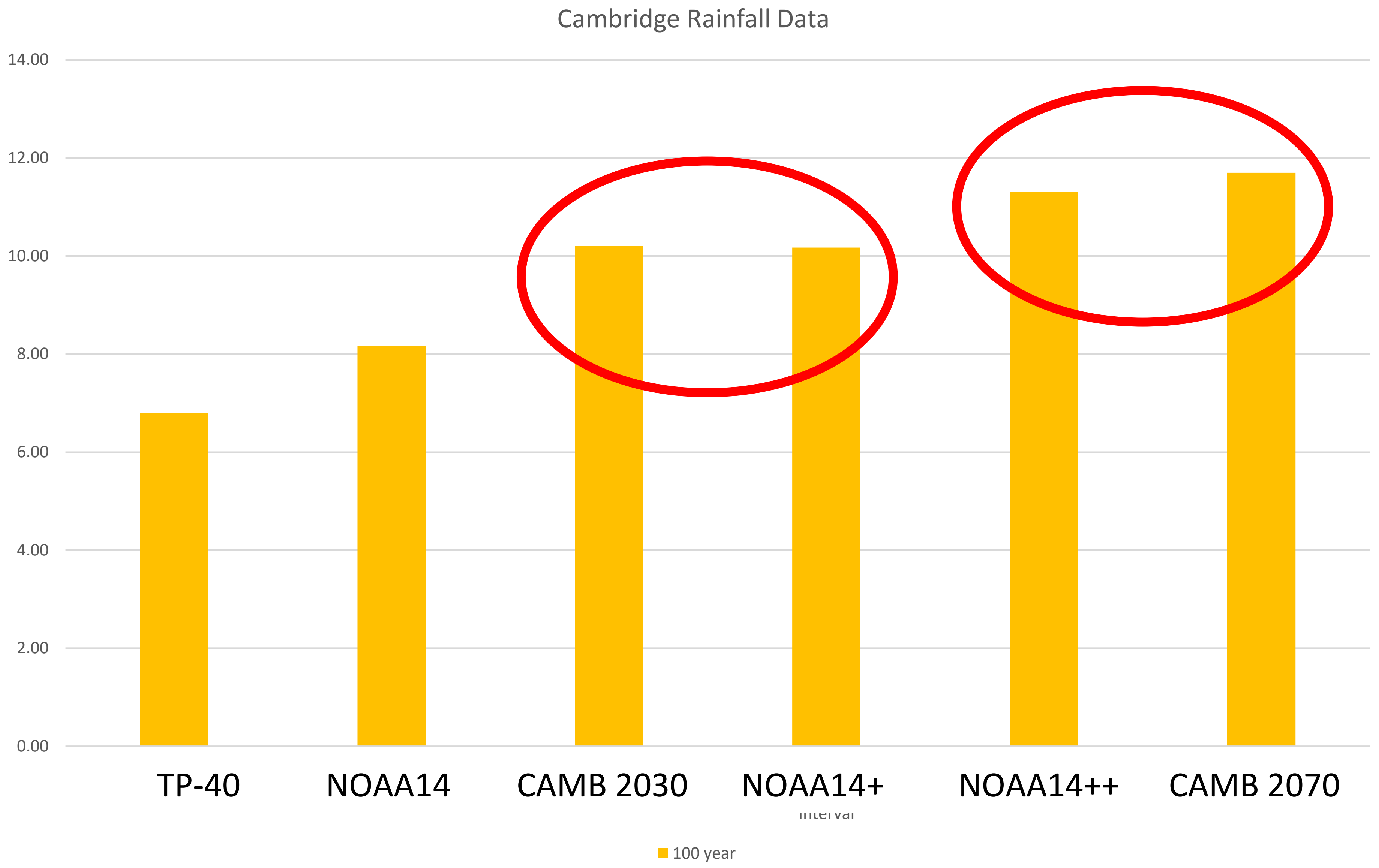
Cambridge Specific Data – 10 Year Storm



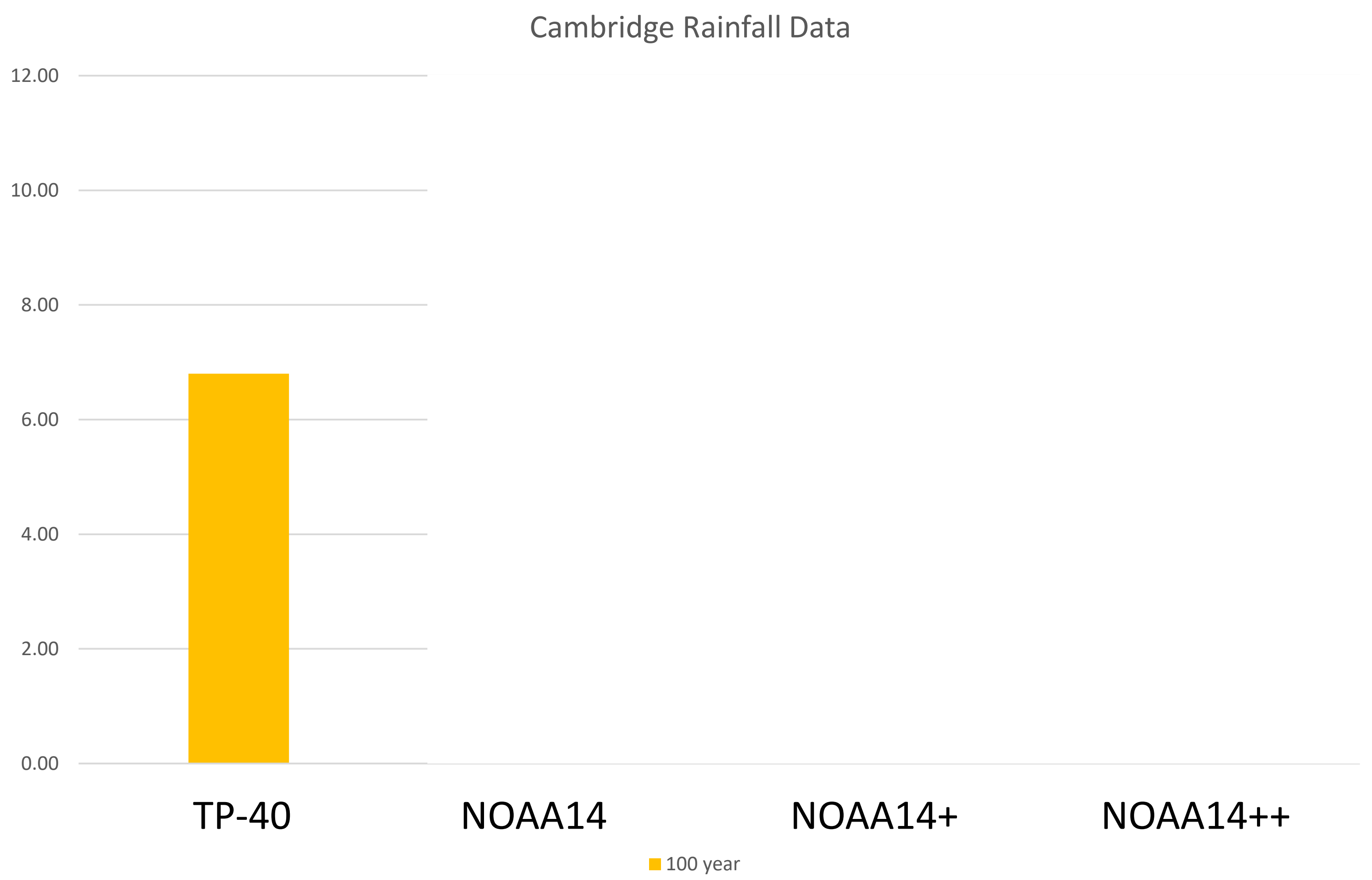
Cambridge Specific Data – 25 Year Storm



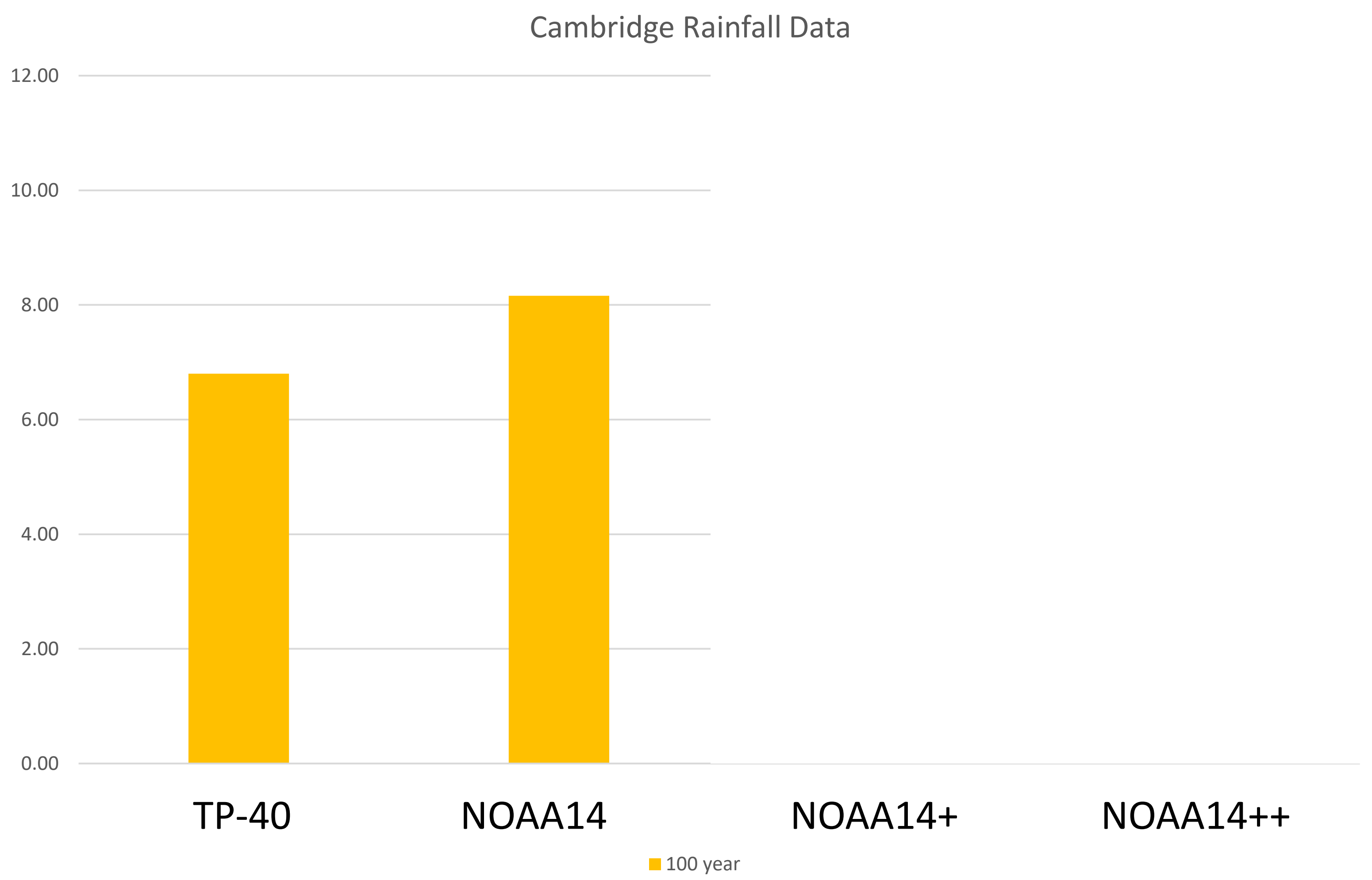
Cambridge Specific Data – 100 Year Storm



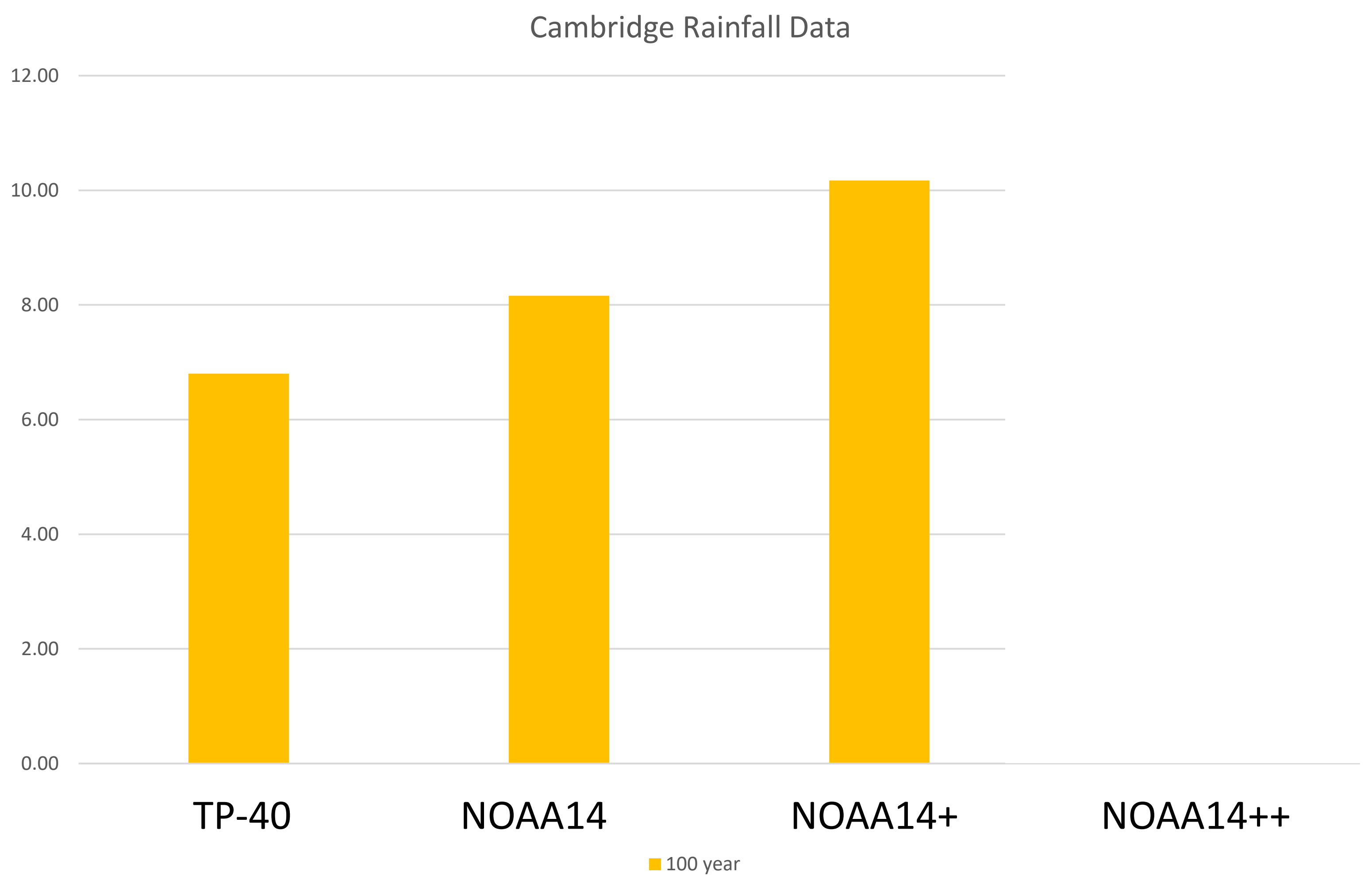
Recommend Full NOAA 90%ile



Recommend Full NOAA 90%ile

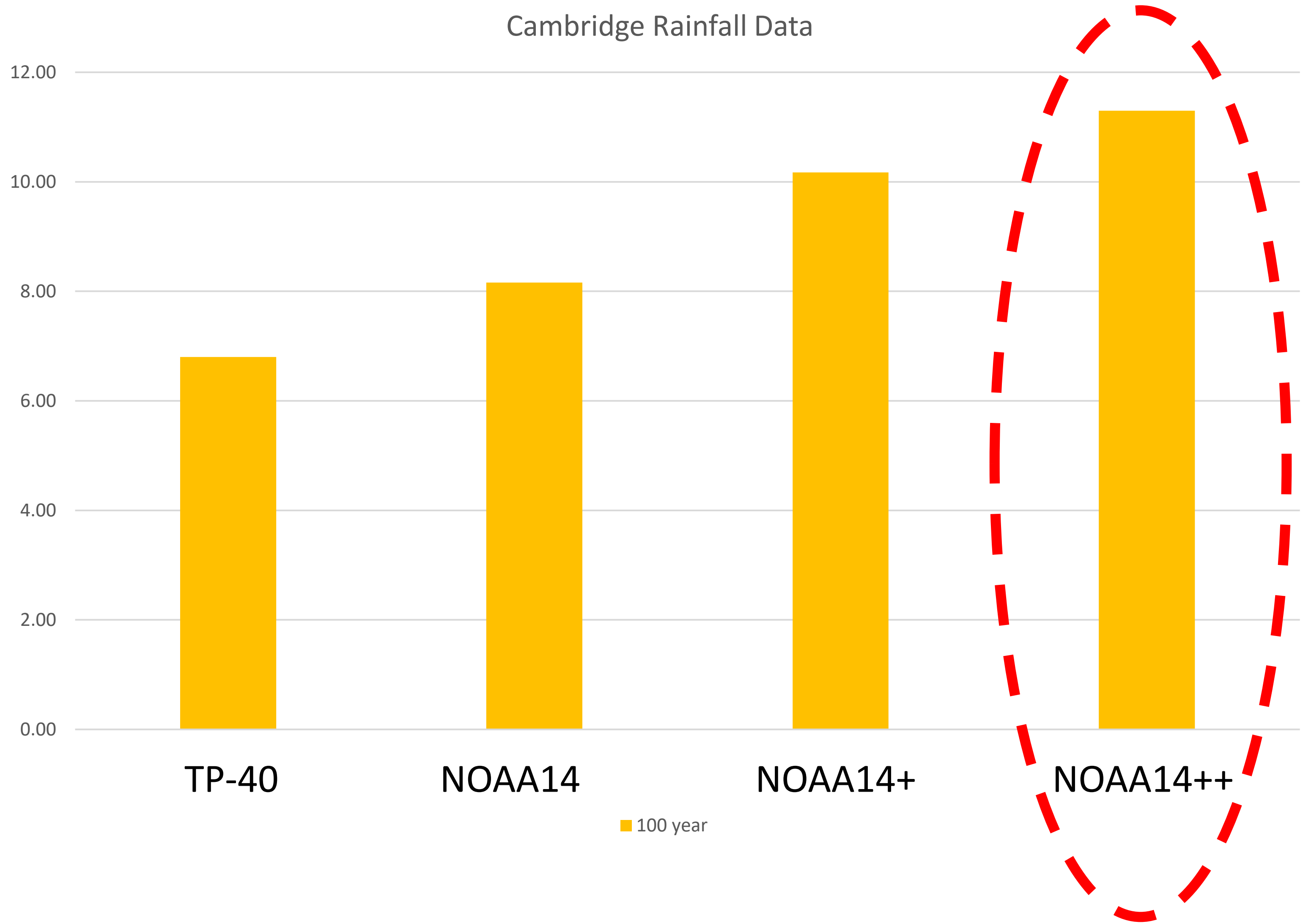


Recommend Full NOAA 90%ile



Recommend Full NOAA 90%ile

Go beyond NOAA Atlas 14+ to NOAA14++. Based on current data but provides increased level of protection and factor of safety.



John Livsey, Town Engineer, Lexington

It is **past due and prudent for the state as well as the municipalities to lead the way** and require that designs not only are proper for our current realities but will also **accommodate the projected future rainfalls.**

To have **consistency throughout Massachusetts** as well designs meeting realistic projected futures instead of storms of the distant past we will be working toward making the **infrastructure much more sustainable and resilient**.

What are we doing with this information?

Engaging with regional efforts.

Modifying designs for city infrastructure.

Update development standards and regulations. Individual communities cannot reduce flood risk alone, so these state efforts are critical.

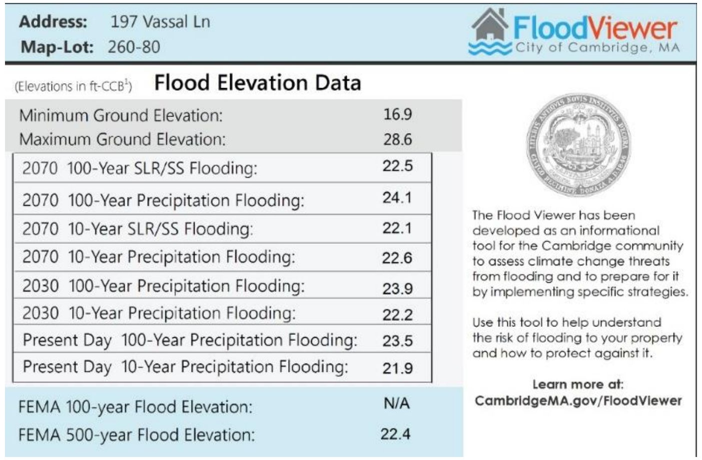
Source: Kyle Klein, City of Cambridge

Flood Protection Guidance – Beyond FEMA

Cambridge FloodViewer provides accessible flood extent & elevation data (Precip & SLR/SS)

Cambridge Design Flood Elevation Guidance

- Build/protect to 2070 10% annual risk
- Recover from 2070 1% annual risk



Address: 197 Vassal Ln
Map-Lot: 260-80

FloodViewer City of Cambridge, MA

(Elevations in ft-CCB[1]) Flood Elevation Data

Minimum Ground Elevation:	16.9
Maximum Ground Elevation:	28.6
2070 100-Year SLR/SS Flooding:	22.5
2070 100-Year Precipitation Flooding:	24.1
2070 10-Year SLR/SS Flooding:	22.1
2070 10-Year Precipitation Flooding:	22.6
2030 100-Year Precipitation Flooding:	23.9
2030 10-Year Precipitation Flooding:	22.2
Present Day 100-Year Precipitation Flooding:	23.5
Present Day 10-Year Precipitation Flooding:	21.9
FEMA 100-year Flood Elevation:	N/A
FEMA 500-year Flood Elevation:	22.4

The Flood Viewer has been developed as an informational tool for the Cambridge community to assess climate change threats from flooding and to prepare for it by implementing specific strategies.

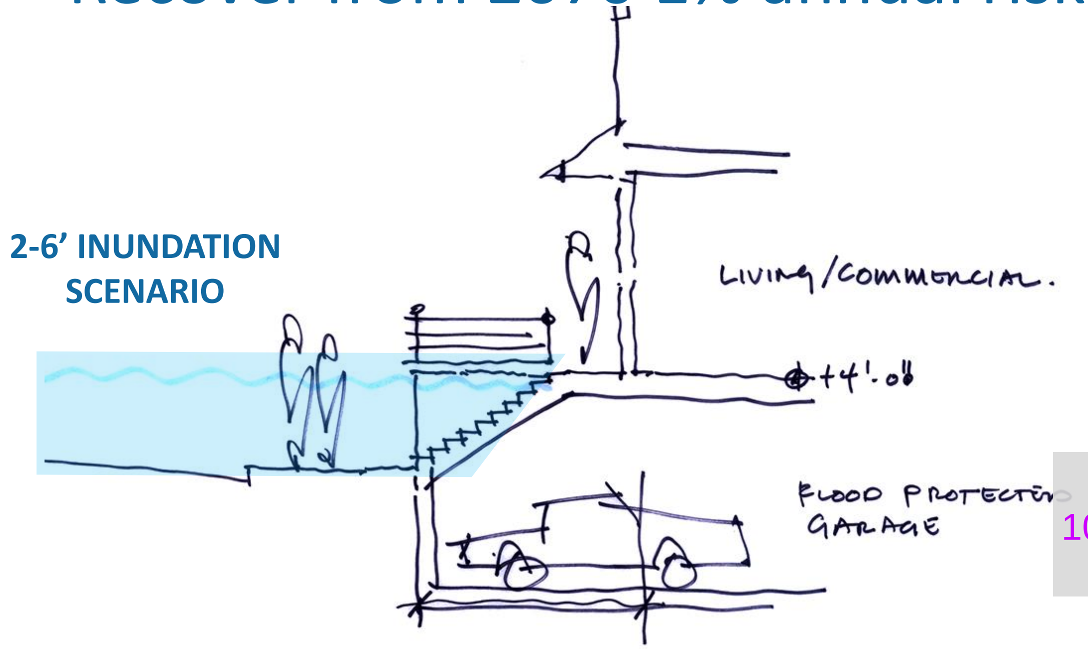
Use this tool to help understand the risk of flooding to your property and how to protect against it.

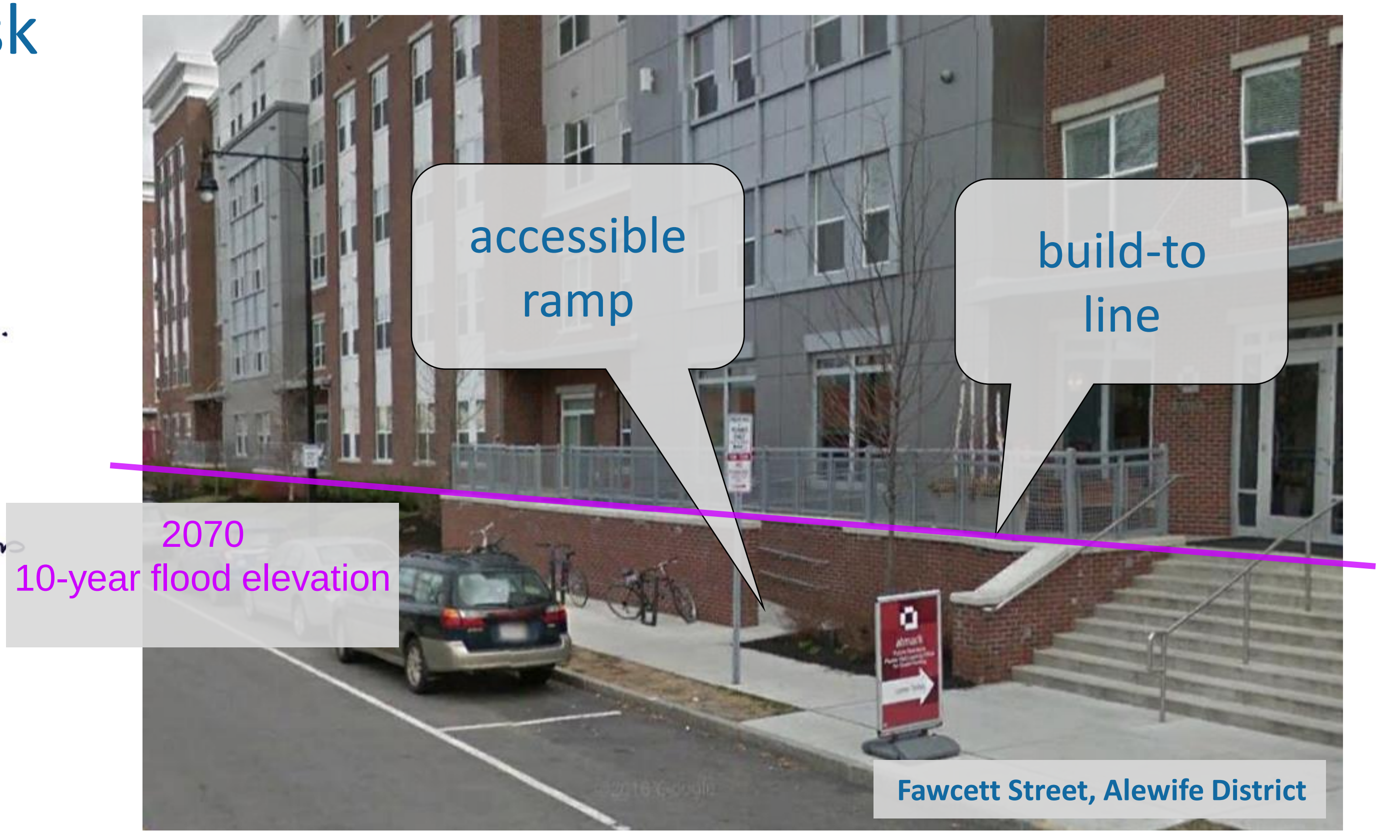
Learn more at: CambridgeMA.gov/FloodViewer

Flood Protection Guidance

Cambridge Design Flood Elevation Guidance

- Build/protect to 2070 10% annual risk
- Recover from 2070 1% annual risk





Stormwater Management – What and How?

Conservation Commission

Cambridge – NOAA Atlas 14, minimally

Lexington – Cornell

Winchester – Cornell

Stormwater Control Permit:

Projects before Planning Board and City Engineer Discretion. 2030 precip – going towards 2070 precip. Strong support from community.

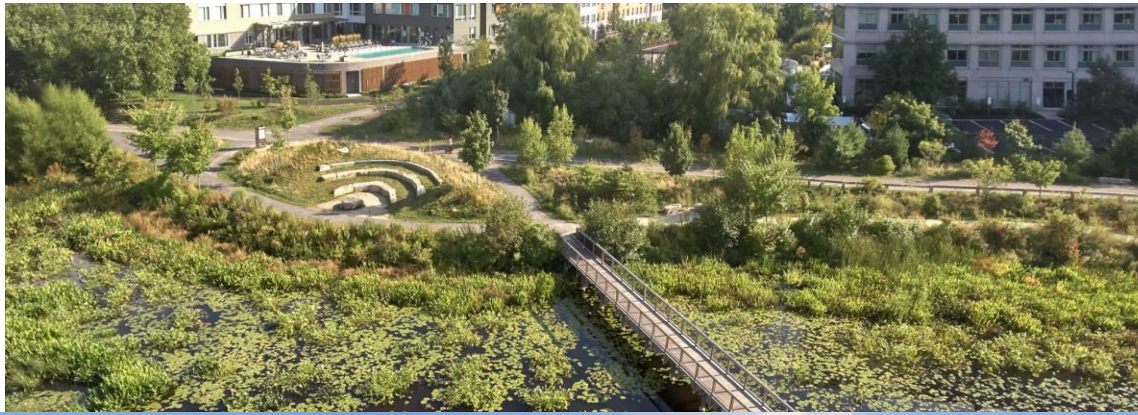
Building Permit Pre-Review – all major renovations and basement additions (requirements match scale of project).

Next Steps

Update zoning and stormwater regulations.

Managing Stormwater

Managing Stormwater in Dense Environments



Managing Stormwater in Dense Environments

- *Cambridge Crossing Commons*

Managing Stormwater in Dense Environments

- *Moulton Street Parking Lot, VHB Consultants.*
- *One Broadway Landscaping area, VHB Consultants.*
- *Longfellow Road Open Space, City of Cambridge.*

Managing Stormwater in Dense Environments

- *Mass + Main Development / Under Parking Lot & Walkway*
- *Source: VHB Consultants*

Managing Stormwater in Dense Environments

- *City of Cambridge 400,000 gallon stormwater tank*
- *Source: Kleinfelder + Stantec Consultants*

Environmental Investment Makes $$ Sense

MOODY'S
INVESTORS SERVICE

ESG considerations

Environmental

The city is committed to addressing environmental risk associated with flooding and heat exposure. To date, the most comprehensive mitigation projects include improving natural barriers around the Alewife neighborhood as well as heat mitigation efforts through its urban canopy-public shade tree investment program. Longer term the city expects to release its Climate Change Preparedness and Resilience Plan in 2020 that includes net zero action plan for government, residential and commercial development.

S&P Global
Ratings

We believe Cambridge's greatest credit risks are threats to its vibrant and growing economy. In particular, rising sea levels from climate change could directly affect taxable properties. The city has a history of proactively addressing future challenges, and, to this end, management maintains a number of long-term plans that generate shorter term decision-making.

The city is currently developing a "Climate Change Preparedness & Resilience (CCPR) Plan," described by management as its blueprint for reducing greenhouse gas emissions and addressing flood risk and storm water management. Management expects to complete this plan in the spring of 2020. In addition, Cambridge conducted a "Climate Change Vulnerability Assessment" to identify its specific vulnerabilities and inform the CCPR. Finally, the city has also undertaken efforts to reduce residential trash disposal, plant and maintain new trees throughout the city, and expand curbside organics collection.

RMC strongly supports state efforts to update standards & improve resiliency