Boston Planning and Development Agency
Climate Change Checklist Guidance

In October 2017 in conformance with the Mayor's 2014 Climate Action Plan and the 2016 Climate Ready Boston recommendations, the Boston Planning and Development Agency (BPDA) updated the Climate Change policy to require all development projects subject to Boston Zoning Article 80 Large Project, Planned Development Area, and Institutional Master Plan review, including modifications and updates, to consider and analyze the impacts of future climate conditions and to incorporate measures to avoid, eliminate, or mitigate greenhouse gas emissions and impacts related to climate change in project planning, design, and construction.

Climate Change Research and Information

Following are links to information about the City of Boston's climate change policies and practices including:

- *"Climate Ready Boston", 2016 Report*
- "*Climate Change and Sea Level Rise Projections for Boston*", 2016 report of the Boston Research Advisory Group
- *"Climate Change and Extreme Weather Vulnerability Assessments And Adaptation Options for the Central Artery*", MassDOT-FHWA Pilot Project, June 2015
- *"Greenovate Boston",* the 2014 update of the climate action plan
- "*Building Resilience in Boston: Best Practices for Climate Change Adaptation and Resilience for Existing Buildings*", Linnean Solutions, The Built Environment Coalition, The Resilient Design Institute, 2013.
- "*Enhancing Resilience in Boston: A Guide for Large Buildings and Institutions".* A Better City. 2015.
- *"The Commercial Net Zero Energy Building Market in Boston",* A Better City, 2017
- *"The Power of Zero, Optimizing Value for Next Generation Green*", BNIM, Integral Group, Davis Langdon / AECOM, and AIA COTE, 2015 (cost study of net zero energy buildings).

For additional information visit boston.gov/climate-ready.

Climate Change Resiliency and Preparedness Checklist

A completed Climate Change Resiliency and Preparedness Checklist (Climate Change Checklist) is due at each of the following Article 80 or similar filings:

- Initial Filing – with a Project Notification Form, Notice of Project Change, or other initial filing or update.
- Design / Building Permit – in conjunction with BPDA final design review but prior to requesting a building permit; provide an updated CC Checklist reflecting final project planning.
- Construction / Certificate of Occupancy – in conjunction with construction competition but prior to requesting a final Certificate of Occupancy; provide an updated CC Checklist reflecting actual built conditions.

CC Checklists are to be completed online

To better capture response data, the CC Checklist is provided as a fillable online form. Completed online forms should be saved for inclusion within each BPDA filing. The CC Checklist, along with Article 37 submissions, will be reviewed by the Interagency Green Building Committee (IGBC).

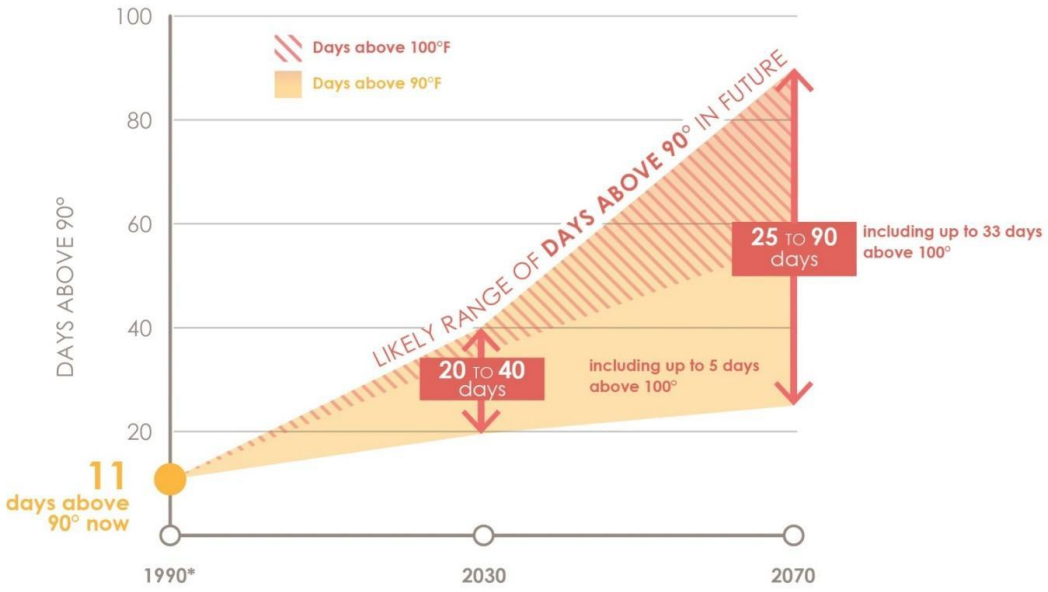
Greenhouse Gas Reduction

Reducing greenhouse gas emissions is critical to avoiding more extreme climate change conditions. Mayor Martin Walsh has set a goal for Boston to be carbon neutral by 2050. New building planning and design should employ a comprehensive approach to maximize building energy efficiency and include onsite clean and renewable energy strategies to ensure the constructed building has minimized greenhouse gas emissions.

Additionally, project planning should identify future adaptation strategies for advancing building energy efficiency, clean and renewable energy production, and other measures for achieving carbon net zero / net positive performance by 2050. Projects should use the Massachusetts Environmental Policy Act Protocol when calculating greenhouse gas emissions.

Extreme Heat

Annual average temperature in Boston increased by about 2˚F in the past hundred years and will continue to rise due to climate change. By the end of the century, the average annual temperature could be 56° (compared to 46° now) and the number of days above 90° (currently about 10 a year) could rise to 90.



* Baseline represents historical average from 1971-2000
Upper values from high emissions scenario. Lower values from low emissions scenario.

Data source: Rossi et al. 2015

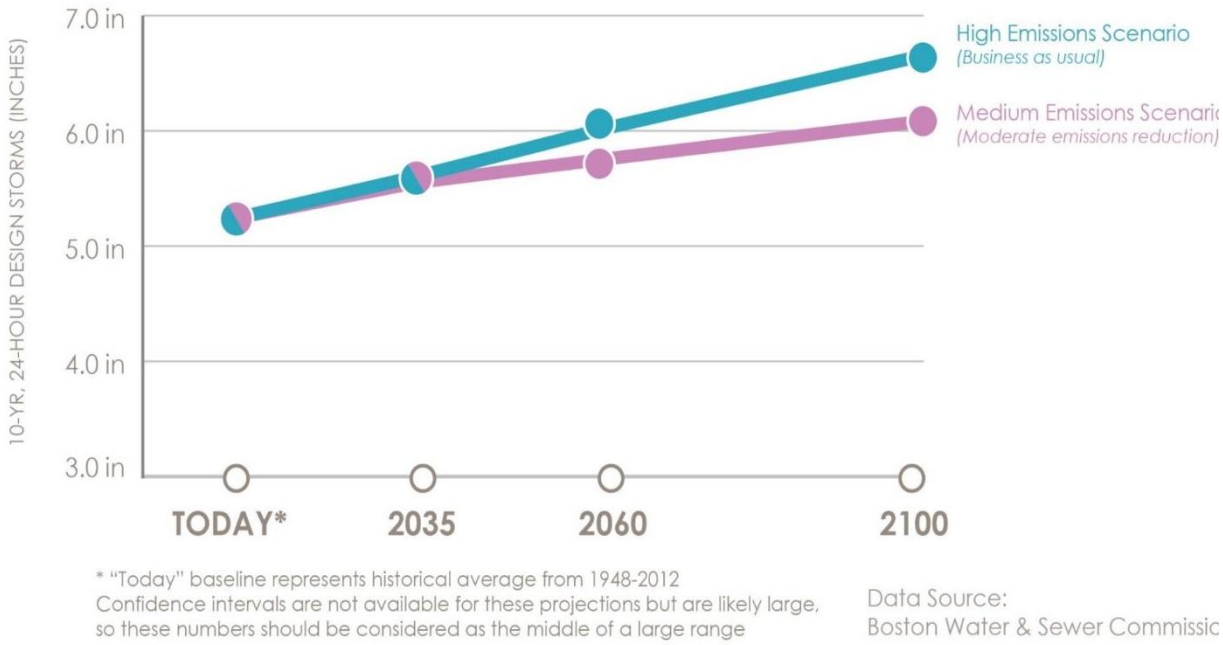
New buildings should be planned and designed to minimize thermal cooling and heating requirements. Passive strategies, including building siting, orientation, fenestration and envelope design, should be prioritized over mechanical system solutions. Building mechanical systems should

be designed to meet present and future conditioning requirements without diminishing system efficiency.

Additionally, project planning should identify future strategies for adapting to higher annual temperatures and more extreme heat waves including both building envelope and mechanical systems.

Extreme Precipitation Events

From 1958 to 2010, there was a 70 percent increase in the amount of precipitation that fell on the days with the heaviest precipitation. Currently, the 10-Year, 24-Hour Design Storm precipitation level is 5.25". There is a significant probability that this will increase to at least 6" by the end of the century. Additionally, fewer, larger storms are likely to be accompanied by more frequent droughts.



New buildings should be planned and designed to manage additional annual precipitation including rainwater harvesting, on-site stormwater retention and infiltration strategies.

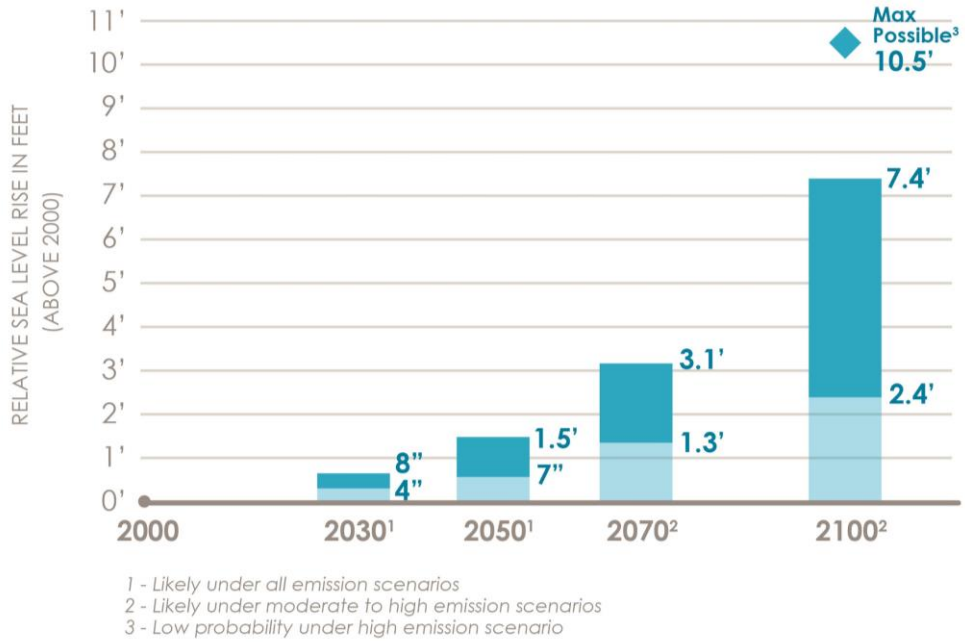
Additionally, project planning should identify future adaptation measures for managing additional precipitation.

Sea Level Rise

Climate Ready Boston's Research Advisory Group used three greenhouse gas emissions scenarios — high ("business as usual"), medium, and low (consistent with the 2015 Paris accords) — to project future sea-level rise in Boston. As indicated in the Boston Research Advisory Group (BRAG) Report,

under the medium emissions scenario, there is a 5% probability that sea level rise will be higher than three feet by 2070 and a 65% probability that sea level rise will be higher than three feet by 2100.

Based on these greenhouse gas emission scenarios, or other plausible greenhouse gas emissions scenarios, the sea level in Boston will continue to rise throughout the century and will exceed three feet sooner in the high emission scenario, later in the low emission scenario. For the BPDA Climate Change Checklist these scenarios represent reasonable future climate conditions and sea level rise risk thresholds for evaluating new development impacts.



The implications of these scenarios, represented on BPDA Sea Level Rise Flood Hazard Areas (SLR-FHA) map including flood water elevations, are based upon a 1% annual chance flood event with 40 inches of sea level rise (SLR) as derived from the MassDOT-FHWA Boston Harbor Flood Risk Model (BH-FRM). The 40" of SLR is a combination of the mean sea level rise (3.2 feet above 2013 tide levels) plus 2.5 inches to account for local land subsidence.

These measures may be updated based upon future climate science and coastal flooding assessments.

Projects should first evaluate if the location and site conditions are vulnerable to flooding:

- To determine if the Project site is within a FEMA SFHA, visit: https://msc.fema.gov/portal.
- To determine if the Project site is within the BPDA Sea Level Rise Flood Hazard Area (SLR-FHA), visit: *(see attached map. This map will be replaced with an online mapping tool).*

Project sites and buildings located in either the FEMA SFHA or the SLR-FHA may be vulnerable to flooding due to either present or future conditions, including rising sea levels.

Projects and sites located in the SLR-FHA should use the mapping tool to determine the project's Sea Level Rise Base Flood Elevation and calculate the Sea Level Rise Design Flood Elevation by adding 12" of freeboard for buildings, and 24" of freeboard for critical facilities and infrastructure and buildings with ground floor residential units.

The Sea Level Rise Design Flood Elevation should be used as the minimum performance target for the project and for reducing or eliminating flood risk and potential damage.

Checklist responses should identify design conditions (immediate) and future adaptation strategies for meeting or exceeding the SLR Design Flood Elevation and managing the flooding scenario represented by the SLR-FHA map. Strategies include raising the elevation of the site and access routes, elevating building ground floors, dry and wet flood proofing, locating critical building equipment and systems above potential flood heights, and deploying temporary barricades.

Disclaimer

The SLR-FHA and flood water elevations represented on this map are for planning purposes. The 40-inch SLR rise forecast and resulting flood water elevations do not represent a worst case SLR scenario. Project proponents are encouraged to reference the BRAG report and evaluate their own tolerance for risk given the specifics of their project's site, location, uses and functional life to determine if additional flood hazard mitigation and prevention measures should be incorporated into their project. Compliance with these guidelines does not guarantee against present or future flooding and resulting damages.

Climate Change Checklist Appendix

Flood Insurance Discount

Elevating a building above minimum freeboard requirements can help protect a project from future flooding and may lead to reductions in federal flood insurance premiums. Both residential and commercial projects that incorporate up to four feet of freeboard may be eligible for discounts. Please visit the Massachusetts Office of Coastal Zone Management freeboard webpage for more information.

Glossary

1% Annual Chance Flood: also known as the **100-Year Flood** and the **Base Flood**. Defined by FEMA as a flood with a 1% annual chance of occurring or being exceeded. FEMA Flood Insurance Rate Maps delineate the extent of the **Base Flood**, along with its corresponding Base Flood Elevations.

100-Year Floodplain: the boundary of a flood that has a 1% annual chance of occurring or being exceeded. Also referred to as **Special Flood Hazard Areas (SFHA)** on FEMA Flood Insurance Rate Maps.

Adaptation: changes that respond to anticipated environmental risks.

Base Flood Elevation (BFE): defined by FEMA as the top of water elevation projected for a specified flooding scenario. BFEs listed on FEMA Flood Insurance Rate Maps are based on the 1% Annual Chance Flood.

Boston City Base (BCB): a city-wide datum that can be converted to NAVD88 by using a conversion factor of BCB-6.46 feet.

Boston Harbor Flood Risk Model (BH-FRM): created as part of the Massachusetts Department of Transportation (MassDOT) and Federal Highway Administration (FHWA) Resilience Pilot Project. The model was developed by UMass-Boston, Woods Hole Group, Inc. and the University of New Hampshire. The project uses climate projections to simulate flooding from extreme weather and sea level rise, in order to plan for future resilience.

Building Floodproof Elevation: a BPDA term for the height below which water will not enter the building, including above and below grade building conditions and openings.

Coastal Flood Exceedance Probability (CFEP): the likelihood that a location will experience a flood during a given year. The MassDOT BH-FRM uses the 1% CFEP and the 0.1% CFEP to estimate flood depths in 2013, 2030 and 2070.

Critical Facilities and Infrastructure: defined by FEMA as a facility where even a low risk of disruption would constitute a severe threat. FEMA includes hospitals, fire stations, police stations, critical record storage facilities, and similar structures within this scope. The American Society of Civil Engineers also includes

facilities related to energy, water, transportation, communication systems, and natural and virtual resources within their definition of critical facilities.

Design Flood Elevation (DFE): defined by FEMA as the height of the lowest occupiable floor (when wet floodproofing), or the height of the lowest structural member of an inhabitable floor (when elevating a building). The DFE is separated from the BFE by freeboard.

Federal Emergency Management Agency (FEMA): manages the federal government's response to natural and manmade disasters. FEMA also manages the NFIP and produces Flood Insurance Rate Maps (FIRM).

Flood Insurance Rate Map (FIRM): maps produced by FEMA that delineate the borders of the 100-year floodplain and corresponding Base Flood Elevations. The flood projections shown on FIRMs are based on historic data, and do not include factors related to future sea level rise.

Floodproofing: defined by FEMA as structural or non-structural interventions that reduce flood damage to a space or a building.

Freeboard: defined by FEMA as a factor of safety, or a buffer between predicted flood levels and a building's lowest occupiable floor. In other words, the distance between the SLR-BFE and the SLR-DFE.

North American Vertical Datum of 1988 (NAVD88): a base measurement created by the National Geodetic Survey and used to calculate or compare elevations. NAVD88 can be converted to BCB by using a conversion factor of NAVD88+6.46 feet.

Resilience: the ability of a system to prepare for, withstand, and recover quickly from a disaster. Ideally, resilient systems should recover from an event by becoming stronger than they were prior to the stress.

Sea Level Rise Base Flood Elevation (SLR-BFE): a BPDA term for the top of water elevation predicted by the BH-FRM's 1% CFEP in 2070 scenario. This includes 3.2' of sea level rise above 2013 tide levels, an additional 2.5" to account for subsidence, and the 1% Annual Chance Flood. The SLR-BFE is separated from the SLR-DFE by freeboard.

Sea Level Rise Design Flood Elevation (SLR-DFE): a BPDA term for the height of the lowest occupiable floor. This elevation is separated from the SLR-BFE by freeboard.

Sea Level Rise Flood Hazard Area (SLR-FHA): a BPDA term that delineates the extent of flooding projected in the BH-FRM for the 1% CFEP in 2070 scenario.

Sustainability: practices that protect the health of people and the environment.