

Citations and Sources

Data used in this report came from a variety of sources. Metrics such as marsh transitions, number of buildings flooded and miles of roads impacted are based on assessments of existing model results. The models used are state-of-the-art, but they are based on a number of assumptions and various input conditions that come with inherent limitations. The Trustees used publicly available data for other metrics, including beach erosion rates, public access, and miles of armored shoreline. Our sources include (in order of appearance in the document):

1. The Worst Massachusetts Hurricanes of the 20th Century.

(<https://www.mass.gov/service-details/the-worst-massachusetts-hurricanes-of-the-20th-century>)

2. MA Barrier Beach Inventory. (<https://www.mass.gov/service-details/massachusetts-barrier-beach-inventory>)

3. Massachusetts State sea level rise projections were developed by DeConto, R.M. and R.E. Kopp (2017). *Massachusetts Sea Level Assessment and Projections; Technical memorandum*. More details on Massachusetts State Sea Level Rise projections can be found at (<https://resilientma.mass.gov/resources/resource::2152>).

The 'high' rate of sea level rise is what is used in our flood risk analyses using MC-FRM (Massachusetts Coast Flood Risk Model) as recommended by the Massachusetts Office of Coastal Zone Management (CZM) and UMass-Boston. Assumed increases in sea level are +1.3 ft, +2.6ft, +4.4 ft as soon as 2030, 2050, and 2070. These values of sea level rise were calculated from published projections of sea level elevation using the mean water level for Woods Hole of -0.17 ft NAVD88 in present day (centered around a 2008 baseline).

4. Climate change projections from Resilient MA.

(<https://resilientma.mass.gov/changes>)

5. Impacts to buildings and roads from coastal flooding. Information about the flood modeling can be found at (https://eea-nesc-um-dataservices-assets-prd.s3.amazonaws.com/cms/GUIDE-LINES/MC-FRM_FAQ_04-06-22.pdf). Values for roads and buildings inundated were calculated for each town using the flood scenario extents under the "high" rate of sea level rise, as recommended by Massachusetts Office of Coastal Zone Management (CZM) and UMass-Boston. *Technical Memo: Methodologies for assessing coastal vulnerabilities for The Trustees State of the Coast – South Coast*, Woods Hole Group, 2022.

6. Marsh and coastal habitat changes were provided by Woods Hole Group and derived from CZM's Massachusetts Sea Level Affecting Marshes Model (SLAMM) project. The high sea level rise scenario from which SLAMM results are presented is 7.1 feet of rise for Buzzards Bay from 2011-2100. Details on the SLAMM model can be found at (<https://www.mass.gov/service-details/report-on-modeling-the-effects-of-sea-level-rise-on-coastal-wetlands>)

7. Historic closures of New Bedford Harbor Hurricane Barrier from US Army Corps of Engineers; John MacPerson, Operations Manager (email communication July 19, 2022).

8. Eelgrass extents were calculated by the Buzzards Bay Coalition using data from the Buzzards Bay National Estuary Program.

9. Bay scallop landings for Buzzards Bay were calculated by the Buzzards Bay Coalition using data from the Massachusetts Division of Marine Fisheries.

10. NOAA's tide gauge trends for Woods Hole.

(https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8447930)

11. Hurricane extents were obtained from data at MassGIS.

(<https://maps.massgis.digital.mass.gov/MassMapper/MassMapper-CZM-MORIS.html>)

12. Massachusetts Coast Sea Level Rise.

(<https://resilientma.mass.gov/changes/sea-level-rise>)

13. Previous sea level rise projections from Parris et al. (2012).

Global sea level rise scenarios for the United States National Climate Assessment, NOAA.

14. NOAA sea level rise projections from Sweet et al. (2022).

Global and regional sea level rise scenarios for the United States. Technical report NOS01. (<https://oceanservice.noaa.gov/hazards/sealevelrise/sealevel-rise-tech-report.html>)

15. Short- and long-term erosion rates, beach erosion rates, and shoreline change analyses were derived from USGS Coastal Change Hazards Portal.

(<https://marine.usgs.gov/coastalchangehazardportal>)

16. Coastal Public Access data was derived from data at MassGIS.

(<https://maps.massgis.digital.mass.gov/MassMapper/MassMapper-CZM-MORIS.html>). This dataset includes more than 1,900 publicly accessible sites along the Massachusetts coast that are owned by government agencies and nonprofits and open to the public. It includes beaches, rocky coasts, shore-side parks, public boat ramps, harbor walks, coves, marshes and creeks, overlooks, islands (some that are only accessible by boat), and rights-of-way.

17. Shoreline Characterization Layers from CZM were sourced from

the Massachusetts Ocean Resources Information System (MORIS) at (<https://maps.massgis.digital.mass.gov/MassMapper/MassMapper-CZM-MORIS.html>) and the *Report of the Massachusetts Coastal Erosion Commission, Volume 1: Findings and Recommendations*, and *Volume 2: Working Group Reports*, (<https://www.mass.gov/service-details/massachusetts-coastal-erosion-commission>)

18. **Shore Protection Structures** from CZM were sourced from the Inventories of Seawalls and Other Coastal Structures website. (<https://www.mass.gov/service-details/inventories-of-seawalls-and-other-coastal-structures>)
19. Woods Hole Group, Inc. analysis of **MassGIS Data: Protected and Recreational Open Space** (December 2021) including inventories of the conservation and outdoor recreational facilities owned by federal, state, county, municipal, and nonprofit enterprises.
20. **Massachusetts StormSmart Coasts Program.** (<https://www.mass.gov/stormsmart-coasts-program>)
21. **Salt marsh carbon** sequestration estimate from Mcleod et al. (2011). *A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2.*
22. **NOAA Tide Datums** provide information on tidal ranges for New Bedford, Falmouth, and Boston. (<https://tidesandcurrents.noaa.gov/stations.html?type=Datums>)
23. **Allens Pond restoration** information from Mass Audubon; Danielle Perry, Coastal Resilience Program Director (email communication July, 2022).
24. **Salt marsh accretion rates** for Plum Island Sound estuary from Hopkinson et al. (2018). *Lateral marsh edge erosion as a source of sediments for vertical marsh accretion.* Journal of Geophysical Research: Biogeosciences. (<https://doi.org/10.1029/2017JG004358>)
25. **Economic impact of fisheries at Port of New Bedford** from Martin Associates (2019). *Economic impact study of New Bedford/Fairhaven Harbor.*
26. **Port of Fall River** (<https://www.fallriverma.org/port-authority/>)
27. **Landings information for fish and shellfish** provided by Massachusetts Division of Marine Fisheries; Erich Drusket (email communication March 29, 2022).
28. **New Bedford Harbor Hurricane Barrier.** (<https://portofnewbedford.org/wp-content/uploads/2021/12/NBHB-2022-Tide-Watch-Schedule.pdf>)
29. **Recommended New Bedford port upgrades and resiliency measures** from Foth Infrastructure & Environmental, LLC and Fathom Resources, LLC (2021). *New Bedford Harbor Port Assessment Summary.*
30. **Resilient Design Guidelines New Bedford Harbor: A guide for the Port of New Bedford to bolster building and infrastructure resilience in the face of sea level rise and storm surge,** June 2020.
31. **Buzzards Bay National Estuary Program.** (www.buzzardsbay.org)
32. **Nitrogen pollution in Buzzards Bay.** Buzzards Bay Coalition. (savebuzzardsbay.org)
33. **Impaired waterbodies** from MA Department of Environmental Protection, Integrated Waters List. (<https://www.mass.gov/lists/integrated-lists-of-waters-related-reports>)
34. **Nitrogen-reducing septic systems** in West Falmouth. Buzzards Bay Coalition. (savebuzzardsbay.org)
35. The Upper Bay **Regional Wastewater Feasibility Assessment,** Buzzards Bay Coalition and partners, 2016-2021.
36. **Municipal Vulnerability Planning project reports** prepared under the Massachusetts Municipal Vulnerability Program (MVP). (<https://www.mass.gov/info-details/municipal-vulnerability-preparedness-mvp-program-planning-reports>)
37. **Communications with municipal officials** were conducted with conservation agents, town administrators, conservation agents, engineers, and others in the form of one interview per town and follow-up emails, February–March, 2022.
38. **Eelgrass declines in Narragansett Bay** from Save the Bay. (https://www.savebay.org/bay_issues)
39. **Coastal population** of United States at (<https://oceanservice.noaa.gov/facts/population.html>)
40. **Ocean View Farm protection project** summary from Dartmouth Natural Resources Trust. (<https://dnrt.org/oceanview/>)
41. **Marsh Island salt marsh restoration** project summary from Buzzards Bay Coalition; Sara Quintal, Restoration Ecologist (email communication August 8, 2022).
42. **Bay friendly living:** yard care and lifestyle tips to save time, money and the bay, Save the Bay. (savebay.org/bay-friendly-living)
43. **Envision Resilience Narragansett Bay.** (<https://www.envisionresilience.org>)
44. **Collins Cove Salt Marsh Restoration Project.** (<https://www.salemsound.org/livingShoreline.html>)
45. **Costs of flood mitigation versus loss** from Federal Emergency Management Agency (2018). *Natural hazard mitigation save – Interim Report.* (fema.gov/sites/default/files/2020-07/fema_mitsaves-fact-sheet_2018.pdf)