ResilientCoasts

DRAFT PLAN

APPENDIX V

Public Beach Vulnerability Technical Documentation

ResilientMass   ResilientCoasts

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Technical Documentation for Public Beach Vulnerability

1 | Introduction

The Massachusetts coast is largely composed of sandy or gravely beach interspersed with rocky headlands, developed shoreline, and saltmarsh. Beaches make up a majority of exposed coastline and provide significant economic and ecological value acting as tourist attractions, natural habitats, and coastal defenses, contributing to tourism revenue, biodiversity, and flood protection. Like many natural features, beaches are subject to numerous threats including rising sea levels, erosion, and human interference.

Human alternation of the shoreline in the form of shoreline stabilization (revetments, groins, seawalls, bulkheads, etc.) can block or alter the natural movement of sand and sediment along the coast (longshore drift) leading to updrift accretion where sand accumulates on the side of the structure facing the prevailing currents, building up the beach and, concurrently, downdrift erosion where areas on the opposite side of the structure experiences a shortage of sediment, leading to erosion and beach loss. Likewise, seawalls and other hard shore parallel structures reflect wave energy back towards the shore, which can concentrate wave force and accelerate erosion in front of the structure.

More research is needed to better understand the relative long-term vulnerability of Massachusetts beaches to climate change and other forces; however, some publicly available data can help identify areas at more or less risk. To narrow the focus on the beaches that currently provide the greatest public benefits, this analysis was limited to publicly accessible beaches (both publicly and privately-owned) on the ocean-facing shoreline. The following section details the analysis of stretches of public beaches along the Massachusetts coast that are most at risk for erosion and potential disappearance, using publicly available data, statewide and for each CRD.

2 | Public Beach Vulnerability

The primary data sources used to analyze beach vulnerability were:

- Massachusetts Shoreline Change Transects[1]
- Massachusetts Department of Environmental Protection Wetlands dataset[2]
- Massachusetts Shoreline Stabilization Structures dataset[3]
- Massachusetts Land Cover/Land Use dataset[4]
- Massachusetts Protected and Recreational Open Space dataset[5]

Four datasets were used to understand the development conditions of the ocean-facing shoreline: Massachusetts Shoreline Change Transects (to identify whether beaches are eroding or remained static), Massachusetts Department of Environmental Protection Wetlands dataset (to identify locations of

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[1] Massachusetts shoreline change transects (1970-2014), available at: https://czm-moris-mass-eoeea.hub.arcgis.com/datasets/c53478d6afb84459b711d9b6d9361f23_1/explore?location=42.033399%2C-70.524176%2C8.54

[2] MassDEP Wetlands dataset (2005), available at: https://www.mass.gov/info-details/massgis-data-massdep-wetlands-2005

[3] MA Shoreline Stabilization Structures (2025) dataset, available at: https://czm-moris-mass-eoeea.hub.arcgis.com/maps/14938ac47b43427f87a96231fc1eaec5/about

[4] MA 2016 Land Cover/Land Use dataset, available at: https://www.mass.gov/info-details/massgis-data-2016-land-coverland-use

[5] MA Protected and Recreational OpenSpace (2025) dataset, available at: https://www.mass.gov/info-details/massgis-data-protected-and-recreational-openspace

beaches), Massachusetts Shoreline Stabilization Structures dataset (to identify locations of armoring), and Massachusetts Land Cover/Land Use dataset (to identify areas where the beach is backed by developed lands). The Massachusetts Protected and Recreational Open Space dataset was then used to isolate only the beaches that are publicly accessible, whether publicly or privately-owned.

To identify which stretches of public beach along the coast are most vulnerable to severe erosion (both horizontal and vertical) and even potential disappearance, the analysis identified Massachusetts beaches that have eroded or remained static over the past 50 – 70 years. As a dynamic feature, some beaches have accreted (accumulated sand rather than lost it) during that timeframe, and those beaches were excluded from the analysis.

To focus the analysis on beaches with the greatest potential vulnerability, beaches with maximum human alteration – e.g., coastal engineering structures (armoring) and/or backed by developed lands in the form of commercial, residential, or other development including roads and other impervious surface, were identified.

Ultimately, the analysis isolated public beaches that met all of the following criteria: eroding or static, publicly accessible, armored, and/or backed by development.

Three different scenarios were analyzed individually – public beaches that have a developed shoreline, public beaches that have an armored shoreline, and public beaches that have an armored and a developed shoreline. The reasoning for these groupings is that while developed shorelines are vulnerable to erosion because of the impact they have on natural dynamic processes of beaches, armored shorelines are even more vulnerable.

The focus on publicly accessible beaches is important because in many parts of the coast, these areas are a limited but important community resource. Where publicly accessible beaches are vulnerable and threaten to narrow or disappear over time, a critical public resource may be lost.

Public beaches that were identified as developed and armored are considered to be "highly vulnerable." These are identified in the far-right column in the table below.

Table 1. Public Beach Vulnerability by Coastal Resilience District

Coastal Resilience District	Assessed Shoreline*	Public Beaches		Public and Developed		Public and Armored		Public, Developed, and Armored ("Highly Vulnerable"	
	Miles of shoreline	Miles of Shoreline	% of Assessed Shoreline	Miles of Shoreline	% of Public Beach	Miles of Shoreline	% of Public Beach	Miles of Shoreline	% of Public Beach
Boston Harbor Islands	25.6	11.1	43%	0	0%	3.6	32%	0	0%
Buzzards Bay	152.3	27.3	18%	9.7	36%	14.6	53%	8.1	30%
Great Marsh	30.6	20.4	67%	4.2	20%	3.2	16%	2.8	14%
Islands	192.4	47.3	25%	10.5	22%	8.2	17%	3.7	8%
Manomet-Sagamore	14.8	2.3	16%	1.5	62%	1.2	51%	1.2	51%
Mid-North Shore	82.9	8.0	10%	5.8	72%	7.1	89%	5.7	71%
Mid-South Shore	57.7	10.4	18%	3.2	31%	3.5	33%	2.9	28%
Mystic-Charles Watersheds	8.1	0.7	9%	0.7	100%	0.7	100%	0.7	100%
Neponset-Weir Watersheds	45.9	9.0	20%	4.4	49%	6.5	72%	4.4	49%
North Cape Cod	73.8	28.7	39%	7.4	26%	4.2	15%	3.5	12%
Outer Cape Cod	86.3	32.7	38%	3.7	11%	0.9	3%	0.5	1%
Saugus Watershed	29.6	6.9	23%	5.7	83%	6.3	92%	5.9	86%
South Cape Cod	47.9	9.6	20%	5.1	53%	6.3	65%	4.6	48%
Total	*848.0*	*214.5*	*25%*	*62*	*29%*	*66*	*31%*	*44*	*21%*

*Assessed shoreline includes miles of immediate, exposed ocean-facing shoreline

3 | Data Methods

Step 1. Create input data.

    A. *Static or eroding shoreline transects*. Open [Massachusetts shoreline change transects (1970-2014)](#) and extract features with the following attributes to a new line feature class.

> SYMBOLOGY = ERODING and NO STATISTICAL CHANGE

Buffer the transects 40 meters to create a polygon feature class (*Static or eroding shoreline transects*).

    B. *2014 Shoreline*. Open Massachusetts shorelines (1800s-2014) and extract the following attribute to a new class (*2014 Shoreline*).

Year = 2014

    C. *Beaches*. Open [MassGIS Data: MassDEP Wetlands (2005), December 2017](#) and extract the following attributes to a new feature class (*Beaches)*:

> IT_VALDESC = BARRIER BEACH SYSTEM, BARRIER BEACH-COASTAL BEACH, BARRIER BEACH-COASTAL DUNE, COASTAL BEACH, and COASTAL DUNE.

    D. *Public access*. Open MassGIS Data: Protected and Recreational OpenSpace, April 2025 and extract the following features to a new feature class (*Public access)*.

> PUBLIC_ACCESS = Y - FULL PUBLIC ACCESS

    E. *Armored*. Open [Shoreline Stabilization Structures](#) and remove the following features to create a new feature class of hardened shoreline stabilization structures (*Public access)*:

PrimaryMaterial ≠ Sandbags

PrimaryType ≠ Sandbags

    F. *Developed shoreline*. Open [MassGIS Data: 2016 Land Cover/Land Use, May 2019](#) and extract all the following attributes to a new feature class (*Developed shoreline)*:

> Generalized Use Name = Commercial, Industrial, Mixed use, primarily commercial, Mixed use, primarily residential, Residential – multi-family, Residential single family, Residential – single family.

Generalized Use Name = Recreation AND Land Cover Name = Impervious

USEGENNAME = Tax exempt AND COVERNAME = Impervious

   USEGENNAME = Right-of-way AND COVERNAME = Impervious

Step 2. Create a derived layer of *Static or Eroding Shoreline / Beach* transects that intersect *Beach and* creating a new feature class (*Static or Eroding Shoreline / Beach).*

Step 3. Create a derived layer of *Static or Eroding Shoreline / Beach | Public* transects by selecting all *Eroding Shoreline / Beach* polygons that intersect *Public Access* and creating a new feature class (*Static or Eroding Shoreline / Beach | Public).*

Step 4. Create a derived layer of *Static or Eroding Shoreline / Beach | Public / Armored* transects selecting all *Eroding Shoreline / Beach / Public* polygons that intersect *Armored* and creating a new feature class (*Static or Eroding Shoreline / Beach | Public / Armored).*

Step 5. Create a derived layer of *Static or Eroding Shoreline / Beach | Public / Developed* polygons by selecting all *Eroding Shoreline / Beach / Public* polygons that intersect Developed and creating a new feature class (*Static or Eroding Shoreline / Beach | Public / Developed).* MENTION BUFFERING

Step 6. Create a derived layer of *Static or Eroding Shoreline / Beach | Public / Armored / Developed* transects combining all *Eroding Shoreline / Beach / Public / Armored* polygons with *Eroding Shoreline / Beach / Public / Developed* polygons and creating a new feature class (*Static or Eroding Shoreline / Beach | Public / Armored / Developed).*

Step 7. Clip the *2014 Shoreline* with the following data layers to create new derived vector feature classes (*Static or Eroding Shoreline / Beach | Public - 2014 Shoreline*, etc.).

   Static or Eroding Shoreline / Beach | Public

   Static or Eroding Shoreline / Beach | Public / Armored

   Static or Eroding Shoreline / Beach | Public / Developed

   Static or Eroding Shoreline / Beach | Public / Armored / Developed

Step 8. Use the Identity tool to create the geometric intersection of all feature layers developed in Step 7 with the *Coastal Resilience Districts* feature class.

Step 9. Calculate the length of coastline in each resultant feature class broken by Coastal Resilience District boundaries.

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