FEMA Region 1 Coastal Erosion Hazard Area Studies – Future Coastal Erosion and Sea Level Rise

Wednesday, November 1st, 2023

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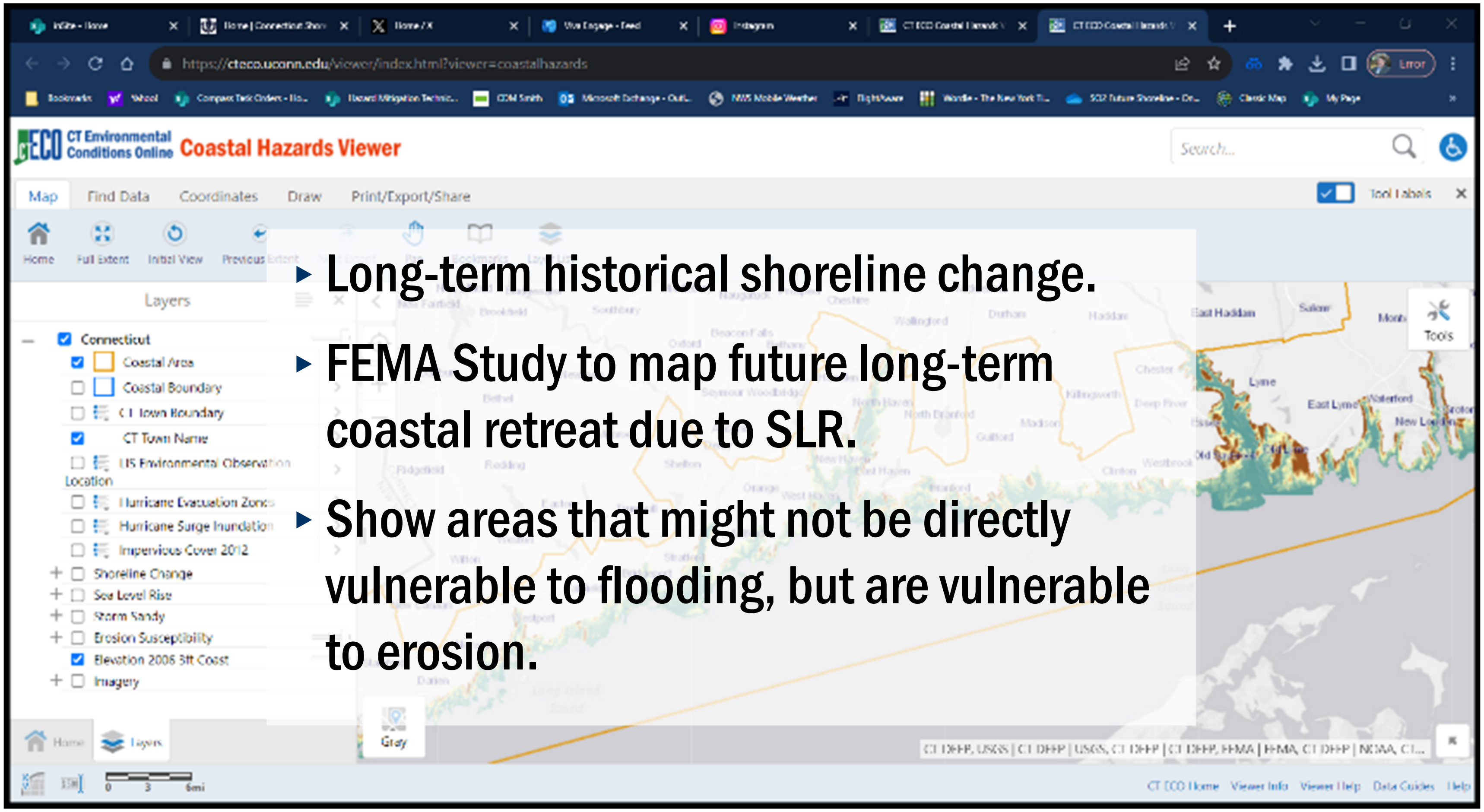
Purpose and Objectives of Study

Ballston Beach
Photo: Reed Timmer, AccuWeather

Sandwich
Photo: Reed Timmer, AccuWeather

- Coastal erosion observed during severe winter storm on January 29-30, 2022

Purpose and Objectives of Study



- Long-term historical shoreline change.
- FEMA Study to map future long-term coastal retreat due to SLR.
- Show areas that might not be directly vulnerable to flooding, but are vulnerable to erosion.

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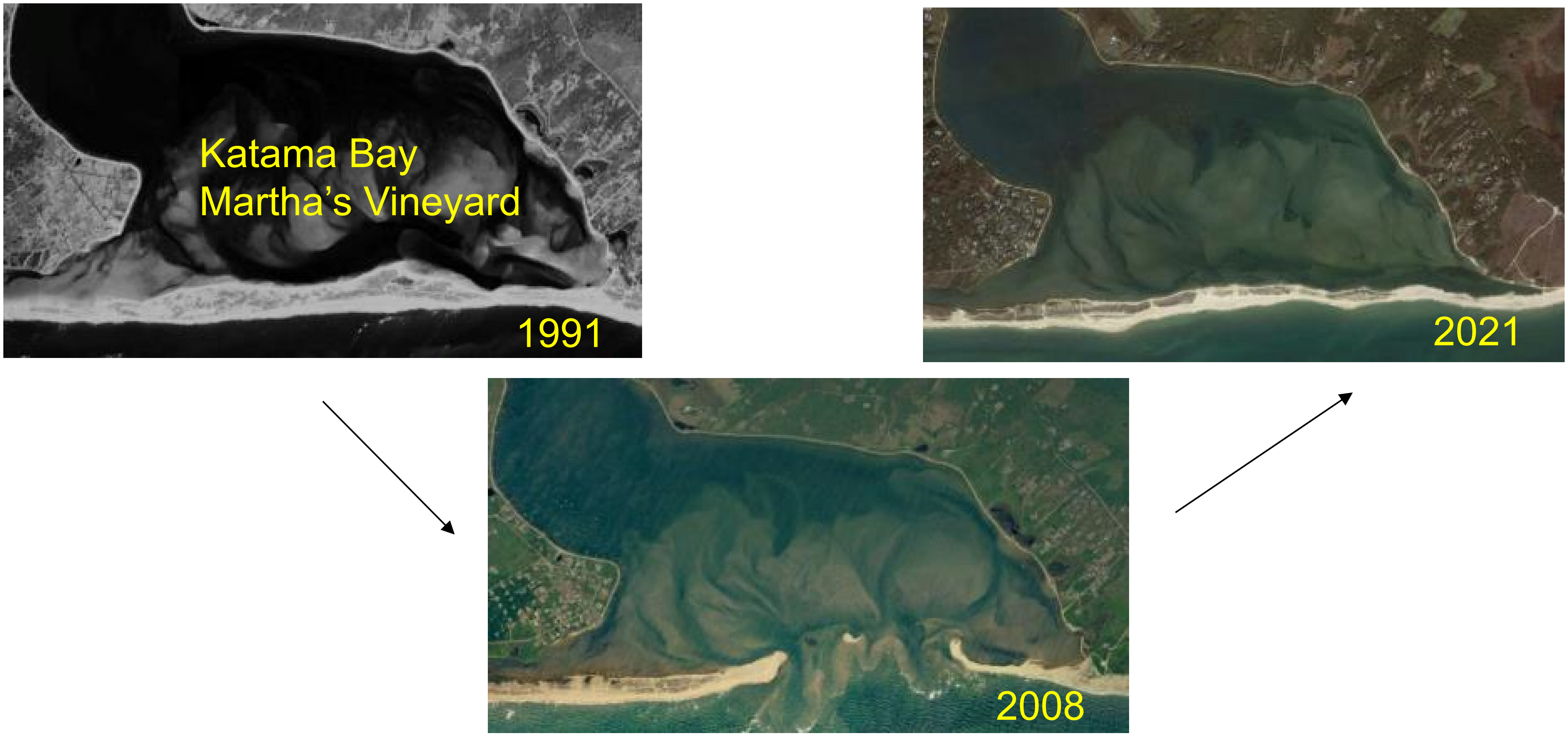
Purpose and Objectives of Study

- Developed maps that show future coastal erosion hazard areas under multiple SLR scenarios for the years 2030, 2050, and 2100.
- Maps can be used to identify areas most at risk and help communities plan for SLR.

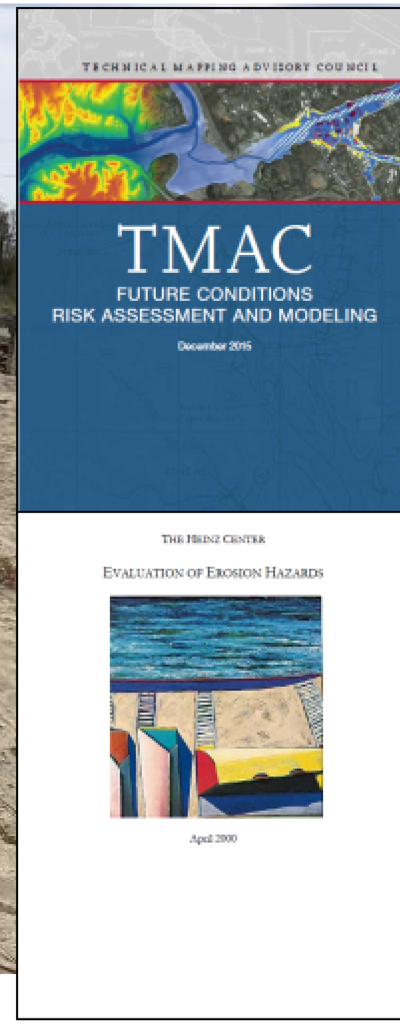
Purpose and Objectives of Study



- Study shows areas at risk due to future SLR, does not predict exactly where the shoreline will be.

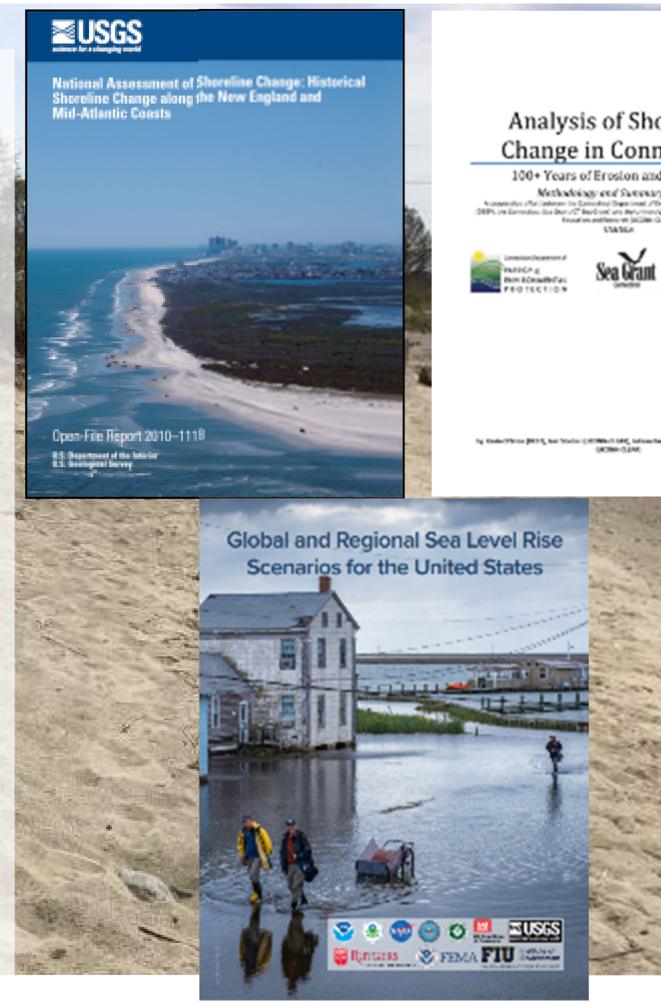
Purpose and Objectives of Study

- 1994 - Congress directed FEMA to prepare and submit an evaluation of economic impacts and feasibility of mapping Erosion Hazard Areas (EHA) as part of the NFIP.
- 1994-1999 – Pilot studies conducted in coastal communities to estimate long-term shoreline change.
- 2000 – Heinz Center Study evaluates feasibility of FEMA mapping coastal erosion hazards.
- 2016 – TMAC recommends FEMA map coastal erosion hazards and future conditions due to SLR.

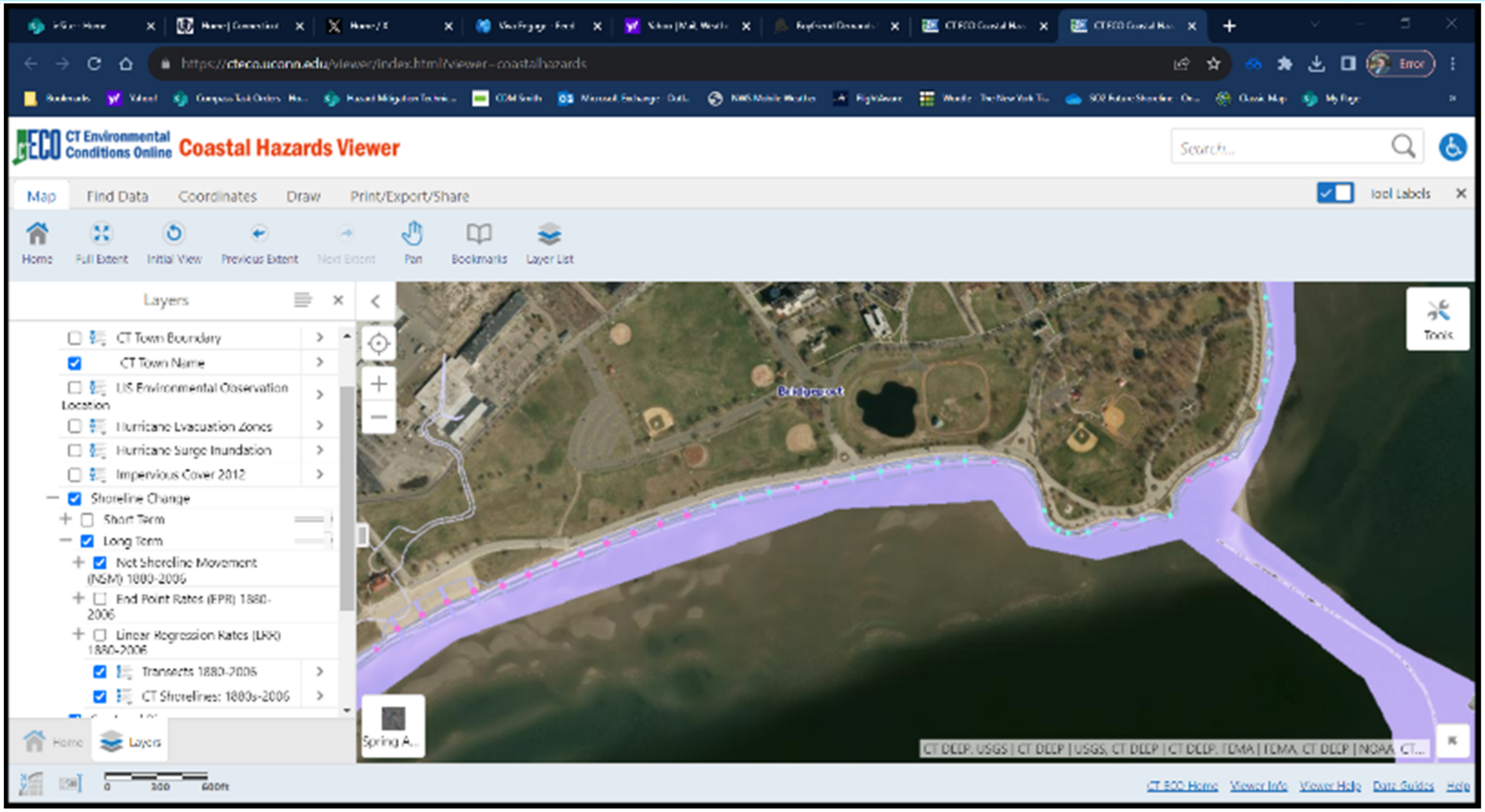


Purpose and Objectives of Study

- There have been several local and regional studies of SLR and coastal erosion.
- Most studies focus on 1) flooding and inundation to future SLR or 2) observed (historical) rates of coastal erosion.
- This study focuses on how SLR will accelerate observed of erosion and what future hazard zones might look like over multiple time frames.



Purpose and Objectives of Study



- Recent studies have focused on historical erosion rates and future flood scenarios.

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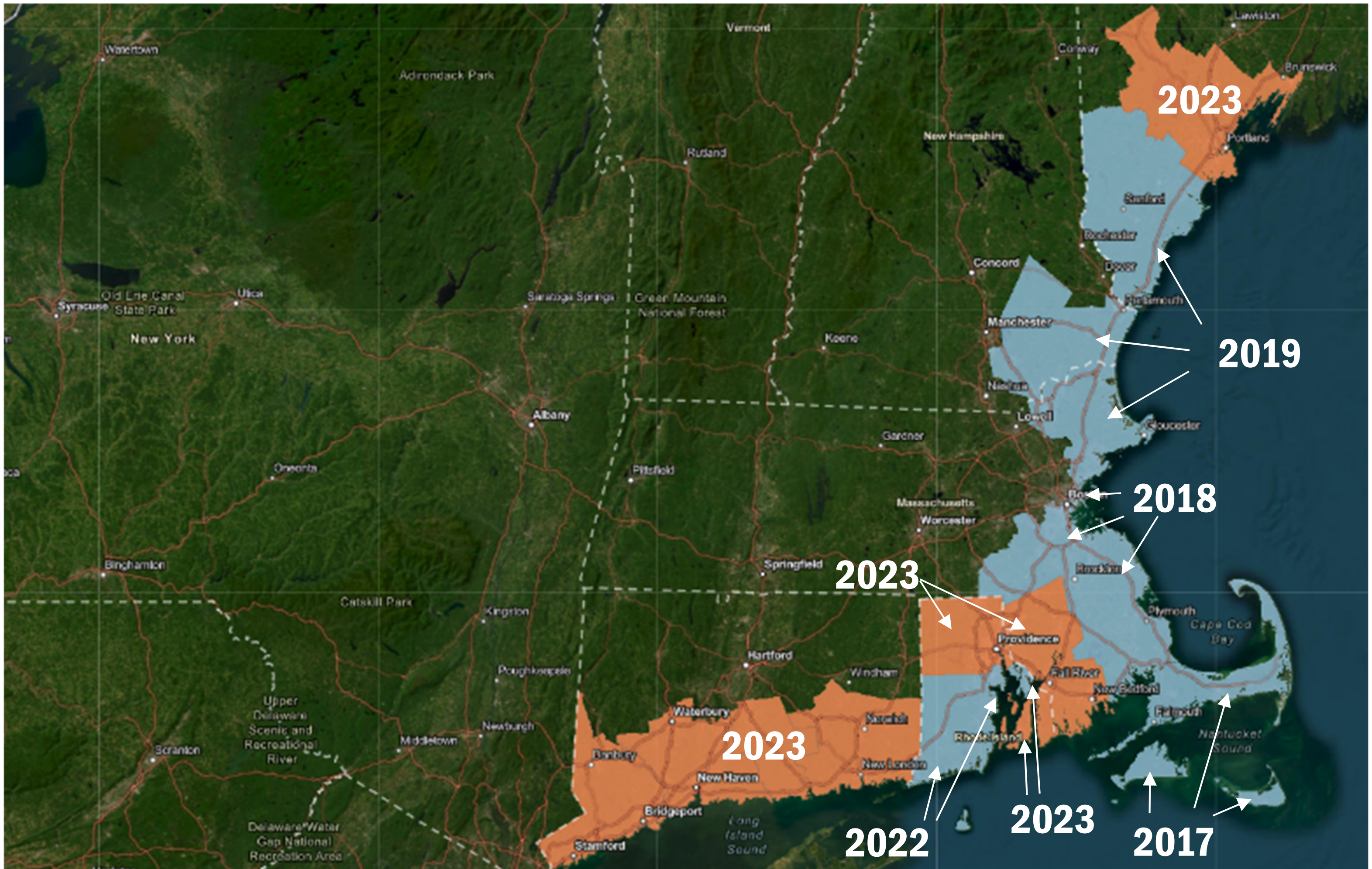
Current Study Status in Region 1



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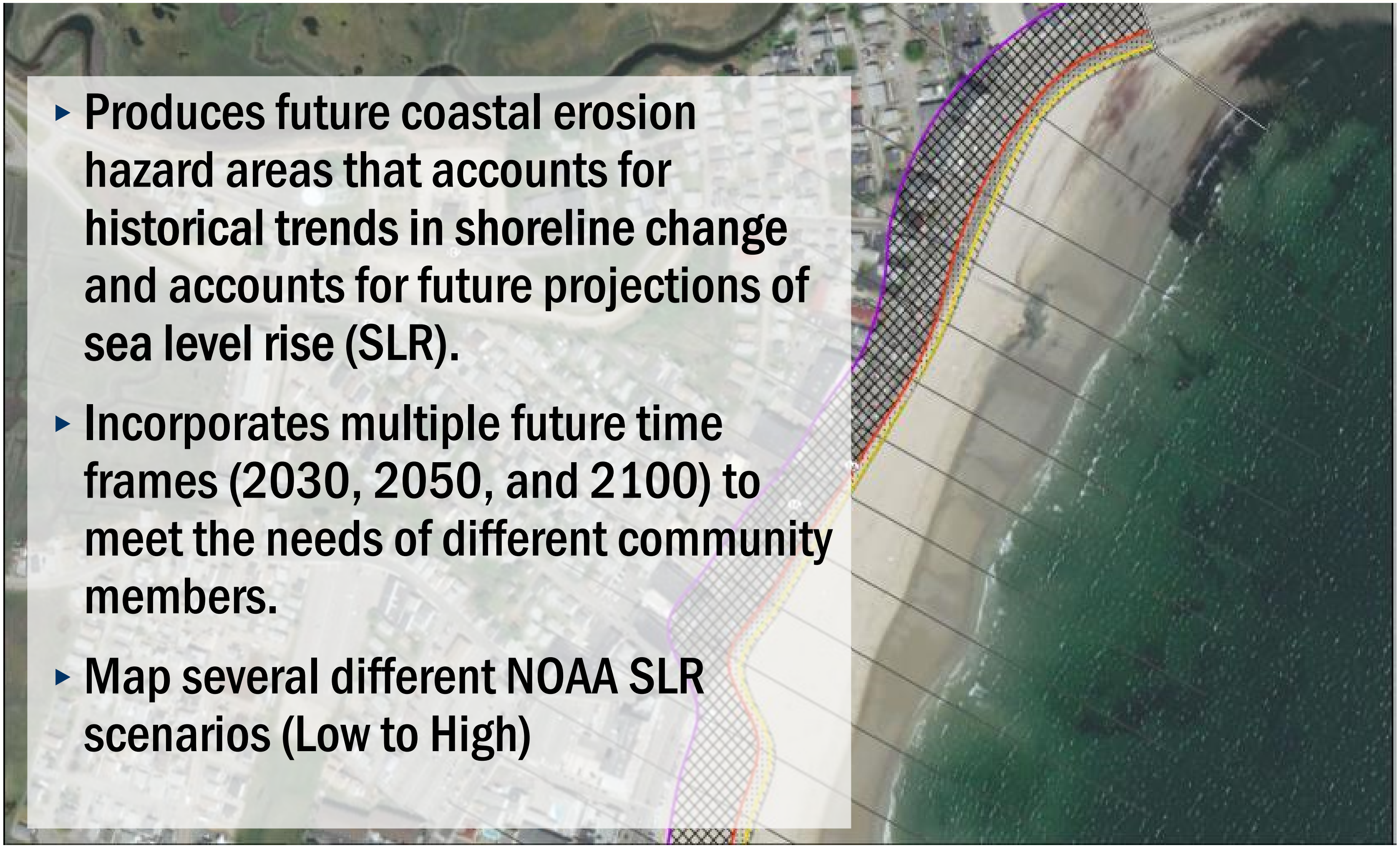
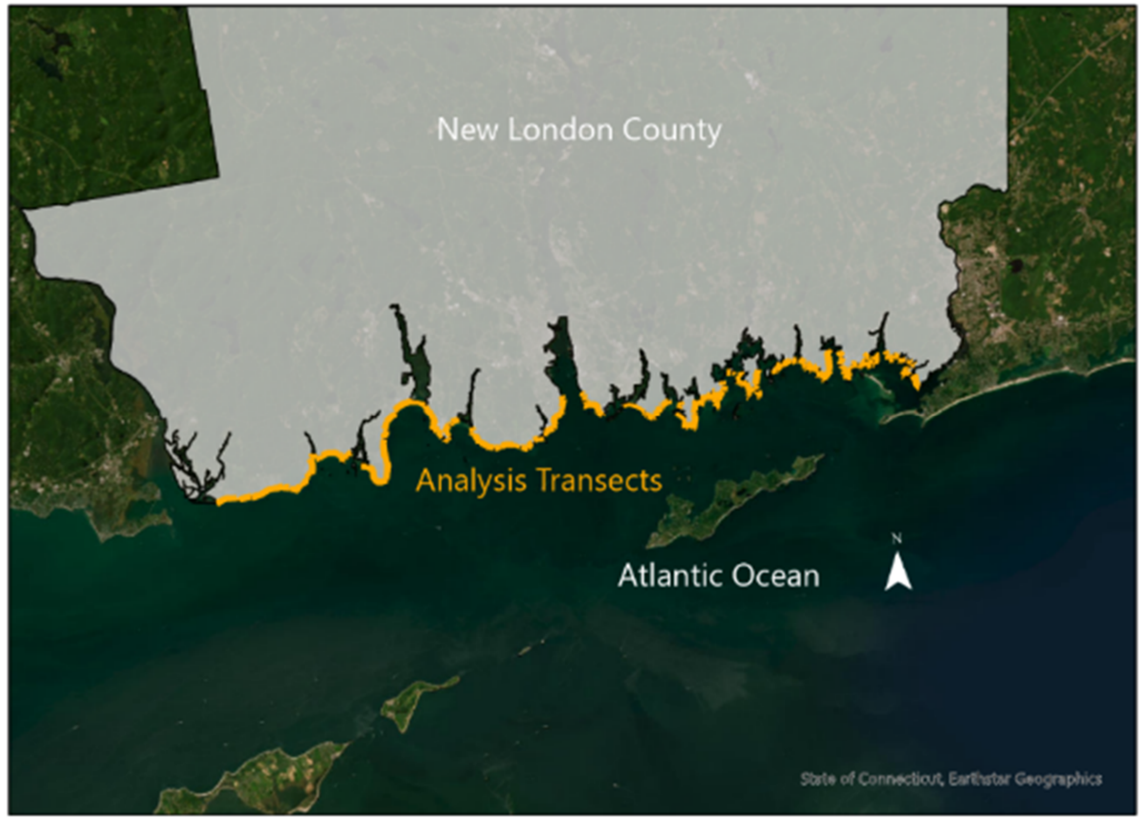
Conceptual Approach



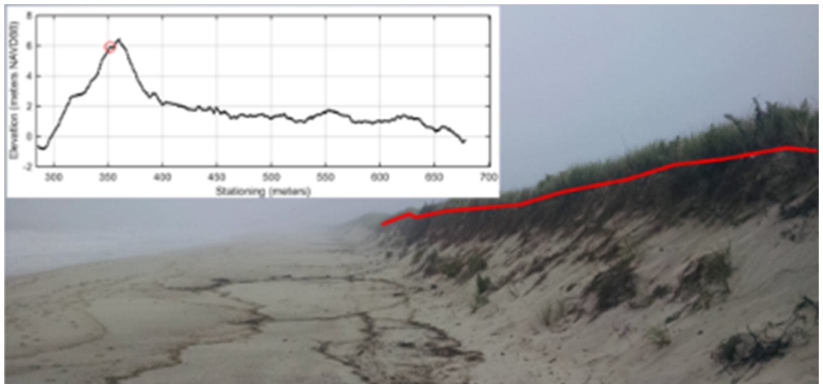
- Produces future coastal erosion hazard areas that accounts for historical trends in shoreline change and accounts for future projections of sea level rise (SLR).
- Incorporates multiple future time frames (2030, 2050, and 2100) to meet the needs of different community members.
- Map several different NOAA SLR scenarios (Low to High)

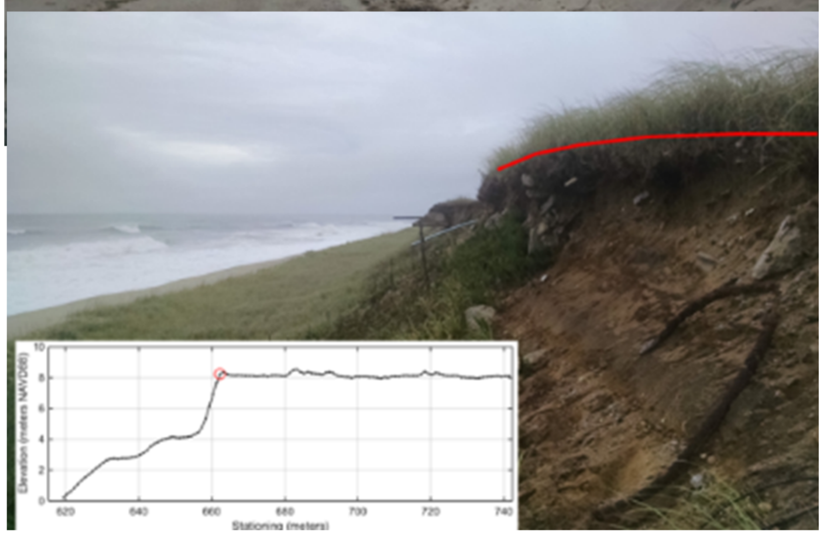
Conceptual Approach – 1-D Transect-Based Analysis

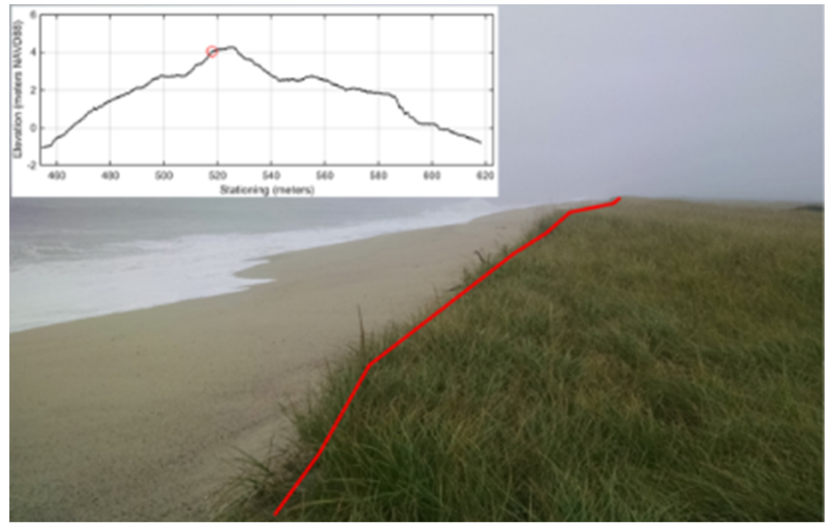
- Spaced every ~50 meters
- Capture a variety of different shoretypes (e.g. sandy, bluff-backed)
- Extracted cross-shore profiles from airborne topographic LiDAR



Conceptual Approach — Identify NPFs







- Identified on each cross-shore profile
- Used to project future erosion inland

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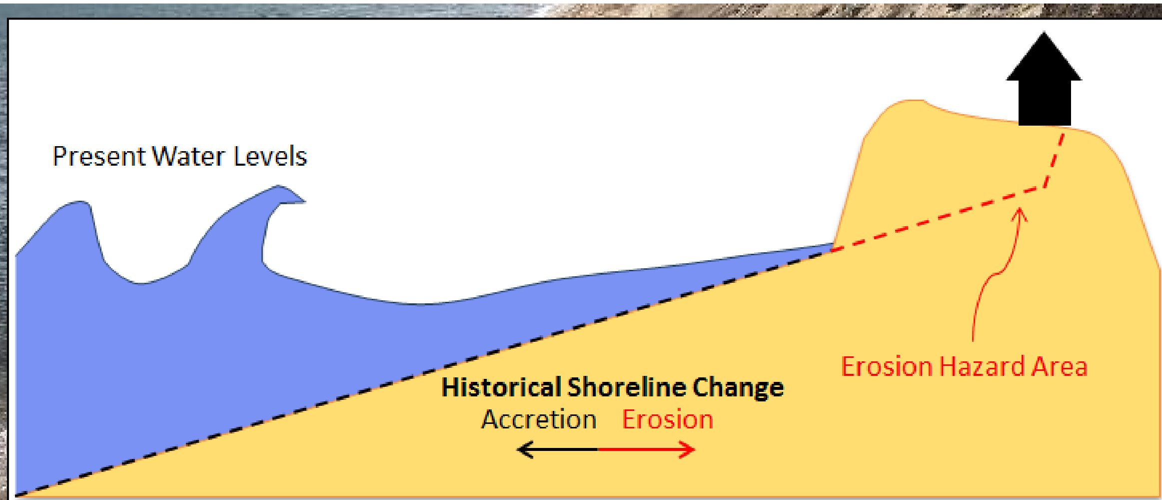
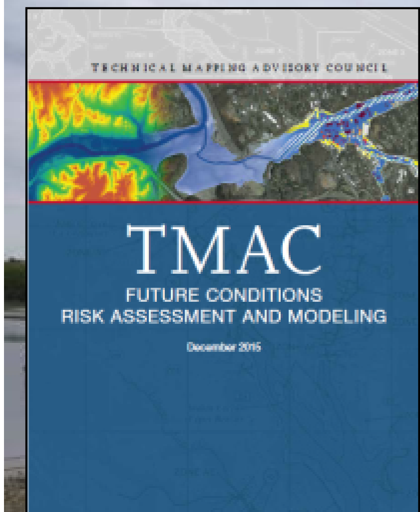
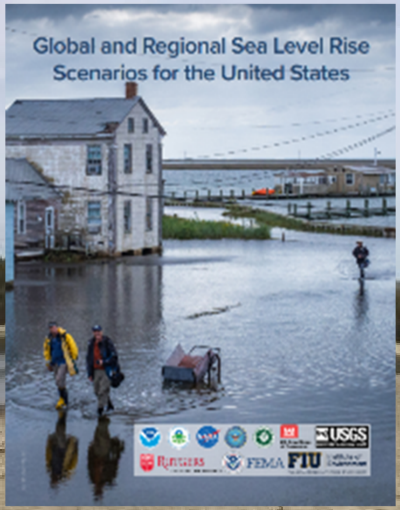
Conceptual Approach

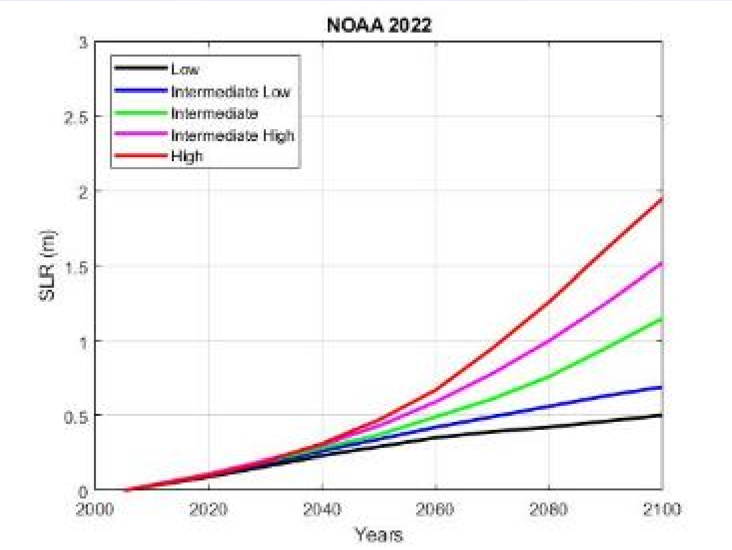


1. Calculate historical, multi-decadal rates of shoreline change (using historical HWLs, aerial photos, etc.)

Study Approach

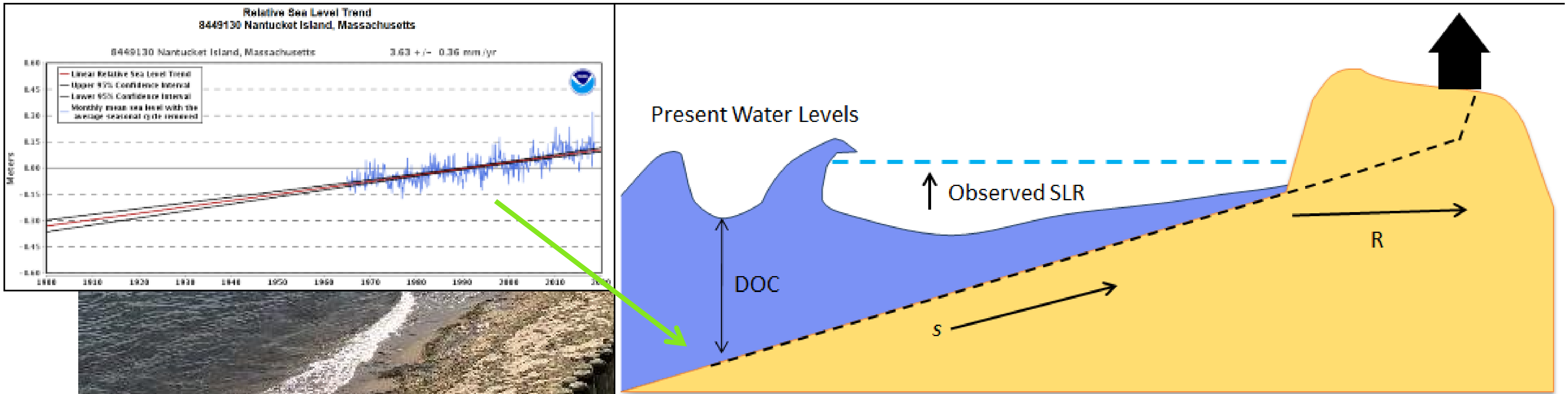






- NOAA Future Global SLR Projections
- Recommended by TMAC.
- “Low, “Intermediate-Low”, “Intermediate”, “Intermediate-High”, and “High” projections.
- For future years 2030, 2050, and 2100.

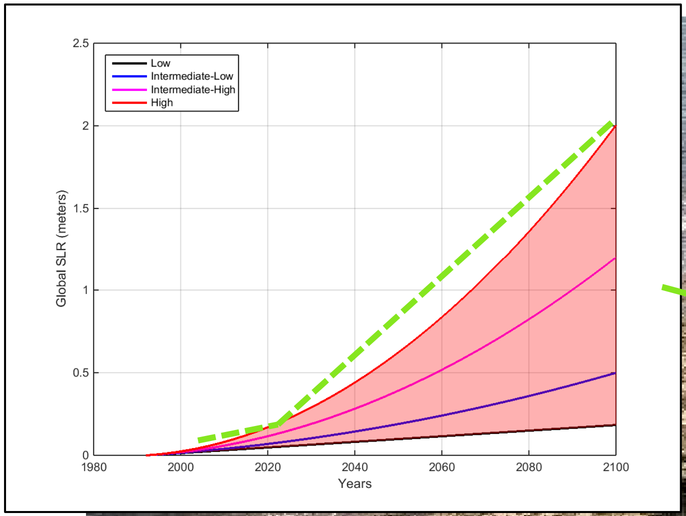
Conceptual Approach

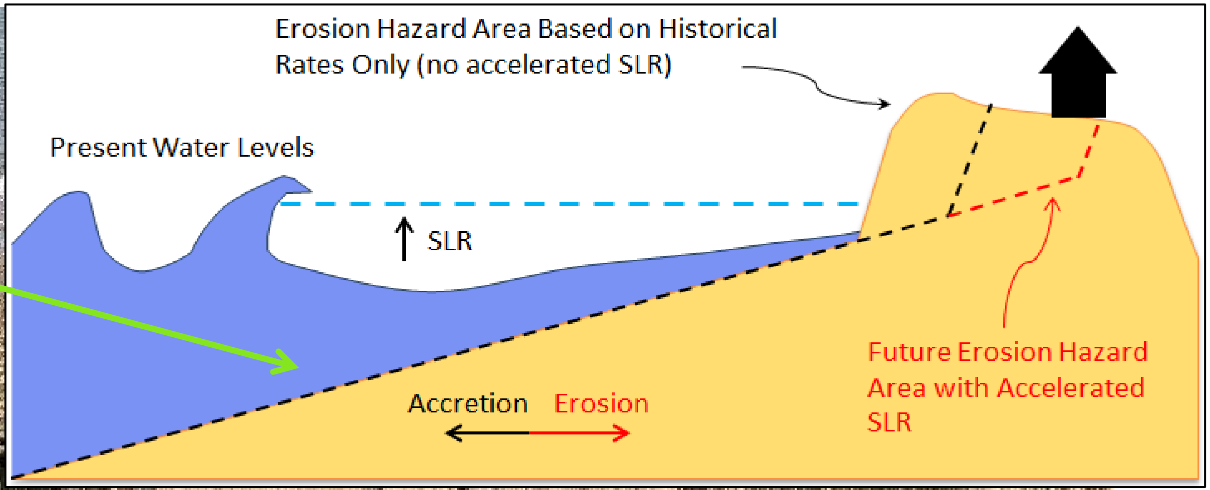


2. Take historical rates of SLR from tide gauges and estimate theoretical shoreline response based on Bruun Rule.

3. Difference between the theoretical response to SLR and the actual historical shoreline change is assumed to be due to nearshore processes (sediment transport, wave effects, etc.)

Conceptual Approach





4. Proportionally increase theoretical shoreline response due to SLR by future SLR scenarios. Maintain historical shoreline trends due to local nearshore processes. Calculate future rate.

5. Project future erosion hazard areas over specific timeframes.

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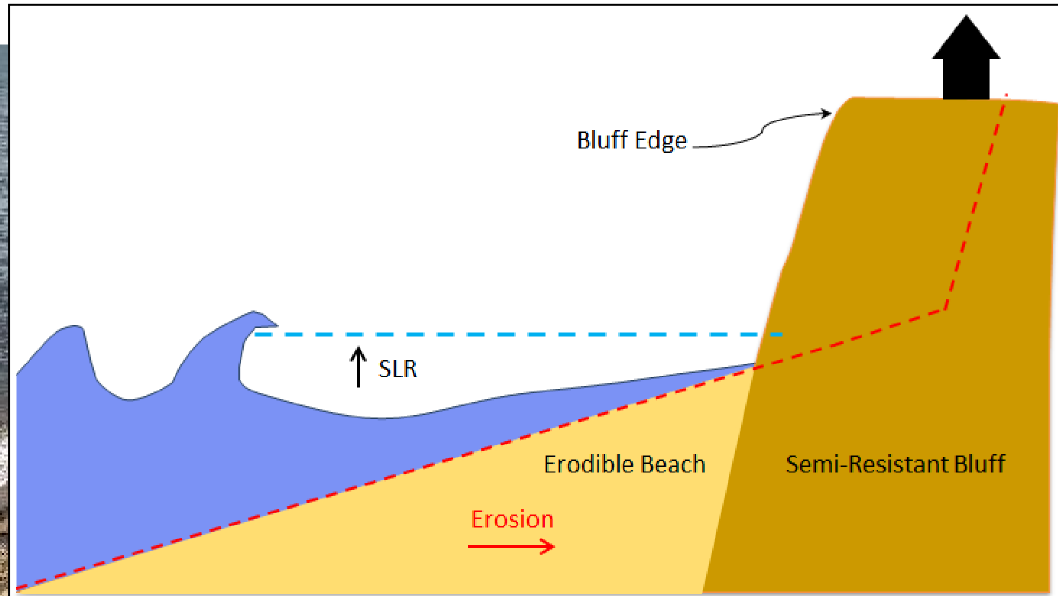
Conceptual Approach



- Sandy beaches and bluffs are treated differently
- Beaches can accrete or erode
- Include an additional factor that accounts for the resistivity of bluffs, based on observed historical erosions rates

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Beaches/Dunes: Compile Historical Shorelines

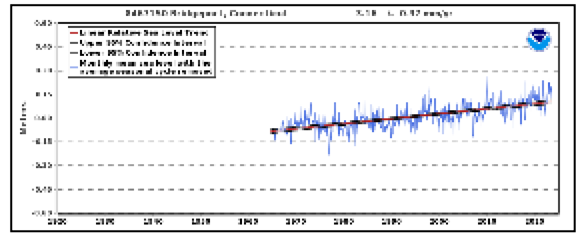
- Historical HWL or MHW shorelines along sandy beaches.

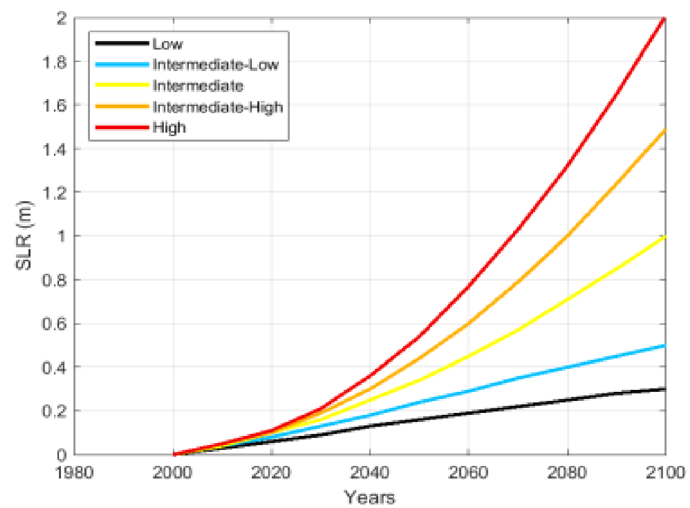
Bluffs: Compile Historical Shorelines

- 20 meters of bluff erosion between 1966 and 2010 in south Plymouth (1.5 feet/year)

Conceptual Approach — Sea Level Rise Factors

- Compare historical sea level rise rates with projected sea level rise rates
- NOAA Future Global SLR Projections
- Recommended by TMAC
- “Low, “Intermediate-Low”, “Intermediate”, “Intermediate-High”, and “High” projections.
- For future years 2030, 2050, and 2100.





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Conceptual Approach — Field Verification

- Visit shoreline sites in latter half of study
- Used GPS to verify shoretypes, erosion hotspots

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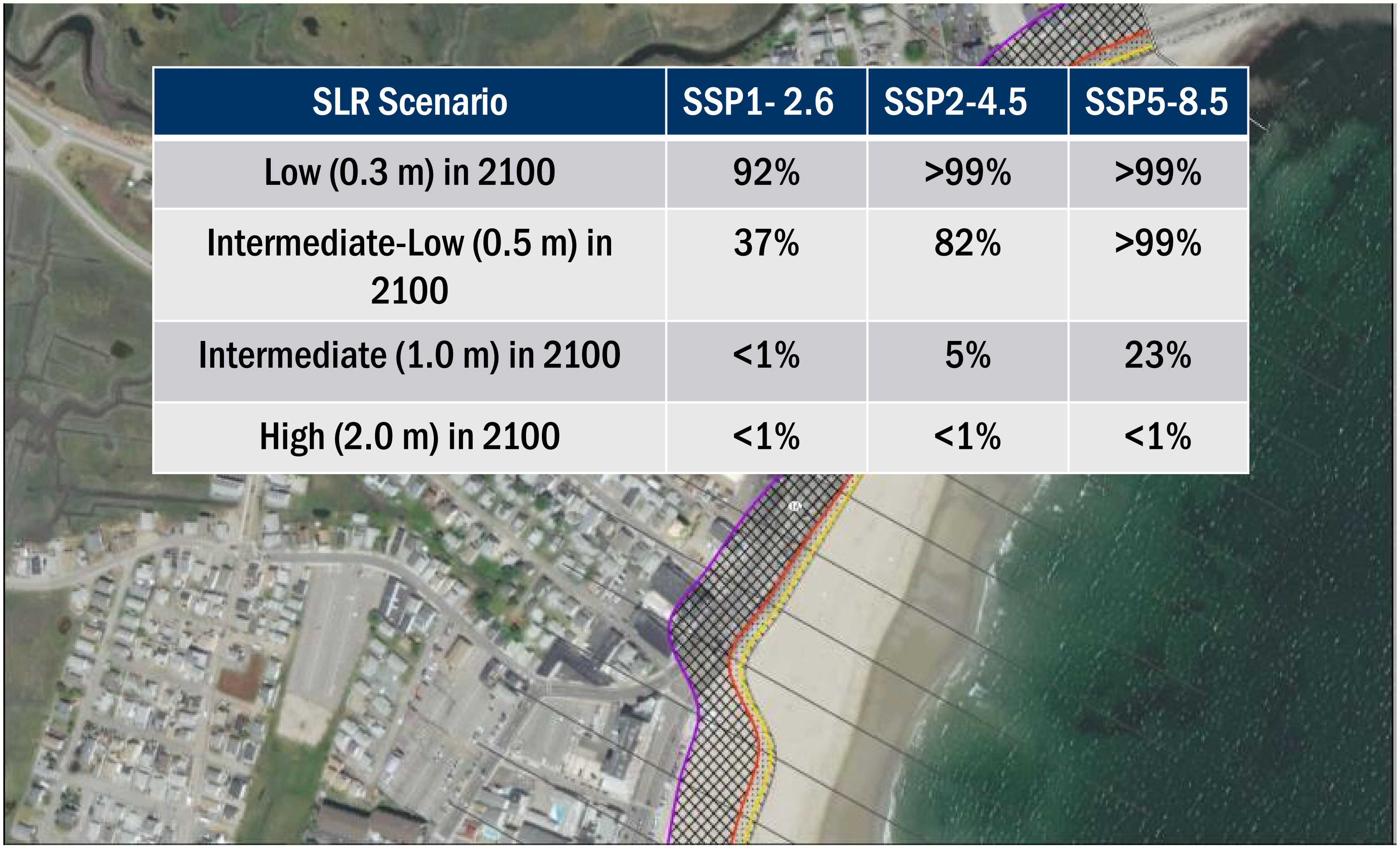
NOAA 2022 - Probability of Stated Outcome



SLR Scenario	SSP1- 2.6	SSP2-4.5	SSP5-8.5
Low (0.3 m) in 2100	92%	>99%	>99%
Intermediate-Low (0.5 m) in 2100	37%	82%	>99%
Intermediate (1.0 m) in 2100	<1%	5%	23%
High (2.0 m) in 2100	<1%	<1%	<1%

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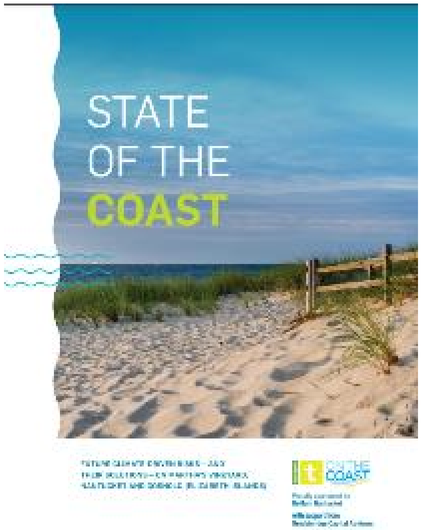
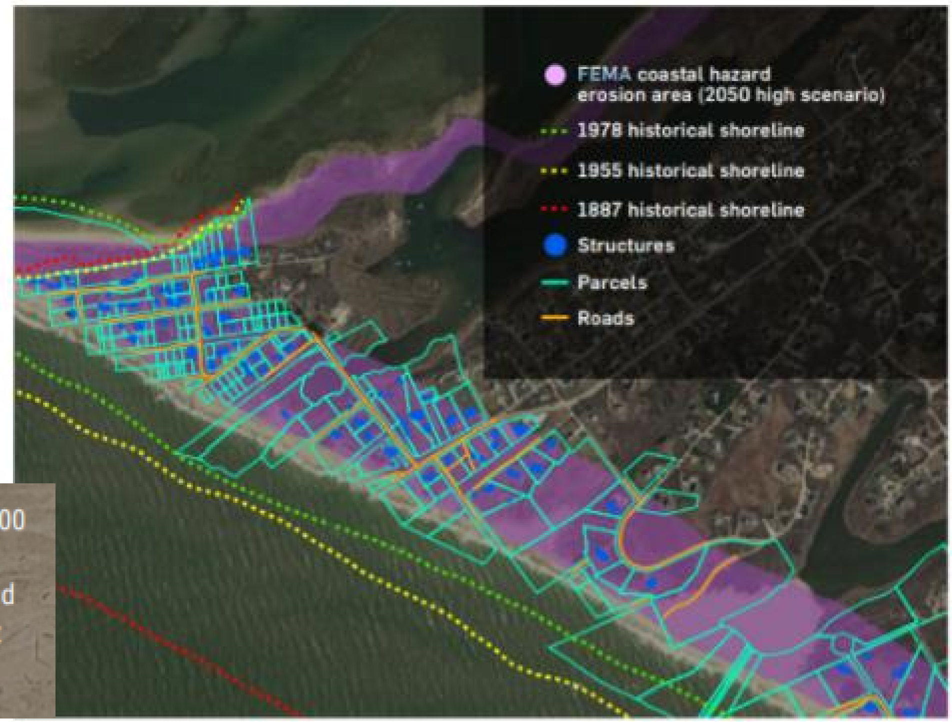
Study Application



FEMA COASTAL HAZARD EROSION AREA (2050 HIGH SCENARIO): MADAKET, NANTUCKET [CIT. 5 AND 10]



- **BEACHES ERODE** Martha's Vineyard beaches have lost more than 1,400 acres since 1897, and Nantucket nearly 1,900 acres. A section of Nantucket's southwest coast, from Madaket to Hummock Pond Road receded about 1,450 feet since 1887 [CIT. 5]. FEMA predicts the coast may erode another 1,350 feet by 2100 [CIT. 10].

- 2021 "State of the Coast" report has incorporated results from this study.

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Study Application

		Gosnold	Aquinnah	Chilmark	West Tisbury	Tisbury	Oak Bluffs	Edgartown	Nantucket
Max Short Term Erosion Rates (Feet/Year) 1970–2014 [CIT. 5]	BEACH	No Data	4.6	6.6	7.8	3.1	5.5	54.5	16.6
Max Long Term Erosion Rates (Feet/Year) 1800s–2014 [CIT. 5]		No Data	4.9	6.2	6.9	3.1	4.4	27.0	11.5
Acreage Lost to Erosion 1887–2014 [CIT. 5]		No Data	40.3	520.2	238.6	21.8	37.1	579.0	1857.8
Acreage Projected to be Lost to Erosion by 2050 (FEMA) [CIT. 10]		No Data	76.7	332.0	135.1	74.0	68.3	585.0	1700.8
Acres Total Marsh Loss in 2050 [CIT. 2]	MARSH	3.6	-3.1	0.3	-8.1	21.8	28.8	227.1	50.0
Acreage of New Marsh Growth or Migration through 2050 [CIT. 2]		0.3	37.5	16.8	10.1	5.4	29.1	89.3	438.0
Structures in Area Flooded from Daily Tidal Flooding in 2050 [CIT. 3]	STRUCTURES FLOODED	10	0	34	1	92	87	76	628
Structures in Areas Flooded from 10-Year Storm in 2050 [CIT. 3]		81	39	164	93	437	554	757	1436
Miles of Road Flooded from Daily Tidal Flooding in 2050 [CIT. 1]	ROADS FLOODED	1.1	0.4	0.9	0.8	2.1	1.4	10.9	25.1
Miles of Road Flooded from 10-Year Storm in 2050 [CIT. 3]		8.7	4.1	11.9	10.5	8.1	11.0	49.4	68.6
Structures in Areas Impacted by Erosion by 2050 (FEMA) [CIT. 10]	EROSION OF STRUCTURES AND ROADS	No Data	3	27	15	108	89	44	500
Miles of Roads Impacted by Erosion in 2050 (FEMA) [CIT. 10]		No Data	0.6	3.4	1.6	1.3	2.8	10.5	24.3

- 2021 “State of the Coast” Report.

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Using the Web Viewer

Web Viewer Link