The N-EWN Knowledge Series

A Continuing Education Series about Engineering with Nature

Katherine Dafforn

Co-Director of the Stone Living Lab and Distinguished Professor of Coastal Resilience at the University of Massachusetts Boston's School for the Environment

Co-developing Coastal Resilience: The Stone Living Lab as a Collaborative Model for Testing Nature-Based Approaches

The Stone Living Lab brings research into practice by designing and testing Nature-based Approaches (NbAs) to strengthen coastal resilience along urban shorelines. Partnering with municipal, state, and federal agencies, and collaborating with members of the Massachusett Tribe at Ponkapoag, the Lab emphasizes projects that inform NbA implementation and provide education for communities and decision-makers. NbAs range from green solutions like saltmarsh restoration to the greening of gray infrastructure, where engineered structures are redesigned for ecological and social co-benefits. In Boston, where saltmarshes have been heavily degraded by historic development and tidal restrictions, the Lab is assessing marsh health to identify stressors and guide future restoration. It is also testing cobble berms—engineered gravel structures that mimic natural storm barriers—as low-impact defenses against wave energy and erosion. In parallel, the Lab is piloting Living Seawalls, modular textured panels that enhance marine biodiversity, marking the first North American deployment of this Australian innovation. Unlike Sydney's sheltered, temperate waters, Boston's installations face colder conditions, ice scour, and intense storms. By tracking co-benefits from biodiversity to wave attenuation, the Lab is showing how global NbA innovations can be adapted locally to transform urban waterfronts into resilient, living systems for both people and nature.

Save the date!

Upcoming webinars will take place the 3rd Thursday of the month.

Sep. 18 12:30pm ET

Katherine Dafforn, PhD; Co-Director, Stone Living Lab & Distinguished Professor, University of Massachusetts Boston

Co-producing Coastal Resilience: The Stone Living Lab as a Collaborative Model for Testing Nature-Based Approaches

Oct. 16 12:30pm ET

Nicholas Muzia, PE; Principal Engineer & Design Build Manager, Sea & Shoreline

Harnessing Submerged Aquatic Vegetation (SAV) as a Natural Infrastructure Tool for Water Quality & Biodiversity

Nov. 20 12:30pm ET

Mr. Josef Rieger; Senior Managing Scientist, Anchor QEA, Inc

Beyond the Dredge: Boosting Remediation Impact with Nature-Based Solutions – The Money Point Case

Register here: https://bit.ly/3gR9ADL or scan:

1 Continuing Education Credit (CEC) is available to attendees

Recorded webinars will be posted online at: https://n-ewn.org/resources/n-ewn-knowledge-seminars/

Presented by:

NETWORK FOR ENGINEERING WITH NATURE

LimnoTech Water Environment Scientists Engineers

UNIVERSITY OF GEORGIA

ERDC

Questions? Please contact:

Sage Paris, LimnoTech

sparis@limno.com

Stone
Living Lab

Co-developing coastal resilience

Thursday, September 18, 2025

UMass Boston · BOSTON HARBOR NOW · JAMES M. & CATHLEEN D. STONE FOUNDATION

Boston

Illustration by Peter Crowther, Boston Magazine

12,000 buildings worth $85 billion and 18,000 people exposed to 1% annual flood risk

8th globally and 4th in US for financial vulnerability to SLR

BRAG (2016) Climate Change and Sea Level Rise Projections for Boston

Sea Level Rise

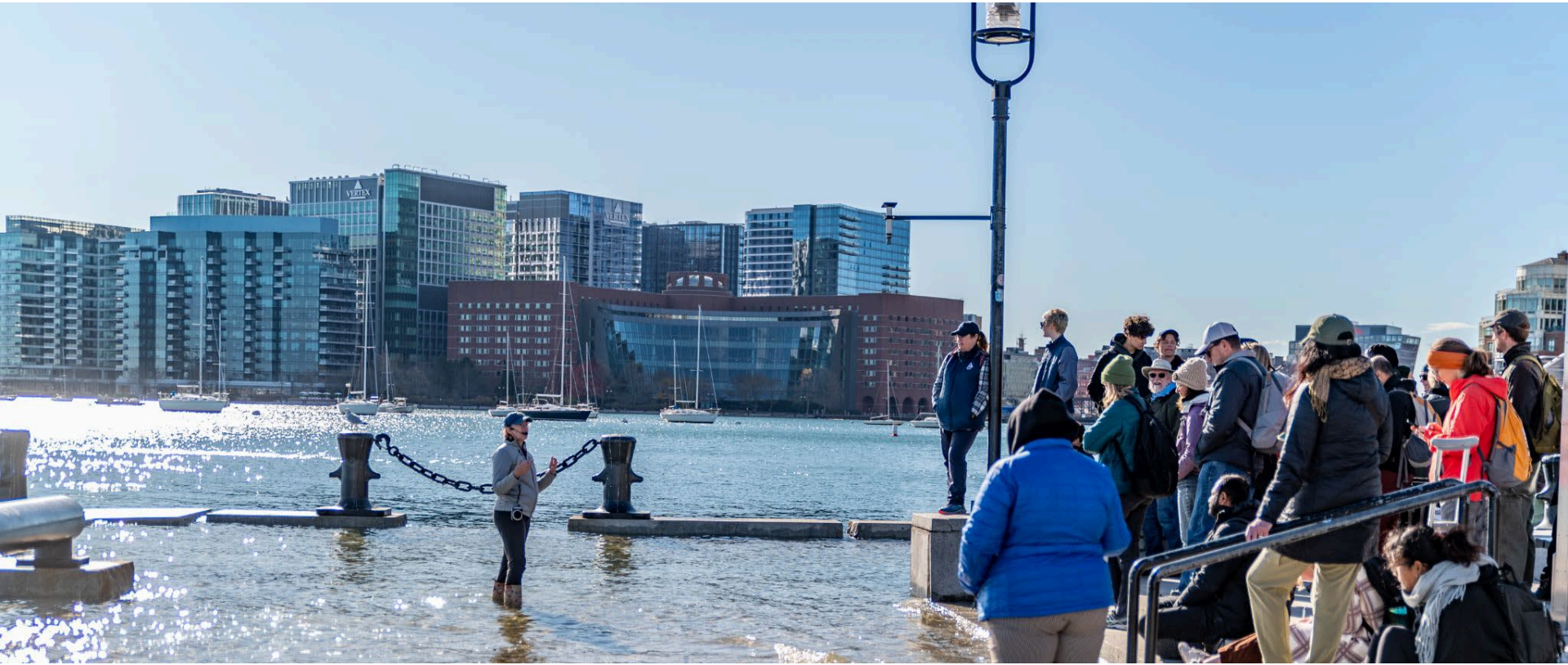
Photo by Hilary Shepard, Dorchester Reporter

SLR at least 9 inches by 2030, 21 inches by 2050 and 36 inches by 2070

Higher-than-average rates of SLR due to land subsidence and ocean dynamics

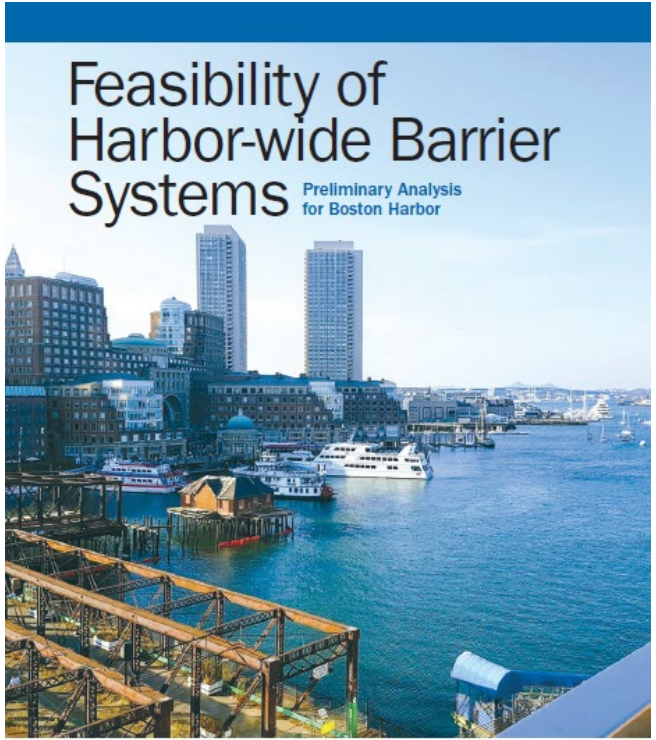
Chronic inundation, where low-lying areas are frequently flooding during high tides

Wicked High Tides



The Stone Living Lab

- Formed in 2018 after a sequence of events:
  - Winter storms bring flooding to Downtown Boston
  - Barrier Report published
  - Design charette at Harvard GSD
- Researching nature-based approaches for climate resilience
- Evidence-based at scale
- Informing local, state and federal government to change policies and drive implementation of NbA
- Learning in Boston Harbor, sharing the results locally and globally



The Stone Living Lab

- A multi-disciplinary team from a unique set of partners
- Researching nature-based approaches for climate resilience
- Learning in Boston Harbor, sharing the results locally and globally
- Evidence-based at scale
- Informing local, state and federal government to change policies and drive implementation of NbA

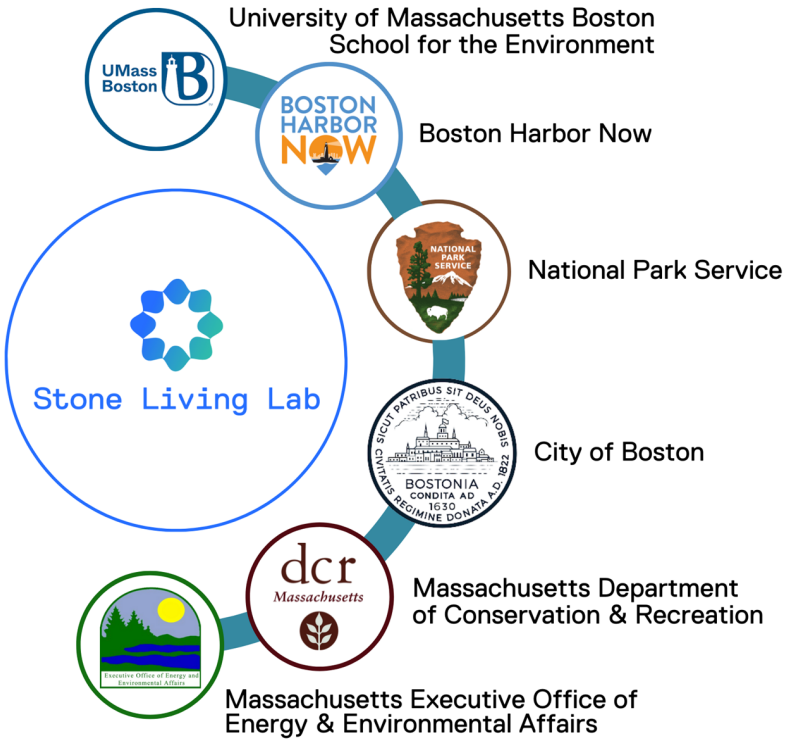
Stone Living Lab

Unique Partnership Structure

JAMES M. & CATHLEEN D.
STONE FOUNDATION

CABOT

11TH HOUR RACING



Stone
Living Lab

Guiding Principles and Focus Areas

Research and Monitoring

Conduct experiments in both basic and applied science and engineering to increase the resiliency of natural and developed coastal systems while maximizing co-benefits and promoting ecological restoration.

Education and Engagement

Engage our communities in education and outreach programs that are equitable, promote innovation and environmental justice, and facilitate hands-on research activities inclusive to all.

Policy Innovation

Collaborate broadly to conduct and translate science, inform policy and planning, and implement the lessons learned from the Stone Living Lab.

Climate Preparedness

Promote creative and flexible solutions, equitable coastal adaptation, and social justice while preparing for, responding to, and educating about climate change.

Core Research and Monitoring Projects

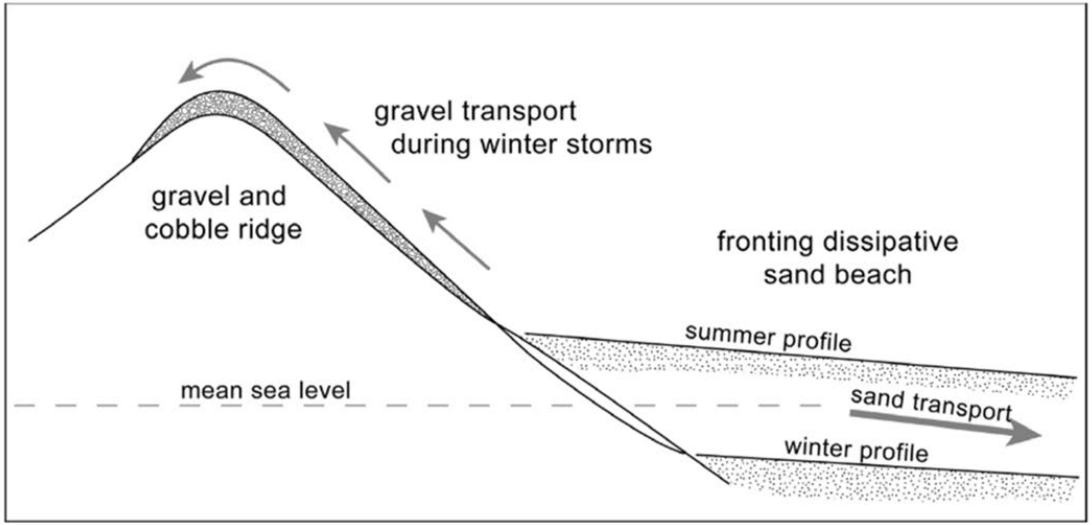
Stone
Living Lab

Cobble Berms

Stone
Living Lab

Cobble Berms

How do they work?

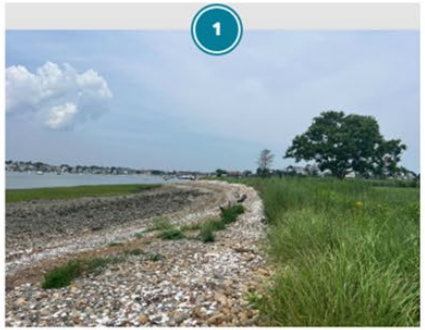


Komar and Allan (2009)

- Dissipate Wave Energy
- Not static, allowed to move
- Cobble movement does not represent failure (natural adaptation)

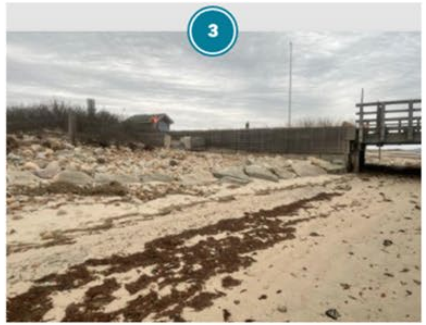
DUXBURY BEACH RESERVATION, INC.
Stone Living Lab
CZM
WOODS HOLE GROUP
A CLS COMPANY

Cobble Berms



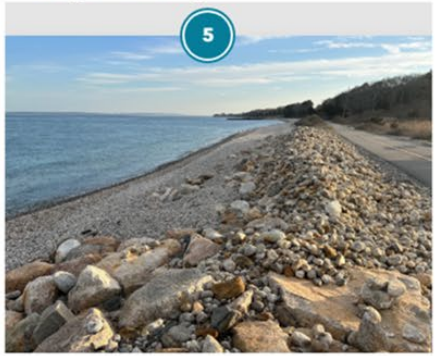
Coughlin Park

Bayside Expo

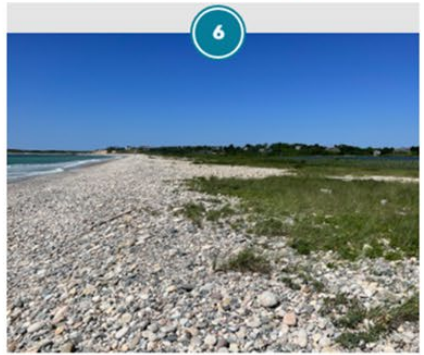


Powder Point Bridge

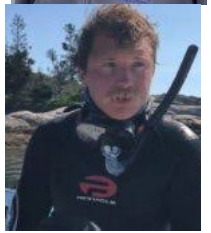
Duxbury Beach Reservation



Trunk River



Stonewall Beach



Intertidal quadrat surveys

Fish-specific Autonomous Reef Monitoring Structures (FARMS)

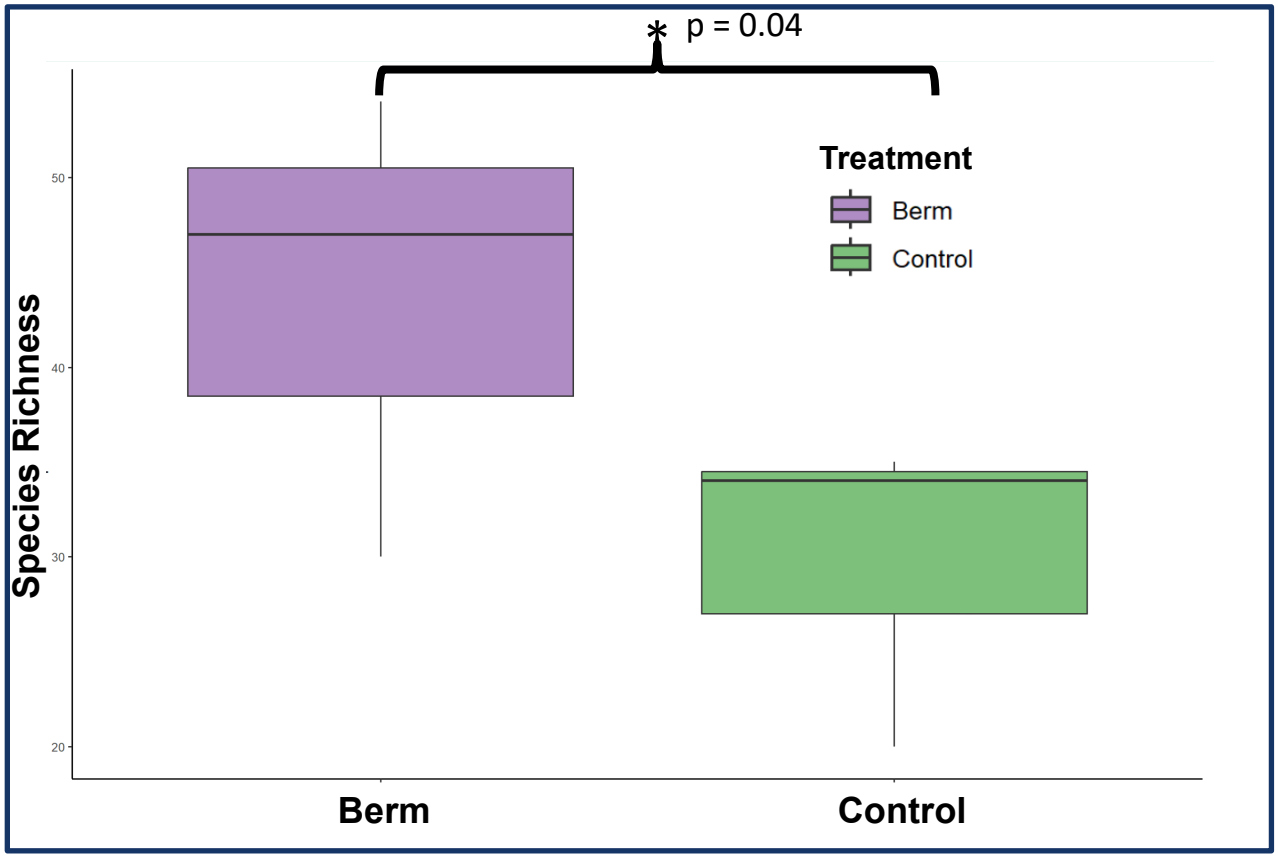
Fish and crab traps

Baited remote intertidal video (BRIVs)

Seine Netting

UMass Boston

Cobble Berms support higher species richness



UMass Boston

Learn more about cobble berms

VIDEO SERIES

What are Cobble Berms?

Join SLL scientists at Duxbury Beach to learn about cobble berms and how they are used for coastal resilience.

WATCH

VIDEO SERIES

Cobble Berms at Duxbury Beach

Learn about the history of Duxbury Beach, and how the Duxbury Beach Reservation Association and partners are protecting this space with cobble berms.

WATCH

FACTSHEET

How Shorelines Behave

An overview of how different natural and artificial shorelines behave during storm events.

DOWNLOAD

FACTSHEET

Top Ten Factors When Considering a Cobble Berm

Factsheet for municipal staff, city planners, or restoration professionals on important factors when considering cobble berms as a nature-based solution.

DOWNLOAD

Living Seawalls

Stone
Living Lab

A construction boom is underway in along coastlines and offshore



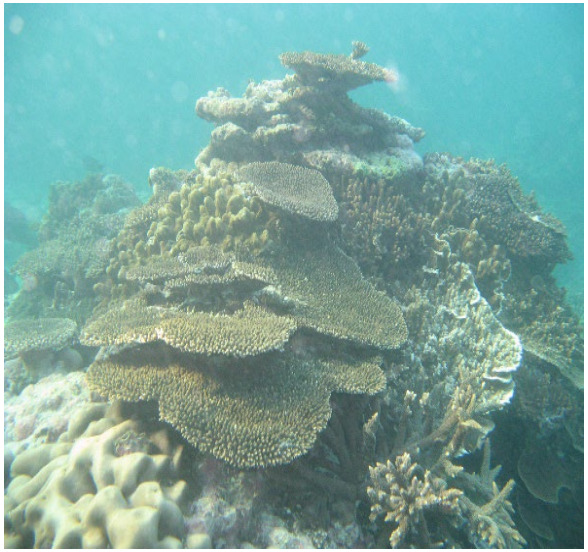




Marine construction is at odds with nature

Can be “mega diverse”

Sydney Harbour has more fish species than entire UK coastline



Hong Kong is a biodiversity hotspot with > 5711 species

Chesapeake Bay has > 3600 species

451 unique species in Boston Harbor

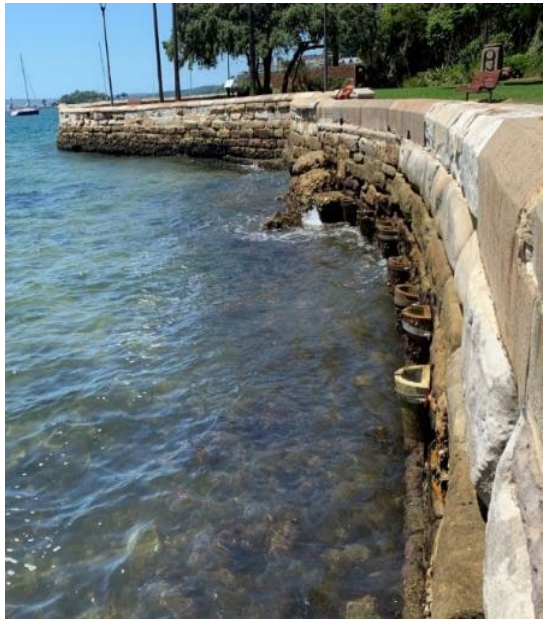
(although 39 non-native and increasing)

Putnam et al. (2024) Historical insights, current challenges: Tracking marine biodiversity in an urban harbor ecosystem in the face of climate change. *Marine Biodiversity*.

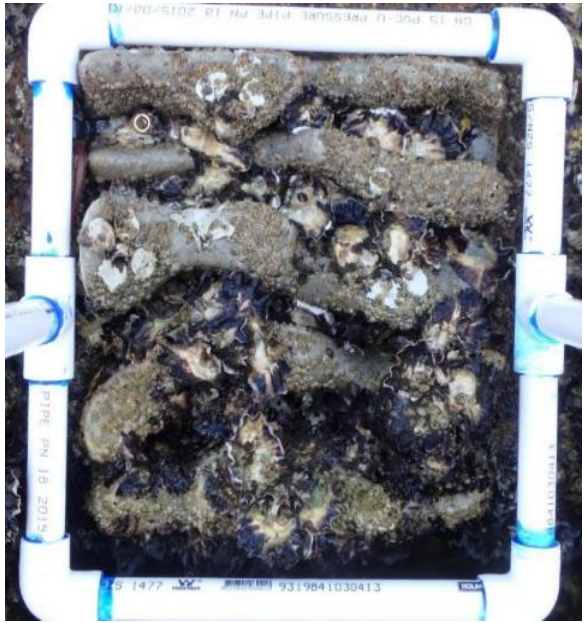
Living Seawalls

over 20 years of Sydney-based research

Seawall block pools



Flower pots



Habitat tiles

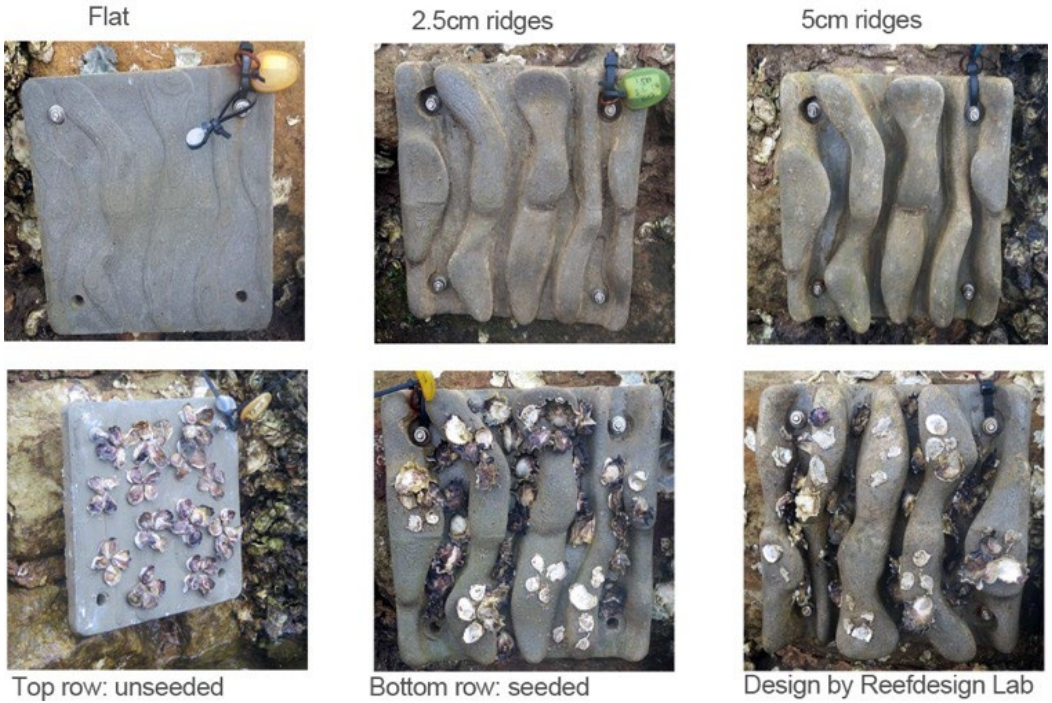
world harbour project

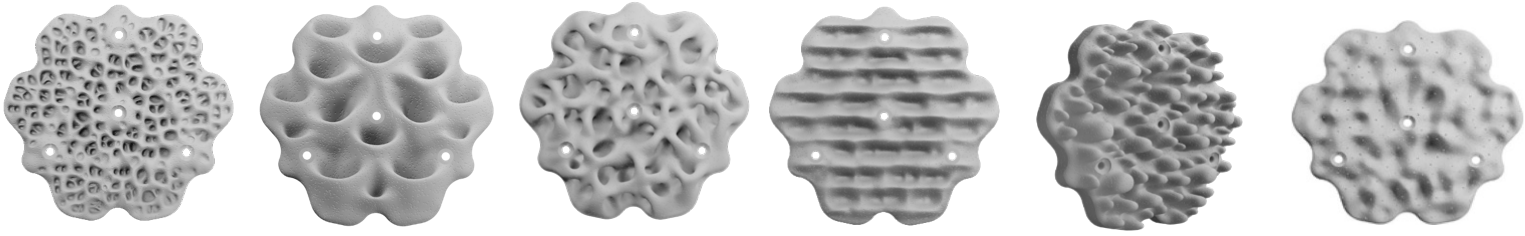
literature reviews were conducted to investigate the common methods used for greening of gray infrastructure:

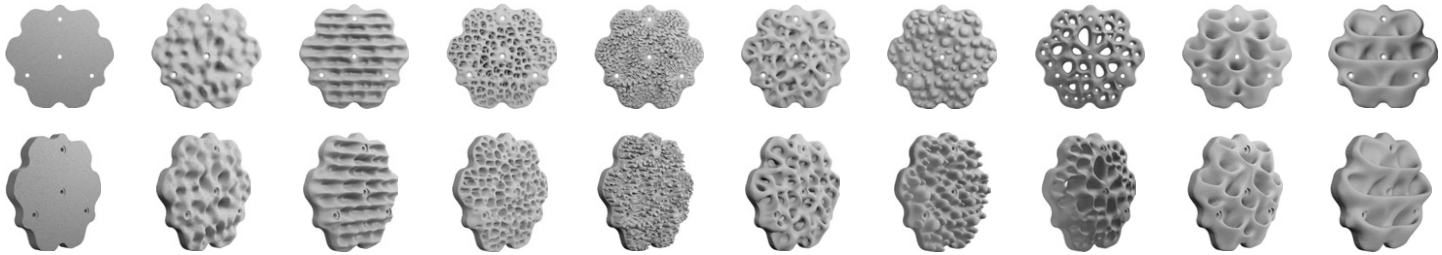
- crevices
- biological habitat (seeding)
- water retaining (rock pools)

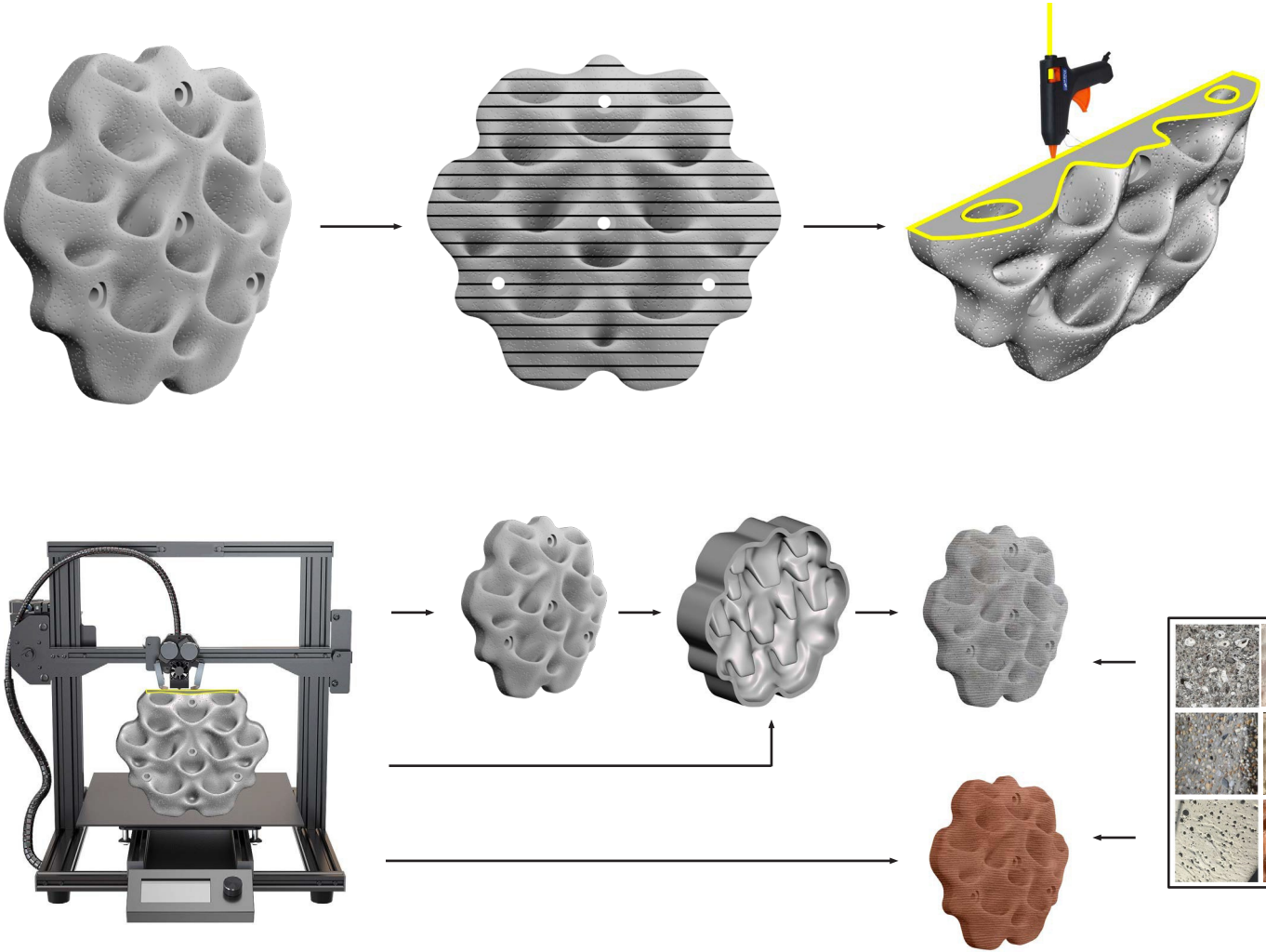
global (13 cities) experiment with crevice habitat tiles:

- positive effects on native shellfish
- protection from predators and heat



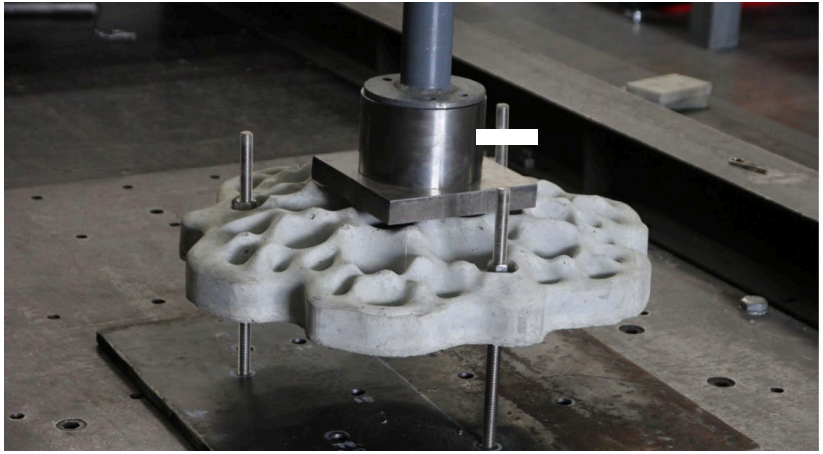






Eco-blend concrete:
20% slag
10% fly ash
70% Portland cement

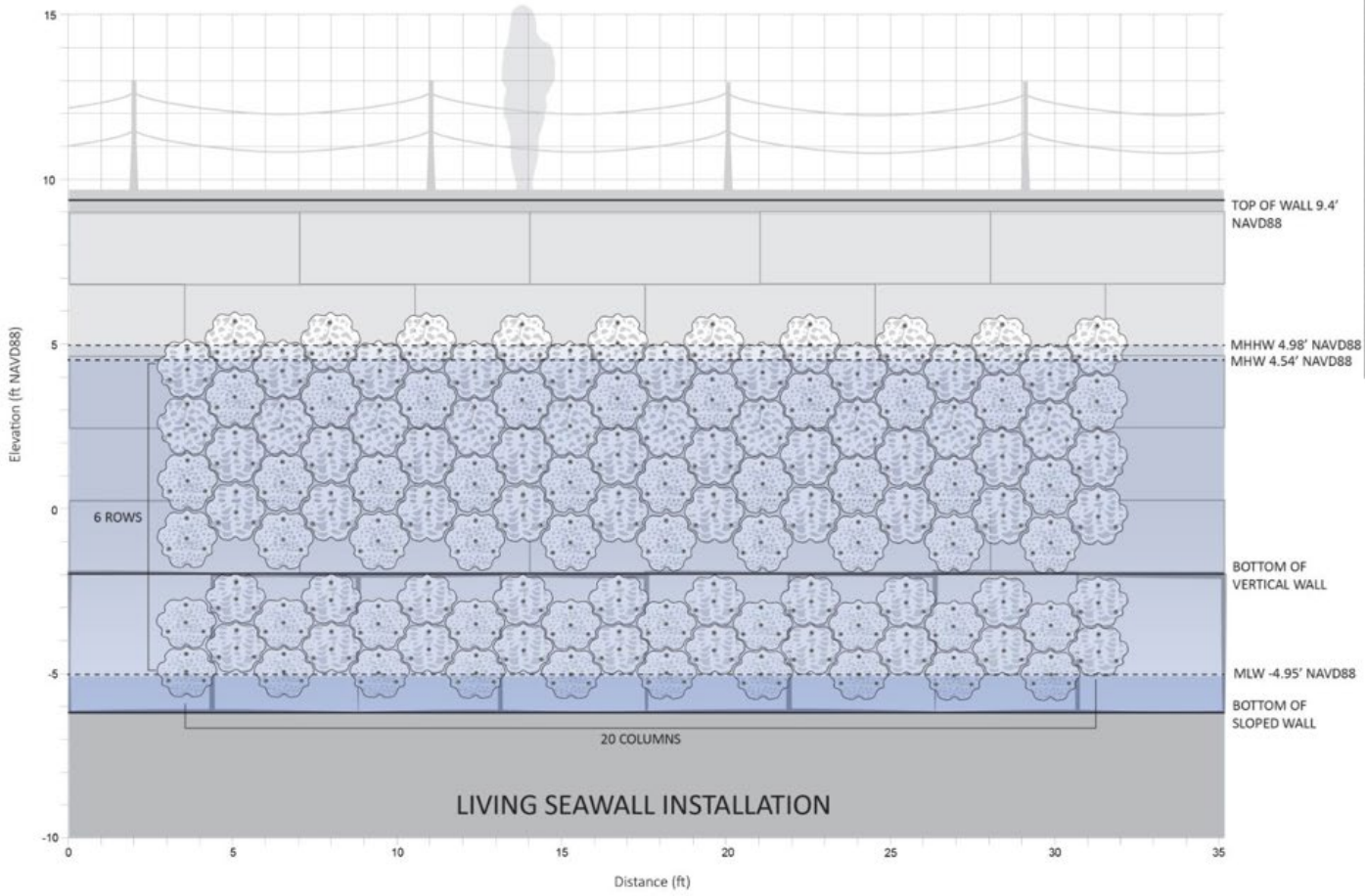
Incorporated upcycled materials –
oyster shells, sandstone

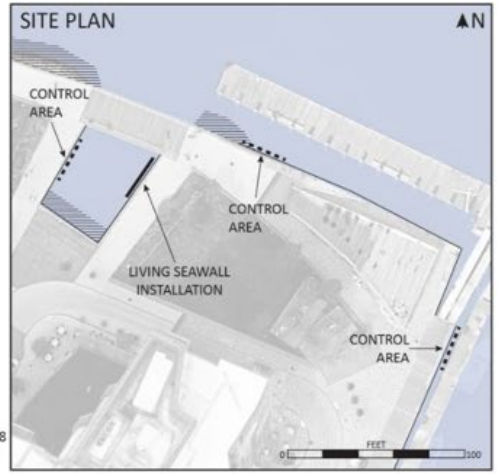


Tiered approval process:

- Permissions from landowners
- City of Boston Conservation Commission – 3y demonstration (removal if found to be maladaptive)
- Chapter 91 license to comply with MA public waterfront access regs
- US ACE reviewed under Section 10 of the Rivers and Harbors Act – challenge due to potential presence of migratory bird species

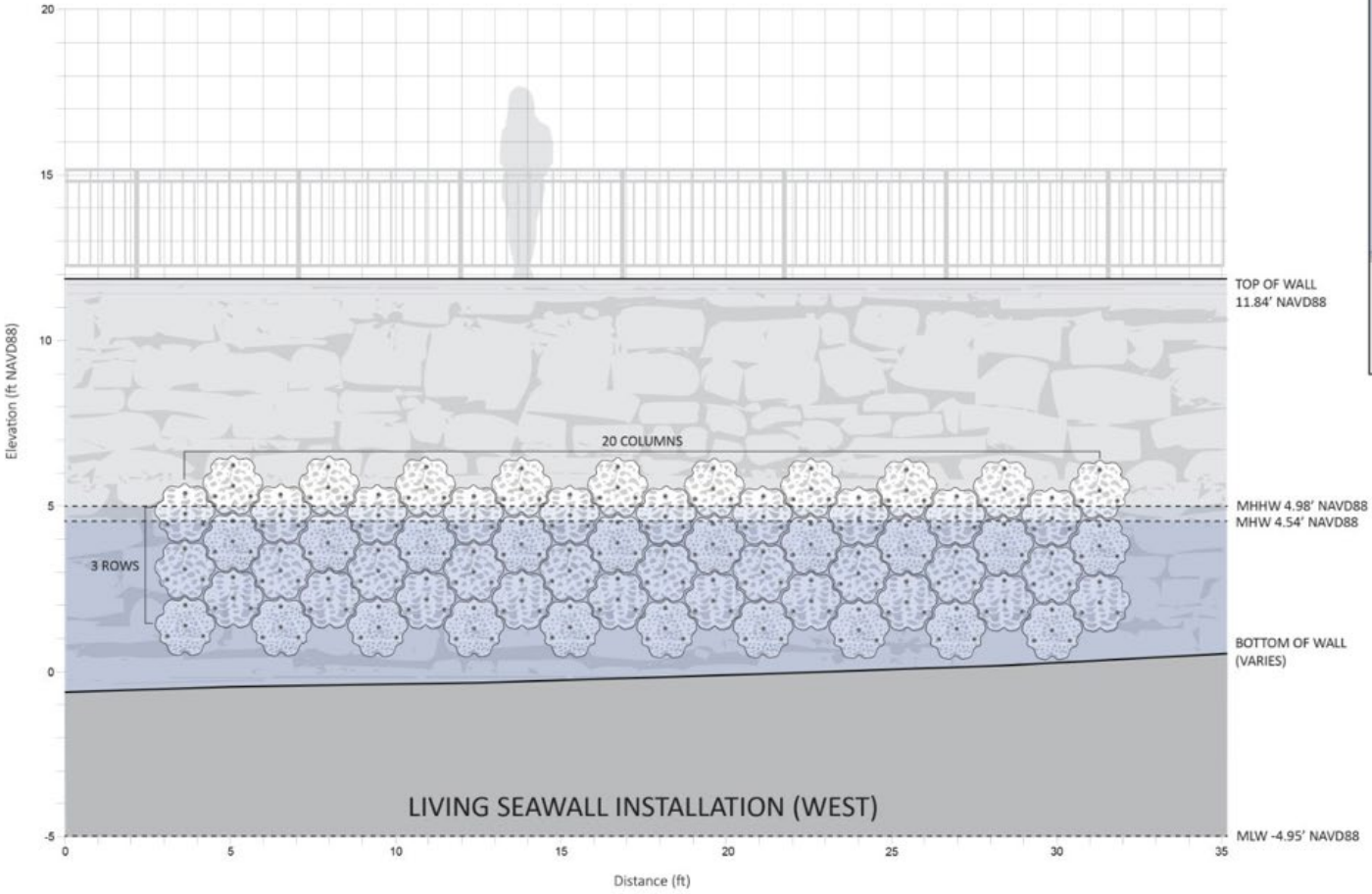
Stone Living Lab

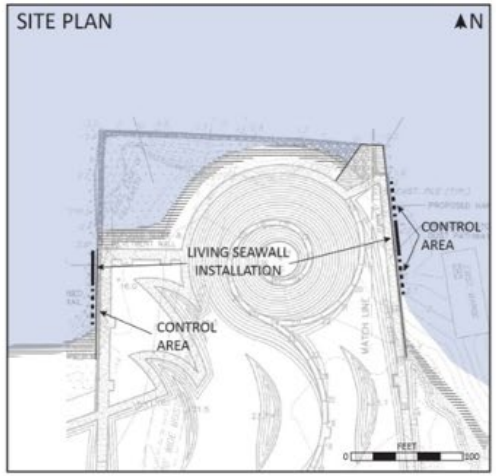




Stone Living Lab

FAN PIER DEVELOPMENT LLC LIVING SEAWALL	
Array of 120 textured panels installed in the intertidal zone of the existing seawall. All work will take place on seawall/coastal bank resource.	12/14/23
0 1 2 3 4 SFT	WOODS HOLE GROUP A CLE COMPANY





Stone Living Lab

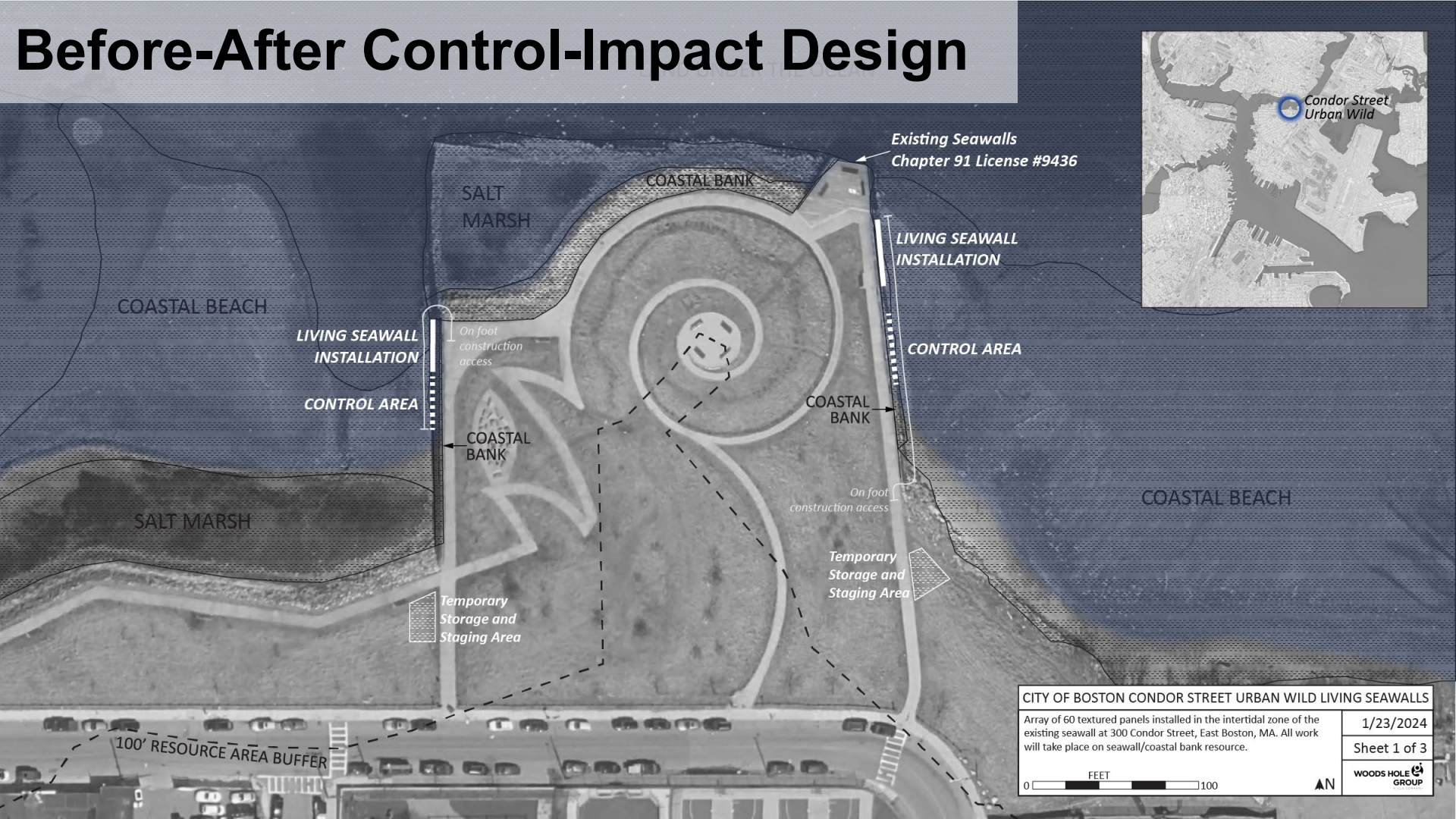
CITY OF BOSTON CONDOR STREET URBAN WILD LIVING SEAWALLS

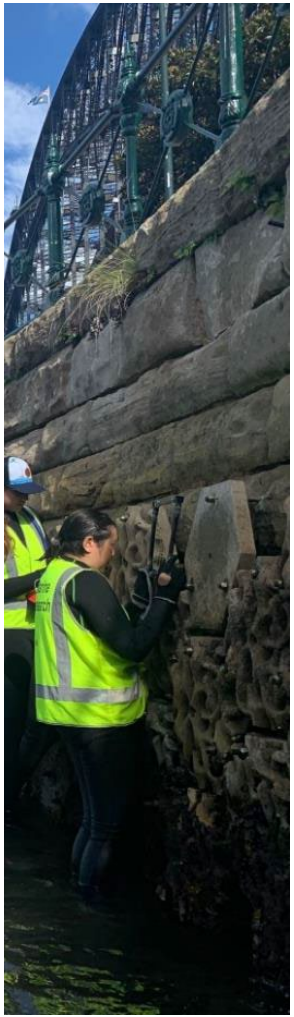
Array of 60 textured panels installed in the intertidal zone of the existing seawall. All work will take place on seawall/coastal bank resource.

12/14/23

WOODS HOLE GROUP
A CLS COMPANY

Before-After Control-Impact Design



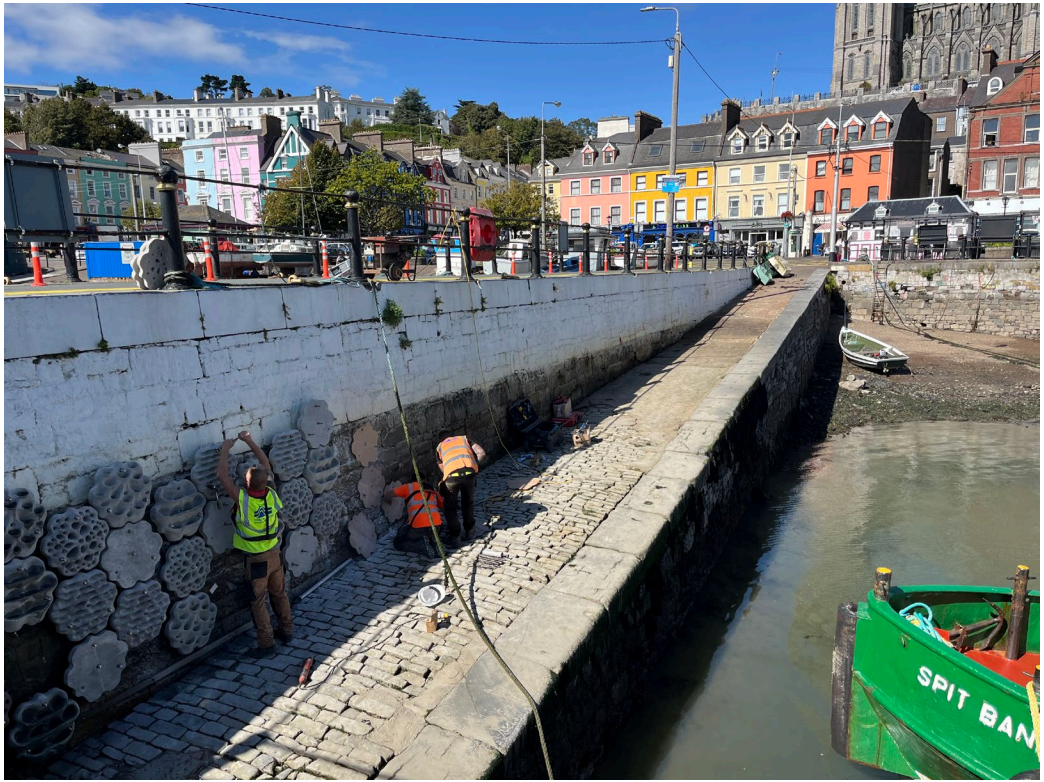



adidas

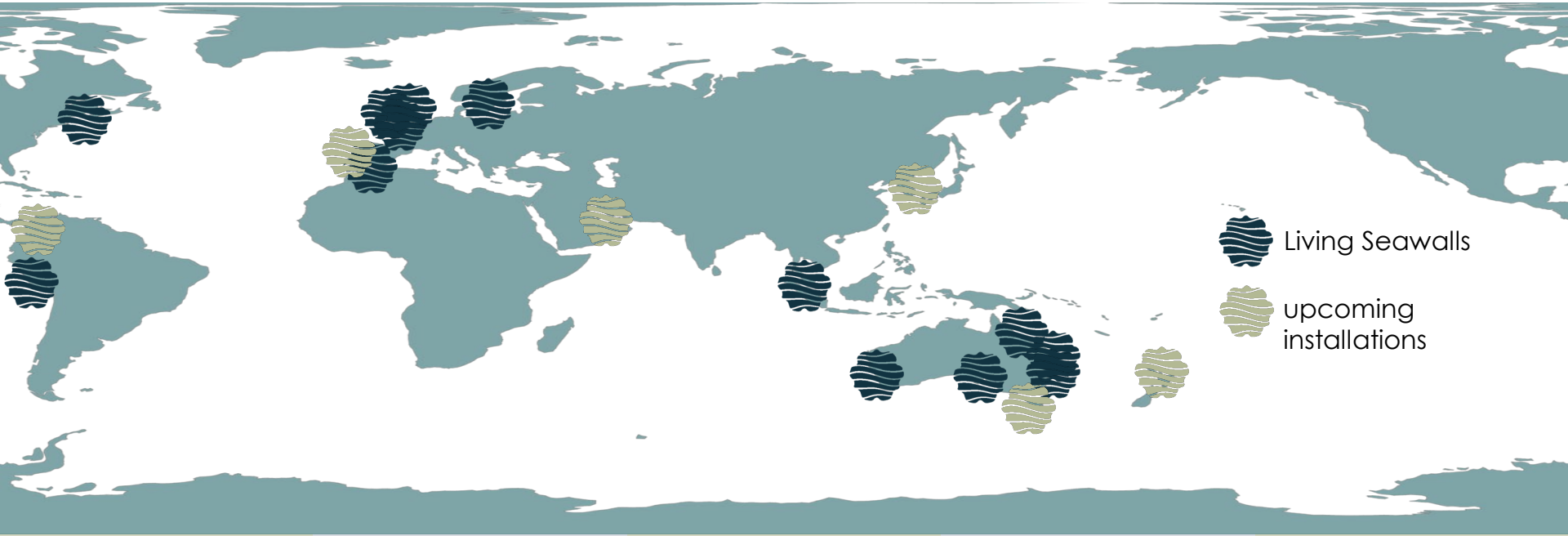
This is One Year of Growth in Plymouth, UK

LIVING SEAWALLS Plymouth

Bringing marine life back to urban shorelines


SPIT BAN

a world-wide reach



23 installations, spanning 4 continents	over 2500 habitat modules used	partnerships with Volvo, DP World, Lendlease & Governments	urban renewal projects to private water frontages	manufacture hubs in Australia & UK/Ireland

a global research program

- **11 designs**, providing protective spaces to seaweeds, shellfish, corals, fish
- **modularity** adapts to local needs
- fabricated using **eco-blend cement**, incorporating upcycled materials
- habitat for up to **150 species**
- up to **3-fold increase** in biodiversity over flat surfaces
- up to **18 degrees** cooler in microhabitats

Climate Change Observatory

Stone
Living Lab

Climate Change Observatory

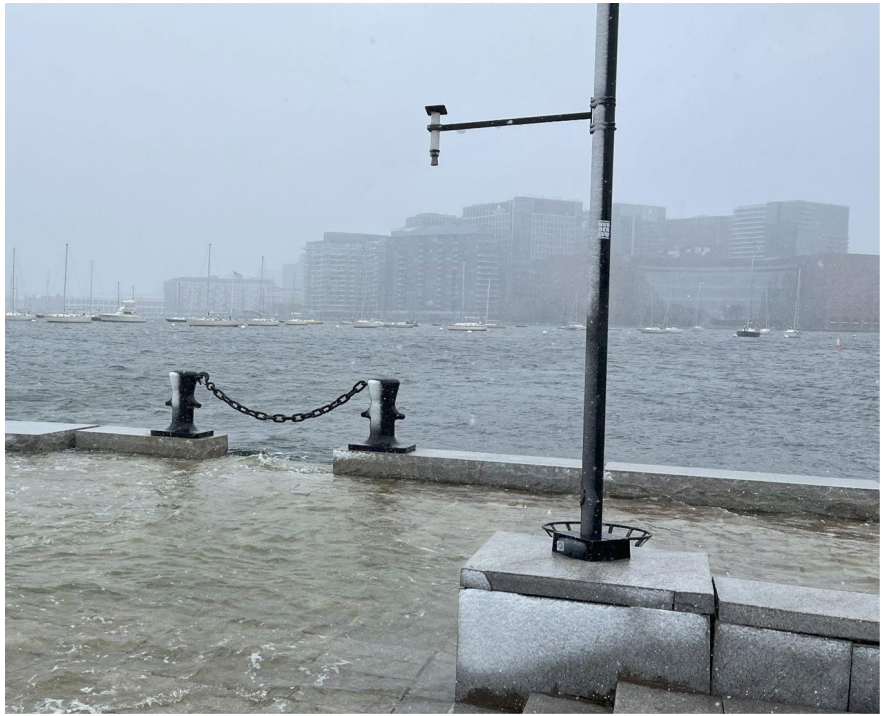
Regular observation and recording of our surroundings

Better understanding of our natural environment through collecting and analyzing data

Real-time including waves, water levels and weather patterns

Long-term changes in the environment including biodiversity, water quality, shoreline change

Supporting evidence-based decision-making



BOSTON HARBOR

Real Time Observational Network

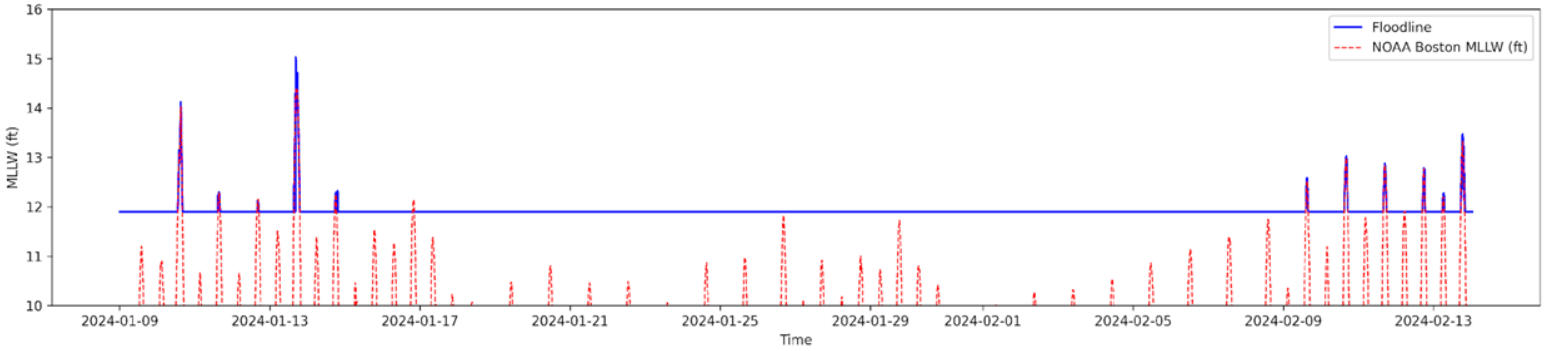
- Overland Flood Observation Station
- Wave Observation Station
- Water Elevation Station
- NOAA Tide Station
- Meteorological Station

BOSTON HARBOR NOW · UMass Boston · WOODS HOLE GROUP · CITY of BOSTON · Stone Living Lab

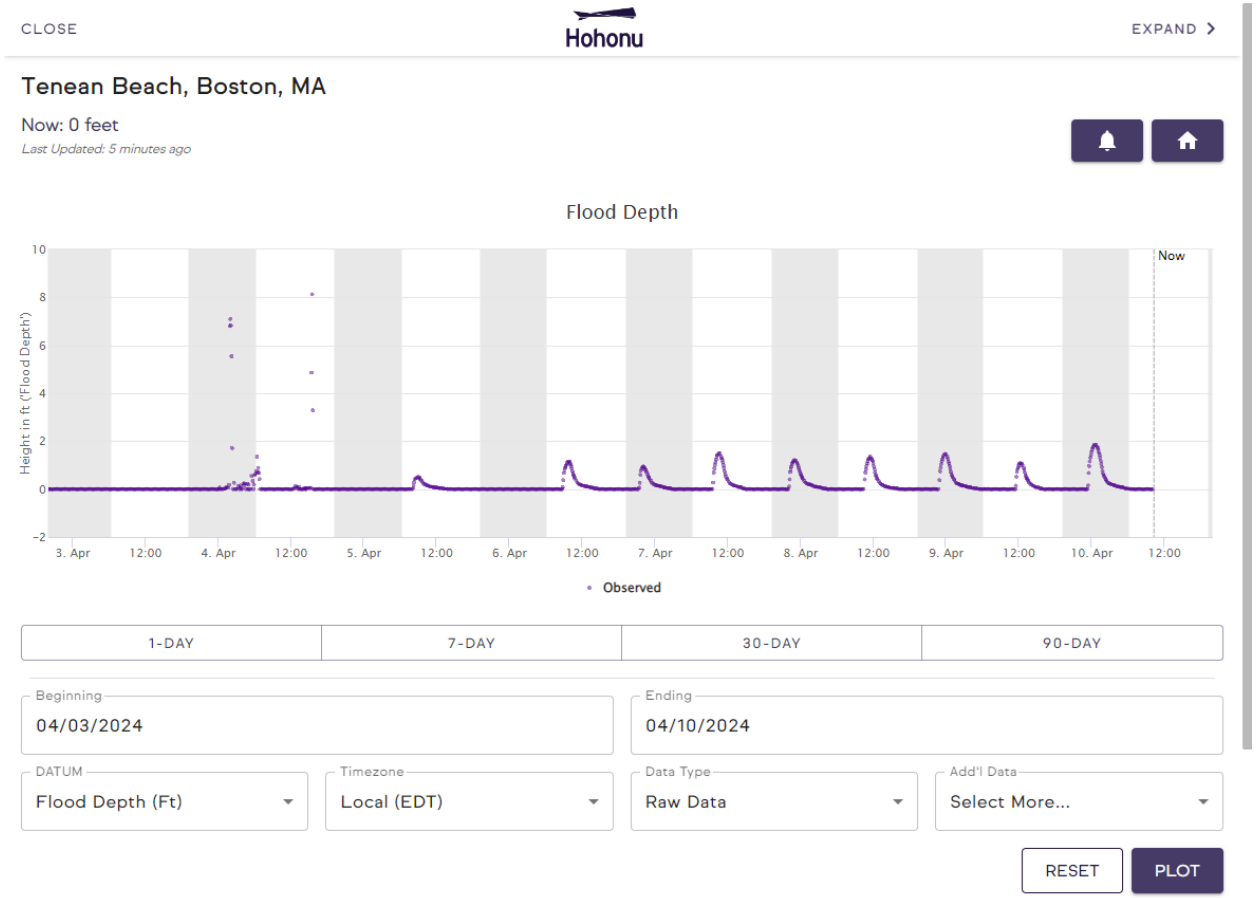
Station ID	Station Type	Latitude	Longitude
Boston Harbor (Offshore) Wave Buoy	Wave Observation	42.34089	-70.91975
Rainsford NE (Nearshore) Wave Buoy	Wave Observation	42.31520	-70.95108
Long Wharf	Overland Flood Observation	42.36047	-70.04848
Morrissey Boulevard	Overland Flood Observation	42.30638	-71.04649
Tenean Beach	Overland Flood Observation	42.29145	-71.04236
East Boston	Overland Flood Observation	42.37670	-71.04121
Lewis Mall, East Boston	Overland Flood Observation	42.36630	-71.04170
Gallops Island	Water Elevation	42.32456	-70.93915
Rainsford Island	Meteorological Station	42.31231	-70.95272
Boston NOAA Tides	NOAA Tide Station	42.353	-71.05
Boston Approach Wave Buoy	NOAA NDBC Wave Station	42.346	70.651


Provincetown Fast Ferry
BALEACIA


East
Boston
Ferry
Water Taxi Stop
TALL SHIP
Massachusetts Bay
Transportation Authority
Lewis Wharf/East Boston -
Long Wharf Ferry



Overland flooding observed at Long Wharf, January – February 2024



Overland flooding observed at Tenean Beach, April 2024

Stone Living Lab

Dashboard

June 04, 2025 03:22:56 PM (LOCAL)

standard metric

News | Dashboard Information

Latest Conditions

Ocean - Harbor Entrance Buoy and NDBC Station 44013

Wave Height	Wave Period	Water Temperature	Wave Direction
0.1 FT	7.4 S	60.0 °F	
2025-06-04 03:00 PM	2025-06-04 03:00 PM	2025-06-04 02:40 PM	2025-06-04 03:00 PM

Weather - Rainsford Island Meteorological Station

Air Temperature	Wind Speed	Gust Speed	Wind Direction
78.0 °F	3.9 MPH	10.0 MPH	
2025-06-04 02:55 PM	2025-06-04 02:55 PM	2025-06-04 02:55 PM	2025-06-04 02:55 PM

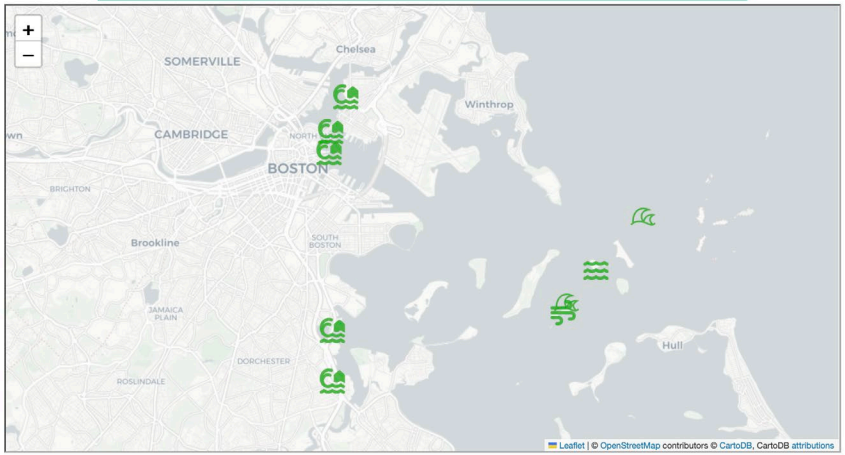
Tide and Flood Level Bulletin

2025-06-04 02:30 PM: Tide is rising and is at -3.4 ft NAVD88

No flooding observed from overland stations.

Wave Height	Gust Speed	Flood Level
Low	Low	Low

Wave Buoys - Weather Stations - Overland Flood Stations - Tide Stations -



Cathleen Stone Island Marsh (SW)

Previously Thompson Island

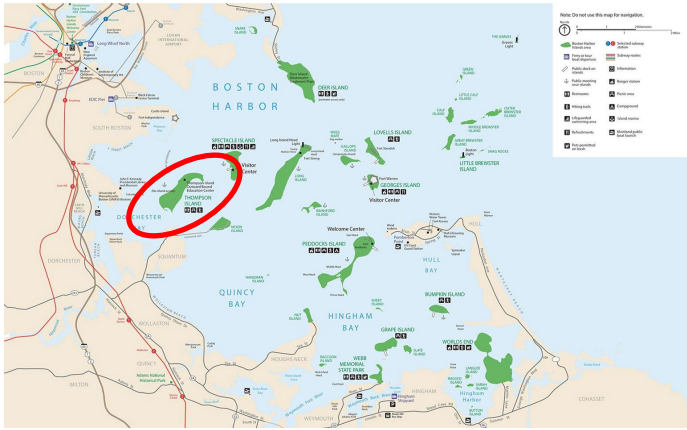
30 Acres (0.12 km^2)

Dominated by *Spartina alterniflora*

Apparent state of poor health

Overall lack of sediment supply

RSLR




CTD
Salinity
Temperature
Depth
STN 3
STN 2
STN 0
STN 1
ADV
Velocity
Volume
Temperature
Google
Imagery ©2025 Google, Map data ©2025
United States
Terms
Privacy
Send Product Feedback
200 ft
3D


Excessive fragmentation
Poor vegetation health
Slumping
Increased open water
Narrow Inlet
Excessive Sediment deposition
Closed Inlets
Google
Imagery ©2025 Google, Map data ©2025
United States
Terms
Privacy
Send Product Feedback
200 ft
3D

Nature-based Approaches Toolbox

1) Innovate and test Living Seawalls
2) Pilot offshore and intertidal boulder fields
3) Test the use of sponge-like nature-based innovations
4) Identify novel NbA technologies
5) Expand the Climate Change Observatory

Stone Living Lab

Thank You! Questions?

Website: stonelivinglab.org - join our mailing list!
Email: kdafforn@stonelivinglab.org
Instagram, Facebook, LinkedIn: @stonelivinglab

Stone
Living Lab

The N-EWN Knowledge Series

A Continuing Education Series about Engineering with Nature

Katherine Dafforn

Co-Director of the Stone Living Lab and Distinguished Professor of Coastal Resilience at the University of Massachusetts Boston's School for the Environment

Co-developing Coastal Resilience: The Stone Living Lab as a Collaborative Model for Testing Nature-Based Approaches

The Stone Living Lab brings research into practice by designing and testing Nature-based Approaches (NbAs) to strengthen coastal resilience along urban shorelines. Partnering with municipal, state, and federal agencies, and collaborating with members of the Massachusett Tribe at Ponkapoag, the Lab emphasizes projects that inform NbA implementation and provide education for communities and decision-makers. NbAs range from green solutions like saltmarsh restoration to the greening of gray infrastructure, where engineered structures are redesigned for ecological and social co-benefits. In Boston, where saltmarshes have been heavily degraded by historic development and tidal restrictions, the Lab is assessing marsh health to identify stressors and guide future restoration. It is also testing cobble berms—engineered gravel structures that mimic natural storm barriers—as low-impact defenses against wave energy and erosion. In parallel, the Lab is piloting Living Seawalls, modular textured panels that enhance marine biodiversity, marking the first North American deployment of this Australian innovation. Unlike Sydney's sheltered, temperate waters, Boston's installations face colder conditions, ice scour, and intense storms. By tracking co-benefits from biodiversity to wave attenuation, the Lab is showing how global NbA innovations can be adapted locally to transform urban waterfronts into resilient, living systems for both people and nature.

Save the date!

Upcoming webinars will take place the 3rd Thursday of the month.

Sep. 18 12:30pm ET

Katherine Dafforn, PhD; Co-Director, Stone Living Lab & Distinguished Professor, University of Massachusetts Boston

Co-producing Coastal Resilience: The Stone Living Lab as a Collaborative Model for Testing Nature-Based Approaches

Oct. 16 12:30pm ET

Nicholas Muzia, PE; Principal Engineer & Design Build Manager, Sea & Shoreline

Harnessing Submerged Aquatic Vegetation (SAV) as a Natural Infrastructure Tool for Water Quality & Biodiversity

Nov. 20 12:30pm ET

Mr. Josef Rieger; Senior Managing Scientist, Anchor QEA, Inc

Beyond the Dredge: Boosting Remediation Impact with Nature-Based Solutions – The Money Point Case

Register here: https://bit.ly/3gR9ADL or scan:

1 Continuing Education Credit (CEC) is available to attendees

Recorded webinars will be posted online at: https://n-ewn.org/resources/n-ewn-knowledge-seminars/

Presented by:

NETWORK FOR ENGINEERING WITH NATURE

LimnoTech Water Environment Scientists Engineers

UNIVERSITY OF GEORGIA

ERDC

Questions? Please contact:

Sage Paris, LimnoTech

sparis@limno.com