Stone
Living Lab

2023 CONFERENCE

Nature-Based Coastal Resilience in Urban Settings

April 26-28, 2023 | Boston

ABOUT THE STONE LIVING LAB

The Stone Living Lab is an innovative and collaborative initiative for testing and scaling up nature-based approaches to climate adaptation, coastal resilience and ecological restoration in the high-energy environment of the Boston Harbor Islands National and State Park. A "Living Lab" brings research out of the lab and into the real world by creating a user-centered, open, innovative ecosystem that engages scientists and the community in collaborative design and exploration. The Lab is a partnership between Boston Harbor Now, UMass Boston's School for the Environment, the City of Boston, the Massachusetts Department of Conservation and Recreation, the Massachusetts Executive Office of Energy and Environmental Affairs, the National Park Service, and the James M. and Cathleen D. Stone Foundation.

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Jeff King, Deputy National Lead, Engineering With Nature (EWN), U.S. Army Corps of Engineers

Paul Kirshen, Research Director, Stone Living Lab and Professor, UMass Boston School for the Environment

Andrew McQueen, Research Biologist, U.S. Army Engineer Research and Development Center (ERDC)

Danielle Perry, Marine Habitat Resource Specialist, National Oceanic and Atmospheric Administration

Rebecca Shoer, Education and Engagement Program Manager, Stone Living Lab

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DAY 1 | WEDNESDAY, APRIL 26

SCHEDULE-AT-A-GLANCE

8:30 am	**Registration Opens**
9:00 am	**Networking & Refreshments**
10:00 am	**Land Acknowledgement, Welcome & Opening Remarks**
10:30 am	**Opening Keynote** • **Melissa Hoffer,** Climate Chief, Commonwealth of Massachusetts
11:00 am	**Keynote Indigenous Knowledge Fireside Chat** • **Charles F. Sams III,** Director, National Park Service • **Elizabeth Solomon,** Massachusett Tribe at Ponkapoag Moderated by: • **Rev. Mariama White-Hammond**, Chief of Environment, Energy, and Open Space, City of Boston
12:00 pm	**Lunch**
1:00 pm	**Breakout Session 1** Attend one of the following breakout discussions • Resilient Coastal Design, Partnerships & Community Engagement (Panels) • What Works: Frameworks, Tools & Lessons Learned (Part I) • Lessons Learned: Policy, Permitting & Funding Strategies
2:30 pm	**Break**
2:45 pm	**Breakout Session 2** Attend one of the following breakout discussions • Working with Salt Marshes to Renew and Preserve Coastlines • M&M: The Importance of Modeling & Monitoring Nature-Based Approaches • Opportunities and Barriers in Infrastructure & Finance
4:15 pm	**Break**
4:30 pm	**Networking Session** • Closing remarks & select poster presentations • Includes complimentary appetizers & drinks
6:00 pm	**End of Conference Day 1**

DAY 1 | WEDNESDAY, APRIL 26 | 1:00 PM TO 2:30 PM

BREAKOUT SESSION 1

BALLROOM | PANEL DISCUSSIONS: 45 MIN. EACH

Resilient Coastal Design, Partnerships & Community Engagement (Part I)

Weaving Climate Resilience, Social Equity, Green Infrastructure, and Open Space: The Moakley Park Case, Boston, MA

ALICE BROWN, Boston Harbor Now; JULIE EATON ERNST, Weston + Sampson; LUMINA MATHURIN; LIZA MEYER, Boston Parks & Recreation; CHRIS REED, Stoss Landscape Urbanism

Belle Isle Marsh and Mill Creak: Urban Resilience through Multiple Stakeholder Collaboration

CAMI MARULANDA, Excel Academy Charter High School; DARYA MATTES, North Suffolk Office of Resilience and Sustainability; CATHERINE MCCANDLESS, Climate Ready Boston, Boston Environment Department; CATHERINE PEDEMONTI, Mystic River Watershed Association; JOHN WALKEY, GreenRoots

ROOM 3540 | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

What Works: Frameworks, Tools & Lessons Learned (Part I)

Informative Tools for Intertidal Impacts: Development of a Biodiversity Assessment & Monitoring Framework for Coastal Resilience

LUCY LOCKWOOD, University of Massachusetts Boston

Developing Guidance for the Application of Natural & Nature Based Features (NNBF) on Developed Shores

AMY BREDES, Stevens Institute of Technology

Greening the Blue Line: Evaluating the Potential of Nature-Based Solutions to Protect Critical Transportation Infrastructure Uplift Communities

KATE DINEEN, A Better City; THOMAS J. NALLY, A Better City; GRACIE VILLA, Weston & Sampson

ROOM 3545 | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

Lessions Learned: Policy, Permitting & Funding Strategies

Regulatory Challenges and Opportunities for Living Shorelines in New England

ALISON BOWDEN, The Nature Conservancy

Coastal Wetlands Restoration with Nature-Based Solutions: Aligning Permitting to Meet the Urgency

HEIDI RICCI, Mass Audubon; RUSSELL HOPPING, The Trustees of Reservations

Sharing Lessons: Adaptive Management to Build Meaningful Partnerships Towards Equitable Conservation

EMMA GILDESGAME, The Nature Conservancy; JONATHAN GUZMAN, Groundwork Lawrence

DAY 1 | WEDNESDAY, APRIL 26 | 2:45 PM TO 4:15 PM

BREAKOUT SESSION 2

BALLROOM | 4:10:40 SESSION: 4 PRESENTERS, 10 MIN. EACH, 40 MINS DISCUSSION

Working with Salt Marshes to Renew & Preserve Coastlines

Opportunities for Applying Natural and Nature-Based Features (NNBF) in Coastal Urban Marshes
ANDREW MCQUEEN, US Army Engineer Research and Development Center

Mastic Beach Restoration: Using Nature-Based Solutions to Improve Resiliency and Restore a Tidal Marsh on Long Island
SARA COPP FRANZ, Rambøll Group; RANDY MANDEL, Rambøll Group

Nature-Based Oyster Castle® Reef Pilot Project: Stabilizing Salt Marsh Shorelines
JENNIFER KARBERG, Nantucket Conservation Foundation

Wave Attenuation and Economic Analysis of Hybrid Marsh-Seawall Nature-Based Solutions
IN HIM "ERNIE" LEE, Massachusetts Institute of Technology

ROOM 3540 | 4:10:40 SESSION: 4 PRESENTERS, 10 MIN. EACH, 40 MINS DISCUSSION

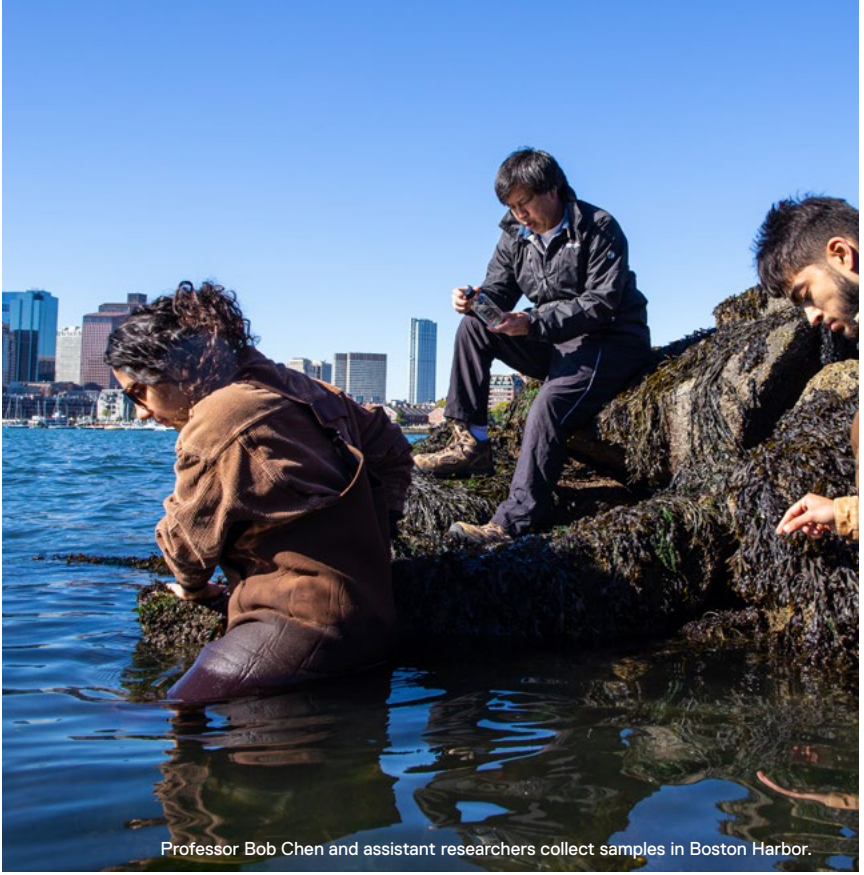
M&M: The Importance of Modeling & Monitoring Nature-Based Approaches

Studying vs Monitoring Nature-Based Solutions: What's Needed and Why?
MARK BORRELLI, Stone Living Lab

LiDAR Monitoring of Annual and Storm-Driven Episodic Erosion at Rainsford Island
FRANCESCO PERI & ALAN BARTELS, University of Massachusetts Boston School for the Environment

Development of a Living Shoreline Model to Compute Ecosystem Restoration Benefits
EMMA DODSWORTH, Virginia Institute of Marine Science, William & Mary

Modeling and Visualizing Artificial Reefs and Their Potential to Protect Coastal Communities
ANNETTE GRILLI, University of Rhode Island



Professor Bob Chen and assistant researchers collect samples in Boston Harbor.

ROOM 3545 | 4:10:40: 4 PRESENTERS, 10 MIN. EACH, 40 MINS DISCUSSION

Opportunities and Barriers in Infrastructure & Finance

A Life Cycle Perspective Framework for Natural Infrastructure-Based Flood Risk Management

MARGARET KURTH, US Army Engineer Research and Development Center

America's Bumbling Infrastructure

GABRIEL CIRA, The Emerald Tutu

Who Benefits from Flood Adaptation? Evidence from U.S. Wide Time Series Data

LIDIA CANO PECHARROMAN, Massachusetts Institute of Technology

Monetary Evaluation of Co-Benefits of Nature-Based Flood Risk Reduction Infratstructure to Promote Climate Justice

PAUL KIRSHEN, Stone Living Lab & University of Massachusetts Boston

DAY 2 | THURSDAY, APRIL 27

SCHEDULE-AT-A-GLANCE

8:30 am	**Registration Opens**
9:00 am	**Networking & Refreshments**
10:00 am	**Land Acknowledgement, Welcome & Opening Remarks**
10:30 am	**Co-Lab-Oration: How Three Climate Labs in Boston and NYC Are Approaching Their Work** • **Joe Christo,** Managing Director, Stone Living Lab • **Sheetal Shah,** Operations & Engagement Lead, Urban Ocean Lab • **Lauren Wang,** Director of Climate Programs, The Trust for Governors Island Moderated by: • **Kimberly Lucas**, Professor, Northeastern University School of Public Policy and Urban Affairs
12:00 pm	**Lunch**
1:00 pm	**Breakout Session 1** Attend one of the following breakout discussions • Sustainable Waterfront Access and Flood Resilience • Societal Co-Benefits of Nature-Based Approaches • What Works: Frameworks, Tools & Lessons Learned (Part II)
2:30 pm	**Break**
2:45 pm	**Breakout Session 2** Attend one of the following breakout discussions • Resilient Coastal Design, Partnerships & Community Engagement • Managing & Responding to Extreme Weather Events • Communications & Community Climate Action: Looking Toward the Future
4:15 pm	**Break**
4:30 pm	**Closing Remarks & Acknowledgements**
5:00 pm	**End of Conference Day 2**

DAY 2 | THURSDAY, APRIL 27 | 1:00 PM TO 2:30 PM

BREAKOUT SESSION 1

BALLROOM | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

Sustainable Waterfront Access and Flood Resilience

A New Resilient and Sustainable Waterfront in One of Boston's Oldest Neighborhood
JOHN FREY, Weston & Sampson

Designing a Critical Piece of Boston's Flood Protection Barrier with the Dorchester Bay City Project
MARK COSTA, Vanasse Hangen Brustlin (VHB); CANAN SAFAR, CV Properties

Nature-Based Solutions to Address Historic Persistent Flooding at Gibson Park and the Riverside Neighborhood
JOHN MCALLISTER, McAllister Marine Engineering

ROOM 3540 | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

Societal Co-Benefits of Nature-Based Approaches

From Analysis to Action: Strategies for Promoting Climate Justice when Implementing Nature-Based Solutions to Coastal Risk
MARCOS LUNA, Salem State University Department of Geography and Sustainability

Recreational Co-Benefits Associated with Shoreline Protection Design
ROBERT GRIFFIN, University of Massachusetts Dartmouth

Human Well-Being, Equity, and Nature-Based Solutions: Assessing Opportunities for Engineering With Nature® for Project Planning and Implementation
ELLIS KALAIDJIAN, Oak Ridge Institute for Science and Education

ROOM 3545 | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

What Works: Frameworks, Tools & Lessons Learned (Part II)

Establishing a Common Framework for Success: A Comparative Analysis of Nature-Based Coastal Resilience Projects to Inform Scaled Implementation
ROSE WINER-CHAN, Massachusetts Institute of Technology

Greening of the Grey: A Precautionary Approach to Ecosystem Service Enhancement in the Marine Built Environment
LOUISE FIRTH, University of Plymouth

Efforts at implementing NBS in the Caribbean: A Retrospective View
LEONARD NURSE, University of the West Indies Cave Hill Campus, Barbados

DAY 2 | THURSDAY, APRIL 27 | 2:45 PM TO 4:15 PM

BREAKOUT SESSION 2

BALLROOM | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

Resilient Coastal Design, Partnerships & Community Engagement (Part II)

Equity-Centered Climate Resilience in Boston Harbor's Lower Mystic Watershed

JULIE WORMSER, Mystic River Watershed Association; MELANIE GÁRATE, Stone Living Lab

Creating Public Access and Opportunity in the Face of Rising Seas

NICK BLACK, Boston Waterfront Initiative, The Trustees of Reservations

Multiple Objective Adaptation Planning under Deep Uncertainty Considering Plurality of Stakeholder Values in East Boston

SHAILEE DESAI, University of Massachusetts Boston

ROOM 3540 | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

Managing and Responding to Extreme Weather Events

Rising Seas and Rising to the Opportunity: The Future of the UMass Amherst Gloucester Marine Station

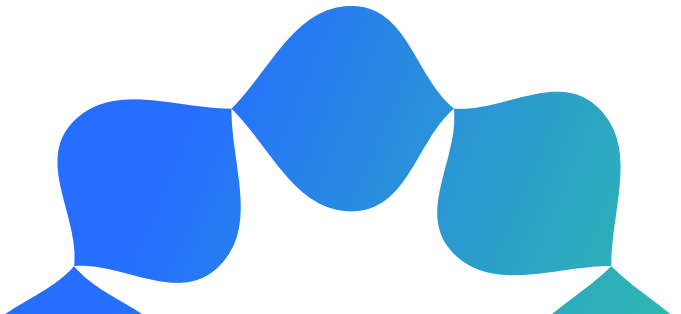
KIRK BOSMA, Woods Hole Group; KATIE KAHL, University of Massachusetts Amherst Gloucester Marine Station; SARA MORRISON, Fuss & O'Neill

Exploring Nature-Based Approaches to Reducing Risk from Petrochemical Releases due to Flooding in the Galveston Bay Area

SHANNON CUNNIFF, Stone Living Lab

Strategies and Conceptual Designs for Adaptation and Coastal Stormwater Discharge in Boston

CHARLIE JEWELL, Boston Water and Sewer Commission; JOHN SULLIVAN, Boston Water and Sewer Commission



ROOM 3545 | ORAL PRESENTATIONS: 20 MIN. PRESENTATIONS + 10 MIN. Q&A EACH

Communications & Community Climate Action: Looking Toward the Future

The 51 Percent Project: How to Talk About Climate Change so People will Listen

SARAH FINNIE ROBINSON, Bost
on University Institute for Global Sustainability

Cool Science: Youth Communicating about Climate Change to Adults through their Art on Public Buses

BOB CHEN, University of Massachusetts Boston

Equipping Communities through Place-based Learning and Research

REBECCA SHOER, Stone Living Lab; ANNIE O'CONNELL, Woods Hole Group

A researcher collects data in Boston Harbor

WEDNESDAY APRIL 26 | 4:30 TO 6:00PM

NETWORKING SESSION

SELECT POSTERS

LiDAR Monitoring of Annual and Storm-Driven Episodic Erosion at Rainsford Island

ALAN BARTELS, University of Massachusetts Boston

Restoration is Resilience: Fish Ponds, Middens, Mangroves and Rivercane as Coastal Futures

DEBRA M. BUTLER, University of Massachusetts Boston

Developing Nature-Based Solutions for Coastal Flood Protection in Boston: A Values Focused Approach

JESSICA LILLQUIST, University of Massachusetts Boston

The Urban-Water-Energy and Food Nexus for Resilience towards Climate Change

BAMGBOYE TAIWO TEMITOPE, University of Oulu

Stone Living Lab researcher holds a model of a Living Seawall panel.

FIELD TRIPS & MORE

Join us for conference outings on Thursday & Friday.
Pre-registration required.

Blunders & Bloopers Night at Dorchester Brewing

THURSDAY APRIL 27 | 6:00 - 9:00PM

Help us close out conference proceedings on a fun note! Come on out to Dorchester Brewing's "Hopservatory" for delicious food, drinks, and to share and hear stories from fellow conference goers about times things haven't gone exactly as planned... Get your story ready to share for this open mic style evening. Anything is fair game, and all are welcome to share as they feel comfortable.

Resilient Boston Harbor Cruises

FRIDAY APRIL 28 | 9:00 - 11:30AM *OR* 5:00 - 7:00PM

Welcome aboard the Columbia Point! Join Stone Living Lab Partners from UMass Boston & the National Park Service to learn about ongoing and planned research & monitoring, as well as community engagement efforts aimed at creating a future where people work *with* nature to make coastal regions resilient and adaptive to climate change, while also enhancing natural and built environments.

Walking Tour of the East Boston Waterfront

FRIDAY APRIL 28 | 12:30 - 2:30PM

East Boston is one of the city's fastest growing and most diverse neighborhoods, and its waterfront near Maverick Square is lined with parks, affordable housing, luxury housing, transportation infrastructure, a fantastic Harborwalk for residents to enjoy, and a living shoreline. Joe Christo, Managing Director of the Stone Living Lab, will lead a walking tour of the area, featuring discussion of several other climate adaptation projects in the works.

Guided Tour & Bird Banding at Belle Isle Marsh

FRIDAY APRIL 28 | 1:00 - 3:00PM

Belle Isle Marsh is the last remaining salt marsh in Boston, nestled within two environmental justice communities: East Boston and Revere. It is characterized by the U.S. Fish and Wildlife Service as one of the most biologically significant estuaries in Massachusetts, including nesting sites for the endangered salt marsh sparrow. Join us along with various partners working on the restoration effort for a tour of Belle Isle, followed by a bird banding demonstration by Sean Riley from the Massachusetts Department of Conservation and Recreation."

NOTES

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The Conference Committee & event organizers have prioritized keeping the 2023 Stone Living Lab Conference as environmentally friendly as possible.

All breakfasts & lunches are vegetarian and will be served in washable, reusable containers generously provided by Usefull.

UMass Boston is generously providing compost bins for the conference to dispose of all food waste in an environmentally friendly way.

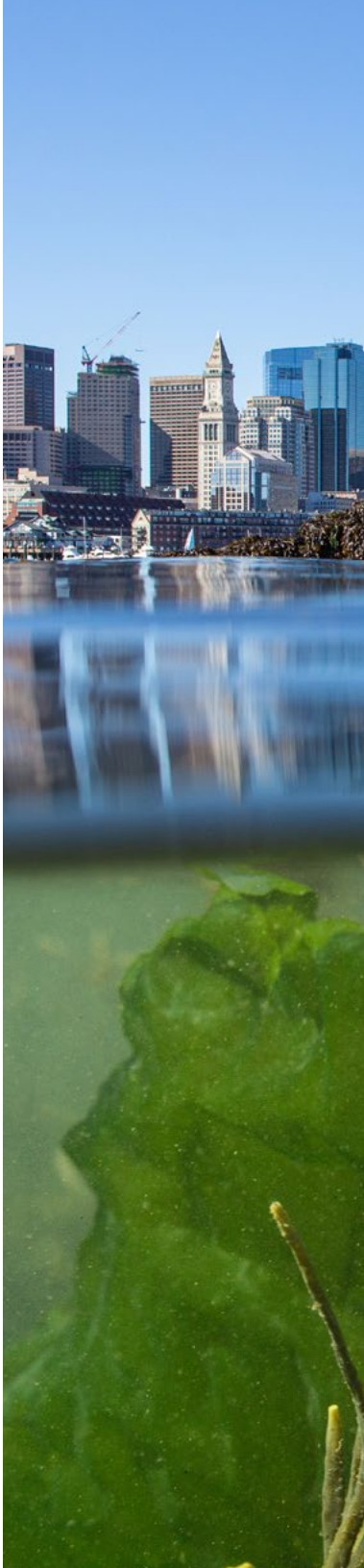
All name tag holders have been borrowed from our partners at Boston Harbor Now and will be returned for reuse during future events.

This program includes select conference information to cut down on paper usage, and a full list of abstracts and authors can be accessed in digital form on the conference webpage.

All greenery consists of potted plants native to Massachusetts rather than cut flowers.

Shuttle bus service will be provided to all off-site field trips & events in an effort to promote carpooling.

Wherever possible, we encourage all Conference participants to make sustainable choices during the conference and beyond.



DAY 1 | WEDNESDAY, APRIL 26 | 1:00 PM TO 2:30 PM

ABSTRACTS: BREAKOUT SESSION 1

Resilient Coastal Design, Partnerships & Community Engagement (Part I)

Weaving Climate Resilience, Social Equity, Green Infrastructure, and Open Space: The Moakley Park Case, Boston, MA

CHRIS REED | Founding Director, Stoss Landscape Urbanism
ALLISON PERLMAN | Project Manager, Boston Parks & Recreation
LIZA MEYER | Senior Landscape Architect, Boston Parks & Recreation
ALICE BROWN | Chief of Planning & Policy, Boston Harbor Now
LUMINA MATHURIN | Park Neighbor and Community Member
JULIE EATON ERNST | Resilience Team Leader, Weston + Sampson

The Moakley Park Resilience Plan transforms one of Boston's largest waterfront open spaces from a largely single-use recreational facility into a resilient and multi-functional 21st century park. Accessible by public transportation and within 15 minutes of the city's most diverse and impacted neighborhoods, Moakley is poised to be an destination park for these adjacent communities and for all of Boston, one that provides safe and equitable access to high quality waterfront open space, community resources, green infrastructure and nature-based resilience features, as well as athletics and events for all ages, abilities, and backgrounds. In doing so, the park plan addresses the city's most pressing climate issues, including stormwater management, urban heat island effect, and coastal flooding, and their disproportionate impact on communities of color and ethnic diversity. The park program and designs were developed from an extensive 4-year public engagement process that included on-site, in person, virtual, online, and focus-group-oriented activities, as well as open houses, walking and bike tours, regular seasonal activities, and a Moakley Day activation event. This process directly informed inclusion and location of key elements, such as community growing gardens, water stations for hot days, gathering and play spaces immediately across the street from public housing, a flexible interior community space for events and for shelter from heat, and a large adventure playground.

Belle Isle Marsh and Mill Creek: Urban Resilience through Multiple Stakeholder Collaboration

CATHERINE PEDEMONTI | Ecological Resiliency Manager, Mystic River Watershed Association
DARYA MATTES | Resilience Manager, North Suffolk Office of Resilience and Sustainability
JAHSON ALEMU | Postdoctoral Scholar, Northeastern University & The Nature Conservancy
CATHERINE MCCANDLESS | Climate Change and Environmental Planning Project Manager, City of Boston
CONOR OFSTHUN | Coastal Scientist, Woods Hole Group
JOHN WALKEY | Director of Waterfront and Climate Justice Initiatives, GreenRoots
ALEX TRAIN | Director of Housing and Community Development, City of Chelsea

Coastal resources that span municipal and jurisdictional boundaries present both opportunities and challenges for climate adaptation. Two examples to the north of Boston are Belle Isle Marsh, bounded by East Boston, Revere, and Winthrop; and Mill Creek, running along the border between Chelsea and Revere. In both cases, municipalities, state agencies, community organizations, and others have come together to share ideas, align priorities, and create capacity to build resilience for these natural resources and the communities that surround them. The 300-acre Belle Isle Marsh is an essential open space and wildlife habitat in Boston Harbor that also offers natural flood protection to the communities of East Boston and Revere, the Town of Winthrop, and the MBTA Blue Line. In recent years, a coalition of landowners and other stakeholders, in collaboration with the wider community, has come together to identify and prioritize cost-effective adaptations along the marsh. These interventions would prevent damage to the neighboring communities and infrastructure while enhancing and extending the marsh's habitat. Mill Creek flows into Chelsea Creek and from there into the Mystic River and Boston Harbor. While the creek is tidally influenced and surrounded by former salt marsh, generations of development has restricted tidal flow while adding contaminants to the creek, degrading the habitat and earning a water quality grade of F from the EPA. Several years ago, a coalition of municipal and community-based partners came together to try to address these problems. The group has met regularly for years to plan efforts to clean up Mill Creek, restore the ecosystem there, and provide waterfront access to Chelsea residents – all while increasing resilience to flooding and heat that will worsen with climate change.

What Works: Frameworks, Tools & Lessons Learned (Part I)

Informative Tools For Intertidal Impacts: Development of a Biodiversity Assessment and Monitoring Framework For Coastal Resilience

MICHELLE STAUDINGER | Science Coordinator, USGS DOI Northeast Climate Adaptation Science Center

MARC ALBERT | Director, Science & Stewardship Partnerships, National Parks of Boston

JAMES GARNER | PhD Candidate, University of Massachusetts Amherst

LUCY LOCKWOOD | PhD Candidate, University of Massachusetts Boston

The Boston Harbor Islands National Recreation Area (BOHA), the only coastal drumlin archipelago in the United States, was named one of America's 11 Most Endangered Historic Places due to threats from sea level rise and other facets of climate change. The National Park Service (NPS) and its land-owning partners within BOHA are considering a range of coastal adaptation actions including nature-based solutions to bolster eroding and flooding shorelines in keeping with the NPS's mission of maintaining ecological integrity and biodiversity, and protection of cultural heritage. In this talk we share some of the initial findings and ongoing work of a joint USGS-NPS project developing a novel, standardized biodiversity assessment and monitoring framework for the intertidal habitats of BOHA. The framework supports the establishment of baseline conditions in advance of any coastal resilience project; the assessment of impacts and changes to intertidal habitats resulting from such a project; and provide a means to track changes due to gradual and acute disturbances from climate change and other stressors. The project has identified and used different site types for developing and testing the framework, including areas with cultural or management importance and biodiversity hotspots. Traditional survey methods, molecular approaches (e.g., eDNA), and image analyses are being evaluated in terms of efficacy, efficiency, and ease of implementation. Ultimately, the project will provide NPS with a range of cost-effective options for rapid, comprehensive intertidal biodiversity assessment, monitoring, and metrics that will help NPS and its partners plan for and learn from coastal resilience projects, and provide effective stewardship of intertidal habitats and near-shore biodiversity in the face rapidly changing conditions from climate change.

Developing Guidance for the Application of Natural and Nature-Based Features (NNBF) on Developed Shores

AMY BREDES | Graduate Assistant, Stevens Institute of Technology
JON MILLER | Research Professor, Stevens Institute of Technology
KATHERINE GANNON | Graduate Assistant, Stevens Institute of Technology
LAURA KERR | Research Engineer, Stevens Institute of Technology
IAN DAY | Graduate Assistant, Stevens Institute of Technology

Developed shorelines represent a significant proportion (14%) of the world's shorelines. Historically these shores have been tamed or hardened using a variety of engineering interventions. Often these interventions have negative impacts on the local ecology. New Jersey (USA) is the most densely populated state in the United States, and not surprisingly has one of the highest percentages (34%) of hardened shorelines. In 2013, New Jersey created a set of engineering guidelines to promote the use of living shorelines or natural and nature-based features (NNBF) in the state. Like most similar documents, the guidance focused on more natural, estuarine, and bay shorelines. Recognizing that many of the traditional NNBF techniques described in the guidelines were less appropriate for developed shorelines, the state recently created a separate set of guidelines for developed shores. That document synthesizes information from peer-reviewed and gray literature, with lessons learned from six case studies to generate guidance for the application of NNBF along the developed shores of New Jersey. The resulting guidance is founded on three core Guiding Principles: 1) Maintain/Restore Natural areas, 2) Design for Resilience and Adaptability, 3) Monitor and Assess; and six recommended Design Elements: 1) Allow Light Penetration, 2) Use Alternative Materials, 3) Increase Surface Roughness, 4) Increase Water Retention, 5) Reduce Slope, and 6) Introduce Curvature. Each piece of guidance has positive ecological, community, and engineering outcomes while also presenting challenges and considerations to planners, designers, and engineers. This guidance recommends that all developed shoreline NNBF projects in the state adhere to the Guiding Principles and that they consider applying the Design Elements where appropriate.

Greening the Blue Line: Evaluating the Potential of Nature-Based Solutions to Protect Critical Transportation Infrastructure and Uplift Communities

KATE DINEEN | Executive Vice President & Chief Operating Officer, A Better City
GRACIE VILLA | Site Designer 1, Weston & Sampson
THOMAS NALLY | Senior Advisor, A Better City
MICHELLE MOON | Principal & Founder, Civic Space Collaborative

East Boston is a vibrant, growing, transit-dependent community that is profoundly vulnerable to flooding. The Project, "Greening the Blue Line," aims to investigate the potential to deploy nature-based solutions along the Blue Line corridor in East Boston to protect critical transportation infrastructure from coastal and stormwater flooding, to support ecosystem restoration, and to improve the health and vibrancy of marginalized communities and commercial districts. 1) Analyze planning documents and vulnerability assessments; 2) Consult with key stakeholders and public officials; 3) Engage with community leaders, community-based organizations, residents, and merchants to explore needs and opportunities and to methodically assess and prioritize desired co-benefits; 4) Develop conceptual design approaches for nature-based solutions for the Orient Heights and Wood Island areas, informed by robust stakeholder and community input; 5) Develop a co-benefit evaluation and monitoring framework to ensure that the projects continue to serve community needs over time; 6) Identify potential funding sources for design and construction; and 7) Publish and brief decision makers on the key findings. Our analysis identified five locations of vulnerability representing a range of typical situations, applying the following site selection criteria: 1/4 mile to the Blue Line, low tree canopy coverage, highly impervious surfaces, high storm inundation risk, and high flood vulnerability in extreme storm events. Our team developed site-specific design concepts featuring interventions like rain gardens, swales, inland wetlands, and trees. These designs were informed by a robust stakeholder engagement process that included interviews, focus groups, a survey, and a design charrette. We learned that nature-based solutions can be designed to effectively protect dense, vulnerable urban neighborhoods, while creating multiple social and economic co-benefits. Next steps may include exploring and advancing select design concepts with city and state partners and community groups, completing additional engineering, securing funding, and utilizing the co-benefits tool.

Lessons Learned: Policy, Permitting & Funding Strategies

Regulatory Challenges and Opportunities for Living Shorelines in New England

ALISON BOWDEN | Director of Science and Strategy, The Nature Conservancy
STEPHEN KIRK | Coastal Program Director, The Nature Conservancy
THERESA DAVENPORT | Post-Doctoral Fellow, Louisiana State University Agricultural Center

Living shorelines are a nature-based solution to coastal erosion and flooding that use or mimic natural processes and design elements and have the capacity to offer additional ecosystem functions and services ('co-benefits'). Certain living shorelines designs call for sediment deposition and/or work below the coastal jurisdictional boundary resulting in challenging environmental permitting given a strong regulatory preference to avoid resource impacts. To identify whether the regulatory environment limits the adoption of living shorelines in New England, an assessment of the regulatory environment was conducted by interviewing a team of coastal managers, scientists, and/or academic partners from each New England coastal state, documenting the regulatory requirements for living shorelines, and synthesizing challenges and opportunities for advancement. All five New England coastal states list at least some regulatory preferences for living shorelines over hardened options, and most require consideration of sea-level rise impacts. Two key regulatory challenges and opportunities emerged, particularly with the federal permitting process in New England. First, the current permitting process was not designed for living shorelines and may disincentivize their use: avoidance of any resource impacts is favored, design standards for living shorelines are lacking, pre-application meetings demand much time, and cumulative impacts are not clearly defined. This may be addressed by documenting and prioritizing cumulative impacts, developing design standards, and increasing reviewer capacity. Second, consideration of future conditions is not prioritized in the permitting process, which may lead to coastal squeeze and threaten coastal resource sustainability. Assessing trade-offs among resource impacts over short and long time scales while considering cumulative impacts and future conditions may help advance and improve decision-making. Future efforts need to incorporate the perspectives of federal regulators and better understand the resource impact assessment process including how trade-offs among current and future conditions are assessed.

Coastal Wetlands Restoration with Nature-Based Solutions: Aligning Permitting to Meet the Urgency

HEIDI RICCI | Director of Policy and Advocacy, Mass Audubon
RUSSELL HOPPING | Ecology Program Director, The Trustees of Reservations

Climate change and sea level rise threaten the well-being of natural and human communities. Coastal wetlands are rapidly deteriorating, along with the critical benefits they provide including storm protection, water purification, carbon storage, habitat for at-risk bird species, and economically important fisheries and recreation opportunities. The losses are exacerbated by historic alterations including thousands of ditches and agricultural embankments. We have a narrow window of opportunity over the next 5-10 years to scale up salt marsh restoration using low impact techniques like runneling and ditch remediation, and to apply other nature-based solutions for climate resiliency along the coastline. Funding for this work has increased dramatically. With hundreds of millions of dollars in federal and state funds available for ecological restoration, Massachusetts has a once-in-a-lifetime opportunity to prepare our landscapes and communities for climate change. However, our outdated regulatory structure was designed to protect wetlands from development and is poorly suited for environmentally beneficial nature-based wetland restoration projects, including those in urban areas. The results are long delays, high costs, and inconsistent outcomes. We will present an overview of this policy issue and how experts and practitioners are working together to engage with the agencies to find solutions. We'll also provide a case study on the Great Marsh where these techniques have been piloted and are now ready to scale up. Mass Audubon and The Trustees are working directly and with many partners on nature-based climate solutions for restoring wetlands and increasing coastal resilience throughout the Massachusetts coastline. We will present both the practical application of these methods and regulatory challenges and opportunities to improve the process, increase efficiency for all involved, and accelerate the pace of restoration.

Sharing Lessons: Adaptive Management to Build Meaningful Partnerships Towards Equitable Conservation

EMMA GILDESGAME | Climate Adaptation Scientist, The Nature Conservancy
JONATHAN GUZMAN | External Affairs Manager, Groundwork Lawrence

Acting on commitments to diversity, equity, inclusion, and justice requires environmental organizations to develop new ways of working, new types of relationships, and new metrics for evaluating knowledge and success. This work towards systemic change is necessarily challenging. The Massachusetts Equitable and Sustainable Climate Funding project, convened by The Nature Conservancy, serves as a case study from which we can learn lessons about how to – and how not to – build equity into environmental and climate work. Massachusetts has ambitious goals to reduce the emissions that cause climate change and support Massachusetts communities in adapting to the climate change impacts we're already facing. However, there is insufficient funding allocated to meet these goals; existing funding often reinforces structural and societal inequities and fails to provide enough funding to the people most impacted by the effects of climate change. A group of environmental conservation, environmental justice, and community advocacy organizations are working together to build an initiative, including draft legislation filed into the 2023-2024 Massachusetts legislature, to ensure that the Commonwealth's climate change goals and funding programs are equitable and prioritize those communities who are first and worst impacted by climate change. To do this work, environmental nonprofit organizations with longstanding partnerships needed to build meaningful, cross-sectoral relationships with smaller, community-based organizations representing a diverse cross-section of Massachusetts communities. Through this work, we learned much about how to effectively share power, make decisions together, compensate community members for their time, and identify and work towards shared goals. This process wasn't easy, and we didn't always get it right. This presentation will be a transparent exploration of our challenges and lessons learned in addition to our successes.

ABSTRACTS: BREAKOUT SESSION 2

Working with Salt Marshes to Renew and Preserve Coastlines

Opportunities for Applying Natural and Nature-Based Features (NNBF) in Coastal Urban Marshes

ANDREW MCQUEEN | Research Biologist, U.S. Army Engineer Research and Development Center
BURTON SUEDEL | Research Biologist, U.S. Army Engineer Research and Development Center
SARA COPP FRANZ | Managing Ecologist, Rambøll Group
VICTOR MAGAR | Principal, Rambøll Group
RANDY MANDEL | Principal - Biodiversity and Nature Restoration, Montrose Environmental Group
CATHERINE PEDEMONTI | Ecological Resiliency Manager, Mystic River Watershed Association

Coastal urban environments provide a nexus between human population centers, coastal infrastructure, and environmental resources. Coastal environments are uniquely vulnerable to climate related impacts (e.g., storm surge, inundation, sea level change) and therefore require careful planning and management to protect communities and valued resources, including coastal habitat. There are significant economic, social, and environmental motivations to explore novel approaches to promote resilience and decrease climate impacts in these urban environments. Belle Isle Marsh, a 300-acre estuary habitat, represents one of the largest and last remaining salt marshes within Boston's city limits and is a valued resource that provides flood resiliency, critical habitat for endangered species, and a local recreational resource. Nature-based solutions (NBS) provide unique opportunities to manage and protect the Belle Isle marsh to enhance coastal flood resilience and protect this valued habitat, including conservation and enhancement of the marsh through integration of Natural and Nature-Based Features (NNBF), sediment beneficial use, and integration of NNBF elements into hybrid infrastructure designs. This project will use diverse partners to identify approaches and designs to promote climate resiliency and to enhance biodiversity and ecological functionality of the Belle Isle Marsh using principles from Engineering With Nature® (EWN) that aim to promote environmental, social, and economic benefits. Information gained at Belle Isle can inform regional and global strategies to use ecosystem resilience opportunities provided by EWN® in urban coastal marshes. To achieve this objective, this research will 1) conduct an assessment of plant genetic diversity in marsh management plans, and 2) provide assessment and recommendations to enhance the resilience and multiple benefits of the marsh ecosystem. Serving as a proof

of concept, such designs will help communicate how NBS can solve pressing challenges in urban marshes. The City of Boston is recognized globally as having high exposure to sea-level change and intensifying coastal storms. The City and the Commonwealth of Massachusetts have developed nation-leading programs to develop climate resilience plans, with NNBF as a cornerstone priority for the State program. Therefore, there is a need to coalesce ideas and feedback from landowners, abutters, resident communities, and other critical stakeholders to explore resilience investments as they may impact the marsh holistically.

Mastic Beach Restoration: Using Nature-Based Solutions to Improve Resiliency and Restore a Tidal Marsh on Long Island

SARA COPP FRANZ | Managing Ecologist, Rambøll Group
TONY EALLONARDO | Ecologist, Rambøll Group
VICTOR MAGAR | Principal, Rambøll Group
RANDY MANDEL | Principal - Biodiversity and Nature Restoration, Montrose Environmental Group
ALAN DUCKWORTH | Environmental Analyst, Town of Brookhaven, New York

The Mastic Beach and Smith Point of Shirley peninsula is home to almost 13,000 residents and is located on the South Shore of Long Island, Suffolk County, NY in the southern portion of the Town of Brookhaven. The Town is one of eight NY Rising Community Reconstruction areas and has been impacted repeatedly by flooding due to sea level rise, storm surge, and rainfall. To respond to these threats, the Town instituted an extensive buy-out program to acquire and remove homes located in high-risk flood areas as part of a managed retreat program. In 2018 and 2020, the Town of Brookhaven was awarded a National Coastal Resilience (NCR) Grant from the National Fish and Wildlife Foundation (NFWF) to develop design plans for the restoration of coastal saltmarsh habitat in the community of southern Mastic Beach. Using nature-based solutions (NBS) such as managed retreat and ecological restoration, the design will 1) restore a saltmarsh ecosystem and provide improved habitat for at risk organisms such as the Saltmarsh Sparrow (Ammodramus caudacutus); 2) reconnect the salt marsh with a natural floodplain through road removals and development of tidal creeks; 3) provide the public with safe recreational access to the marsh; 4) ecologically enhance the existing saltmarsh ecosystem through invasive species control, and 5) provide natural and nature-based features (NNBF) to help buffer future flooding for inland/upland residential communities and allow stormwater to drain more efficiently during precipitation events and minimize wave run-up. Overlapping objectives and restoration goals for Mastic Beach has allowed for extensive collaboration between stakeholders including the local community, nonprofit organizations, and local, county, state, and federal governments.

Nature-based Oyster Castle® Reef Pilot Project: Stabilizing Salt Marsh Shorelines

JENNIFER KARBERG | Director of Research and Partnerships, Nantucket Conservation Foundation

Responding to coastal impacts of climate change requires the adaptation of current wetland regulation standards. To encourage science-based, natural solutions to increasing coastal resilience, conservation-minded research organizations need to design pilot projects to inform these innovations. Faced with coastal salt marsh dieback as well as poorer harbor water quality, the Nantucket Conservation Foundation undertook the laborious process to design and permit an intertidal oyster reef to provide salt marsh protection from storm and wave impacts while improving localized water quality. This solution had not previously been permitted in Massachusetts. Working through the MA In Lieu Fee Program and building partnerships with local shellfish associations, USACE, MA CZM, MA DEP and MA DFW, we obtained permitting within a year and a half with full reef installation completed over 3 days in November 2021. We designed extensive pre- and post-installation monitoring to capture reef impacts to intertidal water movement, storm surge impacts, salt marsh erosion, salt marsh health and harbor water quality as well as monitoring the physical reef successful. This presentation will outline the process of design, permitting and installation of this novel pilot project as well as highlight unique data collection methods including using drone aerial photography to quantify salt marsh vegetation composition as well as tilt meters to model tidal flow and force. This project can serve as an example of how to develop and implement innovative nature-based coastal resilience solutions as well as a providing a model for other salt marsh protection projects.

Wave Attenuation and Economic Analysis of Hybrid Marsh-Seawall Nature-Based Solutions

IN HIM "ERNIE" LEE | MEng Student, Massachusetts Institute of Technology

A seawall fronted by a marsh can be a hybrid, nature-based solution for both rural and urban coastal protection. The wave attenuation achieved by the vegetation can be translated into a reduction in seawall height required for the same level of coastal defense. Inclusion of vegetation not only reduces the capital cost investments for seawall construction, but also delivers values from carbon sequestration and other ecosystem services. A one-dimensional wave propagation model was developed based on first principles to capture four energy dissipation modes: vegetation drag contributed by plant stems and leaves, wave breaking, shoaling and bed friction. After validating the model with field observations, it was applied on a hypothetical seawall-foreshore system to quantify the width of vegetated foreshore required to achieve a specific percentage wave height reduction, which was subsequently translated into a reduction in overtopping rate and required seawall height. Different salt marsh species were explored to compare their effectiveness in wave attenuation performance. To consider a case study of nature-based solution in the urban setting, the model was used to explore the proposed marsh and seawall restoration at Juniper Cove in Salem, Massachusetts. The case study examined both the wave attenuation performances and benefit-cost analysis economic implications of maintaining and expanding the salt marsh extent in front of the existing seawall. Inclusion of vegetation significantly reduced the occurrence and energy dissipated through wave breaking for 10, 50 and 100-year storm scenarios, which would reduce erosion and promote fine sediment deposition that enhances marsh growth in a positive feedback loop.

M&M: The Importance of Modeling & Monitoring Nature-Based Approaches Studying vs. Monitoring Nature-Based Solutions: What's Needed and Why?

MARK BORRELLI | Coastal Geologist, Stone Living Lab

Transdisciplinary, science-based inquiry is needed to better understand the impacts of Nature-Based Solutions (NBS). Often the scale, permitting, and need for a given NBS effectively prohibits the collection of sufficient, pre-installation data. Thus regulators, the public, and the scientific community are left to make decisions regarding the next NBS without a complete understanding of the previous one. Here we present remote sensing data collected in Boston Harbor that can provide baseline data needed to conduct rigorous and repeatable investigations into a full suite of impacts using a transdisciplinary approach for any given NBS.

LiDAR Monitoring of Annual and Storm-Driven Episodic Erosion at Rainsford Island

ALAN BARTELS | Graduate Research Assistant, UMass Boston & Stone Living Lab
IAN PAYNTER | Climate Energy and Environment, Civil Group, Reston VA
FRANCESCO PERI | Research Assistant, UMass Boston & Stone Living Lab
CRYSTAL SCHAFF | Professor, UMass Boston & Stone Living Lab

Boston Harbor and its thirty-four islands and peninsulas have always been subject to erosion, driven by rain, winds, and waves. Climate change threatens to increase erosion over time as sea levels rise and the frequency and intensity of storms increase. In Boston, sea levels are predicted to rise up to 0.5m by mid-century, and up to 2.1m by 2100 (NOAA, 2022). These changes lead to more exposure to waves, storm surge, and ultimately more erosion and flooding. Understanding the dynamics of coastal erosion is essential to guiding the design of coastal shoreline protections, the research of which is one of the goals of the Stone Living Laboratory. However, the episodic nature of storms makes associated erosion events difficult to quantify and distinguish from more incremental erosion caused by seasonal wind and rain and annual freezing and thawing cycles. To improve monitoring of the impact of episodic severe storms on the coastal bluffs and shores of Rainsford Island, the northeast bluff was scanned four times with a high-resolution terrestrial LiDAR (the commercial Riegl VZ400i instrument) over 14 months from July 22, 2021 to October 19, 2022, including before and after the region experienced two hurricanes, Henri and Ida, in late August 2021. In this study we were able to qualitatively and quantitatively assess the locations and magnitude of erosion along the Rainsford bluff that occurred after two major hurricane storm events (short-term) and over the annual seasonal cycle (long-term). These data provide a baseline of erosion on Rainsford, and will better inform the design of coastal shoreline protections tested by the Stone Living Lab.

Development of a Living Shoreline Model to Compute Ecosystem Restoration Benefits

EMMA DODSWORTH | Graduate Student, Virginia Institute of Marine Science, William & Mary
MARK BRUSH | Professor, Virginia Institute of Marine Science
MOLLY MITCHEL | Research Assistant Professor, Virginia Institute of Marine Science

Living shorelines are nature-based coastal adaptations, which have become important replacement habitats for natural marshes lost to sea level rise, erosion, and coastal development. Unlike hardened shorelines, these constructed habitats can leverage natural ecological processes to keep pace with rising sea levels, maintaining their benefits under climate change. This form of shoreline restoration provides watershed-scale benefits across natural and human communities, improving the ecosystem services of the shoreline. Living shorelines are approved as a best management practice (BMP) around the Chesapeake Bay watershed to reduce nutrient and sediment loads in an effort to restore the estuary. However, there are no tools available to compute site-specific nutrient and sediment removals for these restoration practices. Our research will create a widely applicable and directly accessible model for local stakeholders to assess nutrient and sediment removals from different living shoreline designs. This simulation model of living shorelines is being validated with seasonal observations from diverse living shorelines. Seasonal observations were completed fall of 2022 and model development will begin spring of 2023. The model will be used to compute nitrogen removals for representative sites in the lower Chesapeake Bay and will be provided online for stakeholders (restoration planners, resource managers, local government, etc.). Other educational materials (e.g., fact sheets, brochures, websites, videos) will be developed in collaboration with partners to facilitate the use of the model to promote multi-benefit shoreline restoration projects.

Modeling and Visualizing Artificial Reefs and Their Potential to Protect Coastal Communities

ANNETTE GRILLI | Research Professor, University of Rhode Island
AMANDA BABSON | Coastal Landscape Adaptation Coordinator, National Park Service
PETER STEMPEL | Associate Professor, Pennsylvania State University
J.P. WALSH | Professor, University of Rhode Island
PAM RUBINOFF | Coastal Resilience and Extension, University of Rhode Island
ISAAC GINIS | Professor, University of Rhode Island

Many New England coastal communities are protected by beach barrier systems acting as "ecosystem engineers", protecting the urbanized mainland from direct wave impact, while providing a balanced ecosystem evolving with changing conditions. These systems, when operating in healthy conditions, with low anthropogenic impact and in slow climate changing conditions, naturally adapt to sea level rise (SLR) and storm intensification by transgressing. However, beyond some threshold resulting from a combination of rate of change in wave climate conditions and direct anthropogenic effects on the system, as urbanization, the ecosystem engineers' functionality is destabilized. To support the beach barrier systems functionality several Natural and Nature-Based Solutions [NNBS] have been proposed promising different temporal and spatial scale of restoration abilities. In this study we propose the use of an offshore Artificial Reef (AR), classified as NNBS or Coastal Green Infrastructure, to dissipate the wave energy further offshore and protect the shoreline.

Opportunities and Barriers in Infrastructure & Finance

A Life Cycle Perspective Framework for Natural Infrastructure-Based Flood Risk Management

MARGARET KURTH | Research Engineer, US Army Corps of Engineers

A key need for implementing more natural infrastructure is funding to scope, design, construct, monitor, and adaptively manage these projects. The U.S. Army Corps of Engineers (USACE) Systems Approach to Geomorphic Engineering (SAGE) and Engineering With Nature® (EWN) programs have collaboratively developed a series of case studies to share innovative examples of funding and financing natural infrastructure. From homeowner cost-sharing programs to watershed-wide wetland restoration efforts, our case studies highlight funding and financing approaches that can be applied across a range of natural infrastructure techniques and scales. Case studies are focused on factors that enable successful funding, with emphasis on transferable best practices. This lightning talk will introduce lessons learned by projects in California, Texas, Virginia, and New York. We will also present an opportunity for participants to contribute to this ongoing effort.

America's Bumbling Infrastructure

GABRIEL CIRA | Project Lead, The Emerald Tutu

This talk will describe The Emerald Tutu's recent experience with permitting experimental tests and prototypes that support the research and development goals of the broader project, a visionary nature-based infrastructure solution to protect coastlines from storm flooding and improve coastal habitats and water quality. The difficulties and barriers encountered by association with existing coastal infrastructure such as degraded sheet pile retaining walls, abandoned structures, and utility equipment as well as coastal infrastructural uses of public ways such as gas tanker navigation and salt storage will be highlighted. The regulatory interaction of each of these elements with jurisdictional resource areas will be shown, as well as the various regulatory authorities and their representatives. It is widely accepted that regulatory barriers significantly impede climate infrastructure from achieving the scales that are needed to address urban-level crises. Moreover, these intersectional regulatory barriers will be shown to be rife with ideological sentiment, although they purport (explicitly) to be value-neutral. Ultimately, the imprecise, piecewise, and private-property-based legalities of infrastructure permitting will be shown to be a defining feature of a long historical era that must end in order for coastal cities to adapt to rising seas and intensified coastal storms.

Who Benefits from Flood Adaptation? Evidence from U.S. Wide Time Series Data

LIDIA CANO PECHARROMAN | PhD Candidate, Massachusetts Institute of Technology
CHANGHOON HAHN | Post-Doc, Princeton University

Governments are racing to implement new climate change adaptation policies in order to prepare for the increasing damage and frequency of flooding events. In this rush, it is imperative to avoid implementing policies that perpetuate structural inequality and climate injustice. Policies must be evaluated not only for their effectiveness but also through a climate justice lens that considers the intersectionalities between climate and geo-demographics. In this work, we examine a nationwide US flood adaptation program, the FEMA National Flood Insurance Program Community Rating System (CRS), and evaluate how its impact on flood loss depends on the geo-demographics of a community. We conduct the first analysis of this kind by using a statistically powerful data set of 2.5 million flood insurance claims and a Machine Learning based approach with neural density estimation to overcome quantitative challenges that prevented such analyses in the past. We find strong evidence that the CRS is effective at reducing flood losses overall. Moreover, we show that the efficacy of the CRS flood adaption activities depends significantly on geo-demographic characteristics, such as income, flood proneness, and population. For instance, we find that lower income communities benefit the most from the flood adaptation measures, although the benefits are mostly seen by communities with larger populations and moderate to low flood risks. This work provides key insights for crafting and tailoring future flood adaptation policies to make them more effective and to ensure that their implementation advances climate justice.

Monetary Evaluation of Co-Benefits of Nature-Based Flood Risk Reduction Infrastructure to Promote Climate Justice

PAUL KIRSHEN | Professor, University of Massachusetts Boston & Research Director, Stone Living Lab
HANNAH STROUD
DAVID TIMMONS

Climate change disproportionately impacts socially and economically marginalized populations. To rectify this imbalance, adaptation plans can explicitly include projects that not only lower the threat for these populations but also may provide co-benefits that improve the quality of their lives. One method to evaluate these co-benefits or any additional costs to these populations in the analysis of adaptation options is to monetize them. Monetization will convert these generally non-market impacts into monetary units and allow them to be compared with each other as well as other market impacts in benefit-cost analyses. The monetized values can also be weighted by the utility of these benefits and costs to the different socio-economic groups in a population. Using illustrative case studies in two areas of Boston USA with different socio-economic conditions but similar population sizes and flood threats, this evaluation approach is tested when using nature-based solutions (NBS) to lower flood threats. The non-market benefits and costs included are improved air quality, availability of public transportation, recreational space, rent escalation due to gentrification, and prevented loss of wages due to reduction in mental stress. Utility is an inverse function of annual income. The case studies illustrate that by quantifying the non-market impacts the value of including adaptation actions that promote climate justice co-benefits can be shown.

DAY 2 | THURSDAY, APRIL 27 | 1:00 PM TO 2:30 PM

ABSTRACTS: BREAKOUT SESSION 1

Sustainable Waterfront Access and Flood Resilience

A New Resilient and Sustainable Waterfront in One of Boston's Oldest Neighborhood

JOHN FREY | Senior Project Landscape Architect, Weston & Sampson
ROBIN SEIDEL | Team Leader, Weston & Sampson

The East Boston Waterfront is rapidly transforming. An increasing population and housing shortage are spurring development along one of City's oldest neighborhoods. It's also one of the most vulnerable coastal communities regarding near and long-term sea level rise projections. In particular, the areas around Carlton Wharf and Lewis Mall were identified as near-term flood pathways through the City of Boston's Climate Ready Boston initiative in 2017. Working with the City, we developed design options that advanced coastal protection along parts of the East Boston waterfront while at the same time ensuring waterfront access and enhancing coastal habitat. The project utilized a collection of public and private spaces to create a continuous, resilient waterfront. The sites, while close in proximity, presented different challenges and served as examples of the varying urban, coastal conditions throughout the City of Boston. We prioritized adaptation strategies that allowed for flexibility, designed to accommodate temporary flooding and incorporated transitional landscapes and vegetation while maintaining various maritime programming. The practicable designs advanced through this project provide a basis to be continued through design, permitting, and construction. Our team's efforts were critical to ensuring the East Boston waterfront will continue to serve as an inviting and accessible part of the neighborhood and also provide a buffer to the long-term effects of climate change.

Designing a Critical Piece of Boston's Flood Protection Barrier with the Dorchester Bay City Project

MARK COSTA | Senior Water Resources Engineer, Vanasse Hangen Brustlin (VHB)
CANAN SAFAR | Senior VP of Development, CV Properties

The proposed 6.1 million square foot Dorchester Bay City development (the Project) in Boston will incorporate nature-based solutions to mitigate the effects of climate change and enhance resiliency for both the Project and the surrounding neighborhood. The Project will include a flood protection system consisting of a vegetated raised ridge and a raised plateau to prevent flooding through the project site. The project will provide a key link in the Columbia Point barrier system intended to protect the neighborhoods of South Boston, Dorchester, and the South End from coastal flooding and sea level rise. The flood protection system (when coupled with other flood protection measures on the other parts of the neighborhood by others) will nearly eliminate flooding for this area from the 100-year coastal storm event predicted by 2070. The project balances enhancing the resilience of the shoreline and providing flood protection while maintaining the area of Dorchester Shores Reservation as a public recreation space.

Nature-Based Solutions to Address Historic Persistent Flooding at Gibson Park and the Riverside Neighborhood

JOHN MCALLISTER | Principal, McAllister Marine Engineering
RICHARD BALDWIN | Senior Scientist, McAllister Marine Engineering
ELLE BAKER | Open Space and Environmental Planner, City of Revere

Gibson Park and the Riverside Neighborhood in Revere, MA has long been subject to flooding issues, both from stormwater events (e.g., flooding due to precipitation) and from storm surge (e.g., increases in the elevation of the adjacent Pine River which flood the areas) affecting the area. Flooding is mostly associated with river water overtopping the sea wall, dune erosion, redistribution of sand and seawall deterioration. These periodic flooding events are predominantly observed within the study area at the Boatworks property and south along Mill Avenue. The flooding results in flood conditions that prohibit access and movement for the residents and access to their houses. These problems are anticipated to only worsen with rising sea levels and more frequent, more intense storm events; thus, the City has been working to lay out, plan and prepare designs for a redeveloped, more resilient public park facility, consistent with the City's River Front Master Plan using nature-based solutions. Specifically, the project produced four goals for the project: 1) Creating Resiliency – Providing resiliency to the Neighborhood and the Park itself. 2) Serving the Community – Allowing for activities for all users of the community. 3) Addressing Historic High Tide Flooding –Provide a solution for the historic high tide flooding that occurs in the northern end of the Riverside neighborhood. 4) Remediating impacted soils remnant from industrial activities at the former North Shore Boatworks property The Gibson Park project goals are to provide a more resilient, natural interface of the land and the river, provide offline subsurface stormwater storage and to create decentralized stormwater management facilities, to help alleviate flooding in the area while maintaining this parcel for optimal recreational use.

Societal Co-Benefits of Naure-Based Approaches

From Analysis to Action: Strategies for Promoting Climate Justice when Implementing Nature-Based Solutions to Coastal Risk

MARCOS LUNA | Professor, Salem State University
REBECCA SALLEY | Research Assistant, Salem State University
JAMES NEUMANN | Principal, Industrial Economics, Incorporated
MAURA FLIGHT | Principal, Industrial Economics, Incorporated
CHAS FANT | Associate, Industrial Economics, Incorporated

The purpose of this presentation is to summarize and reflect on the state-of-the-practice in methods for estimating the distribution of benefits or co-benefits of Nature Based Solutions to enhance coastal resilience. The emphasis of our project is on evaluating the social equity implications of these approaches and practices for marginalized and socially vulnerable populations. In addition to summarizing scholarly and gray literature, we draw on interviews with community-based organizations representing socially vulnerable populations in communities adjacent to NBS projects that address coastal flood risk. We aim to bring their experiences with such projects forward, and to highlight their concerns and hopes for how NBS projects may, or may not, contribute to efforts to advance social equity in their communities and climate justice more broadly. The ultimate goal of this project is to generate recommendations for key policy and regulatory measures to better ensure that the benefits and co-benefits of nature-based systems can accrue to socially vulnerable populations in close proximity to planned or installed nature-based resilience investments.

Recreational Co-Benefits Associated with Shoreline Protection Design

ROBERT GRIFFIN | Research Assistant Professor, University of Massachusetts Dartmouth

Little is currently known about how recreational activity varies with the design and form of shoreline hazard adaptation projects. Preliminary evidence suggests there is variation in visitation across existing projects, though this does not account for other factors that may simultaneously be driving visitation. Given the importance of recreation to the well-being and economies of coastlines, and the projected scale of change over the coming decades to adapt to flood and erosion hazards, a more systematic understanding of these relationships would be useful for decision making. Disaggregating this relationship across user groups would also be useful for understanding societal objectives like equity of access and distributional impacts of policy decisions. This project characterizes the opportunities and challenges associated with using geographic metadata from social media and mobile phones for disaggregating visitation and visitor preferences associated with the design of shoreline flood and erosion hazard adaptation strategies.

Human Well-Being, Equity, and Nature-Based Solutions: Assessing Opportunities for Engineering with Nature® for Project Planning and Implementation

ELLIS KALAIDJIAN | Research Fellow, Oak Ridge Institute for Science and Education
MARGARET KURTH | Research Engineer, US Army Corps of Engineers
STEPHANIE GALAITSI | Research Environmental Engineer, ERDC (EL)
ELISSA YEATES | Research Hydraulic Engineer, ERDC (CHL)

There is consensus within various academic circles that active and passive exposure to nature enhances human well-being. Considering the human well-being-nature relationship, nature-based solutions (NBS) offer great promise for the US Army Corps of Engineers (USACE) to balance economic, environmental, and societal benefits in civil works projects. To date, however, no standardized approach exists to account for these well-being benefits within the USACE framework for project selection. Well-being benefits of NBS are thus often omitted from evaluations of project benefits, leading to the implementation of project alternatives that may not maximize societal well-being or distribute benefits equitably. Further, projects might fail to include elements or consider alternatives that could deliver more diverse and holistic benefits. Comprehensive benefits accounting for prospective projects can illuminate more optimal project alternatives that may not have been selected under a narrower traditional accounting of cost-benefit analysis. To support the inclusion of human well-being benefits in project development, practitioners need tools to identify how and to whom benefits will accrue. Knowledge gaps about nature's benefits and the need for new resources served as the impetus of this research, which supports the USACE Engineering with Nature® (EWN) program. This presentation will report on the findings of a literature review and proposed geospatial approach to promote equitable distribution of NBS and well-being benefits.

What Works: Frameworks, Tools & Lessons Learned (Part II)

Establishing a Common Framework for Success: A Comparative Analysis of Nature-Based Coastal Resilience Projects to Inform Scaled Implementation

ROSE WINER-CHAN | Master of City Planning Candidate, Massachusetts Institute of Technology

What do four nature-based coastal resilience projects across New York City, Rhode Island, and the Netherlands have in common, and how can lessons learned from these projects help operationalize coastal NBS at scale? In this presentation we'll discuss the results from a comparative analysis of four sites: Hunter's Point South and West Pond, Jamaica Bay in NYC; Rose Larisa Park in Rhode Island; and the Sand Motor in The Netherlands. This analysis, primarily through cross-sector stakeholder interviews, aimed to identify common barriers and success drivers between these projects through the phases of design, construction, maintenance, and M&E and across the elements of governance, finance, and community engagement. The presentation will additionally highlight regional differences in management, regulation, and collaboration to identify adaptable lessons learned, especially between The Netherlands and the U.S. We'll also touch on common success metrics mapped across the four projects that can potentially inform or supplement existing benchmarks to help decision-makers thoughtfully evaluate what project "success" can and should mean, and to whom. Ultimately, this presentation aims to provide information that practitioners and decision-makers engaged in nature-based coastal resilience planning in any context can utilize to anticipate and surmount key challenges and to facilitate more (cost-)efficient, sustainable, and "successful" implementation.

Greening of the Grey: a Precautionary Approach to Ecosystem Service Enhancement in the Marine Built Environment

LOUISE FIRTH | Associate Professor of Marine Ecology, University of Plymouth School of Biological and Marine Sciences

Climate change and coastal urbanisation is driving the replacement of natural habitats with artificial structures and extensive reclaimed land globally. In the marine environment, these novel habitats are often poor surrogates for natural habitats, and a diversity of approaches have been trialled to promote multifunctionality through biodiversity and ecosystem services enhancement. The application of integrated greening of grey infrastructure (IGGI) to the design of artificial shorelines demonstrates how multifunctional structures can provide biodiversity benefits whilst simultaneously serving its primary engineering function. This approach requires an understanding of the types of assemblages and their functional roles that are desirable and feasible in these novel ecosystems. I summarise research carried out by myself and the wider team on IGGI and I outline guidelines and recommendations to provide multiple ecosystem services while maintaining engineering efficacy. Care is required, however, in the wholesale implementation of these recommendations without full consideration of the motives for using IGGI, the desired effects and overall management goals.

Efforts at Implementing NBS in the Caribbean: A Retrospective View

LEONARD NURSE | Retired Professor, University of the West Indies Cave Hill, Barbados

The concept of ecosystem-based management is not new to the Caribbean. Although the focus has primarily been on coastal and marine ecosystems, practitioners have been attempting to implement various restoration measures guided by this thinking for more than two decades. It represents a change in the approach to management of coastal and marine resources that was previously shaped almost exclusively by coastal engineering practice. However, although the use of civil structures is still widely adopted, the growing tendency to integrate grey approaches with functional nature-based solutions is a welcome development. As this apparent paradigm shift gathers momentum, and in the interest of 'good' science, coastal managers in the Caribbean now have an opportunity to revisit elements of their practice that might benefit from an objective review of projects already implemented in different settings. The learning from such retrospective assessments may enhance the economic, scientific and technical value of future projects, as the need to optimize the scarce resources available to the region still remains.

ABSTRACTS: BREAKOUT SESSION 2

Resilient Coastal Design, Partnerships & Community Engagement (Part II)

Equity-Centered Climate Resilience in Boston Harbor's Lower Mystic Watershed

JULIE WORMSER | Senior Policy Advisor, Mystic River Watershed Association
MELANIE GÁRATE | Director of Climate Engagement, Stone Living Lab

The Lower Mystic Watershed portion of Boston Harbor hosts New England's highest concentration of critical transportation, energy, food, and water infrastructure. Living close by and significantly affected by this infrastructure are some of the region's most diverse environmental justice communities. Concerned about their inability to manage climate challenges at a regional scale, 20 neighboring cities and towns voluntarily formed the Resilient Mystic Collaborative (RMC) in 2018. In October 2020, the RMC's Lower Mystic Working Group partnered with emergency management experts and infrastructure managers to hold a regional functional exercise that simulated a major slow-moving winter Nor'easter hitting Boston Harbor. Using the results from this exercise plus academic research, we subcontracted with community-based organizations in each municipality to engage members of priority populations in surveys and focus groups. This dual assessment allowed us to complete an equity-centered regional vulnerability assessment that provided critical insights that would not have emerged from only one or the other exercises. We are now using the results of these vulnerability assessments to design, fund, and construct priority climate investments that will make the most difference to those residents and workers most harmed by the failure of regional critical infrastructure. We hope that this type of integrated analysis that respects the complexity and interconnectedness between people and critical infrastructure becomes more commonplace. We cannot claim to be a resilient region if only the wealthiest among us have what they need to thrive.

Creating Public Access and Opportunity in the Face of Rising Seas

NICK BLACK | Managing Director, Boston Waterfront Initiative The Trustees of Reservations
The Trustees of Reservations (The Trustees) has official site developer designation from Massachusetts Port Authority (Massport) to transform the pier adjacent to Piers Park and the future Piers Park II into a signature waterfront destination, Piers Park III. The proposed waterfront park will create welcoming public open space, model a natural buffer to storm surge and sea level rise, and restore what is currently an unused, abandoned pier. Today, the Piers Park III parcel sits on an abandoned pier adjacent to Piers Park and Piers Park II—a site currently in the design phase with Massport and the Piers PAC. Piers Park, 6.5 acres of green space, opened to the public in 1995. The Trustees will draw on more than a century of expertise in public open space management to deliver an iconic new park, free and open to all, working closely with the community. Currently in its third iteration, the design for Piers Park III offers more ways to interact with and access the water, following public feedback. It also aims to increase accessibility and visibility of the harbor while improving habitat and water quality in and around the site. The existing spit of land and pier act as primary circulation routes, with several smaller paths winding through a series of immersive landscapes, including plantings of salt-tolerant trees, shrubs, and grasses, framing the walkways and providing shade and shelter. The new kayak launch design allows for an inclusive and accessible kayaking experience for all, while the existing rail lines incorporated into the new plan draws visitors out to the end of the pier from the neighboring Phase II.

Multiple Objective Adaptation Planning Under Deep Uncertainty Considering Plurality of Stakeholder Values in East Boston

SHAILEE DESAI | PhD Candidate, University of Massachusetts Boston

PAUL KIRSHEN | Professor, University of Massachusetts Boston & Research Director, Stone Living Lab

ELLEN DOUGLAS | Professor, University of Massachusetts Boston

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The Border Street/Central Square area of East Boston needs effective plans for adapting to present and future uncertain tidal and storm surge flooding. There are many stakeholders in the area including residents, infrastructure providers, the City, businesses, and developers. As an alternative to attempting to develop a "singular articulation" of a public interest, we develop separate plans for each of the stakeholders as a starting point in the planning process. To address the uncertainties of the future climate, for each plan we use the Dynamic Adaptive Policy Pathways (DAPP) approach with explicit consideration of the economic, environmental, and social multiple objectives of each stakeholder. We are seeking plans that are robust to climate change uncertainties as well as different stakeholder viewpoints and values.

Managing and Responding to Extreme Weather Events

Rising Seas and Rising to the Opportunity: The Future of the UMass Amherst Gloucester Marine Station

KATIE KAHL | Extension Assistant Professor, University of Massachusetts Amherst Gloucester marine Station

SARAH MORRISON | Climate Adaptation Business Line Manager, Fuss & O'Neill

ALEX MAXWELL | Resilience Planner, Fuss & O'Neill

KIRK BOSMA | Senior Coastal Engineer and Vice President of Innovation, Woods Hole Group

The UMass Amherst Gloucester Marine Station (GMS) is embarking on an exciting visioning process that both addresses immediate infrastructure needs and shapes longer-term research and experiential learning opportunities for students. UMass has made strategic investments in new faculty hires, planning, and infrastructure improvements aimed at bolstering capacity and ensuring the long-term resilience of the station as a hub for hands-on, immersive marine and coastal research, learning, and engagement. During the next phase of investment at GMS, the University is focusing on addressing issues related to deferred maintenance and more immediate research and teaching needs, while also addressing the impending challenges presented by rising sea levels and changing climatic conditions through the application of natural and nature-based solutions. Adapting the GMS property to future climate impacts will necessitate a reconsideration of fundamental functions. This allows for a reimagining of the facility, and the programs possible, over time. Public perceptions and the financial support and other resources required to maintain the mission of the Station are all primary considerations in this process. This presentation will showcase how the GMS is creating a true living lab, demonstrating innovative coastal climate adaptations by building in resiliency approaches that work with natural systems. Phase I of this work, currently progressing through design and permitting, will be discussed in the context of the longer-term, phased vision. The GMS plans to capitalize on site improvements made over time by exploring ways to integrate teaching, research, and engagement opportunities into key capital improvements such as the current incorporation of habitat panels into needed seawall repairs – transforming them into living seawalls. Using this approach, the future vision as well as current actions, will be shaped by measures for successful adaptation through three lenses: (1) learning and education, (2) marine and coastal research, and (3) engagement with coastal communities.

Exploring Nature-Based Approaches to Reducing Risk from Petrochemical Releases due to Flooding in the Galveston Bay Area

SHANNON CUNNIFF | Scientific Advisory Committee, Stone Living Lab

Two years ago a team composed of experts from Environmental Defense Fund, Texas A&M, and Galveston Bay Foundation embarked on a three-year exploration of whether and where the addition of nature-based solutions could reduce the likelihood and impact of petrochemical releases due to flooding in the Galveston Bay area, and Gulf of Mexico. Floods have already triggered release of petrochemicals into Galveston Bay and the Gulf and due to climate change and subsidence Galveston Bay's petrochemical corridors pose increasing hazards to human populations and the environment. The concentration of economically important facilities adjacent to socially vulnerable populations in low-lying, flood prone areas necessitates innovative and effective climate change adaptation measures. The study team first investigated flood (considering fluvial, pluvial, storm surge and sea level rise sources) and chemical hazards (types of chemicals, facility records, etc.) and assessed the interplay of factors affecting damages and community vulnerability. The team has begun exploring nature-based solutions (NBS) as a means of building greater resilience to the inherently dynamic aspects of flooding and provide multifunctional solutions for communities. As part of this effort, an interactive tool has been created to help identify appropriate NBS, or combinations of NBS, and is being tested. This tool aims to guide communities or petrochemical facility managers through a process that encourages systems thinking and accounts for local circumstances by prompting (a) identification and characterization of area risks; (b) identification of community needs that could be addressed by NBS; and (c) consideration of ecosystem needs. The tool directs users to data sources. It also provides methods for organizing information and selecting the best option(s). Finally it presents other information relevant to pursuing a project. By considering physical, social, economic, and ecological conditions the user will be better able to ascertain whether and which types of NBS may be appropriate for reducing risk of exposure to petrochemical releases due to extreme precipitation and flood events. This tool is built off recent and existing NBS resources and is designed to be more accessible to users with limited experience in this area but with access to data and subject matter experts. This presentation will summarize analytical findings of the team, review the tool, and provide initial insights developed by the project team.

Strategies and Conceptual Designs for Adaptation and Coastal Stormwater Discharge in Boston

CHARLIE JEWELL | Director of Planning and Sustainability, Boston Water and Sewer Commission
BEN AGRAWAL | Principal Engineer, Hazen and Sawyer
CHARLES WILSON | Associate Vice President, Hazen and Sawyer
JOHN SULLIVAN | Chief Engineer, Boston Water and Sewer Commission

In the City of Boston (the City), storm sewer systems typically collect rainfall runoff and discharge by gravity into a receiving waterbody (e.g., Boston Harbor, Fort Point Channel, Neponset River, etc.). If the sea level ("tailwater") is sufficiently high, discharge by gravity is limited or no longer possible, which can lead to surcharging and interior flooding during intense rain events. As such, storm sewers require tailwater conditions below a particular threshold to function as designed, and Sea Level Rise (SLR) is slowly increasing these tailwater elevations. During extreme storm events (i.e., "named" storms such as hurricanes or nor'easters), the combined effect of SLR and storm surge could restrict or prevent stormwater discharge in many locations, leading to widespread flooding throughout the City. This can occur even if the shoreline is protected from the direct impact of storm surge by measures such as shoreline elevation or barriers. Considering this, the Boston Water and Sewer Commission (Commission) undertook the Coastal Stormwater Discharge Analysis to achieve the following goals: 1. Identify Commission-owned outfalls that are vulnerable to higher sea levels, and which may not function (i.e., discharge stormwater) as intended due to future SLR and storm surge (herein referred to as coastal flood vulnerable outfalls). 2. Develop conceptual designs at an initial set of locations to adapt the Commission-owned outfalls with the greatest coastal flood vulnerability. 3. Create a planning framework that could be used to continue to adapt the remainder of the Commission's coastal flood vulnerable outfalls.

Communications & Community Climate Action: Looking Toward the Future

The 51 Percent Project: How to Talk About Climate Change so People will Listen

SARAH FINNIE ROBINSON | Senior Fellow, Boston University Institute for Global Sustainability

As the conversation becomes more urgent in society, academics and scientists focused on climate science and solutions are struggling to get their messages across to critical audiences. The 51 Percent Project identifies standout principles for communicating on climate change from established behavior science, bridging the gap from this literature, which is often difficult for non-academic readers to grasp. This is an invaluable resource to accelerate climate solutions; and largely unknown to mainstream media, policy-makers, financial leaders, and other influential stakeholders. Conference participants will be inspired by practical new ideas for their work. The Project was founded by Sarah Finnie Robinson in 2018 at Boston University's Institute for Global Sustainability, where she is a Senior Fellow. Finnie Robinson presents twelve principles: 1) Talk About It 2) Use Trusted Messengers 3) Keep it Simple 4) Lighten Up! 5) Respect the Science 6) Share Reliable Resources 7) Land the One-Two Punch 8) Use Compelling Images 9) Take Bold Action 10) Deal with Deniers 11) Remember the Money 12) Bring it Home. In her talk, Finnie Robinson offers standout examples for the twelve principles, with success stories of messaging for impactful engagement. Attendees are encouraged to share in an open dialogue. Given the urgency of the climate crisis -- and the historic opportunities of the clean-energy transition underway -- Finnie Robinson prioritizes strategies to reach leaders in communities, organizations, neighborhoods, and businesses. She targets key influencers who are well-positioned to engage others in the ambitious changes we need in order to address this crisis properly.

Cool Science: Youth Communicating about Climate Change to Adults through their Art on Public Buses

BOB CHEN | Professor & Interim Dean, University of Massachusetts School for the Environment

Cool Science integrates science and art to promote youth learning about the science of extreme weather and climate change, the products of which are then displayed on buses and in art exhibitions to promote adult learning. Cool Science's four interrelated strategies are: 1) To create and conduct workshops that support adult mentors in facilitating youth's out-of-home learning of science through art, 2) To design and implement a youth art contest about extreme weather, 3) To display youth artwork in advertising spaces throughout participating Regional Transit Authorities (RTAs) in the New England and the Midwest, and 4) To hold a series of art exhibitions where local artists, scientists, educators, and an all-aged public gather to celebrate the youth, their artwork, and their ideas about extreme weather. Over the last nine years, the Cool Science program won awards and was honored by the White House as an exemplary project to improve climate literacy across a community. It has proven popular and effective among all target audiences. This presentation will focus on the design, implementation, and impacts of blending art and science to engage and educate the public about climate change.

Equipping Communities Through Place-Based Learning and Research

REBECCA SHOER | Education and Engagement Program Manager, Stone Living Lab
ANNIE O'CONNELL | Climate Resiliency Specialist, Woods Hole Group

Community-centered education and research is a growing focus of organizations and research entities, particularly in the field of climate change mitigation and adaptation. This kind of community-centered climate work requires a hyper-local focus and an understanding of the unique challenges and opportunities presented in a single habitat, city block, or single property. Using the principles of place-based thinking and learning, these organizations can ground their work in the unique aspects of a place to foster community-centered learning and action. This presentation will review the Principles of Place-based Learning as developed by the National Park Service: Grounded in Place, Empowering, Collaborative, Integrated, Rigorous, and Real. Participants will reflect how to bring these principles into their own work, and explore how these Principles guide Lab programming including the Summer Teacher Institute and upcoming education and research activities.