

The N-EWN Knowledge Series

A Continuing Education Series about Engineering with Nature



Advancing Dredging and Innovative Beneficial Use Practices for More Resilient Systems



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*EWN Proving Ground Lead
USACE Philadelphia District*

Dr. Lenore P. Tedesco
*Executive Director
The Wetlands Institute*

The US Army Corps of Engineers (USACE), Philadelphia District has been participating in the national Regional Sediment Management (RSM) and Engineering With Nature (EWN) Programs with considerable lessons learned developed for navigation dredging and placement activities in New Jersey, especially since Superstorm Sandy in 2012. Over the last decade, beneficial use placements involving shoreline stabilization and marsh restoration have significantly increased in the Philadelphia District's region, helping to advance practices and policies that keep dredged material in the natural sediment system while enhancing natural infrastructure in the back bays. The Seven Mile Island Innovation Lab (SMIIL) was created in 2019 by the primary partners of USACE, the NJ Department of Environmental Protection and The Wetlands Institute, with goals to advance the science, challenge thinking and promote innovation for dredging and placement practices being implemented in the Philadelphia District's coastal environment. This presentation will focus on examples of successful dredging and innovative placement projects in coastal New Jersey, as well as an overview of SMIIL and overarching lessons learned so far from the ongoing work of over 30 different practitioners and researchers working in this forum.

Save the date!

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

Mar. 21
12:30pm ET

Monica Chasten, USACE Philadelphia District & Lenore P. Tedesco, PhD, The Wetlands Institute
Advancing Dredging and Innovative Beneficial Use Practices for More Resilient Systems

Apr. 18
12:30pm ET

Grant Wiseman, Brendan Player, Martha Farella (Stantec)
CarbonWatch: Streamlining Carbon Measurement, Reporting, and Verification (MVR) in Vegetation and Soil

May 16
12:30pm ET

Molly Reif, Glenn Suir, Christina Saltus (ERDC)
Remote Sensing Capabilities to Support EWN Projects

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:



Questions? Please contact:

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ADVANCING DREDGING AND INNOVATIVE BENEFICIAL USE PRACTICES FOR MORE RESILIENT SYSTEMS

Monica Chasten
Project Manager

U.S. Army Corps of Engineers
Philadelphia District
Operations Division

AND THE TEAM!



US Army Corps
of Engineers®

U.S. ARMY



Government Dredge Merritt working near Ring Island



New Jersey Intracoastal Waterway Maintenance Dredging with Sturgeon Island Beneficial Use Placement



“A Partnership for our Planet”



- **Persist, Innovate, Challenge, Advance, Evolve**
- A Collaborative Approach: *Working Together through the Regional Sediment Management and Engineering with Nature Programs*
- Illustrated Success: *Innovative Navigation Dredging and Placement Projects in New Jersey*
- Building Momentum: *Evolving the Practice for Dredging and Natural Infrastructure to Improve Resilient Systems*



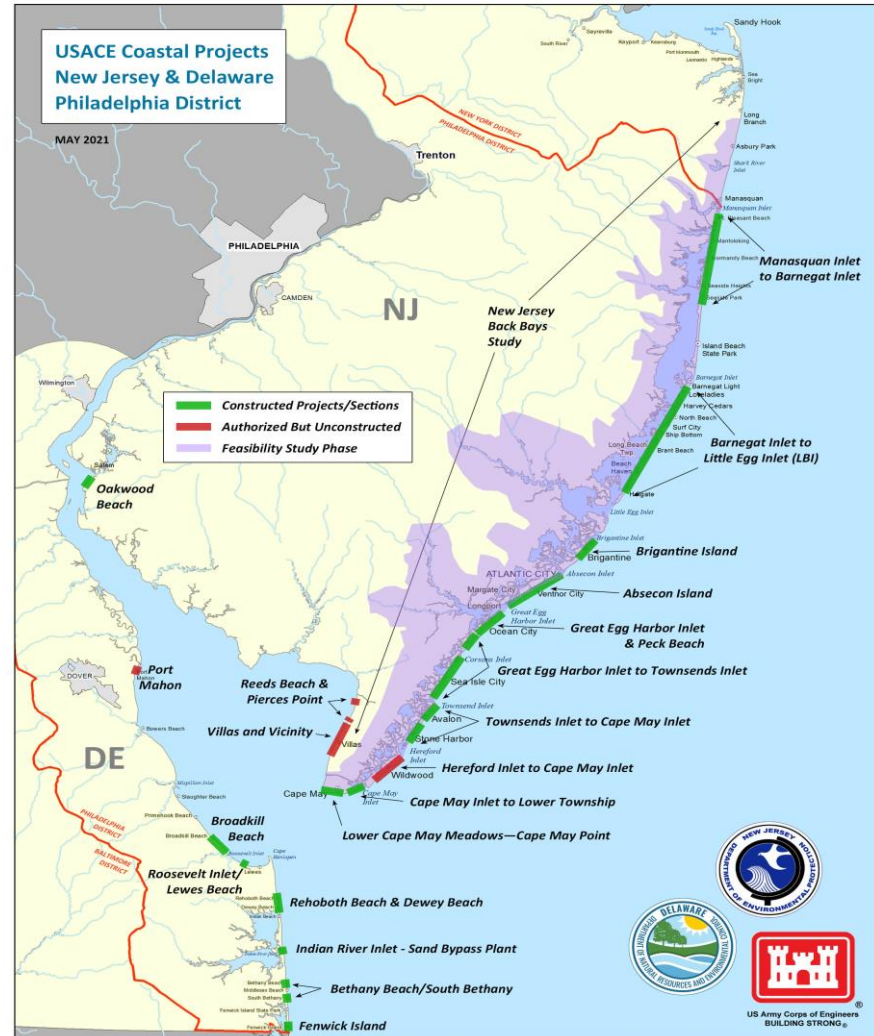
Organizational Perspective

U.S. Army Corps Of Engineers

Philadelphia District



- **Navigation Mission:** maintain federal channels in the Philadelphia District, largest is Delaware River
- **Flood/Coastal Storm Risk Management:** robust beach nourishment program in NJ & DE and 5 Reservoirs in PA
- **Ecosystem Restoration**
- **Regulatory Mission**





Regional Sediment Management (RSM)



A systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable, resilient water resource projects, environments, and communities
= *Healthy Systems*

Navigation/ Dredging



Flood Risk Management



Environmental Restoration



RSM Operating Principles

- Recognize sediment as a regional resource; SEDIMENT AS AN ASSET
- Balanced, economically viable, environmentally sustainable solutions
- Improve economic performance by linking multiple projects
- Optimize operational efficiencies & natural exchange of sediments
- Consider local & regional impacts (physical, environmental, social)

Partnership with USACE's Engineering Research and Development Center (ERDC)

ENGINEERING WITH NATURE

USACE Proving Grounds

Proving Grounds identify opportunities to implement EWN across current and future programs and projects and with other agencies

- Galveston District
- Buffalo District
- **Philadelphia District (2016)**
- Mobile District
- San Francisco District
- St. Louis District
- South Pacific Division



...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration



USACE Navigation Mission



- Nationally, USACE dredges 200 to 300 Million cubic yards annually. Over 5 Billion cubic yards over the last 25 years
- Philly District maintains federal channels, including the Delaware River & Bay, coastal channels through 4 tidal inlets and **the 117-mile New Jersey Intracoastal Waterway**
- In order to dredge, USACE needs:
 - Authorization (law)
 - Appropriation (\$\$)
 - Placement Area (State)
 - Federal Standard
- Navigation O&M is fast time scale!
- Regional Sediment Management and Engineering with Nature Programs important to success

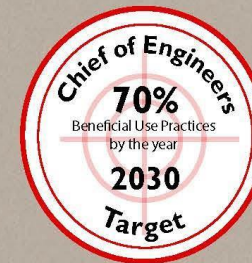


Beneficial Use of Dredged Material in USACE



U.S. Army Corps of Engineers

Beneficial Use of Dredged Material Program Vision



Dredge Material is a valuable resource

- Increased dredging investments create beneficial use of dredge material management opportunities
- Benefits the ecosystem, economy, and can effectively and efficiently deliver the USACE mission.



There are opportunities to expand beneficial use within the Federal Standard

- Operational strategy should inherently include beneficial use placement options.
- If material is needed to implement a project, beneficial use from dredging operations should be considered as an option in the planning and execution strategy.



Partner collaboration is key to our success

- Innovative pursuit, both internally and externally, with partners and stakeholders will:
 - Maximize available solutions, strategies, and tools
 - Develop and apply new approaches and technologies

National Policy for Beneficial Use of Dredged Material

Congressionally established by section 125 of WRDA 2020 in doing so, Congress has underscored the importance of the Beneficial Use of Dredged Material Program

Dredged material is valued as a resource not to be wasted but used for benefits to the ecosystem, economy, and project delivery



Address key obstacles to execution

Over the next 3-5 years, the Corps will expand the beneficial use of dredged material program. Achieving this vision will require all of us to be innovative and work alongside our partners, both internally and externally, to ensure we are finding the best use of sediments derived from our Navigation mission.

Identify, develop, and share beneficial use practices

Collaborate on innovative financing

Identify Key Contributors

Unify Enterprise Purpose

Foster Strong Partnerships

Deliver the Mission



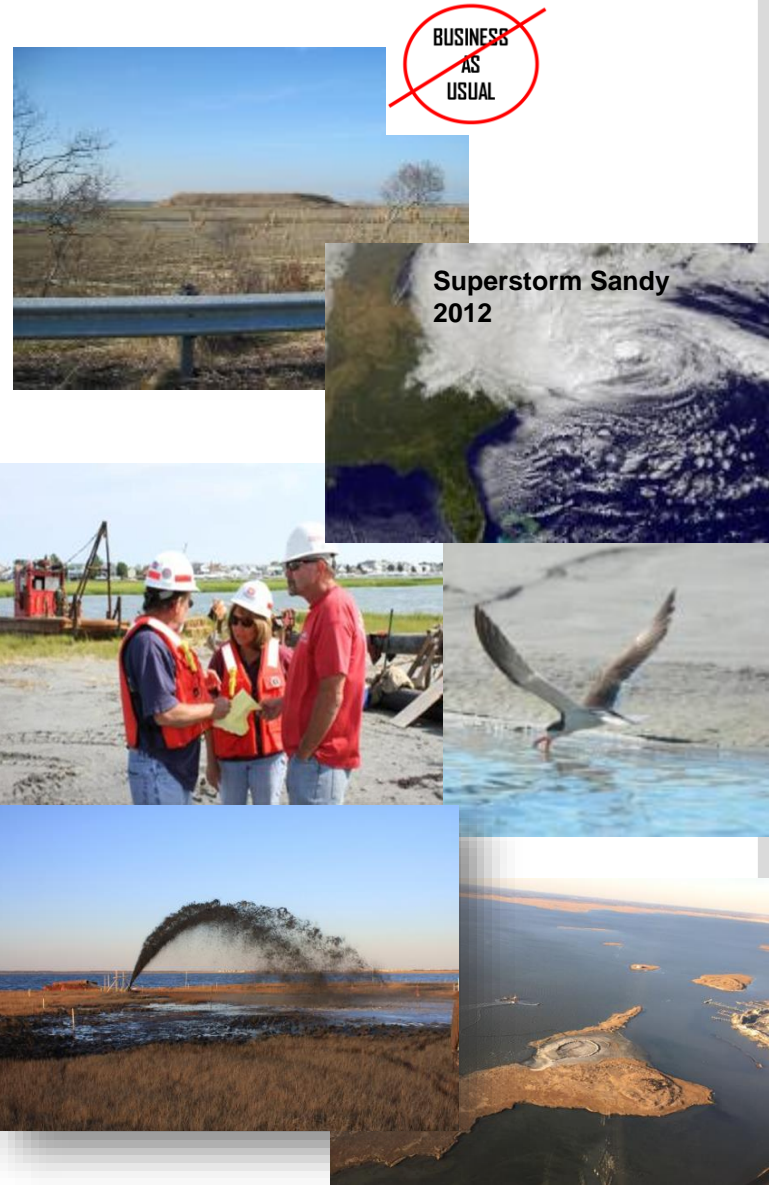
A “Persistent” Approach Navigation and Nature

- *“Sediment is the currency of marsh ecosystems”* ~
Dr. Lenore Tedesco, The Wetlands Institute

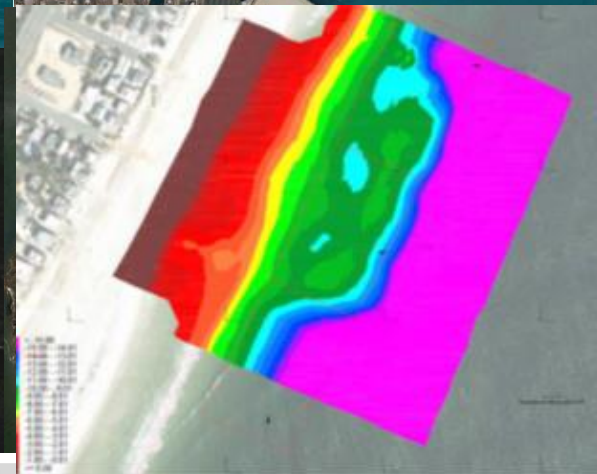
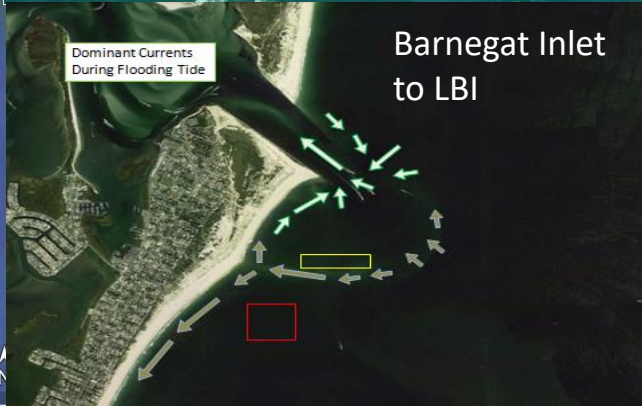
- USACE is perhaps the largest national “sediment broker” due to navigation mission and dredging

Challenge to Change

- How can we improve our stewardship of that clean sediment “currency” and improve system resilience?
- ***Need to challenge our thinking and continue to evolve benefits in a progression from caution and risk-aversion to being cost-effective, proactive and innovative***
- Planning, Design, Permitting, Construction, Monitoring, Adaptive Management
- ***RSM and EWN Programs have and continue to support evolving principles and practices for sediment management and NNBF***

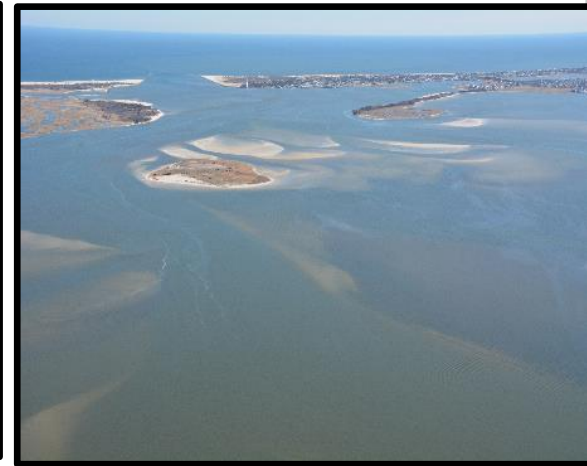
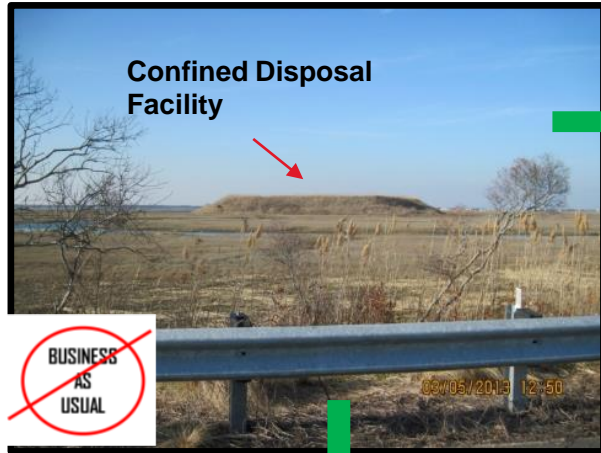


Navigation Channels With Nearshore Nourishment





A Sediment Progression: From Confinement To Natural Infrastructure





Pilots After Hurricane Sandy: EWN in NJ Back Bays



**Mordecai Island Restoration
Beach Haven NJ
(2015 and 2017)**



**“Thin” Layer Placement
(Sediment Enrichment)
Avalon NJ
(2014 and 2016)**



**Elevated Habitat
& TLP
Ring Island NJ
(2014 and 2018)**



Now Back to CDFs??



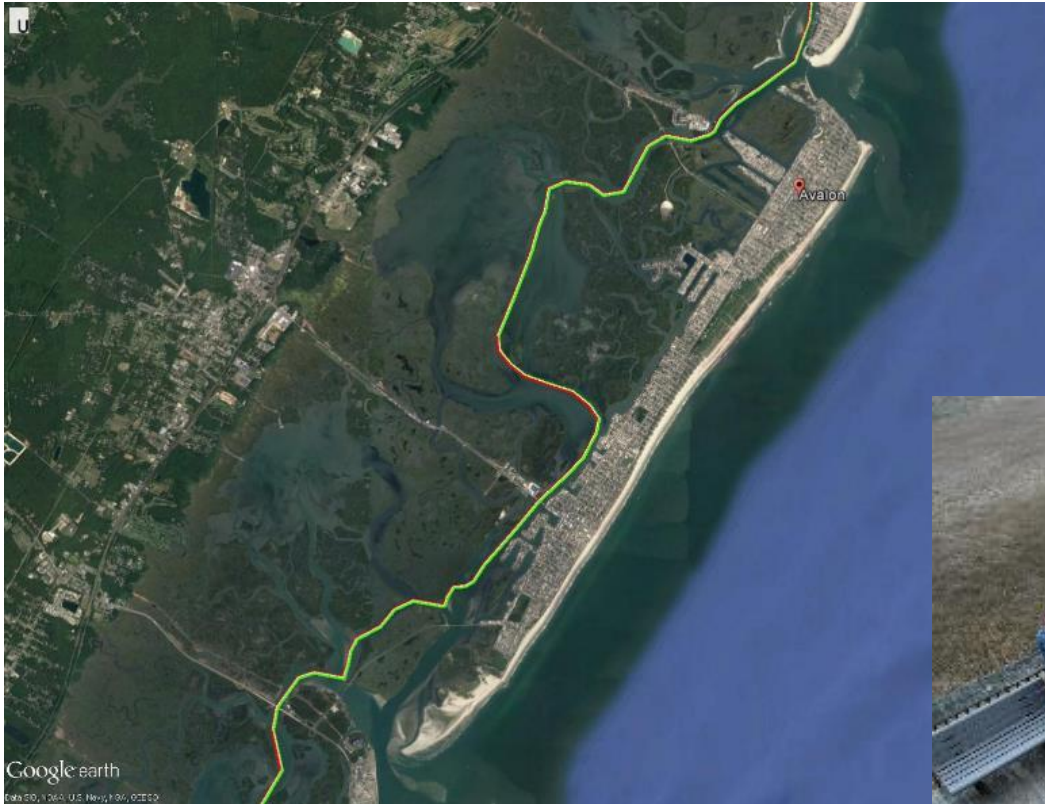
BUILDING MOMENTUM: EVOLVING FROM PILOTS TO SOLUTIONS THROUGH THE SEVEN MILE ISLAND INNOVATION LAB





Seven Mile Island Innovation Laboratory

Established 2019



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Inspired by the Dutch



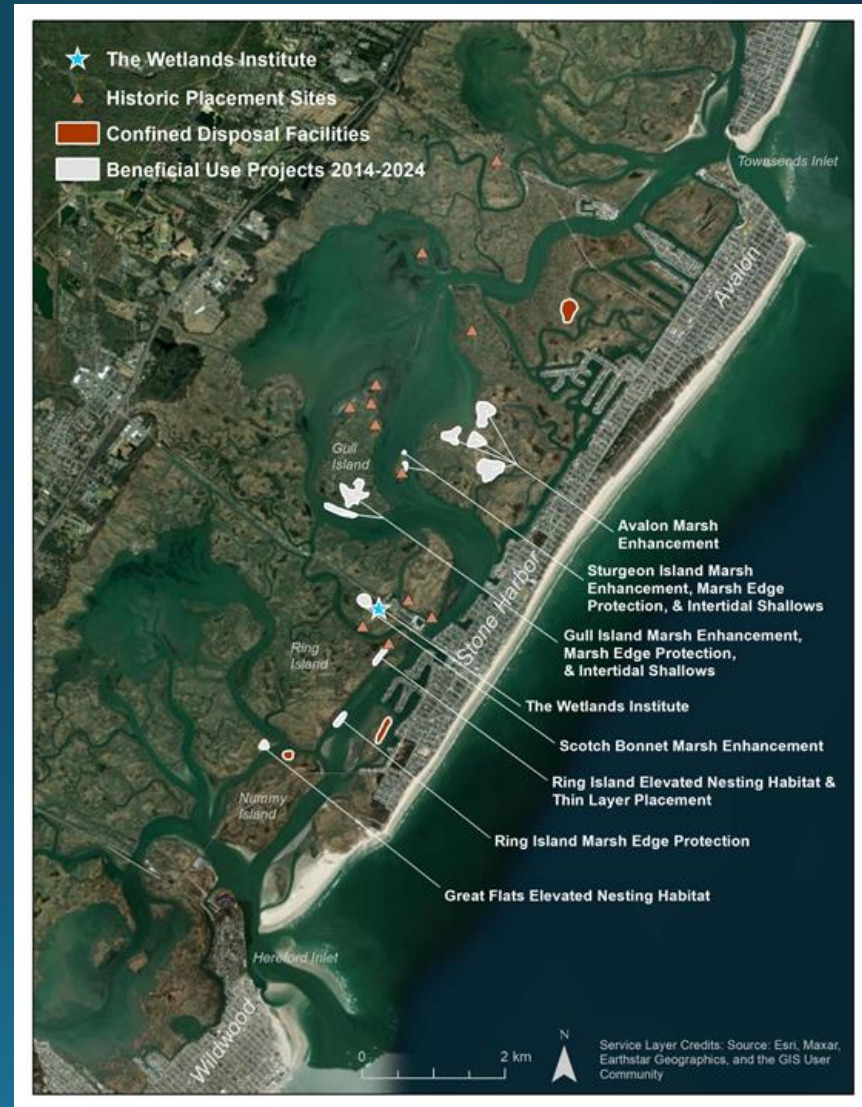
Fine sediment: from waste to resource

Throughout the world, different coasts, shores, lakes and rivers have to deal with excess sediment or sediment shortages. The natural balance between the removal and deposition of sediment is disrupted by human interventions such as dams in a river or ports in an estuary. As a result, sediment doesn't reach places where it is needed and too much accumulates in other locations. Ecosystems are affected and life becomes difficult for plants and animals. People are also pressured, for example in terms of food supplies, ports and leisure activities.

<https://www.ecoshape.org/en/projects/living-lab-mud>

Seven Mile Island Innovation Lab Background

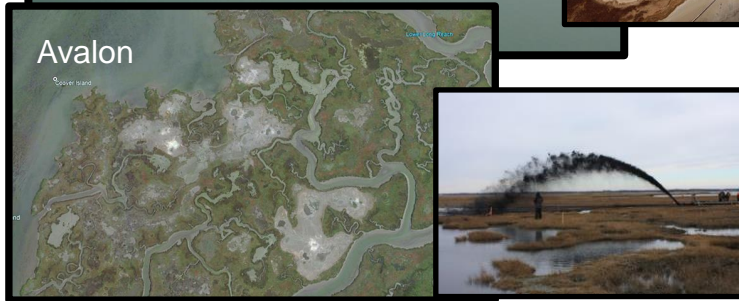
- Established in 2019 as partnership between **USACE, NJDEP and TWI**
- **A Proving Ground** using Natural and Nature-Based Features to provide ecological uplift and enhanced resilience for ecosystems and coastal communities
- **Test Bed** to advance and improve dredging techniques and marsh restoration and coastal feature creation techniques in coastal NJ
- 24 sq mi **Back Bay Marsh Dominated System** with shallow bays, sounds and tidal inlets bisected by the NJ Intracoastal Waterway
- 50+ Member **Working Group** for knowledge sharing
- More than **30 Scientists Working** in SMILL
- Publications, presentations, fact sheets **shared** on TWI and USACE Websites



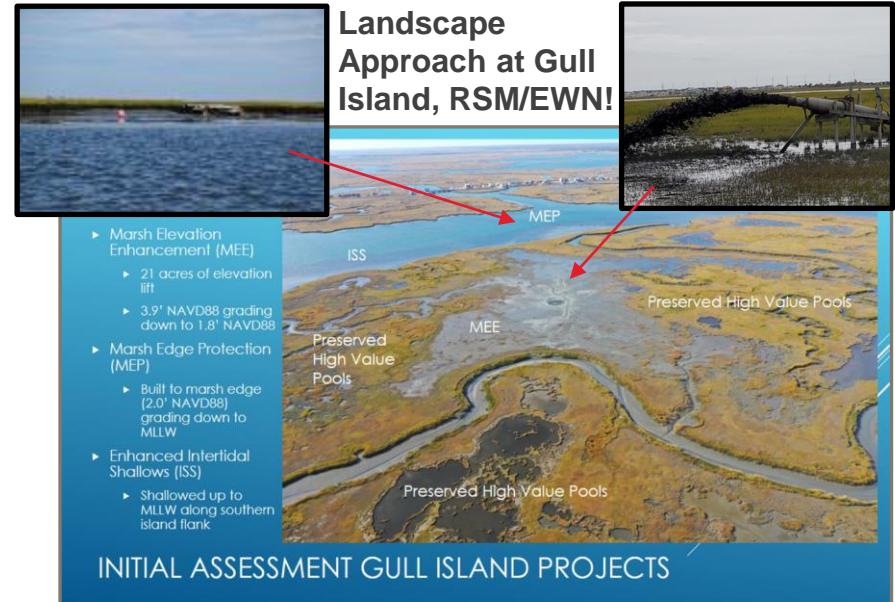
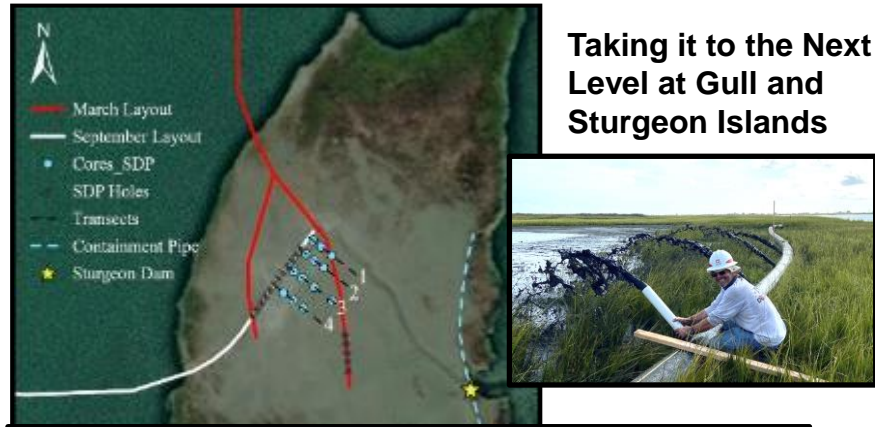
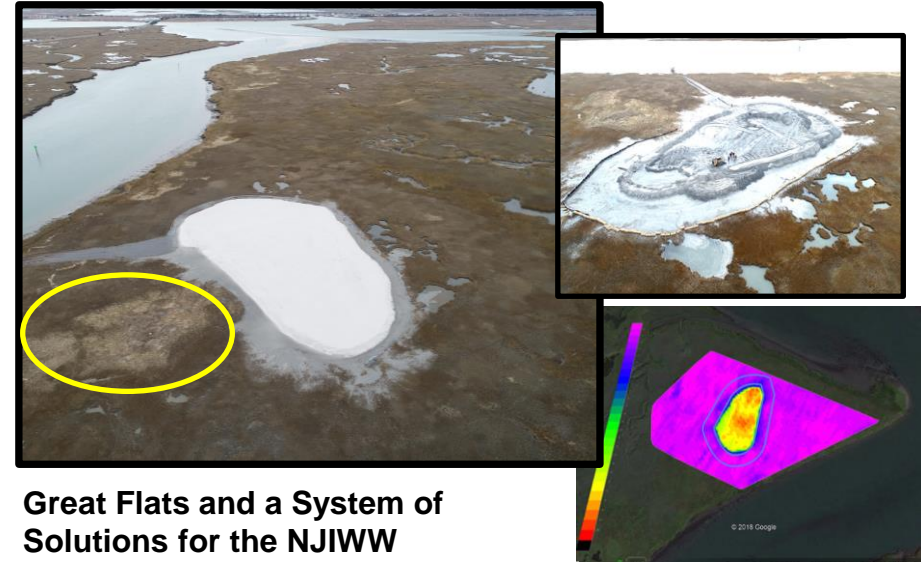


Advancing Dredging & Placement Techniques in SMILL

Learning from the Past, Innovating Now and Evolving to the Future

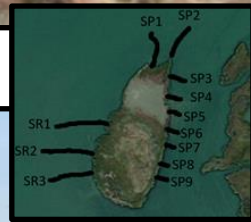


The Original Pilots & Beyond





Importance of Monitoring & Research in SMIL USACE, State of NJ, TWI, UPENN, BC and Others





Monitoring & Research in the Seven Mile Island Innovation Lab



Marsh Vegetation Surveys	ERDC: Piercy/Russ
Hydrodynamic and Suspended Sediment within the SMIIIL	ERDC: ERDC/CHL TR-21-9, Fall, Perkey, Tyler and Welp
Gull-Sturgeon Turbidity	ERDC: Fall, et al., 2022, WEDA Journal of Dredging, Volume 20, No. 1
Sediment Distribution Pipe: Sturgeon-Gull	ERDC: Beardsley, et al., WEDA Journal of Dredging, Volume 20, No. 1
Sturgeon/Gull Sediments/Consolidation	ERDC: Tyler/Harris
GCM Observations & Model Development	ERDC: Perkey/Fall
Sediment/Vegetation Interactions	ERDC: J. Smith/Ramirez
Vessel Wake Impacts on Marshes	ERDC: Priestas/Styles/Bain
Macroalgae/Benthic Surveys	ERDC: Altman/Balazik/Reine
Water Quality and Hydrodynamic Modeling	ERDC: Kim/Ding
Remote Sensing & EWN Landscape Architecture Applications	Univ of Pennsylvania: Burkholder & Van Der Sys
Monitoring and Adaptive Management of Elevated Nesting Habitats	The Wetlands Institute, NJ Fish & Wildlife
Monitoring and Adaptive Management of Gull and Sturgeon Islands	The Wetlands Institute, NJ Fish and Wildlife
Community Engagement Using Mental Modeling	ERDC: Thorne, et al., ERDC TR-22-12
Bathy/Topo/Currents/Sediments/Remote Sensing	USACE Philadelphia
Varied University Research	Univ of Penn, Boston College, Texas State, Louisiana State, Stevens, Univ of Washington, Stockton (Work Group)



SMIIL Overview References



- American Shore and Beach Preservation Association National Conference, 2022, Long Beach, Presentation, “Advancing Navigation Dredging and Innovative Placements to Support Coastal System Resilience in USACE's Philadelphia District”
 - Chasten, M., Tedesco, L. and Kopkash, G. (2022). “Advancing Sediment Solutions in the Seven Mile Island Innovation Laboratory,” Proceedings, 37th International Conference on Coastal Engineering, December 2022, Sydney, Australia, *in press*
 - Chasten, M., Tedesco, L. and Kopkash, G. (2023). “Seven Mile Island Innovation Laboratory: Advancing Beneficial Use Practices to Support Coastal System Resilience,” Proceedings, Coastal Sediments 23, New Orleans, *in press*
 - Additional Info and Fact Sheets:
<https://www.nap.usace.army.mil/Missions/Civil-Works/Coastal-Dredging-Beneficial-Use/>
- <https://wetlandsinstitute.org/smiil/>



Government Dredge Merritt in SMIL: Sept 2023 Keeping Sediment in the System





NJIWW Dredging & Scotch Bonnet Placement 25,000 cy in Fall/Winter 2024



Restoring low marsh in WMA for avian and terrapin habitats, use of coir logs & Y-valve, permitted for multiple lifts over time, complements larger NJDEP/TWI grant project



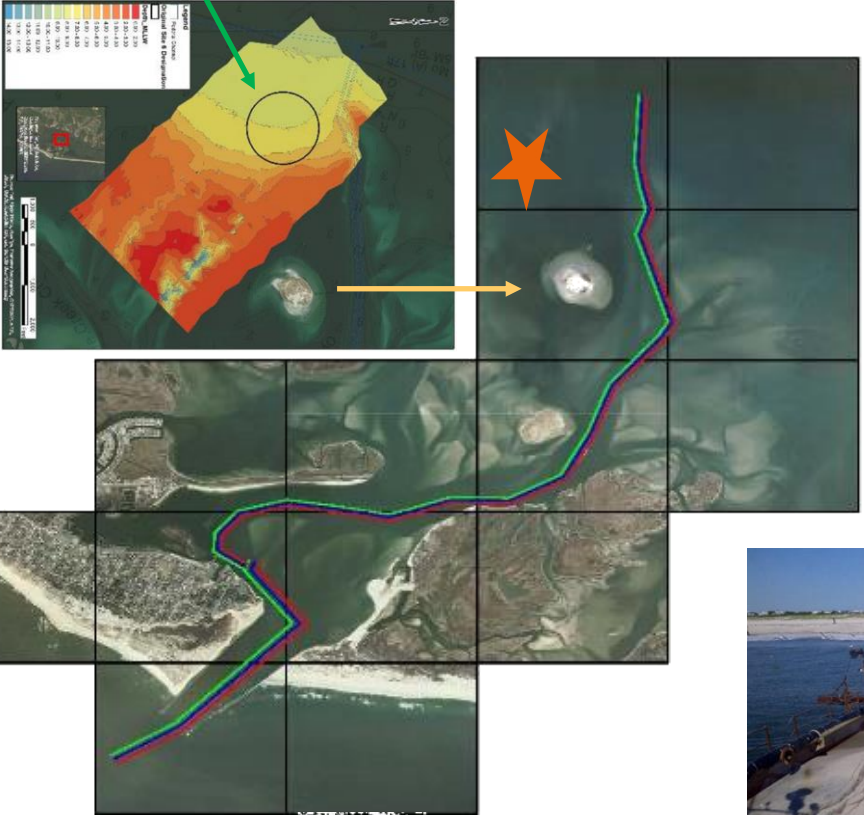
SCALING UP & OVER



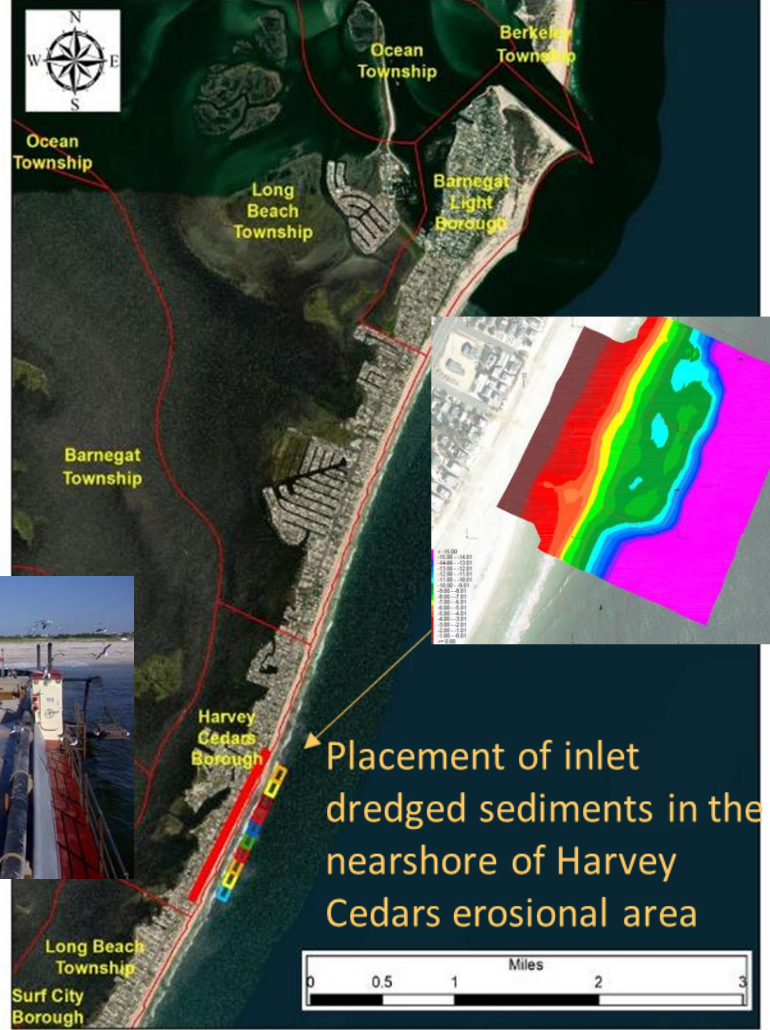
Beneficial Use Placement Opportunities in NJ Using Navigation Channel Sediments: Barnegat Inlet



1122 “Intentional” Island Creation:
Initial Construction Dec 2020, Second Lift Dec 2022



1122 Nearshore Placement:
Constructed Aug 2021

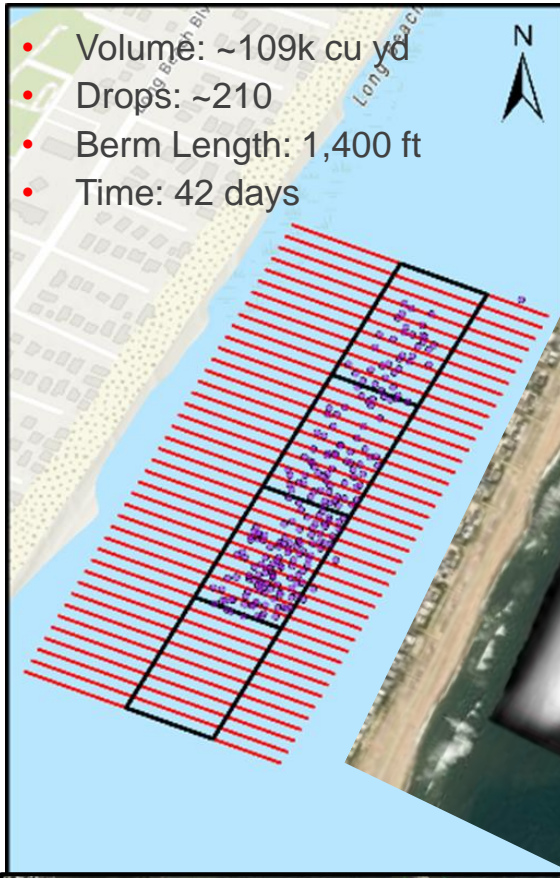


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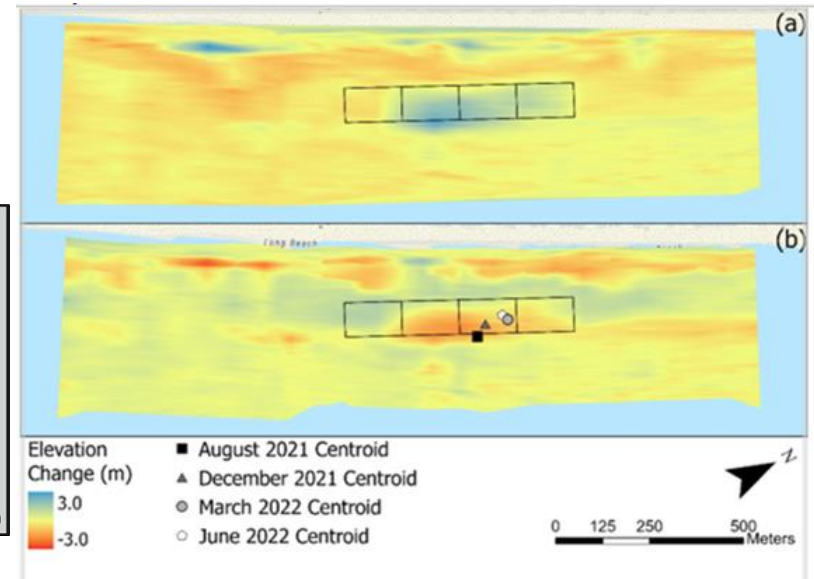
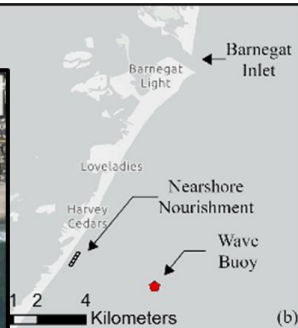




Regional Sediment Management: Monitoring the Harvey Cedars Placement

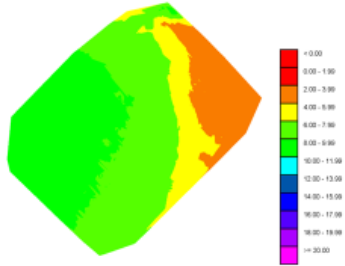


McGill, S. et al., "Morphological Analysis of a Nearshore Nourishment along the Atlantic Coast of New Jersey, USA," *J. Mar. Sci. Eng.* 2022, 10, 1622.

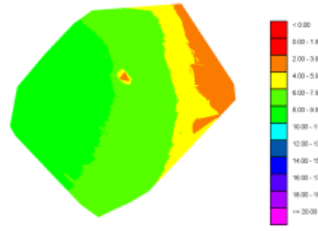




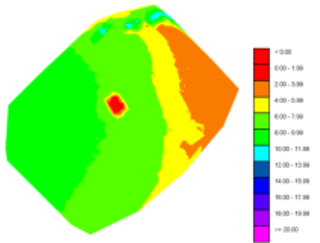
Monitoring the New Island in Barnegat Bay and Developing Lessons Learned



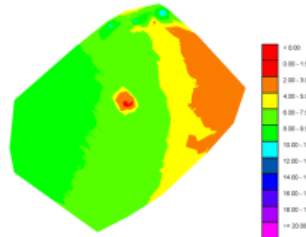
Pre-Construction: October 2020



During Construction: November 2020



Post-Construction: January 2021



After First Year: December 2021

11

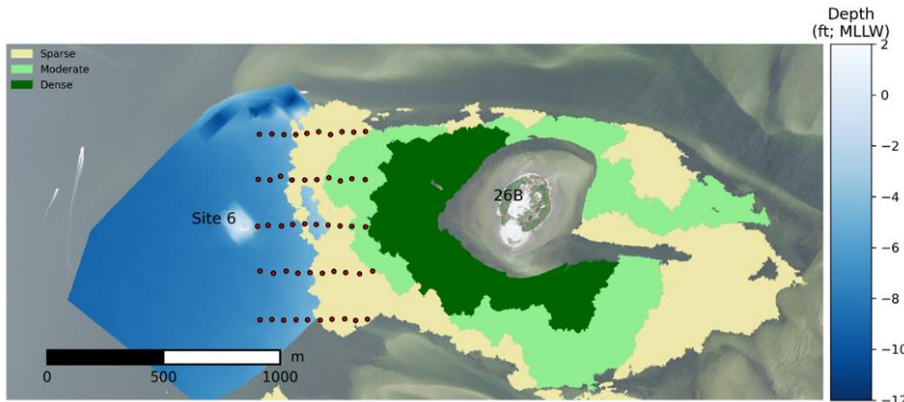


- ★ Dredge Pipe Discharge
- ★ Historic Open Water Placement Sites
- Roving turbidity monitoring





Monitoring, Evaluating and Optimizing Island Creation in Barnegat Bay



ERDC/TN EWN-23-1
Dredged Material Can Benefit Submerged Aquatic Vegetation (SAV) Habitats, Russ, et al, Aug 2023

ADDITIONAL ERDC TECH NOTE in review, “Beneficial Use of Dredged Material for Submerged Aquatic Vegetation Habitats: Overcoming challenges and seeking new opportunities,” Russ, et al , 2024

NEW R&D WORK UNIT: Identifying opportunities and guidance for Beneficial Use of Dredged Material (BUDM) to promote long-term submerged aquatic vegetation (SAV)

PROJECT PLACEMENT AND MONITORING REPORT: Beneficial Use of Dredged Material for Island Creation at Site 6, Oyster Creek Channel Barnegat Inlet Federal Navigation Project, USACE Philadelphia District, December 2023





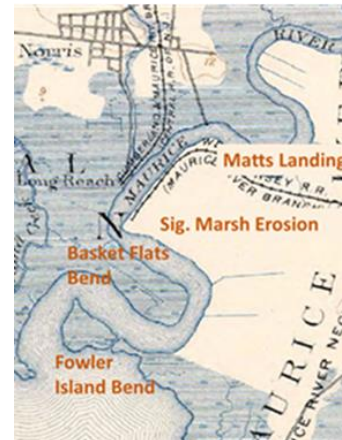
Maurice River NJ



Channel Dredging & Placement (Dec 2023)

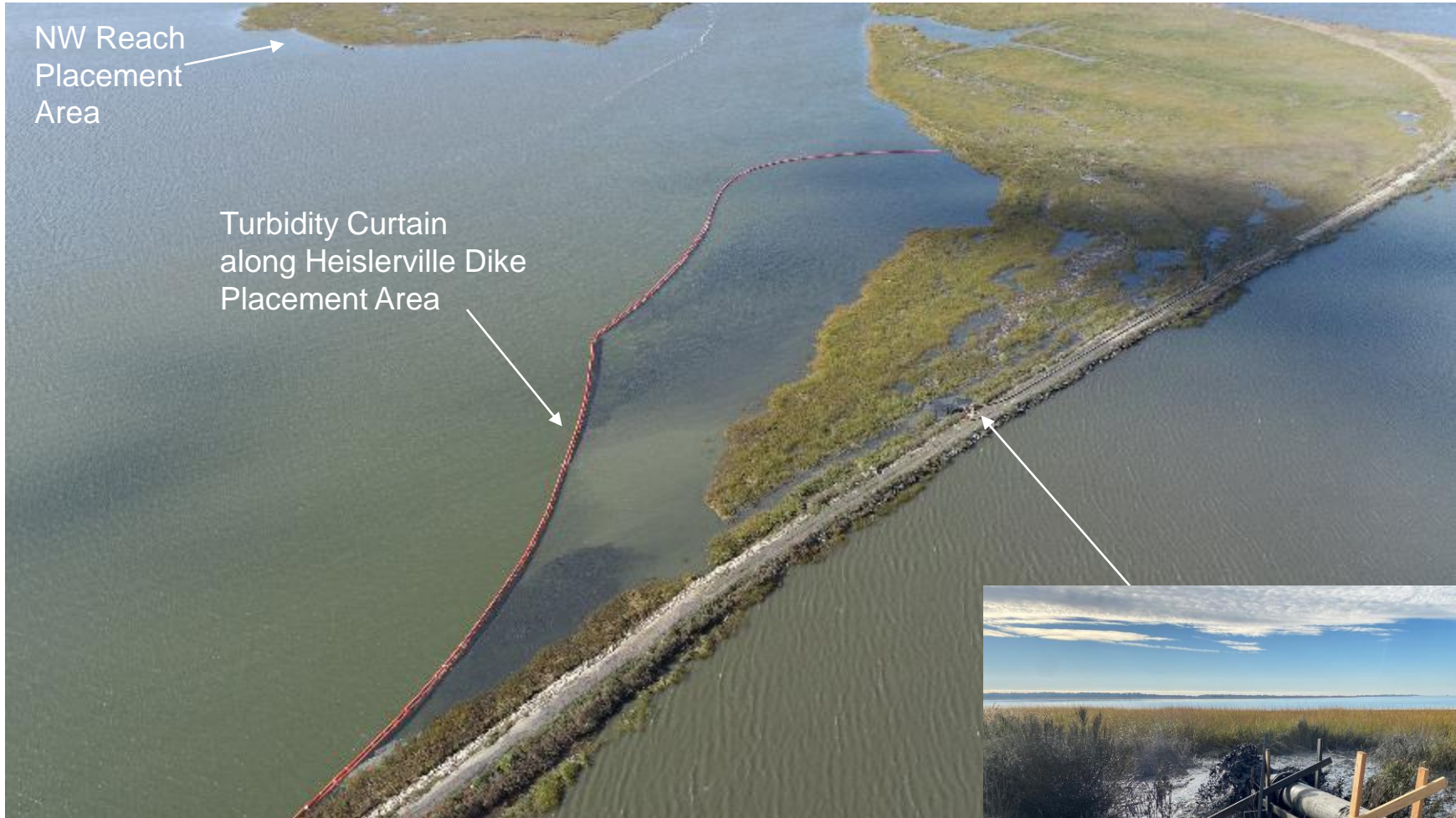


- Previous dredging in 1925 and 1996
- 1996 dredging **DISPOSED** of material in Cape May CDF while region is experiencing devastating erosion
- Contract to dredge channel and beneficially place material in partnership with NJDEP in Heislerville Wildlife Management Area
- **PLANNED** Approx 70,000 cy of fine-grained sediment to be dredged to support a struggling economy
- Changing practice with a new twist in this Delaware Bay community: EWN, UPENN Landscape Architects and SMIL knowledge





Maurice River Dredging & Placement And TRUSTED Partnerships



Approximately 75,000 cubic yards of mixed sediments with BU in State Wildlife Management Area, clearing a channel that has only been dredged twice in 100 years (completed December 2023)

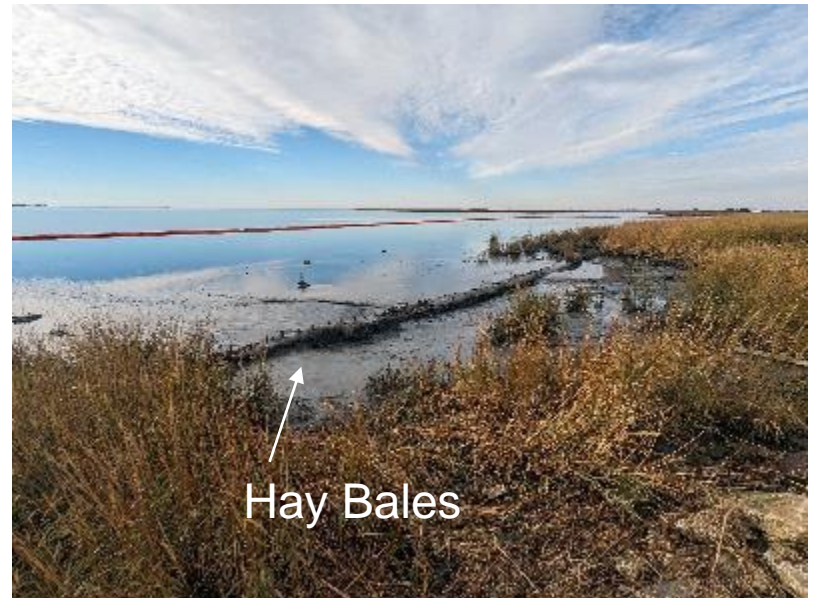




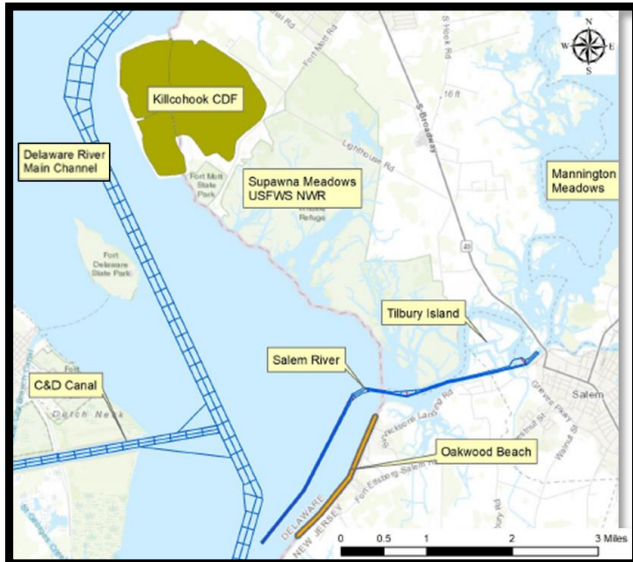
Maurice River Dredging & Placement

Learning Techniques & Adaptive Management

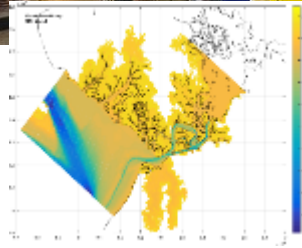
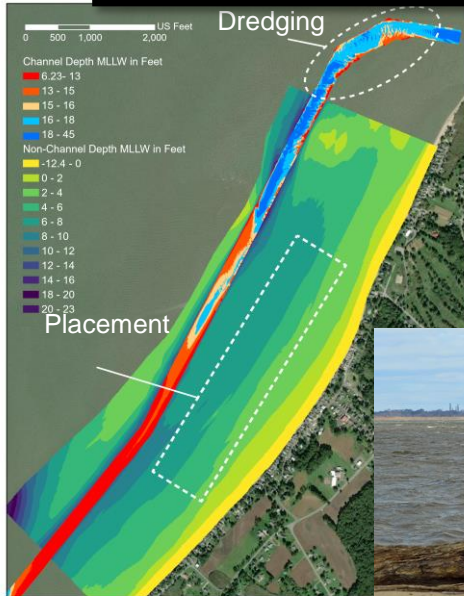
100% DISPOSAL to 100% Beneficial Use!!



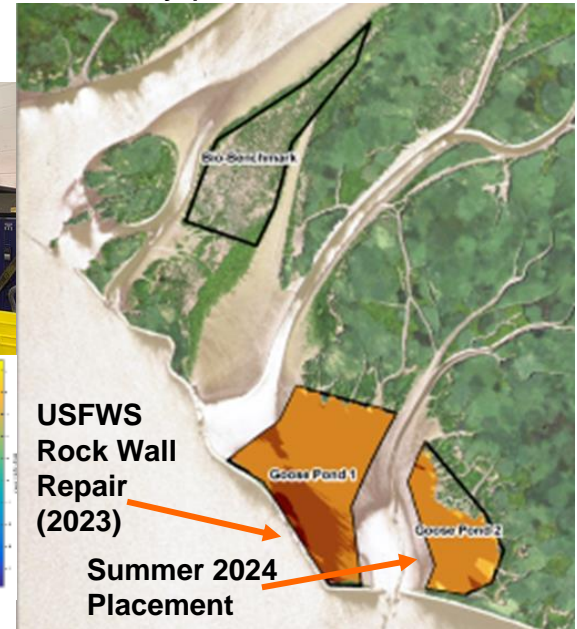
A Systems Approach to Beneficial Use of Fine and Coarse-grained Dredged Material at the Confluence of the Delaware and Salem Rivers



- Leveraging efforts of US Fish & Wildlife Service, Ducks Unlimited and EA Engineering to restore marsh in Supawna Meadows National Wildlife Refuge with 200,000 cy of fine-grained channel sediments
- Partnering with ERDC thru the Regional Sediment Management (RSM) Program and Seven Mile Island Innovation Lab for use of fine-grained dredged material
- Nearshore nourishment with sandy portions of channel using Dredge Murden



CMS Modeling



- Engineer Research and Development Center



Some Operational Lessons Learned



- ***Sediment Testing & Constructability*** up front!
- Strong ***“Purpose and Need”*** Statement is critical including Systems Approach and Resilience
- ***Adaptive management and flexibility are key*** during construction and contract implementation
- Don't Over-Engineer
- Specialized Experience requirements in contract solicitations, maybe RFPs
- Safety!
 - Winter vs environmental windows
 - Pipe moves can't be overdesigned



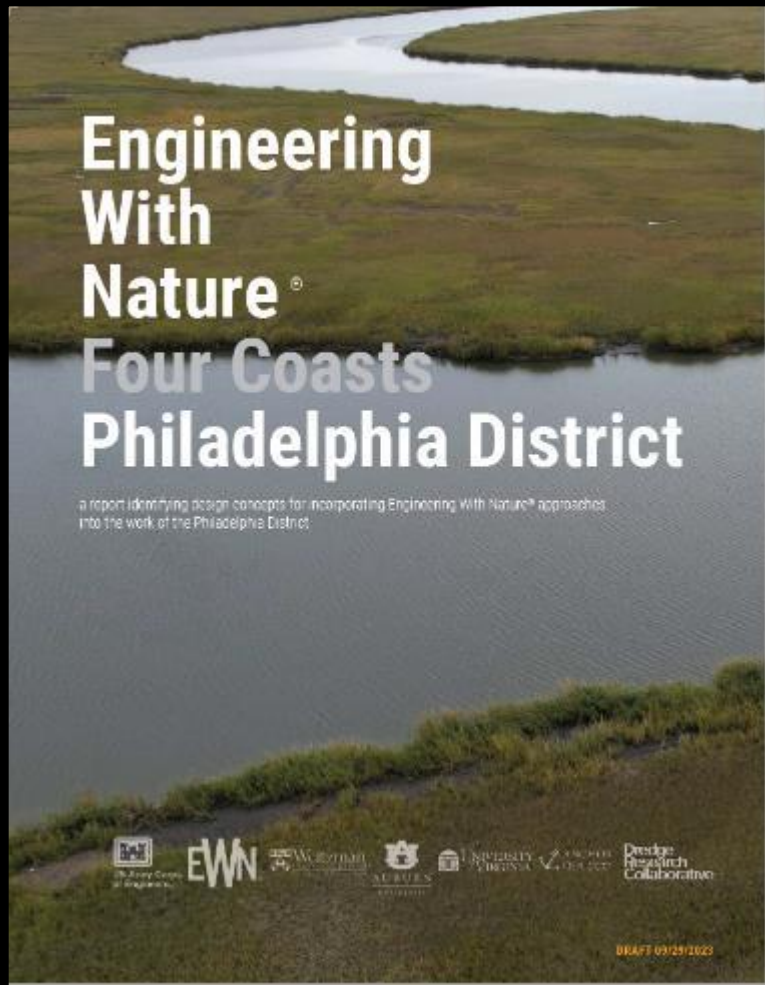


Advancing Practice for Coastal Resilience

Rapid Progress in 10 Years! But more work to do.....

- **Momentum to embrace change; status quo no longer an option given climate change and the need to improve resilient systems**
- USACE has goal progression of 25% (pre-Sandy) to 60% (post-Sandy) to 100% **beneficial use of clean channel sediments** in coastal NJ, setting bar high!
- Increasing BUDM in larger nav channels is important to sustain Chief's 70% goal; ***small successes lead to larger actions***
- Importance of **Trusted Partnerships** are key for long-term Sustainability
- Work with cross-disciplinary teams and ***industry*** to improve designs, constructability and cost efficiency
- **Importance of monitoring** and leveraging with R&D to develop technologies, guidance, collaboration and knowledge/data management
- **Adaptive management** to manage risk are key in dynamic coastal system

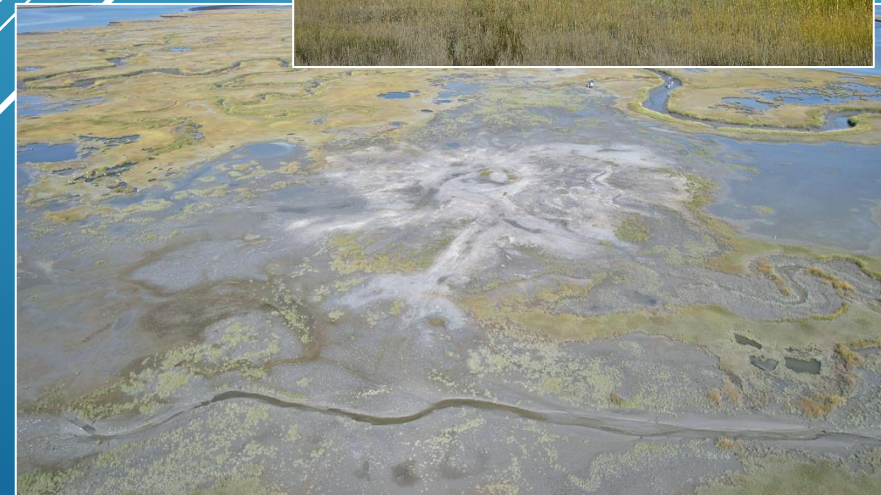
Advancing Natural Infrastructure Approaches in the Philadelphia District



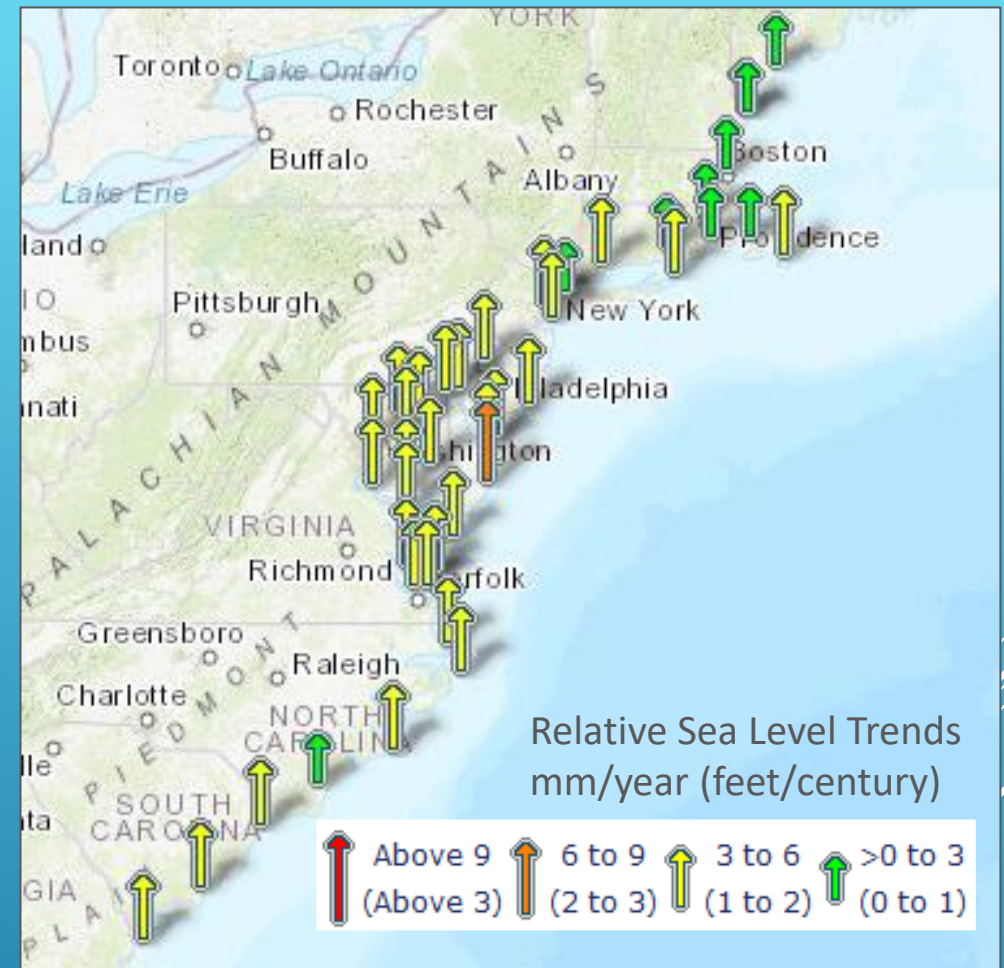
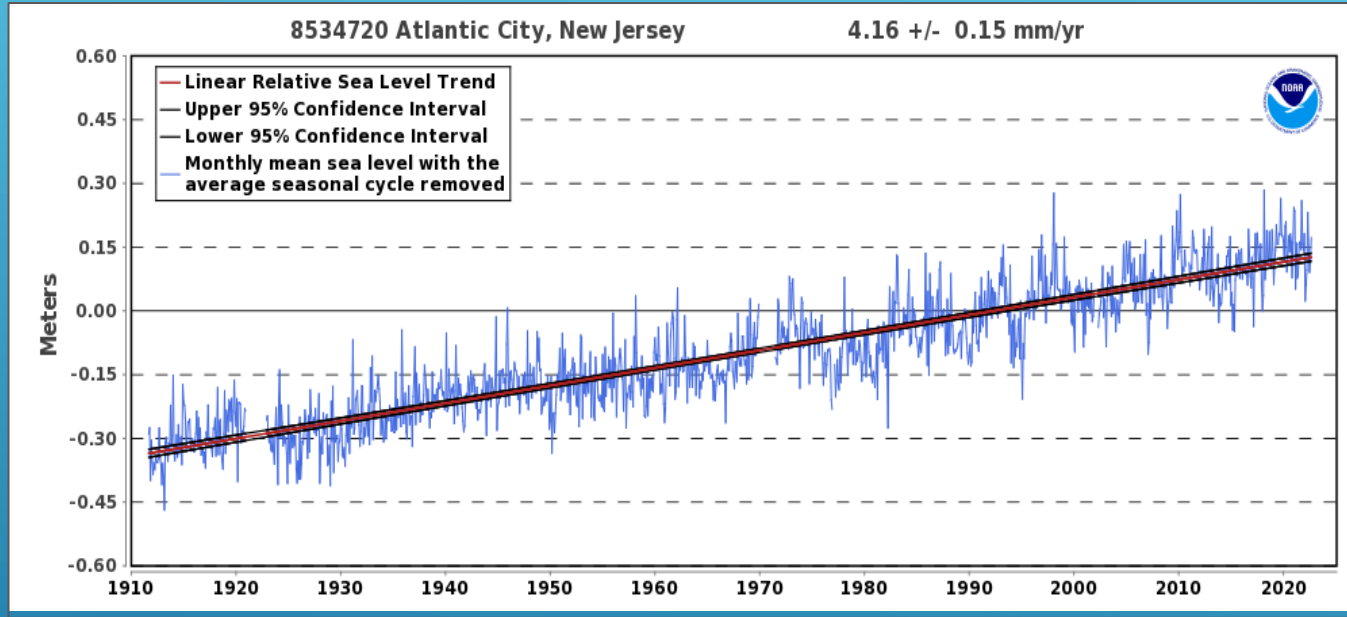


Moving Beyond Case Studies: What We Have Learned from the Seven Mile Island Innovation Laboratory

Lenore P. Tedesco, The Wetlands Institute
Monica Chasten, Jeff McAleer, USACE – Philadelphia District
David Perkey, Brian Harris, Matt Balazik, USACE – ERDC
Lisa Ferguson, Sam Collins, Julie Blum, The Wetlands Institute
Ginger Kopkash, Jason Hearon, Tyler Kinney, Colleen Keller,
Dave Golden and Christina Davis, NJ Fish and Wildlife



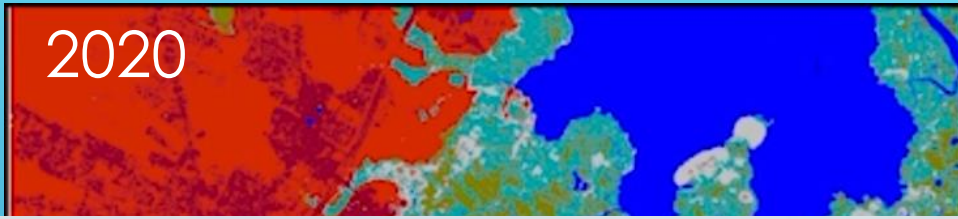
RELATIVE SEA LEVEL TREND



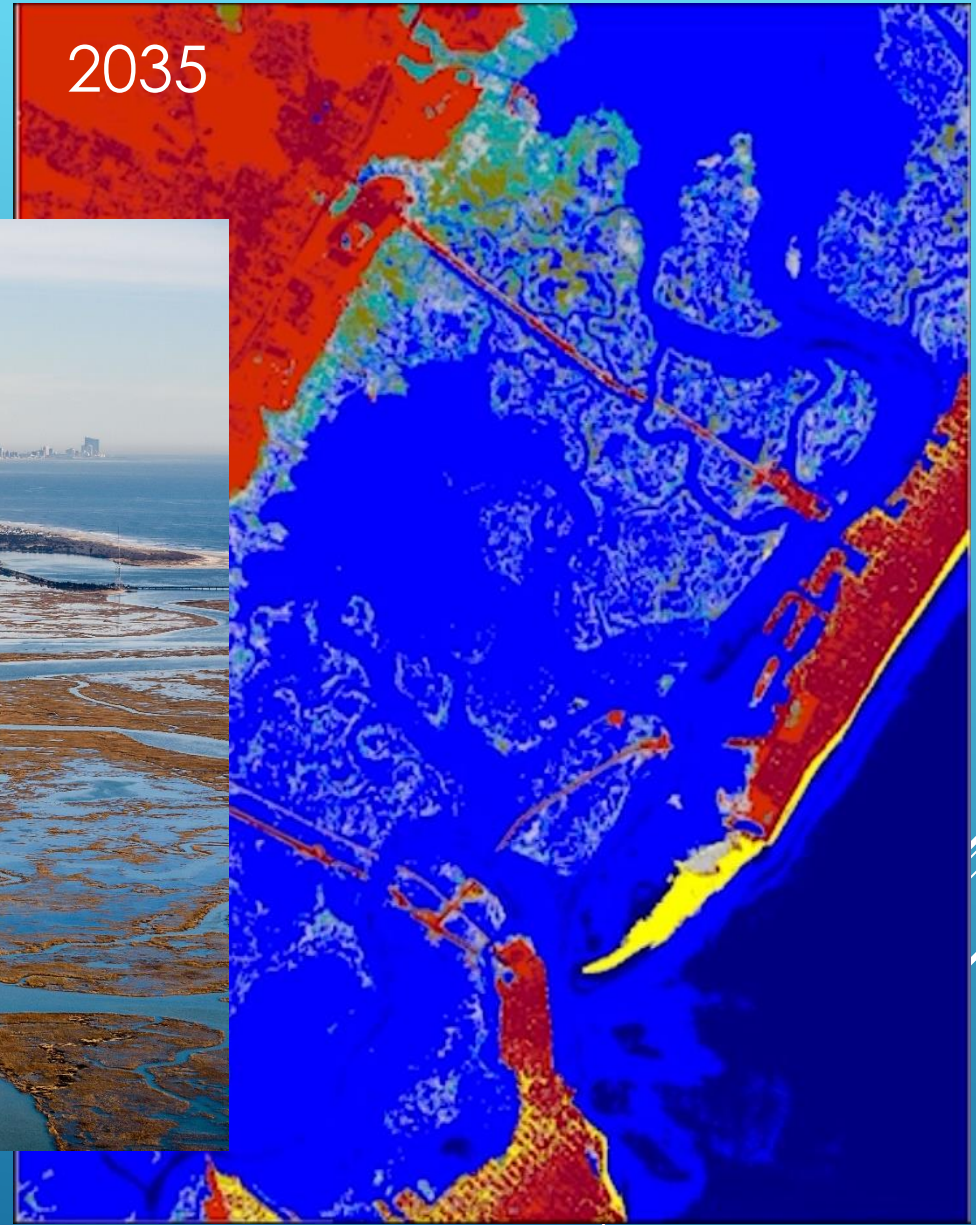
- ▶ New Jersey SLR is 2x Global Average
- ▶ 1911 – 2021 rose 1.36 feet in 100 years
- ▶ Rate has increased from 2010 of 4.04 mm/year to 4.16 mm/year
- ▶ Rate over the last 15 years = 6.1 mm/year

- ▶ Typical marsh accretion rates in the area are 4 mm/year; measured accretion in SMIL marshes confirm this rate
- ▶ Regional subsidence rates are ~2 mm/year

2020

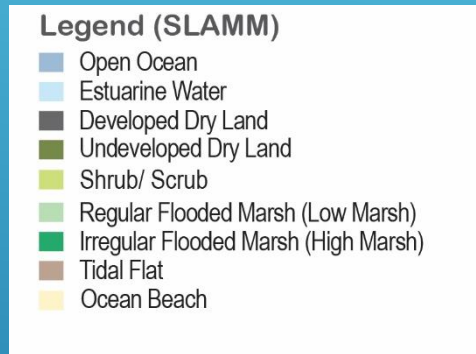
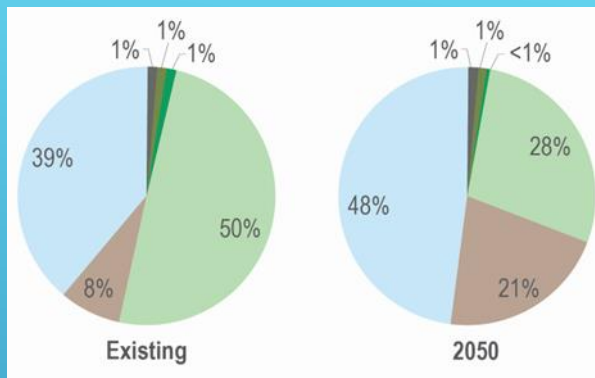
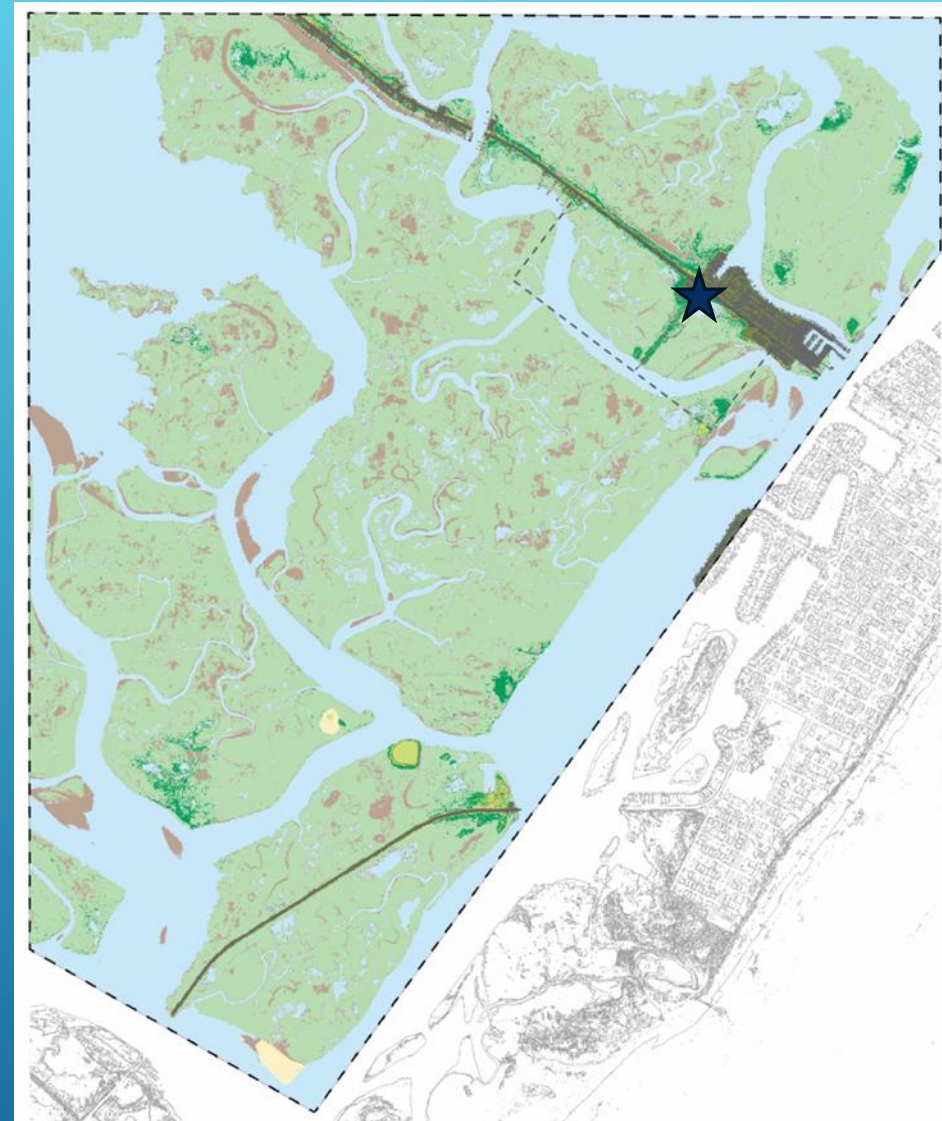


2035



2.68' NAVD88
photo Ted Kingston

HIGH TIDE FLOODING (MHW SLAMM) AND COASTAL RESILIENCE



2020 Existing Conditions

2050 Predicted Conditions

ELEVATION DERIVED HABITAT DISTRIBUTIONS VIA SLAMM

SMIL BENEFICIAL USE PROJECTS

Project drivers are maintenance dredging of NJIWW
 Placement methods are hydraulic dredging and transport

Sediment Type Mixed Fine Sand and Mud

Sediment Type: Fine to Medium Sand

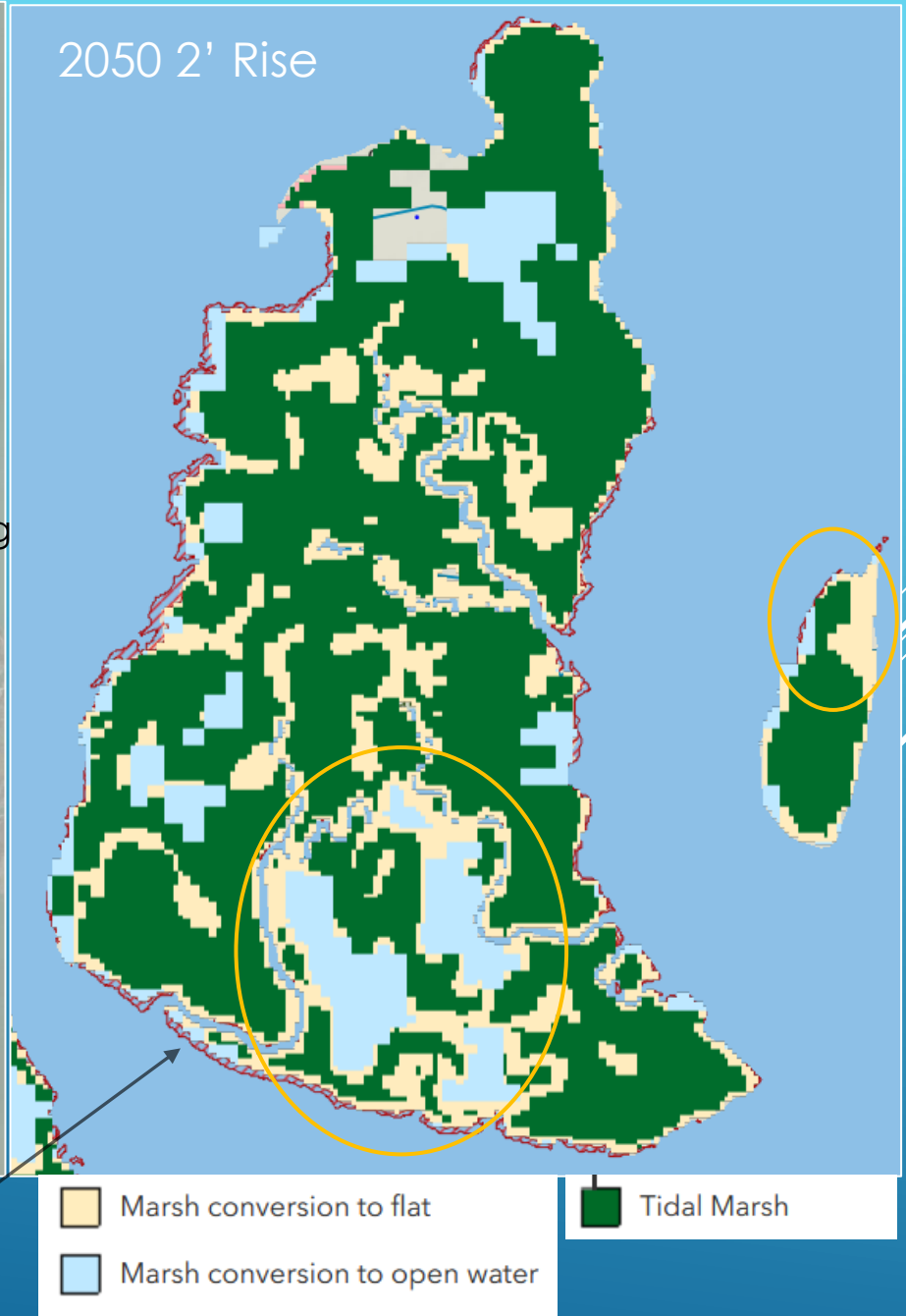
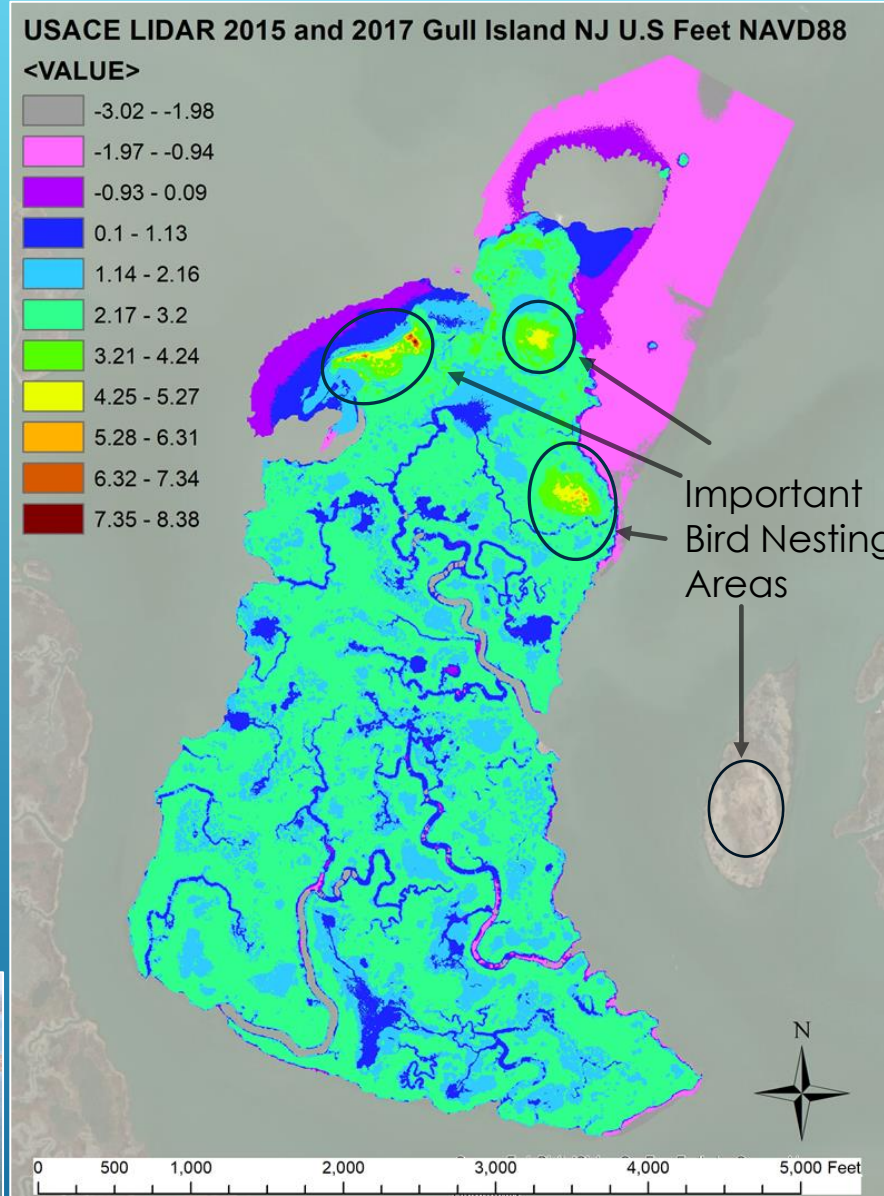
- ▶ Marry site selection with dredging needs
- ▶ Sediments and their location drive site selection
- ▶ Marsh condition assessment then drives project development
- ▶ Marsh need is so great that marrying ecological and dredging needs is effective



- ▶ **Tidal marshes in significant areas of New Jersey have fallen behind rising seas and will benefit from elevation enhancement via sediment inputs.**
 - ▶ Balance short-term impact with long-term benefits
 - ▶ Balance placing in thin layers to preserve existing vegetation (rare) vs thicker placement for more ecological uplift and comparable recovery time
- ▶ **Unconfined sediment placement enables natural process to distribute sediments more effectively and can result in better outcomes when “keeping sediment in the system”.**
 - ▶ Creates more natural marsh gradient and habitat mosaics
 - ▶ Allows for maintenance or rapid establishment of tidal exchange
 - ▶ Adding sediment to the system reestablished tidal channel geomorphology

SMIIL TAKE HOME MESSAGES: WHAT HAVE WE LEARNED (SO FAR)

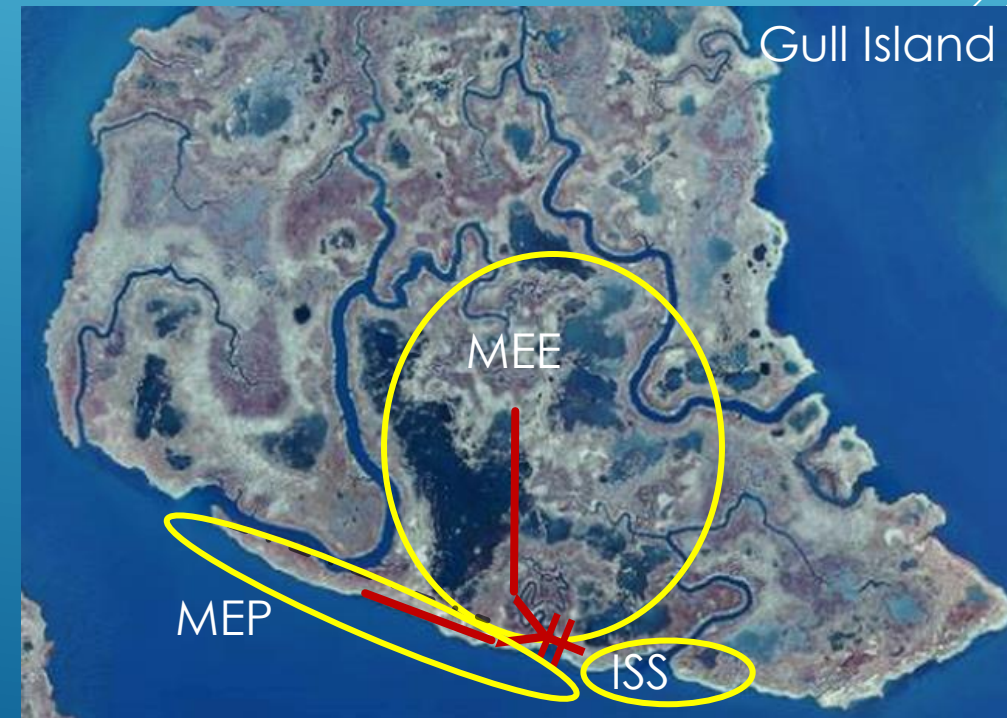
- ▶ Needs Assessment Identified Both Islands for BUDM Projects
 - ▶ Marsh projected to convert to mud flats and open water and already happening
 - ▶ Marsh edge erosion and risks of breaching
- ▶ Thickness of placement based on target elevation goals for marsh stability and habitat needs
- ▶ Large area of coverage favored unconfined placement



Ecological Goals for Both Gull and Sturgeon Island Placements

- ▶ Raise Elevations of Marsh Platforms Across a Gradient of Elevations (MEE)
 - ▶ Wading Bird Nesting Elevations - Transitional Upland Shrub Habitat (>3.5' NAVD88)
 - ▶ High Marsh Elevations for Salt Marsh Sparrow (2.7' – 3.1' NAVD88)
 - ▶ Low Marsh Elevation for Fish Habitat (2.0 – 2.7' NAVD88) and Shorebird and Wader Foraging
- ▶ Create Marsh Edge Protection Zone (MEP)
 - ▶ More Natural Marsh Edge Slope and Wave Energy Buffer
 - ▶ Intertidal Shoal to Marsh Edge Elevation (2.0' NAVD88)
- ▶ Enhance Intertidal and Subtidal Shallows (ISS)
 - ▶ Target Elevations to MLLW Where Macroalgal Flats Transition from Sparse to Densely Vegetated (-1.0 MLLW – 0' MLLW)

ENHANCING A MARSH LANDSCAPE



▶ **Fine-grained sediments build vertically and are deposited locally to much higher extent than is commonly believed**

- ▶ Product of consolidation in source deposits
- ▶ Aggregates and macro-clasts (>250 μm) form during dredging and transport process (Perkey et al, 2024)

▶ Building elevation may require multiple lifts

- ▶ Containment during construction may be needed if target elevations are notably above surrounding marsh

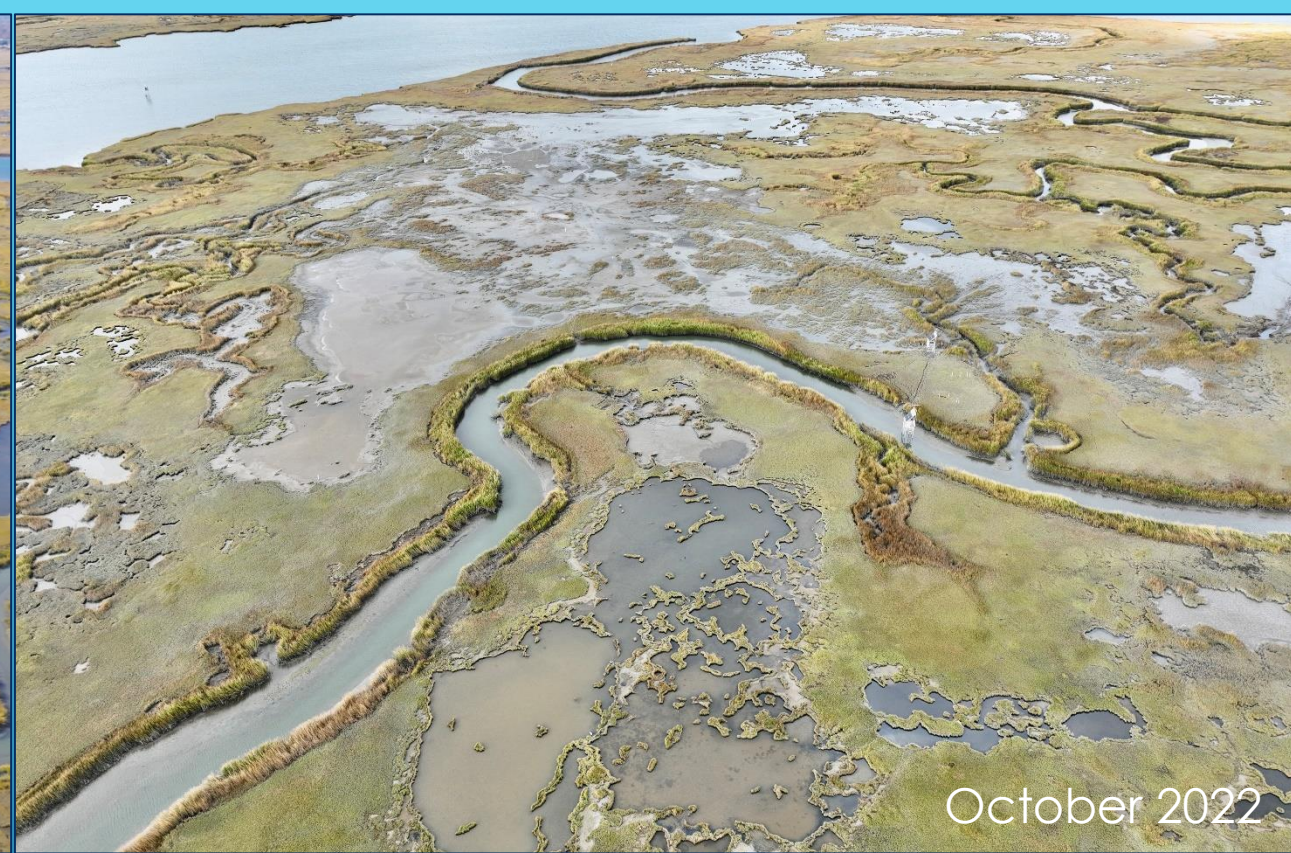
▶ Vegetation recovery does not appear to be related to placement thickness but rather appropriate elevations for flood frequency

- ▶ Benchmark elevations are likely relict and underrepresenting target elevations
- ▶ If placement elevations are too low, may result in lack of vegetation recovery

SMIIL TAKE HOME MESSAGES: WHAT HAVE WE LEARNED (SO FAR)



September 2020



October 2022

- 22 acres of marsh elevation enhancement by up to 2'
- Unconfined placement of 40,000 cubic yards of fine-grained sediments
- Natural flow paths spread material over large portion of placement area
- Lack of containment allowed for tidal connection to establish quickly
- Resulted in habitat mosaic at higher elevations to offset SLR elevation losses
- Excellent *Spartina* recovery and expansion by seedbank



July 2022

MULTIHABITAT UNCONFINED PLACEMENT

2020-11-04

View W Point 2



2021-07-12



2021-09-12



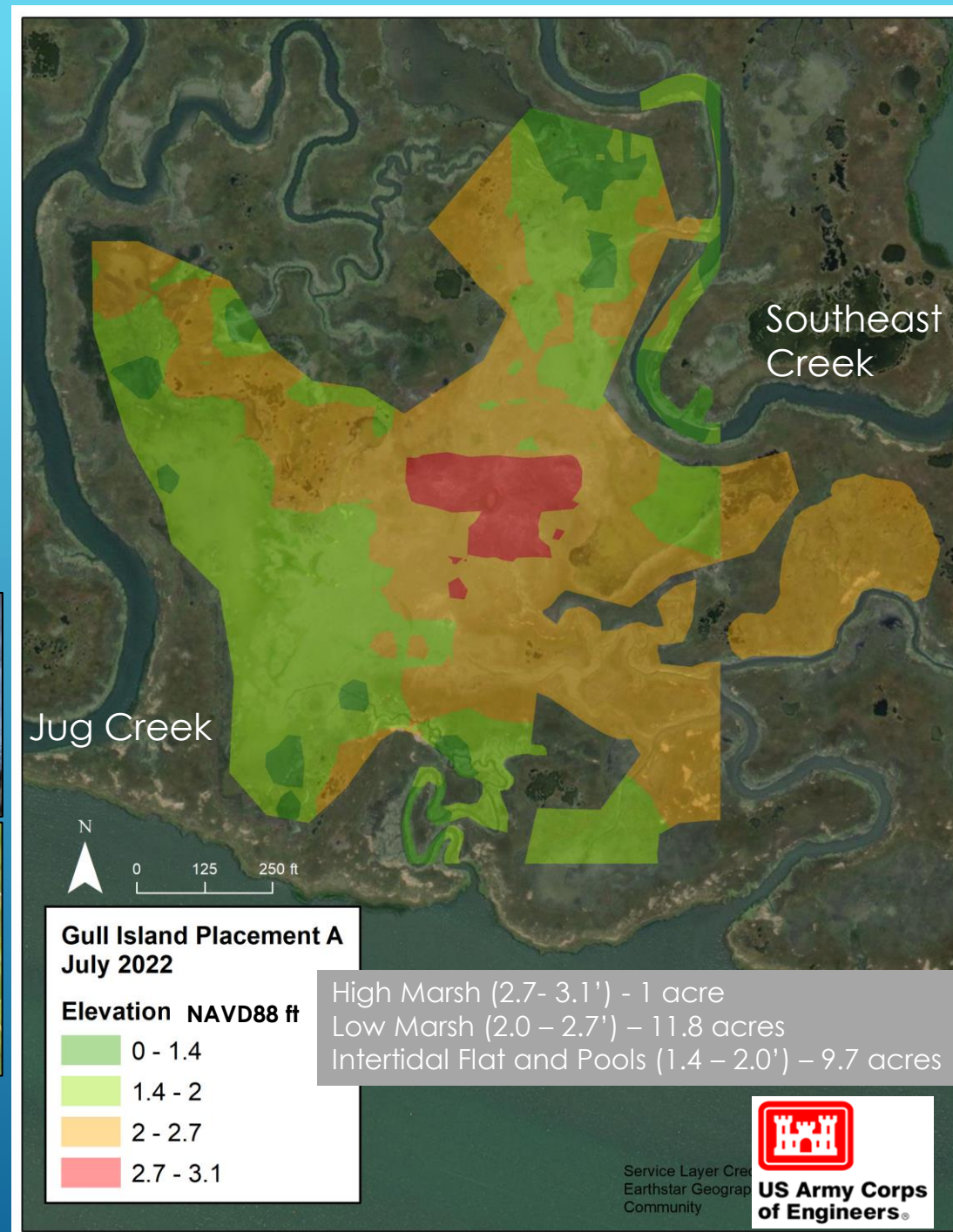
2022-08-02



- ▶ Restored low marsh habitat and shallowed interior intertidal flats and pools into *Spartina* vegetation elevation zones
 - ▶ Created high tide flats for shorebirds and wading birds
 - ▶ Avian surveys documenting more than 25 species utilizing placement area for foraging
- ▶ Created small area of high marsh but below target elevations for transitional wading bird habitat
 - ▶ Salt Marsh and Seaside Sparrows foraging on site
- ▶ Natural vegetation recolonization and expansion proceeding well after 2-year post-placement timeframe



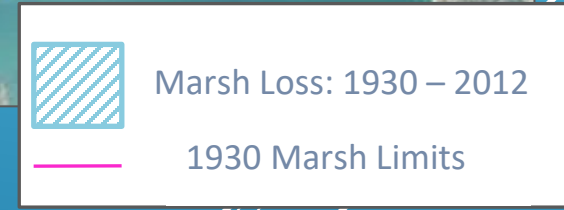
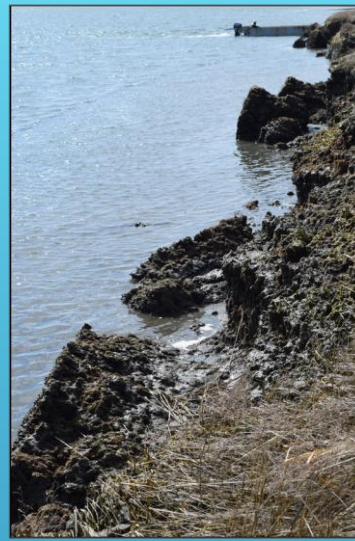
MULTIHABITAT UNCONFINED PLACEMENT



- ▶ **Marsh edge loss is occurring at rapid rates in many areas and needs to be addressed along with marsh interior enhancements.**
- ▶ **It is possible to build subtidal to intertidal berms in the near marsh environment that:**
 - ▶ Have limited turbidity effects and benthic community impact
 - ▶ Persist
 - ▶ Provide marsh edge protection

SMIIL TAKE HOME MESSAGES: WHAT HAVE WE LEARNED (SO FAR)

- Marsh Edge Erosion is Occurring at Rapid Rates
 - Related to storm waves and boat wakes
 - Hydraulic loading of saturated marshes/seepage erosion
- Accelerates marsh loss through pool breaching
- Marsh Edge Loss at Gull Island
 - 25 meters of retreat since 1937
 - ~0.3 m/year retreat rate



USING FINE-GRAINED SEDIMENT TO BUILD MARSH EDGE PROTECTION FEATURES



September 2020
1 Month Post Placement



August 2022
2 Years Post Placement



Indirect Placement – Intertidal Shallows

Marsh Edge Protection Berm

USING FINE-GRAINED SEDIMENT TO BUILD MARSH EDGE PROTECTION FEATURES

Bathymetry Change Aug 2020 to March 2021



Bathymetry Change Aug 2020 to Sept 2023



▶ Placed ~9000 cy of fine-grained sediment (59-73%) in each feature and gained 1 – 2.5' of elevation along marsh edge

▶ More than 90% of directly placed material was accounted for in berm 6 mos post-placement without containment

▶ Features show 30-40% reduction in volume after 36 months



- ▶ Turbidity plume was localized, only extending about 40 m from the discharge pipe and <200 m along shore.
- ▶ Only marginally higher than storm-induced turbidity (Fall et al. 2021)
- ▶ One-week post-placement turbidity returned to background (Fall et al. 2022)



Turbidity (NTU)	
●	2 - 17
●	17 - 24
●	24 - 33
●	33 - 48
●	48 - 71
●	71 - 113
●	113 - 194
●	194 - 298
●	298 - 599
●	599- 991

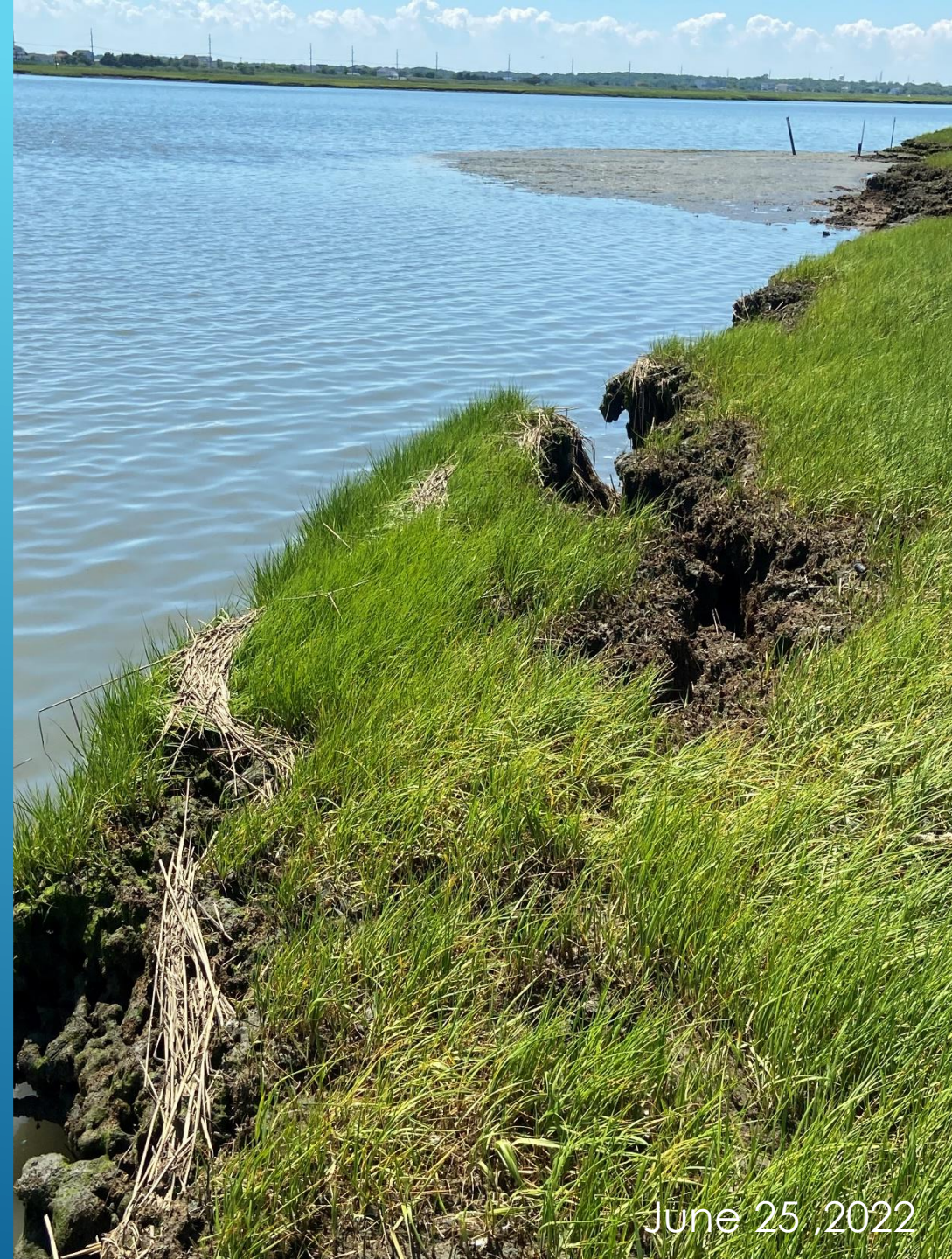


TURBIDITY MONITORING

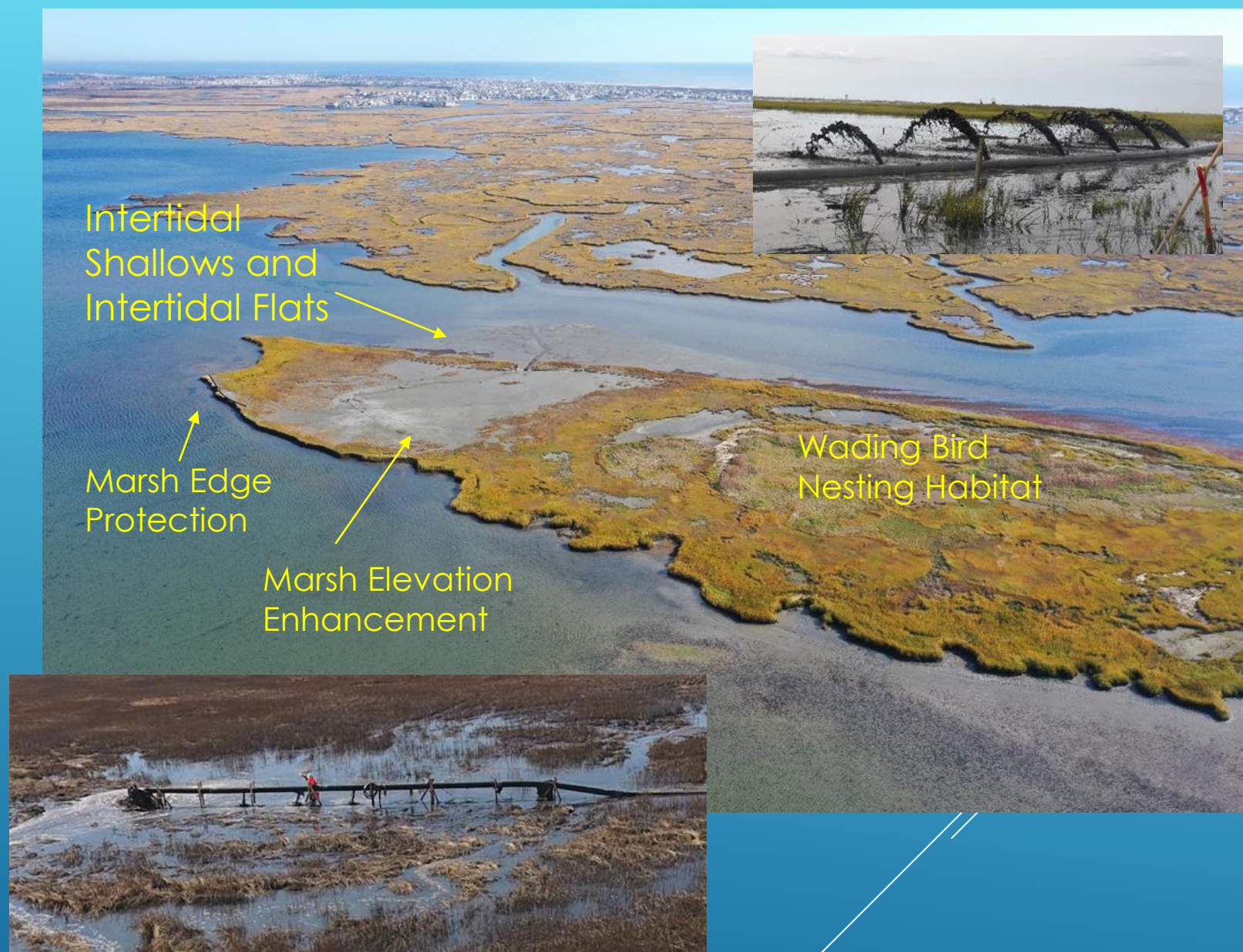


- ▶ Marsh edge collapse occurring away from protection feature
- ▶ No block failure in areas of berms

MARSH EDGE PROTECTION



- ▶ Placed in Two Phases in 2020
 - ▶ March 2020
 - ▶ 4,200 cubic yards
 - ▶ September 2020
 - ▶ 15,000 cubic yards
 - ▶ Mixed fine sand and mud
- ▶ Marsh Elevation Enhancement (MEE)
 - ▶ 3.5 acres of enhancement
 - ▶ 3.0' NAVD88 grading down to 1.9'
- ▶ Marsh Edge Protection (MEP)
 - ▶ Placed small sand ridge along toe of erosional slope
- ▶ Enhanced Intertidal Shallows (ISS)
 - ▶ Shallowed above MLLW along eastern island to extend flats northward
- ▶ Used repetitive placement to build elevation
 - ▶ Fall 2022 Phase 3 placement

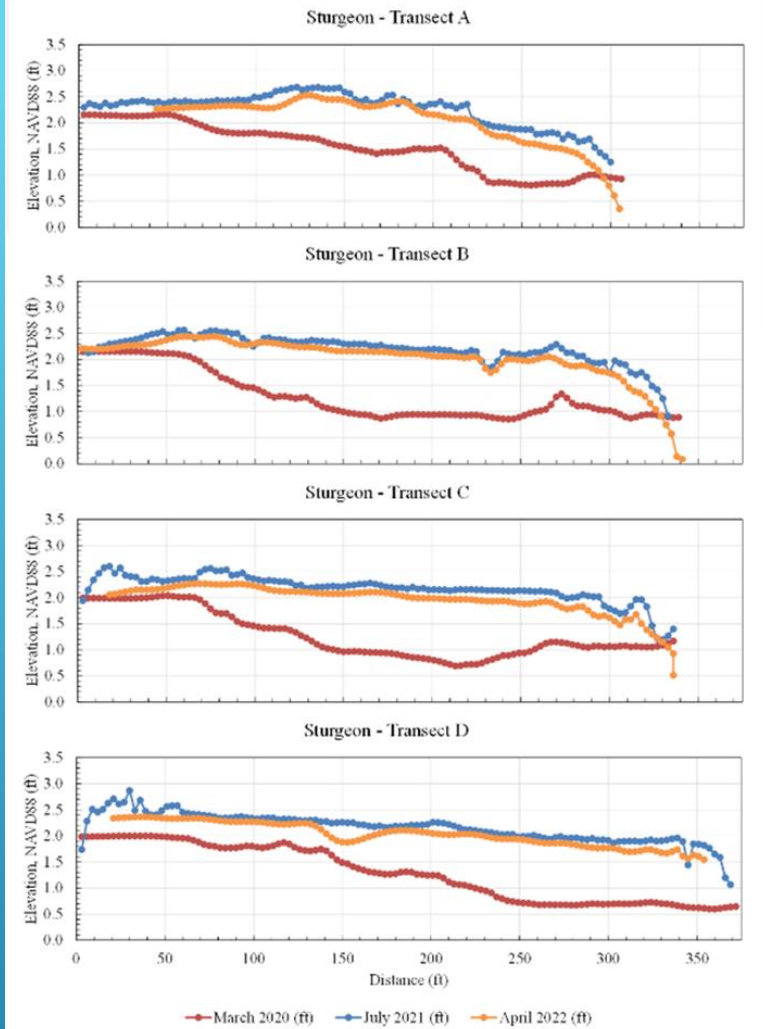
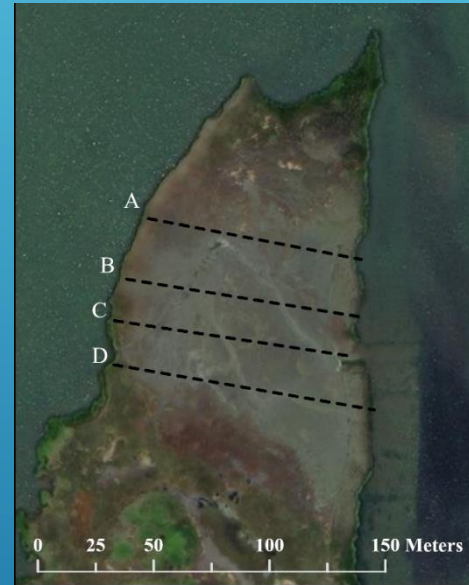


STURGEON ISLAND PLACEMENTS: ENHANCING A MARSH LANDSCAPE

8/2022



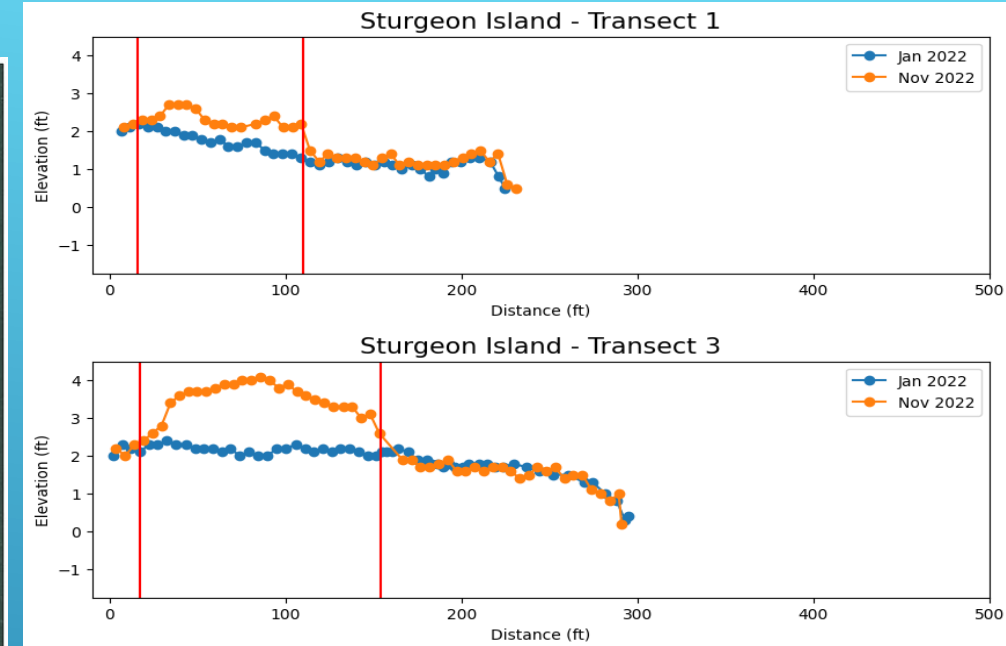
- ▶ 2020 uncontained placement achieved 1.5 – 2.5' of marsh elevation enhancement
- ▶ Rapid vegetation recovery in areas with suitable hydrology driven by elevation
- ▶ Vegetation response unrelated to placement thickness



MARSH ELEVATION CAPITAL WITH RAPID NATURAL VEGETATION RECOVERY

STURGEON ISLAND PHASE 3 – FALL 2022

- ▶ Placed 24,000 CY of fine sand to create sandy marsh edge protection features
 - ▶ Intercepting wave energy
- ▶ Used containment to elevate 0.4 acre for elevated bird nesting habitat
 - ▶ Placed more than 3' of material
 - ▶ Built to 4.0' NAVD88
- ▶ Employed Y-valve to switch between containment and subtidal features
 - ▶ Maintain dredging efficiency
 - ▶ Allow time for contained area to dewater
 - ▶ Slow and manage flow volumes and velocities





2020 UAV Orthomosaic



2021 UAV Orthomosaic



2022 UAV Orthomosaic

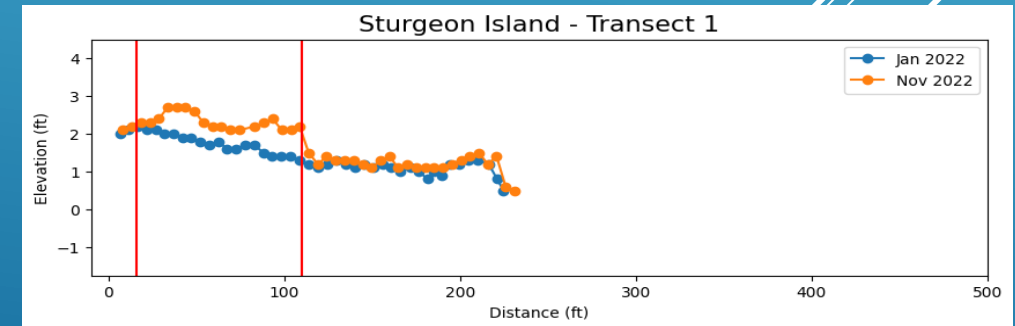


2023 UAV Orthomosaic

STURGEON ISLAND



- ▶ Limited area of *Spartina* die-back during placement
- ▶ No recovery in areas below *Spartina* recruitment elevations (1.8' NAVD88 in SMIL)
- ▶ Vegetation is persisting when outside of colonization elevation
- ▶ Showing importance of role of disturbance without suitable elevation target



MARSH ELEVATION AND VEGETATION RELATIONSHIPS

- ▶ Tidal marshes in significant areas of New Jersey have fallen behind rising seas and will benefit from elevation enhancement via sediment inputs.
 - ▶ Balance short-term impact with long term benefits
 - ▶ Balance placing in thin layers to preserve existing vegetation (rare) vs thicker placement for more ecological uplift and comparable recovery time
- ▶ Unconfined sediment placement enables natural process to distribute sediments more effectively and can result in better outcomes when “keeping sediment in the system”.
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 - ▶ Provide marsh edge protection

SMIIL TAKE HOME MESSAGES: WHAT HAVE WE LEARNED (SO FAR)

ADVANCING SCIENCE AND PRACTICE AT THE SEVEN MILE ISLAND INNOVATION LABORATORY

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- ▶ Wetlandsinstitute.org/SMIL



- ▶ Beardsley, Welp, Harris, McFall, Tyler, and Savant (2022): Sediment Distribution Pipe: Modeling Tool and field Application. WEDA Journal of Dredging, v. 20 (1) 16-37.
- ▶ Chasten, Goldberg, Pasquale, Piercy, Welp, and Golden (2016): Recent Experience with Channel Dredging and Placement to Restore Wetlands In New Jersey, WODCON XXI PROCEEDINGS.
- ▶ Chasten, M., Tedesco, L., and Kopkash, G. (2022). Advancing Sediment Solutions in the Seven Mile Island Innovation Laboratory. *Coastal Engineering Proceedings*, (37), 64-64.
- ▶ Collins, Ferguson, Morey, and Tedesco (2021): Cape May Wetlands Wildlife Management Area Habitat Restoration Monitoring and Evaluation, https://wetlandsinstitute.org/wp-content/uploads/2022/11/FG19-057_TWI_2019-2021_FINAL.pdf
- ▶ Ecoshape (2018): Living Lab for MUD Brochure, www.ecoshape.org.
- ▶ Fall, Perkey, Tyler, and Welp (2021): Field Measurement and Monitoring of Hydrodynamic and Suspended Sediment with the Seven Mile Innovation Laboratory, New Jersey, ERDC/CHL TR-21-9, [https://permanent.fdlp.gov/gpo185925/ERDC-CHLTR-21-9\(1\).pdf](https://permanent.fdlp.gov/gpo185925/ERDC-CHLTR-21-9(1).pdf)
- ▶ Fall, Perkey, Tedesco and Chasten (2022): Impact of Strategic, Unconfined, Dredged Material Placement on Turbidity Within a Shallow Back Bay System: observations from Seven Mile Island Innovation Laboratory, NJ, WEDA Journal of Dredging, v. 20 (1) 38-49.
- ▶ Perkey, D. W., Smith, S. J., Fall, K. A., Tarpley, D. R., and Friedrichs, C. T. (2024). Production and abundance of macro-aggregate bed clasts from moderately consolidated cohesive beds and their implications for sediment management. *Journal of Sedimentary Research*, 94(1), 37-50.
- ▶ Rochette, Chasten, Tedesco, and Kopkash (2019): Seven Mile Island Innovation Laboratory, Overview and Purpose Fact Sheet, www.nap.usace.army.mil.
- ▶ Sea Level Rise in New Jersey: Projections and Impacts – New Jersey Climate Change Resource Center," https://njclimateresourcecenter.rutgers.edu/climate_change_101/sea-level-rise-in-new-jersey-projections-and-impacts/.
- ▶ Tedesco, Chasten, Ferguson, Collins, and Davis (2021): Using Dredged Sediments to Uplift Marshes, Build Subtidal Shallows and Provide Marsh Edge Protection in the Seven Mile Island Innovation Lab, Delaware Estuary Science and Environmental Summit, <https://delawareestuary.org/delaware-estuary-science-and-environmental-summit/>

RELEVANT PUBLICATIONS