NEARSHORE NOURISHMENT STRATEGIES – TECH TRANSFER OF HISTORICAL PROJECTS, PLANNING TOOLS, AND BEST PRACTICES

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COASTAL INLETS RESEARCH PROGRAM

FY22 IN PROGRESS REVIEW

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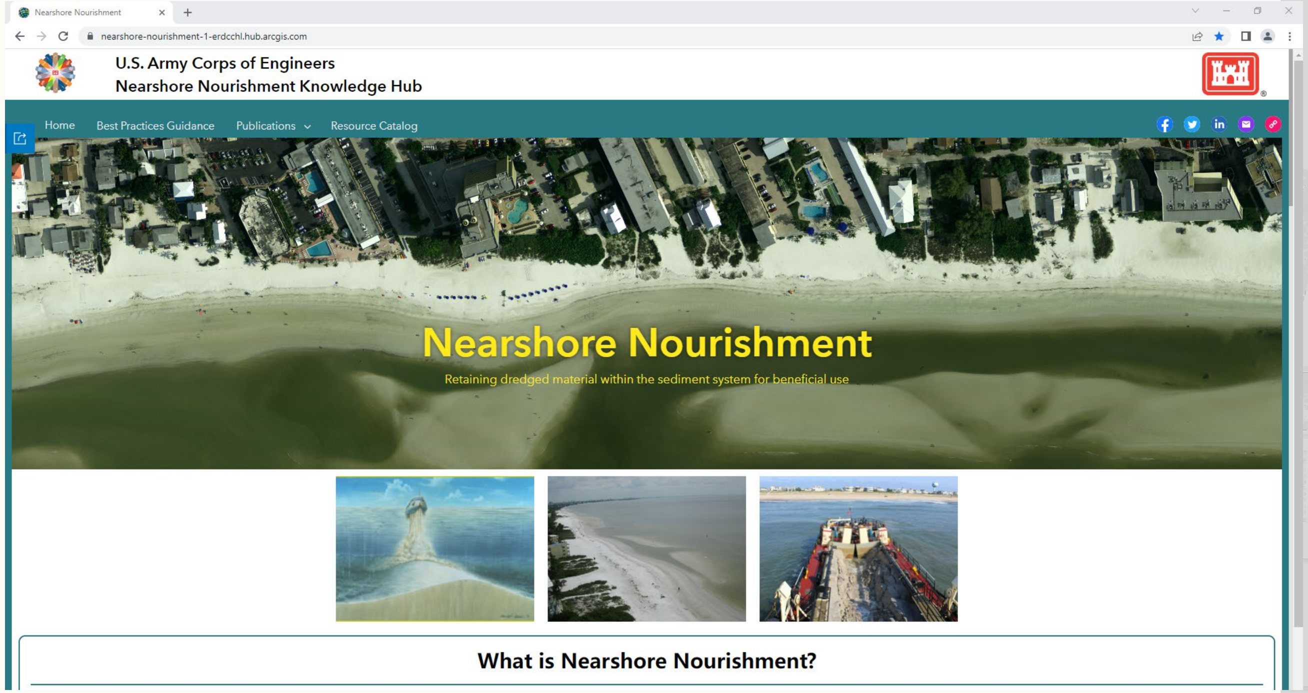
Problem Statement

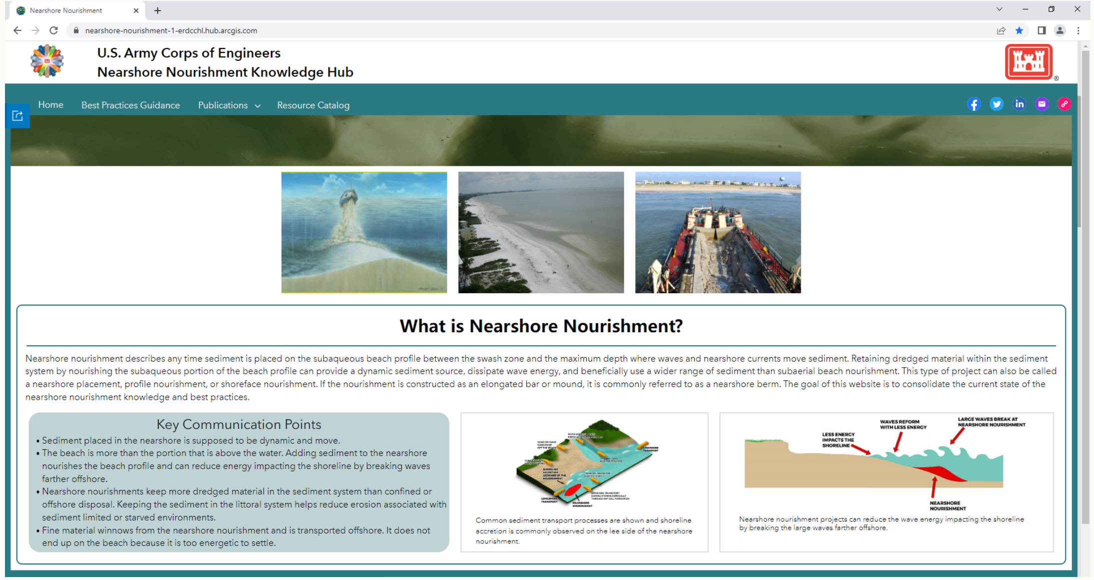
- **Problem:** Extensive progress has been made in nearshore nourishment research through development of planning tools, communication tools, technical documents, and publications documenting current and best practices, but without a central knowledge hub, deliverables are scattered with disparate access locations.
- **Objective:** To further the state of nearshore nourishment practice by consolidating the current knowledge into a single location.

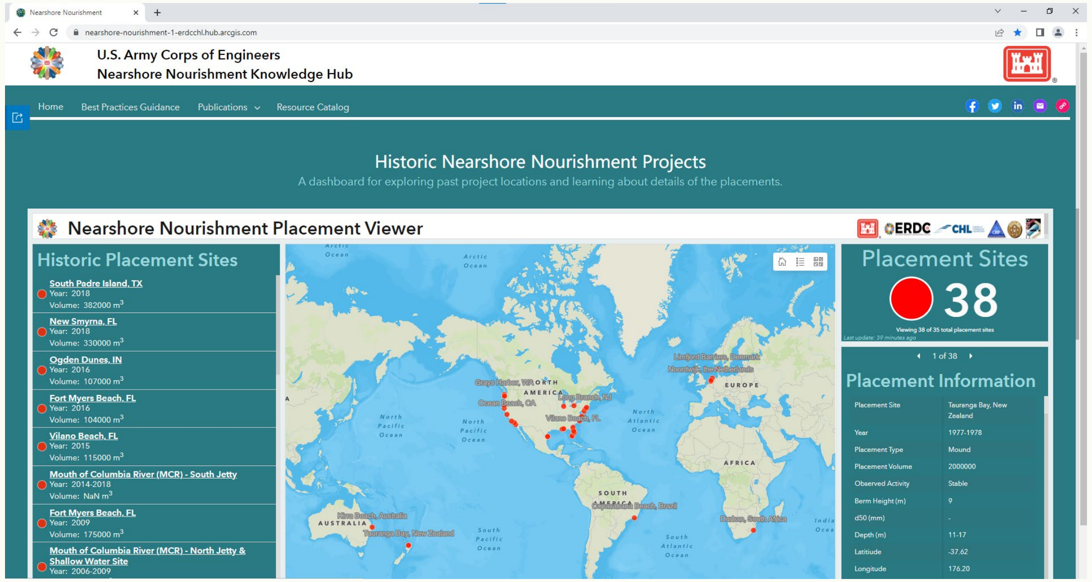


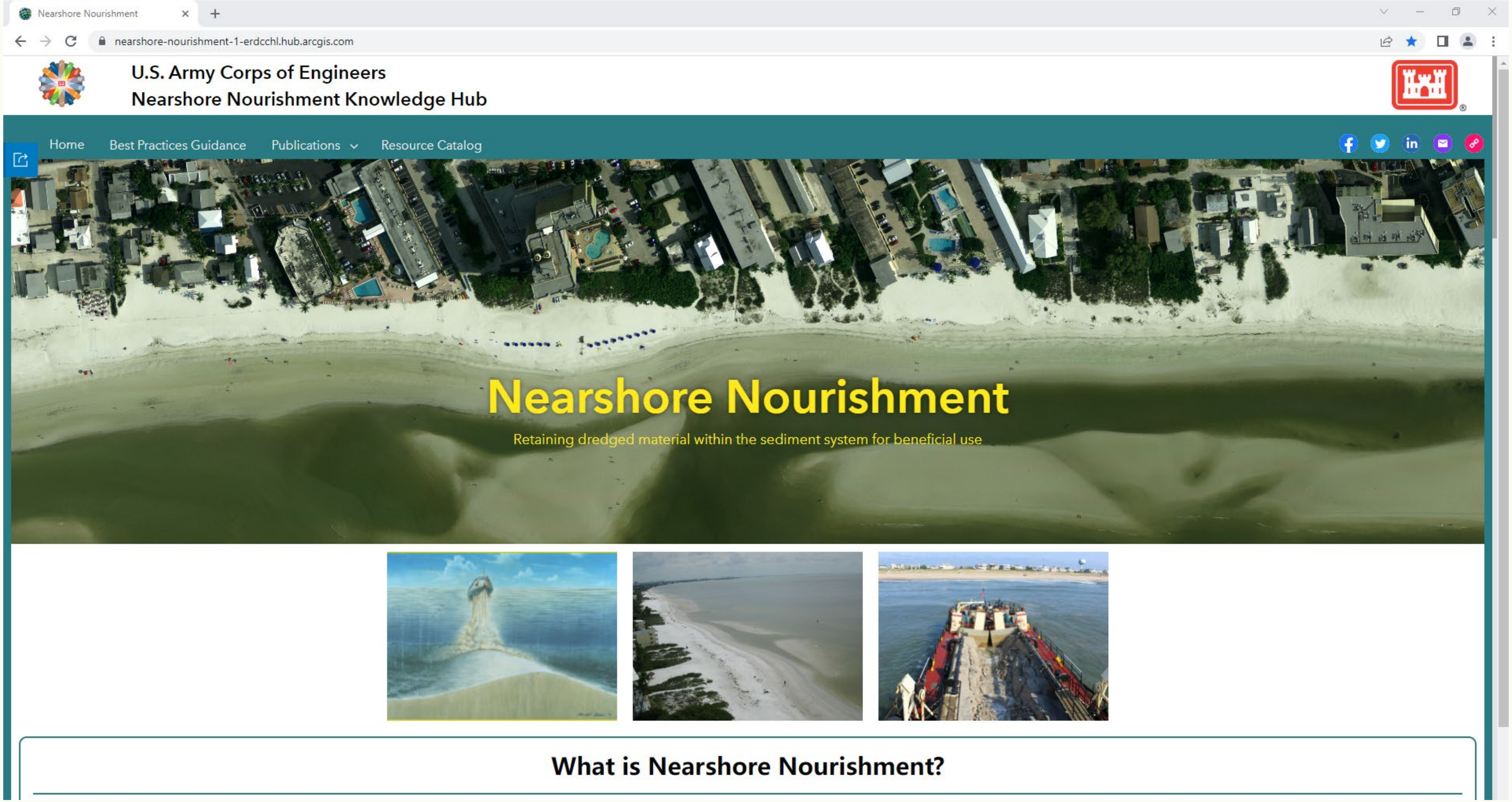
- **Statements of Need**
  - **2021-N-1726: Nearshore Nourishment Best Management Practices**
  - **2020-N-1564: Increasing Beach Nourishment Lifespan with Nearshore Nourishments**
  - **2020-N-1481: Improving scoping level estimates of the lifespans and deflation rates of nearshore nourishments**
  - **2019-N-1386: Strategic Nearshore Placement of Dredged Material to Sustain Coastal Beach & Dune Resilience**

Capability and Strategic Impact Statement

The Nearshore Nourishment Knowledge Hub can quickly familiarize new coastal engineers with nearshore nourishment projects and practices, and benefits experienced coastal engineers by having all the nearshore nourishment information provided from a single hub.






Nearshore Nourishment
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Nearshore Nourishment
Retaining dredged material within the sediment system for beneficial use
What is Nearshore Nourishment?

U.S. Army Corps of Engineers
Nearshore Nourishment Knowledge Hub

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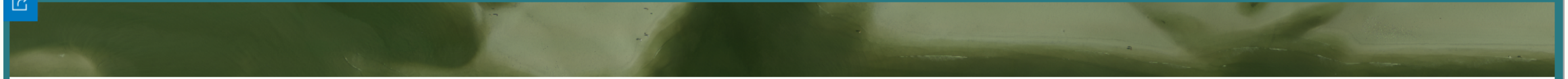
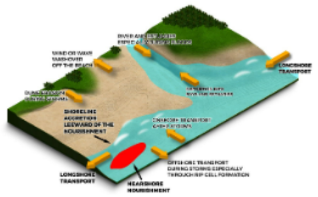


What is Nearshore Nourishment?

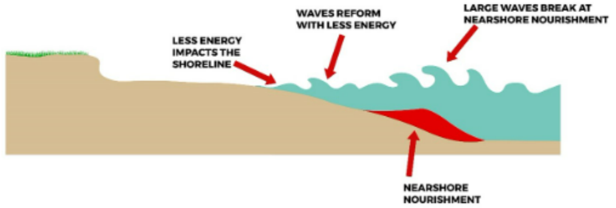
Nearshore nourishment describes any time sediment is placed on the subaqueous beach profile between the swash zone and the maximum depth where waves and nearshore currents move sediment. Retaining dredged material within the sediment system by nourishing the subaqueous portion of the beach profile can provide a dynamic sediment source, dissipate wave energy, and beneficially use a wider range of sediment than subaerial beach nourishment. This type of project can also be called a nearshore placement, profile nourishment, or shoreface nourishment. If the nourishment is constructed as an elongated bar or mound, it is commonly referred to as a nearshore berm. The goal of this website is to consolidate the current state of the nearshore nourishment knowledge and best practices.

Key Communication Points

- Sediment placed in the nearshore is supposed to be dynamic and move.
- The beach is more than the portion that is above the water. Adding sediment to the nearshore nourishes the beach profile and can reduce energy impacting the shoreline by breaking waves farther offshore.
- Nearshore nourishments keep more dredged material in the sediment system than confined or offshore disposal. Keeping the sediment in the littoral system helps reduce erosion associated with sediment limited or starved environments.
- Fine material winnows from the nearshore nourishment and is transported offshore. It does not end up on the beach because it is too energetic to settle.



Common sediment transport processes are shown and shoreline accretion is commonly observed on the lee side of the nearshore nourishment.



Nearshore nourishment projects can reduce the wave energy impacting the shoreline by breaking the large waves farther offshore.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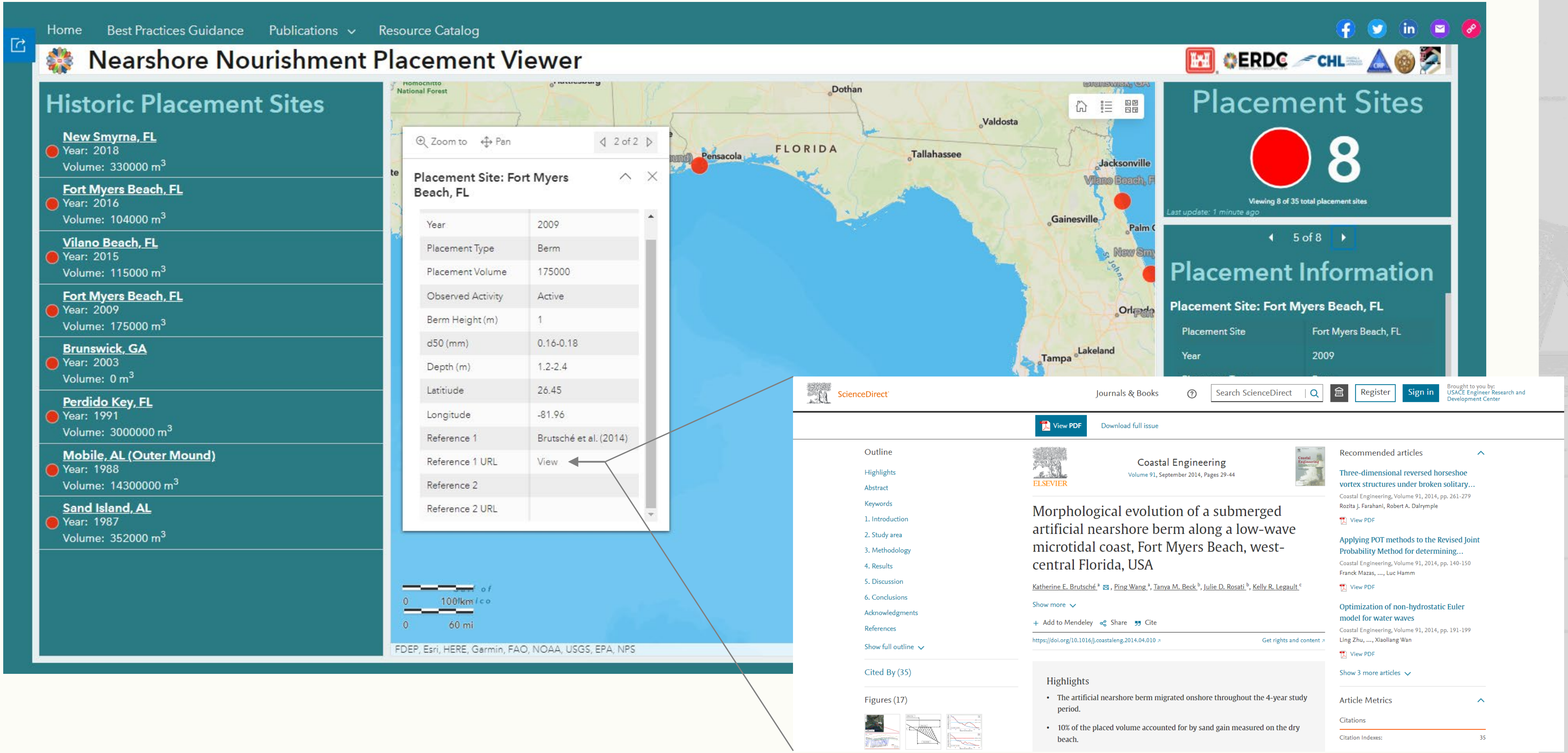
Nearshore Nourishment Placement Viewer
Historic Placement Sites
South Padre Island, TX
Year: 2018
Volume: 382000 m3
New Smyrna, FL
Year: 2018
Volume: 330000 m3
Ogden Dunes, IN
Year: 2016
Volume: 107000 m3
Fort Myers Beach, FL
Year: 2016
Volume: 104000 m3
Vilano Beach, FL
Year: 2015
Volume: 115000 m3
Mouth of Columbia River (MCR) - South Jetty
Year: 2014-2018
Volume: NaN m3
Fort Myers Beach, FL
Year: 2009
Volume: 175000 m3
Mouth of Columbia River (MCR) - North Jetty & Shallow Water Site
Year: 2006-2009
Volume: NaN m3
Ocean Beach, CA
Year: 2005-2007
Volume: 690000 m3
Brunswick, GA
Year: 2003
Arctic Ocean
North Pacific Ocean
North Atlantic Ocean
South Pacific Ocean
South Atlantic Ocean
Southern Ocean
NORTH AMERICA
EUROPE
AFRICA
SOUTH AMERICA
AUSTRALIA
Grays Harbor, WA
Ocean Beach, CA
Long Branch, NJ
New River Inlet, NC
South Padre Island, TX
Limfjord Barriers, Denmark
Noordwijk, the Netherlands
Copacabana Beach, Brazil
Durban, South Africa
Kirra Beach, Australia
Tauranga Bay, New Zealand
0 2000 km
0 1000 mi
Esri, FAO, NOAA, USGS
Powered by Esri
Placement Sites
38
Viewing 38 of 35 total placement sites
Last update: 1 minute ago
4 of 38
Placement Information
Placement Site: South Padre Island, TX
Placement Site South Padre Island, TX
Year 2018
Placement Type Berm
Placement Volume 382000
Observed Activity Active
Berm Height (m)
d50 (mm) 0.19
Depth (m) 9.1
Latitiude 26.11
Longitude -97.16
Reference 1 Figlus et al. (2021)
Reference 1 URL
Reference 2
Reference 2 URL
Last update: 1 minute ago



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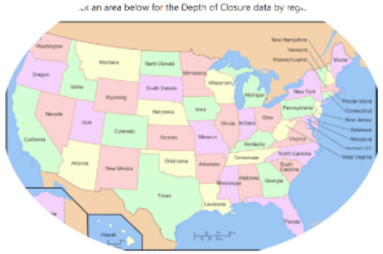
Resources and Tools

A collection of web applications, tools and sites for nearshore nourishment project planning.

The Sediment Mobility Tool (SMT) is a web-based scoping tool that can estimate how frequently sediment placed in the nearshore will move, the cross-shore transport direction, the nearshore wave rose, the transport rate from the placement location, the depth of closure, and how the potential site compares to historical projects.

Use the tool

User's Guide

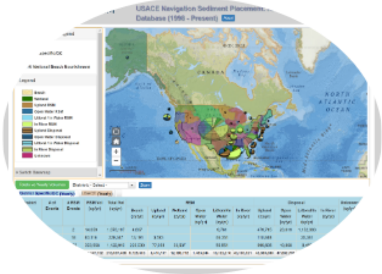


Depth of Closure Information

The depth of closure is the theoretical depth along a beach profile where sediment transport is very small or non-existent. Depth of closure calculations using several different empirical equations are shown as a static layer on the Sediment Mobility Tool and can be downloaded in bulk in spreadsheet form.

View the site

Methodology Description



USACE Navigation Sediment Placement: An RSM Program Database (1998-Present)

The placement of dredged sediment from the inventory of Federal navigation projects is consolidated into this web application. In this database, nearshore nourishment projects are listed as "Littoral/In Water RSM". See the Fact Sheet for additional information.

View the site

Fact Sheet

USACE's Beneficial Use of Dredged Sediment Website

Nearshore nourishment is one common method to beneficially use dredged sediment. The USACE Beneficial Uses of Dredged Sediment Website consolidates publications, guidance documents, success stories, and regional BU efforts on one website.

View the site

Learn More

Learn about best practices for nearshore nourishment projects, and find relevant technical publications to support your work.

Best Practices Guidance

Peer-reviewed Journal Articles

USACE Technical Publications

Contact a Researcher

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Related Links

U.S. Army Corps of Engineers Engineer Research and Development Center

ERDC Coastal & Hydraulics Laboratory

Coastal Inlets Research Program

Regional Sediment Management Program

Dredging Operations and Environmental Research Program

Acknowledgements

This website was created with funding from the US Army Corps of Engineers Coastal Inlets Research Program (CIRP), Regional Sediment Management (RSM) program, and the Dredging Operations and Environmental Research (DOER) program. The nearshore nourishment research team graciously acknowledges the Nearshore Nourishment District Advisory Group (DAG) that has guided and steered research efforts in recent years.

Best Practices Guidance

References, summaries, and key findings for nearshore nourishment project current practice, scoping and planning, design, monitoring, and success.

Current Practice | Scoping and Planning | Design | Monitoring | Success Metrics

Walker et al. (in press) synthesized interviews from all 21 Coastal and Great Lakes USACE Districts to determine the current state of nearshore nourishment practices. Each district was asked about current nearshore nourishment projects, regulations encountered, monitoring conducted, and success metrics used.

Key Findings

- 19 of the 21 Coastal and Great Lakes regularly conduct nearshore nourishment projects.
- Several Districts noted that their open water placement areas may be in the littoral system because the areas are very dynamic due to wave activity, frequent storms, and strong currents.
- Monitoring was not typically conducted because most nearshore nourishments were navigation projects.
- There are significant opportunities to increase beneficial use of dredged sediment through nearshore nourishment.

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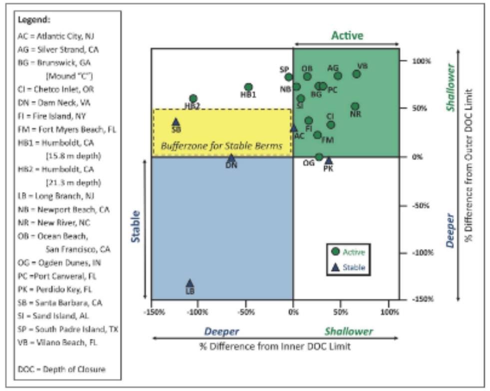
McFall et al. (2021) highlights several rapid techniques to evaluate potential nearshore nourishment sites and analyzes numerous historical projects.



Relationship between depth of closure equations and stability of historical nearshore nourishment projects (from McFall et al., 2021 and expanded from Hands and Allison. 1991).

Key Findings

- Evaluation techniques like the frequency of mobility, mean mobility score, and depth of closure analysis are useful tools to estimate whether nourishments will be stable or active, and how active they may be.
- All the evaluation techniques tested are included in the Sediment Mobility Tool web application.
- The depth of closure active/stable analysis of historical projects from Hands and Allison (1991) was expanded to 20 projects as shown below.

Bain et al. (2021) superimposed cross-shore and longshore sediment transport equations to estimate transport from the placement site of nearshore nourishment projects.

Key Findings

- A recommended technique to estimate transport from the nearshore nourishment was developed by coupling the transport equations from Shaeri et al. (2020) and Dronkers (2016) to provide an order of magnitude estimate of the nourishment lifespan (Will the nourishment still be present in a week, month, or year?).
- The technique is included as an advanced feature in the Sediment Mobility Tool web application

Johnson et al. (2021) numerically modeled three common nearshore nourishment shapes (elongated bar, undulated bar, and discrete mounds) at

Key Findings

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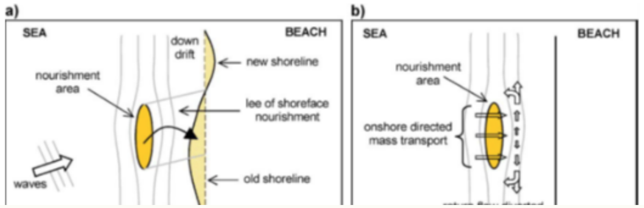
Project Design Considerations

The design rigor of nearshore nourishment projects may vary depending on a range of circumstances (e.g., dredged volume, habitat locations, distance from navigation channel), but all nearshore nourishment projects benefit from some design considerations.

The following items should be considered in the project design:

- Littoral zone extents
- Hydrodynamic conditions
- Expected sediment transport direction
- Sediment budget
- Sediment characteristics of dredged material and the placement area
- Metrics required for 401 Clean Water Certificate
- Is nearshore placement the least cost alternative?
- Is there a long-term strategy for adaptive management?
- Expected equipment limitations
- Expected volume

Morphological and hydrodynamic processes generally occurring at nearshore nourishment project sites:



- Large waves can break over the nearshore nourishment, which dissipates energy, and a calmer climate will occur behind the nourishment.
- Shallower nearshore nourishments will dissipate more wave energy through wave breaking, but the nourishment sediment will disperse from the placement area faster in the more energetic, shallow water.
- Shoreline accretion is very common on the lee side and updrift of the nearshore nourishment (Brutsché et al. 2019), which is usually attributed sand being trapped from a reduction in the wave-driven longshore current (van Duin et al., 2004) and some shoreline erosion downdrift of the nourishment can occur. See Figure a at left.
- Waves that shoal across the nearshore nourishment produce a velocity asymmetry near the bed caused by the wave skewness which generates on-shore directed transport. See Figure b at left. No monitored nearshore nourishments in the US have moved seaward (Ahrens and Hands, 1998).
- Fine material is winnowed from the nearshore nourishment and is transported offshore because it is too energetic to settle in the nearshore and surfzone.

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Current Practice | Scoping and Planning | Design | Monitoring | Success Metrics

Several guidance documents have identified the need to monitor nearshore nourishment projects (Beck et al., 2012). Tyler et al. (2018) details monitoring techniques including bathymetric surveys, sediment sampling, water quality measurements, and wave and current measurements. An example monitoring plan and monitoring frequency is provided. Monitoring during the first year is recommended to capture when most of the morphological changes will occur.

van Rees et al. (2022) provides a monitoring framework for learning to improve natural infrastructure projects which includes initial performance monitoring, long-term monitoring, and research and development monitoring.

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Clearly defined goals and performance metrics for projects will set clear expectations and will lead to long-term project support from local stakeholders and the public. Success metrics are particularly important when a cost-share partner is involved in the project, and documenting metrics of success establishes a body of evidence of successful placements without negative impacts. McFall et al. (2021) provided guidance for project success metrics for each phase of the project that were developed through the interviews with the 21 USACE Coastal and Great Lakes Districts.

Because each project is unique, no universal success metrics were provided, but the following questions were provided assist in determining the useful metrics to highlight successful projects:

Construction Metrics

- Was the sediment placed in the planned location?
- How thick was the placement?
- Were waves seen breaking over the placed sediment during construction?

Post-Construction Metrics

- Can you show no harm was done?
- Did the placed sediment move?
- Did the shoreline or profile change?

Adaptive Management

- Did the sediment move at the expected rate?
- Did the nearshore nourishment positively impact the shoreline?
- Was there any feedback from the community about the project?

Summary

FY22 Major Advances in Capability

The Nearshore Nourishment Knowledge Hub provides a user-friendly and web-accessible format for:

- Key communication points,
- Historical Project Information,
- Tools and useful info about them,
- Best Practices Guidance on Scoping and Planning, Design, Monitoring, and Success Metrics
- A compilation of peer-reviewed journal articles and USACE Technical Publications

FY22 Major Products & Collaborations

- The Nearshore Nourishment Knowledge Hub
- One co-sponsored peer-reviewed journal publication and one SR
- International collaboration to consolidate shoreface nourishment knowledge in a review paper
- Leveraging with work in RSM, DOER, and Section 1122
- Presented one CIRP Tech Discussion and at ICCE 2022

Next Steps

- Finish incorporating CIRP Tech Discussion feedback to add example construction plans and contract documents and finalize Nearshore Nourishment Knowledge Hub release
- Continue collaborating on the shoreface nourishment review paper