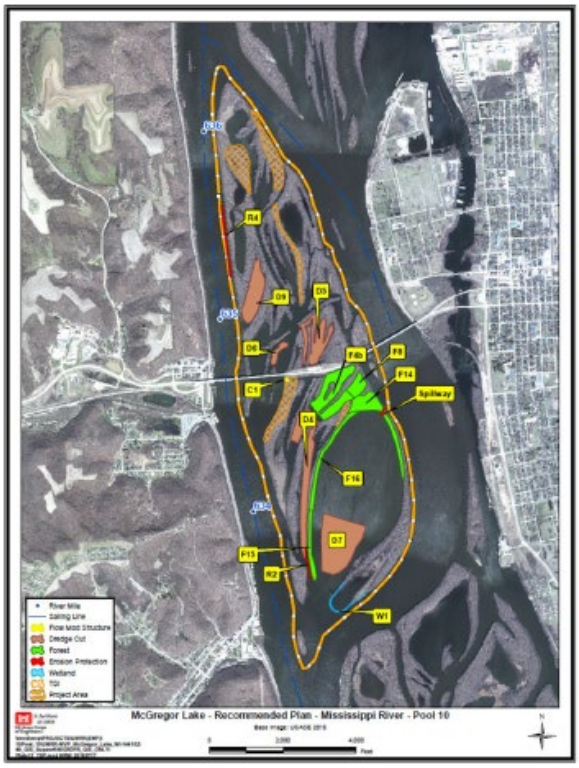
Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Evaluating Upper Mississippi River Dredged Material Restoration Soils

BU Characterization

Ecosystem Restoration Plantings, Riverine



Project Purpose

US Army Corps of Engineers (USACE) ecosystem restoration (ER) and beneficial use of dredged material (BUDM) projects **frequently** construct islands from navigation channel and harbor dredging sand and cap them with fine sediment dredged from backwater aquatic habitat restoration. The "layer cake" methods are generally successful but there is **variation** among sites and **plant species response**. Upper Mississippi River ER and BUDM uses adaptive management to improve their project design but **evaluations are limited** to vegetative response and there is **little knowledge** of soil development and soil-vegetation relationships.

The Upper Mississippi River Restoration Program (UMRR) has completed dozens of projects using dredged material with little evaluation beyond observing vegetation community development. There is little as-built information on soils so determining the mechanism for vegetation success or failure is uncertain.

In collaboration with UMRR and Upper Mississippi River USACE districts, ERDC evaluated **soils physical, chemical, and microbial characteristics which are critical to plant survival.** Pilot studies were supported by USACE St. Paul District (MVP) and ERDC's Dredging Operations Technical Support Program (DOTS).

Project Description

Project planners (UMRR, ERDC, participating USACE districts) designed several projects to evaluate vegetation response to different restoration soils and ERDC **evaluated characteristcs of soils from these restoration sites and soils from a reference site.**

Several experimental plots were investigated in this one project**:**

- Conway Lake Habitat Rehabiliation and Enhancement Project (HREP), to evaluate vegetation response to different depths of fine sediment placement over sand
- McGregor Lake HREP is testing a blended soil methodology over multi-acre project features.
- In Rock Island District inexpensive annual cover crops are being used to condition soils prior to planting expensive native seed mixes.

- ERDC researchers **documented** construction methods and **collected** soil characterization data.
- Pilot studies characterizing floodplain soils started in 2020. The collaboration documented differences in native soils, dredged material placement sites, and restoration soils.

Project Benefits

- Understanding the mechanisms of plant growth on restoration soils will help **optimize** ER/BUDM project design which will **save costs** and **improve** outcomes for vegetative plantings and habitat outcomes on USACE projects.
- Clear documentation and dissemination of ER/BUDM project features will **support** technology transfer and make future project planning and implementation **more efficient** and **cost-effective**.

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Beneficial Use of Dredged Sediments

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Evaluating Upper Mississippi River Dredged Material Restoration Soils

Innovations and Advancements

Upper Mississippi River Restoration is a leader in river habitat restoration design and implementation. Restoration islands have evolved over time to optimize their geomorphic and hydrodynamic function, but little attention was paid to the role of substrates/soils on project success. Many soil treatments have been applied, but typical design includes fine backwater sediment placed 1 – 2 feet over a sand base. UMRR and other restoration projects use adaptive management to improve their Habitat Rehabiliation and Enhancement Project (HREP) design. This project evaluated a range of factors related to dredge material capping and soil blending at different locations. **Guidance from the results will improve future project design for USACE projects managing soft substrates in ecosystem restoration projects and provide the basis for long-term project evaluation at these sites.**

Lessons Learned

Soil science has not been a significant component of USACE ecosystem restoration projects where outcomes are evaluated as habitat and biological response. Concerns over vegetation response to ecosystem restoration measures identified problems and research needs. An adaptive management approach incorporating several projects was adopted to address learning needs.

Partnering

Upper Mississippi River Restoration is a strong partnership of state and federal agencies collaborating on restoration design and evaluation. ERDC support to the program adds new research capabilities to investigate the mechanisms for USACE project success.

Outcomes

ERDC and Upper Mississippi River USACE districts have developed a strong research partnership where local data, resources, and projects can be accessed and augmented by ERDC research and development capabilities to improve project outcomes.

Additional Information?

Upper Mississippi River Restoration:
https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/Upper-Mississippi-River-Restoration/About-Us/
https://acsess.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/cft2.20096

What is next?

USACE BUDM and ecosystem restoration are highly compatible activities that can provide valuable dredged material for efficient navigation operations and project delivery. Activity on the Upper Mississippi River is highly transferable to other projects in the region and beyond where the USACE manages sediment. Pilot studies characterizing floodplain soils started in 2020 through an ERDC-U/MVP/DOTS collaboration documented differences in native soils, dredged material placement sites, and restoration soils. New projects starting FY21 will review project design and construction methods and collect as-built baseline soils data on completed projects.

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Beneficial Use of Dredged Sediments

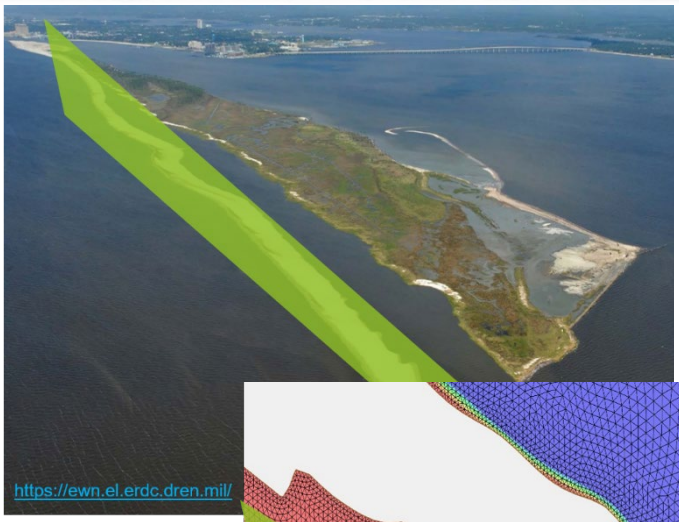
Productive and postive uses of dredged material.

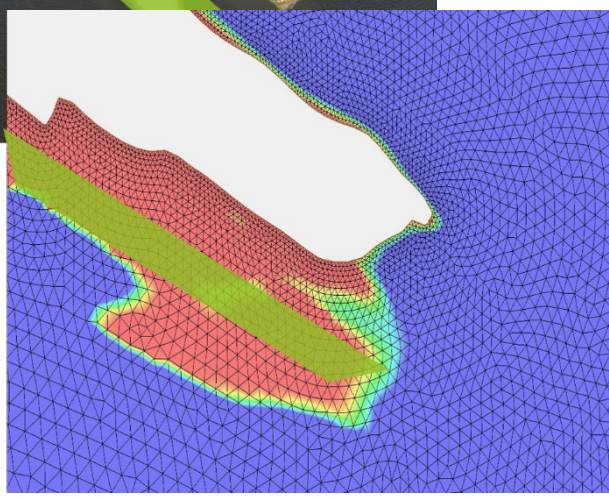
Engineering With Nature (EWN) Coastal STORM (CSTORM) Modeling Toolkit

BU Characterization

Model Development

Project Purpose





Hydrodynamic numerical models are often used to evaluate the potential impact of Engineering With Nature (EWN) features on the coastal resiliency of communities and surrounding ecosystems. These models quantify changes to predicted storm surge values, inundation, and wave attenuation for various hydrodynamic conditions, including a full range of storm events. Presently numerical modeling of EWN features requires a manual integration of Natural and Nature-Based Features (NNBF) into model setups, which entails a high level of skill and a significant time commitment on the modeler's part. Each time the feature is altered, that manual integration must be performed. Consequently, a limited set of NNBF measures will be implemented numerically for a subset of storm conditions, and those effects will be extrapolated to other study regions, increasing the uncertainty of the study conclusions. The purpose of this project is to include a toolkit to create and permutate EWN features within the Coastal STORM – Modeling System (CSTORM-MS) of numerical models, allowing practitioners to evaluate variations of design parameters for varying NNBFs without having to manually modify model setups every time, leading to a significant time and cost savings.

Project Description

- The EWN CSTORM-MS toolkit will be implemented to streamline the inclusion of NNBF designs into the hydrodynamic numerical modeling process.
- This tool will allow the user to quickly add designs of dredged channels and borrow pits, as well as the NNBF features developed through BU practices into hydrodynamic modeling.
- The toolkit is accessible in a Graphical User Interface (GUI) and included guidance that will allow the user to include EWN feature-based designs with the CSTORM suite of numerical models.

Project Benefits

USACE dredges sediment to maintain navigation channels and reservoir capacity, costing the USACE over $1 billion annually. Dredging and placement practices are primarily driven by resource agency policies and are also limited by unknowns in the complete lifecycle process of the system. The EWN CSTORM toolkit allows BU designers and planners the chance to eliminate some of those unknowns. The hydrodynamic effects BU designs will have on coastal/riverine environments can be estimated through the semi-automated development of a numerical model through this toolkit. This allows for additional investigation into various designs at a reduced cost (time/resources).

Partnering

The software company – AQUAVEO Inc. is helping to develop the toolkit's GUI within the existing SurfaceWater Modeling System (SMS) software package. USACE districts have agreed to be toolkit testers during their BU projects as well.

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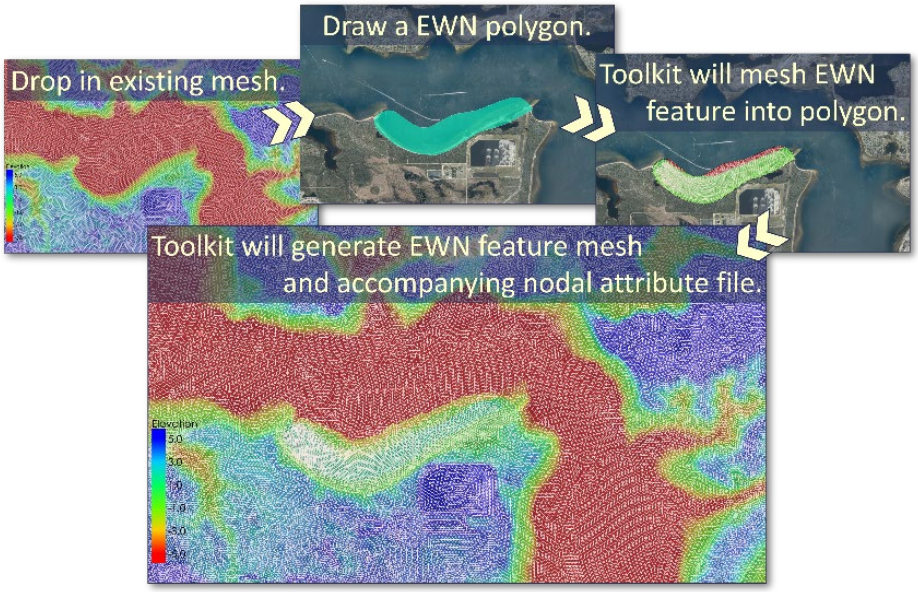
Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Engineering With Nature (EWN) Coastal STORM (CSTORM) Modeling Toolkit

Innovations and Advancements

- Development of a scene builder GUI that allows for the rapid representation of BU NNBF and dredged channel features within the context of the coastal/riverine environment,
- Semi-automated mesh/grid representation of the NNBF/BU features within the CSTORM model setups, and
- Semi-automated assignment of model properties associated with NNBF/BU features upon generation, such as friction coefficients and elevations.



Lessons Learned

- To encougage greater collobration and faster software updating, the toolkit was designed to be able to work outside of the GUI
- Adjustment in modeling resolution needs per BU/NNBF feature can range rapidly per project and surrounding area. Though the toolkit will automatically update resolution to fit the feature's size and type into the existing mesh, the user may need to make some adjustments of their own; based on computational tools available to them and the uncertainty of their input data (i.e., resolution of the DEM used to develop surrounding topography/bathymetry).

Outcomes

The toolkit will aid modelers in two primary ways: streamlining and standaridizing model setup. The GUI will allow users to access automated discretization or re-meshing of the area where an EWN feature is to be added based on the spatial constraints of the feature and then quickly parameterize those BU design features within the CSTORM-MS while automatically incorporating best use guidance.

This product will reduce personnel resources associated with EWN and NNBF feature analysis and design work and allow for more feature analysis. With this toolkit, users will have the ability to rapidly manipulate multiple aspects of BU design, reducing uncertainty related to coastal engineering reliability and resiliency benefit.

Additional Information?

Tritinger A, Massey C, Piercy C, Bryant M, Bukhari F. Engineering with Nature Toolkit for ERDC's Coastal Storm Modeling System. https://cdr.lib.unc.edu/concern/scholarly_works/6d570277j

Massey, T. Chris, Ty V. Wamsley, and Mary A. Cialone. "Coastal storm modeling-system integration." In *Solutions to Coastal Disasters 2011*, pp. 99-108. 2011. https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/476697/coastal-storm-modeling-system/

Massey, T. C., N. R. Pradhan, A. R. Byrd, and D. E. Cresitello. "USACE-ERDC coastal storm modeling systems in support of hurricane sandy operations." *Flood Risk Manage. Newsletter* 6, no. 4 (2013): 2-3.

What is next?

Future research will be done to incorporate sub-domain modeling guidance and procedures into the toolkit. This will allow for rapid sensitivity testing of BU features within a large-scale CSTORM-MS system without the need to re-run the entire mesh each time, which will keep the computational time and resource demand low.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Guidance for Thin Layer Placement (TLP) of Fine and Coarse Grained Sediment

BU Characterization

Back bay, Tidal Wetlands, Near shore

Project Purpose

Thin layer placement (TLP) is the purposeful placement of thin layers of sediment (e.g., dredged material) in an environmentally acceptable manner to achieve a target elevation or thickness. TLP objectives include infrastructure maintenance and the creation, maintenance, enhancement, or restoration ecological function. **Wetland TLP is experiencing a renaissance** due to a confluence of various forcing functions such as rising sea levels, degrading wetlands, limited dredged sediment placement and disposal areas, etc., but **there is a dearth of definitive operational and environmental guidance on how to conduct it, what to monitor for, and what ecological results look like.** Regulatory agencies, including the US Army Corps of Engineers (USACE), have significant concerns with TLP with regard to the "do no harm" principle and uncertainty in how to permit and adaptively manage these projects. **Guidance is required** to optimize acceptance and the success of TLP as a solution to wetland degradation and dredged material placement.

Project Description

The objectives of this research task are to distill knowledge and information from three sources:

1. Past and currently developing TLP projects.
2. Ongoing pertinent TLP research and development activities.
3. Field practitioners who have worked on TLP pilot projects in a variety of environments.

These elements will be synthesized into **guidance** documents designed for use by both USACE and stakeholders to **optimize** the planning, permitting, design, construction, and maintenance of TLP projects.

Project Benefits

Guidance provided by this research task will **improve** the planning, permitting, design, construction, and maintenance of TLP projects to **facilitate** the acceptance and expansion of TLP in using dredged material from navigation projects beneficially to **restore** degraded wetlands.

Innovations and Advancements

While no new research was conducted as part of this effort, many TLP pilot projects occur in a vacuum or with limited communication to external parties. The state of the practice workshop proved to be an excellent problem-solving forum and helped clarify the multiple points-of-view TLP stakeholders may have.

Points of Contact: *Dr. Candice Piercy (ERDC EL),* Candice.D.Piercy@usace.army.mil

Guidance for Thin Layer Placement (TLP) of Fine and Coarse Grained Sediment

Lessons Learned

Guidance documents need not be definitive, especially in emerging areas. However, common sense and best practices may help future projects prevent pitfalls. Additionally, great value comes from clearly defining terms for types of projects where multiple scientific and engineering disciplines interact. Education and communication amongst stakeholders is key to project success.

Partnering

The research is a collaborative effort co-authored with researchers from ERDC's Environmental (Candice Piercy) and Coastal Hydraulics (Tim Welp) Labs and Texas A&M University (Ram Mohan). Additionally, Federal, state, NGO, and industry partners provided input via a workshop on the state of the practice of TLP. All workshop participants had experience with TLP projects in some capacity.

Outcomes

Final document is under review with anticipated release date by end of calendar year 2021.

What is next?

- This document will hopefully aid districts in their pursuit of further developing TLP projects and increase BU.
- The biggest immediate hurdle remains the ability to substantially scale TLP projects in size and application. Many remain pilot or one-off projects. The goal is to advance TLP practice such that it is a common tool to be used for BU.

Points of Contact: *Dr. Candice Piercy (ERDC EL),* Candice.D.Piercy@usace.army.mil

Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Gull Island Habitat Restoration and Marsh Protection, New Jersey

BU Characterization

Back Bay Island Restoration, Marsh edge protection

Project Purpose

Gull Island, in Cape May County, NJ, along with adjacent Sturgeon Island, supports nesting for 25 percent of the wading birds in New Jersey[1]. Habitat suitability has **declined** at Gull Island in recent years, with remnants of historical dredge placements supporting the only remaining suitable habitat. Low marsh and inland tidal flats along the southern portion of the island were selected for dredged material placement to **build elevation** on the marsh platform, as well as along the subtidal flats that **protect** the marsh edge from erosion and support habitat. Philadephia District (NAP) partnered with USACE Engineer Research and Development Center (ERDC), the State of New Jersey and The Wetlands Institute (TWI) to place dredged material from the NJ Intracoastal Waterway through the Seven Mile Island Innovation Laboratory (SMIIL) and evaluate beneficial use of dredge material management practices for marsh restoration and marsh edge protection. Research, supported through various research programs, including the Dredging Operations and Environmental Research Program (DOER) and Regional Sediment Management program (RSM), is being conducted to evaluate the effectiveness of dredged material placement processes.

Project Description

In the Fall of 2020, approximately 40,000 cubic yards were dreged from the NJ Intracoastal Waterway (NJIW) and placed on Gull Island. Material was pumped to a Y-valve which directed flow to two separate placement locations:

1. Dredged slurry was pumped to an interior location on the southern portion of the island. A sandy mound was created near the discharge with the fines distributing farther covering about 20 acres of the marsh platform.
2. Mateiral was directed to pipeline attached to a floating platform along the southern edge of Gull Island, discharging material in open water to create a sandy marsh-edge bar which will serve as edge protection from storm- and boat-induced waves.

- Elevation monitoring is being conducted to evaluate consolidation of the placed material and the extent to which elevation goals have been met. A mass balance is also being perfomed to qualitatively evaluate how sediment was transported and contained across the site and within the surrounding mudflats.
- Submerged Aquatic Vegetation (SAV) and benthics are being monitored to evaluate benefits from the dredged material placements.
- The site will be monitored over time to capture long-term consolidation, vegetation establishment and habitat suitability and use.

Project Benefits

Productive and positive uses of dredged material for this project include (1) raising marsh elevation to create high marsh areas for salt marsh sparrow and wading birds, (2) restoration of unvegetated interior mud flats, (3) enhancing tidal flats for SAV and fish habitat and reducing marsh edge erosion. Additionally, results from the mass balance approach will help in developing a better understanding of sediment transport and consolidation, that will inform future placements for setting project expectations and determining the need (or lack of) for containment for meeting project goals.

[1] USACE. (n.d.). *Seven Mile Island Living Lab – Sturgeon Island Restoration* [Fact sheet]. US Army Corps of Engineers – Philadephia District. https://www.nap.usace.army.mil/Portals/39/docs/Civil/Coastal/Sturgeon-Island-Factsheet-Final.pdf

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Gull Island Habitat Restoration and Marsh Protection, New Jersey

Innovations and Advancements

Innovative practices implemented at Gull Island include **unconfined placement**, which is not typical for fine-grained dredged slurries. The decision to forego confinement techniques reduces costs and limits disturbance to the marsh for installation and removal of containment features, and promoted benefits across multiple island regimes including mounding near the discharge, elevation enhancement of interior tidal flats, and slurry transport through tidal channels and direct placement to build tidal flats. Unconfined placement also allows for creation of natural slopes. **Demonstration of the benefits of unconfined placement and a lack of ecological impacts could result in cost savings and more efficient dredged material placement for future projects.** Additionally, a newly developed tool, the Sediment Profile Imaging (SPI) scanner, was employed for real-time monitoring of placement in subtidal areas. The SPI scanner is inserted into the sediment bed and captures high quality images of the seabed and the overlying water column. The images are used to evaluate bed composition and benthic habitat recovery. It was found to be a useful tool for monitoring placements.

Lessons Learned

From the slurry placed on the marsh platform, much of the sand appears to have deposited within a mound near the pipe discharge, while the fines slurry spread over a larger area with some material making its way to tidal outlets, intentially creating tidal deltas that have persisted. Both indirect placement through tidal channels and direct placement along the flats appear to be effective strategies to shallow the flats above MLLW into a zone more suitable for SAV. While additional monitoring is needed to determine the project's success, early observations indicate successful elevation enhancement and creation of a marsh-edge bar, and did not reveal significant ecological impacts as a result of unconfined placement.

Due to difficulties accessing the site immediately post-placement, remote monitoring techniques are needed. There are also challenges associated with obtaining accurate survey data, such as inability to access the site via ground-based techniques, and interference from vegetation and water coverage for lidar based methodologies.

Partnering

This project represents a collaboration among the consortium of stakeholders within the SMIIL, which includes NAP, TWI, ERDC, the State of New Jersey, academic institutions, and private parties. The SMIIL stakeholders worked together to design and vet placement strategies, and monitor sediment placement and subsequent changes over time. Multiple ERDC teams contributed to the overall success and lessons learned through a range of research and monitoring objectives, evaluating evolution of the mudflats and marsh platform, turbidity and sediment transport, wave and current dynamics, and benthics and SAV.

Outcomes

Success of the dredged material placements at Gull Island is still being evaluated. Field data collection in July 2021 will inform the mass balance, and consolidation behavior as well as stability of the marsh platform. *Spartina* has begun to reestablish on the interior flat suggesting sufficient elevation was attained to support vegetation. The placement area was previously very low and converting from marsh to mud flat; reversal of that trend will be evaluated as an outcome. Long-term success will be measured in terms of habitat suitability and use by wading birds, SAV establishment, and marsh edge stability.

Additional Information?

Additional information on SMIIL and marsh restoration can be found at: https://wetlandsinstitute.org/smiil/ and https://www.nap.usace.army.mil/Missions/Civil-Works/Coastal-Dredging-Beneficial-Use/.

What is next?

Monitoring elevation of Gull Island will be continued and will be used to determine whether additional dredged material is needed and how it should be placed to build elevation to support nesting habitat and a sustainable marsh. Demonstrated success may allow elevation enhancements at other locations across the 287-acre island.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Horseshoe Bend Island, LA

BU Characterization

Riverine; Island Creation

Project Purpose

To meet the anticipated disposal requirements for future channel maintenance from the Horseshoe Bend region of the Atchafalaya River, the US Army Corps of Engineers New Orleans District evaluated the mounding of material at mid-river open water placement sites within a 350-acre (142 ha) area immediately adjacent to the navigation channel and upriver of a small naturally forming island. Beginning in 2002, strategic placement of between 0.5 to 1.8 million cubic yards of sediment was conducted every 1 to 3 years which influenced and contributed to the development of an approximately 35 ha island mid-river (Horseshoe Bend Island). To help understand how and why the island was formed over the last 12 years, the USACE conducted studies to better understand the hydrology of the river used to transfer the mounded material onto the island.

While the strategic placement of dredged sediments upriver of a naturally-occurring island was initially conducted to reduce dredging costs and promote island growth, additional environmental, navigation, and climate change benefits were realized using this innovative placement practice.

This research was funded by the Dredging Operations and Environmental Research (DOER) program. Ongoing research being funded by the Monitoring Completed Navigation Projects (MCNP) program is applying hydrodynamic models to determine the hydrodynamics and sediment characteristics required to successfully apply this best practice elsewhere.

Project Description

The study used a multi-factor ecological assessment including: 1) landscape geomorphology, 2) ecosystem classification, 3) floral communities, 4) avian communities, 5) aquatic invertebrates, 6) soils and biogeochemical activity, and 7) hydrodynamic and sediment modeling.

Project Benefits

Monitoring associated with this project found:

- Horseshoe Bend Island provides habitat and biogeochemical functions at rates comparable or exceeding those at a traditional dredged material supported island and a natural reference island in the area.
- Horseshoe Bend Island supports complex communities of vegetation, invertebrates, soil microbes, and higher organisms, including >85% native species.
- The island's development increased flow velocity and sediment transport, allowing for channel realignment, thereby reducing fuel use and travel time and increased navigation safety.
- The project **substantially** reduced a $4.3M annual dredging requirement to once every 4 to 5 years.

Innovations and Advancements

- The Horseshoe Bend Island project exemplifies what can be achieved through the application of Engineering with Nature (EWN) concepts and practices.
- Investigations quantifying the multiple environmental and other benefits of using dredged material to create riverine islands provides a more complete understanding of the island's formation so this concept can be integrated into other dredging projects.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Horseshoe Bend Island, LA

Lessons Learned

- The practice of strategically placing dredged sediments upriver of a naturally-occurring island aided the island's growth to **produce greater environmental benefits** than using more conventional placement practices.
- Ecological components comprising primary producers, microbial communities, invertebrates that form the basis of aquatic food webs, and higher organisms were studied, providing a comprehensive assessment of dredged material supported wetlands. This **framework can be used in future studies** examining the ecological, societal, and economic value of the strategic placement of dredged material applied in this manner.

What is next?

Current research involves applying hydrodynamic models of the area of the river surrounding Horseshoe Bend Island to determine the hydrodynamics needed to successfully apply strategic placement strategies. The successful results at Horseshoe Bend are being applied elsewhere in coastal Louisiana and beyond.

Additional Information?

Several technical reports are peer-reviewed documents have been produced documenting the results of the project. The project has been internationally recognized and awarded by the Western Dredging Association (WEDA) and others.

Foran, C.M., Burks-Copes, K.A., Berkowitz, J., Corbino, J., and Suedel, B.C. 2018.. *Integr. Environ. Assess. Manage*. 14(6):759-768. DOI: 10.1002/ieam.4084.

Berkowitz, J.F., Green, L., VanZomeren, C.M. and White, J.R. 2016. Evaluating soil properties and potential nitrate removal in wetlands created using an Engineering With Nature based dredged material placement technique. *Ecological Engineering*. 97:381-388.

Suedel, B., Berkowitz, J., Kim, S., Beane, N., Summers, E., Evans, D, and Corbino, J. 2015. Creating Horseshoe Bend Island, Atchafalaya River, Louisiana. *Terra Et Aqua*. 140:26-31.

Partnering

Before sediment was placed in mounds upriver of the sandbar, the project team consulted with state and Federal environmental agencies to obtain feedback on the proposed innovative sediment placement approach as a more sustainable alternative compared to filling in wetlands or dumping the sediment in Atchafalaya Bay. In-kind support was provided by the U.S. Fish and Wildlife Service who provided visual inspections of the island and Great Lakes Dredge and Dock provided photo documentation support.

Outcomes

We demonstrated that each of the factors examined at Horseshoe Bend Island proved comparable or exceeded the other study areas examined, including the naturally formed riverine island and a traditionally created dredged material supported island. Sediment dredged from the adjacent Federal navigation channel during routine maintenance over 12 years was dispersed by the river's currents to self-design the island over time. This **innovative beneficial use** of dredged material for creating Horseshoe Bend Island can be applied in other riverine project scenarios to demonstrate the success and potential benefits of this application of the EWN practice of utilizing natural process for improving wetland creation and restoration outcomes.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Middle Mississippi River Island Creation

BU Characterization

Riverine; Island Creation; Habitat Creation

Project Purpose

There is a history in the United States of closing off side channels to concentrate flow in the main channel for the purpose of maintaining navigation dimensions. This has greatly reduced the availability of island and side channel habitat compared to what would exist on un-managed waterways. Furthermore, the widespread use of bank stabilization and denial of channel cutoffs have removed the natural mechanism for new island creation. The loss of side channels was documented as a major finding of the 1976 Environmental Impact Statement for the navigation project for the Middle Mississippi River (or MMR, the portion of the Mississippi River between the confluences with the Missouri River and Ohio River). A white paper written by St. Louis District (MVS) river engineers in 2011 documented flexible pipe usage, inventoried MMR islands, and discussed means for potential stabilization for an island created from dredged material. **The objective of this project was to use dredged material to create ephemeral islands to test the ability to artificially construct island/side channel habitat on the MMR.** These efforts were funded by the Biological Opinion program (established to offset impacts to threatened and endangered species from the navigation program) and ongoing District Operations and Maintenance for the navigation channel.

Project Description

- Approximately 100,000 cubic yards (cy) of material were placed at RM 103 by the Dredge Potter using flexible dredge pipe in November 2011.This created an ephemeral island approximately 10 acres in size. This location was monitored periodically for the next ~2.5 years until the placed material had eroded.
- Three additional efforts at different locations in the MMR totaling approximately 413,000 cy of material were completed in September 2013, including placement behind a chevron river training structure. Periodic monitoring revealed that the material had eroded in under 3 years.

Project Benefits

Ephemeral island sandbar habitats support a variity of fish species. In this area trawling and electro-fishing collected 625 fish comprising 18 different species. These islands are also a documented habitat type for the formerly listed Least Tern.

Innovations and Advancements

- Ephemeral island creation could be done successfully on the Middle Mississippi River.
- Material placement was successfully done behind an innovative river training structure.
- A permanent spill barge was constructed to aid in the placement of material to higher elevations and in more difficult locations. New connections were purchased for the flexible dredge pipe to speed assembly time to aid usage and reduce cost.
- A new web-based dredging scheduling tool was developed to aid in identifying potential beneficial use windows. The tool takes advantage of long-range Water Control forecasts and pre-dredge surveys to better approximate when dredging locations will become critical for maintaining navigation.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Middle Mississippi River Island Creation

Lessons Learned

- Timing is critical – additional beneficial use island creation efforts are desired, but high water events, the need for a dredging issue in a desired habitat area, and the additional flexibility required for scheduling a non-critical dredging location conflicting with “just-in-time” dredging has prevented further efforts thus far.
- The ephemeral island habitat did not last very long (2-3 years), and additional measures would be necessary to lengthen the benefit of the gained habitat. These additional measures would need further study, test case implementation, and monitoring.
- A consistent, ongoing effort is needed between partners and project leads to identify opportunities.

Partnering

The decision to try ephemeral island creation was a product of collaboration among the River Resources Action Team, a coordination group consisting of the U.S. Army Corps of Engineers – St. Louis District, U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, and the Missouri Department of Conservation focused on sustainable management of the Mississippi within the St. Louis District. The environmental agencies recommended locations where they would like to see habitat enhancement, and St. Louis District responded with where projects would work due to channel geometry and dredging need, along with the funds to accomplish the dredging and survey monitoring. Fish population monitoring was done by the St. Louis District’s environmental partners

Outcomes

Ephmeral island sandbar habitat was created that lasted over two years. Fish sampling showed that these islands did serve as habitat for a variety of species. After 2-3 years, the created island habitat had fully eroded away, due to its dependence on the hydrograph (susceptibility to flood events).

Additional Information?

This effort is documented as a case study in a pending Technical Report:

Gailani, J.Z., Suedel, B.C., McQueen, A.D., Lauth, T.J., Scheiblechner, U., and Toegel, R. 2021. Supporting Bank Stabilization and Riverine Habitat Using Dredged Sediment: Documenting Best Practices. US Army Engineer Research and Development Center, Vicksburg, MS.

The white paper referenced above:

Cox, A.N., J.L. Brown, R.D. Davinroy, and E.J. Brauer. 2011. Engineering Considerations for Island and Sandbar Creation Using Flexible Floating Dredge Disposal Pipe Middle Mississippi River, Miles 200.0 to 0.0. Technical Report M57. Applied River Engineering Center, U.S. Army Corps of Engineers, St. Louis District. 23pp. http://mvswc.mvs.usace.army.mil/arec/Documents/Environmental/M57_Island_and_Sandbar_Creation.pdf.

What is next?

Additional island creation is planned. The MVS dredging project has created and maintains a dredging “master plan” of potential sites for future island creation and creation of other ecologically important habitats. Furthermore, district environmental partners have requested that engineers research means to help stabilize beneficially-placed dredge material to create permanent islands. As such, discussions have begun between MVS and ERDC personnel about the correct way to research the conversion of river training structures into islands and structural means to make beneficial use dredge islands permanent.

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Other POC (MVP), Alison.M.Anderson@usace.army.mil

Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Multipurpose Ecosystem Functions and Engineering Benefits at Historical Dredged Sediment Beneficial Use Projects

BU Characterization

Riverine; Costal; Island and Marsh Creation; Habitat Improvement

Project Purpose

Dredged materials can be used to **improve** environmental outcomes while **maximizing** engineering benefits and **supporting** the Navigation mission. **Few** studies document mid- to long-term project benefits and USACE success stories remain poorly advertised. The purpose of the work unit was to **"fill the gap"** between recently restored systems and their mature counterparts, providing a framework to develop restoration trajectory curves allowing for extrapolation of EWN project benefits throughout a projects lifespan (Fig 1).

This research was funded by the Dredging Operations and Environmental Research (DOER) and Engineering With Nature (EWN) programs.

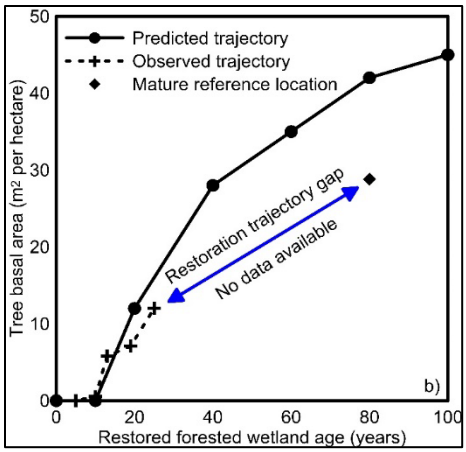


Fig 1. Trajectory curve displaying the "gap" in restoration outcome data (Berkowitz and Szimanski 2020).

Project Description

The study used a multi-factor ecological assessment including analysis of 1) landscape geomorphology, 2) ecosystem classification, 3) floral communities, 4) avian communities, 5) soils and biogeochemical activity, and 6) associated engineering benefits such as navigation channel maintenance, shoreline stabilization, water quality improvements, and elevation maintenance.

Monitoring occurred at 6 historic (i.e., >40 year old) dredged material placement locations across the nation, representing some of the oldest beneficial use project sites for which historic monitoring data is available (Fig 2). Project sites included a wide array of habitat types and landscape settings.

Fig 2. Study locations

Project Benefits

Monitoring associated with this project found:

- The beneficial use sites generally **achieved** the target habitat types designed through landscape evolution and ecological succession.
- The projects have **persisted** for decades without the need for additional intervention or the use of hard infrastructure.
- The study locations are **stable** features that will effectively **provide** ecological functions and engineering **benefits** into the future.
- The analysis highlights the capacity of beneficial use projects to yield **favorable** outcomes at decadal timescales.
- These study locations can **inform** ongoing efforts to incorporate EWN and BU concepts into common practice.

Innovations and Advancements

- These projects exemplify what can be achieved through the application of Engineering with Nature (EWN) concepts and practices, especially when design, implementation, and monitoring couple ecological and engineering perspectives.
- The development of restoration ecological and engineering trajectory curves informs practitioners designing projects and establishing project milestones to ensure that the full suite of habitat and engineering benefits are captured during life-cycle analysis.

Points of Contact: Jacob Berkowitz (ERDC EL), Jacob.F.Berkowitz@usace.army.mil

Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Multipurpose Ecosystem Functions and Engineering Benefits at Historical Dredged Sediment Beneficial Use Projects

Lessons Learned

- The variety of ecological functions and engineering benefits identified occur at different timescales that vary regionally and across different landscape settings.
- This study provides tools to further incorporate engineering benefits into project life-cycle analysis.

What is next?

We are currently publishing our results and will continue to conduct technology transfer to inform practitioners on this topic.

Additional Information?

Several technical reports, conference presentations, and peer-reviewed documents have been produced documenting the results of the project.

Fig 3. Several of the field sites revisited in 2019.

Berkowitz et al., 2021. An assessment of Long-Term, Multipurpose Ecosystem Functions and Engineering Benefits Derived from Historical Dredged Sediment Beneficial Use Projects. ERDC-TR-X

Berkowitz et al., In Press. Revisiting historic dredged material habitat improvement sites informs the future of beneficial use initiatives. Proceedings: Western Dredging Association, Dredging Summit and Expo. 2021. Virtual.

Berkowitz JF. 2021. From rivers to the coasts: Assessing wetland functions in altered landscapes improves ecological outcomes. Society of Wetland Scientists Annual Meeting. Virtual. (Invited oral plenary presentation)

Hurst NR, Berkowitz JF. 2021. Evaluating the Long-Term Success of USACE Wetland Creation Projects: 45 Years in the Making. 13th International symposium on biogeochemistry of wetlands. Virtual. (Oral Presentation)

Berkowitz JF, Szimanski D. 2020. Documenting Engineering with Nature® implementation within the US Army Corps of Engineers Baltimore District – completed projects and opportunities for chronosequence analysis. ERDC/TN EWN-20-3

Berkowitz JF, Hurst N. 2020. Filling the restoration trajectory gap: Evaluating the long term success of created wetlands. Soil Science Society of America Annual Meeting. Virtual. (Oral presentation)

Partnering

The construction of the historic dredged material habitat improvement projects were supported by the Dredging Research Program and the Dredging Operations Technical Support Program. The current monitoring effort was conducted in coordination and with outstanding support from project collaborators from 7 USACE Districts.

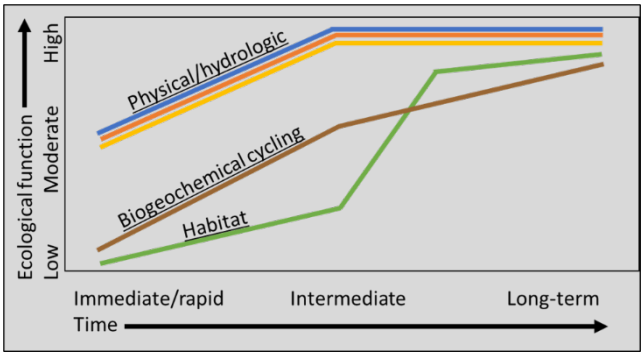


Fig 4. Functional response trajectories to BU.

Outcomes

We demonstrated that a combination of ecological functions and engineering benefits can be documented for beneficial use projects and that those positive outcomes persist for many years when projects integrate both ecosystem and engineering features into project design, implementation, and management. More research is needed to understand the variable time-scales and response rates observed across a variety of functional/engineering categories (Fig 4).

Points of Contact: Jacob Berkowitz (ERDC EL), Jacob.F.Berkowitz@usace.army.mil

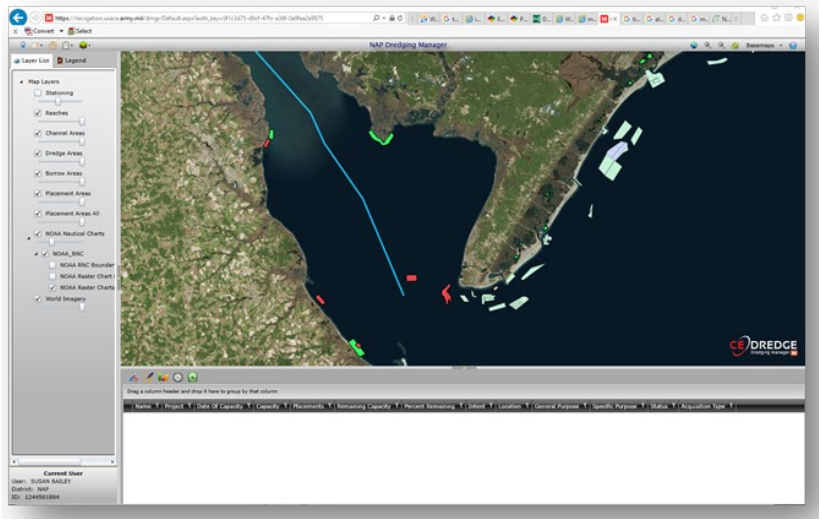
Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

National Placement Data Manager

BU Characterization

All types of dredged material placement



Project Purpose

The National Placement Data Manager concept stems from a request from USACE headquarters **to provide a database** of the Nation's Dredged Material Placement areas (NPDM) along with their corresponding capacities and life spans. An up-to-date database would **provide** readily available information as an alternative to the delayed gathering of information through time consuming data calls. Although the intent of the original request was to develop this database for decision-making by headquarters, such a tool would **provide** utility to Districts for dredged material management and **beneficial use facilitation**.

Funding was provided from the Dredging Operations Technical Support Program (DOTS) to generate a beta version of a database/web tool entitled National Placement Data Manager (NPDM).

Project Description

This beta version was designed to gather information from the Dredging Information System (DIS) regarding historical placements of dredged material, and a database of existing placement areas was provided in ArcMap. However, input was also required by the USACE districts to provide information regarding existing capacity and projected use of the placement areas as well as any plans that would impact capacity, such as site expansion or closure. The collected information was compiled to provide the projected capacity over time and life span of each placement area. Unfortunately, the beta version of NPDM was generated using outdated software, which is no longer supported. The web tool became inoperational before it could be implemented beyond initial beta testing. Funding has not been provided in recent years to regenerate the web tool.

Redevelopment of the tool is being considered under NavPortal where it could be readily incorporated into other tools. Potential exists to utilize the database to optimize dredged material management based on transportation costs, and perhaps ecosystem benefits.

Project Benefits

It is envisioned that this tool, if fully developed, would be useful toward **facilitating beneficial use** of dredged material:

- The tool would not only incorporate traditional dredged material disposal facilities, but would also include identified beneficial use sites, both those used historically and sites potentially available for future use.
- Background information about each site would be provided such as site capacity, placement area type, ownership and restrictions such as material type accepted.
- The ability to view the placement areas on a map, overlaid with our navigation channels would allow for rapid identification of potential placement areas.
- Aggregation of past placements allows analysis of trends with respect to dredged material placement and beneficial use.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

National Placement Data Manager

Innovations and Advancements

NPDM would provide a database of dredged material placement areas which would provide visualization of placement areas with respect to maintained channels, and convenient access to placement area information for planning purposes.

A database of this information is not known to exist. Ready access to accurate, up-to-date placement area information will facilitate dredged material management and optimization of resources for beneficial use.

Lessons Learned

Feedback from Districts on the beta version of the web tool revealed:

- Data collection should be automated to the extent possible, and time requirements by District personnel to input data should be minimized.
- The web tool should be intuitive for users to allow streamlined, accurate data collection.
- Coordination with other programs with similar websites or databases collecting information on beneficial use is needed to reduce redundancy and maximize benefits of the database.
- Based on the lack of utility of the original web tool developed with outdated software, it is important to scrutinize all software tools and expected long-term stability of any databases which will be relied upon for data input.

Partnering

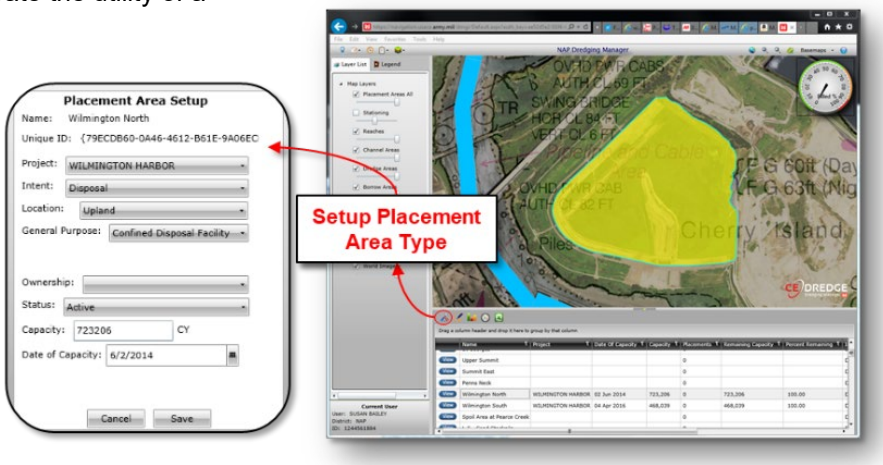
Funding to date for NPDM has been provided by the DOTS Assistance Program. ERDC researchers worked with Teresa Parks of Mobile District on development of the web tool. A portion of the data collected by the web tool comes from IWR's DIS. Several Districts also provided useful feedback on the beta version of NPDM. Future work should be coordinated with the Regional Sediment Management Program and other relevant programs to ensure the database provides utility to others that might utilize the information. The new version of NPDM would likely be developed within USACE Navigation Portal which will allow seamless linkage of data and tools for navigation related purposes.

Outcomes

Further project development is needed to demonstrate the utility of a placement area database.

What is next?

It is recommended that the NPDM database/web tool be developed as described. Coordination is needed with potential District users as well as programs focused on dredged material management and beneficial use to ensure maximum functionality.

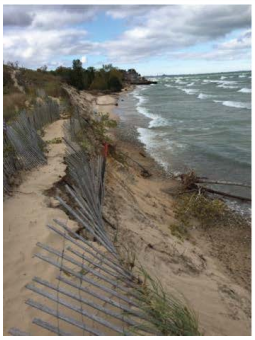


Points of Contact: *Susan Bailey (ERDC EL),* Susan.E.Bailey@usace.army.mil

Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Ogden Dunes Nearshore Nourishment



BU Characterization

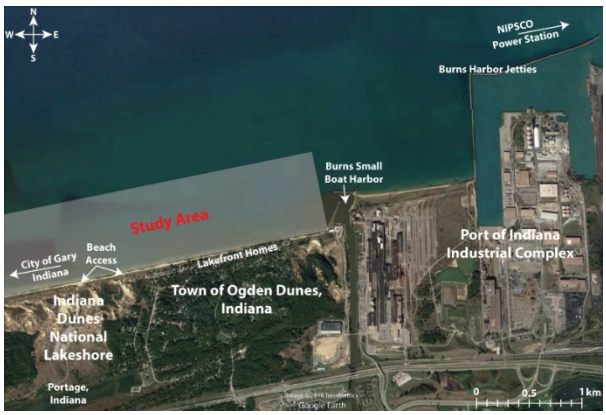
Nearshore Nourishment

Project Purpose

Ogden Dunes, IndianiaIndiana and Indiana Dunes National Park are on the southern Lake Michigan shoreline and are **threatened** by erosion due to changing lake levels and coastal storms.

A **beneficial use** solution that has been applied in this region is to place sediments routinely dredged from the Port of Indiana and the intake for the Northern Indiana Public Service Company (NIPSCO) power plant in the nearshore to **nourish** the beach profile and **mitigate** beach erosion.

The **purpose** of this project was to evaluate nearshore nourishment in this area and to ensure it fulfills its primary design purpose, erosion mitigation.



This project was funded by the USACE Regional Sediment Management (RSM) Program and Chicago District (LRC).

Project Description

ERDC-CHL combined a monitoring effort of the 2016 placement with analysis of historic data to evaluate nearshore nourishment:

- Historical shoreline position from aerial and satellite imagery was **compared** to placement records.
- The site was **qualitatively analyzed** with the Sediment Mobility Tool (SMT).
- The 2016 placement (140,000 yd^3 of dredged sediment) was monitored to identify the **transport direction** of the placed sediment, **shoreline response**, and **reduction of wave energy** on the beach. This was done with bathymetric surveys and wave and current gauges.
- The 2016 nearshore nourishment was also **numerically modeled** with the Coastal Modeling System (CMS).

Project Benefits

- Beneficial placement in the nearshore provides shoreline protection, and maintains ecological habitat and human recreation areas at Indiana Dunes National Park.
- Monitoring of the 2016 placement found placed sediments are being transported shoreward and in the alongshore direction; highlighting the nourishment of the beach profile at the placement area and down drift of the placement area.

Innovations and Advancements

- First study to evaluate the nearshore placement approach in this area (e.g. sediment was placed in the nearshore using bottom-dumping scows with hanging gates in small discrete mounds).
- First study that directly measured the wave energy attenuation due to a nearshore nourishment in this area.
- The transport direction of the placed sediment was quantified during the monitoring period, and the most appropriate CMS modeling parameters were established for the project area.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Ogden Dunes Nearshore Nourishment

Lessons Learned

- The lake froze over one month after the completion of the nearshore nourishment, which significantly limited the monitoring time. Schedule future nearshore nourishment projects earlier for improved monitoring prior to lake freezes.
- One of the current and wave gauges was buried before the nearshore nourishment construction was completed. Regularly downloading data from monitoring gauges or real-time data transfer could reduce the chance of data loss.

Partnering

The US Geological Survey - Central Midwest Water Science Center conducted the bathymetric surveys and deployed/retrieved the current and wave gauges. Several of their researchers co-authored the monitoring technical report. The research for this project was funded by the USACE Regional Sediment Management Program and by the Chicago District (LRC).

Outcomes

- Historical analysis has shown that placing sediment in the nearshore has a positive effect on Lake Michigan's shoreline. The highly erosive conditions of high water levels and several storms in the mid-1980s caused significant erosion, but the shoreline positively accreted when nearshore nourishment practices were implemented.
- Monitoring of the 2016 nearshore nourishment captured the onshore and alongshore sediment transport.

Additional Information?

Technical Report: Analysis of Nearshore Placement of Sediments at Ogden Dunes, Indiana - https://apps.dtic.mil/sti/pdfs/AD1093210.pdf

Technical Report: Nearshore Placement Techniques in Southern Lake Michigan - https://apps.dtic.mil/sti/pdfs/AD1064293.pdf

Technical Note: Physical Monitoring Methods for the Nearshore Placement of Dredged Sediment - https://erdc-library.erdc.dren.mil/jspui/bitstream/11681/26661/1/ERDC-TN%20RSM-18-6.pdf

Conference Abstract: Sediment Transport and Shoreline Response to Nearshore Placement of Dredged Sediment in Southern Lake Michigan, USA (International Conference on Coastal Engineering 2018) - https://doi.org/10.9753/icce.v36.sediment.49

Conference Paper: Nearshore Dredged Material Placement and Transport in Southern Lake Michigan (Coastal Sediments 2019) - https://www.researchgate.net/publication/333165426_NEARSHORE_DREDGED_MATERIAL_PLACEMENT_AND_TRANSPORT_IN_SOUTHERN_LAKE_MICHIGAN

Journal Paper: Transport of Placed Dredged Material in Surf and Nearshore Zone - https://doi.org/10.1061/(ASCE)WW.1943-5460.0000624

What is next?

Future projects are recommended to adjust the contract documents by reducing the placement depth to attenuate more wave energy and by reducing the size of the placement area to construct an artificial bar or nearshore berm, rather than small discrete mounds. Both modifications are expected to increase shoreline protection.

Points of Contact:

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Removal of Beneficial Use Impairments at Duluth Harbor

BU Characterization

Riverine Embayment; Remediation and Restoration

Project Purpose

The Duluth Harbor is part of the designated St. Louis River Area of Concern (AOC) in the Great Lakes with a number of identified beneficial use impairments associated with sediment contamination. **The goal of the projects were to remediate the sediment contamination to remove fish consumption restrictions, reduce fish tumors and deformities, cease degradation of benthos, and restore habitats.** The projects were formulated to accelerate delisting of the AOC.

The **sediment remediation** projects were performed through the Great Lakes Restoration Initiative under EPA's partnership with the Minnesota Pollution Control Agency (MPCA) and the U.S. Army Corps of Engineers (USACE) Detroit District in collaboration with U.S. Army Engineer Research and Development Center (ERDC). The **habitat restoration** projects were performed through a creative partnership among EPA, USACE, MPCA, Minnesota Department of Natural Resources and other local agencies using the regular annual harbor maintenance dredged material beneficially to restore critical aquatic habitat in the St. Louis River AOC.

Project Description

The projects included sediment remediation of three active harbor slips and habitat restoration of two areas of the Duluth Harbor.

- The active slips were **remediated** by capping about 18 acres of contaminated sediment with a two-foot protective layer of local sandy dredged material selected for its properties to sequester heavy metals, dioxins, PCBs and PAHs from the bioactive sediment layer and the water column. The caps were armored and sloped to provide long-term stability considering the erosive nature of prop wash from vessels using these active slips.
- Following an innovative three-year pilot program to determine that navigational material from the Duluth-Superior harbor was clean and safe enough to place in open water, dredged material was placed over a total of 680 acres between 21st Avenue West and 40th Avenue West. Approximately one million cubic yards of dredged material has contributed to **habitat enhancement** through the creation of gradually sloped shorelines, the addition of shoals or islands, and the reduction of acreage exposed to excessive wave energy.

Project Benefits

- The sediment remediation projects are contributing to the removal of restrictions on fish and wildlife consumption and degradation of the benthos. **Eighteen acres have been restored and the waterfront is cleaner for both fish and humans.**
- The habitat restoration projects are contributing to removal of beneficial use impairments including loss of fish and wildlife habitat and restrictions on dredging activities and dredged material placement in the largest freshwater port in the Great Lakes. **The habitat restoration provided a low-cost placement alternative in an area with diminishing upland placement capacity.**
- The benthos have re-established itself in the the project area, however, the full benefits have not been fully realized at this time as vegetation is still being established and fish tissues concentrations are still declining.

Points of Contact:

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Removal of Beneficial Use Impairments at Duluth Harbor

Innovations and Advancements

Fine-grained dredged material was placed hydraulically in shallow areas inaccessible for barge placement operations using an **innovative modification to the discharge pipe** designed to limit entrainment of water, dispersion of the dredged material and turbidity releases from the placement operations and to eliminate the need for silt curtains surrounding the placement operations. A down-pipe with a baffle plate, which descended to the sediment bed, was added to the end of the discharge pipe so as to discharge within the bed of placed material instead of the water column. This method of placement rapidly dissipates the energy of the discharge, prevents the entrainment of water from the water column into the discharge, filters the solids from the carrier water as the solids settle and consolidate, reduces the volume of water released from the placed material and decreases the release of turbidity by about seventy percent.

Lessons Learned

The willingness to include innovation and use of pilot projects can expand the opportunities for beneficial use, reduce costs and improve performance.

Partnering

The cleanup of the slips was performed under the Great Lakes Restoration Initiative's sediment remediation component, the Great Lakes Legacy Act, with matching funding from State of Minnesota Bonding Funds. Minnesota Pollution Control Agency worked with our Federal Partners, the U.S. Environmental Protection Agency's Great Lakes National Program Office and the U.S. Army Corps of Engineers to complete this important cleanup. MPCA performed Focus Feasibility Studies and selected the remedial alternative, ERDC developed designs, and USACE Detroit District developed plans and specifications and oversaw construction.

Outcomes

Eighteen acres of contaminated sediment were successfully capped and 680 acres of habitat enhancements were created.

Additional Information?

https://www.epa.gov/great-lakes-aocs/st-louis-river-aoc#restoration

https://www.greatlakesmud.org/minnesota1.html

What is next?

The success of these projects is leading to additional projects in the harbor, including capping of two additional slips.

Points of Contact:

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Other POC (OTHER), lucie.amundsen@state.mn.us

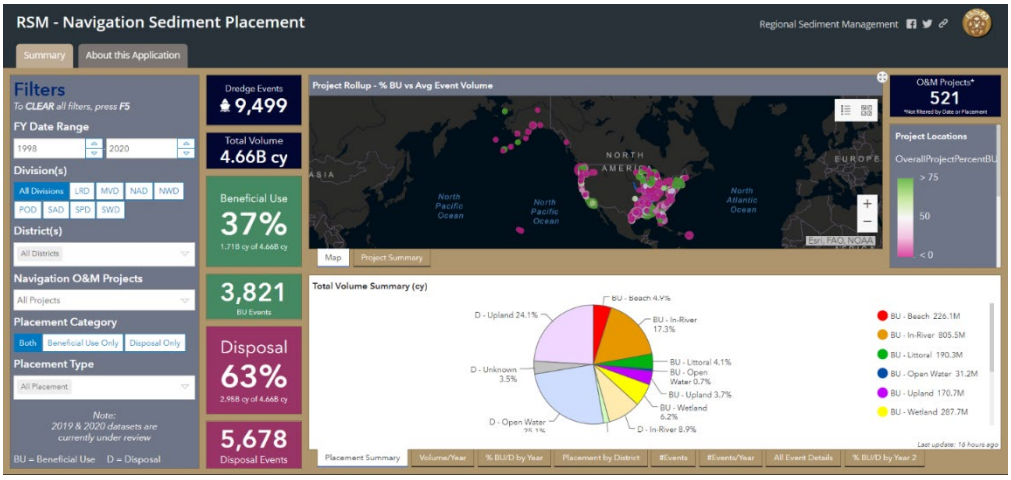
Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

RSM National Sediment Data Placement Viewer

BU Characterization

Data collection/evaluation; development of comprehensive BU database which ecompasses encompasses a broad area of BU characterization (e.g Beach Restoration, Littoral, Riverine, Wetlands, etc).



Project Purpose

The Regional Sediment Management (RSM) Program has encouraged the beneficial use of dredged sediment in lieu of disposing of the sediment in offshore or upland disposal sites. While USACE Districts have been incorporating beneficial use strategies in their projects, quantifying the prevalence and the additional benefits through this have been challenging to document using existing DIS data alone.

This project, funded by the ERDC RSM Program, inventories Federal navigation projects nationwide to determine the extent to which RSM goals and beneficial use of dredged material have been implemented across the USACE Districts at the project and District levels. Data is organized into a comphrensive database, providing an essential tool for evaluating dredge disposal activities and supporting the continued development of the of beneficial use strategies regionally and nationally.

Project Description

Data from the USACE Institute for Water Resources (IWR) Navigation Data Center's Dredging Information System (DIS) is utilized and refined using intra-agency outreach to obtain District-managed information and data. The data viewer categorizes the dredge placement efforts between disposal and beneficial use for beach, in-river, littoral, open water, upland, or wetland zones. This data is quality checked and uploaded on a yearly basis and includes USACE dredging data from 1998-Present.

Project Benefits

- Having an enterprise-wide database solution with single project as well as district, division and national interactive viewing capabilities makes this data more accessible and valuable, supporting the spread of beneficial use strategies regionally and nationally.
- The public-facing database allows any user (federal agency, resource agency, stakeholder, local government, etc.) to determine total project dredge volume over time, project iterations, beneficial use placement areas, and the percentage of beneficial use opportunities realized.

Innovations and Advancements

This data viewer is an all in one viewer for dredge placement activies, and is a public facing website, allowing anyone to access and query dredge disposal activities.

Lessons Learned

There is a continued need for more in depth data in regards to dredge disposal operations. The additional of geotechnical information, along with known dredge disposal sites will allow for more analysis of beneficial use practices.

Points of Contact:

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

RSM National Sediment Data Placement Viewer

Partnering

ERDC partners with the USACE Districts across the country to perform QC operations for all DIS data, and provide supplemental data as needed to determine actual quantities removed, and placement method.

Outcomes

- Public Facing Web-application enhances ability for USACE to promote its beneficial use program to congressionals, stakeholders, partners, and public. https://www.arcgis.com/apps/MapSeries/index.html?appid=0ea8fc0a956f46068428c862e7497233
- Quantification of beneficial use by placement type will allow USACE to continue to assess which placement methods are having the most success, and identify future opportunities for continued use.
- Quality Checked (QC) database of USACE DIS data containing dredged placement totals, filterable by project, district, division, and placement method. ERDC utilizes existing DIS data in conjunction with district supplied supplemental data to create database for this project.

What is next?

CHL will continue to add perform QC operations of District data and load date into the viewer on a yearly basis. Future endeavors include utilization of RMS data to integrate material type into the database along with placement sites in conjunction with type of placement.

Points of Contact:

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Other POC (ERDC, CHL), Michael.A.Hartman@erdc.dren.mil

Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Sturgeon Island Habitat Restoration and Marsh Edge Protection, New Jersey

BU Characterization

Back Bay Island Habitat Restoration, Marsh Edge Protection

Project Purpose

Sturgeon Island, in Cape May County, NJ, along with adjacent Gull Island, support nesting for 25 percent of the wading birds in New Jersey[1]. Habitat suitability has declined at Sturgeon Island in recent years. Low marsh and pool areas on Sturgeon were selected for **elevation enhancement via dredged material placement** to create suitable nest areas above storm flood elevations. Philadephia District (NAP) partnered with USACE Engineer Research and Development Center (ERDC), the State of New Jersey and The Wetlands Institute (TWI) to design placement of dredged material from the NJ Intracoastal Waterway (NJIW) on Sturgeon Island as part of this effort. Research, supported through various research programs, including the Dredging Operations and Environmental Research Program (DOER), is being conducted to evaluate the effectiveness of dredged material placement processes aimed toward habitat restoration through elevation enhancement.

Project Description

- In March 2020 approximately 4,200 cubic yards of dredged sediment was placed on Sturgeon Island prior to interruption due to COVID 19. Material from the NJIW was pumped to a Y-valve on the island which split flow between a pipe with a nozzle and an elevated sediment distribution pipe (see figure above). The distribution pipe was tested by ERDC to evaluate its ability to separate the flow for construction of a sand berm. Partial containment was accomplished using a 14-inch water-filled pipe along the lower side of the island, along with efforts to plug the tidal creek within the placement area.
- An additional 15,000 cubic yards of dredged sediment was placed in Fall 2020. Material was initially placed within the interior of the northern portion of the island using the sediment distribution pipe. Later, the discharge was repositioned to place sediment along the northern edge of the island to protect against marsh edge erosion.
- Elevation monitoring is being conducted to evaluate consolidation of the placed material and the extent to which elevation goals were met by these placements. A mass balance is being perfomed to quantify sediment volumes contained on the site and within the surrounding mudflats.
- Monitoring around the sediment distribution pipe is being performed to evaluate its effectiveness in separating sand from the dredge slurry.
- Submerged Aquatic Vegetation (SAV) and benthics are being monitored to evaluate benefits from the placements.
- The site will be monitored over time to capture long term consolidation, vegetation establishment and habitat suitability and use.

Project Benefits

- Federal channels along the New Jersey Intracoastal Waterway near Sturgeon Island required dredging to maintain authorized depths. This project used those channel sediments to increase elevation to offset erosion, subsidence, and sea level rise on Sturgeon Island. Sediments which did not remain on the island were captured on the mudflats. The mudflats not only provide habitat for submerged aquatic vegetation and fish, but also enhance marsh edge protection for the steep scarp which is subject to erosion from storm- and boat-induced waves.
- The project provided excellent opportunities to study the dynamics of unconfined and partially confined dredged material placement and the use of a sediment distribution pipe for building localized elevation.
- Developing a better understanding of sediment transport and consolidation will inform future placements for setting project expectations and determining the need (or lack of) for containment for meeting project goals.
- Evaluation of the sediment distribution pipe will determine its potential effectiveness for future use to build berms for containment or other purposes.

[1] USACE. (n.d.). *Seven Mile Island Living Lab – Sturgeon Island Restoration* [Fact sheet]. US Army Corps of Engineers – Philadephia District. https://www.nap.usace.army.mil/Portals/39/docs/Civil/Coastal/Sturgeon-Island-Factsheet-Final.pdf

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Sturgeon Island Habitat Restoration and Marsh Edge Protection, New Jersey

Innovations and Advancements

Innovative practices implemented at Sturgeon Island include the use of a sediment distribution pipe to segregate sand, and use of a water-filled dredge pipe as a containment feature.

Cone penetrometer testing (CPT) was conducted prior to placement; future CPT could be employed to indicate how the site is recovering compared to pre-placement conditions.

Lessons Learned

Existing topography caused the dredged material slurry to short circuit to the tidal channel and efforts to plug the channel using hay bales, coir logs and marine plywood were largely ineffective. However, sediment losses from the island resulted in useful sediment deposits to the surrounding mudflats.

The water-filled pipe as a simple containment method proved to be reasonably effective. Significant seepage was observed beneath the pipe in areas where the local surface was not smooth and dredged sediment build-up on the discharge side of the pipe exerted enough load to move the pipe laterally in some locations. Both issues can be resolved relatively easily by placing a mat beneath the pipe and providing some lateral support for the pipe. The pipe also remained in place for about five months post-placement. While the presence of the barrier provided continued containment and time for the sediment to stabilize, it also prevented drainage and desiccation of the dredged fill.

Due to difficulties accessing the site immediately post-placement, remote monitoring techniques are needed.

Partnering

This project represents a collaboration among the consortium of stakeholders within the Seven Mile Island Innovation Laboratory (SMIIL), which includes NAP, TWI, ERDC, the State of New Jersey, academic institutions, and private parties. The SMIIL stakeholders worked together to design and vet placement strategies, and monitor sediment placement and subsequent changes over time. Multiple ERDC teams contributed to the overall success and lessons learned through a range of research and monitoring objectives, evaluating evolution of the mudflats and marsh platform, sediment distribution pipe effectiveness, construction-related turbidity, and benthics and SAV.

Outcomes

Success of the dredged material placements at Sturgeon Island is still being evaluated. Field data collection in July 2021 will inform the mass balance, and consolidation behavior and effectiveness of the sediment distribution pipe. Long-term success will be measured in terms of habitat suitability and future use by wading birds.

Additional Information?

Additional information on SMIIL and marsh restoration can be found at: https://wetlandsinstitute.org/smiil/ or https://www.nap.usace.army.mil/Missions/Civil-Works/Coastal-Dredging-Beneficial-Use/

Publications to date:

Fall, K.A., Perkey, D.W., Tyler, Z.J., Welp, T.W., 2021. Field measurement and monitoring of hydrodynamic and suspended sediment within the Seven Mile Island Innovation Laboratory, New Jersey. ERDC/CHL TR-21-9. http://dx.doi.org/10.21079/11681/40980

What is next?

Additional dredged material placement is planned for Sturgeon Island in Fall 2021. Monitoring habitat and elevation changes will continue as we evaluate the need for additional dredged material and how it should be placed to build elevation to support nesting habitat.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

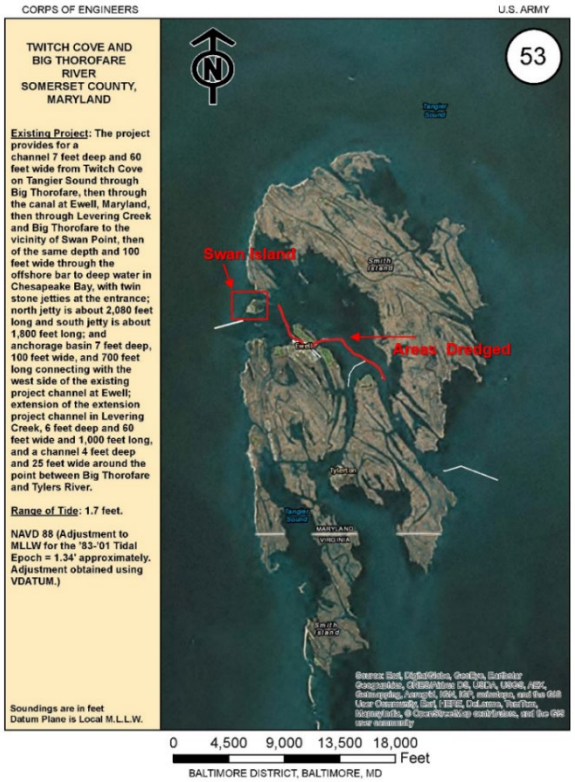
Swan Island, MD Restoration Project

BU Characterization

Bay; Island Creation

Project Purpose

Coastal islands and marshes of the Chesapeake Bay are disappearing along with the critical ecosystem services and shoreline protection benefits they provide. At Swan Island, high rates of shoreline erosion and subsidence have deteriorated the island's natural habitat and its ability to shelter the nearby town of Ewell from wave energy. In 2015, O&M funding was provided to the USACE Baltimore District to support maintenance dredging the Twitch Cove and Big Thorofare federal navigation channels, which provide access to towns on Smith Island. In 2019, the USACE Baltimore District restored Swan Island with the sediment dredged from these nearby channels. Historically, efforts focused on strategic placement of dredged sediments upriver of the islands in an effort to reduce dredging costs and promote island growth through sediment migration. However, additional environmental, navigation, and climate change benefits were realized by directly placing sediment on the island.



Project Description

Approximately 80,000 cubic yards of sediment were dredged from Big Thorofare & Twitch Cove Channels in 2019 and beneficially used to restore Swan Island. The sediment consisted roughly of 65% sand and 35%. Approximately 12.2 acres of island were restored, which consisted of 0.8 acres of dune, 7.6 acres of high marsh, and 3.8 acres of low marsh. Vegetation was planted during the restoration and included *Am. Breviligulata* on the dunes; *P. amarum, Sp. patens*, and *P. virgatum* on the high marsh; and *Sp. Alterniflora* on the low marsh.

Project Benefits

The project provided an opportunity to keep sediment in the Chesapeake Bay and beneficially use it to restore Swan Island. By pursuing the project in this way, Swan Island was restored, which resulted in diverse types of habitat being created as well as preservation of a bird rookery on the western side of the island. In addition, restoration of the island produced a natural breakwater that is reducing erosion and providing storm risk reduction benefits to nearby Smith Island.

Partnering and Collaboration

USACE Baltimore District, ERDC, NOAA's National Centers for Coastal Ocean Science (NCCOS) scientists, US Fish and Wildlife Service and the Maryland Department of Natural Resources partnered to develop a research plan focused on the restoration of Swan Island. This group, with their specific skillsets and expertise, are collecting the physical and ecological data necessary to evaluate the performance of the island and associated benefits derived from this restoration project. Other efforts include assessing the impacts of Swan Island restoration on nearshore benthic communities (oysters and seagrasses), intertidal marsh habitat, and long-term resilience of the island to erosion and sea level rise.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Swan Island, MD Restoration Project

Innovations and Advancements

- The Swan Island Restoration Project is a multi-agency collaboration effort that is leveraging diverse resources, skillsets and expertise to advance Engineering with Nature (EWN) concepts and practice.
- Preliminary pre- and post-construction data suggests multiple ecological, social, and engineering benefits are being achieved.
- Quantifiable data is being used to develop models that will inform the design and construction of future islands projects.
- Models are being develop in conjunction with landscape architectural renderings to depict the maturation of island systems over time. Outputs will be more broadly understood by public and inform future adaptive management actions.

Lessons Learned

- Environmental and ecological response to BU placement can vary seasonally.
- Year-round data is needed to truly estimate the impact of changes to sediment loads in these systems.
- Restored islands are highly dynamic and require considerable attention during the construction phase of a project.
- Setting appropriate elevations and incorporating planting into construction phase greatly accelerates function and accrued benefits.
- Vegetative planting designs should be accompanied by landscape architecture renderings for the best planting outcomes.

What is next?

Ecological and hydrodynamic models will continue to be refined and advanced to more fully characterize and understand the natural processes surrounding Swan Island how it performs following restoration. Models will be applied to other islands in a variety of systems to further calibrate outputs and enhance their predictive capabilities. Research specific to vegetation planting is also being pursued to better understand how the low marsh species respond to various planting techniques.

Additional Information?

Davis, Jenny, Paula Whitfield, Danielle Szimanski, Becky R. Golden, Matt Whitbeck, Joe Gailani, Brook Herman, Amanda Tritinger, Sally C. Dillon, and Jeffrey King. "A framework for evaluating island restoration performance: A case study from the Chesapeake Bay." *Integrated Environmental Assessment and Management* (2021).

https://coastalscience.noaa.gov/news/swan-island-restoration-begins/

https://coastalscience.noaa.gov/project/evaluating-efficacy-of-island-restoration-and-enhancement-for-coastal-protection/

Outcomes

The collaborative research team is still actively collecting data and evaluating results. However, findings to date reveal a diverse suite of ecosystem service functions being more prevalent on the island following restoration. Swan Island is also a critical piece of land due to the presence of a heron rookery at the west end and serving as a tie-in for the USACE owned and operated jetty at the mouth of the Big Thorofare channel, which provides critical access to Smith Island from the west. Restoration of the island has prevented future loss and degradation of these critical resources as well. Finally, restoration of Swan Island is providing increased ecosystem service provisions, increased resilience of Swan Island to future sea-level rise, and abatement of erosive losses for the town of Ewell. This project is producing environmental, economic and social benefit, which are the three pillars of what constitutes and USACE Engineering with Nature project.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Systematic beneficial use of dredged sediments: matching sediment needs with dredging requirements in San Francisco Bay

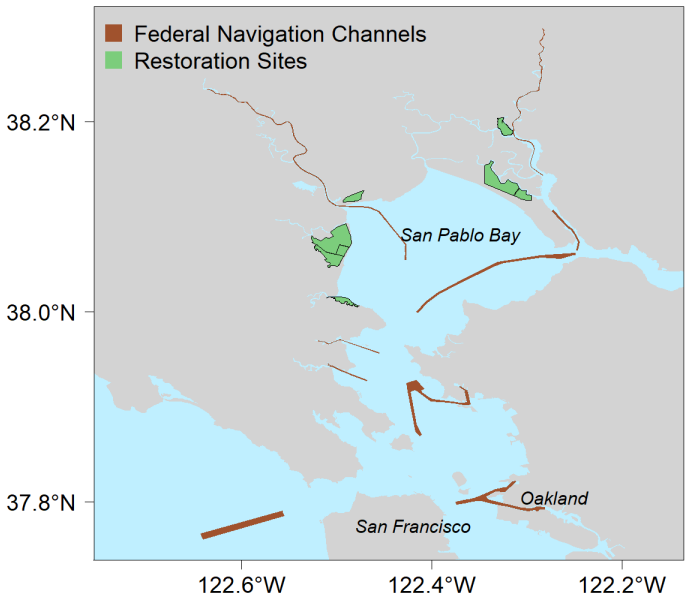
BU Characterization

Back bays, Tidal Wetlands

Project Purpose

Beneficially using dredged sediment from navigation channel maintenance can potentially fulfill the need for sediment at coastal restoration projects. Despite high demand for sediment to fill subsided San Francisco Baylands, perceived high cost and complicated logistics are barriers to changing status quo from disposal to beneficial use. The regional vision to restore 100,000 acres of tidal marsh aims to buffer climate impacts, adapt to sea level rise (SRL), and restore vibrant ecosystems is contingent on sufficient supply of sediment for initial restoration and renourishment.

This project is developing and demonstrating a framework for the combined use of modern geospatial tools with process-based ecological models, and optimization algorithms can facilitate more BU in support of coastal restoration efforts. The utility of the resulting method will be to identify the most beneficial and cost-effective coastal restoration beneficial use projects in light of navigation dredging needs and SLR. This research is funded by the Dredging Operations and Environmental Research (DOER) program.



Project Description

Optimization of dredge material removal, transportation, and placement entails definition of all potential sources, sinks, and routes, along with associated volumes, schedules, costs, and benefits.

- The volume available for beneficial use is being determined by historical activity and shoaling forecasting.
- Placement area sediment restoration needs are being defined based on geographic area and the modelled ideal elevation of each site. The method captures that need will be dynamic over time with SLR and considers multiple scenarios.
- Project costs are being developed from prior studies and with USACE experts. Benefits of BU placement, which do not usually play a role in placement decisions, will be accounted for, to the greatest extent possible. These components serve as the inputs to the optimization model, executed in the USACE-development model, Dredge Material Management Decisions (D2M2) software.

Project Benefits

- BU has been identified as a **necessity** in San Francisco baylands – to "**protect** billions of dollars of bay-front housing and infrastructure (including neighborhoods, business parks, highways, sewage treatment plants, and landfills)…**purify** the Bay's water, **support** endangered wildlife, nurture fisheries, and provide people access to nature within the urban environment" (Dusterhoff et al. 2021).
- Prospective benefits of BU are being quantified with the objective of identifying placement options that maximize benefits and minimize costs, e.g., habitat units, carbon sequestration, transportation cost savings, and more.

The primary benefit of the project is to help overcome barriers to substantially scaling-up and normalizing BU by demonstrating a BU framework that can be applied at scale to promote sustainable BU practices, facilitating the delivery of social and environmental benefits while still fulfilling the US Army Corps of Engineers navigation mission. The framework applies logical feasibilities and can account for vast benefits that justify placement costs.

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Systematic beneficial use of dredged sediments: matching sediment needs with dredging requirements in San Francisco Bay

Innovations and Advancements

The framework utilizes process-based ecological models to forecast the sediment needs for healthy, functional ecological systems. Optimization is utilized to discover combinations of dredge sediment sources and placement areas to minimize cost and maximize benefit.

Dredge Material Management Plans (DMMPS) and Ecosystem Restoration Missions are not coordinated in the current state-of-practice. Research and development can plan a role in support the transition to more efficient and effective mission execution.

Lessons Learned

- While several studies have been conducted analyzing the vulnerability and resilience of wetlands, some even estimating the quantity of sediment to maintain and restore those wetlands, the link between restoration and resiliency goals and navigational dredging has not been explicitly explored.
- There is untapped potential for using optimization in USACE District Operations. Demonstrations, model certification, and ERDC support are needed to promote the use of optimization for routine operational activities.

Partnering

The research is a collaborative effort of researchers in two ERDC labs. District personel will be engaged for their expertise in dredge cost estimating and logicstics. Research results will be aimed at San Francisco District, in particular the PDTs developing the 1122 BU demonstration project and the new dredged material management plan[1]. The workflow will be applicable to all USACE districts.

Outcomes

While the project application to San Fracisco Bay is ongoing, it is expected that the project will serve as an example of how systematic analysis of this kind can be used to align coastal ecosystem restoration and coastal resiliency goals with dredged material management in a mutually beneficial manner.

Additional Information?

Technical Report: Towards systematic beneficial use of dredged sediments in San Pablo Bay: Demonstration of a proposed framework for matching sediment needs with dredging requirements (in process)

Technical Note: Systematic beneficial use of dredged sediments: matching sediment needs with dredging requirements (in review)

Conference Proceedings Paper: Boyd, B., Piercy, C., Bates, M., Gailani, J., Morris, J., Bridges, T. (2019). Dredging realities and rising seas: a systems approach to wetland beneficial use of dredged sediments. Coastal Sediments.

Download D2M2 software: https://dots.el.erdc.dren.mil/models5.html (update expected Summer FY21)

What is next?

- The results and products of this study are anticipated to be applied across USACE to support sustainable long-term dredged material management strategies which support a more natural sediment budget and reduce dredged material transportation costs while minimizing adverse impacts associated with current practices.
  - The analysis can guide partner agencies to target restoration projects in areas most conducive to beneficial use of dredge material and find other solutions for areas that are not.

[1] Julie Beagle is serving as contact for this effort

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Thin Layer Placement of Dredged Material Website and Map-Portal

BU Characterization

This project encompasses a broad area of BU characterization since the "Thin Layer Placement of Dredged Material Website and Map-Portal" includes a database and case studies where dredged material has been used beneficially for different purposes such as habitat restoration, sediment remediation, thin layer capping for contaminant isolation, marsh restoration, island creation, or wetland creation.

Project Purpose

Thin layer placement (TLP) is the purposeful placement of thin layers of sediment (e.g., dredged material) in an environmentally acceptable manner to achieve a target elevation or thickness. TLP is a versatile technique that can be used to restore many intertidal habitats, including all types of tidal marshes and beaches. **Our overarching goal is to share resources that will help promote successful TLP projects.**

The Thin Layer Placemet of Dredge Material website and map-portal are a living resource of information and provide access to all available resources supporting the planning, design, and construction of beneficial use projects employing this technique. During the first year of this project, funding was received through both the Regional Sediment Management (RSM) and Dredging Operations and Technical Support (DOTS) programs, and after the first year it was funded through the DOTS program only. The website is frequently updated to incorporate new resources, design and modeling tools, and case studies. The site is publicly available; thus, facilitating the use of thin layer placement by disseminating information globally and capturing both domestic and international case studies, construction practices, and lessons learned.

The objectives of this effort are to continue maintaining and adding valuable information and resources to the Thin Layer Placement (TLP) of Dredged Material website and map portal.

Project Description

- A website was developed and released to the public that contains resources for TLP practices (https://tlp.el.erdc.dren.mil/). The website serves as a portal to the most readily accessible **resources**, including literature, available case studies, and external resources, and **provides** means for users to submit case studies for inclusion on the site.

- A GIS map-based portal for entry of case studies, placement site, and sediment source locations associated physical and chemical data, hydrodynamics, bathymetry, design drawings, reports, and other available information was also developed in conjunction with the website landing pages, **providing** geographically oriented information resource for project planning, permitting, design, construction, monitoring, and cost.

Project Benefits

- The TLP website **documents** the current state of knowledge regarding thin layer placement of dredged material (to minimize impacts of disposal or to achieve specific beneficial use objectives), **compiling** resources relevant to planning, permitting, design, cost estimating, construction, and monitoring. Data entered into the website database can be accessed by users for multiple uses, including planning, site design, and modeling.

- The site **provides effective dissemination** of current beneficial use practices and knowledge, as well as existing information relevant to all phases of individual projects.
    - Multiple layers will be displayed on the map based portal including the National Channel Framework, the location of placement areas, dredging schedules, sediment databases such as SAGA (when available), and other types of beneficial use sites.

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Thin Layer Placement of Dredged Material Website and Map-Portal

  - Overlaying the navigation channels and placement areas with existing sediment data provides a robust resource regarding potential source material, and this will **facilitate** the interaction of beneficial use planning with navigation dredging operations and dredged material management.

- Collectively, these resources will **facilitate** and **advance** the practice and acceptance of beneficial use both within USACE as well as within other agencies and the private sector.

Innovations and Advancements

- This website is a vital source of information, knowledge, and experience on TLP. The site contains a growing body of searchable resources pertaining to all stages of dredged-material based beneficial use projects related to TLP.
- The ERDC team has continuously added case studies and resources available in the literature throughout the past few years. The website continues to grow, and collaboration with people working on TLP projects for including new case studies is key to continue disseminating informations and promoting successful TLP projects.
- A video, which has been developed, will be added to the welcome page to simply explain the TLP technique and its purpose.

Lessons Learned

New resources and case studies are added yearly. The case studies include pictures and a factsheet highlighiting lessons learned from each particular project. Hence, the lessons learned from TLP projects are shared with the community of practice and information related to those case studies continues to be disseminated.

Partnering

The ERDC DOTS program has mainly funded this effort. The RSM program was funded during year one. USACE Districts, private firms, federal agencies, and state agencies have contributed for hosting workshops related to TLP of dredged material and for providing key literature used in the resources page, and also for the development of case studies factsheets.

Outcomes

- Aggregates the current state of knowledge regarding thin layer placement of dredged material
- Consolidates literature/references pertaining to all project phases – from design to post-construction monitoring
- Provides a centralized, accessible, and consolidated resource for case studies
- Provides a vehicle for collection of case studies worldwide

Additional Information?

https://tlp.el.erdc.dren.mil/

https://usace.maps.arcgis.com/apps/MapSeries/index.html?appid=a731fd32f85c44109b9269e7c8d9c68f

What is next?

Continue to add new resources and case studies to the website. Stimulate the community of practice to submit their own project factsheets and case studies.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Upper Mississippi Beneficial Reuse of Dredged Material

BU Characterization

Riverine, Inland waterways, upland disposal

Project Purpose

On average, the USACE St. Paul (MVP) and the Rock Island (MVR) Districts combine for over 1.25 MCY of dredged material from the Upper Mississippi River each year. As this is a pooled system, the majority of this material is placed at upland placement sites, mostly owned by the Federal Government. In fact, MVP owns over 1500 acres to be utilized as material placement sites.

While the districts on the upper Mississippi have had some successful beneficial use projects, such as island creation and marsh restoration, **there are other opportunities that could be realized by broadening the definition of beneficial use.**

Utilization of the clean sands as construction material could provide an avenue to reuse much of the dredged material on the Upper Mississippi. As part of a broader "Navigation Strategic Vision" funded by the MVP, and with support from the Regional Sediment Management Program (RSM), CHL is **exploring** the ability to **expand** the definition of Beneficial Use, especially pertaining to inland systems.

Project Description

The objective of this project is to:

- Research dredged material disposal in similar US and foreign waterways
- Quantify financial impacts of upland disposal on MVPs Dredge Materail Management Program (DMMP) on dredge cost/cy
- Engage with stake holders and industry to find collaborative and innovative opportunities for dredged material use.

Project Benefits

- Expanding the definition of Beneficial Use for inland systems will **provide** disticts with more **opportunity** for creative reuses of dredged material
- Finding alternative placement sites for dredged material will **limit the footprint** of these upland material placement sitesPartnering with construction industry to utilize clean material dredged from the river may have **positive impacts and potential reductions** of upland mining operations.

Innovations and Advancements

The St. Paul and Rock Island USACE Districts have created and held a kickoff meeting or the "Upper Mississippi Beneficial Use Working Group", comprising of many state and federal agencies including: Department of Transportation (Iowa,Illinois, Minnesota, Missouri, Wisconsin), Department of Natural Resources (Illinois, Wisconsion, Minnesota, Missouri), EPA, NRCS, UMRBA, and USFWS to name a few. This large collaborative effort is a great advancement working towards successful benefical use applications.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Upper Mississippi Beneficial Reuse of Dredged Material

Lessons Learned

The Upper Mississippi River Project was created with no project sponsor, limiting its ability for an outside funding source, and assistance with dredged material placement. In many other similar waterways of the US, project sponsors assist, or in some cases, are responsible for finding upland placement sources for dredged material.

Partnering

As mentioned previously, the ability to utilize the vast amount of clean sand on the upper Mississippi River is of importance to an array of local, state, and federal agencies. The outcomes from this effort can have significant positive impacts to other inland systems in the US.

Outcomes

Annual Meetings of the Upper Miss Beneficial Working

Expanded use of dredged material

Reduction of upland placement sites

Additional Information?

https://www.mvp.usace.army.mil/Missions/Navigation/Channel-Maintenance/Beneficial-Use-of-Dredge-Material/

https://www.mvr.usace.army.mil/Missions/Navigation/Dredging/Beneficial-Use/

What is next?

- Continued engagement with stake holders and partners to find new opportunities for utilization of dredged material.
- Seek ways to quantify the benefits of “non-standard” beneficial use projects.
- Continue to work alongside MVP, MVR and the Regional Sediment Management (RSM) program to implement these efforts.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Recycling Dredge Material into Manufactuered Top Soil

BU Characterization

Manufactured Topsoil

Project Purpose

- Illinois Waterway dredged material placement sites are filling and alternative sites or uses were **needed**.
- **Manufactured soils using dredged material** was proposed as an alternative in 2015.
- The investigations were started as an Regional Sediment Management (RSM) program project with Rock Island District (MVR) that led to a private-public-municipal meeting establishing an ongoing partnership.
- The project moved to ERDC and Dredging Operations Technical Support (DOTS) who supported a manufactured soil workshop with representatives from 6 states held in Peoria, IL in August 2019.
- The partnership led by the Tri-County Regional Planning Commission includes more than 30 agencies/companies from the Peoria region and State of Illinois. There has been Illinois Department of Transportation (IDOT) investments in beneficial use of dredged sediments (BUDM) utilization and MVR support for offloading sand from placement sites to beneficial use.

Project Description

Illinois Waterway beneficial use of dredged material was devised as an alternative to support Corps navigation and ecosystem restoration missions by developing a private-public partnership to manage dredged material.

- Sand from navigation channel dredging and fine sediment dredged for aquatic ecosystem restoration was **blended** together with additional organic enrichment (i.e., compost) to **create high quality topsoil** products that can be used in construction, stormwater management, and agriculture.
- Scientists from the USDA in IL worked with researchers from ERDC Enviromental Laboratory to engineer top soils and evaluate their physical and chemical properties to determine their ability to sustain native plant growth and absorb contaminants.
- The objectives were to make space in dredged material placement sites and fund ecosystem restoration with profits from soil sales.
- Interest in the process ranges from a local composter who is selling bulk and bagged soil to international manufacturers who have researched and implemented soil manufacturing schemes.

Project Benefits

- This project has built an effective partnership that brings BUDM concepts to Illinois Waterway sediment management.
- The Corps leased a loader for a beneficial use site so users can easily access material. Over 10,000 yards of Corps sand and 6,000 yards of fine sediment from a private terminal were taken in the first year.
- Soil sales are not being tracked, but the composter sells to a bagger, who sells to big box stores in Central Illinois so the retail distribution is established and the commercial/mincipal network is accessible through existing relationships.
- There is an ongoing IDOT collaboration to create better perfoming materials for roadway stormwater management.

This project is a **demonstration** of the Technology Transfer opportunities for private-public partnerships in sediment management. Sediment provides valuable aggregate material that can be resourced into local markets as demonstrated

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Recycling Dredge Material into Manufactuered Top Soil

in Minnestoa and now in Illinois. The approach applies widely and is being applied to Upper Ohio River lock replacements and marine deep draft dredging among other places.

Innovations and Advancements

The State of Minnesota is a leader in stormwater management who developed engineering specifications for highway drainage (e.g., shoulders, ditches, topsoil, etc.). Their drainage requirements were met well by the rounded river sand available in municipal dredged material storage areas. Through commercial utilization a stockpile of sand was relocated and new marine terminal facilities could be constructed to generate public and private revenue while maintaining a dependable placement site for Corps navigation operations.

The “Minnestoa Model” is eminantely transferable to other Corps areas of operation. Opportunities can be realized by creative thinking and broad partnerships to integrate BUDM opportunities.

Commercial use of dredged material is an innovative and cost effective alternative to traditional upland sediment placement requirements.

Lessons Learned

One partner stated that BUDM in manufactured soil is “logical, not easy”. It has taken many years to socialize the concept and find individuals with capacity to do the work. The process required significant coordination and dedication from disparate interests working at large and small scale. Interest and awareness is growing, and we were warned it takes five years for markets to mature. We are in the second season of soil manufacturing and competition and cooperation is increasing with awareness.

Partnering

This research started as a channel maintenance investigation that rapidly grew to include ecosystem restoration in the Peoria Lake Comprehensive Conservation Plan which was a Planning Assistance to States project that forged the partnership with Rock Island District, Tri-Country Regional Planning Commission and 30 other agencies/individuals..

Outcomes

BUDM planning and manufactured soil implementation in the Illinois Waterway will support Corps operations and boost regional economic development by selling sustainable aggregate products..

Additional Information?

Evaluation of engineered soils for bioretention areas containing dredged Illinois River sand, compost, biosolids, and pyrolyzed biosolids.
https://acsess.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/cft2.20096

What is next?

We will continue to support expansion of Illinois Waterway dredged material in aggregate and manufactured topsoil markets. We are seeking distributors in the Chicago and St. Louis regions with larger material needs that can be easily reached. We are also investigating other sites and partners in the Illinois Waterway, Upper Mississippi River, Lake Red reck reservoir sustainability, Ohio River lock replacement, and Miami deep draft harbor dredging.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Vilano Beach Nearshore Nourishment

BU Characterization

Nearshore Nourishment

Project Purpose

Nearshore placement is becoming an increasingly utilized method for the beneficial use of dredged material from operations and maintenance dredging of navigation channels. It is important to have an understanding of what happens to sediment once it is placed in the nearshore. Generally, O&M navigation dredging projects do not have the funding, time, expertise or equipment required to provide comphrensive answers to these questions. **The goal of this project was to combine innovative technologies with intensive field monitoring to investigate shoreline response and transport direction of dredged sediment placed in the nearshore.**

The research was funded by the USACE Regional Sediment Management (RSM) program, Coastal Inlet Research Program (CIRP), Dredging Operations and Environmental Research (DOER) program, and the Jacksonville District (SAJ).

Project Description

In 2015, 115,000 m^3 (150,000 yd^3) of material was dredged from St. Augustine Inlet and placed in the nearshore of Vilano Beach, Florida. The goals of the placment was to nourish the beach profile and protect the shoreline by dissipating wave energy by creating nearshore berms farther offshore. Material was placed into two separate nearshore berms.

To understand changes in the berms over time and evaluate their effectiveness of protecting the shoreline:

- Pre/Post construction bathymetric surveys were conducted.
- The Radar Inlet Observing System (RIOS) was deployed monitor morphologic changes in the berms between surveys
- The Coastal Modeling System (CMS) and Sediment Mobility Tool (SMT) were used to illustrate and predict morphologic changes and impacts to the hydrodynamic conditions in the nearshore.

Project Benefits

- Two key tools for monitoring placement (CMS model and SMT) were validated with extensive field data. Both will be very helpful in planning, executing and monitoring future placement applications.
- The placement of material into two nearshore berms led to material being transported onshore, keeping the material in the system and avialble to nourish the beach. This insight will guide future placement strategies for this area.
- Placing close to the shore and mainting material is the system has the possibliyt to lead to greater shoreline protection and an increase human recreation areas on Vilano Beach.

Innovations and Advancements

This project investigated how the shape of the nearshore nourishment influenced the shoreline response, and provided a new field method for doing this. It was the first project in which nearshore nourishment was monitored with RIOS to capture the morphological evolution between surveys and time lapse cameras were used to monitor the construction.

Lessons Learned

- These results substantiate the use of nearshore berms as a beneficial use of dredged sediment to protect the shoreline and keep the sediment in the littoral system.
- Low cost time lapse cameras assisted monitoring the construction and RIOS is a useful tool to monitor the morphological evolution between surveys.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

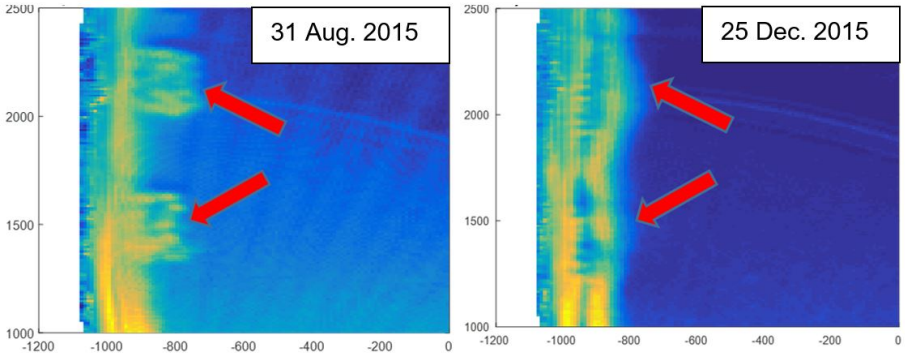
Vilano Beach Nearshore Nourishment

Partnering

The Vilano Beach Homeowners Association identified and coordinated the use of beach house balconies to mount time lapse cameras. The research project was funded by the USACE Regional Sediment Management (RSM) program, Coastal Inlet Research Program (CIRP), Dredging Operations and Environmental Research (DOER) program, and the Jacksonville District (SAJ).

Outcomes

This study demonstrates the benefits of nearshore nourishment projects to keep sediment in the littoral system and dissipate erosive wave energy farther offshore. A mild shoreline accretion was observed on the lee side of the bar-shaped northern berm while a more peaked shoreline cusp was observed on the lee side of the mound-shaped southern berm. This is likely due to the reduced wave energy on the lee side of the nearshore berm caused by wave breaking. The placed sediment was observed moving landward and fusing to the beach profile and difusing in the alongshore direction.



What is next?

- Future projects are recommended to consider the shape of the nearshore nourishment and the potential shoreline response to it.
- Benefiical use of sediments to create nearshore berms was efficient in this environment. Similar monitoring at other envrioments will be helpful in designing best practices for this benefical use approach.

Additional Information?

Journal Article: Strategic Nearshore Placement of Dredged Sediment at Vilano Beach, Florida - https://www.researchgate.net/publication/320443554_Strategic_nearshore_placement_of_dredged_sediment_at_Vilano_Beach_Florida

Trade Journal Article: Innovative Nearshore Berm Placement Techniques at Vilano Beach, FL and Application of the Sediment Mobility Tool - https://www.researchgate.net/publication/320443399_Innovative_Nearshore_Berm_Placement_Techniques_at_Vilano_Beach_FL_and_Application_of_the_Sediment_Mobility_Tool

Conference Paper: Strategic Placement of Dredged Material in Vilano Beach, Florida - https://www.researchgate.net/publication/333169091_STRATEGIC_PLACEMENT_OF_DREDGED_MATERIAL_IN_VILANO_BEACH_FLORIDA_USA

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Beach Nourishment Along the South Atlantic Coast

BU Characterization

Coastal; sandy beach nourishment; species protection and conservation

Project Purpose

Beach nourishment actions need to consider all aspects that could impact nesting marine turtles and their behavoirs, including nest site selection, digging substrate, nest geometry and viability, and hatchling emergence. To assist the USACE in meeting compliance for the Endangered Species Act (ESA) and state regulations pertaining to the **protection** and **conservation** of listed marine turtles, we reviewed current beach nourishment approaches to identify important feartures for nesting turtles.

Originally, we had hoped to use data from the Florida Fish and Wildlife Commission, and provide an assessment of USACE contributions to marine turtle nesting success and any changes in population status for the six ESA listed turtle species that nest in the South Atlantic Division. However, it was determined that these data are incomplete and do not provide sufficient resolution to address this issue.

To fill this gap, we reviewed beach nourishment practices that target creation and enhancement of marine turtle nesting habitat as a path forward to improving USACE compliance under ESA. This project was funded by the Ecosystem Management and Restoration Research Program (EMRRP) which focused on compiling best management practices to benefit shoreline-dependent species during USACE coastal engineering projects. We focused on Floridia, since the majority of all marine turtle nesting within the Unitied States nest in this state.

Project Description

This study initially spent over a year in consultation with USACE Jacksonville District (SAJ) personnel and turtle researchers at the Florida Fish and Wildlife Commision to procure and assess the role of beach nourishment on nesting marine turtle along the Atlantic Coast of Florida. Once data were found to be incomplete and unusable to address questions on turtle nesting success and population status, we then focused on doing a thorough literature review and completed a EMRRP Technical Report that summarizes USACE coastal engineering actions that create or enhance sandy beach habitat for nesting mariang turtles.

Project Benefits

An essential benefit of this effort is a technical report that constitutes **a 1-stop shop on all factors** that need to be addressed when implementing beach nourishment projects that can benefit nesting marine turtles.

The ideas compiled and expressed in the Technical Report provide important information for future efforts to use beach nourishment as a tool, to not only provide coastal storm protection and recreational opportunities, but to also build and enhance nesting habitat for marine turtles.

Innovations and Advancements

- Since all species of marine turtles that nest in the Unitied States are listed under ESA, providing this information permits USACE managers to better maintain legal compliance for the conservation and protection of these species.
- Efforts to proactively manage and engineer beach nourishment to benefit listed marine species can also be used in a Section 7(a)(1) conservation planning action with the U.S. Fish and Wildlife Serive. This process streamlines ESA compliances, reduces or eliminates jeopardy Biological Opinions, and promotes better outcomes for the target species.

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Beneficial Use of Dredged Sediments

Productive and postive uses of dredged material.

Beach Nourishment Along the South Atlantic Coast

Lessons Learned

One critical piece of information gathered is that much more research will need to be implemented to study the **long-term impacts** of beach nourishment on nesting marine turtles.

Consistancy in standard nest survey protocols are essential to be able to address both positive and negative impacts of beach nourishment on nesting turtles and other shoreline-dependent species.

Specific beach characteristics needed to benefit turtles may differ among turtle species, such that coastal engineers will need to assess which species regularly nest (or historically nested) on the section of beach to be renourished.

Partnering

We consulted with turtle biologists with the USACE Jacksonville District (SAJ) and the Florida Fish and Wildlife Commission. Principle partners include Robbin Trindell, Florida Fish and Wildlife Commission, and Aubree Hershorin, biologist, USACE SAJ.

Outcomes

The outcome of this effort was the development of an EMRRP Technical Report that thoroughly researches current science and management understanding of beach nourishment impacts on nesting marine turtles. A summary of features to consider during beach nourishment include:

- Matching sand substrate to the current or known historical type.
- Beach nourishment should not occur during the known nesting period (generally from March to October).
- Impaction concerns: heavy machinery used to shape beach may impact sand preventing females from digging nest chamber.. Tilling beach after renourishment may be an option.
- Minimize the use of artificial lights; impacts of lights can be minimized by reducing number,wattage and changing the angle of direction.
- Nesting behaviors for all species of marine turtles are similar; the female locates her natal beach, ascends the beach profile, digs out her egg chamber, deposits her eggs, and then buries and camouflages the nest.
- Good nesting beaches must provide easy accessibility by the females, sufficient elevations to minimize tidal indulation, adequate moisture for nest construction, and compatible sediment to permit gas diffusion and maintain optimal temperatures for egg development.
- Beaches subject to nourishment may be prone to erosions and escarpment that may limit or prevent turtles from nesting on a renourished beach; efforts must be made to monitor beach condition.

What is next?

Future work is needed to establish long-term monitoring of nesting marine turtles on beaches that are nourished by USACE. We intend to build on this work by building better partnerships and teams that can work to write proposals, procure grants, and conduct the necessary research and to produce future products and peer-reviewed articles that will improve our understanding on beach nourishment actions on populations of nesting turtles in the United States.

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Beach Nourishment Along the South Atlantic Coast

Additional Information?

In addition to the EMRRP Technical Report (currently in press) this work unit has produced other reports that are in internal review or in development.

Reine, K. J. 2021. A Review of Beach Nourishment Impacts on Marine Turtles. ERDC/EL TR-EMRRP-SI-XX. Vicksburg, MS; U.S. Army Engineer Research and Development Center. (In Press).

Guilfoyle, M. P., J. F. Jung, R. A. Fischer, and D. D. Dickerson. 2019. Developing Best Management Practices for Coast Engineering Projects that Benefit Atlantic Coast Shoreline-dependent Species. ERDC/TN-EMRRP-SI-38; U.S. Army Engineer Research and Development Center.

Guilfoyle, M. P., P. Hartfield, R. A. Fischer, J. F. Jung, and K. J. Reine. 2021. Implementing Section 7 (a)(1) Conservation Planning During USACE Coastal Engineering Projects. Vicksburg, MS; U.S. Army Engineer Research and Development Center. (In Press).

Guilfoyle, M. P., W. Golder, B. Winn, R. A. Fischer, and J. F. Jung. 2022. Best Management Practices to Improve Habitats and Increase Populations of Seasonal Shorebirds during U.S. Army Corps of Engineers Coastal Engineering Projects. ERDC/EL TR-EMRRP-SI-XX. Vicksburg, MS; U.S. Army Engineer Research and Development Center. (In Development).

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