ERDC/CHL SR-22-4

Coastal and Hydraulics Laboratory

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Current State of Practice of Nearshore Nourishment by the United States Army Corps of Engineers

Brooke M. Walker, Douglas R. Krafft, Brian C. McFall, Hande McCaw, and Scott L. Spurgeon

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Under Funding Account Code U4376874; AMSCO Code 089500

Abstract

This US Army Corps of Engineers (USACE) special report prepared by the US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, provides an overview of the current state of practice for nearshore nourishment with dredged sediment. This special report was completed with responses and input from professionals across the dredging and placement teams from each of the USACE Coastal and Great Lakes districts, providing comprehensive overviews of the decision trees these districts utilize in the placement of their dredged sediment. This report describes the general practice of nearshore nourishment, the impediments and concerns faced by nearshore nourishment projects, and the practical methods utilized by the Coastal and Great Lakes districts for their nearshore nourishment projects. Understanding the current state of practice, along with the general and specific impediments the districts face, enables further research in and development of best practices for use across the USACE and better communication of the practice to other stakeholders.

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Preface

This study was conducted for the US Army Corps of Engineers (USACE) by the US Army Engineer Research and Development Center (ERDC), under the USACE Dredging Operations and Environmental Research (DOER) Program, Coastal Inlets Research Program (CIRP), and the Regional Sediment Management (RSM) Program, under Funding Account Code U4376874; AMSCO Code 089500. The technical monitors were Dr. Todd S. Bridges, ERDC Environmental Laboratory, program manager, DOER Program; Dr. Tanya M. Beck, ERDC Coastal and Hydraulics Laboratory (ERDC-CHL), program manager, CIRP; and Dr. Katherine E. Brutsché, ERDC-CHL, program manager, RSM Program.

The work was performed by the Coastal Engineering Branch of the Navigation Division of the ERDC-CHL and the USACE New England District. At the time of publication of this report, Ms. Lauren M. Dunkin was chief, Coastal Engineering Branch; Ms. Ashley E. Frey was chief, Navigation Division; and Mr. Charles E. Wiggins was the ERDC technical director for Navigation. The deputy director of ERDC-CHL was Mr. Keith W. Flowers, and the director was Dr. Ty V. Wamsley.

The commander of ERDC was COL Christian Patterson, and the director of ERDC was Dr. David W. Pittman.

1 Introduction

1.1 Background

As a part of its Navigation mission, the US Army Corps of Engineers (USACE) dredges over 25,000 mi[1] of rivers and channels and 400 ports and harbors, collecting over 220 million cu yd of sediment (USACE 2021). Sand aggregate is the second most-used natural resource after fresh water, and it is being harvested and used at an unsustainable rate – at nearly twice the rate that the global river system creates it (United Nations 2014). With the knowledge that this sediment is an invaluable resource, the USACE seeks opportunities to beneficially use this dredged sediment. The Beneficial Use of Dredged Material is "the intentional placement of dredged sediment to provide economic, environmental, and societal benefits" (Bridges et al. 2015). Nearshore nourishment is one such practice.

Nearshore nourishment is the placement of sediment within the active littoral system. This practice nourishes and protects the beach profile. Wave action can naturally sort the placed sediment — winnowing the fine material and transporting the coarser fraction onshore (McFall et al. 2021a). Additionally, placed sediment can dissipate wave energy, thereby reducing wave energy on the beach profile. Nearshore nourishment provides a favorable alternative to both direct beach placement and offshore disposal, as it can be less expensive due to lower mobilization costs and allows for less-than-beach-quality sediment to still be used beneficially (Brutsché et al. 2019; Bain et al. 2021; McFall et al. 2021b).

The practice of nearshore nourishment is supported by research conducted through several USACE programs, including the Regional Sediment Management (RSM) Program and the Coastal Inlets Research Program, along with the Engineering With Nature® Initiative. Additionally, of the 21 USACE Coastal and Great Lakes districts, 19 actively implement nearshore nourishment projects, highlighting the emphasis the USACE has placed on the practice and the growing support

[1] For a full list of the spelled-out forms of the units of measure used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248-52, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

the practice has from relevant stakeholders. Based on the current state of the practice, the USACE can develop best practices to standardize the application of nearshore nourishment, support cost savings, and provide better communication of the practice to relevant communities and stakeholders across the USACE Coastal and Great Lakes districts.

1.2 Objective

This work compiles and communicates the current state of nearshore nourishment practices across the USACE Coastal and Great Lakes districts.

1.3 Approach

To determine the current state of nearshore nourishment practices, teleconferences with each of the 21 USACE Coastal and Great Lakes districts were held with representatives from the districts' engineering, planning, operations, and regulatory sections. These calls took place between March and July 2020. Each district was asked the same series of questions:

1. Describe and provide examples of your current nearshore nourishment efforts.
2. What regulations do you encounter or must account for when you attempt nearshore nourishment projects?
3. Does the District place any sediment outside of the surf zone?
4. Does the District do any monitoring of their nearshore nourishment projects?
5. What metrics do the Districts use to determine the success of a nearshore nourishment project?
6. Does the District place any dredged sediment near coastal structures?

For each call, a team from the US Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), including Brian C. McFall, Douglas R. Krafft, Brooke M. Walker, and Scott L. Spurgeon, along with Hande McCaw from the USACE New England District (NAE), took notes and then assembled those notes into the *Nearshore Nourishment Practices White Paper*[1]. The success metrics were

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[1] McFall, B., H. McCaw, D. Krafft, B. Walker, and S. Spurgeon. 2020. *Nearshore Nourishment White Paper*. ERDC/CHL White Paper. Vicksburg, MS: US Army Engineer Research and Development Center.

published separately (McFall et al. 2021b). From the white paper, details from each district were compiled into a spreadsheet to execute a direct comparison and analysis of how each Coastal and Great Lakes district performs nearshore nourishment. The RSM Beneficial Use Database (USACE [n.d.], RSM Program Navigation Sediment Placement Database) provided additional data regarding dredged material placement statistics. Results from the analysis are provided in this ERDC/CHL special report. The Beneficial Use Database can be accessed via this link (last accessed 19 July 2022): https://www.arcgis.com/apps/MapSeries/index.html?appid=0ea8fc0a956f46068428c862e7497233.

This ERDC/CHL special report is divided into three main sections. Chapter 1 provides a brief background of nearshore nourishment and a discussion of the methodology of data collection. Chapter 2 outlines the current state of nearshore nourishment practices along with a review of other ways dredged sediment is being used beneficially, based on the input from the Coastal and Great Lakes districts. Chapter 3 provides observations collected from the data, and potential paths forward to support the districts' efforts to practice nearshore nourishment. The information collected from the districts are presented in groups based on geographic locations, not necessarily USACE Divisions. For example, the Gulf Region consists of the Mobile (SAM), New Orleans (MVN), and Galveston (SWG) Districts even though they are from three different divisions. Organizing the results by geographic locations was chosen because all the districts in the regions will have similar wave climate and shoreline morphology, and the same dredges tend to operate in the geographic area (e.g., Pacific dredges do not operate in the Atlantic), leading to similar dredging techniques and placement operations.

2 Current State of Practice of Nearshore Nourishment

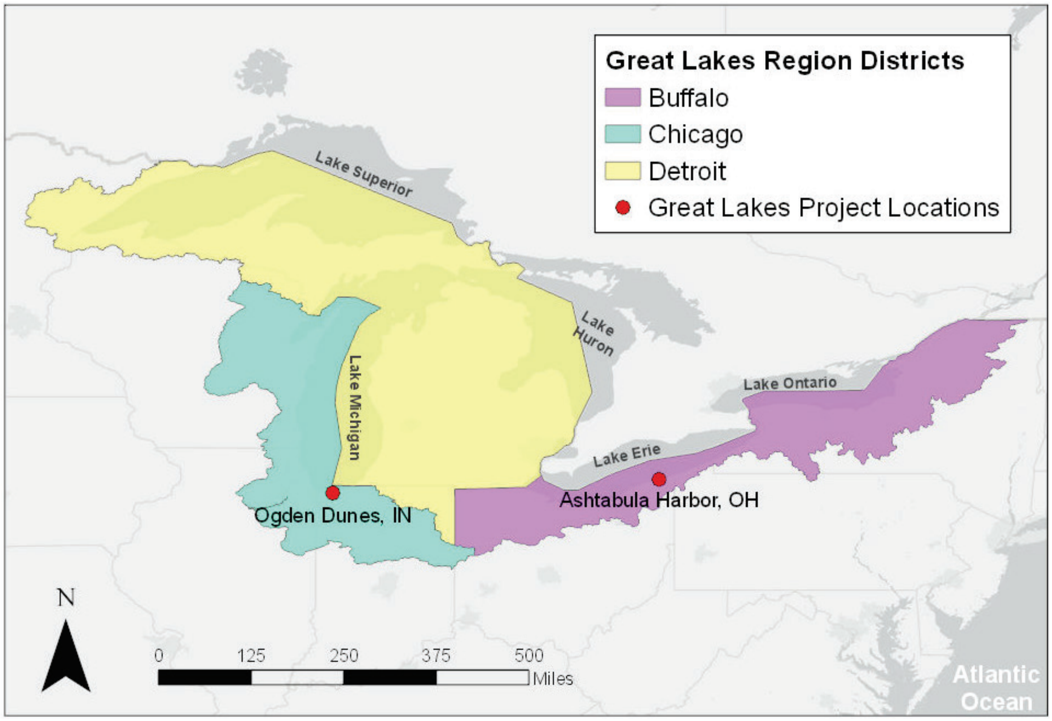
2.1 District nearshore nourishment practices

To best describe the current state of nearshore nourishment practices, this ERDC/CHL special report relays the data collected in a regional approach. This report recognizes that every USACE Coastal and Great Lakes district has different goals, priorities, and unique challenges to overcome when practicing nearshore nourishment. By broaching the data regionally, this report highlights the similarities among the districts' efforts while acknowledging the differences.

2.1.1 The Great Lakes Region

The Great Lakes Region includes the Chicago (LRC), Detroit (LRE), and Buffalo (LRB) Districts. States represented in this region include Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York. Figure 1 highlights the geographic boundaries of the Great Lakes Region. Note that the Great Lakes Region uses the International Great Lakes Datum (IGLD) to measure the water levels of the Great Lakes. The IGLD is a joint effort between Canada and the United States to maintain a consistent measuring standard for the Great Lakes, connecting waterways, and the St. Lawrence River System (National Oceanic and Atmospheric Administration [NOAA], n.d.). When discussing the nearshore nourishment projects, it is assumed that lake-level measurements were taken using the IGLD standard. Between 2015 and 2020, the Great Lakes Region dredged over 18 million cu yd of sediment (USACE, n.d.).

Figure 1. The Great Lakes Region with nearshore nourishment project locations.



According to data compiled from the RSM Program Navigation Sediment Placement Database, from 2015 to 2020, LRC dredged over 740,000 cu yd of sediment, with 22.6% placed within the known littoral system. Over the same time period, LRE dredged a total of 6.8 million cu yd, with 4.8% placed within the known littoral system and 1.2% placed in open water. From 2015 through 2020, LRB dredged over 10.5 million cu yd, with 52.8% placed within the known littoral system (USACE, n.d.). Other placement locations are provided in Table 1.

Table 1. Placement locations for the Great Lakes Region from 2015 through 2020.

District	Cubic Yards	On the Beach	Known Littoral System	Open Water	Upland	Wetlands	Unspecified
Chicago (LRC)	744.29k	6.0%	22.6%		71.4%		
Detroit (LRE)	6.8M	24.7%	4.8%	1.2%	48.8%	11.8%	8.7%
Buffalo (LRB)	10.51M		52.8%	32.4%	14.4%		0.5%

The nearshore nourishment projects in these districts are typically completed using a mechanical or cutterhead dredge and placed using bottom dumping scows or hydraulic pumps. LRE and LRB base their placement on the known high and low water levels of the lakes. LRE places its dredged sediment between the high-water mark and 12 ft of water depth.

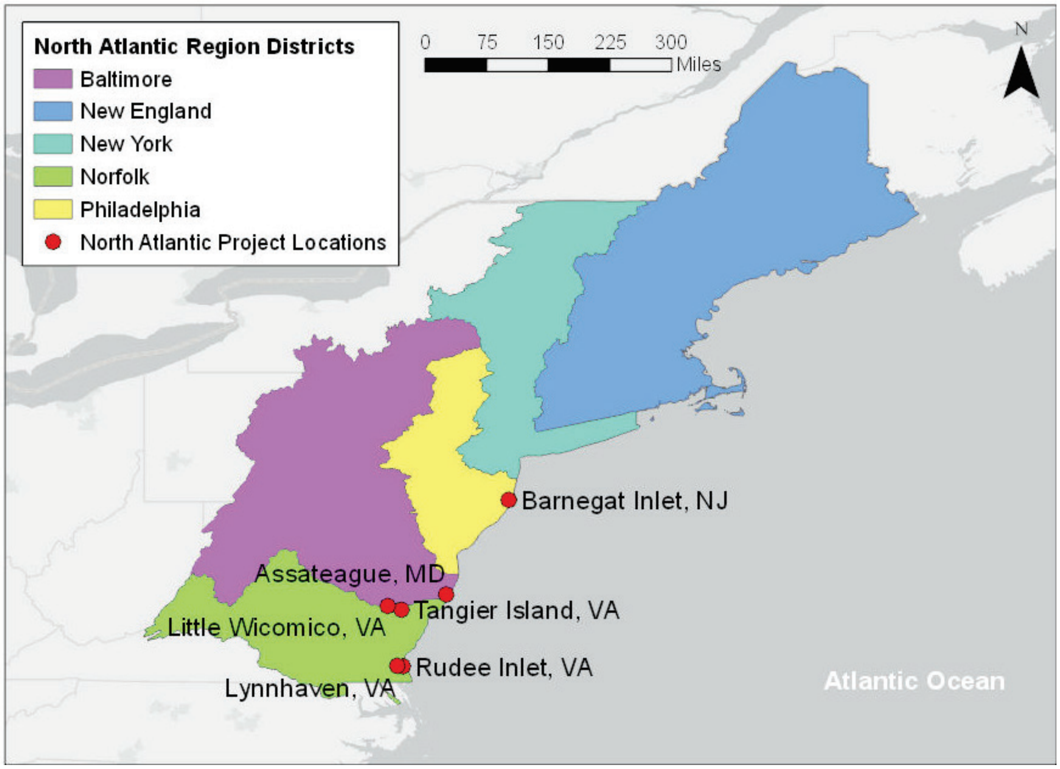
LRB has historically placed sediment between 8 and 12 ft below mean low lake level, but 2020/2021 project plans for Ashtabula Harbor involved a bottom-dump scow placing material in shallower water. Shoreline impacts of the deeper placements have been difficult to observe. Across the Great Lake Region, a large quantity of the dredged sediment is not considered suitable for nearshore placement due to the percentage of fines.

LRC traditionally places its sediment at the 18 ft contour. The June/July 2016 placement of nearly 140,000 cu yd of dredged material at Ogden Dunes, Indiana, was also placed at a depth of 18 ft. This dredged sediment came primarily from the Port of Indiana and consisted of sediment with a fine percentage determined to be appropriate for beach nourishment. The sediment was placed as an irregular mound with discrete identifiable peaks. Two post-placement surveys determined that the centroid of the sediment moved onshore and in the alongshore direction, confirming sediment transport modeling of the nearshore nourishment effort (Young et al. 2020).

2.1.2 The North Atlantic Region

The North Atlantic Region includes the NAE, New York (NAN), Philadelphia (NAP), Baltimore (NAB), and Norfolk (NAO) Districts, which maintain the federal navigation channels, waterways, and coastlines of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia (Figure 2). From 2015 to 2020, these districts dredged a combined total of 93.7 million cu yd. Thirty-six percent of this sediment was placed upland, 36% was placed in open water, 9% was placed directly onto the beach, and 5% was placed in beneficial use sites in wetland areas, rivers, and open water. The remainder was placed in unspecified sites (USACE, n.d.).

Figure 2. The North Atlantic Region with nearshore nourishment project locations from 2015 through 2020.



According to the RSM Program Navigation Sediment Placement Database, from 2015 and 2020, NAE dredged over 15 million cu yd, with 1.5% placed within the known littoral system. Over the same period, NAN dredged nearly 12.5 million cu yd, placing 0% within the known littoral system, but 63.7% directly onto the beach. Over the same 5 yr, NAP dredged 17 million cu yd. While NAP did not place any within the known littoral system, 93.4% of the sediment was placed directly onto the beach. NAB dredged over 16.3 million cu yd, with none being placed within the known littoral system. NAO dredged nearly 29 million cu yd, placing 1.3% within the known littoral system (USACE, n.d.). A full accounting of the placements within the North Atlantic Region is provided in Table 2.

Table 2. Placement locations for the North Atlantic Region from 2015 through 2020.

District	Cubic Yards	On the Beach	Known Littoral System	Open Water	Upland	Wet-lands	In-River	Unspecified
New England (NAE)	15.15M	3.2%	1.5%	89.8%	2.3%			3.1%
New York (NAN)	12.44M	63.7%		14.2%	22.1%			
Philadelphia (NAP)	17.07M	93.4%					1.0%	5.7%
Baltimore (NAB)	16.32M			39.6%	29.8%	1.1%		29.6%
Norfolk (NAO)	28.73M	1.0%	1.3%	47.7%	24.2%		2.0%	23.9%

To implement their nearshore nourishment projects, the North Atlantic Region districts commonly use split-hull hopper dredges. These dredges typically come from the USACE fleet rather than being contract dredges. The *Currituck* and *Murden* (Figure 3) are smaller dredges and can get closer to shore than most available contract dredges. However, the NAO project at Tangier Island, Virginia, uses a cutterhead, and the Lynnhaven, Virginia, project typically uses the *Merritt*, a side-cast dredge from the USACE fleet, if a split-hull hopper is not available. Though the NAN does not implement nearshore nourishment projects very often, it uses a combination of cutterhead and hopper dredges and then hydraulically pumps the dredged material.

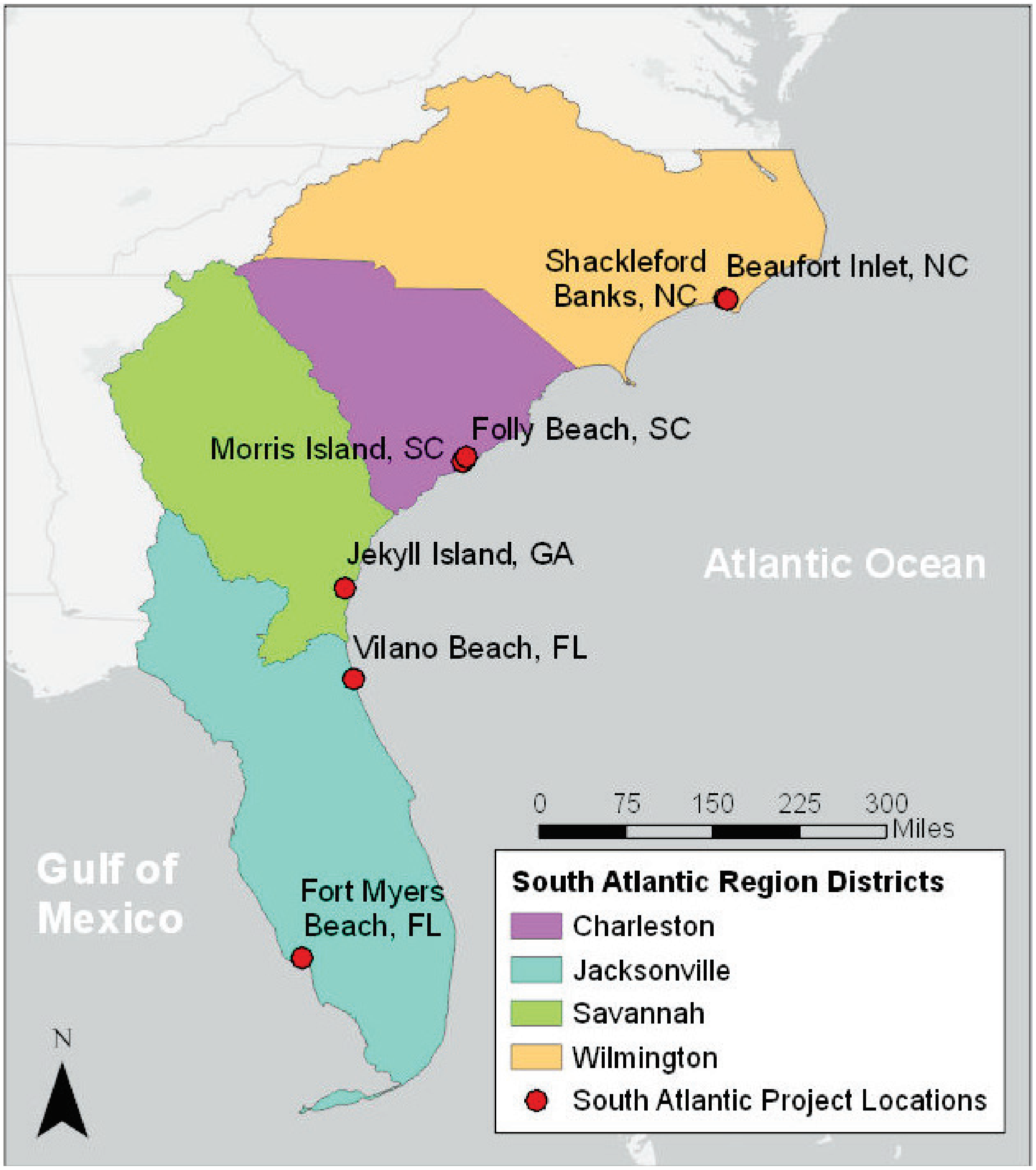
Figure 3. Split-hull hopper dredge *Murden*.

Dredging and placement take a variety of forms across the North Atlantic Region. NAN places its suitable dredge material above the mean high-water elevation. NAP typically pulls only small volumes of material from around its coastal inlets for placement at its project at Barnegat Inlet, New Jersey. At Assateague, Maryland, NAB places its dredged sediment within the surfzone. In the NAO, nearshore nourishment strategies at Rudee Inlet and Lynnhaven, Virginia, include placements as shallow as the 5 ft contour. Elsewhere, NAO places its sediment landward of the accepted Depth of Closure (DOC), or the depth at which sediment transport is negligible.

2.1.3 The South Atlantic Region

The South Atlantic Region includes the Wilmington (SAW), Charleston (SAC), Savannah (SAS), and Jacksonville (SAJ) Districts, which provide support and maintenance to the federal navigation waterways of North Carolina, South Carolina, Georgia, and most of Florida (Figure 4). These districts dredged a combined total of nearly 259 million cu yd of sediment over the 5 yr period between 2015 and 2020 (USACE, n.d.).

Figure 4. The South Atlantic Region with nearshore nourishment project locations.



According to data compiled from the RSM Program Navigation Sediment Placement Database, from 2015 to 2020, SAW dredged nearly 43.5 million cu yd, placing 0.3% within the known littoral system. SAC dredged 57.7 million cu yd, placing 68% in open water sites, with none being placed within the known littoral system. SAS dredged 60.7 million cu yd, with none placed within the known littoral system. SAJ dredged 46.7 million cu yd, with 0.5% placed within the known littoral system (USACE, n.d.). Table 3 provides a more complete accounting of placement locations for the South Atlantic Region.

Table 3. Placement locations for the South Atlantic Region from 2015 through 2020.

District	Cubic Yards	On the Beach	Known Littoral System	Open Water	Upland	Wetlands	Unspecified
Wilmington (SAW)	43.46M	18.1%	0.3%	8.7%	41.9%		31.0%
Charleston (SAC)	57.69M	1.0%		68.4%	26.9%		3.7%
Savannah (SAS)	60.7M			20.4%	78.0%		1.6%
Jacksonville (SAJ)	46.72M	15.6%	0.5%	32.9%	31.3%	1.7%	18.0%

The districts use a variety of methods for dredging and placement. SAW and SAC predominantly use split-hull hopper dredges to complete their nearshore nourishment projects. At Beaufort Inlet, North Carolina, SAW will sometimes use a side-casting dredge to place sediment along the downdrift side of the inlet during the outgoing tide. SAW prefers to place its sediment in small cells within the nearshore rather than mounding the material. SAC initiated a pilot study on nearshore berm placement at Folly Beach, South Carolina, in the spring of 2021.

The SAS has beneficially used dredged sediment in the nearshore at Brunswick Harbor, Georgia, with a cutterhead dredge and a hydraulic pump to place sediment in a series of placement sites south of the entrance channel. Sediment transport at some of these placement sites may have been either less active than anticipated or directed back towards the federal navigation channel. Sediment dredged from the Brunswick Harbor entrance channel is more frequently transported by split-hull hopper to an ODMDS, which has been observed be dispersive (USEPA and USACE 2013).

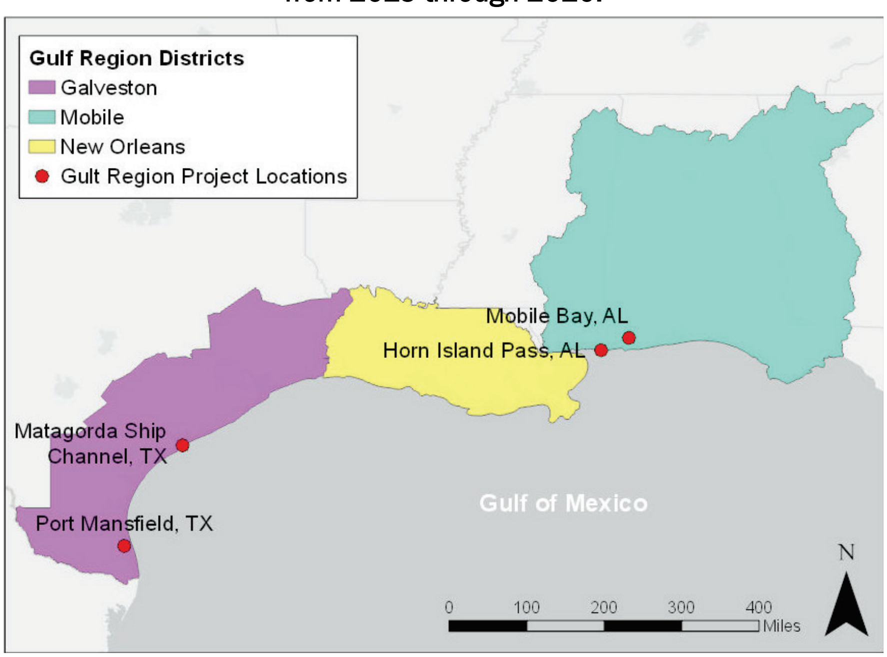
SAJ uses a combination of hopper and cutterhead dredges to place sediment in 10 to 20 ft of water. In 2015, sediment from St. Augustine Inlet and the Atlantic Intercoastal Waterway was placed in the nearshore at Vilano Beach, Florida. The project utilized the USACE split-hull dredge *Murden* to place approximately 150,000 cu yd in the nearshore at approximately 10 ft deep, in two distinct 328 yd long features parallel to the shore. One was placed as a linear bar-like feature, and the other was placed in a mound configuration. Prior to placement, several modeling tools were used to predict how the sediment would move, including the Sediment Mobility Tool and the Coastal Modeling System. Post placement was monitored through surveys and camera arrays. The placement was monitored through December 2015, and the sediment dispersed completely, with shoreline gains on the lee side of the nourishments (Brutsché et al. 2017; McFall et al. 2017).

In 2009, SAJ began a 2 yr study of an artificial nearshore berm. A total of 225,000 cu yd of sediment from the Ft. Myers Beach Harbor Channel was dredged using an 18 in. cutter suction dredge (*Wilko*) and then pumped across Estero Island to the nearshore bar placement location at Ft. Myers Beach. The goal of this placement was to mimic the morphodynamics of a natural bar. The berm was monitored for 2 yr to evaluate the processes and changes occurring at the berm and the adjacent beaches. The results of the study revealed that the berm migrated onshore 300 ft during those 2 yr of study (Wang et al. 2013; Brutsche et al. 2014).

2.1.4 The Gulf Region

The Gulf Region is unique in that it includes USACE districts from three separate USACE divisions. These districts were grouped due to their geographic proximity and similar dredging and nearshore nourishment efforts. The region includes the SAM, MVN, and SWG Districts, which provide support and maintenance to the federal navigation waterways of the panhandle of Florida, Alabama, Mississippi, Louisiana, and Texas (Figure 5). Combined, these districts dredged an estimated 587 million cu yd from 2015 through 2020 (USACE, n.d.).

Figure 5. The Gulf Region with nearshore nourishment project locations from 2015 through 2020.



According to data compiled from the RSM Program Navigation Sediment Placement Database, from 2015 to 2020 SAM dredged 50.2 million cu yd, placing 29.6% within the known littoral system. MVN dredged over 423 million cu yd, placing 0.4% within the known littoral system. Much of the great quantity of sediment dredged by MVN is instead placed in-river or used in wetlands. SWG dredged 113.8 million cu yd, placing 0.2% within the known littoral system (USACE, n.d.). SWG acknowledges that a significant portion of its sediment is placed in open water; however, there is evidence that these open-water locations may be active, with substantial sediment movement even outside of storm events. An example of this scenario is presented in Section 2.2. Further discussion about active deep-water sites is presented in Section 3. Table 4 provides additional placement location information for the Gulf Region.

Table 4. Placement locations for the Gulf Region from 2015 through 2020.

District	Cubic Yards	On the Beach	Known Littoral System	Open Water	Upland	Wetlands	In-River	Unspecified
Mobile (SAM)	50.18 M	10.0%	29.6%	30.4%	1.7%			27.9%
New Orleans (MVN)	423.24 M	0.9%	0.4%	31.4%	8.6%	19.2%	37.3%	2.2%
Galveston (SWG)	113.77 M	0.7%	0.2%	39.7%	36.9%	2.2%		20.4%

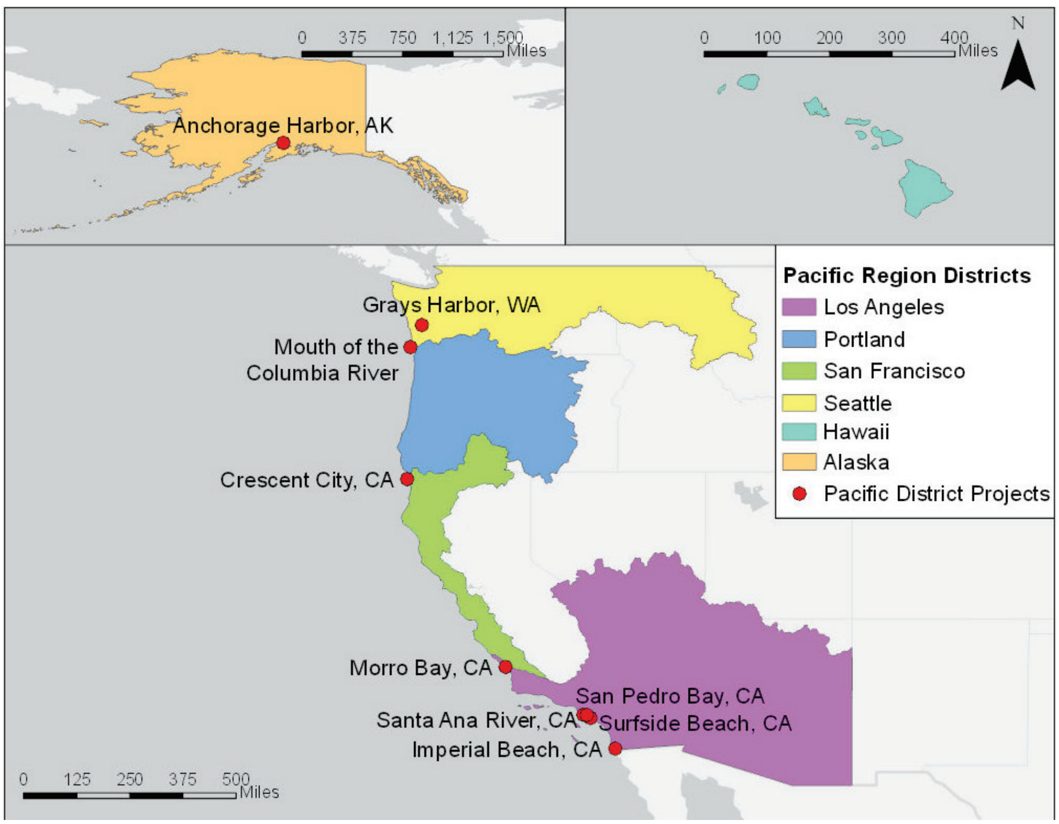
The Gulf Region districts traditionally use cutterhead dredges and a combination of pipelines and spill barges for the placement of sediment. SAM encounters very high wave energy, particularly during the winter months, which limits the depth at which equipment can safely operate. At Horn Island Pass (DA10), Alabama, SAM built a temporary land bridge to the desired placement area in depths of 8 to 10 ft. The land bridge disappeared during a storm, highlighting the extreme wave energy and the efficient transport of sediment in that environment. In Mobile Bay, SAM performs thin layer placements in the bay and surrounding estuaries on a regular basis.

MVN nearshore nourishments are often approximately 100 ft from the shoreline. At Matagorda Ship Channel, Texas, the SWG places sediment between 8 and 20 ft of water depth. At the Port Mansfield, Texas, entrance channel, sediment is placed within the surf zone.

2.1.5 The Pacific Region

The Pacific Region includes the Los Angeles (SPL), San Francisco (SPN), Portland (NWP), Seattle (NWS), Alaska (POA), and Honolulu (POH) Districts, which provide support and maintenance to the federal navigation waterways of California, Oregon, Washington, Alaska, and Hawaii. The geographic boundaries are shown in Figure 6. Between 2015 and 2020, the USACE dredged approximately 105.5 million cu yd of sediment from waterways leading into the Pacific Ocean (USACE, n.d.).

Figure 6. The Pacific Region with nearshore nourishment project locations from 2015 through 2020.



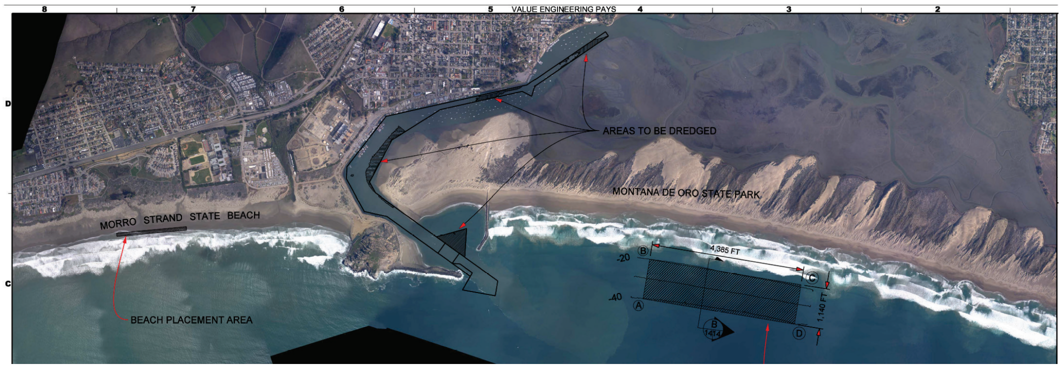
According to data compiled from the RSM Program Navigation Sediment Placement Database, from 2015 to 2020, SPL dredged over 12 million cu yd, placing 8.6% within the known littoral system. SPN dredged 18 million cu yd, with 15.9% placed within the known littoral system. NWP dredged over 60 million cu yd, placing 9.6% within the known littoral system. NWS dredged over 7 million cu yd, placing 0.6% within the active system. POA dredged 7.5 million cu yd, with 47% placed within the known littoral system. POH dredged 460,000 cu yd, with none being placed within the known littoral system (USACE, n.d.). Additional placement locations are shown in Table 5.

Table 5. Placement locations for the Pacific Region from 2015 through 2020.

District	Cubic Yards	On the Beach	Known Littoral System	Open Water	Upland	Wet-lands	In-River	Unspecified
Los Angeles (SPL)	12.21M	84.6%	8.6%	4.3%	2.4%			
San Francisco (SPN)	18M		15.9%	51.3%	1.3%	9.2%		22.3%
Portland (NWP)	60.12M	2.9%	9.6%	27.1%	11.8%		29.6%	19%
Seattle (NWS)	7.17M	1.20%	0.6%	78%	0.9%			19.2%
Alaska (POA)	7.55M	2.30%	47.3%	45.4%	1.1%		3.9%	
Hawaii (POH)	460K			87%				13%

The Pacific Region districts use a variety of methods for dredging and placement. SPL uses a combination of the hopper (including the USACE *Yaquina*), clamshell, and cutterhead dredges. For placement, most of its projects utilize a bottom dumping scow; however, the project at Santa Ana River, California, utilized a pipeline to place the sediment in the surf zone. For SPL, there is also a large range of depth for placement, depending on wave activity and known erosion hot spots. At Morro Bay, California, SPL places in 40 ft of water 4 to 5 mi from the channel in a downdrift area, as shown in the placement box in Figure 7. The dredge sediment from San Diego Bay is placed in the nearshore at Imperial Beach, and the sediment from the Los Angeles River Estuary is placed in a nearshore berm at San Pedro Bay. Sediment from Anaheim Bay is placed in 15 to 30 ft of water at the Naval Weapon Station Seal Beach. Additionally, SPL is planning to use a bottom dumping hopper to fill depressions in the nearshore at Surfside Beach, California.

Figure 7. Morro Bay Beach, California, and nearshore placement areas.



In general, SPN and NWP utilize bottom-dumping hoppers to place sediment. NWP performs thin layer placements along its shorelines to avoid mounding. Studies of larger features at the Mouth of the Columbia River[1] have helped to gather support for nearshore nourishments by documenting that the placed sediment is an active part of the littoral system, and by analyzing observed transport from the placement area.

SPN typically places in water depths of 35 to 40 ft. SPN encounters high energy wave environments, which limit the ability to place sediment shallower. At Crescent City, California, a clamshell dredge and scow have historically been used, but in 2020 the sediment was hydraulically dredged and placed in a pocket beach before being transported to the nearshore. NWS utilizes the USACE hopper dredges *Essayons* and *Yaquina* to place sediment in the nearshore of estuaries and the Pacific Ocean. At Grays Harbor, sediment is extracted from the Inner Harbor by clamshell dredge and placed at the inlet throat with bottom-dumping scows during the outgoing tide.

POA and POH do not perform nearshore nourishment at beaches. There are a variety of environmental, legal, and cost barriers that limit these districts from conducting nearshore nourishment; however, POA does place a large quantity of sediment in the relatively deep, but highly dynamic environment, of Anchorage Harbor, described in more detail in Section 2.3. This large placement quantity is considered in the littoral system because it is actively transported by waves and tidal currents.

[1] Hudson, A., H. Moritz, and J. Norton. (in review). *Sediment Mobility, Closure Depth, and the Littoral System – Oregon and Washington Coast.* ERDC/CHL Technical Note. Vicksburg, MS: US Army Engineer Research and Development Center.

2.2 Common concerns and regulatory interests

The Federal Standard is defined by US Environmental Protection Agency (USEPA 2007) regulations as “the least costly dredged material disposal or placement alternative (or alternatives) that is consistent with sound engineering practices and meets all federal environmental requirements, including those established under the Clean Water Act (CWA) (US Congress 1972a, with amendments) and the Marine Protection, Research, and Sanctuaries Act (MPRSA) (US Congress 1972b, with amendments).” Each of the Coastal and Great Lakes districts must apply these regulations to all dredging and placement projects, in addition to the state and local regulations, which vary significantly across the country. The following sections provide greater detail for the common concerns and challenges associated with regulations for each region.

2.2.1 The Great Lakes Region

A major concern when implementing nearshore nourishment projects in the Great Lakes Region is the percentage of fines in the sediment, due to the grain size distribution of the districts’ dredged material. Each state included in this region has different regulations and allowances for fines. Wisconsin is shared by LRC and LRE, and the Wisconsin State regulations have been particularly stringent, requiring greater than 90% coarse sediment. Due to this, nearshore nourishment projects have been nearly impossible to implement in Wisconsin. Other states included in the LRC purview are Indiana and Illinois. Indiana prefers in-lake placements; Illinois will allow them but requires less than 20% fines in the sediment, and chemical and physical testing every 5 yr or prior to dredging. LRC is seeking a regional Clean Water Act Section 401 Certification to improve efficiency of implementing nearshore placement efforts by reducing the need to seek individual project compliance (USACE 2020).

LRE works with the Michigan Department of Natural Resources (MDNR) to complete its dredging and placement projects outside of fish spawning windows. When MDNR provides an exception to the fish spawning window, the LRE goal is to keep turbidity at a minimum. Like Wisconsin, Michigan requires 90% coarse material for placement in the nearshore. Sediment with lower percentages must either be placed at a depth of at least 30 m or must be taken to an upland disposal site. LRE works with the states in its purview to obtain the Clean Water Act Section 401 Certification. In addition to these concerns, LRE must work with the states, local landowners, and dredging contractors to coordinate real estate agreements for land access.

The State of Ohio federal waterways are under the purview of the LRB. One of the impediments to nearshore nourishment that came up in the meeting with the LRB was the grain size distribution of the dredged sediment. A large amount of sediment is dredged from the harbors along Lake Erie, but this often contains high percentages of fines. As of 2020, Ohio prohibits open lake placement of dredged materials. Instead of open lake placements, LRB is looking to utilize its dredged material in wetland nourishment projects and upland placement sites.

2.2.2 The North Atlantic Region

The North Atlantic Region districts manage their dredging and nearshore placement projects around a variety of ecological and regulatory parameters. The NAE is very conscious of protecting the eelgrass and lobster populations. Accordingly, its projects require environmental analysis with sub-aquatic vegetation and shellfish surveys. The NAP and NAB also work to reduce environmental impacts. At the request of the National Fish and Wildlife Foundation, the NAP performs benthic life surveys at Barnegat Inlet, New Jersey. Additionally, the NAP is working with stakeholders to resolve concerns about sea bird habitats. The NAB specifically places sediment in the nearshore rather than directly onto the beach at Little Wicomico, Virginia, to protect the larva of the Tiger Beetle.

The NAE requires any placed dredge material with greater than 15% fines to be investigated thoroughly, with contaminated sediment placed in a Section 404 disposal site or an aquatic disposal cell. The NAN works with the New York Department of Environmental Conservation to provide a demonstration of need for every project, including environmental impacts of the proposed project. NAN works to balance these requirements with the promotion of beneficial re-use from the state's Coastal Zone Management program.

For projects within the NAP purview, the percentage of fines must match native sediment, and any fines greater than 20% require chemical testing. The NAB is restricted from open water placement by the State of Maryland; thus, its placements within the State of Maryland must all be in the nearshore or directly onto the beach; however, the NAB extends into the State of Virginia, which allows for some open water placement. The

NAO requests water quality permits from the Virginia Department of Environmental Quality (VDEQ). The major concern for VDEQ permitting is the percentage of fines — any sediment used for beneficial use must contain 85% to 90% sand. The Virginia Marine Resource Commission (VMRC) supports beneficial use and nearshore placement projects, but overboard placement sites are typically cheaper to utilize and still meet the Federal Standard. To place in the overboard sites, the NAO requests permitting from the VMRC. With direct beach placement, NAO must verify sediment compatibility for public beaches. Private lands require real estate and hold-harmless agreements to be in place prior to placement.

2.2.3 The South Atlantic Region

The South Atlantic Region districts manage their dredging and nearshore placement projects around protecting sensitive or endangered habitats/species. For the SAW, all dredging is done in the winter to align with National Oceanic and Atmospheric Administration-enforced environmental windows. The SAC recognizes the need to protect fish and sea turtle habitats and has implemented processes around sediment transport and fines to encourage sea turtle nesting. Along with protecting critical habitats, the SAS must also account for several historical and archeological sites along the beach. The SAJ works with regulatory agencies to protect seagrass and turtle habitats, along with the coral reef system.

All SAW dredging and nearshore operations must be permitted by the North Carolina Department of Environmental Quality, Division of Water Resources. SAW is allowed to place navigation channel dredge material in Coastal Barrier Resources Act sites. Greater than 90% sand is considered beach quality. Pushback from the National Marine Fisheries Service (NMFS) has contributed to preventing similar quality sediment from being used to nourish the nearshore of Shackleford Banks, North Carolina, because it is only 80% sand although local sediment at the proposed location is similar.

The SAC works with state agencies to communicate the impacts of nearshore placement efforts. At Morris Island, South Carolina, there was concern about clogging tidal creeks due to the silt content of the proposed sediment. The NMFS required a sediment transport model to show that dredging in Georgetown, South Carolina, would not unduly impact fish habitats. While there are no official regulations for maximum percentages of fines, the South Carolina Department of Health Office of Ocean and

Coastal Management, and South Carolina Fish and Wildlife prefer greater than 90% sand.

The SAS works with the Environmental Protection Agency (EPA) to acquire the MPRSA Section 103 permit for their projects, and requirements for the certification have been growing in accordance with 33 C.F.R 325 (US Congress 2012). The Georgia Department of Natural Resources requires sediment placed in the nearshore to be beach quality and defines *beach quality sand* as greater than 90% sand.

The State of Florida has stringent turbidity rules in place to protect seagrass habitats and the coral system. The SAJ projects are limited to 29 Nephelometric Turbidity Units, which is a measure of suspended particles in water, with measurements taken outside of the mixing zone. Additionally, borrow material used for beach placement must consist of no more than 5% fines; navigation material for beach placement must be no more than 10% fines. Nearshore placements utilizing navigation project dredge material must contain no more than 20% fines.

2.2.4 The Gulf Region

Similar to the South Atlantic Region, regulations in the Gulf Region are ecologically based. Turtle and bird nesting windows are important scheduling considerations in the Gulf Region. The turtle nesting windows topic arose in the conversations with SAM and SWG. Bird nesting windows and sea bird habitat (specifically the Piping Plover) restrictions are also important factors in SAM and MVN nearshore nourishments, respectively.

The Gulf Region districts do not have codified grain size limitations for their placement sediments, but the sediment should be compatible with the placement area. The SAM limits the thickness of its placements to 6 in. deep, with a hard limit of no more than 1 ft deep. For direct and nearshore placements, the sediment must be compatible with the local beach. The MVN complies with regulations of the Clean Water Act for placement in its Clean Water Act sites. SWG does not maintain any permanent nearshore nourishment placement sites adjacent to navigation channels to limit the backfilling of the channels. While stringent fines percentages have been suggested, the grain size distribution along the Texas Gulf Coast is too varied to implement such restrictions.

2.2.5 The Pacific Region

The Pacific Region districts encounter a variety of environmental and regulatory parameters for their dredging and placement operations. The SPL does not perform any dredging between April and September due to bird breeding activities and grunion spawning on the beach. Additionally, the NMFS requires the monitoring of marine mammals on some of the SPL projects, and the monitoring of sea turtles at the Port of Long Beach. The SPN works actively with the NMFS and crabbers to reduce concerns regarding placement mounds affecting crabbing. Additionally, no placements are allowed within the Monterrey Bay Marine Sanctuary, which prevents the beneficial reuse of material from Moss Landing, California. The NMFS is also highly involved with the POA dredging and placement projects due to the population of marine mammals. The NMFS requires observers, sound profiling, and stand-off distance requirements to protect the marine life.

Each district also encounters various water quality requirements from local, state, and federal regulators. The California Coastal Commission enforces the Coastal Zone Management Act for both the SPL and SPN. The districts must be able to validate the transport of the sediment and the nourishment of the beaches. The SPL works with the California State Water Quality Control Board to acquire water quality permits. The district uses sediment with less than 10% fines for direct placement and less than 20% fines for nearshore placement.

The NWP works closely with the EPA to acquire water quality certificates and the selection of Clean Water Act sites for material placement. Additionally, the NWP works with the State of Oregon for approval on placement sites. To obtain approval, the NWP must be able to outline the quantity of material being placed, the various placement locations, dredge transit routes, and what monitoring will be done at the placement site. The NWS also coordinates with the EPA on the selection of beneficial use sites. For the dredging and placement sites within Puget Sound, Washington, the NWS requests permitting every 5 to 10 yr from a working group comprised of several state entities along with the EPA. There are several projects where the NWS and NWP are both involved, and these projects require additional baseline benthic life surveys.

When the POA places material upland, there is a substantial review process involving the Alaska Department of Environmental Conservation (ADEC)

Division of Water and the Division of Solid Waste. If the sediment is contaminated, the Division of Spill Prevention will also be brought in to review the placement plan. Beneficial reuse is further complicated by real estate constraints, as dredged sediment cannot be used on private property. For in-water placement, the ADEC, Division of Water, issues the Section 401 Water Quality Certificate. Additionally, there are several POA projects that also require coordination with the Alaska floodplain program.

The Hawaii Department of Health issues the Section 401 Water Quality Certificate for the POH. Historically, the POH utilized a “Small Scale Beach Restoration” permit to perform projects of less than 10,000 cu yd. The Hawaii Office of Conservation and Coastal Lands permits the POH beach nourishment project. The permit limits fines to 6%, and the sediment gradient must match.

2.3 Other uses for dredge sediment

Dredged sediment is beneficially used in a variety of contexts across the nation. Many of these applications involve nearshore nourishments within the known littoral zone and are discussed in the preceding sections. In addition to queries regarding nearshore nourishment, questions were also asked regarding sediment placed outside of the surf zone near coastal structures. Participant responses to these questions are presented here, along with any additional information not already addressed. The organic nature of the discussions around the state of the practice resulted in a variety of topics beyond the primary questions driving the research effort. These examples are included here as well to document the information provided, and to provide a fuller picture of how districts utilize their dredged sediment.

2.3.1 The Great Lakes Region

In addition to traditional nearshore nourishment, the LRC and LRE place their sediment near coastal structures. LRC hydraulically pumps sediment directly onto the beach next to the Burns Small Boat Harbor. LRE generally places its sediment in the nearshore in up to 8 ft of water next to the jetty (up to 5,000 ft downdrift) to shore up the jetty. LRC has several other direct placement projects, including Michigan City Harbor and Calumet Harbor. LRC also provides direct placements at the request of local communities and stakeholders.

2.3.2 The North Atlantic Region

The North Atlantic Region has several applications of beneficially placed dredged sediments. The NAN has several projects where dredge sediment is placed near coastal structures on the subaerial beach. At Lake Montauk Harbor, New York, sediment is placed within 400 ft of the west jetty. The Manasquan Inlet, New Jersey, project places sediment 200 to 300 ft from the jetties. At Shark Inlet and Shinnecock Inlet, New Jersey, NAN places sediment much farther away — 1,000 ft downdrift of Shark Inlet, and 1.5 mi from the jetty at Shinnecock Inlet, due to a sediment transport reversal node. At Little Wicomico, Maryland, the NAB places sediment 3,000 ft downdrift of the jetty, and at Fishing Creek, Maryland, the material is placed 4,000 ft downdrift of the jetty. Additionally, sediment is also piped directly onto the beach at Fishing Creek, Maryland. At Rudee Inlet, Virginia, the NAO typically places sediment approximately 2,900 ft north of the jetty due to a net transport to the north, but when using the side-cast placement, the material is placed in a scour hole on the north side of the jetty, due to depth limitations of equipment.

At Nantucket East, Massachusetts, and Kennebuck, Maine, the NAE places dredged sediment outside of the surf zone at approximately the 24 ft contour. NAE uses dispersal placements rather than berms to limit potential navigation risks in these areas. At Manasquan Inlet and Shark River, New Jersey, the NAN places sediment at the 25 ft contour, and at Sandy Hook Channel, New Jersey, material is placed between 30 and 60 ft deep. When placing outside of the surf zone, the NAP places its material between 10 and 20 ft deep.

2.3.3 The South Atlantic Region

The South Atlantic Region places dredged material directly onto the beach. The SAJ completed a direct placement of dredge sediment at New Smyrna Beach, Florida, using a cutterhead and hydraulic pump. The pipe used for the placement eventually was buried under the material and could not be retrieved. SAW has placed sediment directly onto the beach at the request of the local historical society. Additionally, the South Atlantic districts perform several projects outside of the surf zone. At Shackleford Banks, North Carolina, the SAW places sediment between 17 and 35 ft of water, noting a 22 ft DOC. At Folly River/Stono River Inlet, South Carolina, the SAC uses a side-casting dredge to place sediment downdrift of the channel. At St. Lucie Inlet, Florida, the SAJ places sediment at a depth of 20 ft, and at Canaveral Harbor, Florida, sediment is placed at -23 ft North American Vertical Datum. SAJ prefers deeper placements when placing outside of surf zone, due to a lower equipment mobilization cost.

The SAC, SAS, and SAJ place near coastal structures, as well. At Murrells Inlet, South Carolina, the SAC places sediment at the landward end of the jetty due to erosion concerns. Another placement is planned for the south jetty at Charleston Harbor to stabilize its landward end. The SAS places sediment directly onto the beach adjacent to the structure at Fort Pulaski, Georgia. The SAJ has several placements near coastal structures with the general practice of placing at a known erosion hotspot or downdrift of the structure. The SAJ considers the sediment transport nodal point and places material farther south to limit transportation back into the inlet.

Both the SAC and SAS utilize dredge material to create bird nesting islands. SAC places sediment greater than 65% sand in the Charleston Harbor to maintain its bird nesting habitat. SAS places sediment west of the channel at Brunswick Harbor, Georgia, to create a bird island.

2.3.4 The Gulf Region

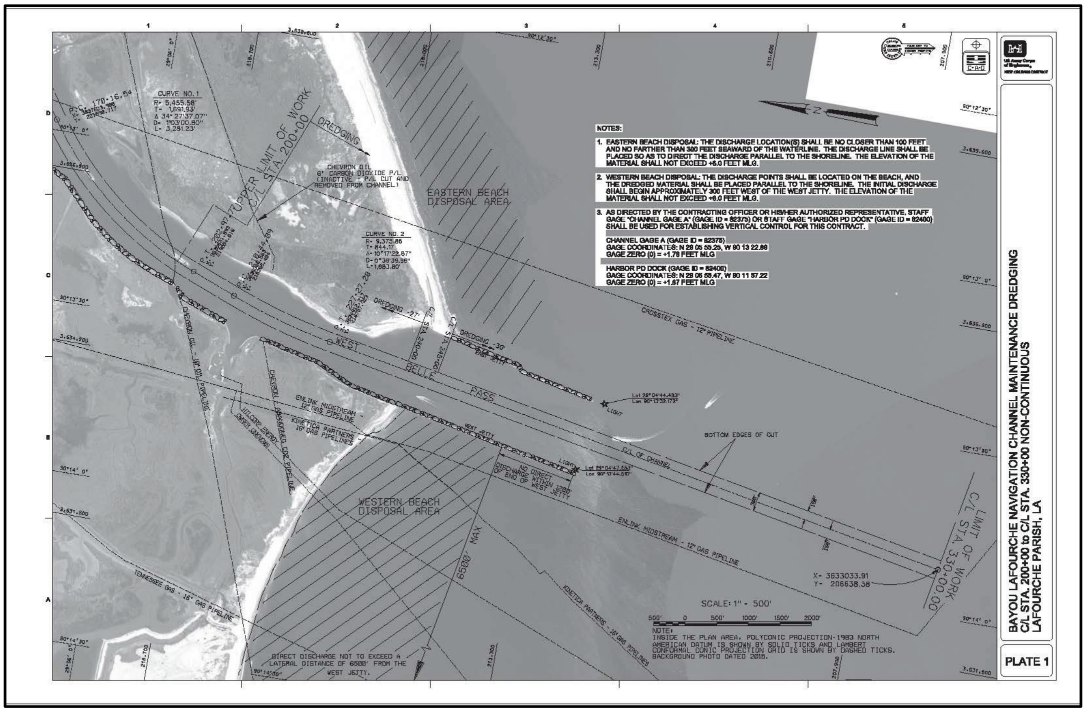
The Gulf Region applies various beneficial use placement strategies outside of nearshore placement. The MVN utilizes thin layer placements to build up the marsh elevation at Baptist Collette, Louisiana, in a beneficial use project. The SWG has multiple direct placement projects where it utilizes a combination of hopper and cutterhead dredges and then pump sediment onto the sub-aerial beach. Material from the Corpus Christi Ship Channel can be placed onto the dune at Mustang Island. Sandy material from South Padre Island, Texas, is placed directly onto the adjacent beach. Sabine Pass, Texas, and Colorado River Locks, Texas, dredge material is pumped out to their adjacent beaches. Sediment from Galveston Bay, Texas, is pumped out to a beach approximately 8 mi away.

The SAM uses bottom-dump hoppers to place sediment outside of the surf zone. At the Sand Island Beneficial Use Area, sediment is placed in 25 ft of water, and while the site is outside of the commonly used DOC, the sediment does appear to be transported during storm events. Following a sediment tracer study at the Houma Navigation Channel, the MVN placed sediment in 15 to 20 ft of water, 3 to 4 mi from the barrier island (Rosati and Lawton 2011). Historically, this sediment was placed in an offshore disposal site, but the revised placement allows for resettling of sediment on the barrier island.

At SWG, sediment dredged from the outer channel at South Padre Island, Texas, is placed in an Ocean Dredged Material Disposal Site (ODMDS). To quantify whether sediment placed in the ODMDS moves onshore, SWG undertook a sediment tracer study in 2018. The SWG placed 500,000 cu yd of sediment 4,000 ft offshore in 30 ft of water, in a nearshore berm. After completing the placement, 4,400 lb of tracer particles were deployed to determine where and how quickly sediment from the berm moves. The results of the tracer study determined that the sediment does move from the nearshore berm, indicating the ODMDS is within the DOC, showing the placement does nourish the beach profile. However, the time period over which this movement occurs could be years rather than months. SWG considers this site within the littoral zone (Figlus et al. 2021).

All three of the Gulf districts place sediment near coastal structures. The SAM, at Perdido Pass, Alabama, pumps sediment directly onto the beach on the west side of jetty. In 2019, additional sediment was placed onto the east side and behind the jetty and weir, due to known erosion hot spots. The MVN places sediment along the shoreline adjacent to the jetty at both Port Fourchon and Bayou Lafourche (Figure 8). The MVN uses a crescent-shaped fill area to protect the jetties from shoreline undercutting. The SWG pumps sediment to the west of the jetties at Sabine Pass, Texas. Material from the Colorado River Lock is pumped out downdrift to bypass material. The material pumped to Mustang Island is used to prevent island breaching and to protect the jetty. Finally, sediment from Port Mansfield, Texas, is pumped to the adjacent shoreline to protect the jetty.

Figure 8. Port Fourchon, Louisiana, placement plan along Jetties, provided by the MVN.



2.3.5 The Pacific Region

The SPL, NWS, POA, and POH utilize direct placement for several of their projects. The SPL uses a cutterhead dredge and hydraulically places sediment at both Port Hueneme and Oceanside Harbor, California. The NWS uses a cutterhead dredge at Willapa Bay, Washington, to place onshore at the dune, but this is done infrequently due to its high cost. Additionally, an 18 in. or smaller dredge is used to remove sediment from La Push, Washington, and then the sediment is pumped over the spit to the adjacent beach. Sediment from Puget Sound, Washington, can be placed directly onto the beach or in various dispersive or non-dispersive sites depending on budget and erosion concerns.

The POA uses cutterhead dredges to remove sediment from Homer, Ninilchik Harbors, and Port of Nome, Alaska. The sediment is then pumped to trucks to be taken upland, dewatered, and then trucked back down for direct placement onto the beaches adjacent to the dredge site. The littoral transport is west to east at Port of Nome, Alaska, so the sediment is placed onto the beach east of the harbor. Sediment from Ninilchik Harbor, Alaska, can also be used as road construction material. The POH has a direct placement project in the planning phase. Sandy material from the outer harbor of Haleiwa Small Boat Harbor will be excavated and then placed into a scow for natural dewatering. Once dewatered, the material will be placed near the beach groin.

Each of the Pacific Region districts (except SPL) places sediment outside of the surf zone. The SPN places sediment in 40 ft of water due to the draft limitations of the large hopper dredges that make up the available USACE and contract dredge companies' fleets. The NWP has multiple projects where sediment is placed within the 60 ft contour. Studies have shown that this sediment moves onshore in typical conditions. Historically, the NWS has placed sediment from Grays Harbor, Washington, 3 to 3.5 mi offshore; however, this placement site has not been used since the early 1990s. Sediment from Puget Sound, Washington, can be placed into either one of five non-dispersal sites offshore, but the NWS prefers to use two shallower dispersal sites and a direct placement option for this sediment. The POA uses a hopper dredge to place sediment from Anchorage, Alaska, 3,500 ft offshore in depths of 90 to 100 ft. It is unknown where this sediment reaches the bottom due to the highly dynamic conditions of the water. Sediment from Dillingham, Alaska, is hydraulically placed in 20 ft of water in the Tikchik River. The POA places approximately 100,000 cu yd into the river, and due to the dynamic conditions, there is virtually no change at the placement area between pre- and post-surveys. The POH uses offshore sites between 50 and 60 mi away when placing outside of the surf zone.

Each of the Pacific Region districts practices placement near coastal structures. The SPL places sediment as close to the groin field as possible at the City of Newport to trap sediment. The SPN has historically placed sediment from Humboldt Bay into the nearshore next to the jetties, although there has been concern that this sediment is being transported back into the channel. The NWP places sediment from the Mouth of the Columbia River project along the north jetty to prevent the scouring of the jetty toe. The NWP is also planning to extend the jetty at Baker Bay, Oregon, as the pile dikes have detached and the shoreline at the jetty has eroded significantly. The NWS has three projects where sediment is placed near coastal structures. The south jetty at Grays Harbor has been undermined before, so sediment is placed into the nearshore along the jetty. Sediment is placed onto the spit at La Push, Washington, to support the revetment. At Puget Sound, Washington, sediment is placed near training structures to prevent erosion near the rock dike that holds the

Snohomish River in its current configuration. At Ninilchik, Alaska, the POA places sediment as a dynamic cap on top of the wood and concrete revetment that was built to protect the harbor after a 1964 earthquake. The POH has planned placement of sand near the beach groin at Haleiwa Small Boat Harbor.

3 Conclusions and Recommendations

3.1 Conclusions

This report has presented the current state of nearshore nourishment practices for the Coastal and Great Lake Regions, including how and where the districts place their dredged sediment. Additionally, a thorough review of the various community and regulatory concerns that each district faces has been presented. From this review, several observations can be made.

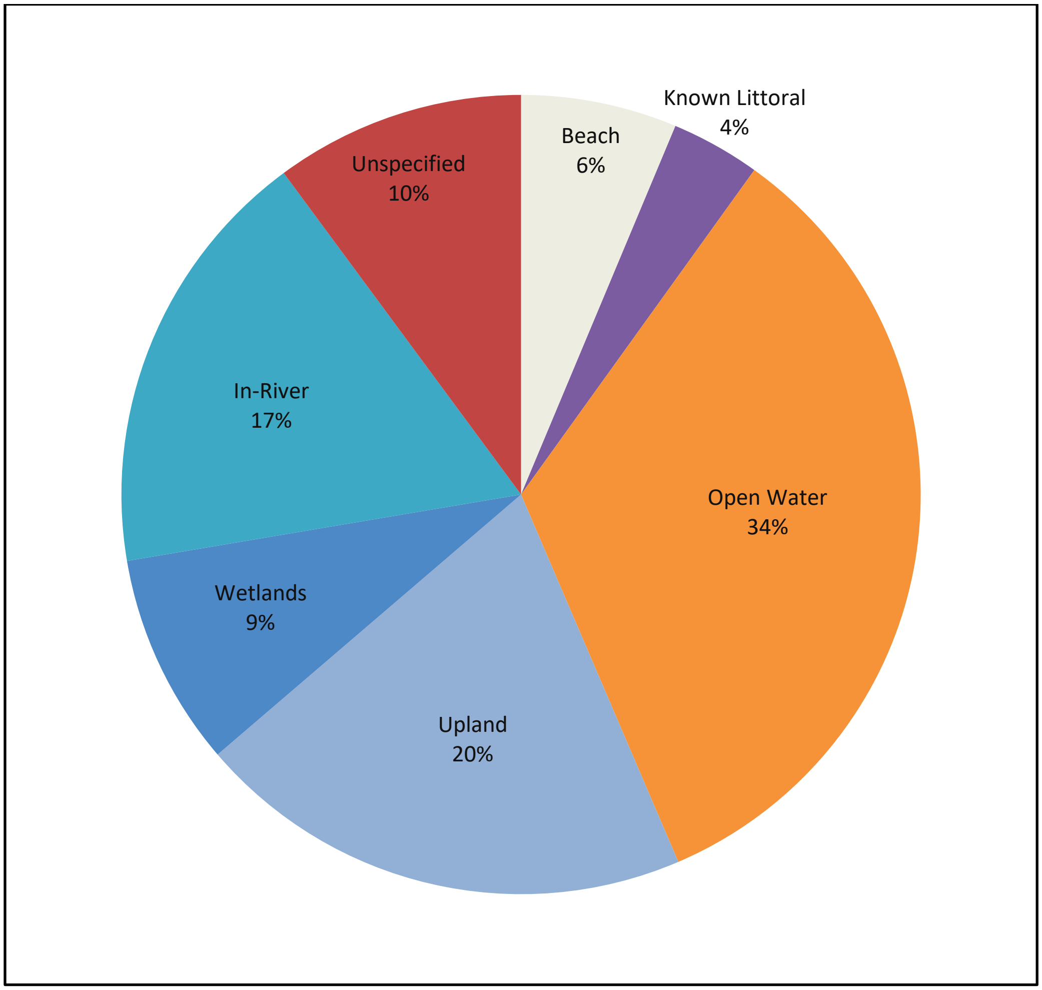
The RSM Beneficial Use Database (https://www.arcgis.com/apps/MapSeries/index.html?appid=0ea8fc0a956f46068428c862e7497233) contains information for all known federal and non-federal beach nourishment projects across the United States. The database utilizes data acquired from the USACE Dredging Information System and is refined and edited to provide the highest quality results possible given the data source. The goal of the database is to provide a comprehensive overview of how the USACE places sediment with an impetus for reducing disposal of sediment. This report utilized the RSM Beneficial Use Database to quantify the types of placements each USACE district utilizes and to provide observations on those placement types (Elko et al. 2022).

From 2015 to 2020, the USACE dredged and placed over 1 billion cu yd in various placement locations. The USACE Coastal and Great Lakes districts utilized the different placement locations based on cost, historical practices, and stakeholder interests. Table 6 provides a review of how much material is dredged by each district and what percentage of material is placed in each placement location. As seen in Figure 9, open water placement accounted for 34% of material placement, and upland disposal made up 20%. Seventeen percent of dredged material was placed in-river, 9% in wetlands, and 6% directly onto the beach. Ten percent was placed in locations that were either not recorded or the data have not been added to the RSM Beneficial Use Database. Over the 5 yr period of 2015–2020, less than 4% (37 million cu yd) of the 1 billion cu yd (Figure 9) of all dredged material from the Coastal and Great Lakes districts has been placed back into the known littoral system. However, this does not account for all beneficially used sediment, which the RSM Beneficial Use Database estimates at 38% of all USACE dredged sediment (USACE, n.d.).

Table 6. Placement locations across Great Lakes and Coastal districts from 2015 through 2020.

District	Cubic Yards	On the Beach	Known Littoral System	Open Water	Upland	Wetlands	In-River	Unspecified
LRC	744.29k	6.00%	22.60%	-	71.40%	-	-	-
LRE	6.8M	24.70%	4.80%	1.20%	48.80%	-	11.80%	8.70%
LRB	10.51M	-	52.80%	32.40%	14.40%	-	-	0.50%
NAE	15.15M	3.20%	1.50%	89.80%	2.30%	-	-	3.10%
NAN	12.44M	63.70%	-	14.20%	22.10%	-	-	-
NAP	17.07M	93.40%	-	-	-	-	1.00%	5.70%
NAB	16.32M	-	-	39.60%	29.80%	1.10%	-	29.60%
NAO	28.73M	1.00%	1.30%	47.70%	24.20%	-	2.00%	23.90%
SAW	43.46M	18.10%	0.30%	8.70%	41.90%	-	-	31.00%
SAC	57.69M	1.00%	-	68.40%	26.90%	-	-	3.70%
SAS	60.7M	-	-	20.40%	78.00%	-	-	1.60%
SAJ	46.72M	15.60%	0.50%	32.90%	31.30%	1.70%	-	18.00%
SAM	50.18M	10.00%	29.60%	30.40%	1.70%	-	-	27.90%
MVN	423.24M	0.90%	0.40%	31.40%	8.60%	19.20%	37.30%	2.20%
SWG	113.77M	0.70%	0.20%	39.70%	36.90%	2.20%	-	20.40%
SPL	12.21M	84.60%	8.60%	4.30%	2.40%	-	-	-
SPN	18M	-	15.90%	51.30%	1.30%	9.20%	-	22.30%
NWP	60.12M	2.90%	9.60%	27.10%	11.80%	-	29.60%	19%
NWS	7.17M	1.20%	0.60%	78%	0.90%	-	-	19.20%
POA	7.55M	2.30%	47.30%	45.40%	1.10%	-	3.90%	-
POH	460K	-	-	87%	-	-	-	13%

Figure 9. Placement locations of dredged material from the USACE Coastal and Great Lakes districts between 2015 and 2020. Data sourced from the RSM Beneficial Use Database (USACE, n.d.).



There is substantial evidence that the percentages for placement in the known littoral system, thus the data for beneficial use, may not reflect the actual amount of sediment placed within the active littoral system. Several USACE Districts (SAM, SWG, NWS, and POA, in particular) noted that there is significant evidence that many of their open water placement sites are very dynamic due to wave activity, frequent storms, and strong currents, and the placed sediment may still be active within the placement area.

Hallermeier (1978, 1981) defined an Inner DOC and an Outer DOC. The Inner DOC delineates the seaward extent of significant bed activity due to waves and nearshore circulation. The Outer DOC is the seaward limit of where surface waves will cause little sediment transport. The Inner DOC commonly captures the typical annual profile fluctuations. Many deep open water placement areas where sediment transport has been observed are within the Outer DOC. Empirical DOC relationships consider only wave forcing. Many active deep open water placements could also be significantly influenced by tidal currents. Thus, while there is a large percentage of material being placed in open water sites, with additional studies and monitoring it is likely to be determined that a significant amount of sediment placed in these open water sites is active within the littoral system.

With the USACE goal to significantly increase the beneficial reuse of dredged sediment, it is vitally important to accurately report and track the placement of all dredged sediment. Between 2015 and 2020, the Coastal and Great Lakes districts placed over 100 million cu yd in unspecified locations, meaning that there were no data or unclear data as to where this sediment was placed. This highlights the importance of creating a single point of reporting and data retrieval for dredging and placement of sediment data. The effort to consolidate and coalesce these data has resulted in the RSM Navigation Sediment Placement Database (USACE n.d.); however, it is the responsibility of all dredging and beneficial use stakeholders to ensure that this database is maintained, updated accurately (and in a timely manner), and utilized effectively to drive decision making for dredge material placements.

3.2 Recommendations

The current state of nearshore nourishment practices confirms that the Coastal and Great Lakes districts recognize the USACE goal of beneficially reusing dredged sediment. There has been a concerted effort from many of the districts to plan and implement beneficial use projects, including nearshore nourishments. In fact, several of the districts have completed planning and feasibility studies to support nearshore nourishment projects but have encountered regulatory challenges and local stakeholder reticence when getting approval. In the future, there are several ways to encourage districts to conduct nearshore placement projects, increase buy-in from regulatory entities and local stakeholders, and ultimately support the USACE goal of beneficial reuse.

- Monitoring is not traditionally required for navigation dredging projects; however, these regular events provide tremendous opportunities to build supporting evidence for the benefits of nearshore nourishment. Additionally, pre- and post-project surveys offer opportunities for improving placement methods and location selection based on actual sediment movement.

- The utilization of a single database to store dredging and placement data will provide the opportunity for more effective discussion and collaboration between Coastal and Great Lakes districts. Sharing methods and results of various placement efforts offers better and more efficient decision making within each district and across the USACE and solidifies best practices for USACE cost savings.
- There are several districts that place significant amounts of sediment in upland sites. There is tremendous potential to reduce the amount of sediment being placed in the upland sites and increase dredged sediment beneficial use. With an improved understanding of the decision-making process requiring upland placement, alternative beneficial use concepts could be identified.
- The research and development of better modeling and projection tools is key to increasing beneficial use through nearshore nourishment. Additionally, the development of communication tools describing the benefits (environmental impact data, visualizations of long-term positive changes to beach profiles, and cost-benefit summaries) of nearshore nourishment that districts can utilize in conversations with local stakeholders would enable the districts to build stronger relationships with their impacted communities and their state and local regulators.

The current state of nearshore nourishment practices shows that there are significant opportunities for growing the USACE beneficial use program. Understanding the unique project environments, challenges, and successes of all the Coastal and Great Lakes districts nearshore nourishment efforts is the first step to identify best practices and ultimately lead to more successful and cost-effective projects.

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Appendix: Dredge Material Quantities and Placement Percentages (2015–2020)

Table A-1 lists dredge material placement within littoral system; Table A-2 lists unspecified placement of dredge material.

Table A-1. Dredge material placement within littoral system.

District	Cubic Yards	Known Littoral System	Cubic Yards in Littoral System (total cu yd * littoral %)
SPL	12,210,000	8.60%	1,050,060
SPN	18,000,000	15.90%	2,862,000
NWP	60,120,000	9.60%	5,771,520
NWS	7,170,000	0.60%	43,020
POA	7,550,000	47.30%	3,571,150
POH	460,000		
LRC	744,290	22.60%	168,210
LRE	6,800,000	4.80%	326,400
LRB	10,510,000	52.80%	5,549,280
NAE	15,150,000	1.50%	227,250
NAN	12,440,000		
NAP	17,070,000		
NAB	16,320,000		
NAO	28,730,000	1.30%	373,490
SAW	43,460,000	0.30%	130,380
SAC	57,690,000		
SAS	60,700,000		
SAJ	46,720,000	0.50%	233,600
SAM	50,180,000	29.60%	14,853,280
MVN	423,240,000	0.40%	1,692,960
SWG	113,770,000	0.20%	227,540
Total	1,009,034,290		37,080,140

Table A-2. Unspecified placement of dredge material.

District	Cubic Yards	Unspecified	Cubic Yards Unspecified (total cu yd * unspecified %)
SPL	12,210,000		
SPN	18,000,000	22.30%	4,014,000
NWP	60,120,000	19.00%	11,422,800
NWS	7,170,000	19.20%	1,376,640
POA	7,550,000		
POH	460,000	13.00%	59,800
LRC	744,290		
LRE	6,800,000	8.70%	591,600
LRB	10,510,000	0.50%	52,550
NAE	15,150,000	3.10%	469,650
NAN	12,440,000		
NAP	17,070,000	5.70%	972,990
NAB	16,320,000	29.60%	4,830,720
NAO	28,730,000	23.90%	6,866,470
SAW	43,460,000	31.00%	13,472,600
SAC	57,690,000	3.70%	2,134,530
SAS	60,700,000	1.60%	971,200
SAJ	46,720,000	18.00%	8,409,600
SAM	50,180,000	27.90%	14,000,220
MVN	423,240,000	2.20%	9,311,280
SWG	113,770,000	20.40%	23,209,080
Total	1,009,034,290		102,165,730

Unit Conversion Factors

Multiply	By	To Obtain
cubic yards	0.7645549	cubic meters
miles (nautical)	1,852	meters
miles (US statute)	1,609.347	Meters
pound (lb)	0.453592	kilograms

Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
CHL	Coastal and Hydraulics Laboratory
DOC	Depth of Closure
EPA	Environmental Protection Agency
ERDC	US Army Engineer Research and Development Center
IGLD	International Great Lakes Datum
LRB	Buffalo District
LRC	Chicago District
LRE	Detroit District
MDNR	Michigan Department of Natural Resources
MVN	New Orleans District
NAB	Baltimore District
NAE	New England District
NAN	New York District
NAO	Norfolk District
NAP	Philadelphia District
NMFS	National Marine Fisheries Service
NWP	Portland District
NWS	Seattle District
ODMDS	Ocean Dredged Material Disposal Site
POA	Alaska District
POH	Honolulu District
RSM	Regional Sediment Management
SAC	Charleston District
SAJ	Jacksonville District
SAM	Mobile District
SAS	Savannah District

SAW	Wilmington District
SPL	Los Angeles District
SPN	San Francisco District
SWG	Galveston District
USACE	US Army Corps of Engineers
VDEQ	Virginia Department of Environmental Quality
VMRC	Virginia Marine Resource Commission

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
August 2022	Final Report	FY20–FY21

4. TITLE AND SUBTITLE
Current State of Practice of Nearshore Nourishment by the United States Army Corps of Engineers

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Brooke M. Walker, Douglas R. Krafft, Brian C. McFall, Hande McCaw, and Scott L. Spurgeon

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Coastal and Hydraulics Laboratory
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

New England District
US Army Corps of Engineers
696 Virginia Rd.
Concord, MA 01742-2718

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDC/CHL SR-22-4

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 3910-6199

10. SPONSOR/MONITOR'S ACRONYM(S)
ERDC

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
Funding Account Code U4376874; AMSCO Code 089500

14. ABSTRACT
This US Army Corps of Engineers (USACE) special report prepared by the US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, provides an overview of the current state of practice for nearshore nourishment with dredged sediment. This special report was completed with responses and input from professionals across the dredging and placement teams from each of the USACE Coastal and Great Lakes districts, providing comprehensive overviews of the decision trees these districts utilize in the placement of their dredged sediment. This report describes the general practice of nearshore nourishment, the impediments and concerns faced by nearshore nourishment projects, and the practical methods utilized by the Coastal and Great Lakes districts for their nearshore nourishment projects. Understanding the current state of practice, along with the general and specific impediments the districts face, enables further research in and development of best practices for use across the USACE and better communication of the practice to other stakeholders.

15. SUBJECT TERMS
Beach nourishment, Coastal engineering, Dredging, Dredging spoil, Sedimentation and deposition, Sediment transport, Shorelines

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Brooke M. Walker
Unclassified	Unclassified	Unclassified	SAR	49	**19b. TELEPHONE NUMBER** *(Include area code)* 601-634-6031