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Trends in the USACE Ocean Disposal Database (1976–2015)

Justin L. Wilkens, Burton C. Suedel, and Kenneth N. Mitchell

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Trends in the USACE Ocean Disposal Database (1976–2015)

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Abstract

This technical report reviews the placement of dredged sediment at ocean dredged material disposal sites (ODMDS) from 1976-2015. This report uses data obtained from the Ocean Disposal Database (ODD), a repository of ocean disposal data submitted by USACE Districts. These data are collected in order to fulfill the London Convention (LC) obligations to report annually the amount and location of dredged sediments placed in ocean waters. The LC report is published annually, but until now, a long-term compilation analysis of the ODD dataset has never been conducted. Analyzing the database for long-term trends shows that the ODD can help answer questions related to policies concerning placement of dredged sediments in ocean waters. Additionally, historical trends provide the USACE with information about ODMDS activity to assist in the short- and long-term management of dredged sediment placed at these sites. There is limited ancillary data outside of the required data fields to support LC reporting activities. Therefore, this report leaves open the possibility for further research into the reasons for the observed trends. In order to better understand ODD trends, it is recommended that data from other related databases be integrated into a broader and more comprehensive framework.

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Preface

This study was initiated and funded by the Engineer Research and Development Center (ERDC) Dredging Innovations Group (DIG), managed by Kenneth N. Mitchell under Project Number 455084.

The work was performed by the Environmental Risk Assessment Branch (CEERD-EPR) of the, Environmental Processes and Engineering Division (CEERD-EP), U.S. Army Engineer Research and Development Center - Environmental Laboratory (ERDC-EL), and the Coastal Engineering Branch (CEERD-HNC) of the Navigation Division (CEERD-HN), U.S. Army Engineer Research and Development, Center Coastal and Hydraulics Laboratory (ERDC-CHL). At the time of publication, Dr. William Nelson was Branch Chief CEERD-EPR, Mr. Warren P. Lorentz was Division Chief, CEERD-EP, Ms. Tanya M. Beck was Branch Chief CEERD-HNC, Ms. Jackie S. Pettway was Division Chief, CEERD-HN, Dr. Jack E Davis was Acting Director, ERDC-EL, and Mr. Jeffrey R. Eckstein was Director, ERDC-CHL.

COL Ivan P. Beckman was Commander of ERDC, and Dr. David W. Pittman was the Director.

Unit Conversion Factors

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
cubic inches	1.6387064 E-05	cubic meters
cubic yards	0.7645549	cubic meters
fathoms	1.8288	meters
feet	0.3048	meters
miles (nautical)	1,852	meters
square yards	0.8361274	square meters
tons (long) per cubic yard	1,328.939	kilograms per cubic meter
tons (2,000 pounds, mass)	907.1847	kilograms
tons (2,000 pounds, mass) per square foot	9,764.856	kilograms per square meter
yards	0.9144	meters

Acronyms and Abbreviations

CHL	Coastal and Hydraulics Laboratory
DIG	Dredging Innovations Group
DoD	Department of Defense
DOTS	Dredging Operations Technical Support
DQM	Dredging Quality Management Program
e-CFR	Electronic Code of Federal Regulations
EIS	Environmental Impact Statements (EIS)
EL	Environmental Laboratory
EP	Environmental Processes and Engineering Division
EPR	Environmental Risk Assessment Branch
ERDC	Engineer Research Development Center
HQUSACE	Headquarters, U.S. Army Corps of Engineers
IMO	International Maritime Organization
LC	London Convention
MPRSA	Marine Protection, Research and Sanctuaries Act
ODD	Ocean Disposal Database
ODMDS	Ocean Dredged Material disposal Sites
SMMP	Site Management Monitoring Plans
TR	Technical Report
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

1 Introduction

1.1 Background

The United States is a Contracting Party to the London Convention (LC) for the Prevention of Marine Pollution by Dumping Wastes and Other Matter (London Convention 1972). This agreement controls deliberate disposal at sea of wastes or other matter, including dredged sediment, from vessels, aircraft, and platforms. The LC became effective in 1975 and requires yearly reporting from all Contracting Parties on the amount and location of materials disposed of at sea (London Convention 1972). In 1972, the United States Congress enacted the Marine Protection, Research and Sanctuaries Act (MPRSA). The MPRSA regulates the disposal at sea of all materials that would adversely affect major components including aquatic organisms, habitat, and people. The MPRSA implements the requirements of the LC, and is the legislative authority regulating the disposal of dredged sediment into ocean waters, including territorial seas.

The U.S. Army Corps of Engineers (USACE) is authorized under MPRSA section 103 to transport dredged sediment for the purpose of placement into ocean waters. In the case of non-federal dredging projects that seek to transport and place sediment in ocean water, a permit must be obtained from the USACE before dredging activity can commence. Prior to disposal at an ocean site, sediment dredged by federal or non-federal projects is subject to environmental criteria established jointly by the USACE and the U.S. Environmental Protection Agency (USEPA) following *40 CFR Parts 220-229* (USEPA/USACE 1991). Under MPRSA *Section 102 and 40 CFR 228*, the USEPA is authorized to designate specific geographic areas known as ocean dredged material disposal sites (ODMDS). Dredged sediment transported to the ocean for placement requires use of a USEPA designated ODMDS where feasible. When the designated ODMDS is not feasible to use, the USACE can select other sites for short-term use for placement under MPRSA section 103 upon USEPA agreement. Studies for the evaluation and selection of an ODMDS, as well as a list of current sites by USEPA region, are found in *40 CFR Part 228*. USACE regulations for ocean disposal are published in *33 CFR*. The USEPA and USACE jointly develop site management plans for each ODMDS.

To meet LC reporting requirements, the Engineer Research and Development Center - Environmental Laboratory (ERDC-EL), Vicksburg, MS, has collected and compiled LC required data every year since 1976. The International Maritime Organization (IMO), the United Nations specialized agency responsible for regulating shipping and the prevention of marine pollution by ships, administers the LC and provides guidance for collecting data. Since 1976, the ERDC-EL has annually collected data from USACE districts placing dredged sediment at ocean sites. Funding for this effort is provided by the ERDC Dredging Operations Technical Support (DOTS) Program. The ERDC-EL enters and maintains the data in the Ocean Disposal Database (ODD), a relational database built in Microsoft Access. The database is organized in-to subject-based tables (e.g., ODMDSs, dredge event) each with a unique identifier. The relations defined between tables provides access and the ability to sort data in a variety of ways. The ERDC-EL collaborates with USEPA to prepare annual reports to fulfill the LC obligation. All ODD data is accessible to the public via a web application (<https://odd.el.erdcdren.mil/>). Prior to the effort documented in this report, no comprehensive review of placement trends at U.S. ocean dredged material disposal sites over time has been conducted.

1.2 Objectives

The focus of this report is to review trends in the placement of dredged sediment at ODMDSs within U.S. waters, from 1976, the first year the LC report was required, through 2015, using data mined from the ODD. The documentation of such data over time provides several advantages, including a measure of all dredged sediment placed in the ocean since 1976, a benchmark for future data comparisons, and improved data collection and quality. This review provides the USACE with information about ODMDS activity to assist in the short- and long-term management of dredged sediment placed at these sites. The report also provides policymakers with insights into recent trends in open water placement of dredge sediment relative to historical norms, thereby helping to inform discussions of future investments into dredged sediment management strategies generally. The ERDC Dredging Innovations Group (DIG) funded this effort per its charge from the USACE Navigation Business line to provide advanced analytics and program-level efficiency evaluations of USACE-sponsored dredging activities.

1.3 Approach

This report is not intended to resolve issues related to the use or status of an ODMDS. Instead, the report provides an unbiased review of dredged sediment disposal at ocean sites over time. Historically, ocean disposal has often been referred to as ocean dumping, and sites have sometimes been referred to as ocean dump sites. Ocean disposal is carefully regulated per the LC agreement and MPRSA, therefore, placement of dredged sediment is not indiscriminate, occurring only at approved sites. The word “dump” has negative connotations including for example, carelessness and in reference to depositing garbage. To overcome these negative connotations, the terms disposal, place, or placement are used for the remainder of this report because they align more closely to the action of putting something in a particular place, as is the case for disposal of dredged sediment. Because the ODD is structured by calendar year, some dredge projects straddle two calendar years and are essentially recorded as two separate projects. Contract identification numbers were not historically collected as part of the data call, therefore, positively identifying projects between years was not feasible. As a result, dredge projects are referred to instead as dredge events to better describe the use of the ODMDS.

1.4 Scope

The lack of historical information about ocean placement from other databases precludes direct comparisons with the ODD. Environmental Impact Statements (EIS) and Site Management Monitoring Plans (SMMPs) exist for most ODMDSs. The SMMP provides management and monitoring strategies for placement in the ODMDSs. In some cases the EIS and SMMP documents contain historical placement information, but this is usually limited to dates and placement quantities. Taken together, the ODD data along with EIS and SMMP data helps to describe historical use of ODMDSs.

2 Methods

2.1 Source of data

The IMO provides guidance for the type of information required to meet the LC obligations. In addition to the required data, ERDC-EL collects other relevant data to describe the ocean site and placement activities (Table 1). The annual data call conducted by ERDC-EL is the primary source of historical ODMDS information. The LC and ERDC-EL reporting requirements rarely change, this allows for the comparison of data through time. The placement of dredged sediment excavated from federal and non-federal coastal areas is accomplished by the USACE dredge fleet and contracted dredge fleet. The annual data call is a complete census of USACE Districts who either had federal or non-federal events that placed dredge sediment at an ODMDS. All USACE Districts with active coastal dredging programs receive the yearly data call. Project managers, physical scientists, biologists, and regulatory project managers report the required ocean placement data. ODD data along with EIS and SMMP data are used collectively to describe the historical use of ODMDSs in this report. Table 1 and Appendix A contain a detailed summary of the ODMDS data set evaluated in this report.

2.2 Data quality

Upon completion of the data call forms by USACE District personnel, the submitted information was reviewed by ERDC-EL, and if necessary, returned with instructions to resubmit. ERDC-EL assumes the data submitted by each District is accurate, with the exception of obvious errors (e.g., fields left blank, incorrect placement site). The resources to cross reference reported data are mostly limited to historical records found in EIS and SMMP documents. To help determine data quality, data from these documents are compared to those reported to ERDC-EL. To date, a total of 984 records have been identified in EIS and SMMP documents, of these, 62% match ODD placement quantities and years in which they occurred, 25% have inconsistent years/dates or placement quantities or both, and 13% are unreported placement events. Potential sources of error likely include the manner in which the data were originally collected and processed as well as mistakes by either the District responder or personnel at ERDC-EL. Examples of such mistakes include reporting of incorrect information, inaccurate estimates of reported quantities, and instances

where data call questions were misinterpreted. Some districts have not responded each year or they have mistakenly reported no placement in some years. Starting in 2012, ERDC-EL redesigned the data call form and increased documentation to reduce misinterpretation. Starting in 2004, there has been a decline in the number of inconsistent and unreported placement events with a more noticeable drop beginning in 2012. For this report, if the placement event has been confirmed in both the EIS and SMMP, the record is corrected in the database along with other data if available (e.g., dredge type).

2.3 Data analysis

This report describes data collected about the ODMDSs and placement at the ODMDS from 1976 to 2015, the latest year of data availability at the time of this report. Site management and monitoring are not included because these data are extensively documented in other reports including SMMPs (e.g., USEPA/USACE 2008) and USEPAs ODMDS monitoring assessment reports (e.g., USEPA 2013(a); USEPA/USACE 2003). A summary of data fields in the ODD is provided in Table 1. The data fields with an asterisk (*) are included in this report. Reported averages are followed by their standard deviation (mean \pm SD).

Table 1. Data fields available for describing an ocean dredged material disposal site, disposal and site management.

Category	Required By	Field	Description	Source of Data
	LC	LC disposal site code	Two-letter prefix for country code and the disposal site code (e.g., US-161)	ERDC-EL
	LC*	Disposal Site Name	Name of disposal site	40CFR228.15
	LC*	Major Ocean Area	Ocean area (see LC-LP.1/Circ.34, 21 January 2010 for list of ocean areas)	ERDC-EL
	LC	Sea Area	Sea area within the major ocean area (e.g., Mid-Atlantic Bight)	ERDC-EL
	LC	Sub-sea Area	Sub-sea area within the sea area where disposal site was located (e.g., Massachusetts Bay)	ERDC-EL
	LC	Map of Disposal Site	Small scale map showing disposal site	ERDC-EL
	LC	Geodetic Datum	Defines size/shape of earth and origin/orientation of coordinate systems used to map earth	40CFR228.15
	LC	Coordinates	North/South and East/West decimal degrees.	40CFR228.15
	LC*	Shape of Placement Site	Point, line, circle, segment of a circle, or polygon	40CFR228.15
	LC	Radius of Placement Site	Meters	40CFR228.15
	LC	Internal Waters	Waters on the landward side of the baseline which the territorial sea was measured	BOEM/BSEE*
Disposal Site	ERDC-EL	Law	MPRSA 102 or 103 site	40CFR228.15
	ERDC-EL*	Designated Date	Date site was designated	USEPA
	ERDC-EL*	USACE	USACE Division and District using the site	USACE
	ERDC-EL	State	State associated with site	40CFR228.15
	ERDC-EL*	SMMP	Site Management and Monitoring Plan (SMMP) start/end year	USACE/USEPA
	ERDC-EL	Size	Size of site in square nautical miles	40CFR228.15
	ERDC-EL	Average Depth	Average depth of disposal site	40CFR228.15
	ERDC-EL	Minimum Depth	Minimum depth of disposal site	40CFR228.15
	ERDC-EL	Maximum Depth	Maximum depth of disposal site	40CFR228.15
	ERDC-EL*	Primary Use	Dredged sediment disposal only	40CFR228.15
	ERDC-EL	Restrictions on Use	Restrictions on site (e.g., where the sediment can originate from)	40CFR228.15
	ERDC-EL*	Period of Use	The period of time the site was to remain available for use	40CFR228.15
	ERDC-EL	Site Notes	Brief notes on any entry, (e.g., notes about shape or bearings that define the location)	ERDC-EL

Category	Required By	Field	Description	Source of Data
Disposal	LC	Method of Disposal at Sea	Placement at sea operations conducted via: ship, vessel, barge, aircraft, or other [explain]	USACE
	LC*	Total Quantity	Total quantity of dredged sediment placed at a specific site.	USACE
	LC*	Disposal Reporting Units	Cubic meters, cubic yard and/or metric ton used for dredged sediment	USACE
	LC	Disposal Notes	Brief notes on any entry	USACE
Disposal Cont'd	ERDC-EL	Dredge event Name	Name of dredge event	USACE
	ERDC-EL	Dredge Locale	Area where dredging operation occurred (e.g., Mississippi River, Vicksburg, MS)	USACE
	ERDC-EL*	Event Type	Federal or non-Federal dredging operation	USACE
	ERDC-EL	Sediment Type	Slurry or Cohesive sediment	
	ERDC-EL*	Start Date	Start date of dredging operation	USACE
	ERDC-EL*	End Date	End date of dredging operation	USACE
	ERDC-EL	Method of Dredge	Dredging method used to remove sediment: hydraulic, mechanical, clamshell, hopper	USACE
ERDC-EL*	Method of Transport	Method used to transport sediment for disposal at sea: hopper, pipeline, scow	USACE	
Site Mgmt.	LC	Monitoring	Was Monitoring Conducted during the Reporting Period? Yes/No	USACE/USEPA
	LC	Monitoring Time	If Field Monitoring was Conducted, when was it done? (before, during, after placement at sea, other [explain])	USACE/USEPA
	LC	Field Monitoring Survey	If Field Monitoring was Conducted, what type of survey was completed? (biological, geological, chemical, physical, other [explain])	USACE/USEPA
	LC	Adverse Impact	If Field Monitoring was Conducted, has an adverse impact(s) been found beyond that predicted? Yes/No	USACE/USEPA
	LC	Adverse Impact Note	If an adverse impacts(s) was noted, describe briefly (e.g. physical, chemical or biological) and their spatial or temporal variation	USACE/USEPA
	LC	Field Monitoring Reference	Access to the Field Monitoring Report. Website/URL link or other reference.	USACE/USEPA
	LC	Compliance Monitoring	Was Compliance Monitoring Conducted for a Permit(s) Issued to Use the placement Site? Yes/No	USACE
	LC	Compliance in check	If Compliance Monitoring was Conducted, were the placement at sea operations found to be in compliance with the permit(s)? Yes/No	USACE
	LC	Compliance Follow-Up	If placement at sea operations were not in compliance, is follow-up action planned? Yes/No	USACE
	LC	Compliance Reference	Access to Compliance Monitoring Report. Website/URL link or other reference.	USACE
LC	Monitoring Notes	Brief notes on any monitoring entries.	USACE/USEPA	

ERDC-EL	Site Management	selective disposal (used specific area of site); seasonal restrictions (disposal occurred during limited time); capping (disposal of sediment followed by covering-cap)
ERDC-EL	Exclusion Criteria	Did dredged sediment meet the exclusion criteria (see 40CFR227.13b)? Yes or No
ERDC-EL	Bioassay Test	Was bioassay testing completed? Yes or No
ERDC-EL	Bioassay Test Year	Last Year bioassay was completed.

3 Results and Discussion

3.1 Ocean dredged material disposal sites

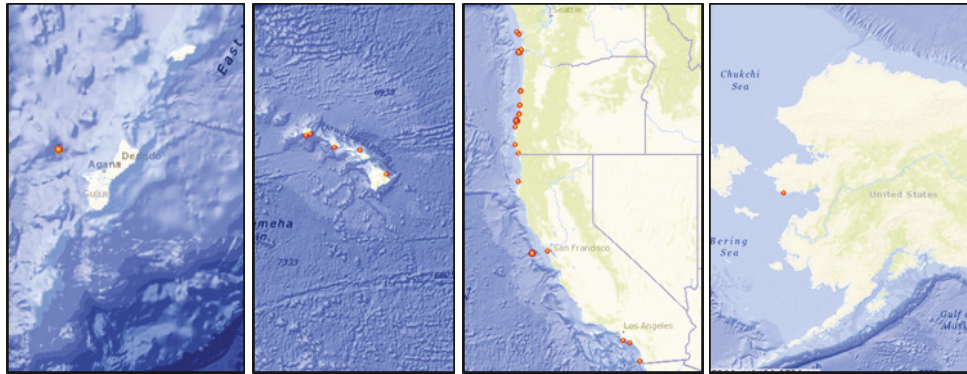
Since 1976, 140 ODMDs have been used for placement of dredged sediment at sea. Of the 140 sites, 91 are currently active (see *40 CFR 228.15* placement sites designated on a final basis). Active sites are shown in Figure 1.

USACE Districts use on average 42 sites (37%) of the total available active sites per year (Figure 2). The availability of active ODMDs over time has decreased from 140 to 91 sites annually (Figure 3). The decrease in sites is mostly due to the closure or de-designation of USACE 103 sites and/or interim sites. Placement information and designation dates were used to describe the number of years all sites were available for use and the percentage of time used. The percentage of time used or unused was determined by counting the number of years a placement event occurred divided by the total available years. In the total time that ocean sites have been available for placement, placement activities occurred in 50% of those years.

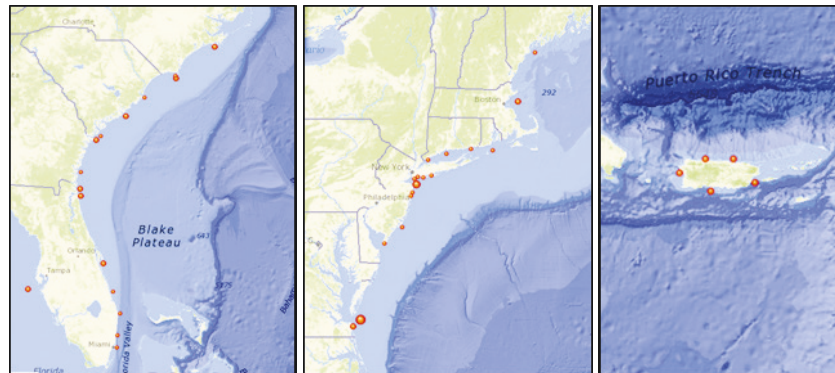
ODMD information found in *40 CFR 228.15* (Section 102 sites) was used to provide a summary of geographical features and site regulations. Geographically, the Atlantic Ocean consisted of 49 sites, 32 are active (65%), the Gulf of Mexico contributed 43 sites, 30 are active (70%), and the Pacific Ocean accounted for 48 sites, 29 are active (60%; Figure 4). The USACE South Atlantic Division accounted for the most sites (39). The fewest sites (8) were found in the Pacific Ocean Division. The Portland, Jacksonville, Galveston, and New Orleans Districts had the highest numbers of ODMDs with 26, 19, 18, and 14 sites, respectively, or 55% of the total number of sites nationally.

Figure 1. Map of ocean dredged material disposal sites (ODMDS) actively used by dredging operations (credit USEPA ocean disposal map <https://www.epa.gov/ocean-dumping/ocean-disposal-map>). (A). Pacific Ocean. (B). Atlantic Ocean. (C). Gulf of Mexico.

A.



B.



C.

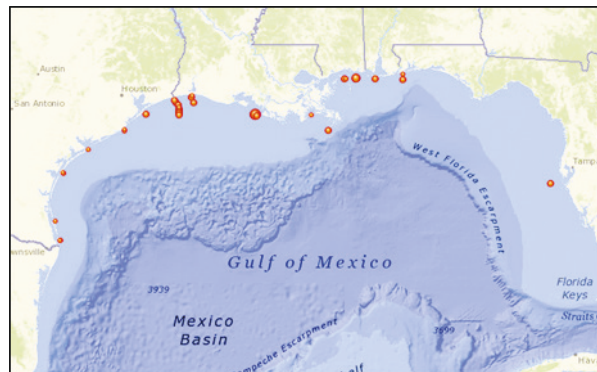


Figure 2. The total number of ocean dredged material disposal sites available for use each year from 1976–2015.

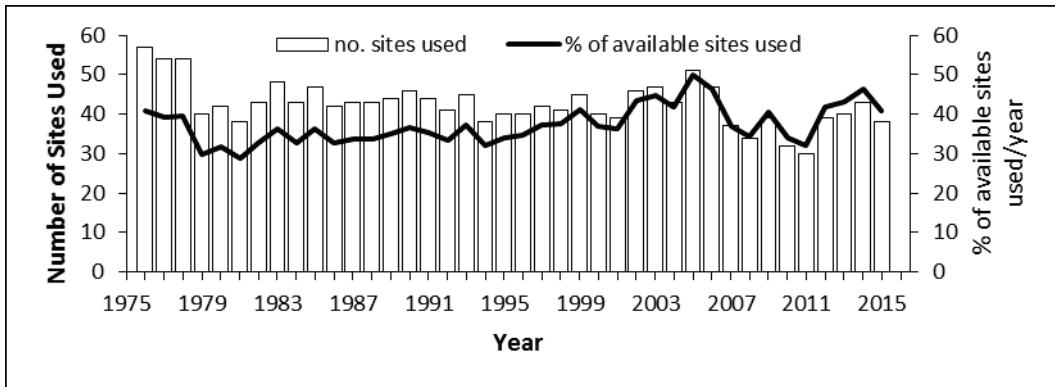


Figure 3. The total number of ocean dredged material disposal sites available for use each year from 1976–2015.

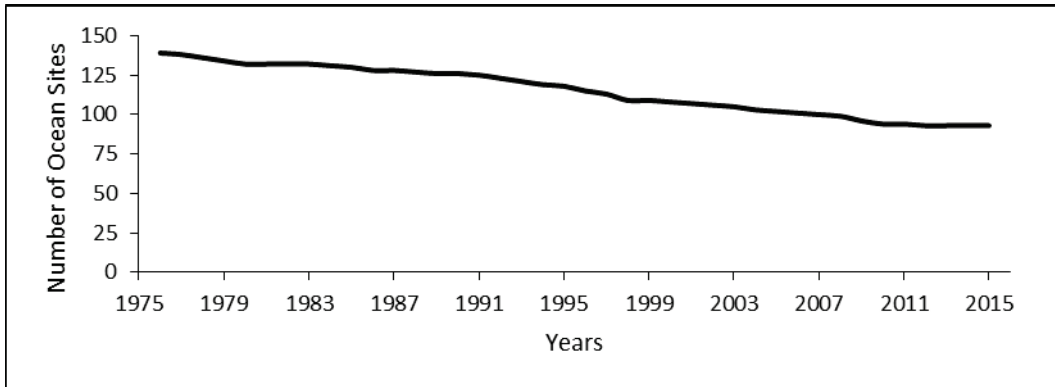
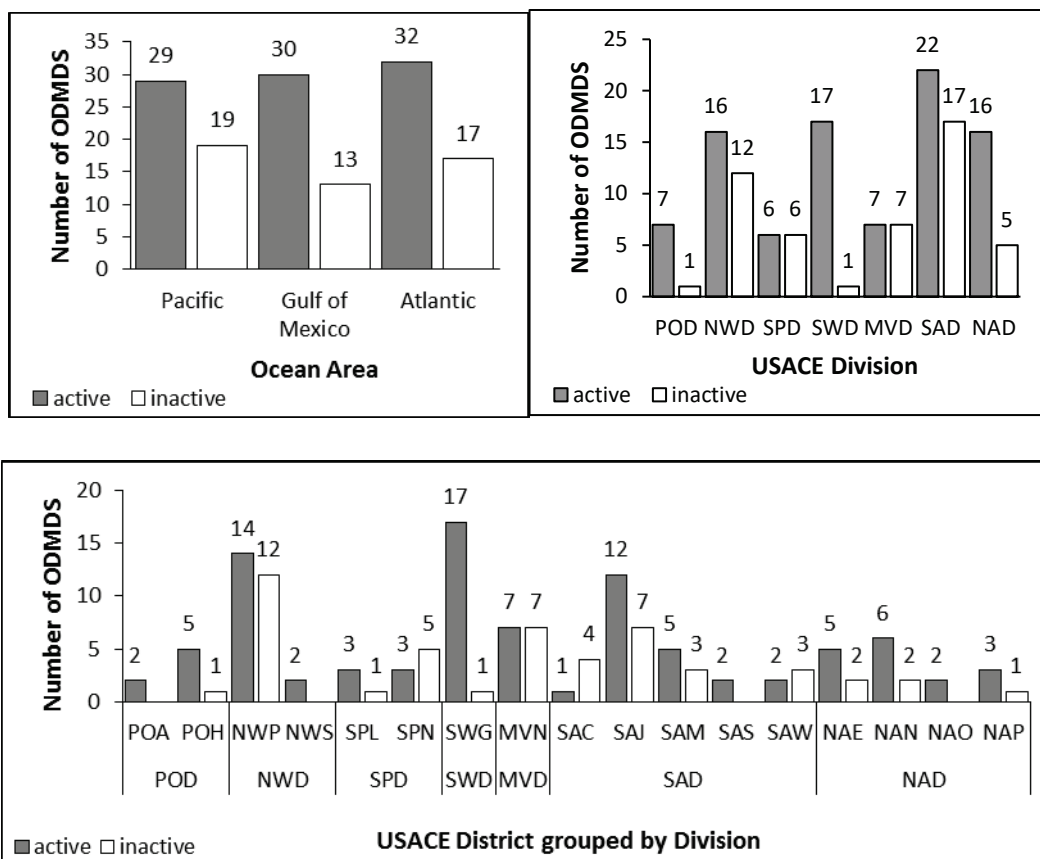
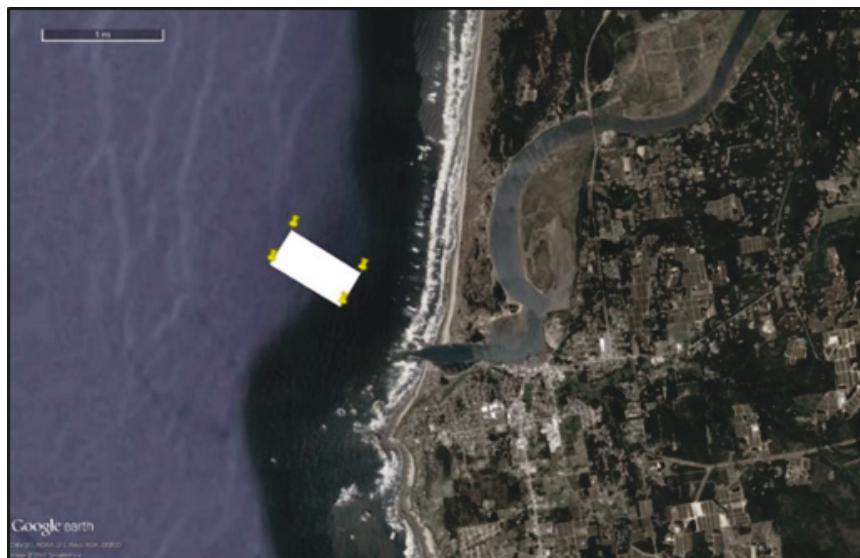


Figure 4. Number of active (grey) and inactive (white) ocean dredged material disposal sites by ocean area (top left), USACE Division (top right), and USACE District grouped by USACE Division (bottom).



The majority (85%) of ODMDSs are polygon shaped (e.g., square, rectangular or irregularly shaped) and the remaining (15%) are circular or oval shaped. Nearly all ODMDSs are located five nautical miles or less from the port, harbor, or navigation channel from which it receives sediment. For example, the Coquille River Entrance ODMDS is limited to dredged sediment from the Coquille Estuary and River, OR, and adjacent areas, and is located less than two nautical miles from the river entrance (Figure 5). The one exception is the San Francisco Deep Ocean Site located nearly fifty nautical miles off shore. The site is used as an alternative to placement in the San Francisco Bay, CA. This ODMDS is the deepest at 3,000 m and the farthest from the shore of all ODMDSs nationwide.

Figure 5. Coquille River Entrance ocean dredged material disposal site located near Coquille Estuary and River, Oregon.



Recently, USEPA Region 4 and USACE South Atlantic Division classified sites that had not been used within five years, and that were not expected to be used within the next five years, as inactive (USEPA/USACE 2013). This designation is expected to conserve agency resources that would otherwise be needed to develop SMMPs and implement monitoring plans. If monitoring as described in the SMMP is not in fact implemented at an active site, then that site can be suspended or closed. The other ODMDS marked as inactive in the ODD and not falling under the previously mentioned classification are de-designated or closed. Notes or remarks about these closed sites are limited, but some indicate the sites were no longer needed. In most such instances, no specific reason is provided (such as mounding of sediment or capacity exceedance) for the closure. It should be noted that in 1970s and 1980s, many sites were designated as interim sites, these were approved for a limited time only. In many cases it is apparent that interim sites were simply closed or a Section 103 site had been replaced by a Section 102 site, but due to limited documentation this interpretation is rarely definitively stated. The percentage of sites used per year has increased slightly over time because there are fewer sites available for use and because the current site locations are likely more appropriate than previous sites (Figure 2).

Of the 91 active sites, 86 sites are presently designated for continuous use or for an indefinite period of time. The exceptions are all on the west coast and include the Humboldt Open Ocean Disposal Site and the San

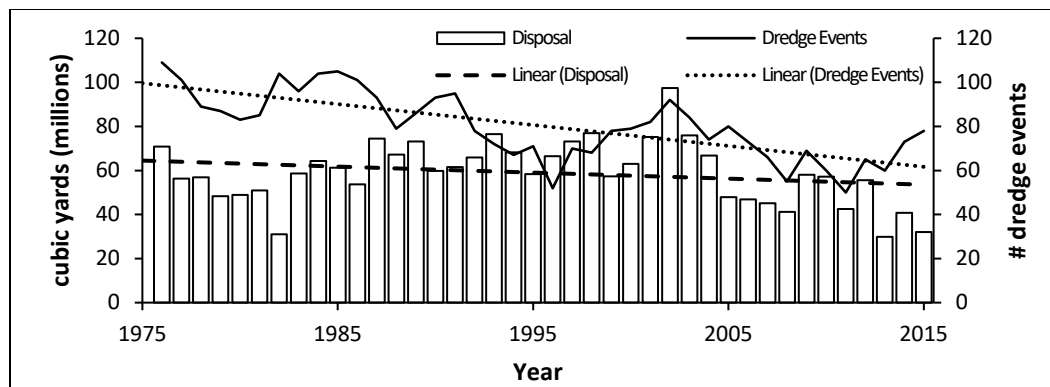
Francisco Deep Ocean Site, these are restricted to a 50-year period of continuing use. The Mouth of Columbia River-Deep Water site can be used continuously, or until sediment mounds to a specified height. The Grays Harbor Eight Mile site is one-time use over multiple years until the site is designated. The Los Angeles/Long Beach (LA-2) site is designated for continuing use, but subject to submission of a revised Consistency Determination to the California Coastal Commission. Of the 91 active sites, 89 sites presently have no placement volume limits. The exceptions include the Mouth of the Columbia River-Deep Water site which is designated for continuing use or until the placed sediment mounds to an average height of 40 ft when the site is to be re-evaluated, and the San Francisco Deepwater Ocean Site which is limited to 4.8 million cy³ of sediment each year the site remains open.

3.2 Ocean disposal data trends

3.2.1 Geographic

An analysis conducted as part of this effort provides the geographic and temporal trends for placement of dredged sediment at ODMDs. The analysis includes placement quantities categorized by the following: ocean area (Pacific Ocean, Atlantic Ocean, and Gulf of Mexico), dredge methods (hydraulic or mechanical), class of work (maintenance or new dredging), USACE Districts and Divisions, and temporal trends (1976-2015). Since 1976, 3,206 dredge events have placed 2.36 billion cy³ of dredged sediment at 140 ODMDs (Figure 6).

Figure 6. Total disposal volume per year from 1976–2015 and number of dredge events for all major ocean areas combined (Pacific, Atlantic, Gulf of Mexico).

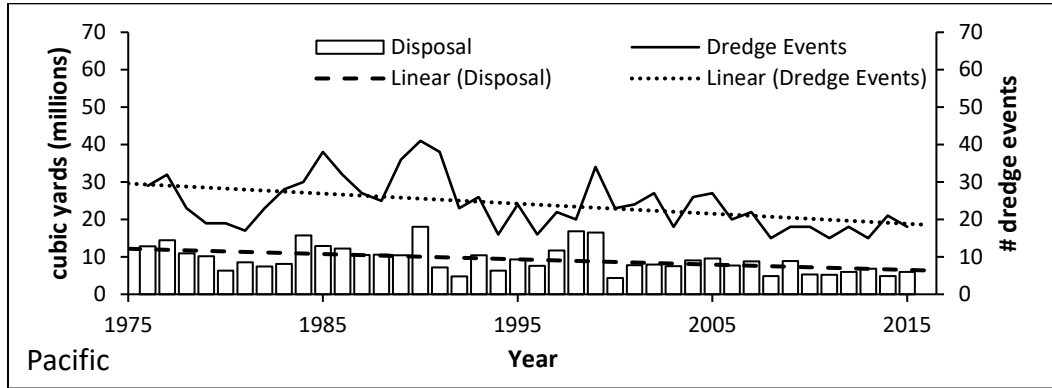


Federal dredge events account for 2.1 billion cy³ of placement, the remainder of sediment (24 million cy³) is from non-federal dredge events permitted to use the ODMDS (e.g., private industry). Approximately 1.89 billion cy³ of dredged sediment have been placed in sites that are presently active, and the remainder, 0.54 billion cy³, have been placed in sites that are now inactive. It should be noted that the actual number of dredge events is lower than the figure cited above because ocean placement is reported into the ODD by calendar year. Dredging events often cross calendar years, and so in many cases, single dredging events that straddle the next year are recorded in the ODD as if there were two separate events. Thus, attempting to sum events across multiple years will result in an overestimate of the true number of dredge events utilizing ocean placement. Given this information, it is still apparent that the number of events utilizing ocean placement sites each year has trended downward through the decades while placement volume has remained relatively stable, albeit with a slight decrease overall. The Atlantic Ocean accounts for most of the decline in the number of events utilizing an ocean site, followed by the Pacific Ocean, and Gulf of Mexico (Figure 7).

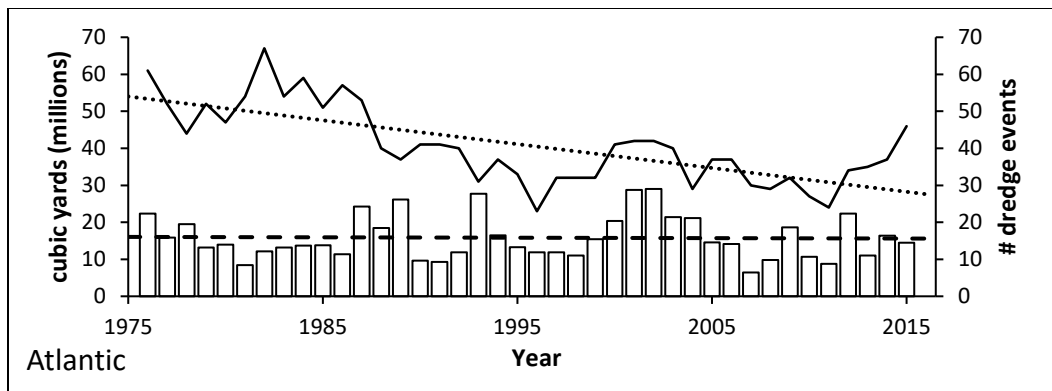
On an annual basis, an average (\pm SD) of 80 ± 15 dredge events have placed 58.8 ± 14 million cy³ of dredged sediment. Geographically, 57% of the dredged sediment placed in the ocean sites occurred in the Gulf of Mexico (Figure 8). Districts along the Atlantic and Pacific coasts generally have more dredge events but lower placement quantities, while in the Gulf of Mexico there were fewer dredge events but placement quantities tend to be two to four times larger. The New Orleans District alone accounts for nearly 63% of the total historical placement volume since 1976. The Pacific Ocean sites account for 16% of the total sediment placed in the ocean sites, and of this amount, over 64% was placed by the Portland District. The Atlantic Ocean sites account for 27% of the total placement volume and are more evenly distributed among the Districts reporting ocean placement.

Figure 7. Total disposal volume per year from 1976–2015 of dredged sediment and number of dredge events by major ocean area. (A) Pacific, (B) Atlantic, and (C) Gulf of Mexico.

A



B



C

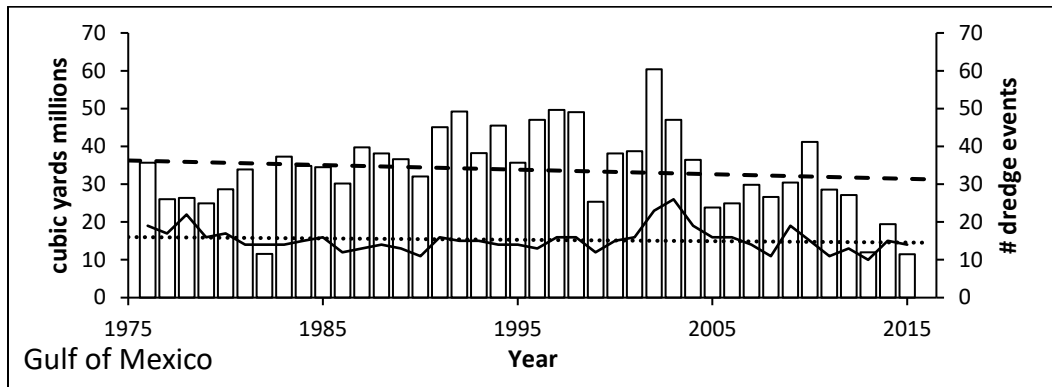
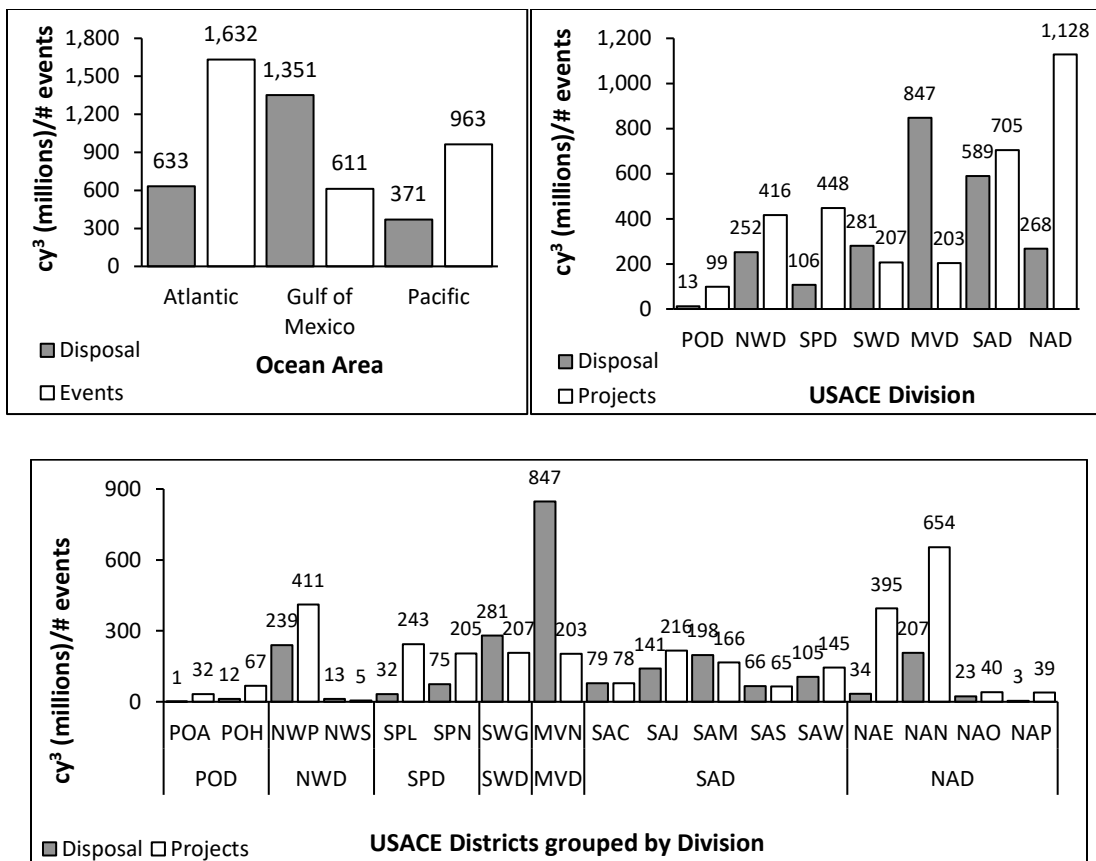


Figure 8. Total quantity of dredged sediment placed by ocean area (top left), USACE Division (top right), and USACE District grouped by USACE Division (bottom).



3.2.2 Federal and non-federal dredge events

An analysis of dredge event type (federal or non-federal) and class of work (new work or maintenance) provided trends about the nature of dredging events that depend on ocean placement. Federal dredge events are those that a USACE-owned dredge or contractor is used to transport and place dredged sediment at an ODMDS (authorized under MPRSA section 103). Permitted dredge events (non-federal) are those events permitted by the USACE (under MRPSA section 103) to transport and place sediment at an ODMDS. To classify type of work, the new work designation included excavation of new navigation channels or expansion of existing channels, while maintenance dredging represented the removal of accumulated sediment from an existing navigation channel.

Of the 3,206 yearly dredging events, 2,879 are classified as maintenance, 260 represent new work, and the remaining 67 are unclassified events. Overall, the use of ODMDSs for maintenance work started to decline beginning in the 1980s (Figure 9). Geographically, the Atlantic Ocean

maintenance work accounted for most of the decrease while the Gulf of Mexico and Pacific Ocean remained relatively stable. A possible explanation for the decrease in maintenance work in the Atlantic region is the increase in dredging events classified as new work during the same time period. Since 1976, maintenance work has accounted for over 2.08 billion cy³ of placement while new work has placed 222 million cy³ (Figure 10).

Figure 9. The number of dredge events classified as maintenance or new work by major ocean area (ALL= ocean areas combined).

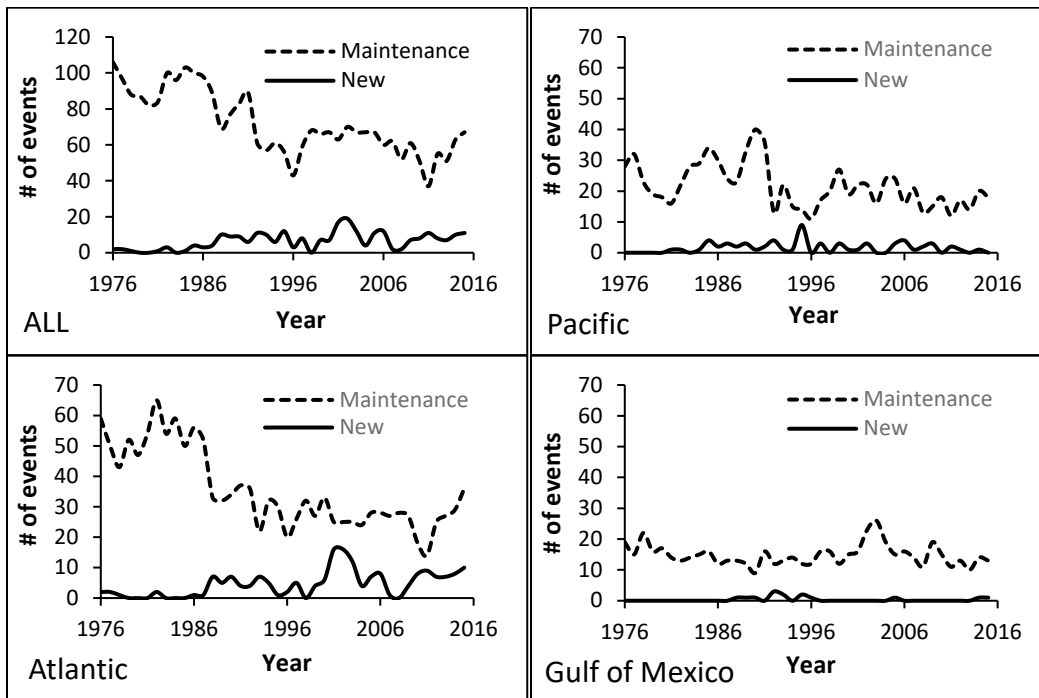
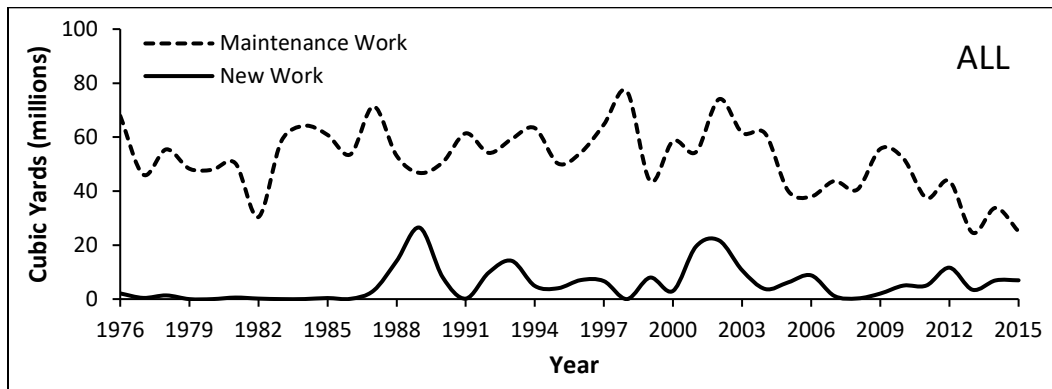
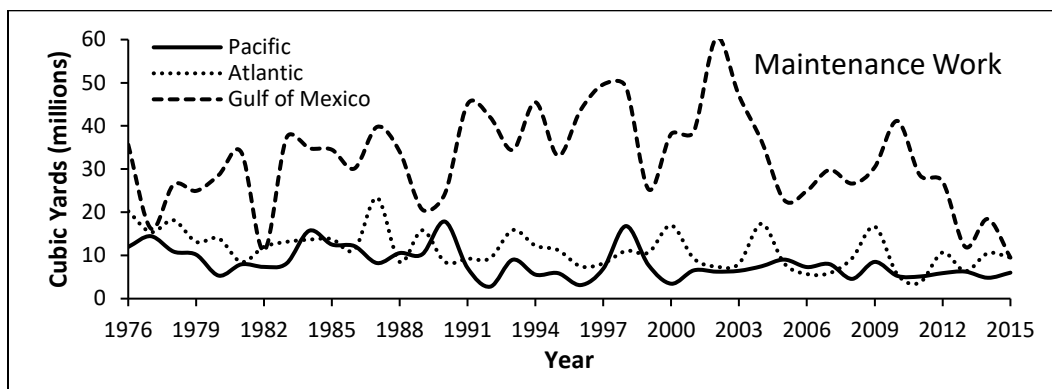


Figure 10. Sum of placement by year from 1976–2015 for dredge events classified as maintenance or new work. (A) All ocean areas combined (Pacific Ocean, Atlantic Ocean, Gulf of Mexico), (B) maintenance work, and (C) new work.

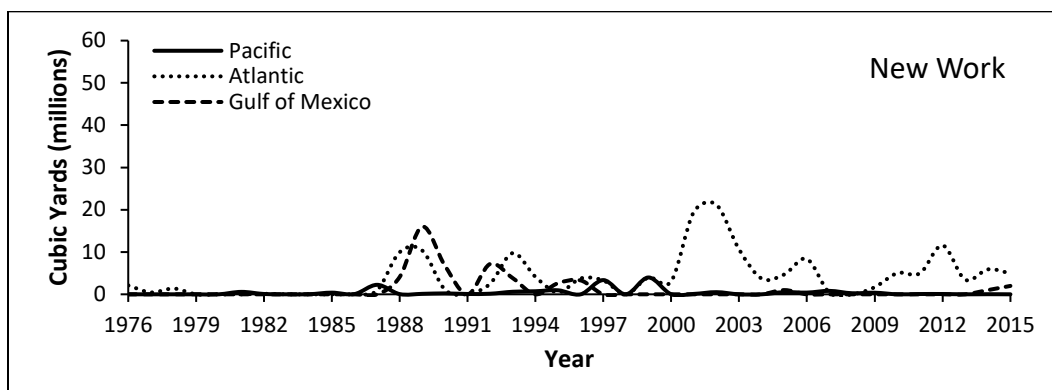
A.



B.



C.



3.2.3 Dredge type

For the purposes of this analysis, dredge types are divided into mechanical or hydraulic dredges. Mechanical dredges remove sediment by scooping sediment from the bottom, these include clamshell dredges and bucket dredges. During a dredging event that utilizes mechanical dredges, the sediment is usually placed on a barge and transported to an ODMDS. Hydraulic dredges suction a mixture of sediment and water from the bottom. The two main types of hydraulic dredges are trailing suction hopper dredges and cutter suction dredges. The hopper dredges use pumps to suction sediment from the bottom into the ship's hopper. When the hopper reaches its capacity, dredging is stopped and the dredge vessel travels to an ODMDS where the sediment is discharged from the bottom of the ship. The cutter suction dredges remove sediment through an intake pipe and then usually pump the sediment out of a discharge pipeline, sometimes into a transport barge but more commonly directly into the ODMDS.

The most commonly used dredging method reported by USACE Districts was categorized as hydraulic (Figure 11), with more than 2,000 dredging events using a hydraulic type dredge to place over 1.9 billion cy³ of sediment. Mechanical dredges have been used by nearly 1,000 events in the ODD, placing over 300 million cy³. In recent years, the use of hydraulic dredges has decreased while the use of mechanical dredges has increased, resulting in near equal use and placement volumes. Geographically, the Gulf of Mexico dredging events account for most of the decrease in use of hydraulic dredges, the Atlantic Ocean dredging events account for most of the increase in use of mechanical dredges (Figure 12).

Figure 11. Number of dredge events using a hydraulic or mechanical dredge from 1976–2015.

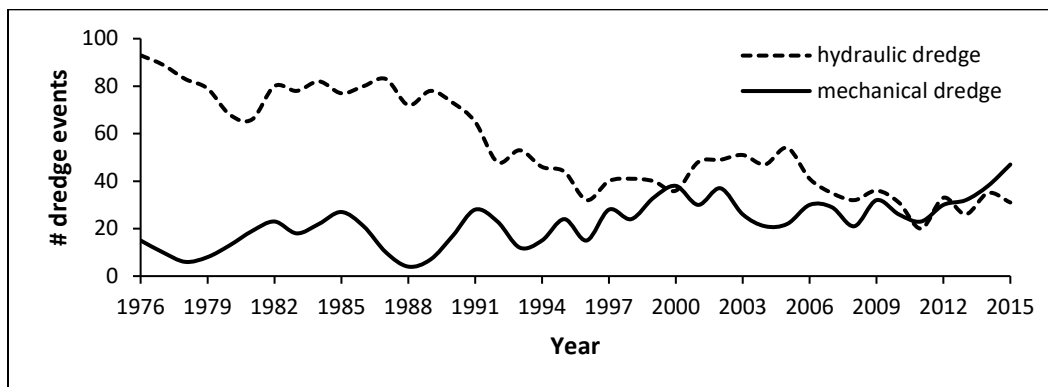
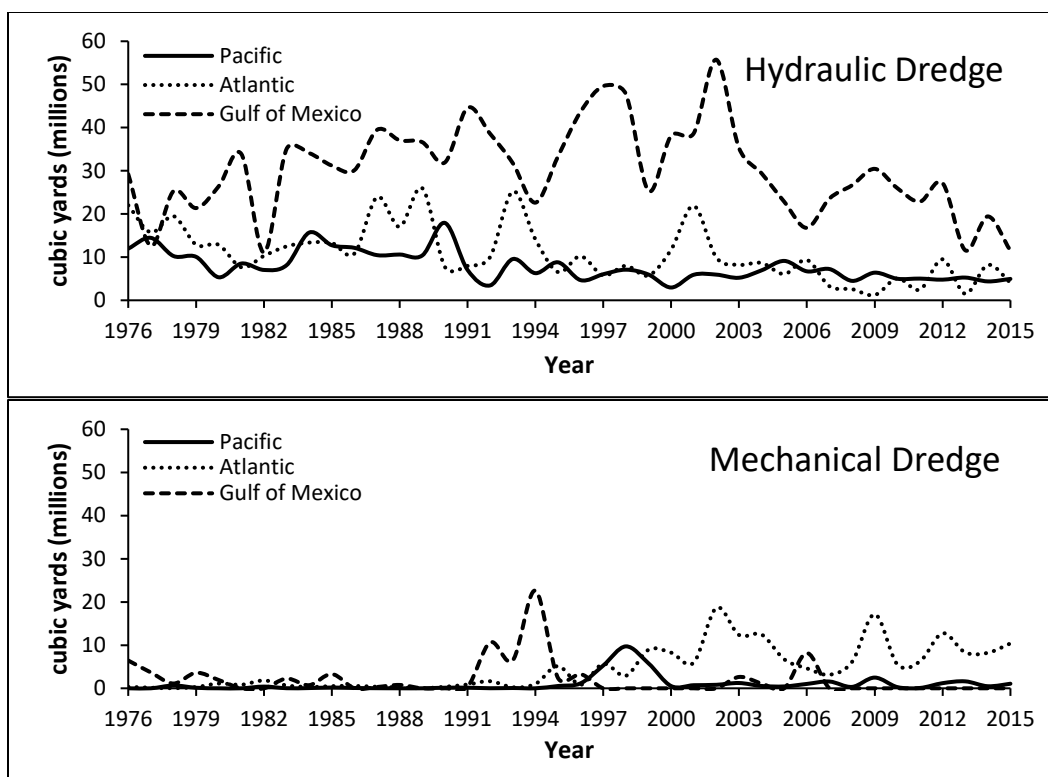


Figure 12. Total quantity of dredged sediment placed by ocean area (Pacific Ocean, Atlantic Ocean, and Gulf of Mexico) using a hydraulic (top) or mechanical dredge (bottom) from 1976-2015.



3.2.4 Dredge event duration

Dredging event duration in days has been averaged for each year and summarized over time by dredge method and event type. In determining the average starting and ending month for dredging events, roughly 22% of the events were removed from consideration owing to the calendar year structure of the ODD. Events that straddle two calendar years are essentially recorded as two separate events within the ODD, the first ending on 31 December and the second beginning on 1 January, with placed volumes and other quantities prorated. To avoid the resulting bias towards the first and last day of each calendar year, such events have been excluded from the start/end analysis. Because dredging contract numbers have not always been reported, no attempt has been made to sort those events that cross years. In spite of this limitation, 78% of the events have still been included to determine duration and start/end months of dredging events in the ODD.

The average (\pm SD) dredge event duration is a highly variable quantity, at 65 ± 71 days (Figure 13). The mode and median of duration were 1 and 37

days, respectively. The average (\pm SD) duration of maintenance work is 62 ± 10 days while new work took longer and with much more variability at 100 ± 43 days (Figure 14). Dredge event duration does not reflect the actual number of days of dredging or the number of trips made to an ODMDS. This information has not been collected in the annual data calls and is not required to meet the LC report needs. Dredge event duration does not correlate with placement volume ($R^2=0.09$) (Figure 15). The start and end months for dredging events are relatively evenly distributed as reflected in the frequency distribution shown in Figure 16. The average (\pm SD) start month is May (5.7 ± 3.2) while the average end month is July (7.2 ± 3.3) indicating that a preponderance of dredging events disposing sediment in ODMDSs are active in spring and summer months.

Figure 13. The average dredge event duration (days) per year from 1976–2015 for dredging events classified as maintenance or new work.

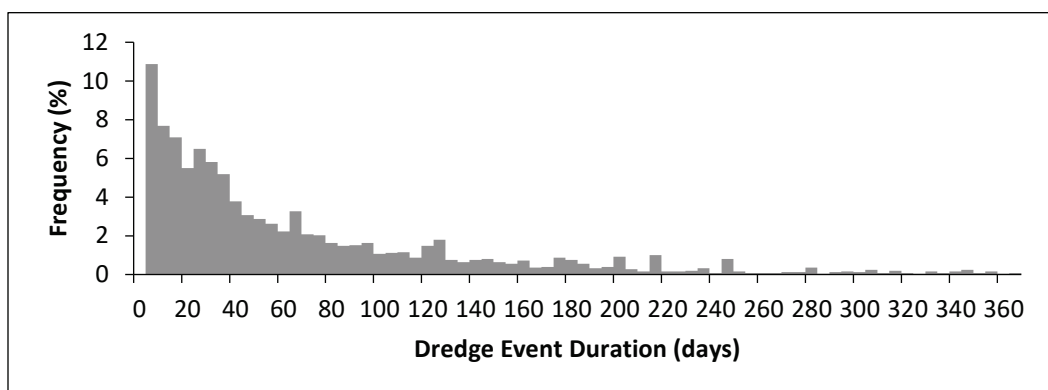


Figure 14. The average dredge event duration (days) from 1976-2015 for dredging events classified as maintenance or new work.

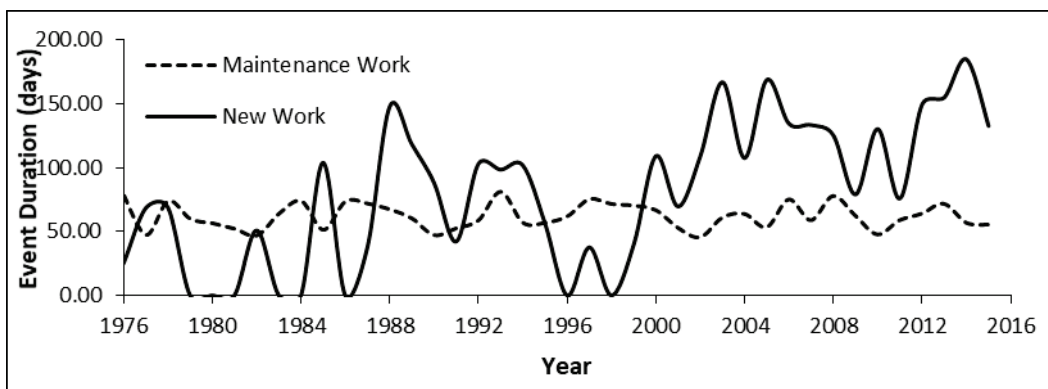


Figure 15. Dredge event duration (days) and disposal volume.

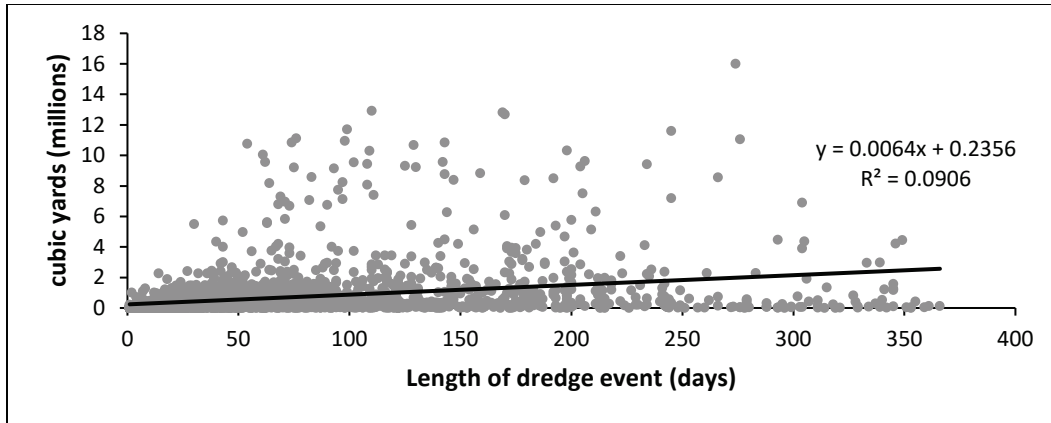
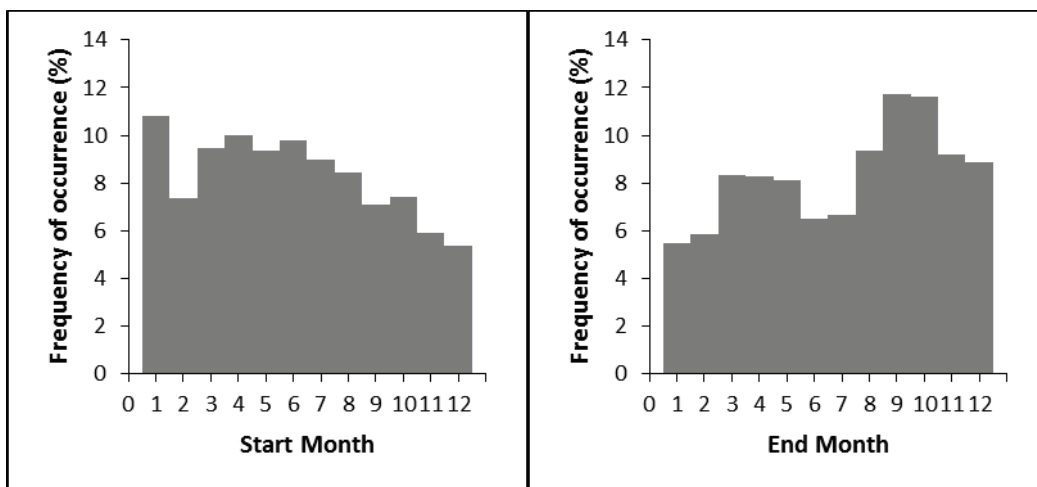
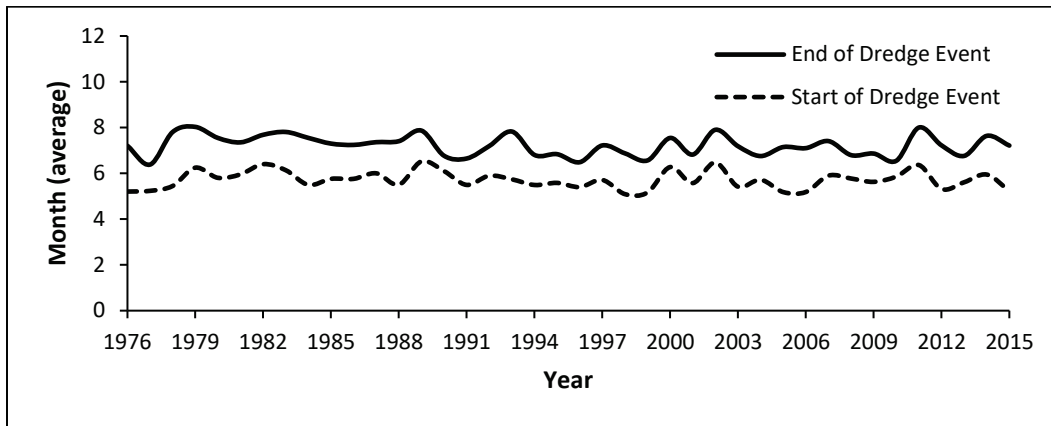


Figure 16. The average starting and ending month over time (top) and the starting (bottom left) and ending (bottom right) month frequency distribution of dredging events analyzed.



4 Summary

This Technical Report (TR) reviews the placement of dredged sediment at ODMDS from 1976–2015. The report uses data obtained from the ODD, a repository of ocean placement data submitted by USACE Districts. These data are used to fulfill the LC obligations to report annually the amount and location of dredged sediment placed in ocean waters. Other than the annual LC report, a compilation such as this one of the yearly ODD datasets had not been conducted to date.

There are limited ancillary data outside of the required data fields to support LC reporting activities. Therefore, this report leaves open the possibility for further research into the reasons for the observed trends. For instance, ERDC-EL is aware of many dredging events that have used an ODMDS for only a portion of the total dredged sediment, with the remainder used in other areas (e.g., beneficial use applications). However, for these events it is not possible to determine the fraction of dredged sediment that has been placed at an ODMDS or other areas using the ODD data. This information has not been required for the LC report, but it would help better define the role of ODMDSs going forward and document other uses of the dredged sediment. To better understand ODD data, integration of information from other databases as well as the addition of new questions to the ODD data call should be considered. Complementary data exists in other USACE databases that could be used in the future to investigate more discrete trends in the ocean placement data. For example, the National Dredging Quality Management Program (DQM) is an automated dredging monitoring system that could provide other complementary data for ocean placement events since 2012 (USACE DQM n.d.). New data requested or imported from other databases outside the scope of the LC should be carefully considered in terms of their value to the ODD and the broader USACE dredging program.

Compiling and analyzing the data in the database helps demonstrate how the ODD can help answer general questions concerning long-term trends in placement of dredged sediment in the ocean. The documentation of such data over time provides several advantages including a measure of all dredged sediment placed in the ocean since 1976, a benchmark for future data comparisons, and improved data collection and quality. At a time when the long-term fiscal outlook for federally maintained navigation events is unclear, it is imperative that policymakers and those tasked with

management of the USACE dredging program have meaningful, quantitative, and objective sources of information upon which to base decisions.

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Appendix A: Summary Data for Ocean Dredged Material Disposal Sites

Table A1. Summary data for ocean dredged material disposal sites.

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
Alaska										
	Nome-East	1976	2007	0.81	22	0.37	40	48	A	PAC
	Nome-West	1978	2006	0.16	10	0.30	38	26	A	PAC
Charleston										
	Charleston	1976	2015	66.53	46	11.80	40	83	A	ATL
	Georgetown Harbor	1976	2006	7.23	16	1.00	31	52	I	ATL
	Port Royal	1998	2003	0.53	3	1.00	6	50	I	ATL
	Port Royal Harbor, North	1976	1995	2.16	5	0.80	20	25	I	ATL
	Port Royal Harbor, South	1977	1995	2.66	8	1.00	19	26	I	ATL
Galveston										
	Brazos Island Harbor	1976	2007	8.21	20	0.42	40	45	A	GOM
	Brazos Island Harbor (42-Foot Project)	1992	1992	0.58	1	0.42	24	4	A	GOM
	Corpus Christi New Work	1998	-	-	-	1.40	18	-	A	GOM
	Corpus Christi Ship Channel	1976	2015	17.86	21	0.63	40	53	A	GOM
	Freeport Harbor Interim Site	1976	1991	14.44	15	0.43	16	88	I	GOM
	Freeport Harbor Maintenance (45 Ft Project)	1990	2015	49.17	34	1.53	26	92	A	GOM
	Freeport Harbor New Work (45 Ft Project)	1990	2015	6.02	4	2.64	26	15	A	GOM
	Galveston	1976	2015	58.56	29	6.60	40	63	A	GOM
	Matagorda Ship Channel	1976	2012	8.41	14	0.56	40	35	A	GOM
	Port Mansfield	1976	2002	3.09	13	0.42	40	30	A	GOM
	Sabine-Neches Material Site 1	1976	2012	20.15	13	2.40	40	33	A	GOM
	Sabine-Neches Material Site 2	1985	2009	16.81	9	4.20	31	29	A	GOM
	Sabine-Neches Material Site 3	1987	2014	21.93	13	4.70	29	45	A	GOM
	Sabine-Neches Material Site 4	1981	2014	55.26	21	4.20	35	60	A	GOM

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
	Sabine-Neches Material Site A	2014	-	-	-	4.00	2	-	A	GOM
	Sabine-Neches Material Site B	2013	-	-	-	4.03	3	-	A	GOM
	Sabine-Neches Material Site C	2013	-	-	-	4.03	3	-	A	GOM
	Sabine-Neches Material Site D	2013	-	-	-	4.03	3	-	A	GOM
Honolulu										
	Former Honolulu/Pearl Harbor Sites	1976	1999	4.12	18	0.00	24	33	I	PAC
	Hilo	1977	2012	0.27	5	0.77	39	13	A	PAC
	Kahului	1977	1999	0.17	3	0.77	39	8	A	PAC
	Nawiliwili	1977	1999	1.21	5	0.77	39	13	A	PAC
	Port Allen	1977	1999	0.16	2	0.77	39	5	A	PAC
	South Oahu	1981	2011	5.78	34	1.52	35	49	A	PAC
Jacksonville										
	Arecibo Harbor	1978	1982	0.24	2	1.00	38	5	A	ATL
	Canaveral Harbor	1976	2013	26.35	57	4.00	40	83	A	ATL
	Charlotte Harbor	1976	1988	2.04	7	0.86	13	46	I	GOM
	Fernandina Beach	1976	2015	40.76	48	4.00	40	95	A	ATL
	Fort Pierce Harbor	1976	2014	1.09	8	1.00	39	21	I	ATL
	Jacksonville	1976	2015	21.50	47	4.56	40	75	A	ATL
	Key West	2005	2007	0.29	2	0.00	3	67	I	GOM
	Mayaguez Harbor	1976	1978	0.06	2	1.00	40	5	A	ATL
	Miami	1985	2015	10.40	13	1.00	31	35	A	ATL
	Palm Beach Harbor	2005	2013	0.01	1	1.00	11	9	A	ATL
	Palm Beach Harbor East (<2004)	1980	1983	0.52	3	1.00	4	75	I	ATL
	Palm Beach Harbor West (<2004)	1979	1979	0.05	1	0.01	1	100	I	ATL
	Ponce Harbor	1976	2005	1.52	4	1.00	40	8	A	ATL
	Port Everglades Harbor	1978	2013	0.53	5	1.00	38	11	A	ATL
	San Juan Harbor	1976	2014	12.01	18	0.98	40	30	A	ATL

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
	St. Augustine Harbor #1	1976	1977	0.30	3	0.00	2	100	I	ATL
	St. Lucie Inlet	1977	1979	0.22	4	0.00	3	100	I	ATL
	Tampa	1977	1997	23.04	26	4.00	39	26	A	GOM
	Yabucoa Harbor	1988	-	-	-	1.00	28	-	A	ATL
Los Angeles										
	Los Angeles/Long Beach (LA-2)	1976	2015	7.34	52	0.77	40	68	A	PAC
	Newport Beach (LA-3)	1976	2015	4.86	131	0.77	40	78	A	PAC
	San Diego (LA-5)	1976	2014	18.81	58	0.77	40	58	A	PAC
	San Diego Point Loma	1976	1978	0.90	2	0.80	3	67	I	PAC
Mobile										
	Gulfport-Eastern Site	1977	2005	15.30	8	2.47	39	21	A	GOM
	Gulfport-Western Site	1982	2015	13.49	16	5.20	34	44	A	GOM
	Mobile	1976	2015	126.34	91	4.80	40	95	A	GOM
	Panama City	1977	1987	0.41	3	0.26	11	27	I	GOM
	Pascagoula	1992	2014	30.02	29	18.50	24	75	A	GOM
	Pascagoula (<1992)	1976	1990	5.85	11	1.00	15	73	I	GOM
	Pensacola Nearshore	1983	1987	0.27	2	2.48	5	40	I	GOM
	Pensacola Offshore	1981	2014	6.50	6	4.53	35	17	A	GOM
New England										
	Cape Arundel	1976	2009	1.32	35	0.05	34	41	I	ATL
	Central Long Island Sound	2000	2015	3.82	27	2.42	16	94	A	ATL
	Massachusetts Bay	1976	2015	15.51	197	3.14	40	95	A	ATL
	Portland	1977	2015	5.58	86	1.00	39	85	A	ATL
	Rhode Island Sound Disposal Site	2003	2015	7.62	10	1.00	13	62	A	ATL
	Saint Helena Island	1977	1984	0.13	10	0.00	8	50	I	ATL
	Western Long Island Sound	2005	2015	0.19	30	1.56	11	100	A	ATL

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
New Orleans										
	Atchafalaya R., Bayous Chene, Boeuf, Black (East)	1976	2002	222.01	30	9.14	40	58	A	GOM
	Atchafalaya River Bar 103	2002	2011	40.03	4	0.00	10	40	I	GOM
	Atchafalaya River Bar Channel	-	-	-	-	7.31	-	-	I	GOM
	Atchafalaya River, Bayous Chene, Boeuf, Black (West)	2002	2015	110.54	20	36.24	14	93	A	GOM
	Barataria Bay Waterway	1976	1988	3.56	5	1.40	40	13	A	GOM
	Calcasieu Material Site 1	1976	2008	71.98	14	1.76	40	35	A	GOM
	Calcasieu Material Site 2	1983	2015	88.83	27	3.53	33	76	A	GOM
	Calcasieu Material Site 3	1981	2015	14.26	9	5.88	35	26	A	GOM
	Freshwater Bayou, Bar Channel	1978	1994	2.01	3	1.00	17	18	I	GOM
	Houma Navigation Canal	1976	1997	4.06	9	2.08	22	41	I	GOM
	Mississippi River Gulf Outlet	1976	2005	93.86	33	6.03	30	100	I	GOM
	Mississippi River South Pass	1977	1978	3.98	2	0.00	2	100	I	GOM
	Mississippi River Southwest Pass	1976	2015	189.49	44	3.44	40	100	A	GOM
	Mississippi River Tiger Pass Bar Channel	1978	1985	2.64	3	3.20	8	38	I	GOM
New York										
	Axel Carlson Reef	2005	2008	1.12	6	3.02	4	100	I	ATL
	East Rockaway Inlet, Long Island	1976	2010	0.11	3	0.81	40	8	A	ATL
	Fire Island Inlet, Long Island	1990	-	0.00	0	1.09	26	0	A	ATL
	Historic Area Remediation Site	1991	2015	76.71	154	15.70	25	80	A	ATL
	Jones Inlet	1990	-	0.00	0	1.19	26	0	A	ATL
	Mud Dump	1976	1997	124.48	484	2.20	22	100	I	ATL
	Rockaway Inlet	1990	-	0.00	0	0.38	26	0	A	ATL
	Shark River	2002	2006	4.29	7	0.60	14	29	A	ATL
Norfolk										
	Dam Neck	1981	2015	22.00	37	8.00	35	74	A	ATL

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
	Norfolk	1993	2014	1.25	3	50.26	23	9	A	ATL
Philadelphia										
	Absecon Inlet	1976	1978	0.40	5	0.28	40	8	A	ATL
	Barnegat Inlet	1999	2008	1.57	10	0.00	10	100	I	ATL
	Cold Springs Inlet	1977	2008	0.90	13	0.13	39	31	A	ATL
	Manasquan	1977	2007	0.56	11	0.11	39	28	A	ATL
Portland										
	Chetco	1976	2012	0.90	25	0.09	40	60	A	PAC
	Coos Bay Material Site E	1976	2006	12.70	23	0.13	40	40	A	PAC
	Coos Bay Material Site F	1976	2015	29.02	41	0.13	40	90	A	PAC
	Coos Bay Material Site H	1985	2013	6.15	24	0.13	31	48	A	PAC
	Coquille River Entrance	1976	2014	1.27	38	0.17	40	95	A	PAC
	Mouth of Columbia River Site A	1976	1997	23.36	19	0.00	22	86	I	PAC
	Mouth of Columbia River Site B	1976	1997	35.72	26	0.25	22	91	I	PAC
	Mouth of Columbia River Site E	1976	2003	56.00	34	0.00	28	96	I	PAC
	Mouth of Columbia River Site F	1989	2002	8.61	7	0.80	14	50	I	PAC
	Mouth of the Columbia River (Deep Water Site)	2004	2015	18.90	13	10.50	12	100	A	PAC
	Mouth of the Columbia River (Shallow Water Site)	2004	2015	23.18	12	1.40	12	100	A	PAC
	Port Orford	1977	1977	0.12	1	0.03	1	100	I	PAC
	Rogue River	1976	2015	1.84	35	0.13	40	83	A	PAC
	Siuslaw (South Site)	2010	-	0.00	0	0.16	6	0	A	PAC
	Siuslaw Interim Site A (1977-1995)	1976	1995	3.78	19	0.73	20	95	I	PAC
	Siuslaw River Site B (1996-2009)	1995	2009	0.52	9	0.00	15	60	I	PAC
	Siuslaw River Site C (1996-2009)	1995	2004	0.27	5	0.00	10	50	I	PAC
Portland cont'd										
	Siuslaw (North Site)	2010	2015	0.54	6	0.26	6	100	A	PAC

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
	Tillamook Bay Entrance	1976	1976	0.04	1	0.14	1	100	I	PAC
	Umpqua River (North Site)	2009	2015	1.18	10	0.43	7	100	A	PAC
	Umpqua River (South Site)	2009		0.00		0.43	7	0	A	PAC
	Umpqua River Interim	1976	1991	2.89	16	0.00	16	100	I	PAC
	Yaquina Bay (1986-2001)	1986	2000	4.65	16	0.00	15	100	I	PAC
	Yaquina Bay Interim Site (1978-1985)	1976	1985	3.84	10	0.14	10	100	I	PAC
	Yaquina Bay (North Site)	2001	2015	2.43	16	0.71	15	87	A	PAC
	Yaquina Bay (South Site)	2012	2015	1.02	5	0.71	4	100	A	PAC
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San Francisco										
	Channel Bar Site (SF-8)	1976	2015	17.29	37	1.20	40	80	A	PAC
	Crescent City Harbor	1976	1993	0.33	5	0.00	18	28	I	PAC
	Farallon Islands (B-1-B)	1993	1993	0.99	1	0.00	1	100	I	PAC
	Humboldt Bay Harbor	1976	1996	10.18	51	0.02	21	76	I	PAC
	Humboldt Open Ocean Disposal Site	1990	2015	27.54	56	1.00	26	100	A	PAC
	Moss Landing	1996	1996	0.01	1	0.00	1	100	I	PAC
	Nearshore	1988	2001	2.50	4	0.00	14	21	I	PAC
	San Francisco Deep Ocean Site	1994	2015	15.71	50	6.50	22	91	A	PAC
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Savannah										
	Brunswick Harbor	1976	2015	32.39	31	2.00	40	73	A	ATL
	Savannah	1976	2015	33.31	34	4.26	40	73	A	ATL
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Seattle										
	Grays Harbor Eight Mile	1990	1990	0.22	1	0.50	26	4	A	PAC
	Grays Harbor Southwest Navigation Site	1990	1993	12.40	4	1.25	26	15	A	PAC
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Wilmington										
	Morehead City (1976-1985)	1976	1992	10.53	14	8.00	17	65	I	ATL
	Morehead City	1987	2015	13.75	27	8.00	29	79	A	ATL

USACE District	Ocean Dredged Material Disposal Site	First Used (year)	Last Used (year)	Disposal (x10 ⁶ cy ³)	Dredge Event (N)	Size (nm ²)	Open (years)	Used (%)	Status	Ocean
	New Wilmington	2002	2015	28.33	24	9.40	14	86	A	ATL
	Wilmington	1987	2008	41.31	57	2.30	22	86	I	ATL
	Wilmington Harbor (1976-1992)	1976	1992	11.14	23	2.30	17	76	I	ATL

First used (year) – the first year disposal occurred or the designation date (or whichever was earlier; >1976); Last used (year) – the last year of disposal activity for an active site or the year when the site was de-designated for inactive sites; size (nm²) – the size of the ocean disposal site; active (years) – the number of years a site was open for disposal; used (%) – the percentage of years disposal occurred while the site was active; status – the current status of a site (A = Active; I= Inactive); Ocean – the ocean area where the site was located (PAC= Pacific Ocean; ATL= Atlantic Ocean; GOM= Gulf of Mexico).

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14. ABSTRACT This technical report reviews the placement of dredged sediment at ocean dredged material disposal sites (ODMDS) from 1976-2015. This report uses data obtained from the Ocean Disposal Database (ODD), a repository of ocean disposal data submitted by USACE Districts. These data are collected in order to fulfill the London Convention (LC) obligations to report annually the amount and location of dredged sediments placed in ocean waters. The LC report is published annually, but until now, a long-term compilation analysis of the ODD dataset has never been conducted. Analyzing the database for long-term trends shows that the ODD can help answer questions related to policies concerning placement of dredged sediments in ocean waters. Additionally, historical trends provide the USACE with information about ODMDS activity to assist in the short- and long-term management of dredged sediment placed at these sites. There is limited ancillary data outside of the required data fields to support LC reporting activities. Therefore, this report leaves open the possibility for further research into the reasons for the observed trends. In order to better understand ODD trends, it is recommended that data from other related databases be integrated into a broader and more comprehensive framework.					
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