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# USACE Navigation Sediment Placement: An RSM Program Database (1998 – 2019)

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**PURPOSE:** This US Army Corps of Engineers (USACE), Regional Sediment Management (RSM), technical note describes a geodatabase of federal coastal and inland navigation projects developed to determine the extent to which RSM goals have been implemented across the USACE at the project and district levels. The effort (1) quantified the volume of sediment dredged from federal navigation channels by both contract and USACE-owned dredges and (2) identified the placement type and whether sediment was placed beneficially. The majority of the dredging data used to populate the geodatabase were based on the USACE Dredging Information System (DIS) database (USACE 2022), but when available, the geodatabase was expanded to include more detailed USACE district-specific data that were not included in the DIS database. Two datasets were developed in this study: the National Dataset and the District-Specific and Quality-Checked Dataset. The National Dataset is based on statistics extracted from the combined DIS Contract and Government Plant (GP) data. This database is a largely unedited database that combined two available USACE datasets. Due to varying degrees of data completeness in these two datasets, this study undertook a data refinement process to improve the information. This was done through interviews with the districts, literature search, and the inclusion of additional district-specific data provided by individual districts that often represent more detailed information on dredging activities. The District-Specific and Quality-Checked Database represents a customized database generated by this study. An interactive web-based tool was developed that accesses both datasets and displays them on a national map that can be viewed at the district or project scale.

**INTRODUCTION:** This study considers RSM implementation to be the beneficial and/or cost-effective utilization of navigation sediments to quantify nationwide progress since 1998 when the RSM Program was formalized within the USACE during the 67th Coastal Engineering Research Board (CERB) meeting, themed *Regional Sediment Management*. Since that time, the concept of RSM has expanded beyond a coastal focus to incorporate riverine and reservoir systems, the beneficial use of dredged sediments for environmental enhancement, and the provision of more sustainable and resilient approaches (Rosati et al. 2001).

**DATA SOURCES:** This study inventoried dredge volume and placement type at federal navigation projects using data from the USACE DIS. The geodatabase was then expanded to incorporate internal district dredging databases, which often provide more detailed information than the DIS database. The intent of this study was to utilize existing data resources and augment those sources when necessary.

**Dredging Information System (DIS) Data.** DIS is a national database that tracks USACE dredging projects from advertisement to completion for contract dredging operations. The GP database contains information on dredging activities performed by USACE-owned and operated dredges. Data entry is controlled and managed by district personnel. The databases are maintained and supported by the USACE Institute for Water Resources, Navigation Data Center

(USACE 2022). Data entry is designed to include pre-bid estimates, bid opening, and project completion dredging statistics. However, districts often do not enter actual dredging quantities upon completion of a project.

At the time of publication, DIS was undergoing a major update ("DIS 2.0") that included more detailed placement types based on EM1110-2-5025 (USACE 2015) sediment placement classification guidelines. For purposes of this study, the DIS data fields for volume and placement type were most important. The 10, single-letter, DIS placement type codes are listed in Table 1. This study expanded the codes from one to three letters to provide more detail. Codes that combine more than one type of placement, or mixed or unknown placement, were initially assigned unknown placement types (e.g., XXX).

Several single-letter DIS placement type codes could represent, but are not limited to, RSM placement. For example, the overboard and open water (O) code could characterize placement of navigation sediment into the littoral system by side casting; however, the O code may also represent non-RSM placement such as offshore placement. Another example of an RSM practice that was not well-characterized in DIS is beneficial use through beach and wetland creation. The literature review and district interviews confirmed that wetland creation is categorized as either wetland nourishment or creation (W) or upland (U). W (and beach nourishment (B)) is all-inclusive of RSM placement while U includes other forms of upland placement areas. Additional data such as internal district databases and district interviews were utilized to clarify the differences in placement types that are not apparent in the DIS placement codes.

**Channel Framework and Civil Works Information System (CWIS) Data.** Two additional datasets to assist with spatially locating the dredging projects and standardizing project names were utilized. The National Channel Framework (NCF) database provides spatial polygons of the USACE navigation channels indicating dredging locations. To align the locations of the navigation projects listed in the DIS, NCF identifiers (IDs) and polygon locations (navigation channel reaches) were used. Each project within the NCF contains multiple polygons representing the navigation channels reaches. In this study, the multiple channel reaches were combined for each navigation project and represented as a point feature at the centroid of each combined project polygon.

CWIS numbers are unique project codes assigned by Headquarters (HQ), USACE. These numbers are used for budgeting, accruing costs, and reporting the status of a project. Since the CWIS numbers are tied to a single project name, the CWIS names were used to rename the irregular project names that are listed in the DIS and GP data (an artifact of manual project name entry). The combination of the DIS, GP, and CWIS data created what is referred to in this study as the *Nationwide Dataset*.

**District-Specific (internal) Data.** All districts were queried to share internal district-specific data. by Several Districts provided an internally maintained database for dredging projects. These databases were generally more detailed than data included in the DIS databases. For the other districts, the DIS data were manually edited to reflect the district-specific information provided during the interview and review process. The data refinement process described here transformed the National Dataset into what is referred to in this study as the District-Specific and Quality-Checked Dataset.

**Table 1. DIS placement code descriptions.**

| DIS Code | DIS Placement Type | DIS Definition | Assign Code |
|---|---|---|---|
| B | Beach Nourishment | Beach restoration in which hydraulically pumped dredged material is directly placed onto an eroded beach. | BCO |
| C | Confined | Placement of dredged material within diked nearshore or upland confined placement facilities that enclose and isolate the dredged material from adjacent waters. | DUL |
| D | Underwater Confined | Placement of dredged material in an underwater area that is or will be isolated from the overlaying water with a layer of clean material. | DOC |
| M | Mixed | Placement or discharge location or combination of locations that is not represented by other categories. | XXX |
| O | Overboard and Open Water | Placement of dredged material in rivers, lakes, estuaries, or oceans via pipeline or surface release from hopper dredges. | DOC |
| S | Open and Upland | Combination of open-water and upland placement of material from a single dredging project, when volumes are not clearly separable. | XXX |
| T | Beach Nourishment and Upland | Combination of beach nourishment and upland placement of material from a single dredging project, when volumes are not clearly separable. | XXX |
| U | Upland | Placement of dredged material on land above adjacent water surface elevation. | DUL |
| W | Wetland Nourishment or Creation | Wetland restoration in which hydraulically pumped dredged material is directly placed in a wetland area. | BES |
| X | Undefined | Any method or combination of placement methods not otherwise defined. | XXX |

**CREATING DATASETS FOR THE RSM DATABASE:** The customized DIS data were incorporated into a Geographic Information System database that spatially displayed the results. Quantitative and qualitative data were collected to review disposal and beneficial placement projects. USACE has a significant amount of historical dredge data compiled in the DIS databases. The intent of this study was to utilize existing data resources and augment those sources when necessary.

Although extensive, the DIS data are not designed to quantify beneficial use or RSM projects. Therefore, the databases were augmented through an extensive literature review, interviews with each USACE district, and with internal district-specific data, when available. A coding system was developed to distinguish between the various types of placement. Each dredging event was then quality checked manually to determine the placement intent and to reduce the volume of unknown sediment placement.

An automated data integration toolset of specific rules was developed to standardize names, incorporate repeatability, allow for data tracking, dynamically link the data to spatial locations, and minimize review times. Programming was written using Python® Version 2.7 to allow for seamless integration with ArcGIS software and to minimize future work when importing new or

updated data. The first step was to identify and group specific projects using the DIS, GP, NCF, and CWIS data. Since projects have different names within the same dataset, as well as different names between datasets, an automated method for identifying matching projects while minimizing the hands-on time of the user was critical.

**National Dataset.** The DIS and GP datasets obtained from the USACE are separate datasets. This section describes how the two were merged and analyzed to develop the National Dataset used in this study. For this study, DIS contract dredging records between 1998 and 2019 were utilized to capture projects dredged after the formal establishment of the RSM program. Also, projects with volumes less than 30,000 cy were not selected for analysis. It was necessary to make general placement assumptions (Table 2) based on the capabilities for each government-owned dredge because many dredging events in the GP dataset were classified with "O" placement code, indicating open water placement. The intent of this placement was unclear.

An algorithm was developed to match DIS (contract) and GP project names. The results were then manually quality checked. Only names within the same district were compared to increase accurate matching. CWIS IDs were also linked to projects based on name matching.

The final step before compiling the data tables was to assign placement codes. Placement codes were expanded from one (Table 1) to three letters to further describe the type of placement. The three-letter codes are based on Childs (2015) (Table 3). Placement codes in DIS 2.0 will follow USACE (2015) sediment placement classification guidelines; thus, future iterations of this database will also be updated.

In this study, the categorization is based on the intent of the placement, either for beneficial use (BU) or disposal. For BU placement, the codes are further separated into ocean, coastal nearshore, coastal onshore, estuary, inland lake, inland river, and upland. The placement codes are separated by ocean, in-water, and upland. Codes that combine placement types were assigned as "unknown" because DIS does not provide information about how much volume was placed by the various placement methods. A Python script used the crosswalk listed in Table 3 under "Assign Code" to convert the original DIS codes (National Dataset) or the district-specific placement codes to the new three-letter code.

Data tables were developed at the project and district level for both the National Dataset and District-Specific and Quality Checked Dataset. The project-level data tables grouped all the dredging events with the same assigned NCF IDs and calculated dredging statistics. The same statistics were calculated at the district level. For purposes of the data visualization, placement codes were aggregated into unknown, beach, upland, wetland, open water, littoral, and river-based (Table 3).

**Table 2. Placement codes assigned to each government-owned dredge represented in the GP dataset based on assumptions on the placement capabilities for each vessel.**

| Dredge | Placement code | District and Placement Capabilities |
|---|---|---|
| *Currituck* | DOC for O; XXX for S | SAW: Split hull, special purpose dredge, can remove sediment in 6 ft[1,2] of water, can also transport sediment to the downdrift beach and deposit it in the surf zone. |
| *Essayons* | BCO for B; DOC for O | NWP: 6,423 cy ocean certified hopper dredge equipped for bottom dump or 2 in. pump out. 35 to 94 ft dredging depth, minimum 36 ft draft. |
| *Fry* | XXX for S; DOC for O | SAW: Sidecaster decommissioned in 2010. |
| *Goetz* | DUL | MVP: Cutterhead for river maintenance pumps into upland placement areas. |
| *Hurley* | XXX for T; DOC for O | MVM: Dustpan, surface discharges in water. |
| *Jadwin* | DOC | MVK: Dustpan, surface discharge. |
| *McFarland* | BCO for B; DOC for D, O; DUL for C, U; XXX for M, S, T, X | NAP: Deep-draft ocean-going hopper, triple capability for direct pump out, bottom discharge and sidecasting or boom discharge. |
| *Merritt* | XXX for S; DOC for O | SAW: Sidecaster. |
| *Murden* | DOC for O; XXX for S | SAW: Same as CURRITUCK above. |
| *Potter* | DOC for O; XXX for M | St. Louis District: Dustpan for river maintenance. |
| *Schweizer* | DOC for O | SAW: Sidecaster, decommissioned. |
| *Thompson* | DUL for C/U; XXX for M | MVP: Cutterhead. |
| *Wheeler* | DOC for O; XXX for X | MVN: 8,256 cy hopper 29 ft draft, bottom dump. |
| *Yaquina* | BCO for B; DOC for O; XXX for M | NWP: Hopper (1,050 cy) 16 ft draft, well-suited for dredging small, shallow coastal entrances. |

**District-Specific and Quality-Checked Dataset.** Once the data tables were generated, a manual three-step quality assurance/quality control process refined data for those districts that did not provide district-specific data. First, the project groupings were checked. Second, all dredging events with unknown placement codes (XXX; Table 1) were identified and examined in detail, first through a literature search, and if needed, through district interviews, to reduce the volume of unknown sediment placement. This involved quality checking hundreds of dredging events. Finally, open water and upland types were examined to distinguish whether the intent was for beneficial use. This distinction is not provided in DIS data.

This quality-checking step of data from districts that did not provide district-specific data, combined with quality-checked district-specific data from Little Rock, Memphis, New Orleans, New England, Portland, Los Angeles, San Francisco, Rock Island, St. Louis, St. Paul, Tulsa, Walla

[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.
[2] For a full list of the unit conversions used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 345-7, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

Walla, and Galveston Districts created the second database used in this study, the District-Specific and Quality Checked Dataset.

**RESULTS:** This study has provided updated statistics on USACE dredging and placement on a national scale. While the US Environmental Protection Agency and USACE (EPA USACE 2007) estimated that approximately 200 to 300 Mcy of sediment is dredged annually by USACE, this study found that an average of 214 Mcy was removed annually from navigation projects from 1998 through the end of 2018 (herein referred to as 1998–2019). The same report estimated that 20% to 30% of the total volume dredged was placed beneficially (EPA and USACE, 2007). The National Dataset, which represents essentially raw DIS data, estimates beneficial placement at 13% of the total volume dredged. However, the refined District-Specific and Quality Checked Dataset indicates that 39% or 82.1 Mcy/yr of navigation sediment is placed beneficially (Table 4).

The quality-checking and data-refinement process of this study also resulted in a substantial reduction in the volume of unknown placement type. According to the National Dataset, 38.5 Mcy/yr of navigation sediment was characterized as having an unknown placement type. The refined District-Specific and Quality Checked Dataset has only 2.7 Mcy/yr characterized with an unknown placement type. Additional interviews and refinement of this database may result in further reduction of the unknown volume.

The number of dredging events and the number of RSM events (those that placed sediment beneficially) recorded in the database increased markedly once the National Dataset was refined, supplemented, and quality checked. The number of identified dredging events from 1998 to 2019 increased from 4,478 to 8,261, which illustrates that the refinement process acquired many dredging events not captured in the DIS. The number of RSM-classified dredging events also increased drastically from 468 to 4,265, which illustrates that the refinement process identified an order of magnitude more dredging events that utilized RSM principles than the National Dataset.

A comparison of the upper and lower frames of Figure 1 provides an overview of some of the differences between the National Dataset and the District-Specific and Quality Checked Dataset, detailed in Table 4. The total volume dredged is represented by the size of the wedges in the pie charts.

Nationally, over 2 Bcy of sediment have been placed in non-beneficial use sites from 1998 to 2019. This is shown as the striped volume in the pie chart in the lower frame of Figure 1. Converted to an annual statistic, approximately 129 Mcy are not placed beneficially each year (Table 4). This statistic begins to shed light on the potential national volume that could be, but is not presently, used beneficially.

For example, if sediments are uncontaminated and compatible within a given standard, there may be an opportunity to combine beach or ecosystem projects with navigation projects, or to use less-compatible sediments in beneficial or more cost-effective deposition. Several major navigation projects in the United States faced with legacy contamination in the past, such as New York/New Jersey Harbor, now plan to place nearly 100% of dredged sediment beneficially.

The District-Specific and Quality Checked Dataset is accessible through a USACE enterprise webapp (Emery 2022). Figure 2 provides an example for the New Orleans District where 66% of sediment was placed beneficially between 1998 and 2019.

**Table 3. Placement Codes (adapted from Childs [2015]) including Geodatabase Mapping Codes (in bold).**

| New Placement Intent | New Placement Location | New Placement Purpose | Assign Code |
|---|---|---|---|
| Beneficial Use | Ocean | Capping, Ecological Habitat<br>**Open Water RSM** | BOC |
| Beneficial Use | Coastal Nearshore (sub-tidal) | Beach Nourishment (via nearshore berm creation), RSM, Ecological Habitat<br>**Littoral/In Water RSM** | BCN |
| Beneficial Use | Coastal Onshore (tidal) | Beach Nourishment (beach disposal), RSM, Levee Construction, Ecological Habitat, Multipurpose<br>**Beach** | BCO |
| Beneficial Use | Estuary | Marsh Creation, Bay Restoration (via Thin Layer Placement), Island Nourishment, Beach Nourishment, Levee Construction, Flood Risk Management, Ecological Habitat, etc.<br>**Wetland** | BES |
| Beneficial Use | Inland River | Island Nourishment, Beach Nourishment, Levee Construction, Flood Risk Management, Ecological Habitat, etc.<br>**In River RSM** | BIR |
| Beneficial Use | Inland Water | Sidecaster or open-water placement in river<br>**In River RSM** | BIW |
| Beneficial Use | Upland (above 100-yr FP) | Ecological Habitat, Soil Reuse, Land Development, etc.<br>**Upland RSM** | BUL |
| Disposal | Ocean | Ocean Disposal, Ocean Dredged Material Disposal Site<br>**Open Water Disposal** | DOC |
| Disposal | Inwater | Confined Disposal Facility, (Un)confined Aquatic Disposal<br>**In River Disposal** | DIR |
| Disposal | Inwater | Confined Disposal Facility, (Un)confined Aquatic Disposal,<br>**Littoral/In Water Disposal** | DIW |
| Disposal | Upland | Confined Disposal Facility, Landfill<br>**Upland Disposal** | DUL |

**Table 4. Summary statistics for all USACE Navigation projects.**

| All USACE Navigation Projects | National Datasets (cy from 1998 to 2019) | National Datasets (cy/yr) | District-Specific and Quality-Checked (cy from 1998 to 2019) | District-Specific and Quality-Checked (cy/yr) |
|---|---|---|---|---|
| Total Volume Dredged | 3,797,619,791 | 179,557,787 | 4,248,847,997 | 213,937,489 |
| Volume Placed Beneficially | 509,759,353 | 23,361,540 | 1,663,804,511 | 82,147,752 |
| % Placed Beneficially | 13% | 13% | 39% | 38% |
| # Dredging Events | 4,478 | 213.2 | 8,621 | 410.5 |
| # Dredging Events Placed Beneficially (RSM Events) | 468 | 22.3 | 4,265 | 203.1 |
| % Dredging Events Placed Beneficially | 10% | N/A | 49% | N/A |
| Unknown Volume | 807,242,727 | 38,514,885 | 55,478,459 | 2,759,670 |
| BU Volume Placed on Beaches | 130,036,803 | 6,014,718 | 206,030,523 | 9,725,633 |
| BU Volume Placed in Wetlands | 379,722,550 | 17,346,817 | 240,687,153 | 12,199,712 |
| BU Volume Placed in Littoral Zone* | 0 | 0 | 208,752,139 | 10,122,216 |
| BU Volume Placed in River | 0 | 0 | 805,518,896 | 40,195,521 |
| BU Volume Placed in Open Water* | 0 | 0 | 31,369,679 | 1,433,944 |
| BU Volume Placed Upland* | 0 | 0 | 171,446,121 | 8,470,707 |
| Volume Not Placed Beneficially | 2,480,617,711 | 117,681,362 | 2,529,565,027 | 129,030,067 |

* Assumed that certain GP dredges are placing sediment beneficially in the littoral zone because they have no other way to dispose of material (e.g., sidecasters). No DIS option to indicate whether open water or upland codes are beneficial or disposal; therefore, all open-water and upland codes in national datasets are assumed to be disposal. During the database refinement process, an effort was made to determine whether the upland code represented disposal (e.g., Confined Disposal Facility) or beneficial use (e.g., habitat creation).

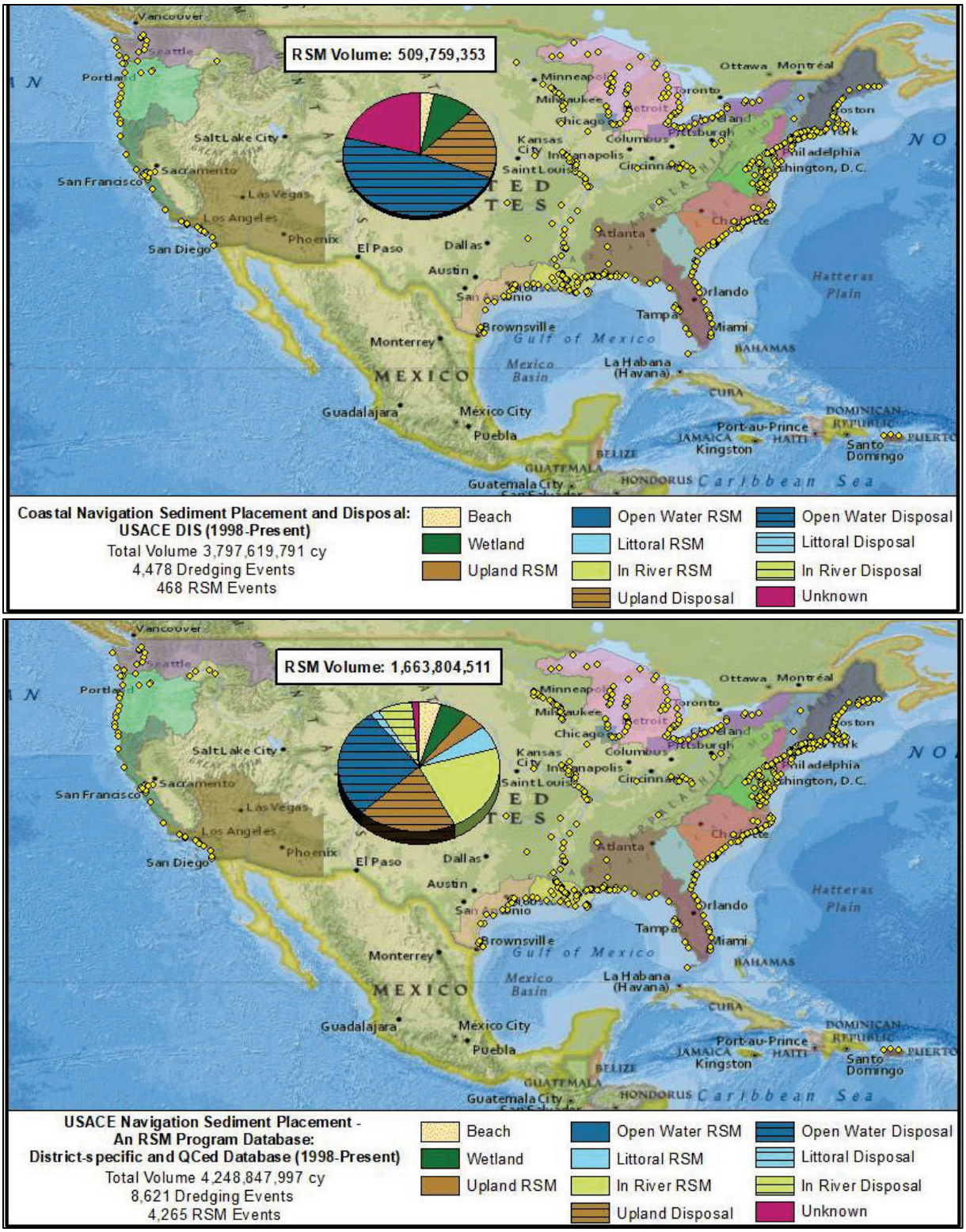


Figure 1. Nationwide summary of navigation sediment placed using the National Dataset (DIS, top) and the District-Specific and Quality-Checked Dataset (bottom). Striped wedges indicate sediment disposal. From 1998 through 2019, 375 navigation projects (dots) have placed 39% or approximately 1.7 Bcy of dredged sediment beneficially according to the refined database (bottom). Compare that to 13% or approximately 509 Mcy of dredged sediment beneficially according to the DIS.

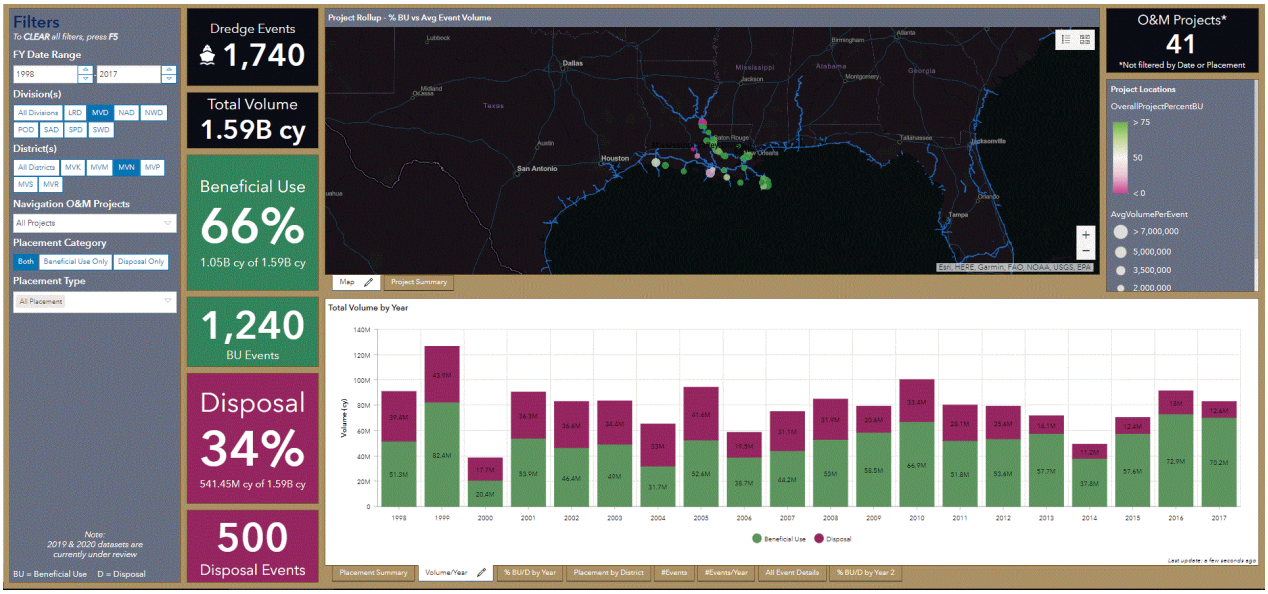


Figure 2. USACE RSM - Navigation Sediment Placement Database highlighting the New Orleans District.

**ADDITIONAL INFORMATION:** This technical note was prepared by Nicole Elko, nelko@elkocoastal.com, member of the Coastal Engineering Research Board and president of Elko Coastal Consulting, Inc. The study was conducted as an activity of the RSM Program, a Navigation Research, Development, and Technology portfolio program administered by HQ USACE. For information on the RSM Program, please consult http://rsm.usace.army.mil or contact the Program Manager, Dr. Katherine E. Brutsché at Katherine.E.Brutsche@usace.army.mil. For information regarding this RSM-TN, please contact Michael Hartman, Michael.A.Hartman@usace.army.mil.

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