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Sediment as a Regional Resource in the Low-Commercial-Use Navigation Program, Mathews County, VA

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PURPOSE. This Coastal and Hydraulics Engineering Technical Note (CHETN) describes a case study in which a Regional Sediment Management (RSM) strategy was developed in Mathews County, VA. The RSM effort began after severe shoaling had occurred in some of the County's Federal navigation channels following several years of no maintenance dredging. The County realized that low funding levels for dredging low-commercial-use Federal channels would likely persist into the future. Yet the County desires continued US Army Corps of Engineers (USACE or Corps) involvement in future maintenance dredging. This CHETN describes how the RSM initiative facilitated discussions to identify opportunities for future dredging while respecting the performance-based budgeting guidance in the USACE low-commercial-use navigation program. This effort was supported by the US Army Engineer Research and Development Center (ERDC) Coastal and Hydraulics Laboratory (CHL) RSM Program, and the US Army Engineer District, Norfolk (NAO).

INTRODUCTION. Mathews County (Figure 1) is located on the western shore of the Chesapeake Bay approximately 65 miles east of Richmond, VA, and 56 miles north of Norfolk, VA. Mathews County is bordered mostly by water with the Chesapeake Bay on the east, Mobjack Bay on the south, the North River on the west, and the Piankatank River on the north. The County has about 350 miles of tidal shoreline. Gloucester County adjoins Mathews County and forms part of the Mathews County's western boundary. Mathews County is mostly rural, with a small population.



Figure 1. Mathews County, VA.

Commercial fishing, boat repair, marine construction, ecotourism, and other marine activities are important economic endeavors that provide sources of income for many County residents. These commercial activities predominantly occur on the five Federal navigation projects in the County: (1) Queens Creek, (2) Milford Haven, (3) Winter Harbor, (4) Horn Harbor, and (5) Davis Creek (Figure 2). All five projects are shallow-draft. Four of the five projects require periodic maintenance dredging to provide safe navigation for the commercial users.

Mathews County serves as the local sponsor for these five Federal navigation channels. For the Mathews County RSM initiative, these Federal channels and a few other Federal project components were considered as a system to focus on the County's needs across the region.

RSM GOALS. Due to the lack of maintenance dredging of the Federal channels and the conclusions of a Section 1135 New Point Comfort Environmental Restoration Study, the County realized that an individual project approach to addressing water resource issues was no longer feasible, and that a regional approach would be necessary. The Mathews County RSM effort allowed NAO to take a regional perspective in addressing and evaluating the individual projects as a system, to participate in regional discussions with the USACE and stakeholders, and to examine the sediment distribution and movement across the County as a system.

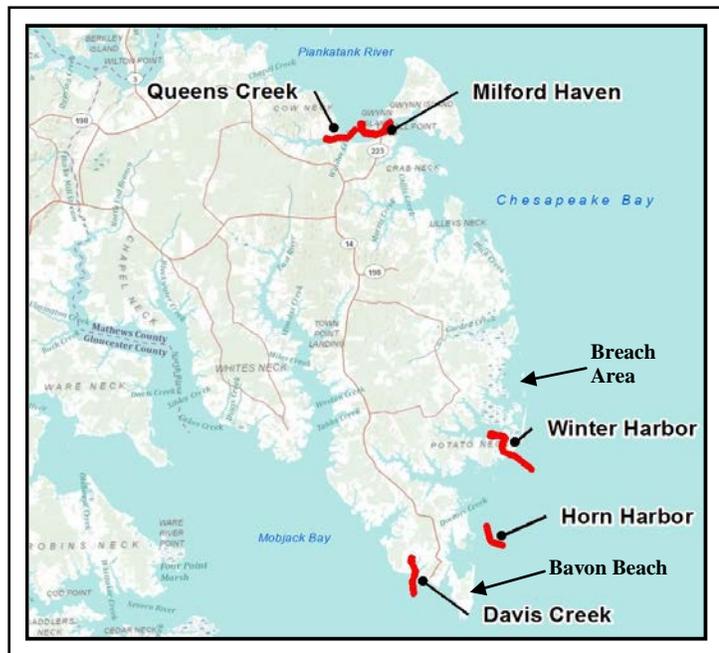


Figure 2. Five low-commercial-use Federal navigation channels in Mathews County, VA.

SYSTEM BOUNDARY AND

COMPONENTS. NAO coordinated with Mathews County, the local sponsor for the low-commercial-use projects, to define the boundary and components of the region. The NAO team consulted with the Virginia Institute of Marine Science (VIMS), College of William and Mary, which is commissioned to advise the Virginia Marine Resource Commission (Hardaway et al. 2010, Milligan et al. 2012).

NAO defined the initial regional boundary to coincide with the County boundaries, and identified the following five shallow-draft low-commercial-use Federal navigation channels: (1) Queens Creek, (2) Milford Haven, (3) Winter Harbor, (4) Horn Harbor, and (5) Davis Creek and York River Entrance Channel deep-draft Federal navigation channel. Each of these projects has currently-used and historically-used placement sites. These placement sites, along with Baltimore Harbor's Wolf Trap Dredged Material Management Area, were included in the Mathews County RSM region.

The team periodically re-evaluated the boundary and components of the region as conditions evolved. This review and evaluation occurred three times during the life of the Mathews County RSM initiative for the following areas: (1) Garden Creek (after review, not included in the region), (2) Put-In Creek (after review, not included in the region), and (3) Bavon Beach (added as a regional component, Figure 2).

RSM STRATEGY IN MATHEWS COUNTY. The Mathews County RSM team executed the initiative consistent with several of the National USACE RSM Program goals. Table 1 lists the pertinent goals and identifies the outcomes of the Mathews County RSM effort that best fit each National Goal (Rosati et al. 2001 [rev 2004]).

Table 1. Goals and outcomes of the Mathews County, VA, RSM strategic approach.

National RSM Goals (ERDC/CHL CHETN-XIV-1: Rosati et al. 2001, rev. 2004)	Outcomes
<p>To foster Federal, state, and local partnerships for the RSM strategy; unified vision; cost-sharing; and co-leadership of RSM actions.</p>	<ul style="list-style-type: none"> • The Mathews County RSM effort enabled the Norfolk District to facilitate customer, stakeholder, and team communications; and to re-engage customers and stakeholders not involved in the USACE processes since the last maintenance dredging cycles prior to performance-based budgeting. • A unified vision was developed to include cost-sharing efforts, leverage of funding, and co-ownership of RSM actions. This resulted in a Section 22 cost-shared study to develop a range of costs for implementing a low-commercial-use navigation channel maintenance program on the Middle Peninsula.
<p>To improve RSM practices within the USACE.</p>	<ul style="list-style-type: none"> • The Norfolk District re-examined its one-each placement strategy providing placement sites for individual projects. Using a systems approach, the team performed a County-wide examination of how Federal channel sediments may accomplish a greater benefit to the region. • A unified management of the channels allows the Norfolk District to explore placement strategies that could provide additional storage capacity for navigation projects, and provide storage capacity of projects that currently have no approved and permitted placement sites.
<p>To reduce life-cycle costs or increase life-cycle benefits for existing Federal projects.</p>	<ul style="list-style-type: none"> • In the current performance-based budget climate, Mathews County's concern was how to accomplish Federal channel dredging in the future. • The Mathews County RSM strategy was focused so that maintenance of the Federal channels could be managed as a program rather than as individual projects. • As local sponsor, the County had a desire to integrate the maintenance of the channels into other coastal projects around the County so that these other coastal projects would benefit from the maintenance dredging of the Federal channels. While this may result in a higher total program cost, several component projects could potentially contribute funds to the overall project. This leveraging would reduce the cost burden on individual projects.
<p>To improve regional project efficiencies by engaging cross-mission objectives of the Corps.</p>	<ul style="list-style-type: none"> • The Mathews County RSM efforts served to unite: <ul style="list-style-type: none"> ○ General Operation & Maintenance (O&M) efforts ○ American Recovery and Reinvestment Act dredging projects in Mathews County ○ Coordination within the District's Regulatory program ○ Outputs of a Continuing Authorities Program Section 1135 Environmental Restoration Feasibility Study. • The RSM efforts enabled the District to group the outcomes of these efforts together and to form a sediment management recommendation for the system.
<p>To improve decision support technology for RSM.</p>	<ul style="list-style-type: none"> • Historical Mathews County hydrographic and mapping data was converted to digital format and developed into a historical knowledge database. Several Corps coastal computer modeling programs were used to calculate wave conditions and develop a sediment budget. • The resulting knowledge database allowed the Mathews County RSM team to make decisions on how to best manage sediments as a regional resource in the future.
<p>To document unique elements of RSM, and provide guidance for future implementation of RSM actions.</p>	<ul style="list-style-type: none"> • Specific to the low-commercial-use navigation projects in Mathews County, the RSM funding allowed the Norfolk District to investigate how the project environments have changed since implementation of performance-based budgeting, and to develop a conceptual strategy to accommodate these changes during future dredging events. • The RSM strategy developed for Mathews County provides a flexible way to address changing environmental and physical conditions as they occur.

IMPACTS OF PERFORMANCE-BASED BUDGETING ON MATHEWS COUNTY'S FEDERAL CHANNELS. The USACE civil works budget has historically provided Federal funds to dredge and maintain low-commercial-use Federal navigation projects. However, many of the low-commercial-use projects in the USACE inventory do not perform well under current budget metrics. As a result, these projects do not receive sufficient funding to sustain the maintenance dredging required to function as designed and authorized. The five projects in Mathews County, VA, are examples of low-commercial-use projects that do not fare well under the current performance-based budgeting climate. Mathews County realized that the Federal budget constraints are likely to continue into the future; however, the Federal navigation channels will need to be maintained for the watermen and commercial users, and to address other concerns of the County including waterfront properties tax base and recreational use of the channels. Because the County is concerned that future maintenance dredging is not guaranteed, the NAO team focused efforts on an Operations budgeting perspective for Mathews County, VA (Figure 3).

Mathews County has other water resource concerns because of its geographic setting in a low-lying area with a long coastline. Mathews County is increasingly susceptible to damage from storms, even during lower intensity events. In the future, as water levels increase and land continues to subside, future damages will likely worsen and begin impacting new areas. The mean sea level trend at Gloucester Point, VA (16 miles south of Mathews County), is 3.81 millimeters per year (mm/year) rise with a 95% confidence interval of +/- 0.47 mm/year rise based on monthly mean sea level data from 1950 to 2003. That is equivalent to a change of 1.25 ft rise in 100 years. This 3.81 mm/year rise compares to the global rate of 1.8 mm/year (+/-0.5 mm) rise for the same time period (Bates et al. 2008).

Some of the more severely damaged areas are the shoreline between Bavon Beach and New Point Comfort lighthouse, and the barrier island breach (Figure 2) north of Winter Harbor Channel where erosion has caused a significant loss of beach and dune habitat (Table 2). NAO completed the final feasibility report for Chesapeake Bay shoreline erosion in Mathews County, VA, in May 2007 (USACE 2007). The feasibility report was the result of a Continuing Authorities Program Section 1135 Environmental Restoration Study which concluded that there was no Federal interest. Yet, from the County's perspective, habitat loss continues with potential for even greater losses projected into the future.

The data in Table 2 pertain to habitats that were delineated visually from aerial photography within the vicinity of the shoreline to represent change. Note that Table 2 is not intended to be a complete representation of the marsh and beach habitats in Mathews County.

DATA MANAGEMENT AND ANALYSES, SENSITIVE TO STAKEHOLDER AND CUSTOMER PERSPECTIVES. Several of the Mathews County component projects are old and have been in the Federal project inventory for a long time. While large quantities of historical data and maps were available, the information was located in many difference offices and spread among several agencies. The data were standardized and consolidated into a knowledge database for use in developing a preliminary sediment budget and in formulating an RSM strategy. Table 3 summarizes the data sets and describes their use to develop the RSM strategy.

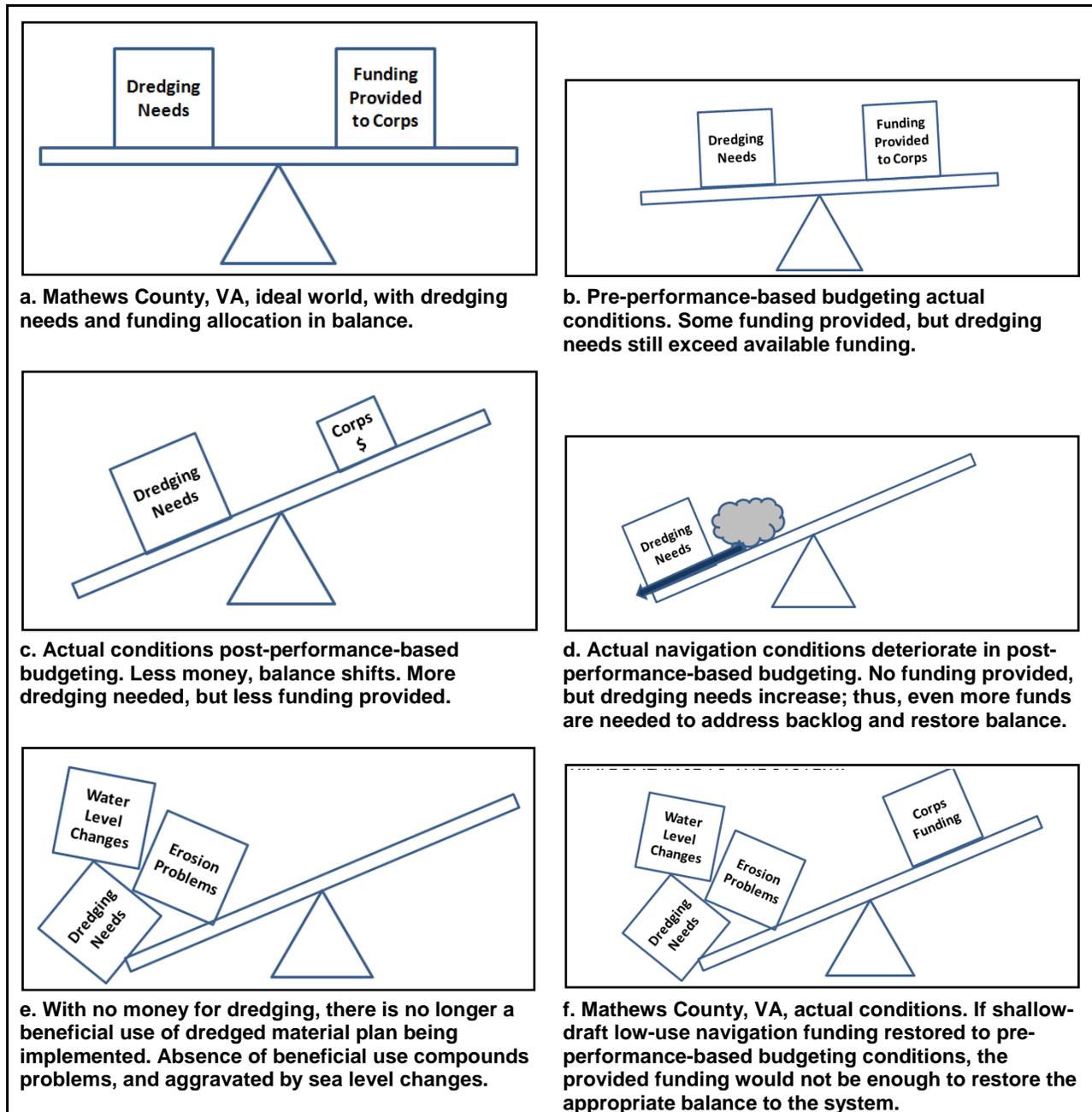


Figure 3. Operations budgeting perspective for Mathews County, VA.

Several Corps, State, and local initiatives paralleled development of the RSM strategy. Through the RSM initiative, the NAO Product Development Team (PDT) coordinated the efforts to a greater extent than typically possible during the development of individual Operations and Maintenance (O&M) projects. This approach helped the PDT to avoid or minimize conflicts with the other concurrent activities. When possible, the PDT worked to ensure that the RSM efforts were complementary, or made recommendations to modify the other initiatives so that a greater regional goal could be accomplished. Table 4 lists the concurrent work efforts and how those were treated in the RSM effort. This treatment helped the PDT fulfill the national RSM goal of improving regional project efficiencies by engaging cross-mission objectives of the Corps.

Table 2. Trends in Mathews County, VA, marsh and beach habitats along the Chesapeake Bay shoreline.

Year	Shoreline Type	Total Area (acres)	Date Range	Shoreline Type	Change in Area (acres)	Rate of Change (acres/year)
1937	Marsh	1990	1937-1953	Marsh	-50	-3
	Beach	320		Beach	-110	-7
1953	Marsh	1940	1953-1978	Marsh	-70	-3
	Beach	210		Beach	70	3
1978	Marsh	1870	1978-1994	Marsh	-10	-1
	Beach	280		Beach	-50	-3
1994	Marsh	1860	1994-2009	Marsh	-110	-7
	Beach	230		Beach	-10	-1
2009	Marsh	1750	Total Change	Marsh	-240	-3
	Beach	220	1937-2009	Beach	-100	-1

Table 3. Historical data consolidated into the knowledge database.

Data Set	How Data Set Was Used in Developing the Mathews County, VA, RSM Strategy
<ul style="list-style-type: none"> Current and historical submerged aquatic vegetation (important birding areas) 	<ul style="list-style-type: none"> To avoid resource conflicts To evaluate locations for potential resources enhancement using dredged material
<ul style="list-style-type: none"> Hydrographic survey data (shoreline, beach, and habitat changes, including Bavon Beach dune monitoring) 	<ul style="list-style-type: none"> To observe historical trends in bottom elevations To predict probable future conditions
<ul style="list-style-type: none"> Historical sediment receptor sites 	<ul style="list-style-type: none"> To document historical placement locations To document prior beneficial use successes To document preliminary dredging quantity estimates and evaluate future remaining capacity
<ul style="list-style-type: none"> Historical Federal channel alignments and hydrographic surveys 	<ul style="list-style-type: none"> To minimize dredging by seeking favorable channel alignments To evaluate whether channels have shifted over time due to large regional sediment dynamics

Table 5 lists the Corps computer models used during the Mathews RSM study, and summarizes the outcomes of the modeling efforts. Some outputs of the modeling efforts were used to develop the Preliminary Sediment Budget for Mathews County. Some pre-conceptual designs for placement of dredged material from the Federal channels were formulated by the PDT. The PDT used the modeling results to perform preliminary evaluations of the impacts of placing future dredged material in some locations recommended by the Mathews County RSM strategy.

KEY OUTCOME 1. When the scope of the Mathews County RSM effort was originally developed, two major work products were anticipated: (1) a consolidated historical database and development of an information knowledge database, and (2) development of a preliminary sediment budget. VIMS assisted in completing the two products. Figure 4 shows the historical knowledge data viewer for the features around the Queens Creek and Milford Haven projects.

Table 4. Concurrent initiatives coordinated during Mathews County, VA, RSM effort.

Initiative	Activity
American Reinvestment and Recovery Act (ARRA)	<ul style="list-style-type: none"> • Data were imported from the two Mathews County projects dredged (Winter Harbor and Queens Creek). • Queens Creek Association was engaged as a stakeholder.
Operations & Maintenance, General Appropriations	<ul style="list-style-type: none"> • Future out-year Capability Budget Packages were submitted, consistent with RSM efforts. • Future funding for dredging through Operations & Maintenance allocations were found to be unreliable for low-commercial-use projects. Performance-based budgeting constrains future maintenance. • From an Operations & Maintenance viewpoint, the PDT examined alternative ways of managing sediment from the Federal channels as a system resource. This might reduce future maintenance frequency and maintenance backlog.
US Fish and Wildlife Service (USFWS) Environmental Restoration	<ul style="list-style-type: none"> • USFWS was seeking sand sources for restoration efforts, and wanted to participate in RSM. • USFWS noted a leveraging potential with adjacent property owners.
Continuing Authorities Program Section 1135	<ul style="list-style-type: none"> • New Point Comfort Environmental Restoration Study noted a negative Federal interest. • The 1135 study also noted a negative Federal interest, but a local need for the plan that was developed in the Feasibility Report is still there. Local interest asked that RSM efforts consider the former New Point Comfort study area. • The 1135 study also noted that there was leveraging potential with other funding sources.
Mathews County Shoreline Management Strategy	<ul style="list-style-type: none"> • RSM efforts were coordinated with the VIMS shoreline management strategy initiative to help prevent conflicts. • RSM funding allowed the District PDT to work in conjunction with the VIMS staff. • RSM outcomes were congruent with the recommendations of the shoreline management strategy.

KEY OUTCOME 2. A study of the Mathews County Federal channel sediments as a system resource revealed that revisions to the Dredged Material Management Plans (DMMPs) for two O&M projects (Queens Creek and Horn Harbor) may be attractive options in the future (Figure 5).

Potential revisions to the DMMPs for these two projects may produce leveraging opportunities since better systems management of the dredged material may result in benefits to a greater number of stakeholder groups. The goal is to develop a multiple purpose effort regional in scope and to leverage several funding sources, thereby resulting in a sustainable maintenance program for the navigation channels. The contributed funds, Memoranda of Agreement (MOA), and regulatory permits could serve to reduce the Federal cost burden for maintaining the channels in the future (Figure 6).

Table 5. Data management and analyses, Mathews County, VA RSM effort.

Tools Used or Developed	Organization Responsible for Using Tool for Mathews County RSM	Application for Mathews County RSM
Geographic Information System (GIS) Data Viewer	NAO using VIMS data feed	<ul style="list-style-type: none"> • Provides visual display of shoreline changes over time. • Identifies shoreline accretion and erosion trends, and how they vary with time. • Presents the results of the preliminary sediment budget, • Identifies channel locations. • Provides Submerged Aquatic Vegetation (SAV) maps.
e-Coastal	NAO, ERDC, and the US Army Engineer District, Mobile	<ul style="list-style-type: none"> • Provides Mathews County RSM document consistent with e-Coastal national standard.
Digital Shoreline Analysis System (DSAS)	VIMS using NAO data feed	<ul style="list-style-type: none"> • Includes entire Mathews County shoreline in model. • Presents model changes in shoreline from 1937-2009. • Exports graphical output to data viewer for PDT use. • Illustrates how marsh intersects most shorelines, and shows how the mostly marsh barrier island system has been breached in several areas. • Shows that some Mathews County shorelines, like those around Gwynn's Island, are hardened.
STeady State Spectral WAVE (STWAVE)	VIMS	<ul style="list-style-type: none"> • Model may be applied to the portions of Mathews County shoreline fronting the Chesapeake Bay. • Provides graphical output.
GENERALized Model for Simulating Shoreline Change (GENESIS)	VIMS	<ul style="list-style-type: none"> • Team considered using this model during the Mathews County RSM effort, but this model was not actually used at Mathews County for the following two reasons: <ol style="list-style-type: none"> 1. The scale of the study area, and the quantities and movements of sediment, were too small in the study area. 2. Found mostly longshore movement of sediments in Mathews County, with no ebb/flood shoals.

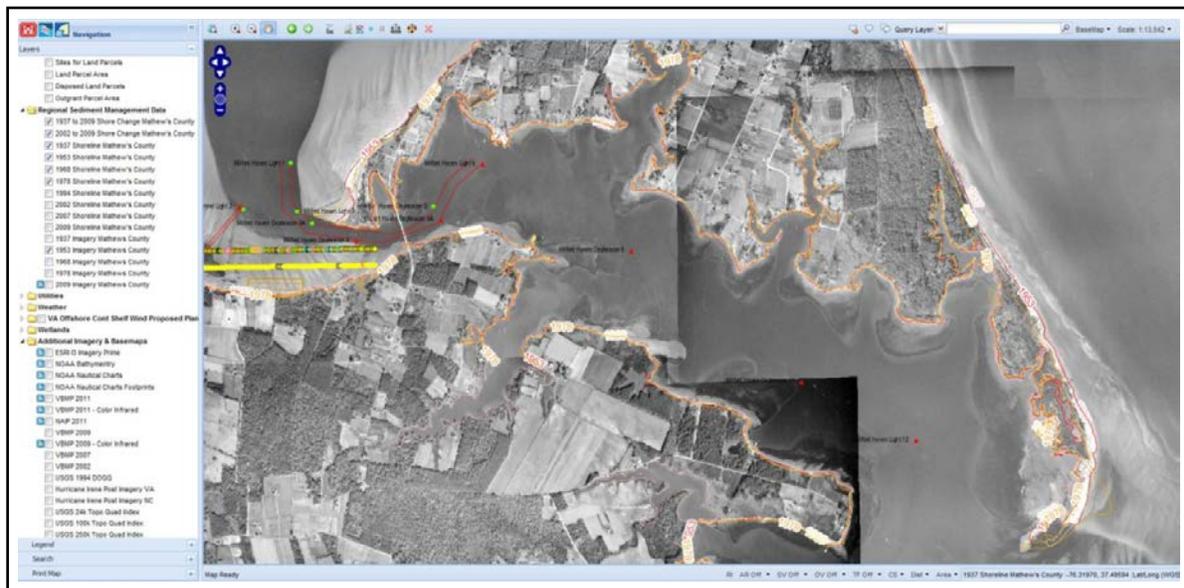


Figure 4. GIS web viewer to view and explore RSM data with other GIS data. For more information, see <http://web.vims.edu.physical/research/shoreline/RSM.html>



Figure 5. Project maps for Queens Creek and Horn Harbor Federal channels, showing historic and potential alternative placement areas as a result of RSM.



Figure 6. Potential leveraged solution concept for achieving future channel maintenance, and accomplishing RSM goals within Mathews County, VA.

KEY OUTCOME 3. Low-commercial-use pilot project funding was secured for Queens Creek and Horn Harbor as a result of Key Outcome 2. Headquarters, USACE, provided funds for NAO to prepare plans and specifications for dredging these two projects in accordance with local initiatives, and to transfer these plans and specifications to the local sponsor to execute. NAO is currently continuing with the development of these pilot project plans and specifications for dredging Queens Creek and Horn Harbor, and for placing the material in accordance with the RSM strategy.

KEY OUTCOME 4. Mathews County is a member of the Chesapeake Bay Middle Peninsula Public Access Authority (MP-PAA). The MP-PAA recognizes that shorelines are high priority natural areas, and that it is critical to set aside access sites for all types of recreational activities important to the economy and to the citizens of the Commonwealth of Virginia. The MP-PAA served as the local sponsor for a Section 22 “Planning Assistance to States Cost-Shared Study” that included developing a cost estimate for a maintenance program for the Federal channels

within the geographic bounds of the six-county authority (USACE 2011). NAO provided the technical expertise for the study that also developed conceptual designs for long-term placement of dredged material from the channels, developed conceptual ideas of how to leverage funds between projects to reduce overall program costs, identified possible funding sources and mechanisms, and informed decision-makers about risks that could cause prices to fluctuate up or down with time. NAO also provided the MP-PAA with environmental regulatory guidelines for pursuing a maintenance program for the Federal (and other) channels within the geographic area of interest. Another product of the Section 22 study was a spreadsheet for decision-makers to use for testing “what-if” scenarios for project combinations.

During the development of the MP-PAA cost estimate for the Federal channel maintenance program, a similar Section 22 cost-shared study was underway for the Northern Neck Public Access Authority. Some of these two efforts were merged to explore cross-region opportunities and efficiencies.

CONCLUSIONS. This CHETN documents the purpose, development, and outcomes of the Mathews County, VA, Regional Sediment Management (RSM) initiative. This RSM initiative explored the challenges facing the customers and users of projects in a low-commercial-use navigation inventory after an extended period with little to no channel maintenance. The problems were found to extend beyond the front-line users of the channel, since other stakeholders around these projects are also experiencing adverse impacts. Local initiatives are underway to find solutions to these challenges, as evidenced in three of four Key Outcomes of the Mathews County, VA, RSM initiative.

ADDITIONAL INFORMATION. This Coastal and Hydraulics Engineering Technical Note (CHETN) was prepared by Douglas Stamper, Donna Milligan, and Jeffrey Swallow, US Army Engineer District, Norfolk, VA (NAO), and Dr. Scott Hardaway, Virginia Institute of Marine Sciences, College of William and Mary, as part of the Virginia RSM studies funded by the USACE RSM Program. Additional information pertaining to the RSM Program can be found at:

<http://rsm.usace.army.mil>

<http://web.vims.edu/physical/research/shoreline/RSM.html>

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<http://chl.erd.c.usace.army.mil/library/publications/chetn/pdf/chetn-xiv-34.pdf>

REFERENCES.

- Bates, B. C., Z. W. Kundzewicz, S. Wu, and J. P. Palutikof. 2008. *Climate Change and Water*. Geneva, Switzerland: Secretariat, Intergovernmental Panel on Climate Change.
- Hardaway, C. S., Jr., D. A. Milligan, C. H. Hobbs, C. A. Wilcox, K. P. O'Brien, and L. Varnell. 2010. *Mathews County shoreline management plan: Special report in applied marine science and ocean engineering*. No. 417. Gloucester Point, VA: Virginia Institute of Marine Science, College of William & Mary.
<http://web.vims.edu/physical/research/shoreline/Publications-ShoreMgt.htm>
- Milligan, D. A., C. S. Hardaway, Jr., C. A. Wilcox, and M. C. Cox. 2012. *Regional Sediment Management Plan: Mathews County, VA, Special Report in Applied Marine Science and Ocean Engineering*, No. 434. Gloucester Point, VA: Virginia Institute of Marine Science, College of William and Mary.
- Rosati, J. D., B. D. Carlson, J. E. Davis, and T. D. Smith. 2001 (rev. 2004). *The Corps of Engineers National Regional Sediment Management Demonstration Program*. Coastal and Hydraulics Engineering Technical Note ERDC/CHL CHETN-XIV-1. Vicksburg, MS: US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC-CHL).
<http://chl.erd.c.usace.army.mil/library/publications/chetn/pdf/chetn-xiv-1.pdf>
- USACE. 2007. *Chesapeake Bay shoreline erosion, Mathews County, Virginia, New Point Comfort Area ecosystem restoration study*. Final Feasibility Report. Norfolk, VA: US Army Engineer District, Norfolk.
- _____. 2011. *Water resources planning assistance to states; Shallow draft navigation and sediment management plan for the Middle Peninsula Chesapeake Bay Public Access Authority*. Section 22 Report. Norfolk, VA: US Army Engineer District, Norfolk.

ACRONYMS AND ABBREVIATIONS.

Term	Definition
ARRA	American Recovery and Reinvestment Act
CHETN	Coastal and Hydraulics Engineering Technical Note
CHL	Coastal and Hydraulics Laboratory
DSAS	Digital Shoreline Analysis System
ERDC	Engineer Research and Development Center
GENESIS	GENeralized Model for Simulating Shoreline Change (GENESIS)
GIS	Geographic Information System
MOA	Memorandum of Agreement
MP-PAA	Chesapeake Bay Middle Peninsula Public Access Authority
NAO	US Army Engineer District, Norfolk
O&M	Operations and Maintenance
PDT	Product Development Team
RSM	Regional Sediment Management
SAV	Submerged Aquatic Vegetation
STWAVE	STeady WAVE [numerical model]
US	United States
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service
VIMS	Virginia Institute of Marine Science

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