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Post-Project Monitoring of a Navigation Solution in a Dynamic Coastal Environment, Smith Island, Maryland

Year One of Post-Project Monitoring

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Matt T. Balazik, Luis E. Santiago, Daniel O. Mensah,
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Abstract

In 2018, jetties and a sill were constructed by the US Army Corps of Engineers (USACE) adjacent to the Sheep Pen Gut Federal Channel at Rhodes Point, Smith Island, Maryland. These navigation improvements were constructed under Section 107 of the Continuing Authorities Program. Material dredged for construction of the navigation structures and realignment of the channel were used to restore degraded marsh. Following construction and dredging, 1 year of post-project monitoring was performed to evaluate the performance of navigation improvements with respect to the prevention of shoaling within the Sheep Pen Gut channel, shoreline changes, and impacts to submerged aquatic vegetation (SAV). Given the short period of record after the completion of the navigation improvements, it was difficult to draw conclusions regarding stability of the channel, structures, and shoreline. Therefore, this report documents methodology and baseline conditions for monitoring, except for SAV, which was found to be potentially impacted by construction.

A second year of monitoring was funded by the USACE Regional Sediment Management Program for fiscal year 2020. Findings can be used to inform plan formulation and design for USACE navigation projects by illuminating considerations for placement of structures to prevent shoaling and by informing SAV management decisions.

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Contents

Abstract	ii
Figures and Tables	iv
Preface	v
1 Introduction	1
Background.....	1
Objectives.....	3
Approach	4
2 Data Collection and Monitoring	5
Bathymetric and topographic data	5
Sediment sampling.....	7
Structural surveys.....	10
Submerged aquatic vegetation (SAV) monitoring.....	11
3 Observations	16
Channel stability	16
Shoreline change.....	18
Sediment transport	20
SAV.....	21
4 Conclusions and Recommendations	26
Conclusions.....	26
Recommendations	26
References	28
Unit Conversion Factors	29
Acronyms and Abbreviations	30
Report Documentation Page	

Figures and Tables

Figures

Figure 1. Location of Rhodes Point Navigation Project (preconstruction channel is shown).....	2
Figure 2. Aerial view of the completed jetties and sill at the Rhodes Point Navigation Project in June 2018, prior to dredging of the channel (photo credit: Coastal Design & Construction, Inc).....	3
Figure 3. February 2019 grab sample locations.....	9
Figure 4. June 2019 grab sample locations.....	10
Figure 5. Crew setting up transects for future analysis of structural stability.....	11
Figure 6. Top: SAV sampling quadrat. Bottom: Example of quadrat with 15 squares having vegetation present, resulting in 60% coverage.....	13
Figure 7. SAV monitoring locations: North Area (black rectangles), South Area (red rectangle), MDDNR survey area (blue rectangle), and reference area (green rectangle).....	14
Figure 8. Changes in channel elevation for pre-dredge conditions (comparison of November 2017 to June 2018) and post-dredge conditions (comparison of February 2019 to July 2019).....	17
Figure 9. Shoreline changes from 1849 to present.....	19
Figure 10. Shoreline elevation differences between 2015 and 2019.....	20
Figure 11. Locations of Areas X, Y, and Z described in the text.....	21
Figure 12. SAV survey results within the South Area in June 2019. The yellow-shaded polygon is the 2016 SAV coverage; the grey-shaded polygon is the 2017 coverage, and the blue-shaded polygon is the where SAV occurred in both 2016 and 2017.....	24
Figure 13. SAV survey results within the reference area. The yellow-shaded polygon is the 2016 SAV coverage, the grey-shaded polygon is the 2017 coverage, and the blue-shaded polygon is where SAV occurred in both 2016 and 2017.....	25

Tables

Table 1. Dates and sources of bathymetric survey data used for comparisons.....	6
Table 2. Maps generated to compare bathymetric conditions of the channel and adjacent areas.....	7
Table 3. Sediment volume in the Sheep Pen Gut channel above 1.8 m.....	18

Preface

This study was conducted for the US Army Corps of Engineers (USACE), Regional Sediment Management (RSM) Program, and the USACE Baltimore District (NAB), under Project No. 48419, “RSM NAB Smith Island.” The USACE National RSM program manager at the time of publication of this report was Dr. Katherine Brutsché.

The work was performed by the Planning, Engineering, and Operations Divisions of the USACE NAB and the US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC-CHL) and Environmental Lab (ERDC-EL) Wetlands and Coastal Ecology Branch. Ms. Patricia M. Tolley was Chief, Wetlands and Coastal Ecology Branch, and Mr. Mark Farr was Chief, Environmental Laboratory Division. At the time of publication of this report, COL John T. Litz was the NAB Engineer. The Deputy Director of ERDC-CHL was Mr. Jeffrey R. Eckstein, and the Director was Dr. Ty V. Wamsley.

The Commander of ERDC was COL Teresa A. Schlosser, and the Director was Dr. David W. Pittman.

1 Introduction

Background

Smith Island is a historically significant group of small islands in the Chesapeake Bay, primarily in Maryland. Located in Somerset County, Maryland, Smith Island is home to three small villages, Rhodes Point, Tylerton, and Ewell. Many of the residents of the island rely on the use of the Sheep Pen Gut federal navigation channel for their livelihoods related to fishing or tourism, due to easy access to the Bay. Sheep Pen Gut is a natural waterway, modified by decades of dredging. Prior to construction of the navigation improvements at the channel near Rhodes Point, the channel in-filled at rates of up to 1 m/yr* due to the energy of the open Bay and substantial littoral drift along the shoreline of the island. In addition, given exposure to the Bay, erosion of the shoreline was occurring at a rate of up to 2.5 m/yr. In 2017, Somerset County constructed segmented breakwaters along the Bay shoreline to reduce erosion.

In June 2018, the US Army Corps of Engineers (USACE) in cooperation with the Maryland Department of Natural Resources (MDDNR), Somerset County, and the Maryland Department of Housing and Community Development completed construction of navigation improvements adjacent to the Sheep Pen Gut Federal channel at Rhodes Point (Figure 1). This project was completed under Section 107 of the Continuing Authorities Program. The navigation improvements included the construction of two jetties adjacent to the Sheep Pen Gut channel to prevent shoaling within the channel and a segmented stone breakwater/sill constructed along the shoreline south of the jetties (Figure 2). The sill was constructed to protect the shoreline and provide containment for sediment excavated during construction of the structures and dredged from the Sheep Pen Gut channel.

* 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>.

Dredging of the Sheep Pen Gut channel occurred in November 2018. The dredged and excavated material was placed to beneficially restore previously existing wetlands behind the newly constructed stone sill. Project structures were placed to avoid impacts to existing submerged aquatic vegetation (SAV) as SAV is a vital living resource in the Chesapeake Bay. Marsh vegetation was planted at the placement site in June 2019, with planting of the higher elevation hummock area scheduled for fall 2019.

Figure 1. Location of Rhodes Point Navigation Project (preconstruction channel is shown).

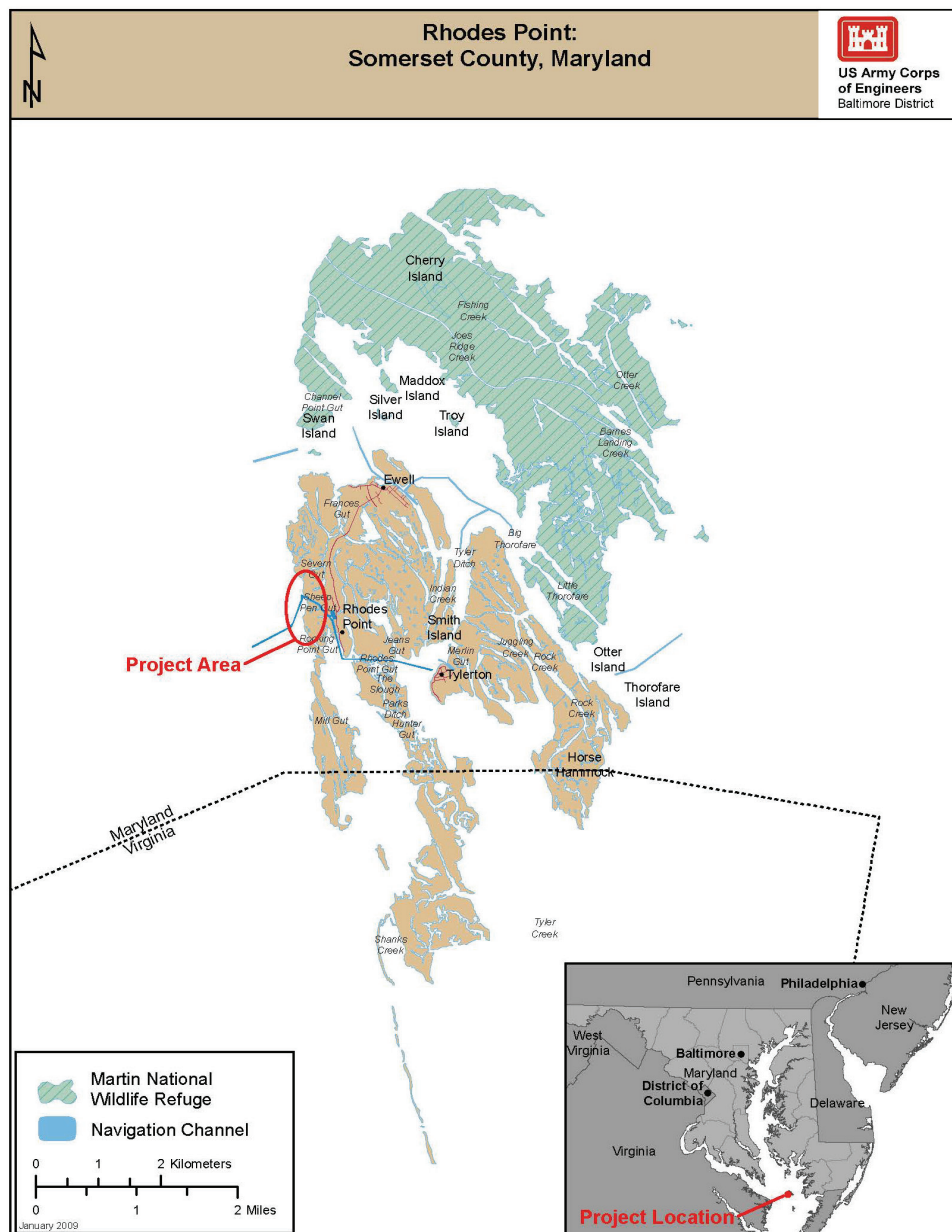


Figure 2. Aerial view of the completed jetties and sill at the Rhodes Point Navigation Project in June 2018, prior to dredging of the channel (photo credit: Coastal Design & Construction, Inc).



Objectives

This technical report provides the results of 1 year of post-project monitoring of these recently constructed navigation structures. The primary purpose of this monitoring was to evaluate the performance of the navigation improvements, including jetties and a segmented sill, with respect to the prevention of shoaling within the Sheep Pen Gut federal navigation channel, shoreline changes, and impacts to SAV. Shoreline response to coastal structures, including scour and deposition, will be evaluated to improve design criteria and methodology for the placement of navigation structures in dynamic coastal environments. Findings from the monitoring will inform future plan formulation and design for USACE navigation projects by illuminating potential considerations for placement of structures to prevent shoaling, as well as by informing SAV management decisions and the consideration of indirect impacts of projects on SAV.

Approach

The following data were collected in support of this project. Methodology and observations are described in Section 2.

- Bathymetric surveys
- Topographic and shoreline surveys
- Structural surveys
- Sediment grain size analyses
- SAV occurrence data

2 Data Collection and Monitoring

Bathymetric and topographic data

Bathymetric survey data were collected for two sampling events in February and July 2019. In addition, pre-construction survey data were compiled, which included data collected since 1996. The survey data were evaluated to discern whether the structures are acting as intended to reduce sedimentation within the Sheep Pen Gut channel and also to determine if the jetties or sill are inducing sedimentation or scouring within the channel or adjacent to the structures. The extent of the surveyed area is consistent with the surveyed and modeled area for the Rhodes Point Section 107 Navigation Project. Topographic data were collected in February and July 2019 along the shoreline. These data were compared to pre-construction survey data to evaluate changes to the shoreline.

Topographic survey data were processed into geographic information systems (GIS) format to assist in the evaluation of bathymetric and topographic data. Points were converted using the Display XY tool and exported to an ArcGIS shapefile as a point dataset. The source datum for the survey data is Maryland State Plane, NAD 1983 (US feet), for the horizontal units and the North American Vertical Datum of 1988 (feet) for the vertical datum. The survey data were converted into a triangulated irregular network (TIN) dataset using the Create TIN tool in ArcGIS Pro. Standard settings are used (No Constrained Delaunay). To avoid interpolation in areas with no data, an outer boundary is created by using the TIN Edge tool to create a shapefile of the structure of the triangles. Lines interpolated between data points were determined by identifying the maximum distance between points using the Near tool. Lines in triangles exceeding 30 m were deleted from the TIN Edge resulting in an area approximately representative of the survey data. A polygon with a 1.5 m buffer was created around the network to constrain the TIN.

The Edit TIN tool is used to create the outer boundary of the TIN surface using the polygon shapefile as an outer boundary and using the “Hard Line” type. This limits interpolation outside of the polygon area. TIN surfaces were converted into raster using the TIN to Raster tool to allow for the use of mathematical functions in the Raster Calculator when appropriate. The March 2018 survey data and the April–June 2015 topographic survey data were both converted using this tool.

Some topographic survey elevations were collected in the vertical datum NAVD 88, whereas all project data is in Mean Lower Low Water (MLLW) referencing the tidal epoch 1983–2001 at Ewell, Maryland, which is also the project construction datum. These data were converted by using the Raster Calculator to adjust elevations to MLLW. The following function is applied in the Raster Calculator, using the datum diagram on the Rhodes Point Section 107 Navigation Project as-builts below:

$$\text{NAVD88} + 1.04' = \text{MLLW}.$$

The March 2019 survey was compared against baseline conditions in the topographic survey completed in April–June 2015 using the Raster Calculator. Topographic elevation differences between the surfaces were calculated, and maps were generated showing the elevation differences between the raster layers (e.g., Figure 10).

Bathymetric surveys were collected by USACE, the MDDNR, and by the subcontractor Waterways Surveys & Engineering Ltd. on behalf of Coastal Design & Construction, Inc. (Table 1). The available bathymetric survey data are summarized below.

Table 1. Dates and sources of bathymetric survey data used for comparisons.

Date	Source	Project Phase	Description
19 May 2015 & 11 June 2015	USACE	Planning Phase (baseline conditions)	Full bay and channel
02 November 2017	Maryland DNR	Pre-Construction Survey	Partial bay and channel
07 June 2018	Maryland DNR	Post-Construction of Jetties	Channel only
25 September 2018	Waterway Surveys & Engineering Ltd.	Pre-Dredge Survey	Partial bay and channel
14 November 2018	Waterway Surveys & Engineering Ltd.	Post-Dredge Survey	Partial bay and channel
26 February 2019	USACE	Monitoring (+3 months)	Full bay and channel
10 July 2019	USACE	Monitoring (+7 months)	Full bay and channel

Bathymetric survey data were available as multipoints in XYZ, txt, and drawings files and were imported into ArcGIS Pro. The datasets were then processed into TIN surfaces following the procedures detailed for the topographic survey data. Bathymetric surveys were compared in TIN

format using the Surface Difference tool in ArcGIS Pro. Table 2 shows the comparisons that were completed using the existing bathymetric surveys to assess the change in depth in the surveyed channel and near-shore areas adjacent to the completed project. Two outputs are specified in this tool: a vector shapefile that illustrates areas above, below, and the same as the previous elevation (i.e., the difference between the input and the reference surface) and an elevation difference TIN. The vector shapefile also includes volumetric differences between the two bathymetric surveys for areas where both surveys intersect. Maps were generated showing the elevation differences between the bathymetric surveys and the vector surface difference layer for a simplified display (see Figure 8 for an example of these comparisons).

Table 2. Maps generated to compare bathymetric conditions of the channel and adjacent areas.

Input Surface	Reference Surface	Description of Comparison
June 2018	November 2017	Post-construction of jetties to pre-construction of jetties
September 2018	May-June 2015	Pre-dredge conditions to baseline conditions
July 2019	May-June 2015	Monitoring survey to baseline conditions
July 2019	June 2018	Monitoring survey to post-construction of jetties
July 2019	September 2018	Monitoring survey to pre-dredge conditions
July 2019	February 2019	Monitoring surveys (7 months to 3 months post-dredging)

Sediment sampling

Sediment samples were collected prior to this study for the design of the Rhodes Point Section 107 Navigation Project. These pre-construction data were considered for this evaluation and included data from samples collected in October 2001, August 2008, and June 2015, before the navigation improvements were constructed. Data collected as a part of this monitoring program are referred to as post-construction samples and were collected in February 2019 and June 2019. Sample locations and soil characteristics for pre and post-construction samples are stored in a project database and are available upon request.

Pre-construction data. A field investigation was conducted in October 2001. Drill holes were accomplished by the Standard Penetration Test procedure. Eight borings were completed, and all the borings were completed to a depth of 8 m below Bay bottom. However, only the surficial sediment type was analyzed for the 2019 RSM study and are included in this technical report.

August 2008 data: Drill holes were accomplished by the Standard Penetration Test procedure. Fourteen borings were completed, and the depths of the borings varied from 1.8 m to 7.6 m below Bay bottom. However, only the surface soil type was analyzed for the RSM study and included in this technical note.

June 2015 data: Sixteen grab samples were collected in June 2015. The samples were visually examined and were analyzed using mechanical sieve tests for each sample. Material was classified using ASTM D 2487.

Post-construction data. In February 2019, 29 grab samples were collected. All 29 samples were visually inspected, and 25 samples were analyzed using mechanical sieve tests. Material was classified by ASTM D 2487. Figure 3 shows sample locations for February 2019.

In June 2019, 40 grab samples were collected. All samples were visually inspected, and 25 samples were analyzed using mechanical sieve tests for each sample. Material was classified by ASTM D 2487. Figure 4 shows sample locations or June 2019.

Figure 3. February 2019 grab sample locations.

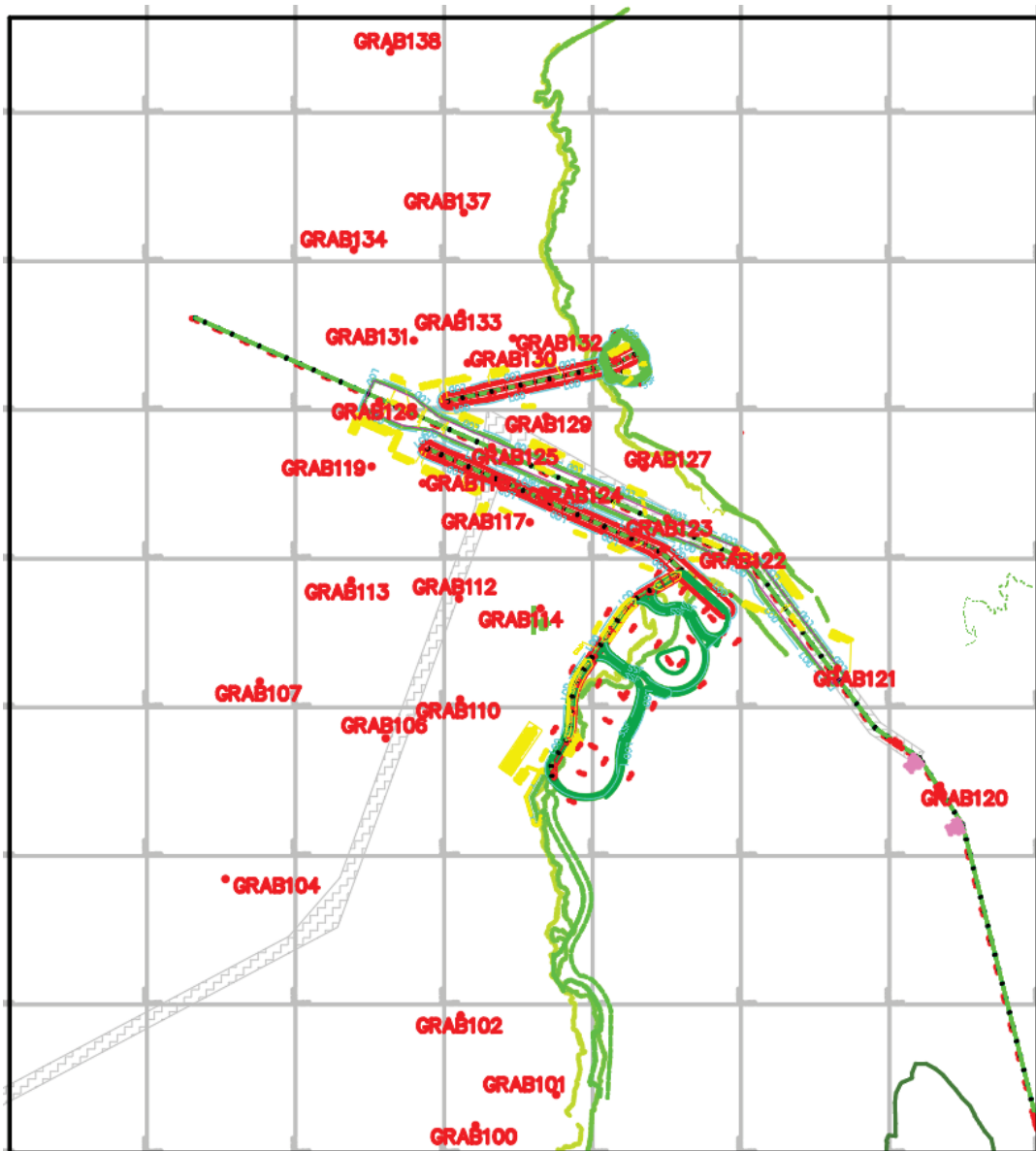
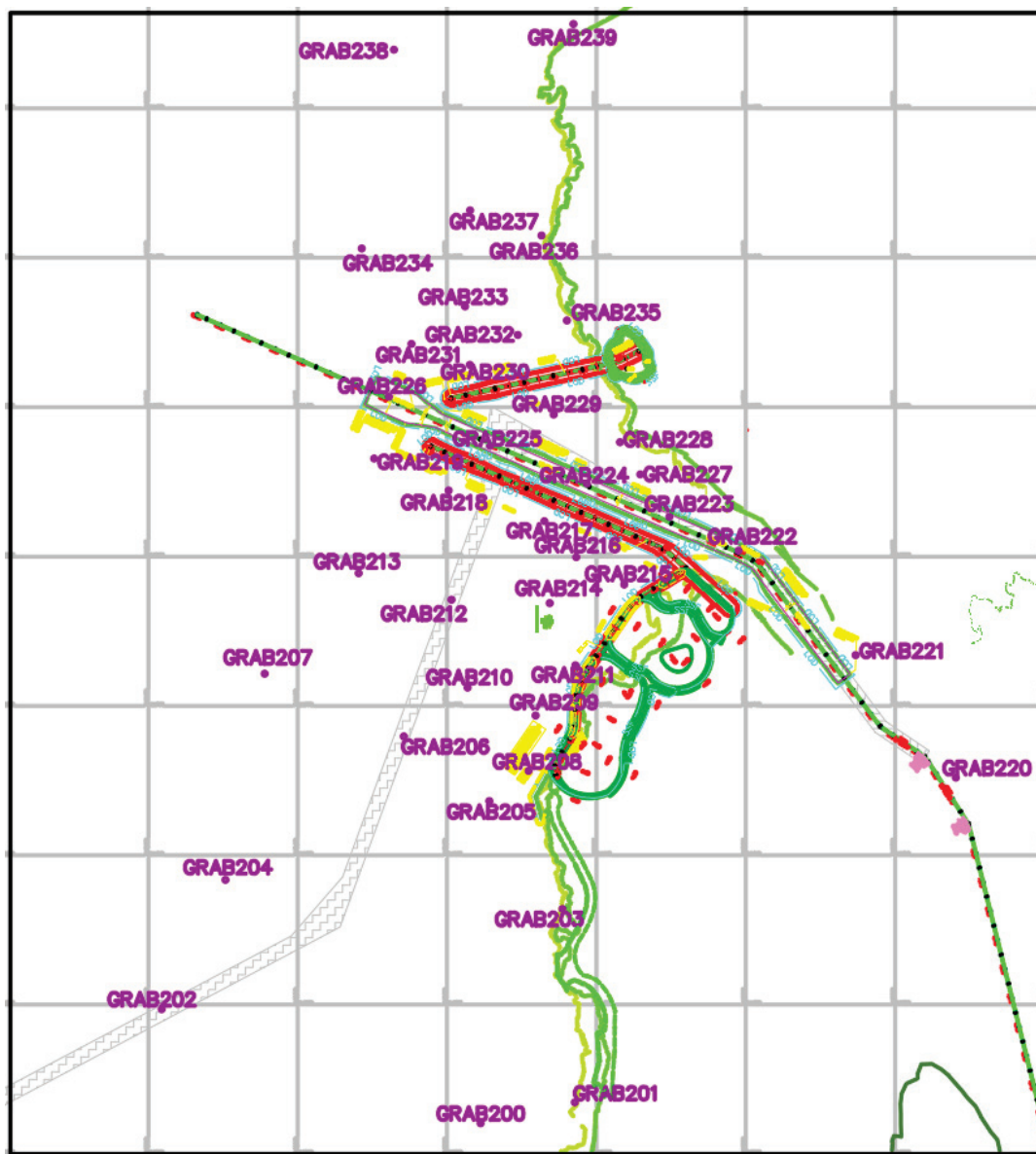


Figure 4. June 2019 grab sample locations.



Structural surveys

Two civil surveys of the jetty and sill structures were originally planned for February and July 2019 to assess the stability of the navigation project structures. However, due to extreme weather conditions and safety concerns in the winter of 2019, it was not possible to access the structures in early 2019. In June 2019, a three-man team set up transects measuring at stations every 61 m along the centerline of the north and south jetty and along a portion of the sill (Figure 5). Points were not taken on a portion of the sill because those segments were unreachable due to the tide, and other parts were submerged.

Points were taken near the waterline, at approximately mid slope, at the top of slope, on the left and right sides, and on the jetty centerline. Large sturdy rocks were selected for the point locations, and most points (except those that were near or in the water or had algae on top of them) were spray marked. Photos of each marked point was taken. For each point, the following were recorded: station, point location along the transect, point elevations, photo number, and the approximate latitude and longitude of the photos.

Figure 5. Crew setting up transects for future analysis of structural stability.



Submerged aquatic vegetation (SAV) monitoring

SAV habitat occurrence in the Chesapeake Bay is largely governed by the amount of light that reaches the plants. This is related to water depth and clarity, with occurrence also influenced by bottom sediment character (sand versus mud or peat). SAV is monitored annually by the Virginia Institute of Marine Science (VIMS) in the Chesapeake Bay, which constitutes perhaps the best long-term annual record of SAV monitoring in the world. VIMS mapping is based on aerial surveys supplemented by ground-truthing. In addition to this record, MDDNR independently sampled the project area in 2015. SAV beds in the Rhodes Point area contain two species: *Ruppia maritima* and *Zostera marina*.

The placement of the structures at Rhodes Point navigation improvement project avoided direct SAV habitat impacts by positioning the jetties and channel improvements out of mapped SAV areas. Because it was believed that the jetties and channel could alter patterns of bottom sedimentation and erosion, and consequently water depths, monitoring of changes to SAV occurrence was desirable. Changes in water depths could also be affected by escape of placed dredged material and/or reduced erosion through placement of the sill. Barge impacts to the bottom during construction could also impact SAV.

SAV monitoring was conducted in June 2019 to understand whether the channel alignment had any impacts on *Ruppia maritima* and *Zostera marina* coverage in the project area. Some potential natural factors and anthropogenic stressors that could impact SAV within the project area include precipitation and nutrient input, predation and biological disturbance (e.g., due to cownose rays or mute swans), physical disturbance or displacement due to barge bottom impacts or outwelling of placed material, and alteration of sedimentation, erosion, and turbidity patterns due to project implementation.

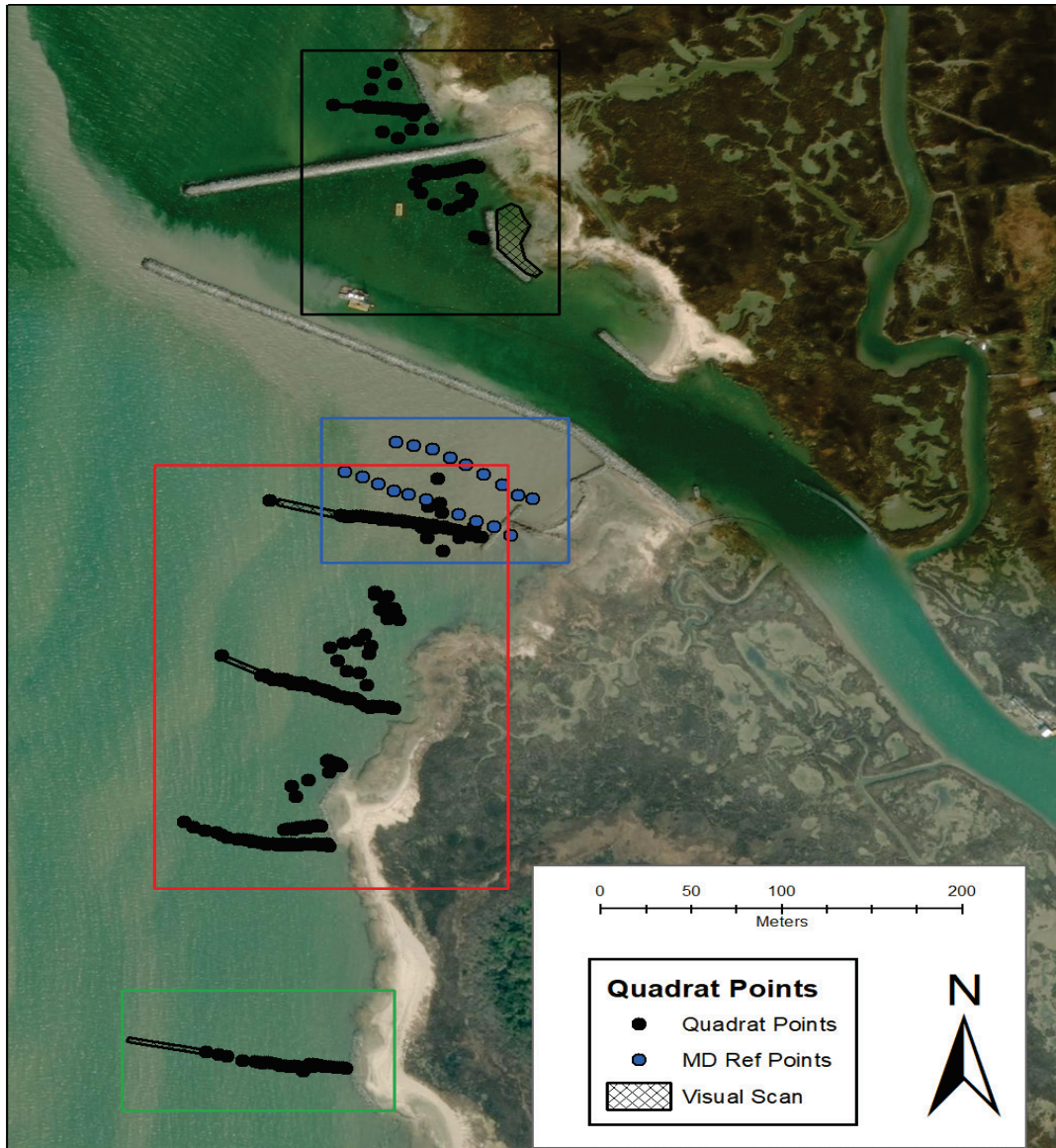
Sampling was conducted during the growing season of both SAV species on June 24–25, 2019. SAV abundance was measured using a 0.5 m² quadrat divided into twenty-five 10 × 10 cm squares (Figure 6). A grid cell was considered covered when at least one SAV shoot was located within the grid cell. Species coverage for each species and total coverage within a quadrat were determined by the number of cells each species occupied within the quadrat. Quadrat samples were taken at odd intervals of quadrat flips from the starting point. A global positioning system coordinate was taken for each quadrat sample. In areas of completely uniform coverage along transects, quick visual scans were conducted to save time.

Figure 6. Top: SAV sampling quadrat. Bottom: Example of quadrat with 15 squares having vegetation present, resulting in 60% coverage.



Five stratified randomly selected transects perpendicular from shore were measured for SAV coverage within the project footprint: one north of the northern rock jetty, one south of the northern rock jetty, and three south of the southern rock jetty (Figure 7). The project footprint is considered to encompass the area where material was dredged, construction was carried out, and dredged material was placed for beneficial use. A transect 500 m south of the south jetty and outside of the project footprint was sampled as a reference location as it was assumed that it will be minimally impacted by the project. Each transect started at the shore edge and continued perpendicular from shore until water depth reached 1.5 m. SAV rarely grows at depths >1.1 m mean low water in this area of the Chesapeake Bay, so sampling to a depth of 1.5 m should account for all SAV in the area.

Figure 7. SAV monitoring locations: North Area (black rectangles), South Area (red rectangle), MDDNR survey area (blue rectangle), and reference area (green rectangle).



During the period of time in which surveys were conducted, daily tidal range did not exceed 0.37 m, and tidal ranges during sampling did not exceed 0.34 m referenced to MLLW. In addition to transect surveys, 50 randomly selected points were sampled where SAV has occurred in the past based on previous aerial surveys conducted by the VIMS SAV survey. These random points help account for sparse SAV coverage and provide a better estimate of coverage throughout the entire study area. Points sampled by MDDNR taken in August 2015, prior to project construction,

were resampled. These provide a previously sampled point within the area of likely project effects.

In addition to field sampling in the project vicinity, VIMS SAV mapping are used as an additional means to characterize the Rhodes Point beds, as well as to evaluate SAV performance regionally. The years 2017 and 2018 were particularly wet years for the region. Fresh water inflow and nutrient loading may have driven heightened algal growth that could contribute to or even overshadow local factors. VIMS SAV mapping for 2019 was not available at the time this report was prepared.

3 Observations

To evaluate change in conditions of the study area, the data must be put into the context of pre- and post-construction of the navigation improvements. The following timeline is provided for project construction:

- Construction of the jetties and sill: January to June 2018
- Dredging of the Sheep Pen Gut Navigation Channel (to 6 ft depth): November 2018
- Planting of the placement site low and high marsh elevations: June 2019
- Planting of the placement site hammock elevations: September 2019 (incomplete at time of study).

Channel stability

The following comparisons were completed using the existing bathymetric surveys to assess the change in depth in the channel and the surveyed near-shore areas adjacent to the completed project. Based on the timing of the surveys relative to construction, dredging, and post-project monitoring, the November 2017 to June 2018 comparison (pre-dredge) and the February 2019 to July 2019 (post-dredge) comparisons were determined to be the most useful.

Figure 8 shows comparison of the channel condition for two different time periods. The pre-dredge condition (top) is a comparison of the change in channel elevation for a time period prior to dredging (November 2017–June 2018). Although dredging had not yet occurred, the structures were completed in June 2018. For that period, most of the channel experienced a small amount of scouring, although within the interior of the channel, accretion is evident moving inland. The channel was dredged in November 2018. The bottom section of Figure 8 shows a post-dredge comparison of changes in channel condition, between February 2019 and July 2019. During this time, most of the channel is below the previous elevation, including the interior where scouring appears to have occurred. Some sediment build up appears present at the mouth of the channel. When evaluating the survey point data more closely, the change in elevation between February and July 2019 is a matter of a few inches at the most; therefore, additional time is needed to determine the post-construction change.

Using a different methodology, evaluation of sediment volume within the channel (above 1.8 m depth) from channel cross-sections, indicates a similar trend (Table 3). As observed prior to the project and also during construction, sedimentation occurred in the channel in the years leading up to construction of the project (1998–2017). A survey done by MDDNR in June 2018 following completion of construction of the jetties, indicates a significant reduction of sediment in the channel. Note that surveys performed by MDDNR do not use the same methodology as bathymetric surveys conducted by USACE. However, the reduction in sediment is also evident in the survey done by the dredging contractor (Waterways) immediately before dredging (IBD). It is possible that bottom disturbance during construction, excavation of material to build the jetties, and/or self-scouring of the channel upon completion of the structures contributed to removal of sediment within the channel. This trend appears to continue following dredging completed in November 2018. From the volumes calculated, there is a substantial reduction of sediment within the channel following the after-dredge (AD) survey performed by the contractor, up to the first monitoring event in February 2019. Since February, conditions within the channel above 1.8 m have been stable.

Figure 8. Changes in channel elevation for pre-dredge conditions (comparison of November 2017 to June 2018) and post-dredge conditions (comparison of February 2019 to July 2019).

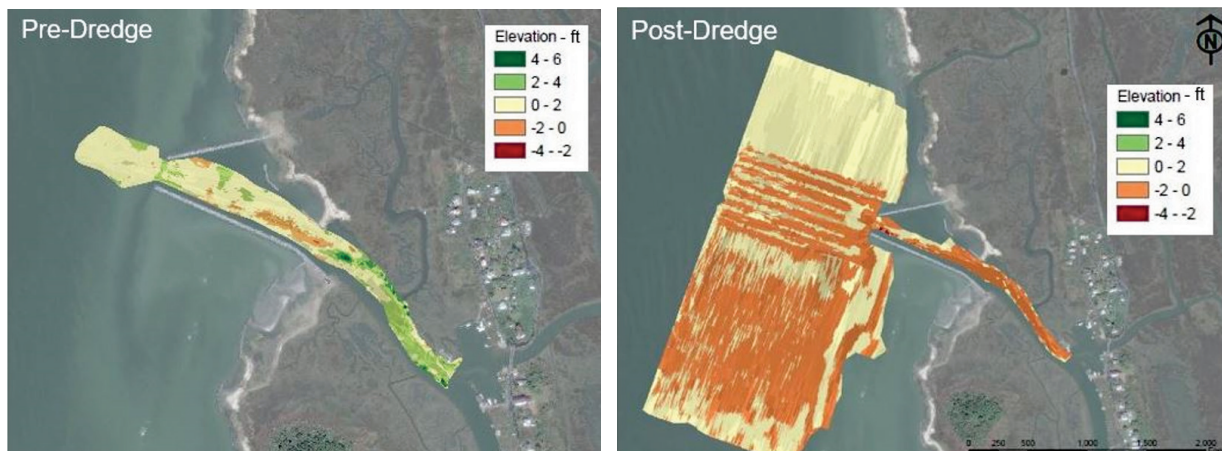


Table 3. Sediment volume in the Sheep Pen Gut channel above 1.8 m.

Agency (Survey Type)	Month	Year	Volume (yd ³)	Volume (m ³)
USACE	July	1998	5236.7	4003.7
USACE	March	2008	7829.2	5985.9
USCAE	June	2015	7564.5	5783.5
USACE (IBD*)	November	2017	8793.5	6823.1
MDDNR	June	2018	4016.4	3070.8
Waterways (IBD)	September	2018	5780.8	4419.7
Waterways (AD**)	November	2018	1926.0	1472.5
USACE (AD)	February	2019	573.0	438.1
USACE	July	2019	579.9	443.4

*IBD - Immediately before dredging

**AD - After dredge

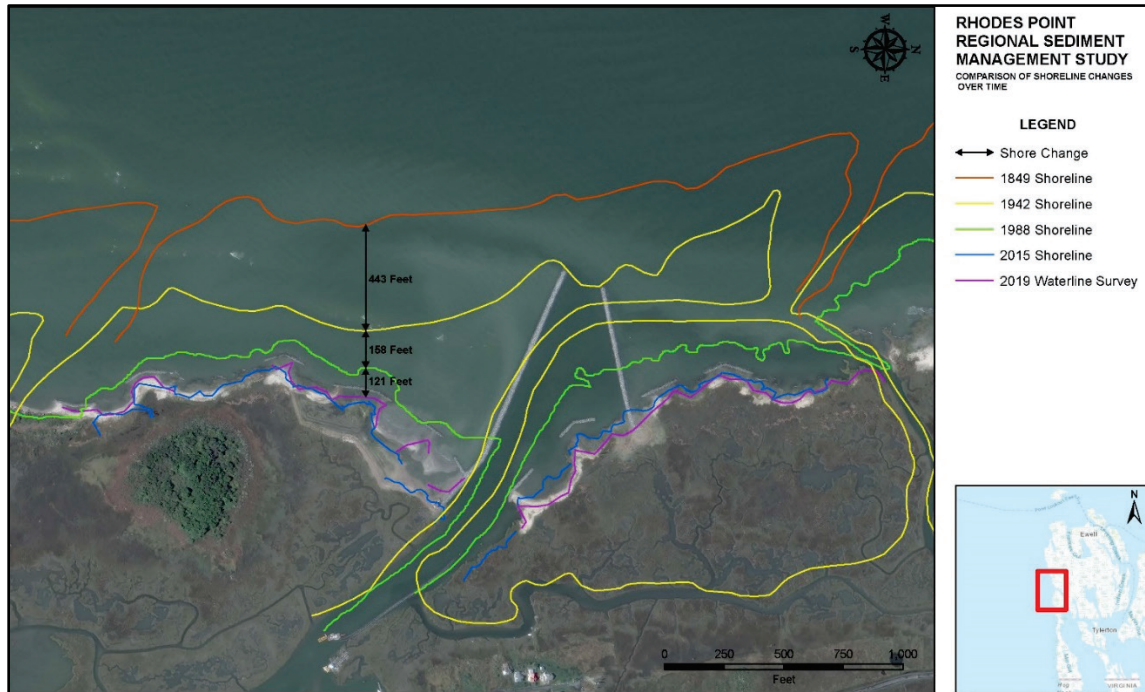
Shoreline change

Existing and historical shoreline data were used to map shoreline change over time. The historical shoreline layers were already available in the Maryland State Plane, NAD 83, coordinate system from previous analyses completed from the project and from the Maryland Geological Survey (MGS 2000). The waterline points from the 2019 survey were extracted from the GIS data using the information in the attribute table populated by the field surveyors. A polyline shapefile and a new feature were created in an EDIT environment that links the points along the shoreline. Gaps in the survey data were kept in the waterline shapefile for consistency. A map was generated from the historical shoreline and the waterline shapefiles from the 2019 and 2015 surveys. This is shown in Figure 9, along with shoreline change over time using other available data. Note that tidal variation in this area may have an influence on the waterline at the time of survey, so observed variations likely reflect changes in geomorphology plus differing water levels.

As can be seen from the evaluation (Figure 9), shoreline has significantly changed in the study area from 1849 to the present. The length of the Sheep Pen Gut channel has shortened significantly due to shoreline erosion and its location has shifted to the southeast. Prior to the emplacement of the jetties, the federal navigation channel extended out of Sheep Pen Gut at the location of the jetties, but then took a sharp turn to the southwest, to reach deeper water in the Bay. A darker area can be seen in Figure 9, extending perpendicular from the end of the south jetty, which

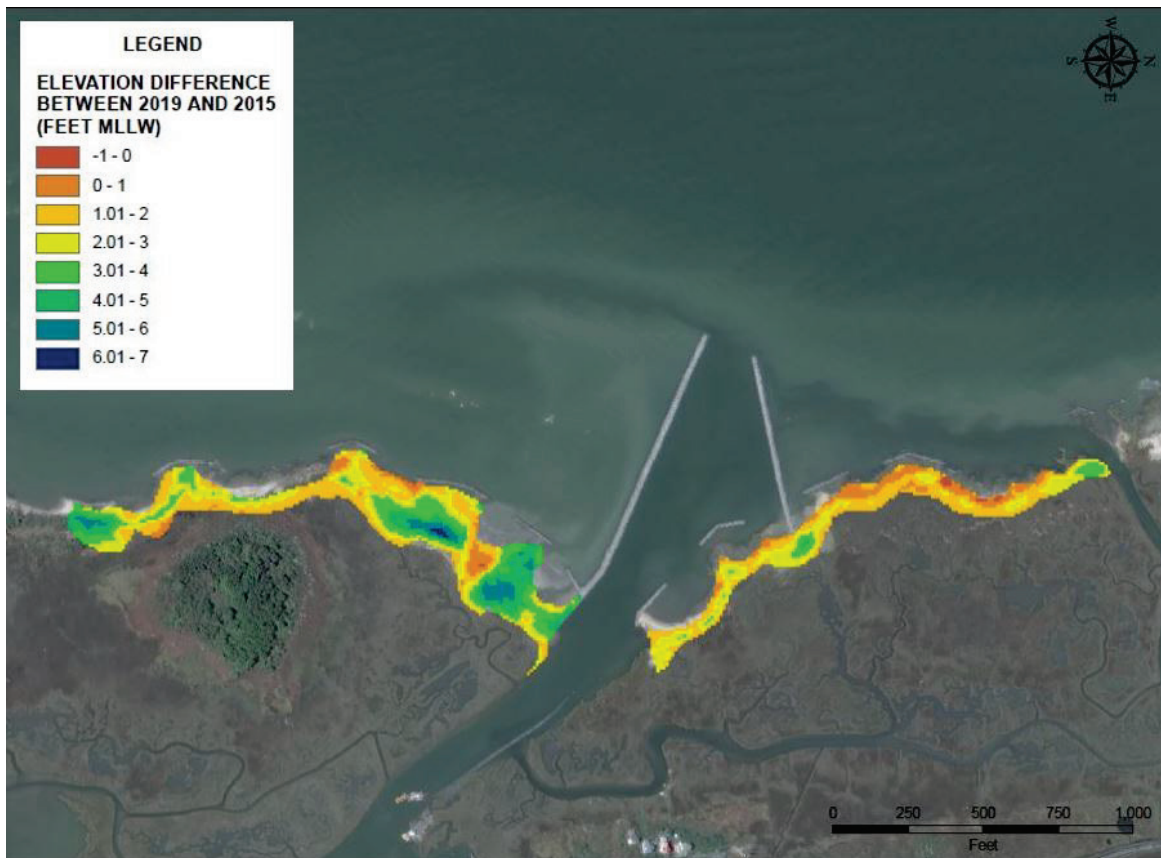
is the former federal channel. Given the shoreline changes, that turn in the channel was no longer necessary to reach deep water when the Rhodes Point Section 107 Navigation Project was constructed.

Figure 9. Shoreline changes from 1849 to present.



Topographic shoreline changes are shown in Figure 10, which compares the preconstruction shoreline (2015) to the shoreline post-dredge material placement (2019). Changes in elevation seen in the figure are largely due to the placement of dredged material behind the sill. In addition to the sill emplaced for the Rhodes Point Section 107 Navigation Project conducted by USACE, breakwaters were also constructed by Somerset County in 2017 along the shoreline to the north and south of the USACE project, with material potentially placed behind those breakwaters.

Figure 10. Shoreline elevation differences between 2015 and 2019.



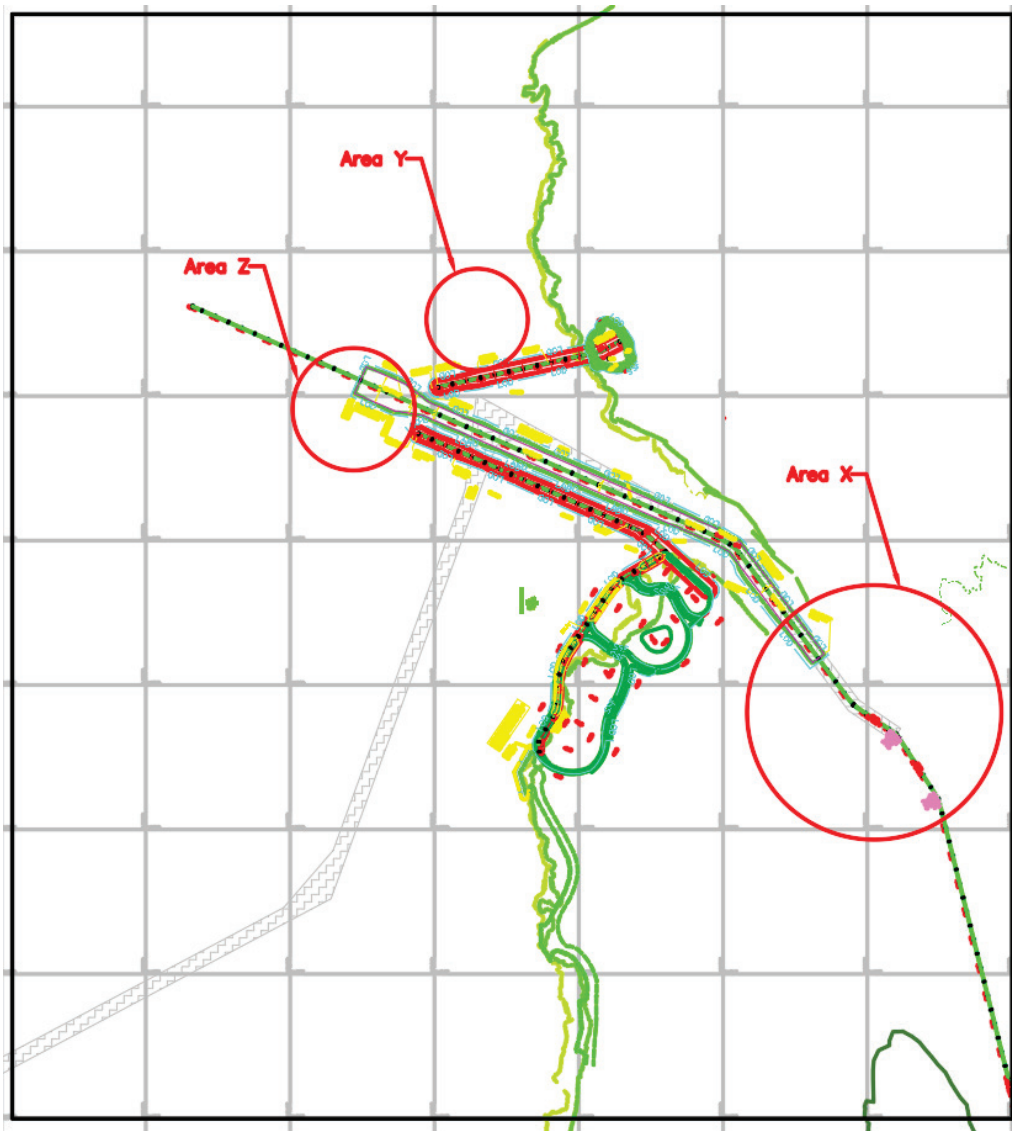
Sediment transport

The following observations were gained from the evaluation of the characteristics of the surface sediment samples pre and post-construction; however, with such a short period of record since dredging, it is difficult to draw conclusions based upon the data.

- Prior to construction, surface sediment outside of the channel was categorized as silt and clay; however, post-construction (after dredging) sediment is characterized as poorly graded sand (i.e., well-sorted) (Figure 11, Area Y and Z).
- Post-construction, material on the interior of the channel has become more silty, transitioning from poorly graded (i.e., well-sorted) sand during February 2019 to sandy silt in June 2019 (Figure 11, Area X).
- Based on the post-dredge bathymetric survey data comparison, the north side of the channel has gained material from February 2019 to July 2019 (Figure 8, post-dredge).
- Material has accumulated outside of the channel/jetty mouth from February 2019 to July 2019 (Figure 8, post-dredge).

With such a short period of record and the dynamic nature of this environment, it is difficult to draw any conclusions from grain size analyses as the observed changes in grain size could be related to material accumulation or erosion.

Figure 11. Locations of Areas X, Y, and Z described in the text.



SAV

During the 2-day field survey, 376 quadrat points were sampled along with six quick visual scans covering approximately 200 m² (Figure 7). Both *Ruppia maritima* and *Zostera marina* were observed during the survey. Based on the VIMS aerial surveys, 290 of the 332 quadrat points overlapped where SAV had been recorded in 2016, 2017, or both years in

the project footprint. Of the 290 quadrat points that had SAV in previous years, only 20 had SAV coverage during this survey.

No SAV was observed during the survey of the North Area. Maps prepared by VIMS in 2016 and 2017, showed SAV density of 10%–40%. Even though SAV had not occurred behind the sill prior to being constructed, the post-construction area had conditions where SAV could colonize. Accordingly, a visual scan was conducted behind a stone sill inside of the two jetties, but no SAV was present. Based on touch, the area south of the jetty had significant undulation with organic sediments and was different from the area north of the jetty, south of the southern jetty, and the reference transect 500 m south of the project, which had a smoother bottom and less organic material.

The 19 points previously surveyed by MDDNR were within the project impact area <70 m from the southern jetty (Figure 7). Eight of the 19 previously sampled points had SAV coverage in 2015, and the distribution overlapped almost exactly with the 2016 VIMS mapping. No SAV was found at these MDDNR points during the June 2019 survey. The only difference in sampling method was that the survey in 2015 used a 0.25 m² quadrat as opposed to a 0.5 m² quadrat (current study), meaning that the June 2019 survey covered four times the bottom area of the 2015 MD DNR survey and thus was more likely to encounter SAV if it were in the area.

A total of 239 quadrat points were sampled in the South Area (Figure 12), 214 of which were mapped as having SAV density of 40%–70% (2016) and 10%–40% (2017) by VIMS. Of these, only 21 (10%) had SAV during sampling in June 2019. All 21 points were in areas that were mapped as having SAV in both 2016 and 2017. Most of the quadrats that did have SAV coverage (18, 86%) were on the most southern transect at the very edge of the project footprint. No SAV was observed during two quick visual scans.

The reference transect consisted of 44 quadrat samples and a 45 m visual scan (Figure 13). All the points and visual scan had SAV mapped in 2016 and 2017. There was no SAV in the portion close to shore where SAV was mapped in 2016 (equivalent to 13 quadrat samples on the transect); however, 30 of 31 quadrat samples overlapping the area where SAV was mapped in both 2016 and 2017 had SAV present with 93% having complete SAV bottom coverage. Based on small leaf size, it appeared that *Ruppia maritima* was spreading in a shoreward direction to where SAV

was delineated only in 2016 and not in 2017. The entire 45 m visual scan area had complete bottom coverage by SAV. SAV continued offshore of the visual scan endpoint, but due to strong waves and incoming tide, sampling could not go out to 1.5 m deep at low water. Based on the visual survey and very dense growth, it is hypothesized that SAV coverage continued to at least to where SAV was mapped in 2016 and 2017.

Where SAV was present, both species were found in close proximity, with *Ruppia maritima* occurring a bit closer to shore. However, as the observed SAV coverage was low overall, it is difficult to make any conclusive statements about potential differences in species zonation patterns.

The survey results indicate that SAV is largely absent adjacent to the placement area (and potential area of effect) except in the most southern extent of the project footprint where it is present, but sparse. It is too early in the study to determine why the SAV beds are not present as there are many variables that could be effecting SAV within the project footprint. These variables could include precipitation and nutrient input, biological disturbance, physical disturbance or displacement, alteration of sedimentation, and erosion and turbidity patterns due to project implementation. The reduction of SAV in the project footprint may also be due to the extremely wet winter and spring in the Chesapeake Bay region.

At the time of this report preparation, regional SAV data from VIMS for 2019 was not yet available to characterize regional SAV health. However, numerous rafts of *Ruppia maritima* and *Zostera marina* were observed while traveling to the study location and both species were scattered along rack lines so SAV is growing in this region of the Bay. Erosion of the backfill area exposed to direct wave energy caused by the great fetch across the open Bay was observed. It is possible that the southern jetty is holding suspended sediments in the area, exacerbating effects of sediment lost from the placement site. Based on dense SAV beds used as a reference just outside of the project footprint and observations in the Southern Area, it would appear that erosion of the placed material and/or disturbance during construction has negatively impacted SAV within the project area. The Northern Area did not seem to be suffering from wave exposure like the Southern Area, but the bottom seemed highly disturbed, possibly due to construction. This recent disturbance may be a factor contributing to the absence of SAV in the Northern Area. Considering the dense SAV beds

within close proximity to the project footprint, there is the potential these beds will recolonize the area adjacent to the project structures.

Additional observations were made shoreward of the stone sill in the Southern Area of the project footprint. The placed dredged material had recently been planted within 3 weeks of the SAV monitoring. The areas where waves from the bay had a straight line path to the backfill was experiencing significant erosion, including erosion of recently planted *Spartina alterniflora* plugs, which were likely uprooted by waves prior to the roots being able to establish in the soil. The higher elevation *Spartina patens* appeared very healthy and stable.

Figure 12. SAV survey results within the South Area in June 2019. The yellow-shaded polygon is the 2016 SAV coverage; the grey-shaded polygon is the 2017 coverage, and the blue-shaded polygon is the where SAV occurred in both 2016 and 2017.

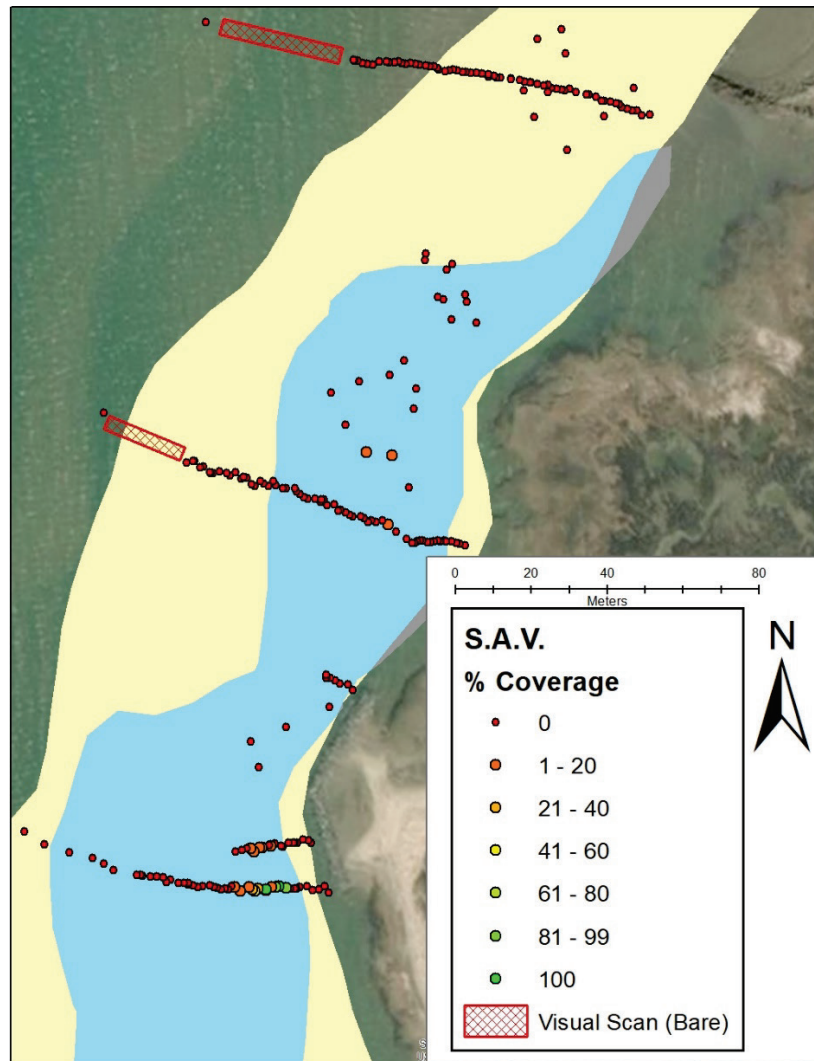
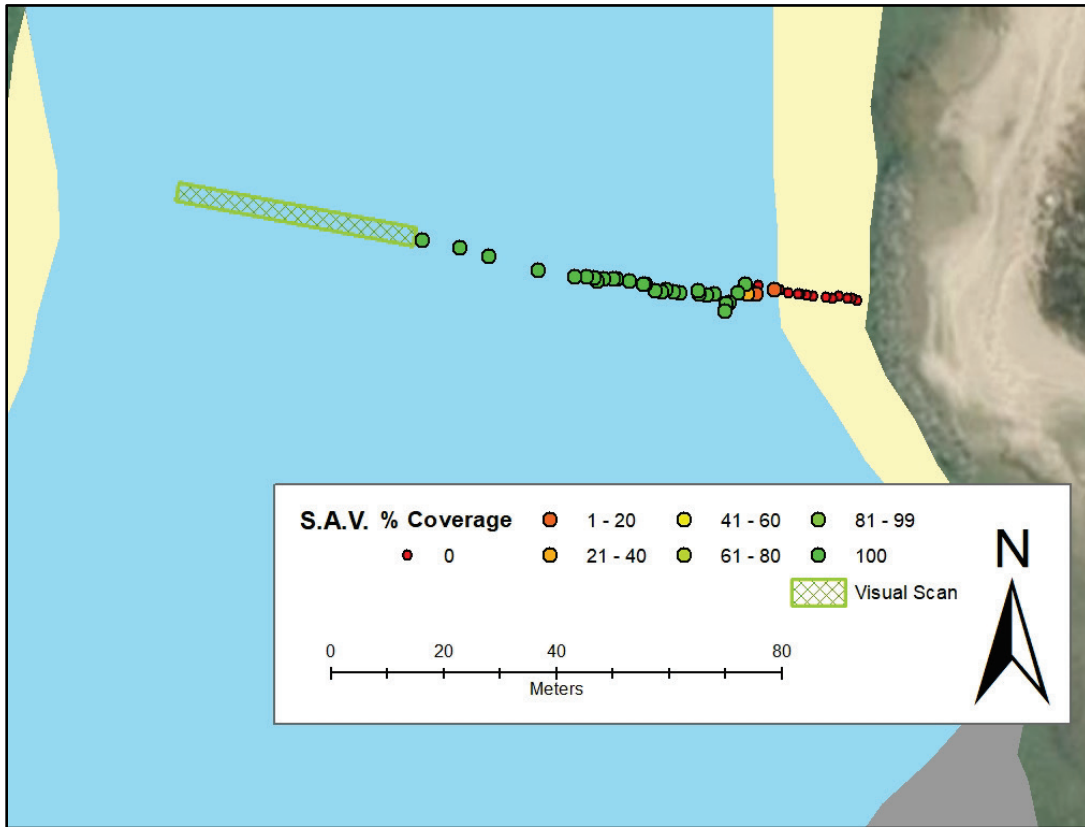


Figure 13. SAV survey results within the reference area. The yellow-shaded polygon is the 2016 SAV coverage, the grey-shaded polygon is the 2017 coverage, and the blue-shaded polygon is where SAV occurred in both 2016 and 2017.



4 Conclusions and Recommendations

Conclusions

Given the short period of record following the completion of the navigation improvements, it is difficult to draw any conclusions regarding the stability of the channel, structures, and shoreline. The structures were completed in June 2018, and the dredging was performed in November 2018; therefore, the monitoring data collected under this study represent a good baseline for base-year conditions. Planting of the placement site is still ongoing and scheduled to be completed in October 2019, which has had implications for shoreline and SAV stability.

With respect to SAV, disturbance and erosion of the placement site has had a potential impact. When originally planned, the shoreline sill was intended to be built as a continuous sill to contain the placed dredge material, with notches cut into the sill later to allow water to access the marsh. However, upon the start of construction, conditions in the Bay were unexpectedly shallow, such that the sill had to be built as a segmented breakwater due to construction feasibility. This has led to erosion of the placement site due to the strong waves through the segmented breakwaters. In retrospect, a staggered breakwater might have been able to reduce the wave energy and better contain the placed material. Note that prior to mid-June 2018, the placement site was bare (not yet planted). Therefore, it is anticipated that once the site becomes stabilized by the planted vegetation, erosion will be significantly reduced.

Recommendations

It is recommended that the monitoring activities conducted this year be extended for an additional year to better evaluate post-construction conditions. For future monitoring of the navigation structures, the transects that were established on the structures should be used to evaluate changes in jetty profile, relative movement of stones, settlement of the jetties, and overall structural stability of jetties and sill, which could provide an assessment of the impacts of wave action. Continued collection of bathymetric surveys and grain size data should occur to evaluate channel conditions with respect to shoaling. Additionally, SAV monitoring next growing season is recommended to evaluate the recovery of SAV in the project area. There are abundant SAV propagules in Bay waters, and

natural recolonization of disturbed areas that become suitable for SAV growth are anticipated. It is also suggested that water quality monitoring occur within the project footprint and the reference location to better understand differences between the two sites. Two continuous-sampling water quality sondes could be deployed to create long-term datasets describing water quality within the footprint area where SAV has been impacted and the reference area where SAV is flourishing.

References

MGS (Maryland Geological Survey). 2000. *Historical Shorelines, 1841-1976; Chesapeake Bay Region of Maryland*, Edition 1.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	1.6387064 E-05	cubic meters
cubic yards	0.7645549	cubic meters
feet	0.3048	meters
inches	0.0254	meters
miles (US statute)	1,609.347	meters
square feet	0.09290304	square meters
square inches	6.4516 E-04	square meters
square miles	2.589998 E+06	square meters
square yards	0.8361274	square meters
yards	0.9144	meters

Acronyms and Abbreviations

GIS	geographic information systems
IBD	immediately before dredging
MDDNR	Maryland Department of Natural Resources
MLLW	Mean Lower Low Water
RSM	Regional Sediment Management
SAV	submerged aquatic vegetation
TIN	triangulated irregular network
USACE	US Army Corps of Engineers
VIMS	Virginia Institute of Marine Science

REPORT DOCUMENTATION PAGE

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				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
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14. ABSTRACT In 2018, jetties and a sill were constructed by the US Army Corps of Engineers (USACE) adjacent to the Sheep Pen Gut Federal Channel at Rhodes Point, Smith Island, Maryland. These navigation improvements were constructed under Section 107 of the Continuing Authorities Program. Material dredged for construction of the navigation structures and realignment of the channel were used to restore degraded marsh. Following construction and dredging, 1 year of post-project monitoring was performed to evaluate the performance of navigation improvements with respect to the prevention of shoaling within the Sheep Pen Gut channel, shoreline changes, and impacts to submerged aquatic vegetation (SAV). Given the short period of record after the completion of the navigation improvements, it was difficult to draw conclusions regarding stability of the channel, structures, and shoreline. Therefore, this report documents methodology and baseline conditions for monitoring, except for SAV, which was found to be potentially impacted by construction. A second year of monitoring was funded by the USACE Regional Sediment Management Program for fiscal year 2020. Findings can be used to inform plan formulation and design for USACE navigation projects by illuminating considerations for placement of structures to prevent shoaling and by informing SAV management decisions.					
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