Appendix A

Appendix A

Rhodes Point Section 107 Navigation Improvement Project
Somerset County, Maryland

Essential Fish Habitat Impact Assessment
May 2017

Prepared by: Baltimore District, U.S. Army Corps of Engineers (USACE)

Pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act, USACE is required to prepare an Essential Fish Habitat (EFH) Assessment for all proposed actions associated with the small navigation project at Rhodes Point, Smith Island, Somerset County. Based on the prescribed protocol for preparation of an EFH Assessment, the assessment is comprised of the following components:

1. A description of the proposed action;
2. A listing of the life stages of all species with EFH designated in the project area;
3. An analysis of the effects of the proposed action;
4. The federal agency's opinions regarding the effects of the proposed action; and,
5. Proposed mitigation, if applicable.

I. DESCRIPTION OF THE PROJECT AREA

Smith Island is located approximately eight miles west of Crisfield, Somerset County, Maryland, in the Chesapeake Bay. Rhodes Point, on the west side of Smith Island, is a complex of salt marshes, tidal creeks, and shallow water areas. There are also inhabited upland areas near the project area.

Water depths in the project area range from two to three feet in the Sheep Pen Gut to approximately ten feet at the western extent of the proposed jetties.

Smith Island is located roughly 65 miles north of the mouth of the Chesapeake Bay. The island is surrounded by brackish water (mesohaline) typical of the middle Bay, with a salinity ranging from 13 to 19 parts per thousand (ppt). The average water temperature in the area ranges from 82 °F in July to 39 °F in February. Natural shoreline erosion and resuspension of bottom sediments by waves reduces water clarity in the vicinity of the island. The silty marsh soils, composed of fine particles add suspended solids to the water when eroded, decreasing light availability in the area.

II. DESCRIPTION OF THE PROPOSED ACTION

USACE maintains a navigation channel from Rhodes Point northwest through Sheep Pen Gut for about a half mile before entering the Bay, where it then stretches southwest to deep water in the open Chesapeake Bay. This channel is subject to continuous sedimentation resulting in the formations of shoals.

The proposed action (Figure 1) is to implement a small navigation project, which includes realignment of the navigation channel, construction of jetties, and a stone sill. The dredged material and other suitable excavated material will be beneficially used for restoration, enhancement and protection of the wetland located south of the Sheep Pen Gut federal channel. The proposed project would realign a portion of the authorized dimensions of the federal navigation channel at Smith Island in Sheep Pen Gut. The channel would be hydraulically dredged to extend to the -6-foot mean lower low water (MLLW) contour (plus an additional 1 foot allowed for overdredging). Following realignment, the federal channel will be 1,900 feet long in total, extending from within the mouth of Sheep Pen gut into the Chesapeake Bay. From the mouth of Sheep Pen Gut to 1,750 feet from the mouth, the channel will be 50 feet wide. The last 150 feet into the Bay will be 100 feet wide. This realignment of the channel provides more direct access to the Bay. The alignment extends the existing authorized channel by approximately 425 feet northwestward but it removes the need to dredge and maintain the portion of the navigation channel that runs in a southwest direction.

The construction of two jetties (which involves hydraulic dredging of bay bottom and placement of stone) is proposed to reduce shoaling of the realigned and dredged channel. The jetty to the north of the navigation channel would be approximately 650 feet long by 50 feet wide at its base and 6 feet wide at its crest with a footprint of 0.75 acres and aligned from deep water to the existing shoreline in a northeasterly direction. The jetty south of the navigation channel would be approximately 1,150 feet long by 50 feet wide at its base and 6 feet wide at its crest, with a footprint of 1.32 acres and aligned in an east-west direction parallel to the federal channel. Both jetties will be built to a crest elevation of +5 feet MLLW. The construction of a stone sill along the eroding shoreline will contain the material dredged from the channel and the material excavated from the jetty foundation. The stone sill will be approximately 850 feet long, 5 feet wide at the crest, 30 feet wide at the base, with an approximate footprint of 0.6 acre. The sill will be built to a crest elevation of +3 feet MLLW. This sill will provide stabilization for approximately 850 feet of eroding shoreline and will protect approximately 15 acres of wetlands.

Dredged material from the channel, jetty, and sill footprints is estimated to be 24,000 cubic yards (cy). This material will be used beneficially to restore, enhance, and protect wetlands behind the stone sill and to reinforce the tie-in point around the north jetty-tie in. The material will be planted with native plant species restoring about 2.5 acres of wetlands and enhancing approximately 2.5 acres of wetlands. The dredged material will be placed hydraulically. The stone sill will have a series of low notches (openings) for shallow water habitat interaction with the shoreline.

Planting of the restored areas will take place after the dredged material dewaters. No work will be done during the Time of Year (TOY restrictions) of April 1 to October 31 with the possible exception of the planting of native plants on the dredged material. There will be no access roads required. There will be a limit of disturbance (LOD) of approximately 25 feet for placement of material and access and movement, and also a fan shaped pad at the jetty tie in locations. The entire LOD, including the placement area and 25 foot buffer, for both the north jetty tie-in and placement area south of the south jetty, encompasses approximately 7 acres. Planting will be done on the land and staging will be via barge or within LOD (Figure 2).

Figure 1. Proposed Action

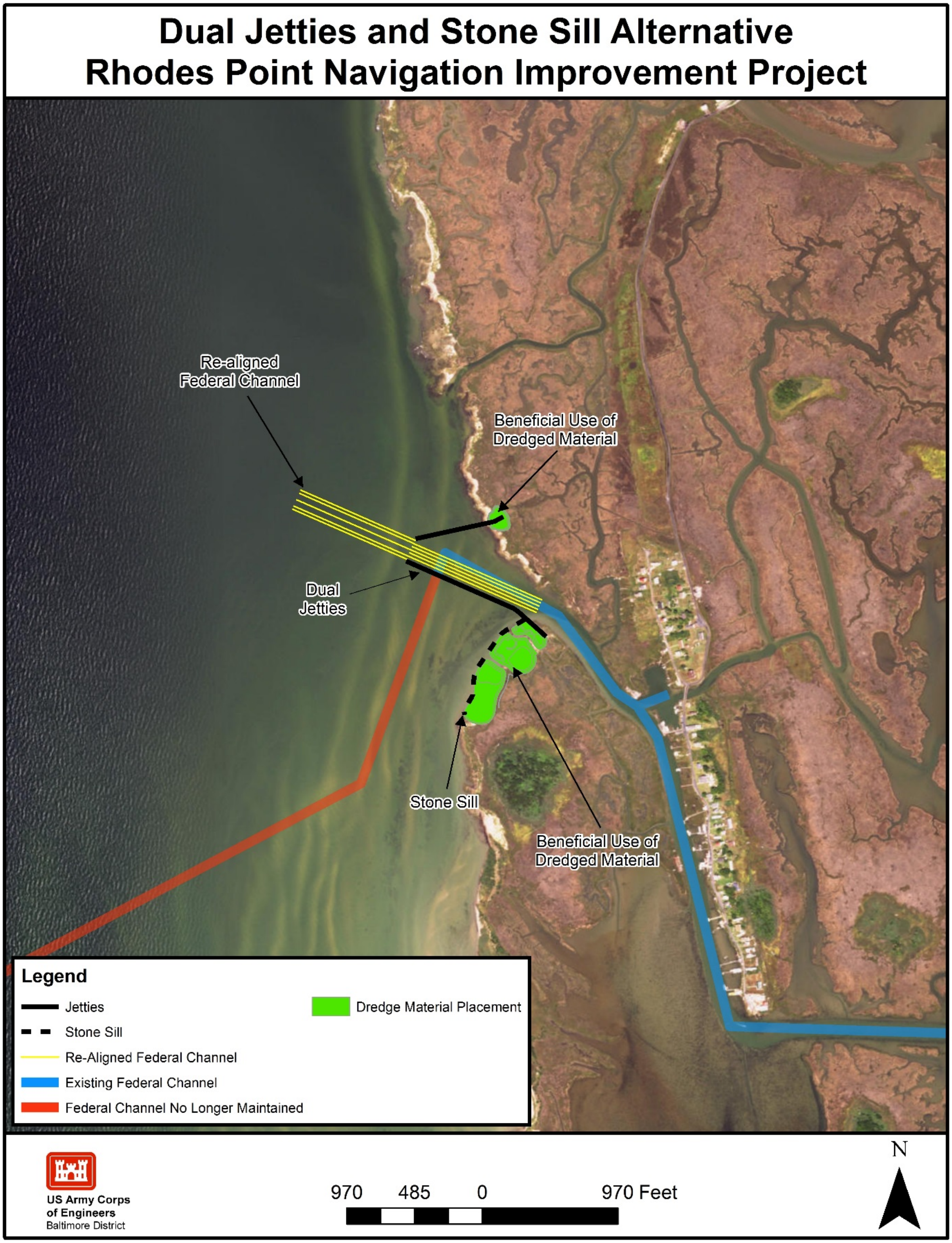


Figure 2. Proposed Action Planting Zones

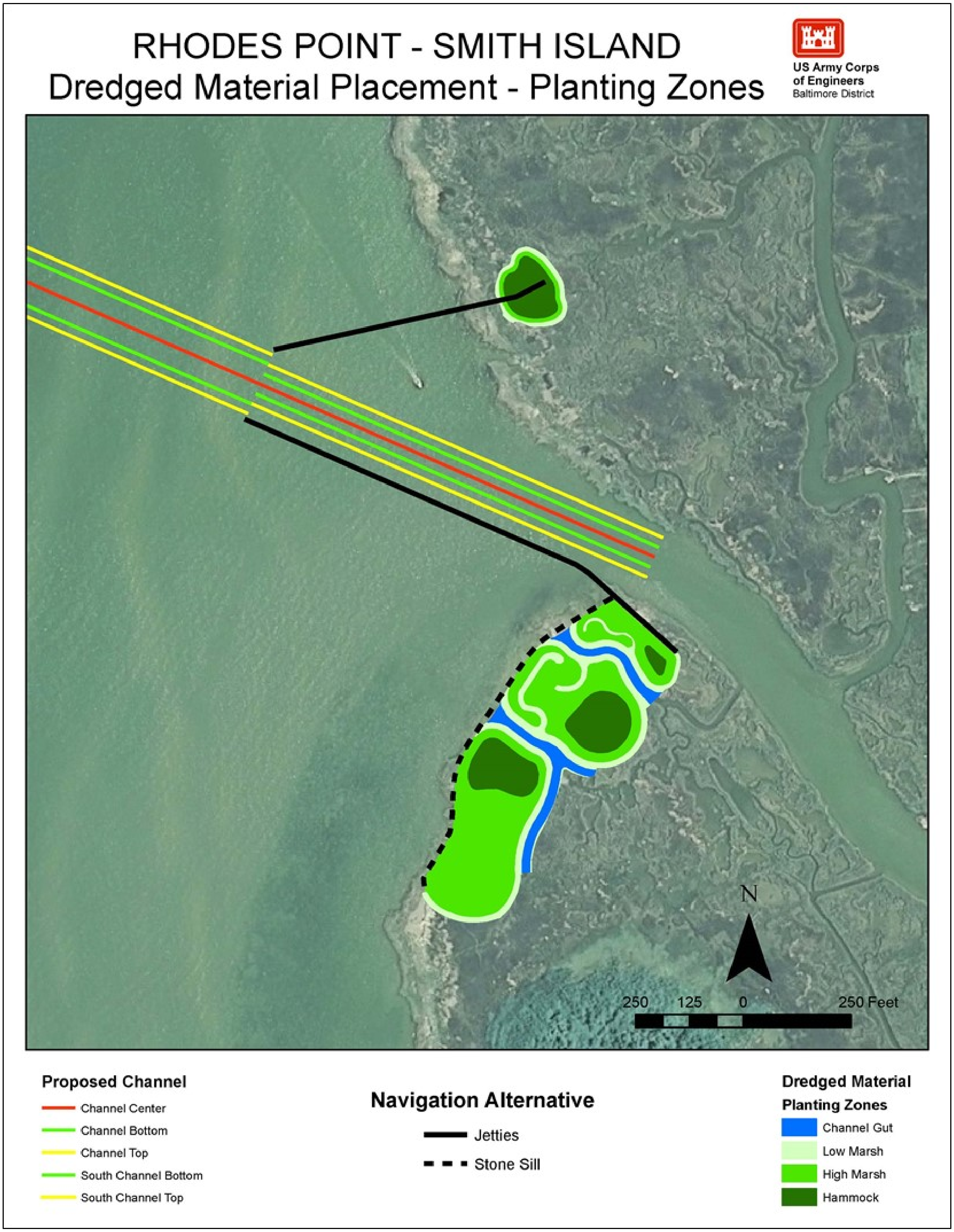
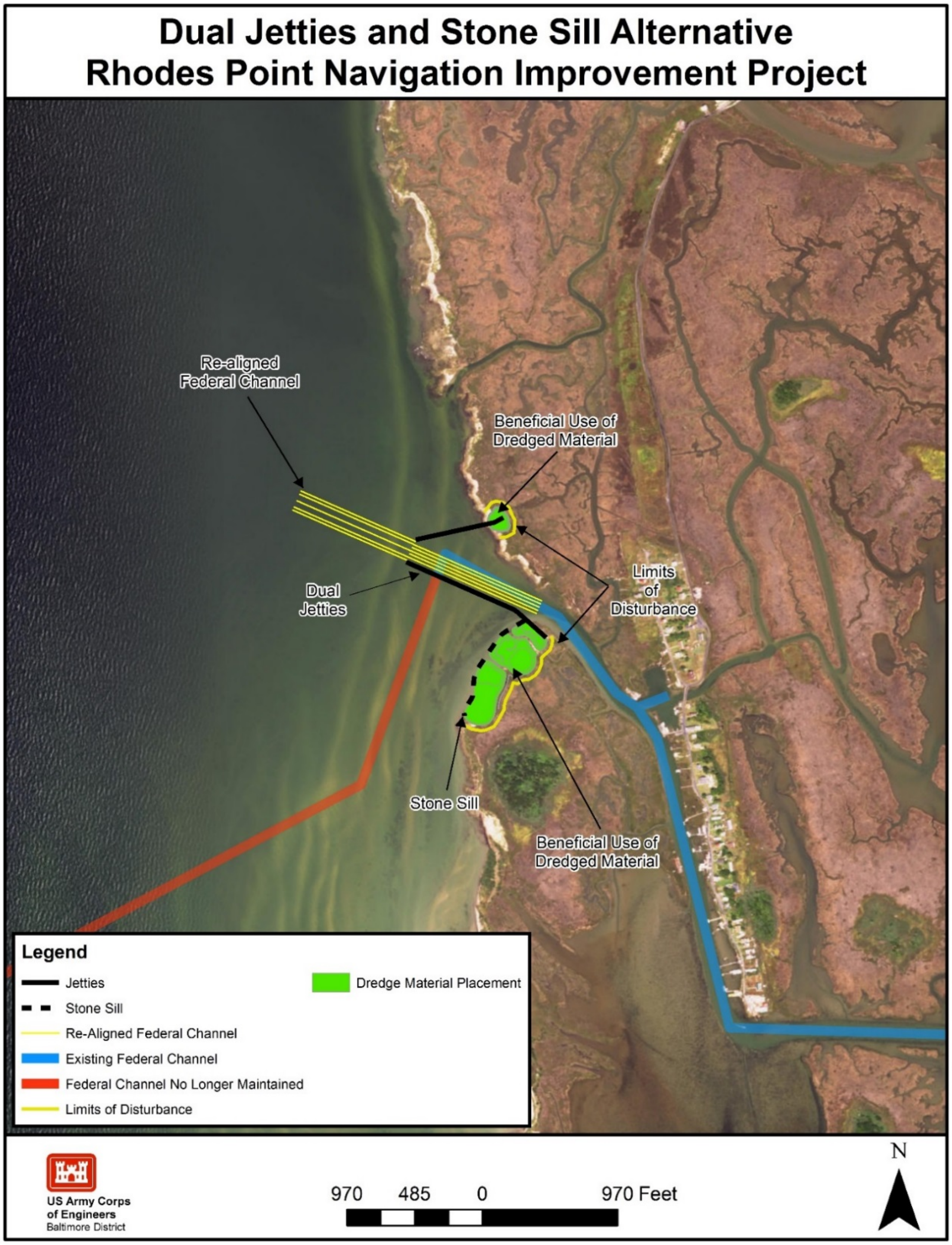


Figure 3. Proposed Action with Limit of Disturbance



III. SPECIES WITH EFH DESIGNATED IN THE PROJECT AREA

EFH is designated to occur for 10 species in the Smith Island area (Table 1).

Table 1: Species with EFH designated in the Rhodes Point Project Area

Species	Egg	Larvae	Juvenile	Adult
Summer flounder (*Paralichthys dentatus)*			X	X
Bluefish (*Pomatomus saltatrix)*			X	X
King mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
Cobia *(Rachycentron canadum)*	X	X	X	X
Dusky shark *(Carcharhinus obscurus)*		X		
Sandbar shark *(Carcharhinus plumbeus)*		X		X
Clearnose Skate (*Raja eglanteria)*			X	X
Little Skate (*Leucoraja erinacea)*			X	X
Winter Skate (*Leucoraja ocellata)*			X	X

Source: NOAA 2015

In coordination National Marine Fisheries Service (NMFS), it was concluded that of the 10 species with EFH designated in the study area vicinity, only two required consideration in this EFH Impacts Assessment (K Beard, personal communication, May 6, 2015). The project is located in waters designated as EFH for the following species and their life stages: summer flounder (*Paralichthys dentatus*), juvenile and adult life stages, and bluefish (*Pomatomus saltatrix*), juvenile and adult life stages. (National Marine Fisheries Service, Northeast Region, Habitat Conservation Division EFH web site; *www.nero.nmfs.gov/ro/doc/hcd.htm*).

Summer flounder may be found in juvenile and adult life stages at the project area. Juveniles may use salt marsh creeks as nurseries while adults may be found in shallow waters. Additionally, SAV has been identified as a Habitat of Particular Concern (HAPC) for both juvenile and adult summer flounder under the tenets of the Magnuson Stevens Act. SAV beds in the project area constitute HAPC for summer flounder, so the assessment will consider potential impacts to HAPC for that species.

Bluefish may be found in juvenile and adult life stages at the project site. Both life stages are usually found in open waters, but could venture close enough to shore to be impacted. Other species listed in Table 1 were determined unlikely to be present in the project area, as summarized below.

King mackerel are mainly found along the oceanic coast and will only venture into the southern end of the Chesapeake Bay. It is not likely that they will be found in the project area, since it is not along the oceanic coast, and is towards the middle of the Chesapeake Bay.

Spanish mackerel are mainly found along the oceanic coast and will only venture into the southern end of the Chesapeake Bay. It is not likely that they will be found in the project area.

Cobia are found in areas with higher salinity than the Rhodes Point project area, and are therefore unlikely to be found in the project area.

Dusky sharks prefer warm water temperatures and don't usually venture as far north as the Rhodes Point project area. It is not likely they will be found in the project area.

Sandbar sharks are limited to the lower Chesapeake Bay mouth, preferring higher salinity and coastal waters. They are not likely to be found in the project area.

Clearnose skate have been found throughout the bay but are generally located closer to the mouth of the bay. They also have a preference for water with higher salinity and greater depth than the project area. They are not likely to be found in the project area.

Little skate are found in the mouth of the bay in cooler, deeper, higher salinity water. They are not likely to be found in the project area.

Winter Skate are generally found in the southern bay, if at all. They prefer a higher salinity than is found in the majority of the bay. They are not likely to be found in the project area.

IV. IMPACTS TO SPECIES WITH EFH DESIGNATED IN THE PROJECT AREA

The following provides a brief overview of pertinent natural history for each species/life history stage, an analysis of impacts to individuals, habitat, and prey of these species of the proposed action, as well as a cumulative impacts of other dredging and dredged material placement actions.

A. SUMMER FLOUNDER (juvenile and adult life history stages)

1. Natural History

Adult and older juvenile summer flounder enter the Chesapeake Bay during spring and early summer, and exit the Bay in fall (Murdy et al. 1997). Adult summer flounder overwinter in the ocean and only enter the Bay in late spring. Larvae and young juveniles migrate into the Bay in October and prefer shallower waters; they typically overwinter and grow in the southern portion of the Bay. Older juveniles are generally distributed inshore and in estuarine areas throughout their range during the spring, summer, and fall. During colder months they move into deeper (oceanic) waters (Murdy et al. 1997, Fahay et al. 1999).

Both adults and juveniles exhibit a marked preference for sandy bottom and/or SAV beds, particularly areas near shorelines (NMFS 2000). SAV has been identified as a HAPC for both juvenile and adult summer flounder under the tenets of the Magnuson-Stevens Act.

Summer flounder feed on a variety of small fish, shrimp, and crabs that occur in the Chesapeake Bay. Prey include species such as grass shrimp (*Palaemonetes pugio*), Atlantic silversides (*Menidia menidia*), and bay anchovy (*Anchoa mitchilli*). Grass shrimp prefers sand bottom and/or

SAV, similar to summer flounder preferences, while forage finfish are generally widespread in occurrence in shallow waters. Each of these food items occurs in the middle bay.

2. Impacts Assessment

a. Impacts to Individuals

Summer flounder may be present in the waters of the project area during warmer months, when water temperatures increase above 52 ºF. Juvenile summer flounder are found in water depths of 1.6 feet to 16 feet, and adults in 0 feet to 82 feet. Direct impacts to summer flounder individuals are unlikely, even if construction occurs during warmer months, because flounder are strong swimmers and would be able to avoid dredging and construction disturbances. During cooler months no direct physical impacts to individuals are expected because they are unlikely to be present. USACE will adhere to construction TOY restrictions (April 15 to October 15) to minimize degradation of aquatic resources, thus there should be no impacts to summer flounder.

b. Habitat Impacts

The bottom sediment at Rhodes Point consists primarily of sand. Realigning the channel, construction of the jetties, stone still, and placement of dredged material to restore wetlands would thus cause the loss of about 2.25 acres of preferred shallow water habitat for summer flounder. Sandy substrates are predominant along the western Smith Island shoreline, and the proposed action is negligible relative to the overall acreage of sandy bottom in the Bay. Thus, this loss of preferred habitat is not expected to impact summer flounder populations.

Summer flounder utilize brackish marsh edge, the sill will be notched to allow fish access and the restored marsh will have channels as part of the Proposed Action. These habitat enhancement are expected to compensate somewhat for proposed conversion of open water and benthic habitats to wetland habitat.

As stated previously, SAV is an HAPC for juvenile and adult summer flounder. Persistent and extensive beds of SAV exist at the mouth of Sheep Pen Gut and along the shoreline south of the existing channel as stated by NOAA (May 4, 2015 email correspondence, see Appendix D) and MD DNR in letter correspondence (May 12, 2015).

SAV location and densities vary annually. From 2012-2015[1] SAV has not been present within any of the Proposed Action footprints of the jetties, sill, or channel. Figure 4 depicts SAV location and densities in the project area for the most recent year data is available, which is 2015. The last time any SAV was present in any of the Proposed Action project footprints was 2011 in which low densities occurred within the channel and proposed northern jetty (Figure 5). The encroachment of SAV into the channel in this time period occurred because the channel has not been maintained to its authorized depth of 6 feet. Figure 6 depicts SAV presence and density in the project area annually from 2011-2014.

[1] 2016 data was not available at the writing of this document.

A continuous stone structure along the shoreline would reduce water circulation and could impact SAV. Therefore USACE added notches to the proposed stone sill to improve circulation and flow of water thus minimizing impacts to SAV (May 4, 2015 email correspondence see Appendix D). Additionally USACE aligned the stone sill so that it follows the existing fringe alignment of the existing SAV footprint and will adhere to TOY restrictions and not conduct any construction from April 15-October 15 when SAV is dormant to minimize SAV impacts.

A likely positive impact from the Proposed Action to SAV would be from the stabilization of the shoreline provided by the stone sill. The expected reduction in sediment loading will improve water clarity offshore and in the interior creeks, possibly benefiting SAV.

In summary, since SAV has not been present in any of the Proposed Action footprints since 2012 and USACE will be implementing designs and TOY restrictions to minimize impacts to the SAV USACE has determined that there are no expected long-term impacts to SAV. USACE has been in discussion with the sponsor (Somerset County) and MDDNR to discuss post-construction monitoring of SAV presence in this area.

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Figure 4 SAV in Project Area- 2015

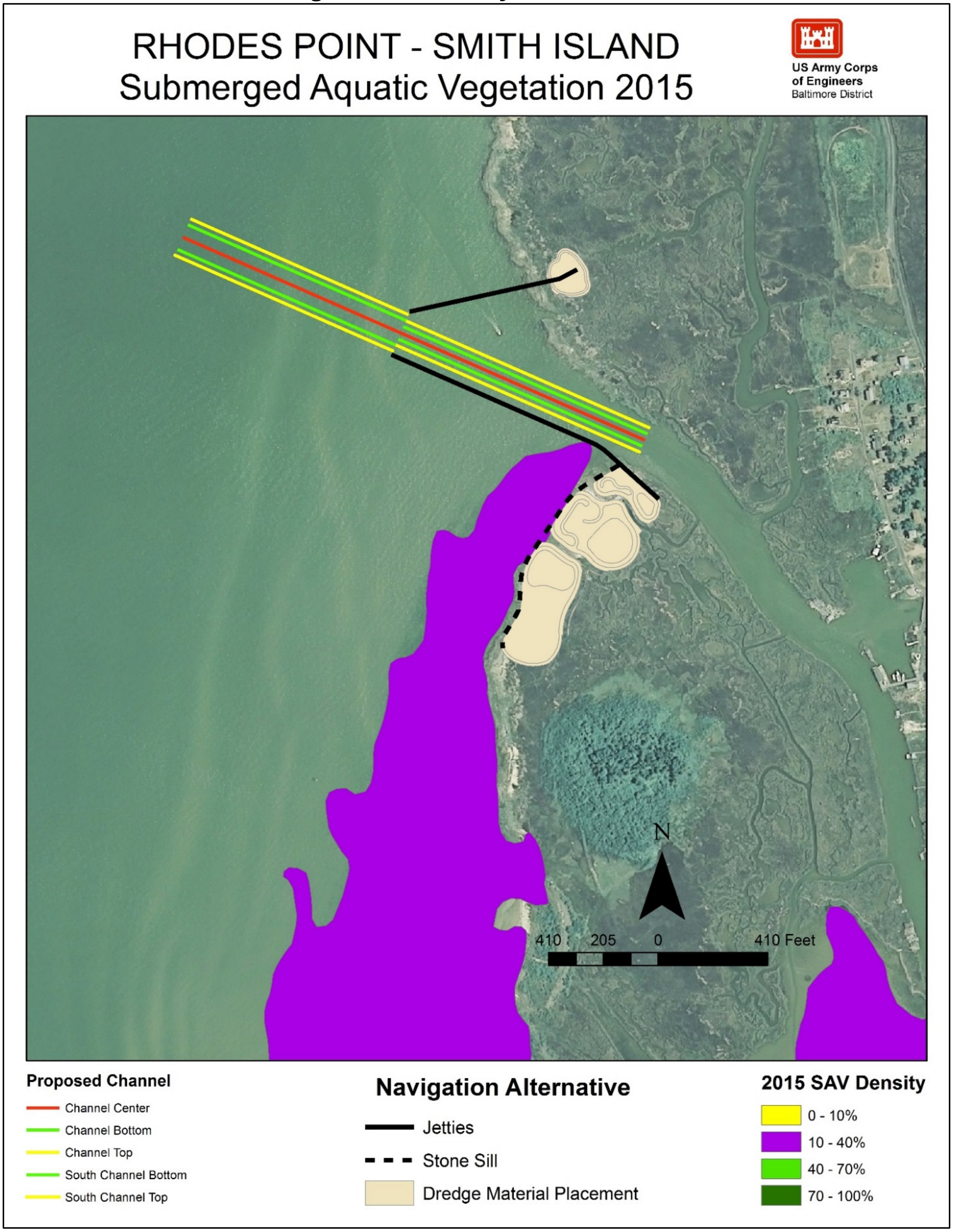


Figure 5 SAV in Project Area 2002-2015

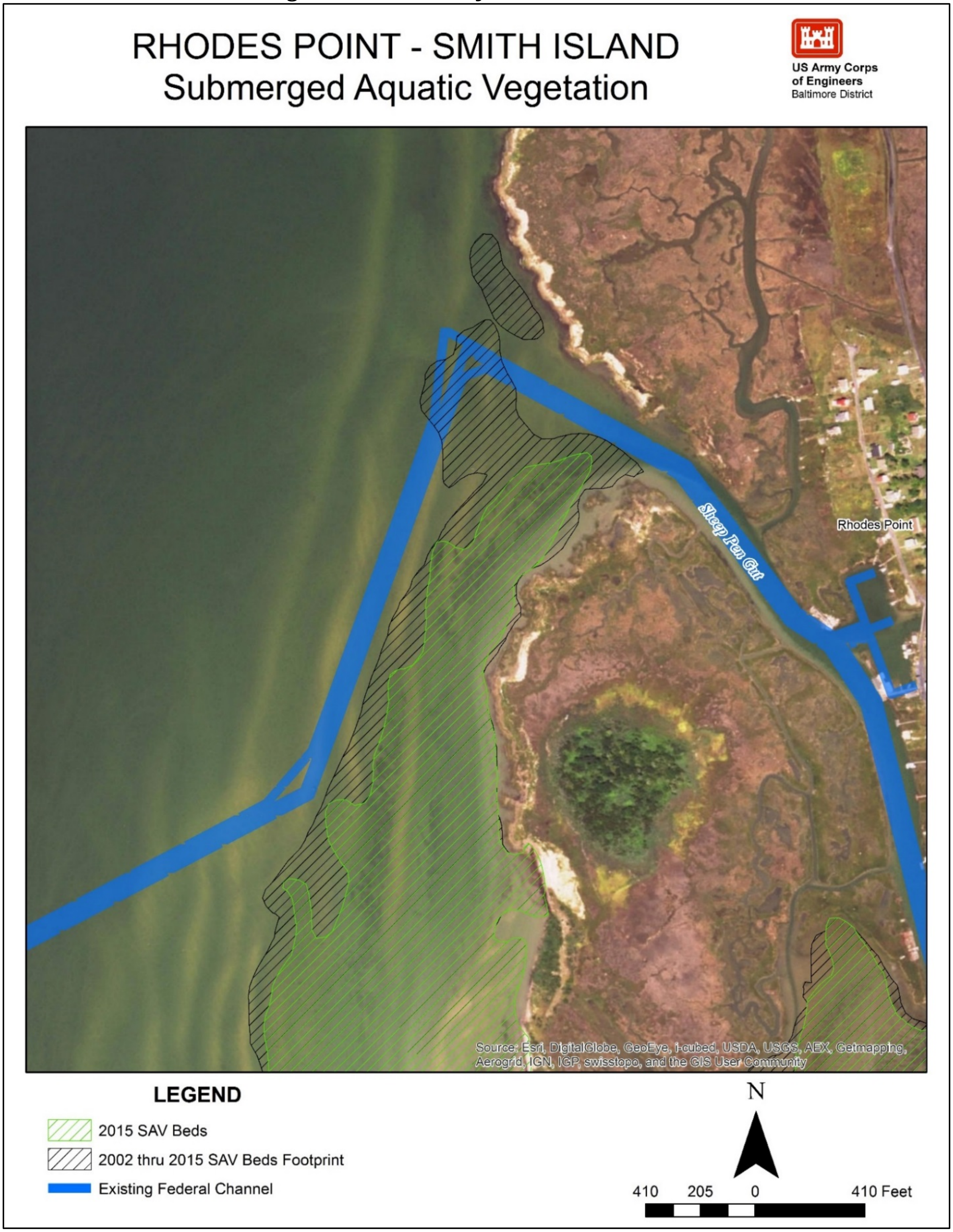
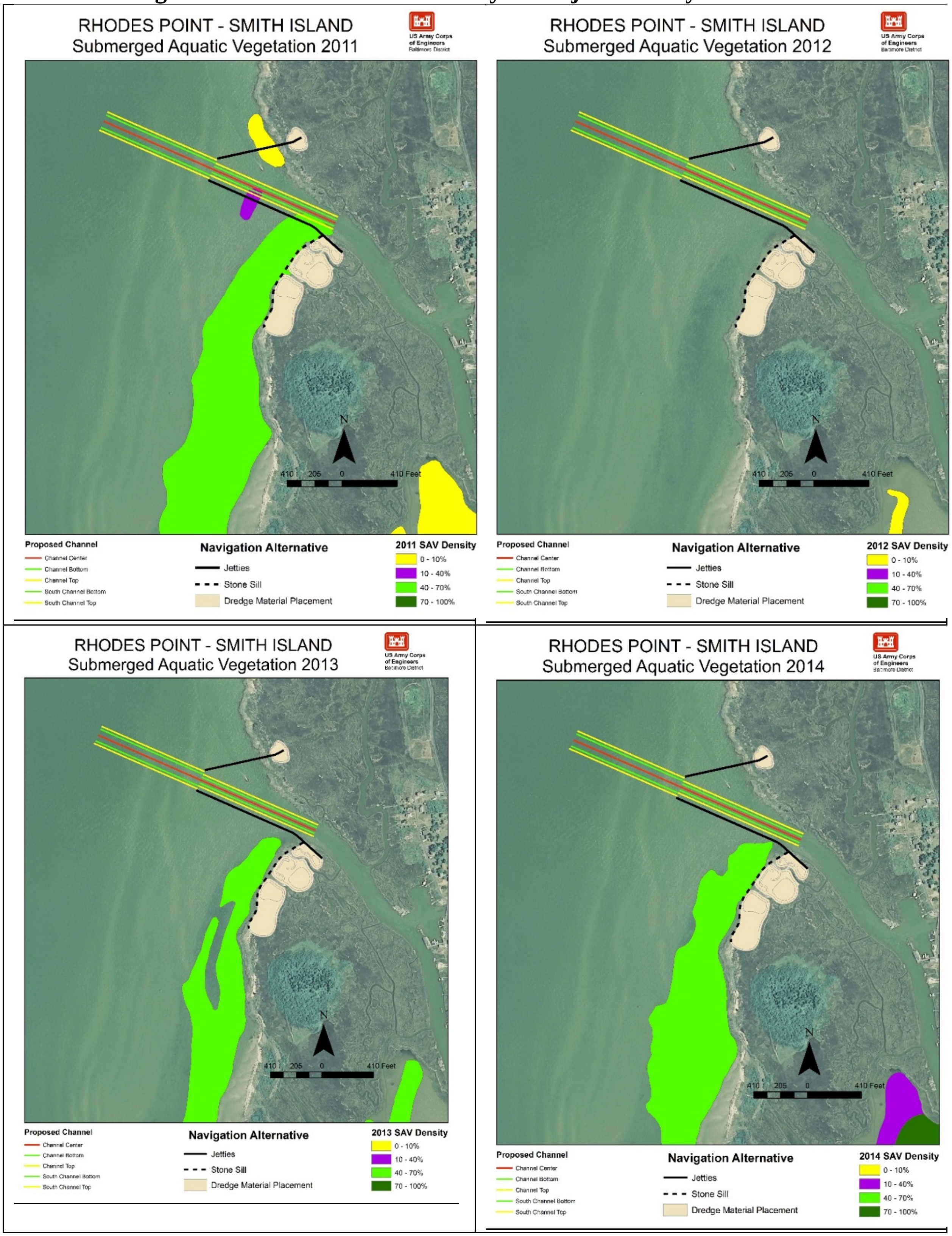


Figure 6 SAV Location and Density in Project Vicinity: 2011-2014



c. Impacts to Prey

The beneficial use of dredged material that will restore or enhance approximately 5 acres of wetlands would provide habitat for prey species. Approximately (5.4 acres[2]) of bay bottom will be disturbed. Relatively non-motile benthic prey would be buried as a result of jetty construction and dredging. The reduction of benthic macroinvertebrate communities as a result of dredging and to a lesser extent shoreline reconstruction would reduce biomass available for consumption by summer flounder that may use these areas as feeding grounds in the short term, but benthic populations would return over time. However, forage fish and invertebrates consumed by summer flounder occur over a broad area of the bay. Although the project will cause permanent loss of roughly 5.4 acres of open water and temporary disturbance of benthic habitat for summer flounder prey species, population levels of prey species are expected to remain regionally healthy because of ready availability of these lost habitats elsewhere in the immediate area. Restored brackish marsh will support a wide variety of summer flounder forage species and partially compensate for the loss of open water habitat and disturbance to bottom habitats. The Sheep Pen Gut navigation channel dredging area will likely recover a benthic community comparable to pre-project conditions within several years following cessation of dredging, as is typical of benthos occurring on sands and fine mobile estuarine deposits (Newell et al. 1998).

d. Cumulative Impacts

The Proposed Action is not anticipated to result in cumulative adverse effects. Actions by federal and non-federal entities that are (1) in the reasonably foreseeable future or can be reasonably forecasted, (2) planned, or (3) on-going in the study area are summarized below with a brief description of potential impacts.

Periodic maintenance dredging is conducted around Smith Island in small navigation channels including Twitch Cove and Big Thorofare. The last time these channels were dredged was 2009. Currently, USACE has a solicitation out for the maintenance dredging of these channels and the contract is planned to be awarded in early 2017. Dredging will likely not begin until the fall of 2017 (due to TOY restrictions). Maintenance dredging of the federal channels in these locations would result in displacement of fish and benthic resources immediately after dredging. These dredging projects will cause only temporary bottom disturbance and loss of benthos that could serve as forage for summer flounder.

The USFWS Fog Point Living Shoreline Restoration Project, at the Glenn Martin National Wildlife Refuge on the northern half of Smith Island began in July 2015 and was completed in June 2016. Construction of a living shoreline will help protect nearby Smith Island communities from the effects of intense storms and sea-level rise, as well as wildlife and habitat at Glenn Martin National Wildlife Refuge. The project is supported by federal funding from the Hurricane Sandy Disaster Relief Act. This project constructed 20,950 feet of living shoreline to stabilize a highly vulnerable shoreline at Martin National Wildlife Refuge and directly protects over 1,200 acres of quality tidal high marsh, SAV and clam beds:

[2] Proposed Action features (sill, jetties, and channel) footprints are approximately 4.55 acres, and wetland will convert approximately 0.86 acres of shallow water habitat.

https://www.fws.gov/hurricane/sandy/projects/FogPoint.html. Further, the dredged material from the Twitch Cove and Big Thorofare federal navigation channels will be beneficially used to restore dune and wetland habitat on Swan Island, which is part of the Glenn Martin National Wildlife Refuge. The material on Swan Island will be contained and planted for stabilization.

In early 2017 Somerset County completed construction of a living shoreline at Rhodes Point. Overall, the project should have positive environmental benefits given the historic loss of 211 acres of Hog Neck Peninsula and associated wetlands. The project provides shoreline erosion control to a shoreline that was eroding 1.5 to 9.3 feet a year, and prevent breaches of the Hog Neck Peninsula that protects the existing Rhodes Point community and the extensive SAV beds in the lagoon landward of the Hog Neck project shoreline.

The material dredged from various other USACE projects in the Bay is placed at other sites, versus the site laid out in the Proposed Action. There is no action to utilize a single location for placing dredged material from these unrelated channels that would create a cumulative effect. The periodic dredging of the Federal navigation channels in the Chesapeake Bay results in periodic minor turbidity and disturbance of fish and other aquatic organisms. Temporary reductions in benthos within a limited area could occur from consecutive or concurrent dredging/placement operations. The occasional disturbance of fish does not inhibit their growth or population size. The turbidity produced is of short duration, and contributes very little sediment to the natural ebb and flow of sediments in the area. For these reasons, the Proposed Action would not contribute to any significant adverse cumulative impact on summer flounder in the project area. The beneficial cumulative impact of the proposed action are stabilizing a portion of shoreline of a rapidly eroding area (Smith Island) improving habitat in the area for summer flounder.

The largest direct impact to summer flounder populations regionally is recreational and commercial fishing pressure (Murdy 1997). Proper management of fishing is the most critical measure to ensure stable summer flounder populations at this time, unless other environmental conditions change substantially.

B. BLUEFISH

1. Natural History (juvenile and adult life history stages)

Juvenile and adult bluefish enter the Chesapeake Bay spring through summer, leaving the Chesapeake Bay in late fall. Maryland Department of Natural Resources (MD DNR) monitoring data for the middle bay area indicate that the area reaches the optimum temperature for bluefish immigration (greater than 68°F) in late May/early June and falls to the out migration temperature (less than 59°F) in late October/early November. Bluefish are ubiquitous within the bay, and both adult and juvenile bluefish would be expected to be present in the project area.

Adults are pelagic, are not typically bottom feeders, and are strong swimmers that can easily avoid turbid conditions. Juveniles are generally found in pelagic waters, but also use shallower estuarine waters as nurseries. If construction and dredging occur during the months of November to April bluefish are unlikely to be found in the project area. In the event they are in the project area, they are expected to be able to avoid dredging and construction activities. Juveniles tend to concentrate in shoal waters, and are opportunistic feeders, foraging on a wide variety of estuarine life in the pelagic zone and over a variety of bottom types (Lippson, 1973).

2. Impacts Assessment

a. Impacts to Individuals

Juvenile and adult bluefish are good swimmers and should easily be able to avoid construction activities in warm weather months. During cooler weather months no direct physical impacts to individuals are expected because they are unlikely to be present. Bluefish are unlikely to be present around the project from late October through early May due to their temperature preferences (Packer et al. 1999).

b. Habitat Impacts

The Proposed Action would lead to a loss of approximately 2.25 acres of shallow water habitat. The sill and tidal wetland habitat would be former open water lost to bluefish. Because of the great abundance of open water habitat in the bay, no detrimental impacts to bluefish populations are expected. Although dredging the navigation channel would disturb the bottom, open water habitat would remain in the navigation channel, thus no long-term impacts to bluefish habitat are expected. The restored brackish marshes will support juvenile bluefish. These changes would compensate somewhat for loss of open water habitat.

c. Impacts to Prey

Although there will be a permanent reduction of open water due to the placement of the jetties and the stone sill, these areas will provide some ancillary fish habitats for foraging and refugia. There will be a permanent loss of benthic habitat under the footprint of the rock and a temporary loss of benthic communities as a result of dredging, however, benthic communities are expected to recover in a short period of time. During this recovery period there will be a reduced benthic biomass available for consumption by finfish. However, due to bluefish being opportunistic feeders, their prey can be found over a broad area of the bay and impacts to individual prey species is expected to be minimal. The restored wetland will support a wide variety of forage species consumed by bluefish. This would be expected to compensate somewhat for conversion of open water and benthic habitats and ultimately be a habitat enhancement for this species.

d. Cumulative Impacts

Cumulative effects from other projects discussed in the section on summer flounder impacts should not be significant relative to juvenile or adult bluefish because of the ubiquitous distribution and opportunistic feeding habits of this species within the bay.

V. FEDERAL AGENCY’S OPINION ON PROJECT IMPACTS TO EFH

In summary:

1. Adult and juvenile bluefish and summer flounder occur in the proposed project area waters. The proposed project will restore 3.7 acres of wetland while minimizing loss of shallow water habitat (2.25 acres). The completed project will also provide a more stable habitat for future SAV beds and fish habitat. The impacts to the EFH in the project area are not significant. Up to 5.4 acres of bottom will be disturbed during dredging. This will result in a temporary loss of benthic habitat for summer flounder until such time as bottom conditions recover.

2. The brackish marsh will support juveniles of summer flounder and bluefish as well as a wide variety of their forage species. The restoration of this habitat is expected to compensate somewhat for loss of open water and benthic habitats.

3. Maryland tidal waters contain areas of SAV habitat designated as HAPC. Projects are screened to avoid impacts to SAV. Since SAV has not been present in any of the Proposed Action footprints since 2011 and USACE will be implementing the recommendations of the resource agencies to minimize impacts to the SAV bed along the shoreline south of the exiting channel where the stone sill will be constructed USACE has determined that there are no expected long-term impacts to SAV.

4. Sill and jetty construction, and hydraulic dredging and placement of sand landward of the sill must comply with state (Maryland Department of the Environment) water quality standards, and should result in only short term, minor perturbations to local water quality, and minimal impacts to individuals of both species.

5. Although other federal, state, and privately sponsored projects occur in the project vicinity that cause the disturbance of bottom habitat, these projects are periodic and should not significantly affect summer flounder and bluefish, and their associated EFH. Overall, direct, secondary, and cumulative impacts to EFH and associated species will be minimal as a result of the Proposed Action.

6. Other species with EFH designated in the project area presented in Table 1 are not known to occur in the vicinity of the project area.

In conclusion, USACE, after reviewing relevant fisheries information and analyzing potential project impacts, has determined that the proposed action will not have a substantial adverse effect on EFH, or on species with designated EFH in the project area. Overall, direct, secondary, and cumulative impacts to EFH and associated species will be minimal. The project would protect and restore brackish marsh habitat for species managed under the Magnuson-Stevens Act.

VI. MITIGATION

Because this proposal will result in minimal impacts to designated EFH of summer flounder and bluefish and the project is designed to protect and enhance EFH, no mitigation has been proposed.

VII. LITERATURE CITED

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Appendix B

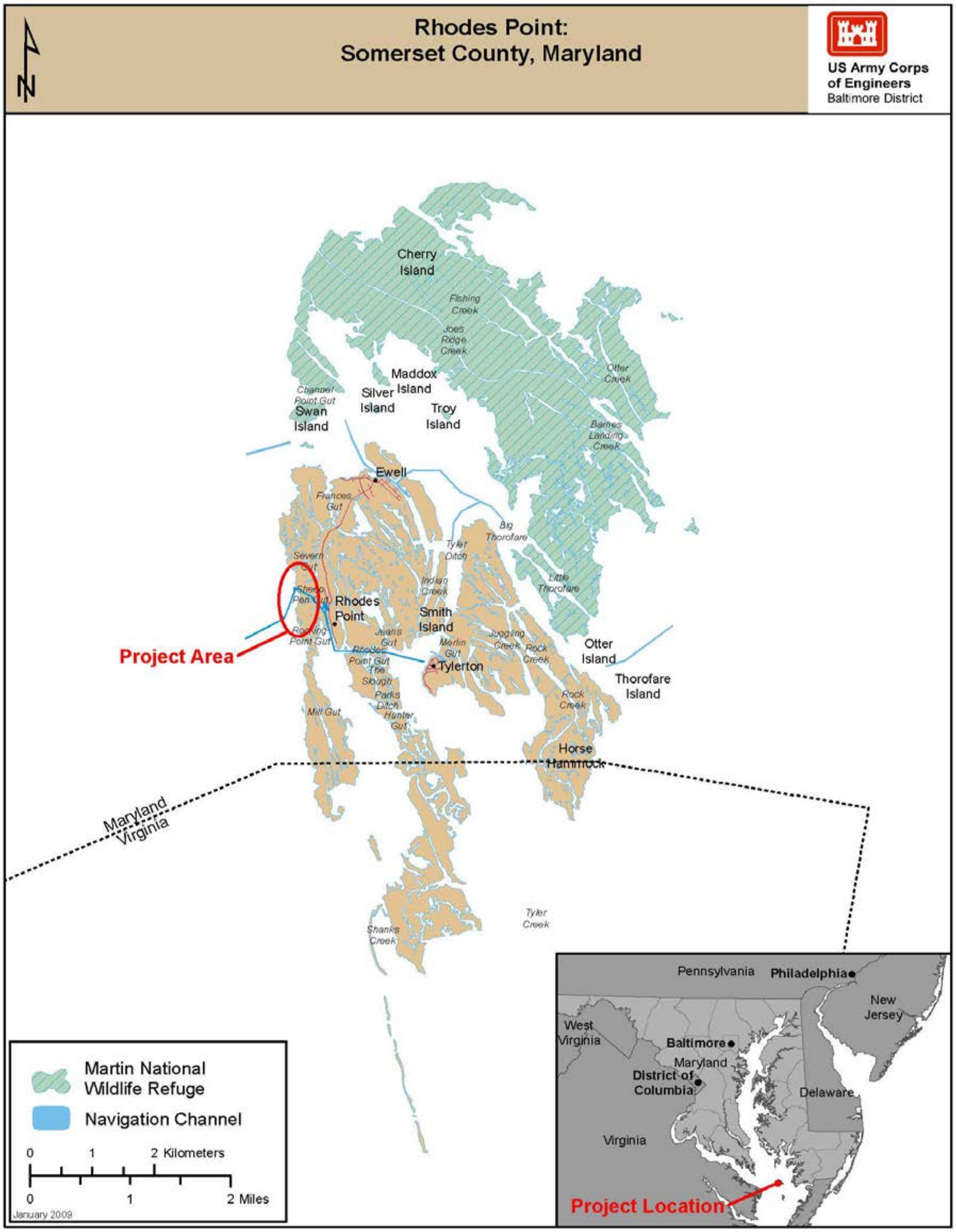
CLEAN WATER ACT
SECTION 404(b) (1) EVALUATION
RHODES POINT NAVIGATION IMPROVEMENT PROJECT
SOMERSET COUNTY, MARYLAND

I. Project Description

A. Location

Rhodes Point is located on Smith Island, Somerset County, Maryland, which is a small complex of salt marsh islands separated by tidal waterways in the Chesapeake Bay (Figure 1). Smith Island lies west of the town of Crisfield, in Somerset County, Maryland at approximately N 37° 58’ 00’’ degrees latitude and W 76° 02’ 00’’ degrees longitude. Rhodes Point is only accessible by boat and is at least a 45-minute ride to Crisfield, MD. The area is shown on the U.S. Geological Survey Kedges Strait 7.5' quadrangle topographic map. The Rhodes Point project is located on the southwest side of the island near the confluence of Sheep Pen Gut and the Chesapeake Bay.

Figure 1. Proposed Project Location



B. General Description

The U.S. Army Corps of Engineers, Baltimore District (USACE) maintains a navigation channel from Rhodes Point northwest through Sheep Pen Gut for about a half mile before entering the Bay, where it then stretches southwest to deep water in the open Chesapeake Bay. This channel is subject to continuous sedimentation resulting in the formations of shoals.

The proposed action (Figure 2) is to implement a small navigation project, which includes realignment of the navigation channel, construction of jetties, and a stone sill. The dredged material and other suitable excavated material will be beneficially used for restoration, enhancement and protection of the wetland located south of the Sheep Pen Gut federal channel. The proposed project would realign a portion of the authorized dimensions of the federal navigation channel at Smith Island in Sheep Pen Gut. The channel would be hydraulically dredged to extend to the -6-foot mean lower low water (MLLW) contour (plus an additional 1 foot allowed for overdredging). Following realignment, the federal channel will be 1,900 feet long in total, extending from within the mouth of Sheep Pen gut into the Chesapeake Bay. From the mouth of Sheep Pen Gut to 1,750 feet from the mouth, the channel will be 50 feet wide. The last 150 feet into the Bay will be 100 feet wide. This realignment of the channel provides more direct access to the Bay. The alignment extends the existing authorized channel by approximately 425 feet northwestward but it removes the need to dredge and maintain the portion of the navigation channel that runs in a southwest direction.

The construction of two jetties (which involves hydraulic dredging of bay bottom and placement of stone) is proposed to reduce shoaling of the realigned and dredged channel. The jetty to the north of the navigation channel would be approximately 650 feet long by 50 feet wide at its base and 6 feet wide at its crest with a footprint of 0.75 acres and aligned from deep water to the existing shoreline in a northeasterly direction. The jetty south of the navigation channel would be approximately 1,150 feet long by 50 feet wide at its base and 6 feet wide at its crest, with a footprint of 1.32 acres and aligned in an east-west direction parallel to the federal channel. Both jetties will be built to a crest elevation of +5 feet MLLW. The construction of a stone sill along the eroding shoreline will contain the material dredged from the channel and the material excavated from the jetty foundation. The stone sill will be approximately 850 feet long, 5 feet wide at the crest, 30 feet wide at the base, with an approximate footprint of 0.6 acre. The sill will be built to a crest elevation of +3 feet MLLW. This sill will provide stabilization for approximately 850 feet of eroding shoreline and will protect approximately 15 acres of wetlands.

Dredged material from the channel, jetty, and sill footprints is estimated to be 24,000 cubic yards (cy). This material will be used beneficially to restore, enhance, and protect wetlands behind the stone sill and to reinforce the tie-in point around the north jetty-tie in. The material will be planted with native plant species restoring about 2.5 acres of wetlands and enhancing approximately 2.5 acres of wetlands (Figure 3). The dredged material will be placed hydraulically. The stone sill will have a series of low notches (openings) for shallow water habitat interaction with the shoreline.

Construction will be done entirely from the water (with the exception of grading the dredged material and planting at the placement sites and when the jetties are tied into the land at the tie-in location) in months outside of Time of Year (TOY restrictions) of April 1 to October 31 with the possible exception of the planting of native plants on the dredged material. There will be no access roads required. There will be a limit of disturbance (LOD) of approximately 25 feet for placement of material and also a fan shaped pad at the jetty tie in locations. Planting will be done on the land and staging will be via barge or within the LOD (Figure 4).

Figure 2. Proposed Action

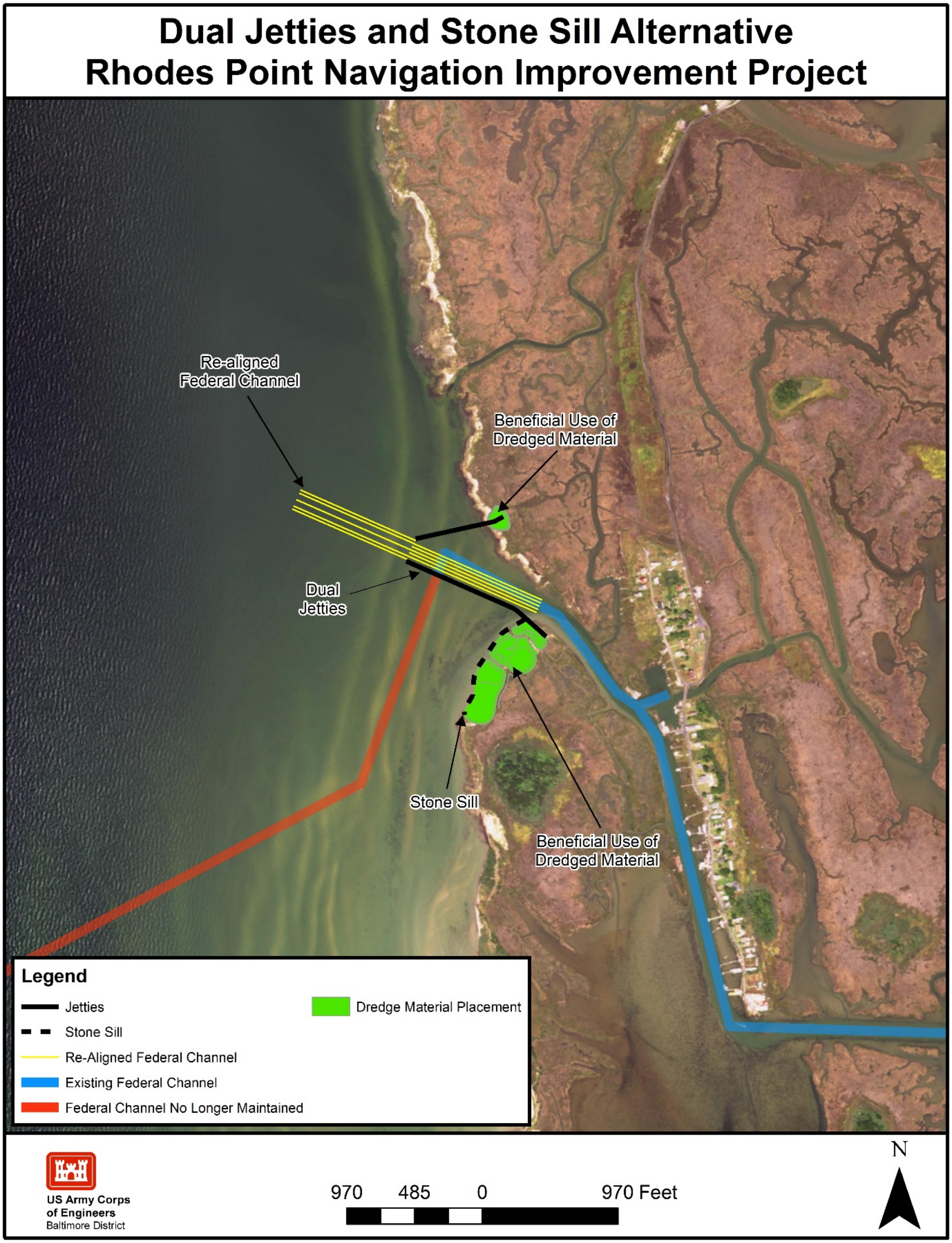


Figure 3. Proposed Action Planting Zones

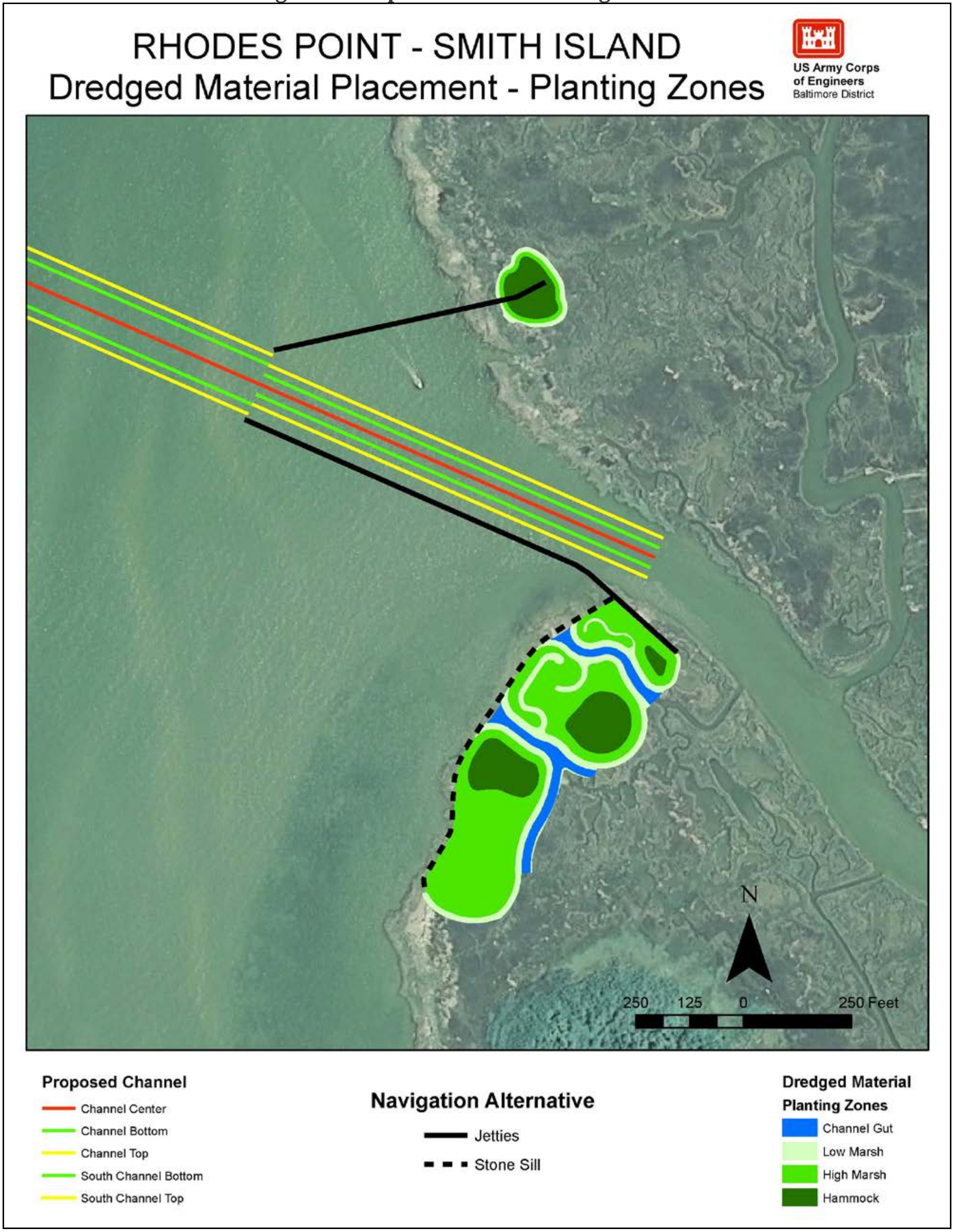
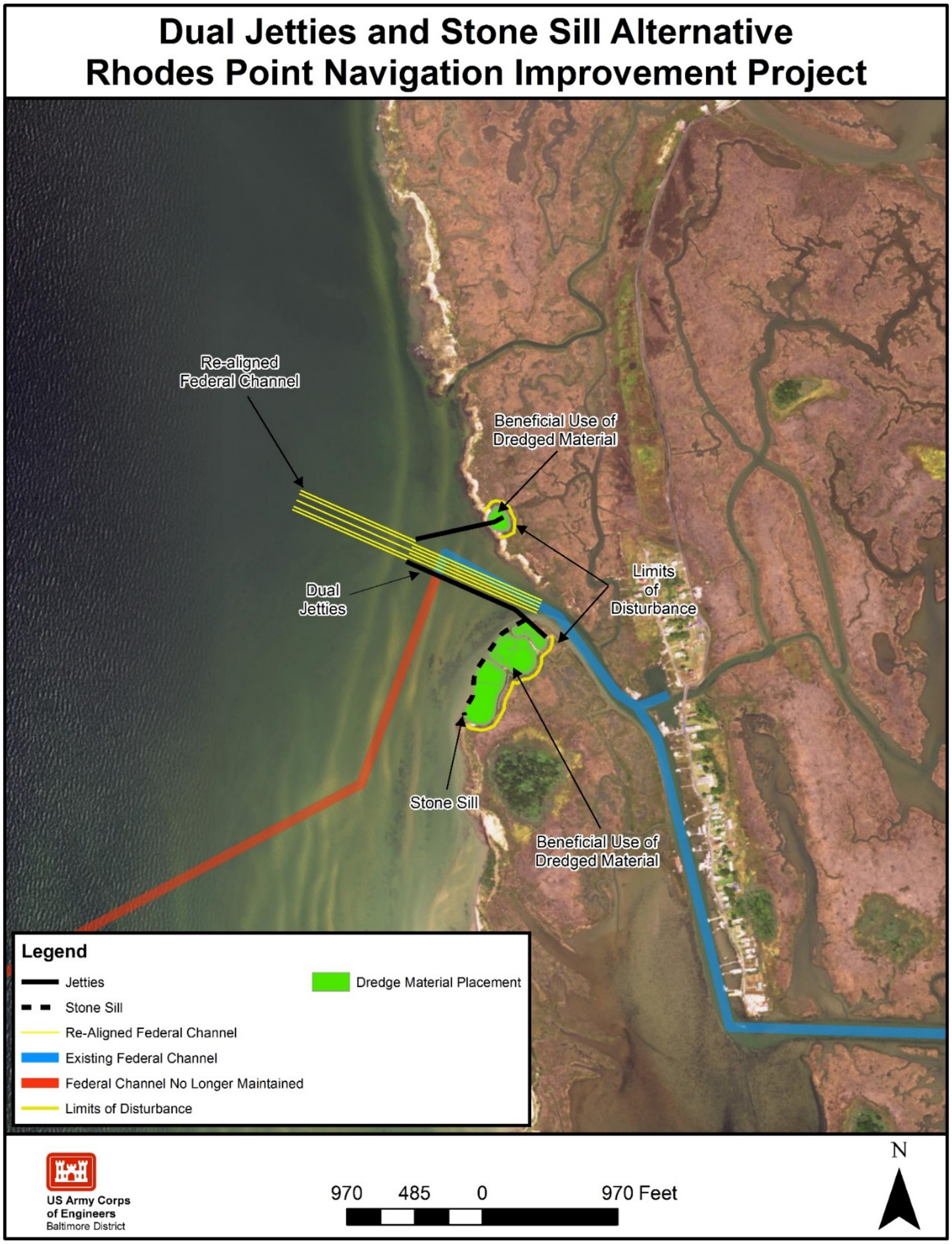


Figure 4. Proposed Action with Limit of Disturbance



C. Authority & Purpose

Section 107 of the River and Harbor Act of 1960, as amended, provides authority for USACE to develop projects and improve navigation, including dredging of channels, anchorage areas, and turning basins and construction of breakwaters, jetties, and groins, through a partnership with non-federal government sponsor such as cities, counties, special chartered authorities (such as port authorities), or units of state government for harbor protection.

The purpose of the project is to provide improvements to the federally maintained channel located in Sheep Pen Gut to improve and maintain navigable access. A secondary benefit of the project is the beneficial use of dredged material for the stabilization of the highly erodible shoreline along the western shore of Smith Island south of Sheep Pen Gut. Currently, the federal navigation channel is in constant need of dredging to maintain navigable access.

D. General Description of Discharge Material

1) **Characteristics of Fill Material** - Approximately 24,000 cy of medium to fine sand and silt material will be used to restore the wetlands. The jetties and stone sill will be constructed of placed stone on top of geotextile. The armor stone size ranges for the jetty trunk are 810-1,620 pounds with the head 1,425-2,850 pounds (the head section is the outer 150 feet). The stones for the sill are sized at 650-1,100 pounds. It is likely that heavy operating equipment will be brought in via barge to the placement site to grade the area so it is at appropriate elevations for wetland planting.

2) **Source of Fill materials** -The stone will be barged in from land-based quarries and the source of fill material for the marsh restoration is the navigation channel dredging and foundation material from the jetty, and stone sill locations.

E Description of the Proposed Discharge Site

The discharge site is open water as well as eroding shoreline and wetlands located along 850 linear feet on the western shoreline of Smith Island. Discharge material will also be placed at the north jetty tie-in area (Figure 2). The shoreline is actively eroding, contributing to severe loss of wetlands and, eroded sediment that has the potential to bury nearby SAV beds (Figure 5 and 6). The jetties will be located north and south of the realigned channel. The proposed stone sill would be located in shallow waters, and constructed along 850 feet of the shoreline, just south of Sheep Pen Gut Channel. The dredged material will be beneficially used to restore or enhance 5 acres of wetlands landward of the stone sill and around the north jetty tie-in area. The fill area is recently eroded wetland with fine sediments accumulated from the eroded wetland. The site of the north jetty tie-in area is also eroded marsh, which has resulted in shallow water with fine sediments.

Figure 5 SAV in Project Area (2015)

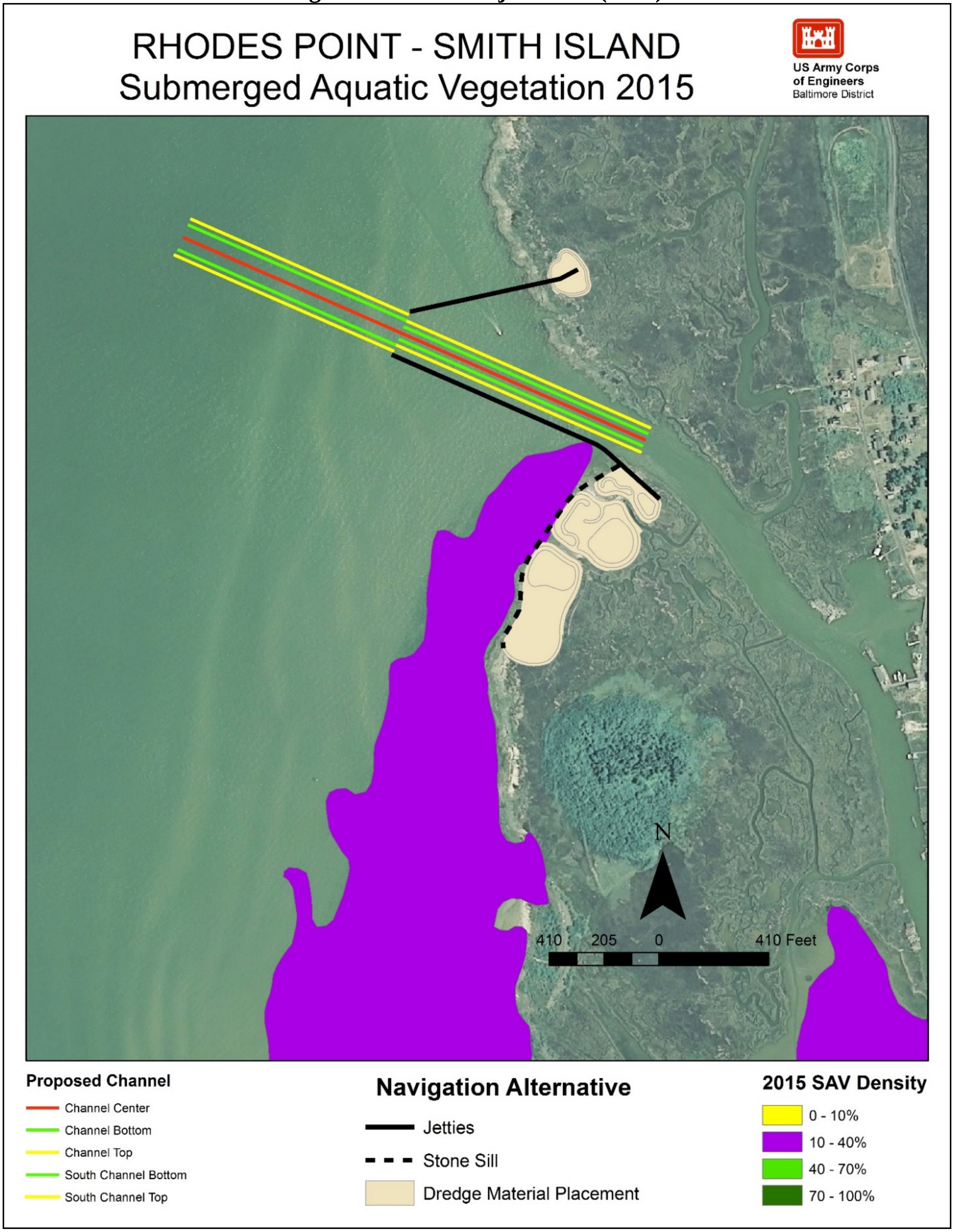
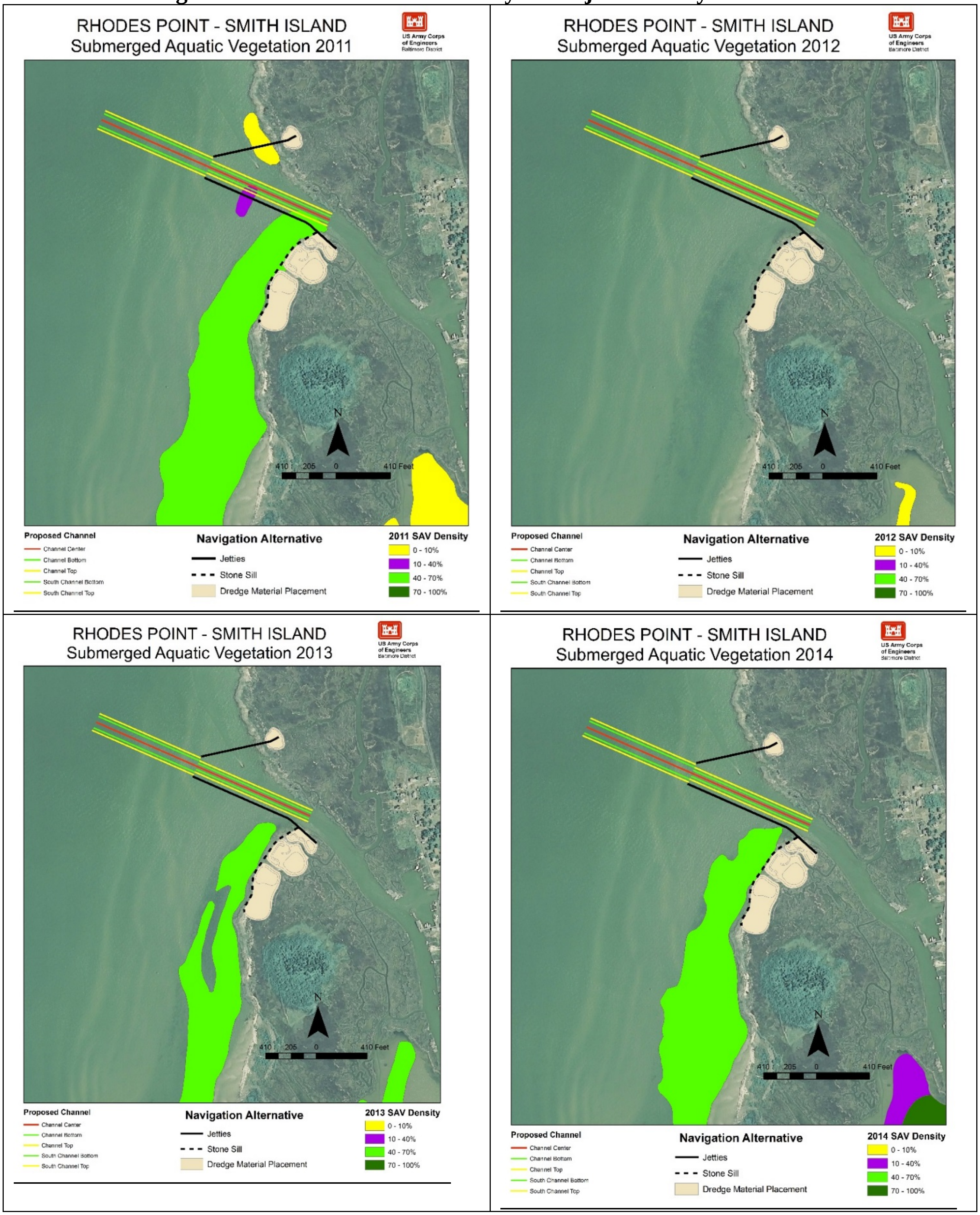


Figure 6 SAV Location and Density in Project Vicinity: 2011-2014



F. Description of Dredging and Placement Method

The area where both jetties and the stone sill will be placed will be hydraulically dredged. Geotextiles will be placed and then the stone. The jetties and sill will be stone structures, placed by cranes from barges in the water. The Sheep Pen Gut navigation channel will be hydraulically dredged to realign the channel. This material will be placed hydraulically behind the stone sill. It is anticipated that these construction activities will take up to 5 months. Several weeks after placement (to allow for dewatering) this area will be graded likely with heavy operating equipment so that the dredged material is at appropriate elevations for wetland planting. Dredged material will then be planted with native plant species to tie into the existing wetland. All equipment will be brought via barge onto the placed dredged material to grade. Once placement and planting is complete portions of rock will be removed from the sill to create notches to allow for tidal flushing and access to the wetland by aquatic organisms.

Best-management practices (BMPs) will be used for construction and dredging activity. Time of year restrictions for aquatic resources in the area will be adhered to. This time of year restriction currently includes "in-water" construction activities from occurring between April 1 and October 31. This time of year restriction is for SAV, oysters, anadromous fish and sea turtles. Construction will comply with all applicable federal, state, and local laws concerning environmental pollution control and abatement. Construction will not pollute with fuels, oils, bitumens, calcium, acid waste, or other harmful materials. A turbidity curtain will be maintained during construction. It will be weighted at the bottom and the top must float. It will be of sufficient height to provide complete coverage at high tide. It will be advanced as necessary during construction. The turbidity curtain will minimize sediment entering the water column and affecting water quality.

Dredged material will not be placed on sensitive areas of bay bottom, including oyster bars, SAV beds, or known fish spawning areas.

II. Factual Determinations

A. Physical and Substrate Determinations

1) Substrate elevation and slope - The elevation of Smith Island averages one to two feet above mean high water. Topographic changes are very gentle to essentially flat, and large expanses of shallow water (less than two feet deep) surround the island in all directions. The jetties for the preferred alternative would be built to a crest of +5 feet MLLW

2) Sediment Type - The discharged material is primarily sand, silt, mud and shell.

   Dredged/Fill Material Movement –When stones are placed for the jetties and sill bay bottom will be displaced and any fines will circulate locally and temporarily and likely travel towards land if suspended long enough based on circulation patterns (Appendix E). During dredging of the channels the bay bottom material will be hydraulically moved and placed behind the newly constructed sill on the existing shoreline below the Sheep Pen Gut. Fines will circulate locally and temporarily and likely travel towards land if suspended long enough based on circulation patterns (Appendix E). The jetties are designed to interrupt sedimentation into the channel, allowing for continued boat access. At the placement site, equilibrium is expected to develop behind the stone sills, creating crescent shaped peninsulas commonly observed behind stone sills. The material will tie into existing wetland and restore additional wetlands. Because the placement sites will be planted, the material is expected to stabilize within a full season after construction. Wave and tidal action, which are the predominant causes of erosion, are expected to be reduced by the Proposed Action and no significant material movement is expected. There is an expected reduction in the rate of shoreline erosion both inside the mouth of Sheep Pen Gut and along the shoreline south of the proposed jetties. The jetties will not alter how the shorelines experience surge but will deflect energy from normal waves and tides. The stone sill will protect against crashing waves that may otherwise erode the shoreline. An increase in scour along the slope of the structures are also likely to occur. These impacts are minor but permanent. During construction there will be minor temporary impacts to wave action due to the dredging activity in the channel and placement of stone for the jetties and sill as there will be barges in the water deflecting wave energy. Construction will comply with all applicable federal, state, and local laws concerning environmental pollution control and abatement. Construction will not pollute with fuels, oils, bitumens, calcium, acid waste, or other harmful materials. A turbidity curtain will be maintained during construction. It will be weighted at the bottom and the top must float. It will be of sufficient height to provide complete coverage at high tide. It will be advanced as necessary during construction. The turbidity curtain will minimize sediment entering the water column and affecting water quality. Minor, localized sediment disturbance is expected during construction from excavation, dredging, and geotextile and rock placement but the use of a turbidity curtain should minimize this movement.

3) Physical Effects on Benthos - Dredging of the channel will temporarily and placement of the jetties and stone sill will permanently disturb the existing substrate and benthos.

4) Other Effects - None expected.

5) Actions Taken to Minimize Impacts – Marsh restoration efforts will use native material from the area. Environmental protection measures, such as BMPs and soil and erosion control measures will be employed to avoid and minimize impacts to the aquatic environment. Construction specifications will state that compliance is mandatory for all applicable environmental protection regulations for pollution control and abatement.

B. Water Circulation, Fluctuation, and Salinity Determinations

1) Water Quality
   a) Salinity - No change expected.
   b) Chemistry - No change expected.
   c) Clarity - Temporary, localized changes are expected in the immediate vicinity during construction and dredging of the realigned channel and discharge on the marsh. Minor and temporary reduction expected during placement due to turbidity. No long-term impact expected.
   d) Color - Temporary, localized changes are expected in the immediate vicinity during construction and dredging of the realigned channel and discharge on the marsh. Minor and temporary change expected during construction due to minor increase in turbidity. No long-term impact expected.
   e) Odor - No change expected.
   f) Taste - Not applicable.
   g) Dissolved Gas Levels - Changes in dissolved gas levels and content are expected to occur at the placement sites as a result of the transition from a shallow water habitat to a tidal marsh. Temporary, short term, and localized minor negative impacts are expected.
   h) Nutrients - No long-term change expected. Minor, short-term, localized releases of nutrients can be expected. The material to be dredged is predominantly clay and sandy silts with a low fine/organic component and nutrient releases are expected to be minimal.
   i) Eutrophication - Not expected to occur.
   j) Temperature - No change expected.

2) Current Patterns and Circulation
   a) Current Patterns and Flow - Minimal effects are expected. Wave energy is expected to be reduced, reducing erosion on Smith Island. Hydrologic and hydraulic (H&H) modeling focused on areas in and around the channel and adjacent beaches for a relative comparison of without project and with project conditions. Modeling was used to evaluate the optimal geometry and size of structures (number of structures, and their placement location, orientation, length); assess the efficacy of proposed jetty alternatives; and develop water level, wave, current and shoaling estimates for structural design calculations. The modeling of waves, currents and shoaling in the channel suggest little change in tidal circulation within the established channel entrance, but these models were not designed to specifically look at circulation deeper within the channel or the larger surrounding shoreline area. Short-term estimates of morphology change based on 1-month long simulation with waves, currents, and sediment transport cannot be extrapolated to predict long-term channel shoaling rates. However, a 1-month simulation of sediment transport helps to determine sedimentation patterns in the channel and outside along neighboring shorelines. During construction minor, temporary impacts to localized water circulation and patterns are expected due to activity of

placement in the water and barge activity in addition to the newly constructed sill and jetties. The two stone jetties and stone sill will become permanent structures that will alter (limit) the water depth within the footprint of these structures. The channel realignment will extend westerly by 425 from the end of the existing channel at a -6-foot MLLW contour (plus an additional 1 foot allowed for overdredging). These components will also alter water circulation; the sheltering by jetties of the new (realigned) channel is expected to reduce wave energy/waters current circulation in the channel and in areas in the lee of these structures. The jetties also provide an indirect protection to the north and south shorelines Water circulation and depth will not be altered at the larger, tributary-level. However, at the local scale, minimal changes are expected and any impacts to the aquatic ecosystem would be minor.

b) Velocity - Minor changes are expected around the jetty area. After construction, the jetties would slow water down and reduce waves on adjacent shorelines, however within the channel velocities would increase. These changes in velocity are not expected to be significant enough to impact the surrounding environment. In addition, slowing of velocity is expected to occur at the placement sites as a result of the construction of shoreline stabilizing tidal marsh.

c) Water Stratification - It is unlikely that water stratification will occur at the placement sites when dredged material is placed over the existing substrate. The substrate is similar in composition to the dredged material, and no negative impacts are expected.

d) Hydrologic Regime of Water Body - The hydrologic regime at the placement site will change from a tidal shallow water system to a tidal marsh system.

3) Normal Water Level Fluctuations - No change in water levels will occur. The tidal range would remain the same.

4) Salinity Gradients - No change expected.

5) Actions Taken to Minimize Impacts - The use of hydraulic dredging is expected to minimize the resuspension of dredged material into the water column. Any sandy substrates disturbed by dredging is expected to settle out of the water column in the vicinity of the dredging. Following project completion, the channel should have increased capability to self-scour. This will permit future dredging to be required less frequently and therefore, minimize the frequency of dredging impacts. Maintenance dredging is expected to occur every 8 years, as opposed to the current cycle of 3 to 4 years. Environmental protection measures will be employed to avoid and minimize impacts to the aquatic environment.

Construction specifications will state that compliance is mandatory for all applicable environmental protection regulations for water circulation and currents.

C. Suspended Particulate/Turbidity Determinations

1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Placement Site - Minor, localized, and short-term impacts are expected to occur in the area of the placement sites. Coarse-grain size material will rapidly settle out of suspension. Finer grained material may take 24 to 36 hours before settling. Turbidity levels are expected to rapidly return to background levels once placement is completed.

2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column
   a) Light Penetration - Minor, temporary, and localized reduction in light penetration is expected to occur during construction. No change is expected after construction. Any turbidity created by these actions is expected to be generally within the range of natural turbidity levels.
   b) Dissolved Oxygen - Minor, temporary, and localized reduction in dissolved oxygen due to turbidity may occur during construction. Following construction, a rapid return to pre-project conditions is expected.
   c) Toxic Metals and Organics - No toxic metals or organics above background levels are expected to be released into the water column.
   d) Pathogens - No pathogens are expected to be released into the water column.
   e) Aesthetics - Minor and temporary impacts may occur during placement of the material due to clouding of water and the presence of construction equipment. Following construction, a rapid return to pre-project conditions is expected.
   f) Temperature - No change expected.

3) Effects on Biota
   a) Primary Production, Photosynthesis - Minor, temporary, and localized reduction in photosynthesis and primary production due to turbidity impacts to phytoplankton may occur during construction activities. Following construction, a rapid return to pre-project conditions is expected.

   b) Suspension/Filter Feeders - Minor, temporary, and localized impacts to suspension feeders (such as jellyfish) and to filter feeders (such as oysters, clams) in the area may occur due to increases in turbidity created by construction activities. Following construction, a rapid return to pre-project conditions is expected. Some organisms may be physically removed from the area by the hydraulic dredging.

   c) Sight Feeders - Minor, temporary, and localized impacts due to turbidity may occur during construction. Following construction, a rapid return to ambient conditions is expected. In addition, some organisms may be physically removed from the area by the hydraulic dredging. Mobile organisms are expected to be able to leave the area upon commencement of construction to avoid impacts.

4) Actions Taken to Minimize Impacts - The use of hydraulic dredging is expected to minimize the resuspension of dredged material into the water column. USACE is setting these Time of year restrictions to minimize impacts to the aquatic resources in the area. Turbidity curtains will be used to minimize the resuspension of sediment into the water column during dredging and placement activities. Any sandy substrates disturbed by dredging is expected to settle out of the water column in the vicinity of the dredging

D. Contaminant Determinations

No evidence exists to suggest the presence of toxic metals or organics in the dredged material or in the vicinity of proposed dredging or placement. Dredged material from the channel will be primarily a mixture of mud, sand, silt, shell. The fill material (dredged material and stone) is clean, uncontaminated, and the stone is from an approved source.

E. Aquatic Ecosystem and Organism Determinations

1) Effects on Plankton – Construction activities are expected to have minor, temporary impacts on plankton populations in the vicinity of the project area. Local depressions of macro zooplankton, phytoplankton, and photosensitive zooplankton may occur, but would be short in duration and to species that are common throughout the region. The majority of the plankton occurring at the site would be comparable to plankton that is widely dispersed and abundant over a broad region of the Chesapeake Bay. The impacts would be localized and not significant in the long-term. In the short-term, the turbidity associated with dredging and construction is likely to suppress light penetration into the water column and could locally depress the phytoplankton community. No significant adverse impacts are expected to any particular species as a result of the minor and local increase in turbidity. Following construction, planktonic organisms would return to the work area.

2) Effects on Benthos - Placement of the jetty and stone sill structures will result in the conversion of bare fine sand substrate to rock and wetland. The proposed placement site supports wetland habitat including high marsh, low marsh, and hammocks. Riprap habitat with rock crevices will develop along the stone jetties and stone sill. Non-mobile benthic organisms will be destroyed at the time of construction. Mobile benthos will relocate at the time of construction. The 5 acres of wetland restored by the Proposed Action will produce resultant long-term benefits to the benthic community by providing food web support. Benthos are expected to recolonize the newly stabile area with a resultant long-term benefit to the benthic community expected to occur. An indirect effect of the Proposed

Action would be the attraction of benthic organisms and fish that require or prefer hard substrate to the jetties. This would enhance a different group of organisms than what had been present in the channel area, but would provide some compensation for the lost benthic habitat.

3) Effects on Nekton - Construction activities are expected to have minor, temporary impacts on nekton. Due to entrainment, it is anticipated that there may be temporary negative impacts to fisheries during the dredging operations. Nekton are expected to be able to exit the project area during construction to avoid impacts and then return to the area upon completion of the Proposed Action. Incorporation of TOY restrictions will also offset potential negative impacts. Long-term benefits to nekton are expected to result from the construction of the marsh. The planting of plants along the shore behind the stone sill is expected to restore approximately 5 acres of wetland in the project area. This area will provide habitat beneficial to species that provide sustenance to resident nekton species. Notches in the stone sill have been incorporated into design to allow for improved fish passage and adequate flushing to improve habitat. The stone sill and the jetties will reduce wave action to the eroding shoreline, thus improving turbidity in the area for nekton.

4) Effects on Aquatic Food Web - Construction activities are expected to have minor, temporary impacts on the aquatic food chain. The food web at the placement site will experience permanent changes from a shallow water-based to a wetland based food web. The long-term effects are expected to be positive since the Proposed Action would provide habitat for a wider variety of organisms than is currently available at the site. The exchange and interaction between hammocks, wetland, and the channels is anticipated to provide a food source for benthic, finfish, and avian species.

5) Effects on Special Aquatic Sites
    a) Sanctuaries and Refuges – The Proposed Action will have no effects on sanctuaries or refuges. The nearest wildlife refuge, Martin National Wildlife Refuge, is located approximately 1.5 miles to the north and the project will have no adverse effect.
    b) Tidal wetlands - The Proposed Action will restore approximately 5 acres of tidal wetlands. This is expected to provide habitat for fish and wildlife.
    c) Tidal flats - Not applicable.
    d) Vegetated Shallows - SAV is plentiful off of the western shoreline. Construction designs have been carefully selected to minimize vegetated areas. By reducing erosion, there may be an increase in light attenuation, leading to beneficial effects on local SAV beds.

6) Threatened and Endangered Species - No effects to rare, threatened or endangered species are expected as a result of the project based on correspondence from both the U.S. Fish and Wildlife Service (USFWS), Maryland Department of Natural

Resources (MD DNR) and National Marine Fisheries Service (NMFS). USFWS Information for Planning and Consultation (IPAC) website indicated that there are no records of the presence of any federally listed rare, threatened, or endangered species under USFWS purview. A state search was also done indicating that there are no records of the presence of any state listed rare, threatened, or endangered species in the project vicinity under MD DNR purview. In a letter dated April 17, 2015 (Appendix D), National Marine Fisheries Service indicated four federally listed threatened or endangered sea turtles have been documented to visit the Chesapeake Bay and the coastal waters of Maryland and Virginia. These include the threatened Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead (*Carella caretta*), and the endangered Kemp's ridley (*Lepidochelys kempi*), green (*Chelonia mydas*) and leatherback sea turtles (*Dermochelys coriacea*). Sea turtles are transient to the Chesapeake Bay and the project vicinity. Sea turtles are expected to be present in the Bay from April through mid-November of each year. During cooler weather months when construction would occur, sea turtles are unlikely to be present in the project area. Additionally, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are present in the Chesapeake Bay and its adjacent rivers and tributaries, and the coastal waters of Maryland and Virginia. The New York Bight, Chesapeake Bay, South Atlantic and Carolina DPS of Atlantic sturgeon are endangered; the Gulf of Maine DPS is threatened. Individuals originating from any of these DPS could occur in the project area. Atlantic sturgeon are found throughout the tidal waters of the Chesapeake Bay. Atlantic sturgeon could be present in the project area, but monitoring suggests that they are not common (NFMS, 2009).

7) Other Wildlife - It is expected that shorebirds, terrapins, and other mobile species will temporarily relocate during construction. Detrimental impacts to other wildlife are expected to be temporary and insignificant. Some disturbance to terrestrial wildlife may also occur due to construction activities; however these effects are temporary, not significant, and would not be expected to limit their growth or population size. TOY restrictions would be implemented to protect oyster bars and wintering and migratory waterfowl.

8) Actions to Minimize Impact - persistent and extensive beds of SAV exist at the mouth of Sheep Pen Gut and along the shoreline south of the existing channel as stated by NOAA (May 4, 2015 email correspondence, see Appendix D) and MD DNR in letter correspondence (May 12, 2015).

   SAV location and densities vary annually. From 2012-2015 SAV has not been present within any of footprints of the jetties, sill, or channel. Figure 5 depicts SAV location and densities in the project area for the most recent year data is available, which is 2015. The last time any SAV was present in any of the project footprints was 2011 in which low densities occurred within the channel and proposed northern jetty. The encroachment of SAV into the channel in this time period occurred because the channel has not been maintained to its authorized depth of 6 feet. Figure 6 depicts SAV presence and density in the project area annually from 2011-2014. A continuous stone structure along the shoreline would reduce water circulation and could impact SAV. Therefore USACE added notches to the proposed stone sill to improve circulation and flow of water thus minimizing impacts to SAV (May 4, 2015 email correspondence see Appendix D). Additionally USACE aligned the stone sill so that it follows the existing fringe alignment of the existing SAV footprint and will adhere to TOY restrictions and not conduct any construction from April 15-October 15 when SAV is dormant to minimize SAV impacts. A likely positive impact from the Proposed Action to SAV would be from the stabilization of the shoreline provided by the stone sill. The expected reduction in sediment loading will improve water clarity offshore and in the interior creeks, possibly benefiting SAV.

In summary, since SAV has not been present in any of the Proposed Action footprints since 2012 and USACE will be implementing designs and TOY restrictions to minimize impacts to the SAV USACE has determined that there are no expected long-term impacts to SAV. USACE has been in discussion with the sponsor and MD DNR to discuss post-construction monitoring of SAV presence in this area.

F. Proposed Disposal Site Determinations

1) Mixing Zone Determination - Not applicable.

2) Determination of Compliance with Applicable Water Quality Standards - Construction activities will be conducted in accordance with all applicable state water quality standards.

3) Potential Effects on Human Use Characteristic

a) Municipal and Private Water Supply - Not applicable.
b) Recreational and Commercial Fisheries - Construction may temporarily impede navigation activity. A winter construction schedule will be used to minimize impacts to the local fishing economy. The restoration of tidal wetlands will provide habitat for juvenile game species, fish and crabs. The project provides safe and economical navigation for all boat traffic in and out of Sheep Pen Gut federal navigation channel between Rhodes Point and the Chesapeake Bay. The dredging of the federal navigation channel helps to support the area's economy by allowing a full range of commercial waterman and recreational watercraft to enter the Bay. Overall, the project will have a net positive beneficial impact to navigation.
c) Water Related Recreation - Construction may temporarily impede recreational use of the water in this area. The impacts are expected to be minor and temporary. A winter construction schedule will reduce impacts on most recreational boating (the summer season is when recreational use is the

highest). Recreational boaters in the project area would be able to safely navigate through the mouth of the channel upon completion of the Proposed Action. The dredging and construction operations may temporarily require the redirection of any boat traffic around the area. Boaters may experience some delays during this time. It is anticipated that a beneficial impact to recreation would occur once the construction is completed and access to Rhodes Point is restored.

d) Aesthetics - Construction of the Proposed Action would alter the natural aesthetics at Rhodes Point. This impact would be permanent. The proposed jetties would be constructed to a crest of +5 ft MLLW. The south jetty have a length of 1,150 feet. The north jetty would have a length of 650 feet. A low profile sill (will be built to a crest height of +3 feet MLLW) was incorporated into the design to limit large stone structures at the site. This is expected to be a minor impact to the Bay-wide viewshed. The Proposed Action is not anticipated to block the viewshed of adjacent properties. The stone sill would stabilize approximately 850 feet of shoreline. There would also be a temporary and minor reduction in aesthetics during dredging and construction activities.

e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves – No adverse effects are expected.

G. Determination of Secondary Effects on the Aquatic Ecosystem

Minor impacts may occur after construction due to the planting. Disturbance to vegetative areas that will need to recover from construction are expected to remain localized and short term in nature.

III. Finding of Compliance or Non-Compliance with Restrictions on Discharge

A. Adaptation of the Section 404(b)(1) Guidelines to This Evaluation

No adaptations of the Guidelines were made relative to this Evaluation.

B. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem

Dredging and jetty construction are water dependent by nature and require either excavation of supra-tidal sites to intertidal elevations or filling into open water habitat. In this case, the proposed action was configured to minimize detrimental environmental impacts and maximize benefits to a specific, local navigation channel.

C. Compliance With Applicable State Water Quality Standards

The proposed dredging and placement of material, jetty construction, and associated activities will comply with Maryland water quality standards.

D. Compliance With Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act

The proposed fill material is not anticipated to violate the Toxic Effluent Standard of Section 307 of the Clean Water Act. N/A.

E. Compliance With Endangered Species Act of 1973

In full compliance. There will be no impacts to these resources.

F. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

No Marine Sanctuaries, as designated in the Marine Protection, Research, and Sanctuaries Act of 1972, are located within the study area. N/A.

G. Evaluation of Extent of Degradation of Waters of the United States

No adverse impacts permanent or temporary to the aquatic ecosystem diversity, productivity and stability, and recreation, aesthetics and economic values will occur as a result of this project.

The proposed dredging and placement of material, jetty construction, and associated activities will not result in significant adverse impacts on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish and shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and wildlife will not be significantly adversely affected. Significant adverse impacts on aquatic ecosystem diversity, productivity and stability, and recreation, aesthetics and economic values will not occur as a result of the Proposed Action.

H. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

Appropriate and practical steps to minimize potential impacts of the placement of fill material in aquatic systems will be followed. This includes the implementation of BMPs and the planting of marsh plants in the tidal wetland. On the basis of the 404 (b)(1) guidelines, the proposed placement sites are specified as complying with the inclusion of appropriate and practical conditions to minimize contamination or adverse effects to the aquatic ecosystem. Best management practices such as erosion control measures along with minimizing the footprint of the project components to only the area needed to achieve project purpose have minimized adverse effects.

I. Determination of Cumulative Effects on the Aquatic Ecosystem

The Proposed Action is not anticipated to result in cumulative adverse effects. Actions by federal and non-federal entities that are (1) in the reasonably foreseeable future or can be reasonably forecasted, (2) planned, or (3) on-going in the study area are summarized below with a brief description of potential impacts.

Periodic maintenance dredging is conducted around Smith Island in small navigation channels including Twitch Cove and Big Thorofare. The last time these channels were dredged was 2009. Currently, USACE has a solicitation out for the maintenance dredging of these channels and the contract is planned to be awarded in early 2017. Dredging will likely not begin until the fall of 2017 (due to TOY restrictions). Maintenance dredging of the federal channels in these locations would result in displacement of fish and benthic resources immediately after dredging. These dredging projects will cause only temporary bottom disturbance and loss of benthos.

The USFWS Fog Point Living Shoreline Restoration Project, at the Glenn Martin National Wildlife Refuge on the northern half of Smith Island began in July 2015 and was completed in June 2016. Construction of a living shoreline will help protect nearby Smith Island communities from the effects of intense storms and sea-level rise, as well as wildlife and habitat at Glenn Martin National Wildlife Refuge. The project is supported by federal funding from the Hurricane Sandy Disaster Relief Act. This project constructed 20,950 feet of living shoreline to stabilize a highly vulnerable shoreline at Martin National Wildlife Refuge and directly protects over 1,200 acres of quality tidal high marsh, SAV and clam beds: https://www.fws.gov/hurricane/sandy/projects/FogPoint.html.
Further, the dredged material from the Twitch Cove and Big Thorofare federal navigation channels will be beneficially used to restore dune and wetland habitat on Swan Island, which is part of the Glenn Martin National Wildlife Refuge. The material on Swan Island will be contained and planted for stabilization.

In early 2017 Somerset County completed construction of a living shoreline at Rhodes Point (Figure 5-2). Overall, the project should have positive environmental benefits given the historic loss of 211 acres of Hog Neck Peninsula and associated wetlands. The project provides shoreline erosion control to a shoreline that was eroding 1.5 to 9.3 feet a year, and prevent breaches of the Hog Neck Peninsula that protects the existing Rhodes Point community and the extensive SAV beds in the lagoon landward of the Hog Neck project shoreline.

The material dredged from various other USACE projects in the Bay is placed at other sites, versus the site laid out in the Proposed Action. There is no action to utilize a single location for placing dredged material from these unrelated channels that would create a cumulative effect. The periodic dredging of the Federal navigation channels in the Chesapeake Bay results in periodic minor turbidity and disturbance of fish and other aquatic organisms. Temporary reductions in benthos within a limited area could occur from consecutive or concurrent dredging/placement operations. Depending on the location to be dredged and the placement site, some disturbance of terrestrial wildlife may also occur during these activities. These effects are not significant. The occasional disturbance of fish and wildlife does not inhibit their growth or population size. The turbidity produced is of short duration, and contributes very little sediment to the natural ebb and flow of sediments in the area. For these reasons, the Proposed Action would not contribute to any significant adverse cumulative impact on natural resources in the project area. Additionally the Proposed Action would not pre-empt any planned or ongoing actions in the area. Based on the minor nature of the impacts associated with the previous dredging of the proposed project, the current dredging is not expected to contribute to adverse cumulative impacts. The beneficial cumulative impact of the proposed action are stabilizing a portion of shoreline of a rapidly eroding area (Smith Island) and navigation improvements to the small channel of the Proposed Action will be connecting to a larger network of navigation channels in and around Smith Island.

J. Determinations of Secondary Effects on the Aquatic Ecosystem

The placement of dredged material will not impede the continued use of the waters surrounding Smith Island for fishing, boating, and other water-based commerce, transportation, and recreation. This represents the status quo for the Smith Island area. Indirect effects resulting from the Proposed Action have been discussed previously in this analysis under each category. No significant secondary impacts are expected from the Proposed Action.

K. On the Basis of the Guidelines the proposed Disposal Site(s) for the Discharge of Dredged or Fill Material is:

__√__ (1) Specified as complying with the requirements of these guidelines; or
_____ (2) Specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem; or
_____ (3) Specified as failing to comply with the requirements of these guidelines.

REFERENCES

Evans, J., A. Norden, F. Cresswell, K. Insley, and S. Knowles. 1997. Sea Turtle Strandings in Maryland, 1991 through 1995. The Maryland Naturalist 41(1-2): 23-34.

National Marine Fisheries Service (NMFS). 2009. Agency correspondence from NMFS to USACE on 7 May 2009 on the "2009 EA for Maintenance dredging of Twitch Cove and Big Thoroughfare, and Rhodes Point to Tylerton Federal Navigation Channels.

Appendix C

Comments received will be compiled and added to Appendix C after completion of the public review period.

Appendix D

Label	Date	Summary of correspondence
1	1 April 2015	Public Notice-USACE notifying public of study start and full mailing list.
2	1 April 2015	USACE letter to MDE requesting information.
3	1 April 2015	USACE letter to DNR Wildlife and Heritage office requesting information.
4	1 April 2015	USACE letter to DNR Integrated Policy and review unit requesting information.
5	1 April 2015	USACE letter to the state clearinghouse requesting information.
6	1 April 2015	USACE letter to the NMFS requesting information.
7	1 April 2015	USACE letter to the USFWS requesting information.
8	17 April 2015	Letter response from NOAA indicating that four species of federally listed threatened or endangered sea turtles under our jurisdiction are found seasonally in the Chesapeake Bay and the coastal waters of Maryland and Virginia: the threatened Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead (Caretta caretta), and the endangered Kemp's ridley (Lepidochelys kempi), green (Chefonia mydas) and leatherback sea turtles (Dermochelys coriacea). These species are seasonally present in the Bay, typically from April - November. Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) are present in the Chesapeake Bay and its adjacent rivers and tributaries, and the coastal waters of Maryland and Virginia. The New York Bight, Chesapeake Bay, South Atlantic and Carolina DPS of Atlantic sturgeon are endangered; the Gulf of Maine DPS is threatened. Individuals originating from any of these DPS could occur in the project area. Shortnose sturgeon (Acipenser brevirostrum) are present in the Chesapeake Bay and some of its tributaries, including the Susquehanna and Potomac Rivers. Shortnose sturgeon are endangered throughout their range. As listed species are likely to be present in the vicinity of the proposed projects, a consultation pursuant to section 7 of the ESA may be necessary. As project details develop, we recommend you consider the following effects of the projects on sea turtles and sturgeon: • Injury or mortality due to capture, impingement or entrainment in a dredge; • Effects of increased suspended sediment through dredging and disposal; • Impacts of dredge and dredged materials disposal vessels; • Potential impacts of change in vessel traffic in the widened channels; • Suspension of contaminated sediment; • Discharge of any other pollutant; • Loss of prey and, • Any impacts to habitat or conditions that make affected water bodies less suitable for these species.
9	29 April 2015	Rhodes Point Site visit- USACE, USFWS, NOAA

10	4 May 2015	Email from NOAA with a recommendation to have a sill with windows, landward of existing SAV beds.
11	6 May 2015	NMFS review of USACE EFH designation indicating that 1. There is EFH designated for some skate species in the Chesapeake Bay, which are not included on the tables on our website. You can find the information here <http://www.greateratlantic.fisheries.noaa.gov/hcd/skateefhmaps.htm> . 2. You don't need to include red drum. Management of that species was given to the states a few years ago, but our website hasn't been updated. 3. SAV beds are HAPC for summer flounder <http://www.greateratlantic.fisheries.noaa.gov/hcd/summerflounder.htm> .
12	11 May 2015	Letter response from MD Historical Trust indicating no historic properties affected by project.
13	12 May 2015	Letter response from DNR indicating (1) there is a designated natural oyster bar (NOB 36-2) located approximately 4,000 feet west of the mouth of sheep pen gut. The existing channel comes to within 2,000 feet of the southern border of this NOB. No hydraulic dredging should be performed within 500 yards of NOB from 1 June-30 September. If mechanical dredging is to occur within 500 yards of an NOB it should not occur from 16 December-14 March or 1 June through 30 September. (2) Persistent and extensive beds of SAV at the mouth of Sheep Pen Gut along the shoreline to the north and south. Proposed placement of dredged material for marsh restoration should not be performed from 15 April-15 October to minimize impacts to SAV. (3) Coordinate with Critical Area commission.
14	13 May 2015	MD Department of Planning letter. DNR, Transportation and MD Department of Planning including Maryland Historical Trust and Somerset County found the project to be consistent with their plans, programs, and objectives. MHT has determined the project will have no effect on historic properties. Department of Planning stated that the project is aligned with state planning vision for transportation. MDE indicated that any solid waste should be disposed of properly and recycled if possible. The waste Diversion and utilization program should be contacted for hazardous waste.
15	1 June 2015	USACE email to the Critical Area Commission requesting information.
16	15 June 2015	NOAA email providing EFH and protected species in the project area. Recommending a stone sill with windows constructed landward of existing SAV can help sustain wetlands at Rhodes point while also improving habitat for NOAA trust resources.
17	15 June 2015	Letter response from NOAA offering preliminary comments: (1) Threatened or endangered species under the jurisdiction of NOAA Fisheries may occur within the project area. As a result, further consultation with the Protected Resources Division may be required to comply with the Endangered species act. (2) The proposed project area includes waterways that may provide habitat for forage species. Further coordination with NOAA Fisheries may be required to comply with the Fish and wildlife coordination act (3) Essential Fish Habitat (EFH) has been designated within the project area. Further EFH consultation by the federal action agency may be required as part of the federal permit process. For a listing

		of EFH and further information, please go to our website at: http://www.greateratlantic.fisheries.noaa.gov/habitat/efh/efhoverview.html to comply with the Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat
18	18 June 2015	Letter response from MDNR-Wildlife Heritage Service has determined that there are two active waterbird colonies that occur within the vicinity of this project site. Disturbance includes actions such as cutting nest trees, cutting nearby trees or nearby construction that causes abandonment of chicks by the adults. One colony is mixed heron species and the other supports great blue herons. The agency encourages the following guidelines (1) Establish a protection area of 1/4 mile radius from the colony's outer boundary. Within this area establish three zones of protection: Zone 1 extends from the outer boundary of the colony to a radius of 330 feet, Zone 2 extends from 330 feet to 660 feet in radius, and Zone 3 extends from 660 feet to 1/4 mile (1320 feet). 2. During the cumulative breeding season for these heron species, 15 February through 15 August, all human entry into Zone 1 should be restricted to only that essential for protection of the heron colony. Human disturbance of colony sites that results in significant mortality of eggs and/or chicks is considered a prohibited taking under various state and federal regulations. 3. No land use changes, including development or timber harvesting, should occur in Zone 1. 4. Construction activities, including clearing, grading, building, etc., should not occur within Zones 1 and 2. 5. Selective timber harvesting may occur in Zone 2, but clearcutting should be avoided. 6. No construction or timber harvesting activities should occur within the 1/4 mile protection area during the heron breeding season.
19	24 June 2015	MDNR email correspondence noting that NOB-32 would not have much relevance to the project as there is only a handful of oysters in this designated oyster sanctuary.
20	14 April 2016	-Meeting summary of NOAA USACE and FWS meeting to discuss Rhodes Point. FWS agreed that new alignment is on the right track. With regards to proposed fill material placement site, they did have some concerns that it would be filling the existing marsh more that was originally expected, but they would be willing to have an open discussion regarding this issue as long as the project does not change the overall nature of the marsh. They would also like engineered channels in the marsh where USACE plans on filling with dredged material from the navigational channel and the creation of breakwaters in the stone sill to allow for fish passage. -NOAA appreciated the revisions to the stone sill alignment to avoid impacts to the existing SAV habitat. Another concern was are there really are enough benefits to outweigh the impacts to their species. NOAA would like to see windows in the stone sills to allow for fish passage along with any other modifications we can do to beef up the marsh habitat for fish and to allow adequate flushing to occur. It will be important that stone sills are aligned such to allow fish to traverse both ways from the stone sills and within the channels within the marsh. NOAA would like to see some sort of mitigation with regards to SAV, would like to bring Lee Karrh from Maryland Department of Natural Resources into that discussion. Additionally NOAA would like USACE to overlay the 2015

		SAV GIS layer in order to better determine the current extent of existing SAV habitat to minimize impacts during project design.
21	20 June 2017	USACE letter to MDE requesting Water Quality Certification.

D-1

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Annapolis, Maryland 21401

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Wetlands and Waterway Construction Program
Maryland Department of the Environment
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Baltimore, Maryland 21230

Kirk G. Simpkins
P.O. 550
Princess Anne, MD 21853-0550

US Army Corps of Engineers
Baltimore District

Public Notice

Rhodes Point, Somerset County, Maryland Section 107

All Interested Parties: The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources (MDDNR), is proposing to restart work on the Rhodes Point, Somerset County, Maryland Section 107 project. Section 107 of the River and Harbor Act of 1960 provides authority for the Corps of Engineers to improve navigation including dredging of channels, anchorage areas, and turning basins and construction of breakwaters, jetties and groins, through a partnership with non-Federal government sponsors. This notice has been prepared to announce our intention to prepare an environmental assessment for the proposed project.

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

USACE is in the process of preparing an environmental assessment to reexamine jetty and sill alternatives that would minimize impacts to SAV and tidal wetlands while meeting navigation improvement needs. USACE is coordinating with resource agencies towards this purpose.

For federal and state resource agencies receiving a copy of this notice, we request that you provide information concerning interests within your organization's area of responsibility or expertise within 30 days from the date of this notice to the address below. A timely review of this information and a written response will be greatly appreciated.

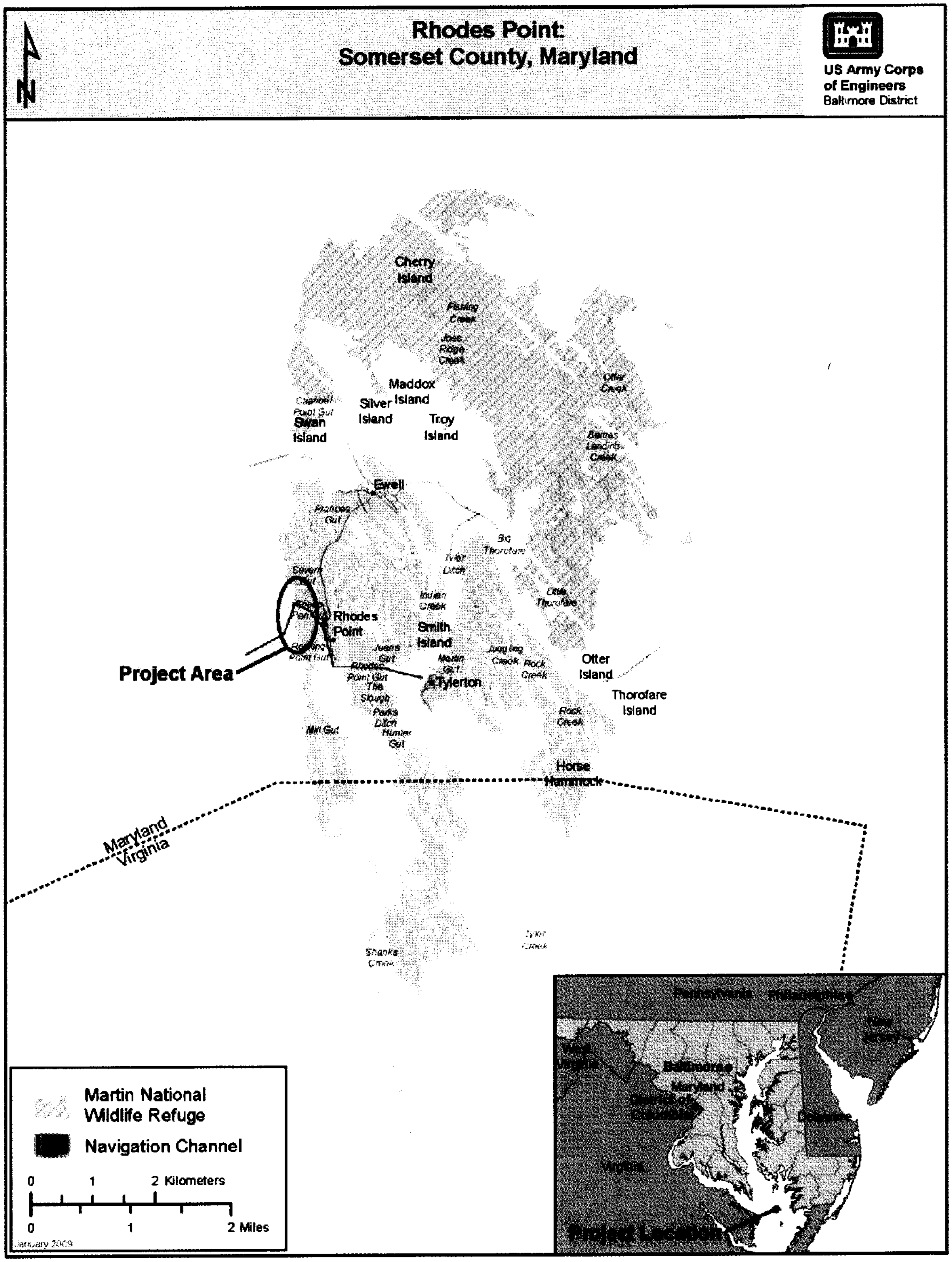
Please direct all correspondence to following address:

U.S. Army Corps of Engineers, Baltimore District
c/o Chris Spaur 11600-G
10. S. Howard Street
Baltimore, MD 21201

If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Daniel M. Bierly
Chief, Civil Project Development Branch

Enclosure
Site Map


Rhodes Point:
Somerset County, Maryland
N
US Army Corps
of Engineers
Baltimore District
Cherry Island
Maddox Island
Silver Island
Swan Island
Troy Island
Ewell
Rhodes Point
Smith Island
Tylerton
Otter Island
Thorofare Island
Horse Hammock
Project Area
Maryland
Virginia
Martin National Wildlife Refuge
Navigation Channel
0 1 2 Kilometers
0 1 2 Miles
Project Location

D-2

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P. O. BOX 1715
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Planning Division

Mr. Elder Ghigiarelli
Deputy Program Manager
Wetlands and Waterway Construction Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230

Dear Mr. Ghigiarelli:

The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources, is proposing to continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, Maryland. The USACE will be preparing an environmental assessment for this study. The purpose of this letter is to request any information your office may have regarding the study area (enclosure 1).

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

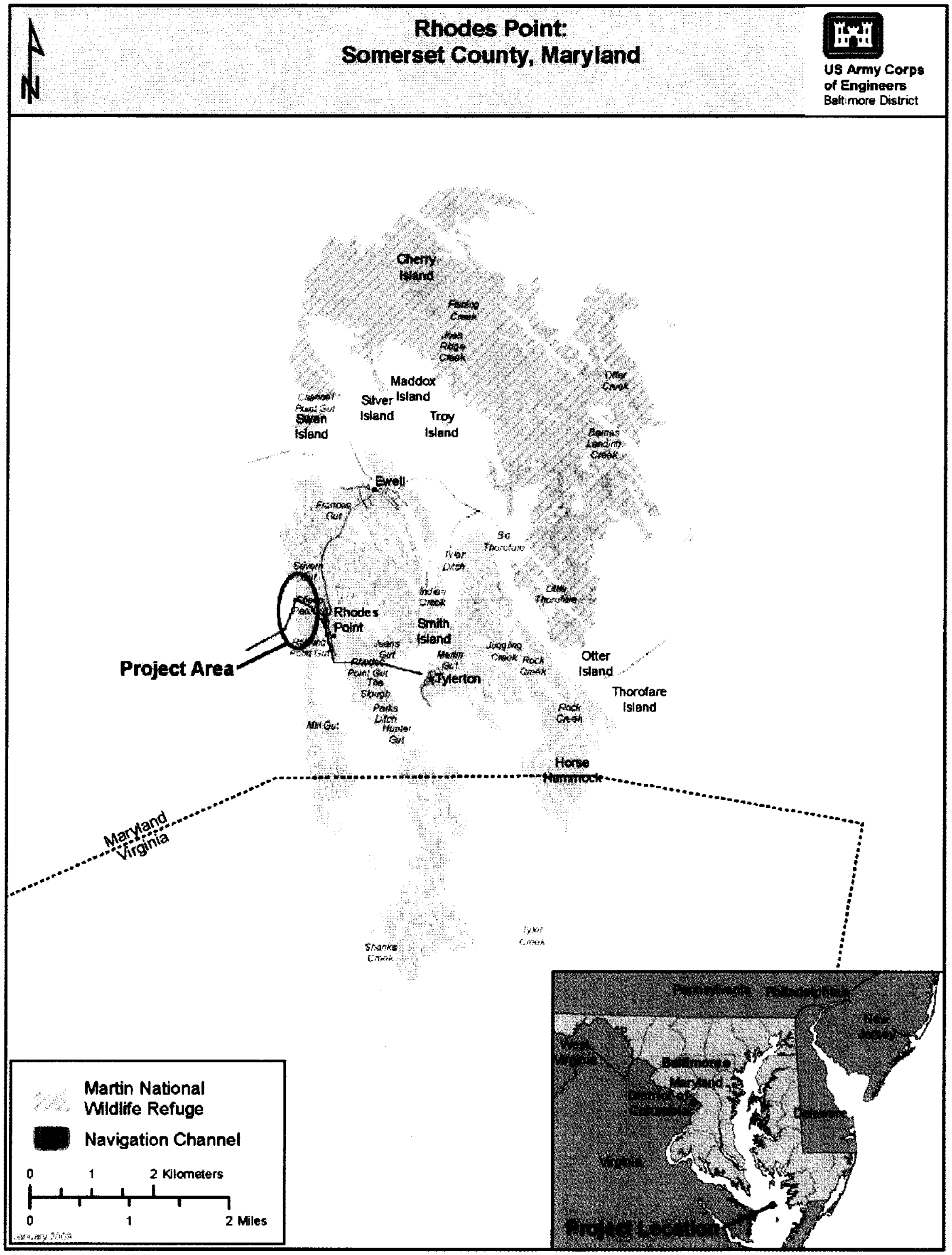
A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

We are currently preparing our National Environmental Policy Act documentation for this study. Please provide any information or concerns your agency may have that may assist us in the preparation of these documents. If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Sincerely,

Daniel M. Bierly
Chief,
Civil Project Development Branch

Enclosure
Site Map



U.S. ARMY CORPS OF ENGINEERS – BALTIMORE DISTRICT
P.O. Box 1715, Baltimore, MD 21203
http://www.nab.usace.army.mil

D-3

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
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BALTIMORE, MARYLAND 21203-1715

Planning Division

Ms. Lori Byrne
Wildlife and Heritage Service
Maryland Department of Natural Resources
Tawes State Office Building, E-1
580 Taylor Avenue
Annapolis, Maryland 21401

Dear Ms. Byrne:

The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources, is proposing to continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, Maryland. The USACE will be preparing an environmental assessment for this study. The purpose of this letter is to request any information your office may have regarding the study area (enclosure 1).

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

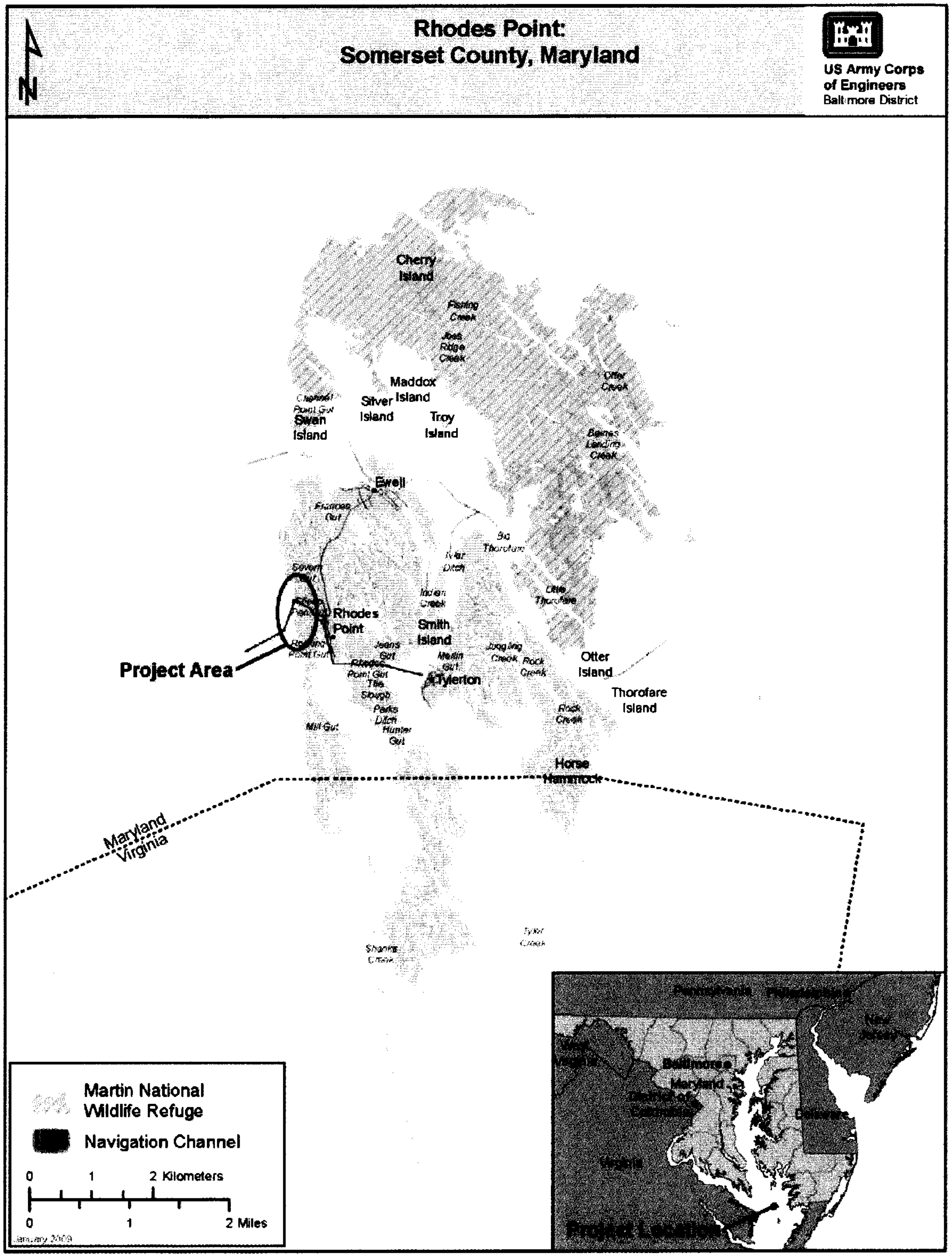
USACE is requesting any information your office may have on the presence of state-listed rare, threatened, and endangered species. This request is for the study area shown on the enclosed vicinity map (Enclosure). Please provide USACE with any comments or concerns regarding any protected plant and animal species in the area. Coordination letters have also been sent to the U.S. Fish and Wildlife Service (Chesapeake Bay Field Office in Annapolis) and the National Oceanic and Atmospheric Administration Fisheries for information on federally protected species listed by Section 7 of the Endangered Species Act. If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Sincerely,

Daniel M. Bierly
Chief,
Civil Project Development Branch

Enclosure
Site Map

CF: Tony Redman (MD DNR)
CPD Reading File



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D-4

DEPARTMENT OF THE ARMY
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Planning Division

Mr. Tony Redman
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Maryland Department of Natural Resources
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Annapolis, MD 21401

Dear Mr. Redman:

The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources, is proposing to continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, Maryland. The USACE will be preparing an environmental assessment for this study. The purpose of this letter is to request any information your office may have regarding the study area (enclosure 1).

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

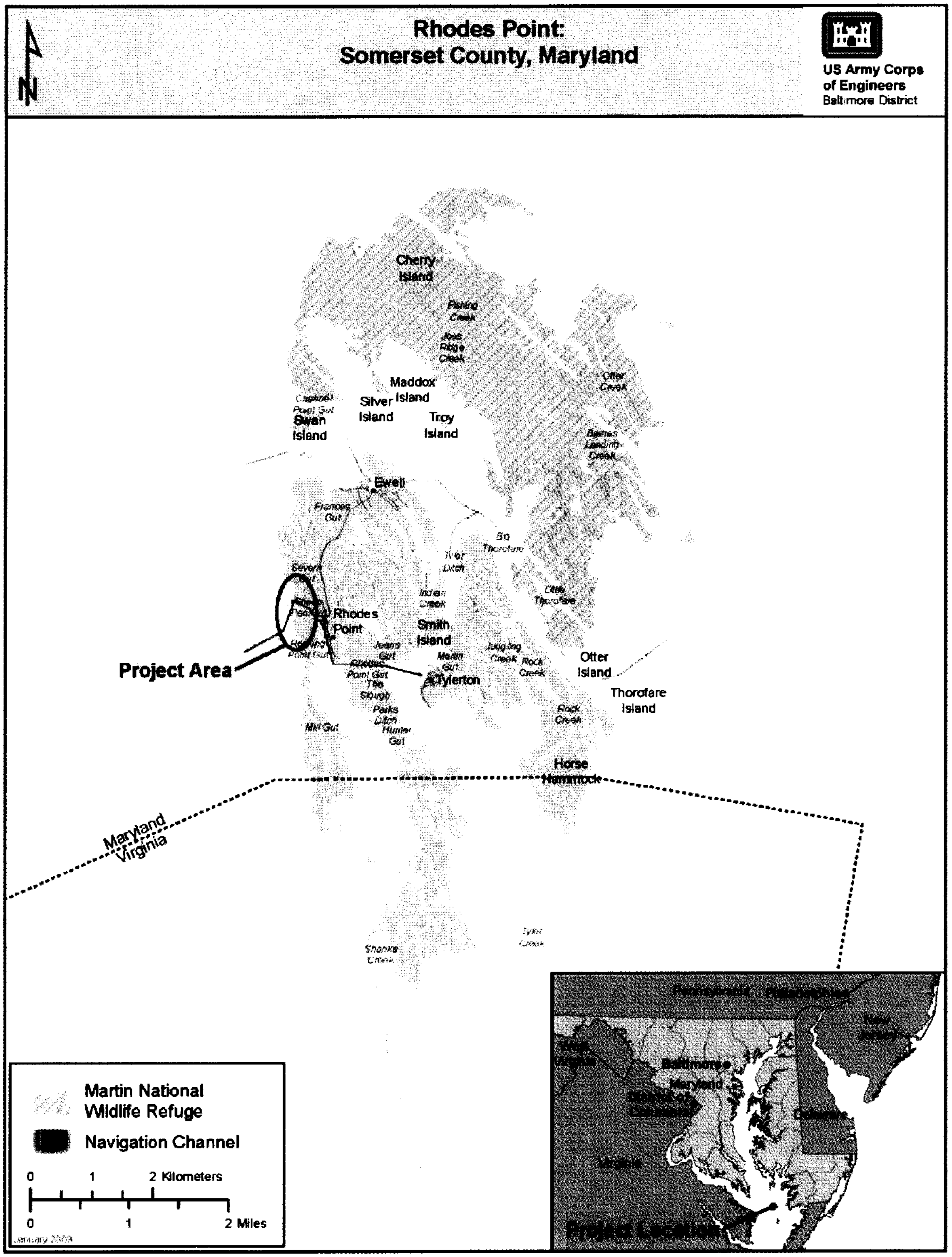
A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

We are currently preparing our National Environmental Policy Act documentation for this study. Please provide any information or concerns your agency may have that will assist us in the preparation of these documents. If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Sincerely,

Daniel M. Bierly
Chief,
Civil Project Development Branch

Enclosure
Site Map



U.S. ARMY CORPS OF ENGINEERS – BALTIMORE DISTRICT
P.O. Box 1715, Baltimore, MD 21203

http://www.nab.usace.army.mil

D-5

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P. O. BOX 1715
BALTIMORE, MARYLAND 21203-1715

Planning Division

Ms. Linda Janey
State Clearinghouse
Maryland Department of Planning
301 West Preston Street. Suite 1101
Baltimore, Maryland 21201-2305

Dear Ms. Janey:

The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources, is proposing to continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, Maryland. The USACE will be preparing an environmental assessment for this study. The purpose of this letter is to request any information your office may have regarding the study area (enclosure 1).

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

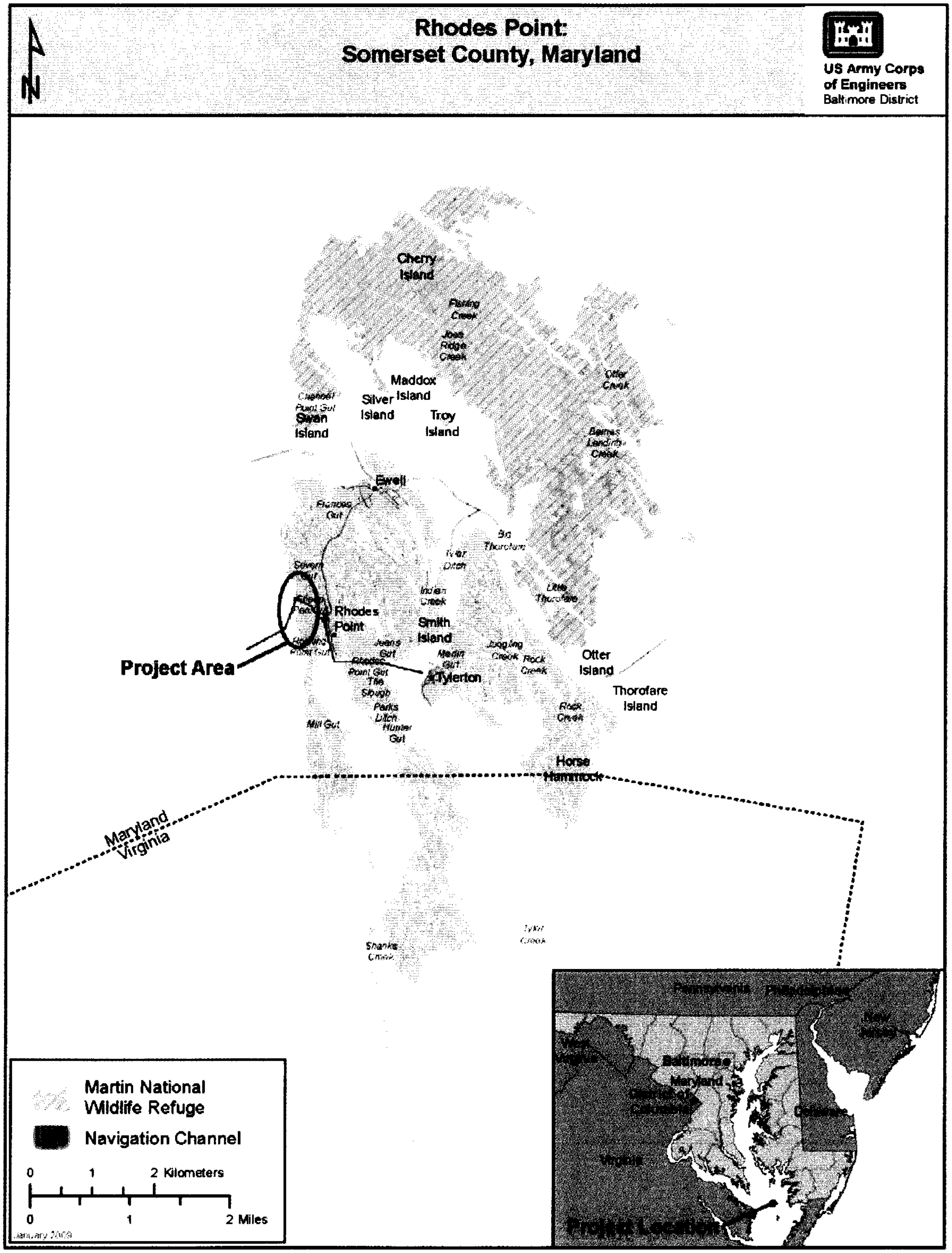
We are currently preparing our National Environmental Policy Act documentation for this study. Please provide any information or concerns your agency may have that will assist us in the preparation of these documents. If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Sincerely,

Daniel M. Bierly
Chief,
Civil Project Development Branch

Enclosure
Site Map

CPD Reading File



U.S. ARMY CORPS OF ENGINEERS – BALTIMORE DISTRICT
P.O. Box 1715, Baltimore, MD 21203

http://www.nab.usace.army.mil

D-6

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P. O. BOX 1715
BALTIMORE, MARYLAND 21203-1715

Planning Division

Brian D. Hopper
Protected Resources Division
National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office
177 Admiral Cochrane Dr.
Annapolis, MD 21401

Dear Mr. Hopper:

The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources, is proposing to continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, Maryland. The USACE will be preparing an environmental assessment for this study. The purpose of this letter is to request any information your office may have regarding the study area (enclosure 1).

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

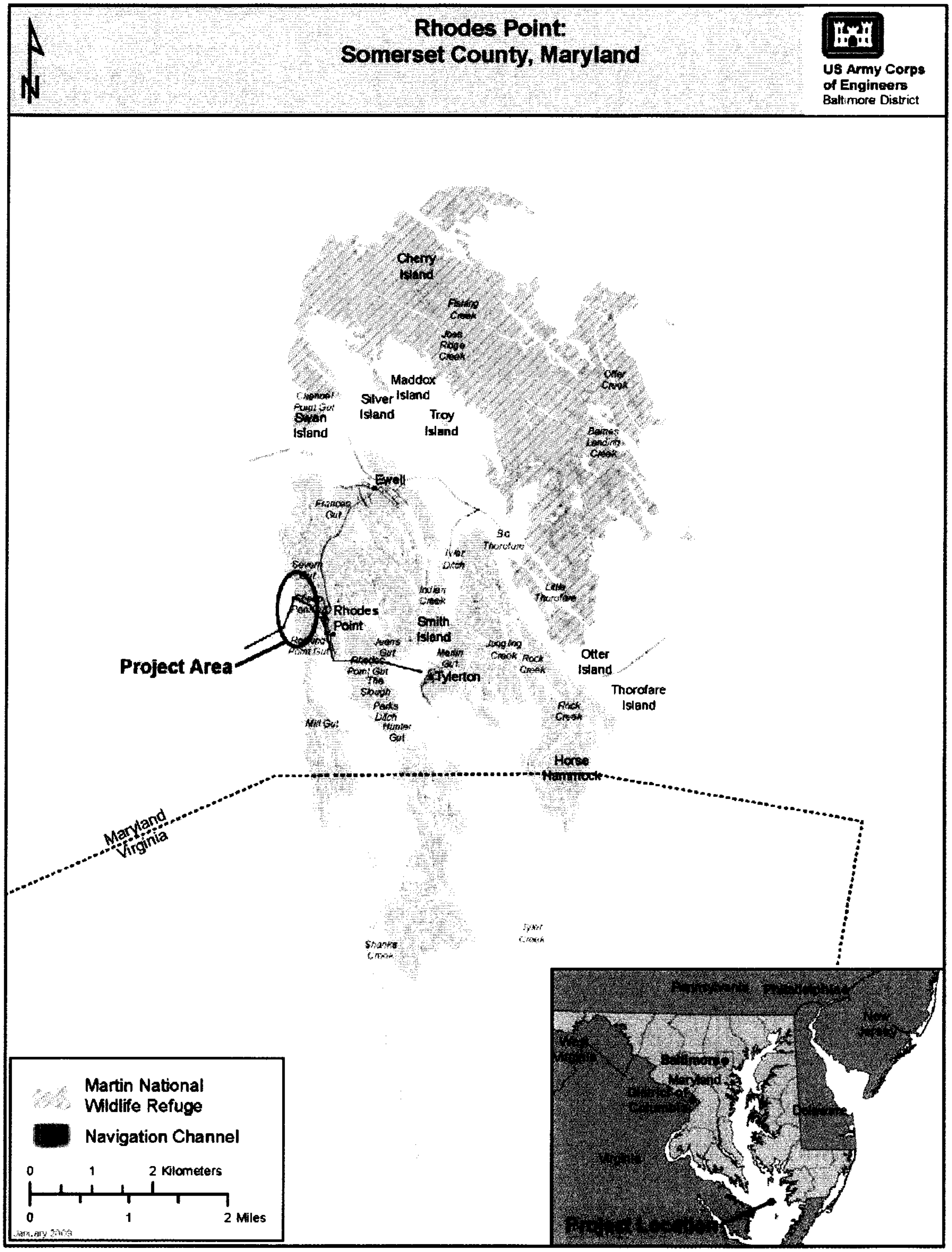
The USACE is requesting any information your office may have on the presence of federally protected species listed by Section 7 of the Endangered Species Act (ESA). This request is for the study area shown in the enclosed figure. Coordination letters have also been sent to Ms. Genevieve LaRouche, of the U.S. Fish and Wildlife Service (USFWS) Chesapeake Bay Field Office and Ms. Lori Byrne of the Wildlife and Heritage Service Maryland Department of Natural Resources, for information concerning listed and trust species. If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Sincerely,

Daniel M. Bierly
Chief,
Civil Project Development Branch

Enclosure
Site Map

CF: CPD Reading File
Kimberly Damon-Randall
Mark Murray-Brown


Rhodes Point:
Somerset County, Maryland
N
US Army Corps
of Engineers
Baltimore District
Cherry Island
Maddox Island
Silver Island
Swan Island
Troy Island
Ewell
Rhodes Point
Smith Island
Tylerton
Otter Island
Thorofare Island
Horse Hammock
Project Area
Maryland
Virginia
Martin National Wildlife Refuge
Navigation Channel
0 1 2 Kilometers
0 1 2 Miles
Project Location

D-7

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P. O. BOX 1715
BALTIMORE, MARYLAND 21203-1715

Planning Division

Ms. Genevieve LaRouche
Field Supervisor
Chesapeake Bay Field Office
U.S. Fish & Wildlife Service
177 Admiral Cochrane Drive
Annapolis, MD 21401

Dear Ms. LaRouche:

The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources, is proposing to continue the Section 107 Small Navigation project at the Rhodes Point, Smith Island, Maryland. The USACE will be preparing an environmental assessment for this action. The purpose of this letter is to request any information your office may have regarding the project area (enclosure 1).

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

The USACE is requesting any information your office may have on the presence of federally protected species of animals and plants listed by Section 7 of the Endangered

Species Act (ESA) within the study area. The U.S. Fish and Wildlife Service web site (http://ecos.fws.gov/ipac/) was consulted to prepare an Information, Planning, and Conservation Report (enclosure 2) which identified no endangered species, critical habitats, or national wildlife refuges in the immediate project area. However, the report identified 27 migratory birds of potential concern and wetlands in the project vicinity.

A letter has also been sent to Mr. Brian Hopper, Marine Habitat Resources Specialist, Office of Protected Resources, National Oceanic and Atmospheric Administration Fisheries Service, and Ms. Lori Byrne, Wildlife and Heritage Service, Maryland Department of Natural Resources, regarding Section 7 of the ESA.

We also request the Service's assistance in fulfilling the requirements of the Fish and Wildlife Coordination Act (FWCA) related to this project. USACE is committed to incorporating U.S. Fish and Wildlife Service input and interests throughout the study process, and your assistance is greatly appreciated. Please provide a point of contact for this coordination.

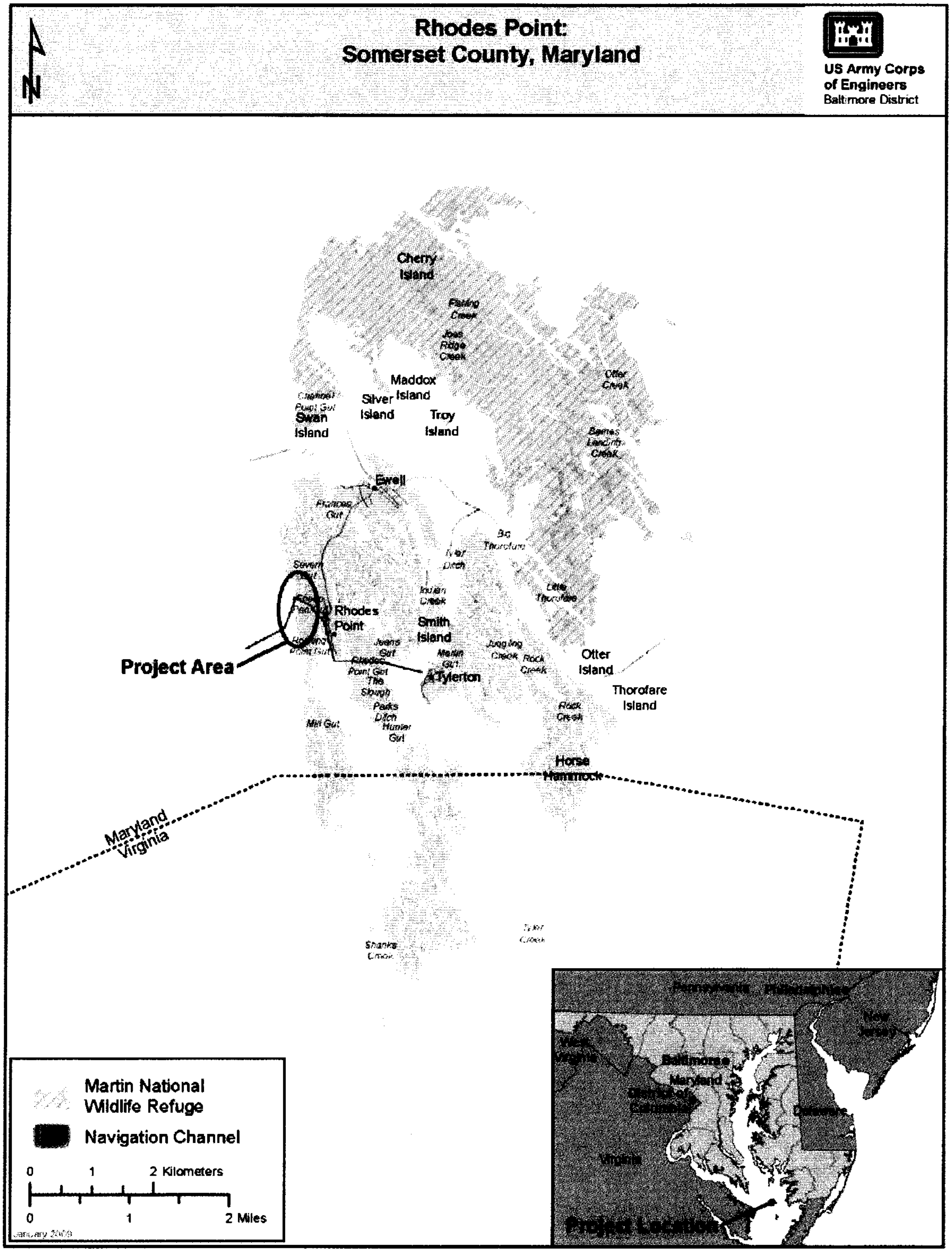
If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Sincerely,

Daniel M. Bierly
Chief,
Civil Project Development Branch

Enclosures
Site Map
Information, Planning, and Conservation Report

CF: Christopher Guy


Rhodes Point:
Somerset County, Maryland
N
US Army Corps
of Engineers
Baltimore District
Cherry Island
Maddox Island
Silver Island
Swan Island
Troy Island
Ewell
Rhodes Point
Smith Island
Tylerton
Otter Island
Thorofare Island
Horse Hammock
Project Area
Maryland
Virginia
Martin National Wildlife Refuge
Navigation Channel
0 1 2 Kilometers
0 1 2 Miles
Project Location

U.S. Fish and Wildlife Service

Trust Resources List

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

Chesapeake Bay Ecological Services Field Office
177 ADMIRAL COCHRANE DRIVE
ANNAPOLIS, MD 21401
(410) 573-4599

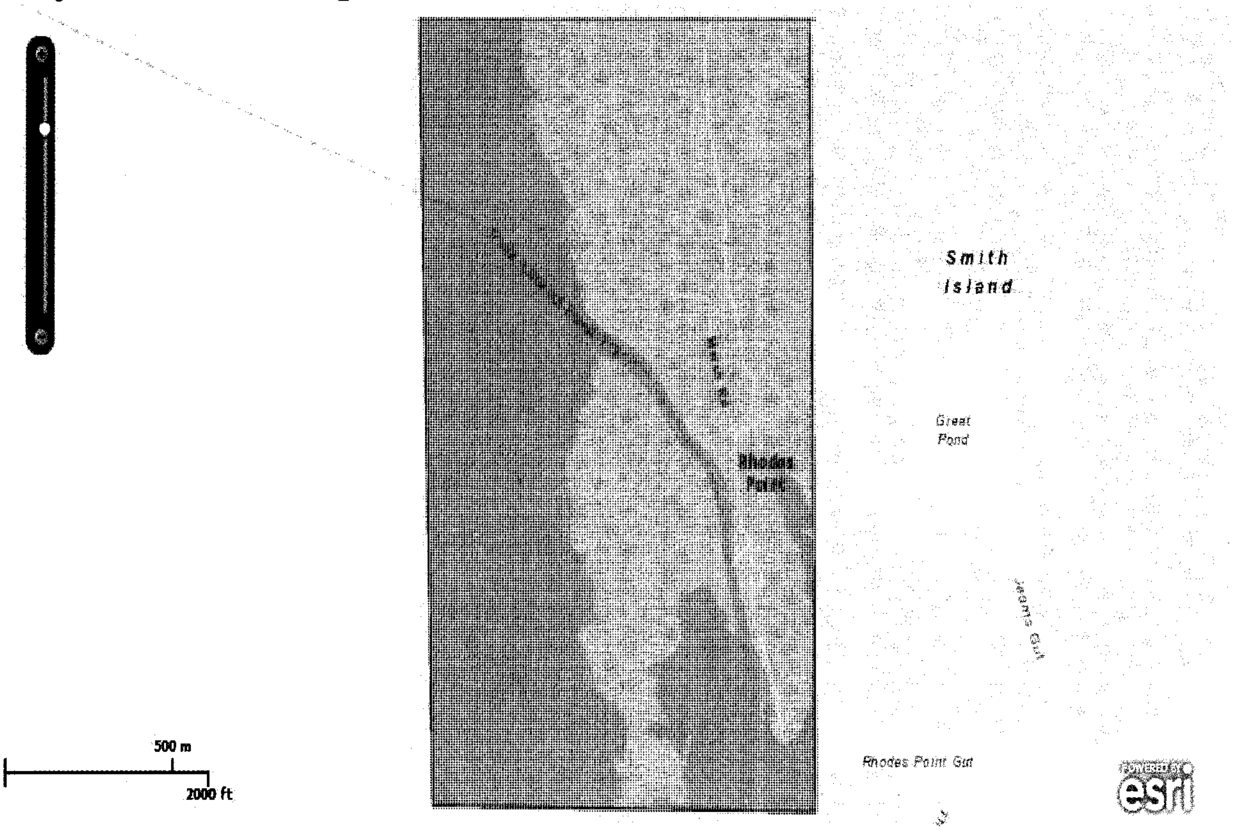
Project Name:

Rhodes Point

U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:



Project Counties:

Somerset, MD

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-76.0396161 37.98574506, -76.0393586 37.9689663, -76.0526623 37.9690982, -76.0531773 37.9857417, -76.0396161 37.98574506)), ((-76.0396161 37.98574506, -76.0396161 37.9857451, -76.0394444 37.9857451, -76.0396161 37.98574506)))

Project Type:

Land - Flooding

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are no listed species found within the vicinity of your project.

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. For more information regarding these Acts see: http://www.fws.gov/migratorybirds/RegulationsandPolicies.html.

All project proponents are responsible for complying with the appropriate regulations protecting birds when planning and developing a project. To meet these conservation obligations, proponents should identify potential or existing project-related impacts to migratory birds and their habitat and develop and implement conservation measures that avoid, minimize, or compensate for these impacts. The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

For information about Birds of Conservation Concern, go to: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

To search and view summaries of year-round bird occurrence data within your project area, go to the Avian Knowledge Network Histogram Tool links in the Bird Conservation Tools section at: http://www.fws.gov/migratorybirds/CCMB2.htm.

For information about conservation measures that help avoid or minimize impacts to birds, please visit: http://www.fws.gov/migratorybirds/CCMB2.htm.

Trust Resources List

Migratory birds of concern that may be affected by your project:
There are **27** birds on your Migratory birds of concern list. The underlying data layers used to generate the migratory bird list of concern will continue to be updated regularly as new and better information is obtained. User feedback is one method of identifying any needed improvements. Therefore, users are encouraged to submit comments about any questions regarding species ranges (e.g., a bird on the USFWS BCC list you know does not occur in the specified location appears on the list, or a BCC species that you know does occur there is not appearing on the list). Comments should be sent to the ECOS Help Desk.

Species Name	Bird of Conservation Concern (BCC)	Species Profile	Seasonal Occurrence in Project Area
American Oystercatcher (*Haematopus palliatus*)	Yes	species info	Year-round
American bittern (*Botaurus lentiginosus*)	Yes	species info	Wintering
Bald eagle (*Haliaeetus leucocephalus*)	Yes	species info	Year-round
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	Yes	species info	Breeding
Fox Sparrow (*Passerella liaca*)	Yes	species info	Wintering
Gull-billed Tern (*Gelochelidon nilotica*)	Yes	species info	Breeding
Horned Grebe (*Podiceps auritus*)	Yes	species info	Wintering
Kentucky Warbler (*Oporornis formosus*)	Yes	species info	Breeding
Least Bittern (*Ixobrychus exilis*)	Yes	species info	Breeding
Least tern (*Sterna antillarum*)	Yes	species info	Breeding
Lesser Yellowlegs (*Tringa flavipes*)	Yes	species info	Wintering
Marbled Godwit (*Limosa fedoa*)	Yes	species info	Wintering
Nelson's Sparrow (*Ammodramus nelsoni*)	Yes	species info	Wintering
Peregrine Falcon (*Falco peregrinus*)	Yes	species info	Wintering
Pied-billed Grebe (*Podilymbus podiceps*)	Yes	species info	Year-round

Prairie Warbler (*Dendroica discolor*)	Yes	species info	Breeding
Prothonotary Warbler (*Protonotaria citrea*)	Yes	species info	Breeding
Purple Sandpiper (*Calidris maritima*)	Yes	species info	Wintering
Red Knot (*Calidris canutus rufa*)	Yes	species info	Wintering
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	Yes	species info	Year-round
Rusty Blackbird (*Euphagus carolinus*)	Yes	species info	Wintering
Saltmarsh Sparrow (*Ammodramus caudacutus*)	Yes	species info	Year-round
Seaside Sparrow (*Ammodramus maritimus*)	Yes	species info	Year-round
Short-billed Dowitcher (*Limnodromus griseus*)	Yes	species info	Wintering
Short-eared Owl (*Asio flammeus*)	Yes	species info	Wintering
Snowy Egret (*Egretta thula*)	Yes	species info	Breeding
Wood Thrush (*Hylocichla mustelina*)	Yes	species info	Breeding

NWI Wetlands (USFWS National Wetlands Inventory).

The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

Trust Resources List

Data Limitations, Exclusions and Precautions
The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Exclusions - Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Precautions - Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

IPaC is unable to display wetland information at this time.

U.S. Fish and Wildlife Service

Trust Resources List

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

Chesapeake Bay Ecological Services Field Office
177 ADMIRAL COCHRANE DRIVE
ANNAPOLIS, MD 21401
(410) 573-4599

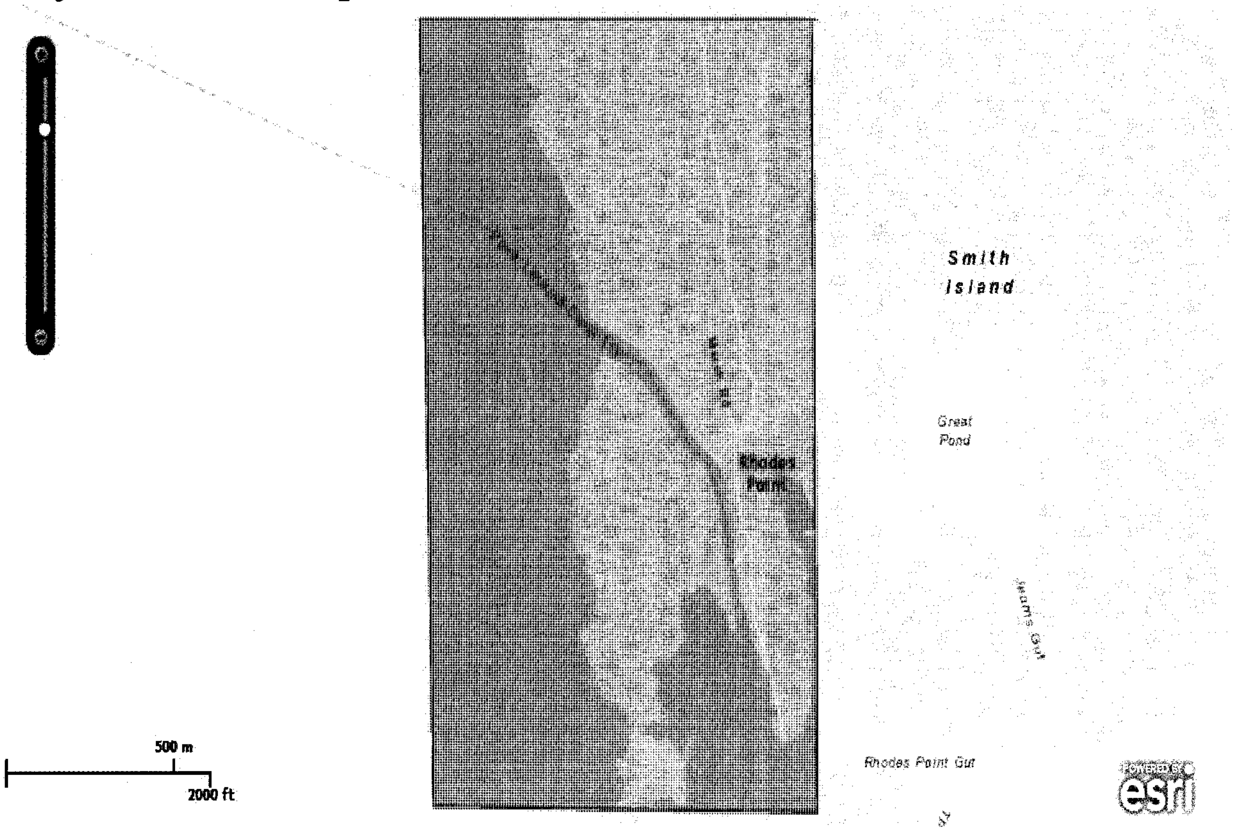
Project Name:

Rhodes Point

U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:



Project Counties:

Somerset, MD

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-76.0396161 37.98574506, -76.0393586 37.9689663, -76.0526623 37.9690982, -76.0531773 37.9857417, -76.0396161 37.98574506)), ((-76.0396161 37.98574506, -76.0396161 37.9857451, -76.0394444 37.9857451, -76.0396161 37.98574506)))

Project Type:

Land - Flooding

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are no listed species found within the vicinity of your project.

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. For more information regarding these Acts see: http://www.fws.gov/migratorybirds/RegulationsandPolicies.html.

All project proponents are responsible for complying with the appropriate regulations protecting birds when planning and developing a project. To meet these conservation obligations, proponents should identify potential or existing project-related impacts to migratory birds and their habitat and develop and implement conservation measures that avoid, minimize, or compensate for these impacts. The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

For information about Birds of Conservation Concern, go to: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

To search and view summaries of year-round bird occurrence data within your project area, go to the Avian Knowledge Network Histogram Tool links in the Bird Conservation Tools section at: http://www.fws.gov/migratorybirds/CCMB2.htm.

For information about conservation measures that help avoid or minimize impacts to birds, please visit: http://www.fws.gov/migratorybirds/CCMB2.htm.

Trust Resources List

Migratory birds of concern that may be affected by your project:
There are **27** birds on your Migratory birds of concern list. The underlying data layers used to generate the migratory bird list of concern will continue to be updated regularly as new and better information is obtained. User feedback is one method of identifying any needed improvements. Therefore, users are encouraged to submit comments about any questions regarding species ranges (e.g., a bird on the USFWS BCC list you know does not occur in the specified location appears on the list, or a BCC species that you know does occur there is not appearing on the list). Comments should be sent to the ECOS Help Desk.

Species Name	Bird of Conservation Concern (BCC)	Species Profile	Seasonal Occurrence in Project Area
American Oystercatcher (*Haematopus palliatus*)	Yes	species info	Year-round
American bittern (*Botaurus lentiginosus*)	Yes	species info	Wintering
Bald eagle (*Haliaeetus leucocephalus*)	Yes	species info	Year-round
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Fox Sparrow (*Passerella liaca*)	Yes	species info	Wintering
Gull-billed Tern (*Gelochelidon nilotica*)	Yes	species info	Breeding
Horned Grebe (*Podiceps auritus*)	Yes	species info	Wintering
Kentucky Warbler (*Oporornis formosus*)	Yes	species info	Breeding
Least Bittern (*Ixobrychus exilis*)	Yes	species info	Breeding
Least tern (*Sterna antillarum*)	Yes	species info	Breeding
Lesser Yellowlegs (*Tringa flavipes*)	Yes	species info	Wintering
Marbled Godwit (*Limosa fedoa*)	Yes	species info	Wintering
Nelson's Sparrow (*Ammodramus nelsoni*)	Yes	species info	Wintering
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Saltmarsh Sparrow (*Ammodramus caudacutus*)	Yes	species info	Year-round
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The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

Trust Resources List

Data Limitations, Exclusions and Precautions
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IPaC is unable to display wetland information at this time.

U.S. Fish and Wildlife Service

Trust Resources List

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

Chesapeake Bay Ecological Services Field Office
177 ADMIRAL COCHRANE DRIVE
ANNAPOLIS, MD 21401
(410) 573-4599

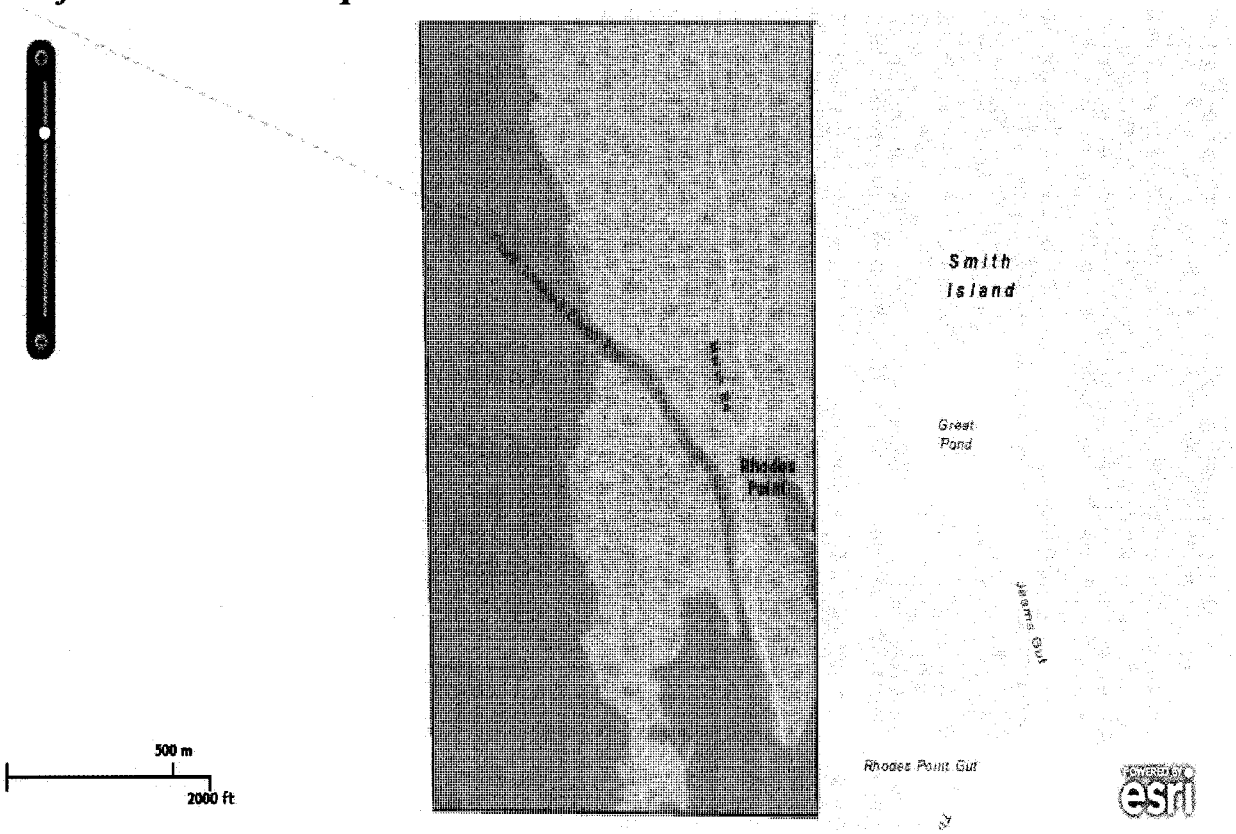
Project Name:

Rhodes Point

U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:



Project Counties:

Somerset, MD

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-76.0396161 37.98574506, -76.0393586 37.9689663, -76.0526623 37.9690982, -76.0531773 37.9857417, -76.0396161 37.98574506)), ((-76.0396161 37.98574506, -76.0396161 37.9857451, -76.0394444 37.9857451, -76.0396161 37.98574506)))

Project Type:

Land - Flooding

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are no listed species found within the vicinity of your project.

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. For more information regarding these Acts see: http://www.fws.gov/migratorybirds/RegulationsandPolicies.html.

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For information about Birds of Conservation Concern, go to: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

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Species Name	Bird of Conservation Concern (BCC)	Species Profile	Seasonal Occurrence in Project Area
American Oystercatcher (*Haematopus palliatus*)	Yes	species info	Year-round
American bittern (*Botaurus lentiginosus*)	Yes	species info	Wintering
Bald eagle (*Haliaeetus leucocephalus*)	Yes	species info	Year-round
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	Yes	species info	Breeding
Fox Sparrow (*Passerella liaca*)	Yes	species info	Wintering
Gull-billed Tern (*Gelochelidon nilotica*)	Yes	species info	Breeding
Horned Grebe (*Podiceps auritus*)	Yes	species info	Wintering
Kentucky Warbler (*Oporornis formosus*)	Yes	species info	Breeding
Least Bittern (*Ixobrychus exilis*)	Yes	species info	Breeding
Least tern (*Sterna antillarum*)	Yes	species info	Breeding
Lesser Yellowlegs (*Tringa flavipes*)	Yes	species info	Wintering
Marbled Godwit (*Limosa fedoa*)	Yes	species info	Wintering
Nelson's Sparrow (*Ammodramus nelsoni*)	Yes	species info	Wintering
Peregrine Falcon (*Falco peregrinus*)	Yes	species info	Wintering
Pied-billed Grebe (*Podilymbus podiceps*)	Yes	species info	Year-round

Trust Resources List

Prairie Warbler (*Dendroica discolor*)	Yes	species info	Breeding
Prothonotary Warbler (*Protonotaria citrea*)	Yes	species info	Breeding
Purple Sandpiper (*Calidris maritima*)	Yes	species info	Wintering
Red Knot (*Calidris canutus rufa*)	Yes	species info	Wintering
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Saltmarsh Sparrow (*Ammodramus caudacutus*)	Yes	species info	Year-round
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Wood Thrush (*Hylocichla mustelina*)	Yes	species info	Breeding

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Trust Resources List

Data Limitations, Exclusions and Precautions
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U.S. Fish and Wildlife Service

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177 ADMIRAL COCHRANE DRIVE
ANNAPOLIS, MD 21401
(410) 573-4599

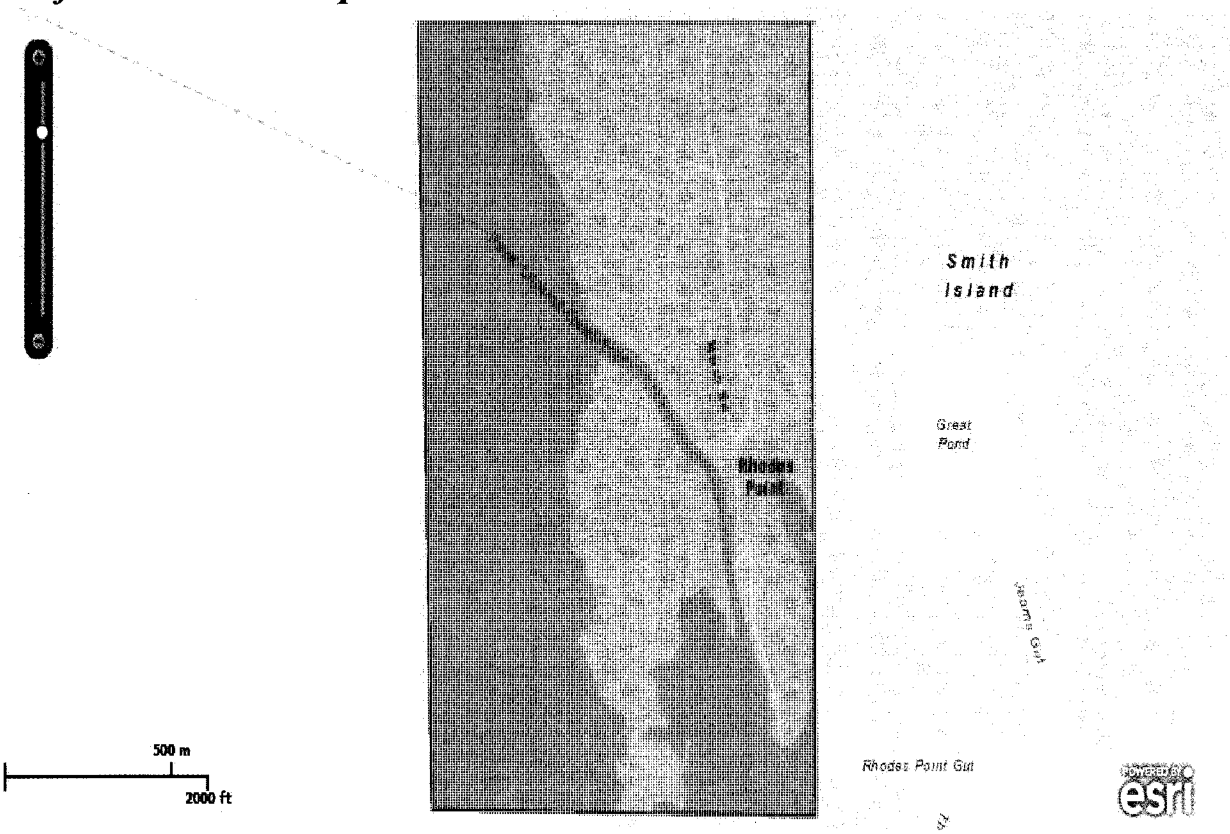
Project Name:

Rhodes Point

U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:



Project Counties:

Somerset, MD

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-76.0396161 37.98574506, -76.0393586 37.9689663, -76.0526623 37.9690982, -76.0531773 37.9857417, -76.0396161 37.98574506)), ((-76.0396161 37.98574506, -76.0396161 37.9857451, -76.0394444 37.9857451, -76.0396161 37.98574506)))

Project Type:

Land - Flooding

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are no listed species found within the vicinity of your project.

Critical habitats within your project area:

There are no critical habitats within your project area.

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Trust Resources List

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Trust Resources List

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U.S. Fish and Wildlife Service

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177 ADMIRAL COCHRANE DRIVE
ANNAPOLIS, MD 21401
(410) 573-4599

Project Name:

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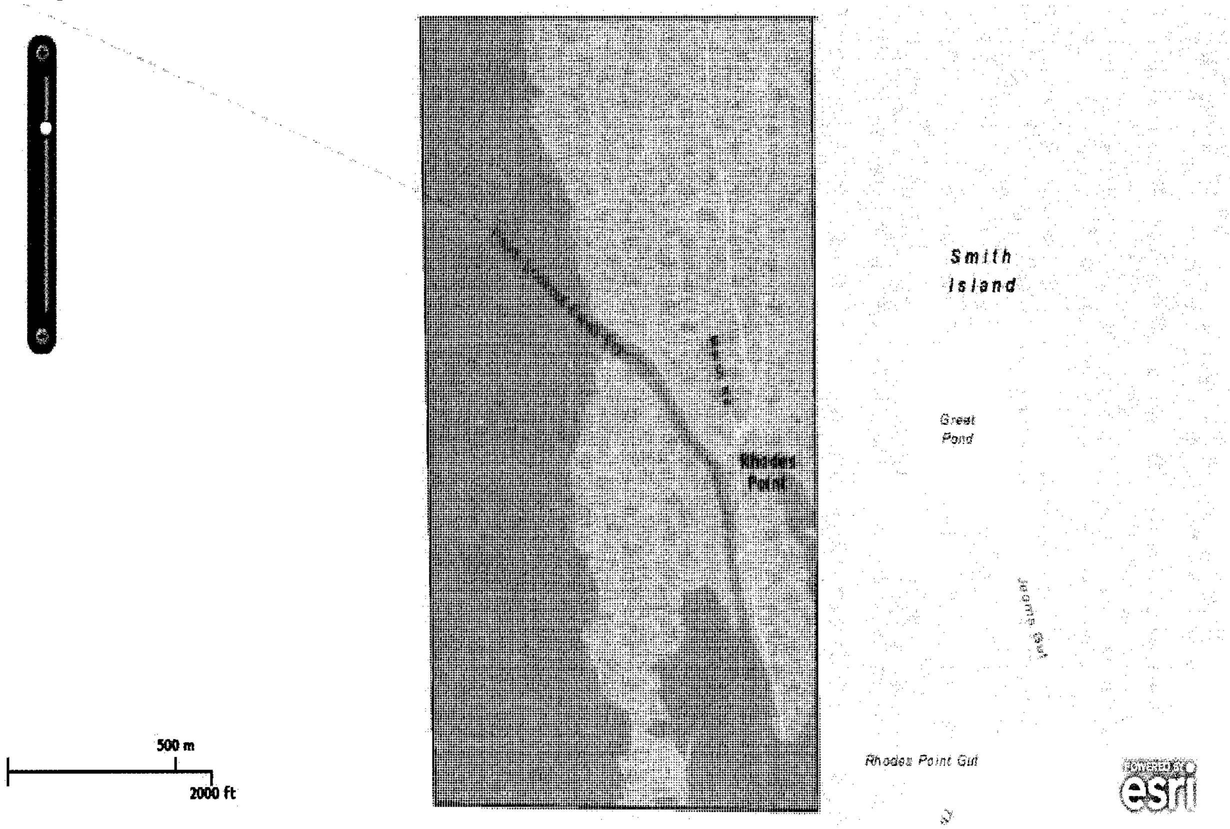
U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:



Project Counties:

Somerset, MD

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-76.0396161 37.98574506, -76.0393586 37.9689663, -76.0526623 37.9690982, -76.0531773 37.9857417, -76.0396161 37.98574506)), ((-76.0396161 37.98574506, -76.0396161 37.9857451, -76.0394444 37.9857451, -76.0396161 37.98574506)))

Project Type:

Land - Flooding

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are no listed species found within the vicinity of your project.

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

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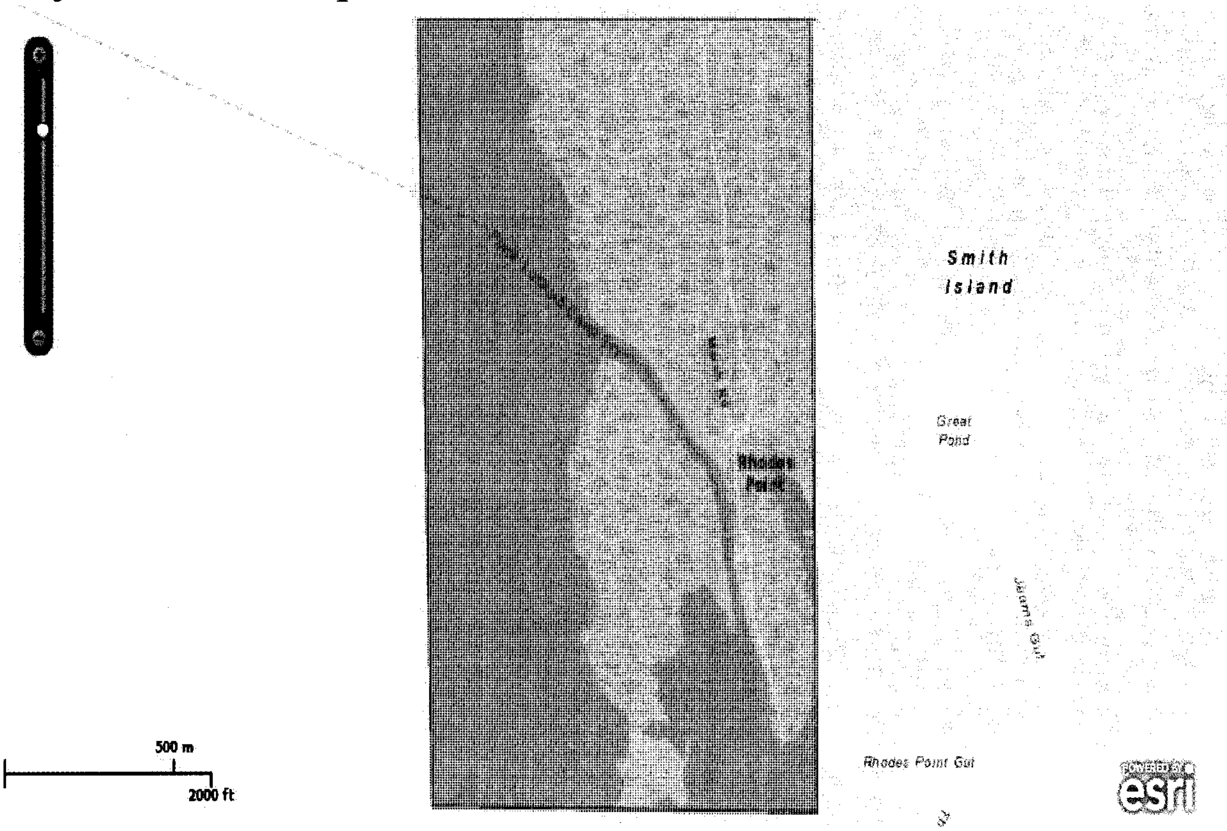
Project Location Map:



Project Counties:

Somerset, MD

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Project Type:

Land - Flooding

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are no listed species found within the vicinity of your project.

Critical habitats within your project area:

There are no critical habitats within your project area.

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. For more information regarding these Acts see: http://www.fws.gov/migratorybirds/RegulationsandPolicies.html.

All project proponents are responsible for complying with the appropriate regulations protecting birds when planning and developing a project. To meet these conservation obligations, proponents should identify potential or existing project-related impacts to migratory birds and their habitat and develop and implement conservation measures that avoid, minimize, or compensate for these impacts. The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

For information about Birds of Conservation Concern, go to:
http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

To search and view summaries of year-round bird occurrence data within your project area, go to the Avian Knowledge Network Histogram Tool links in the Bird Conservation Tools section at: http://www.fws.gov/migratorybirds/CCMB2.htm.

For information about conservation measures that help avoid or minimize impacts to birds, please visit:
http://www.fws.gov/migratorybirds/CCMB2.htm.

Trust Resources List

Migratory birds of concern that may be affected by your project:

There are **27** birds on your Migratory birds of concern list. The underlying data layers used to generate the migratory bird list of concern will continue to be updated regularly as new and better information is obtained. User feedback is one method of identifying any needed improvements. Therefore, users are encouraged to submit comments about any questions regarding species ranges (e.g., a bird on the USFWS BCC list you know does not occur in the specified location appears on the list, or a BCC species that you know does occur there is not appearing on the list). Comments should be sent to the ECOS Help Desk.

Species Name	Bird of Conservation Concern (BCC)	Species Profile	Seasonal Occurrence in Project Area
American Oystercatcher (*Haematopus palliatus*)	Yes	species info	Year-round
American bittern (*Botaurus lentiginosus*)	Yes	species info	Wintering
Bald eagle (*Haliaeetus leucocephalus*)	Yes	species info	Year-round
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	Yes	species info	Breeding
Fox Sparrow (*Passerella liaca*)	Yes	species info	Wintering
Gull-billed Tern (*Gelochelidon nilotica*)	Yes	species info	Breeding
Horned Grebe (*Podiceps auritus*)	Yes	species info	Wintering
Kentucky Warbler (*Oporornis formosus*)	Yes	species info	Breeding
Least Bittern (*Ixobrychus exilis*)	Yes	species info	Breeding
Least tern (*Sterna antillarum*)	Yes	species info	Breeding
Lesser Yellowlegs (*Tringa flavipes*)	Yes	species info	Wintering
Marbled Godwit (*Limosa fedoa*)	Yes	species info	Wintering
Nelson's Sparrow (*Ammodramus nelsoni*)	Yes	species info	Wintering
Peregrine Falcon (*Falco peregrinus*)	Yes	species info	Wintering
Pied-billed Grebe (*Podilymbus podiceps*)	Yes	species info	Year-round

Prairie Warbler (*Dendroica discolor*)	Yes	species info	Breeding
Prothonotary Warbler (*Protonotaria citrea*)	Yes	species info	Breeding
Purple Sandpiper (*Calidris maritima*)	Yes	species info	Wintering
Red Knot (*Calidris canutus rufa*)	Yes	species info	Wintering
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	Yes	species info	Year-round
Rusty Blackbird (*Euphagus carolinus*)	Yes	species info	Wintering
Saltmarsh Sparrow (*Ammodramus caudacutus*)	Yes	species info	Year-round
Seaside Sparrow (*Ammodramus maritimus*)	Yes	species info	Year-round
Short-billed Dowitcher (*Limnodromus griseus*)	Yes	species info	Wintering
Short-eared Owl (*Asio flammeus*)	Yes	species info	Wintering
Snowy Egret (*Egretta thula*)	Yes	species info	Breeding
Wood Thrush (*Hylocichla mustelina*)	Yes	species info	Breeding

NWI Wetlands (USFWS National Wetlands Inventory).

The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

Trust Resources List

Data Limitations, Exclusions and Precautions

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Exclusions - Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Precautions - Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

IPaC is unable to display wetland information at this time.

D-8

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

APR 17 2015

Daniel M. Bierly
Chief, Civil Project Development Branch
Department of the Army
Baltimore District, Army Corps of Engineers
P.O. Box 1715
Baltimore, MD 21203-1715

Re: Smith Island Navigation Project

Dear Mr. Bierly:

We received your letter on April 6, 2015, regarding the Small Navigation Study at the Rhodes Point, Smith Island, Maryland. In your letter, you requested information on the presence of threatened and endangered species and critical habitat listed under the jurisdiction of NOAA's National Marine Fisheries Service (NMFS). It is our understanding that you are exploring the feasibility of realigning the existing federal navigation channel, which includes 1,000 linear foot twin jetties on either side of the channel and a 200 foot long jetty extension located landward of the south jetty to prevent flanking. We offer the following comments.

Four species of federally listed threatened or endangered sea turtles under our jurisdiction are found seasonally in the Chesapeake Bay and the coastal waters of Maryland and Virginia: the threatened Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead (*Caretta caretta*), and the endangered Kemp's ridley (*Lepidochelys kempi*), green (*Chelonia mydas*) and leatherback sea turtles (*Dermochelys coriacea*). These species are seasonally present in the Bay, typically from April – November.

Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are present in the Chesapeake Bay and its adjacent rivers and tributaries, and the coastal waters of Maryland and Virginia. The New York Bight, Chesapeake Bay, South Atlantic and Carolina DPS of Atlantic sturgeon are endangered; the Gulf of Maine DPS is threatened. Individuals originating from any of these DPS could occur in the project area.

Shortnose sturgeon (*Acipenser brevirostrum*) are present in the Chesapeake Bay and some of its tributaries, including the Susquehanna and Potomac Rivers. Shortnose sturgeon are endangered throughout their range.

Several endangered species of large whales, including the right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), finback (*Balaenoptera physalis*), the sei whale

(*Balaenoptera borealis*), and the sperm whale (*Physeter macrocephalus*) are seasonally present along the Atlantic seaboard, including off the coast of Maryland and Virginia. It does not appear that the proposed actions would overlap with areas where listed whales occur.

As listed species are likely to be present in the vicinity of the proposed projects, a consultation pursuant to section 7 of the ESA may be necessary. As project details develop, we recommend you consider the following effects of the projects on sea turtles and sturgeon:

- Injury or mortality due to capture, impingement or entrainment in a dredge;
- Effects of increased suspended sediment through dredging and disposal;
- Impacts of dredge and dredged materials disposal vessels;
- Potential impacts of change in vessel traffic in the widened channels;
- Suspension of contaminated sediment;
- Discharge of any other pollutant;
- Loss of prey and,
- Any impacts to habitat or conditions that make affected water bodies less suitable for these species.

The US Army Corps of Engineers will be responsible for determining whether the proposed action may affect listed species. If you have any questions regarding these comments, please contact Brian D. Hopper (410-573-4592; brian.d.hopper@noaa.gov).

NMFS' Habitat Conservation Division (HCD) is responsible for overseeing issues related to Essential Fish Habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act and other NOAA trust resources under the Fish and Wildlife Coordination Act. If you have any questions regarding EFH, please contact Kristy Beard (410-573-4542; Kristy.Beard@noaa.gov).

Sincerely,

Mark Murray-Brown

for

Kim Damon-Randall
Assistant Regional Administrator for
Protected Resources

Enclosure

EC: Beard, HCD; Spaur, ACOE

File Code: Non-Fisheries\ACOE\Technical Assistance\2015\Smith Island

D-9

Rhodes Point Navigation Improvement Project

Location: Rhodes Point, Smith Island, Maryland

Date: April 29, 2015

Time: 11:00 – 3:00

Attendance

Tony Clark (USACE)
Chris Spaur (USACE)
Seth Keller (USACE)
Carol Ohl (USACE
John Svitil (USACE)
Tom Laczo (USACE)
Jim Ludlum (USACE)
Chris Guy (USFWS)
Michelle Magliocca (NOAA)

Agenda Items

1. View Existing Conditions of the project site.
2. Stone Sill Alignments
3. Discuss potential Environmental Impacts

Action Items

1. Provide agencies updated modeling results
2. Provide agencies updated SAV footprint in relation to alignment
3. Provide agencies updated dredging quantities for placement

Other Notes

USFWS and NOAA think the idea of a sill with windows, landward of existing SAV beds, is something NOAA can support. Since the sill is just conceptual at this point, we'll be able to provide more detailed feedback once we see a project design showing the actual footprint in relation to existing SAV.

D-10

From: Clark, Anthony A NAB
Sent: Tuesday, May 05, 2015 12:49 PM
To: Spaur, Christopher NAB
Subject: FW: [EXTERNAL] Rhodes Point (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

fyi

-----Original Message-----
From: Michelle Magliocca - NOAA Federal [mailto:michelle.magliocca@noaa.gov]
Sent: Monday, May 04, 2015 8:38 AM
To: Clark, Anthony A NAB
Subject: [EXTERNAL] Rhodes Point

Hi Tony,

It was great to meet you last week and I think the site visit was very productive. Just to reiterate what I said on site, I think the idea of a sill with windows, landward of existing SAV beds, is something NOAA can support. Since the sill is just conceptual at this point, we'll be able to provide more detailed feedback once we see a project design showing the actual footprint in relation to existing SAV.

I'll be out of the country and tied up in all-day meetings from May 7 through May 21, but happy to look at any further material you have when I'm back in the office.

Thanks,
Michelle

--

Michelle Magliocca
NOAA Fisheries

Habitat Conservation Division
177 Admiral Cochrane Drive
Annapolis, MD 21401
410-573-4559
www.nmfs.noaa.gov <http://www.nmfs.noaa.gov/>

<https://lh4.googleusercontent.com/oDRE7GW-HK9U7Jcpihy6xN4gbWKzA6Wi9oBeAnQEnz_8PcO4nPuqbGH_-ZNt7InLiSclF8ybZkB0tutCjRSRKgipQCSjE_kYwzS7YCDK1zym_Yez_DU>

Classification: UNCLASSIFIED
Caveats: NONE

Compton, Anna M NAB

From: Keller, Seth D NAB
Sent: Monday, August 29, 2016 9:01 AM
To: Compton, Anna M NAB
Subject: FW: [EXTERNAL] Re: Rhodes Point EFH designation (UNCLASSIFIED)
Attachments: Rhodes point efh species determination.docx

-----Original Message-----
From: Keller, Seth D NAB
Sent: Wednesday, May 06, 2015 11:19 AM
To: Kristy Beard - NOAA Federal <kristy.beard@noaa.gov>
Cc: Michelle Magliocca - NOAA Federal <michelle.magliocca@noaa.gov>; Spaur, Christopher NAB <Christopher.C.Spaur@usace.army.mil>
Subject: RE: [EXTERNAL] Re: Rhodes Point EFH designation (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Kristy,

Thanks for the quick response. I updated the document to reflect the skates, omit the red drum and note the HAPC for summer flounder. Juvenile and adult Clearnose skate, juvenile and adult little skate and juvenile and adult winter skate have EFH designations in the proposed project area. It is unlikely that any of these species will be found in the project area, as they usually don't venture much further than the southern end of the Bay and/or prefer water with higher salinity.

Thanks again,

Seth

Seth Keller
US Army Corps of Engineers
Baltimore District, Planning Division
seth.d.keller@usace.army.mil
410 962 4940

-----Original Message-----
From: Kristy Beard - NOAA Federal [mailto:kristy.beard@noaa.gov]
Sent: Wednesday, May 06, 2015 10:14 AM
To: Keller, Seth D NAB
Cc: Michelle Magliocca - NOAA Federal
Subject: [EXTERNAL] Re: Rhodes Point EFH designation (UNCLASSIFIED)

Hi Seth,

Three things:

D-11

1. There is EFH designated for some skate species in the Chesapeake Bay, which are not included on the tables on our website. You can find the information here <http://www.greateratlantic.fisheries.noaa.gov/hcd/skateefhmaps.htm> .
2. You don't need to include red drum. Management of that species was given to the states a few years ago, but our website hasn't been updated.
3. SAV beds are HAPC for summer flounder <http://www.greateratlantic.fisheries.noaa.gov/hcd/summerflounder.htm> .

Otherwise it looks good. I like the way you summarized why other species are unlikely to be affected.

Let me know if you have questions,
Kristy

On Wed, May 6, 2015 at 8:53 AM, Keller, Seth D NAB <Seth.D.Keller@usace.army.mil> wrote:

Classification: UNCLASSIFIED
Caveats: NONE

Kristy,

My name is Seth Keller from the U.S. Army Corps of Engineers, Baltimore Planning Division. I have been coordinating with Michelle Magliocca on the EFH designations for the Rhodes Point project. Since she will be out of town she suggested I contact you.

The project will roughly consist of the construction of jetties, a sill and channel dredging. I have attached a public notice and map of the area. If you need more information let me know.

The Rhodes Point proposed project area has designated EFH for eight species. Of these, three are likely to occur at the proposed site and will be included in the EFH assessment. These are juvenile and adult bluefish, juvenile and adult summer flounder and all life stages of red drum. We also noted that the SAV beds are HAPC for red drum in the project location.

The remaining five species with EFH designations in the project area will not be included in the EFH assessment, as they are not likely to be found there. These are king mackerel, Spanish mackerel, cobia, dusky sharks and sandbar sharks. I have attached a document with the rationale for coming to this conclusion. Would you review the document and confirm that these are the correct species and life stages to include in the EFH assessment?

Thank you,

Seth

Seth Keller
US Army Corps of Engineers
Baltimore District, Planning Division
seth.d.keller@usace.army.mil
410 962 4940 <tel:410%20962%204940>

Classification: UNCLASSIFIED
Caveats: NONE

--

Kristy Beard
Marine Habitat Resource Specialist
Habitat Conservation Division

NOAA Fisheries
177 Admiral Cochrane Drive
Annapolis, MD 21401
410-573-4542

http://www.nmfs.noaa.gov/ <http://www.nmfs.noaa.gov/pr/>

Classification: UNCLASSIFIED
Caveats: NONE

D-12

MAY 1 1 2015

RECEIVED
APR 06 2015
BY: TJN

20150 1315

US Army Corps of Engineers
Baltimore District

Public Notice

Rhodes Point, Somerset County, Maryland Section 107

All Interested Parties: The U.S. Army Corps of Engineers, Baltimore District (USACE) in partnership with the Maryland Department of Natural Resources (MDDNR), is proposing to restart work on the Rhodes Point, Somerset County, Maryland Section 107 project. Section 107 of the River and Harbor Act of 1960 provides authority for the Corps of Engineers to improve navigation including dredging of channels, anchorage areas, and turning basins and construction of breakwaters, jetties and groins, through a partnership with non-Federal government sponsors. This notice has been prepared to announce our intention to prepare an environmental assessment for the proposed project.

In January 2003, an approved feasibility report for this study included the realignment of the existing federal navigation channel with an approximately 1,300 linear foot long jetty to the north and a 1,500-foot jetty to the south to protect it from shoaling and a series of breakwaters along the shoreline for containment of the dredged material and stabilization of the shoreline.

When the project was restarted in 2008, new hydrographic and topographic surveys of the existing conditions were performed. The proposed project was revised to include an approximately 1,500 linear foot navigation channel, which includes 1,000 linear foot twin jetties on either side of the navigation channel, with a 200 foot long jetty extension located landward of the south jetty to prevent flanking.

A submerged aquatic vegetation (SAV) survey was performed in 2008 by the Maryland Department of Natural Resources. The survey showed substantial SAV (32 acres) immediately south of the mouth of Sheep Pen Gut. In coordination with the resource agencies, the Corps revised the plan to minimize impact to the existing SAV bed. The proposed breakwaters have been downsized to a stone sill approximately 1,500 linear feet along the shoreline. The proposed plan still includes the placement of the sandy dredged material behind the sill and native plantings to restore tidal wetlands. The sill will also provide protection of the existing wetlands at Rhodes Point.

USACE is in the process of preparing an environmental assessment to reexamine jetty and sill alternatives that would minimize impacts to SAV and tidal wetlands while meeting navigation improvement needs. USACE is coordinating with resource agencies towards this purpose.

For federal and state resource agencies receiving a copy of this notice, we request that you provide information concerning interests within your organization's area of responsibility or expertise within 30 days from the date of this notice to the address below. A timely review of this information and a written response will be greatly appreciated.

The Maryland Historical Trust has determined that there are no historic properties affected by this undertaking

TJN VN
5/6/15

Please direct all correspondence to following address:

U.S. Army Corps of Engineers, Baltimore District
c/o Chris Spaur 11600-G
10. S. Howard Street
Baltimore, MD 21201

If you have any questions, please contact Christopher Spaur by email at christopher.c.spaur@usace.army.mil or by telephone at (410) 962-6134.

Daniel M. Bierly
Chief, Civil Project Development Branch

Enclosure
Site Map

D-13

Martin O'Malley, *Governor*
Anthony G. Brown, *Lt. Governor*
Joseph P. Gill, *Secretary*
Frank W. Dawson III, *Deputy Secretary*

12 May 2015 15-MIS-195

Mr. Daniel M. Bierly
Civil Project Development Branch
U.S. Army Corps of Engineers, Baltimore District
P.O. Box 1715
Baltimore, MD 21203-1715

Attn: Christopher Spaur

Subject: Environmental Assessment Section 107 Small Navigation Study – Rhodes Point, Smith Island; Chesapeake Bay; Somerset County

Dear Mr. Bierly:

This letter is in response to your request for information and concerns that the Department of Natural Resources may have in reference to a possible project to realign approximately 1,500 linear feet of federal navigation channel, construct 1,000 linear feet of twin jetties on either side of the navigation channel, a 200 foot long jetty extension located landward of the south jetty to prevent flanking and 1,500 linear feet of stone sill. Sandy dredged material would be placed behind the stone sill and planted with native wetland vegetation. The proposed project site is located at Sheep Pen Gut, Rhodes Point, Smith Island.

To ensure that impacts to aquatic resources on the project site and downstream are first avoided, and then minimized to the maximum extent possible, we request that the following concerns and recommendations be fully incorporated into the review of the proposed activities:

1. There is a designated natural oyster bar (NOB 36-2) located approximately 4,000 feet west of the mouth of Sheep Pen Gut. The existing Federal navigation channel comes to within about 2,000 feet of the southern boundary of this NOB. The information that we received to review did not indicate a proposed route for the realigned navigation channel. However, the realigned channel should avoid NOB 36-2. Dredging within the boundaries of NOB 36-2 could result in impacts to oysters and/or oyster habitat on the natural oyster bar.

2. The area within the boundaries of these NOBs is specifically established, reserved, and protected from activities and impacts considered detrimental to oyster populations or destruction of the bottom. Oysters spawn and subsequently set their spat during the period June through September in estuarine sections of rivers and the Bay. During this period, dredge units can entrain and destroy oyster eggs and larvae. In addition, sediments resuspended by dredging activities may affect oysters. Potentially, larval oysters could be starved by ingesting sediment particles which are the same size as prey organisms. Larval oysters could also delay metamorphosis to spat because the substrate is covered with loose sediments and is therefore unsuitable. Oysters also become inactive during the colder months of the year and are more liable to burial (inability to clear themselves of deposited sediment) during this period of reduced activity. A buffer zone of 500 yards has been established adjacent to the natural oyster bar to protect oyster resources on the NOB. No hydraulic dredging should be performed within 500 yards of an NOB during the period 1 June through 30 September. If mechanical dredging is to occur within 500 yards of an NOB

it should not be conducted during the periods 16 December through 14 March or 1 June through 30 September.

3. The Department's records and the information we received to review notes the presence of persistent and extensive beds of submerged aquatic vegetation at the mouth of Sheep Pen Gut and along the shoreline to the north and south. The proposed placement of dredged material for marsh restoration should not be performed during the period 15 April through 15 October to minimize impacts to submerged aquatic vegetation.

4. The proposed project should be coordinated with the Critical Area Commission to ensure that it meets the requirements of the State's Critical Area law.

Should you require additional information regarding these comments, please feel free to contact Roland Limpert at 410-260-8333.

Sincerely,

Gregory Golden, Manager
Project Review Division

cc: Elder Ghigiarelli, MDE

D-14

May 13, 2015

Mr. Christopher Spaur
U.S. Army Corps of Engineers, Baltimore District
P.O. Box 1715
Baltimore, MD 21203-1715

STATE CLEARINGHOUSE RECOMMENDATION

State Application Identifier: **MD20150407-0244**
Applicant: U.S. Army Corps of Engineers, Baltimore District
Project Description: Scoping: U.S. Army Corps of Engineers, Baltimore District (USACE) in Partnership with the Maryland Department of Natural Resources (DNR), Proposing to Continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, MD
Project Address: Somerset County- Smith Island
Project Location: Somerset County
Approving Authority: U.S. Department of Defense DOD/ARMY
Recommendation: **Consistent with Qualifying Comment(s)**

Dear Mr. Spaur:

In accordance with Presidential Executive Order 12372 and Code of Maryland Regulation 34.02.01.04-.06, the State Clearinghouse has coordinated the intergovernmental review of the referenced project. This letter constitutes the State process review and recommendation. This recommendation is valid for a period of three years from the date of this letter.

Review comments were requested from the Maryland Department(s) of Natural Resources, Transportation, the Environment and the Maryland Department of Planning, including the Maryland Historical Trust; and Somerset County.

The Maryland Department(s) of Natural Resources, Transportation and the Maryland Department of Planning, including the Maryland Historical Trust; and Somerset County found this project to be consistent with their plans, programs and objectives.

The Department of Transportation stated that "as far as can be determined at this time, the subject has no unacceptable impacts on plans or programs."

The Maryland Historical Trust has determined that the project will have "no effect" on historic properties and that the federal and/or State historic preservation requirements have been met.

The Maryland Department of Planning stated that the Project is aligned with the State Planning Vision for "Transportation" (a well-maintained multimodal transportation system).

The Maryland Department(s) of Environment found this project to be generally consistent with their plans, programs and objectives, but included certain qualifying comments summarized below.

1. Any solid waste including construction, demolition and land clearing debris, generated from the subject project, must be properly disposed of at a permitted solid waste acceptance facility, or recycled if possible. Contact the Solid Waste Program at (410) 537-3315 for additional information regarding solid waste activities and contact the Waste Diversion and Utilization Program at (410) 537-3314 for additional information regarding recycling activities.

2. The Waste Diversion and Utilization Program should be contacted directly at (410) 537-3314 by those facilities which generate or propose to generate or handle hazardous wastes to ensure these activities are being conducted in compliance with applicable State and federal laws and regulations. The Program should also be contacted prior to construction activities to ensure that the treatment, storage or disposal of hazardous wastes and low-level radioactive wastes at the facility will be conducted in compliance with applicable State and federal laws and regulations.

Any statement of consideration given to the comments(s) should be submitted to the approving authority, with a copy to the State Clearinghouse. The State Application Identifier Number must be placed on any correspondence pertaining to this project. The State Clearinghouse must be kept informed if the approving authority cannot accommodate the recommendation.

Please remember, you must comply with all applicable state and local laws and regulations. If you need assistance or have questions, contact the State Clearinghouse staff person noted above at 410-767-4490 or through e-mail at nasrin.rahman@maryland.gov. **Also please complete the attached form and return it to the State Clearinghouse as soon as the status of the project is known.** ***Any substitutions of this form must include the State Application Identifier Number.*** **This will ensure that our files are complete.**

Thank you for your cooperation with the MIRC process.

Sincerely,

Linda C. Janey, J.D., Assistant Secretary

LCJ:NR
cc:

Amanda Degen - MDE
Tina Quinichette - MDOT
Greg Golden - DNR
Ralph Taylor - SMST
John Leocha/LaVerne Gray - MDPLR&WC
Dan Rosen - MDPI-R
Tracey Gordy - MDPLL
Beth Cole - MHT

15-0244_CRR.CLS.doc

Maryland Department of Planning

Larry Hogan, Governor
Boyd Rutherford, Lt. Governor

David R. Craig, Secretary
Wendi W. Peters, Deputy Secretary

PROJECT STATUS FORM

Please complete this form and return it to the State Clearinghouse upon receipt of notification that the project has been approved or not approved by the approving authority.

TO: **Maryland State Clearinghouse**
Maryland Department of Planning
301 West Preston Street
Room 1104
Baltimore, MD 21201-2305

DATE: ____________________
(Please fill in the date form completed)

FROM: ______________________________
(Name of person completing this form.)

PHONE: ____-____-________
(Area Code & Phone number)

RE: **State Application Identifier:** **MD20150407-0244**
Project Description: Scoping: U.S. Army Corps of Engineers, Baltimore District (USACE) in Partnership with the Maryland Department of Natural Resources (DNR), Proposing to Continue the Section 107 Small Navigation Study at the Rhodes Point, Smith Island, MD

PROJECT APPROVAL

This project/plan was: ☐ **Approved** ☐ **Approved with Modification** ☐ **Disapproved**

Name of Approving Authority: ______________________________ **Date Approved:** ____________

FUNDING APPROVAL

The funding (if applicable) has been approved for the period of:

______________________, **201**___ **to** ______________________, **201**___ **as follows:**

Federal $:	**Local $:**	**State $:**	**Other $:**
____________	____________	____________	____________

OTHER

☐ *Further comment or explanation is attached*

D-15

From: Spaur, Christopher NAB
Sent: Monday, June 01, 2015 7:12 AM
To: 'Lisa.Hoerger@maryland.gov'; 'customerservice@dnr.state.md.us'
Cc: Clark, Anthony A NAB; Gomez, Michele NAB; Furney, Frederick V NAB
Subject: EA Preparation Notice for Critical Area Commission (UNCLASSIFIED)
Attachments: Rhodes Point Map.pdf; Rhodes Point Public Notice.pdf

Classification: UNCLASSIFIED
Caveats: NONE

Critical Area Commission Folks

The U.S. Army Corps of Engineers surface mailed a public notice announcing preparation of an Environmental Assessment (EA) for proposed navigation improvements at Rhodes Point on Smith Island on April 1st. It has come to my attention that the address we used for the Critical Areas Commission was incorrect. Accordingly, in the event you did not receive this notice, I am emailing you a copy of it (attached).

Please review this notice and provide us any comments you have on the proposed improvements. We will send out copies of the draft EA for agency review when the document is prepared to that level.

Thanks for your consideration of this matter,

Chris

Classification: UNCLASSIFIED
Caveats: NONE

D-16

From: Michelle Magliocca - NOAA Federal [michelle.magliocca@noaa.gov]
Sent: Monday, June 15, 2015 1:50 PM
To: Spaur, Christopher NAB
Cc: Gomez, Michele NAB
Subject: [EXTERNAL] Rhodes Point Information Request
Attachments: IR_Rhodes Point.pdf

Hi Christopher,

I apologize for the delayed response, but attached is a brief information request response regarding EFH and protected species in the project area of Rhodes Point.

As discussed at the site visit on April 29, I think a stone sill with windows, constructed landward of existing SAV, can help sustain the wetlands at Rhodes Point while also improving the habitat for NOAA trust resources. I am waiting to see a proposed project design before I can provide detailed comments or conservation recommendations.

Thanks,
Michelle

--

Michelle Magliocca
NOAA Fisheries

Habitat Conservation Division
177 Admiral Cochrane Drive
Annapolis, MD 21401
410-573-4559
www.nmfs.noaa.gov <http://www.nmfs.noaa.gov/>

<https://lh4.googleusercontent.com/oDRE7GW-HK9U7Jcpihy6xN4gbWKzA6Wi9oBeAnQEnz_8PcO4nPuqbGH_-ZNt7InLiSclF8ybZkB0tutCjRSRKgipQCSjE_kYwzS7YCDK1zym_Yez_DU>

D-17

June 15, 2015

TO: Christopher Spaur,
U.S. Army Corps of Engineers, Baltimore District
10 S. Howard Street
Baltimore, MD 21201

SUBJECT: Rhodes Point, Somerset County, Maryland Section 107

We have reviewed the information provided to us in a public notice regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered Species Act

Threatened or endangered species under the jurisdiction of NOAA Fisheries may occur within the project area. As a result, further consultation with the Protected Resources Division may be required. If you wish to discuss this further, please contact Brian Hopper at 410-573-4592 or brian.d.hopper@noaa.gov.

Fish and Wildlife Coordination Act

The proposed project area includes waterways that may provide habitat for forage species. Further coordination with NOAA Fisheries may be required.

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat

Essential Fish Habitat (EFH) has been designated within the project area. Further EFH consultation by the federal action agency may be required as part of the federal permit process. For a listing of EFH and further information, please go to our website at: http://www.greateratlantic.fisheries.noaa.gov/habitat/efh/efhoverview.html#. If you wish to discuss this further, please call 410-573-4559 or e-mail michelle.magliocca@noaa.gov.

D-18

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Larry Hogan, *Governor*
Boyd K. Rutherford, *Lt. Governor*
Mark J. Belton, *Secretary*
Mark L. Hoffman, *Acting Deputy Secretary*

June 18, 2015

U.S. Army Corps of Engineers
c/o Chris Spaur 11600-G
10 S. Howard Street
Baltimore, MD 21201

RE: Environmental Review for Small Navigation Study, Rhodes Point, Smith Island, Somerset County, Maryland.

Dear Mr. Spaur:

The Wildlife and Heritage Service has determined that there are two active waterbird colonies that occur within the vicinity of this project site. One colony is mixed heron species and the other supports great blue herons. The approximate locations are indicated on the attached map. Heronries are a rare resource that should be protected. Significant mortality of chicks or eggs resulting from disturbance of the colony during the breeding season is a violation of the U.S. Migratory Bird Treaty Act. Disturbance includes actions such as cutting nest trees, cutting nearby trees or nearby construction that causes abandonment of chicks by the adults. We would encourage the applicant to implement the following guidelines:

1. Establish a protection area of ¼ mile radius from the colony's outer boundary. Within this area establish three zones of protection: Zone 1 extends from the outer boundary of the colony to a radius of 330 feet, Zone 2 extends from 330 feet to 660 feet in radius, and Zone 3 extends from 660 feet to ¼ mile (1320 feet).
2. During the cumulative breeding season for these heron species, 15 February through 15 August, all human entry into Zone 1 should be restricted to only that essential for protection of the heron colony. Human disturbance of colony sites that results in significant mortality of eggs and/or chicks is considered a prohibited taking under various state and federal regulations.
3. No land use changes, including development or timber harvesting, should occur in Zone 1.
4. Construction activities, including clearing, grading, building, etc., should not occur within Zones 1 and 2.
5. Selective timber harvesting may occur in Zone 2, but clearcutting should be avoided.
6. No construction or timber harvesting activities should occur within the ¼ mile protection area during the heron breeding season.

The Department of Natural Resources' Wildlife and Heritage Service provides assistance to those interested in protecting this resource. The above guidelines are usually suitable for protection of most Great Blue Heron colonies. Specific protection measures depend upon site conditions, planned activities, colony site type and history, and other factors. For more specific technical advice regarding your project and Great Blue Heron protection, please contact WHS.

Thank you for allowing us the opportunity to review this project. If you should have any further questions regarding this information, please contact me at (410) 260-8573.

Sincerely,

Lori A. Byrne,
Environmental Review Coordinator
Wildlife and Heritage Service
MD Dept. of Natural Resources

ER# 2015.0520.so
Cc: D. Brinker, DNR
J. McCann, DNR
K. Charbonneau, CAC

D-19

From: Mitch Tarnowski -DNR- [mitch.tarnowski@maryland.gov]
Sent: Wednesday, June 24, 2015 5:56 PM
To: Spaur, Christopher NAB
Subject: [EXTERNAL] Re: Church Creek Yates Bar / NOB 36-2 off Smith Island (UNCLASSIFIED)

Hi Chris-

It's probably been a couple of decades at least since that bar (Church Creek in Yates parlance) has been surveyed, probably because there's nothing to find. We just completed a patent tong survey of the Lower Mainstem East oyster sanctuary, which extends adjacent to and just west of NOB 36-2. The entire sanctuary (some 9.5 nm in length) had only a handful of oysters in almost 300 samples. It was mostly sand and some cobbles (to which a few oysters attached) with some buried shells. I can send you the spreadsheet (including coordinates), but the eastern edge of this sanctuary is some 2 nm from Smith I, so I'm not certain it would have much relevance to this project. Let me know.

You were conspicuous in your absence at yesterday's Coastal STAC meeting. Actually, it was a pretty poor turnout. The biggest news was that Darlene Wells retired.

Take care-
Mitch

Mitchell Tarnowski
Shellfish Biologist
Maryland Dept. of Natural Resources
Tawes State Office Building, B-2
Annapolis, MD 21401
Tel: 410-260-8258 Fax: 410-260-8279

"It is a riddle wrapped in a mystery inside an enigma..." -W. Churchill

On Wed, Jun 24, 2015 at 6:39 AM, Spaur, Christopher NAB <Christopher.C.Spaur@usace.army.mil> wrote:

Classification: UNCLASSIFIED
Caveats: NONE

Mitch

Greetings from Baltimore.

USACE/Somerset County are proposing construction of a jetty at Sheep Pen Gut to protect the navigation channel into Rhodes Point from the Bay (Somerset County is sponsoring). For the project environmental assessment, I'm interested in getting recent information on the oyster population at NOB 36-2 off western Smith Island.

I looked through the last several years of fall surveys at http://dnr2.maryland.gov/fisheries/Pages/shellfish-monitoring/reports.aspx, but didn't see that it was specifically investigated (I could've missed it). Please email me a link(s) to DNR reports that provide information on that bed, or send me an electronic copy(ies) if not too large.

Thanks,

Chris

Classification: UNCLASSIFIED
Caveats: NONE

D-20

April 14, 2016 Rhodes Point Discussion with USFWS and NMFS:

Participants:

NOAA NMFS: Michelle Magliocca

USACE-Tony Clark, Michele Gomez, Robin Armetta

USFWS- Chris Guy

Notes:

On April 14, 2016, there was a short meeting between the USACE, USFWS, and NOAA to discuss the Rhodes Point, Section 107 project.

Tony provided a short overview to the group on the updates both ERDC and Baltimore District has completed since the last time the group had gotten together with regards to the proposed alternatives.

The new proposed alternative shows a shift in the alignment of the north jetty with a connection to the shoreline while the alignment of the south jetty remains the same.

There was also discussion of perhaps shifting the alignment of the stone sills to avoid impacts to SAV. There is a way to move the breakwaters to follow the existing fringe alignment of the existing SAV footprint.

Thoughts from USFWS:

After discussing the proposed alterative, Chris said that the new alignment is on the right track. With regards to proposed fill material placement site, they did have some concerns that it would be filling the existing marsh more that was originally expected, but they would be willing to have an open discussion regarding this issue with the project team as long as the project team does not change the overall nature of the marsh.

USFWS would also like to see if the project team can try and engineer some channels in the marsh where we are planning on filling with dredged material from the navigational channel and create breakwater in the stone sill to allow for fish passage.

Thoughts from NOAA NMFS:

Michelle said that she appreciated the revisions to the stone sill alignment to avoid impacts to the existing SAV habitat.

Struggle because there really are enough benefits to outweigh the impacts to their species. As Chris mentioned, she would like to see windows in the stone sills to allow for fish passage along with any other modifications we can do to beef up the marsh habitat for fish and to allow adequate flushing to occur. It will be important that our proposed alterative and alignment of the stone sills allow fish to traverse both ways from the stone sills and within the channels within the marsh. Michelle also stated she would like to see some sort of mitigation with regards to SAV, but she is not sure what form that might take and would like to bring Lee Karrh from Maryland Department of Natural Resources into that discussion.

The one other thing Michelle mentioned was that she would like us to overlay the 2015 SAV GIS layer in order to better determine the current extent of existing SAV habitat to minimize impacts during project design.

D-21

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 1715
BALTIMORE, MD 21203-1715

REPLY TO
ATTENTION OF

Planning Division

Mr. Elder Ghigiarelli, Jr.
Deputy Program Administrator
Wetlands and Waterways Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230

JUN 20 2017

Dear Mr. Ghigiarelli:

The United States Army Corps of Engineers (USACE) Baltimore District is requesting a Water Quality Certification (WQC) and Coastal Zone Consistency Certification for the improvements to navigation to Sheep Pen Gut federal navigation channel near Rhodes Point, Somerset County, Maryland as outlined in the *Rhodes Point Navigation Improvement Project Somerset County, Maryland, Environmental Assessment* (EA) emailed to you on May 25, 2017. Appendix B of the EA is the 404(b)(1) analysis and is enclosed for your review (Enclosure 1). USACE and the Maryland Department of Natural Resources are partnering to complete this work. A public notice will be published shortly and distributed to you and other interested parties.

Shoaling of the federal navigation channel is impairing navigation in and out of Sheep Pen Gut. Proposed work includes the realignment and straightening of the channel and construction of two jetties. The proposed channel will be dredged to a depth of -6 feet mean lower low water, with the main channel 50 feet wide by 1,000 feet long with an additional 100 feet by 150 feet flare at the Chesapeake Bay end. The resulting 24,000 cubic yards of sand and silt will be beneficially used to restore and enhance wetlands along the southern shoreline. A rock sill along approximately 850 linear feet of the shoreline will be placed to stabilize the dredged material. Some material will also be used to reinforce the north jetty tie-in with the land. This tie-in area and the restored wetland area will be planted with native wetland vegetation.

Construction is anticipated to be completed within a five month period. Construction sequence would be 1) construction of the stone sill and jetties, 2) dredging of the navigation channel to the new alignment, 3) placement of dredged material behind the stone sill, 4) grading the dredged material to the planned elevations, 5) planting native plants on the material, and 6) removal of portions of stone sill to create notches to allow for tidal interaction. Planting of the restored areas will take place after the dredged material dewaters. No in-water construction work will be conducted between April 1 through October 30, of any year to protect submerged aquatic vegetation, anadromous fish, and sea turtles.

USACE is requesting a water quality certification for the proposed activity at Rhodes Point. We have determined that the proposed activity complies with and will be conducted in a manner consistent with the approved Maryland Coastal Zone Management Program and request your concurrence with this consistency determination. We appreciate your timely response to our request. If you have any questions, please contact Ms. Anna Compton 410-962-7633 or by email at Anna.M.Compton@usace.army.mil.

Sincerely,

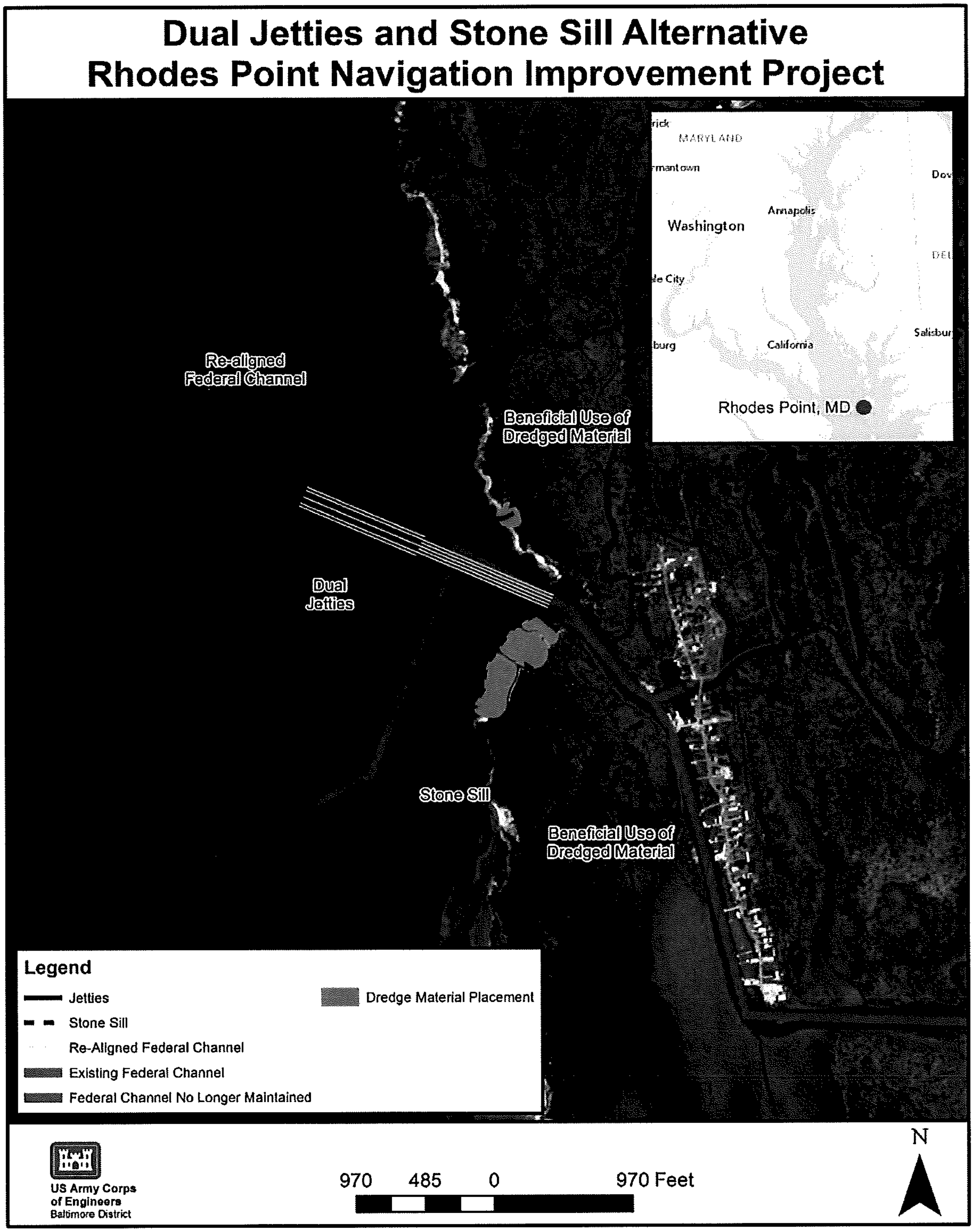
For Michele Gomez

Daniel M. Bierly
Chief, Civil Project Development Branch

Enclosure

1. Rhodes Point Navigation Improvement Project Somerset County, Maryland, Environmental Assessment 404(b)(1) analysis

Figure 1. Rhodes Point Proposed Project



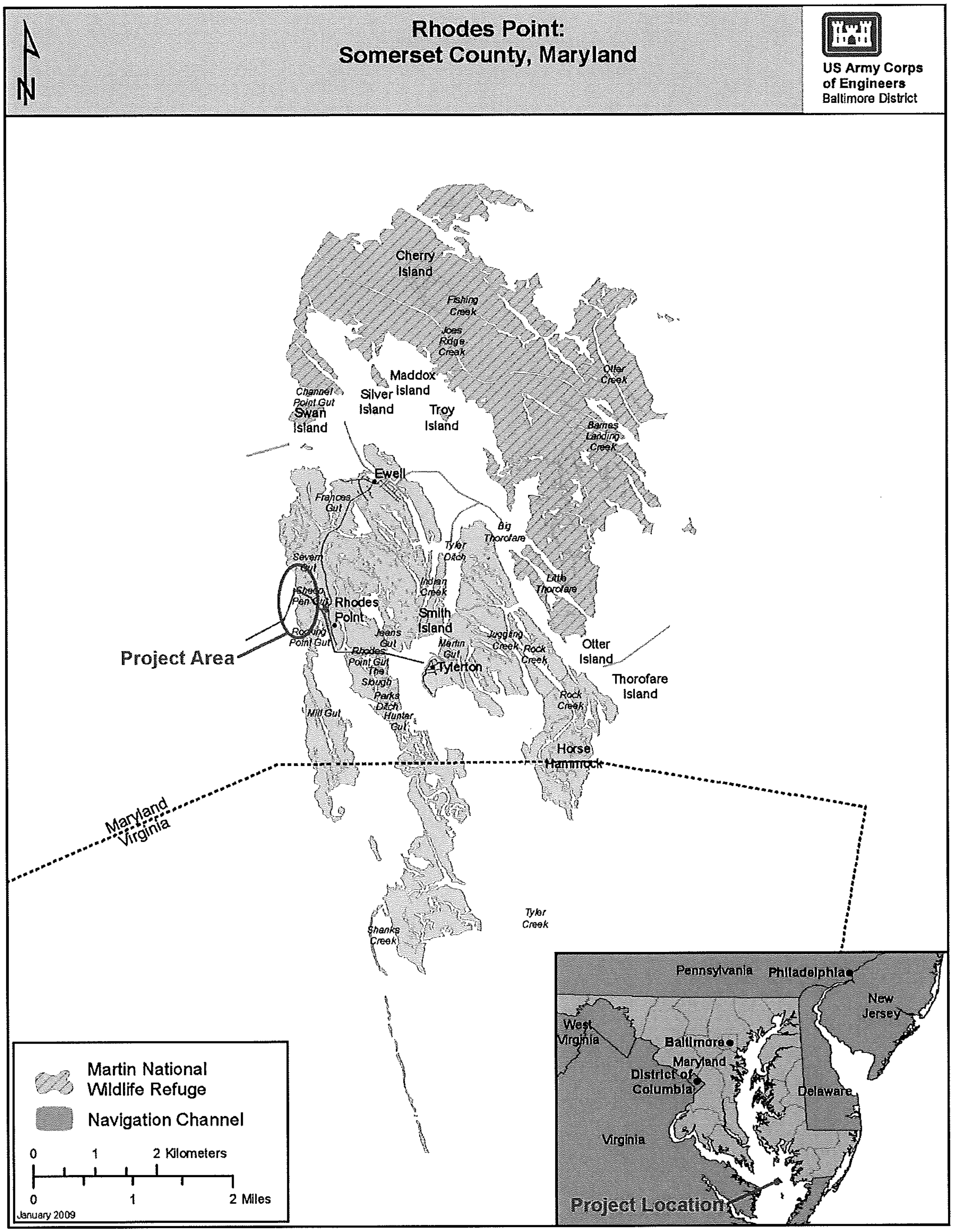
CLEAN WATER ACT
SECTION 404(b) (1) EVALUATION
RHODES POINT NAVIGATION IMPROVEMENT PROJECT
SOMERSET COUNTY, MARYLAND

I. Project Description

A. Location

Rhodes Point is located on Smith Island, Somerset County, Maryland, which is a small complex of salt marsh islands separated by tidal waterways in the Chesapeake Bay (Figure 1). Smith Island lies west of the town of Crisfield, in Somerset County, Maryland at approximately N 37° 58' 00'' degrees latitude and W 76° 02' 00'' degrees longitude. Rhodes Point is only accessible by boat and is at least a 45-minute ride to Crisfield, MD. The area is shown on the U.S. Geological Survey Kedges Strait 7.5' quadrangle topographic map. The Rhodes Point project is located on the southwest side of the island near the confluence of Sheep Pen Gut and the Chesapeake Bay.

Figure 1. Proposed Project Location



B. General Description

The U.S. Army Corps of Engineers, Baltimore District (USACE) maintains a navigation channel from Rhodes Point northwest through Sheep Pen Gut for about a half mile before entering the Bay, where it then stretches southwest to deep water in the open Chesapeake Bay. This channel is subject to continuous sedimentation resulting in the formations of shoals.

The proposed action (Figure 2) is to implement a small navigation project, which includes realignment of the navigation channel, construction of jetties, and a stone sill. The dredged material and other suitable excavated material will be beneficially used for restoration, enhancement and protection of the wetland located south of the Sheep Pen Gut federal channel. The proposed project would realign a portion of the authorized dimensions of the federal navigation channel at Smith Island in Sheep Pen Gut. The channel would be hydraulically dredged to extend to the -6-foot mean lower low water (MLLW) contour (plus an additional 1 foot allowed for overdredging). Following realignment, the federal channel will be 1,900 feet long in total, extending from within the mouth of Sheep Pen gut into the Chesapeake Bay. From the mouth of Sheep Pen Gut to 1,750 feet from the mouth, the channel will be 50 feet wide. The last 150 feet into the Bay will be 100 feet wide. This realignment of the channel provides more direct access to the Bay. The alignment extends the existing authorized channel by approximately 425 feet northwestward but it removes the need to dredge and maintain the portion of the navigation channel that runs in a southwest direction.

The construction of two jetties (which involves hydraulic dredging of bay bottom and placement of stone) is proposed to reduce shoaling of the realigned and dredged channel. The jetty to the north of the navigation channel would be approximately 650 feet long by 50 feet wide at its base and 6 feet wide at its crest with a footprint of 0.75 acres and aligned from deep water to the existing shoreline in a northeasterly direction. The jetty south of the navigation channel would be approximately 1,150 feet long by 50 feet wide at its base and 6 feet wide at its crest, with a footprint of 1.32 acres and aligned in an east-west direction parallel to the federal channel. Both jetties will be built to a crest elevation of +5 feet MLLW. The construction of a stone sill along the eroding shoreline will contain the material dredged from the channel and the material excavated from the jetty foundation. The stone sill will be approximately 850 feet long, 5 feet wide at the crest, 30 feet wide at the base, with an approximate footprint of 0.6 acre. The sill will be built to a crest elevation of +3 feet MLLW. This sill will provide stabilization for approximately 850 feet of eroding shoreline and will protect approximately 15 acres of wetlands.

Dredged material from the channel, jetty, and sill footprints is estimated to be 24,000 cubic yards (cy). This material will be used beneficially to restore, enhance, and protect wetlands behind the stone sill and to reinforce the tie-in point around the north jetty-tie in. The material will be planted with native plant species restoring about 2.5 acres of wetlands and enhancing approximately 2.5 acres of wetlands (Figure 3). The dredged material will be placed hydraulically. The stone sill will have a series of low notches (openings) for shallow water habitat interaction with the shoreline.

Construction will be done entirely from the water (with the exception of grading the dredged material and planting at the placement sites and when the jetties are tied into the land at the tie-in location) in months outside of Time of Year (TOY restrictions) of April 1 to October 31 with the possible exception of the planting of native plants on the dredged material. There will be no access roads required. There will be a limit of disturbance (LOD) of approximately 25 feet for placement of material and also a fan shaped pad at the jetty tie in locations. Planting will be done on the land and staging will be via barge or within the LOD (Figure 4).

Figure 2. Proposed Action

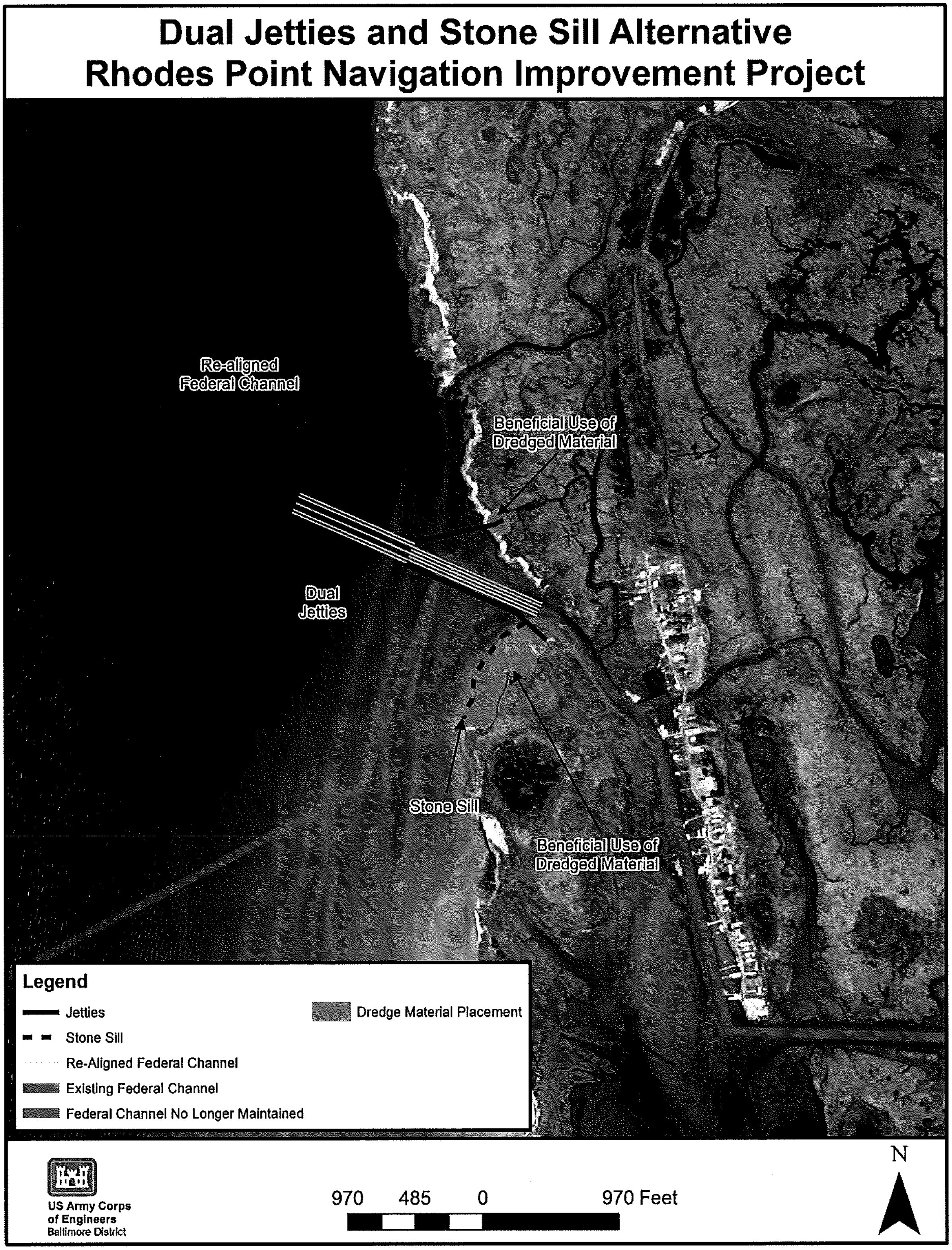


Figure 3. Proposed Action Planting Zones

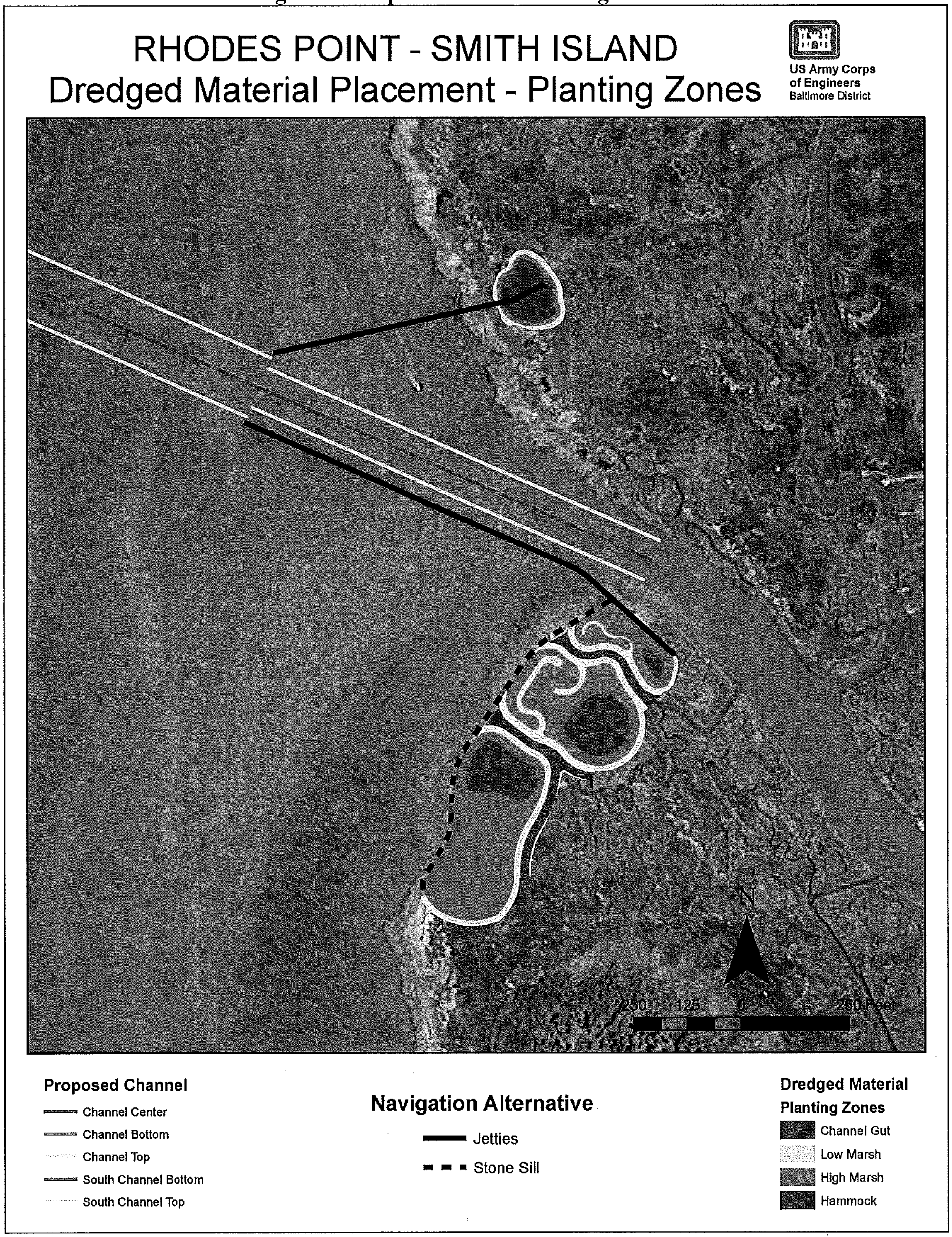
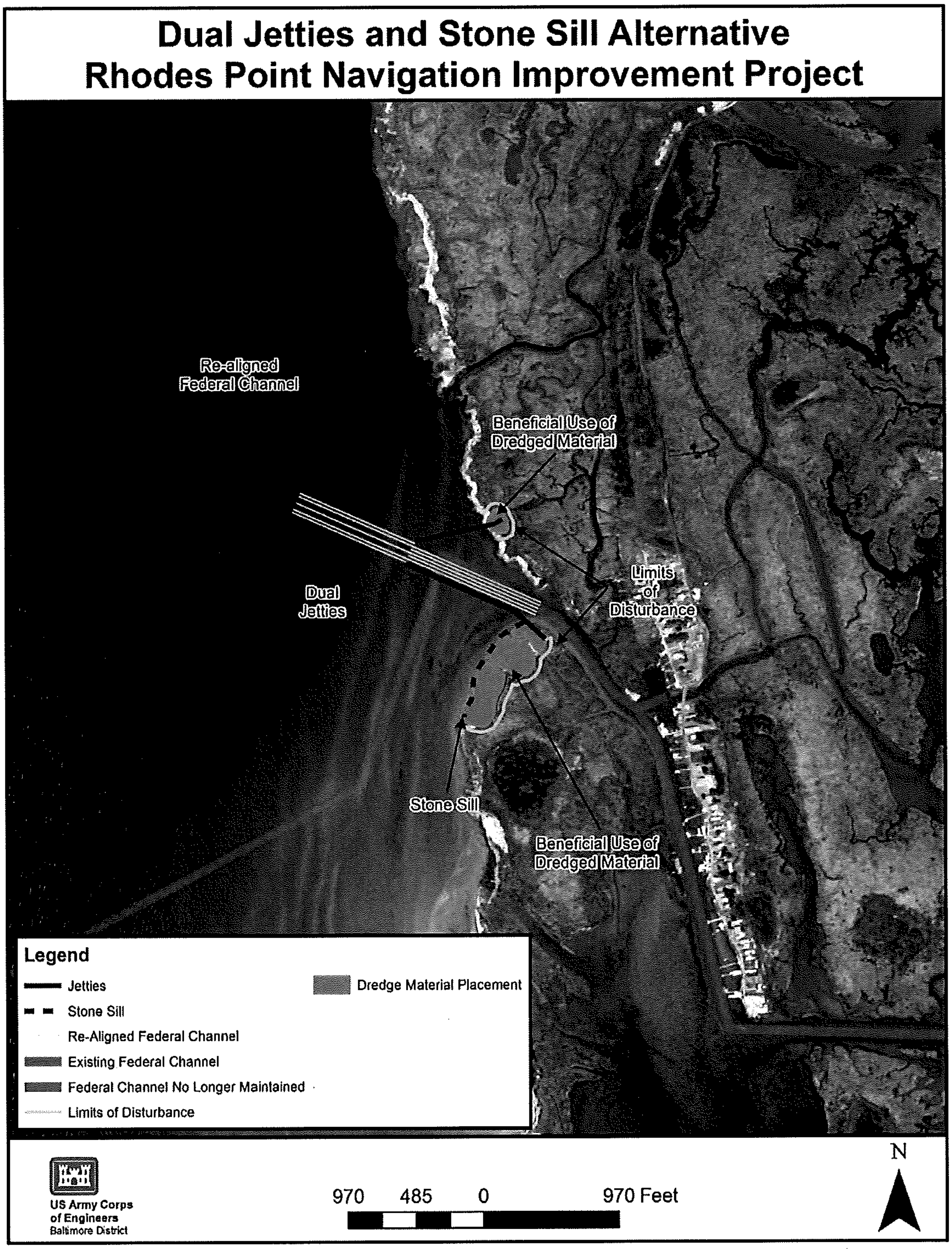


Figure 4. Proposed Action with Limit of Disturbance



C. Authority & Purpose

Section 107 of the River and Harbor Act of 1960, as amended, provides authority for USACE to develop projects and improve navigation, including dredging of channels, anchorage areas, and turning basins and construction of breakwaters, jetties, and groins, through a partnership with non-federal government sponsor such as cities, counties, special chartered authorities (such as port authorities), or units of state government for harbor protection.

The purpose of the project is to provide improvements to the federally maintained channel located in Sheep Pen Gut to improve and maintain navigable access. A secondary benefit of the project is the beneficial use of dredged material for the stabilization of the highly erodible shoreline along the western shore of Smith Island south of Sheep Pen Gut. Currently, the federal navigation channel is in constant need of dredging to maintain navigable access.

D. General Description of Discharge Material

1) **Characteristics of Fill Material** - Approximately 24,000 cy of medium to fine sand and silt material will be used to restore the wetlands. The jetties and stone sill will be constructed of placed stone on top of geotextile. The armor stone size ranges for the jetty trunk are 810-1,620 pounds with the head 1,425-2,850 pounds (the head section is the outer 150 feet). The stones for the sill are sized at 650-1,100 pounds. It is likely that heavy operating equipment will be brought in via barge to the placement site to grade the area so it is at appropriate elevations for wetland planting.

2) **Source of Fill materials** -The stone will be barged in from land-based quarries and the source of fill material for the marsh restoration is the navigation channel dredging and foundation material from the jetty, and stone sill locations.

E Description of the Proposed Discharge Site

The discharge site is open water as well as eroding shoreline and wetlands located along 850 linear feet on the western shoreline of Smith Island. Discharge material will also be placed at the north jetty tie-in area (Figure 2). The shoreline is actively eroding, contributing to severe loss of wetlands and, eroded sediment that has the potential to bury nearby SAV beds (Figure 5 and 6). The jetties will be located north and south of the realigned channel. The proposed stone sill would be located in shallow waters, and constructed along 850 feet of the shoreline, just south of Sheep Pen Gut Channel. The dredged material will be beneficially used to restore or enhance 5 acres of wetlands landward of the stone sill and around the north jetty tie-in area. The fill area is recently eroded wetland with fine sediments accumulated from the eroded wetland. The site of the north jetty tie-in area is also eroded marsh, which has resulted in shallow water with fine sediments.

Figure 5 SAV in Project Area (2015)

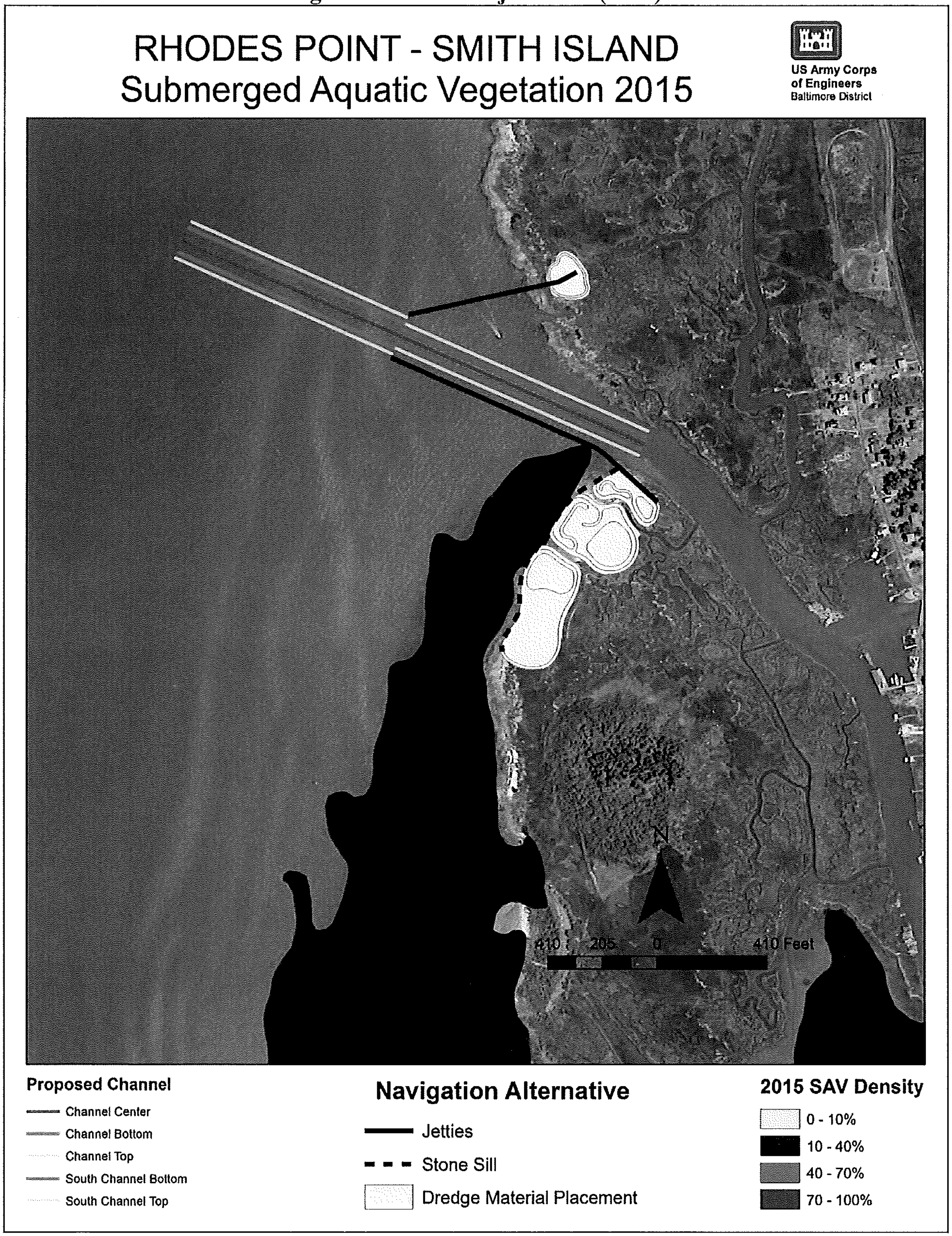


Figure 6 SAV Location and Density in Project Vicinity: 2011-2014

F. Description of Dredging and Placement Method

The area where both jetties and the stone sill will be placed will be hydraulically dredged. Geotextiles will be placed and then the stone. The jetties and sill will be stone structures, placed by cranes from barges in the water. The Sheep Pen Gut navigation channel will be hydraulically dredged to realign the channel. This material will be placed hydraulically behind the stone sill. It is anticipated that these construction activities will take up to 5 months. Several weeks after placement (to allow for dewatering) this area will be graded likely with heavy operating equipment so that the dredged material is at appropriate elevations for wetland planting. Dredged material will then be planted with native plant species to tie into the existing wetland. All equipment will be brought via barge onto the placed dredged material to grade. Once placement and planting is complete portions of rock will be removed from the sill to create notches to allow for tidal flushing and access to the wetland by aquatic organisms.

Best-management practices (BMPs) will be used for construction and dredging activity. Time of year restrictions for aquatic resources in the area will be adhered to. This time of year restriction currently includes "in-water" construction activities from occurring between April 1 and October 31. This time of year restriction is for SAV, oysters, anadromous fish and sea turtles. Construction will comply with all applicable federal, state, and local laws concerning environmental pollution control and abatement. Construction will not pollute with fuels, oils, bitumens, calcium, acid waste, or other harmful materials. A turbidity curtain will be maintained during construction. It will be weighted at the bottom and the top must float. It will be of sufficient height to provide complete coverage at high tide. It will be advanced as necessary during construction. The turbidity curtain will minimize sediment entering the water column and affecting water quality.

Dredged material will not be placed on sensitive areas of bay bottom, including oyster bars, SAV beds, or known fish spawning areas.

II. Factual Determinations

A. Physical and Substrate Determinations

1) Substrate elevation and slope - The elevation of Smith Island averages one to two feet above mean high water. Topographic changes are very gentle to essentially flat, and large expanses of shallow water (less than two feet deep) surround the island in all directions. The jetties for the preferred alternative would be built to a crest of +5 feet MLLW

2) Sediment Type - The discharged material is primarily sand, silt, mud and shell.

   Dredged/Fill Material Movement –When stones are placed for the jetties and sill bay bottom will be displaced and any fines will circulate locally and temporarily and likely travel towards land if suspended long enough based on circulation patterns (Appendix E). During dredging of the channels the bay bottom material will be hydraulically moved and placed behind the newly constructed sill on the existing shoreline below the Sheep Pen Gut. Fines will circulate locally and temporarily and likely travel towards land if suspended long enough based on circulation patterns (Appendix E). The jetties are designed to interrupt sedimentation into the channel, allowing for continued boat access. At the placement site, equilibrium is expected to develop behind the stone sills, creating crescent shaped peninsulas commonly observed behind stone sills. The material will tie into existing wetland and restore additional wetlands. Because the placement sites will be planted, the material is expected to stabilize within a full season after construction. Wave and tidal action, which are the predominant causes of erosion, are expected to be reduced by the Proposed Action and no significant material movement is expected. There is an expected reduction in the rate of shoreline erosion both inside the mouth of Sheep Pen Gut and along the shoreline south of the proposed jetties. The jetties will not alter how the shorelines experience surge but will deflect energy from normal waves and tides. The stone sill will protect against crashing waves that may otherwise erode the shoreline. An increase in scour along the slope of the structures are also likely to occur. These impacts are minor but permanent. During construction there will be minor temporary impacts to wave action due to the dredging activity in the channel and placement of stone for the jetties and sill as there will be barges in the water deflecting wave energy. Construction will comply with all applicable federal, state, and local laws concerning environmental pollution control and abatement. Construction will not pollute with fuels, oils, bitumens, calcium, acid waste, or other harmful materials. A turbidity curtain will be maintained during construction. It will be weighted at the bottom and the top must float. It will be of sufficient height to provide complete coverage at high tide. It will be advanced as necessary during construction. The turbidity curtain will minimize sediment entering the water column and affecting water quality. Minor, localized sediment disturbance is expected during construction from excavation, dredging, and geotextile and rock placement but the use of a turbidity curtain should minimize this movement.

3) Physical Effects on Benthos - Dredging of the channel will temporarily and placement of the jetties and stone sill will permanently disturb the existing substrate and benthos.

4) Other Effects - None expected.

5) Actions Taken to Minimize Impacts – Marsh restoration efforts will use native material from the area. Environmental protection measures, such as BMPs and soil and erosion control measures will be employed to avoid and minimize impacts to the aquatic environment. Construction specifications will state that compliance is mandatory for all applicable environmental protection regulations for pollution control and abatement.

B. Water Circulation, Fluctuation, and Salinity Determinations

1) Water Quality
   a) Salinity - No change expected.
   b) Chemistry - No change expected.
   c) Clarity - Temporary, localized changes are expected in the immediate vicinity during construction and dredging of the realigned channel and discharge on the marsh. Minor and temporary reduction expected during placement due to turbidity. No long-term impact expected.
   d) Color - Temporary, localized changes are expected in the immediate vicinity during construction and dredging of the realigned channel and discharge on the marsh. Minor and temporary change expected during construction due to minor increase in turbidity. No long-term impact expected.
   e) Odor - No change expected.
   f) Taste - Not applicable.
   g) Dissolved Gas Levels - Changes in dissolved gas levels and content are expected to occur at the placement sites as a result of the transition from a shallow water habitat to a tidal marsh. Temporary, short term, and localized minor negative impacts are expected.
   h) Nutrients - No long-term change expected. Minor, short-term, localized releases of nutrients can be expected. The material to be dredged is predominantly clay and sandy silts with a low fine/organic component and nutrient releases are expected to be minimal.
   i) Eutrophication - Not expected to occur.
   j) Temperature - No change expected.

2) Current Patterns and Circulation
   a) Current Patterns and Flow - Minimal effects are expected. Wave energy is expected to be reduced, reducing erosion on Smith Island. Hydrologic and hydraulic (H&H) modeling focused on areas in and around the channel and adjacent beaches for a relative comparison of without project and with project conditions. Modeling was used to evaluate the optimal geometry and size of structures (number of structures, and their placement location, orientation, length); assess the efficacy of proposed jetty alternatives; and develop water level, wave, current and shoaling estimates for structural design calculations. The modeling of waves, currents and shoaling in the channel suggest little change in tidal circulation within the established channel entrance, but these models were not designed to specifically look at circulation deeper within the channel or the larger surrounding shoreline area. Short-term estimates of morphology change based on 1-month long simulation with waves, currents, and sediment transport cannot be extrapolated to predict long-term channel shoaling rates. However, a 1-month simulation of sediment transport helps to determine sedimentation patterns in the channel and outside along neighboring shorelines. During construction minor, temporary impacts to localized water circulation and patterns are expected due to activity of

placement in the water and barge activity in addition to the newly constructed sill and jetties. The two stone jetties and stone sill will become permanent structures that will alter (limit) the water depth within the footprint of these structures. The channel realignment will extend westerly by 425 from the end of the existing channel at a -6-foot MLLW contour (plus an additional 1 foot allowed for overdredging). These components will also alter water circulation; the sheltering by jetties of the new (realigned) channel is expected to reduce wave energy/waters current circulation in the channel and in areas in the lee of these structures. The jetties also provide an indirect protection to the north and south shorelines Water circulation and depth will not be altered at the larger, tributary-level. However, at the local scale, minimal changes are expected and any impacts to the aquatic ecosystem would be minor.

b) Velocity - Minor changes are expected around the jetty area. After construction, the jetties would slow water down and reduce waves on adjacent shorelines, however within the channel velocities would increase. These changes in velocity are not expected to be significant enough to impact the surrounding environment. In addition, slowing of velocity is expected to occur at the placement sites as a result of the construction of shoreline stabilizing tidal marsh.

c) Water Stratification - It is unlikely that water stratification will occur at the placement sites when dredged material is placed over the existing substrate. The substrate is similar in composition to the dredged material, and no negative impacts are expected.

d) Hydrologic Regime of Water Body - The hydrologic regime at the placement site will change from a tidal shallow water system to a tidal marsh system.

3) Normal Water Level Fluctuations - No change in water levels will occur. The tidal range would remain the same.

4) Salinity Gradients - No change expected.

5) Actions Taken to Minimize Impacts - The use of hydraulic dredging is expected to minimize the resuspension of dredged material into the water column. Any sandy substrates disturbed by dredging is expected to settle out of the water column in the vicinity of the dredging. Following project completion, the channel should have increased capability to self-scour. This will permit future dredging to be required less frequently and therefore, minimize the frequency of dredging impacts. Maintenance dredging is expected to occur every 8 years, as opposed to the current cycle of 3 to 4 years. Environmental protection measures will be employed to avoid and minimize impacts to the aquatic environment.

Construction specifications will state that compliance is mandatory for all applicable environmental protection regulations for water circulation and currents.

C. Suspended Particulate/Turbidity Determinations

1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Placement Site - Minor, localized, and short-term impacts are expected to occur in the area of the placement sites. Coarse-grain size material will rapidly settle out of suspension. Finer grained material may take 24 to 36 hours before settling. Turbidity levels are expected to rapidly return to background levels once placement is completed.

2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column
   a) Light Penetration - Minor, temporary, and localized reduction in light penetration is expected to occur during construction. No change is expected after construction. Any turbidity created by these actions is expected to be generally within the range of natural turbidity levels.
   b) Dissolved Oxygen - Minor, temporary, and localized reduction in dissolved oxygen due to turbidity may occur during construction. Following construction, a rapid return to pre-project conditions is expected.
   c) Toxic Metals and Organics - No toxic metals or organics above background levels are expected to be released into the water column.
   d) Pathogens - No pathogens are expected to be released into the water column.
   e) Aesthetics - Minor and temporary impacts may occur during placement of the material due to clouding of water and the presence of construction equipment. Following construction, a rapid return to pre-project conditions is expected.
   f) Temperature - No change expected.

3) Effects on Biota
   a) Primary Production, Photosynthesis - Minor, temporary, and localized reduction in photosynthesis and primary production due to turbidity impacts to phytoplankton may occur during construction activities. Following construction, a rapid return to pre-project conditions is expected.

   b) Suspension/Filter Feeders - Minor, temporary, and localized impacts to suspension feeders (such as jellyfish) and to filter feeders (such as oysters, clams) in the area may occur due to increases in turbidity created by construction activities. Following construction, a rapid return to pre-project conditions is expected. Some organisms may be physically removed from the area by the hydraulic dredging.

   c) Sight Feeders - Minor, temporary, and localized impacts due to turbidity may occur during construction. Following construction, a rapid return to ambient conditions is expected. In addition, some organisms may be physically removed from the area by the hydraulic dredging. Mobile organisms are expected to be able to leave the area upon commencement of construction to avoid impacts.

4) Actions Taken to Minimize Impacts - The use of hydraulic dredging is expected to minimize the resuspension of dredged material into the water column. USACE is setting these Time of year restrictions to minimize impacts to the aquatic resources in the area. Turbidity curtains will be used to minimize the resuspension of sediment into the water column during dredging and placement activities. Any sandy substrates disturbed by dredging is expected to settle out of the water column in the vicinity of the dredging

D. Contaminant Determinations

No evidence exists to suggest the presence of toxic metals or organics in the dredged material or in the vicinity of proposed dredging or placement. Dredged material from the channel will be primarily a mixture of mud, sand, silt, shell. The fill material (dredged material and stone) is clean, uncontaminated, and the stone is from an approved source.

E. Aquatic Ecosystem and Organism Determinations

1) Effects on Plankton – Construction activities are expected to have minor, temporary impacts on plankton populations in the vicinity of the project area. Local depressions of macro zooplankton, phytoplankton, and photosensitive zooplankton may occur, but would be short in duration and to species that are common throughout the region. The majority of the plankton occurring at the site would be comparable to plankton that is widely dispersed and abundant over a broad region of the Chesapeake Bay. The impacts would be localized and not significant in the long-term. In the short-term, the turbidity associated with dredging and construction is likely to suppress light penetration into the water column and could locally depress the phytoplankton community. No significant adverse impacts are expected to any particular species as a result of the minor and local increase in turbidity. Following construction, planktonic organisms would return to the work area.

2) Effects on Benthos - Placement of the jetty and stone sill structures will result in the conversion of bare fine sand substrate to rock and wetland. The proposed placement site supports wetland habitat including high marsh, low marsh, and hammocks. Riprap habitat with rock crevices will develop along the stone jetties and stone sill. Non-mobile benthic organisms will be destroyed at the time of construction. Mobile benthos will relocate at the time of construction. The 5 acres of wetland restored by the Proposed Action will produce resultant long-term benefits to the benthic community by providing food web support. Benthos are expected to recolonize the newly stabile area with a resultant long-term benefit to the benthic community expected to occur. An indirect effect of the Proposed

Action would be the attraction of benthic organisms and fish that require or prefer hard substrate to the jetties. This would enhance a different group of organisms than what had been present in the channel area, but would provide some compensation for the lost benthic habitat.

3) Effects on Nekton - Construction activities are expected to have minor, temporary impacts on nekton. Due to entrainment, it is anticipated that there may be temporary negative impacts to fisheries during the dredging operations. Nekton are expected to be able to exit the project area during construction to avoid impacts and then return to the area upon completion of the Proposed Action. Incorporation of TOY restrictions will also offset potential negative impacts. Long-term benefits to nekton are expected to result from the construction of the marsh. The planting of plants along the shore behind the stone sill is expected to restore approximately 5 acres of wetland in the project area. This area will provide habitat beneficial to species that provide sustenance to resident nekton species. Notches in the stone sill have been incorporated into design to allow for improved fish passage and adequate flushing to improve habitat. The stone sill and the jetties will reduce wave action to the eroding shoreline, thus improving turbidity in the area for nekton.

4) Effects on Aquatic Food Web - Construction activities are expected to have minor, temporary impacts on the aquatic food chain. The food web at the placement site will experience permanent changes from a shallow water-based to a wetland based food web. The long-term effects are expected to be positive since the Proposed Action would provide habitat for a wider variety of organisms than is currently available at the site. The exchange and interaction between hammocks, wetland, and the channels is anticipated to provide a food source for benthic, finfish, and avian species.

5) Effects on Special Aquatic Sites
   a) Sanctuaries and Refuges – The Proposed Action will have no effects on sanctuaries or refuges. The nearest wildlife refuge, Martin National Wildlife Refuge, is located approximately 1.5 miles to the north and the project will have no adverse effect.
   b) Tidal wetlands - The Proposed Action will restore approximately 5 acres of tidal wetlands. This is expected to provide habitat for fish and wildlife.
   c) Tidal flats - Not applicable.
   d) Vegetated Shallows - SAV is plentiful off of the western shoreline. Construction designs have been carefully selected to minimize vegetated areas. By reducing erosion, there may be an increase in light attenuation, leading to beneficial effects on local SAV beds.

6) Threatened and Endangered Species - No effects to rare, threatened or endangered species are expected as a result of the project based on correspondence from both the U.S. Fish and Wildlife Service (USFWS), Maryland Department of Natural

Resources (MD DNR) and National Marine Fisheries Service (NMFS). USFWS Information for Planning and Consultation (IPAC) website indicated that there are no records of the presence of any federally listed rare, threatened, or endangered species under USFWS purview. A state search was also done indicating that there are no records of the presence of any state listed rare, threatened, or endangered species in the project vicinity under MD DNR purview. In a letter dated April 17, 2015 (Appendix D), National Marine Fisheries Service indicated four federally listed threatened or endangered sea turtles have been documented to visit the Chesapeake Bay and the coastal waters of Maryland and Virginia. These include the threatened Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead (*Carella caretta*), and the endangered Kemp's ridley (*Lepidochelys kempi*), green (*Chelonia mydas*) and leatherback sea turtles (*Dermochelys coriacea*). Sea turtles are transient to the Chesapeake Bay and the project vicinity. Sea turtles are expected to be present in the Bay from April through mid-November of each year. During cooler weather months when construction would occur, sea turtles are unlikely to be present in the project area. Additionally, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are present in the Chesapeake Bay and its adjacent rivers and tributaries, and the coastal waters of Maryland and Virginia. The New York Bight, Chesapeake Bay, South Atlantic and Carolina DPS of Atlantic sturgeon are endangered; the Gulf of Maine DPS is threatened. Individuals originating from any of these DPS could occur in the project area. Atlantic sturgeon are found throughout the tidal waters of the Chesapeake Bay. Atlantic sturgeon could be present in the project area, but monitoring suggests that they are not common (NFMS, 2009).

7) Other Wildlife - It is expected that shorebirds, terrapins, and other mobile species will temporarily relocate during construction. Detrimental impacts to other wildlife are expected to be temporary and insignificant. Some disturbance to terrestrial wildlife may also occur due to construction activities; however these effects are temporary, not significant, and would not be expected to limit their growth or population size. TOY restrictions would be implemented to protect oyster bars and wintering and migratory waterfowl.

8) Actions to Minimize Impact - persistent and extensive beds of SAV exist at the mouth of Sheep Pen Gut and along the shoreline south of the existing channel as stated by NOAA (May 4, 2015 email correspondence, see Appendix D) and MD DNR in letter correspondence (May 12, 2015).

   SAV location and densities vary annually. From 2012-2015 SAV has not been present within any of footprints of the jetties, sill, or channel. Figure 5 depicts SAV location and densities in the project area for the most recent year data is available, which is 2015. The last time any SAV was present in any of the project footprints was 2011 in which low densities occurred within the channel and proposed northern jetty. The encroachment of SAV into the channel in this time period occurred because the channel has not been maintained to its authorized depth of 6 feet. Figure 6 depicts SAV presence and density in the project area annually from 2011-2014. A continuous stone structure along the shoreline would reduce water circulation and could impact SAV. Therefore USACE added notches to the proposed stone sill to improve circulation and flow of water thus minimizing impacts to SAV (May 4, 2015 email correspondence see Appendix D). Additionally USACE aligned the stone sill so that it follows the existing fringe alignment of the existing SAV footprint and will adhere to TOY restrictions and not conduct any construction from April 15-October 15 when SAV is dormant to minimize SAV impacts. A likely positive impact from the Proposed Action to SAV would be from the stabilization of the shoreline provided by the stone sill. The expected reduction in sediment loading will improve water clarity offshore and in the interior creeks, possibly benefiting SAV.

In summary, since SAV has not been present in any of the Proposed Action footprints since 2012 and USACE will be implementing designs and TOY restrictions to minimize impacts to the SAV USACE has determined that there are no expected long-term impacts to SAV. USACE has been in discussion with the sponsor and MD DNR to discuss post-construction monitoring of SAV presence in this area.

F. Proposed Disposal Site Determinations

1) Mixing Zone Determination - Not applicable.

2) Determination of Compliance with Applicable Water Quality Standards - Construction activities will be conducted in accordance with all applicable state water quality standards.

3) Potential Effects on Human Use Characteristic

a) Municipal and Private Water Supply - Not applicable.

b) Recreational and Commercial Fisheries - Construction may temporarily impede navigation activity. A winter construction schedule will be used to minimize impacts to the local fishing economy. The restoration of tidal wetlands will provide habitat for juvenile game species, fish and crabs. The project provides safe and economical navigation for all boat traffic in and out of Sheep Pen Gut federal navigation channel between Rhodes Point and the Chesapeake Bay. The dredging of the federal navigation channel helps to support the area's economy by allowing a full range of commercial waterman and recreational watercraft to enter the Bay. Overall, the project will have a net positive beneficial impact to navigation.

c) Water Related Recreation - Construction may temporarily impede recreational use of the water in this area. The impacts are expected to be minor and temporary. A winter construction schedule will reduce impacts on most recreational boating (the summer season is when recreational use is the highest). Recreational boaters in the project area would be able to safely navigate through the mouth of the channel upon completion of the Proposed Action. The dredging and construction operations may temporarily require the redirection of any boat traffic around the area. Boaters may experience some delays during this time. It is anticipated that a beneficial impact to recreation would occur once the construction is completed and access to Rhodes Point is restored.

d) Aesthetics - Construction of the Proposed Action would alter the natural aesthetics at Rhodes Point. This impact would be permanent. The proposed jetties would be constructed to a crest of +5 ft MLLW. The south jetty have a length of 1,150 feet. The north jetty would have a length of 650 feet. A low profile sill (will be built to a crest height of +3 feet MLLW) was incorporated into the design to limit large stone structures at the site. This is expected to be a minor impact to the Bay-wide viewshed. The Proposed Action is not anticipated to block the viewshed of adjacent properties. The stone sill would stabilize approximately 850 feet of shoreline. There would also be a temporary and minor reduction in aesthetics during dredging and construction activities.

e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves – No adverse effects are expected.

G. Determination of Secondary Effects on the Aquatic Ecosystem

Minor impacts may occur after construction due to the planting. Disturbance to vegetative areas that will need to recover from construction are expected to remain localized and short term in nature.

III. Finding of Compliance or Non-Compliance with Restrictions on Discharge

A. Adaptation of the Section 404(b)(1) Guidelines to This Evaluation

No adaptations of the Guidelines were made relative to this Evaluation.

B. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem

Dredging and jetty construction are water dependent by nature and require either excavation of supra-tidal sites to intertidal elevations or filling into open water habitat. In this case, the proposed action was configured to minimize detrimental environmental impacts and maximize benefits to a specific, local navigation channel.

C. Compliance With Applicable State Water Quality Standards

The proposed dredging and placement of material, jetty construction, and associated activities will comply with Maryland water quality standards.

D. Compliance With Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act

The proposed fill material is not anticipated to violate the Toxic Effluent Standard of Section 307 of the Clean Water Act. N/A.

E. Compliance With Endangered Species Act of 1973

In full compliance. There will be no impacts to these resources.

F. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

No Marine Sanctuaries, as designated in the Marine Protection, Research, and Sanctuaries Act of 1972, are located within the study area. N/A.

G. Evaluation of Extent of Degradation of Waters of the United States

No adverse impacts permanent or temporary to the aquatic ecosystem diversity, productivity and stability, and recreation, aesthetics and economic values will occur as a result of this project.

The proposed dredging and placement of material, jetty construction, and associated activities will not result in significant adverse impacts on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish and shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and wildlife will not be significantly adversely affected. Significant adverse impacts on aquatic ecosystem diversity, productivity and stability, and recreation, aesthetics and economic values will not occur as a result of the Proposed Action.

H. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

Appropriate and practical steps to minimize potential impacts of the placement of fill material in aquatic systems will be followed. This includes the implementation of BMPs and the planting of marsh plants in the tidal wetland. On the basis of the 404 (b)(1) guidelines, the proposed placement sites are specified as complying with the inclusion of appropriate and practical conditions to minimize contamination or adverse effects to the aquatic ecosystem. Best management practices such as erosion control measures along with minimizing the footprint of the project components to only the area needed to achieve project purpose have minimized adverse effects.

I. Determination of Cumulative Effects on the Aquatic Ecosystem

The Proposed Action is not anticipated to result in cumulative adverse effects. Actions by federal and non-federal entities that are (1) in the reasonably foreseeable future or can be reasonably forecasted, (2) planned, or (3) on-going in the study area are summarized below with a brief description of potential impacts.

Periodic maintenance dredging is conducted around Smith Island in small navigation channels including Twitch Cove and Big Thorofare. The last time these channels were dredged was 2009. Currently, USACE has a solicitation out for the maintenance dredging of these channels and the contract is planned to be awarded in early 2017. Dredging will likely not begin until the fall of 2017 (due to TOY restrictions). Maintenance dredging of the federal channels in these locations would result in displacement of fish and benthic resources immediately after dredging. These dredging projects will cause only temporary bottom disturbance and loss of benthos.

The USFWS Fog Point Living Shoreline Restoration Project, at the Glenn Martin National Wildlife Refuge on the northern half of Smith Island began in July 2015 and was completed in June 2016. Construction of a living shoreline will help protect nearby Smith Island communities from the effects of intense storms and sea-level rise, as well as wildlife and habitat at Glenn Martin National Wildlife Refuge. The project is supported by federal funding from the Hurricane Sandy Disaster Relief Act. This project constructed 20,950 feet of living shoreline to stabilize a highly vulnerable shoreline at Martin National Wildlife Refuge and directly protects over 1,200 acres of quality tidal high marsh, SAV and clam beds: https://www.fws.gov/hurricane/sandy/projects/FogPoint.html.
Further, the dredged material from the Twitch Cove and Big Thorofare federal navigation channels will be beneficially used to restore dune and wetland habitat on Swan Island, which is part of the Glenn Martin National Wildlife Refuge. The material on Swan Island will be contained and planted for stabilization.

In early 2017 Somerset County completed construction of a living shoreline at Rhodes Point (Figure 5-2). Overall, the project should have positive environmental benefits given the historic loss of 211 acres of Hog Neck Peninsula and associated wetlands. The project provides shoreline erosion control to a shoreline that was eroding 1.5 to 9.3 feet a year, and prevent breaches of the Hog Neck Peninsula that protects the existing Rhodes Point community and the extensive SAV beds in the lagoon landward of the Hog Neck project shoreline.

The material dredged from various other USACE projects in the Bay is placed at other sites, versus the site laid out in the Proposed Action. There is no action to utilize a single location for placing dredged material from these unrelated channels that would create a cumulative effect. The periodic dredging of the Federal navigation channels in the Chesapeake Bay results in periodic minor turbidity and disturbance of fish and other aquatic organisms. Temporary reductions in benthos within a limited area could occur from consecutive or concurrent dredging/placement operations. Depending on the location to be dredged and the placement site, some disturbance of terrestrial wildlife may also occur during these activities. These effects are not significant. The occasional disturbance of fish and wildlife does not inhibit their growth or population size. The turbidity produced is of short duration, and contributes very little sediment to the natural ebb and flow of sediments in the area. For these reasons, the Proposed Action would not contribute to any significant adverse cumulative impact on natural resources in the project area. Additionally the Proposed Action would not pre-empt any planned or ongoing actions in the area. Based on the minor nature of the impacts associated with the previous dredging of the proposed project, the current dredging is not expected to contribute to adverse cumulative impacts. The beneficial cumulative impact of the proposed action are stabilizing a portion of shoreline of a rapidly eroding area (Smith Island) and navigation improvements to the small channel of the Proposed Action will be connecting to a larger network of navigation channels in and around Smith Island.

J. Determinations of Secondary Effects on the Aquatic Ecosystem

The placement of dredged material will not impede the continued use of the waters surrounding Smith Island for fishing, boating, and other water-based commerce, transportation, and recreation. This represents the status quo for the Smith Island area. Indirect effects resulting from the Proposed Action have been discussed previously in this analysis under each category. No significant secondary impacts are expected from the Proposed Action.

K. On the Basis of the Guidelines the proposed Disposal Site(s) for the Discharge of Dredged or Fill Material is:

__√__ (1) Specified as complying with the requirements of these guidelines; or
_____ (2) Specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem; or
_____ (3) Specified as failing to comply with the requirements of these guidelines.

REFERENCES

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National Marine Fisheries Service (NMFS). 2009. Agency correspondence from NMFS to USACE on 7 May 2009 on the "2009 EA for Maintenance dredging of Twitch Cove and Big Thoroughfare, and Rhodes Point to Tylerton Federal Navigation Channels.

Appendix E

ERDC/CHL TR-16-17

Coastal and Hydraulics Laboratory

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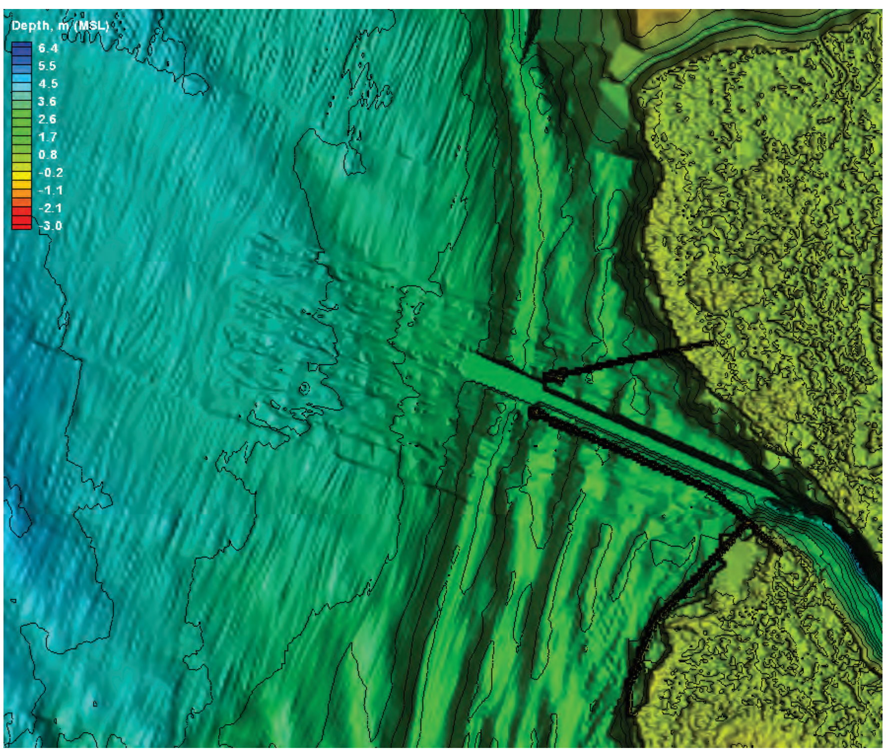
Coastal Inlets Research Program

Hydrodynamic Modeling for Channel and Shoreline Stabilization at Rhodes Point, Smith Island, Maryland

Zeki Demirbilek, Lihwa Lin, Thomas D. Laczo, and Anthony A. Clark

November 2016



Hydrodynamic Modeling for Channel and Shoreline Stabilization at Rhodes Point, Smith Island, Maryland

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Final report

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Under Project No. 113464, "Rhodes Point, MD"

Abstract

This report documents numerical wave and flow modeling for stabilizing a shallow-draft navigation channel and adjacent shorelines at Rhodes Point, located on Smith Island, MD, in the Chesapeake Bay. The U.S. Army Engineer District, Baltimore (NAB), is considering structures to protect the western entrance of the channel and reduce erosion of shorelines by stabilizing the channel. The U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), performed a numerical study to develop preliminary designs for the optimal location of structures and to determine effects of waves and hydrodynamics on the structures.

The Coastal Modeling System (CMS)-Wave and CMS-Flow models were used for wave and flow modeling in the Chesapeake Bay. Numerical results indicated Alternative 1, with a shore-connected north jetty nearly normal to the north shoreline at the channel entrance and a south jetty parallel to the channel with revetment structures protecting the south shorelines, offered a cost-effective solution by reducing wave energy inside the channel and along the shores. Alternative 2 with two parallel jetties provided similar wave energy reduction in the channel and along the shorelines but showed higher currents and erosional pockets developing in the channel, which could undermine the stability of the jetties.

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Preface

This study was conducted for the U.S. Army Engineer District, Baltimore (NAB), under the Baltimore District, Planning Division, Civil Project Development Branch; Project No. 113464, "Rhodes Point Project, Maryland." The technical monitor was Thomas D. Laczo (CENAB-ENC-W).

This study was partially funded by the USACE Coastal Inlets Research Program (CIRP), Headquarters, U.S. Army Corps of Engineers (HQUSACE), Washington D.C. (Project Element No. 060000, Project No. 454634, Task No. A1100, Work Unit No. 58F268). The USACE CIRP Program Manager was Dr. Julie D. Rosati, CEERD-HF-CI. Jeffrey A. McKee was the HQUSACE Navigation Business Line Manager overseeing the CIRP Program.

At the time of publication, James D. Gutshall was Chief, CEERD-HN-H; Tanya M. Beck was Chief, CEERD-HN-C; Dr. Jackie S. Pettway was Chief, CEERD-HN; and W. Jeff Lillycrop (ERDC-CHL) was the ERDC Technical Director for Civil Works and Navigation Research, Development, and Technology Transfer (RD&T) portfolio. The Director of ERDC-CHL was José E. Sánchez.

The Commander of ERDC was COL Bryan S. Green, and the Director was Dr. Jeffery P. Holland.

Unit Conversion Factors

Multiply	By	To Obtain
degrees (angle)	0.01745329	radians
feet	0.3048	meters
inches	0.0254	meters
$feet^2$	0.0929	$meters^2$
gallons (U.S. liquid)	0.003785412	cubic meters
gallons (U.S. liquid) per minute per foot	0.00020699	cubic meters per second per meter
pounds (mass)	453.59237	grams
pounds (force)	4.448222	Newtons

1 Study Needs and Plan

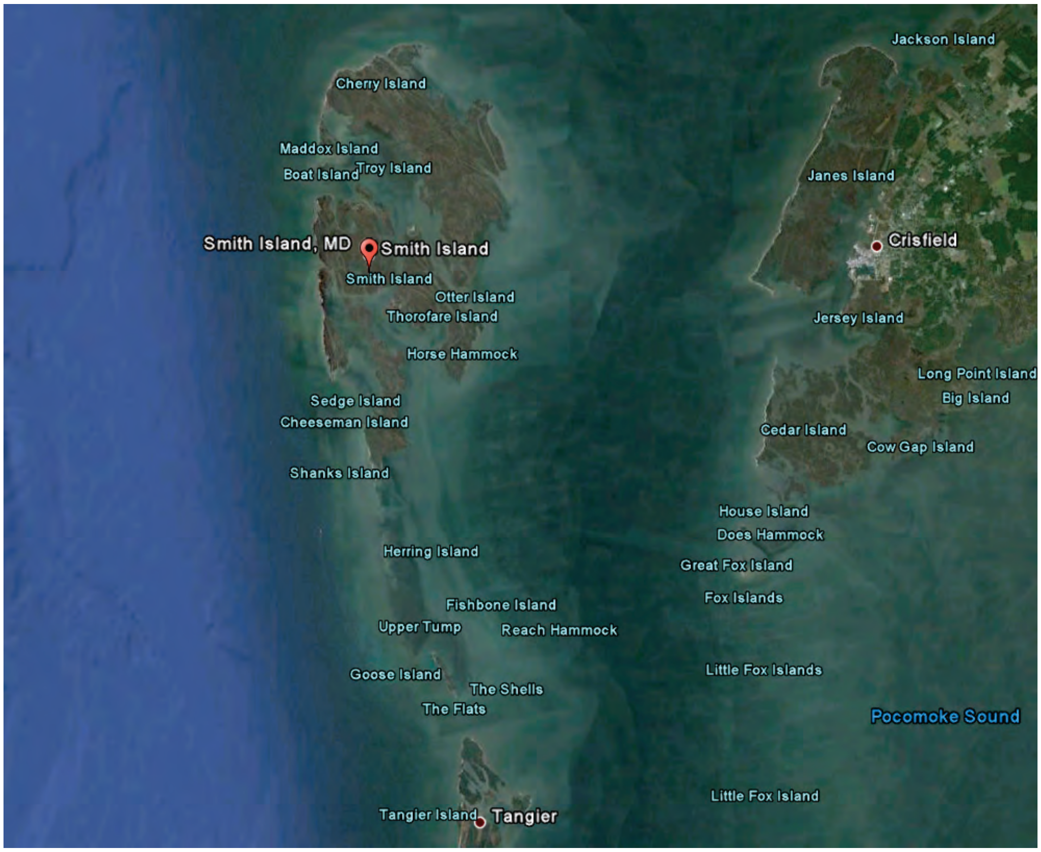
1.1 Background

Details of a numerical modeling study conducted for stabilization of the Rhodes Point west navigation channel, located on Smith Island, MD, in the Chesapeake Bay, are described in this report. Estimates of water level, wave, current, sediment transport, and morphologic change inside this narrow channel and along the eroding north and south shorelines of the west entrance channel were calculated with an integrated numerical wave, current, and morphology change model. The modeling area included the west entrance channel and the connecting short mid-section of the narrow boat canal. The study investigated the optimal geometry and size of structures (number of structures and their placement location, orientation, and length), assessment of the efficacy of proposed jetty alternatives, and development of water level, wave, and current estimates for follow-up structural design calculations. Impacts of environmental forcings (winds, water levels, waves, and currents) on areas of interest were examined with and without structures, using numerical models. Details of the numerical modeling study, tasks, results, and findings are provided in this report.

The study area of interest includes the west channel and navigation canal that passes through the Sheep Pen Gut on Smith Island, MD, that connect Rhodes Point to the Chesapeake Bay (Figures 1-1 and 1-2). Rhodes Point is located on the west side of Smith Island (37.98o N Latitude, 76.03o W Longitude). Smith Island, located between Tangier Sound to the east and Chesapeake Bay to the west, lies mostly in the Maryland portion of the Chesapeake Bay, straddling the Maryland and Virginia state line with only its southern tip on the Virginia side.

Smith Island is approximately 10 miles west of City of Crisfield, MD, and 95 miles south of Baltimore, and consists of several smaller islands separated by shallow tidal creeks or channels called “guts.” Smith Island is sparsely populated and has three small residential fishing communities. These are Rhodes Point, Ewell, and Tylerton, all located in Maryland and are accessible only by boat. The small upland regions are the residential portions of these three fishing towns. The land elevation in the study area is low, with several fine-grained sand ridges, marshlands, and numerous creeks. The island’s highest elevations are only 3 to 5 feet (ft) (1 to 1.5 meters [m]) above mean sea level (MSL) at the populated areas of the island.

Figure 1-1. Location of Smith Island in the Chesapeake Bay.



As shown in Figures 1-2 and 1-3, there is a 150 ft wide boat channel located at the midpoint of Smith Island that runs east-west across the island and passes through the Sheep Pen Gut and Rhodes Point. Technically termed a navigation channel, this narrow canal is maintained by U.S. Army Engineer District, Baltimore (NAB), for small-boat traffic. The average width and depth of this east-west linkage route are approximately 50 m and 3 m, respectively, which vary in different segments along the canal. The canal supports seafood and tourism needs of Smith Island, which are two sources of livelihood for the island residents. Fishermen have mooring docks and seafood-processing sheds and other infrastructure for the fishing fleet along the shorelines on both sides of the canal. Maintenance and improvement of this canal are critical to the economy of the island. Proposed improvements for the west entrance to Rhodes Point section of the canal include realignment of the channel, protecting it with two jetties, protection of north and south shorelines to prevent flanking, and establishing fill areas behind the shore protection. These modifications are expected to reduce the cost of channel dredging to improve the use of the channel by larger boats and reduce the erosion of shorelines caused by waves and currents.

Figure 1-2. Channels, creeks, guts, and three main towns of Smith Island.

The east side of the island as shown in Figures 1-1 through 1-3 is well sheltered from the effects of storms, northeasters, and hurricanes. The short fetch distances from the Delmarva Peninsula do not provide sufficient distance for large wind waves to generate and grow. The longest fetch on the east side of Smith Island is along Tangier Sound. Wind-generated waves from the south can grow and propagate through Tangier Sound. These waves affect the east side of Smith Island and Janes Island (Figure 1-1) and may be the primary source of chronic flooding at the vulnerable town of Crisfield, MD. In contrast, the western side of Smith Island is connected to Chesapeake Bay and is exposed to large wind waves approaching the island from the northwest through southwest quadrants. Consequently, the west shoreline of Smith Island has long experienced progressive flooding and erosion. Based on prevailing wind patterns in the Chesapeake Bay, the longshore transport along the Smith Island west shoreline appears to be towards the south.

Figure 1-3. Existing western channel entrance at Sheep Pen Gut.

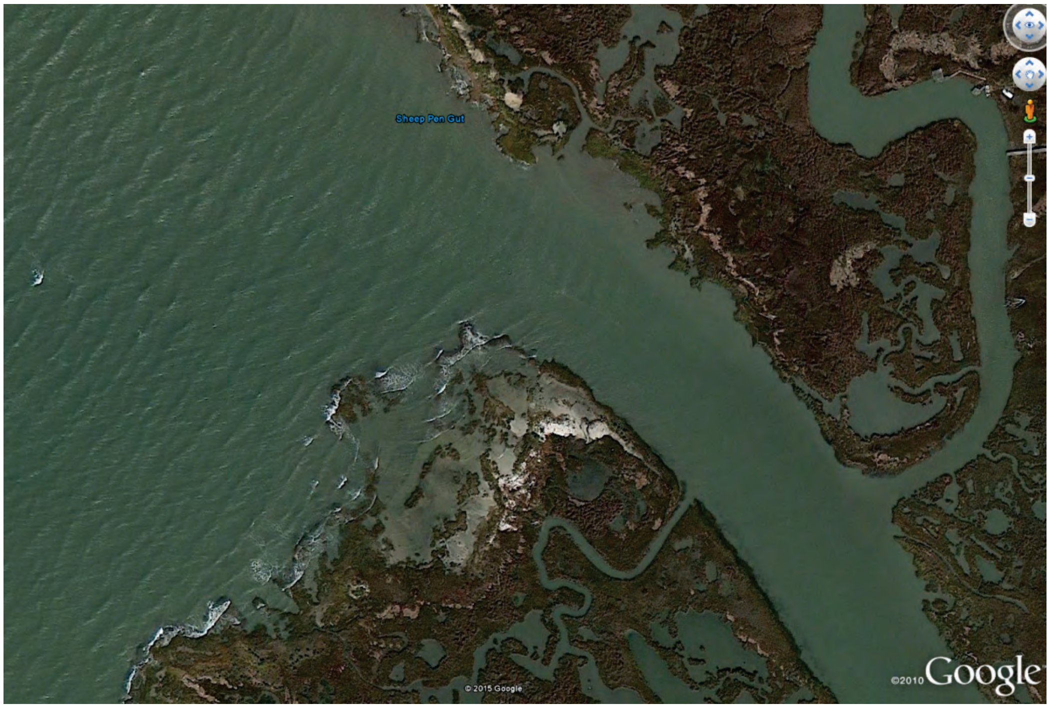


Figure 1-4. The dual-jetty system evaluated in the 2009 modeling study.

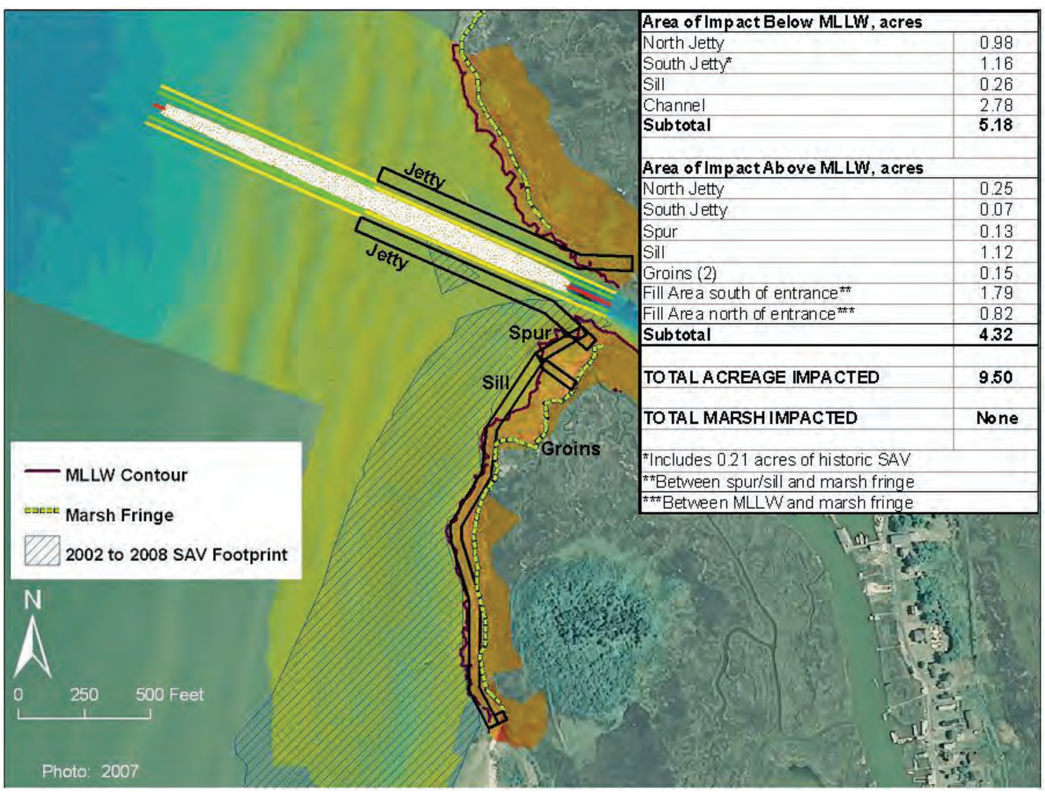


Figure 1-4 shows a proposed realigned channel with dual jetties that was investigated by NAB in a feasibility study in 2009 (Kraus 2009). This jetty configuration is Alternative 2 (Alt-2) in the present study that will be re-evaluated using the latest bathymetry and environmental forcing conditions (winds, waves, water levels, and currents). The extent of reduction of waves and currents along the channel and north and south shorelines, estimates of channel shoaling rates with/without jetties, and wave parameters for jetty structure design will be investigated in the present modeling study. The water level variations will include the effects of sea level rise (SLR).

1.2 Objectives

The objectives of this study were to perform a numerical modeling evaluation for the west entrance channel at Rhodes Point without jetties ("no-project," Alt-0) and one Alternative with jetties (Alt-1) to reduce wave energy in the western portion of the canal. Alt-2 from the 2009 study was re-evaluated. The present study shows comparison of hydrodynamic, wave, and sediment transport modeling results for Alt-0, Alt-1, and Alt-2 to determine effects of the proposed infrastructure modifications to the entrance channel. Engineering estimates of environmental forcings (winds, waves, currents, and water levels) at the west entrance channel are investigated for future design of a realigned channel with jetties. The impacts of jetties on wave energy reduction, changes on shoaling patterns of the entrance channel, and structural design estimates for jetties and south shore revetment are provided.

1.3 Modeling approach

The project team agreed on a modeling approach that was commensurate with the study schedule. Since no field data were available for winds, water levels, waves, and currents at Rhodes Point, the model-calculated estimates of waves, flow, and sediment transport were necessary. Because no field data were available, the modeling results could not be checked against site measurements, but the modeling results were required for qualitative evaluation of the Alternatives and recommended solutions.

The study site is exposed to open water in Chesapeake Bay. In the absence of field data, the study team considered using results from recent studies, including the Tangier Island project (Demirbilek et al. 2015), the North Atlantic Coast Comprehensive Study (NACCS) post-Sandy study (Cialone et al. 2015), and the preliminary 2009 numerical modeling study for Rhodes Point (Kraus 2009). These three studies were evaluated, as well as other prior and ongoing studies by the USACE, other government agencies, and academic institutes of the Chesapeake Bay for available metocean sources of day-to-day conditions and storms data applicable to the Rhodes Point study. For its primary mission of regional-scale project performance evaluation, the NACCS used a large domain study to model the east coast region from Maine to Virginia. A detailed resolution of project-specific areas within Chesapeake Bay would require developing finer resolution grids and re-running the Bay-scale models, analyzing and preparing wind, water level, wave, and current predictions for any local study in the Bay.

The metocean forcing developed for Tangier Island (Demirbilek et al. 2015) located south of this project site had considered different storms and time periods and therefore could not be used for Rhodes Point. The 2009 feasibility modeling study for Rhodes Point (Kraus 2009) had used older bathymetry data. The difference between bathymetries used in the 2009 grid and 2015 survey data are highlighted in Figure 1-5. On the Bay side where surveys overlap in the west entrance, and areas along north and south shorelines, there is considerable bathymetric difference between 2009 and 2015 bathymetry data. Because of these issues, including the resolution of model grids and differences in bathymetry, the 2009 study forcing and results could not be used in the present modeling. Consequently, the modeling for this project could not be leveraged with recently completed studies.

Both the existing channel condition (no-project) and proposed channel realignment with jetties (with project) were investigated in the present study. Two structure Alternatives (Alt-1 and Alt-2) were evaluated relative to Alt-0 (no-project) in terms of effects of structures on waves, currents, and channel sedimentation (shoaling). Sketches of two geometries, Alt-1 and Alt-2, are shown in Figures 1-6 and 1-7, respectively. Details of these Alternatives are described in Chapter 2.

The Coastal Modeling System (CMS) was used to calculate waves, hydrodynamics, sediment transport, and morphology change (Demirbilek and Rosati 2011; Lin and Demirbilek 2005; Lin and Demirbilek 2011a,b). Wave modeling results (wave height, period, direction, and water depth) along the proposed structure footprints were used for the preliminary structure design calculations, as discussed in Chapter 3. The structure calculations include armor stability, wave runup, and wave transmission through and overtopping the structures. The bathymetric, shoreline, and land data provided by the NAB were used to generate the numerical model grids in the present study. The bathymetry data included a 2012 lidar and a 2015 survey. Figure 1-8 shows the coverage area for the two data sets. Figures 1-9 and 1-10 show the extent of water and land coverages from these data sets at the project site.

Figure 1-5. Bathymetry difference between 2009 grid and 2015 surveys.

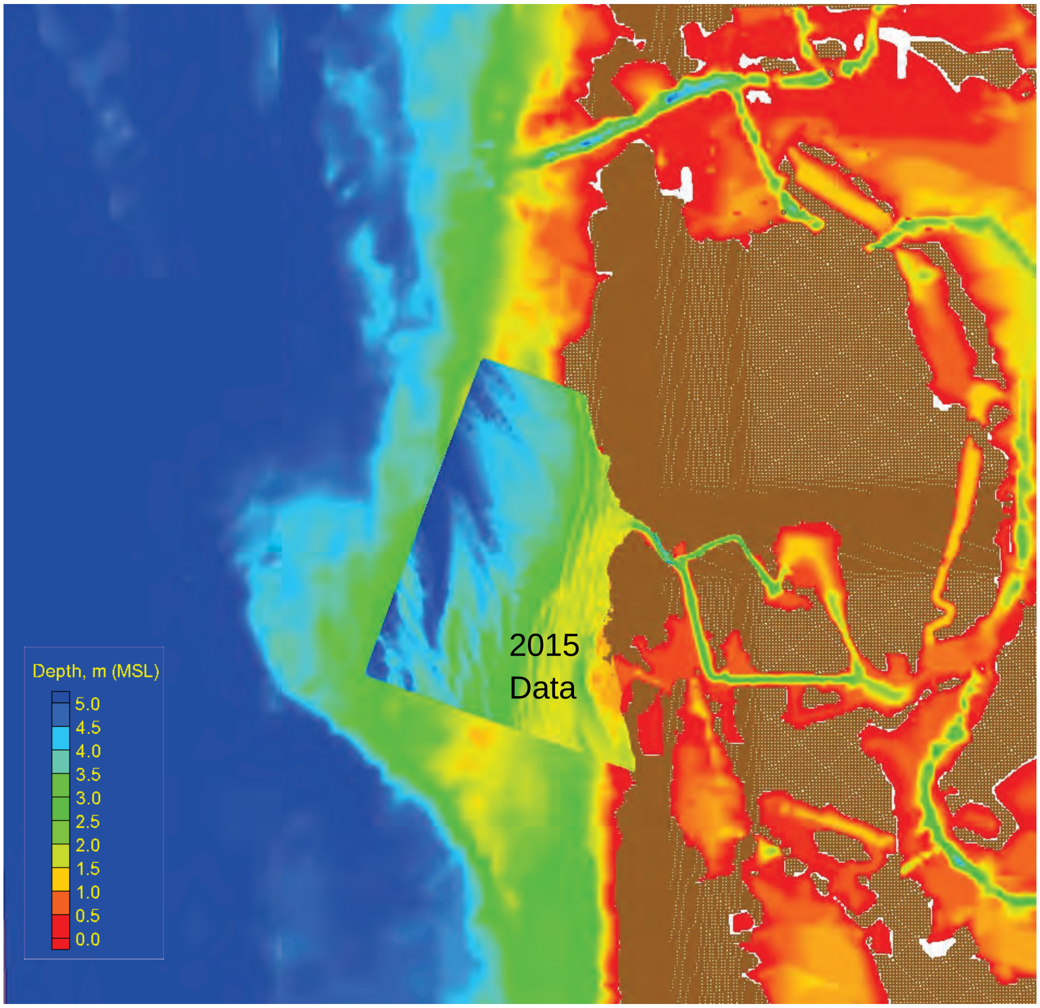


Figure 1-6. Shore-normal north jetty at Rhodes Point (Alt-1).

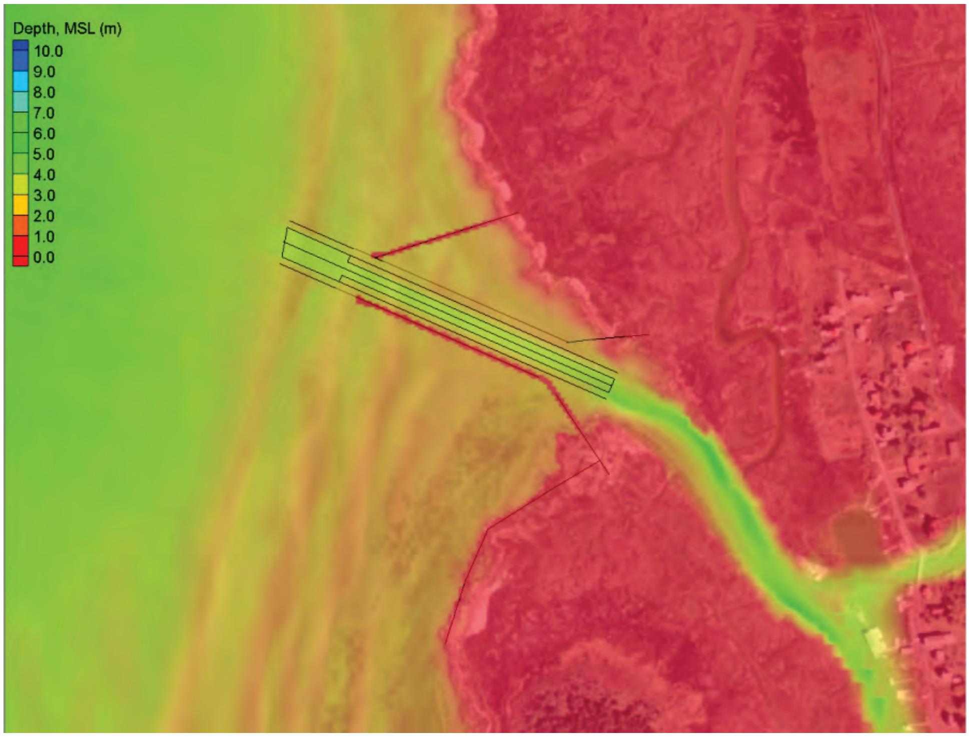


Figure 1-7. Parallel jetties at the Rhodes Point (Alt-2).

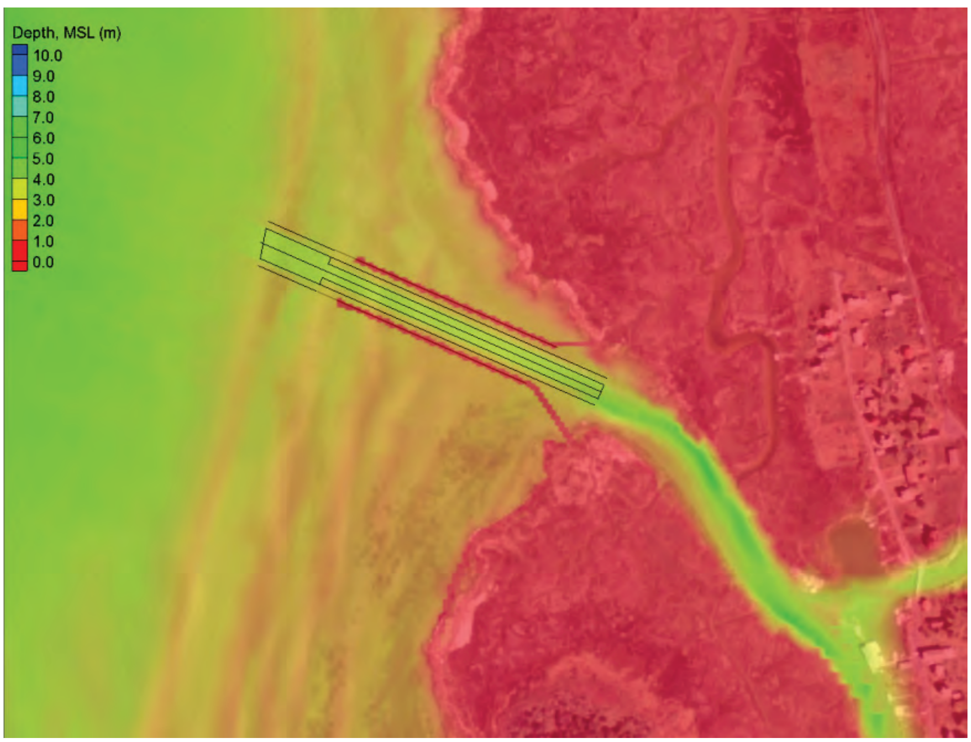


Figure 1-8. 2012 lidar survey land coverage of Smith Island and Rhodes Point.

Figure 1-9. The 2012 lidar data coverage at the project site.

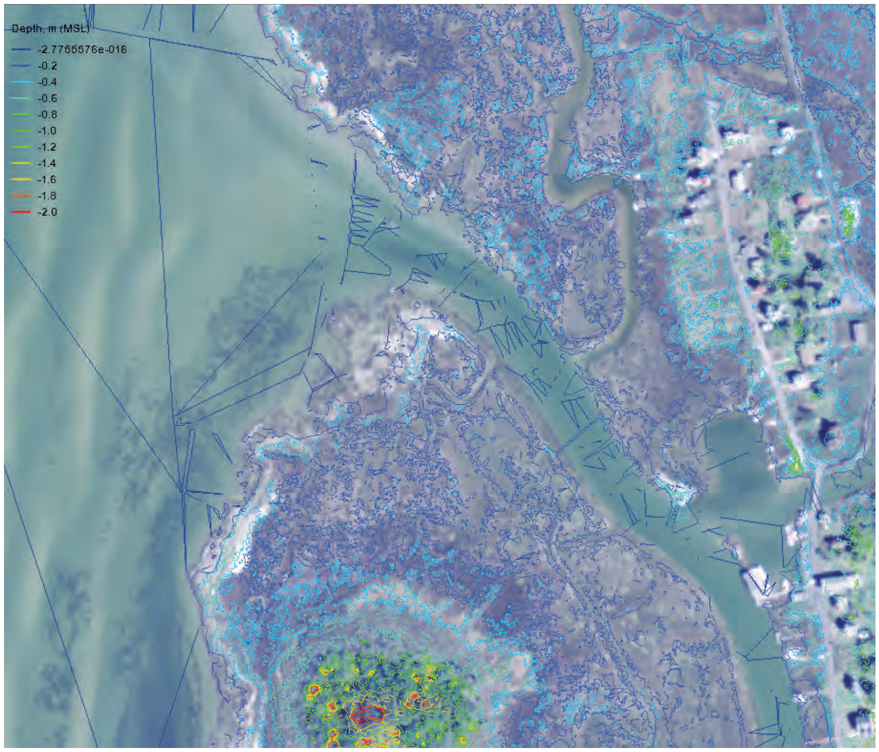
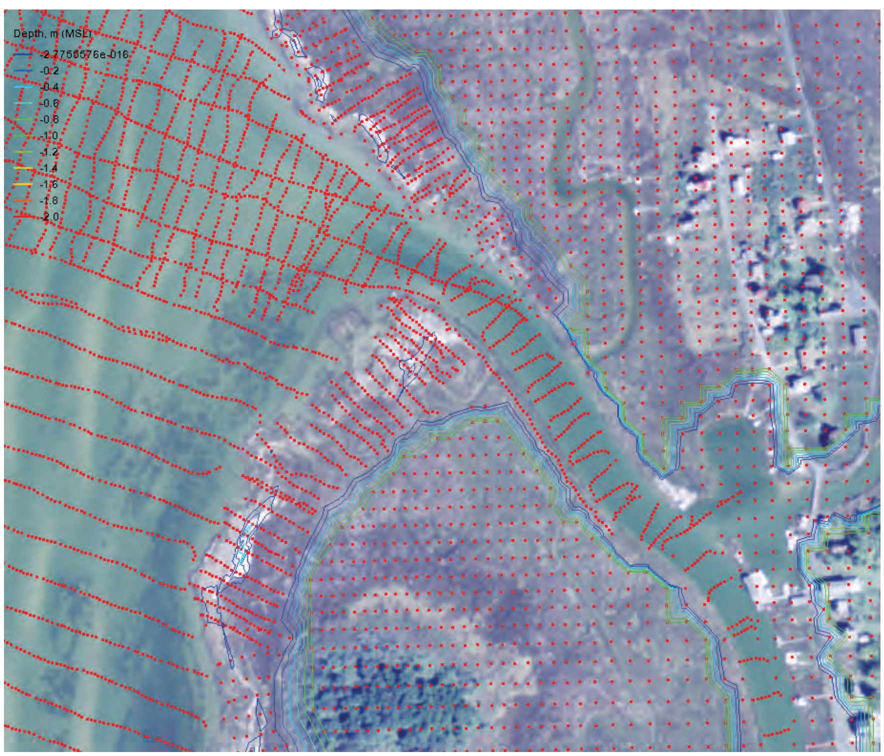


Figure 1-10. The 2015 survey coverage at the project site.



Forcing conditions for the numerical models were obtained from the meteorological and oceanographic (metocean) data sources. The metocean data (winds, waves, and water levels) available from various data sources and previous studies were assembled for nonstorm and storm conditions. Hurricane Sandy was selected as the design storm to represent a 50-year storm return period. Numerical models were set up with these data and conditions. Details of simulations performed for the existing (Alt-0) and with project Alternatives (Alts 1 and 2) are described in Chapter 2.

1.4 Tasks

Five primary activities of this numerical modeling study were (a) collect and format the input data required for numerical modeling for winds, tides, storms, bathymetry, sediments, and ancillary data; (b) set up and run wave, flow, and sediment transport models for both “as is” and “with project” scenarios; (c) document the reduction of waves and currents in the entrance area “with project” scenario, including changes in wave, flow, and sediment transport in the vicinity of proposed jetty and revetment structures, along the channel, and north and south shorelines on both sides of channel; (d) develop estimates of forcing parameters (water levels, waves, and currents) for jetty structural calculations from the modeling study results, and (e) discuss progress and issues with NAB on a regular basis as needed. The project-specific tasks are described next.

Task 1. Metocean forcing (winds, waves, tides, currents, water levels). Task 1 included preparing metocean forcing data required for numerical models. The local wave climate affecting the west side of Smith Island at Rhodes Point was generated within the Chesapeake Bay. Waves were estimated in the Bay by using wind input to a wave generation and propagation model. Available sources of day-to-day wind data applicable to Rhodes Point were obtained from local airports in the Chesapeake Bay region. The Hurricane Sandy wind fields were assembled for the Bay-scale simulations and for finer resolution modeling at Rhodes Point.

Task 2. Modeling of Alternative (Alt-1) and “as is” (Alt-0) geometries using post-Sandy bathymetry. The parallel-jetty Alternative considered in the 2009 feasibility study was remodeled in this study because of significant improvements to the CMS after completion of that study. New grids with proper resolution and updated bathymetry were generated using Task 1 data for Alt-0 (without), and Alt-1 and Alt-2 (with) project geometries.

The recommended locations of the realigned channel and parallel jetties from the 2009 study, and length and width of structures, were represented in the new grids. Coupled wave and flow models were used to evaluate changes to the location, size, and geometry of the jetty structures. Refined grids were used for accuracy of wave predictions at the inlet for representing wave diffraction, reflection, and transmission around the jetty structures.

Task 3. Channel sedimentation and morphology change modeling. Because the boat channel is a federally maintained, shallow-draft waterway regularly dredged by NAB, the proposed jetty structures should not exacerbate shoaling problems in the channel. Sediment grain size data were utilized from grab samples obtained by NAB that consisted of a mixture of sands and fine-grained material and were used in sediment transport modeling.

The CMS simulations with and without jetty structures were performed to determine the expected depositional and erosional areas in the west channel and along the north and south shorelines of Sheep Pen Gut to identify potential impacts of the proposed jetties on these most likely impacted areas.

Task 4. Wave parameters for structural design. Task 4 simulated storm wave conditions using CMS-Wave and local wind data. Wave estimates were developed along the realigned channel, seaward face of an equal length dual jetty system and a shore-normal north jetty system. Finally, model results were extracted along the perimeter of jetties, and wave heights, wave period, and water level were used in structural design to estimate structures (jetties and south shore revetment), crest elevation, crest width, side slopes, and stone size.

Task 5. Technical report. The last task summarized details of the modeling study to NAB in a report (this present technical report).

1.5 Report layout

Chapter 2 describes details of the numerical modeling study, including model domain, bathymetry, grids, forcing types, structural alternatives, save stations, conditions simulated, a comparison of Alternatives, and study findings and recommendations. Chapter 3 describes the structural design calculations, including determination of jetty structure stone size on front and leeside of the jetties, and transmitted wave heights for jetty structure crest elevation of 5 ft (1.52 m) above the mean lower low water (MLLW) and 8 ft (2.4 m) crest width for three structural side slopes (V:H = 1:1.5, 1:2, and 1:2.5). The design estimate for the south shore revetment is based on a recent study at Tangier Island. The effects of SLR and general subsidence of the Bay were considered in the calculations. The study conclusions are summarized in Chapter 4.

2 Numerical Modeling of Waves, Currents, and Sediment Transport

2.1 Purpose

This numerical modeling study investigated waves and hydrodynamics at the western channel of Rhodes Point and developed wave, current, water-level, and sediment transport estimates with proposed jetties to reduce wave energy in the navigation channel. The geometries of the proposed structural Alternatives were investigated relative to the existing channel without jetty structure or south shore revetment. The effects of jetty structures on waves, currents, and sedimentation in the channel are described in this chapter.

2.2 Numerical models

The CMS was used to simulate waves, currents, sediment transport, and morphology change. The CMS includes wave, flow, and sediment transport modeling tools for coastal inlets and navigation projects (Demirbilek and Rosati 2011). Development and enhancement of CMS capabilities and tools have continued over the last 10 years. The version of the CMS model used in the present study has significant advancements included as compared to the version used in the 2009 feasibility study.

The CMS is an integrated modeling system that consists of a spectral wave model (CMS-Wave) and a two-dimensional (2D) circulation model (CMS-Flow) which includes sediment transport and morphology change capabilities. CMS-Wave is a steady-state, 2D spectral wave model (Lin et al. 2008; Lin et al. 2011a,b and 2005) capable of simulating coastal wave processes with ambient currents at open coast, bays and ports, and estuaries that include navigation channels and inlets.

CMS-Flow is a 2D hydrodynamic and sediment transport model capable of simulating depth-averaged circulation, salinity, and sediment transport forced by tides, wind, atmospheric pressure gradient, river inflow, and waves (Buttolph et al. 2006; Sanchez et al. 2011a,b). It solves the fluid mass and momentum conservation based on the continuity and momentum equations including terms for the Coriolis force, wind stress, wave stress, bottom stress, and turbulent diffusion.

The CMS uses the Surface-water Modeling System (SMS) (Zundel 2006) interface for grid generation, model setup, analysis of model results, plotting, and post-processing. Both CMS-Wave and CMS-Flow have been validated in many coastal/lake/bay projects and studies, and a comprehensive collection of CMS validation and verification cases is provided by Demirbilek and Rosati (2011), Lin et al. (2011a,b), and Sanchez et al. (2011a,b). Appendix A describes and summarizes additional information about the CMS and its capabilities.

The development of advances to CMS-Wave to address the project's specific needs was funded by the U.S. Army Corps of Engineers (USACE) Coastal Inlets Research Program (CIRP), a research and development program in the USACE Navigation Business Line. Three features of CMS-Wave required additional changes to model coding and improvement of wind inputs for storms. The revised model required considerable additional testing. The first set of coding changes involved modifications and testing of the full-plane and parent-child capabilities of the model for hurricanes and northeasters in the Chesapeake Bay estuary. The second set of changes included development of pre- and post-processing analysis codes for model setup. The third set of changes involved development of tools for structural design calculations.

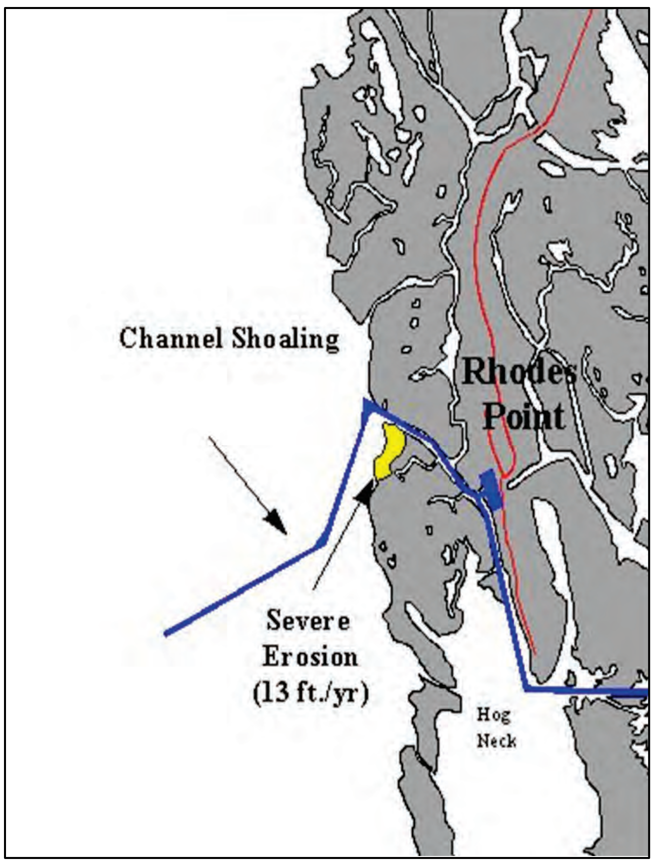
Because no field data were available at Rhodes Point, the model was calibrated and validated with water level and current gauges in the vicinity of the project site. For additional information about the verification and validation (V&V) of CMS, interested readers should see a series of four reports published on V&V of CMS. These include Demirbilek and Rosati (2011) for a summary of approximately 30 test cases. Grays Harbor, WA, and Matagorda Bay, TX, were among the calibration and validation cases for field testing at bays and estuaries.

The project Alternatives were compared to without project condition based on a quantitative estimate of waves, currents, and sediment transport. Due to the absence of field data, the magnitudes of waves, flow, and sediment transport were not used in the selection of a recommended solution, so only a relative comparison of Alternatives is discussed. Thus, the wave, flow, and morphology changes in the channel are described by a relative comparison of Alternatives. Estimates for preliminary structural design calculations are provided. Details of the modeling, study findings, and structures (jetties and south shore revetment) design calculations are described next.

2.3 Model domain and bathymetry

The modeling area in this study was the west side of Smith Island where the existing western channel entrance at Sheep Pen Gut connects to Rhodes Point and a boat canal (Figure 2-1). Outside of the entrance, the channel turns southward and then to the southwest on the Chesapeake Bay side (Kraus 2009). At the entrance, the channel connects to a much narrower canal that is oriented to the southeast. This narrow and shallow canal cuts through the middle of Smith Island, connecting the east and west sides of Smith Island at Sheep Pen Gut. Width of the boat canal varies, with an average width of approximately 100 ft (30 m).

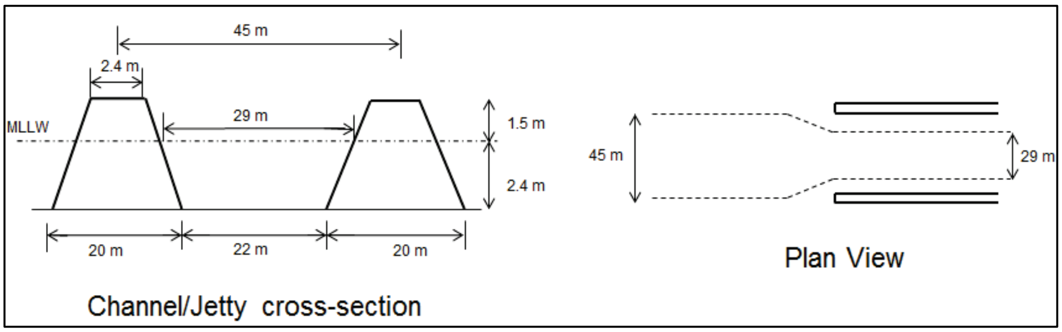
Figure 2-1. Existing western channel entrance at Rhodes Point.



Recent surveys indicated this nearshore region of Smith Island west of the Rhodes Point entrance has experienced severe storm-induced shoaling with erosion along the shorelines. NAB has proposed a realigned channel protected by jetties. The realigned new channel would be oriented west-northwest and have a depth of 8 ft (2.4 m) MLLW.

In the 2009 feasibility study (Kraus 2009), a dual parallel jetty system with a realigned channel was proposed, and is Alt-2 in the present study. The crest elevation, crest width, and base width of the proposed jetties are +5 ft (1.52 m) above MLLW, 8 ft (2.4 m), and 65 ft (20 m), respectively. Figure 2-2 shows approximate dimensions and cross sections of the channel and jetties. The tie-ins (or spurs) connecting the two east ends of both jetties to the land are 200 ft long (61 m) and have crest elevations of +5 ft (1.52 m) MLLW. The District is considering disposal areas between the tie-ins and sills and fringe of the marsh vegetation north and south of the entrance shorelines.

Figure 2-2. Channel and jetty dimensions and cross sections.



NAB provided survey data covering parts of the west channel, canal, and adjacent land areas. These survey data were augmented with data from other sources, including U.S. Geological Survey (USGS) coastal shoreline data and National Oceanic and Atmospheric Administration (NOAA) digital elevation model (DEM) data. The combined data set was necessary to properly resolve the details of the channel geometry and bathymetry, irregularly shaped shorelines, and elevations of the joining land areas for numerical modeling purposes. The extent of available bathymetry data and surveys are shown in Figures 2-3 and 2-4. The NAB 2015 survey had detailed coverage of the channel bathymetry and areas between the channel and north and south shorelines. The 2015 survey included land elevations for limited land areas along the north and south shorelines. Recent aerial photos were used to define the land-water interface.

Figure 2-3 shows the DEM quad sheets covering the Chesapeake Bay area. Figure 2-4 shows the 2012 post-Sandy lidar data for the west channel entrance and vicinity area. Figure 2-5 shows the coverage area of the west channel entrance for the NAB 2015 survey. MSL was used as the vertical datum for merging the 2012 lidar and 2015 surveys.

Figure 2-3. DEM bathymetry quad sheets for Chesapeake Bay.

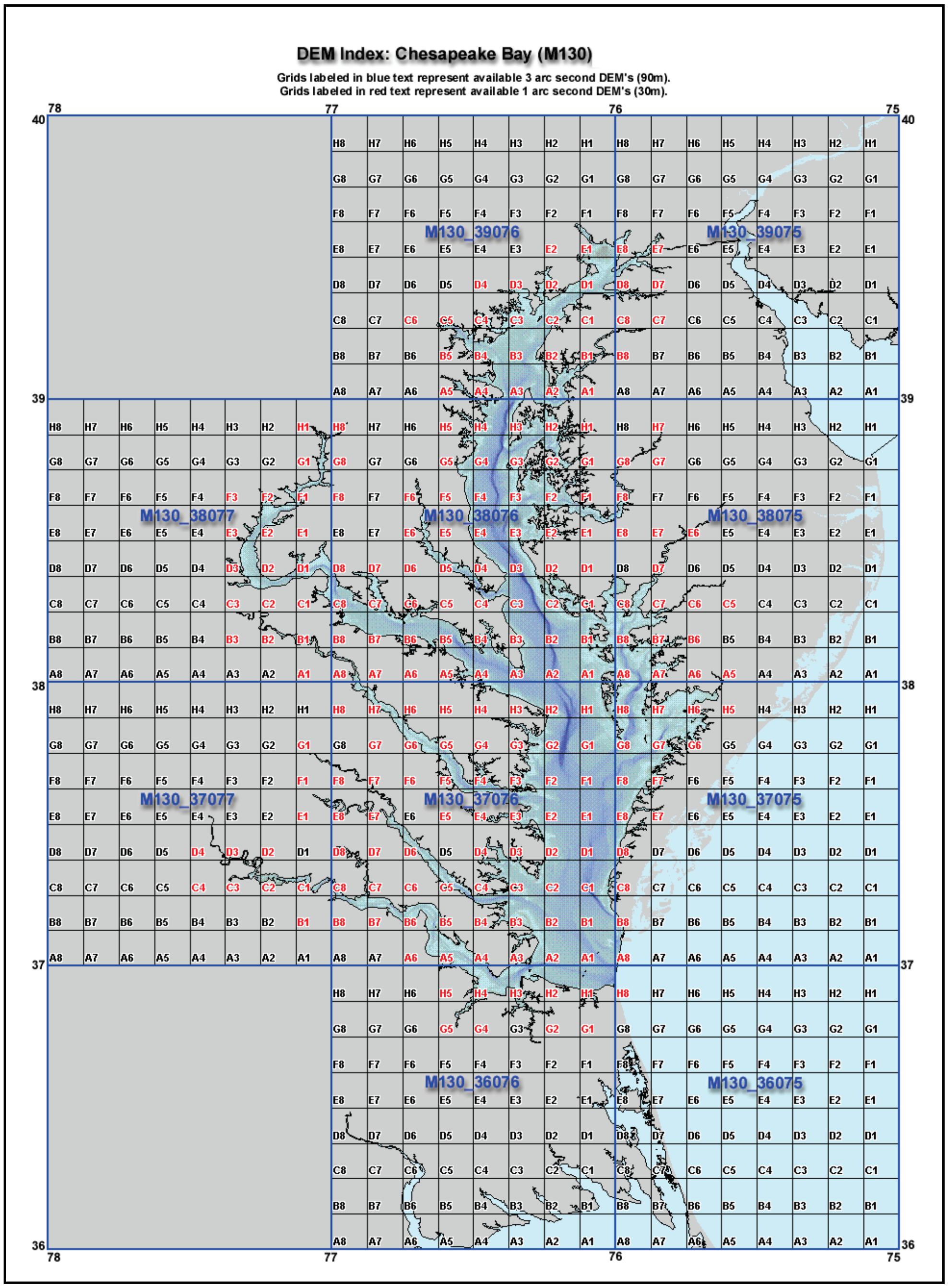


Figure 2-4. Post-Hurricane Sand lidar elevation contours for Smith Island.

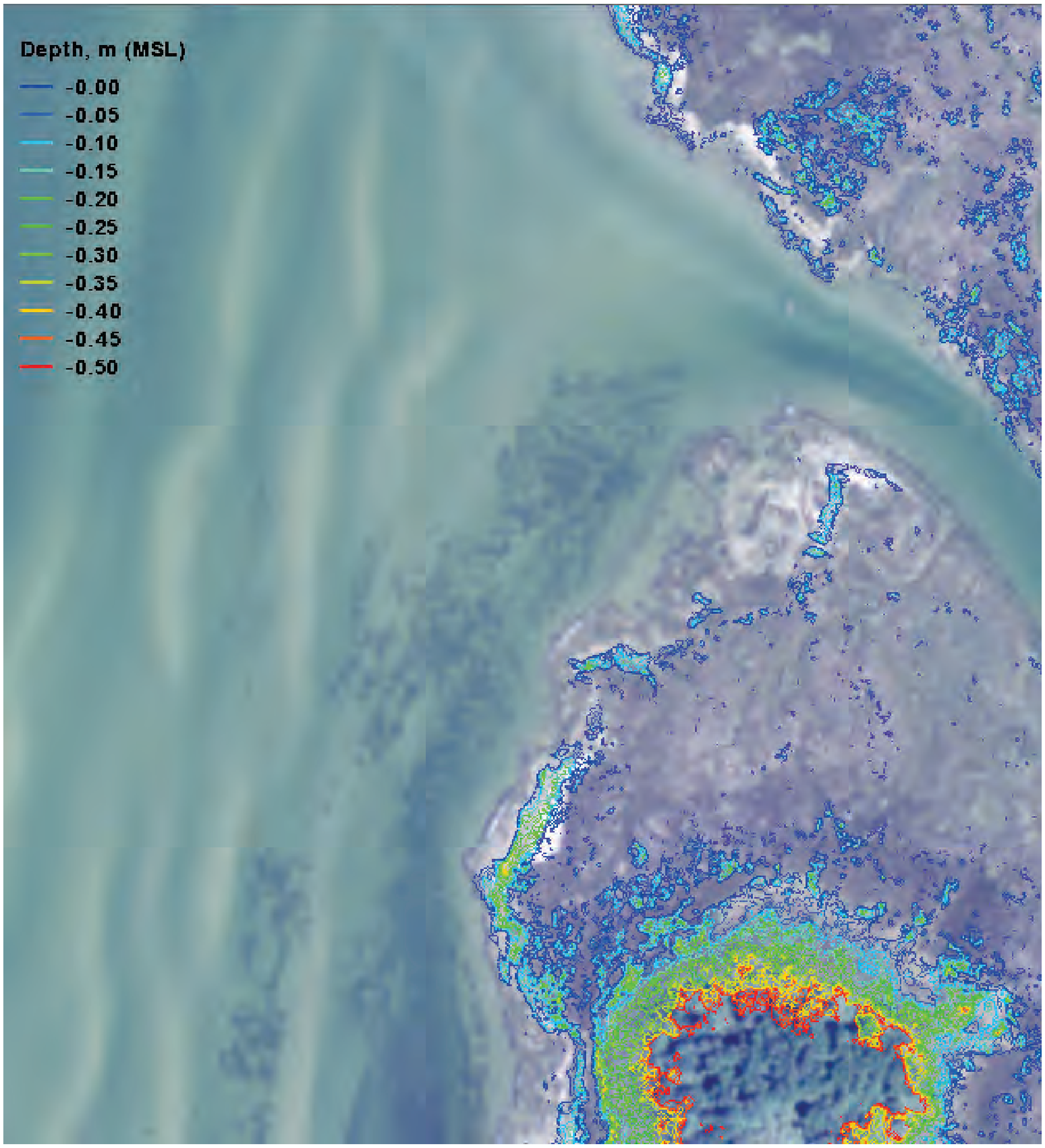
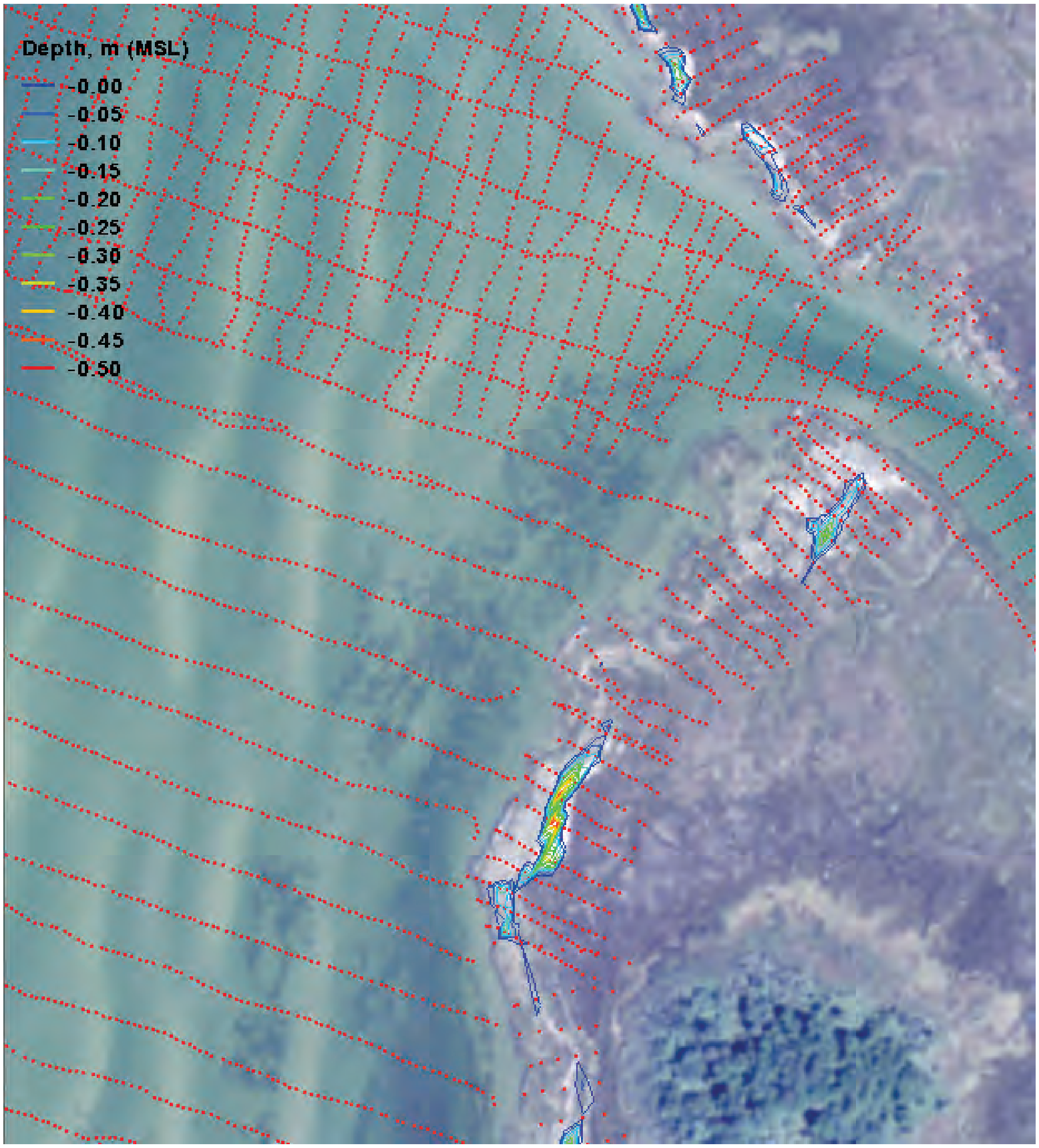


Figure 2-5. NAB 2015 survey data for west channel entrance (red points).



A dogleg north jetty (yellow line in Figure 2-6) was originally proposed to replace the long north jetty in Alt-2. This dogleg north jetty geometry was later modified to a simple shore-normal geometry (Figure 2-7) to reduce structural cost. In Figure 2-6, approximate shorelines (red lines) were extracted from aerial photos. Purple lines represent tentative locations of jetty and revetment structures that were considered initially. The final geometries of Alternatives (Alts 1 and 2) evaluated are described in Section 2.6.

Figure 2-6. North and south shorelines extracted from aerial photos (red lines).

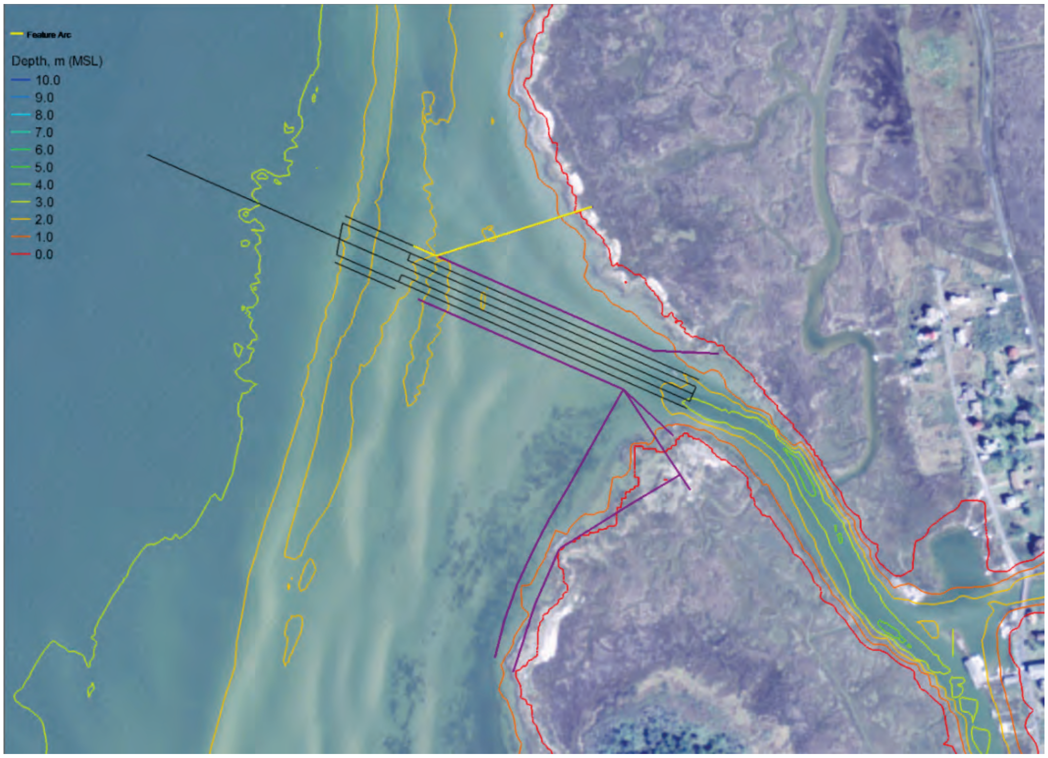
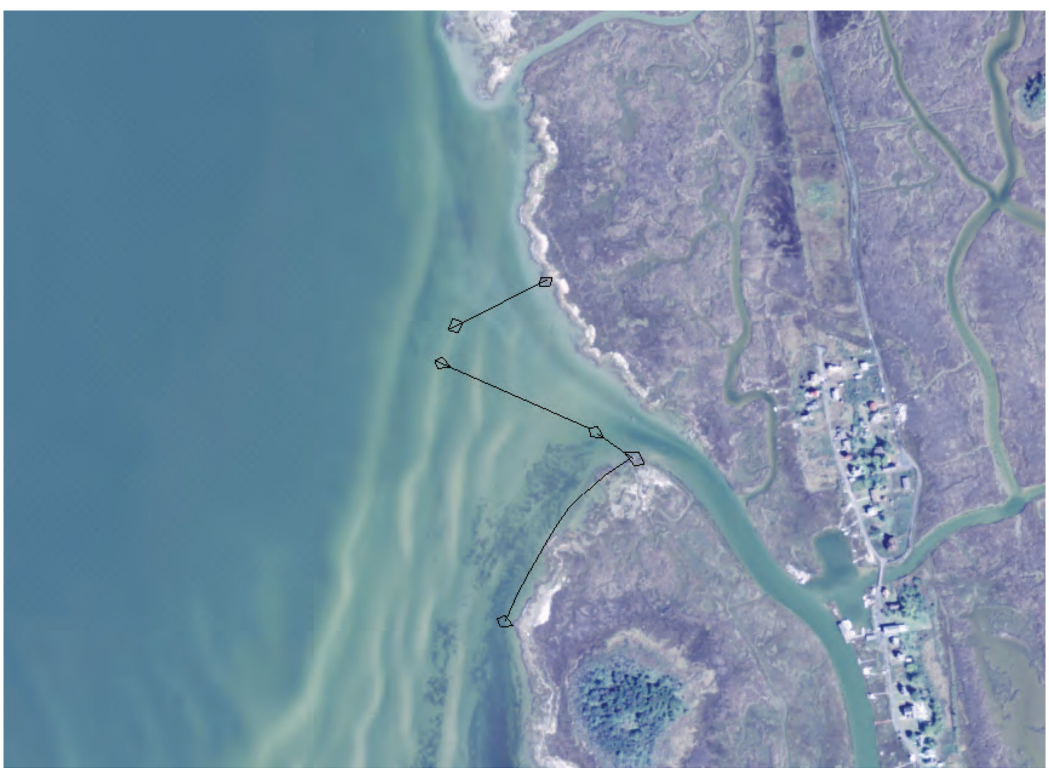


Figure 2-7. Sketch of shore-normal north jetty.



2.4 Metocean data

Figure 2-8 shows water level and wind stations available in the vicinity of the study area. These include the National Data Buoy Center (NDBC) buoy 44058 (Stingray Pt, VA), and NDBC buoy 44062 (Gooses Reef, MD), and six NOAA Coastal Stations: Rappahannock Light, VA (CB0801/RPLV2, NOAA Station 8632837); Cove Point LNG Pier, MD (CB1001/COVM2); Lewisetta, VA (LWTV2, NOAA Station 8635750); Bishops Head, MD (BISM2 8571421); Chesapeake Bay Bridge Tunnel, VA (CBBV2, NOAA Station 8638863); and Windmill Pt, VA (NOAA Station 8636580). Figures 2-9 and 2-10 show the time series of water level and wind data, respectively, for 2014 from these stations.

Figure 2-8. Water level and wind stations in the vicinity of study area.

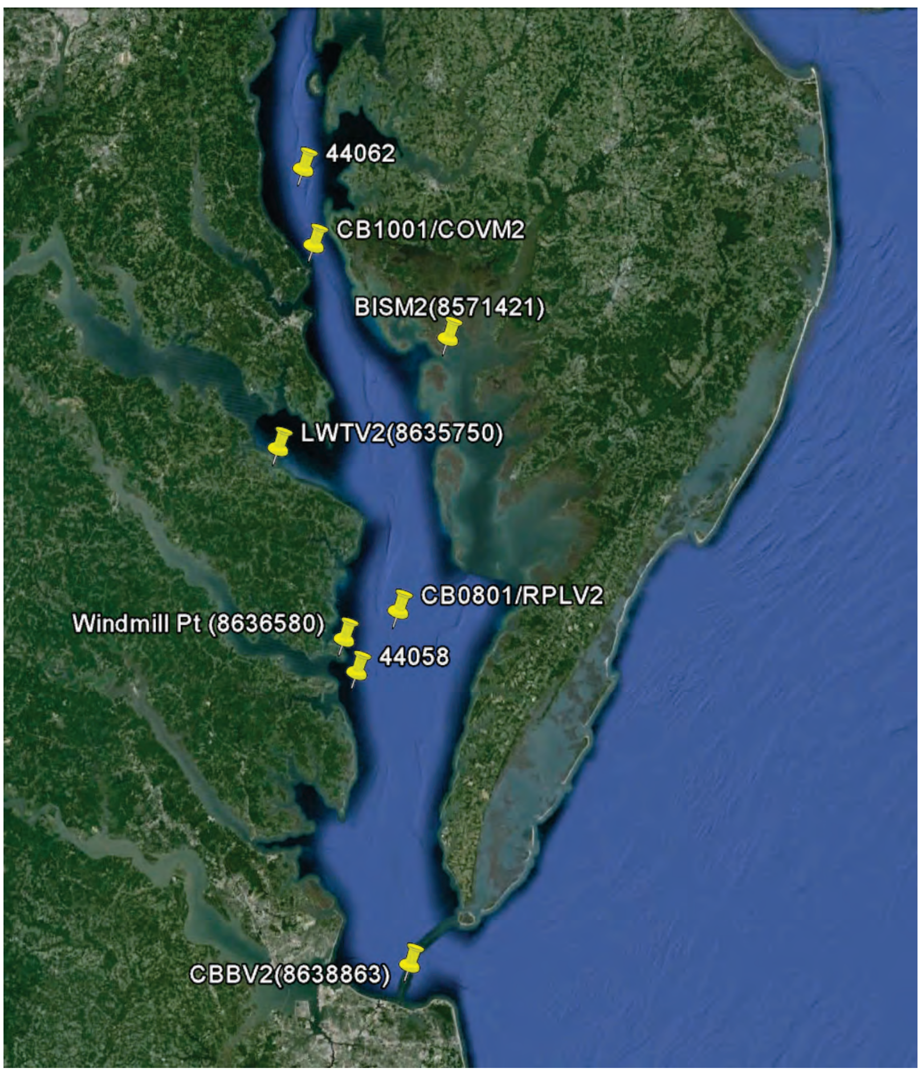
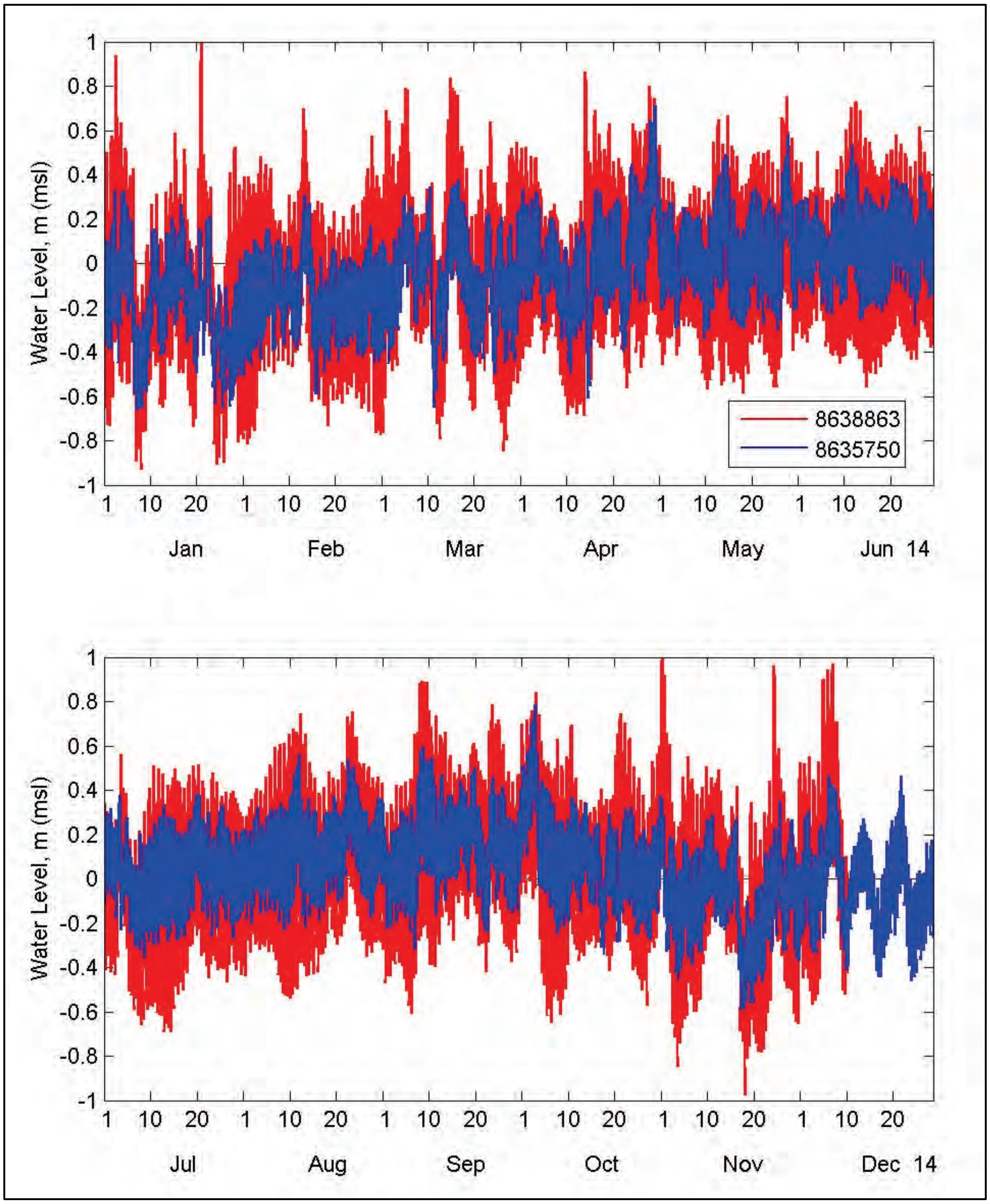
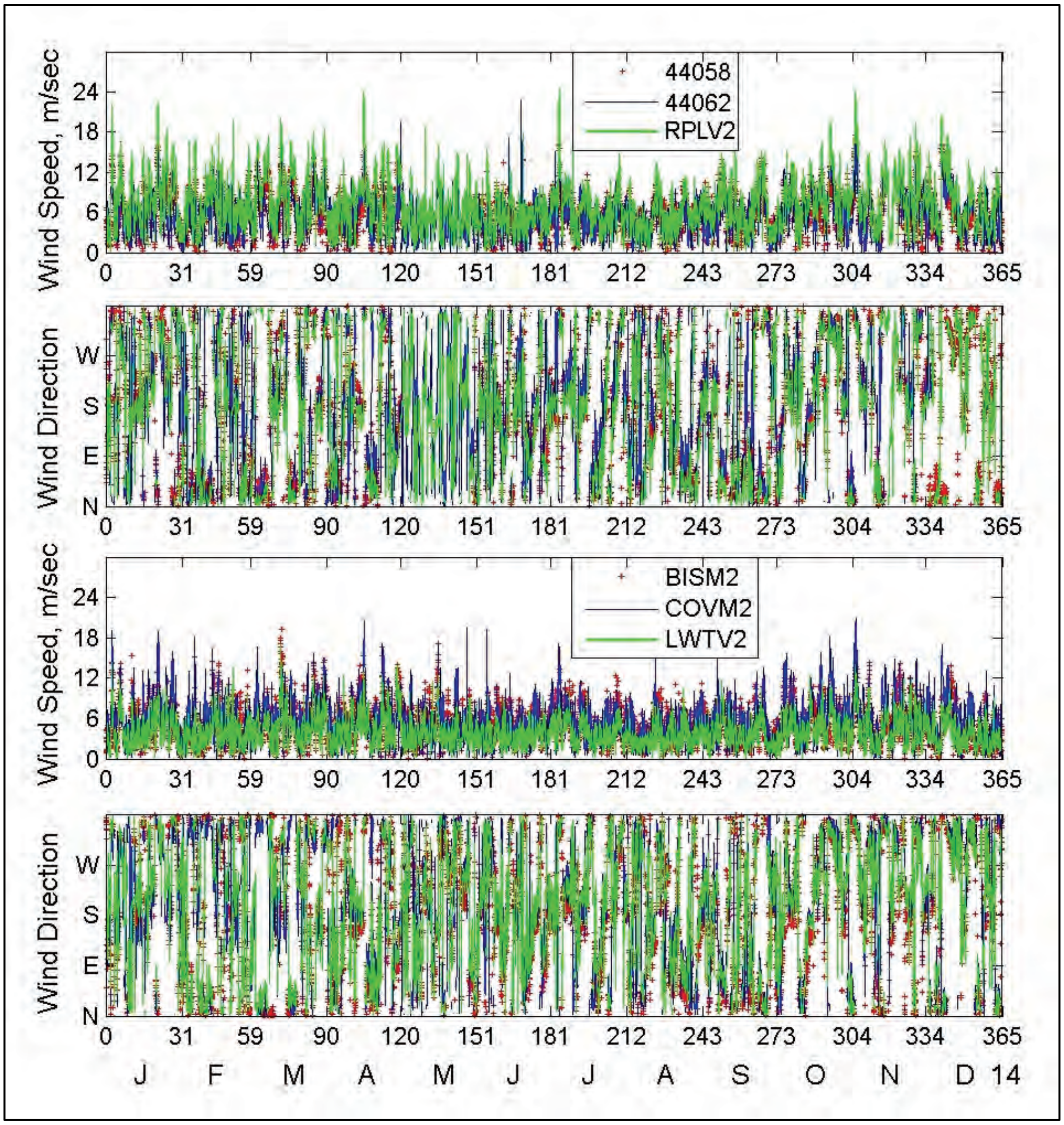


Figure 2-9. Example water level time series for 2014 at Lewisetta, VA (8635750), and Chesapeake Bay Bridge Tunnel (8638863).



Because Smith Island and the middle portion of the Chesapeake Bay are not exposed to open ocean waves, locally generated waves affecting the west side of the Smith Island were developed by using local winds as input to CMS-Wave.

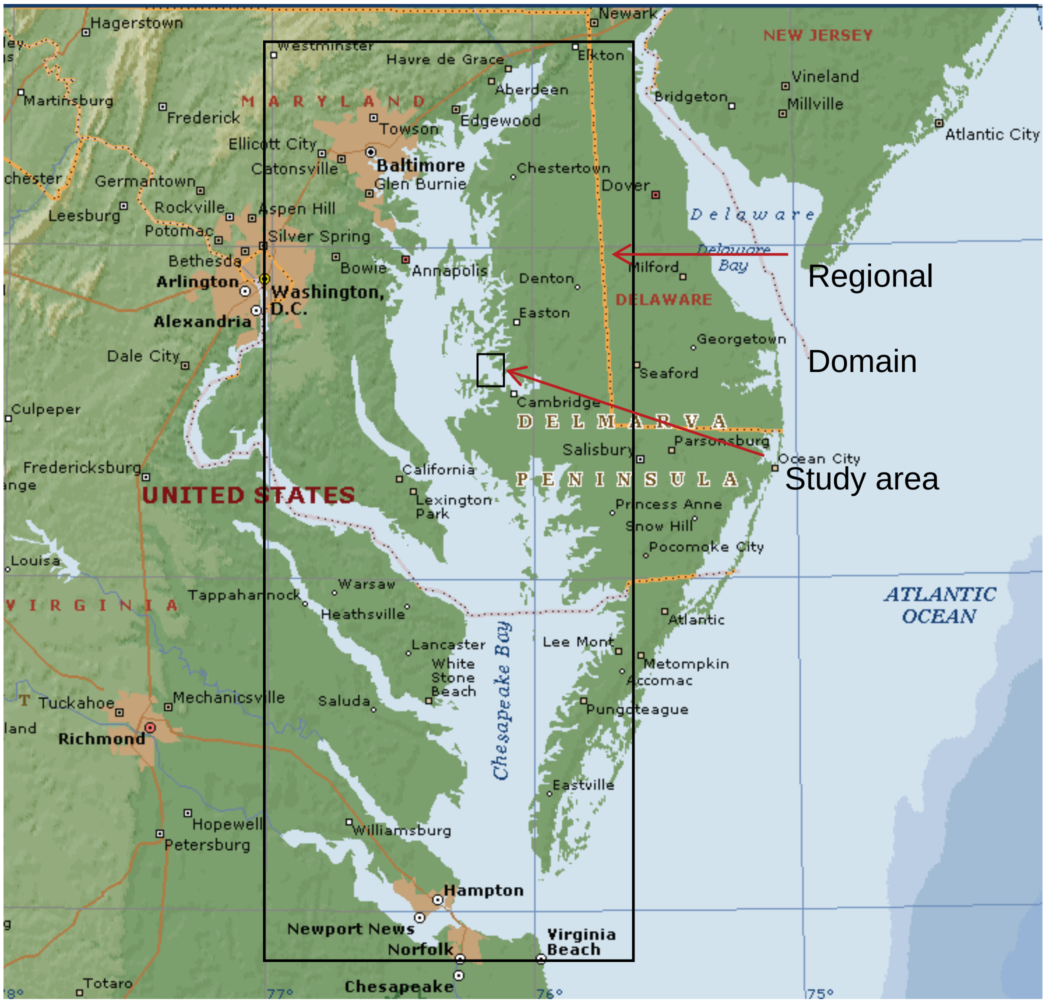
Figure 2-10. Wind data time series for 2014 at different stations.



2.5 Model grids

Figure 2-11 shows the CMS modeling grid domains for the entire Chesapeake Bay (large rectangle box) and local Smith Island (small rectangle box). The bay-wide large grid domain covering approximately 60 by 180 miles (100 by 300 kilometer [km]), is referred to as the “regional grid.” This Bay-scale grid has a constant grid cell size of 1,600 by 1,600 ft (500 by 500 m), and water depths in this grid vary from 0 to 150 ft (0 to 45 m). Figure 2-12 shows the water depth contour map associated with the regional grid.

Figure 2-11. Extent of regional (bay-wide) and local (Smith Island) modeling domain.



The Smith Island local grid domain is approximately 7.8 by 11.6 miles (12.5 by 18.5 km) with varying cell spacing ranging from 10 to 330 ft (3 to 100 m). Figure 2-13 shows the existing local grid depth contours and model domain covers the Smith Island.

Figure 2-14 shows the local CMS-Wave grid bathymetry representing the existing west channel configuration at Rhodes Point. The zoomed image in Figure 2-15 provides details of the depth contours at the west entrance channel and north and south shoreline seaward of the canal at Rhodes Point. This grid has a finer-resolution bathymetry on the west side of Smith Island and especially at the west channel of Rhodes Point. The water depths in the grid vary from 0 to 20 ft (0 to 6.1 m). This baseline geometry, designated as Alt-0, was used in the evaluation of the two proposed Alternatives (Alt-1 and Alt-2) which included jetty and revetment structures.

Figure 2-12. Regional Chesapeake Bay grid depth contour map.

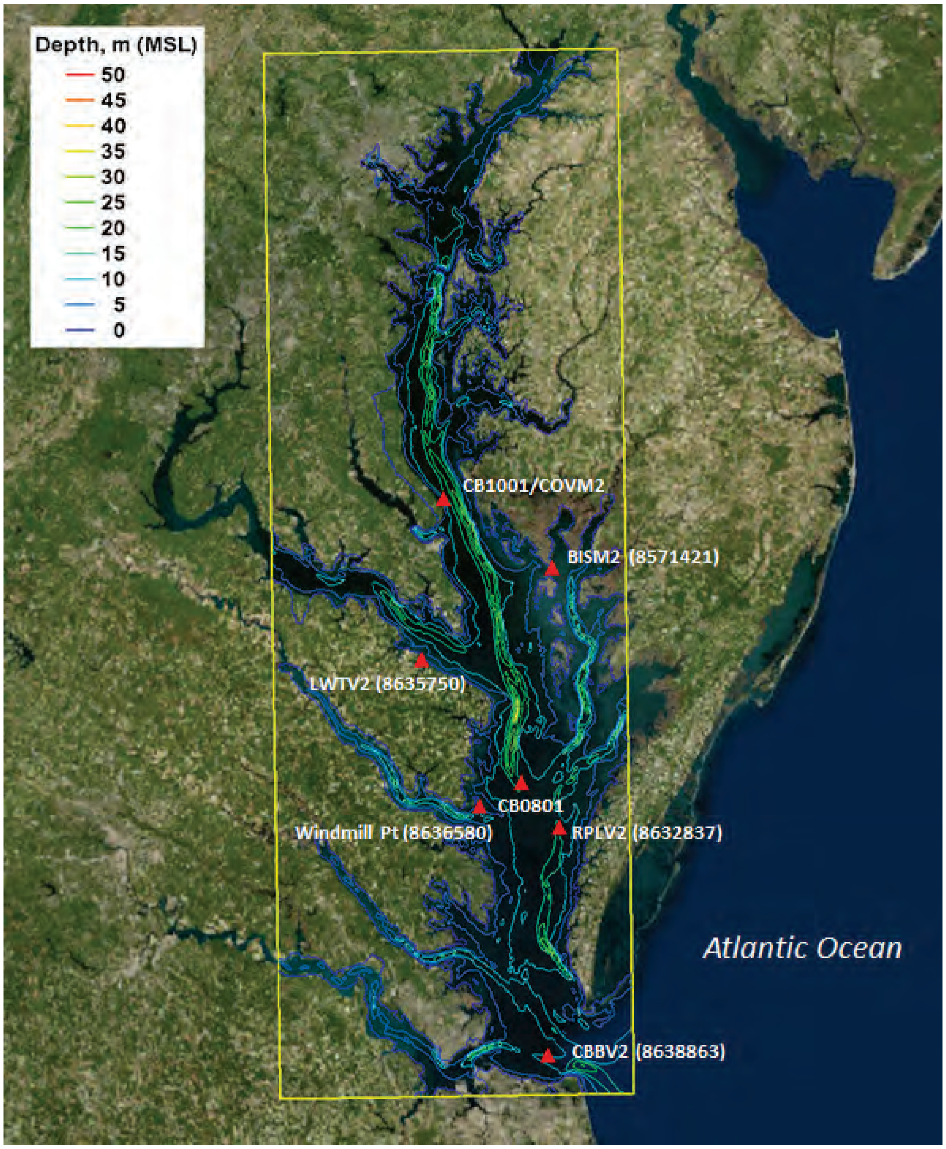


Figure 2-13. Local Smith Island grid depth contour map.

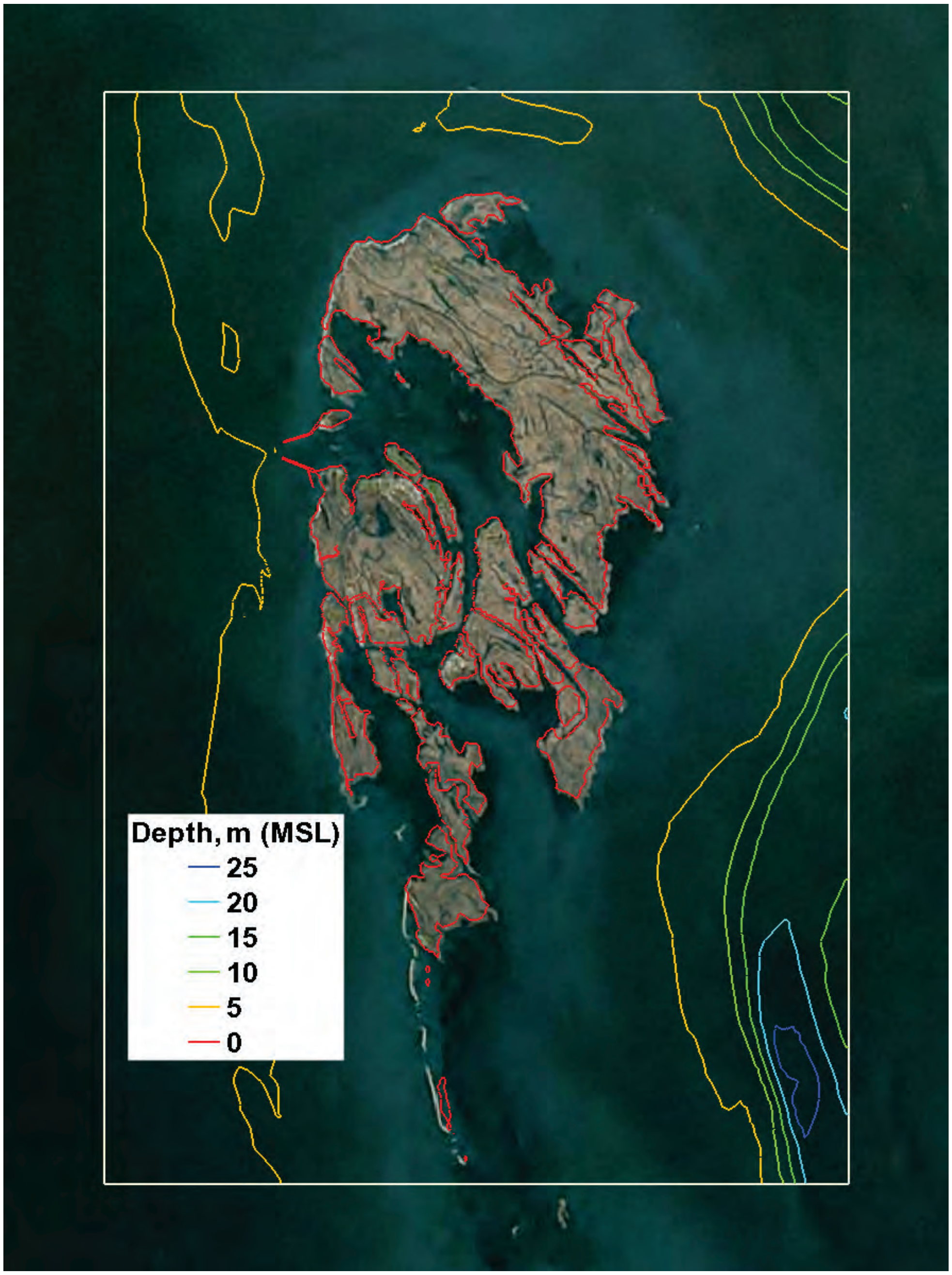


Figure 2-14. Local CMS-Wave grid depth contours at Rhodes Point and vicinity.

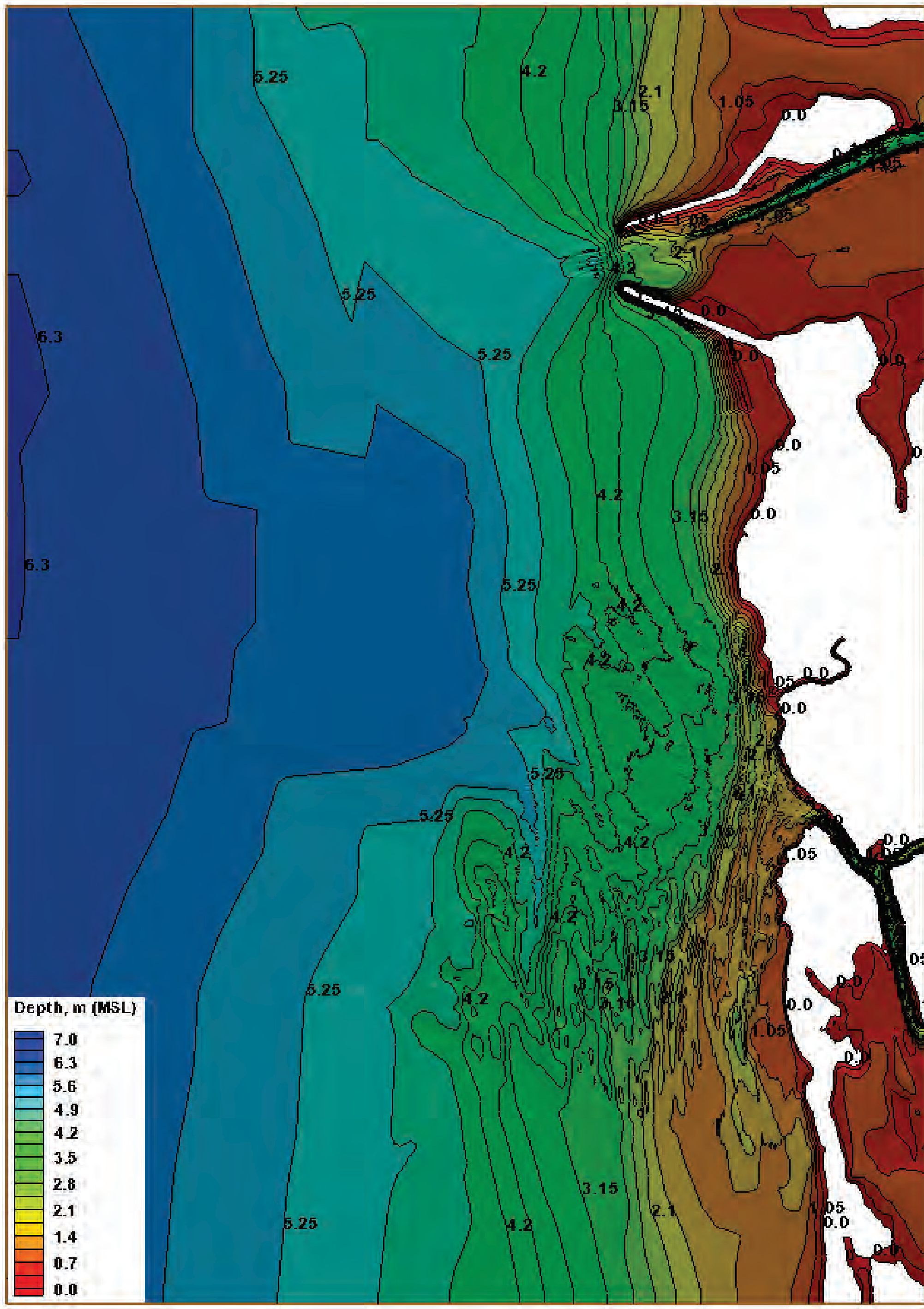
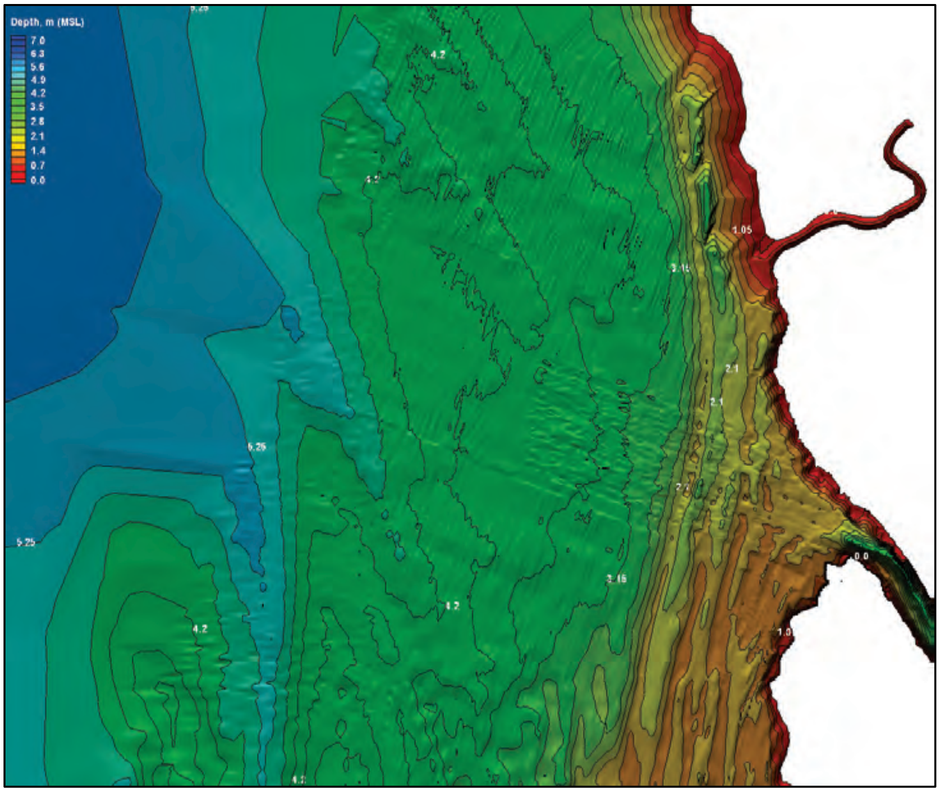


Figure 2-15. Depth contours covering the western channel and seaward areas of the canal entrance.



A modeling approach consistent with the main goal of the present study was used. This included quantitative estimates of waves and calculations of wave heights for no-project versus alternative condition, and preliminary jetty and revetment structure design calculations. The study team selected a 1-month simulation in summer, a 1-month simulation in winter, and Hurricane Sandy as the design storm condition. The months of August and February 2014 were selected for the 1-month simulations in summer and winter, respectively. Hurricane Sandy was simulated for a 6-day period (26–31 October 2012). Because of low wave energy (calm bay condition) during August 2014, only winds and tidal forcings were included in the simulation for this month (e.g., no wave input).

2.6 Existing channel and structural Alternatives

Additional information about the three channel configurations investigated is provided in this section. These included the existing channel geometry without structures and two Alternatives with jetty and revetment structures. The configurations were designated as Alt-0 (existing), Alt-1 and Alt-2, and are depicted in Figures 2-16, 2-17, and 2-18, respectively. The five transects, T1 through T5, were created to extract model output as displayed on each figure with the channel centerline showing the location of channel.

Figure 2-16 shows the existing geometry (Alt-0). There is only a natural channel in the “without project” case, so an imaginary channel with five output transects is shown in reference to Alternatives. The numbering scheme used for save locations along each transect is noted. The output transects have the following stations: T1 (1–17), T2 (18–28), T3 (29–55), T4 (56–74), and T5 (75–95). The distance between stations on each transect was 10 m.

Figure 2-16. Existing channel geometry (Alt-0) with five transects (T1 to T5).

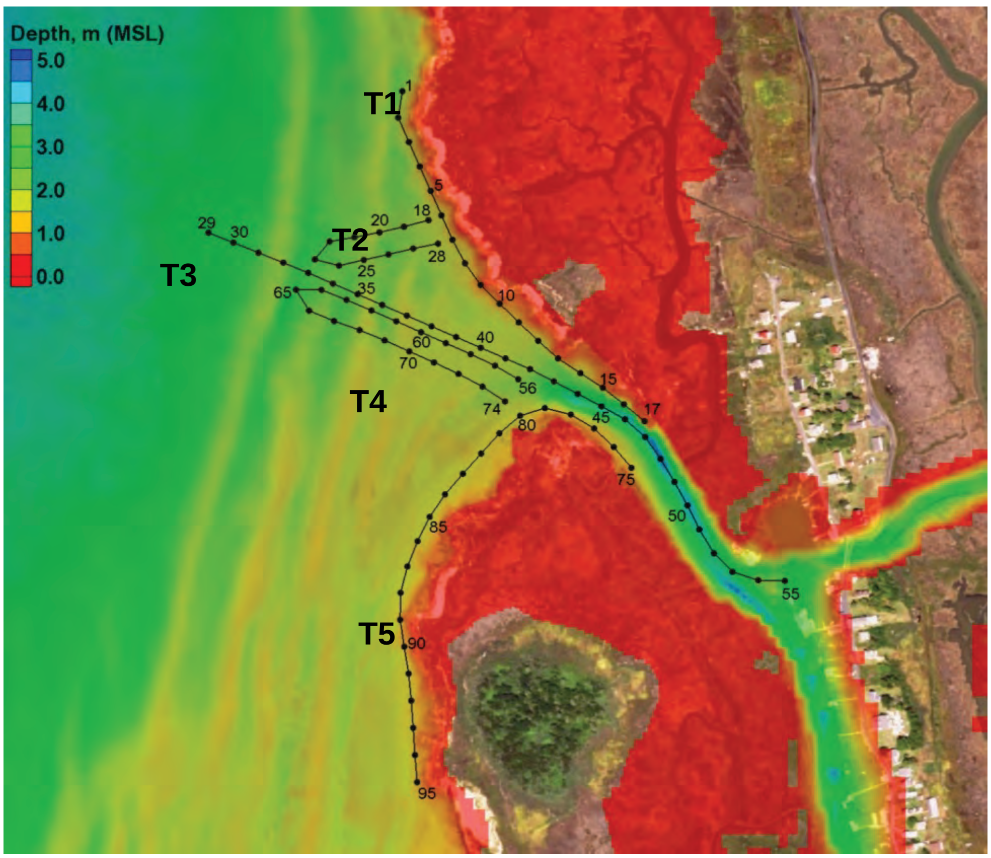


Figure 2-17. Alt-1 channel geometry (a) with a shore-normal north jetty and (b) five output transects (T1 to T5).

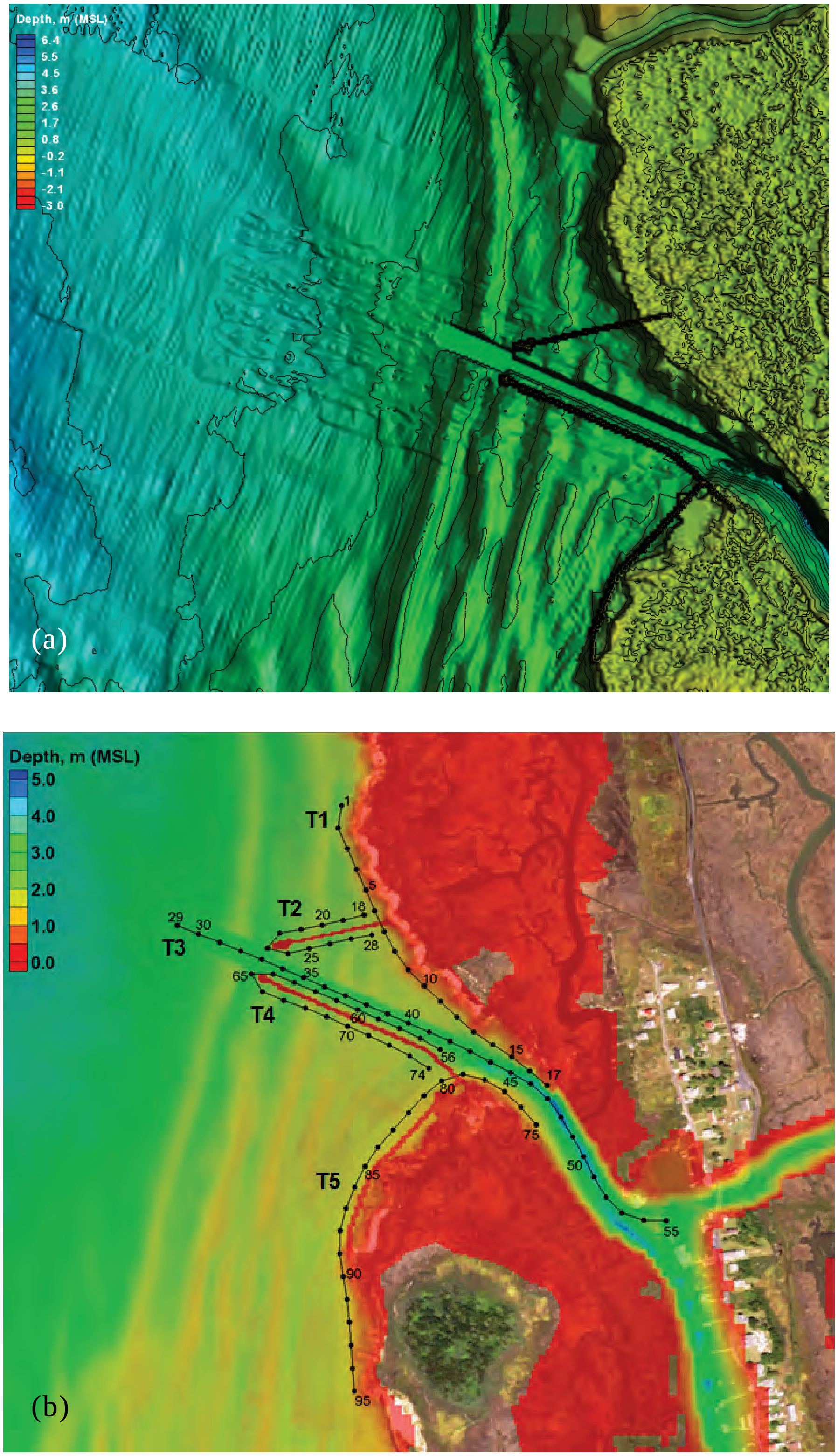
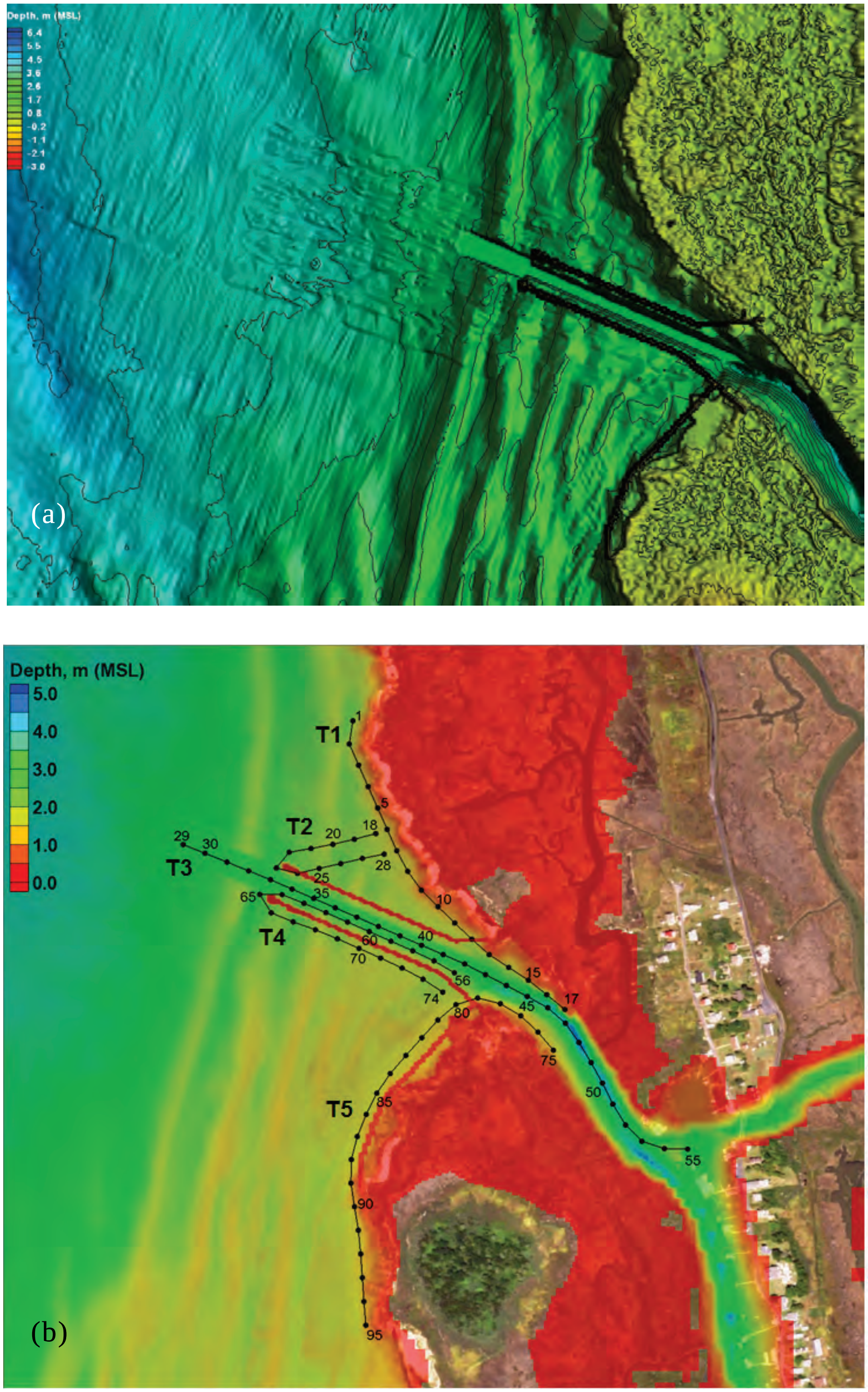


Figure 2-18. Alt-2 channel geometry (a) with a parallel north jetty and (b) five output transects (T1 to T5).



Alt-1 representing the new realigned channel geometry with a shore-normal north jetty is shown in Figures 2-17(a), and with the five output transects in Figure 2-17(b). The 688 ft (210 m) long north jetty was oriented in a SW to NE direction, with the last 130 ft (40 m) segment on land. The 820 ft (250 m) long first segment of the south jetty paralleling the channel centerline was oriented in a NW to SE direction. The second segment (tie-in) was 310 ft (95 m) long, with the last 165 ft (50 m) of this jetty structure on land. The low-crested revetment dike for protection of the south shorelines was 840 ft (280 m) long. Figures 2-16, 2-17, and 2-18 show the canal at Rhodes Point that splits Smith Island and establishes a water connection between the west and east sides of island.

Figure 2-18(a) and Figure 2-18(b) show the Alt-2 configuration and output transects T1 to T5, respectively. Alt-2 was considered in the 2009 feasibility project and was re-evaluated in the present study. It has two parallel jetties situated along north and south edges of the channel. The jetties are each 800 ft (245 m) long. Both the north and south parallel sections join with a dogleg segment (tie-in), connecting to the land north and south of the entrance. The second segment of the north jetty was 295 ft (90 m) long, with 82 ft (25 m) of it on land. The second segment of the south jetty was 345 ft (105 m) with 195 ft (60 m) of it on land. The low-crested revetment dike for protection of the south shorelines was 920 ft (280 m) long. The same output stations were used for all Alternatives.

The terminal ends of the north and south jetties at the shorelines were assumed to have appropriate land elevation to minimize the likelihood for destabilization and flanking. The north jetty in Alt-1 was a shorter structure because its land connection point was moved farther away from the mouth of canal. The shore connection points for the north and south jetties in Alt-2 were much closer to the entrance canal. The tie-in of the north jetty in Alt-2 connected to the north shoreline at a distance of 210 ft (70 m) from the canal entrance. The south jetty tie-in was 100 ft (30 m) from the entrance. The total length (linear footage) of the jetties was kept as short as possible to reduce the structural cost. The north jetty lengths for Alt-1 and Alt-2 were approximately 665 ft (200 m) and 1,000 ft (305 m), respectively. The south jetty was 1,000 ft (305 m) for both Alternatives. The jetties in both Alternatives were represented in the numerical model by a rubble-mound structure with a crest elevation of +5 ft (1.5 m) above MLLW and crest width of 8 ft (2.4 m). The water depths in the areas of interest ranged from 0 to 22 ft (0 to 6.5 m) in the west channel and seaward area of the Chesapeake Bay.

2.7 Forcing conditions

Rhodes Point and vicinity area are affected by annually and seasonally changing forcing conditions in the Chesapeake Bay. These include metocean events such as storms, northeasters, hurricanes, and normal winds, waves, and tidal conditions. The dominant winds are from the north and northwest in the winter and from the southwest in the summer while local breeze shifts the wind direction on a daily basis. Larger waves generally occur during northeasters and tropical storms when high winds blow across the bay. The west shoreline of Smith Island is exposed to open water in the lower Bay area where strong wind can generate large waves.

Figure 2-19 shows two sample wind roses for 2011 and 2012 from NOAA station 8632837 at Rappahannock Light, VA. Winds with magnitudes greater than 20 knots (~ 10 meters per second [m/sec]) mostly follow a longer fetch along the north–south direction in the lower bay. During northeasters with sustained winds of 30 to 40 knots (~ 15 to 20 m/sec), local wave heights ranging from 5 to 8 ft (~1.5 to 2.5 m) can occur along the west side of Smith Island.

A 6-day storm simulation (26–31 October 2012) covering the Hurricane Sandy period was selected to represent the 50-year return period event at Smith Island. This forcing condition was used for evaluating the effectiveness of the west entrance with jetties in reducing wave energy in the channel. For more common, less intense forcing conditions (typical conditions), the CMS simulations were conducted for one summer month (August 2014) and one winter month (February 2014).

The water level forcing from Station 9638863 (Chesapeake Bay Bridge Tunnel) and wind input from Station 8632837 (Rappahannock Light) were used in the bay-scale regional grid (parent grid) simulation (Figures 2-8 and 2-12). Results from this simulation were used for model calibration and driving the local Smith Island grid (child grid). For the model calibration, model-calculated water level results were saved at the location of three water level Stations (Bishops Head, 8571421; Lewisetta, 863570; Windmill Point, 8636580), and currents were saved at the two current data Stations (Cove Point, 8577018; Rappahannock Light, 8632837), and were compared with measurements.

Figure 2-19. Wind roses for 2011 and 2012 at Rappahannock Light, VA (8632837).

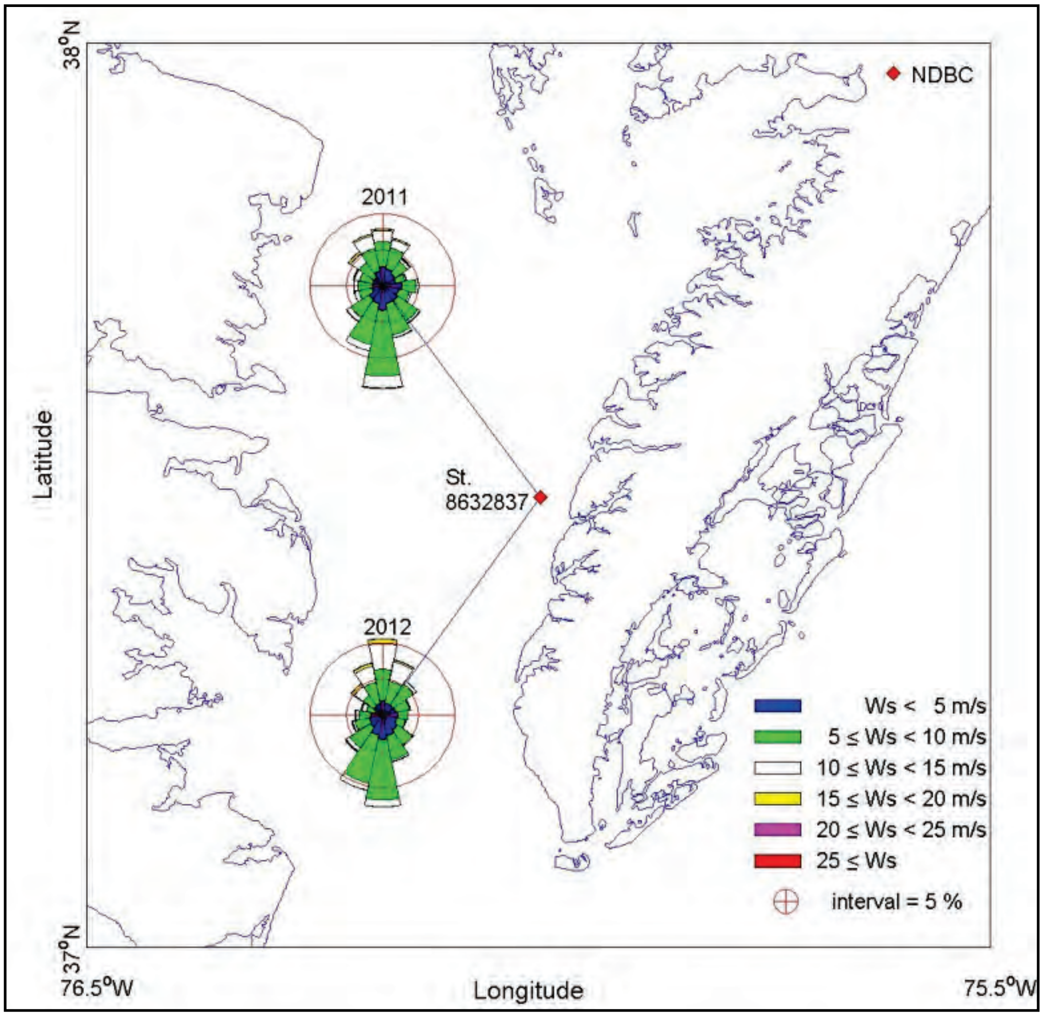


Figure 2-20 shows the model-data comparison of calculated water levels at Bishops Head, MD; Lewisetta, VA; and Windmill Pt, VA, near the project site. Good correlation between model water levels and data was obtained. The correlation coefficients between model water levels and data at Stations 8571421, 8635750, and 8636580 were 0.98, 0.97, and 0.93, respectively.

Figure 2-21 shows the model-data comparison of calculated currents along the east-west (E-W) and north-south (N-S) directions for NOAA stations at Rappahannock Light, VA, and Cove Point, MD. The correlation coefficients between calculated E-W components of currents and data at CB0801 and CB1001 were 0.27 and 0.88, respectively. The low correlation between calculated E-W current components and data at CB0801 was likely due to increased wind-wave interaction at lower current speeds. Higher correlation coefficients of 0.89 were obtained between calculated N-S components of current and data at both CB0801 and CB1001. Overall, the model calibration results indicated a good model-data agreement for calculated water levels and current magnitudes in the bay.

Figure 2-20. Calculated and measured water levels for August 2014 at Bishops Head MD (8571421), Lewisetta VA (8635750), and Windmill Point VA (8636580).

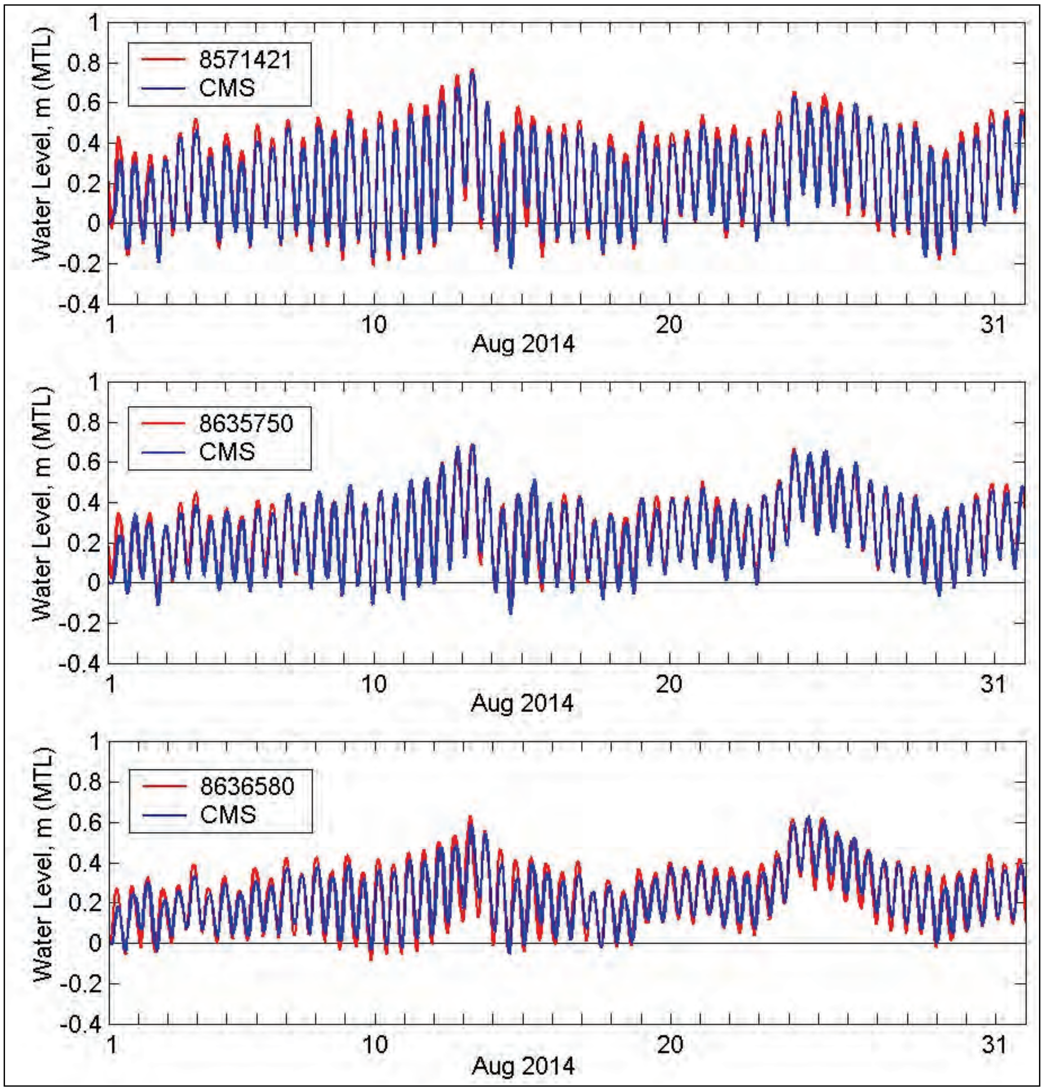
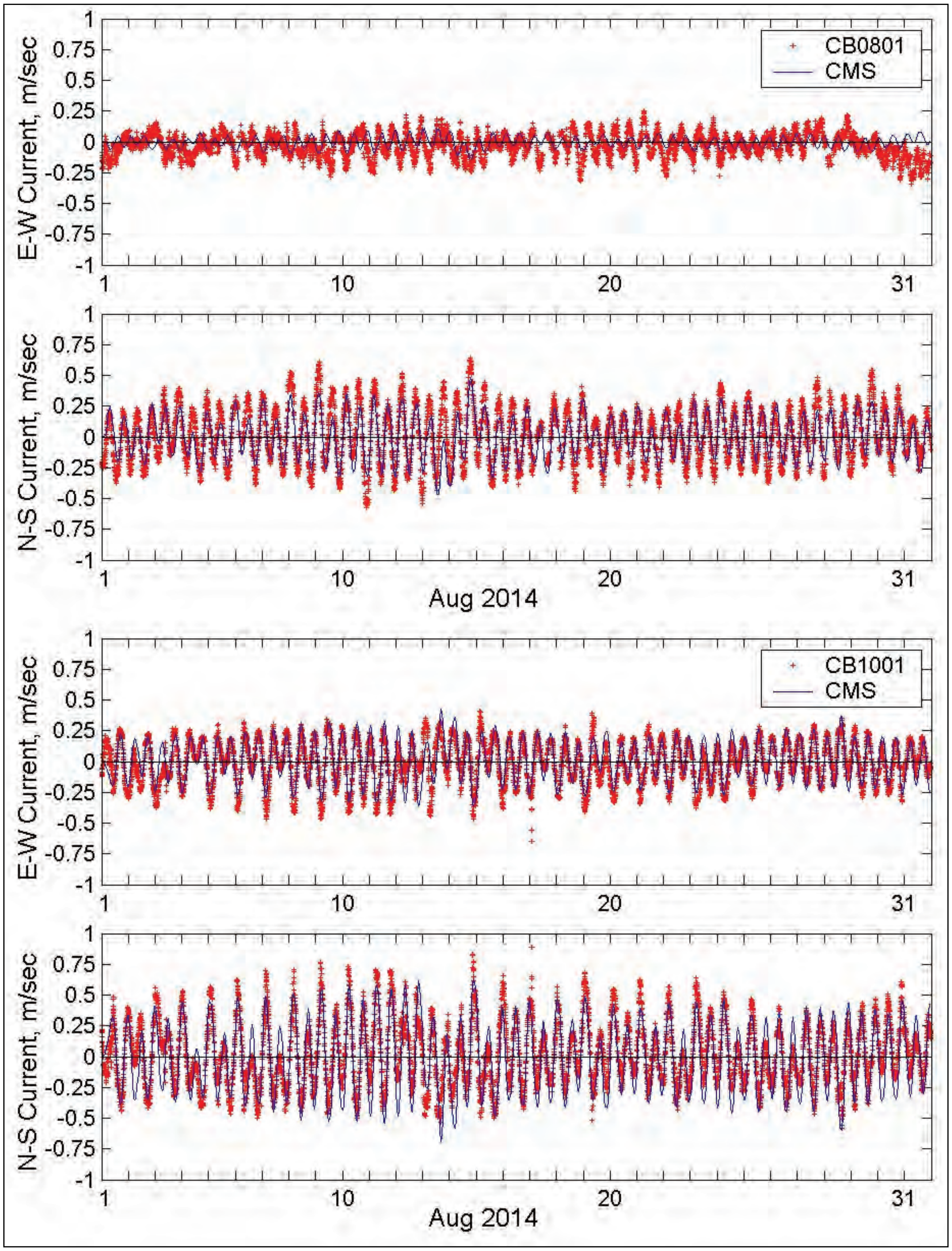


Figure 2-21. Calculated and measured currents for August 2014 at Rappahannock, VA (CB0801), and Cove Point, MD (CB1001).



2.8 Save stations

Numerical model results were extracted along five transect lines (T1 to T5), covering the north and south jetties, channel centerline, and along the north and south shorelines. Figure 2-22 shows the five transects with save stations (points) on each transect. The spacing between the points is 100 ft (30 m). A total of 95 save stations was placed along the channel centerline, north and south shorelines, and around the perimeter of jetty and revetment structures. The save stations are shown in Figures 2-23, 2-24, and 2-25 for Alt-0, Alt-1, and Alt-2, respectively.

For clarity, all 95 save stations along five transects have been marked on Figures 2-23, 2-24, and 2-25, for Alt-0, Alt-1, and Alt-2, respectively. Only the start and end stations are labeled in these figures.

Figure 2-22. Transects (lines) for extraction of model results.

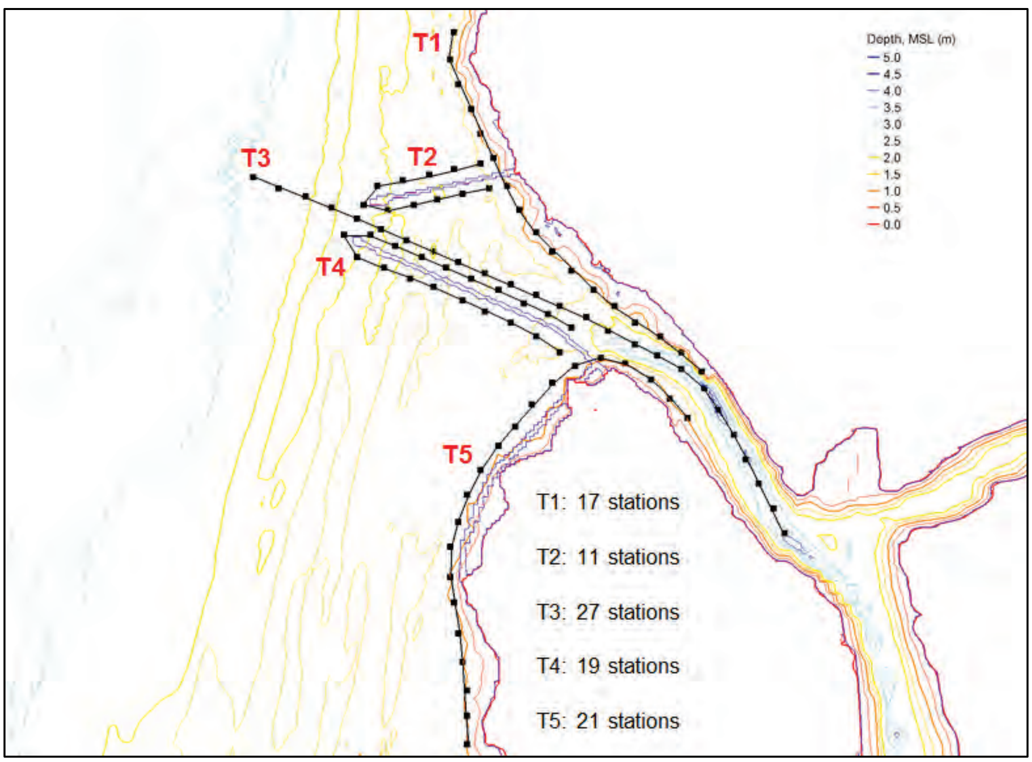


Figure 2-23. Save stations for Alt-0.

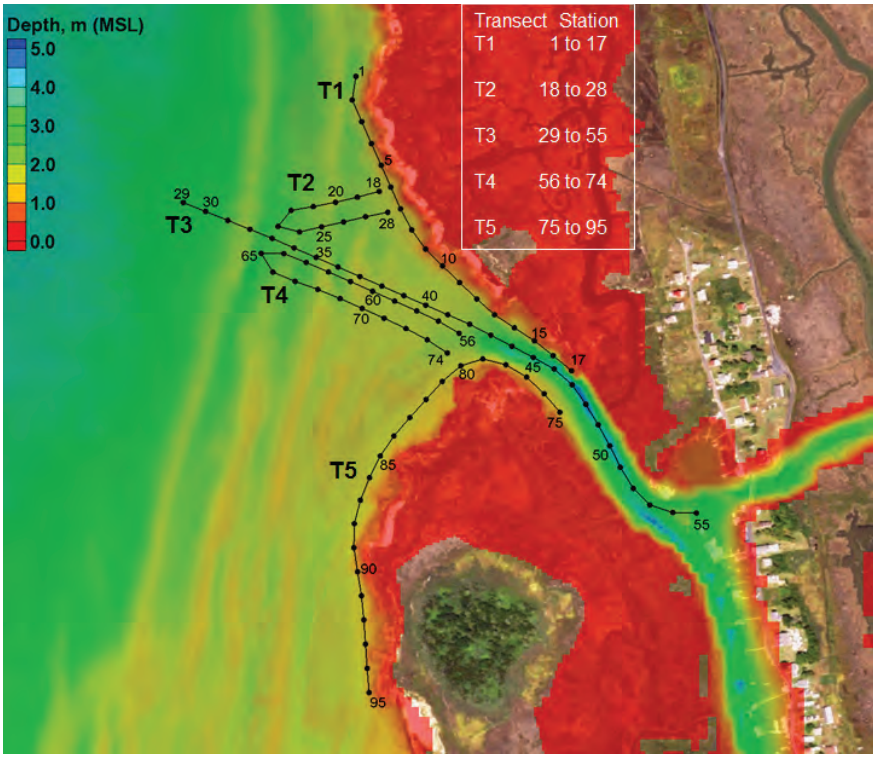


Figure 2-24. Save stations for Alt-1.

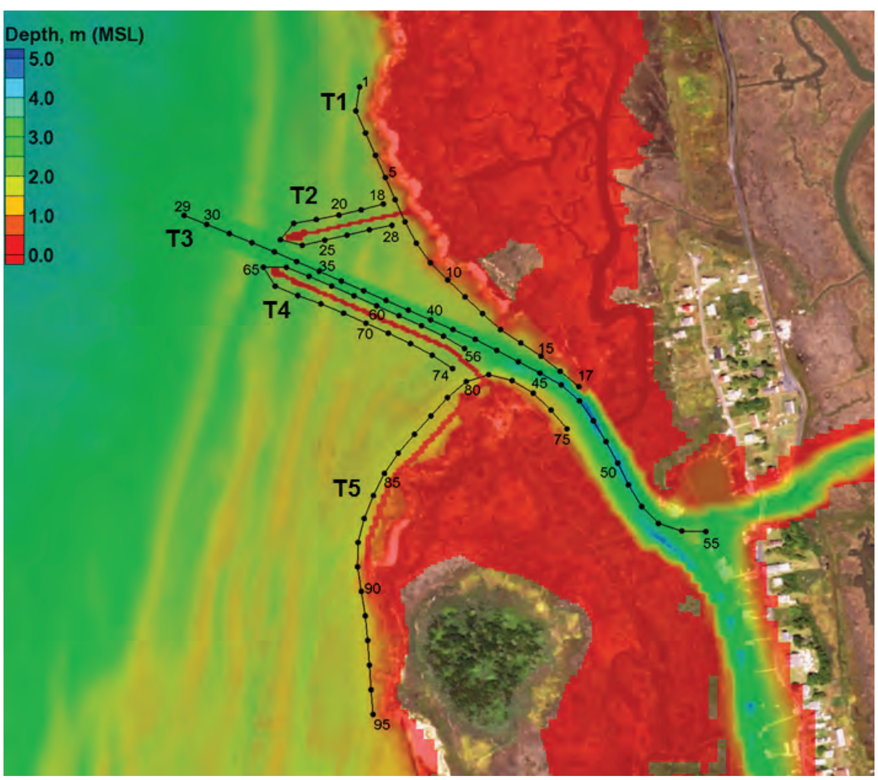
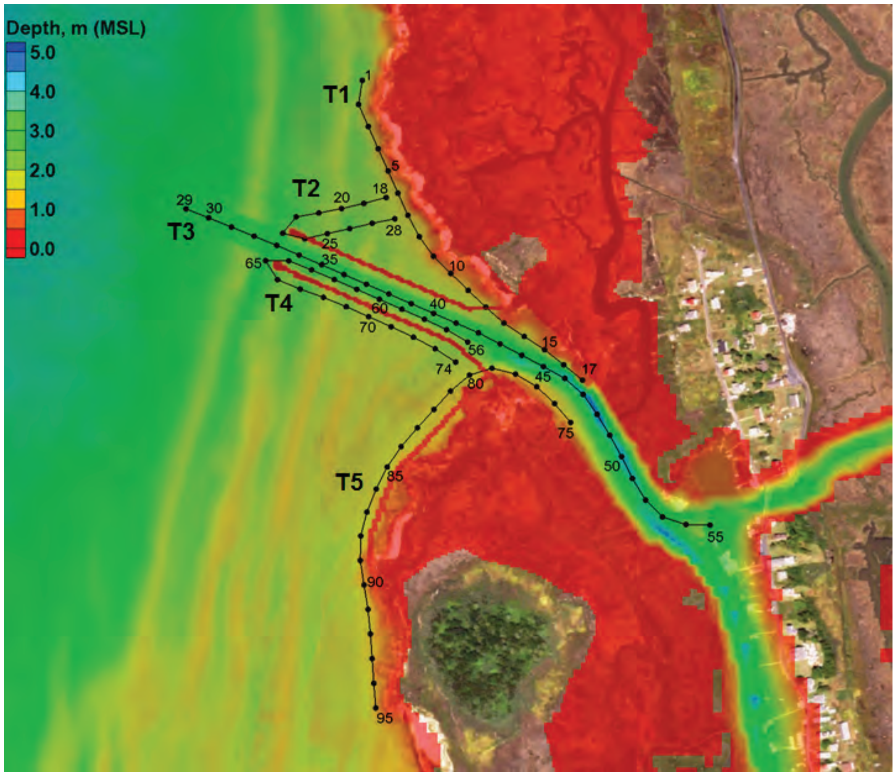


Figure 2-25. Save stations for Alt-2.



2.9 Simulated conditions

Combined CMS-Wave and CMS-Flow simulations were performed for Alt-0, Alt-1, and Alt-2 for the three conditions listed in Table 2-1. Condition 1 was for the month of August 2014, during which waves were small and not considered in this simulation. Because waves were small, model calculations only included winds, currents, and sediment transport. Condition 2 was for the month of February 2014, representing northeaster forcings common in the Chesapeake Bay during the winter season. Winds, waves, currents, and sediment transport were considered in this 1-month simulation. Condition 3 was for Hurricane Sandy, with a simulation time from 26–31 October 2012, and included winds, waves, flow, and sediment transport. Hurricane Sandy represented a 50-year tropical storm, and structural design calculations considered results of this simulation. For simulation of the three conditions, the gauge data including wind fields and water levels were used. Hurricane Sandy wind and pressure fields used as forcing for Condition 3 were extracted from the NACCS post-Sandy study database (Cialone et al. 2015).

Table 2-1. Simulation conditions.

Alt	Cond. 1: August 2014 (Flow and sediment transport)	Cond. 2: February 2014 (Flow, wave, and sediment transport)	Cond. 3: Hurricane Sandy 26-31 October 2012 (Flow, wave, and sediment transport)
0	x	x	x
1	x	x	x
2	x	x	x

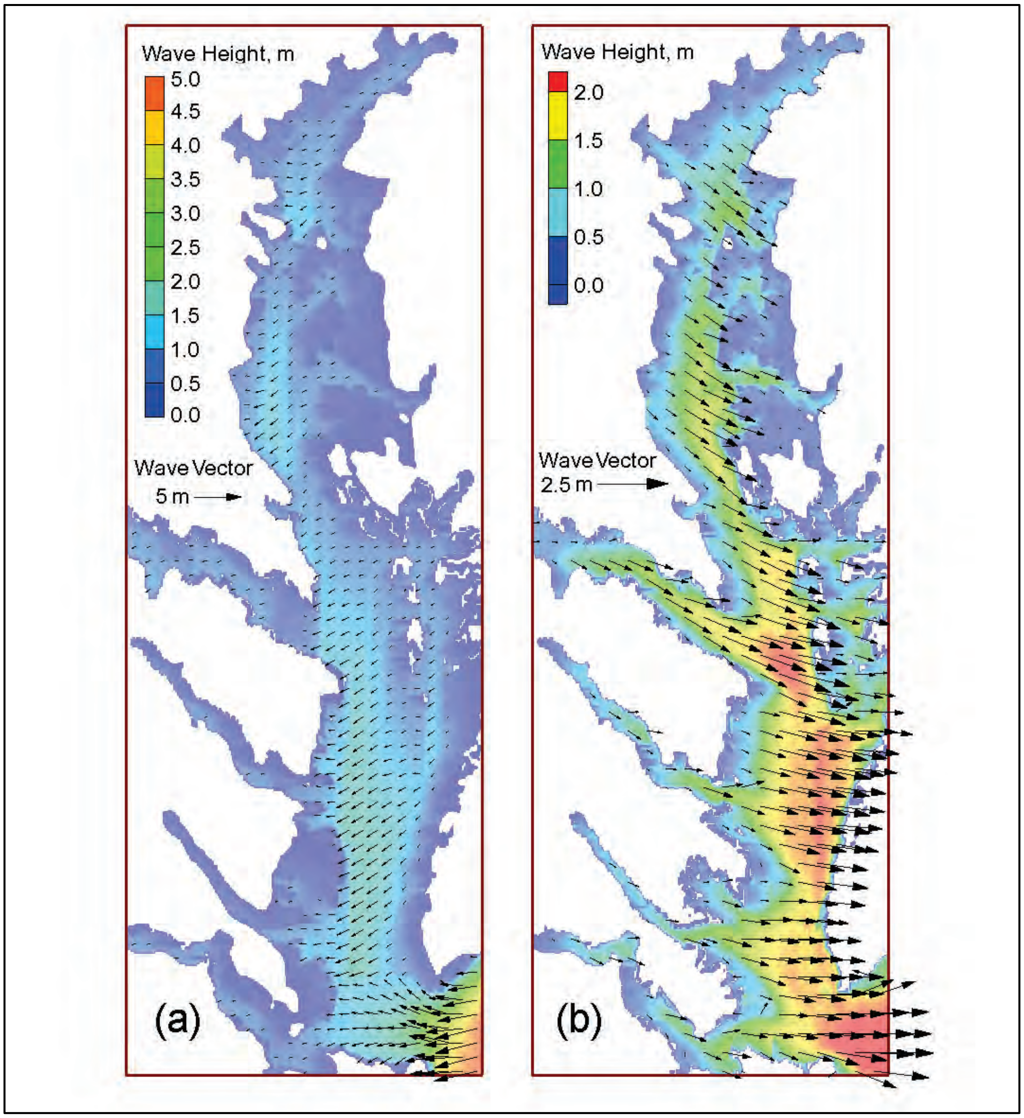
Hurricane Sandy, representing a 50-year return period, was used in the numerical simulations for the existing west channel without a structure (without project) and for two Alternatives with jetty and revetment structures (with project). The model simulations were first conducted in the regional grid for waves and flow only, without sediment transport. The results from the regional simulations were provided as input to the local Smith Island grid for calculation of wave, flow, and sediment transport at the project site.

Three simulations were performed for three conditions (Table 2-1) using the large regional grid to develop spatially varying estimates of waves, water levels, and currents in the Chesapeake Bay. For example, Figure 2-26 shows the bay-wide wave-height field calculated by the regional model for Hurricane Sandy. Results indicate higher wave heights calculated outside Chesapeake Bay (red color region in Figure 2-26), which reduces significantly inside the Bay. Analysis of water levels for Hurricane Sandy indicated a maximum water level of 5 ft (~1.5 m) along the western shore of Smith Island.

2.10 Performance of Alternatives

Results from the wind-wave simulations for the entire bay were used as input to the fine-resolution local grid to develop the estimates of waves, flow, water levels, currents, and sediment transport at the project site. A total of nine simulations (three conditions × three Alternatives) was simulated with the local grid.

Figure 2-26. Calculated wave heights in the Chesapeake Bay for Hurricane Sandy: (a) 29 October 2012 at 0600 GMT and (b) 30 October 2012 at 0600 GMT.



Figures 2-27, 2-28, 2-29 show the maximum wave fields for the three Alternatives Alt-0, Alt-1, and Alt-2, respectively, in the western channel of Sheep Pen Gut for a northeaster storm on 16 February 2014 at 0000 GMT.

Figures 2-30, 2-31, and 2-32 show the snapshots of wave height fields for the three Alternatives Alt-0, Alt-1, and Alt-2 on 30 October 2012 at 1200 GMT for Hurricane Sandy. These color-contours of wave fields provide a “big picture” of the wave height variation over the modeling domain, showing a direct comparison of the Alternatives evaluated.

Figure 2-27. Maximum wave height field for Alt-0 in the western channel (northeaster, 16 February 2014 at 0000 GMT).

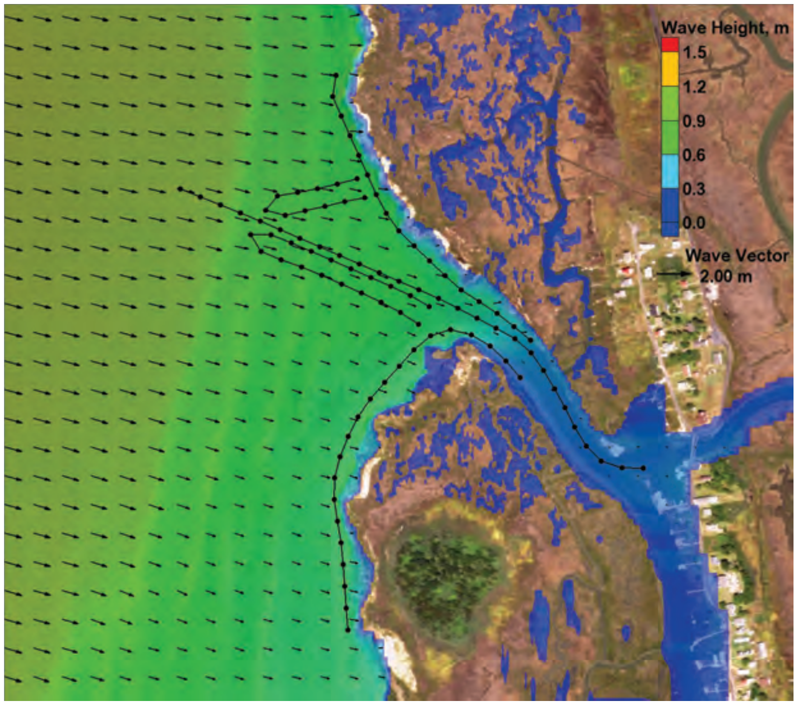


Figure 2-28. Maximum wave height field for Alt-1 in the western channel (northeaster, 16 February 2014 at 0000 GMT).

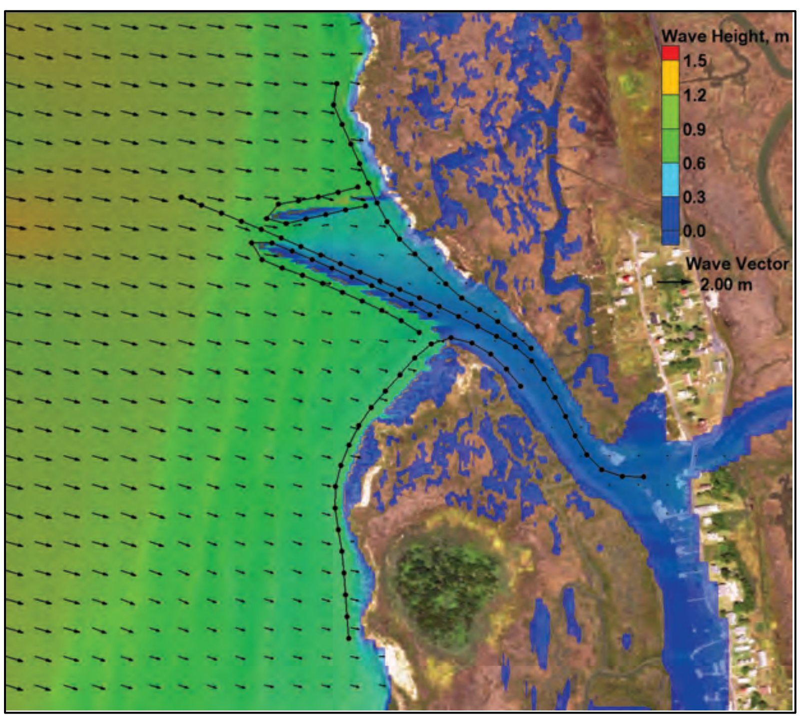


Figure 2-29. Maximum wave height field for Alt-2 in the western channel (northeaster, 16 February 2014 at 0000 GMT).

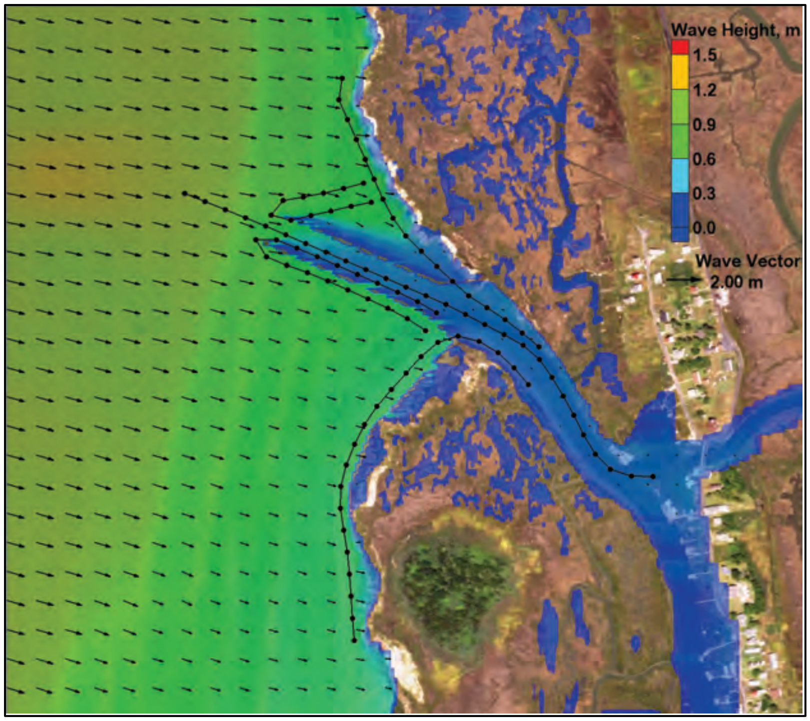


Figure 2-30. Maximum wave height field for Alt-0 in the western channel (Hurricane Sandy, 30 October 2012 at 1200 GMT).

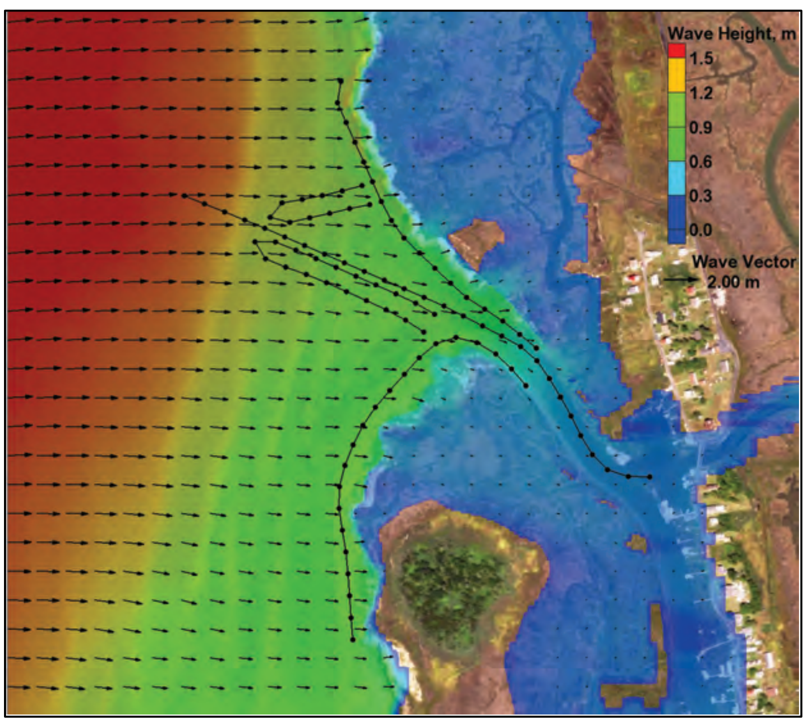


Figure 2-31. Maximum wave height field for Alt-1 in the western channel (Hurricane Sandy, 30 October 2012 at 1200 GMT).

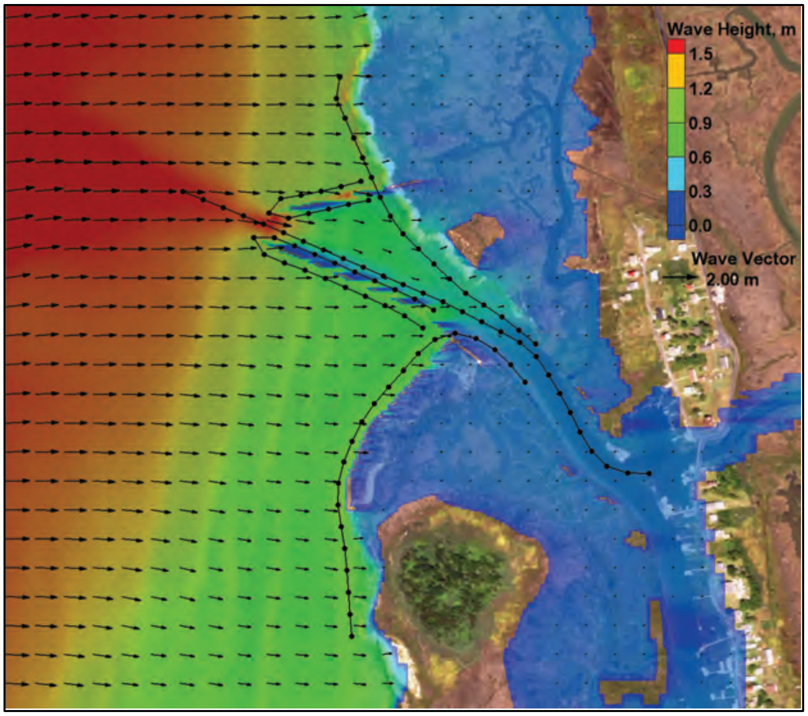
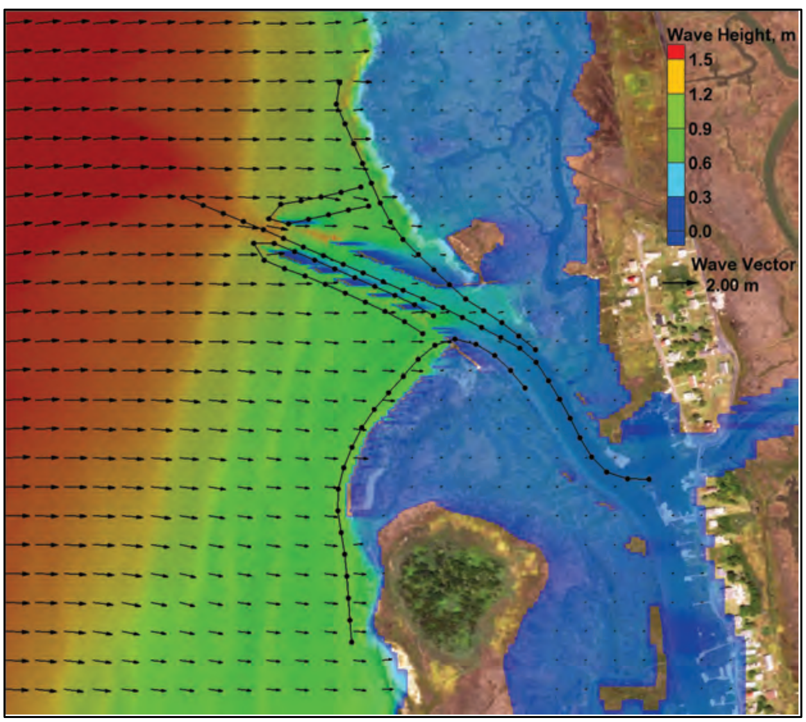


Figure 2-32. Maximum wave height field for Alt-2 in the western channel (Hurricane Sandy, 30 October 2012 at 1200 GMT).



The red/orange color area in Figures 2-27 to 2-32 represents the largest wave heights, green represents moderate wave heights, and smaller wave heights are in the blue region. The largest wave heights are calculated seaward of the western channel, which are reduced through the channel eastward toward the narrow canal. These results confirm that the added jetties helped to reduce waves in the channel. The wave height reduction along the channel was similar for Alt-1 and Alt-2, with a slightly greater reduction occurring between the north jetty and shoreline for Alt-1.

Overall, wave heights for the existing (no-project) configuration were greater than wave heights for two Alternatives (with project) through the new realigned channel. These spatial plots indicated wave heights were greater seaward of the western channel, and jetties helped to reduce waves eastward throughout the channel.

2.11 Detailed analysis of results

Numerical model results along the north and south shorelines and the channel centerline were analyzed for Alt-0, Alt-1, and Alt-2 along the five transects described earlier (Figures 2-23, 2-24, 2-25) for the three chosen simulation conditions (see Table 2-1). The modeling results are compared here to investigate the performance of each Alternative in relation to wave-energy, current, and morphology change in the areas of primary interest. The goal of this detailed analysis was to determine the degree of protection offered by the proposed Alternatives as compared to the existing channel (Alt-0). A wave-reduction analysis was performed by comparing Alternatives (Alt-1 and Alt-2) to the existing channel (Alt-0). Wave height analysis results are provided for northeaster and tropical storms simulations because waves were not considered in Condition 1 (Table 2-1). These are followed by calculated current and morphology change estimates for all three conditions.

2.11.1 Comparison of Alternatives for wave heights

The wave height variations along the north shoreline (T1), channel centerline (T3), and south shoreline (T5), are displayed in Figures 2-33, 2-34, and 2-35, respectively. The locations where north and south jetties intersect with T1, T3, and T5 have been marked on these figures. These snapshots represent the maximum wave heights extracted from 1-month winter simulation (Condition 2 in Table 2-1) on 16 February 2014 at 0000 GMT. As shown in Figure 2-33, there is a noticeable variation in wave height along T1 for the three Alternatives that ranged from 0.3 to 2.6 ft (0.1 to 0.8 m). The largest wave heights were calculated on the north segment of T1 at Stations 1 to 5. At Stations 7 to 9, calculated wave heights for Alt-2 were generally greater than wave heights for Alt-1 and slightly smaller at Stations 10 to 14.

Figure 2-33. Maximum wave height comparisons along the north shoreline transect T1 for a northeaster (16 February 2014 at 0000 GMT).

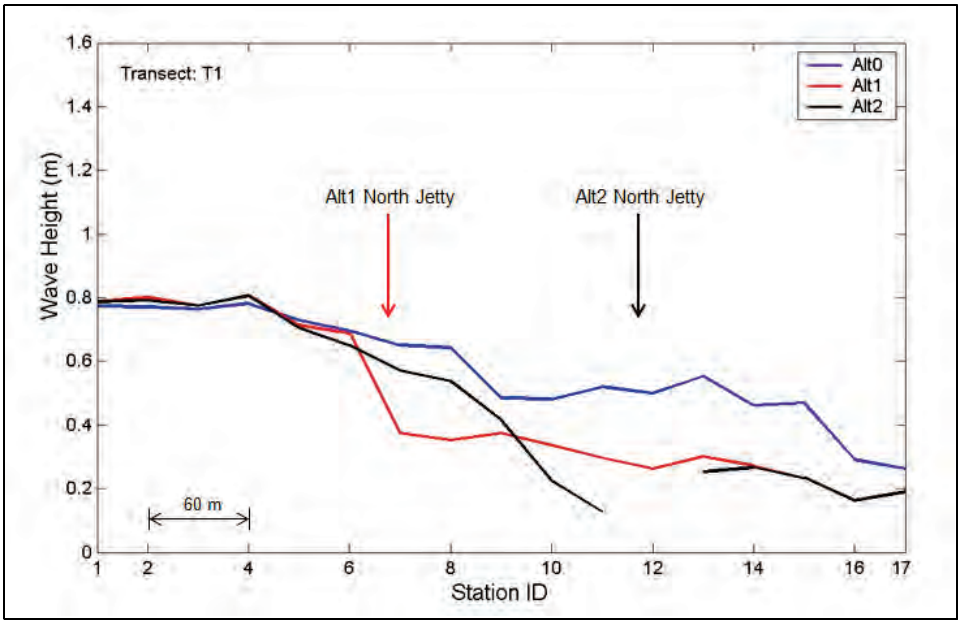


Figure 2-34. Maximum wave height comparisons along the channel centerline transect T3 for a northeaster (16 February 2014 at 0000 GMT).

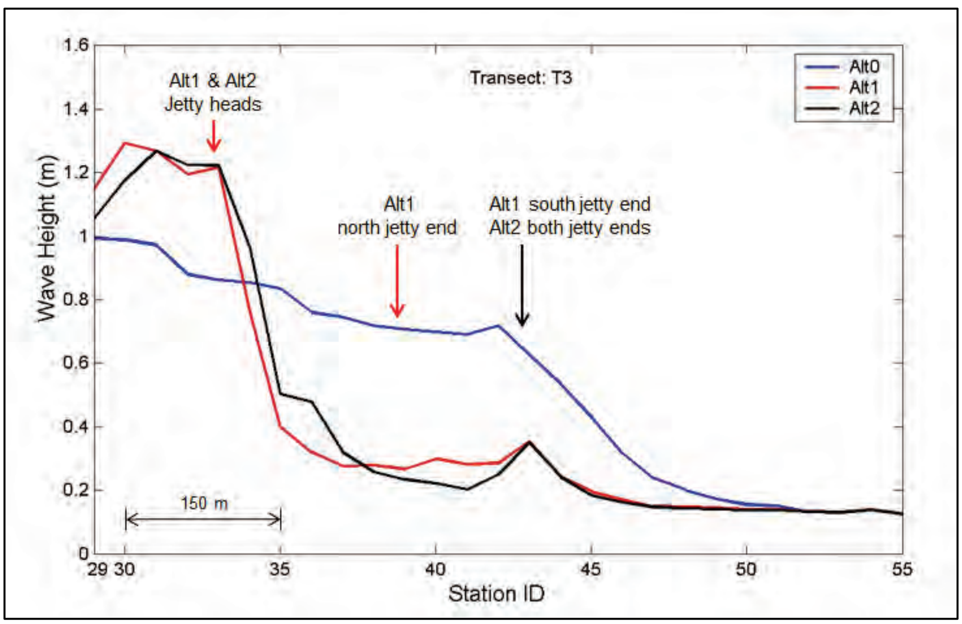
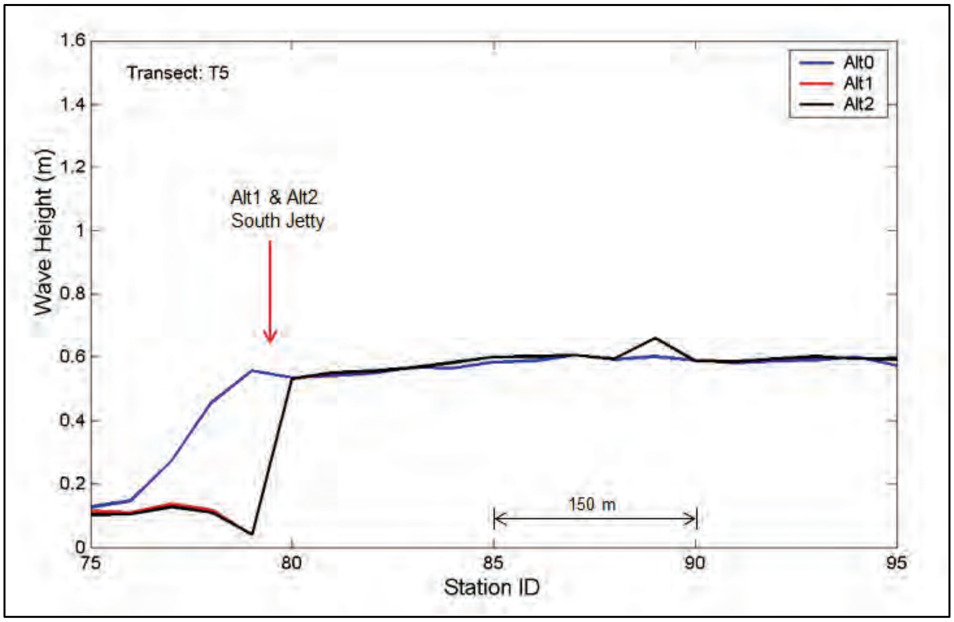


Figure 2-35. Maximum wave height comparisons along the south shoreline transect T5 for a northeaster (16 February 2014 at 0000 GMT).



Calculated wave heights for the northeaster (Condition 2) along T3 are provided in Figure 2-34, representing the extracted maximum wave heights on 16 February 2014 at 0000 GMT. Comparison to Figure 2-33 shows wave heights exhibit similar variation along this transect (e.g., higher waves in Bay side along the channel and decreasing wave heights eastward along the channel). The range of wave heights varied from 0.3 to 4.3 ft (0.1 to 1.3 m), with larger wave heights at Stations 29 to 33. Overall, the calculated wave height reduction for Alt-1 was greater than that for Alt-2, where the channel was less protected by North Jetty in Alt-1. Results for Condition 2 along T5 are provided in Figure 2-35. Wave heights varied from 0 to 2 ft (0 to 0.6 m) along T5 for the northeaster. Wave heights along the channel centerline (T3) were greater than those along the north (T1) and south (T5) shoreline transects, respectively.

In summary, results for the three Alternatives indicated a significant variation in wave heights along T3. Larger wave heights were calculated along the seaward section of T3 (Stations 29 to 33).

Model results along T1, T3, and T5 for Hurricane Sandy (Condition 3) are provided in Figures 2-36, 2-37, and 2-38, respectively, for the maximum wave height field that occurred on 30 October 2012 at 1200 GMT. As expected, larger wave heights were obtained for Condition 3 than Condition 2. The north shoreline is more protected in Alt-1 and Alt-2 while the south shoreline is not. Alt-1 and Alt-2 produced similar estimates along T5. This can be seen from comparison of results in Figures 2-36 vs. 2-38 and in Figures 2-33 vs. 2-35. The north shoreline can be expected to erode less with Alt-1 and Alt-2 than with Alt-0 because of the protection provided by jetties. The south shoreline is protected with the revetment in Alt-1 and Alt-2.

Figure 2-36. Maximum wave height comparisons along the north shoreline transect T1 for Hurricane Sandy (30 October 2012 at 1200 GMT).

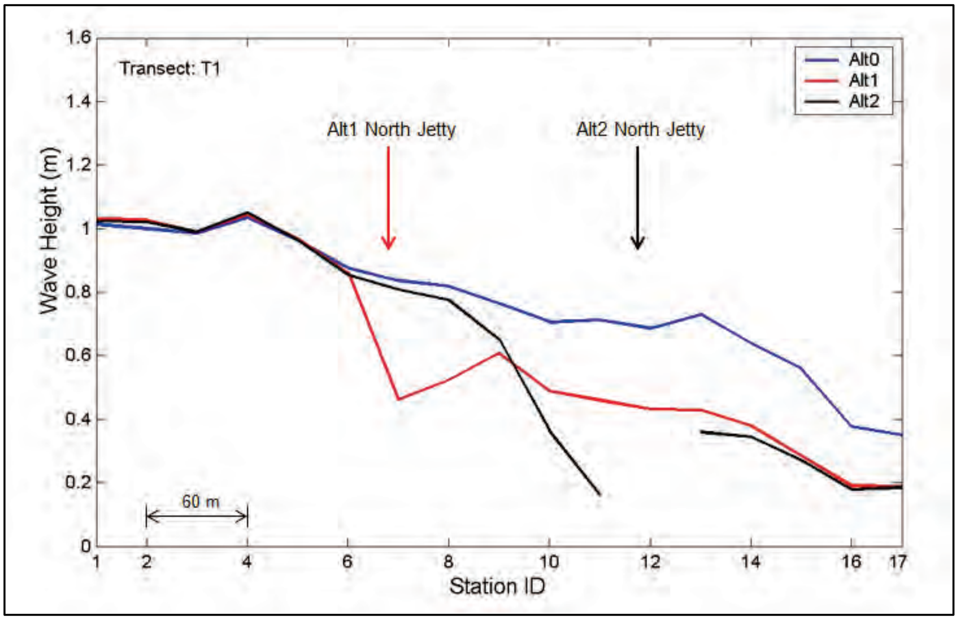


Figure 2-37. Maximum wave height comparisons along the channel centerline transect T3 for Hurricane Sandy (30 October 2012 at 1200 GMT).

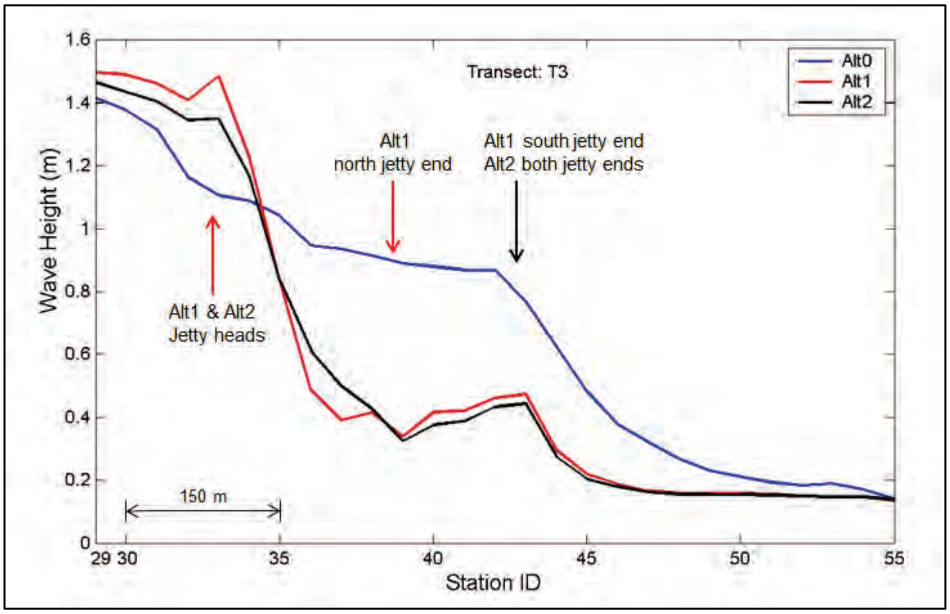
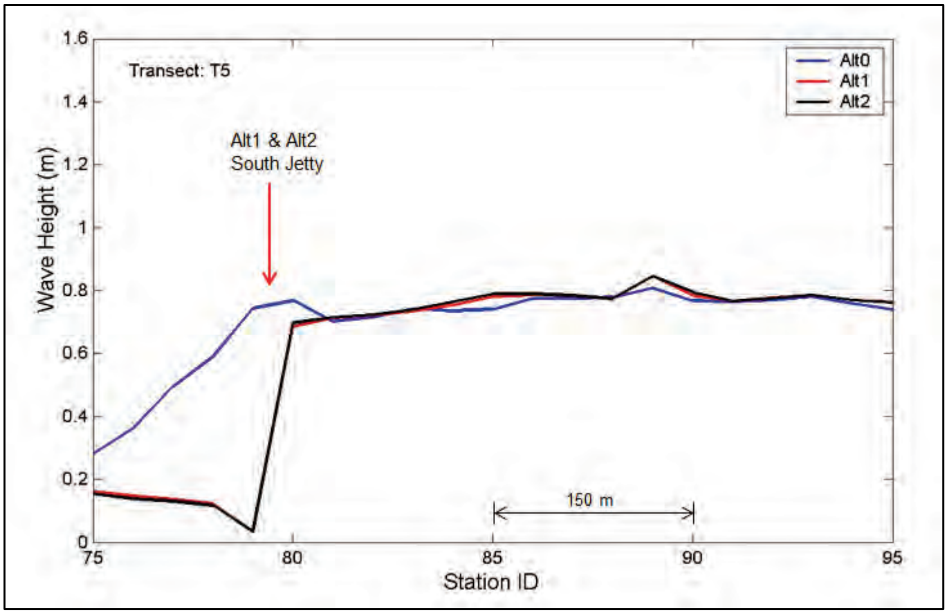


Figure 2-38. Maximum wave height comparisons along the south shoreline transect T5 for Hurricane Sandy (30 October 2012 at 1200 GMT).



Model results (Figures 2-33 to 2-38) indicated that both Alt-1 and Alt-2 provided a significant reduction in wave height inside the jetty entrance along the channel (T3) as compared to Alt-0. Model wave heights from Alt-1 and Alt-2 increased more than 25% immediately seaward of the jetty entrance. Such an increase could be due to a combination of effects including convergence (focusing) of waves entering the channel at the jetty heads, waves against currents during ebb tidal flow, and wave reflection and diffraction effects by the jetties. In summary, wave heights reduced along the channel centerline for both Alt-1 and Alt-2 moving eastward between Stations 33 and 55. Although the north jetty in Alt-1 was approximately only half the length of north jetty in Alt-2, results for Conditions 2 and 3 indicated Alt-1 was as effective as Alt-2. Over the entire length of T3, Alt-1 yielded a slightly greater reduction in wave height than Alt-2. The largest wave heights were calculated along T3, smallest along T5, and values for T1 were in between.

Between the north and south jetties, wave heights reduced consistently along the channel centerline for both Alt-1 and Alt-2, with a 50% maximum wave height reduction attained. In general, Alt-1 and Alt-2 produced a similar reduction. For example, the wave height at Station 40 was 0.7 ft (0.2 m) for Alt-2, 1 ft (0.3 m) for Alt-1, and 2.5 ft (0.75 m) for Alt-0, respectively. These estimates indicated a three-fold wave height reduction was possible with the jettied channel geometries evaluated.

To interpret calculated wave heights and wave height reduction achieved with each Alternative, several statistics including the maximum and mean wave heights and percent reduction along T1, T3, and T5 were calculated for each Alternative. The analysis of wave-height reduction from Alt-1 and Alt-2 was based on a wave height reduction factor calculated as the percentage of wave-height reduction relative to the wave heights in the existing channel (Alt-0) without the project condition. This was defined as

$$\left|\frac{\text{(Wave Height for Alternative) - (Wave Height for Existing Channel)}}{\text{(Wave Height for Existing Channel)}}\right|\times 100\%$$

Tables 2-2, 2-3, and 2-4 provide a summary of wave height statistics for T1, T3, and T5, respectively, for February 2014 (Condition 2), and Tables 2-5, 2-6, and 2-7 for Hurricane Sandy (Condition 3). All Stations on each transect were included in the calculation of wave height and morphology change statistics provided in Tables 2-2 through 2-7. The zero value of wave height reduction was assigned if no reduction was calculated. The maximum wave height affects the operations and navigability while the mean wave height affects the sediment transport in the study area.

Along T1 (north shoreline) in Alt-1 and Alt-2, wave statistics were calculated separately for the west segment (Station 1 to Station 6) not protected by north jetty, and the east segment (Station 7 to 17), which was either fully or partially protected by north jetty. Wave statistics were similar for Alt-0, Alt-1, and Alt-2 along the unprotected west segment of T1. There was a significant wave height reduction along the protected east segment of Alt-1 and Alt-2 located in the lee of north jetty. Along the protected segment of T1, Alt-1 provided roughly 50% maximum and 40% average wave height reduction (Table 2-2) for Conditions 2 and 3. Alt-2 yielded 75% and 42% reduction, respectively (Table 2-5).

Along T3 (channel centerline) in Alt-1 and Alt-2, wave statistics were calculated separately for the west segment (Station 29 to Station 33) outside the jetty entrance (unprotected channel) and the east segment (Station 34 to 55) inside the jetty entrance (protected channel). Along the east segment of T3 (inside jetty entrance), the maximum and mean wave height reductions for both Alt-1 and Alt-2 were approximately 65% and 35%, respectively (Tables 2-3 and 2-6). Along the unprotected west segment (outside jetty entrance), model wave heights for Alt-1 and Alt-2 increased more than 25% as compared to Alt-0. This increase was due to a combination of wave interaction with the jetty heads, waves against ebbing currents, and stronger wave reflection and diffraction effects at and around the tips of jetties.

Table 2-2. Calculated wave height statistics along T1 (16 February 2014 at 0000 GMT).

Alt	Max wave height (m)	Mean wave height (m)	Max wave height reduction* (%)	Mean wave height reduction* (%)
	Unprotected segment of North shoreline in Alt-1 and Alt-2 (Sta 1 to Sta 6)			
0	0.78	0.75	0	0
1	0.81	0.76	2.3	0
2	0.81	0.75	6.8	0.2
	Protected segment of North shoreline in Alt-1 and Alt-2 (Sta 7 to Sta 17)			
0	0.65	0.48	0	0
1	0.37	0.29	50.3	40.0
2	0.57	0.28	75.4	42.2

* Calculated as the percentage change of wave heights of Alt-1 and Alt-2 from Alt-0.

Table 2-3. Calculated wave height statistics along T3 (16 February 2014 at 0000 GMT).

Alt	Max wave height (m)	Mean wave height (m)	Max wave height reduction* (%)	Mean wave height reduction* (%)
	Along channel segment outside the jetty entrance in Alt-1 and Alt-2 (Sta 29 to Sta 33)			
0	1.00	0.94	0	0
1	1.29	1.22	0	0
2	1.27	1.19	0	0
	Along channel segment inside the jetty entrance in Alt-1 and Alt-2 (Sta 34 to Sta 55)			
0	0.85	0.46	0	0
1	0.76	0.24	63.0	35.5
2	0.96	0.25	70.7	35.0

* Calculated as the percentage change of wave heights of Alt-1 and Alt-2 from Alt-0.

Along T5 (south shoreline) in Alt-1 and Alt-2, wave statistics were calculated separately for the east segment (Station 1 to Station 6) protected by the south jetty and the south segment (Station 7 to Station 17), which is not protected by the south jetty. Along the protected segment of T5 (Station 75 t0 Station 79), maximum and mean wave height reductions were more than 90% and 50%, respectively (Tables 2-4 and 2-7). Overall, the unprotected segments of T1 and T5 were neither affected by the jetties or had a minor wave height increase/decrease primarily due to local wave processes. Along the unprotected segment of T3 outside the jetty entrance, wave heights for Alt-1 and Alt-2 increased 25% or more due to waves interacting with the jetty heads, waves against ebbing currents, and wave reflection and diffraction around the jetty tips.

Table 2-4. Calculated wave height statistics along T5 (16 February 2014 at 0000 GMT).

Alt	Max wave height (m)	Mean wave height (m)	Max wave height reduction* (%)	Mean wave height reduction* (%)
	Protected segment of south shoreline in Alt-1 and Alt-2 (Sta 75 to Sta 79)			
0	0.56	0.31	0	0
1	0.14	0.10	92.8	50.4
2	0.13	0.10	92.6	54.0
	Unprotected segment of south shoreline in Alt-1 and Alt-2 (Sta 80 to Sta 95)			
0	0.60	0.58	0	0
1	0.66	0.59	0.8	0
2	0.66	0.59	0.8	0

* Calculated as the percentage change of wave heights of Alt-1 and Alt-2 from Alt-0

Table 2-5. Calculated wave height statistics along T1 (30 October 2012 at 1200 GMT).

Alt	Max wave height (m)	Mean wave height (m)	Max wave height reduction* (%)	Mean wave height reduction* (%)
	Unprotected segment of north shoreline in Alt-1 and Alt-2 (Sta 1 to Sta 6)			
0	1.03	0.98	0	0
1	1.04	0.99	1.6	0
2	1.05	0.98	2.3	0
	Protected segment of north shoreline in Alt-1 and Alt-2 (Sta 7 to Sta 17)			
0	0.84	0.65	0	0
1	0.61	0.40	50.0	40.0
2	0.81	0.39	77.2	43.1

* Calculated as the percentage change of wave heights of Alt-1 and Alt-2 from Alt-0.

Table 2-6. Calculated wave height statistics along T3 (30 October 2012 at1200 GMT).

Alt	Max wave height (m)	Mean wave height (m)	Max wave height reduction* (%)	Mean wave height reduction* (%)
	Along channel segment outside the jetty entrance in Alt-1 and Alt-2 (Sta 29 to Sta 33)			
0	1.42	1.28	0	0
1	1.50	1.47	0	0
2	1.47	1.40	0	0
	Along channel segment inside the jetty entrance in Alt-1 and Alt-2 (Sta 34 to Sta 55)			
0	1.09	0.57	0	0
1	1.23	0.34	61.8	36.2
2	1.17	0.34	63.7	36.9

* Calculated as the percentage change of wave heights of Alt-1 and Alt-2 from Alt-0.

Table 2-7. Calculated wave height statistics along T5 (30 October 2012 at 1200 GMT).

Alt	Max wave height (m)	Mean wave height (m)	Max wave height reduction* (%)	Mean wave height reduction* (%)
	Protected segment of south shoreline in Alt-1 and Alt-2 (Sta 75 to Sta 79)			
0	0.74	0.49	0	0
1	0.16	0.12	95.4	70.0
2	0.15	0.11	95.4	71.3
	Unprotected segment of south shoreline in Alt-1 and Alt-2 (Sta 80 to Sta 95)			
0	0.81	0.76	0	0
1	0.84	0.76	10.7	0
2	0.85	0.77	9.2	0

* Calculated as the percentage change of wave heights of Alt-1 and Alt-2 from Alt-0.

2.11.2 Comparison of Alternatives for currents and sediment transport

The current and morphology change calculated for the summer-month (August 2014) simulation are included in the results provided in this section. Figures 2-39 to 2-47 provide the variation of calculated current along the north shoreline (T1), channel centerline (T3), and south shoreline (T5), respectively, for the three conditions simulated. These snapshots represent the CMS-calculated maximum current extracted from the simulations for three conditions (Table 2-1) at the maximum flood/ebb stage.

Figure 2-39. Maximum currents along T1 (August 2014).

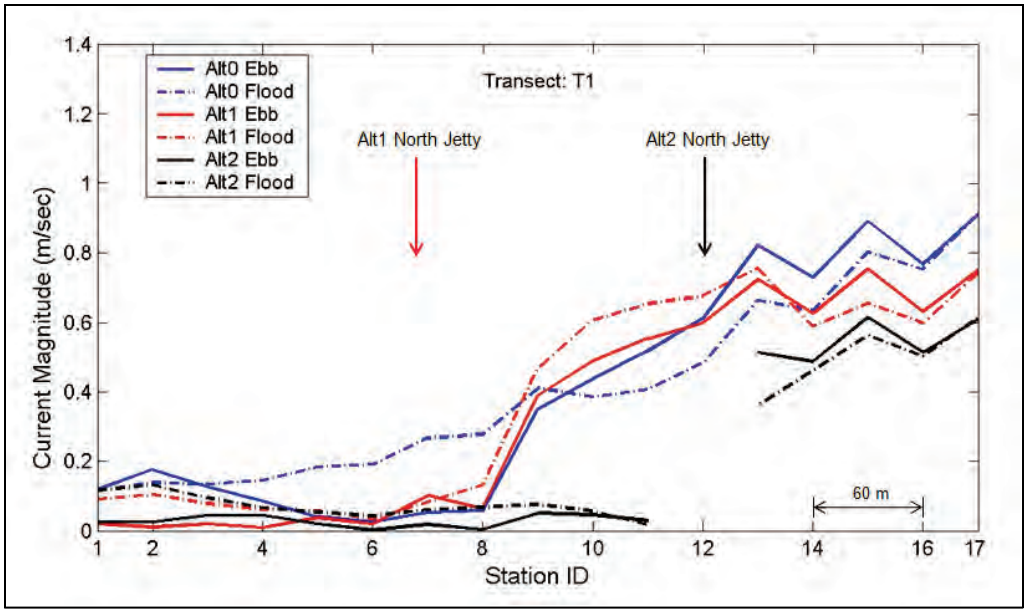


Figure 2-40. Maximum currents along T1 (February 2014).

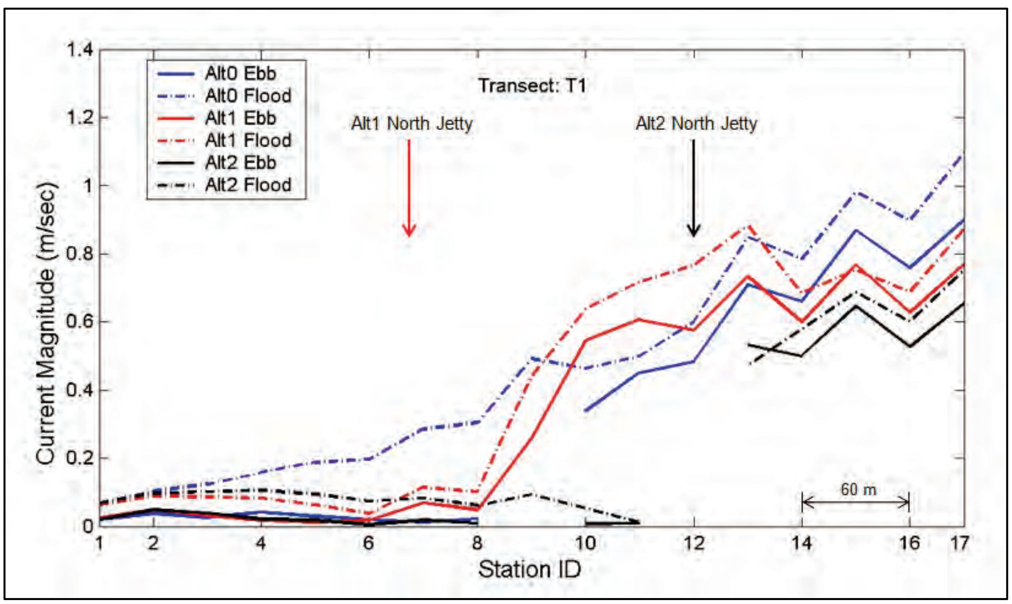


Figure 2-41. Maximum currents along T1 (Hurricane Sandy).

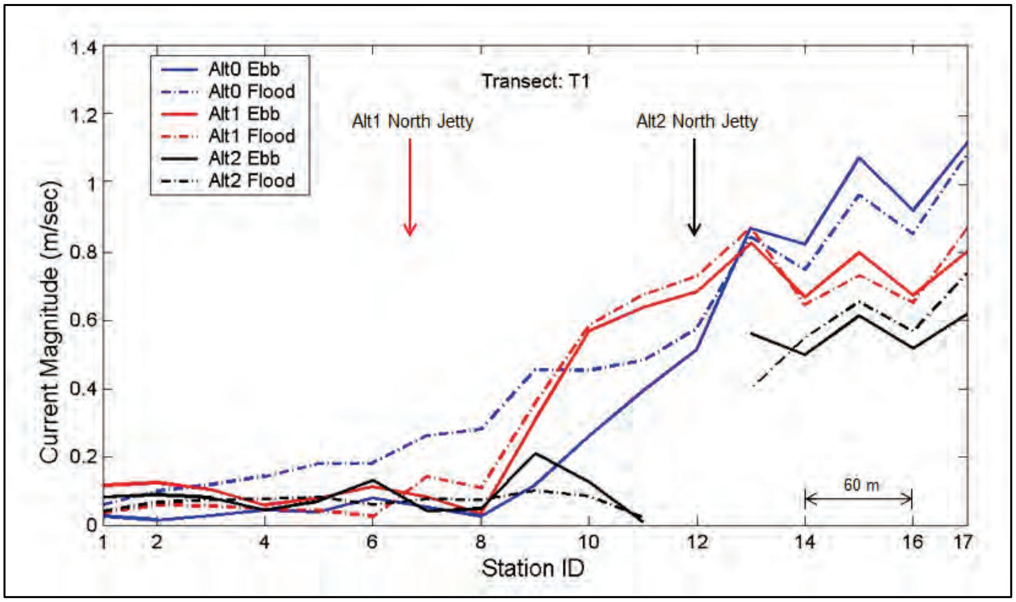


Figure 2-42. Maximum currents along T3 (August 2014).

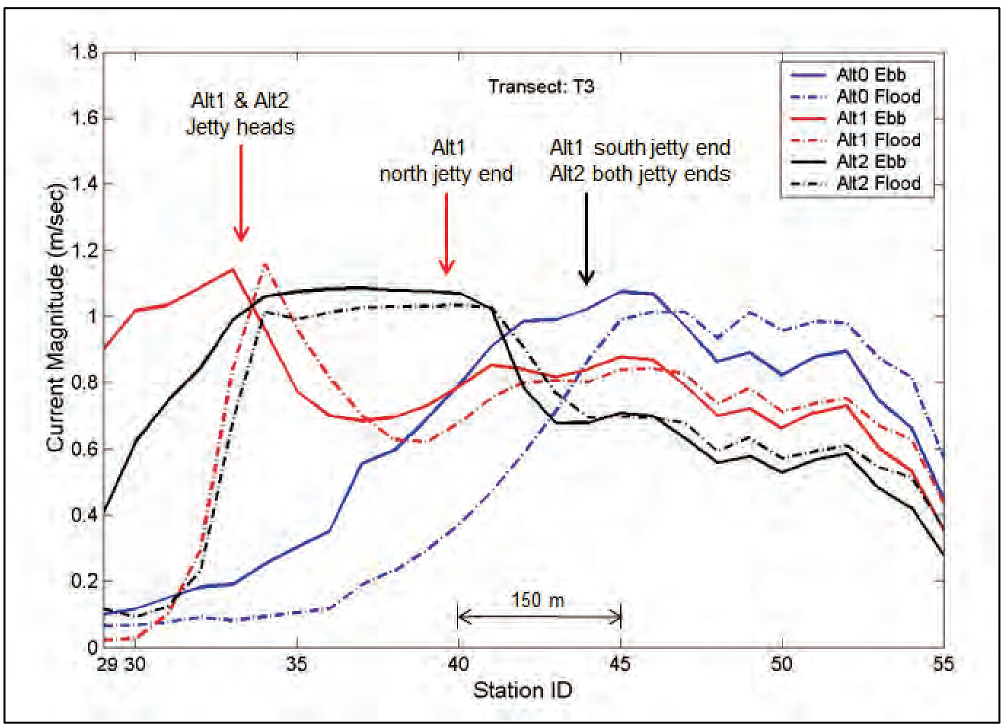


Figure 2-43. Maximum currents along T3 (February 2014).

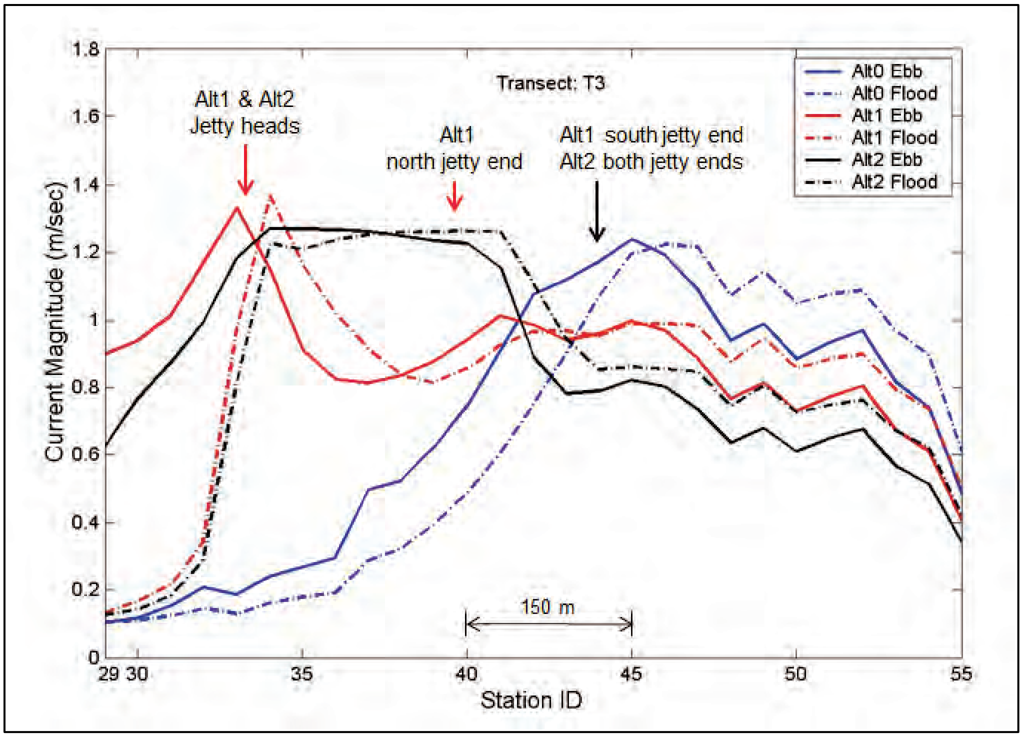


Figure 2-44. Maximum currents along T3 (Hurricane Sandy).

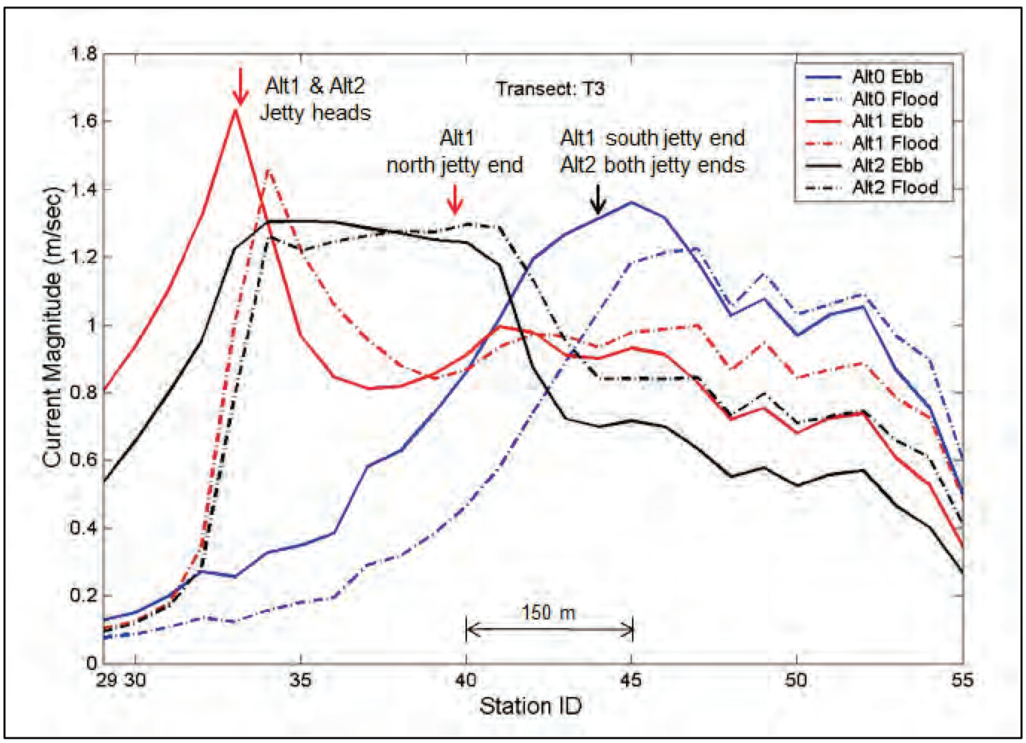


Figure 2-45. Maximum currents along T5 (August 2014).

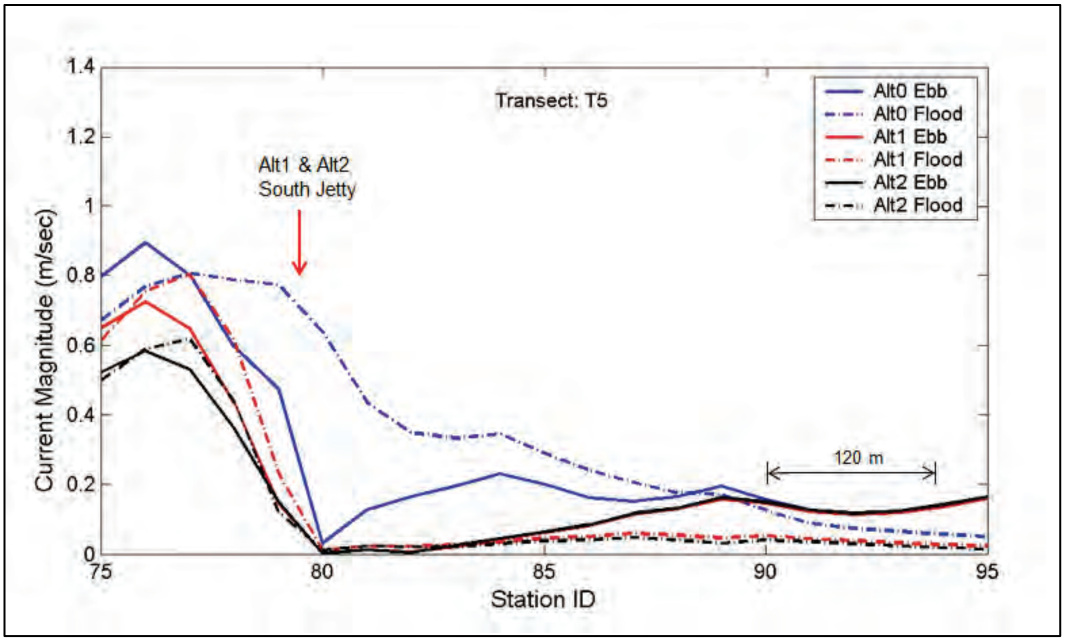


Figure 2-46. Maximum currents along T5 (February 2014).

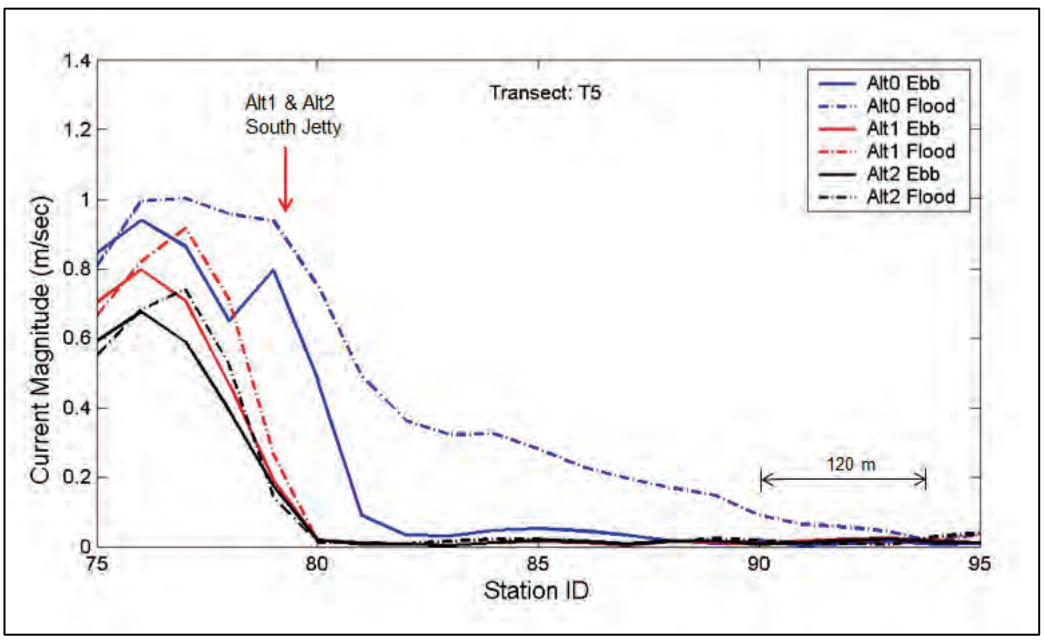
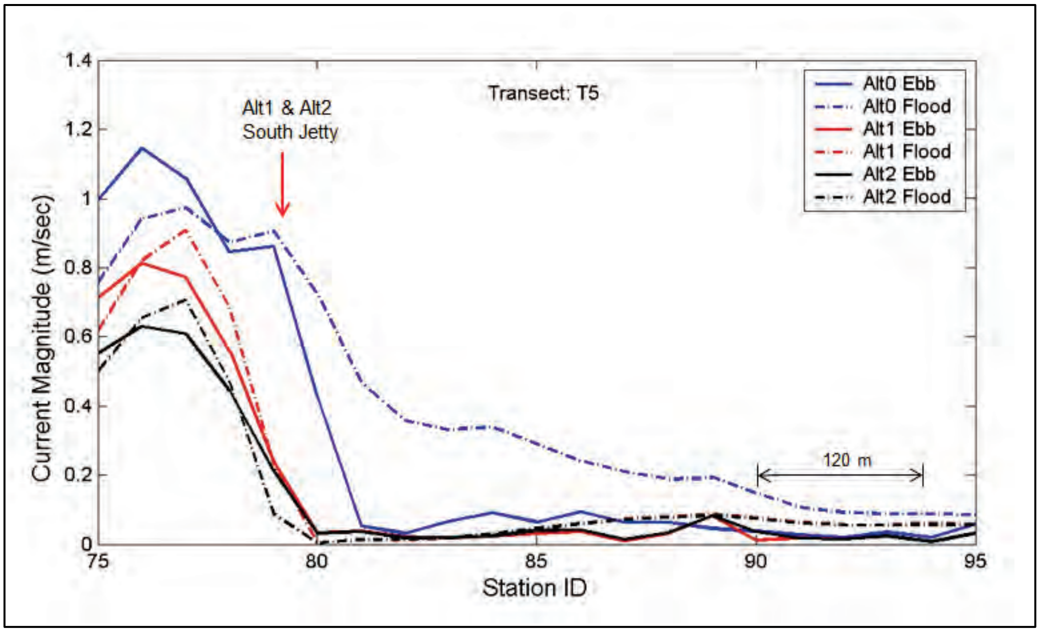


Figure 2-47. Maximum currents along T5 (Hurricane Sandy).



Figures 2-39, 2-40, and 2-41 show current magnitude along T1 at flood/ebb for the three Alternatives and three conditions (Table 2-1) simulated. Model calculated currents for August 2014, February 2014, and Hurricane Sandy were relatively weak (average less than 0.7 ft/sec [0.2 m/sec]) in the northern segment of T1 (Stations 1 to 8). Current speeds increased southward toward the canal throat from Stations 8 to 17, reaching a maximum of 3.3 ft/sec (1.1 m/sec). For August 2014, there is no clear trend between the flood and ebb current for any Alternative. However, for the February 2014 simulation, the current speeds along the entire length of T1 during flood flows were greater than ebb current for the three Alternatives. The difference in the maximum current between Alt-1 and Alt-2 was small and less than 0.5 ft/sec (0.15 m/sec) that would not affect the navigability of small boats. Concerning the potential for erosion of the north shoreline, currents generated with Alt-1 and Alt-2 were similar in the northern section of T1 but were different in the southern section, where difference increased closer to the canal entrance.

Figures 2-42, 2-43, and 2-44 show the variation in current magnitude along the channel centerline (T3). Maximum flood/ebb current for the three Alternatives is shown in these plots for the three conditions simulated. Model calculated currents for August 2014, February 2014, and Hurricane Sandy varied from 0.3 to 5.2 ft/sec (0.1 to 1.6 m/sec). For August 2014, the flood current in the channel was stronger close to the canal between Stations 45 to 55 while the ebb current increased westward.

The same trend in current speed was obtained for the February and August 2014 simulations, with the maximum current increasing to 4.3 ft/sec (1.3 m/sec). Both flood/ebb currents dropped sharply between Stations 33 to 35. The maximum current reached 5.2 ft/sec (1.6 m/sec) for Hurricane Sandy, and the difference between the flood and ebb currents increased and expanded along the channel as compared to currents for the February and August 2014 simulations.

Figures 2-45, 2-46, and 2-47 show the maximum flood/ebb current speed along the south shoreline (T5) for the three Alternatives (Alt-0, Alt-1, and Alt-2). The maximum currents of February and August 2014 and Hurricane Sandy ranged from 0 to 3.6 ft/sec (0 to 1.1 m/sec) along T5 for different Alternatives. The strong current speeds between Stations 75 to 80 decreased sharply along the south edge of canal and increased slowly over the rest of T5. Current speed was rather weak between Stations 80 and 95, with an average speed of 0.7 ft/sec (0.2 m/sec). Similar current speed estimates were obtained along the south and north shorelines, with stronger currents occurring along both shorelines closer to the canal entrance.

The sediment transport was calculated in the CMS-Flow local grid covering the Rhodes Point. Sediment grain size data from grab samples by NAB were obtained in June 2015. The sediment data consisted of primarily sand in the study area. A constant D_{50} of 0.2 mm was used in the present simulations.

Figure 2-48 shows estimates of the morphology change calculated along T1, T3, and T5 for the August 2014 simulation. These 1-month erosion and deposition estimates were less than 1.3 ft (0.4 m) for Alt-0, with the largest morphology change occurred along the channel centerline (T3).

The morphology change estimates for the February 2014 simulation along T1, T3, and T5 are provided in Figure 2-49. These erosion/deposition estimates for 1 month were similar in magnitude to August 2014 estimates, with a maximum value of 1.3 ft (0.4 m) for Alt-0 obtained along T3. However, the spatial variations along the three transects are different.

Figure 2-48. Morphology changes along T1, T3, and T5 (August 2014).

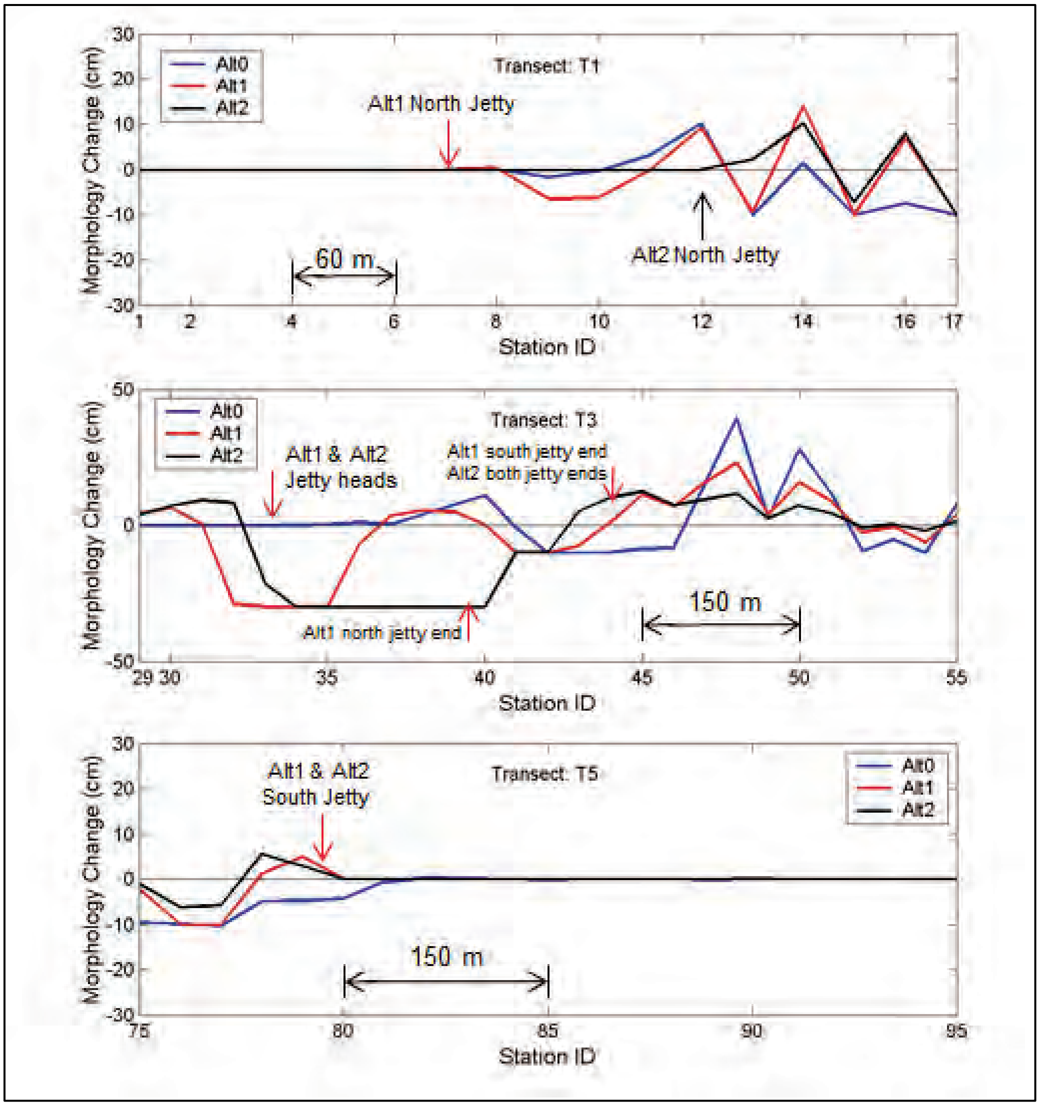


Figure 2-49. Morphology changes along T1, T3, and T5 (February 2014).

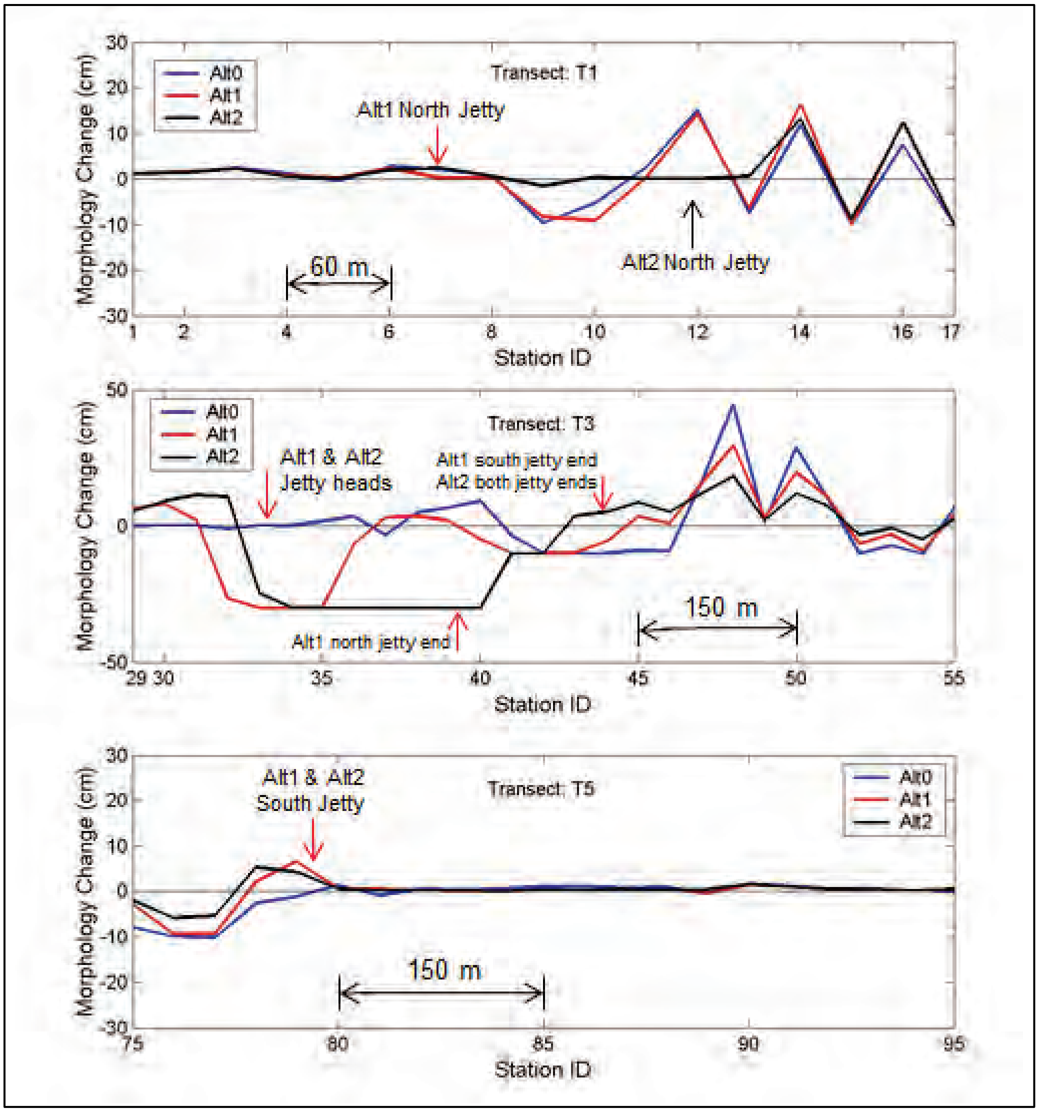
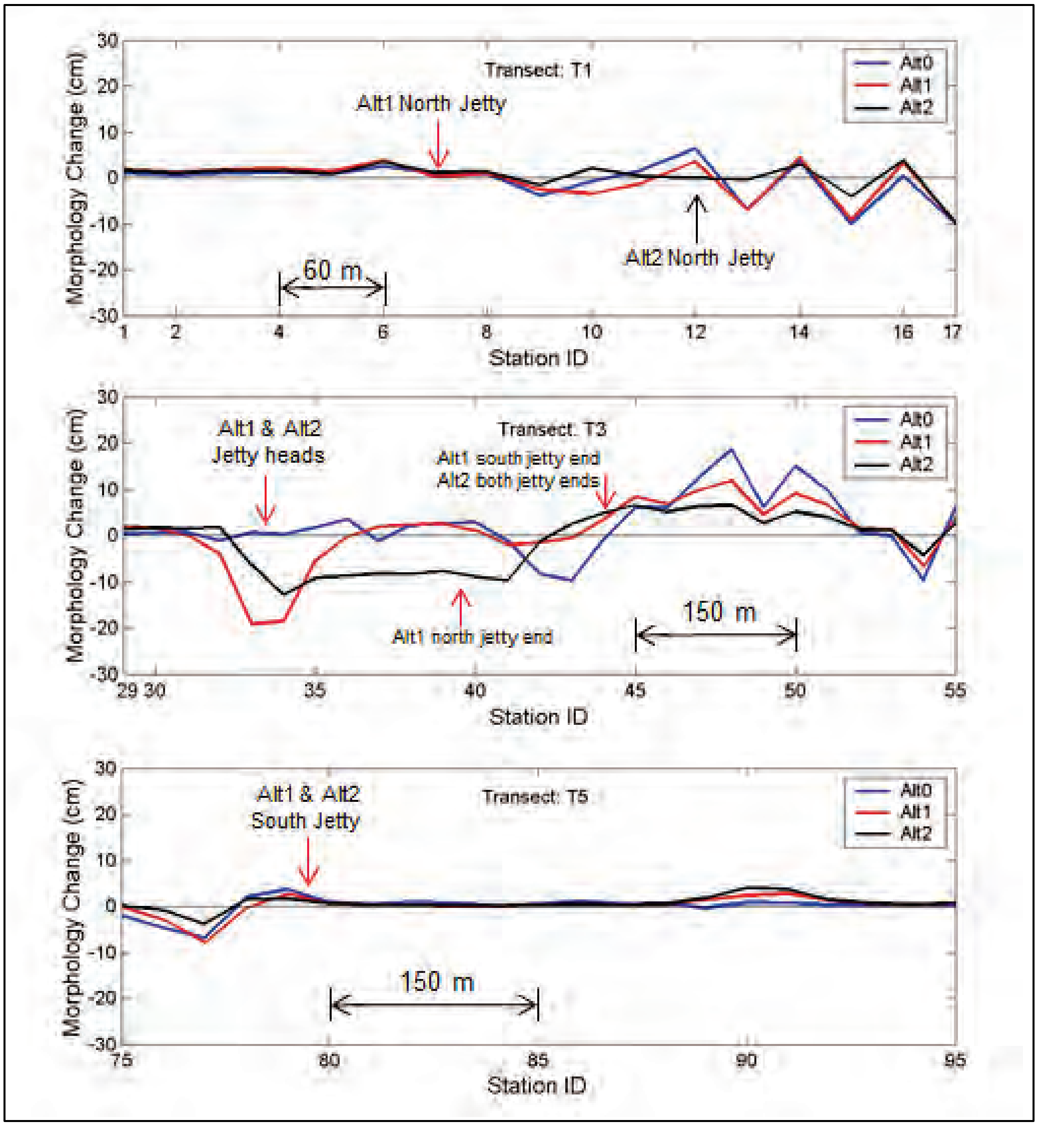


Figure 2-50 displays the morphology change estimates for Hurricane Sandy for the 26–31 October 2012 simulation. The spatial variation of erosion/deposition estimates along T1, T3, and T5 are provided. The maximum morphology change of approximately 0.7 ft (0.2 m) occurred along T3, where the maximum current was present. Although the calculated magnitudes of sediment transport are similar to August and February 2014 simulation results, the spatial variation of erosion and accretion along each transect was different.

Figure 2-50. Morphology changes along T1, T3, and T5 (Hurricane Sandy).



Figures 2-51, 2-52, and 2-53 show the spatial pattern of morphology change for Alt-0, Alt-1, and Alt-2, respectively, at the end of the August 2014 simulation with the peak ebb current field at 31 August 2014 at 1400 GMT, in which blue represents erosion and red represents deposition. Figure 2-54, 2-55, and 2-56 show the model morphology change pattern for Alt-0, Alt-1, and Alt-2, respectively, with the peak flood current field at 31 August 2014 at 2100 GMT with the same color legend.

Figure 2-51. Morphology change for Alt-0 (ebb current, 31 August 2014 at 1400 GMT).

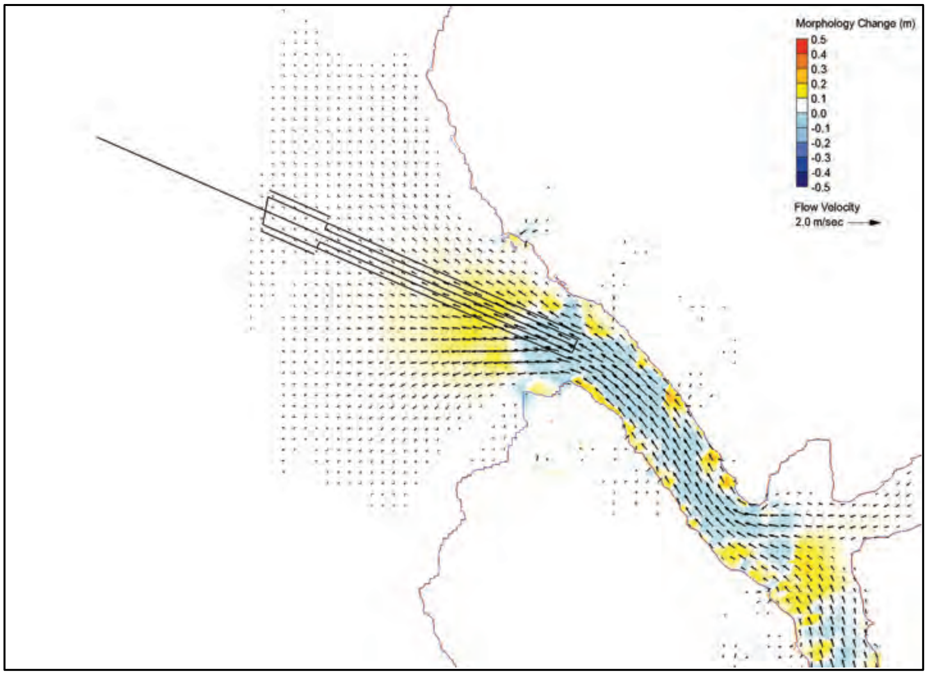


Figure 2-52. Morphology change for Alt-1 (ebb current, 31 August 2014 at 1400 GMT).

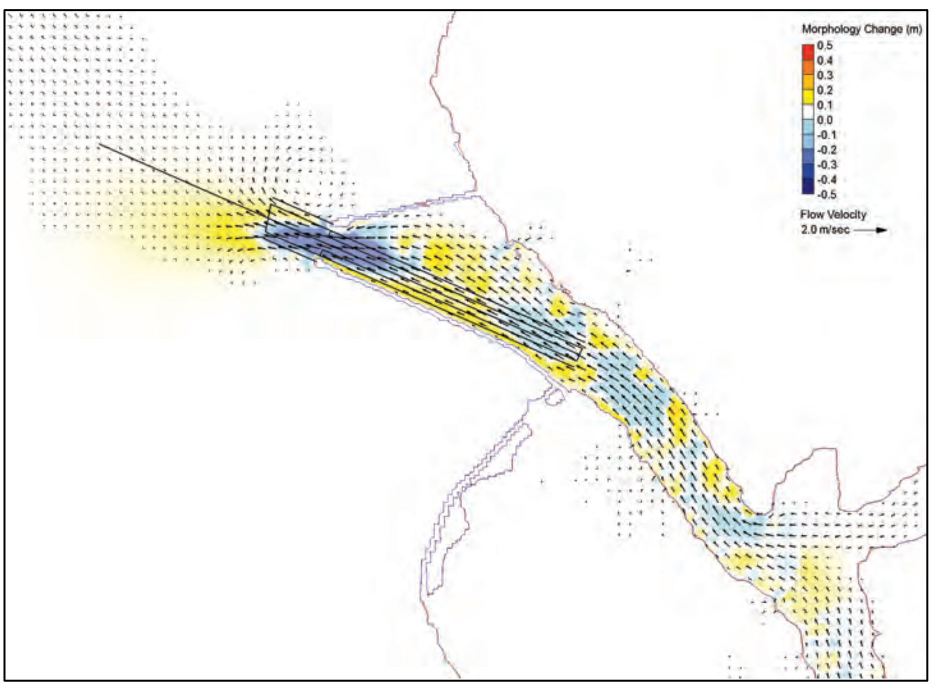


Figure 2-53. Morphology change for Alt-2 (ebb current, 31 August 2014 at 1400 GMT).

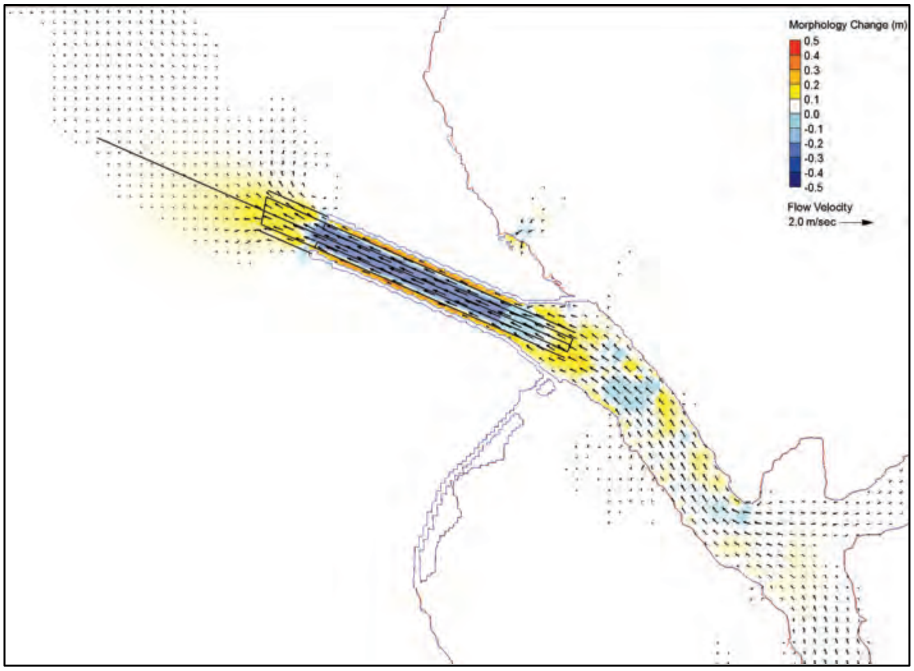


Figure 2-54. Morphology change for Alt-0 (flood current, 31 August 2014 at 2100 GMT).

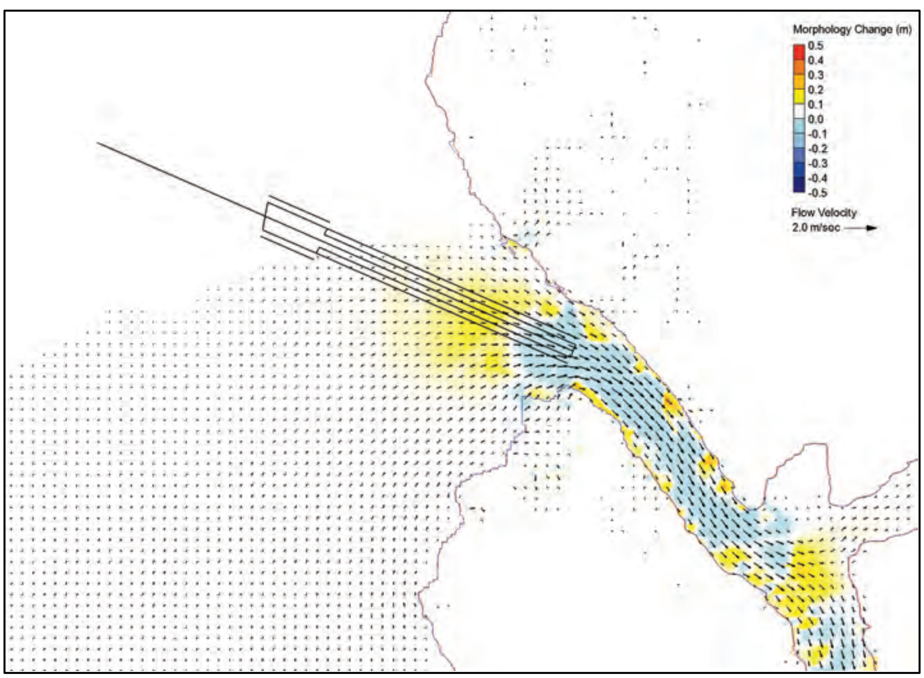


Figure 2-55. Morphology change for Alt-1 (flood current, 31 August 2014 at 2100 GMT).

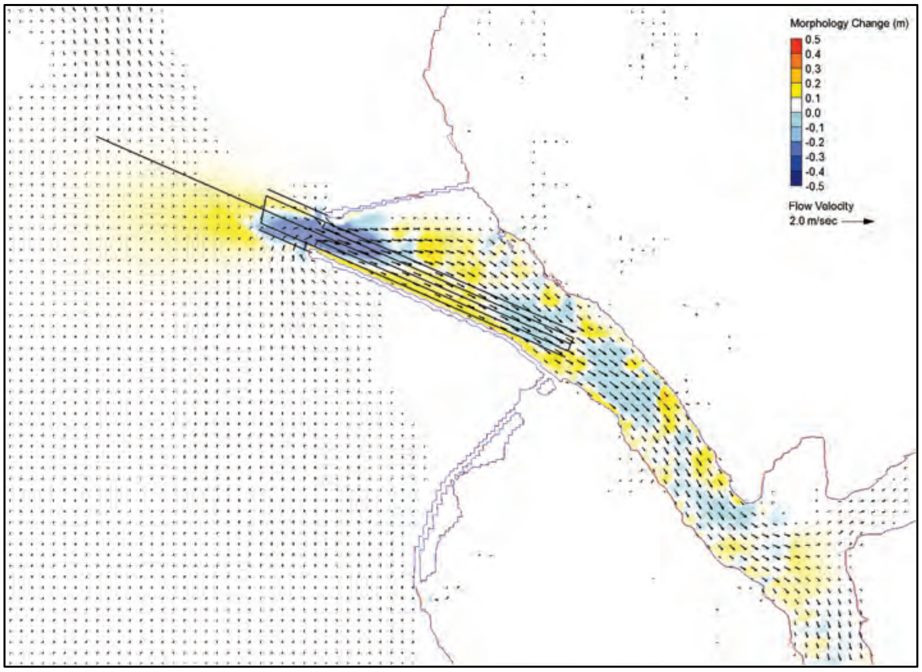
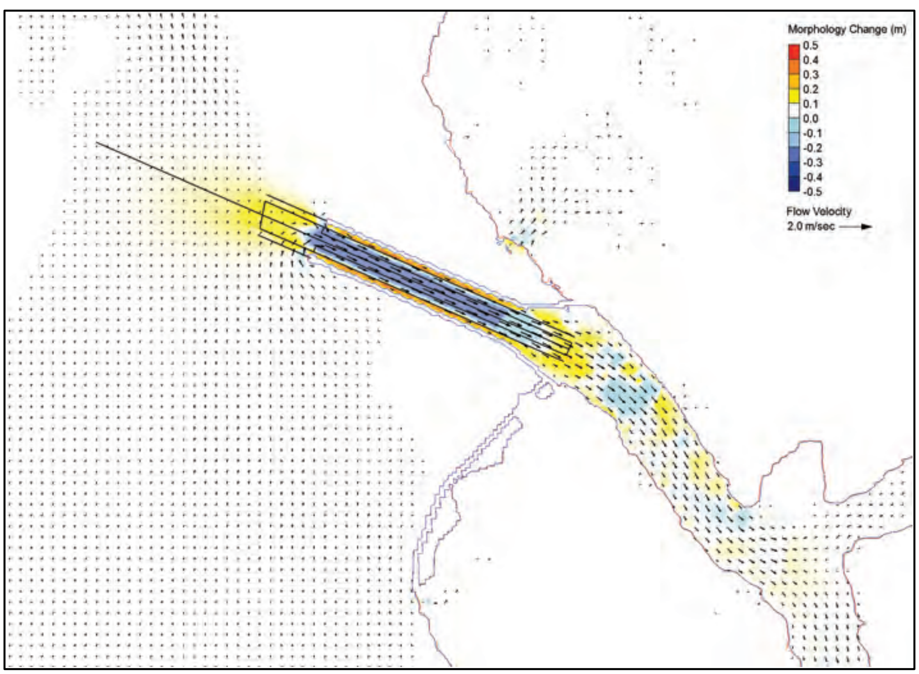


Figure 2-56. Morphology change for Alt-2 (flood current, 31 August 2014 at 2100 GMT).



The summary statistics for morphology change are provided in Tables 2-8, 2-9, and 2-10 for Conditions 1, 2, and 3. Conditions 1 and 2 were 1-month-long simulations whereas Condition 3 was a 6-day simulation. The bed change along T1, T3, and T5 was calculated along these transects. The purpose of the sediment transport calculations was to determine the effect of the jetties on channel erosion/accretion. The short-term estimates of morphology change based on a 1-month-long simulation with waves, currents, and sediment transport cannot be extrapolated to predict long-term channel shoaling rates. However, a 1-month simulation of sediment transport helps to determine sedimentation patterns in the channel and outside along neighboring shorelines.

Table 2-8. Calculated maximum bottom scour and accretion along T1.

Alt	Condition 1	Condition 2	Condition 3
0	-10 cm / 10 cm	-10 cm / 15 cm	-10 cm / 6 cm
1	-10 cm / 14 cm	-10 cm / 16 cm	-10 cm / 6 cm
2	-10 cm / 10 cm	-10 cm / 13 cm	-10 cm / 4 cm

Table 2-9. Calculated maximum bottom scour and accretion along T3.

Alt	Condition 1	Condition 2	Condition 3
0	-10 cm / 39 cm	-10 cm / 45 cm	-10 cm / 19 cm
1	-30 cm / 23 cm	-30 cm / 30 cm	-20 cm / 12 cm
2	-30 cm / 12 cm	-30 cm / 19 cm	-13 cm / 7 cm

Table 2-10. Calculated maximum bottom scour and accretion along T5.

Alt	Condition 1	Condition 2	Condition 3
0	-10 cm / 1 cm	-10 cm / 2 cm	-7 cm / 4 cm
1	-10 cm / 5 cm	-10 cm / 7 cm	-8 cm / 3 cm
2	-6 cm / 6 cm	-6 cm / 5 cm	-4 cm / 4 cm

The results in Tables 2-8, 2-9, and 2-10 indicate the maximum bottom erosion along T1, T3, and T5 remained less than 1.6 ft (0.5 m) within 1-month duration. A self-scouring channel with jetties is beneficial for the long-term channel maintenance. For the three Alternatives with three conditions simulated, the calculated maximum erosion and accretion along T1 were 0.3 ft (0.1 m) and 0.5 ft (0.16 m), respectively. Along channel centerline transect T3, maximum erosion/accretion were 1 ft (0.3 m) and 1.5 ft (0.45 m), respectively. The erosion and accretion along the south shoreline transect line T5 were 0.3 ft (0.1 m) and 0.2 ft (0.07 m), respectively. Model results indicated different sediment patterns developing along the north and south shorelines, with comparatively less erosion of the south shoreline.

For Alt-1 along the channel centerline, the sediment pattern shows increased bottom erosion around the jetty entrance. This is due to converging of flow and stronger interaction between waves and currents near the jetty heads. For Alt-2, the channel erosion increases between the parallel jetties due to constrained currents. The channel erosion in Alt-1 and Alt-2 is not linear with time as the channel cross section changes (e.g., channel becomes wider and deeper between jetties). The erosion in the channel is expected to reach equilibrium as coarser bed material is encountered. Because of lack of current field data and detail information about the channel bed layers, model predictions could not be calibrated and validated in the channel. Due to these uncertainties, both flow and sediment transport estimates can be over predicted. Local field data collection would help to address these uncertainties.

2.12 Estimates for structure design

The calculated wave-height, period, direction, and water-level estimates at locations on the windward side of the north and south jetties were extracted for structural calculations, as described in Chapter 3. Wave direction is in the meteorological convention (e.g., direction waves coming from).

3 Structural Design Calculations

3.1 Selection of design wave and water level

For design estimates of jetty stone size, the storm with a statistical return period of 50 years (Hurricane Sandy for this study) was used. Wave heights and wave periods for the 50-year event were described in Chapter 2. Although the tidal range is small in the area of Smith Island, a significant storm surge occurred during the design event. A still-water level rise of 5 ft (~1.5 m) for Hurricane Sandy was selected to include tidal fluctuations, storm surge, and wave setup.

All calculations have been expressed in the System International (SI) and American Customary (English) units. A table of conversions is included at the beginning of this report to assist in conversion between these units. The methodology used herein follows Melby (2010) and is updated in Melby et al. (2015).

3.2 Stability equations

3.2.1 Stable seaside armor stone size

Stable armor stone size is computed here based on 50-year return period wave and water level conditions. See Chapter 2 for details. The well-known Hudson equation has been used for years to determine armor stability (Hudson 1959; Department of the Army 1984). In stability number form, the Hudson equation is given by

$$N_s = \frac{H_{1/10}}{\Delta D_{n50}} = (K_D \cot\theta)^{1/3} \tag{3-1}$$

where N_s is the stability number, $H_{1/10}$ is the average height of the highest 10% of waves; $\Delta = S_r - 1$, with $S_r = \rho_r / \rho_w$ = immersed specific gravity of the armor stone with ρ_r = density of armor stone and ρ_w = density of water at the project site; D_{n50} is nominal stone size defined as $D_{n50} = (M_{50}/\rho_r)^{1/3}$, where M_{50} = median mass of armor stone; K_D is an empirical coefficient and θ is the seaside jetty structure slope angle. K_D takes into account all parameters not in the equation. The Hudson equation was originally developed for monochromatic waves, and use of the equation with irregular wave height statistics has been discussed by many authors. The most common application of the equation utilizes $H_{1/10}$ for depth-limited wave conditions with the depth-limited breaker height limited to 0.78 * local water depth. Values published for K_D in the USACE *Coastal Engineering Manual* (USACE 2015) are appropriate. The Hudson equation assumes damage based on 0% to 5% eroded volume.

The seaside armor stability is computed based on the maximum wave momentum flux for nonlinear steep waves in shallow water (Melby and Kobayashi 2011). This corresponds to the case where armor stability is at its minimum. A non-linear wave momentum flux using Fourier solution (Melby and Hughes 2004) provides the following equation:

$$\left(\frac{M_F}{\rho_w g h^2}\right)_{\max} = A_0\left(\frac{h}{gT_m^2}\right)^{-A_1}$$

$$A_0 = 0.639\left(\frac{H_{m0}}{h}\right)^{2.026} \qquad (3\text{-}2)$$

$$A_1 = 0.180\left(\frac{H_{m0}}{h}\right)^{-0.391}$$

where M_F is the momentum flux as calculated in Equation (3-2), g is acceleration of gravity, h is local water depth, T_m is mean wave period, and $H_{m0} = H_s = 4\,(m_0)^{1/2}$ is the wave height of the zeroth moment of a wave energy spectrum. Note the n^{th} moment of the incident wave energy spectrum, $E(f)$, over frequency f is given by

$$m_n = \int_0^{\infty} f^n E(f)df \qquad (3\text{-}3)$$

Two stability equations result from the fit of Equation (3-2) to data, which are

$$N_m = \frac{1}{a_m}\left(\frac{S}{K_s\sqrt{N_z}}\right)^{0.2} \qquad (3\text{-}4)$$

and

$$N_m = \left(\frac{(M_F / \gamma_w h^2)_{\max}}{\Delta} \right)^{1/2} \frac{h}{D_{n50}} \tag{3-5}$$

The coefficient a_m for plunging waves is given by

$$a_m = \frac{1}{5P^{0.18}\sqrt{\cot\theta}} \qquad s_m \geq s_{mc} \tag{3-6}$$

and for surging waves, it is given by

$$a_m = \frac{s_m^{P/3}}{5P^{0.18}(\cot\theta)^{0.5-P}} \quad s_m < s_{mc} \tag{3-7}$$

where

$$s_m = H_{m0} / L_{m,} \qquad s_{mc} = -0.0035\cot\theta + 0.028 \tag{3-8}$$

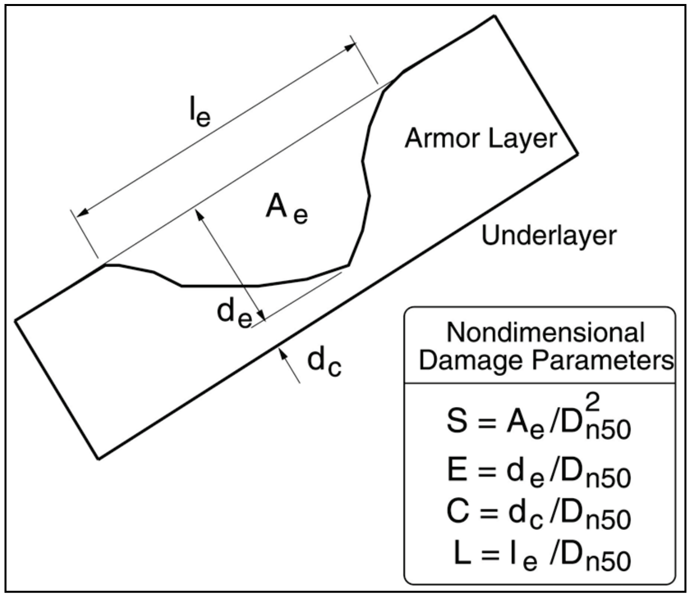
Equating Equation (3-4) to Equation (3-5) yields the stable stone size as

$$D_{n50} = ha_m \left(\frac{S}{K_s\sqrt{N_z}} \right)^{-1/5} \left(\frac{(M_F / \gamma_w h^2)_{\max}}{\Delta} \right)^{1/2} \tag{3-9}$$

The variables S and A_e are related to damage level and illustrated in Figure 3-1. The remaining parameters that appear in Equation (3-4) to Equation (3-9) are as follows: N_m = the momentum flux stability number, P = notional permeability of the structure, $S = A_e/(D_{n50})^2$ = normalized eroded area (also known as the damage level, see Figure 3-1), A_e = eroded area, L_m = wave length, N_z = storm duration/T_m, K_s = an empirical parameter that accounts for accelerated damage occurring with constant wave conditions, $\gamma_w = \rho_w$ g = specific weight of water, s_m = local wave steepness, and s_{mc} = critical wave steepness.

The acceptable damage level (S) is dependent on the seaward slope angle. Recommended values of S by Van Gent and Pozueta (2004) for different structural slopes are as follows: S = 4 for 1V: 1.5H slope; S = 5 for 1V:2H slope; and S = 10 for 1V:4H slope.

Figure 3-1. Illustration of damage parameters.



The permeability of the structure is defined by P. For an impermeable dike, P = 0.1. For a traditional multilayer breakwater, P = 0.4 – 0.6. Use of small core material that effectively restricts transmission would give a permeability of P = 0.4. In the absence of more detailed information, a value of P = 0.4 was used in this study.

3.2.2 Stable leeside armor stone size

The leeside stability equations given by Van Gent and Pozueta (2004) were reformulated by Melby (2010) to be similar to seaside equations defined as

$$D_{n50} = a_{ls}\left(\frac{S_{ls}}{K_{ls}\sqrt{N_z}}\right)^{-1/r}\left(\frac{u_{1\%}T_{m-1,0}}{125\sqrt{\Delta}}\right) \tag{3-10}$$

with

$$a_{ls} = (\cot\varphi)^{-2.5/r}[1+10\cdot\exp(-R_{c-rear}/H_s)]^{1/r} \tag{3-11}$$

where S_{ls} is the leeside damage, K_{ls} = 1 and r = 6 are empirical fit parameters for steady wave conditions, $u_{1\%}$ = maximum crest velocity exceeded by 1% of the waves, $T_{m\text{-}1,0} = m_{\text{-}1}/m_0$ of incident spectrum, $T_{m\text{-}1,0} = T_p/1.1$ for a JOint North Sea WAve Project (JONSWAP) incident wave spectrum (USACE 2015), ϕ = leeside slope angle, $R_{c\text{-}rear}$ = freeboard of leeside edge of crest, H_s

= H_{m0} of incident wave spectrum, and $(D_{n50})_{ls}$ = the nominal stone size, and Δ_{ls} = density parameter for the leeside armor, respectively.

Following Van Gent and Pozueta (2004), Melby (2010) introduced the leeside stability number, N_{ls}, and defined it as

$$N_{ls} = \left(\frac{u_{1\%} T_{m-1,0}}{125 (D_n \sqrt{\Delta})_{ls}} \right) = \frac{1}{a_{ls}} \left(\frac{S_{ls}}{K_{ls} \sqrt{N_z}} \right)^{1/r} \qquad (3\text{-}12)$$

Based on Equation (3-11) and Equation (3-12), Melby (2010) expressed the storm leeside damage for constant wave conditions was expressed as

$$S_{ls} = K_{ls} \sqrt{N_z} \left(a_{ls} N_{ls} \right)^r \qquad (3\text{-}13)$$

The crest velocity exceeded by 1% of the waves was estimated as

$$\frac{u_{1\%}}{\sqrt{g H_s}} = \frac{1.7 (\gamma_{f-C})^{0.5} \left(\frac{z_{1\%} - R_c}{\gamma_f H_s} \right)^{0.5}}{\left(1 + 0.1 \frac{B_c}{H_s} \right)} \qquad (3\text{-}14)$$

where $\gamma_{f\text{-}C}$ = friction factor on crest, γ_f = friction factor on seaward slope, R_c = freeboard of seaside crest, B_c = breakwater crest width, and $z_{1\%}$ = run-up exceeded by 1% of incident waves. The friction coefficients ($\gamma_{f\text{-}C}$ and γ_f) and run-up ($z_{1\%}$) can be computed using the following equations:

$$\gamma_f = \gamma_{f-C} = \begin{cases} 0.55 & \xi_{s,-1} \le 2 \\ 0.05625 * (\xi_{s,-1} - 2) + 0.55 & 2 < \xi_{s,-1} < 10 \\ 1.0 & \xi_{s,-1} \ge 10 \end{cases} \qquad (3\text{-}15)$$

and

$$\frac{z_{1\%}}{\gamma H_s} = \begin{cases} c_0 \, \xi_{s,-1} & for \; \xi_{s,-1} \le p \\ c_1 - c_2 / \xi_{s,-1} & for \; \xi_{s,-1} > p \end{cases} \qquad (3\text{-}16)$$

where $c_2 = 0.25\, c_1^2/c_0$, $p = 0.5\, c_1/c_0$, $\gamma = \gamma_f \gamma_\beta$ is the reduction factor for roughness (γ_f) and angular wave attack (γ_β), and $\xi_{s,-1}$ is the Iribarren parameter based on the first negative moment wave period:

$$\xi_{s,-1} = \frac{\tan\varphi}{\sqrt{\dfrac{H_s}{L_{m-1,0}}}} \tag{3-17}$$

with

$$L_{m-1,0} = \frac{gT_{m-1,0}^2}{2\pi} \tag{3-18}$$

For the Rhodes Point jetties, values of c_0 = 1.45 and c_1 = 5.1 were selected (Van Gent and Pozueta 2004) for calculation of $z_{1\%}$ by Equation (3-16) and γ_β = 1.0 for normally incident waves. Substituting these values, Equation (3-16) becomes

$$\frac{z_{1\%}}{\gamma_f\ H_s} = \begin{cases} 1.45\xi_{s,-1} & for\ \xi_{s,-1} \le 1.76 \\ 5.10 - 4.485 / \xi_{s,-1} & for\ \xi_{s,-1} > 1.76 \end{cases} \tag{3-19}$$

A schematic illustration of the seaside damage on a rubble-mound jetty structure is shown in Figure 3-2, indicated by Damage Conditions (DC) 1 and 2 in Figure 3-2. The DC 1 shows damage initiation that occurs as the armor is displaced near the still water line but has not extended into the filter layers. The DC 2 shows extensive damage over the entire active zone of the seaward side extending into the filter layers and even into the core and crest. Once seaside damage reaches DC 2, the jetty structure will breach during the storm. The leeside damage is illustrated in Figure 3-3, showing that damage begins on the rear crest and erodes seaward through the crest.

Figure 3-2. Illustration of damage on a rubble-mound structure (USACE 2015).

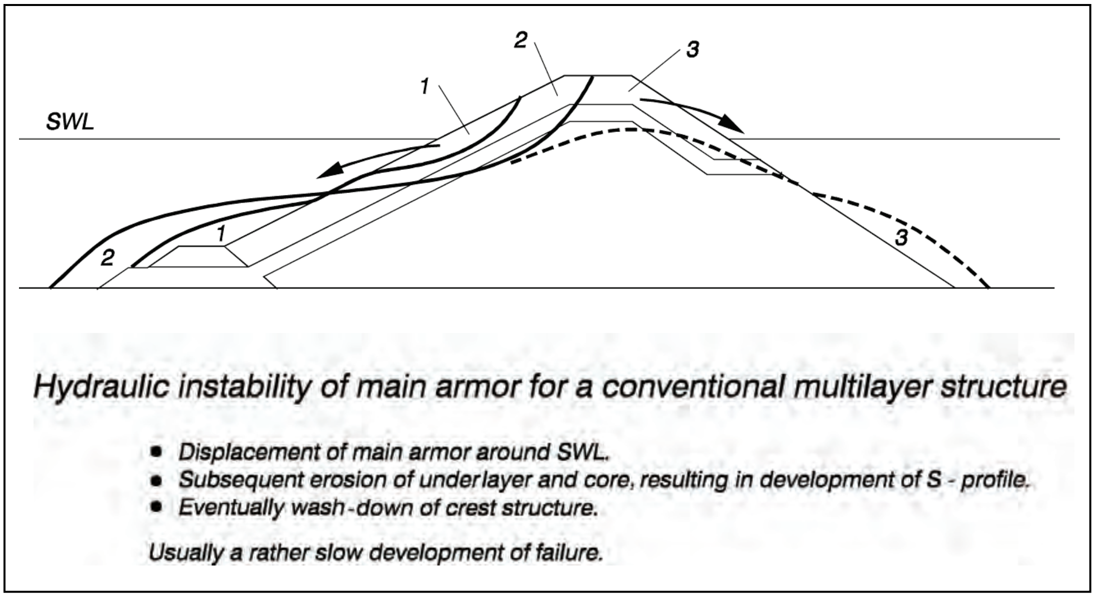
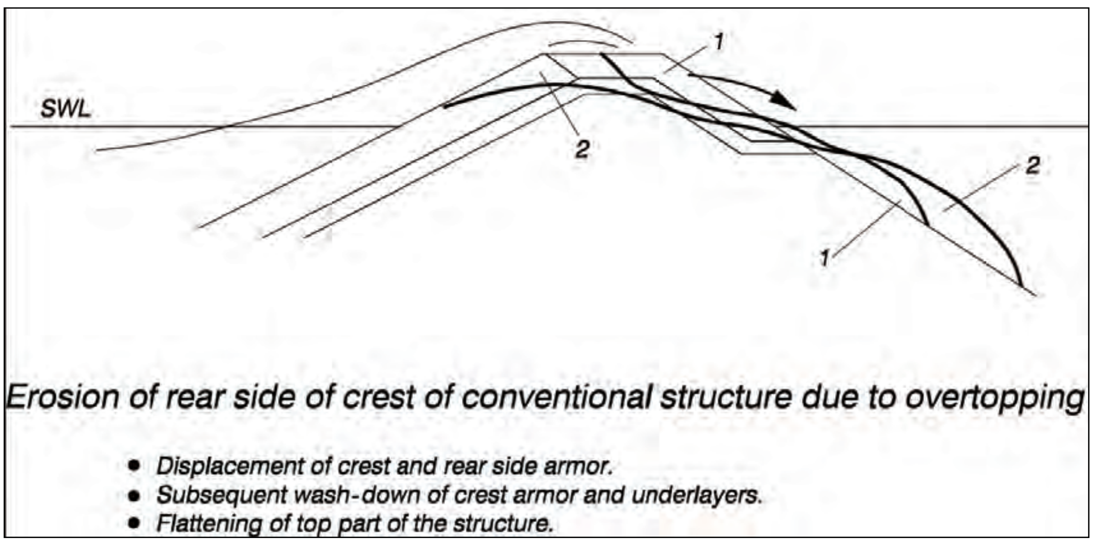


Figure 3-3. Leeside erosion of a rubble-mound breakwater (USACE 2015).



3.3 Wave overtopping transmission

Wave run-up (on a gentle slope) rubble-mound jetty structure is typically on the order of 1.5 to 1.6 times the incident wave height (USACE 2015). Wave run-up ($z_{1\%}$) is calculated using Equation (3-16). Wave overtopping occurs when $u_{1\%} > 0$ in Equation (3-14). The transmission due to overtopping represents the transformation of wave height from the seaside of the breakwater, $(H_s)_i$ or H_s , to the leeside of the jetty structure, $(H_s)_t$. This type of wave transmission is worse for heavily damaged sections that have lowered or submerged crest elevations. The transmission coefficient

$K_t = (H_s)_t/(H_s)_i$ is computed for permeable rubble-mound breakwaters using the following relations proposed by d'Angremond et al. (1996) as

$$K_t = -0.4\frac{R_c}{H_s} + 0.64\ [\frac{B_c}{H_s}]^{-0.31}(1 - e^{-0.5\xi_{s,-1}}) \qquad (3\text{-}20)$$

Equation (3-20) is applicable to small crest width of $B_c/H_s < 8$.

3.4 Design structure

3.4.1 Assumptions

Incident wave direction was included in the stability calculations assuming waves approach normal to the structure ($\gamma_\beta = 1.0$).

Calculations assumed three values of side slopes; these were 1V:1.5H (θ=21.8 degrees [deg]), 1V:2H (θ=26.6 deg), and 1V:2.5H (θ=33.7 deg). In the absence of detailed information on stone that will be used, a specific rock weight (ρ_r g) of 165 pounds per cubic foot (lb/ft^3) or o.0825 ton/ft^3 or 2.91 ton/m^3 and a minimum damage level of $S = S_{ls} = 2$ were assumed. For short jetty structures, both seaside and leeside crest freeboards were assumed to be equal ($R_c = R_{c\text{-}rear}$).

3.4.2 Calculations

The design jetties had a constant crest height of 3.84 ft (1.17 m) above MSL and a constant crest width of 8 ft (2.4 m). Equation (3-9) and Equation (3-10) with the above assumptions were used to calculate stable armor stone sizes at each save location (Stations 19, 21, 23, 65, 68, and 71) shown in Figure 2-23 (Alt-0), Figure 2-24 (Alt-1), and Figure 2-25 (Alt-2). Tables 3-1, 3-2, and 3-3 present the calculated stone size/weight and transmitted wave heights associated with three breakwater side slopes: θ (= ϕ) = 21.8 deg (1V:2.5H), 26.6 deg (1V:2H), and 33.7 deg (1V:1.5H), respectively. The stone weight (ton) in these tables was calculated as ρ_r g $(D_{n50})^3$.

Table 3-1. Stone weights and transmitted wave heights (side slope 1V:2.5H).

Sta	Storm Water Level, MSL (ft)	Depth, MSL (ft)	Design Wave Ht (ft)	Design Wave Period (sec)	Sea-side Armor Diam (ft)	Sea-side Armor Weight (ton)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	Trans Coef	Trans Wave Height (ft)
19	5.00	5.75	3.15	4.8	1.03	0.09	1.19	0.14	0.47	1.48
21	5.00	6.00	3.30	4.8	1.07	0.10	1.21	0.15	0.46	1.53
23	5.00	7.70	4.10	4.8	1.29	0.18	1.31	0.19	0.44	1.80
65	5.00	7.70	3.80	4.8	1.21	0.15	1.27	0.17	0.45	1.70
68	5.00	5.05	2.90	4.8	0.96	0.08	1.15	0.13	0.48	1.40
71	5.00	4.80	2.60	4.8	0.88	0.06	1.10	0.11	0.50	1.30
Max	5.00	7.70	4.10	4.8	1.29	0.18	1.31	0.19	0.50	1.80

Table 3-2. Stone weights and transmitted wave heights (side slope 1V:2H).

Sta	Storm Water Level, MSL (ft)	Depth, MSL (ft)	Design Wave Ht (ft)	Design Wave Period (sec)	Sea-side Armor Diam (ft)	Sea-side Armor Weight (ton)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	Trans Coef	Trans Wave Height (ft)
19	5.00	5.75	3.15	4.8	1.15	0.13	1.41	0.23	0.51	1.60
21	5.00	6.00	3.30	4.8	1.20	0.14	1.44	0.24	0.50	1.66
23	5.00	7.70	4.10	4.8	1.44	0.25	1.56	0.32	0.48	1.97
65	5.00	7.70	3.80	4.8	1.35	0.20	1.52	0.29	0.49	1.85
68	5.00	5.05	2.90	4.8	1.08	0.10	1.36	0.21	0.52	1.50
71	5.00	4.80	2.60	4.8	0.99	0.08	1.30	0.18	0.53	1.39
Max	5.00	7.70	4.10	4.8	1.44	0.25	1.56	0.32	0.53	1.97

Table 3-3. Stone weights and transmitted wave heights (side slope 1V:1.5H).

Sta	Storm Water Level, MSL (ft)	Depth, MSL (ft)	Design Wave Ht (ft)	Design Wave Period (sec)	Sea-side Armor Diam (ft)	Sea-side Armor Weight (ton)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	Trans Coef	Trans Wave Height (ft)
19	5.00	5.75	3.15	4.8	1.33	0.19	1.72	0.42	0.55	1.74
21	5.00	6.00	3.30	4.8	1.38	0.22	1.76	0.45	0.55	1.81
23	5.00	7.70	4.10	4.8	1.66	0.38	1.93	0.59	0.53	2.18
65	5.00	7.70	3.80	4.8	1.56	0.31	1.87	0.54	0.54	2.04
68	5.00	5.05	2.90	4.8	1.24	0.16	1.66	0.38	0.56	1.62
71	5.00	4.80	2.60	4.8	1.14	0.12	1.58	0.33	0.57	1.49
Max	5.00	7.70	4.10	4.8	1.66	0.38	1.93	0.59	0.57	2.18

3.4.3 Discussion

If waves overtop the jetty crest and are transmitted to the leeside of the structure, the design generally requires greater armor stone size on the leeside than the stone on the seaside of the structure. The steeper the jetty side slopes are, the greater the stable armor stone size would be both on the seaside and leeside of the jetty. Steeper side slopes also introduce stability problems and increase wave refraction, reflection, and diffraction.

Tables 3-1 to 3-3 indicate that the maximum design stone diameter occurs on the leeside of the jetty and increases from 1.31 to 1.93 ft (0.4 to 0.6 m) for side slopes 1V:2.5H and 1V:1.5H, respectively. The corresponding single stone weight on the leeside increases from 0.19 ton to 0.59 ton for the side slope of 1V:2.5H and 1V:1.5H, respectively. These estimates indicate that large stones would be required at the seaward end of the jetties (Station 23 and Station 65) where larger storm waves can break over the steeper structure slopes at deeper water depths.

3.5 Low-crested jetty

The calculations presented in the preceding sections developed a design for a traditional jetty with minimal damage during a 50-year storm event. The design structure has a constant crest height of 3.84 ft (1.17 m) above MSL and constant crest width of 8 ft (2.4 m). The structure had a constant crest height of 3.84 ft (1.17 m) and crest width of 8 ft (2.4 m). Because the design storm assumed a water level of 5 ft (1.53 m) MSL, the design structure would be submerged under this condition, making it a low-crested structure. At this water elevation, much of the island where the north and south jetties are located will be inundated, and there is little point in having a jetty that is higher than the surrounding land mass. As the water depth over a structure increases, the effects of waves on the structure decrease. A low-crested jetty was therefore considered.

There is only limited research on the armor layer stability of submerged structures. CIRIA (2007) presents results from Vidal et al. (1995) for stability of submerged structures. Nominal stone diameter, D_{n50}, is calculated by solving the linear quadratic equation below:

$$\frac{H_s}{\Delta D_{n50}} = A + B\frac{R_c}{D_{n50}} + C\left(\frac{R_c}{D_{n50}}\right)^2 \qquad (3\text{-}21)$$

where A, B, and C are coefficients that vary with the level of damage and the segment of the structure. For example, the coefficients for the initial damage on structures having seaside and leeside slopes of 1V:1.5H are given in Table 3-4.

Table 3-4. Coefficients for initial damage estimate of submerged rubble-mound structure.

Segment	A	B	C
Front slope	1.831	-0.245	0.0119
Crest	1.652	0.0182	0.159
Back slope	2.575	-0.54	0.115
Total section	1.544	-0.23	0.053

Results of the stone size calculations are shown below in Tables 3-5, 3-6, and 3-7 with three breakwater side slopes: θ (= ϕ) = 21.8 deg (1V:2.5H), 26.6 deg (1V:2H), and 33.7 deg (1V:1.5H), respectively. In general, the overall maximum stone diameters and weights calculated from the submerged jetty structure equation, Equation (3-21), are smaller than those calculated from Equation (3-9) and Equation (3-10). The results of the submerged jetty analysis confirm that the armor stone weights calculated for a low-crested jetty should be stable at the design water level. Results indicate stone weight increases with increasing structure side slopes.

Table 3-5. Low-crest structure stone weights (side slope 1V:2.5H).

Sta	Storm Water Level, MSL (ft)	Depth, MSL (ft)	Design Wave Ht (ft)	Design Wave Period (sec)	Sea-side Armor Diam (ft)	Sea-side Armor Weight (ton)	Crest Armor Diam (ft)	Crest Armor Weight (ton)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)
19	5.00	5.75	3.15	4.8	0.68	0.03	0.90	0.06	0.97	0.07
21	5.00	6.00	3.30	4.8	0.72	0.03	0.96	0.07	1.02	0.09
23	5.00	7.70	4.10	4.8	0.92	0.07	1.24	0.16	1.33	0.19
65	5.00	7.70	3.80	4.8	0.85	0.05	1.14	0.12	1.22	0.15
68	5.00	5.05	2.90	4.8	0.61	0.02	0.81	0.04	0.87	0.05
71	5.00	4.80	2.60	4.8	0.53	0.01	0.68	0.03	0.75	0.03
Max	5.00	7.70	4.10	4.8	0.92	0.07	1.24	0.16	1.33	0.19

Table 3-6. Low-crest structure stone weights (side slope 1V:2H).

Sta	Storm Water Level, MSL (ft)	Depth, MSL (ft)	Design Wave Ht (ft)	Design Wave Period (sec)	Sea-side Armor Diam (ft)	Sea-side Armor Weight (ton)	Crest Armor Diam (ft)	Crest Armor Weight (ton)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)
19	5.00	5.75	3.15	4.8	0.76	0.04	0.96	0.07	1.00	0.08
21	5.00	6.00	3.30	4.8	0.80	0.04	1.02	0.09	1.05	0.09
23	5.00	7.70	4.10	4.8	1.03	0.09	1.32	0.19	1.36	0.21
65	5.00	7.70	3.80	4.8	0.95	0.07	1.21	0.15	1.25	0.16
68	5.00	5.05	2.90	4.8	0.69	0.03	0.86	0.05	0.89	0.06
71	5.00	4.80	2.60	4.8	0.60	0.02	0.74	0.03	0.77	0.04
Max	5.00	7.70	4.10	4.8	1.03	0.09	1.32	0.19	1.36	0.21

Table 3-7. Low-crest structure stone weights (side slope 1V:1.5H).

Sta	Storm Water Level, MSL (ft)	Depth, MSL (ft)	Design Wave Ht (ft)	Design Wave Period (sec)	Sea-side Armor Diam (ft)	Sea-side Armor Weight (ton)	Crest Armor Diam (ft)	Crest Armor Weight (ton)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)
19	5.00	5.75	3.15	4.8	0.88	0.06	1.04	0.09	1.02	0.09
21	5.00	6.00	3.30	4.8	0.93	0.07	1.11	0.11	1.08	0.10
23	5.00	7.70	4.10	4.8	1.19	0.14	1.43	0.24	1.40	0.23
65	5.00	7.70	3.80	4.8	1.09	0.11	1.31	0.18	1.28	0.17
68	5.00	5.05	2.90	4.8	0.79	0.04	0.94	0.07	0.92	0.06
71	5.00	4.80	2.60	4.8	0.69	0.03	0.81	0.04	0.79	0.04
Max	5.00	7.70	4.10	4.8	1.19	0.14	1.43	0.24	1.40	0.23

3.6 Revetment

The proposed jetty systems for Rhodes Point include a rock revetment for protecting the shoreline along the south side of the inlet. However, there is not much information available in the literature about the size and weight of submerged structures during storms at different water depths under the combined effects of different water levels, waves, and currents. Consequently, a range of 600 to 1,000 lb (0.3 to 0.5 ton) for armor stone weight for the south shoreline revetment is recommended. This recommendation was based on a similar recommendation for a recent study involving revetment design at Tangier Island (Demirbilek et al. 2015), where armor stone with weight ranging from 600 to 1,000 lb (0.3 to 0.5 ton) was suggested for the design of a revetment.

At Tangier Island, there is evidence that some of the revetment stones have moved. Overall, the rock revetment protecting the west side of the south shoreline of Tangier Island (it is located just south of Rhodes Point) has performed extremely well. No design records were found, and a letter indicated the revetment at Tangier Island used armor stone from 600 to 1,000 lb (0.3 to 0.5 ton) with 75% greater than 750 lb (~0.4 ton). Assuming this represented the design of the as-built structure, the design would yield average armor stone of 800 lb (0.4 ton). This is approximately half the seaside armor weight estimates for a low-crested structure (Tables 3-5, 3-6, and 3-7). On the basis of information for the Tangier Island revetment structure, and given the absence of any other design guidance, a 1,000 lb (0.5 ton) armor stone is recommended for the south shoreline revetment. Considering uncertainties involved with the design of revetment structures and for avoiding potential movement of the stones as occurred at Tangier Island, a safety factor of 1.25 may be used. This would increase the average armor stone to 1,250 lb (0.625 ton) for Rhodes Point south shoreline revetment as an upper bound design estimate.

3.7 Jetty response with sea level rise (SLR)

The effects of SLR on the performance and stability of the jetties were investigated for three estimates of projected SLR trends (Houston 2012; Church and White 2011; USACE 2011; Demirbilek et al. 2005) as follows:

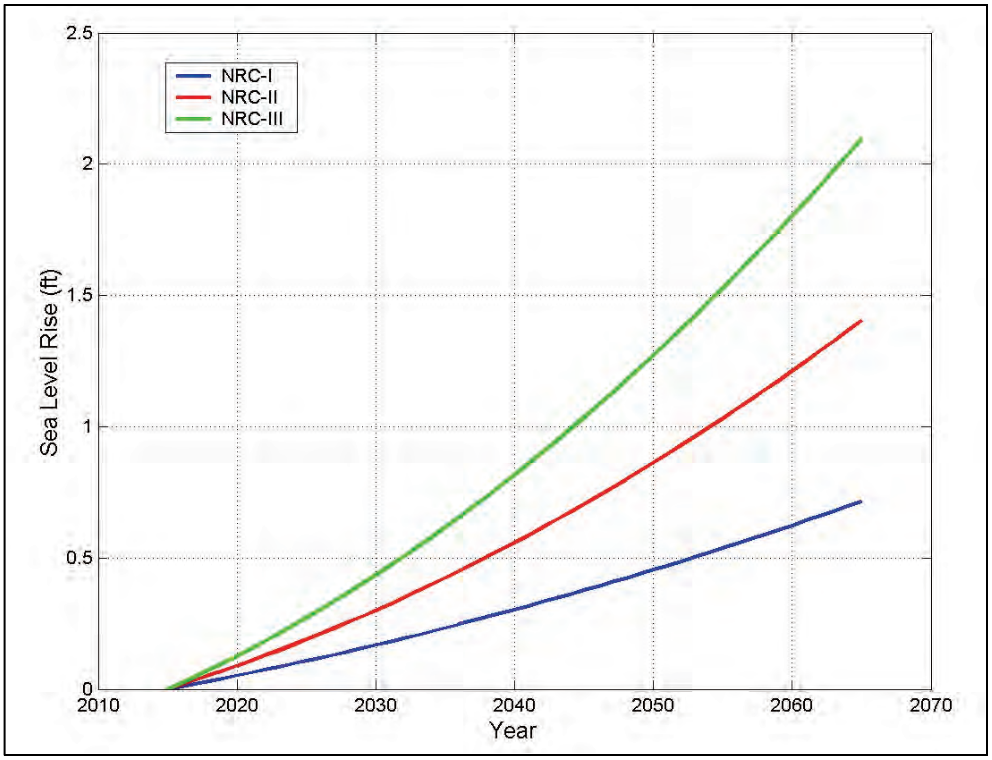
1. National Research Council (NRC)-I
2. NRC-II
3. NRC-III.

The SLR in meters was computed using the following equation:

$$\bar{\eta}(Y_2)-\bar{\eta}(Y_1)=a_0(Y_2-Y_1)+b_0[(Y_2-Y_0)^2-(Y_1-Y_0)^2] \qquad (3\text{-}22)$$

where Y_0 , Y_1 , and Y_2 are times in years, $\bar{\eta}(Y_2)-\bar{\eta}(Y_1)$ is the mean SLR from Y_1 to Y_2. The coefficients a_0 and b_0 were calibrated based on the data set with the starting year (a reference year) Y_0 in the data set. (See USACE [2011]) for additional information. For the Chesapeake Bay, a_0 = 1.7 mm/year, b_0 = 0.0271 mm/year^2 for NRC-I, b_0 = 0.07 mm/year^2 for NRC-II, and b_0 = 0.113 mm/year^2 for NRC-III with Y_0 = 1992. Figure 3-4 shows SLR scenarios for 2015 to 2065 (Y_1 to Y_2), converted to feet.

Figure 3-4. Sea level rise based on NRC-I, NRC-II, and NRC-III.



Boon et al. (2010) and Church and White (2011) reported that the mean SLR in the Chesapeake Bay area was approximately 0.015 ft/year (4.5 mm/year), which corresponded to a rise of 0.74 ft (0.2 m) over 50 years. Therefore, NRC-I provides a reasonable approximation of the most likely SLR scenario if the past is an indicator of future conditions (0.72 ft [0.22m] over 50 years) and the NRC-II serves as a reasonable upper bound (1.4 ft [0.43 m] over 50 years). For 100-year design, the SLR estimates for NRC-I and NRC-II are 1.9 ft (0.6 m) and 4.0 ft (1.2 m), respectively. Boon et al. (2010) also estimated subsidence in the Chesapeake Bay area of -4 mm/year, which corresponded to an increase in depth of 0.65 ft (0.2 m) over 50 years and 1.3 ft (0.4 m) for 100 years.

Assuming the NRC-I SLR as the most likely to occur, and adding 0.65 ft (0.2 m) for bay wide subsidence, the water depth at the jetty structure will increase by 1.37 ft (0.4 m) in 50 years, assuming adequate foundation materials are used to place the jetty stone and weight-induced subsidence would not be an issue. In this case, the crest elevation would reduce from 3.84 ft (1.2 m) to 2.47 ft (0.8 m) above the MSL. Assuming the NRC-II as the upper bound of the expected SLR, and adding 0.65 ft (0.2 m) for subsidence, the depth at the jetty structure would increase by as much as

2.04 ft (0.6 m) in 50 years. In this case, the crest elevation would be 1.8 ft (0.5 m) above the MSL.

If the water level increases, the jetty freeboard is reduced by the same amount. The seaside armor stone calculations are not sensitive to the change of freeboard, but the leeside armor stones can become unstable if the freeboard is reduced (Demirbilek et al. 2015). Tables 3-8, 3-9, and 3-10 present calculated leeside armor stones and transmitted waves at each of the save locations (Stations 19, 21, 23, 65, 68, and 71) if the depth increases by 1.37 ft (0.4 m) (NRC-I plus subsidence) or 2.04 ft (0.6 m) (NRC-II plus subsidence) for three breakwater side slopes: θ (= $\emptyset$) = 21.8 deg (1V:2.5H), 26.6 deg (1V:2H), and 33.7 deg (1V:1.5H), respectively. The calculation results indicate maximum transmitted wave heights are approximately 12% greater for NRC-I plus subsidence and 20% greater for NRC-II plus subsidence, as compared to no-SLR scenarios. Using these estimates, the maximum stone size (diameter) increased by 12% to 15% for NRC-I plus subsidence and by 18% to 22% for NRC-II plus subsidence.

Table 3-8. Leeside stones estimates with SLR (side slope 1V:2.5H).

Sta	Storm Water Level, MSL (ft)	Design Wave Ht (ft)*	Depth, MSL (ft)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	**Trans Wave Ht (ft)**	Depth, MSL (ft)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	**Trans Wave Ht (ft)**
			Depth increases by 1.37 ft				Depth increases by 2.04 ft			
19	5.00	3.15	7.12	1.40	0.23	2.03	7.80	1.51	0.28	2.30
21	5.00	3.30	7.37	1.42	0.24	2.08	8.04	1.52	0.29	2.34
23	5.00	4.10	9.07	1.50	0.28	2.34	9.74	1.60	0.34	2.61
65	5.00	3.80	9.07	1.47	0.26	2.24	9.74	1.57	0.32	2.51
68	5.00	2.90	6.42	1.37	0.21	1.94	7.10	1.48	0.27	2.21
71	5.00	2.60	6.17	1.33	0.19	1.84	6.84	1.45	0.25	2.11
Max	5.00	4.10	9.07	1.50	0.28	2.34	9.74	1.60	0.34	2.61

* Design wave period = 4.8 sec. Depth increases of 1.37 ft (NRC-I) and 2.04 ft (NRC-II) include subsidence in Chesapeake Bay.

Table 3-9. Leeside stones estimates with SLR (side slope 1V:2H).

Sta	Storm Water Level, MSL (ft)	Design Wave Ht (ft)*	Depth, MSL (ft)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	**Trans Wave Ht (ft)**	Depth, MSL (ft)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	**Trans Wave Ht (ft)**
			Depth increases by 1.37 ft				Depth increases by 2.04 ft			
19	5.00	3.15	7.12	1.64	0.36	2.15	7.80	1.75	0.45	2.42
21	5.00	3.30	7.37	1.66	0.38	2.21	8.04	1.78	0.46	2.47
23	5.00	4.10	9.07	1.77	0.46	2.52	9.74	1.87	0.54	2.78
65	5.00	3.80	9.07	1.73	0.43	2.40	9.74	1.84	0.51	2.67
68	5.00	2.90	6.42	1.60	0.33	2.05	7.10	1.72	0.42	2.32
71	5.00	2.60	6.17	1.54	0.30	1.93	6.84	1.67	0.39	2.20
Max	5.00	4.10	9.07	1.77	0.46	2.52	9.74	1.87	0.54	2.78

Design wave period = 4.8 sec. Depth increases of 1.37 ft (NRC-I) and 2.04 ft (NRC-II) include subsidence in Chesapeake Bay.

Table 3-10. Leeside stones estimates with SLR (side slope 1V:1.5H).

Sta	Storm Water Level, MSL (ft)	Design Wave Ht (ft)*	Depth, MSL (ft)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	Trans Wave Ht (ft)	Depth, MSL (ft)	Lee-side Armor Diam (ft)	Lee-side Armor Weight (ton)	Trans Wave Ht (ft)
			Depth increases by 1.37 ft				Depth increases by 2.04 ft			
19	5.00	3.15	7.12	1.98	0.64	2.29	7.80	2.11	0.78	2.55
21	5.00	3.30	7.37	2.01	0.67	2.36	8.04	2.14	0.81	2.62
23	5.00	4.10	9.07	2.16	0.83	2.73	9.74	2.28	0.98	3.00
65	5.00	3.80	9.07	2.11	0.77	2.59	9.74	2.23	0.92	2.85
68	5.00	2.90	6.42	1.93	0.59	2.17	7.10	2.07	0.73	2.44
71	5.00	2.60	6.17	1.86	0.53	2.03	6.84	2.01	0.66	2.30
Max	5.00	4.10	9.07	2.16	0.83	2.73	9.74	2.28	0.98	3.00

Design wave period = 4.8 sec. Depth increases of 1.37 ft (NRC-I) and 2.04 ft (NRC-II) include subsidence in Chesapeake Bay.

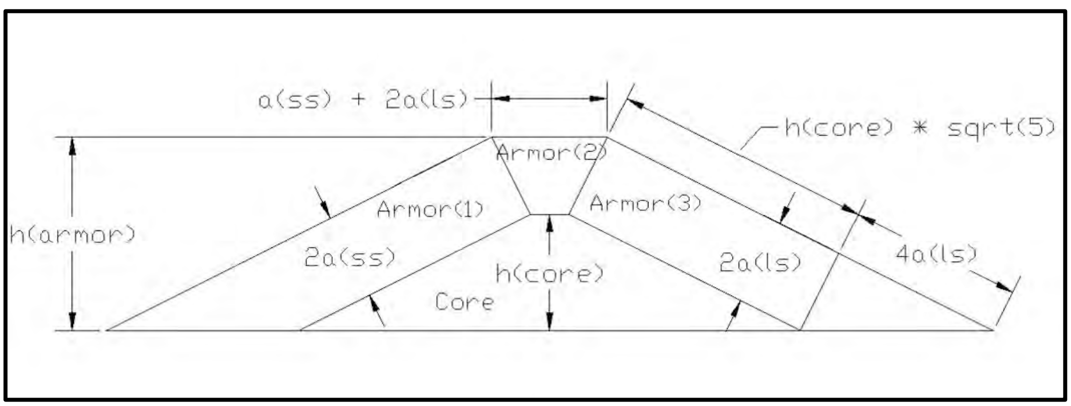
The subsidence mentioned in Tables 3-8, 3-9, and 3-10 refers to the general subsidence of the Chesapeake Bay and does not address local subsidence caused by the weight of the jetty compressing the underlying soil substrate. The design jetty crest elevation should be increased to the desired crest elevation after the structure has settled. Also, no wave data were available to calibrate the numerical model, which lends potentially large uncertainty to this analysis. Therefore, the jetty and revetment design presented in this report may require further revision to account for possible settlement of the structure.

3.8 Cross-section design

The cross section is considered to include a core plus underlayers covered by two layers of armor stone. For simplicity, the volume of the under layers will be included with the core volume. Sufficient crest width needs to have at least three armor stones. If the leeside armor stones are different from the seaside armor stones, the crest width is based on one smaller stone and two larger stones, regardless of whether the larger stones are on the seaside or leeside (Demirbilek et al. 2015).

Figure 3-5 shows idealized cross-sectional areas with the seaside armor stone layer, leeside armor stone layer, and core beneath armor stone layer for jetty structure side slope = 1V:2H. Armor (1) is the cross-sectional area of the seaside armor, where a(ss) is the nominal diameter of the seaside armor stone. Armor (3) is the cross-sectional area of the leeside armor, where a(ls) is the nominal diameter of the leeside armor stone. Armor (2) is in the transition between Armor (1) and Armor (2). Therefore, because the leeside stone would be larger than the seaside stone, it is divided into one-third seaside armor and two-thirds leeside armor. The core stone is typically significantly less expensive than the armor stone and less expensive to place.

Figure 3-5. Idealized cross-section of jetty (side slope 1V:2H).



Tables 3-11 and 3-12 present the idealized cross-section areas of armor stone and core at each of the save locations (Stations 19, 21, 23, 65, 68, and 71) if the depth increases by 1.37 ft (0.4 m) (NRC-I plus subsidence) or 2.04 ft (0.6 m) (NRC-II plus subsidence), respectively, for the breakwater side slope angle of θ = 26.6 deg (1V:2H).

Table 3-11. Cross sections of armor stone and core for 1.37 ft depth increase by NRC-I plus subsidence (side slope 1V:2H).

Sta	h* (armor) (ft)	Seaside Stone Diam (ft)	Leeside Stone Diam (ft)	Total Area Seaside Armor (ft²)	Total Area Leeside Armor (ft²)	Total Area Crest Layer Armor (ft²)	Area of Core + Underlayers (ft²)
Depth increases by 1.37 ft; *h = crest elevation above MSL (2.47 ft) + depth.							
19	9.60	1.15	1.64	44.1	59.7	23.1	134.3
21	9.84	1.20	1.66	47.1	62.0	23.7	140.0
23	11.54	1.44	1.77	66.0	78.8	26.7	187.2
65	11.54	1.35	1.73	62.4	77.3	26.0	193.0
68	8.89	1.08	1.60	38.3	53.4	22.1	115.5
71	8.64	0.99	1.54	34.3	50.0	21.1	113.0

Table 3-12. Cross sections of armor stone and core for 2.04 ft depth increase by NRC-II plus subsidence (side slope 1V:2H).

Sta	h* (armor) (ft)	Seaside Stone Diam (ft)	Leeside Stone Diam (ft)	Total Area Seaside Armor (ft²)	Total Area Leeside Armor (ft²)	Total Area Armor Stone (ft²)	Area of Core + Underlayers (ft²)
Depth increases by 2.04 ft; *h = crest elevation above MSL (1.8 ft) + depth.							
19	9.60	1.15	1.75	44.1	62.9	24.1	130.1
21	9.84	1.20	1.78	47.1	65.7	24.6	135.1
23	11.54	1.44	1.87	66.0	82.5	27.4	182.7
65	11.54	1.35	1.72	62.4	76.9	25.9	193.5
68	8.89	1.08	1.67	38.3	55.2	22.7	113.0
71	8.64	0.99	1.87	34.3	58.3	24.1	101.8

The calculations of armor stone stability in Equation (3-2) to Equation (3-19) do not consider the jetty heads. In the Hudson equation, Equation (3-1), the stability coefficient K_D = 2.0 for jetty trunks with breaking waves and two layers of armor stone while for jetty heads with a 1:2 slope, the recommended coefficient (two layers of armor and breaking waves) is K_D = 1.6 (USACE 2015). This resulted in a 25% increase in stone size. In the absence of other guidance, armor stone sizes on the jetty heads (Stations 23 and 65) were calculated in the same manner as on the jetty trunks and were increased by 25%.

4 Conclusions

This report documents numerical wave, flow, and morphology change modeling for evaluation of the effectiveness of jetties for a shallow draft navigation channel at Rhodes Point, MD. U.S. Army Engineer District, Baltimore (NAB), is considering realignment of the western entrance channel protected by jetties and a revetment to protect the eroding south shoreline. The sheltering by jetties of the new (realigned) channel is expected to reduce wave energy in the channel and in areas in the lee of these structures. The jetties also provide an indirect protection to the north and south shorelines. The two Alternatives and existing channel geometry investigated by numerical models included north and south jetties connecting to north and south shorelines. Both Alternatives included the same revetment structure for protecting the south shoreline.

The Coastal Modeling System (CMS, including CMS-Wave and CMS-Flow) was used in this study. A number of advances to CMS-Wave were necessary to address this project's special needs. The Coastal Inlets Research Program (CIRP) funded these developments to improve the model's capabilities. These included development and testing of the full-plane and parent-child capability for hurricanes and northeasters in this estuary setting, developing pre- and post-processing analysis codes for model setup, and developing wave and water levels parameters for structural design calculations required at and around jetty and revetment structures.

Structural designs were estimated based on numerical wave and hydrodynamic modeling conducted for a 50-year design based on Hurricane Sandy wind speed, wave, and water-level conditions. A still-water level of 5 ft (1.5 m) was selected to include tide, storm surge, and wave setup. Two structure Alternatives were evaluated to identify an optimal design as determined by the level of wave-energy reduction in the navigation channel. The hydrodynamic modeling study results (e.g., wave height, period, direction, and water level) along the western side of the proposed jetty footprint were used in the preliminary structural design calculations. These calculations included jetty stability, run-up/overtopping, and transmission through and over the structure.

Results shown in Chapters 2 and 3 indicated performance of Alt 1 and Alt-2 were similar for the conditions evaluated. Negligible differences were obtained between these Alternatives in terms of their effects on waves, currents, and sediment transport calculated in the western channel and along the north and south shorelines. Both Alternatives are recommended as viable options to consider based on the level of wave reduction results provided in Chapter 2. A comparison of the two Alternatives indicated each performed equally well in reducing wave energy in the channel (Chapter 2). Without any jetty structure, results indicated wave dampening is comparatively less in the western channel and comparatively larger wave heights reached the north and south shorelines. Alt-1 with a shorter shore-normal north jetty of 650 ft (200 m) provided as much wave-reduction benefits as the longer 1,000 ft (305 m) north jetty in Alt-2.

Results indicated that for either Alternative with jetties, waves are strongly reduced from the jetty heads through the western portion of the channel. Wave energy dissipated to the extent that wave heights were reduced as compared to incident waves in the bay. Model results also indicated that the greatest benefits to be accrued by the Alternatives will occur in this western channel. Towards the east, the impacts of jetties on waves, currents, and shoaling in the narrow canal were relatively much less. For Condition 2 (February 2014) representing a northeaster month, the maximum and mean wave heights of 5.6 ft (1.7 m) and 1 ft (0.3 m) were estimated in the channel centerline, and the corresponding wave height reductions were 78% and 35.5%, respectively. For Hurricane Sandy, maximum and mean wave heights were 5 ft (1.52 m) and 1.8 ft (0.55 m), and wave reduction factors were 60% and 26%, respectively. For Condition 1 (August 2014), Condition 2 (February 2014), and Condition 3 (Hurricane Sandy), the maximum flood/ebb currents in the channel centerline were 3.6, 4.3, and 5.2 ft/sec (1.1, 1.3, and 1.6 m/sec), respectively. Both Alternatives exhibited the same trend in current fields, with stronger currents occurring between the jetty heads at the entrance to the channel. Currents were generally stronger along the north shoreline as compared to south shoreline, with stronger currents near along the shoreline closer to the canal entrance. While the numerical modeling results suggested a jettied channel provides significant wave-reduction benefits, it is recognized that other criteria may be used in selection of an optimal alternative. The construction cost for Alt-1 would be significantly less because of a shorter north jetty, so for this reason Alt-1 might be the preferred Alternative.

The results for morphology change indicated that the magnitude of change was small for three conditions simulated. The maximum change of 1 ft (0.3 m) occurred along the channel centerline. The spatial morphologic variation along three transects (north shoreline, channel centerline, and south shoreline) had different erosion/deposition patterns. Generally, sediment transport/morphology change for the three conditions followed the variation in the associated current fields.

Preliminary estimates for structural design of jetties and revetments were provided in this report to assist NAB in the selection between the two Alternatives evaluated. The information provided may be used in the estimate of jetty and revetment structure construction costs involved. Estimates include the stable armor stone sizes for both the seaside and leeside of a conventional multilayer rubble-mound jetty. Calculations were performed for a +5 ft (1.5 m, MLLW) or 3.84 ft (1.17 m, MSL) baseline structural crest elevation and three jetty side slopes of 1V:1.5H; 1V:2H; and 1V:2.5H. A 5 ft (1.52 m, MSL) still-water elevation was used for storm surge plus subsidence. Stone weights and transmitted waves heights for these slopes were calculated. Based on the size of the armor stones, cross-sectional areas were calculated for the seaside armor, leeside armor, and a combined core plus under layers. With a 5 ft (1.52 m) MSL surge plus subsidence, the relative jetty crest elevation will be reduced substantially or submerged completely. This would be a concern because structures with low crest elevation are particularly susceptible to leeside damage by overtopping waves. For this reason, the armor stone sizes for the seaside and leeside have to be recalculated if NAB decides to decrease the crest elevation of jetties.

The stone weights and transmitted wave heights for side slopes of 1V:2.5H, 1V:2H, and 1V:1.5H were provided in Chapter 3 in Tables 3-1, 3-2, and 3-3, respectively. Seaside armor weights for these three slopes were 360, 500, and 760 lb (0.18, 0.25, and 0.38 ton), and the corresponding leeside armor weights were 0.19, 0.32, 0.59 ton. Maximum transmitted wave heights for these slopes were 5.9, 6.5, and 7.1 ft (1.8, 1.97, and 2.18 m), respectively. Transmitted wave heights were calculated at each save station for the crest elevation considered. The jetty structure would require greater armor stone size on the leeside than the stone on the seaside if waves were transmitted to the leeside of the jetty structure by overtopping the jetty structure's crest. Generally, steeper jetty structure side slopes require larger/heavier stable armor stone size both on seaside and leeside of the jetty structure. For example, results indicated the maximum design stone diameter would increase from 1.31 to 1.93 ft (0.4 to 0.6 m) for jetty structure side slopes changing from 1V:2.5H to 1V:1.5H, respectively, and in turn, the single stone weight would increase from 380 to 1,180 lb (0.19 to 0.59 ton). Consequently, large stones might be required at the seaward end of the jetties where larger storm waves could break over the steeper jetty structure slopes at deeper water depths.

It is noted that with a design storm water level elevation of 5 ft (1.52 m) MSL, the jetties and most of the island will be inundated. Under such conditions, there is no reason to increase the crest elevation of the jetties greater than the designed 3.84 ft (1.2 m) MSL. The effects of waves on jetties diminish as the depth of water above the structure increases. Because the low-crested jetty structure becomes submerged, waves are less affected by the structure. The estimates for low-crested jetties were also provided (Tables 3-5, 3-6, and 3-7). Results indicated maximum stone sizes and weights calculated for the submerged jetties were smaller than those for the exposed jetty structures. For a 1V:2.5H jetty side slope, maximum seaside and leeside armor weights were 140 and 380 lb (0.07 and 0.19 ton) (Table 3-5), respectively. Maximum seaside and leeside armor weights were 180 and 420 lb (0.09 and 0.21 ton) for 1V:2H slope (Table 3-6) and 280 and 460 lb (0.14 and 0.23 ton) for 1V:1.5H slopes (Table 3-7), respectively. Results indicated stone size increasing with increasing side slopes. Although a low-crested jetty structure would obviously have greater transmission, it would be less expensive to build and still provide a high level of energy reduction for typical wave conditions.

A range of 600 to 1,000 lb (0.3 to 0.5 ton) for armor stone weight for the south shoreline revetment was recommended in Chapter 3, with 1,250 lb (0.625 ton) as upper bound design estimate by applying a safety factor of 1.25 to minimize potential movement of stones. This was based on the recommendation made for a recent study for nearby Tangier Island south shoreline revetment structures. There was not much information available about the size and weight of submerged revetments during storms at different water depths under the combined effects of different water levels, waves, and currents.

The effects of SLR on the performance and stability of the Rhodes Point jetties were investigated, and results are provided in Chapter 3 in

Tables 3-8, 3-9, and 3-10 for three jetty side slopes. Results for the cross-section design estimates are provided in Table 3-11 and 3-12 for one jetty side slope (1V:2H), assumed to be the most likely slope used in construction. Transmitted wave heights were also calculated for the expected freeboard after 50 years of the most likely SLR (NRC-I) and also for a larger SLR to provide an upper limit (NRC-II). The effects of SLR with subsidence were factored into the calculations as depth increase and tables provide results for adjusted depths for both scenarios. In both cases, a constant rate of subsidence for Chesapeake Bay was included. Adjustment to wave heights at these increased depths and local settling caused by the weight of the jetty structure on the in situ material were not considered in these calculations. The emphasis for SLR calculations was on the expected effects of the SLR on leeside armor size and weight and transmitted wave heights.

Results for the 50-year SLR projection with the land subsidence for NRC-I curve (e.g., depth increase of 1.37 ft [0.4 m]) and jetty slope of 1V:2.5 indicated maximum leeside armor stone diameter, weight, and transmitted wave height were 1.5 ft (0.5 m), 560 lb (0.28 ton) and 2.34 ft (0.7 m), respectively. Using the NRC-II projected SLR (depth increase= 2.04 ft [0.6 m]), these values increased to 1.6 ft m (0.5 m), 680 lb (0.34 ton), and 2.61 ft (0.8 m).

For jetty side slope of 1V:2H, the NRC-I based estimates for maximum leeside armor stone diameter, weight, and transmitted wave height were 1.77 ft (0.5 m), 920 lb (0.46 ton), 2.52 ft (0.8 m), respectively. Using the NRC-II projected SLR, these values increased to 1.87 ft (0.6 m), 1,080 lb (0.54 ton), and 2.78 ft (0.8 m), respectively. For jetty side slope of 1V:1.5H, the NRC-I based estimates for maximum leeside armor stone diameter, weight, and transmitted wave height were 2.16 ft (0.7 m), 1,660 lb (0.83 ton), and 2.73 ft (0.8 m), respectively. Using the NRC-II projected SLR, these values increased to 2.28 ft (0.7 m), 1,960 lb (0.98 ton), and 3.0 ft (0.9 m), respectively. The bayside maximum armor stone size and weight for the above jetty structure condition remain nearly the same as without the SLR scenarios (Tables 3-1, 3-2, and 3-3). At the design water level plus the SLR with subsidence, much of the island will be inundated, leaving the jetties exposed as the isolated structure.

A site inspection should guide NAB to determine the desired land anchor points both for north and south jetties. These land anchor points should be selected at high tide at some proper high land elevation available. Jetty connection locations should be moved if necessary to avoid low-lying and erosional spots. The selection of locations for the jetty roots should consider the nearest points shown in the models grids that offer some elevation and areas which include more resistant to erosion.

The structural design estimates were based on a 50-year design storm and a 5 ft (1.5 m) storm surge for a 5 ft (1.5 m) jetty crest elevation (MLLW) and 8 ft (2.4 m) crest width. It is likely that a more severe storm can occur during the life of the structure. The empirical equations used in these structural design estimates were based on assuming a low level of damage during the design event. The formulas include uncertainties with several parameters used in various equations.

In addition, measured wave and current data were not available to calibrate the numerical model. Impacts of these on calculated estimates would require further research and more time and funding. Due to these uncertainties, either the design estimates could be adjusted by incorporating a safety factor, or alternatively a more extreme design storm (i.e., a 100-year event) could be used in future design estimates. For the latter option, a detailed sensitivity analysis of key parameters affecting the design estimates should be performed to determine wave runup, overtopping, transmission, and SLR effects associated with a 100-year storm event on the required stone size and weight for the seaside/leeside of jetties.

Because further research and design estimates for a 100-year storm are cost prohibitive, the stone sizes for a 50-year design storm with the NRC curve II plus the subsidence yielded 3.84 ft (1.2 m) MSL (which is approximately 4 ft [1.2 m] MSL or 5 ft [1.5 m] MLLW) crest elevation for the jetties. Hence, this estimate of 4 ft (1.2 m) MSL (5 ft [1.5 m] MLLW) is recommended for the jetty design crest height at Rhodes Point, MD.

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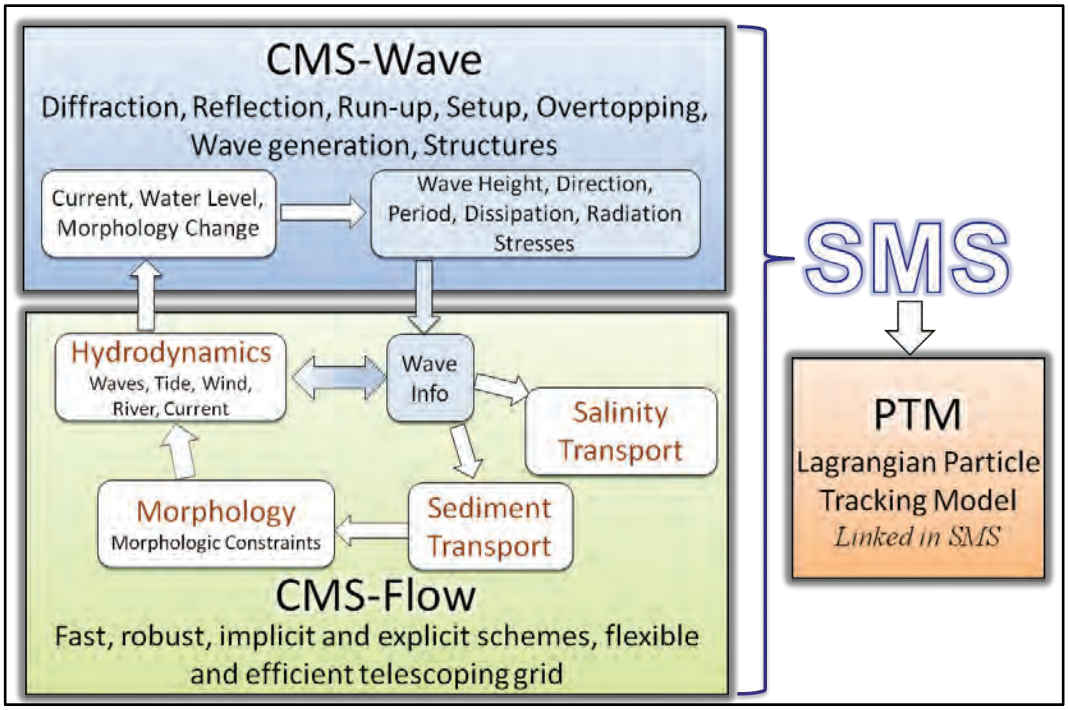
Appendix A: Description of the Coastal Modeling System (CMS)

The CMS was used for the numerical modeling estimates of waves, currents, and sediment transport at Rhodes Point, Smith Island, MD. A brief description of the CMS is provided here for completeness.

As shown in Figure A-1, the CMS is an integrated suite of numerical models for waves, flows, and sediment transport and morphology change in coastal areas. This modeling system includes representation of relevant nearshore processes for practical applications of navigation channel performance and sediment management at coastal inlets and adjacent beaches. The development and enhancement of CMS capabilities continues to evolve as a research and engineering tool for desk-top computers. CMS uses the Surface-water Modeling System (SMS) (Zundel 2006) interface for grid generation and model setup, as well as plotting and post-processing. The Verification and Validation (V&V) Report 1 (Demirbilek and Rosati 2011) and Report 2 (Lin et al. 2011) have detailed information about the CMS-Wave features, and evaluation of the model's performance skills in a variety of applications. Report 3 and Report 4 by Sanchez et al. (2011a,b) describe coupling of wave-flow models and hydrodynamic and sediment transport and morphology change aspects of CMS-Flow. The performance of CMS for a number of applications is summarized in Report 1, and details are described in the three companion V&V Reports 2, 3, and 4.

The CMS-Wave, a spectral wave model, was used in this study because of the large extent of modeling domain over which wave estimates were required. It solves the steady-state wave-action balance equation on a nonuniform Cartesian grid to simulate steady-state spectral transformation of directional random waves. Wind-wave generation and growth, diffraction, reflection, dissipation due to bottom friction, white-capping and breaking, wave-current interaction, wave runup, wave setup, and wave transmission through structures are the main wave processes included in the CMS-Wave.

Figure A- 1. The CMS framework and its components.



CMS-Wave is designed to simulate wave processes with ambient currents at coastal inlets and in navigation channels. The model can be used either in half-plane or full-plane mode for spectral wave transformation (Lin and Demirbilek 2005; Lin et al. 2008; Demirbilek et al. 2007). The half-plane mode is default because in this mode CMS-Wave can run more efficiently as waves are transformed primarily from the seaward boundary toward shore. Lin et al. (2008, 2011) provides features of the model and step-by-step instructions with examples for application of CMS-Wave to a variety of coastal inlets, ports, structures, and other navigation problems. Publications listed in the V&V reports and this report provide additional information about the CMS-Wave and its applications. Additional information about CMS-Wave is available from the CIRP website: http://cirp.usace.army.mil/wiki/CMS-Wave.

The CMS-Flow, a two-dimensional shallow-water wave model, was used for hydrodynamic modeling (calculation of water levels and currents) in this study. The implicit solver of the flow model was used in this study. This circulation model provides estimates of water level and current given the tides, winds, and river flows as boundary conditions. CMS-Flow calculates hydrodynamic (depth-averaged circulation), sediment transport, morphology change, and salinity due to tides, winds, and waves.

The hydrodynamic model solves the conservative form of the shallow-water equations that includes terms for the Coriolis force, wind stress, wave stress, bottom stress, vegetation-flow drag, bottom friction, wave roller, and turbulent diffusion. Governing equations are solved using the finite volume method on a nonuniform Cartesian grid. V&V Report 3 and Report 4 by Sanchez et al. (2011a,b) provides instruction for the preparation of the model at coastal inlet applications. Additional information about CMS-Flow is available from the CIRP website: http://cirp.usace.army.mil/wiki/CMS-Flow.

The CMS-Flow modeling tasks for this study included specification of surface winds, atmospheric pressures, and water levels for input to the model. The effects of waves on the circulation were input to the CMS-Flow and have been included in the simulations performed for this study.

There are three sediment transport models available in CMS-Flow: (a) a sediment mass balance model, (b) an equilibrium advection-diffusion model, and (c) a nonequilibrium advection-diffusion model. Depth-averaged salinity transport is simulated with the standard advection-diffusion model and includes evaporation and precipitation. The V&V Report 1, Report 3, and Report 4 describe the integrated wave-flow-sediment transport and morphology change aspects of CMS-Flow. The performance of CMS-Flow is described for a number of applications in the V&V reports.

Appendix B: Datums

B.1 Horizontal datums

The horizontal datum used for coordinate data input into the models was NAD83, State Plane Virginia, South (Federal Information Processing Standard state code: 4502) in meters.

B.2 Vertical datums

The vertical datum used in this study was MTL (mean tide level) in meters, based on NOAA benchmark at Bishops Head, Hoopers Strait, MD (Station 8571421). The station information is given as follows:

Station ID: 8571421 PUBLICATION DATE: 11/19/2012

Name: BISHOPS HEAD, HOOPERS STRAIT, MARYLAND

NOAA Chart: 12261 Latitude: 38° 13.2' N

USGS Quad: WINGATE Longitude: 76° 2.3' W

Tidal datums at BISHOPS HEAD, HOOPERS STRAIT based on:
LENGTH OF SERIES: 6 YEARS
TIME PERIOD: September 05 - August 09, and April 10 - March 12

TIDAL EPOCH: 1983-2001

CONTROL TIDE STATION: 8571892 CAMBRIDGE, CHOPTANK RIVER

Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in meters:
HIGHEST OBSERVED WATER LEVEL (10/30/2012) = 1.309
MEAN HIGHER HIGH WATER MHHW = 0.624

MEAN HIGH WATER MHW = 0.575

North American Vertical Datum NAVD88 = 0.380

MEAN SEA LEVEL MSL = 0.307

MEAN TIDE LEVEL MTL = 0.307

MEAN LOW WATER MLW = 0.039

MEAN LOWER LOW WATER MLLW = 0.000

LOWEST OBSERVED WATER LEVEL (01/03/2008) = -0.559

The data above were obtained from the website http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8571421%20Bishops%20Head,%20MD&type=Bench%20Mark%20Data%20Sheets.

REPORT DOCUMENTATION PAGE

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Hydrodynamic Modeling for Channel and Shoreline Stabilization at Rhodes Point, Smith Island, MD

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5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
060000

5d. PROJECT NUMBER
113464

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A1100

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58F268

6. AUTHOR(S)
Zeki Demirbilek, Lihwa Lin, Thomas D. Laczo and Anthony A. Clark

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

8. PERFORMING ORGANIZATION REPORT NUMBER
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Baltimore, MD 21201
Headquarters. U.S. Army Corps of Engineers
Washington, DC 20314-1000

10. SPONSOR/MONITOR'S ACRONYM(S)
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12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
This report documents numerical wave and flow modeling for stabilizing a shallow draft navigation channel and adjacent shorelines at Rhodes Point, located on Smith Island, Maryland, in Chesapeake Bay. The U.S. Army Engineer District, Baltimore (CENAB), maintains the channel and is considering structures to protect the western entrance of the channel on Chesapeake Bay side to reduce erosion of shorelines by armoring and stabilizing the channel. The U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), performed a numerical modeling study to develop preliminary structure design estimates by investigating the optimal location for the structures, and by determining how structures in the impacted areas would be affected by waves and hydrodynamics. Estimates of water levels, waves, currents, and morphology change in and around the channel and adjacent beaches were calculated for a relative comparison of no-project (Alternative-0) and two alternatives investigated, and for the preliminary structural design calculations. The Alternative-1with a shore-normal north jetty provided a significant reduction in waves and currents in the channel and along the shorelines, offering a cost-effective solution. Alternative-2 with two parallel jetties provided similar wave energy reduction in the channel and along the shorelines, but showed higher currents and erosional pockets developing in the channel which could undermine the stability of the jetties.

15. SUBJECT TERMS
Channels (Hydraulic engineering), Chesapeake Bay (Md. And Va.), Coastal Engineering, Hydrodynamics—Computer Simulation, Jetties, Numerical Analysis, Rhodes Point (Md.), Shorelines, Waves—Computer simulation

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Zeki Demirbilek
Unlimited	Unlimited	Unlimited	SAR	110	19b. TELEPHONE NUMBER (Include area code) 601-634-2834

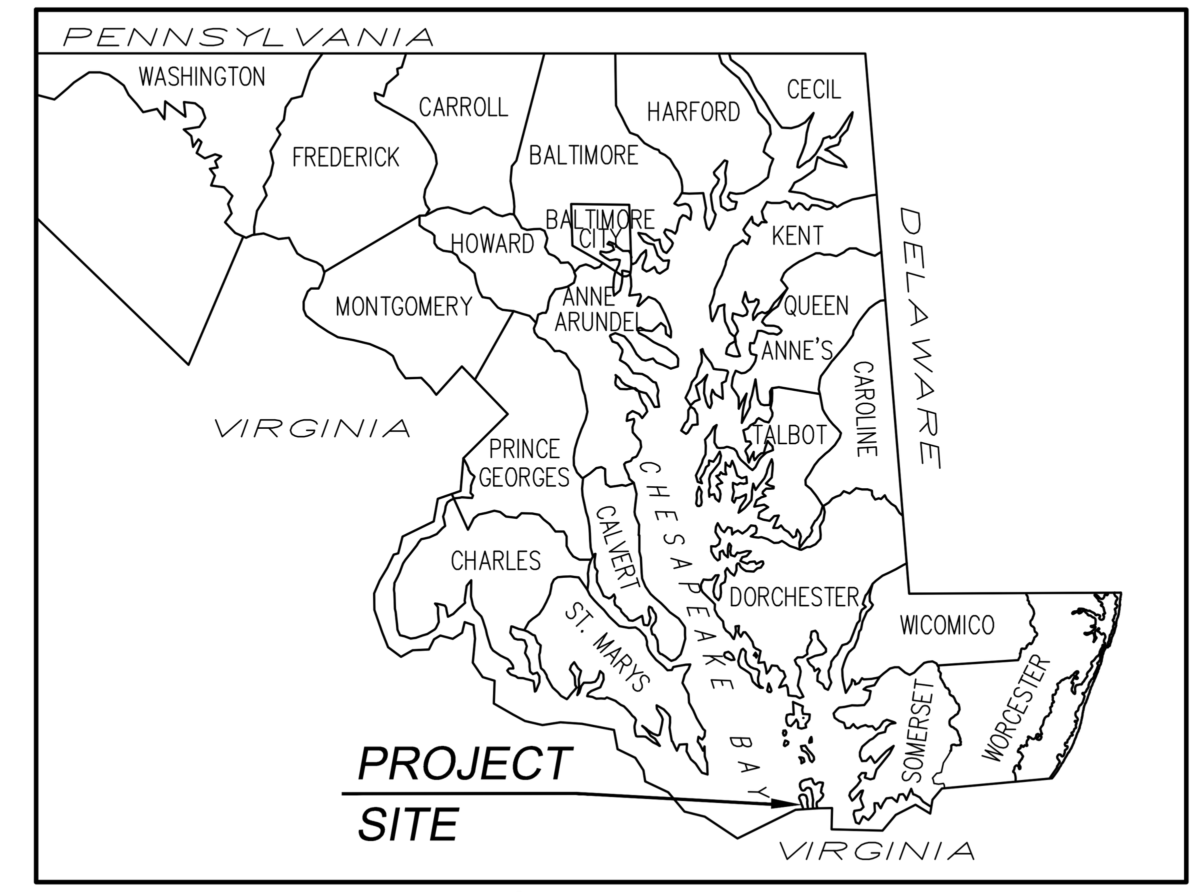
Appendix F

RHODES POINT

Living Shoreline Restoration and Erosion Control Project

ON SMITH ISLAND

Somerset County, Maryland

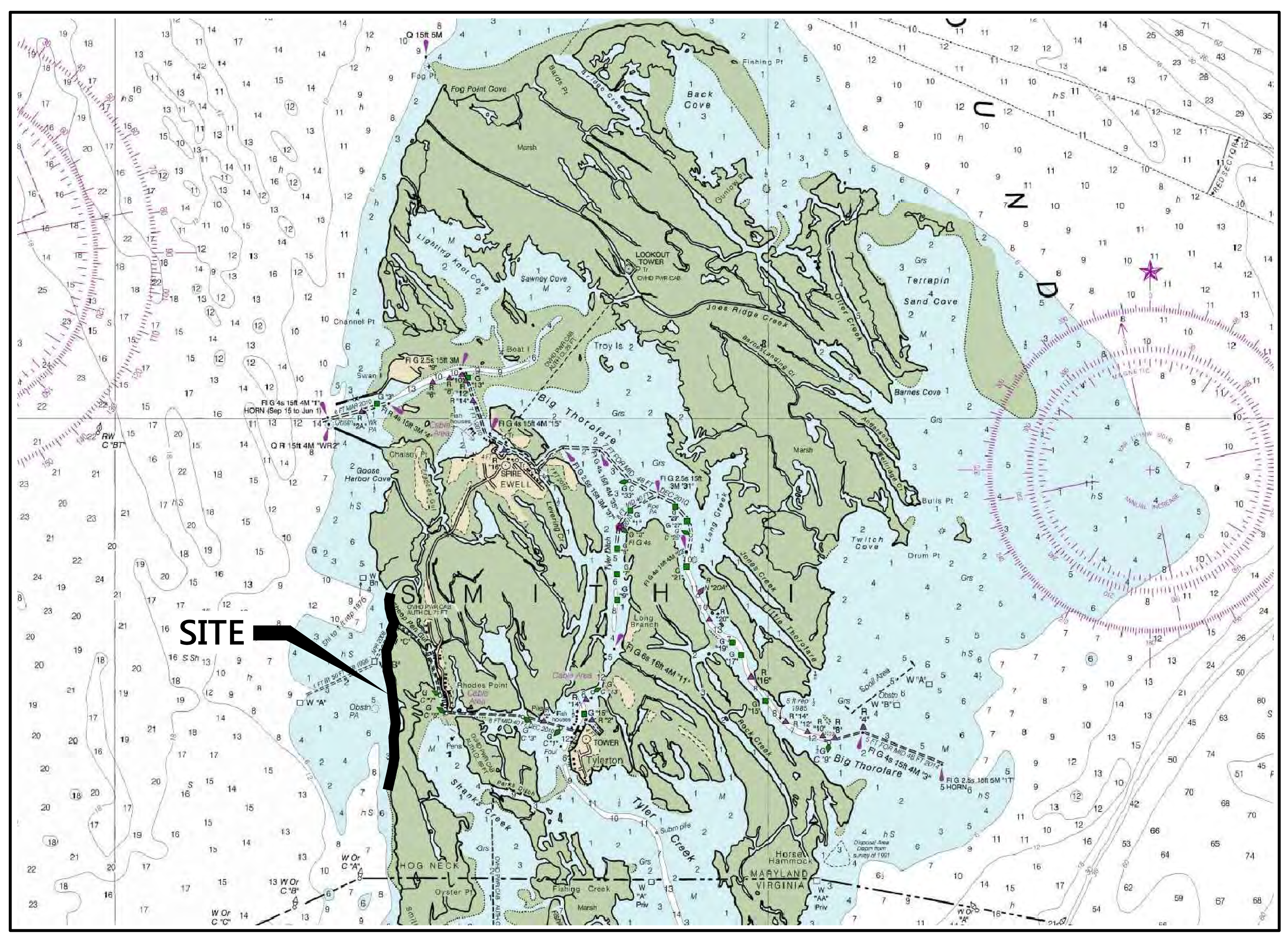


SITE MAP

NOT TO SCALE

Index

No.	Drawing Title
C-1	Cover Sheet
C-2	Existing Conditions & Sheet Index
C-3	Proposed Shoreline Layout
C-4	Proposed Shoreline Layout
C-5	Proposed Shoreline Layout
C-6	Proposed Shoreline Layout
C-7	Proposed Shoreline Layout
C-8	Proposed Shoreline Layout
C-9	Typical Sections
C-10	Sediment and Erosion Control Notes & Details



Location Map

0 2,000 4,000 Feet

GENERAL NOTES

1. Mean tidal range is 1.6 feet.
2. Horizontal control was established by a closed loop traverse.
3. Vertical control is 0.0 feet = MLW.
4. Topographic and hydrographic data obtained during November 2015. Coordinate systems is MD state plane.
5. All dimensions and coordinates given in feet.
6. Existing topography has contour intervals are every 1 ft above O.OMLW and every 1 ft below MLW.
7. All earth/rock interfaces to receive filter cloth.

CONSTRUCTION SCHEDULE FOR SEDIMENT AND EROSION CONTROL

I. Contractor/Developer is to notify the Delmarva RC&D (443-235-8514) of the date construction is to begin at least five (5) days prior to the date.(Time Frame=1 day)

2. Install Breakwaters Structures & Beach fill. (410 days)

3. Placement narrative- the proposed Breakwater Structures will be staked out according the drawings. Then the placement of the Breakwater Structures will be adjusted relative to the marsh scarp at the time of construction. Sand fill will be placed immediately after structure installation.

4. The sand fill is the planting area for the low and high marsh species. The contractor will plant the high marsh as soon as it is practical after structure installation. Allow at least two weeks for time, tide and waves to adjust the low marsh planting areas to "equilibrate". Low marsh planting may occur on sand and peat as the adjusted shoreline platform behind each structure allows.

OWNER'S/DEVELOPERS CERTIFICATION:

I / We hereby certify that all clearing, grading, construction, and/or development will be done pursuant to this plan and that any responsible personnel involved in the construction project will have a certificate of attendance at a Maryland Department of the Environment approved training program for the control of erosion and sediment before beginning the project. I/We hereby authorize the right of entry for periodic on-site evaluation by appropriate inspection and enforcement authority or the State of Maryland, Department of the Environment.

Date ________ Owner/Developer Signature ________

MDE Training Card No. ________ Print Name and Title ________

DESIGN CERTIFICATION

I hereby certify that this plan has been designed in accordance with the 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, the 2000 Maryland Stormwater Design Manual, Volumes I & II including supplements, the Environment Article Sections 4-101 through 116 and Sections 4-201 and 215, and the Code of Maryland Regulations (COMAR) 26.17.01 and COMAR 26.17.02 for erosion and sediment control and stormwater management, respectively.

5/25/16 — Date

Glenn G. Gass — Designer's Signature

Md. Registration No 14544
P.E., R.L.S., RLA, or R.A. (circle one)

Glenn G. Gass — Print Name

PROFESSIONAL CERTIFICATION

I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 14544 , *Expiration Date:* 16 August 2017."

Glenn G. Gass — Glenn G. Gass

5/25/16 — Date

STANDARD STABILIZATION NOTE:

Following initial soil disturbance or re-disturbance, permanent or temporary stabilization must be completed within:

a.) three (3) calendar days as to the surface of all perimeter dikes, swales, ditches, perimeter slopes, and all slopes steeper than 3 horizontal to 1 vertical (3:1); and

b.) seven (7) calendar days as to all other disturbed or graded areas on the project site not under active grading

STATE OF MARYLAND
GLENN G. GASS
No. 14544
PROFESSIONAL ENGINEER

Glenn G. Gass

BORING NOTE:

SOIL BORINGS WERE OBTAINED FOR DESIGN PURPOSES ONLY. BORING DATA IS PROVIDED FOR THE CONTRACTORS CONVENIENCE AND IS APPLICABLE ONLY AT THE SPECIFIED POINTS WHERE THE BORINGS WERE PERFORMED. NEITHER ENGINEER OR THE GOVERNMENT WARRANT THE CONTINUITY OF SUBSURFACE CONDITIONS. ALL ELEVATIONS REFER TO MLW DATUM.

Summerset County
Soil Conservation District

MAY 25, 2016

COASTLINE DESIGN, P.C.

Cad File No. 3221312-cov

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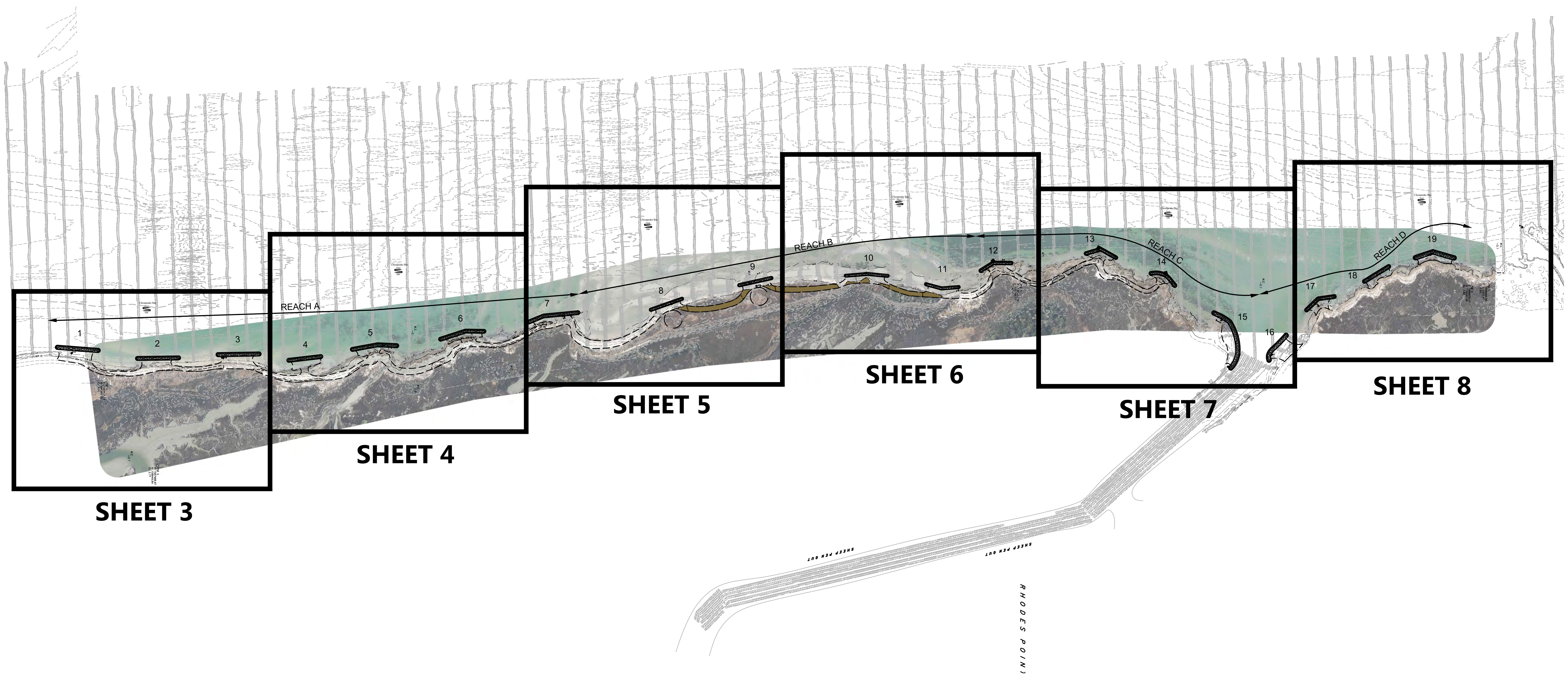

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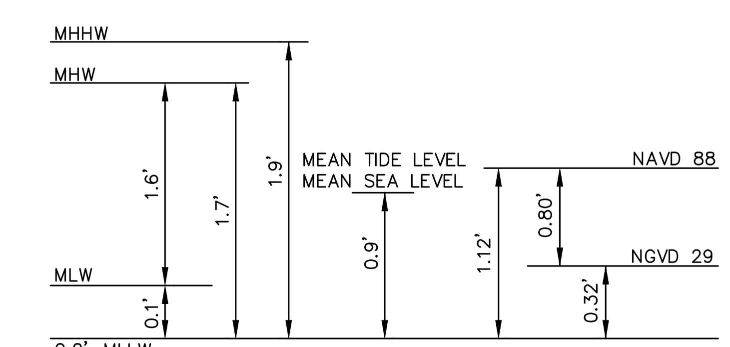
CONSTRUCTION ACCESS NOTES:

1. LAND AND WATER ACCESS ALLOWED FOR BREAKWATERS #1 THROUGH #11.
2. LAND ACCESS ONLY ALLOWED FOR BREAKWATERS #12 THROUGH #14 DUE TO PRESENCE OF SAV.
3. WATER ACCESS ONLY FOR BREAKWATERS #15 THROUGH #19.



DATUM COMPARISONS
SCALE : NONE

DATUM INFORMATION WAS OBTAINED FROM NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) TAKEN FROM THE EWELL STATION.

COASTLINE DESIGN, P.C.

Rhodes Point Living Shoreline Restoration and Erosion Control Project

On Smith Island
Somerset County, Maryland

No.	Revision	Date	Appd.

Designed by: CSH/GGG
Checked by: GGG
Issued for: Final
Date: May 25, 2016

Drawing Title: Existing Conditions and Sheet Layout

Drawing Number: C-2

Sheet 2 of 10

Project Number: 32213.25

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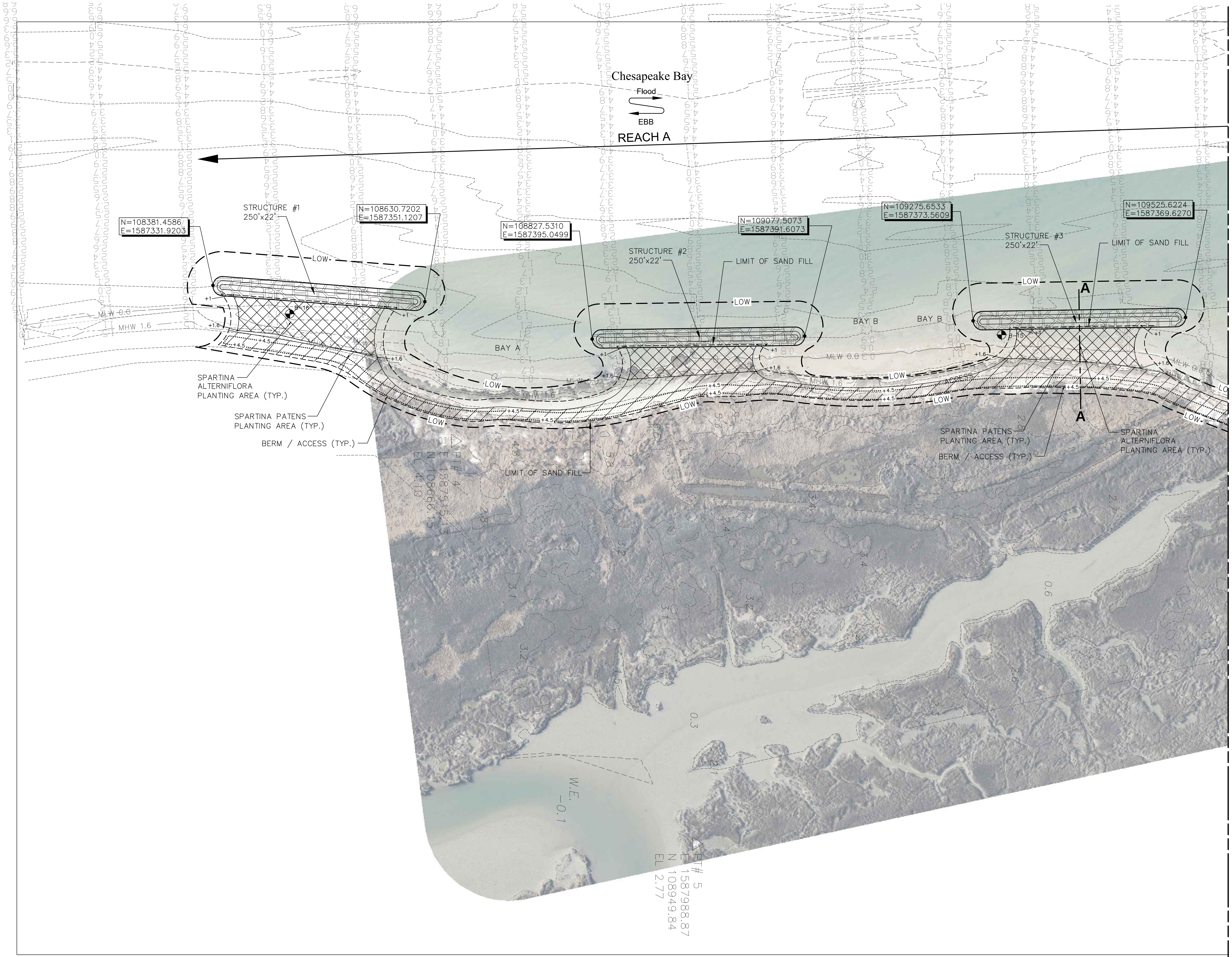

Legend

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TARGET # ELEV.=2.765 N=124148.504 E=1587255.507	TARGET/BENCHMARK LOCATIONS
	EXISTING MAJOR CONTOURS
	EXISTING MINOR CONTOURS
	EXISTING MEAN LOW WATER 0.0
	EXISTING MEAN HIGH WATER 1.6
-X.X	EXISTING GROUND SPOT SHOT
	PROPOSED LIMIT OF FILL
LOW	LIMIT OF WORK (LOW)
	PROPOSED BREAKWATER
	PROPOSED PLANTING SPARTINA ALTERNIFLORA
	PROPOSED PLANTING SPARTINA PATENS & AMERICAN BEACH GRASS
	BERM / ACCESS

N

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Rhodes Point Living Shoreline Restoration and Erosion Control Project

On Smith Island
Somerset County, Maryland

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Drawing Number: C-3

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Sheet 3 of 10

Glenn G. Gass

Project Number: 32213.25

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Legend

B-#	VIBRA CORE SAMPLE LOCATIONS
TARGET # ELEV.=2.765 N=124148.504 E=1587255.507	TARGET/BENCHMARK LOCATIONS
	EXISTING MAJOR CONTOURS
	EXISTING MINOR CONTOURS
	EXISTING MEAN LOW WATER 0.0
	EXISTING MEAN HIGH WATER 1.6
-X.X	EXISTING GROUND SPOT SHOT
	PROPOSED LIMIT OF FILL
LOW	LIMIT OF WORK (LOW)
	PROPOSED BREAKWATER
	PROPOSED PLANTING SPARTINA ALTERNIFLORA
	PROPOSED PLANTING SPARTINA PATENS & AMERICAN BEACH GRASS
	BERM / ACCESS

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Rhodes Point Living Shoreline Restoration and Erosion Control Project

On Smith Island
Somerset County, Maryland

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Drawing Title: **Proposed Shoreline Layout**

Drawing Number: C-4

Sheet 4 of 10

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Glenn G. Gass

Project Number: 32213.25

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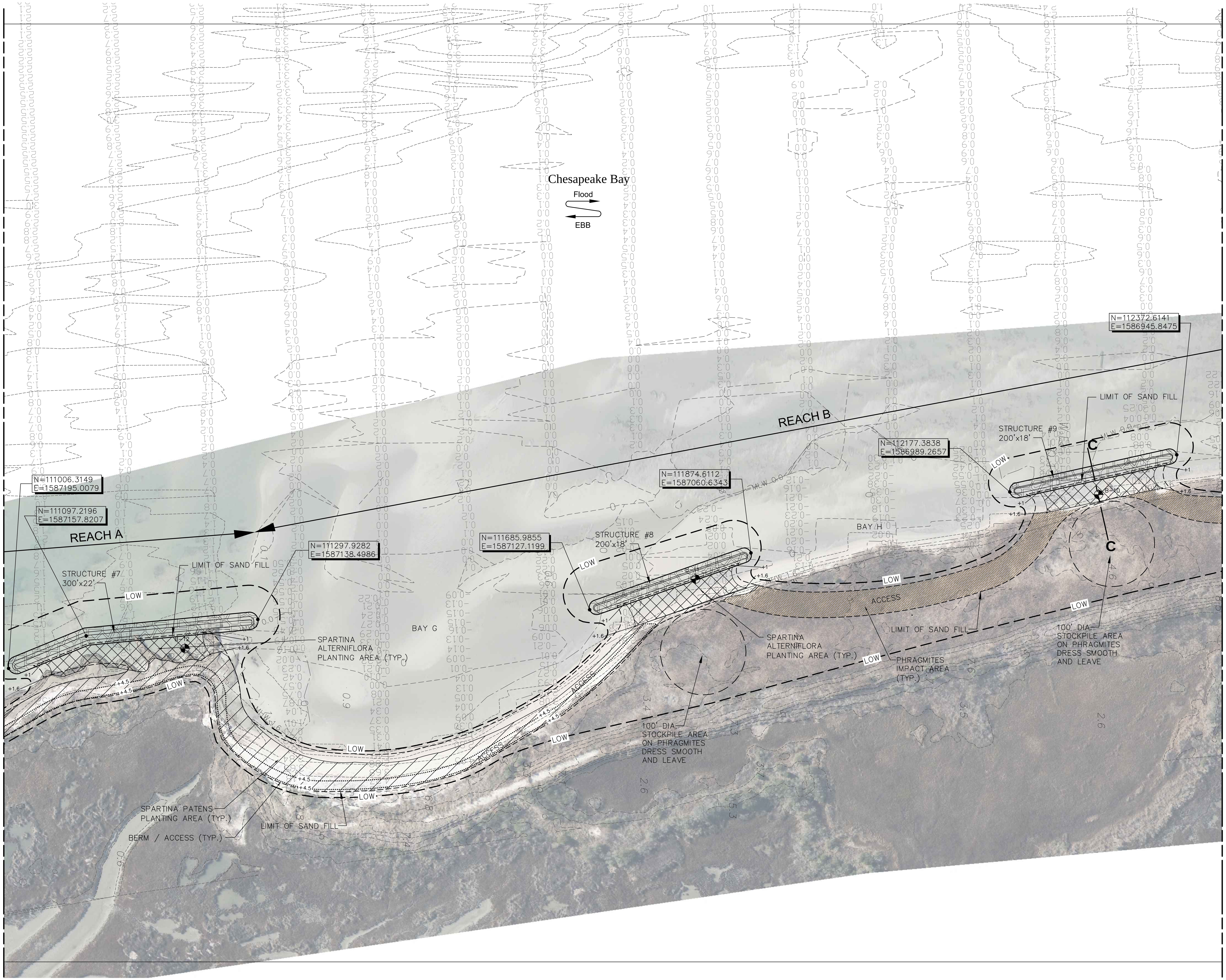

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- EXISTING MINOR CONTOURS
- EXISTING MEAN LOW WATER 0.0
- EXISTING MEAN HIGH WATER 1.6
- EXISTING GROUND SPOT SHOT (-X.X)
- PROPOSED LIMIT OF FILL
- LIMIT OF WORK (LOW)
- PROPOSED BREAKWATER
- PROPOSED PLANTING SPARTINA ALTERNIFLORA
- PROPOSED PLANTING SPARTINA PATENS & AMERICAN BEACH GRASS
- BERM / ACCESS

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On Smith Island
Somerset County, Maryland

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Drawing Title: **Proposed Shoreline Layout**

Drawing Number: C-5

Sheet 5 of 10

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Glenn G. Gass

Project Number: 32213.25

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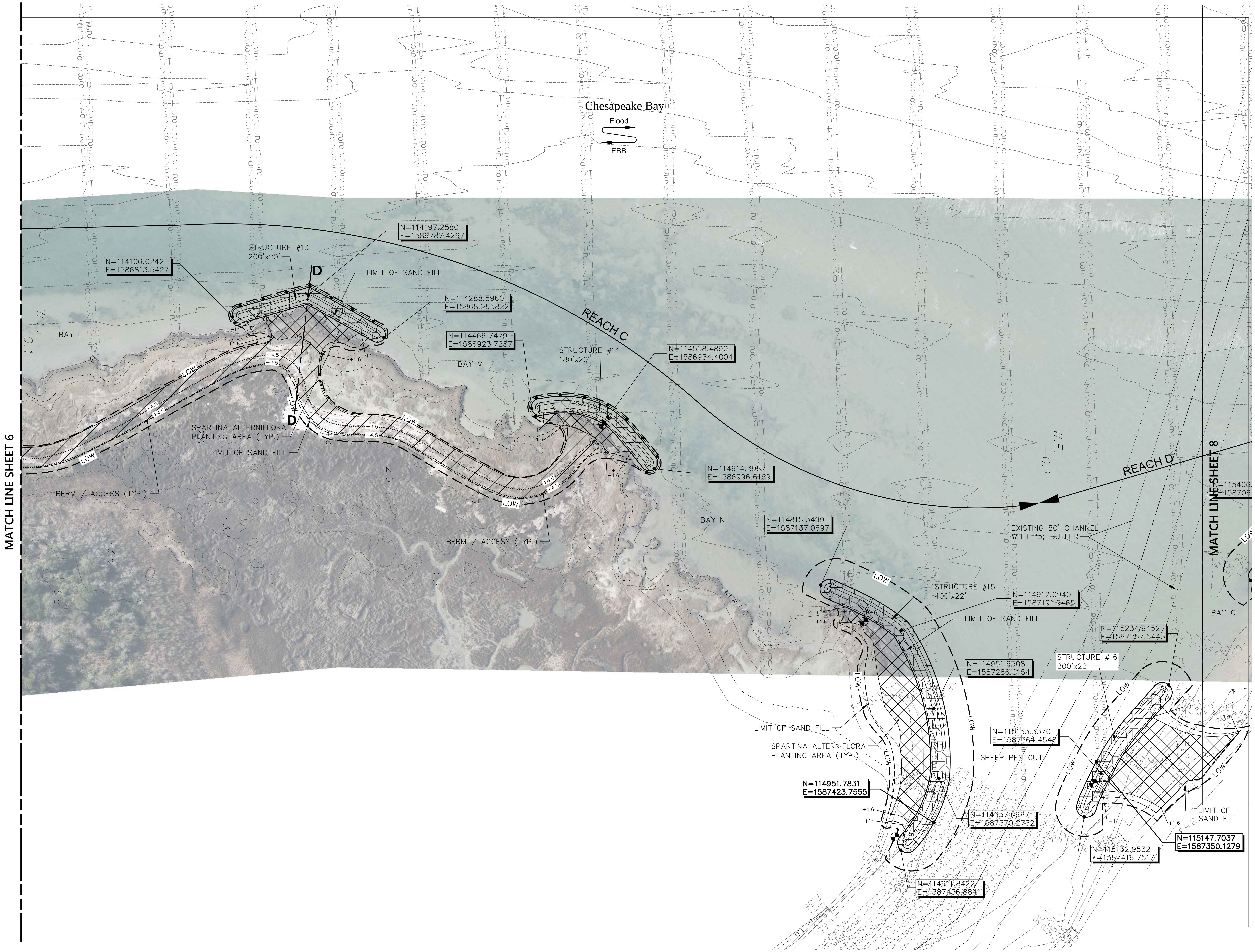

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	EXISTING MINOR CONTOURS
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	EXISTING MEAN HIGH WATER 1.6
-X.X	EXISTING GROUND SPOT SHOT
	PROPOSED LIMIT OF FILL
LOW	LIMIT OF WORK (LOW)
	PROPOSED BREAKWATER
	PROPOSED PLANTING SPARTINA ALTERNIFLORA
	PROPOSED PLANTING SPARTINA PATENS & AMERICAN BEACH GRASS
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Rhodes Point Living Shoreline Restoration and Erosion Control Project

On Smith Island
Somerset County, Maryland

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Drawing Title
Proposed Shoreline Layout

Drawing Number
C-7

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Sheet 7 of 10

Glenn G. Gass

Project Number
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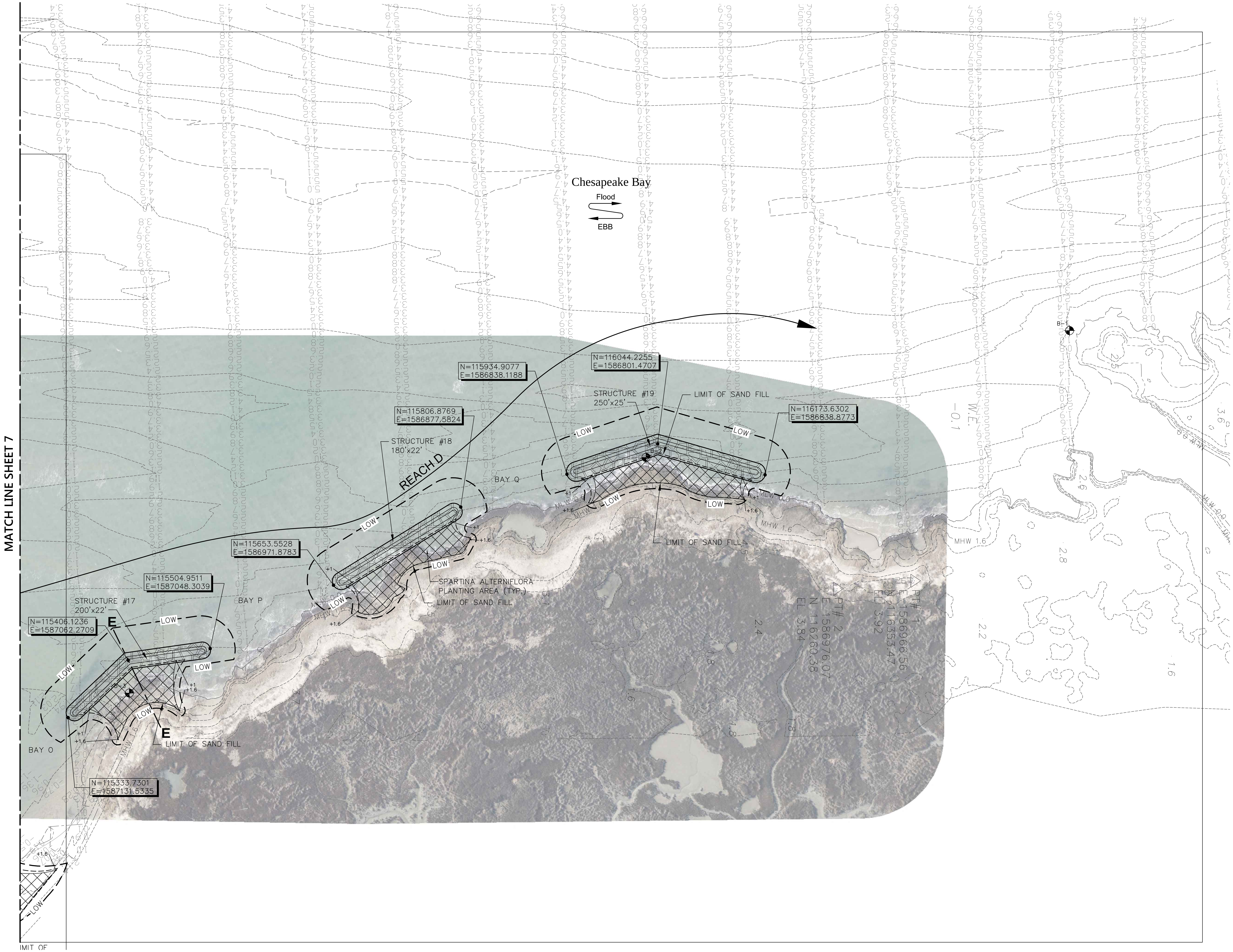

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- PROPOSED LIMIT OF FILL
- LIMIT OF WORK (LOW)
- PROPOSED BREAKWATER
- PROPOSED PLANTING SPARTINA ALTERNIFLORA
- PROPOSED PLANTING SPARTINA PATENS & AMERICAN BEACH GRASS
- BERM / ACCESS

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SCALE IN FEET

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Rhodes Point Living Shoreline Restoration and Erosion Control Project

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Somerset County, Maryland

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Drawing Title
Proposed Shoreline Layout

Drawing Number
C-8

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Sheet 8 of 10

Project Number
32213.25

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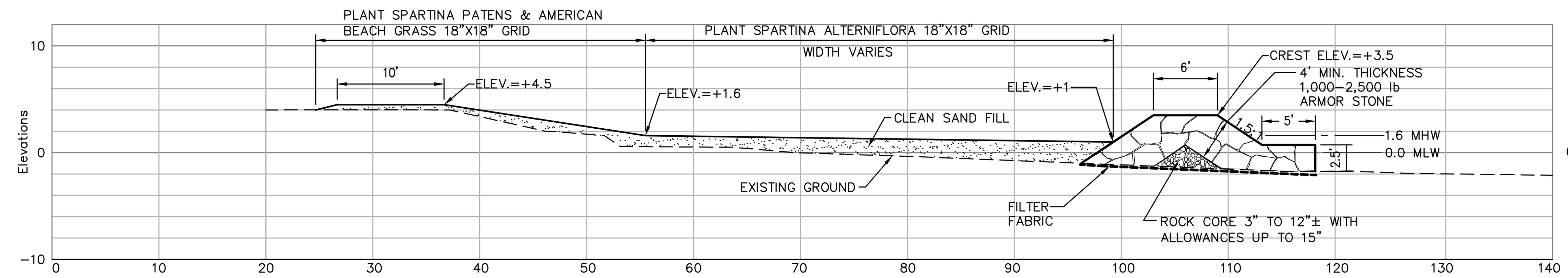
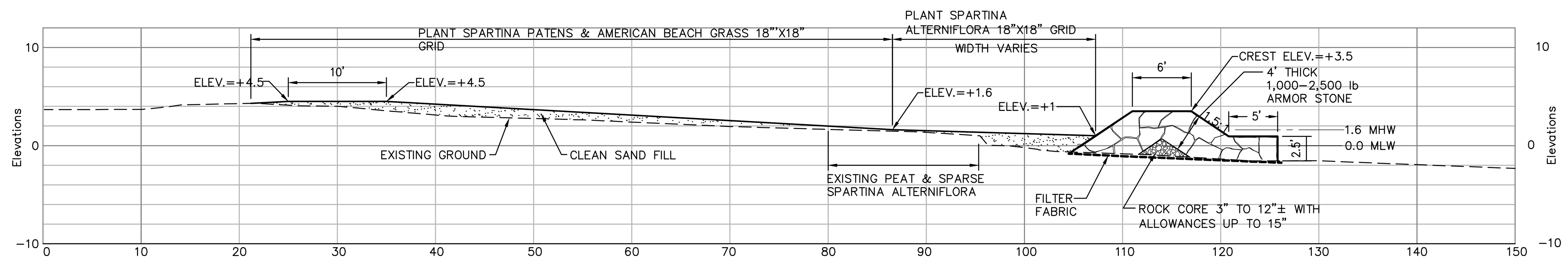
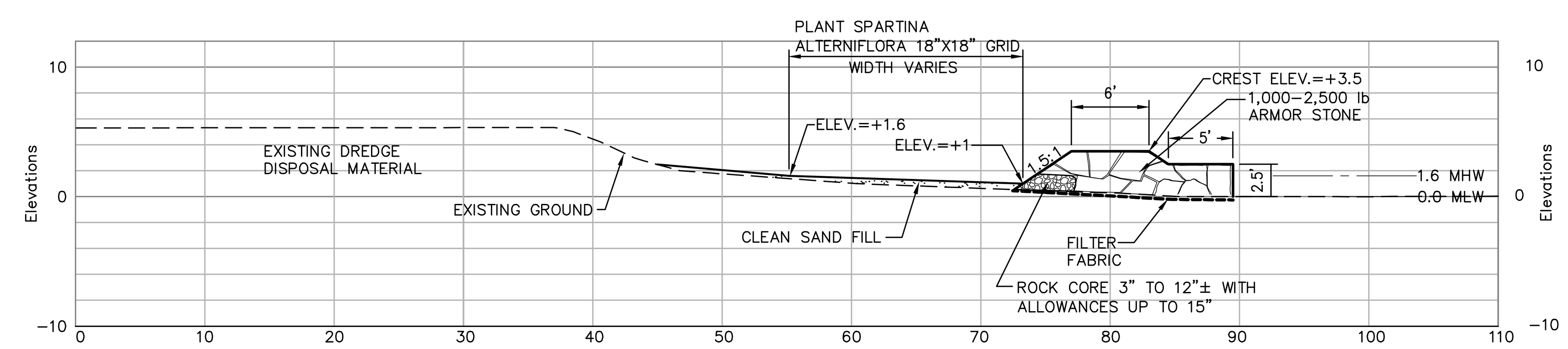


TYPICAL SECTION A-A FOR BREAKWATERS #1, #2, #3, & #4



TYPICAL SECTION B-B FOR BREAKWATERS #5, #6, & #7



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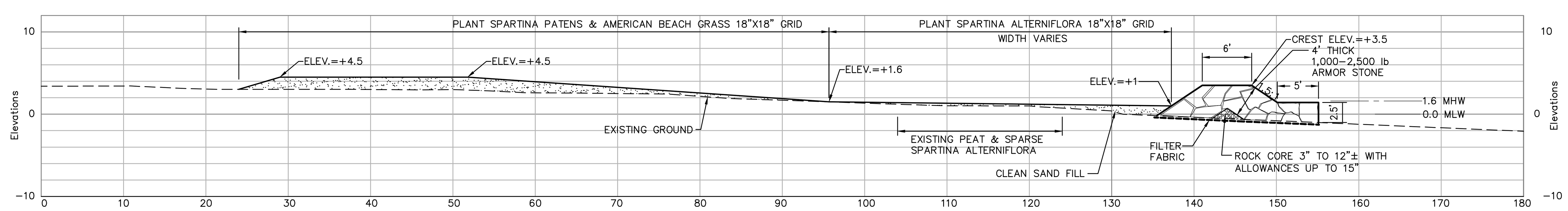

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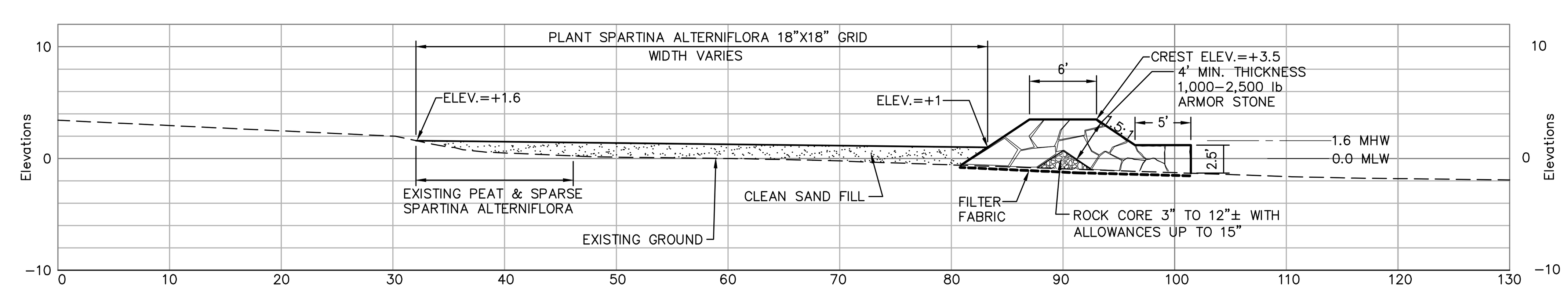

TYPICAL SECTION FOR E-E BREAKWATERS #15, #16, #17, #18, & #19

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SCALE IN FEET

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Rhodes Point Living Shoreline Restoration and Erosion Control Project

On Smith Island
Somerset County, Maryland

No.	Revision	Date	Appvd.

Designed by | Checked by

Issued for: Final
Date: May 25, 2016

Drawing Title
Typical Sections

Drawing Number
C-9

Sheet 9 of 10

STATE OF MARYLAND
GLENN G. GASS
No. 14544
PROFESSIONAL ENGINEER

Glenn G. Gass

Project Number
32213.25

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STANDARD EROSION AND SEDIMENT CONTROL NOTES
The Maryland Department of Environment requires that these notes, in their entirety, be included on the erosion and sediment control plan. It is recognized that every note may not apply to all projects. The requirement of any individual note not applicable to the subject project is not binding upon the applicant or the applicant's contractor.

1. The contractor shall notify the MARYLAND DEPARTMENT OF ENVIRONMENT (MDE) at (410) 537-3510 seven (7) days before commencing any land disturbing activity and, unless waived by the Administration, shall be required to hold a pre-construction meeting between project representatives and a representative of MDE.

2. The contractor must notify MDE in writing and by telephone at the following points:
A. The required pre-construction meeting.
B. Following installation of sediment control measures.
C. During the installation of sediment basins (to be converted into permanent
stormwater management structures) at the required inspection points (see Inspection Checklist on plan). Notification prior to commencing construction of each step is mandatory.
D. Prior to removal or modification of any sediment control structure(s).
E. Prior to removal of all sediment control devices.
F. Prior to final acceptance.

3. The contractor shall construct all erosion and sediment control measures per the approved plan and construction sequence and shall have them inspected and approved by the agency inspector or MDE Inspector prior to beginning any other land disturbances. Minor sediment control device location adjustments may be made in the field with the approval of the MDE Inspector. The contractor shall ensure that all runoff from disturbed areas is directed to the sediment control devices and shall not remove any erosion or sediment control measure without prior permission from MDE Inspector and agency inspector. The contractor must obtain prior agency and MDE approval for changes to the Sediment Control Plan and / or Sequence of Construction.

4. The contractor shall protect all points of construction ingress and egress to prevent the deposition of materials onto public roads. All materials deposited onto public roads shall be removed immediately.

5. The contractor shall inspect daily and maintain continuously in an effective operating condition all erosion and sediment control measures until such times as they are removed with prior permission from MDE Inspector and agency inspector.

6. All sediment basins, trap embankments and slopes, perimeter dikes, swales and all disturbed slopes steeper or equal to 3:1 shall be stabilized with sod or seed and anchored straw mulch, or other approved stabilization measures, as soon as possible but no later than Three (3) calendar days after establishment. All areas disturbed outside of the perimeter sediment control system must be minimized. Maintenance must be performed as necessary to ensure continued stabilization.
(Requirement for stabilization may be reduced to immediate days for sensitive areas.)

7. The contractor shall apply sod or seed and anchored straw mulch, or other approved stabilization measures to all disturbed areas and stockpiles within seven (7) calendar days after stripping and grading activities have ceased in the area. Maintenance shall be performed as necessary to ensure continued stabilization. (Requirement may be reduced to immediate days for sensitive areas.)
A. The seed mix shall be annual rye and fescue. The seed mix shall NOT contain lespedeza.

8. Prior to removal of sediment control measures, the contractor shall stabilize and have established permanent stabilization for all contributory disturbed areas using sod or an approved permanent seed mixture with required soil amendments and an approved anchored mulch. Wood fiber mulch may only be used in seeding season where the slope does not exceed 10% and grading has been done to promote sheet flow drainage. Areas brought to finished grade during the seeding season shall be permanently stabilized as soon as possible, but not later than seven (7) calendar days after establishment. When property is brought to finished grade during the months of November through February, and permanent stabilization is found to be impractical, temporary seed and anchored straw mulch shall be applied to disturbed areas. The final permanent stabilization of such property shall be applied by March 15 or earlier if ground and weather conditions allow.
9. The site's approval letter, approved Erosion and Sediment Control Plans, daily log books, and test reports shall be available at the site for inspection by duly authorized officials of MDE and the agency responsible for project.

10. Surface drainage flows over unstabilized cut and fill slopes shall be controlled by either preventing drainage flows from traversing the slopes or by installing protective devices to lower the water downslope without causing erosion. Dikes shall be installed and maintained at the top of a cut or fill slope until the slope and drainage area to it are fully stabilized, at which time they must be removed and final grading done to promote sheet flow drainage. Protective methods must be provided at points of concentrated flow where erosion is likely to occur.

11. Permanent swales or other points of concentrated water flow shall be stabilized with sod or seed with an approved erosion control matting, rip-rap, or by other approved stabilization measures.

12. Temporary sediment control devices may be removed, with permission of MDE Inspector and agency inspectors, within thirty (30) calendar days following establishment of permanent stabilization in all contributory drainage areas. Stormwater management structures used temporarily for sediment control shall be converted to the permanent configuration within this time period as well.

13. No permanent cut or fill slope with a gradient steeper than 3:1 will be permitted in lawn maintenance areas. A slope gradient of up to 2:1 will be permitted in nonmaintenance areas provided that those areas are indicated on the erosion and sediment control plan with a low-maintenance ground cover specified for permanent stabilization. Slope gradient steeper than 2:1 will not be permitted with vegetative stabilization.

14. For finished grading, the contractor shall provide adequate gradients to prevent water from ponding for more than twenty four (24) hours after the end of a rainfall event. Drainage courses and swale flow areas may take as long as forty-eight (48) hours after the end of a rainfall event to drain. Areas designed to have standing water shall not be required to meet this requirement.

15. Sediment traps or basins are not permitted within 20 feet of a foundation that exists or is under construction. No structure may be constructed within 20 feet of an active sediment trap or basin.

16. The MDE Inspector has the option of requiring additional safety or sediment control measures, if deemed necessary.

17. All trap depth dimensions are relative to the outlet elevation. All traps must have a stable outfall. All traps and basins shall have stable inflow points.

18. Vegetative stabilization shall be performed in accordance with the Standards and Specifications for Soil Erosion and Sediment Control. Refer to appropriate specifications for temporary seeding, permanent seeding, mulching, sodding, and ground covers.

19. Sediment shall be removed and the trap or basin restored to its original dimensions when the sediment has accumulated to one quarter of the total depth of the trap or basin. Total depth shall be measured from the trap or basin bottom to the crest of the outlet.

20. Sediment removed from traps (and basins) shall be placed and stabilized in approved areas, but not within a floodplain, wetland or tree-save area. When pumping sediment laden water, the discharge must be directed to a sediment trapping device prior to release from the site. A sump pit may be used if sediment traps themselves are being pumped out.

21. All water removed from excavated areas shall be passed through a MDE approved dewatering practice or pumped to a sediment trap or basin prior to discharge to a functional storm drain system or to stable ground surface.

22. Sediment control for utility construction for areas outside of designed controls or as directed by engineer or MDE Inspector:
A. Call "Miss Utility" at 1-800-257-7777 48 hours prior to the start of work.
B. Excavated trench material shall be placed on the high side of the trench.
C. Trenches for utility installation shall be backfilled, compacted, and stabilized at the end of each working day. No more trench shall be opened than can be completed the same day, unless;
D. Temporary silt fence shall be placed immediately downstream of any disturbed area intended to remain disturbed for more than one day.

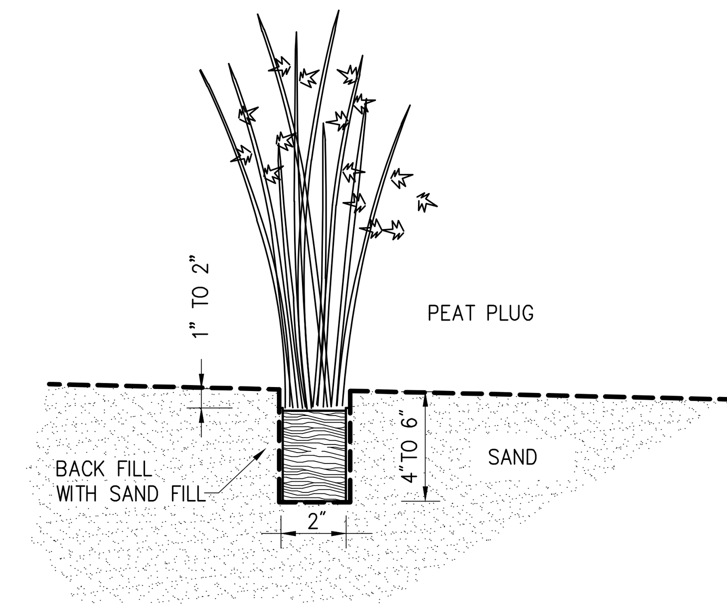
23. Where deemed appropriate by the engineer or inspector, sediment basins and traps may need to be surrounded with an approved safety fence. The fence must conform to local ordinances and regulations. The developer or owner shall check with local building officials on applicable safety requirements. Where safety fence is deemed appropriate and local ordinances do not specify fencing sizes and types, the following shall be used as a minimum standard: The safety fence must be made of welded wire and at least 42 inches high, have posts spaced no farther apart than 8 feet, have mesh openings no greater than 2 inches in width and 4 inches in height with a minimum of 14 gauge wire. Safety fence must be maintained and in good condition at all times.

24. Off-site spoil or borrow areas on State or federal property must have prior approval by MDE and other applicable State, federal, and local agencies; otherwise approval must be granted by the local authorities. All waste and borrow areas off-site must be protected by sediment control measures and stabilized.

25. Sites where infiltration devices are used for the control of stormwater, extreme care must be taken to prevent runoff from unstabilized areas from entering the structure during construction. Sediment control devices placed in infiltration areas must have bottom elevations at least two (2) feet higher than the finish grade bottom elevation of the infiltration practice. When converting a sediment trap to an infiltration device, all accumulated sediment must be removed and disposed of prior to final grading of infiltration device.

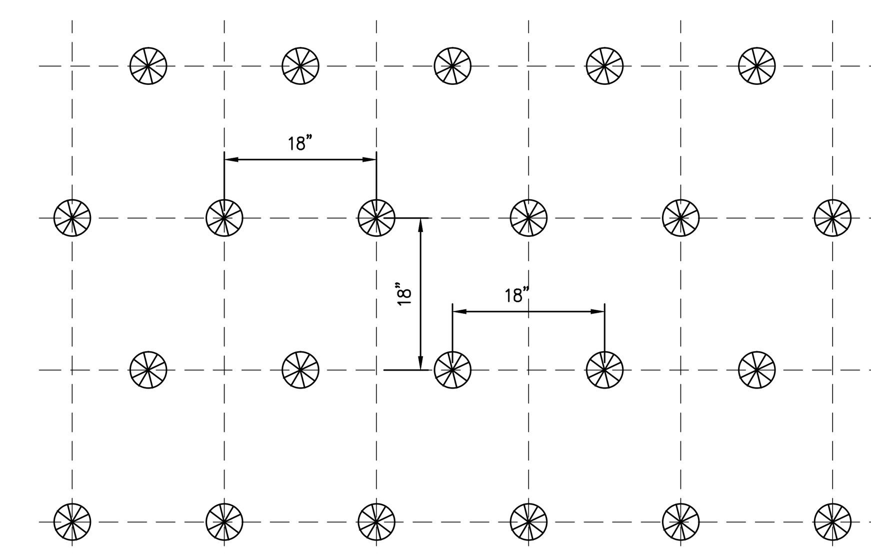
26. When a storm drain system outfall is directed to a sediment trap or sediment basin and the system is to be used for temporarily conveying sediment laden water, all storm drain inlets in non-sump areas shall have temporary asphalt berms constructed at the time of base paving to direct gutter flow into the inlets to avoid surcharging and overflow of inlets in sump areas.

27. Site Information:
a. Total Area within LOW 15.8 Acres
(base, campus, park, etc.)
b. Area Disturbed XXX SF.
c. Area to be Roofed or Paved N/A Acres
d. Total Cut 0 Cubic Yards
e. Total Fill 0 Cubic Yards
f. Off-Site Waste / Borrow Area Location will be the responsibility of the contractor.



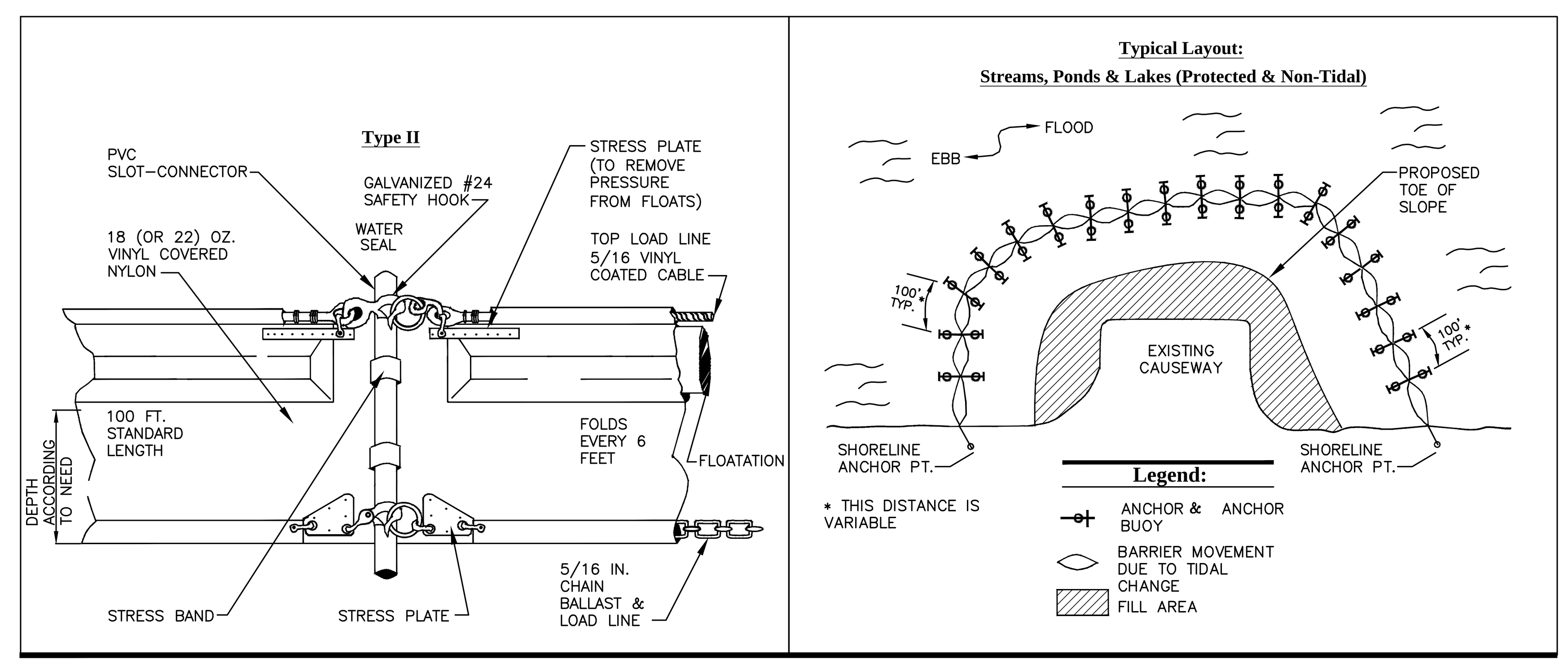
Emergent Planting Detail

N.T.S.



Planting Grid Detail

N.T.S.



Turbidity Curtain

COASTLINE DESIGN, P.C.

Rhodes Point Living Shoreline Restoration and Erosion Control Project

On Smith Island
Somerset County, Maryland

No.	Revision	Date	Appd.

Designed by: CSH/GGG
Checked by: GGG
Issued for: Final
Date: May 25, 2016

Drawing Title
Erosion & Sediment Control Notes and Details

Drawing Number
C-10

Sheet 10 of 10

STATE OF MARYLAND — GLENN G. GASS — No. 14544 — PROFESSIONAL ENGINEER

Glenn G. Gass

Project Number
32213.25