§204 Detailed Project Report and
Environmental Assessment for
Beneficial Use of Dredged Materials
From Maintenance Dredging

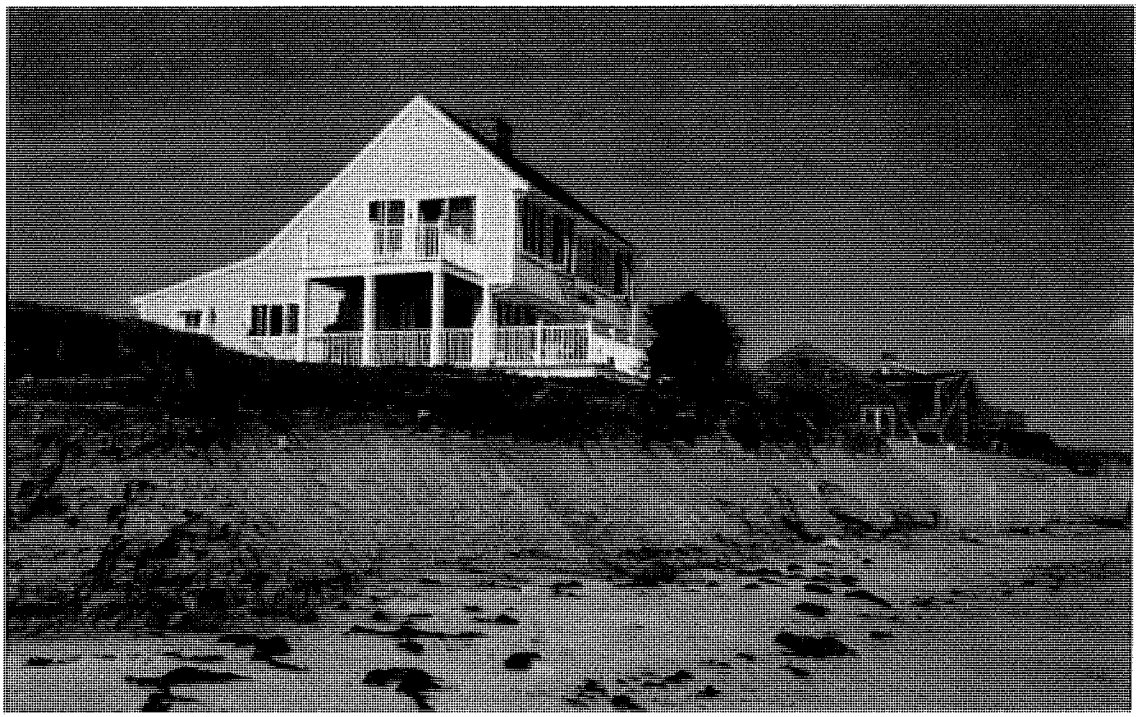
Cape Cod Canal, Town Neck Beach

Sandwich, Massachusetts

US ARMY CORPS
OF ENGINEERS
New England District

JUNE 2015

CAPE COD CANAL
AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS
§ 204 BENEFICIAL USE OF DREDGED MATERIAL
DETAILED PROJECT REPORT



JUNE 2015

U.S. Army Corps of Engineers
New England District

EXECUTIVE SUMMARY

This Study investigated the beneficial use of dredged material to be removed from maintenance of the Federal Navigation Project for the Cape Cod Canal as nourishment directly placed on Town Neck Beach in the Town of Sandwich, Massachusetts. This study is authorized by Section 204 of the Water Resources Development Act (WRDA) of 1992 (33 USC Sec. 2326), as amended. The study area is shown in Figure ES-1.

Town Neck Beach, located east of the east entrance of the Cape Cod Canal, has sustained coastal storm damages and experienced localized, acute, erosion along the beach face exposed to Cape Cod Bay. The recent annual coastal erosion rate has been estimated at 5 feet per year, far in excess of the long term average for this region. The Town of Sandwich has expressed their concern and an interest in conducting a Section 111 - Shore Damage Prevention or Mitigation Caused by Federal Navigation Projects study and/or Section 103 - Beach Erosion and Hurricane and Storm Damage Reduction study, to develop long term solutions to their erosion problems. However, the upcoming maintenance of the Cape Cod Canal provides an opportunity for immediate relief to the most critically at risk properties while longer-term solutions are investigated through these other authorities.

The Federal Base Plan for maintenance dredging of the Federal Navigation Project (FNP) including dredging of the 32 foot deep Canal channel and the 25 foot deep East Mooring Basin (EMB), involves maintenance dredging by a seagoing hopper dredge with placement of the dredged material at the Cape Cod Canal Disposal Site (CCCDS) located northeast of the east entrance of the Canal. The maintenance operation planned for the 2015-2016 dredging season is atypical of recent maintenance operations in that it involves advance maintenance dredging in the Canal proper as well as the EMB. Approximately 150,000 cubic yards (CY) of material would be removed from the channel and EMB in order to reach the authorized depths of 32 feet and 25 feet, respectively, and advance maintenance depths of up to -40 feet Mean Lower Low Water (MLLW) and -34 feet MLLW, respectively. Authorization to perform advance maintenance to these depths was granted by the North Atlantic Division (NAD) to the New England District (NAE) in NAD's memorandum to NAE dated 28 July 2014.

As part of the 204 study, two areas in Sandwich, Massachusetts subject to erosion were initially examined: Town Neck Beach and Spring Hill Beach. A beach fill plan for Town Neck Beach was ultimately recommended for implementation in connection with the upcoming maintenance operation. The quantity of material available from the maintenance dredging is relatively small and providing the material at the most up drift location, closest to the Cape Cod Canal, makes the most sense from a coastal processes standpoint. Sand placed on Town Neck Beach would provide protection to down drift beaches such as Spring Hill Beach (albeit limited compared to direct placement of material) as coastal processes carry that sediment alongshore.

At Town Neck Beach, a 2,500 foot long stretch of beach would be nourished with the 150,000 cubic yards of sand removed from the Canal. This area includes 29 shorefront lots and 7 structures that would experience damage or loss within the five year 2015-2020 period of analysis. The beach fill would be used to increase the elevation and width of the beach berm, with a portion of the material used to reconstruct the dunes. The seaward slope of the fill from the berm down to the vicinity of the mean low water elevation, would be graded to no steeper than 1:10. The berm width would be approximately 60 feet.

Dredging would be accomplished by a hopper dredge with direct pump-off capability that would travel to Town Neck Beach and discharge the dredged material into a line moored offshore of the beach. The material would be pumped ashore and graded. Construction would take about three months during the period of 1 November to 31 March. The construction window is intended to protect shorebirds and their critical habitat including the Federally threatened Piping Plover on the beach and fisheries in the dredging areas.

The purpose of the Section 204 project, and the benefits produced are solely for coastal storm damage reduction. Benefits for the beach fill include delaying the loss and damage of the protected properties for the lifespan of the beach fill. The lifespan of the beach fill is estimated at five years. The structures to be protected are private dwellings and one restaurant.

The estimated benefits of the project include delays in damages to structures, value of land lost, and increased recreation benefits. Total annualized benefits are estimated at $814,270. Benefit-cost analysis for the plan yields annual costs of $365,255, annual net benefits of $449,015 and a benefit-cost ratio of 2.2.

The cost of the Section 204 beneficial use project would be the increase in cost for direct placement of sand on the beach compared to the cost of the Base Plan for placement in CCDS. The Federal Base Plan has an estimated total cost of approximately $3,533,000. The estimated total cost for the beach nourishment plan is approximately $5,181,000. Therefore the increased cost for construction of the beach nourishment plan is estimated at $1,648,000, including a design cost of $75,000, real estate costs of $95,000 and a construction cost of $1,478,000. The 35 percent non-Federal share of the §204 project is estimated at $576,800, with a Federal share of $1,071,200.

Implementation of the Section 204 project requires approval of this report; securing all required Federal, State and local regulatory approvals for the modified disposal plan and a commitment of funds by the Federal Government and the non-Federal Sponsor. A Project Partnership Agreement will be executed between the Corps and the Town of Sandwich. The Town will acquire all required easements for construction and maintenance of the beach fill and public use and access to the beaches receiving the fill.

CAPE COD CANAL AND TOWN NECK BEACH SANDWICH, MASSACHUSETTS SECTION 204 PROJECT FOR BENEFICIAL USE OF DREDGED MATERIALS PROJECT INFORMATION	
Length of Beach fill	2,500 Feet
Number of Properties with Calculated 5-Year Benefits	29
Beach fill Volume	150,000 CY
§204 Project Cost	$1,648,000
§204 Annual Cost	$365,255
§204 Project Benefits	$814,270
Net Annual Benefits	$449,015
Benefit-Cost Ratio	2.2
Federal Share 65%	$1,071,200
Non-Federal Share 35%	$576,800

Table ES-1: Section 204 Project Information

SECTION 204

Added Disposal Costs (65% Federal – 35% Non-Federal)

Year	TPC	LERRD & PCT	Scheduled Construction	Percentage	Non-Federal Cash	Federal Cash
1	1,648,000	95,000	1,648,000	100	481,800	1,071,200
Total	1,648,000	95,000	1,648,000	100	481,800	1,071,200

FY2015 = Year 1.

MAINTENANCE

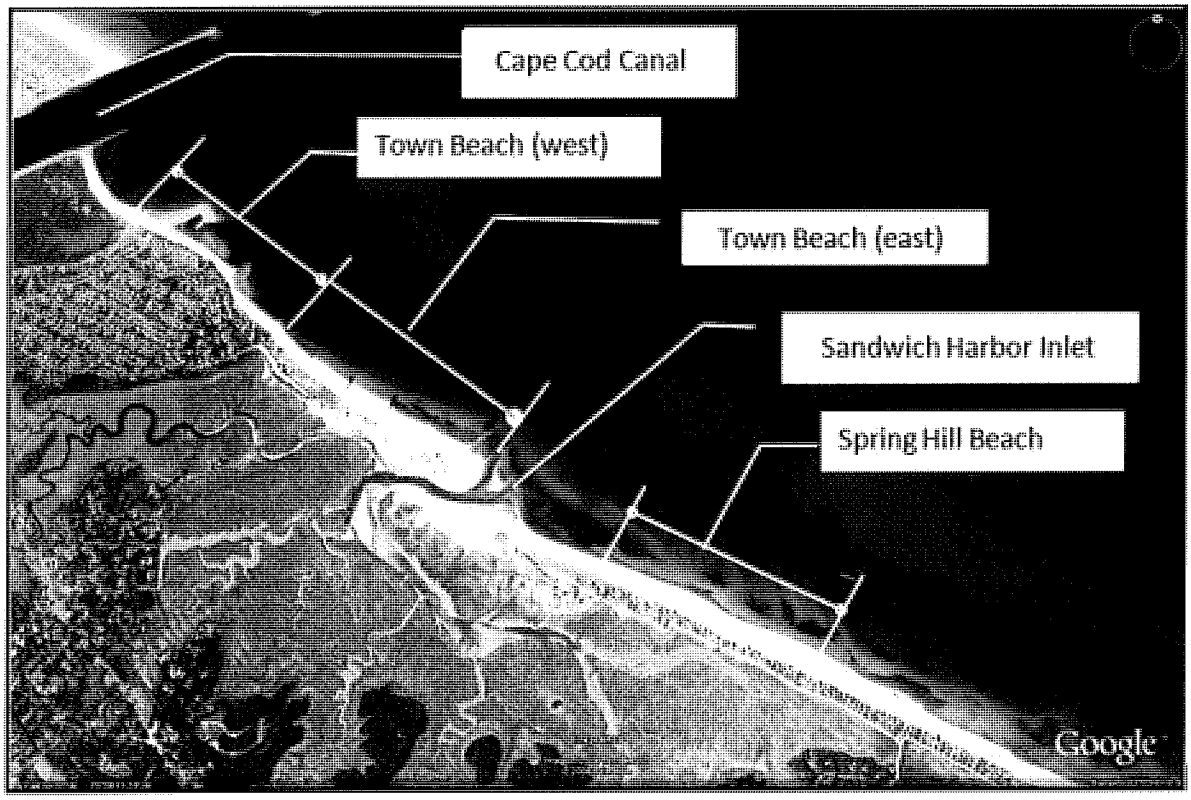
Dredging Costs (100% Federal)

Year	TPC	Scheduled Construction	Percentage	Federal Cash
1	3,533,000	3,533,000	100	3,533,000
Total	3,533,000	3,533,000	100	3,533,000

FY2015 = Year 1.

Note: Contract Award projected for September 2015 with construction commencing in November 2015.

Table ES-2: Section 204 Cost Allocation Information



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INTRODUCTION

The Corps of Engineers, New England District, at the request of the Town of Sandwich, Massachusetts has investigated the coastal storm damage problems at Town Neck Beach and Spring Hill Beach to determine the Federal interest in participating in the cost of beneficial use of dredged material from the planned fiscal year 2015 dredging of the Cape Cod Canal Federal Navigation Project. The least costly method of disposing of the dredged material from the Cape Cod Canal maintenance dredging is placement in the open water at the Cape Cod Canal Disposal Site (CCCDS) offshore of the east entrance of the Canal. This method however, does not provide any erosion protection when compared to the direct placement along the beach, within the nearshore littoral system. Local interests are concerned with recent, severe and ongoing erosion along sections of two beaches and requested that the material be placed directly on Town Neck Beach to immediately protect public and private property and infrastructure. This report examined whether the additional cost of placing sand directly on one or both of the beaches was economically justified or otherwise eligible for Federal participation.

Town Neck and Spring Hill beaches, as shown in Figure ES-1, are directly exposed to Cape Cod Bay to the east. Town Neck Beach and Spring Hill Beach are down drift of the Cape Cod Canal east entrance. The Cape Cod Canal's east entrance is flanked by two stone jetties, all features of the Federal Navigation Project. Town Neck Beach extends from the east jetty to the Sandwich Harbor inlet and fronts the residential developments and geological formation known as Town Neck. The Town of Sandwich owns a strip of beach seaward of the residential properties along Town Neck. Spring Hill Beach extends from the Sandwich Harbor inlet to Long Creek. The southeastern end of Spring Hill Beach is privately owned and developed with homes and cottages. A nearby power utility company owns the area immediately adjacent to the southern jetty on the east end of the Cape Cod Canal. Town Neck Beach is divided into east and west sections for the analysis in this document as shown in Figure ES-1. The beaches are comprised of a mix of sand, gravel, and cobble with substantial dunes. Sandwich Harbor is located near the center of the project area and serves to connect an extensive salt marsh system with Cape Cod Bay. The upper reaches of this salt marsh system directly abut many areas of historic downtown Sandwich. The study area is located entirely within Barnstable County and the Massachusetts 9th Congressional District.

STUDY PURPOSE AND AUTHORITY

The shoreline of Sandwich is experiencing severe coastal erosion. The Town has requested on several occasions that the dredged material from maintenance of the Cape Cod Canal be placed directly on the beaches within the Town. This Detailed Project Report documents the feasibility study's findings concerning engineering feasibility, environmental and other effects, economic justification, and non-Federal sponsorship. The report is the decision document for recommendations concerning Federal participation in project implementation.

Under the Continuing Authority of Section 204 of the Water Resources Development Act (WRDA) of 1992, as amended by Section 2037 of WRDA 2007, the Corps may evaluate projects for the beneficial use of dredged material from Federal navigation projects. Specifically, this authority allows the Corps to study, design, and implement, projects to reduce hurricane and coastal storm damage to property, or for the protection, restoration, and creation of aquatic and ecologically related habitats in connection with the dredging of an authorized navigation project. Under this authority, the Corps is able to share in the costs of construction in excess of the least costly effective means of carrying out maintenance of the Federal navigation project. The Corps may fund project studies and design, and may participate in project implementation provided a non-Federal public sponsor agrees to provide 35 percent of these additional costs; provide all lands, easements and rights of way, and agree to maintain the project, among other requirements. The Town of Sandwich Massachusetts has agreed to act as the non-Federal Sponsor for this project.

The western end of the project study area is located at the south jetty at the east entrance to the Cape Cod Canal. The eastern boundary is Long Creek. Within this area there are three sections where shorefront properties are in danger of damage or loss. These areas include: (1) a 2,500-foot long section known as Town Neck Beach extending from the first groin east of the Canal to the beginning of the Town Beach parking lot at Wood Avenue, containing 29 shorefront lots; (2) a small 3,100-foot long section of beach located between Wood Avenue and the eastern jetty of the former location of the Sandwich Harbor inlet, and (3) a 14,000-foot long section of Spring Hill Beach located between the eastern jetty of the former location of the Sandwich Harbor inlet and Long Creek, fronting over 150 shorefront lots. Because of the limited quantity of sand available for beneficial reuse and the fact that coastal processes will naturally transport the material in an easterly direction, this study focused on Town Neck Beach, the most westerly area of concern. The longer reach along Spring Hill Beach will be considered in the Section 111 study, which will consider long term effects. Photographs of Town Neck Beach can be found in Appendix A.

The study focuses on the difference in the estimated cost of the Federal Base Plan and the alternative of directly placing dredged sand onto Town Neck Beach. To determine economic justification, that difference in cost is compared to the coastal storm damages that would be avoided by placing the sand on the beach (benefits), which consist of delayed storm damages. It should be noted that benefits would be directly limited by the amount of sand generated by navigation maintenance activities and the period that material is expected to remain on the beach before storm erosion resumes.

PRIOR STUDIES AND REPORTS

There have been many past reports regarding the Cape Cod Canal project and its related features; however, no prior studies or reports comprehensively examined beneficial uses of material dredged from the Canal. Two recent reports considered beneficial uses for material dredged from the Canal at specific locations.

Woods Hole Group prepared an "Expanded Environmental Notification Form – Proposed Town of Sandwich Dune and Beach Reconstruction Project" in May of 2014 for the Town of Sandwich in November 2004. This report describes a comprehensive plan to use 400,000 CY of sand to protect and restore Town Neck Beach. A portion of the 400,000 CY was assumed to come from the Canal.

The document entitled "Draft Environmental Impact Report for Beach Management, Inlet Stabilization and Maintenance Dredging for Sandwich Harbor, Sandwich, Massachusetts," was prepared by Woods Hole Group for the Town of Sandwich in November 2004. This study examines the feasibility of using the sand derived from the maintenance dredging of the Canal to nourish the beach and dune resources of Town Neck Beach and stabilizing the Sandwich Harbor inlet that has suffered significant erosion and the breaching of a jetty. The report indicates that the proposed project would represent "Phase II" of the re-use program. "Phase I" was implemented in April 2004 and created significant beach and dune resources along a portion of the Town Beach in Sandwich. This project was coordinated by the Town of Sandwich and was not funded by the Corps of Engineers. Town Beach and the Sandwich Harbor inlet are located near the east end of the Canal.

Further, an "Initial Assessment of Federal Interest for Continuing Authority Feasibility Investigation Section 145/204 Beneficial Uses of Dredged Material Regional Sediment Management Study, Cape Cod Canal, Bourne, Sandwich, Wareham and Falmouth, MA" dated January 2006 examines opportunities to use sand dredged from the Cape Cod Canal to nourish beaches in the vicinity. A very basic analysis was performed to determine the impacts of beach erosion. A rudimentary beach fill design was performed for each of the beaches to help determine the volume of sand needed for each beach. Although all of the information presented in this report is based on preliminary estimates, the results indicate that there are sufficient benefits for most of the sites to warrant continued evaluation for the placement of dredged material on the Town of Sandwich beaches.

EXISTING CONDITIONS

Tidal Datum and Littoral System

New England tides are semi-diurnal, with two cycles of different ranges every 24 hours and 50 minutes (lunar orbit). The tidal elevation data for the river entrance at Sandwich Harbor are shown in Table 1.

TABLE 1
SANDWICH
TIDAL DATUMS AND ELEVATIONS

	FT-MLLW	FT-NAVD88
Highest Observed Water Level	13.05	7.82
Mean Higher High Water	9.45	4.22
Mean High Water	8.96	3.73
North American Vertical Datum	5.23	0.00
Mean Tide Level	4.70	-0.53
Mean Sea Level	4.59	-0.64
Mean Low Water	0.23	-5.00
Mean Lower Low Water	0.00	-5.23
Lowest Observed Water Level	-3.25	-8.48

***Highest and Lowest water levels for the period between 1970 to 1976 (Between 1970 and 1976 NOAA, installed a temporary bench recorder to get the amplitude and phase correction to a control station like Boston. Table 1 incorporated that data.).**

Property Ownership

In Massachusetts, a shorefront property owner owns to the mean low water elevation, with public access to the intertidal portion of the property limited to fishing, fowling and navigation. The Town of Sandwich owns a strip of land in front of the private lots, which makes part of the beach available to the public. The remainder of the Town Beach is located to the east of the area containing private lots. With the Federal project, private landowners will grant access to the beach in front of their homes.

Utilities and Transportation Infrastructure

No utilities were identified that may be in jeopardy from a collapse of roads in the project area. However, if long term erosion is left unimpeded, it could eventually undermine Town Neck Road, the main emergency evacuation route for the Town. A total infrastructure replacement cost for Town Neck Road is approximated at $3.9 million, which includes pavement, drainage, and sign replacement (April 2008 price level). Damage to Town Neck Road and Freeman Avenue could isolate those not evacuated prior to a storm event. These damages were not included in the economic analysis because they were not expected to be realized within the five year period of analysis. However, this project would significantly delay those damages from occurring, and because they are not far removed from the period of analysis, it was pertinent to acknowledged/qualify them in this section.

Environmental Resources

An Environmental Assessment (EA), including a Finding of No Significant Impact was prepared for the Cape Cod Canal maintenance dredging pursuant to Section 404(b)(1) of the Clean Water Act, including the alternative of placing the dredged material on Town Neck Beach.

Nesting and fledging shorebirds will require restrictions, should the beach nourishment alternatives be used. These birds begin arriving at area beaches on about April 1 and conclude fledging on about September 30. Any beach fill slopes would need to be graded to at least 1:10 (ht/l) and the beach management plans of the State and municipalities would need to address shorebird needs and issues to protect those species. The Town will comply with the USFWS requirements for management plans, accordingly. Please refer to the attached EA for a comprehensive description of environmental resources and associated project impacts.

The above referenced work window of November 1 through March 31 also provides protection for most of the fish species for which the State had concerns, including diadromous fisheries, horseshoe crab and shellfish spawning, and shore-zone and juvenile fishes. The project will not directly impact lobster habitat or eelgrass. Both NMFS and the State had concerns with turbidity and moving sediments impacting the eelgrass bed, but the beds are a reasonable distance from the placement activities to minimize any impacts.

NMFS also had concerns about the placement of sand over some of the rocky intertidal habitat impacting juvenile cod habitat. Most of the rock habitat is only visible due to erosion and although some of this habitat will be temporarily covered by sand, erosion will expose the rock habitat again within the 5 year life cycle of the project.

NMFS, EPA and the State had concerns for the eelgrass growing seaward of the placement site on Town Neck Beach. No eelgrass will be directly buried and equilibrium of the beach is not anticipated to negatively impact eelgrass beds based on the historically erosion prone conditions of this area.

Cultural Resources

The Town of Sandwich is considered the oldest town on Cape Cod, built around the unique natural resources found in its coastal environment. According to the Sandwich Historical Commission, "The location was appealing, for the broad marshes bordering the sea resembled those of Sandwich, England, and were immensely valuable. With little effort the marshes could immediately provide salt hay for livestock, unlike upland or "English hay" which required cultivation by the settlers." Additionally, resources such as a brickyard presumably responsible for thwarting the British warships in the War of 1812, The Boston and Sandwich Glass Company and other businesses of the colonial era were built in close proximity to Town Neck Beach. That being the case, many of those historical/cultural resources are expected to benefit from the proposed project, by virtue of the added coastal storm protection that a widened/elevated beach inherently provides. Please refer to the attached EA for a comprehensive description of the historical/cultural resources and associated project impacts.

PLAN FORMULATION

Public Involvement

The Corps has been coordinating with the Town of Sandwich concerning erosion issues for several years and on a regular basis since July 2014 when funding was approved for the maintenance dredging. The project team, local stakeholders and agency representatives have toured Town Neck Beach and Spring Hill Beach to visually assess conditions. Representatives of the Corps, State agencies, Federal and State elected officials, Town officials and local citizens' organizations have participated in both site visits and various meetings throughout the Feasibility Study process. In addition to coordinating the Section 204 study effort with the Town of Sandwich, the Corps has also preliminarily discussed its long term goals for addressing the interaction between the Cape Cod Canal and the Sandwich Beaches via other study efforts (e.g. Section 111). The Corps continues to communicate with the Town in order for both parties to maintain a consistent understanding of the local problems, needs and opportunities for federal participation. Photos from 2014 and 2015 site visits are available in Appendix A.

Problems and Opportunities

Town Neck Beach and Spring Hill Beach have sustained coastal storm damages and have experienced acute, localized erosion along the beach face exposed to Cape Cod Bay. Residences and one commercial building have potential for severe future damages. The recent annual coastal erosion rate for the area under consideration in Sandwich has been estimated at 5 feet per year, far in excess of the long term average for this region. The impending channel maintenance dredging presents an opportunity to address some of the erosion problems immediately with an understanding that such a fix would likely have only short term benefits. The Town has also expressed interest in conducting a Section 111 study that would investigate the Canal jetties' cause and effect relationship with beach erosion in the area as well as recommend long term strategies for addressing those problems. That study is currently in the Federal Interest Determination phase and is expected to advance as soon as this Section 204 effort has been completed.

Maintaining adequate depths for vessel transit and mooring in the Canal requires periodic maintenance dredging, which creates a source of sand that could be used beneficially. Typically, the dredged material is placed offshore at an open water disposal site as the least-cost alternative. The most recent dredging of the Canal in 2010 removed 106,000 cubic yards of sand from the 32-foot deep channel and East Mooring Basin to obtain sand to cap confined aquatic disposal cells in Boston Harbor and the lower Mystic River. Prior to that, dredging in 2002 and 2003, removed 52,536 and 64,212 cubic yards of material, respectively. The material was placed at the Cape Cod Canal Disposal site in Cape Cod Bay and at the Cleveland Ledge Disposal area in Buzzard's Bay. In 2000, 162,200 cubic yards of material were removed and placed at the Cape Cod Canal Disposal site in Cape Cod Bay and at the Cleveland Ledge Light Disposal area in Buzzard's Bay. These dredging events involved the removal of maintenance material as well as advanced maintenance material so the amount attributable to regular maintenance dredging is much less. An analysis of the quantity of material removed from the Canal since 1987 indicates that the normal recurring amount of maintenance material to be removed is approximately 40,000 cubic yards every five years.

However, dredging scheduled for 2015 was approved to include advanced maintenance dredging so that the total volume of material to be removed is estimated at 150,000 cubic yards. The most recent condition survey shows a controlling depth of 30 feet MLLW rather than the 32 foot authorized project depth. The availability of sand in close proximity to eroding beaches provides the opportunity to beneficially use the dredged material for storm damage protection.

Without-Project Condition (Future Beach Conditions with No Federal Action)

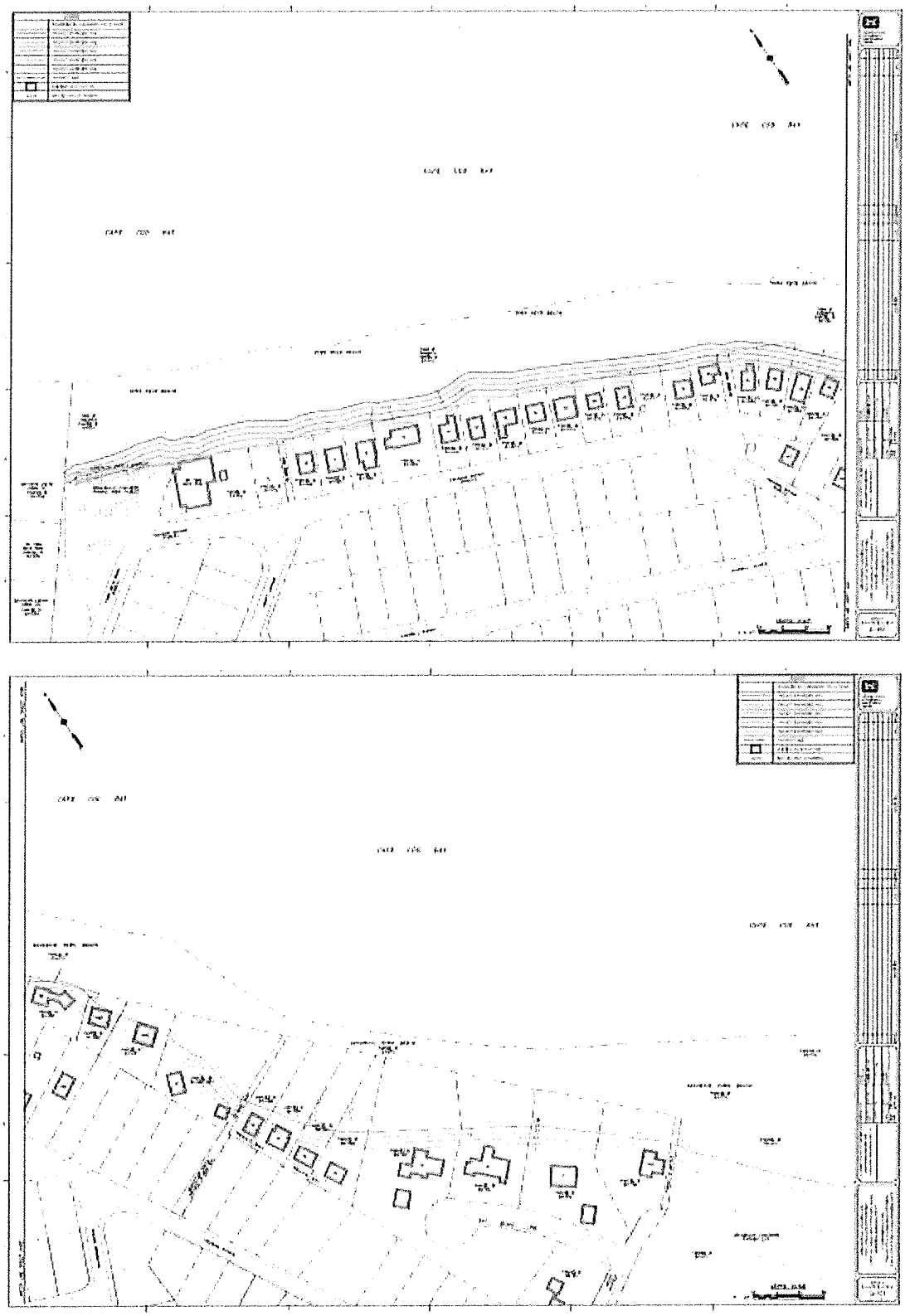
Future without-project conditions forecast the conditions expected during the period of analysis if the beneficial use project is not constructed. The future without-project conditions scenario provides the basis from which alternative plans are formulated and damages are calculated. For this study, conditions over the next five years were forecast assuming sand is not placed on Town Neck Beach. The analysis specifically evaluated which structures and/or infrastructure would be damaged by coastal erosion and when they would be damaged, assuming the erosion rate does not change over that five year period.

During the coastal analysis it was apparent that the erosion rates (3-9 ft/yr) in recent history were substantially faster than the historic rate of erosion (1-2½ ft/yr). Through discussions with the Town, the Project Development Team (PDT) and the Town's contractor, Woods Hole Group, an erosion rate of five feet per year for both the with- and without-project conditions scenarios was applied[1]. If protective measures are not implemented, it is anticipated that long-term erosion will continue at a similar rate and eventually threaten shorefront structures along the beach, as well as the water and electric infrastructure located under the road. Figures 1 and 2 depict the shoreline retreat projections in two year increments.

(It should be noted that estimated shoreline projections were prepared prior to Winter Storm Juno in January 2015, which resulted in erosion of up to 20 feet in some locations along Town Neck and Spring Hill Beach. Given that Juno has only expedited the realization of future damages in the project area and given the time-sensitive nature of this study, updated projections were not included in this document. The Corps re-surveyed the area in March of 2015and will update plans for real estate acquisition and construction purposes.)

With-Project Condition (Future Beach Conditions with Federal Action

Future with-project conditions forecast the most likely conditions expected during the period of analysis if the selected beneficial use project is constructed. The future with-project condition provides the basis from which benefits resulting from the construction project are calculated. This study forecasts the conditions expected on Town Neck Beach over the next five years if the 150,000 cubic yards of available material is placed directly onshore, during maintenance dredging of the Canal expected in the 2015-2016 dredging season. The analysis specifically evaluated how the project will either prevent or delay coastal erosion damages to structures and infrastructure over the five year (2015-2020) period of analysis. It assumes the erosion rate will not change over that time. It is estimated that the project would result in approximately $815,000 of total annualized damages prevented. The Economic Analysis, found in Appendix B, contains a comprehensive discussion of the economic analysis conducted for this project. Lastly, it should be noted that sea level rise at any predicted rate is not expected to impact the project within the period of analysis (refer to Appendix F).



Figures 1 and 2: Erosion Rate Contours

Development of Alternatives

Two alternatives for the maintenance of the Cape Cod Canal have been developed: the Federal Base Plan (i.e. dredging with open water disposal at the CCCDS), and dredging with direct placement of the dredged material on Town Neck Beach. Given the swift currents in the Canal and the distance of the dredge areas to the CCCDS and Town Neck Beach, use of a hopper dredge with direct pump-off capability is the only practicable alternative for performing the maintenance dredging and transporting and offloading the material. The alternative for placement of Cape Cod Canal dredged material on Town Neck Beach was developed based on meeting the following goals and objectives:

- Prevent or delay coastal erosion damages to life and property, including homes, commercial structures, and public infrastructure.
- Provide an economically viable solution. The additional benefits of onshore placement of the material must outweigh the costs of that placement.
- Provide a constructible solution. Onshore placement of dredged material has many construction related challenges due to environmental restrictions, equipment availability and wave and tide activity.
- Provide an environmentally acceptable solution with minimized impacts to shoreline as regulated by Massachusetts Coastal Zone Management and other similar Federal and State resource agencies.

Constraints

The impacts of expected future conditions were generally understood from the beginning of the study. That, combined with the readily available opportunity to address those impacts, limited the alternatives expected to adequately achieve the project purpose. The breadth of alternatives that could realistically be evaluated was also limited by time and sand quantity constraints.

- Time: The maintenance dredging of the CCC is a matter of navigational safety and is expected to take place regardless of whether a Section 204 study is completed by the time the 2015 'dredge window' is open. Consequently, the breadth of analysis was accounted for the compressed schedule.

- Sand Quantity: In addition to time constraints, the limited amount of sand expected to be dredged impacted the development of alternatives. Ideally the level of protection would drive the quantity of material sought, but in this case the sand quantity was effectively predetermined. The erosion concerns in this region extend far beyond the reach of 150,000 cubic yards of sand, but since that was the working estimate of available material, the development of alternatives needed to consider that constraint.

Federal Base Plan – Open Water Disposal

The Federal Base Plan for maintenance dredging of the Cape Cod Canal, as practiced for the past several decades, is dredging using a hopper dredge with open water disposal in Cape Cod Bay at the CCDS, shown in Figure 3, below. The hopper dredge discharges dredged material by opening the doors in the hopper floor at the disposal location. Possible consequences of the Federal Base Plan would include continued erosion and retreat of the beaches, resulting in greater damages to property sooner than if the dredged sand was placed directly on the beach.

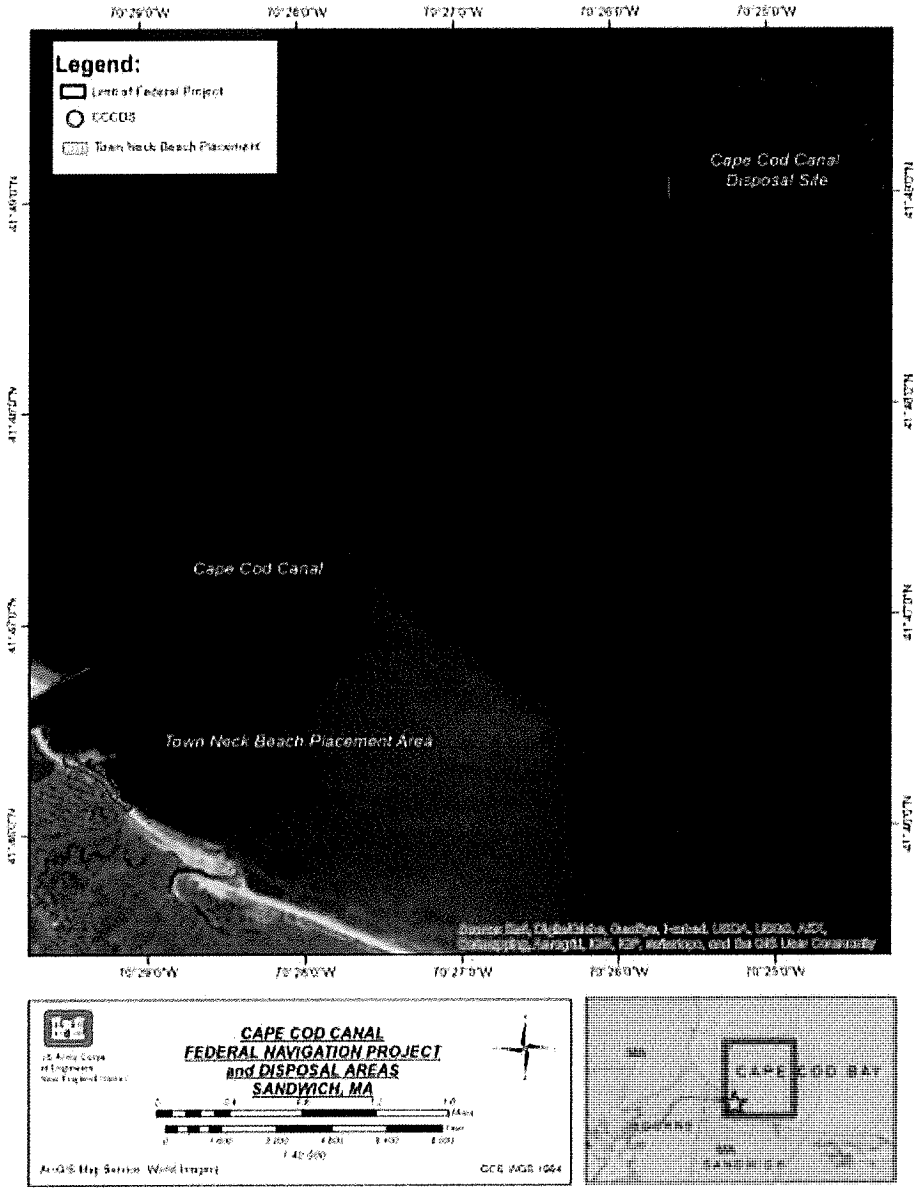


Figure 3: Cape Cod Bay Disposal Site

Beneficial-Use – Direct Placement on Town Neck Beach

This alternative proposes construction of a 2,500 foot long beach fill project with a 60-foot wide berm at elevation 13 ft MLLW using 150,000 cubic yards of material to be dredged for maintenance of the Cape Cod Canal. A portion of the material would be used to reconstruct the existing dune face. The new dune face would be planted with dune grass and sand fencing would be installed. Construction would involve direct placement by a self propelled, medium-sized pump out-capable hopper dredge.

For the volume of material available, and the locations of the structures in danger of damage, it was determined that the beach fill would be most effective over a 2,500 linear foot stretch of beach extending from the first groin east of the canal jetty to the beginning of the Town Beach parking lot. The USACE software package RMAP was used to design the fill with the assumption that the material was generally compatible with the existing beach material. The resulting analysis determined that a beach berm width of approximately 60 feet would result if the entire 150,000 cubic yards were placed on Town Neck Beach and the beach fill equilibrated from the constructed slope. At the predicted rates of erosion, this volume of fill would delay further losses of property for the next about five years. The increased berm width will vary somewhat over the project area due to natural variations in the existing beach face and the tapered fill at the northern end caused by the tie in of the beach fill to the natural salient formation. A sample beach profile and plan view are shown in Figures 4 and 5.

To determine the effects of placing dredged material on the beach, a cross-sectional beach fill construction design must be determined appropriate for the topography, local coastal processes, amount of material available and the length of beach to be protected. USACE LIDAR data was used to develop cross sections of the beaches at various locations along the study area to develop a design for placing this material on Town Neck Beach. Detail on these cross sections can be found in Appendix C.

About 150,000 cubic yards of material is available based upon the most recent condition surveys. The precise quantity that will be dredged will depend on pre-dredging survey quantities, the dredging footprint, and the amount of pay and non-pay overdepth material actually removed by the contractor. The quantity available for dredging could increase beyond 150,000 CY if shoaling has continued since the last condition survey. The quantity available for dredging could decrease if recent storm activity such as Winter Storm Juno caused material to be flushed into Cape Cod Bay. The 150,000 CY estimate is considered a reasonable assumption for planning and design purposes.

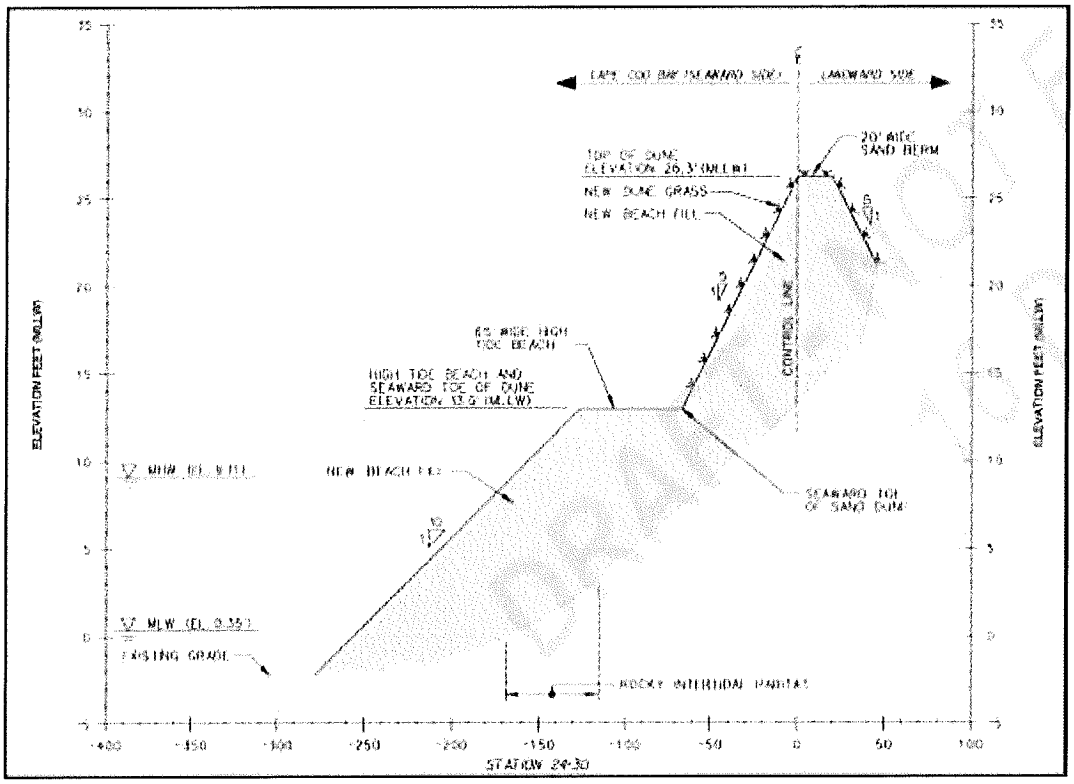


Figure 4: Typical Beach Fill Profile

Figure 5: General Town Neck Beach Nourishment Plan

PLAN EVALUATION

Cost Estimates for Alternative Plans

Cost estimates have been developed for both the Federal Base Plan and the beneficial use alternative. The estimates were developed using the Corps of Engineers Dredge Estimating Program with inputs based on recent construction bids for work of this type in New England. Cost estimates were prepared using 2015 Price Levels and include construction contract costs and non-contract costs. Construction contract estimates include costs for mobilization and demobilization of the construction plant, unit costs for dredging, placing, and shaping of the dredged material, and costs for planting and fencing. The contract unit costs for dredging and placement include removal of the material from the channel, transport and placement of the material onto the beach, contractor profit, overhead and bonds, and spreading and grading of the material on the beach. A contingency of 20 percent was applied to the contract costs according to the risk associated with each construction method.

The costs for fencing and planting of the finished dune face were computed by square feet of beach fill, assuming planting of the new dune crest and face, and fencing along both the dune crest and dune toe, and laterally at each public access way. Fencing along the dune toe would allow for elevation of the fence, or gaps in the fence line, during the shorebird season at intervals specified by the U.S. Fish and Wildlife Service (every 250 feet is used in the current design) to permit bird access to the dunes. Fencing in these areas would be lowered back to the beach surface, or reset, after the shorebird season.

Non-contract costs include Corps of Engineers costs for project design, engineering during construction supervision and administration of the contract. Design costs include preparation of Plans and Specifications, specifications surveys (hydrographic and topographic), final regulatory approvals, execution of the Project Partnership Agreement, contracting and project management costs during design. Supervision and Administration costs include costs for pre- and post-construction surveys, contract administration, supervision and inspection of construction activities, contracting and project management during construction, and close-out of the contract and project accounts.

Under the Section 204 authority, feasibility costs are 100 percent Federal. Design and construction phase costs are cost-shared with the non-Federal sponsor. Base plan costs were subtracted from the beneficial use alternatives costs to determine Section 204 project costs. As Federal and non-Federal costs were apportioned at a 65/35 rate. The full project cost, including design costs, was used for computing the Section 204 project costs, annual costs and for benefit-cost analysis. The project cost estimate summaries are provided in Appendix D.

Annual Costs

In order to compare project costs with project benefits, both must be placed on an equal basis. Costs are annualized by amortizing the Section 204 project first costs over the project life and annualizing any operations and maintenance costs for the beach fill project. Cost amortization used a five year period of analysis with a capital recovery factor of 0.2207 applied to the first cost. Annual maintenance costs include management and redistribution of the beach fill and maintenance of the dune fencing and plantings. Management of the Section 204 beach fill project would increase the Town 's annual maintenance effort as more sand has been added to the beaches.

Economic Analysis

Methodology

An economic analysis, which included a Benefit to Cost Ratio, was performed for the placement of dredged material from the Cape Cod Canal Federal Navigation Project to provide coastal storm risk reduction measures in the Town of Sandwich, Massachusetts. The analyses followed USACE guidance for conducting economic evaluations as contained in ER 1105-2-100, Appendix F, Amendment #2 (31 January 2007), Section III, "Section 204, Water Resource Development Act of 1992, as amended – Beneficial Use of Dredged Material."

The economic benefits of providing coastal storm damage protection through beneficial use of dredged material were calculated in two steps. First, the projected without-project conditions were compared to the with-project condition. Then, the least-cost disposal plan associated with the Navigation maintenance dredging (base plan) is compared to the cost of providing the coastal storm damage protection. This analysis was conducted using the Fiscal Year 2015 Federal interest rate for water resources projects of 3.375%. A five year period of analysis was used. The following paragraphs briefly describe the estimated damages prevented and the cost comparison. The comprehensive economic analysis report is provided in Appendix C.

Structural Damages

The study evaluated 30 residential structures at risk of being undermined due to coastal erosion. The depreciated replacement value of each structure was based on field observations and tax assessment records available from the Town of Sandwich. For the purpose of this economic analysis, a structure was considered damaged when the erosion line reached the seaward edge of the structure. Coastal engineering determined that the 150,000 cubic yards of beach fill would last approximately five years. In the with-project scenario, it was assumed that the erosion rate would remain at five feet per year and that the structures would be damaged five years later than they would in a without-project scenario. A total of 7 structures with a total present value of $2.03 million are expected to be damaged due to coastal erosion within the next five years if risk reduction measures are not implemented. That number would decrease to zero in the with-project scenario, yielding annual benefits of approximately $448,370 ($2,031,600 x CRF of .2207) as shown in Table 2 below.

Land Loss Avoided

The value of land lost to erosion was estimated using average land values obtained from the Town of Sandwich property assessment office. In order to compute those averages land values of 12 shorefront properties (38% of structure inventory) were compared to land values of 12 properties in the backshore. The average price per acre was approximately $2.1M on the shore front compared to $740K in the backshore, or $49.00 compared to $17.00 per square foot. The equation below presents the land valuation and calculation for Land Lost Due to Erosion:

(2,500 Linear Feet) x (5 Feet per Year of Erosion) = 12,500 Square Feet per Year
(12,500 Square Feet per Year) x ($17.00 per Square Foot) = $212,500 per Year

Recreational Benefits

Beach nourishment plans consider recreational benefits in addition to prevented storm damages. Beach nourishment provides enhanced recreational benefits based on the overall enhanced beach experience. Recreational benefits for Federal Water Resource Projects are calculated using the Unit Day Value Method (UDV) as detailed in Corps Economic Guidance Memorandum #15-01, "Unit Day Values for Recreational, Fiscal Year 2015." The recreation experience was evaluated through a point system that cross referenced overall visitor experience to the dollar values provided in the economic guidance memorandum, thereby determining the average dollar value per day per user, or UDV.

The beneficial use of dredge material will add substantial area for beachgoers and fishermen to access the beach without trespassing on private lots. The beach nourishment alternative at Town Neck Beach generated a total of 72 points and a UDV of $9.73, compared to the without-project value of 33 points and a UDV of $6.52. The UDV amount was multiplied by the number of beach visitors to determine the value of recreational benefits. The UDV for annual attendance in the with-project condition compared to the without-project condition yields an annual recreation benefit value of $153,400 for dry beach space at Town Neck Beach.

Cost Comparison

The benefit of providing coastal storm damage protection through beneficial use of dredged material is equal to the reduction in annual damages between the without- and with-project conditions plus the additional recreational benefits obtained from the widened beach. The least-cost disposal plan associated with the Navigation maintenance dredging was compared to the cost of providing the coastal storm damage protection. Open water disposal is the least-cost Federal base plan, which is compared to beach nourishment using a pump-off hopper dredge to place dredge disposal material on the beach in Sandwich. The cost difference between these plans was then used to determine the overall Cost Benefit Ratio of the project. Table 2 below presents the cost comparison between the two plans and the economic justification for the 204 project.

Sandwich 204 2015 Economic Update		
	Federal Base Plan Open Water Placement	**Pump-off Hopper Dredge at Spring Hill Beach**
2015 Total First Cost	$ 3,533,000	$ 5,181,000
IDC - 4 Months @ 3.375%	14,900	21,900
2015 Total Investment	**$ 3,547,900**	**$ 5,202,900**
Incremental Cost of Beach Renourishment		$ 1,655,000
Capital Recovery Factor for 5 Years at 3.375%		0.2207
2015 Annual Costs for 5-Year Period of Analysis		$ 365,255
Annual Benefits for 5-Year Period of Analysis		
-Reduced Structure Damage		$ 448,370
-Reduced Land Loss		212,500
-Increased Recreation Unit Day Value		153,400
Total Benefits		$ 814,270
Net Annual Benefits		$ 449,015
Benefit:Cost Ratio		2.2

Table 2: Cost Comparison

Conclusion

The incremental construction cost of beach renourishment over the Federal base plan is $1,655,000 or $365,255 when annualized over the 5-year period of analysis. Net annual benefits amount to $449,015 yielding a positive Benefit to Cost Ratio of 2.2 to 1.

These benefits indicate a positive National Economic Development plan for beneficial use of dredged material to provide coastal storm damage reduction measures in the Town of Sandwich, Massachusetts.

Environmental Impacts

An Environmental Assessment, Finding of No Significant Impact, and Clean Water Act Section 404(b)(1) Evaluation was prepared for this project and is included with this Detailed Project Report. Construction windows have been established in coordination with Federal and State agencies for protection of aquatic resources in the dredging area (horseshoe crabs spawning (no work 1 May to 30 June)), and for protection of shorebirds and other resources along the beach (birds (no work 1 April to 31 August) and shorezone and juvenile fish (1 May to 31 October). Work would therefore occur between 1 November and 31 March. Burial of some intertidal rocky habitat will occur with the beach nourishment and this would temporarily impact some juvenile cod essential fish habitat, but erosion will expose the rocks again over time. With beach slopes that consider shorebird needs, construction windows and monitoring of piping plovers during the nesting season, as coordinated by the Town, no unavoidable or significant environmental impacts are anticipated from the beach fill project. The distance between eelgrass beds and lobster habitat, and beach placement activities provides protection for those resources. Coordination letters from State and Federal agencies concerning the Endangered Species Act, Essential Fish Habitat, and Fish and Wildlife Coordination Act, and Clean Air Act can be found in the Environmental Assessment. The Environmental Assessment also contains a copy of the Water Quality Certificate.

Real Estate Requirements

A Real Estate Planning Report is included as Appendix E. The report describes the interests required for project implementation and identifies the properties involved, their value, and ownership. The selected plan will require one type of standard permanent easement for the project. All project activities, including mobilization and construction, lay down and storage of contractor materials and equipment, planting of dune grass and placement of sand fences, as well as crossover areas, are located within the project area Limit of Construction. The right-of entry over Sponsored owned land will be addressed through the Authorization for Entry for Construction..

The Town of Sandwich will acquire the permanent easements from the property owners. The property owners have been approached by the Town of Sandwich and explained their options regarding the easement. It is anticipated that the property owners will donate those interests to the Town of Sandwich. There are 10 Parcels, one of which is a right-of-way. These easements are needed for construction, operation and maintenance of the project, along with providing perpetual (permanent) public use and access to the beach.

There was no gross appraisal or Informal Value Estimate for the permanent easements but rather a stipulation of value, as agreed by the Sponsor. Due diligence was performed but market value of beach frontage below mean high water had no discernible value and market evidence was not available to contradict this finding.

A $95,000 of Administrative cost was included in the project cost estimate based on 26 weeks of administrative time over the course of the project or a 20 hour week over a one year period at $100/hour, which includes overhead. This estimate of town involvement on real estate issues including the legal due diligence for the parking lot, staging areas and other incidental costs. This is a relevant cost regardless of whether there is value to the real estate.

The non-Federal Sponsor, the Town of Sandwich, is aware of these requirements and will provide the necessary real estate interests before bids are solicited for construction.

Cultural Resources Impacts

No negative impacts to cultural resources are expected with the project, either under the Federal Base Plan or the beneficial use beach fill alternative. The project has been coordinated with the State Historic Preservation Office as well as the Sandwich Historical Commission. In fact, the beach fill alternative is expected to have a positive impact by virtue of delaying/preventing erosion/flooding impacts to local historically significant resources.

CONCLUSIONS

This report concludes that there is Federal interest in proceeding with implementation of a Section 204 project for the beneficial use of dredged material from the Cape Cod Canal. The analysis indicates that nourishment of Town Neck Beach is feasible, environmentally acceptable, and economically justified.

The Corps, under its Section 204 continuing authorities program may study, design and implement projects to reduce storm damage to property in connection with the dredging of an authorized navigation project. Storm damage reduction was added as a Section 204 project purpose by Section 2037 of the Water Resources Development Act of 2007. The Corps may share in the costs of design and construction in excess of the most cost effective means of carrying out dredging of the Federal navigation project (the Federal Base Plan – in this case offshore disposal placement).

The non-Federal Sponsor, the Town of Sandwich, is capable and willing to enter into a Project Partnership Agreement to share in the cost of construction and provide all real estate interests. Cost sharing for project implementation, exclusive of any real estate costs, where the project purpose and benefits are for coastal storm damage reduction, is 65 percent Federal and 35 percent non-Federal, as specified in Section 103(c) of the Water Resources Development Act of 1986.

This report also concludes that the Section 204 beach fill will only provide a temporary solution for the erosion problems being experienced in the Town of Sandwich. Spring Hill Beach which is just east of the inlet to Sandwich Harbor is also in need of beach material. Accordingly additional studies are recommended under more encompassing State or Federal authorities to address long term needs for shore protection for these and neighboring communities for a more permanent and sustainable solution to coastal erosion in the region. More specifically, the Corps has initiated a Section 111 study that will investigate the level of impact the Cape Cod Canal jetties has on the 'downdrift' beaches as well as potential long term solutions.

RECOMMENDATIONS

This feasibility investigation recommends beneficial placement of dredged material from maintenance dredging of the Cape Cod Canal Federal navigation project as beach fill on a 2,500 foot section of Town Neck Beach in Sandwich, Massachusetts, under the Continuing Authority of Section 204 of the Water Resources Development Act (WRDA) of 1992, as amended by Section 2037 of WRDA 2007. The beach fill will be used to widen and increase the elevation of the beach berm and rebuild dunes to provide protection to shorefront properties. Any new dune surface will be protected by plantings and sand fencing. The Town of Sandwich, Massachusetts has agreed to execute a Project Partnership Agreement with the Government for construction and future maintenance of the project as the non-Federal Sponsor. The Sponsor will ensure management of the beach consistent with public use and access and in accordance with measures to protect shorebirds.

I have considered all significant aspects in the overall public interest including engineering and economic feasibility and environmental, cultural, and social effects in concluding that the approved plan described herein is the best implement able alternative meeting the objectives of this investigation.

I further recommend that this Feasibility Report be the basis for proceeding with Engineering and Design and construction of the approved plan under the authority of Section 204 of the Water Resources Development Act (WRDA) of 1992 (33 USC Sec. 2326), as amended.

The recommendations contained herein reflect information available at this time and current Department of the Army policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of the national civil works construction program nor the perspective of higher review levels of the Executive Branch. Consequently, the approval may be modified before transmission for authorization and /or implementation.

5 JUN 2015
Date

Christopher J. Barron
Colonel, Corps of Engineers
District Engineer

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS, NORTH ATLANTIC DIVISION
FORT HAMILTON MILITARY COMMUNITY
302 GENERAL LEE AVENUE
BROOKLYN NY 11252-6700

CENAD-PD-CS

JUN 19 2015

MEMORANDUM FOR Commander, New England District, US Army Corps of Engineers, 696 Virginia Road, Concord, MA 01742

SUBJECT: Cape Cod Canal, Sandwich, Massachusetts, Section 204, Continuing Authorities Program – Detailed Project Report/Environmental Assessment (Feasibility) (CWIS/P2 #153133)

1. Reference the subject Detailed Project Report (DPR) and Environmental Assessment, funded and prepared, pursuant to Section 204 of the Continuing Authorities Program.

2. I concur with the findings and recommendations of the New England District Commander, COL Christopher J. Barron. The DPR recommends implementation of a beneficial use of dredged material project. This will provide future storm damage risk reduction, through direct placement of sand on Town Neck Beach along a 2,500 linear foot section of highly eroded beach and dune, affording damage prevention over an approximate 5 year period of analysis. The total project costs are estimated at $5.18M. The Federal Base Plan has an estimated total cost of approximately $3.53M. Therefore the increased cost for construction of the beach plan is estimated at $1.65M, which will be cost-shared on a 65 percent Federal and 35 percent non-Federal basis. I confirm that the report complies with all applicable policies and laws.

3. The point of contact is Mr. Joseph Vietri, Chief, Planning and Policy, 347-370-4570.

WILLIAM H. GRAHAM
COL EN
Commanding

APPENDIX A
Site Reconnaissance Photos

August 2014

February 2015 (Post Juno)

August 2014

February 2015 (Post Juno)

August 2014

February 2015 (Post Juno)

APPENDIX B
Economic Analysis

SANDWICH, MASSACHUSETTS
TOWN NECK BEACH

§204 BENEFICIAL USE OF DREDGED MATERIAL STUDY

ECONOMIC ANALYSIS
May, 2015

Introduction

This report presents the economic analysis of using dredged sand from the Cape Cod Canal Federal Navigation Project to provide coastal storm risk reduction measures in the Town of Sandwich, Massachusetts. The analyses follows the U. S. Army Corps of Engineers (USACE) guidance for conducting economic evaluations as contained in ER 1105-2-100, Appendix F, Amendment #2 (31 January 2007), Section III, "Section 204, Water Resource Development Act of 1992, as amended – Beneficial Use of Dredged Material."

The economic benefits of providing coastal storm damage protection through beneficial use of dredged material are calculated in two steps. First, the projected without-project conditions are compared to the with-project condition. Then, the least-cost disposal plan associated with the Navigation maintenance dredging (base plan) is compared to the cost of providing the coastal storm damage protection. This analysis was conducted using the Fiscal Year 2015 Federal interest rate for water resources projects of 3.375%. A five year period of analysis is used.

Description of Study Area

The Cape Cod Canal is a sea level canal located about 50 miles south of Boston, Massachusetts. It intersects a narrow neck of land which joins Cape Cod to the mainland. The Canal extends from Cape Cod Bay on the east to Buzzards Bay on the west. The town of Sandwich is located adjacent to the Canal on the southeast side. The Canal provides safe and efficient passage for commercial and recreational vessels wishing to transit between Cape Cod Bay and Buzzards Bay.

The purpose of the proposed maintenance dredging is to remove shoals from the Federal Navigation Project and restore it to its authorized depth. The proposed project will use the dredged material as beach-fill on a 2,500 foot long eroded section of Town Neck Beach, located adjacent to the south breakwater at the eastern end of the Canal in Sandwich, MA.

The town of Sandwich, in Barnstable County, MA contains primarily suburban residential development, with clusters of commercial and retail development as well as areas of open space. The dredged material will be placed on a public beach known as Town Neck Beach. Selected economic characteristics from the American Community Survey 5-year estimates (2009-2103) show Sandwich has a population of 20,675, contains 9,476 housing units, and has a median household income of $82,617 (http://factfinder.census.gov). The unemployment rate was 4.7% in December 2014 (http://data.bls.gov).

History of Major Storm Events

New England has a long history of severe winter storms. Most winter storms bring to Cape Cod both storm surge and high winds, making the coastline particularly vulnerable to damage. Due to the high development of the coastline, properties and infrastructure are at significant risk of erosion impacts caused by storm surge and high winds. Table 1 below presents a list of Disaster declarations made by the Federal Emergency Management Agency (FEMA) that affected coastal areas. Massachusetts has had thirteen (13) storm-related emergency declarations since 1954 involving coastal flooding and damages.

Table 1 FEMA Major Disaster Declarations

Number	Date	Incident Description
4110	04/19/2013	Severe Winter Storm, Snowstorm, and Flooding
4097	12/19/2012	Hurricane Sandy
4028	09/03/2011	Tropical Storm Irene
1895	03/29/2010	Severe Storm and Flooding
1614	11/10/2005	Severe Storms and Flooding
1364	04/10/2001	Severe Storms & Flooding
975	12/21/1992	Winter Coastal Storm
920	11/04/1991	Severe Coastal Storm
914	08/26/1991	Hurricane Bob
751	10/28/1985	Hurricane Gloria
546	02/10/1978	Coastal Storms, Flood, Ice, Snow
43	08/20/1955	Hurricane, floods
22	09/02/1954	Hurricanes

http://www.fema.gov/disasters/grid/state-tribal-government/2?field_disaster_type_term_tid_1=All

The following storm summaries were provided by Massachusetts Executive Office of Public Safety and Security in the 2013 State Hazard Mitigation Plan, available at http://www.mass.gov/eopss/docs/mema/mitigation/state-hazard-mitigation-plan/massachusetts-state-hazard-mitigation-plan.pdf :

Coastal Storms, Flood, Ice, Snow (DR-546)—February 1978

The February 1978 Blizzard has historically been the benchmark storm for comparison by all subsequent nor'easters. This life-threatening nor'easter crippled most of the Commonwealth with blizzard conditions, extraordinarily heavy snow, high winds, and devastating coastal flooding. The storm claimed 73 lives in Massachusetts and 26 in neighboring Rhode Island. Over 10,000 people had to be sheltered. An unprecedented ban on non-emergency vehicle traffic lasted for a week in much of eastern Massachusetts.

The combination of strong northeast winds and a slow moving storm system along with astronomically high tides brought in a large fetch of water along coastal communities. This caused serious coastal flooding and beach erosion problems resulting in broken seawalls and massive property loss. This event resulted in a federal disaster declaration (DR-546).

Hurricane Bob (DR-914)—August 1991

Hurricane Bob was the second named storm and the first hurricane of the 1991 hurricane season, reaching a Category 3 status. Winds were sustained at 115 mph, impacting North Carolina, Mid-Atlantic States, New England, and Atlantic Canada, causing 15 fatalities. This event resulted in a federal disaster declaration (DR-914).

Severe Coastal Storm (DR-920)—October-November 1991

This storm was an unusual event, as the large Nor'easter moved south and gained strength when it joined what remained of Hurricane Grace, becoming what some refer to as the Perfect Storm. Winds from this event were measured over 80 MPH, with waves over 30 feet in some parts of the coastline. This storm caused flooding and wind damage in several counties and the event resulted in a federal disaster declaration (DR-920).

Coastal Storm (DR-975)—December 1992

This event resulted in 1,874 National Flood Insurance claims in Massachusetts at a cost of nearly $12.7 million.

Severe Storms and Flooding (DR-1364)—March-April 2001

A series of storms occurred in Massachusetts between March 5 and April 16, 2001. These events included a major winter storm, heavy rainfall, and melting snow. On March 5, a major winter storm impacted Massachusetts with near-blizzard conditions, high winds, and coastal flooding. Over 2 feet of snow fell across the interior portion of the Commonwealth. Approximately 80,000 people were without power and businesses and schools were closed for several days. High tides ran 2 to 3 feet above normal, resulting in widespread coastal flooding along the entire east-facing coastline. Beachfront homes and roadways were flooded and sea walls were damaged. Between March 22 and March 31, flooding occurred throughout Massachusetts as a result of melting snow and heavy rainfall. The most severe flooding occurred in the Merrimack Valley. An event on March 30, with heavy snow in parts of interior Massachusetts and heavy rain and strong winds in coastal communities, caused flooding along rivers and streams in the eastern portion. Over 6 inches of rain fell in some areas. This series of flooding events resulted in a federal disaster declaration (DR-1364).

Coastal Storm / Nor'easter (DR-1614)—October 2005

A strong Nor'easter, combined with the remnants of Tropical Storm Wilma, brought heavy rainfall, damaging winds, and coastal flooding to the eastern portion of Massachusetts. Rainfall totals ranged between two and 2.5 inches. The high winds brought down limbs, trees, and wires, resulting in power outages to thousands of people. This event caused approximately $733,000 in property damage.

Tropical Storm Irene (DR-4028)—August 2011

Tropical Storm Irene (August 27-29, 2011) produced significant amounts of rain, storm surge, inland and coastal flooding, and wind damage across southern New England and much of the east coast of the U.S. In Massachusetts, rainfall totals ranged between 0.03 inches (Nantucket Memorial Airport) to 9.92 inches (Conway, MA). These heavy rains caused flooding throughout the Commonwealth and a presidential disaster was declared (DR-4028). Tropical Storm Irene was closely followed by the remnants of Tropical Storm Lee, which brought additional heavy rain to Massachusetts and extended flooding. Severe river erosion occurred in northwestern Massachusetts, closing State Route 2. Landslides were also triggered by the heavy rain and wet soil in this area of steep slopes containing layers of glacial lake clay. The Commonwealth received over $31 million in individual and public assistance from FEMA

Hurricane Sandy (DR-4097)—October-November 2012

Hurricane Sandy was the largest Atlantic hurricane on record, with winds spanning 1,100 miles in diameter, reaching sustained forces of 110 mph. Estimated losses due to damage and business interruption are still being calculated, but are estimated to exceed $65 billion. At present count (December 2012), at least 253 people were killed along the path of the storm, with 131 of those deaths occurring within the U.S. although no deaths occurred in Massachusetts.

Winter Storm Juno—January 2015

Winter Storm Juno was the first significant storm of the New England 2014-2015 winter season. The storm brought upwards of 36 inches of snowfall to certain areas and storm surges caused flooding and erosion along the coast. Sustained winds of 50 mph were felt with gusts up to 75 mph. In the coastal towns of Scituate and Marshfield, MA, the sea walls collapsed resulting in widespread damage to homes and infrastructure.

Benefit Methodology

For this analysis, the without project condition is defined as the Federal Base Plan or least-cost alternative, in which material would be placed at the Cape Cod Disposal Site (CCDS) and no material is placed onshore. The with-project condition is defined as the beneficial placement option in which dredge disposal material is placed on the beach between Town Neck Road and Wood Avenue in the Town of Sandwich, MA.

Project benefits are based on reducing long-term shoreline erosion and the consequent reduction in damages experienced at structures in the Town Neck Beach area. The erosion rates were estimated using two sets of historical data; the MA Coastal Zone Management (MACZM) shoreline erosion rate maps, and the LIDAR data collected by NOAA. For this analysis, the erosion rate of 5.0 Feet per year was used for both the with- and without-project conditions. If protective measures are not implemented, it is anticipated that long-term erosion will continue at the current rate and eventually threaten shorefront structures along the beach as well as the water and electric infrastructure located under the road.

Future Without-Project Condition

The study evaluated 30 residential structures at risk of being undermined due to coastal erosion. The depreciated replacement value of each structure was based on field observations and tax assessment records available from the Town of Sandwich. GPS coordinates were obtained for the existing dune line by a New England District survey team. Damages were analyzed for the Future Without-Project (FWOP) condition using ArcMap Geographic Information Systems (GIS) and Microstation Computer Aided Design (CAD) to overlay the GPS coordinates of the dune line on aerial photographs geo-referenced to parcel maps. Structures closest to the dune line are assumed to be impacted as early as 2016. Past efforts to halt damage due to long term erosion have been unsuccessful. Coir logs and sand bags used in 2015 were overtopped and outflanked, providing no protection against erosion. These temporary protective measures are not expected to be repeated in future years.

The dune line was then advanced landward in two year increments at the 5.0 Feet per year erosion rate. A structure was considered damaged when the erosion line reached the seaward edge of the structure. The present value of the structure was determined for that same year using the current 2015 Fiscal Year Federal Discount Rate of 3.375%. The structure was considered a total loss and was not rebuilt once this occurred. Structures along the entire 2,500 foot length of study area in the without-project condition are valued at $7.5M (2015 Price Level) and are presented in Table 2 below.

With-Project Condition

The with-project condition assumes the placement of dredged material on Town Neck Beach between Town Neck Road and Wood Avenue. Maintenance Dredging of Cape Cod Canal will result in approximately 150,000 cubic yards of sand available for beneficial use. Coastal engineering determined that this amount of material will provide a beach fill that will extend for approximately 2,500 linear feet and will last approximately 5 years. In the with-project condition, it is assumed the erosion rate will remain at 5.0 feet per year, and the structures would be damaged 5 years later than in the without-project condition.

Properties at imminent risk of destruction were located on Google Earth. A linear measurement of approximately 2,500 feet, as shown in Figure 1 below, was used to define the shoreline area where placement of dredge disposal material would have the greatest beneficial effect and reduce the greatest number of potential damages within the next five years.

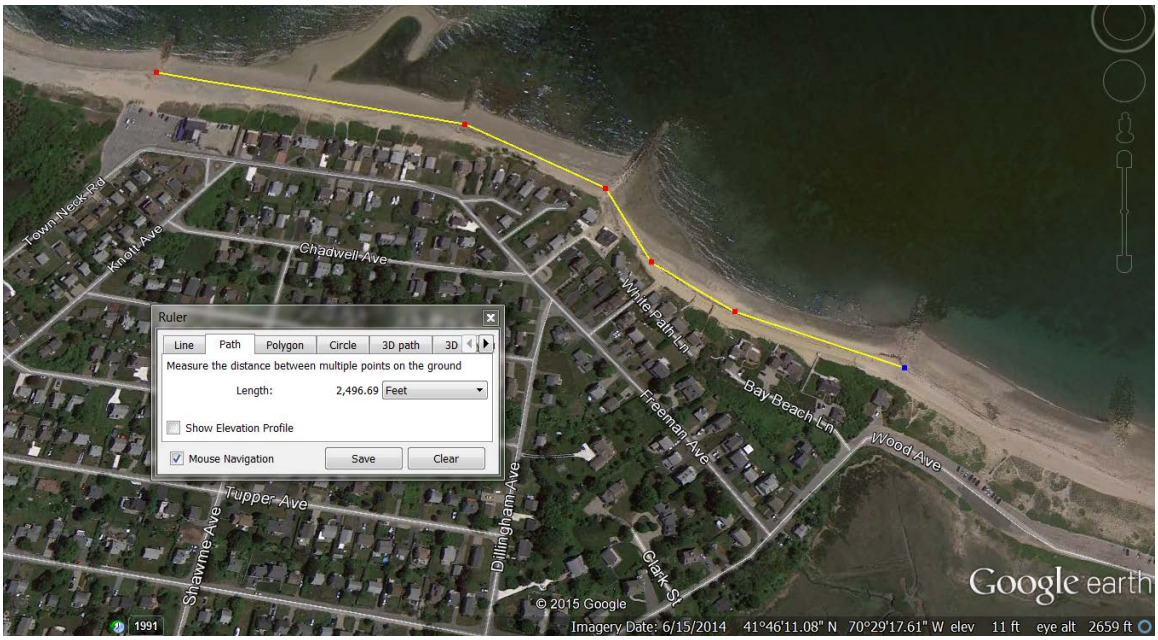


Figure 1 Erosion Impact Zone and Area for Placement of Dredged Material

The present value was determined for structures in the with-project condition based on the additional length of time before erosion undermined the structure. Structure values for the with-project condition are also presented in Table 1 below. To calculate the damages in the with-project condition, only the present value of structures damaged within the 5-year project life were included.

The present value of structures damaged in the without-project condition (shown in **bold** in Table 2) is approximately $2.03 Million compared to zero damages in the with-project condition. Present Value and Annual damages were calculated using the current 2015

Fiscal Year Federal Discount Rate of 3.375% for the 5-year life of the project. A total of 7 structures are expected to be damaged due to coastal erosion within the next five years if risk reduction measures are not implemented. That number would decrease to zero in the with-project condition, yielding annual benefits of approximately $448,400 as shown in Table 3 below. The assessor records for the seven structures were reviewed to determine their foundation types. Only one structure indicated the presence of posts but they were for the deck only. This structure is situated the furthest seaward, is not elevated to a significant height above the ground, and is the most susceptible to long term erosion damages. As long term erosion occurs and the beach and dune line move landward, all seven properties would be undermined and subjected to daily flooding at high tide and would therefore be considered completely destroyed.

Table 2 Structure Values for With- and Without-Project Conditions

Town Neck Beach		***Without-Project Condition***				***Future With-Project Condition***			
Tax Parcel No.	*2015 Structure Value $*	*Year Damage Occurs*	*Year Lost*	*Present Value Factor*	*Present Value $*	*Year Damage Occurs*	*Year Lost*	*Present Value Factor*	*Present Value $*
89-103-	369,013	2022	7	0.7927	292,500	2027	12	0.6715	247,774
89-104-	522,963	2022	7	0.7927	414,500	2027	12	0.6715	351,144
89-105-	399,417	2024	9	0.7418	296,300	2029	14	0.6283	250,962
89-106-	121,513	2019	4	0.8757	**106,400**	2024	9	0.7418	90,133
93-013-	593,431	2023	8	0.7668	455,000	2028	13	0.6495	385,450
93-014-	Vacant	-	-	-	-	-	-	-	-
94-066-	198,895	2024	9	0.7418	147,500	2029	14	0.6283	124,970
94-067-	126,597	2024	9	0.7418	93,900	2029	14	0.6283	79,544
94-068-	284,513	2024	9	0.7418	211,000	2029	14	0.6283	178,766
94-069-	142,867	2024	9	0.7418	106,000	2029	14	0.6283	89,766
94-070-	152,832	2024	9	0.7418	113,400	2029	14	0.6283	96,028
94-071-	203,471	2024	9	0.7418	150,900	2029	14	0.6283	127,845
94-072-	124,665	2024	9	0.7418	92,500	2029	14	0.6283	78,330
94-073-	175,406	2024	9	0.7418	130,100	2029	14	0.6283	110,211
94-074-	87,652	2024	9	0.7418	65,000	2029	14	0.6283	55,074
94-075-	64,061	2024	9	0.7418	47,500	2029	14	0.6283	40,251
94-076-	72,704	2024	9	0.7418	53,900	2029	14	0.6283	45,682
94-077-	Vacant	-	-	-	-	-	-	-	-
94-078-	266,617	2024	9	0.7418	197,800	2029	14	0.6283	167,521
94-079-	86,839	2024	9	0.7418	64,400	2029	14	0.6283	54,563
94-080-	95,583	2023	8	0.7668	73,300	2028	13	0.6495	62,084
94-081-	129,444	2023	8	0.7668	99,300	2028	13	0.6495	84,078

94-082-	99,752	2023	8	0.7668	76,500	2028	13	0.6495	64,792
94-083-	80,839	2022	7	0.7927	64,100	2027	12	0.6715	54,279
94-086-	261,736	2017	2	0.9358	**345,300**	2022	7	0.7927	207,470
94-089-	104,837	2016	1	0.9674	**101,400**	2021	6	0.8194	85,905
94-091-	228,790	2016	1	0.9674	**221,300**	2021	6	0.8194	187,475
94-095-	708,334	2022	7	0.7927	561,500	2027	12	0.6715	475,611
94-101-1	321,628	2023	8	0.7668	246,600	2028	13	0.6495	208,907
94-101-2	648,645	2020	5	0.8471	**549,500**	2025	10	0.7175	465,427
94-101-3	379,486	2019	4	0.8757	**332,300**	2024	9	0.7418	281,486
94-101-4	428,702	2019	4	0.8757	**375,400**	2024	9	0.7418	317,991

Table 3 Annual Benefits to Structures

# Structures Damaged (Bold from Table 1)	7
Present Value of Properties Damaged within 5-Year Project Life	$2,031,600
Capital Recovery Factor-5 years	0.2207
Annual Structure Damages Avoided	**$448,370**

Land Loss Avoided

The value of land lost to erosion was estimated using average land values obtained from the Town of Sandwich property assessment office. Land values of 12 shore front properties (38% of structure inventory) were compared to land values of 12 properties in the backshore. The average price per acre was approximately $2.1M on the shore front compared to $740K in the backshore, or $49.00 compared to $17.00 per square foot. Table 4 below presents the land valuation and calculation for Land Lost Due to Erosion. The toe of the dune was established by a New England District Survey team. The calculation is based on the projected distance eroded landward from the surveyed toe of the dune; occurring during the 5-year period of analysis. Historically, the beach profile has receded landward at a rate of 5 Feet per year with no evidence of accretion. The following equation was used:

(2,500 Linear Feet) x (5 Feet per Year of Erosion) = 12,500 Square Feet per Year

(12,500 Square Feet per Year) x ($17.00 per Square Foot) = $212,500 per Year

Table 4 Land Lost Due to Erosion

Address-Back Shore	Lot Size (Acres)	Assessed Land Value ($)	Address-Shore Front	Lot Size (Acres)	Assessed Land Value ($)
12 Tupper Ave	0.11	141,900	11 Freeman	0.22	499,200
31 Tupper Ave	0.24	166,200	23 Freeman	0.11	431,700
4 Tupper Ave	0.11	141,800	33 Freeman	0.11	431,700

71 Almy Ave	0.11	141,800	39 Freeman	0.12	445,300
22 Tupper Ave	0.34	170,800	45 Freeman	0.37	604,000
28 Wood Ave	0.41	174,000	49R Freeman	0.11	431,700
19 Carmen Ave	0.24	166,000	1 Bay Beach Lane	0.69	555,700
39 Carmen Ave	0.25	166,500	103 Wood Ave	0.46	459,700
37 Wood Ave	0.22	165,000	27 Freeman Ave	0.11	431,700
111 Knot Ave	0.22	165,000	5 Freeman Ave	0.11	431,700
46 Wood	0.11	141,800	7 Freeman Ave	0.11	431,700
14 Almy Ave	0.22	165,000	9 Freeman Ave	0.11	431,700
	2.58	$1,905,800		2.63	$ 5,585,800
Average Price per Acre Back Shore		**$738,682**	Average Price per Acre Shore Front		**$ 2,123,878**
Average Price per Sq Ft @ 43,560 sq ft per acre		$ 16.96	Average Price per Sq Ft @ 43,560 sq ft per acre		$ 48.76
ROUNDED		**$17.00**			
Shoreline Impact Distance (Linear Feet)		2,500			
Landward Erosion per Year (Feet)		5			
Area Eroded each year (Sq Ft)		12,500			
Value of Land Loss Avoided		**$212,500**			

Recreation Benefits

Beach renourishment plans consider recreational benefits in addition to prevented storm damages. Beach renourishment provides enhanced recreational benefits based on the overall enhanced beach experience. Recreational benefits for Federal Water Resource Projects are calculated using the Unit Day Value Method (UDV) as detailed in Corps Economic Guidance Memorandum #15-01, “Unit Day Values for Recreational, Fiscal Year 2015." The recreation experience is evaluated through a point system which rates the beach using the five criteria listed in Table 5 below.

The number of points attributed to the overall visitor experience is cross-referenced to dollar values provided in the economic guidance memorandum to determine the average dollar value per day per user, or UDV. The beneficial use of dredge material will add substantial area for beachgoers and fishermen to access the beach without trespassing on private lots. Beach renourishment alternatives at Town Neck Beach generate a total of 72 points and a UDV of $9.73 compared to the without-project value of 33 points and a UDV of $6.52. The UDV amount is multiplied by the number of beach visitors to determine the value of recreational benefits. The UDV and calculation of number of

visitors are provided in Tables 4 and 5 below. The UDV for annual attendance in the with-project condition compared to the without-project condition yields an annual recreation benefit value of $153,400 for dry beach space at Town Neck Beach.

Table 5 Visitor Calculation

Parking Areas	Town Neck	Boardwalk	Total
Parking spaces	140	42	182
# Days Memorial-Labor Day	105	105	105
Parking capacity per season	14,700	4,410	19,110
People per car	2.5	2.5	2.5
Total visitors (Rounded)	36,800	11,000	47,800

Table 6 Recreation Benefits Based on Unit Day Value

UDV CRITERIA	POINT RANGE	Without Project POINTS	With Project POINTS
Recreation Experience	0 - 30	7	20
Availability of Opportunity	0 - 18	0	0
Carrying Capacity	0 - 14	4	14
Accessibility	0 - 18	14	18
Environmental Aesthetic	0 - 20	8	20
Total Points		33	72
$ Value/User/Day		$6.52	$9.73
Annual Usage		47,800	47,800
Recreation Value		$311,700	$465,100
Annual Recreational Benefits			**$153,400**

Project Benefits

Coastal Storm Damage Reduction

The benefit of providing coastal storm damage protection through beneficial use of dredged material is equal to the reduction in annual damages between the without- and with-project conditions, plus additional recreation benefits obtained from the renourished beach.

Benefits are analyzed further by comparing the least-cost disposal plan associated with the Navigation maintenance dredging (base plan) to the cost of providing the coastal storm damage protection. Open water disposal is the least-cost Federal base plan that is compared to beach renourishment, using a pump-off hopper dredge to place dredge disposal material on the beach in Sandwich. The cost difference between these plans is then used to determine the overall benefit of the project. Table 7 below presents the cost comparison between the two plans.

Table 7 – Cost Comparison

Beneficial Use of Dredge Disposal Material - §204	***Federal Base Plan Open Water Placement***	***Beach Renourishment Pump-off Hopper Dredge***
2015 Total First Cost	$ 3,533,000	$ 5,181,000
IDC - 4 Months @ 3.375%	14,900	21,900
2015 Total Investment	**$ 3,547,900**	**$ 5,202,900**
Incremental Cost of Beach Renourishment		$ 1,655,000
Capital Recovery Factor-5 years		0.2207
2015 Annual Costs for 5-Year Period of Analysis		$ 365,255
Annual Benefits for 5-Year Period of Analysis		
-Reduced Structure Damage		$ 448,370
-Reduced Land Loss		212,500
-Increased Recreation Unit Day Value		153,400
Total Benefits		$ 814,270
Net Annual Benefits		$ 449,015
Benefit:Cost Ratio		**2.2**

Conclusion

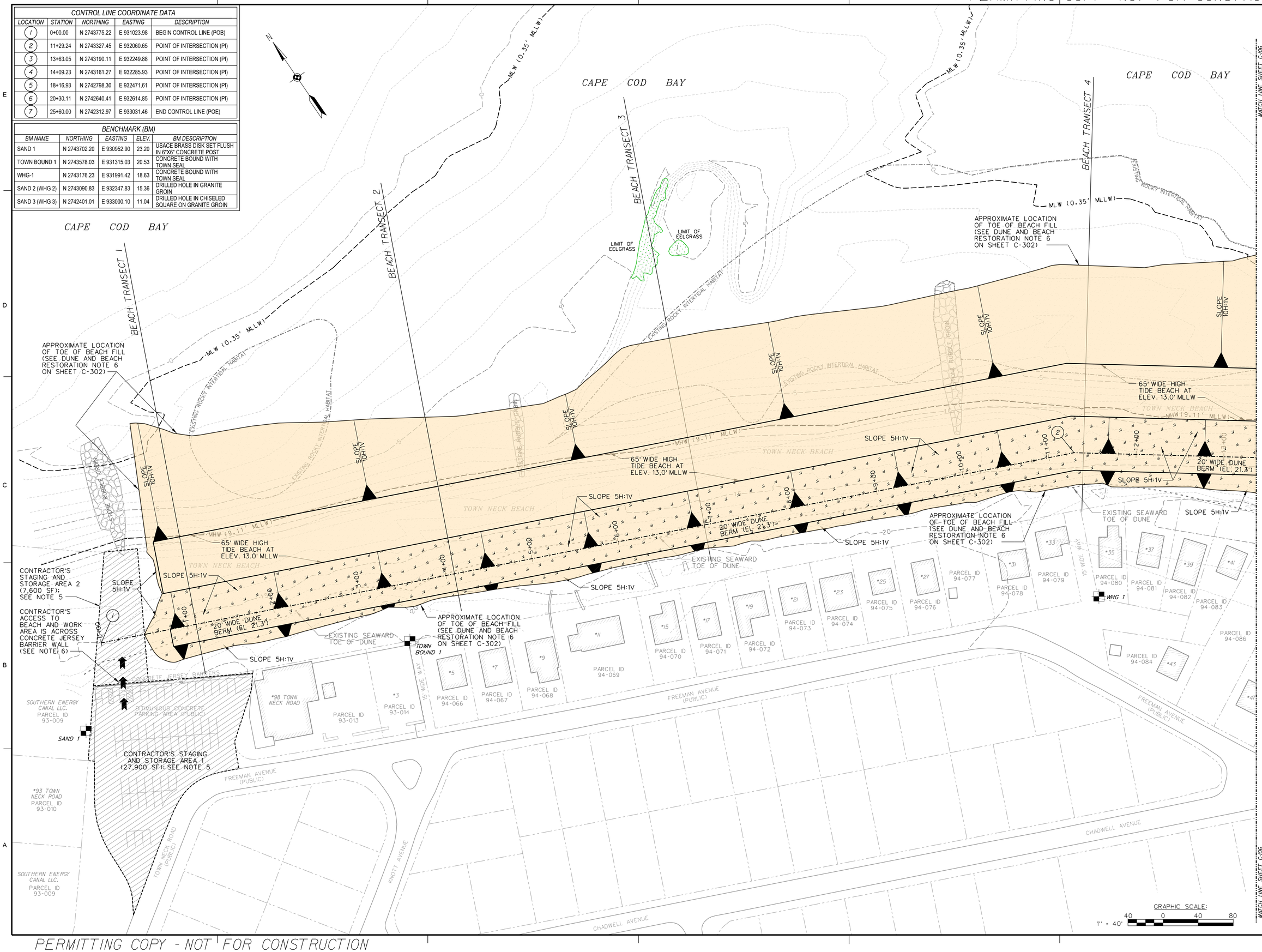
The incremental construction cost of beach renourishment over the Federal base plan is $1,655,000 or $365,255 when annualized over the 5-year period of analysis. Net annual benefits amount to $449,015 yielding a positive Benefit to Cost Ratio of 2.2 to one.

These benefits indicate a positive National Economic Development plan for beneficial use of dredged material to provide coastal storm damage reduction measures in the Town of Sandwich, Massachusetts.

APPENDIX C
Project Plans/Cross Sections

CONTROL LINE COORDINATE DATA				
LOCATION	STATION	NORTHING	EASTING	DESCRIPTION
1	0+00.00	N 2743775.22	E 931023.98	BEGIN CONTROL LINE (POB)
2	11+29.24	N 2743327.45	E 932060.65	POINT OF INTERSECTION (PI)
3	13+63.05	N 2743190.11	E 932249.88	POINT OF INTERSECTION (PI)
4	14+09.23	N 2743161.27	E 932285.93	POINT OF INTERSECTION (PI)
5	18+16.93	N 2742798.30	E 932471.61	POINT OF INTERSECTION (PI)
6	20+30.11	N 2742640.41	E 932614.85	POINT OF INTERSECTION (PI)
7	25+60.00	N 2742312.97	E 933031.46	END CONTROL LINE (POE)

BENCHMARK (BM)				
BM NAME	NORTHING	EASTING	ELEV.	BM DESCRIPTION
SAND 1	N 2743702.20	E 930952.90	23.20	USACE BRASS DISK SET FLUSH IN 6"X6" CONCRETE POST
TOWN BOUND 1	N 2743578.03	E 931315.03	20.53	CONCRETE BOUND WITH TOWN SEAL
WHG-1	N 2743176.23	E 931991.42	18.63	CONCRETE BOUND WITH TOWN SEAL
SAND 2 (WHG 2)	N 2743090.83	E 932347.83	15.36	DRILLED HOLE IN GRANITE GROIN
SAND 3 (WHG 3)	N 2742401.01	E 933000.10	11.04	DRILLED HOLE IN CHISELED SQUARE ON GRANITE GROIN



US Army Corps of Engineers
New England District

DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
CONCORD, MASSACHUSETTS

DESIGNED BY: M. GODFREY
DRAWN BY: M. WEST
CKD BY:
SUBMITTED BY: M. TESSIER
DATE: JANUARY 2015
SOLICITATION NO.:
CONTRACT NO.:
DRAWING CODE: DSC1200
PLOT SCALE: 1" = 40'
PLOT DATE:
SIZE: ANSI F
FILE NAME: C-105.dgn

MAINTENANCE DREDGING AND BEACH AND DUNE RESTORATION
CAPE COD CANAL AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS

SITE PLAN 1
BEACH FILL AREA

SHEET IDENTIFICATION
C-105
SHEET 3 OF 11

CONTROL LINE COORDINATE DATA				
LOCATION	STATION	NORTHING	EASTING	DESCRIPTION
1	0+00.00	N 2743775.22	E 931023.98	BEGIN CONTROL LINE (POB)
2	11+29.24	N 2743327.45	E 932060.65	POINT OF INTERSECTION (PI)
3	13+63.05	N 2743190.11	E 932249.88	POINT OF INTERSECTION (PI)
4	14+09.23	N 2743161.27	E 932285.93	POINT OF INTERSECTION (PI)
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SAND 2 (WHG 2)	N 2743090.83	E 932347.83	15.36	DRILLED HOLE IN GRANITE GROIN
SAND 3 (WHG 3)	N 2742401.01	E 933000.10	11.04	DRILLED HOLE IN CHISELED SQUARE ON GRANITE GROIN

CAPE COD BAY

CAPE COD BAY

MATCH LINE SHEET C-105

MATCH LINE SHEET C-107

APPROXIMATE LOCATION OF TOE OF BEACH FILL (SEE DUNE AND BEACH RESTORATION NOTE 6 ON SHEET C-302)

BEACH TRANSECT 5

BEACH TRANSECT 6

BEACH TRANSECT 7

MLW (0.35' MLLW)

MHW (9.11' MLLW)

SLOPE 10H:1V

STONE RUBBLE GROIN

TRANSITION DUNE BERM ELEVATION FROM 21.3' TO 26.3'

TOWN NECK BEACH

65' WIDE HIGH TIDE BEACH AT ELEV. 13.0' MLLW

14+00

15+00

16+00

17+00

18+00

19+00

20+00

21+00

22+00

23+00

24+00

25+00

SLOPE 5H:1V (TYP.)

SLOPE 5H:4V (TYP.)

20' WIDE DUNE BERM (EL. 26.3')

SAND 2

SAND

PATCH OF EELGRASS

PATCH OF EELGRASS

PARCEL ID 94-086

PARCEL ID 94-089

PARCEL ID 94-091

PARCEL ID 94-095-001

PARCEL ID 94-101-001

PARCEL ID 89-103

PARCEL ID 89-104

PARCEL ID 89-105

PARCEL ID 89-106

PARCEL ID 89-107

PARCEL ID 93-012

*45

*49R

*51R

*49

*5

*2

*4

*6

*8

*5

*3

*1

*103

APPROXIMATE LOCATION OF TOE OF BEACH FILL (SEE DUNE AND BEACH RESTORATION NOTE 6 ON SHEET C-302)

EXISTING SEAWARD TOE OF DUNE

SLOPE 5H:1V

10' WIDE PRIVATE WAY

PRIVATE WAY

PRIVATE WAY

PRIVATE CAR PARK

CONTRACTORS STAGING AND STORAGE AREAS (SEE SHEET C-107)

CONTRACTOR'S ACCESS TO BEACH AREA (SEE SHEET C-107)

TOWN BEACH PARKING LOT BITUMINOUS CONCRETE

BAY BEACH LANE

FREEMAN AVENUE

DILLINGHAM AVENUE

WOOD AVENUE

GRAPHIC SCALE:
40 0 40 80
1" = 40'

US Army Corps of Engineers®
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U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
CONCORD, MASSACHUSETTS

DESIGNED BY: M. GODFREY
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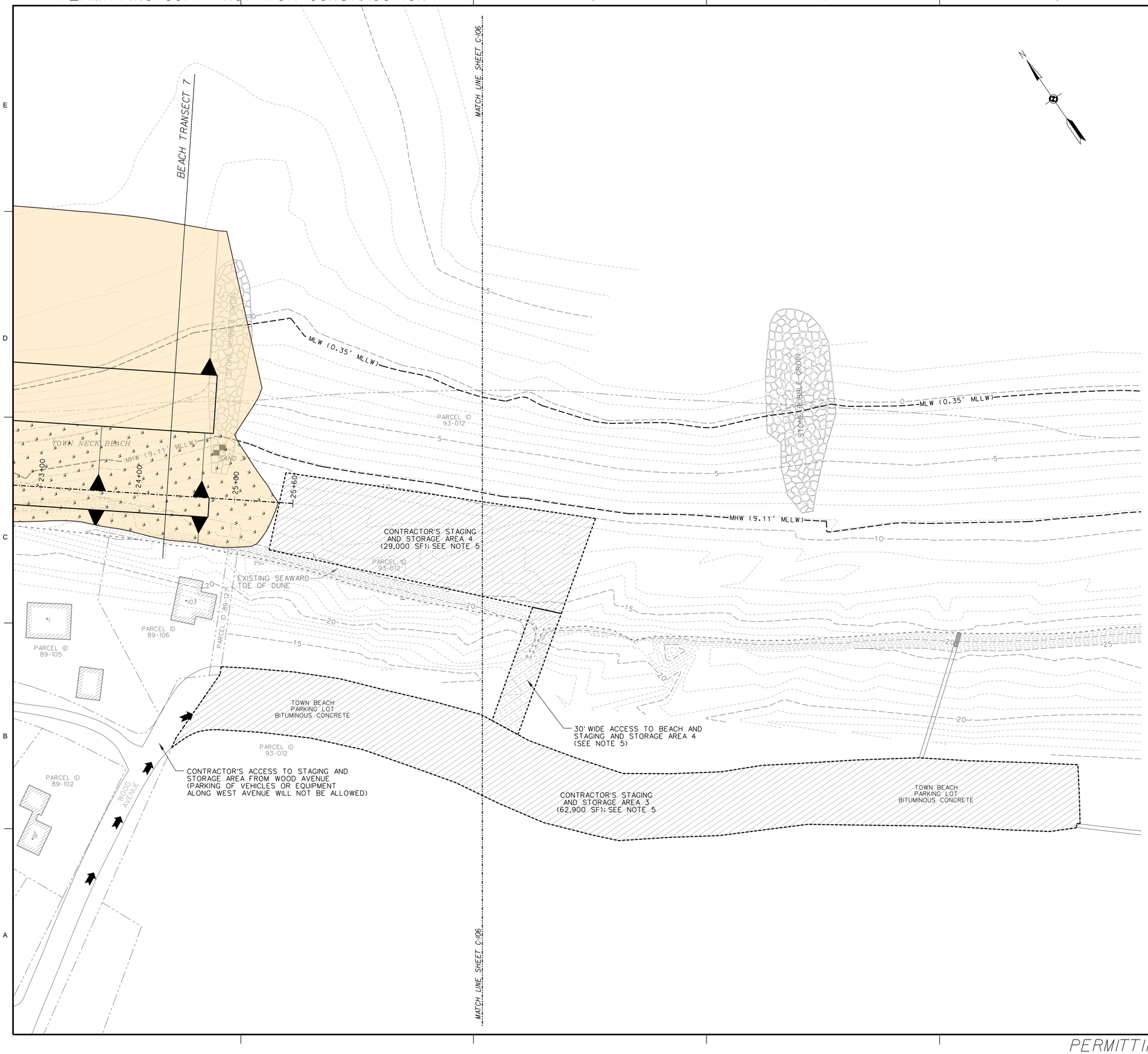
SUBMITTED BY: M. TESSIER
DATE: JANUARY 2015
CHKD BY: MBT
PLOT SCALE: 1" = 40'
PLOT DATE:
SIZE: ANSI F
SOLICITATION NO.:
CONTRACT NO.:
DRAWING CODE: CCC-105
FILE NAME: C-106.dgn

MAINTENANCE DREDGING AND BEACH AND DUNE RESTORATION
CAPE CODE CANAL AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS

SITE PLAN 2
BEACH FILL AREA

SHEET IDENTIFICATION
C-106
SHEET 8 OF 11



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CONCORD, MASSACHUSETTS

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SUBMITTED BY: M. TESSIER
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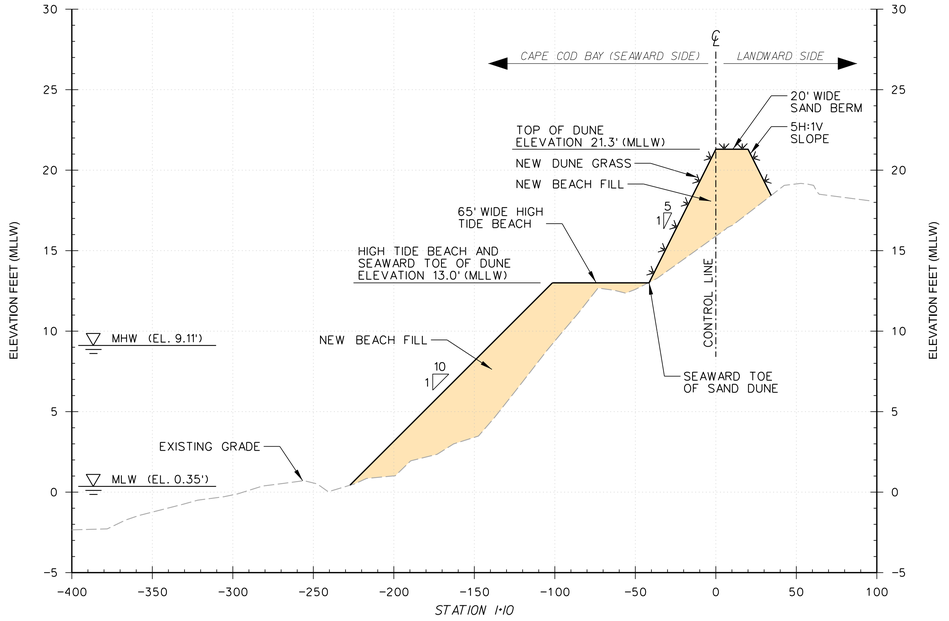
PLOT DATE:
SIZE: ANSI F
DATE: JANUARY 2015
SOLICITATION NO.:
CONTRACT NO.:
DRAWING CODE: DCO-1200
FILE NAME: C-107.dgn

MAINTENANCE DREDGING AND BEACH AND DUNE RESTORATION
CAPE COD CANAL AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS

SITE PLAN 3
BEACH FILL AREA

SHEET IDENTIFICATION
C-107
SHEET 9 OF 11

PERMITTING COPY - NOT FOR CONSTRUCTION



BEACH TRANSECT 1

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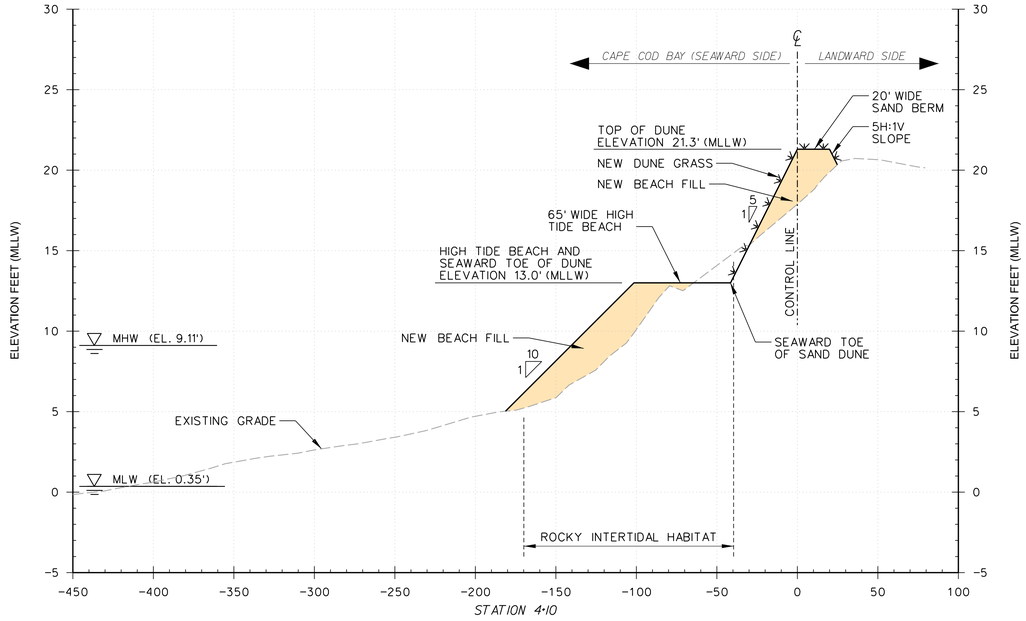
VERT. SCALE: 1"=4'



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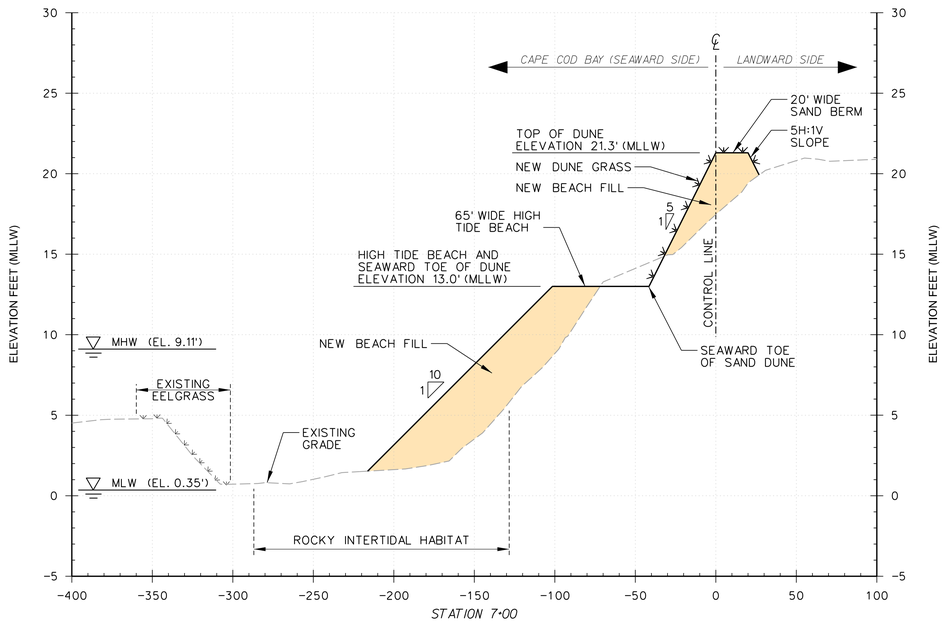

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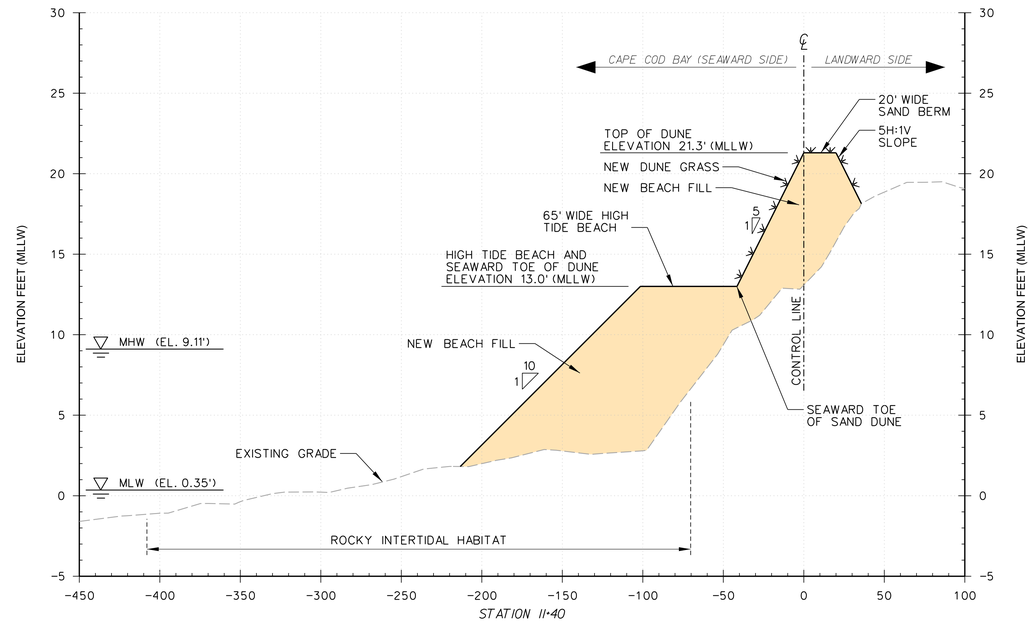

BEACH TRANSECT 4

HORIZ. SCALE: 1"=40'
VERT. SCALE: 1"=4'

GRAPHIC SCALE:
1" = 40' (40 0 40 80)
1" = 4' (4 0 4 8)

NOTE: REFER TO DUNE AND BEACH RESTORATION NOTES ON SHEET C-302.

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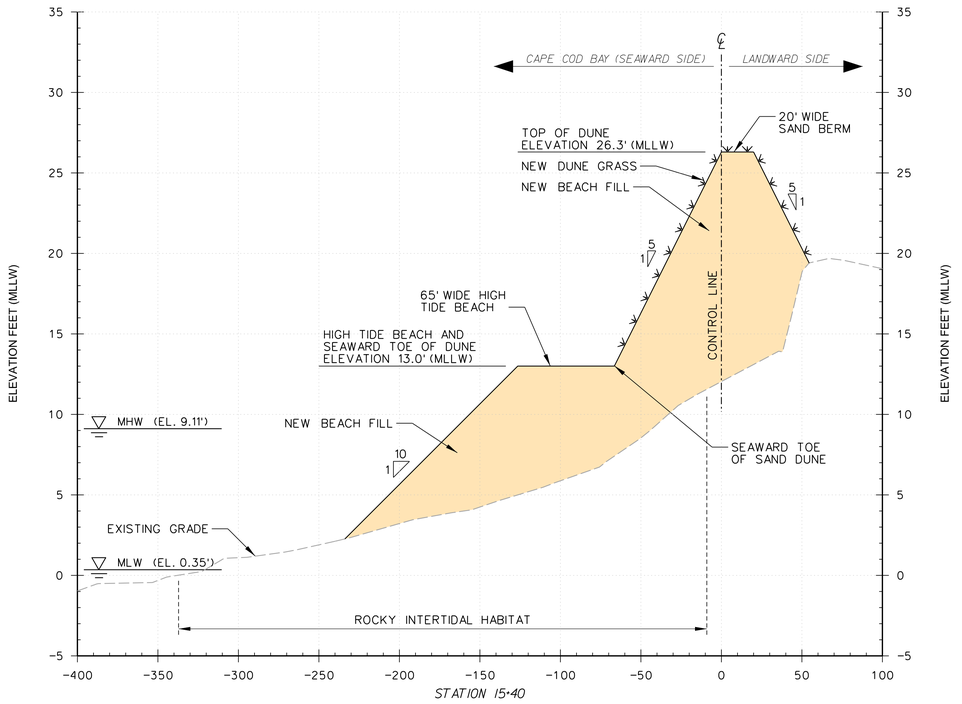
SIZE: ANSI F
DATE: JANUARY 2015
SOLICITATION NO.:
CONTRACT NO.:
DRAWING CODE: COC-1305
PLOT DATE:
FILE NAME: C-301.dgn

MAINTENANCE DREDGING AND BEACH AND DUNE RESTORATION
CAPE COD CANAL AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS

BEACH TRANSECTS 1
BEACH FILL AREA

SHEET IDENTIFICATION
C-301
SHEET 10 OF 11



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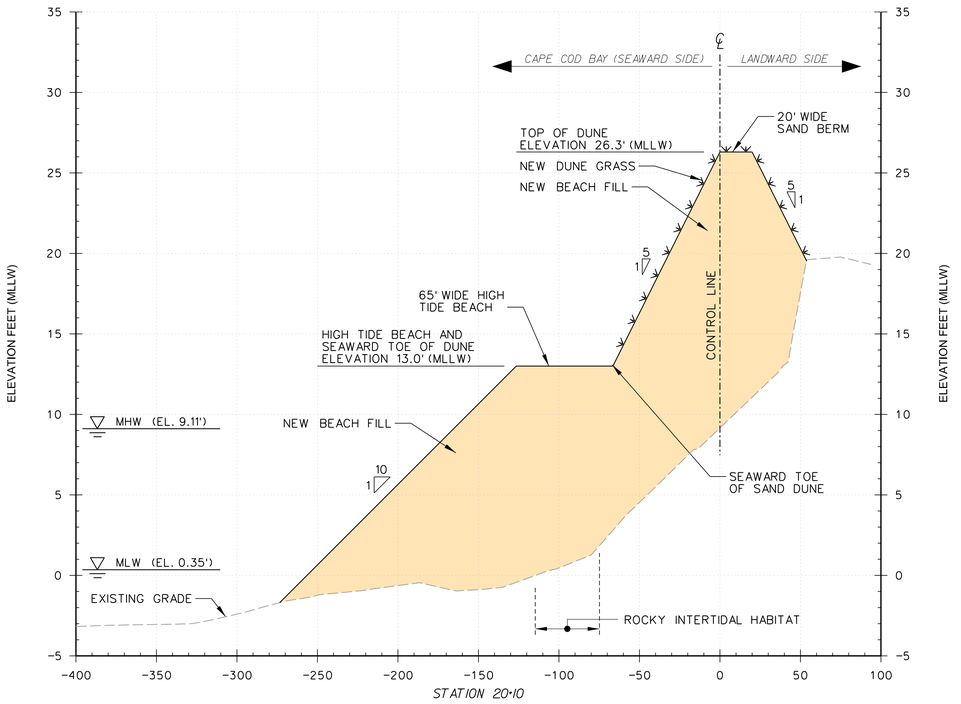
VERT. SCALE: 1"=4'



BEACH TRANSECT 6

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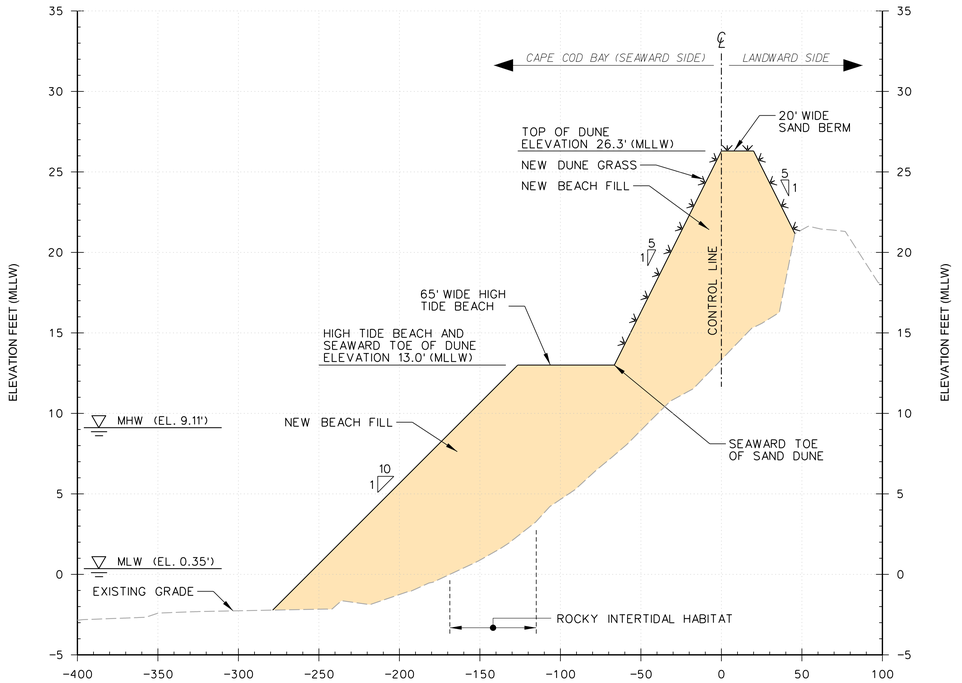
VERT. SCALE: 1"=4'



BEACH TRANSECT 7

HORIZ. SCALE: 1"=40'
VERT. SCALE: 1"=4'

DUNE AND BEACH RESTORATION NOTES:

1. EXISTING CONDITIONS SHOWN ARE FROM A US ARMY CORPS OF ENGINEERS TOPOGRAPHIC SURVEY CONDUCTED DURING JULY 2014 (SEE FIELD BOOK R&H 4529, PAGES 44-77). REFER TO SHEETS C-105 AND C-106 FOR SURVEY BENCHMARK IDS AND DESCRIPTIONS.
2. COORDINATES SHOWN ARE IN U.S. FEET AND REFERENCE THE MASSACHUSETTS MAINLAND STATE PLANE COORDINATE SYSTEM (NAD 1983).
3. ELEVATIONS SHOWN ARE IN U.S. FEET AND REFERENCE THE PLANE OF MEAN LOWER LOW WATER (MLLW).
4. SEE SHEETS C-105 AND C-107 FOR THE CONTRACTOR'S STORAGE AND STAGING AREAS AND LOCATIONS TO ACCESS THE BEACH AND WORK AREAS.
5. THE CONTRACTOR SHALL REFERENCE ALL CONSTRUCTION MEASUREMENTS TO THE TOP OF SAND DUNE BERM CONTROL LINE SHOWN.
6. BEACH FILL SHALL BE ESTABLISHED FROM THE TOP SEAWARD EDGE OF THE SAND DUNE BERMS SHOWN ON THE CONTRACT DRAWINGS AND AS DESCRIBED IN NOTE 7. THE FINISHED GRADE OF BEACH FILL SHALL BE SET USING THE REQUIRED TOP OF SAND DUNE BERM AND HIGH TIDE BEACH ELEVATIONS AND REQUIRED BEACH FILL SLOPES. LIMIT OF THE TOE SHOWN ON THE CONTRACT DRAWINGS IS APPROXIMATE ONLY AND SHALL NOT BE USED TO DETERMINE THE CONSTRUCTION LIMITS OF BEACH FILL.
7. THE BEACH TRANSECTS (CROSS-SECTIONS) SHOWN ACCOUNT FOR THE TOTAL AMOUNT OF DREDGED MATERIAL (BOTH REQUIRED AND OVERDEPTH). BEACH FILL PLACEMENT FOR THE DUNE BERM AND HIGH TIDE BEACH SHALL START FROM THE WEST END (STA. 0+80) AND PROCEED EASTERLY TO THE END LIMITS SHOWN ON THE PLANS. IF IT IS FOUND THAT THE VOLUME OF THE DREDGED MATERIAL ENCOUNTERED DURING CONSTRUCTION IS LESS THAN WHAT WAS ANTICIPATED, THE CONTRACTOR SHALL ADJUST THE PLACEMENT OF THE BEACH FILL (DREDGED MATERIAL) SUCH THAT THE DUNE BERM ELEVATION IS SET TO 21.5' (MLLW) AND THE HIGH TIDE BEACH WIDTH IS REDUCED TO 55' BETWEEN STATIONS STA. 21+00 AND 24+75.
8. REFER TO SPECIFICATION SECTION 01 71 23 FOR AS BUILT REQUIREMENTS WITH SAND FILL.

GRAPHIC SCALE:

1" = 40' — 40 0 40 80

1" = 4' — 4 0 4 8

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New England District

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U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
CONCORD, MASSACHUSETTS

DESIGNED BY: M. COOPREY
DRWN BY: M. WEIT
SUBMITTED BY: M. TESSIER
PLOT SCALE: 1" = 40'
SIZE: ANSI F
DATE: JANUARY 2015
SOLICITATION NO.:
CONTRACT NO.:
PLOT DATE:
DRAWING CODE: COC-1203
FILE NAME: C-302.dgn

MAINTENANCE DREDGING AND
BEACH AND DUNE RESTORATION
CAPE COD CANAL AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS

BEACH TRANSECTS 2
BEACH FILL AREA

SHEET IDENTIFICATION
C-302
SHEET 11 OF 11

APPENDIX D
Cost Estimates

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging**
PROJECT NO: **P2 153133**
LOCATION: **Town Neck Beach, Sandwich, Massachusetts**

DISTRICT: **NAE New England District** PREPARED: **5/1/2015**
POC: **CHIEF, COST ENGINEERING, Patricia Bolton**

This Estimate reflects the scope and schedule in report; Beneficial Use Plan

Program Year (Budget EC): 2015
Effective Price Level Date: 1-Oct- 14
Spent Thru: **10/1/2013**

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
09	CHANNELS & CANALS	$3,833	$701	18%	$4,534		$3,833	$701	$4,534		$4,534	1.9%	$3,907	$715	$4,622
09	CHANNELS & CANALS		-			-						-			
17	BEACH REPLENISHMENT		-			-						-			
	CONSTRUCTION ESTIMATE TOTALS:	$3,833	$701		$4,534		$3,833	$701	$4,534		$4,534	1.9%	$3,907	$715	$4,622
01	LANDS AND DAMAGES	$90	$5	6%	$95		$90	$5	$95		$95	1.1%	$91	$5	$96
30	PLANNING, ENGINEERING & DESIGN	$202	$37	18%	$239		$202	$37	$239		$239	1.9%	$206	$38	$243
31	CONSTRUCTION MANAGEMENT	$182	$33	18%	$215	0.0%	$182	$33	$215		$215	2.1%	$186	$34	$220
	PROJECT COST TOTALS:	$4,307	$777	18%	$5,083		$4,307	$777	$5,083		**$5,083**	1.9%	$4,389	$792	$5,181

_____ CHIEF, COST ENGINEERING, Patricia Bolton

_____ PROJECT MANAGER, William Kavenaugh

_____ CHIEF, REAL ESTATE, Vacant

_____ CHIEF, PLANNING, John Kennelly

_____ CHIEF, ENGINEERING, Scott Acone

_____ CHIEF, OPERATIONS, Frank Fedele

_____ CHIEF, CONSTRUCTION, Sean Dolan

_____ CHIEF, CONTRACTING, Sheila Winston-Vincuilla

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, Michael Keegan

ESTIMATED TOTAL PROJECT COST:
ESTIMATED FEDERAL COST: **65%**
ESTIMATED NON-FEDERAL COST: **35%**

22 - FEASIBILITY STUDY (CAP studies):
ESTIMATED FEDERAL COST:
ESTIMATED NON-FEDERAL COST:

ESTIMATED FEDERAL COST OF PROJECT

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging
LOCATION: Town Neck Beach, Sandwich, Massachusetts
This Estimate reflects the scope and schedule in report; Beneficial Use Plan

DISTRICT: NAE New England District
POC: CHIEF, COST ENGINEERING, Patricia Bolton

PREPARED: 5/1/2015

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 5/1/2015 Estimate Price Level: 41913				Program Year (Budget EC): 2015 Effective Price Level Date: 1 -Oct-14								
				RISK BASED										
WBS NUMBER *A*	Civil Works Feature & Sub-Feature Description *B*	COST ($K) *C*	CNTG ($K) *D*	CNTG (%) *E*	TOTAL ($K) *F*	ESC (%) *G*	COST ($K) *H*	CNTG ($K) *I*	TOTAL ($K) *J*	Mid-Point Date *P*	ESC (%) *L*	COST ($K) *M*	CNTG ($K) *N*	FULL ($K) *O*
	PHASE 1 or CONTRACT 1													
17	BEACH REPLENISHMENT	$3,833	$701	18.3%	$4,534		$3,833	$701	$4,534	2016Q2	1.9%	$3,907	$715	$4,622
17	BEACH REPLENISHMENT													
	CONSTRUCTION ESTIMATE TOTALS:	$3,833	$701	18.3%	**$4,534**		$3,833	$701	$4,534			$3,907	$715	$4,622
01	LANDS AND DAMAGES	$90	$5	5.6%	$95		$90	$5	$95	2015Q4	1.1%	$91	$5	$96
30	PLANNING, ENGINEERING & DESIGN													
0.005	Project Management	$19	$3	18.3%	$22		$19	$3	$22	2015Q4	1.7%	$19	$4	$23
0.005	Planning & Environmental Compliance	$19	$3	18.3%	$22		$19	$3	$22	2015Q4	1.7%	$19	$4	$23
0.025	Engineering & Design	$96	$18	18.3%	$114		$96	$18	$114	2015Q4	1.7%	$98	$18	$115
0.0025	Engineering Tech Review ITR & VE	$10	$2	18.3%	$12		$10	$2	$12	2015Q4	1.7%	$10	$2	$12
0.005	Contracting & Reprographics	$19	$3	18.3%	$22		$19	$3	$22	2015Q4	1.7%	$19	$4	$23
0.005	Engineering During Construction	$19	$3	18.3%	$22		$19	$3	$22	2016Q2	2.9%	$20	$4	$23
0.0025	Planning During Construction	$10	$2	18.3%	$12		$10	$2	$12	2016Q2	2.9%	$10	$2	$12
0.0025	Project Operations	$10	$2	18.3%	$12		$10	$2	$12	2015Q4	1.7%	$10	$2	$12
31	CONSTRUCTION MANAGEMENT													
0.0375	Construction Management	$144	$26	18.3%	$170		$144	$26	$170	2016Q2	2.1%	$147	$27	$174
0.005	Project Operation:	$19	$3	18.3%	$22		$19	$3	$22	2016Q2	2.1%	$19	$4	$23
0.005	Project Management	$19	$3	18.3%	$22		$19	$3	$22	2016Q2	2.1%	$19	$4	$23
	CONTRACT COST TOTALS:	$4,307	$777		**$5,083**		$4,307	$777	$5,083			$4,389	$792	**$5,181**

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging** DISTRICT: **NAE New England District** PREPARED: **5/1/2015**

PROJECT NO: **P2 153133**

LOCATION: **Town Neck Beach, Sandwich, Massachusetts** POC: **CHIEF, COST ENGINEERING, Patricia Bolton**

This Estimate reflects the scope and schedule in report; Beneficial Use Plan

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2015									
						Effective Price Level Date: 1-Oct- 14									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
09	CHANNELS & CANALS	$2,664	$488	18%	$3,152		$2,664	$488	$3,152		$3,152	1.9%	$2,716	$497	$3,213
09	CHANNELS & CANALS		-			-						-			
17	BEACH REPLENISHMENT		-			-						-			
	CONSTRUCTION ESTIMATE TOTALS:	$2,664	$488		$3,152		$2,664	$488	$3,152		$3,152	1.9%	$2,716	$497	$3,213
01	LANDS AND DAMAGES		-			-						-			
30	PLANNING, ENGINEERING & DESIGN	$140	$26	18%	$166		$140	$26	$166		$166	1.9%	$143	$26	$169
31	CONSTRUCTION MANAGEMENT	$126	$23	18%	$149		$126	$23	$149		$149	2.1%	$129	$24	$152
	PROJECT COST TOTALS:	$2,930	$536	18%	$3,466		$2,930	$536	$3,466		**$3,466**	1.9%	$2,987	$547	$3,533

_____ CHIEF, COST ENGINEERING, Patricia Bolton

_____ PROJECT MANAGER, William Kavenaugh

_____ CHIEF, REAL ESTATE, Vacant

_____ CHIEF, PLANNING, John Kennelly

_____ CHIEF, ENGINEERING, Scott Acone

_____ CHIEF, OPERATIONS, Frank Fedele

_____ CHIEF, CONSTRUCTION, Sean Dolan

_____ CHIEF, CONTRACTING, Sheila Winston-Vincuilla

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, Michael Keegan

ESTIMATED TOTAL PROJECT COST:
ESTIMATED FEDERAL COST: **65%**
ESTIMATED NON-FEDERAL COST: **35%**

22 - FEASIBILITY STUDY (CAP studies):
ESTIMATED FEDERAL COST:
ESTIMATED NON-FEDERAL COST:

ESTIMATED FEDERAL COST OF PROJECT

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging
LOCATION: Town Neck Beach, Sandwich, Massachusetts
This Estimate reflects the scope and schedule in report; Beneficial Use Plan

DISTRICT: NAE New England District
POC: CHIEF, COST ENGINEERING, Patricia Bolton

PREPARED: 5/1/2015

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 5/1/2015 Estimate Price Level: 41913				Program Year (Budget EC): 2015 Effective Price Level Date: 1 -Oct-14								
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
17	BEACH REPLENISHMENT	$2,664	$488	18.3%	$3,152		$2,664	$488	$3,152	2016Q2	1.9%	$2,716	$497	$3,213
17	BEACH REPLENISHMENT													
	CONSTRUCTION ESTIMATE TOTALS:	$2,664	$488	18.3%	**$3,152**		$2,664	$488	$3,152			$2,716	$497	$3,213
01	LANDS AND DAMAGES			5.6%										
30	PLANNING, ENGINEERING & DESIGN													
0.005	Project Management	$13	$2	18.3%	$15		$13	$2	$15	2015Q4	1.7%	$13	$2	$16
0.005	Planning & Environmental Compliance	$13	$2	18.3%	$15		$13	$2	$15	2015Q4	1.7%	$13	$2	$16
0.025	Engineering & Design	$67	$12	18.3%	$79		$67	$12	$79	2015Q4	1.7%	$68	$12	$81
0.0025	Engineering Tech Review ITR & VE	$7	$1	18.3%	$8		$7	$1	$8	2015Q4	1.7%	$7	$1	$8
0.005	Contracting & Reprographics	$13	$2	18.3%	$15		$13	$2	$15	2015Q4	1.7%	$13	$2	$16
0.005	Engineering During Construction	$13	$2	18.3%	$15		$13	$2	$15	2016Q2	2.9%	$13	$2	$16
0.0025	Planning During Construction	$7	$1	18.3%	$8		$7	$1	$8	2016Q2	2.9%	$7	$1	$9
0.0025	Project Operations	$7	$1	18.3%	$8		$7	$1	$8	2015Q4	1.7%	$7	$1	$8
31	CONSTRUCTION MANAGEMENT													
0.0375	Construction Management	$100	$18	18.3%	$118		$100	$18	$118	2016Q2	2.1%	$102	$19	$121
0.005	Project Operation:	$13	$2	18.3%	$15		$13	$2	$15	2016Q2	2.1%	$13	$2	$16
0.005	Project Management	$13	$2	18.3%	$15		$13	$2	$15	2016Q2	2.1%	$13	$2	$16
	CONTRACT COST TOTALS:	$2,930	$536		**$3,466**		$2,930	$536	$3,466			$2,987	$547	**$3,533**

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging**
PROJECT NO: **P2 153133**
LOCATION: **Town Neck Beach, Sandwich, Massachusetts**

DISTRICT: **NAE New England District** PREPARED: **5/1/2015**
POC: **CHIEF, COST ENGINEERING, Patricia Bolton**

This Estimate reflects the scope and schedule in report; Beneficial Use Plan

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC):				2015					
						Effective Price Level Date:				1-Oct- 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
09	CHANNELS & CANALS	$1,169	$214	18%	$1,382		$1,169	$214	$1,382		$1,382	1.9%	$1,191	$218	$1,409
09	CHANNELS & CANALS		-			-						-			
17	BEACH REPLENISHMENT		-			-						-			
	CONSTRUCTION ESTIMATE TOTALS:	$1,169	$214		$1,382		$1,169	$214	$1,382		$1,382	1.9%	$1,191	$218	$1,409
01	LANDS AND DAMAGES	$90	$5	6%	$95		$90	$5	$95		$95	1.1%	$91	$5	$96
30	PLANNING, ENGINEERING & DESIGN	$62	$11	18%	$73		$62	$11	$73		$73	1.9%	$63	$12	$75
31	CONSTRUCTION MANAGEMENT	$56	$10	18%	$66	0.0%	$56	$10	$66		$66	2.1%	$57	$10	$68
	PROJECT COST TOTALS:	$1,377	$240	17%	$1,617		$1,377	$240	$1,617		**$1,617**	1.9%	$1,402	$245	$1,647

_____ CHIEF, COST ENGINEERING, Patricia Bolton

_____ PROJECT MANAGER, William Kavenaugh

_____ CHIEF, REAL ESTATE, Vacant

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_____ CHIEF, OPERATIONS, Frank Fedele

_____ CHIEF, CONSTRUCTION, Sean Dolan

_____ CHIEF, CONTRACTING, Sheila Winston-Vincuilla

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, Michael Keegan

ESTIMATED TOTAL PROJECT COST:		**$1,647**
ESTIMATED FEDERAL COST:	65%	$1,071
ESTIMATED NON-FEDERAL COST:	**35%**	$577
22 - FEASIBILITY STUDY (CAP studies):		**$460**
ESTIMATED FEDERAL COST:		$460
ESTIMATED NON-FEDERAL COST:		
ESTIMATED FEDERAL COST OF PROJECT		**$1,531**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging
LOCATION: Town Neck Beach, Sandwich, Massachusetts
This Estimate reflects the scope and schedule in report; Beneficial Use Plan

DISTRICT: NAE New England District
POC: CHIEF, COST ENGINEERING, Patricia Bolton

PREPARED: 5/1/2015

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 5/1/2015				Program Year (Budget EC): 2015								
		Estimate Price Level: 1-Oct-14				Effective Price Level Date: 1 -Oct-14								
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
17	BEACH REPLENISHMENT	$1,169	$214	18.3%	$1,382		$1,169	$214	$1,382	2016Q2	1.9%	$1,191	$218	$1,409
17	BEACH REPLENISHMENT													
	CONSTRUCTION ESTIMATE TOTALS:	$1,169	$214	18.3%	**$1,382**		$1,169	$214	$1,382			$1,191	$218	$1,409
01	LANDS AND DAMAGES	$90	$5	5.6%	$95		$90	$5	$95	2015Q4	1.1%	$91	$5	$96
30	PLANNING, ENGINEERING & DESIGN													
0.005	Project Management	$6	$1	18.3%	$7		$6	$1	$7	2015Q4	1.7%	$6	$1	$7
0.005	Planning & Environmental Compliance	$6	$1	18.3%	$7		$6	$1	$7	2015Q4	1.7%	$6	$1	$7
0.025	Engineering & Design	$29	$5	18.3%	$34		$29	$5	$34	2015Q4	1.7%	$29	$5	$35
0.0025	Engineering Tech Review ITR & VE	$3	$1	18.3%	$4		$3	$1	$4	2015Q4	1.7%	$3	$1	$4
0.005	Contracting & Reprographics	$6	$1	18.3%	$7		$6	$1	$7	2015Q4	1.7%	$6	$1	$7
0.005	Engineering During Construction	$6	$1	18.3%	$7		$6	$1	$7	2016Q2	2.9%	$6	$1	$7
0.0025	Planning During Construction	$3	$1	18.3%	$4		$3	$1	$4	2016Q2	2.9%	$3	$1	$4
0.0025	Project Operations	$3	$1	18.3%	$4		$3	$1	$4	2015Q4	1.7%	$3	$1	$4
31	CONSTRUCTION MANAGEMENT													
0.0375	Construction Management	$44	$8	18.3%	$52		$44	$8	$52	2016Q2	2.1%	$45	$8	$53
0.005	Project Operation:	$6	$1	18.3%	$7		$6	$1	$7	2016Q2	2.1%	$6	$1	$7
0.005	Project Management	$6	$1	18.3%	$7		$6	$1	$7	2016Q2	2.1%	$6	$1	$7
	CONTRACT COST TOTALS:	$1,377	$240		**$1,617**		$1,377	$240	$1,617			$1,402	$245	**$1,647**

Reconnaissance Cost Estimate

Disposal of suitable sand on to South Sandwich Town beaches from dredging the Cape Cod Canal. It assumed that the hydraulic dredging from the Cape Cod Federal Channels will produce 170,000 cu yds from six cannel locations..It is assumed that the sand will be pumped from the hopper dredge by floating and submerged pipelines from to the shoreline. The dredged sand will distributed along the South Sandwich beaches (Town Neck) by shore crews using heavy equipment duty grading equipment.

MARK UP - JOOH 10%, HOOH - 6.5%, Profit - 10%, Bond - Bond Table, Escalation - not used, Contingency - not applied

Assumptions include the development of the cost files consistent across all products. Economic factors updated, fuel cost used based (& included in CEDEP) on April 2015 fuel costs at the Cape Cod Canal. Dump rates of 10 min conservative based on discussions with the Navigation unit @ 10 minutes. All milages were determined based on navigation data to the dump site and the assumed site for the bouy pump and based on distances caculated from the location center of mass to the mouth, then added 3.5 miles to teh CCDS, bouy pump at 2,500lf, from offshore to bouy pump is 1,500lf, and the east end of the beach fill determined at 3,500lf, west end of beach fill 800lf. Materiat determined conservatively at 5% mud, however at some locations mostly sand which when computed the mud calculation is a conservative estimate naturally inflating the estimate.

Estimated by	CENAE-EP-CE
Designed by	Design Proposal
Prepared by	William McIntyre
Preparation Date	5/1/2015
Effective Date of Pricing	10/31/2014
Estimated Construction Time	40 Days

Labor ID: NLS2012 EQ ID: EP14R01 Currency in US dollars TRACES MII Version 4.2

Designed by
Design Proposal

Estimated by
CENAE-EP-CE

Prepared by
William McIntyre

Design Document	Preliminary Design
Document Date	2/13/2015
District	New England District
Contact	William McIntyre
Budget Year	2015
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
CEDEP
OTHER

Timeline/Currency

Preparation Date	5/1/2015
Escalation Date	10/31/2014
Eff. Pricing Date	10/31/2014
Estimated Duration	40 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB12EB-b: MII English Cost Book 2012-b

Labor NLS2012: National Labor Library - Seattle 2012

Note: http://www.wdol.gov is the website for current Davis Bacon & Service Labor Rates. Fringes paid to the laborers are taxable. In a non-union job the whole fringes are taxa
vaca

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP14R01: MII Equipment 2014 Region 01

01 NORTHEAST

Sales Tax	6.00
Working Hours per Year	1,360
Labor Adjustment Factor	1.15
Cost of Money	2.13
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.132
Gas	3.770
Diesel Off-Road	3.660
Diesel On-Road	4.190

Shipping Rates

Over 0 CWT	19.34
Over 240 CWT	17.80
Over 300 CWT	15.56
Over 400 CWT	13.43
Over 500 CWT	6.79
Over 700 CWT	6.79
Over 800 CWT	11.41

Labor ID: NLS2012 EQ ID: EP14R01 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	DirectCost	ContractCost	Escalation	Contingency	ProjectCost
Project Cost Summary Report			**1,166,491**	**1,376,594**	**0**	**0**	**1,376,594**
			5.66	*6.91*			*6.91*
1 Beneficial Use Plan	**169,207.00**	**CY**	**958,491**	**1,168,594**	**0**	**0**	**1,168,594**
			-13.26	*-15.75*			*-15.75*
1.1 Federal Base Plan	**169,207.00**	**CY**	**-2,244,202**	**-2,664,201**	**0**	**0**	**-2,664,201**
			18.93	*22.65*			*22.65*
1.2 Construction Contract	**169,207.00**	**CY**	**3,202,692**	**3,832,795**	**0**	**0**	**3,832,795**
1.2.1 0001 0001-Mobilization	**1.00**	**LS**	**1,200,971**	**1,425,731**	**0**	**0**	**1,425,731**
			2,001,721.76	*2,407,064.60*			*2,407,064.60*
1.2.2 CCC Beneficial Use - Preferred Plan	**1.00**	**EA**	**2,001,722**	**2,407,065**	**0**	**0**	**2,407,065**
			118,000.00	*118,000.00*			*118,000.00*
2 Other	**1.00**	**EA**	**118,000**	**118,000**	**0**	**0**	**118,000**
			62,000.00	*62,000.00*			*62,000.00*
2.1 PED	**1.00**	**EA**	**62,000**	**62,000**	**0**	**0**	**62,000**
			56,000.00	*56,000.00*			*56,000.00*
2.2 S&A	**1.00**	**EA**	**56,000**	**56,000**	**0**	**0**	**56,000**
			90,000.00	*90,000.00*			*90,000.00*
3 Real Estate	**1.00**	**EA**	**90,000**	**90,000**	**0**	**0**	**90,000**

Labor ID: NLS2012 EQ ID: EP14R01 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	Contractor	DirectCost	SubCMU	CostToPrime	PrimeCMU	ContractCost
Contract Cost Summary Report				**1,166,491**	**0**	**958,491**	**210,103**	**1,376,594**
				5.66		*5.66*		*6.91*
1 Beneficial Use Plan	**169,207.00**	**CY**	**1 Dredger**	**958,491**	**0**	**958,491**	**210,103**	**1,168,594**
				-13.26		*-13.26*		*-15.75*
1.1 Federal Base Plan	**169,207.00**	**CY**	**1 Dredger**	**-2,244,202**	**0**	**-2,244,202**	**-420,000**	**-2,664,201**
				18.93		*18.93*		*22.65*
1.2 Construction Contract	**169,207.00**	**CY**	**1 Dredger**	**3,202,692**	**0**	**3,202,692**	**630,103**	**3,832,795**
1.2.1 0001 0001-Mobilization	**1.00**	**LS**	**1 Dredger**	**1,200,971**	**0**	**1,200,971**	**224,760**	**1,425,731**
				2,001,721.76		*2,001,721.76*		*2,407,064.60*
1.2.2 CCC Beneficial Use - Preferred Plan	**1.00**	**EA**	**1 Dredger**	**2,001,722**	**0**	**2,001,722**	**405,343**	**2,407,065**
				118,000.00		*0.00*		*118,000.00*
2 Other	**1.00**	**EA**		**118,000**	**0**	**0**	**0**	**118,000**
				62,000.00		*0.00*		*62,000.00*
2.1 PED	**1.00**	**EA**		**62,000**	**0**	**0**	**0**	**62,000**
				56,000.00		*0.00*		*56,000.00*
2.2 S&A	**1.00**	**EA**		**56,000**	**0**	**0**	**0**	**56,000**
				90,000.00		*0.00*		*90,000.00*
3 Real Estate	**1.00**	**EA**		**90,000**	**0**	**0**	**0**	**90,000**

Labor ID: NLS2012 EQ ID: EP14R01 Currency in US dollars TRACES MII Version 4.2

APPENDIX D.1

Cost Agency Technical Review Certification Statement

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

NAE - PN 153133
Cape Cod Canal, Town Neck Beach, Sandwich Massachusetts
Section 204 Beneficial Uses of Dredged Material (CAP)

The Cape Cod Canal, Sandwich Massachusetts Feasibility Study, as presented by the New England District, has undergone a successful Cost Agency Technical Review (Cost ATR) of remaining costs, performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the cost products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of May 12, 2015, the Cost MCX certifies the estimated total project cost:

FY2015 First Costs:	$1,617,000
Total Project Costs:	$1,647,000
Estimated Federal Costs:	$1,531,000

Note: Cost ATR was devoted to remaining work. It did not review spent costs, which requires an audit process. It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

SKARBEK.JOHN.P.1229040665

Digitally signed by SKARBEK.JOHN.P.1229040665
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=SKARBEK.JOHN.P.1229040665
Date: 2015.05.12 07:46:11 -07'00'

Kim C. Callan, PE, CCE, PM
Chief, Cost Engineering MCX
Walla Walla District

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging**
PROJECT NO: **P2 153133**
LOCATION: **Town Neck Beach, Sandwich, Massachusetts**

DISTRICT: **NAE New England District** PREPARED: **5/1/2015**
POC: **CHIEF, COST ENGINEERING, Patricia Bolton**

This Estimate reflects the scope and schedule in report; Beneficial Use Plan

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC):				2015					
						Effective Price Level Date:				1-Oct- 14					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
09	CHANNELS & CANALS	$1,169	$214	18%	$1,382		$1,169	$214	$1,382		$1,382	1.9%	$1,191	$218	$1,409
09	CHANNELS & CANALS		-			-						-			
17	BEACH REPLENISHMENT		-			-						-			
	CONSTRUCTION ESTIMATE TOTALS:	$1,169	$214		$1,382		$1,169	$214	$1,382		$1,382	1.9%	$1,191	$218	$1,409
01	LANDS AND DAMAGES	$90	$5	6%	$95		$90	$5	$95		$95	1.1%	$91	$5	$96
30	PLANNING, ENGINEERING & DESIGN	$62	$11	18%	$73		$62	$11	$73		$73	1.9%	$63	$12	$75
31	CONSTRUCTION MANAGEMENT	$56	$10	18%	$66	0.0%	$56	$10	$66		$66	2.1%	$57	$10	$68
	PROJECT COST TOTALS:	$1,377	$240	17%	$1,617		$1,377	$240	$1,617		$1,617	1.9%	$1,402	$245	$1,647

_____ CHIEF, COST ENGINEERING, Patricia Bolton

_____ PROJECT MANAGER, William Kavenaugh

_____ CHIEF, REAL ESTATE, Vacant

_____ CHIEF, PLANNING, John Kennelly

_____ CHIEF, ENGINEERING, Scott Acone

_____ CHIEF, OPERATIONS, Frank Fedele

_____ CHIEF, CONSTRUCTION, Sean Dolan

_____ CHIEF, CONTRACTING, Sheila Winston-Vincuilla

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, Michael Keegan

ESTIMATED TOTAL PROJECT COST:		**$1,647**
ESTIMATED FEDERAL COST:	**65%**	$1,071
ESTIMATED NON-FEDERAL COST:	**35%**	$577
22 - FEASIBILITY STUDY (CAP studies):		**$460**
ESTIMATED FEDERAL COST:		$460
ESTIMATED NON-FEDERAL COST:		
ESTIMATED FEDERAL COST OF PROJECT		**$1,531**

Filename: 3031_CAP_SandwichTPCS_May2015FINAL.xlsx
TPCS

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: CCC Beneficial Use of Dredged Mat'ls from Maintenance Dredging
LOCATION: Town Neck Beach, Sandwich, Massachusetts
This Estimate reflects the scope and schedule in report; Beneficial Use Plan

DISTRICT: NAE New England District
POC: CHIEF, COST ENGINEERING, Patricia Bolton

PREPARED: 5/1/2015

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 5/1/2015 Estimate Price Level: 1-Oct-14				Program Year (Budget EC): 2015 Effective Price Level Date: 1 -Oct-14								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1 or CONTRACT 1													
17	BEACH REPLENISHMENT	$1,169	$214	18.3%	$1,382		$1,169	$214	$1,382	2016Q2	1.9%	$1,191	$218	$1,409
17	BEACH REPLENISHMENT													
	CONSTRUCTION ESTIMATE TOTALS:	$1,169	$214	18.3%	$1,382		$1,169	$214	$1,382			$1,191	$218	$1,409
01	LANDS AND DAMAGES	$90	$5	5.6%	$95		$90	$5	$95	2015Q4	1.1%	$91	$5	$96
30	PLANNING, ENGINEERING & DESIGN													
0.005	Project Management	$6	$1	18.3%	$7		$6	$1	$7	2015Q4	1.7%	$6	$1	$7
0.005	Planning & Environmental Compliance	$6	$1	18.3%	$7		$6	$1	$7	2015Q4	1.7%	$6	$1	$7
0.025	Engineering & Design	$29	$5	18.3%	$34		$29	$5	$34	2015Q4	1.7%	$29	$5	$35
0.0025	Engineering Tech Review ITR & VE	$3	$1	18.3%	$4		$3	$1	$4	2015Q4	1.7%	$3	$1	$4
0.005	Contracting & Reprographics	$6	$1	18.3%	$7		$6	$1	$7	2015Q4	1.7%	$6	$1	$7
0.005	Engineering During Construction	$6	$1	18.3%	$7		$6	$1	$7	2016Q2	2.9%	$6	$1	$7
0.0025	Planning During Construction	$3	$1	18.3%	$4		$3	$1	$4	2016Q2	2.9%	$3	$1	$4
0.0025	Project Operations	$3	$1	18.3%	$4		$3	$1	$4	2015Q4	1.7%	$3	$1	$4
31	CONSTRUCTION MANAGEMENT													
0.0375	Construction Management	$44	$8	18.3%	$52		$44	$8	$52	2016Q2	2.1%	$45	$8	$53
0.005	Project Operation:	$6	$1	18.3%	$7		$6	$1	$7	2016Q2	2.1%	$6	$1	$7
0.005	Project Management	$6	$1	18.3%	$7		$6	$1	$7	2016Q2	2.1%	$6	$1	$7
	CONTRACT COST TOTALS:	$1,377	$240		$1,617		$1,377	$240	$1,617			$1,402	$245	$1,647

APPENDIX E
Real Estate Plan

Cape Cod Canal
Sandwich, Massachusetts

Section 204 Study for
Beneficial Use of Dredged Material

REAL ESTATE PLAN

REAL ESTATE PLAN—REP LOCATED IN THE APPENDIX OF THE DETAILED PROJECT REPORT (FEASIBILITY STUDY REPORT)

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
REAL ESTATE DIVISION
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

PREPARED BY:

DANIEL E. JALBERT, MAI, ASA
Review Appraiser / Realty Specialist
MA Certified General Appraiser, License #273
U.S. ARMY CORPS OF ENGINEERS
New England District

EFFECTIVE DATE: February 23, 2015

TABLE OF CONTENTS

1. PROJECT PURPOSE:

The New England District completed a detailed project report (DPR) in accordance with Section 204 of the Water Resources Development Act (WRDA) of 1992 (33 USC Sec. 2326), as amended, pertaining to the beneficial use of dredged material from the Cape Cod Canal Federal Navigation Project (CCC). The DPR investigated the beneficial use of dredged material to be removed from the canal as nourishment directly placed on Town Neck Beach in the town of Sandwich, Massachusetts. The local non-Federal sponsor for the project will be the town of Sandwich.

The purpose of the Section 204 project, and the benefits produced are solely for coastal storm damage reduction. Benefits for the beach fill include delaying the loss and damage of the protected properties for the lifespan of the beach fill. The lifespan of the beach fill is estimated at five years. The structures to be protected are private dwellings and one restaurant.

The DPR concludes that there is Federal interest in implementing a Section 204 beneficial use project in order to address the near-term needs of the town of Sandwich. Long term solutions are also being recommended for study under other Federal authorities.

2. PROJECT AREA DESCRIPTION:

The town of Sandwich is located on the north shore of Sandwich, Massachusetts, facing Cape Cod Bay. It includes approximately 2,500 linear feet of shoreline, between the CCC south jetty (at the end of Town Neck Road) and Sandwich Harbor Inlet (Figure 1). Sandwich Harbor is located to the east of the project area and serves to connect an extensive salt marsh system with Cape Cod Bay.

Beach erosion has been and continues to be a major water resources problem in the town of Sandwich, Massachusetts. The Town is located on Cape Cod, on the southwestern shore of Cape Cod Bay, in Barnstable County. Historically the approximate rate of 2-3 feet per year has eroded along Sandwich Beach. The beaches are comprised of a mix of sand, gravel, and cobble with substantial dunes. The beaches are down drift of the CCC east entrance.

The town of Sandwich requested a Section 204 study seeking use of CCC maintenance dredging material for nourishment of the adjacent beaches. Approximately, 150,000 cubic yards is expected to be available from the 2015/2016 maintenance dredging of the CCC.

Most of the beach within the project site is owned by the town of Sandwich as part of Town Neck Beach. It is a public beach that extends from Sandwich Harbor northwest towards the Canal, and fronts the residential development known as Town Neck Hill.

Figure 1: Town of Sandwich Cape Cod Canal Section 204 Study.

3. RECOMMENDED PLAN:

A recommended construction plan has been chosen to maximize the beneficial use of the dredge materials. Approximately 150,000 cubic yards of material is available based upon the most recent condition surveys. The plan is for the construction of a 2,500 foot long beach fill area, with a 60-foot wide berm using the dredged material from the CCC. A portion of the material would be used to reconstruct the existing dune face. The new dune face would be planted with dune grass and sand fencing would be installed. Construction would involve direct placement by a self propelled, medium-sized pump out-capable hopper dredge.

4. REAL ESTATE MAPPING:

The Project Delivery Team (PDT) confirms whether the proposed navigation maintenance (dredging of CCC) and disposal sites require the acquisition of any real property interests. Based on the application of navigation servitude most of the beach falls within the servitude area for the placement of the dredged material with the exception of ten (10) properties that will require permanent easements. These easements, along with work areas and access over town owned property will be provided by the Town.

The table below is a list of all required parcels for the construction, operation and maintenance of the proposed project. This list provides the owner names, the interests needed, and the parcels identified by block and lot number, as currently recorded in County and Municipal tax property records.

OWNER/INTEREST NEEDED	LOCATION OF PARCEL	PARCEL ID	PARCEL DESCRIPTION
MUNICIPALITIES	**Three (3)**		
Town of Sandwich- work area	Town	93-012	West Parking Lot and
Town of Sandwich- work area	Wood	93-012	East Parking Lot and
Town of Sandwich- work area	Wood	89-127	East Parking Lot and
PRIVATE PARCELS	**Nine (9)**		
M.Duggan/M. Diggins- Easement	49R	94-089	.11 Ac
D. Levesqu Trustee- Easement	51R	94-091	.27 Ac
R & D Asack/5 White Cap- Easement	1-5 White	94-095-001	White Cap Condos 2 units
R & M Moore- Easement Diane RT,M Raynar V Poulos D & I Davis	2,4,6 & 8 White Cap Path	94-101-001 94-101-002 94-101-003 94-101-004	Sandwich Shores Condos 4 units. Field Card: 94-101 includes: (94-098, 94-099, 89-091,
J Ekasala- Easement	5 Bay	89-103	1.28 Ac
M Sheehan Trust- Easement	3 Bay	89-104	.59 Ac
P Joubert/B Hand- Easement	1 Bay	89-105	.69 Ac
B Hartshorn/M Kirby- Easement	103 Wood	89-106	.46 Ac
P&N Sylvia- Easement	45 Freeman	94-086	.37 Ac
PRIVATE Right-Of-Way	**On**		
White Cap Path- Easement	Private Way	No ref. #	No area specified.
TOTALS	**Thirteen (13)**	See Appendix	Field Cards (exception 89-127 has no field card and considered part of the Sandwich Beach, Town of Sandwich).

5. RECOMMENDED ESTATES:

The town of Sandwich has agreed to act as the non-Federal sponsor for this project and will execute a Project Partnership Agreement (PPA) with the District. The local sponsor will be required to obtain and certify acquisition of all real property interests (easements) required for the construction, operation and maintenance of the project. The real property requirements were carefully developed and analyzed by the Real Estate Division, PDT and further refined through the DPR. The real property estate for all private ownerships, "Perpetual Beach Storm Damage Reduction Easement", was based upon the estates found in ER 405-1-12.

PERPETUAL BEACH STORM DAMAGE REDUCTION EASEMENT

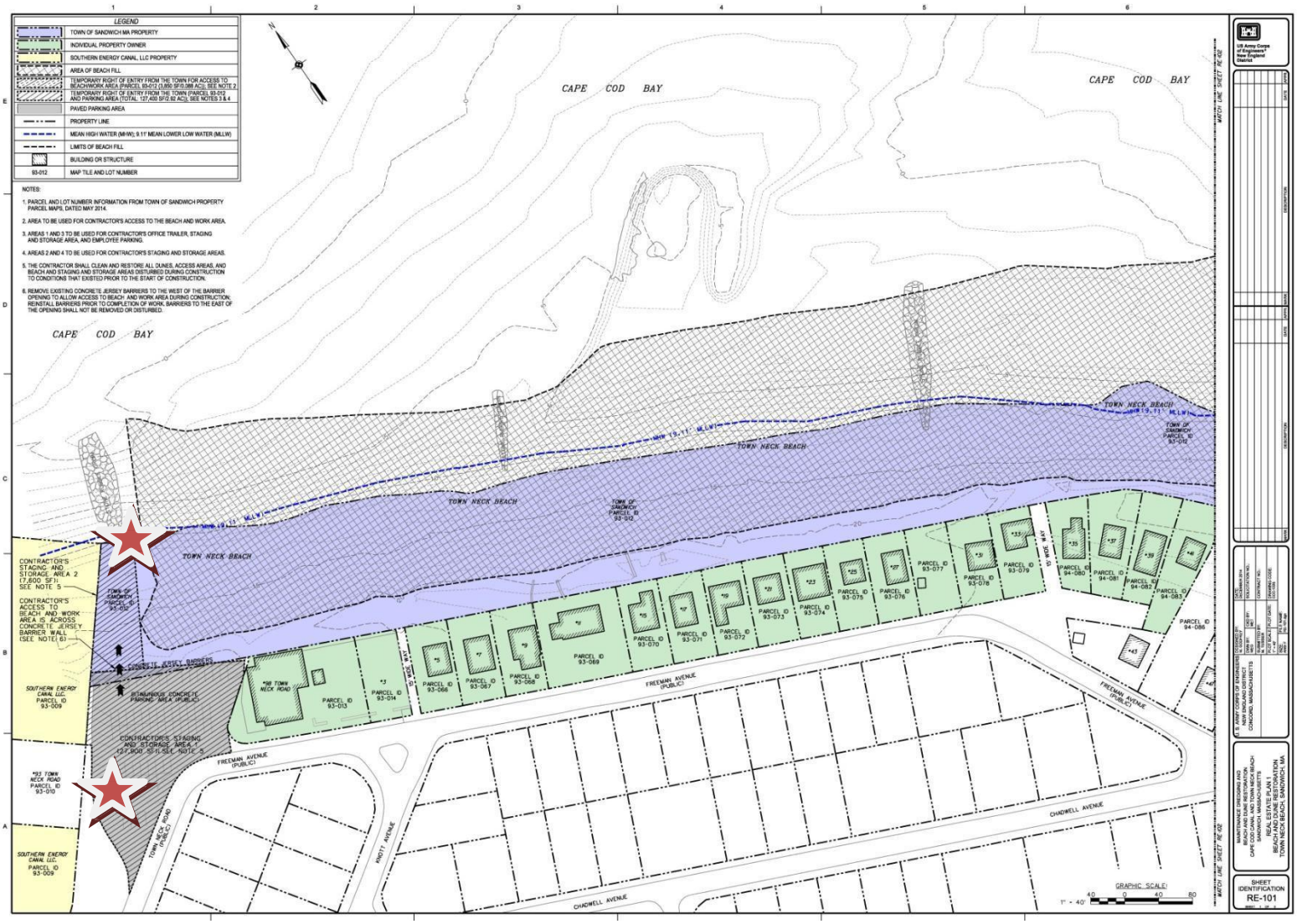
(Standard Estate No. 26)

A perpetual and assignable easement and right-of-way in, on, over and across the land described in Schedule A, for use by the town of Sandwich, its representatives, agents, contractors, and assigns, to construct; preserve; patrol; operate; maintain;
repair; rehabilitate; and replace; a public beach a dune system and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms and dunes; to nourish and re-nourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic re- nourishment and maintenance of the "Cape Cod Canal Sandwich, Massachusetts Section 204 Study for Beneficial Use of Dredged Material Project", Cape Cod Canal Sandwich, Massachusetts Section 204 - Beneficial Uses of Dredged Material Project, together with the right of public use and access; to plant vegetation on said dunes and berms; to erect, maintain and remove silt screens and sand fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas; to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement; reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune over-walk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the (designated representative of the Project Sponsor) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further reserving to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

All project activities, including mobilization and construction, lay down and storage of contractor materials and equipment, planting of dune grass and placement of sand fences, as well as crossover areas, are located within the permanent easement areas. The Town will provide work areas and access through town owned land and will execute the Authorization for Entry for Construction. There are no non-standard estates required for this project.

Plan details referenced below (Figures 2, 3 and 4) depict the limits of construction within the existing federal navigation channel, along with construction areas, which exceed navigational servitude, resulting in the required easements. There are two general areas for permanent easements and work area/access that are required for construction or maintenance.

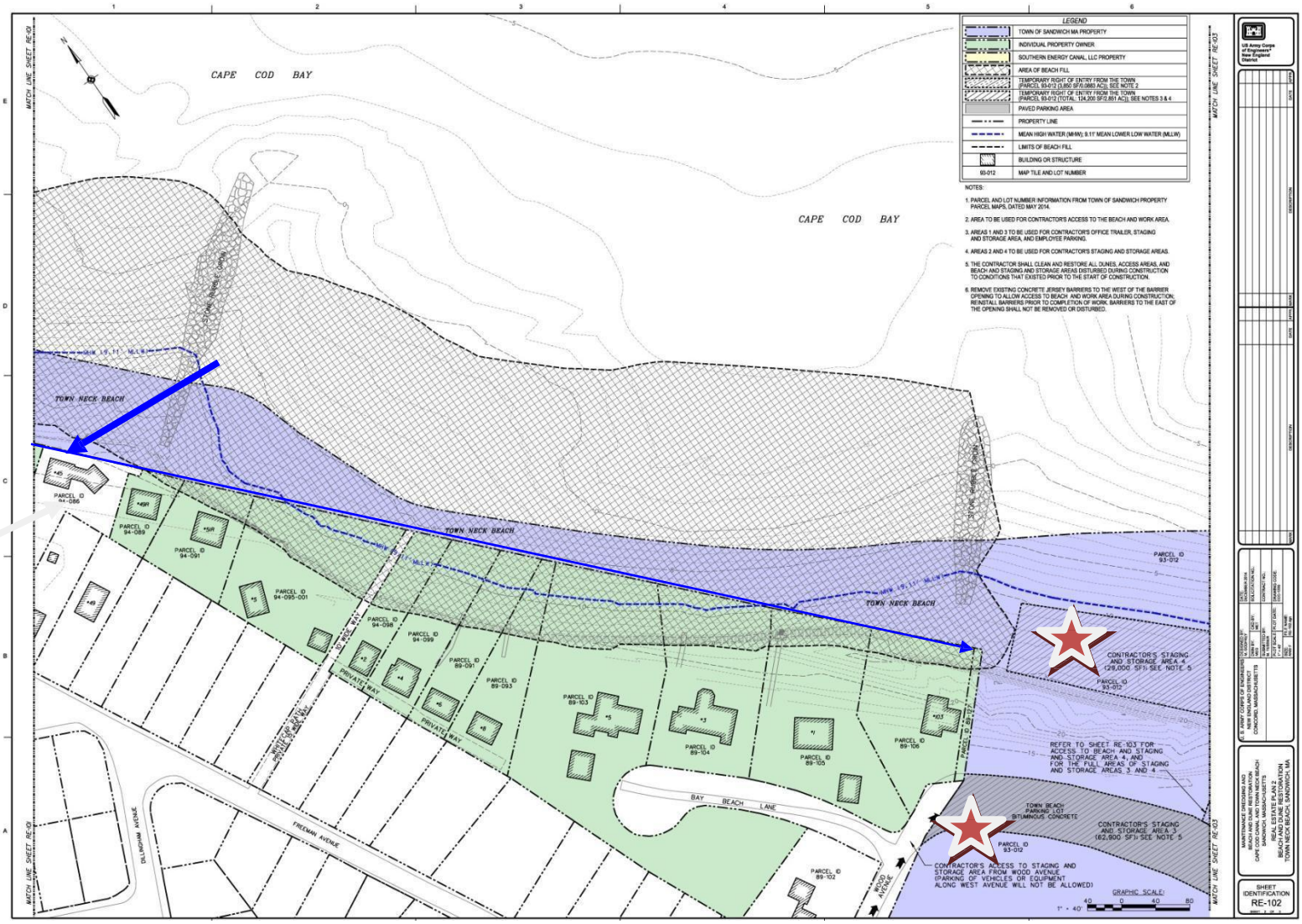
Figure 2: **CCC Sandwich, MA Section 204 Beneficial Uses of Dredge Material Project Plan.**



Shown on this Plan to the West side of the Project is the Staging and Storage Areas 1 & 2. Area 1, consisting of 27,900 SF of parking lot (in grey) and Area 2, consisting of 7,600 SF of beach (in blue), serve as a contractors access area to the beach and construction area, all shown as a diagonal lined area on the corner of Town Neck Road and Freeman Avenue and emphasized with star symbol.

The Town property is off of Town Neck Beach. Continuing to the east the Parcels from 93-013 to 94-083 are not required to have easements and are not in the construction area. The construction area will be to the northwest or the ocean front side of these lots.

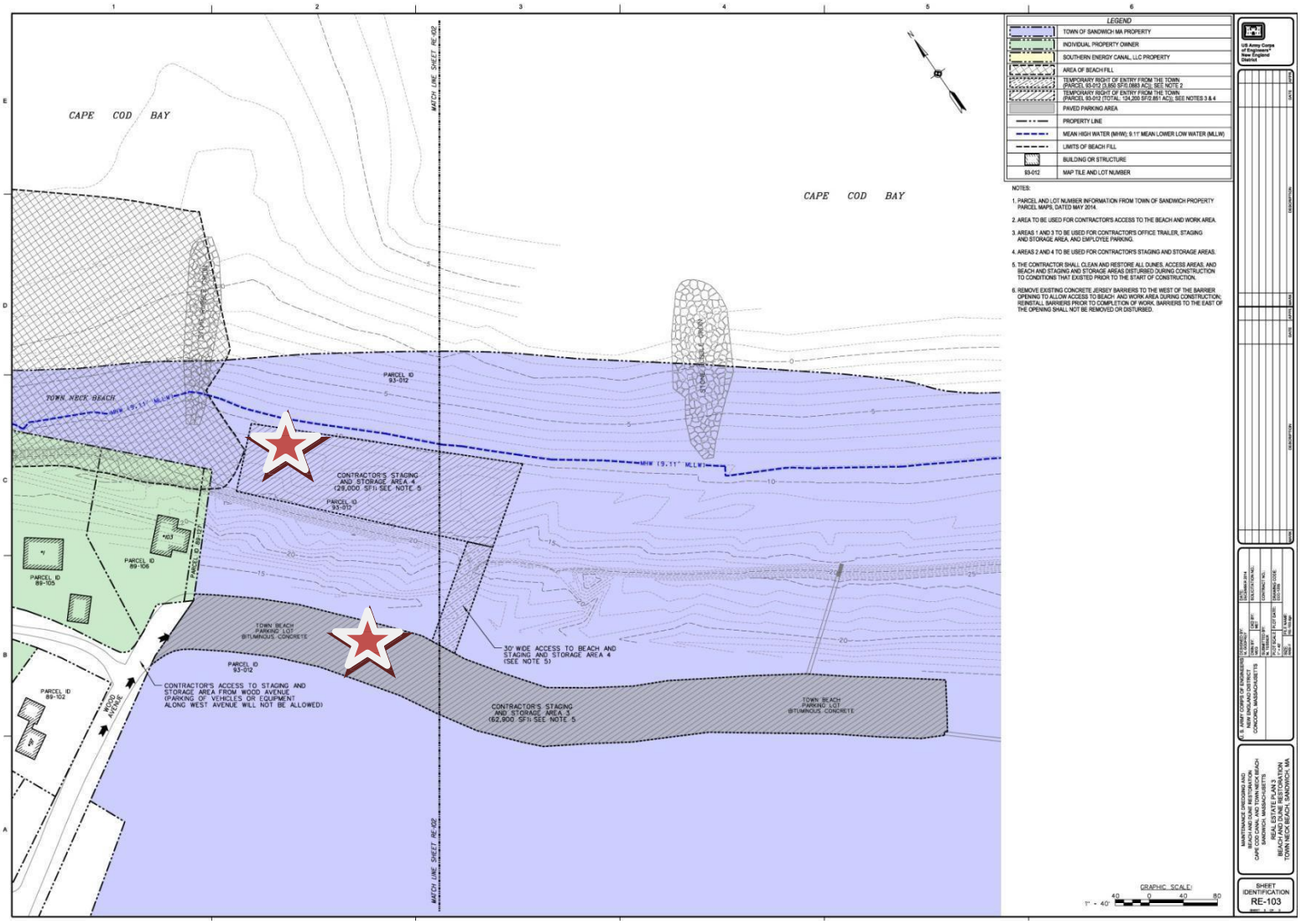
Figure 3: CCC Sandwich, MA Section 204 Beneficial Uses of Dredge Material Project Plan.



Shown on this Plan above to the East side of the Project is the Staging and Storage Area 3 (in grey) and 4 (in blue), described on the page with a "Star" and detailed on the next page. These lots border Town Neck Beach. The Parcels along Freeman Avenue from 94-086 to 89-106 west to east (starting at the blue arrow, are required to have easements and they will be part of the construction area, as shown with the black dash line.

Shown between these nine lots (structures #2,#4,#6,#8 with parcel ID's, respectively, 94-098, 94-099, 89-091 and 89-093, are considered one condominium lot according to the Town of Sandwich) is a private 10' right-of-way to the Beach. This will need a permanent easement, as well.

Figure 4: CCC Sandwich, MA Section 204 Beneficial Uses of Dredge Material Project Plan.



Shown on this Plan on the East side of the Project is the Staging and Storage Areas 3 and 4. These are on Town owned property, Area 3 consists of a paved parking lot 62,900 SF. Area 4 consists of an approximate 30' wide access to the beach and Parcel 93-012, with a total of 29,000 SF Staging and Storage Area, which will be fenced, located off Wood Avenue.

Parcels requiring easements are listed in the Real Estate Mapping section. These lots border Town Neck Beach. The Parcel indicated as 89-127 is referenced as town of Sandwich on the assessor's plans. There will be no parking along Wood Avenue and the parking lot shown in dark grey will be exclusive use for parking for contractors and equipment.

6. EXISTING FEDERAL PROJECTS:

There are no existing Federal projects that will impact the real property component of this project.

7. EXISTING FEDERALLY OWNED LANDS:

There are no existing federal lands that will impact the real property components of this project.

8. LANDS OWNED BY THE NON-FEDERAL SPONSOR:

Project construction does not require the non-Federal Sponsor to convey any lands to the Federal government. However the non-federal Sponsor owns lands along the beach, which will be utilized for access and as work areas in conjunction with project construction requirements.

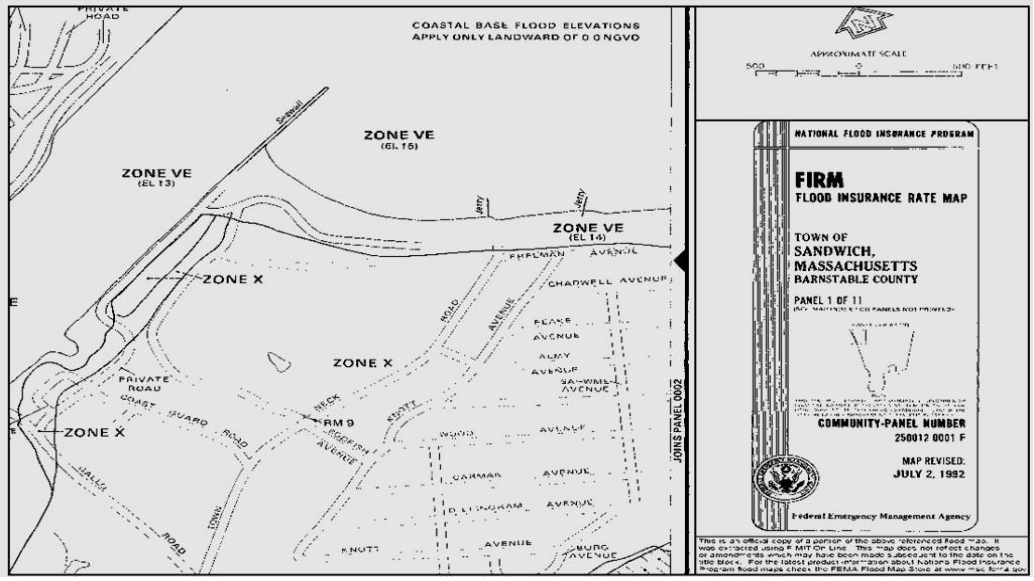
9. NAVIGATIONAL SERVITUDE:

The CENAE Office of Counsel has reviewed this Section 204 project and has determined that the navigational servitude applies to the acquisition of real property interests. Navigational servitude is the right of the federal Government under the Commerce Clause of the U.S. Constitution to use, control, and regulate the navigable waters of the United States. This project is directly related to channel maintenance of the CCC and disposal of the material therefore navigation servitude applies to the Section 204 project.

10. INDUCED FLOODING:

Land subject to Coastal Storm Flowage is land subject to any inundation caused by coastal storms up to and including that caused by the 100-year storm, surge of record, or storm of record, whichever is greater, and includes both V zones (velocity zones or areas of wave action), and A zones (the extent of the quantifiable 100-year coastal floodplain). (See Figure 5).

Figure 5: FEMA FIRM for the project area.



As seen in the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRMs) in Figure 5, the entire project area is within the 100-year flood plain, and is therefore the entire area is classified as Land Subject to Coastal Storm Flowage.

There is nothing in the DPR to indicate that the constructed project features will induce flooding in new areas or increase flooding in existing flood prone areas. Accordingly, there will be no construction or project induced flooding.

11. BASELINE COST ESTIMATE FOR REAL ESTATE:

There are no fee acquisitions required for this project. Permanent easements to be acquired by the town of Sandwich, along with town owned access are necessary for the construction, operation and maintenance of the project. The Town will incur administrative real estate costs associated with these acquisitions. It is anticipated that the easement areas on private land will be donated to the town of Sandwich. The baseline costs represent the scenario if all properties are donated and show an estimate as administrative costs the Town would incur to acquire rights from the private property.

There was no gross appraisal or informal value estimate for the permanent easements but rather a stipulation of value, as agreed by the Sponsor. Due diligence was performed but market value of beach frontage below mean high water had no discernible value and market evidence was not available to contradict this finding.

As addressed in EC 405-1-104 30 Dec 2003, Section 5 on Valuation:

> *"There are various circumstances when stipulation of value is reasonable to support the project. The Government and the non-Federal sponsor may agree to stipulate the amount of credit allowance for a tract(s) on a case-by-case basis."*

The subject easements consist of a strip of land, which is under water at high tide and below mean high water and has no discernible value for the easement rights being granted, while bordering town property. The interest being lost typically is valued based on a before and after value, involving permanent easements. This typically results in the diminution in value prior to the improvements. In the case of the subject Project the area of the easement shows no loss to the area below mean high water. The benefits from the construction will enhance the value of the easement area. The after construction or future value with the improvements of the beach are not considered in estimating the current value.

A waiver can exist for this type of circumstance if requested. A preponderance of evidence failed to show support for discernible land value below mean high water. Common practice suggested no value existed at the time of project inception for the easement areas.

A potential catastrophic loss of real property improvements and infrastructure is not factored into the analysis. The construction of this project would generally be construed as beneficial to individual property owners. A review of ER 1165-2-130, Water Resources Policies and Authorities, Federal Participation In Shore Protection, Paragraph 9 d(1) states. "…the value of LER eligible for credit toward the non- Federal share of shore protection costs is that which is not subject to loss through erosion in the without project condition. LER needed for placement of shore protection project costs is that which is not subject to loss through erosion in the without project condition. LER needed for placement of shore protection project costs is that which is not subject to loss through erosion in the without project condition. LER needed for the placement of shore protection includes project features that prevent the loss of the land itself has no value for crediting purposes." However, the ER also states that the local real estate market **may not** recognize the value of the project in relationship to the required permanent easement requirements-public access and perpetual maintenance agreement (loss of real property rights).

The Town has asked the property owners to donate the interests, which has been discussed with the property owners, according to the Sponsor. In order to be compliant with 42 USC Chapter 61, The Uniform Relocation Assistance And Real Property Acquisition Policies For Federal And Federally Assisted Programs and the regulations relating to this statute, 49 CFR Part 24, Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally-Assisted Programs, the Real Estate Division recommends that the Town be required to obtain waivers of just compensation from property owners, in regards to the acquisition of the required permanent easements.

The value associated with the work and access areas are determined nominal, as result of the benefit of beach replenishment. If all of the easements are acquired through donation, there will be no LER credit to the local Sponsor for the actual easements.

The sponsor would be entitled to credit for the time and money spent acquiring the donated easements. These costs would include surveys, map preparation, deed preparation, negotiations, etc. Based on all of the factors discussed in this section, the total Baseline Cost for Real Estate for the project is estimated at $95,000 and if all properties are donated as anticipated. The $95,000 of administrative cost was based on 26 weeks of administrative time over the course of the project or a 20 hour week over a one year period at $100/hour, which includes overhead. This estimate of town involvement on real estate issues includes their effort to provide the work and access areas along with other incidental costs. These are relevant costs whether there is value to the real estate or no discernible value.

As addressed in ER 405-1-12 1 May 98, 12-18 b-3:

Baseline Cost Estimate for Real Estate.

"(3) Incidental acquisition costs for the Government or non-Federal sponsor may include those incurred for title work, appraisals, review of appraisals, coordination meetings, review of documents, review of P.L. 91-646 actions, legal support and other costs that are incidental to the acquisition of LER required for the project and that are otherwise reasonable, allocable and allowable. Government costs for staff monitoring and for reviewing, approving and crediting LER provided by a non-Federal sponsor are also included."

The administrative costs, summarized as follows:

Administrative Costs:		$ 90,000.00	($9,000/property)
Condemnation Costs:		$ 0	(no cost donated)
Appraisals		$ 0	(waived each)
Real Estate Payments:			
Privately-Owned	10 Properties	$ 0	(No loss in value)
Publically-Owned	3 Properties	$ 0	(donated)
Sub Total		$ 90,000.00	
Contingency 5%:		$ 4,500.00	
	TOTAL:	$ 95,000.00	(rounded)

12. PUBLIC LAW 91-646 RELOCATIONS

There are no facilities or utilities within the project boundaries requiring relocation. This will be reviewed and confirmed at Project Partnership Agreement phase.

13. MINERAL ACTIVITY:

The PDT confirms there is no present or anticipated mining and drilling activity in the vicinity of the project that may affect project purposes and the operation thereof.

14. TIMBER RIGHTS:

The PDT confirms that there are no timber rights required. The project lands are within the navigable waterway.

15. ASSESSMENT OF NON-FEDERAL SPONSOR ACQUISITION CAPABILITY:

The town of Sandwich has real estate easement acquisition requirements, with an estimated nine improved lots and one Right-of-Way. The non-Federal Sponsor has previously participated in other Corps of Engineers cost shared projects and has demonstrated their capabilities in acquiring real estate and performing the related obligations of a non-Federal Sponsor.

16. ZONING:

There are no zoning considerations associated with this project and the land for the permanent easements is zoned R-1 residential.

17. ACQUISITION SCHEDULE:

The non-federal Sponsor will officially initiate real estate acquisition activities after final execution of the PPA, scheduled for July 1, 2015.

A projected schedule has been developed based on the assumption that Federal and non-Federal funds will be available. The tentative schedule for project completion is as follows:

ESTIMATED DATES

Initial Meeting from 2008 Start	July 2014
Initiate Design Plans & Specifications	Oct 2014
Prepare PMP	Oct 2014
Real Estate Appraisal Process Begins, if Required	Dec 2014
Completion of Detailed Plans and Specifications	Jan 2015
Obtain State & Local Permits	May 2015
Obtain Real Estate Easements	Aug 2015
& Signed Project Partnership Agreement (PPA)	July 2015
Bid and Award	Sept 2015
Initiate Construction	Nov 2015
Completion of Construction	May 2016

18. UTILITY AND FACILITY RELOCATIONS:

The PDT confirms that there are no utility or facility relocation requirements.

19. HAZARDOUS, TOXIC AND RADIOACTIVE WASTE:

The sponsor fully understands its responsibilities for assessing the properties for any potential or presence of hazardous waste materials as defined and regulated under CERCLA. There is no known “Superfund” sites or sites presently under CERCLA remediation or response orders identified in the project area. There are no known presences of any substances in the project area that are regulated under CERCLA or other environmental statutes or regulations.

The LER estimate is predicated on the assumption that all lands and properties are clean and require no remediation. The PPA conditions contain specific terms and conditions governing the sponsor’s responsibility for environmental cleanup for CERCLA regulated substances.

20. ATTITUDES OF THE LANDOWNERS:

The non-Federal Sponsor reports overall community support for this project. The record does not indicate any known opposition or public concerns.

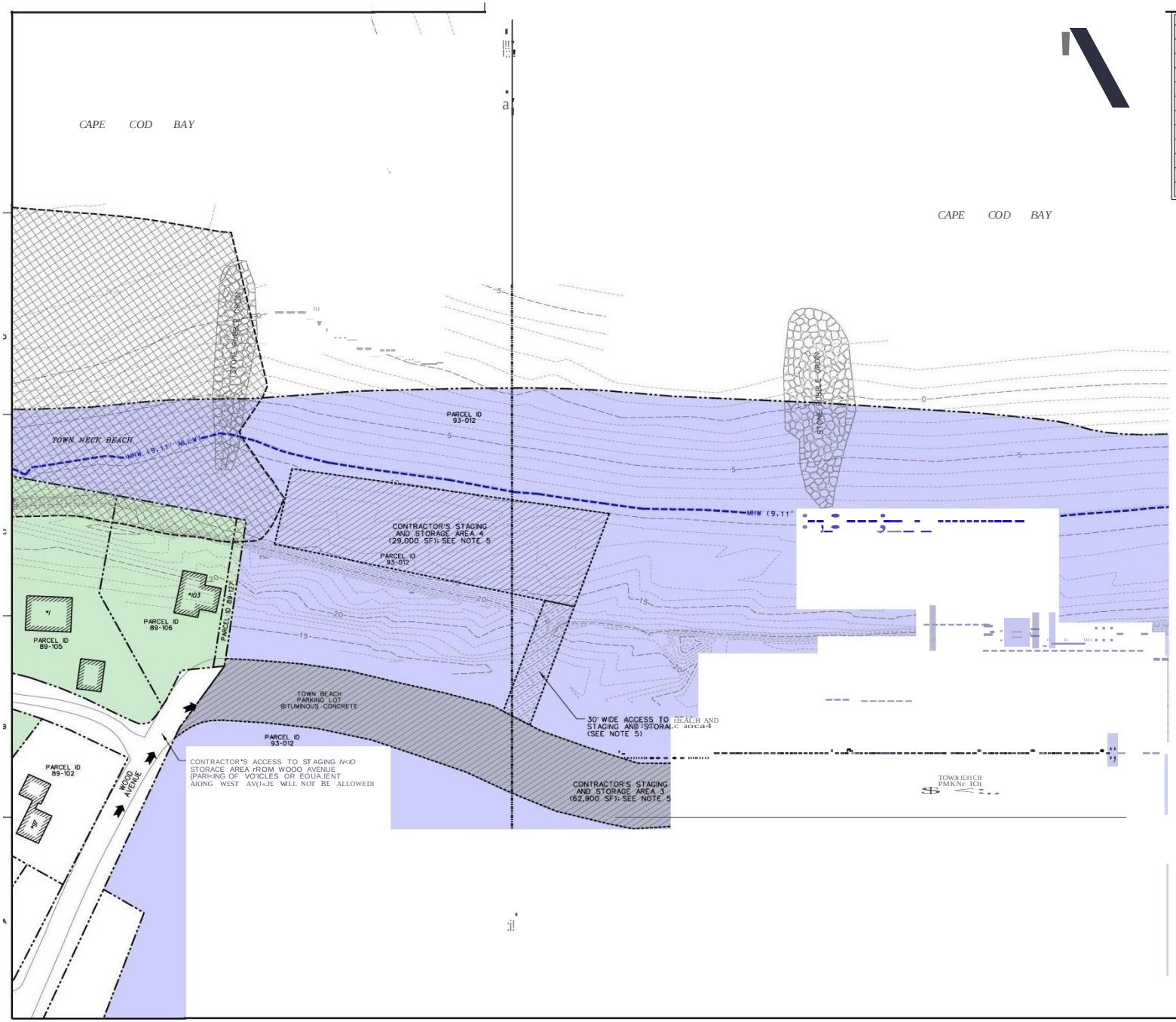
21. NOTIFICATION TO NON-FEDERAL SPONSOR:

The non-federal Sponsor has not executed a feasibility cost share agreement to date but the town of Sandwich has agreed to sign the Project Partnership Agreement on or before July 1, 2015. At this time, the non-federal Sponsor will be required to acquire the real estate interests for project purposes. The non-federal sponsor has been made aware of the risks associated with acquisition of real estate interests prior to PPA.

22. APPENDIX:

This section includes supplemental information required for the report, which includes maps, field cards and zoning reference and copy of the ASSESSMENT OF NON-FEDERAL SPONSOR’S REAL ESTATE ACQUISITION CAPABILITY.

PROJECT PLANS



LEGEND	
	TOWN OF SANDWICH MA PROPERTY
	INDIVIDUAL PROPERTY OWNER
	SOUTHERN ENERGY CANAL, LLC PROPERTY
	AREA OF BEACH FILL
	TEMPORARY RIGHT OF ENTRY FROM THE TOWN (PARCEL 93-012 (3,800 SF/0.0883 AC)); SEE NOTE 2
	TEMPORARY RIGHT OF ENTRY FROM THE TOWN (PARCEL 93-012 (TOTAL: 124,200 SF/2.851 AC)); SEE NOTES 3 & 4
	PAVED PARKING AREA
	PROPERTY LINE
	MEAN HIGH WATER (MHW); 9.11' MEAN LOWER LOW WATER (MLLW)
	LIMITS OF BEACH FILL
	BUILDING OR STRUCTURE
93-012	MAP TILE AND LOT NUMBER

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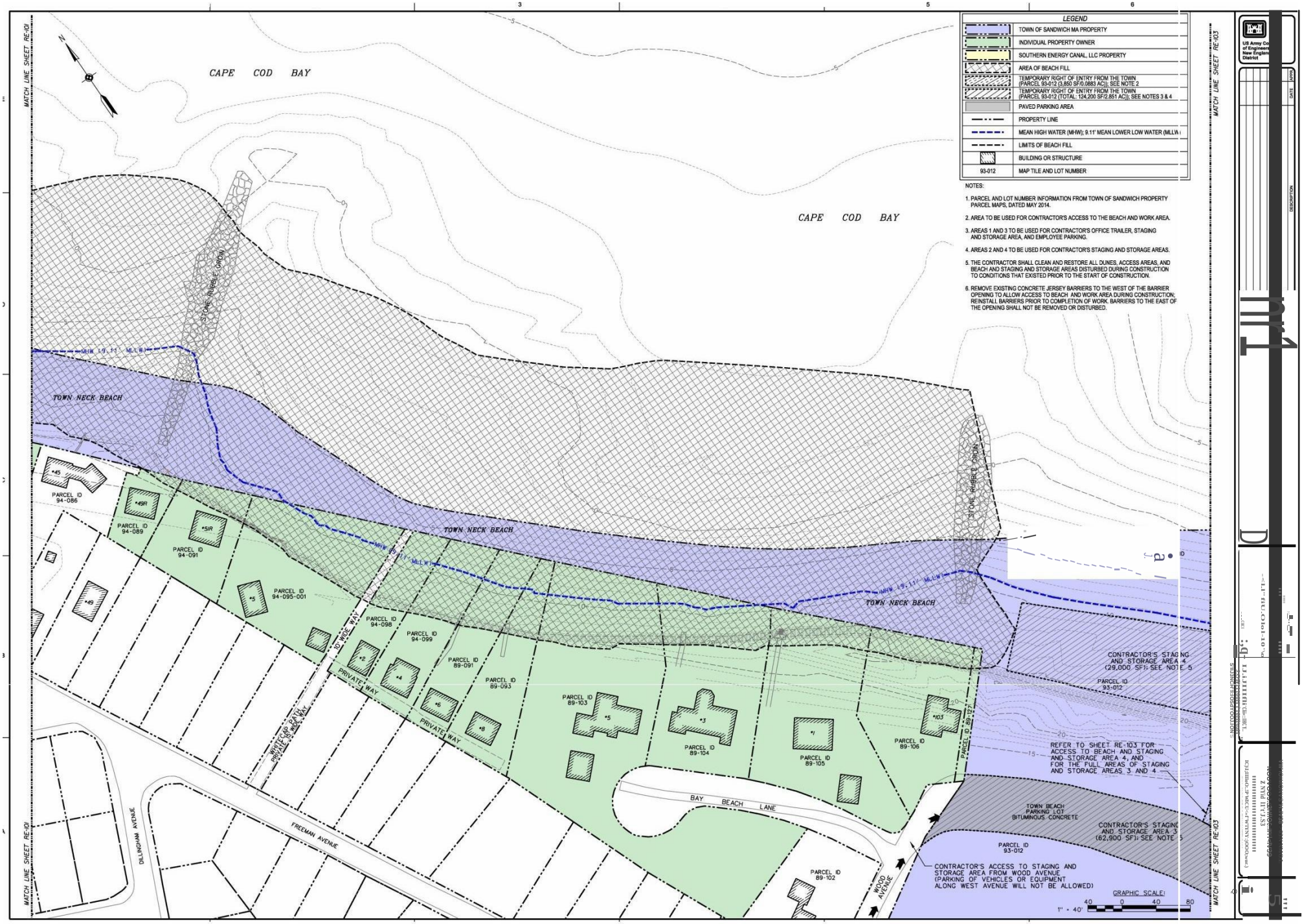
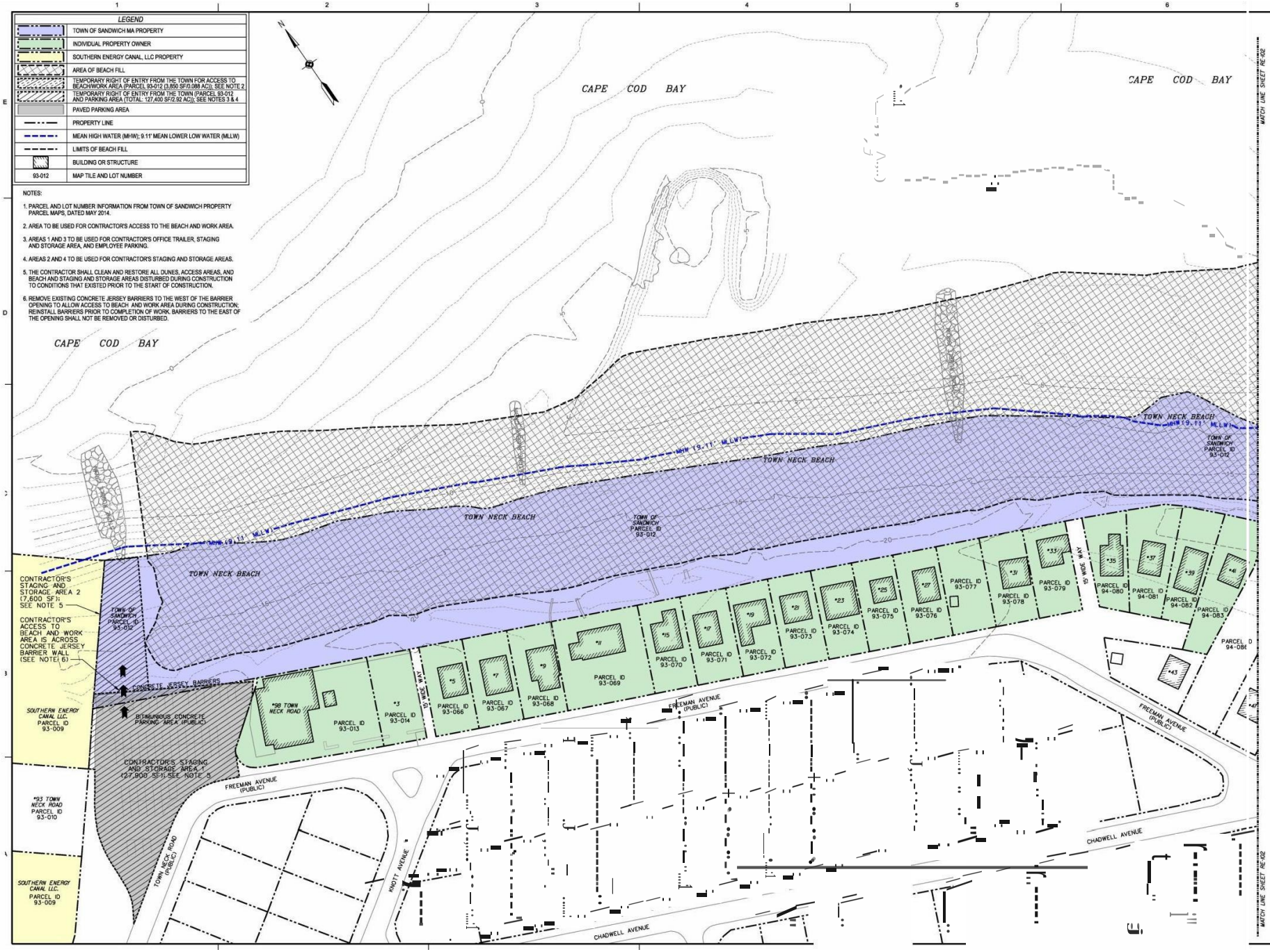
U.S. ARMY CORPS OF ENGINEERS	DESIGNED BY: N. MORRIS	DATE: DECEMBER 2014
NEW ENGLAND DISTRICT CONCORD, MASSACHUSETTS	DRAWN BY: MEG	QUANTITIES BY: N. MORRIS
	QUALITY CHK'D BY: MEG	PLOT SCALE: AS NOTED
	PLOT DATE:	DRAWING CODE: SCOPE
	SIZE: ANSI D	FILE NAME: RE-103.dgn

SHEET IDENTIFICATION
RE-103


LEGEND
TOWN OF SANDWICH MA PROPERTY
INDIVIDUAL PROPERTY OWNER
SOUTHERN ENERGY CANAL, LLC PROPERTY
AREA OF BEACH FILL
TEMPORARY RIGHT OF ENTRY FROM THE TOWN (PARCEL 93-012 (3,850 SF/0.0883 AC)); SEE NOTE 2
TEMPORARY RIGHT OF ENTRY FROM THE TOWN (PARCEL 93-012 (TOTAL: 124,200 SF/2.851 AC)); SEE NOTES 3 & 4
PAVED PARKING AREA
PROPERTY LINE
MEAN HIGH WATER (MHW); 9.11' MEAN LOWER LOW WATER (MLLW)
LIMITS OF BEACH FILL
BUILDING OR STRUCTURE
93-012
MAP TILE AND LOT NUMBER
NOTES:
1. PARCEL AND LOT NUMBER INFORMATION FROM TOWN OF SANDWICH PROPERTY PARCEL MAPS, DATED MAY 2014.
2. AREA TO BE USED FOR CONTRACTOR'S ACCESS TO THE BEACH AND WORK AREA.
3. AREAS 1 AND 3 TO BE USED FOR CONTRACTOR'S OFFICE TRAILER, STAGING AND STORAGE AREA, AND EMPLOYEE PARKING.
4. AREAS 2 AND 4 TO BE USED FOR CONTRACTOR'S STAGING AND STORAGE AREAS.
5. THE CONTRACTOR SHALL CLEAN AND RESTORE ALL DUNES, ACCESS AREAS, AND BEACH AND STAGING AND STORAGE AREAS DISTURBED DURING CONSTRUCTION TO CONDITIONS THAT EXISTED PRIOR TO THE START OF CONSTRUCTION.
6. REMOVE EXISTING CONCRETE JERSEY BARRIERS TO THE WEST OF THE BARRIER OPENING TO ALLOW ACCESS TO BEACH AND WORK AREA DURING CONSTRUCTION; REINSTALL BARRIERS PRIOR TO COMPLETION OF WORK. BARRIERS TO THE EAST OF THE OPENING SHALL NOT BE REMOVED OR DISTURBED.
CAPE COD BAY
CAPE COD BAY
STONE RUBBLE GROIN
STONE RUBBLE GROIN
TOWN NECK BEACH
TOWN NECK BEACH
TOWN NECK BEACH
MHW 9.11' MLLW
MHW 9.11' MLLW
MHW 9.11' MLLW
PARCEL ID 94-086
PARCEL ID 94-089
PARCEL ID 94-091
PARCEL ID 94-095-001
PARCEL ID 94-098
PARCEL ID 94-099
PARCEL ID 89-091
PARCEL ID 89-093
PARCEL ID 89-103
PARCEL ID 89-104
PARCEL ID 89-105
PARCEL ID 89-106
PARCEL ID 89-102
PARCEL ID 93-012
PARCEL ID 93-012
PARCEL ID 93-012
#49
#49R
#51R
#5
#49
#2
#4
#6
#8
#5
#3
#1
#103
10' WIDE WAY
PRIVATE WAY
PRIVATE WAY
WHITE CAP PRIVATE WAY
BAY BEACH LANE
FREEMAN AVENUE
DILLINGHAM AVENUE
WOOD AVENUE
CONTRACTOR'S STAGING AND STORAGE AREA 4 (29,000 SF); SEE NOTE 5
REFER TO SHEET RE-103 FOR ACCESS TO BEACH AND STAGING AND STORAGE AREA 4, AND FOR THE FULL AREAS OF STAGING AND STORAGE AREAS 3 AND 4
TOWN BEACH PARKING LOT BITUMINOUS CONCRETE
CONTRACTOR'S STAGING AND STORAGE AREA 3 (62,900 SF); SEE NOTE 5
CONTRACTOR'S ACCESS TO STAGING AND STORAGE AREA FROM WOOD AVENUE (PARKING OF VEHICLES OR EQUIPMENT ALONG WEST AVENUE WILL NOT BE ALLOWED)
GRAPHIC SCALE:
40 0 40 80
1" = 40'
MATCH LINE SHEET RE-101
MATCH LINE SHEET RE-103
MATCH LINE SHEET RE-101
MATCH LINE SHEET RE-103


LEGEND
TOWN OF SANDWICH MA PROPERTY
INDIVIDUAL PROPERTY OWNER
SOUTHERN ENERGY CANAL, LLC PROPERTY
AREA OF BEACH FILL
TEMPORARY RIGHT OF ENTRY FROM THE TOWN FOR ACCESS TO BEACH/WORK AREA (PARCEL 93-012 (3,850 SF/0.088 AC)); SEE NOTE 2
TEMPORARY RIGHT OF ENTRY FROM THE TOWN (PARCEL 93-012 AND PARKING AREA (TOTAL: 127,400 SF/2.92 AC)); SEE NOTES 3 & 4
PAVED PARKING AREA
PROPERTY LINE
MEAN HIGH WATER (MHW); 9.11' MEAN LOWER LOW WATER (MLLW)
LIMITS OF BEACH FILL
BUILDING OR STRUCTURE
93-012
MAP TILE AND LOT NUMBER
NOTES:
1. PARCEL AND LOT NUMBER INFORMATION FROM TOWN OF SANDWICH PROPERTY PARCEL MAPS, DATED MAY 2014.
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4. AREAS 2 AND 4 TO BE USED FOR CONTRACTOR'S STAGING AND STORAGE AREAS.
5. THE CONTRACTOR SHALL CLEAN AND RESTORE ALL DUNES, ACCESS AREAS, AND BEACH AND STAGING AND STORAGE AREAS DISTURBED DURING CONSTRUCTION TO CONDITIONS THAT EXISTED PRIOR TO THE START OF CONSTRUCTION.
6. REMOVE EXISTING CONCRETE JERSEY BARRIERS TO THE WEST OF THE BARRIER OPENING TO ALLOW ACCESS TO BEACH AND WORK AREA DURING CONSTRUCTION; REINSTALL BARRIERS PRIOR TO COMPLETION OF WORK. BARRIERS TO THE EAST OF THE OPENING SHALL NOT BE REMOVED OR DISTURBED.
CAPE COD BAY
CAPE COD BAY
CAPE COD BAY
TOWN NECK BEACH
MHW (9.11' MLLW)
TOWN NECK BEACH
MHW (9.11' MLLW)
TOWN NECK BEACH
MHW (9.11' MLLW)
TOWN NECK BEACH
TOWN OF SANDWICH PARCEL ID 93-012
TOWN OF SANDWICH PARCEL ID 93-012
TOWN OF SANDWICH PARCEL ID 93-012
CONTRACTOR'S STAGING AND STORAGE AREA 2 (7,600 SF); SEE NOTE 5
CONTRACTOR'S ACCESS TO BEACH AND WORK AREA IS ACROSS CONCRETE JERSEY BARRIER WALL (SEE NOTE 6)
CONCRETE JERSEY BARRIERS
BITUMINOUS CONCRETE PARKING AREA (PUBLIC)
CONTRACTOR'S STAGING AND STORAGE AREA 1 (27,900 SF); SEE NOTE 5
SOUTHERN ENERGY CANAL LLC. PARCEL ID 93-009
SOUTHERN ENERGY CANAL LLC. PARCEL ID 93-009
*93 TOWN NECK ROAD PARCEL ID 93-010
*98 TOWN NECK ROAD
PARCEL ID 93-013
PARCEL ID 93-014
PARCEL ID 93-066
PARCEL ID 93-067
PARCEL ID 93-068
PARCEL ID 93-069
PARCEL ID 93-070
PARCEL ID 93-071
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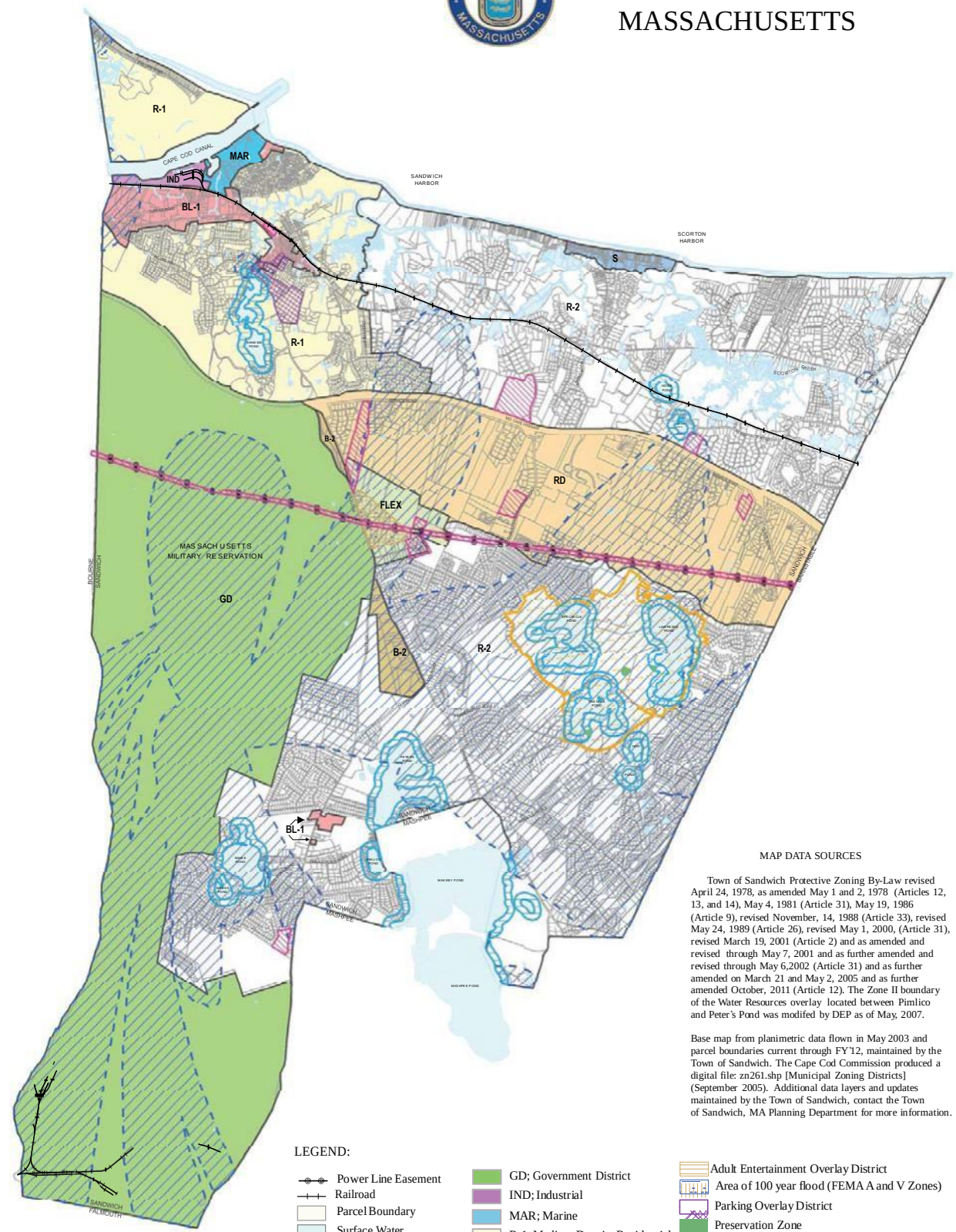
PARCEL ID 94-082
PARCEL ID 94-083
PARCEL D 94-086
15 MOE WAY
15 MOE WAY
FREEMAN AVENUE (PUBLIC)
FREEMAN AVENUE (PUBLIC)
FREEMAN AVENUE (PUBLIC)
TOWN NECK ROAD (PUBLIC)
KNOTT AVENUE
CHADWELL AVENUE
CHADWELL AVENUE
MATCH LINE SHEET RE-102
MATCH LINE SHEET RE-102
US Army Corps of Engineers® New England District
MAINTENANCE DREDGING AND BEACH NOURISHMENT PROJECT
CAPE COD CANAL AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS
REAL ESTATE PLAN I
BEACH NOURISHMENT LOCATION
TOWN NECK BEACH, SANDWICH, MA
SHEET IDENTIFICATION
RE-101

FIELD CARDS / ZONING MAP

ZONING MAP TOWN OF SANDWICH MASSACHUSETTS



MAP DATA SOURCES

Town of Sandwich Protective Zoning By-Law revised April 24, 1978, as amended May 1 and 2, 1978 (Articles 12, 13, and 14), May 4, 1981 (Article 31), May 19, 1986 (Article 9), revised November, 14, 1988 (Article 33), revised May 24, 1989 (Article 26), revised May 1, 2000, (Article 31), revised March 19, 2001 (Article 2) and as amended and revised through May 7, 2001 and as further amended and revised through May 6,2002 (Article 31) and as further amended on March 21 and May 2, 2005 and as further amended October, 2011 (Article 12). The Zone II boundary of the Water Resources overlay located between Pimlico and Peter's Pond was modifed by DEP as of May, 2007.

Base map from planimetric data flown in May 2003 and parcel boundaries current through FY'12, maintained by the Town of Sandwich. The Cape Cod Commission produced a digital file: zn261.shp [Municipal Zoning Districts] (September 2005). Additional data layers and updates maintained by the Town of Sandwich, contact the Town of Sandwich, MA Planning Department for more information.

LEGEND:

- Power Line Easement
- Railroad
- Parcel Boundary
- Surface Water
- BL-1; Business Limited 1
- B-2; Business 2
- FX; FLEX
- GD; Government District
- IND; Industrial
- MAR; Marine
- R-1; Medium Density Residential
- R-2; Low Density Residential
- RD; Ridge District
- S; Shore
- Adult Entertainment Overlay District
- Area of 100 year flood (FEMA A and V Zones)
- Parking Overlay District
- Preservation Zone
- Three Ponds District
- Surface Water Protection District (300 foot buffer of pond shores)
- Water Resources Overlay District
- Wireless Telecommunications Overlay District

SCALE 1:54,000

0 2,250 4,500 Feet

MAP DESCRIPTION: The map depicts municipal and zoning overlay districts as mandated by the town by-laws as of October 2011. The Town of Sandwich uses municipal zoning districts as a planning tool to help regulate uncoordinated or inappropriate uses of the town's land and other resources. Visit http://www.sandwichmass.org/publicdocuments/Town%20Of%20Sandwich.pdf for more information about the municipal zoning districts within the Town of Sandwich. Map boundaries are approximate and not intended for land ownership determination. This map, like all cartographic products, contains inherent aberrations in geography or thematic errors. The Cape Cod Commission and Town of Sandwich cannot be held legally responsible for personal or property damages resulting from any type of use of this map. Contact the Sandwich Planning Department for more information.

MAY 2013

\GIS\Maps\Zoning\Zoning11x17_may2013approved.mxd

Project Name: Cape Cod Canal Sandwich, Massachusetts, Section 204 Study for Beneficial Use of Dredged Material.

Project Location: Sandwich, Massachusetts

Project Sponsor: Sandwich, Massachusetts

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

The preliminary real estate acquisition information is attached to this document.

Legal Authority: Mr. George H. Dunham, Town Manager

Name and title of sponsor's representative providing answers to this section.

Mr. George H. Dunham, Town of Sandwich, 130 Main Street, Sandwich, MA 02563

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?
(**yes**) (no) If yes, list the basis for the legal authority:_*_____
b. Does the sponsor have the power of eminent domain for this project?
(**yes**) (no) If yes, list the basis for the legal authority:_*_____

May 4, 2015 Annual Town Meeting under Article 14.
ARTICLE 14 - Move that the Town vote in accordance with M.G.L. c.40, §14 to accept by purchase or gift or take by eminent domain, from private property owners along the affected Town beaches, any and all permanent and temporary easements associated with the Army Corps of Engineers' proposed Town of Sandwich Dune and Beach Reconstruction Project for access and placement of sediment purposes.
This motion was approved unanimously.

c. Does the sponsor have "quick-take" authority for this project? (**yes**) (no)
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? (yes) (**no**)
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? (yes) (**no**)

II. Human Resource Requirements:

Name and title of sponsor's representative providing answers to this section.

Mr. George H. Dunham, Town of Sandwich, 130 Main Street, Sandwich, MA 02563

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? (yes) (**no**)
b. If the answer to II. a. is "yes," has a reasonable plan been developed to provide such training? **N/A** (yes) (no)
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience

Project Name: Cape Cod Canal Sandwich, Massachusetts, Section 204 Study for Beneficial Use of Dredged Material.

Project Location: Sandwich, Massachusetts

Project Sponsor: Sandwich, Massachusetts

to meet its responsibilities for the project? (**yes**) (no)

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? (**yes**) (no)
e. Can the sponsor obtain contractor support, if required in a timely fashion? (**yes**) (no)
f. Will the sponsor likely request USACE assistance in acquiring real estate? (**yes**) (no) (If "yes," provide description). **Guidance only**

III. Other Project Variables:

Name and title of sponsor's representative providing answers to this section.

Mr. George H. Dunham, Town of Sandwich, 130 Main Street, Sandwich, MA 02563

a. Will the sponsor's staff be located within reasonable proximity to the project site? (**yes**) (no)

b. Has the sponsor approved the project/real estate schedule/milestones? (**yes)** (no) If the answer is no, please fill in the length of time it will take to complete these milestones after the New England District provides the appropriate real estate maps and estates. Some of milestones will overlap. When this happens the number of months needed to complete the next task should only include the additional months to complete that milestone. For example, you may order the title policies and the survey at the same time. If the survey will be completed in two months and the title policies will take three months you would put "2 months" in the survey milestone and "1 month" in the preliminary title policy milestone**. N/A**

Survey legal interests and prepare legal descriptions: _____ months

Obtain preliminary title policies or other form of title information:_____ months.

Appraise all of the property: _____ months

Have the appraisals reviewed by New England District:_____ months

Negotiate with the landowners:_____months

Clear up title issues and close on the property or condemn the property:_____ months

Take possession of the property interests: _____ months

Sponsor signs the Authorization For Entry For Construction:_____

Project Name: Cape Cod Canal Sandwich, Massachusetts, Section 204 Study for Beneficial Use of Dredged Material.

Project Location: Sandwich, Massachusetts

Project Sponsor: Sandwich, Massachusetts

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? (**yes**/no/not applicable)

b. With regard to this project, the sponsor is anticipated to be: highly capable/**fully capable**/moderately capable/marginally capable/insufficiently capable.

(If sponsor is believed to be "insufficiently capable," provide explanation)

V. Coordination:

a. Has this assessment been coordinated with the sponsor? (**yes**/no)

b. Does the sponsor concur with this assessment? (**yes**/no) (If "no," provide explanation)

VI. NOTES:

Prepared by:

JALBERT.DANIEL.E.1473775120 Digitally signed by JALBERT.DANIEL.E.1473775120 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=JALBERT.DANIEL.E.1473775120 Date: 2015.05.18 08:33:26 -04'00' (date) 5-18-15

Dan Jalbert
Appraiser
New England District

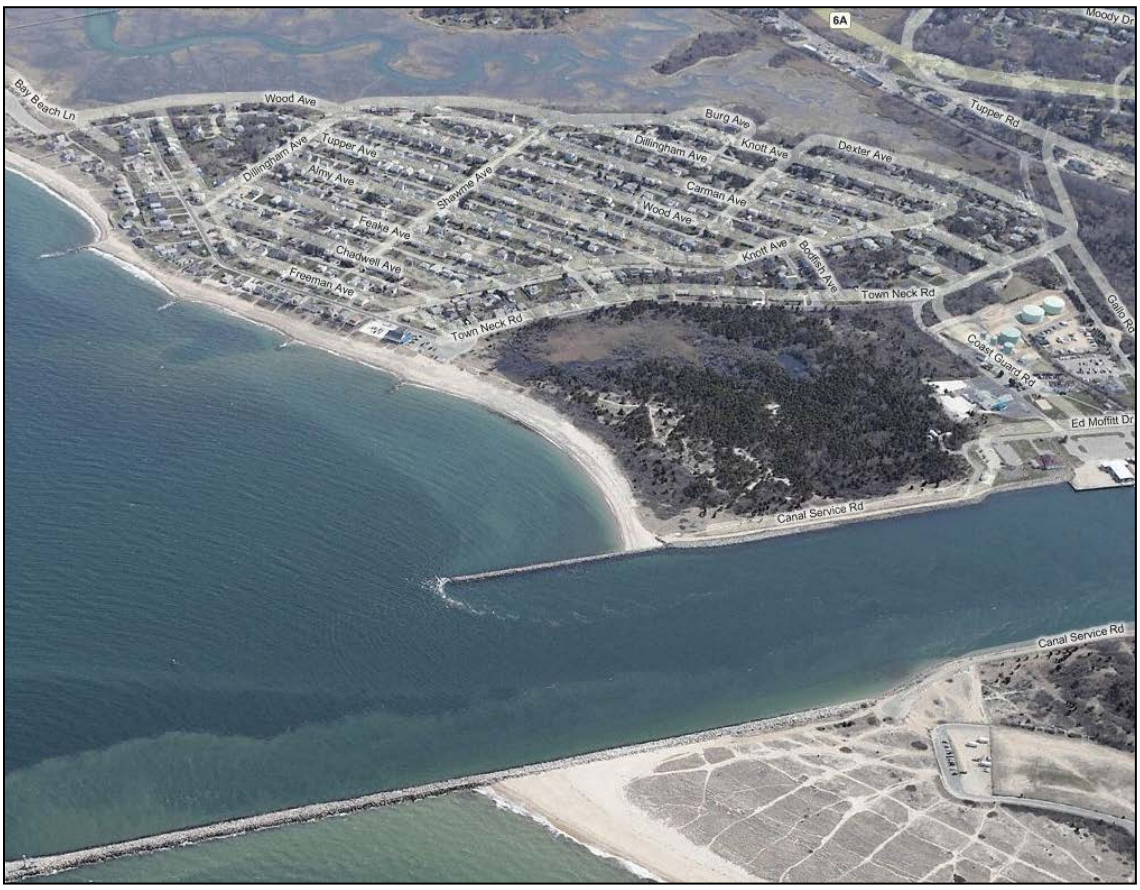
Reviewed by:

MELZER.TODD.ARTHUR.1013979444 Digitally signed by MELZER.TODD.ARTHUR.1013979444 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=MELZER.TODD.ARTHUR.1013979444 Date: 2015.05.18 11:39:06 -04'00' (date)

LTC Todd A. Melzer
Chief, Real Estate Division

Town of Sandwich, MA – Cape Cod Canal
Dredged Sand Placement Study

Coastal Engineering Report



05-06-15

U.S. Army Corps of Engineers
New England District - Water Management Section

1.0 Introduction

The focus of this study was to perform an analysis for the use of dredged sand from the east end of the Cape Cod Canal for near shore/onshore placement within the Town of Sandwich. The study evaluated the feasibility of placing the dredged sand directly on the beach located east, or down drift, of the Canal. The Water Management Section was tasked with providing information that would be used to determine the without project condition for the beaches, assisting in the beach fill design, and developing the information that would be used to determine the with project future condition for the beaches. Additionally, the impacts of the proposed beach fill in the cross shore direction was looked at regarding impacts to bottom habitat. These tasks were completed at a basic level but at an appropriate level to determine the cost effectiveness and validity of beneficially reusing the dredge sand. This must be recognized during the review of this report and the use of any resulting products. The analysis for each task will be discussed further in the following sections.

2.0 Project Study Area

The Study area is located in the Town of Sandwich, MA adjacent to the Cape Cod Canal at the south west end of Cape Cod Bay (Figure 1). A closer view of the study area has been provided in Figure 2. The local tidal tide datums for the project area have been included as Table 1. The NAVD88 elevation was provided by the Civil Design Section.

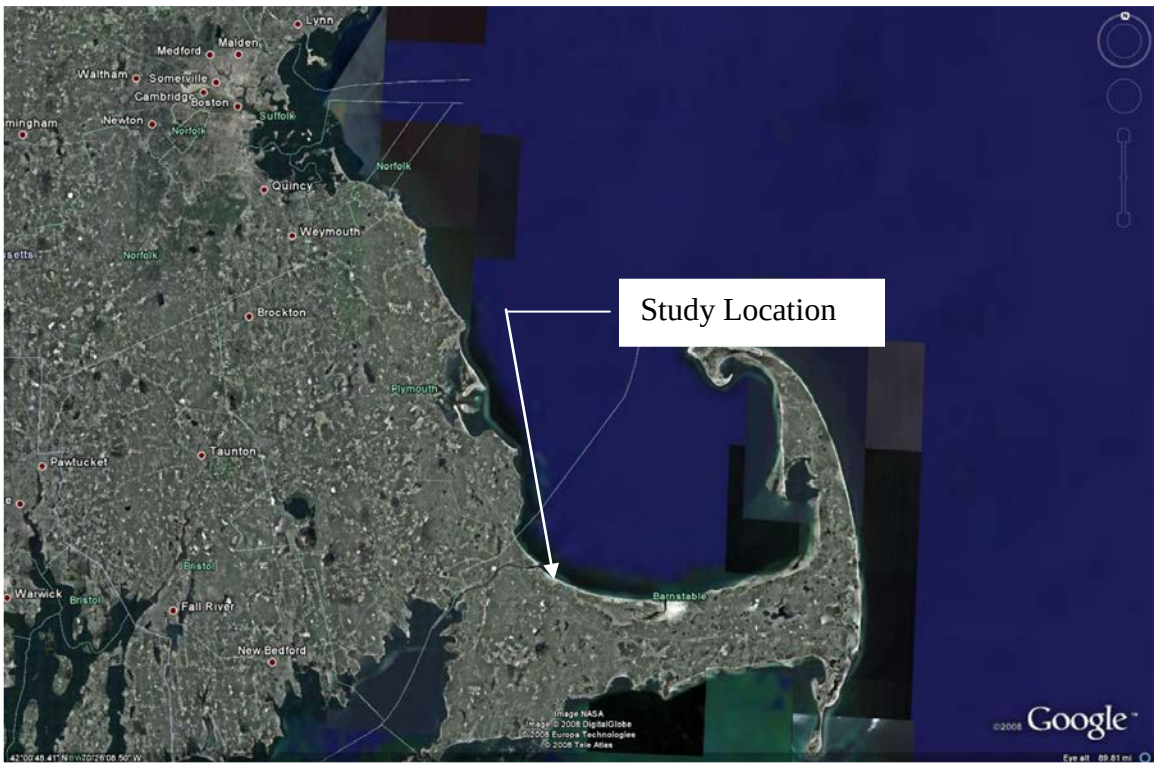


Figure 1. Project location

Figure 2. Study area

Table 1. Local tidal datums

SANDWICH TIDAL DATUMS AND ELEVATIONS		
	FT-MLLW	**FT-NAVD88**
Mean Higher High Water	9.57	4.37
Mean High Water	9.11	3.88
North American Vertical Datum	5.23	0.00
Mean Sea Level	4.82	-0.41
Mean Tide Level	4.59	-0.52
Mean Low Water	0.35	-4.88
Mean Lower Low Water	0.00	-5.11

3.0 Study History Overview

This study area was evaluated for beneficial use of dredged material numerous times over a ten year period. Each time the analysis was refined and adjusted using the most current information available. This is the latest iteration of that analysis. During the earlier efforts two additional beach areas were investigated as well. Based on that previous information and recent storm damage impact areas, only the western beach area was included in this latest analysis and as such only the analysis for that area is included.

4.0 Shoreline Erosion Rate

In order for the benefits of a future project to be determined the without project condition of the beach and the impacts to structures and infrastructure needed to be determined. A simplistic, non process based investigation was conducted for this study. The basic approach was to use historic shoreline erosion rates to project the future condition of the beach. It was assumed the existing/natural beach profile would migrate landward at that rate. As the dune face or bluff crest is migrated these features would intersect building and cause the loss of these buildings. Storm induced erosion that would cause more immediate or near term loss of structures was not included in this analysis. This was done because it was found the more simplistic use of the long term rate was adequate to show a positive project. The more involved storm induced erosion analysis would have been performed if necessary and would have shown greater benefits since structures would have been impacted sooner in the analysis period.

Several different sets of shoreline change data had been used in the previous efforts but for this effort only one was used since it was the most recent and complete. The shoreline data used was taken from the Woods Hole Group's report titled "Expanded Environmental Notification Form - Proposed Town of Sandwich Dune and Beach Reconstruction Project". In this report, the most recent MA CZM office shoreline erosion rates were included and added to resulting in shoreline movement data through the year 2012. Two figures from that report have been included below as Figures 3 and 4. These figures represent the shoreline erosion rate between 1952 and 2012, and between 2001 and 2012. For all shoreline erosion rates the end point method was used. This means that the shoreline change distance between two years was divided by the time between shoreline years to reach an annual erosion rate.

Figure 3. Shoreline erosion rate (1952 to 2012)

The longer term erosion rate between 1952 and 2012 generally was between 1 foot per year and 2.5 feet per year. Typically the longer rate would be used for analysis since it considers the long term variability of the beach system in regards storm frequency and beach change fluctuations. However, given the significant beach erosion that has occurred each winter over the last 8 to 10 years due to numerous nor easters hitting in close sequence the shorter term erosion rate was investigated. As shown in Figure 4, the erosion rate from 2001 to 2012 was considerably higher than the long term rate with the rate in the project area generally being between 3 feet per year and 9 feet per year.

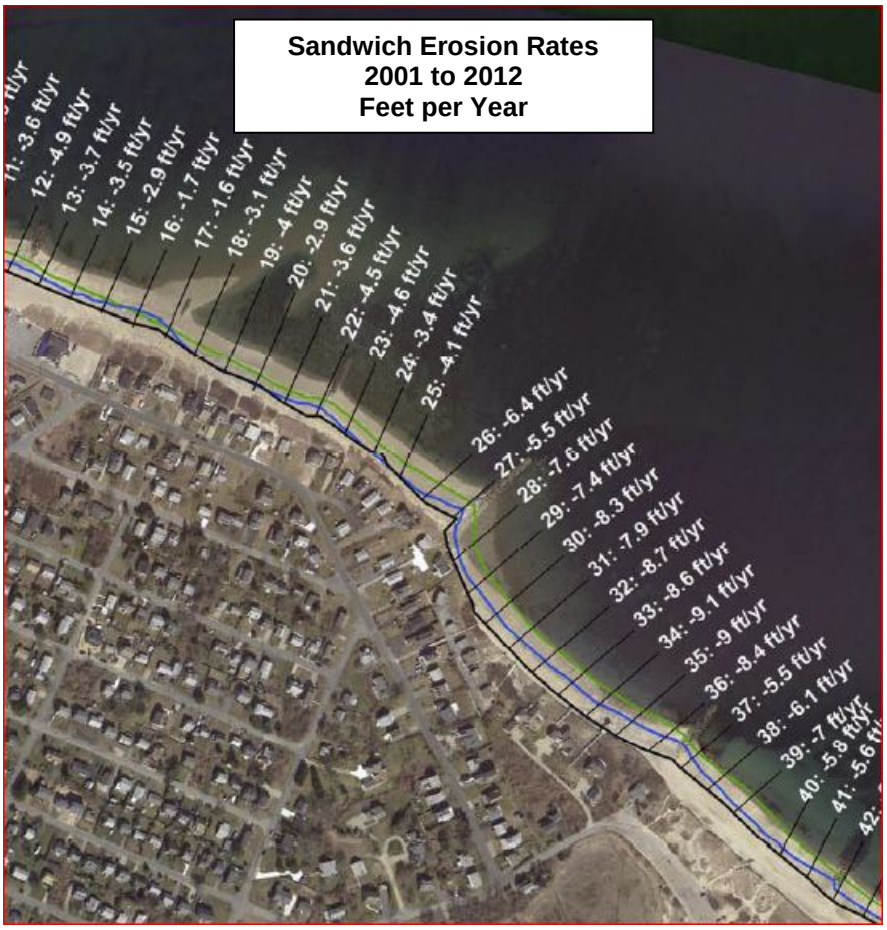


Figure 4. Shoreline erosion rate (2001 to 2012)

Based on the two shoreline erosion rates maps it was apparent that the shorter term rate in recent history was more than double the long term historic rate. Given the recent storm history and beach losses each year over the last decade, including this storm season, it was reasoned the high rate was more indicative. Through discussions with the Town, the PDT and the Woods Hole Group an erosion rate of 5 feet per year for both with and without project conditions was selected for shoreline migration. The 5 feet per year was an average rate across the project area for the short term analysis period. It is fully realized that next year the high frequency winter storm pattern could change and erosion rates to the beach could return to the long term average or less. However, given the short term trend and the short term nature of this project the use of the higher rate was concluded to be justified. Even this higher rate is not the highest erosion rate measured between 2001 and 2012. As shown in Figure 4, erosion rates as high as 9 feet per year are shown.

The 5 feet per year erosion rate was provided to the Civil Design Section and future, without project conditions were mapped in CAD. The existing shoreline position which was the base of the bluff or dune was migrated 5 feet per year over a given time frame. For a 5 year time frame, it was predicted the shoreline would erode or migrate 25 feet landward from the existing condition. The future shoreline position maps were provided

to the Economics Section to determine the associated losses due to the loss of land and lost structures.

5.0 Beach Fill Design

The detailed beach fill design was handled by the Civil Design section but the Water Management Section provided the basic information such as berm elevation, foreshore slope, and dune height elevations. The beach fill parameters were based upon numerous factors and inputs which have been listed below:

1. Existing condition information from beach areas to the east with "healthier" beach conditions were used to estimate beach berm elevation and dune elevations
2. Beach fill designs from the Woods Hole Group report mentioned earlier were factored into the design
3. Geometric controls of fitting the dredged sand volume from the Canal into the study area
4. Trying to minimize direct burial of sub-tidal area and habitat areas of interest (hard bottom habitat and eel grass)

5.1 Dredge and Beach Fill Volume

The estimated dredge volume from the canal was 150,000 to 170,000 cyds. A better estimate of available volume will not be known until final surveys are completed closer to the time of the dredging. The shoaling and sand waves in the federal navigation channel change frequently due to the high current speeds through the Canal. As confirmed through sediment testing, due to the high currents in the Canal there are no fines in the dredge area.

The level of losses available to achieve the design beach profile will greatly depend on the wave environment at the time of placement. Given the protected location of the site within Cape Cod Bay, if there are no storms directly impacting the project area during beach fill placement losses due to long shore and cross shore movement will be minimal. However, if there are storms the losses will be more significant. Due to the unknowns related to dredge fill volume it was assumed that 160,000 cyds will be available for the fill template. This will be adjusted with additional information closer to the dredging project and the beach fill template will be adjusted as necessary. With the 160,000 cyds spread over the approximate 2,500 foot long project area a beach fill density of approximately 65 cyds/ft of beach results.

5.2 Beach Fill Cross Section

To determine the beach berm elevation (flat area of beach) and the dune elevation, LIDAR data from the 2010 National Coastal Mapping Program (NCMP) was used. The area to the east of the project with a more natural, complete profile that consisted of dune features were used along with profiles in the project area to confirm beach berm elevation. Figure 5 shows an over view of the LIDAR plotted as a topographic and

bathymetric surface and Figures 6 and 7 show the beach profiles from that data. As shown in Figure 6, profiles 1 through 4, which were in the study area, include a beach berm at approximately the 2.4 m-NAVD88 elevation. Considering the conversion from NAVD88 to MLLW is 5.23 feet, the beach berm elevation converts to 13.1 ft-MLLW. The design berm elevation was chosen to be 13 ft-MLLW. Since there were no dunes left in the study area the beach directly to the east of the study area was used to determine a natural dune elevation. From Figure 7, profiles 5 and 6 were used, and the dune elevation was taken as 5.5 m-NAVD88 which converts to 23.3 ft-MLLW. The dune was eventually designed to a slightly lower elevation of 21 ft-MLLW. The foreshore slope of the beach or the slope that goes into the ocean was set at typical construction slope of 1V:10H.

With the basic elevations and parameters set the cross section design was developed as far as beach berm width and the width of the dune. These dimensions were refined to fit the aforementioned volume into the profile along with consideration of the Wood Hole Group design. Additionally, volume was increased in the dune to pull some of the sand from the subtidal zone to help and minimize the hard bottom habitat burial. An example of the beach fill constructed profile has been provided as Figure 8 and the plan form layout has been provided as Figure 9.

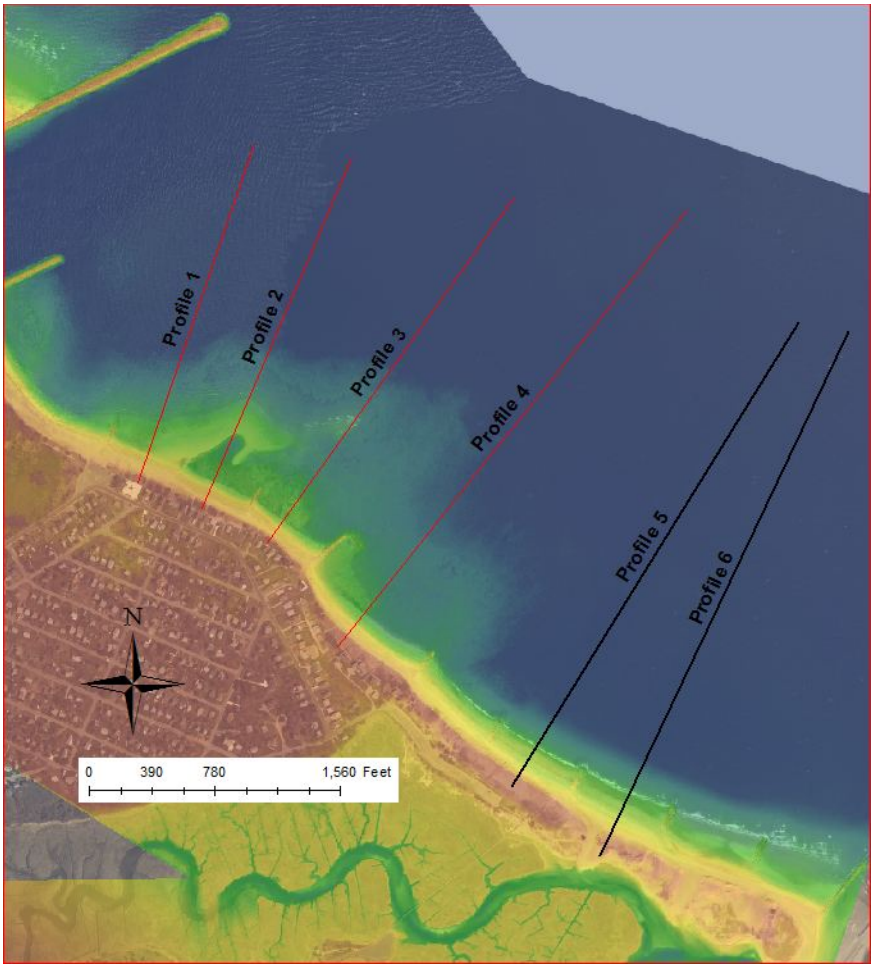


Figure 5. Bathymetric and topographic 2010 LIDAR map with beach transects

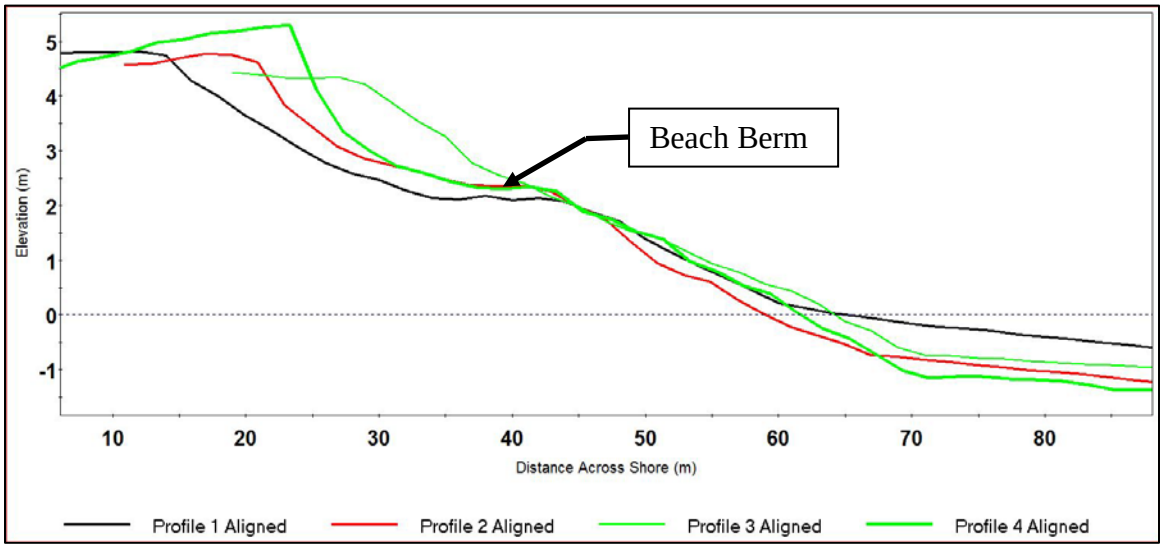


Figure 6. Beach profiles from 2010 LIDAR data set – profiles 1 to 4 (project area)

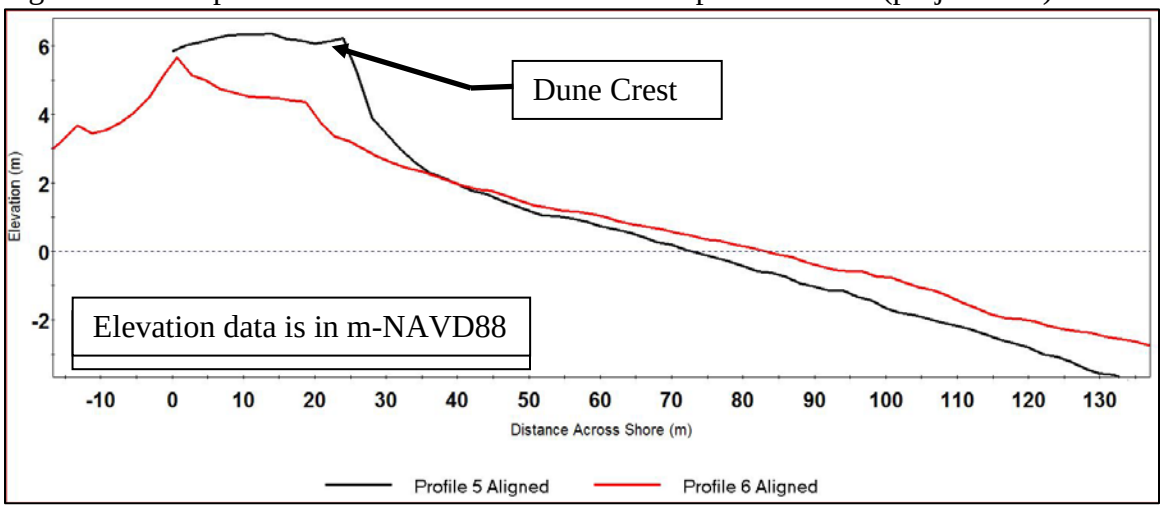


Figure 7. Beach profiles from 2010 LIDAR data set – profiles 5 and 6

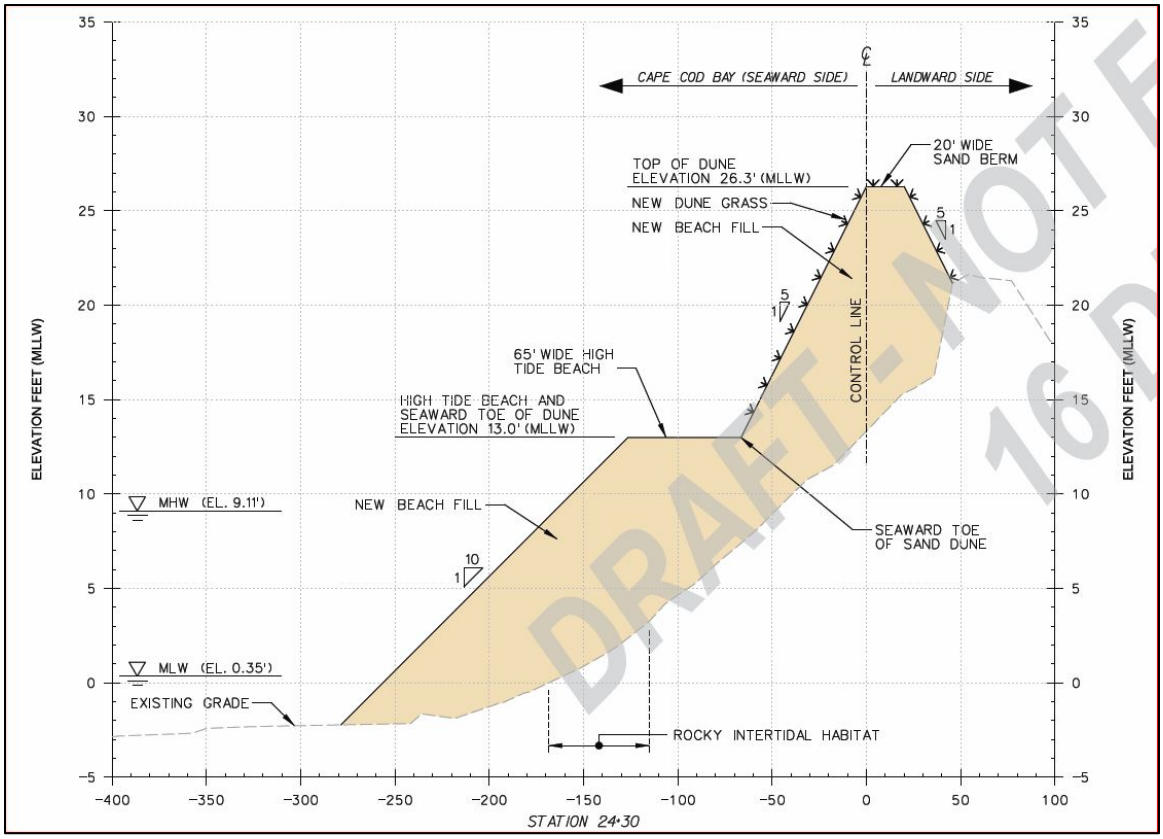


Figure 8. Example beach fill constructed profile

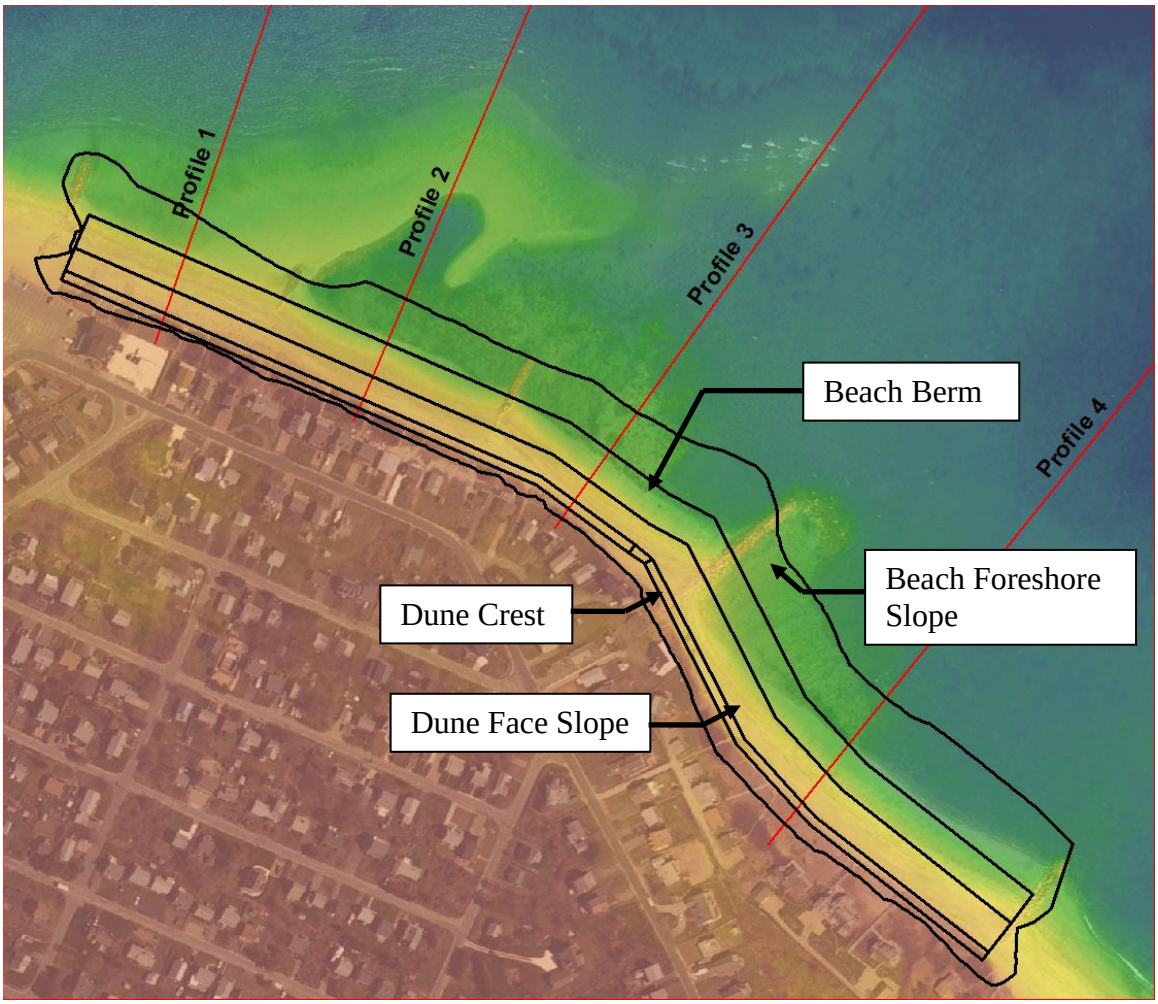


Figure 9. Beach fill plan form

6.0 With Project Condition

In order to determine the benefits of placing the dredged material from the Cape Cod Canal on the beach within the study the longevity of the beach fill, or how long the sand would stay in the project area, had to be determined. An analytical method described in the Coastal Engineering Manual (CEM) was used for this.

One of the key parameters controlling beach fill longevity is the length of the beach fill. Typically the most significant loss of material from a beach fill is from the ends of the fill. For a longer fill the losses from the beach fill end represent a smaller fraction of the fill material. This beach fill is fairly short at 2,500 feet. However, this shorter length is offset to a degree by the presence of the groins, or shore perpendicular rock structures at each end of the project. If a groin is 100% effective at preventing sand from bypassing then no end losses occur and the effective length of the beach fill is doubled for the purposes of calculating loss rate and longevity. Based on field inspections and Figures 5 and 9 it was concluded that the groins are not fully blocking sand transport, which makes the groin end loss reduction effect difficult to determine. As an estimate, it was assumed

the effect of the two end groins would essentially cut the end losses by half or double the effective length of the fill in the longevity calculation to 5,000 feet.

Using equation V-4-12 from the CEM, and the associated active worksheet from the CEM software version, the beach fill longevity was calculated. The worksheet output is shown as Figure 10. The inputs into the worksheet were taken from early versions of this report and from the Woods Hole Groups report. The key input values for the calculation are listed below the figure.

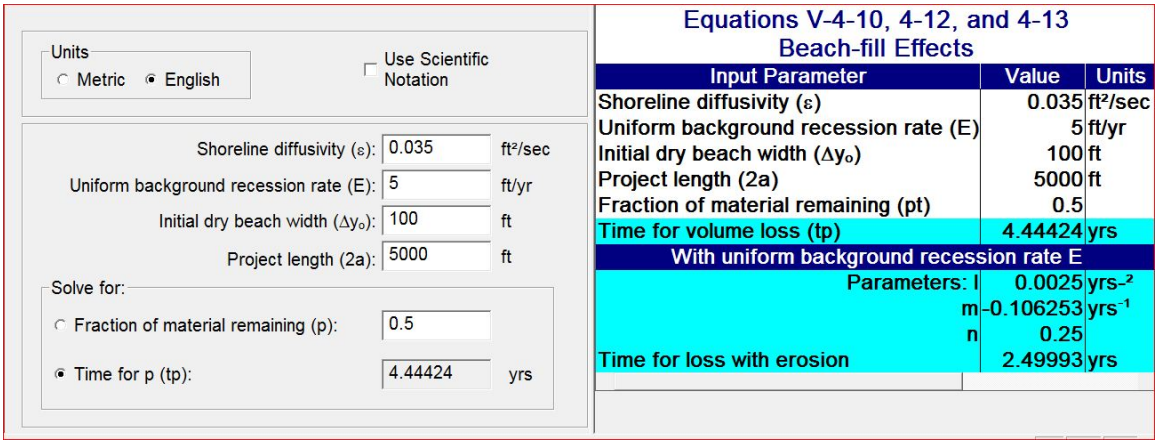


Figure 10. Beach fill longevity calculation worksheet

Longevity Calculation Input:

- Shoreline Diffusivity – this was calculated in a separate Excel spread sheet shown below as Table 2.

Table 2. Shoreline diffusivity calculation

Shoreline Diffusivity					
ε =	**0.035 ft²/sec**				
K =		**K =**	0.77		
$H_{b=}$	Breaking effective wave height	**$H_{b=}$**	1.40	feet	
C_{gb} =	Effective wave celerity	**C_{gb} =**	7.61	feet/s	
h_b =	Breaking effective wave depth	**h_b =**	1.80	feet	
g =	Gravity	**g =**	32.20	ft/s²	
ρ_s/ρ =	Specific gravity of sand	**ρ_s/ρ =**	2.65		
n =	Porosity	**n =**	0.40		
d_b =	Depth of berm	**d_b =**	9.00	feet-NGVD	
d_c =	Depth of closure	**d_c =**	12.00	feet-NGVD	

- The long term background erosion rate, as discussed previously for this analysis was selected as 5 feet per year.

- The initial dry beach width was selected as 100 feet. This is an approximation based on the cross section shown in Figure 9. From this cross section it can be seen that the above MHW beach is wider than 100 feet, but this is the constructed beach profile. The beach will equilibrate to a more natural slope reducing this width. The 100 foot beach width was an estimate taken from the RMAP beach design software which allowed for the determination of the equilibrated beach width associated with the beach fill density used in this project.
- The project length, as discussed was estimated to be 5,000 feet as far as the effective length in this calculation. Once again the beach fill will be 2,500 feet long in the field, the 5,000 foot length is only for the purposes of this calculation.

As shown in Figure 10, the beach fill longevity, labeled as "time for loss (tp)" was provided. The values presented are for the time it takes for 50% of the original beach fill volume to be lost from the site. The 50% value is a typical value used and it is often assumed that when 50% of the volume is lost a renourishement is required. For the calculation provided, 50% of the dredge material will be lost from the beach, with a 5 ft/yr erosion rate in 2.5 years. As volume is removed the beach fill shape becomes more stable since the beach fill ends have spread over time resulting in a gentler transition. This slows the end loss rate and beach fill volume loss. Additionally, as the beach fill erodes, there will be more protection from the groins since the beach fill profile will be further recessed into the groins. With this consideration, based on the calculation provided, a portion of the beach fill will be present to some degree at the five year point and perhaps beyond.

For the economic life analysis, it was decided by the PDT that a five year duration of protection from the beach fill would be used. To incorporate that into the economic analysis, it was assumed that for the five years following the fill no structures would be lost and at the end of the five years, the beach would return to a pre construction condition. The other consideration is that no benefits were determined for the positive impacts the sand will have as it moves out of the project area and through the system to the east, which is in an eroded, vulnerable state.

7.0 Cross Shore Beach Fill Impacts – Environmental Considerations

During the beach fill design process one of the major design considerations and questions was to what extent the near shore hard bottom habitat and a small area of eel grass would be covered during construction and over the long term as the beach fill spread in the cross shore direction to the north. The initial fill placement coverage was fairly easy to determine and was mapped by the Civil Design Section with the assistance of the Environmental Section. The more difficult question was in determining to what extent the sand would migrate in the future.

The first method of determining what the potential for future burial/coverage would be for the beach fill as it equilibrates to a natural slope was to map the depth of closure. Depth of closure is a coastal engineering term that defines a depth that active sediment transport due to waves no longer occurs. For this beach the depth of closure was

calculated to be between 12 and 15 feet below MLLW. The -12 foot contour is shown in Figure 11. Based on this figure, all of the areas of rocky bottom habitat and the eel grass could be covered by sand. Maps showing these habitats can be found within the main report and the environmental section appendix. With the potential maximum aerial extent determined additional considerations such as thickness of sand coverage and localized bathymetric conditions on sedimentation patterns were considered.

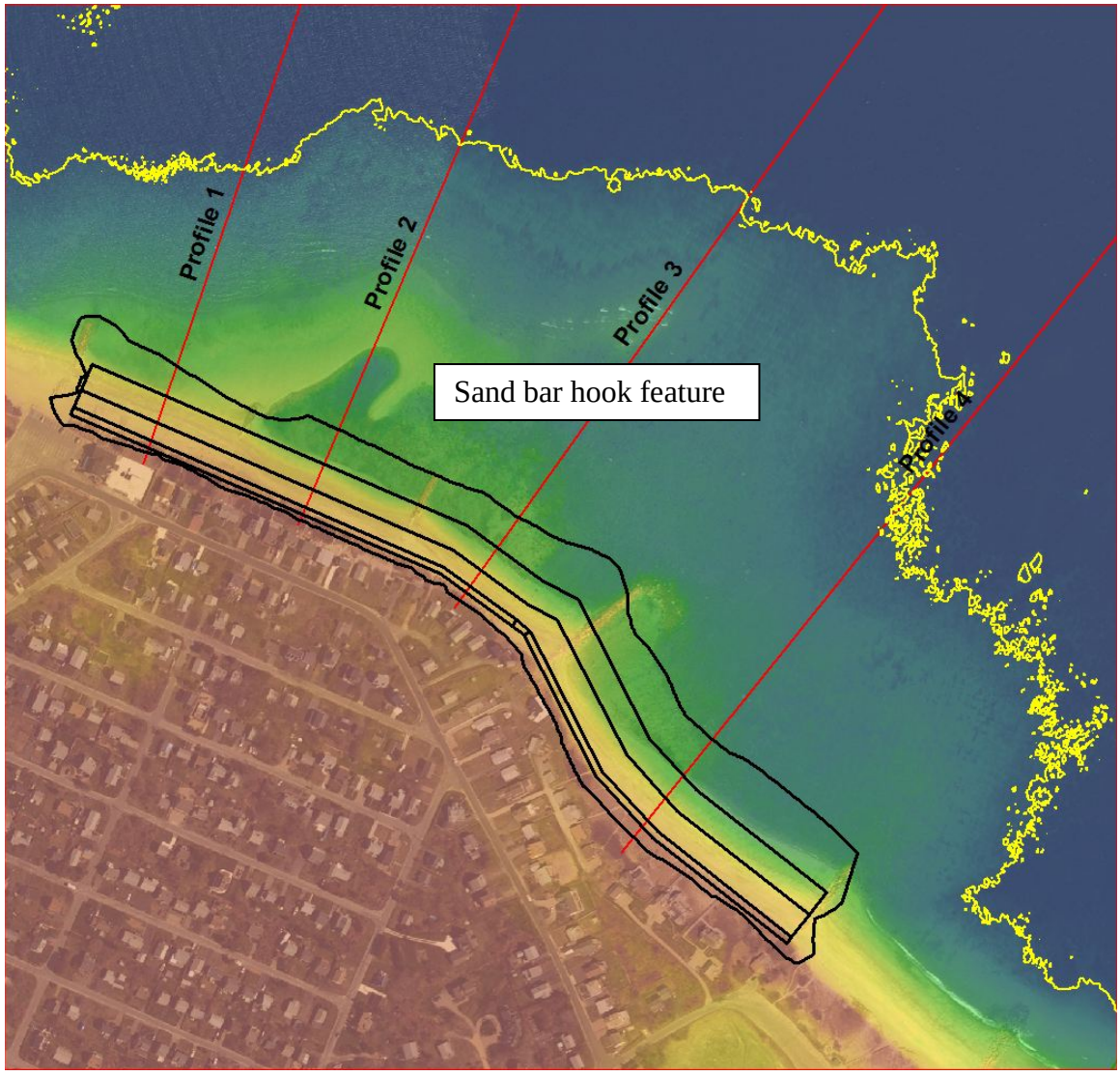


Figure 11. Depth of closure limit and persistent sand bar feature.

To determine the thickness of the sand layer migrating cross shore, the beach design software RMAP was used to adjust the constructed beach slope to an equilibrated natural beach slope. The result can be seen in Figure 12 with the red line showing the idealized constructed beach (dune not shown) and the green line is the equilibrated slope. The figure shows that the constructed beach toe actually pulls back and the sand lens that migrates out to the depth of closure is approximately 0.5 meters or a little over 1.5 feet

thick. That is not a very thick layer and much of this will likely work into the fairly porous rocky bottom areas leaving considerable rocky bottom surface area exposed.

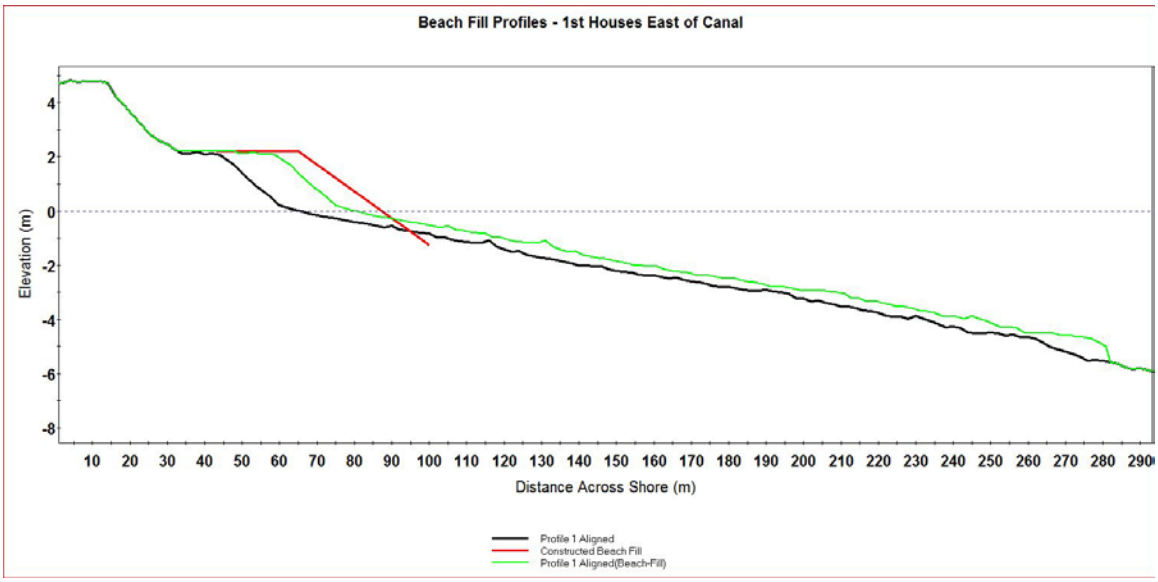


Figure 12. Beach sand cross shore thickness

The second mitigating factor that would suggest that the secondary burial from sand migration would not be too extensive is that the beach fill area is on a point type feature and from aerial photos, the rocky bottom habitat and eel grass area has been exposed for a considerable amount of time, even when the beach was wider and more full of sand. The historical aerial photos showing this online were copyrighted and were not included in this report. Point features such as this tend to shed sand laterally with the cross shore sand being pushed to the sides. This means that sand will likely not move out to the calculated depth of closure but instead be pushed laterally. Additionally, the sedimentation pattern seen in the historical aerial photos indicates that the eel grass area and the non direct buried rocky bottom may not be covered to a great extent. As shown in Figure 10, the hook shaped sand bar which is labeled is seen back to the 1950s. This would indicate a defined sedimentation pattern. It can also be seen the beach profiles cut from the 2010 LIDAR survey which have been provided as Figure 13. In the figure the large offshore submerged hump in the bathymetry can be seen. That is the sand bar shown in Figure 10 and as mentioned in historical photos.

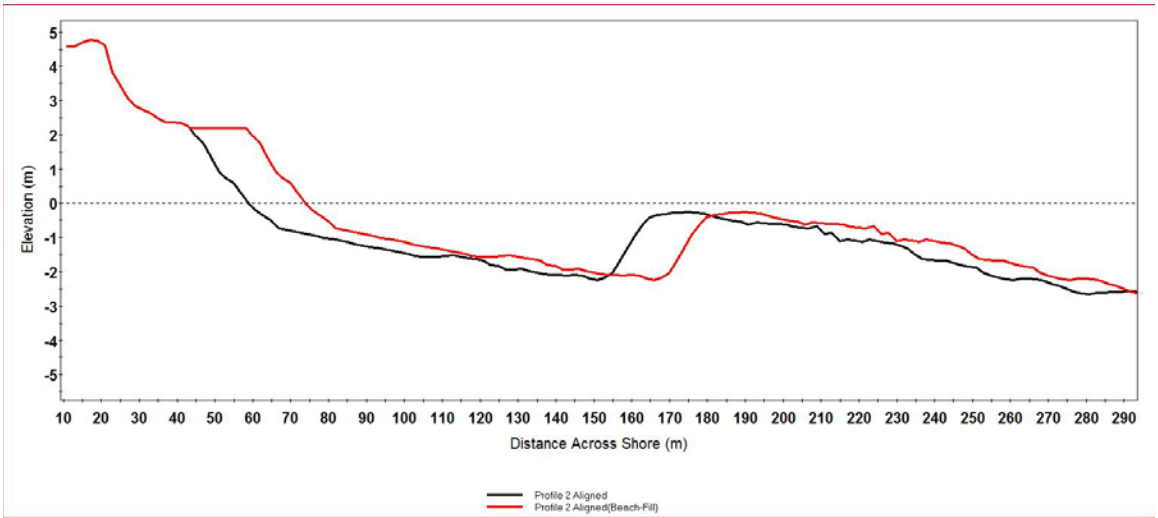


Figure 13. 2010 LIDAR bathymetry – offshore bar/hump feature.

The last factor considered for the habitat impact was time of burial. As discussed in the with project condition, it is anticipated that the beach fill will erode and migrate out of the study area to a large degree within 5 years of the construction. This indicates that impacts to the habitat would be relatively short lived.

Considering the relatively thin theoretical sand lens of 1.5 feet, the likely hood that the sand will migrate more laterally than in the cross shore due to the point feature, and the historic persistence of the habitat areas it was concluded that the impacts in the cross shore direction beyond the direct placement construction impacts would likely be minor. Any impacts would also be relatively short lived given the predicted short life expectancy of the beach fill project.

8.0 Sea Level Rise

Sea level rise was not considered during this project due to the physical and economic life of the project. As reported in Section 6, the project is anticipated to last 5 years. SLR at any predicted rate will not impact the project within that time frame.

9.0 Summary

As part of a Section 204 (beneficial reuse of dredged material) a 2,500 foot long section of the Town of Sandwich beach was investigated for the beneficial placement of dredged sand from the Cape Cod Canal. The Water Management Section was tasked with determining the erosion rate of the beach so without project conditions could be developed, assisting in the design of the beach fill, determining beach fill longevity for the with project analysis, and investigating potential habitat impacts due to the beach fill migration cross shore post construction.

In the analysis it was determined that a 5 foot per year erosion rate was reasonable. A beach fill with a 65 foot wide constructed berm was designed with an elevation of 13 feet MLLW. Dunes with a crest elevation of 21 feet were included. The beach design

matches natural beach beaches near the project site. It was calculated that the beach fill will likely last five years and that was the recommended project life to be used in the economic analysis. Through use of some analytical methods and map analysis it was concluded that the cross shore impacts beyond the direct placement burial would likely not be significant or persistent.

FINAL Environmental Assessment,
Finding of No Significant Impact, and
Section 404(b)(1) Evaluation for
Maintenance Dredging and
Beneficial Use of Dredged Material
for Beach Nourishment

CAPE COD CANAL
SANDWICH, MASSACHUSETTS

AND TOWN NECK BEACH
SANDWICH, MASSACHUSETTS

US ARMY CORPS
OF ENGINEERS
New England District

MAY 2015

FINAL
ENVIRONMENTAL ASSESSMENT
FINDING OF NO SIGNIFICANT IMPACT
AND SECTION 404(b)(1) EVALUATION

CAPE COD CANAL AND TOWN NECK BEACH

MAINTENANCE DREDGING AND BENEFICIAL USE OF DREDGED MATERIAL FOR BEACH NOURISHMENT

SANDWICH, MASSACHUSETTS

Environmental Resources Section
Engineering/Planning Division
U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

MAY 2015

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1.0 INTRODUCTION

This Environmental Assessment (EA) is written for the proposed maintenance dredging of the Cape Cod Canal in Sandwich and Bourne, Massachusetts. The proposed dredging involves the removal of approximately 150,000 cubic yards of clean sand from recurring sand waves in six of the eight to nine shoal areas of the canal. A hopper dredge will perform the work. The sand will either be placed on Town Neck Beach, Sandwich, Massachusetts or disposed of in open water at the Cape Cod Canal Disposal Site. The Town Neck Beach placement site is a candidate for beach nourishment under the United States Army Corps of Engineers (USACE) beneficial use of dredged material program (Section 204 of the Water Resources Development Act of 1992, as amended).

The purpose of this EA is to present information on the environmental features of the project area and to review construction information to determine the potential impacts of the proposed project. This EA describes project compliance with the National Environmental Policy Act of 1969 (NEPA) and all appropriate Federal and State environmental regulations, laws and Executive Orders. Methods used to evaluate the environmental resources of the area included biological sampling, sediment analysis, review of available information, and coordination with appropriate environmental agencies and knowledgeable persons. This report provides an assessment of environmental impacts and alternatives considered along with other data applicable to the Clean Water Act Section 404 (b) (1) Evaluation requirements.

2.0 HISTORY, PURPOSE AND NEED FOR THE PROJECT

The Cape Cod Canal is a sea level canal located about 50 miles south of Boston, Massachusetts. It intersects a narrow neck of land which joins Cape Cod to the mainland. The Canal extends from Cape Cod Bay on the east to the Buzzards Bay on the west. The towns of Bourne and Sandwich are located adjacent to the Canal. The Canal provides safe and efficient passage for commercial and recreational vessels wishing to transit between Cape Cod Bay and Buzzards Bay. The purpose of the proposed maintenance dredging is to restore the authorized depth of the Federal Navigation Project by removing shoals, and the following document addresses the impacts associated with the maintenance dredging of shoaled areas throughout the Canal.

On January 21, 1927, the Federal Government purchased the canal (described above) from Boston, Cape Cod and New York Canal Company for $11,500,000.00. The purchase included a 600 foot stone jetty and a 3000 foot stone breakwater at the east end of the canal. The existing Cape Cod Canal project was authorized by Congress in the River and Harbor Acts of 1935, 1945, and 1958, and completed in April 1963. It provides for an open canal 32 feet deep mean lower low water (MLLW) for a width of 540 feet in the land cut, 500 feet in a straight channel in Buzzards Bay to Wings

Neck, and 700 feet wide beyond Wings Neck. The latter portion of the channel, shown on coastal charts as ending in the vicinity of Cleveland Ledge, actually continues about 3,000 feet beyond the lighthouse to deep water. There are two mooring basins: the west mooring basin on the south side near Hog Island about 3,300 feet long, about 350 feet wide and 32 feet deep, and the east mooring basin on the north side of the channel at Sandwich, about 2,500 feet long, about 350 feet wide and 25 feet deep, but has previously been maintained to 32 feet.

The project is used extensively by deep-draft vessels including oil tankers, tug and barge combinations, cargo and container vessels, cruise ships, ferries as well as recreational vessels. The canal is an integral piece of the corridor for petroleum products being delivered to the northeast region and provides a more protected and direct route for vessels transiting between Buzzards Bay and Cape Cod Bay, to Massachusetts Bay and up to Portland.

The Cape Cod Canal is a highly dynamic area with extremely strong tidal currents and shifting shoals that form in various locations throughout the project. This combination of shifting shoals and strong tidal currents creates hazardous conditions and tidal delays for the deep draft vessels that use the project and increases the risk of a grounding occurring within the Canal. Recent hydrographic surveys indicate that shoaling has occurred in several areas of the project and has reduced the controlling depth by as much as 2 feet (i.e. to 30' Mean Lower Low Water). This reduction has limited the passage of some of the deep draft commercial vessels through the canal, and shoaling in the east mooring basin limits the available space to moor vessels in emergencies (e.g. icing) while transiting the Canal. Further shoaling may cause some of the deep draft vessels to have to transit around Cape Cod thereby increasing the risk profile of these vessels especially during the winter months.

Maintenance dredging in the canal was last performed in 2010. At that time the East Mooring basin was dredged to -32 feet. Over the past 30 plus years the same areas within the channel tended to shoal. See Table 1 for summary of most recent dredging events. A recent hydrographic survey has revealed shoaling at a controlling depth of -30 feet below MLLW that requires that draft restrictions be placed on deep draft vessels transiting the Canal. The Cape Cod Canal operations center recommends that any vessels transiting with a draft greater than 22' contact and consult well in advance with the Marine Traffic Controller.

Table 1. Dredge History of the Canal for the Past Thirty Years

Year	Volume cy	Advanced Maintenance	Disposal
1975	125,620	Channel East Mooring Basin	Cape Cod Canal Disposal Site and Cleveland Ledge Disposal Site
1977	73,054	Channel East Mooring Basin	Cape Cod Canal Disposal Site and Cleveland Ledge Disposal Site
1979	100,000	No	Cape Cod Canal Disposal Site
1986	177,432	Channel East Mooring Basin	Cape Cod Canal Disposal Site
1990	121,952	Channel East Mooring Basin	Cape Cod Canal Disposal Site and nearshore adjacent to Springhill Beach
1998-2000	162,000	Channel East Mooring Basin	Boston Harbor CAD cells cap material
2002	117,000	Channel East Mooring Basin	Cleveland (East) Ledge Disposal Site
Jan. 2010 – March 2010	20,837 85,163	Channel East Mooring Basin	Cap CAD Cells in Boston Harbor Contractor Over-dredged the Mooring Basin to 32 Feet at Own Expense to Yield Material for the Capping Project.

3.0 PROPOSED WORK

3.1 Maintenance Dredging of the Cape Cod Canal

The proposed work involves maintenance dredging and advance maintenance dredging of up to 150,000 cubic yards (cy) of clean sand and gravel from portions of the 32 feet deep channel and the 25 feet deep East Mooring Basin (EMB)

Shoals in the project form as massive sand-wave formations. There are nine areas that typically shoal within the Cape Cod Canal and six of these areas currently have shoals that need to be dredged (see Figure 1). These areas include the South Breakwater shoal, East Mooring Basin-basin shoal, East Mooring Basin-channel shoal, East Sagamore shoal (east of the bridge), Sagamore shoal (west of the bridge), and the Onset shoal. The channel is authorized to a depth of -32 feet deep and the EMB is authorized to a depth of -25 feet. In order to extend the time between dredging events, advance maintenance is being proposed. Advance maintenance is dredging beyond the authorized project feature dimension(s) (i.e. typically, depth) and is allowed in fast-shoaling or critical areas. Within the Canal, the advance maintenance strategy is to reduce the sand wave shoals down to their base to a depth equal to the depth of the surrounding environment. See Table 2 for the proposed dredge depth for each shoal and Figures 2a-2c for survey of shoal areas. The proposed work will be performed by a hydraulic hopper dredge within a three to four month period during the late fall of 2015 to early spring 2016.

A study is currently ongoing under the authority of Section 204 of the Water Resources Development Act of 1992 (as amended) to evaluate the Federal interest in beneficially re-using the dredged material from the Cape Cod Canal project as beach-fill on a 2,500 foot long eroded section of Town Neck Beach in Sandwich. Town Neck Beach is adjacent to the south breakwater at the eastern end of the Canal. The town of Sandwich has been identified as the non-Federal sponsor for cost sharing of the study and the potential beach nourishment. If the Section 204 study is completed in time to coincide with this maintenance dredging event and the study results in a positive benefit/cost ratio, then the material dredged from the Canal could be placed on Town Neck Beach; the cost of which would be shared between the Federal government and the town of Sandwich at a 65 percent and 35 percent ratio, respectively. The town of Sandwich has also expressed interest in receiving the material dredged from the maintenance dredging of the Canal regardless of the outcome of the Section 204 study and has expressed a willingness to pay 100 percent of any additional costs over and above the Federal base plan (i.e. dredging and placement of the material at the Cape Cod Canal Disposal Site (CCCDS)) to have material placed on Town Neck Beach. Alternatively, if for any reason the dredged material cannot be placed on Town Neck Beach (e.g. non-Federal funding is unavailable), the CCCDS would be used for the disposal of the dredged material from the Cape Cod Canal maintenance dredging.

Table 2. Proposed Dredge Depths for Canal Shoal Areas.

Shoal Area	**Required Depth**	**Allowable Over Depth**	**Total Depth**
South Breakwater	38	2	40
East Mooring Basin - Channel	38	2	40
East Mooring Basin - Basin	32	2	34
East Sagamore	34	2	36
Sagamore	37	2	39
Onset	37	2	39

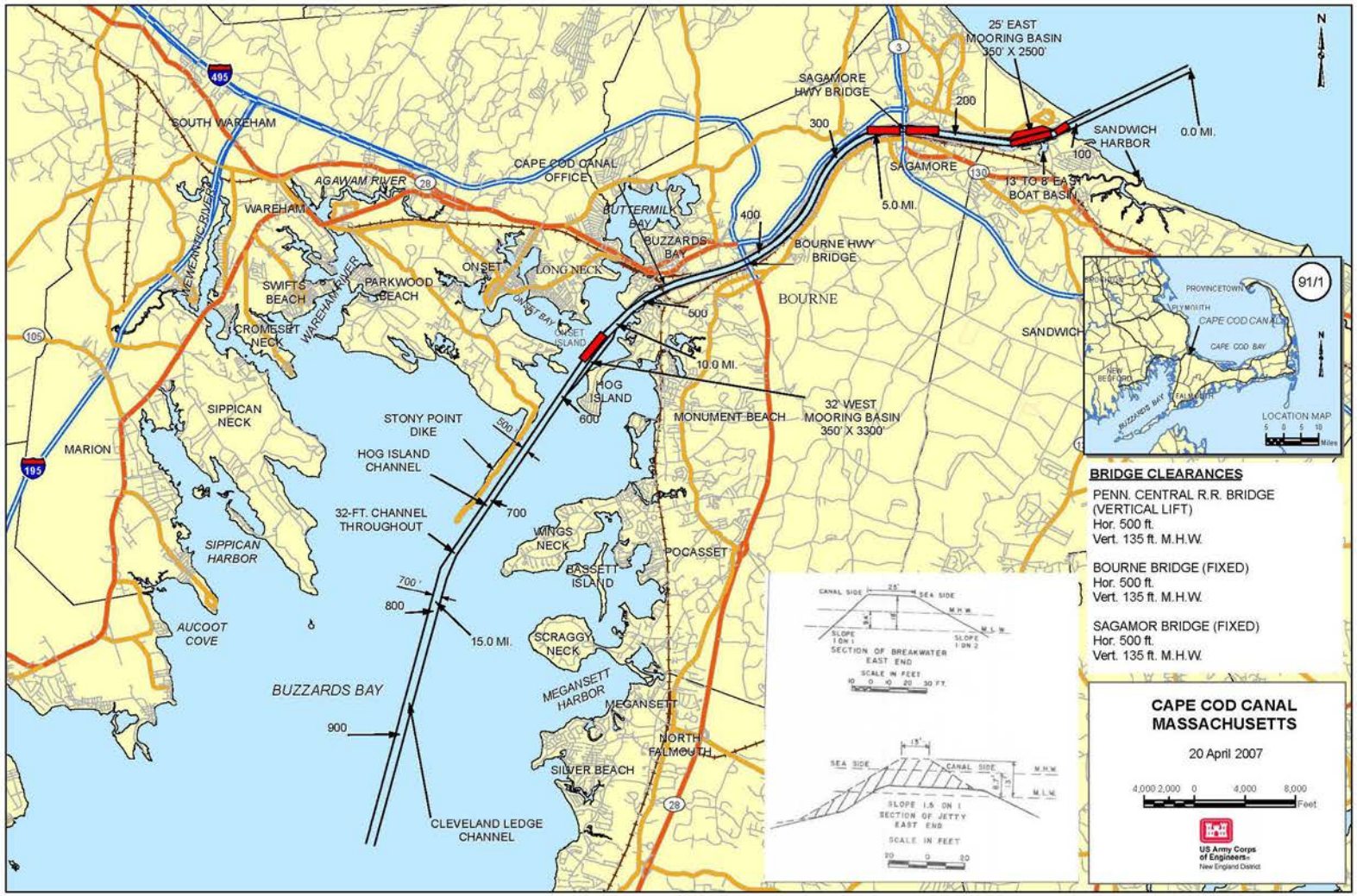

Figure 1. Shoal areas with the Cape Cod Canal Federal Navigation Project.

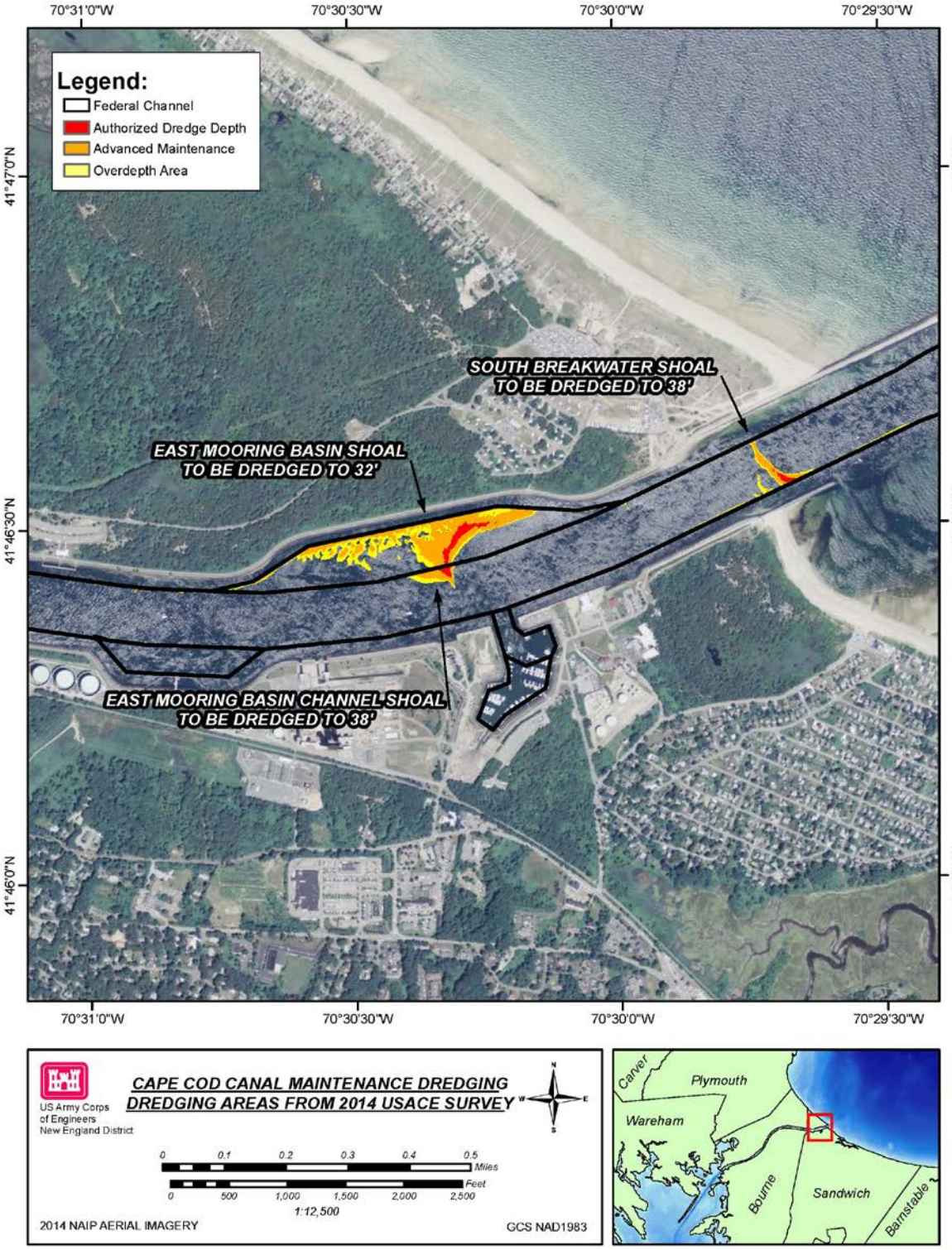

Figure 2a. Shoals in the eastern end of the Cape Cod Canal (south breakwater, east mooring basin, and east mooring basin channel shoals).

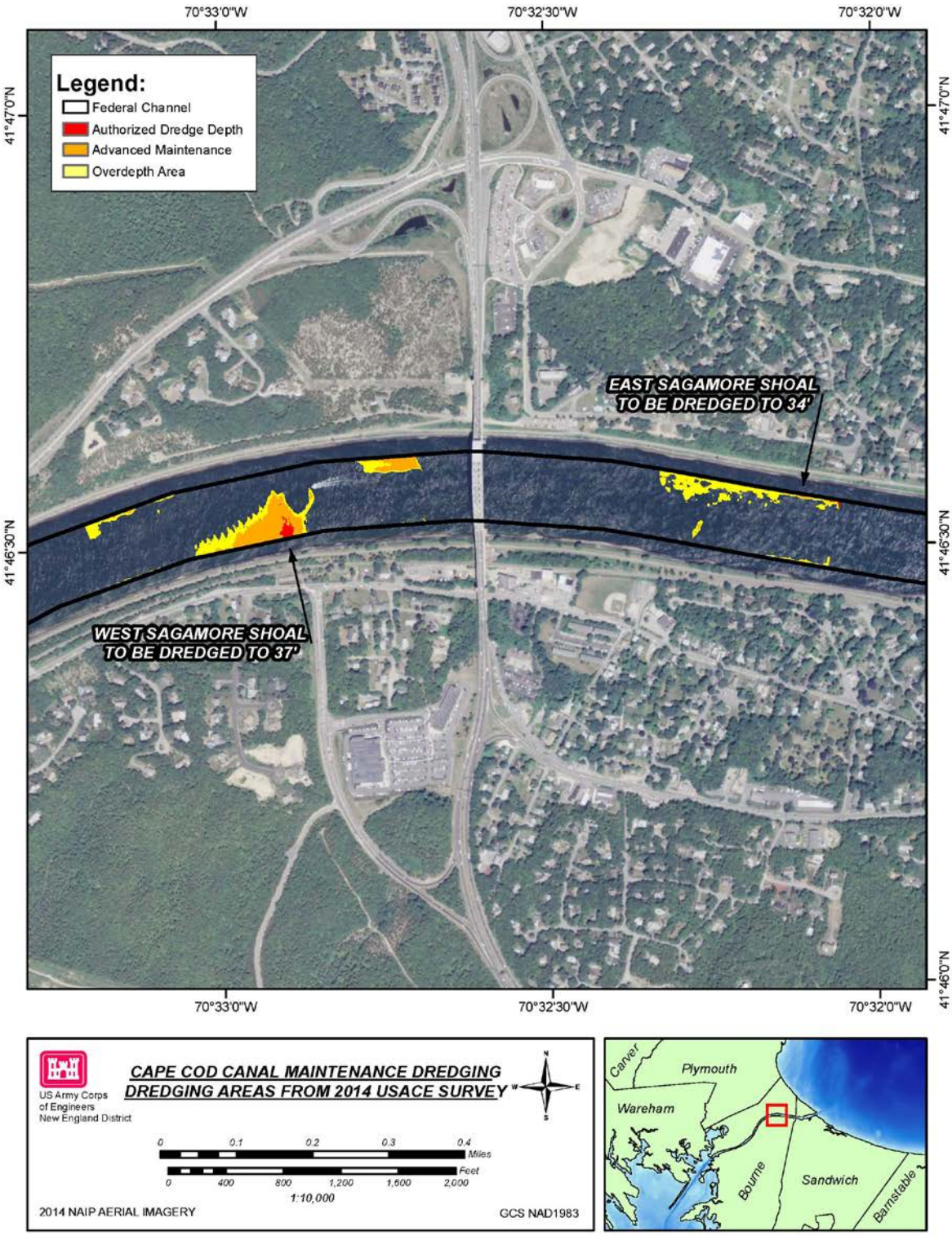

Figure 2b. Shoals near the Sagamore Bridge (east and west Sagamore shoals).

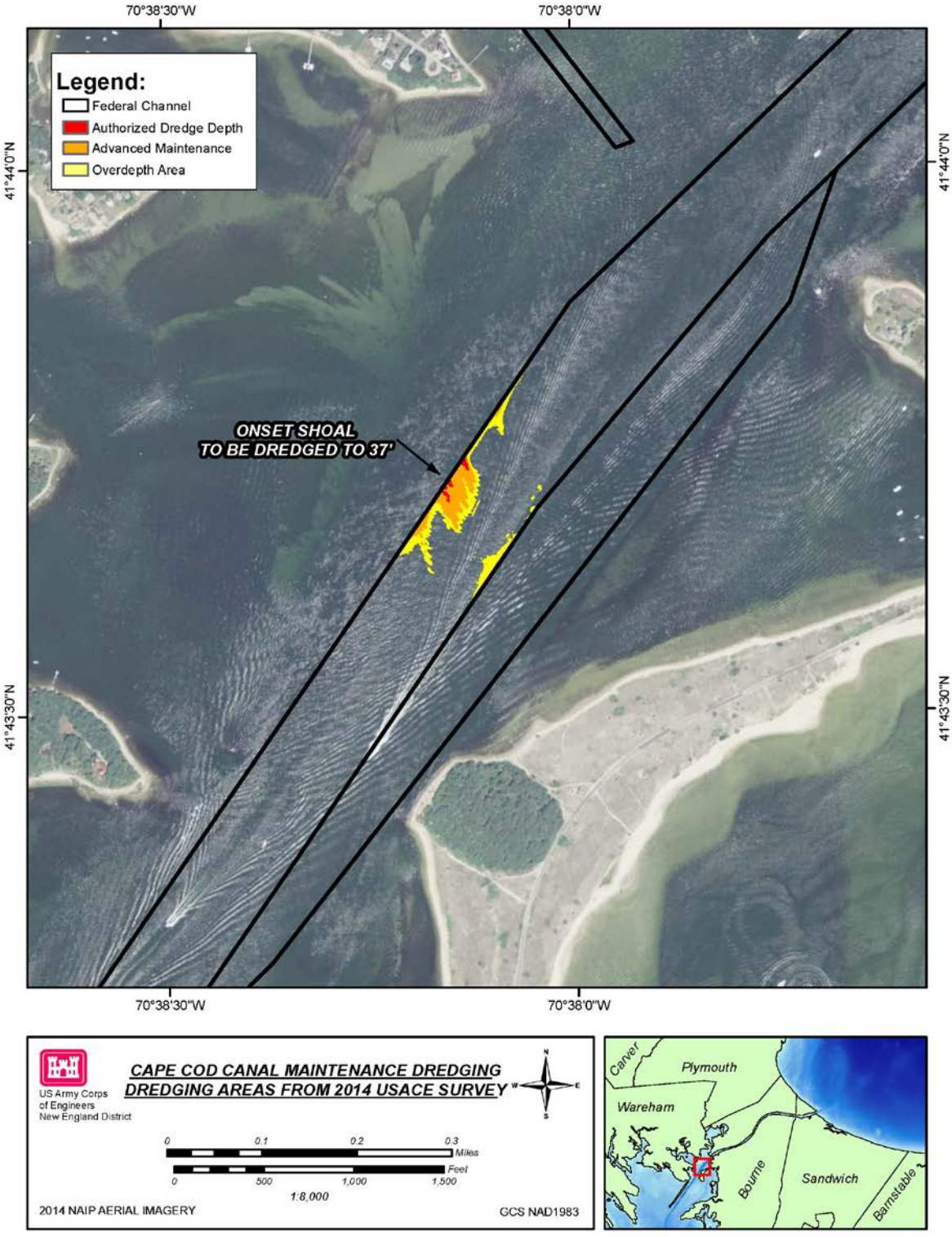

Figure 2c. Shoal area in the western end of the Cape Cod Canal (Onset shoal).

4.0 ALTERNATIVES

4.1 No Action

The No Action Alternative is required to be evaluated as prescribed by NEPA and the Council on Environmental Quality (CEQ). The No Action Alternative serves as a baseline against which the proposed action and alternatives can be evaluated. Evaluation of the No Action Alternative involves assessing the environmental effects that would result if the proposed action did not take place. Under a No Action Alternative, the Cape Cod Canal Federal Navigation Project (FNP) in Cape Cod Bay and Buzzards Bay, Massachusetts would not be dredged. Without dredging, shoaling in the Canal would continue and worsen over time hindering the passage of vessels through the Canal. As navigation conditions become more dangerous, there is the potential for damages to vessels due to groundings, collisions and potential oil spills. Without dredging, shoaling could eventually limit passage of deeper draft vessels through the canal. As a result of these navigation hazards and the likelihood of further deterioration of these conditions within the Federal navigation channel, the No Action Alternative was not considered a viable alternative.

4.2 Alternative Dredging Methods

4.2.1 Hydraulic Dredge

4.2.1.1 Hydraulic Cutterhead Pipeline Dredge

A hydraulic dredge with a cutterhead on the end of an arm connected to a pump loosens the bottom sediments and entrains them in a water-slurry that is then pumped up from the bottom. The material is then discharged away from the channel (side cast) or pumped via a pipeline to a dewatering area or disposal site. A hydraulic dredge is generally used for sandy material that will be disposed of in an upland area or on a nearby beach, or for pumping any type of unconsolidated material in an upland confined (diked) disposal/dewatering area. In general, the length of the canal is too long and the proposed placement site is too far from the shoal areas of the canal for this dredge type to be used. Therefore, this type of hydraulic dredge would not be used for this project.

4.2.1.2 Hopper Dredge

A hopper dredge operates by hydraulically pumping a slurry of bottom sediments into a chamber (hopper) within the vessel. As dredged material settles in the hopper, excess water and fine sediments are discharged into surrounding waters. When the hoppers are full, the drag arms are raised and secured to the vessel, which then travels to the disposal site and then releases or pumps off the material from the hoppers. The dredge then returns to the dredging site to begin another cycle. Hopper dredges come in various sizes from a few hundred cubic yards bin capacity to several thousand yards bin capacity. In New England, hopper dredges are most often used to remove sandy material from harbor entrance channels. In order to fill the hopper bins, the water component of the suctioned slurry is allowed to overflow the bins back into the harbor at

the dredging site. This type of dredge is ideally suited to perform maintenance dredging in the Cape Cod Canal given the strong currents and predominance of sand shoals. There is the potential for direct beach disposal using a hopper dredge with pump out capabilities.

4.2.1.3 Mechanical Dredge

A mechanical dredge consists of a clamshell bucket dredge mounted on a barge. A mechanical dredge operates by excavating sediments with a bucket attached to a crane. Excavated material is deposited into a scow, transported to the disposal site, and released. For open-water or ocean disposal, a split-hull scow is generally used for ease of disposal and to minimize the discharge plume. Although there may be some overflow of water from the scow to maintain efficiency during dredging, it is much less in comparison to hopper dredge operation. Although a mechanical dredge could be used to complete the work, due to the relatively small size of the shoals and their scattered locations throughout the project, the use of a mechanical dredge would not be the most efficient dredge alternative especially in the channel where there are strong currents. Additionally, if the material is placed on Town Neck Beach it would likely require that the dredged material be rehandled (taken out of one scow and placed into a pumpout scow) in order to be pumped out and onto the beach.

4.2.2 Preferred Dredge Alternative

Although there are a number of different dredging methods available, the most efficient methods to accomplish the maintenance dredging of the canal channel and east mooring basin would be a hopper dredge for the reasons stated above.

4.4 Alternative Disposal Areas

4.3.1 Previously Used Open Water Disposal Sites

4.3.1.1 Cape Cod Canal Disposal Site

The Cape Cod Canal Disposal Site (CCCDS) is a circular area, one nautical mile in diameter, located about 3 nautical miles northeast of the Cape Cod Canal Buoy #1. The center is located at 41° 49'N, 70° 25'W (Figure 3). This disposal site has been used for previous canal maintenance dredging activities at least as far back as 1954 and was last used for disposal of maintenance material from the Canal in 1990. CCCDS is a viable disposal alternative for material from the Canal.

4.3.1.2 Cleveland Ledge Disposal Site

The Cleveland Ledge Disposal Site (CLDS) previously known as the Buzzards Bay Disposal Site at Cleveland East Ledge is located just north of the historic disposal area as depicted on the NOAA nautical charts. This site is a rectangular area approximately 2,000 feet long, bearing 106 degrees true and 1,400 feet wide, bearing 16 degrees true. The center of the area is a point 700 yards southeast of Cleveland

East Ledge Light on bearing 304 degrees 30 minutes true. The coordinates of the center point are 41° 37' 40" N, 70° 41' 19" W. Depths in this site range from 33 to 43 feet (10-13 m). This disposal site is closer than the CCCDS to the Onset Shoal and others that regularly shoal and require dredging such as the Cleveland Ledge, Hog Island Channel, and the west mooring basin. This is a previously used site dating back to1954 and last used in 2002 for maintenance dredging of the canal. It has been the preferred disposal site for material dredged from the western end of the canal due to its proximity to these areas, but this alternative removes the sand from the littoral zone.

4.3.2 Nearshore Placement

The nearshore placement alternative involves the placement of dredged material in a nearshore subtidal area from which it has the potential to be moved by littoral processes onto nearby beach areas thus providing an indirect source of beach nourishment. In 1990, clean sand dredged from the Canal was placed in a nearshore disposal area off of Springhill Beach in Sandwich, MA. In this case, the sandy dredged material was placed in a 1500 by 2000 square foot rectangular area in the 15 to 35 foot MLLW isobath east of Sandwich Harbor off of Springhill Beach (see Figure 3). Subsequent to the dredging and disposal operations in 1990, the Massachusetts Division of Marine Fisheries expressed concerns about potential impacts to shellfish and other marine resources in the nearshore region that may prevent any placement of dredge material in this area. The town of Sandwich recently requested that sand be placed on Town Neck Beach located east of the Canal entrance. A Beneficial Use of Dredged Material Section 204 study has been requested by the town of Sandwich for the USACE to further investigate direct beach nourishment alternatives; therefore, nearshore placement is not currently a preferred alternative.

4.3.3 Beach Placement

The material to be dredged from the Cape Cod Canal is clean sand that is suitable for beneficial use purposes such as beach nourishment. The town of Sandwich has requested that a Section 204, Beneficial Use of Dredged Material Study be conducted to evaluate the nourishment of Town Neck Beach. Since 1909 erosion on Town Neck Beach has occurred at an approximate rate of 2-3 feet per year and this rate appears to have accelerated in recent years. This beach is exposed to the full northern fetches of Cape Cod Bay. Generally it is the policy of the Corps of Engineers to keep sand within the littoral system by using beach or nearshore placement sites when practicable.

The town of Sandwich has developed a Dune and Beach Restoration Project for Town Neck Beach in order to reduce vulnerability to coastal storms, sea level rise, and flooding through mitigation of long-term erosion of Town Neck Beach. This restoration or re-nourishment area includes approximately 5,000 feet of shoreline which extends from just south of the Cape Cod Canal (at the end of Town Neck Road) to Sandwich Harbor Inlet. Most of the beach within the project site is owned by the town of Sandwich as part of Town Neck Beach. It is a public beach that extends from Sandwich Harbor northwest towards the Canal, and fronts the residential development known as Town

Neck Hill. Beaches along this coastline of Sandwich, including the project area along Town Neck Beach, have a history of erosion since 1909 and this project will restore the historic beach profile to that which existed in 1952. The Town intends to restore the historic beach profile between Town Neck Beach and the Sandwich Harbor inlet separately from the dredging and placement project described in this EA. The entire restoration will require approximately 400,000 cy of sand. As the dredging of the Cape Cod Canal will not produce this quantity of sand, the project will require several dredging events or the town of Sandwich will need to supplement the dredged material from the canal with other sources to complete the project.

Approximately 150,000 cy of sand will be dredged from the canal with advance maintenance and placed on Town Neck Beach. The material will be placed along a length of 2,500 feet of beach seaward of the homes in Town Neck Hill. This would provide beach nourishment to help protect the homes and is similar to Alternative 3 in the town of Sandwich's restoration proposal (WHG, 2014).

This is the preferred placement alternative for dredged material from the Cape Cod Canal, provided the Section 204 study is completed or the town of Sandwich can finance the additional costs associated with the beach nourishment.

4.3.4 Upland Placement

No upland disposal sites have been identified for this project. Use of any upland placement site would involve dredging the material, offloading the hopper and dewatering the material, loading it into trucks, and then transporting the material to the placement site. This involves double or triple handling of the material and results in significantly greater costs than other available alternatives considered. Also, this alternative would remove the sand from the littoral system without providing any benefits. For these reasons, upland placement is neither a viable nor preferred alternative.

4.3.5 Preferred Disposal Alternative

The material to be removed from the shoal areas of the Cape Cod Canal consists predominantly of clean sand suitable for all methods of disposal/placement described herein. The beneficial use alternative discussed above (beach placement) is preferred over the previously used open water (at CCCDS) disposal site alternative providing that the Federal and non-Federal funds and/or approvals are in place for beach placement. If the Section 204 study is not completed or the town of Sandwich is unable to secure the additional funds needed, then the material will be placed at CCCDS.

Figure 3. Proposed placement areas for the Cape Cod Canal dredge material.

5.0 AFFECTED ENVIRONMENT

5.1 Physical and Chemical Environment

5.1.1 Dredge Sites

The various shoals and sections of the Canal have been sampled and their sediments analyzed for grain size many times in recent years, specifically in 1972, 1977, 1988, 1989, 1996, 1999 and 2001. These analysis consistently show that sediments from these areas to be predominately medium to fine-grained sand with less than 1% silt.

A suitability determination (Appendix C) has indicated that all the maintenance material to be dredged for this project and noted in the above paragraph has been found to be suitable for beach placement and unconfined open-water disposal. Based upon grain size, it meets the exclusionary criteria as set forth in 40 CFR Part 230.60 of the Clean Water Act, and does not require further chemical testing.

5.1.2 Disposal/Placement Sites

5.1.2.1 Cape Cod Canal Disposal Site

The Cape Cod Canal Disposal Site (CCCDS) was last used for disposal of dredged materials from the Cape Cod Canal in 1990. This site was investigated by the Disposal Area Monitoring System (DAMOS) of the New England Division U.S. Army Corps of Engineers (report #84) in 1990 before and after the disposal of approximately 15,000 cy of material from the canal (SAIC, 1993). This site is not considered a regional disposal site, but has been used for disposal of Cape Cod Canal materials for more than 50 years and is an active open water disposal site for clean material from the canal. In 1981, a state sponsored survey of fisheries and dredged material disposal areas (Howe and Germano, 1982) found numerous topographical features such as rock piles and debris at this disposal site so they conducted bottom trawls in an area 1.4 nautical miles north of the disposal site. In 1984, a diver survey found a thin layer (5 cm) of brownish-gray mud overlying coarse sand in the center of the disposal site, brownish-gray mud at least 45 cm deep in the southeast edge and brownish-gray mud with no depth in the northwest edge of the disposal site (Terra Mar International, 1984). The northwest transect also contained a small patch of rock cobble, boulders and gravel.

The 1990 DAMOS monitoring survey (SAIC, 1993) performed at the disposal site showed that the dredged material disposed at the site from 1990 maintenance dredging of the canal was deposited within 300 meters of the disposal buoy with most of the material deposited within150 meters southwest of the buoy to a depth of 1 meter. A historic disposal mound was also identified in the 1990 survey (same area as Video site 3 from the Corps 2006 sampling discussed in Section V.B.2. a.). It was hypothesized to have most likely formed during the disposal of approximately 299,000 cubic yards (cy)

of dredged material deposited in 1980 and 6000 cy in 1986. This mound was found in the northeast corner of the site and was approximately 13 feet (4 m) in height. The difference between pre- and post-disposal surveys indicated that the majority of dredged material was deposited within a 984 foot (300 m) radius of the disposal buoy creating a mound 3.2 feet (1.0 m) in height.

Sediment-profile imaging of this mound did not reveal any clearly defined dredged material layer at the historic mound within the disposal site, but mapping of the dredged material was possible based on the changes in sand content and sediment grain size. The mound center and adjacent areas (150 to 200 meters west and east, respectively) showed increased grain size, shell and sand content compared to areas further away from the mound. Shell lag near the disposal mound was most likely due to erosion or winnowing of finer silt and sand away from the area.

Cape Cod Bay is found on the eastern end of the canal and in general is a shallow body of water with water depths generally less than about 147 ft (45 m). Within the Bay the sediments are composed mostly of sand at water depths shallower than 66 ft (20 m), while silty clayey sediments predominate in water depths greater than about 98 ft (30 m) (Battelle, 1990). The disposal site has an average depth of 75 ft (23 m) (the top of historic disposal mound had a depth of 62 ft (19 m) in 1990).

On 14 September 2006 grab samples were taken for grain size analysis from five sites within the disposal site. Three samples from a nearby reference site were also taken. See Appendix B for grain size curves and map of sample locations. The sediments taken in the grab samples from Site CCB1 (Figure B-2 in Appendix B) consisted of sand and gravel with less than 10% silt but all other disposal site samples and reference site samples consisted of 31-66% sand and 36-69% silt.

5.1.2.2 Beach Placement

Seaward of Town Neck Hill is a rocky headland feature that extends out beyond the exposed rocky intertidal area and the depth contours curve around this feature. Along the eastern end of Town Neck Beach the depth contours between the shoreline and -30 ft are generally shore parallel, with a gradual slope towards the offshore. Greater water depths are present around the entrance to Sandwich Harbor, created by higher current velocities and scouring in the vicinity of the inlet.

The shoreline mapping/erosion rate maps made available through the Massachusetts Coastal Zone Management office (MACZM) showed the erosion rates vary along each stretch of beach with Town Beach (West) eroding at an average rate of 3.8 ft/yr (1.15 m/yr) between 1978 and 1994 (USACE FID,2014). In addition to the MACZM shoreline maps, LIDAR mapping data collected in 2000 and 2007 was available for this stretch of shoreline. This data showed the recession rates to be lower in recent years in front of Town Beach (west) and higher along Town Beach (east) when compared to the MACZM historic rates. The rates were averaged in the two beach areas with the average erosion from the LIDAR data sets being 0.13 ft/yr (0.04 m/yr)

and 6.5 ft/yr (1.99 m/yr) respectively. This agrees with data analyzed by the town of Sandwich for the period of 2001-2012 (WHG, 2014).

The Sandwich region is influenced by locally generated seas, produced within Cape Cod Bay, and swell waves generated in the Atlantic Ocean. This combination of wave sources produces a wide range of wave conditions at the Sandwich shoreline that includes both high frequency seas and longer period waves. Given the orientation of the Sandwich shoreline, only winds from 295 degrees (west-northwest) clockwise to 115 degrees (east-southeast) were determined to affect the Sandwich shoreline; locally generated wind waves were described by the data between 25 degrees to 115 degrees, while ocean generated waves were described by 295 degrees to 25 degrees (WHG, 2014). In addition to the average conditions consisting of both local wind-generated and regional swell waves, a major component of the wave climate at the Sandwich beaches consists of storm waves. In fact, it is likely that due to the smaller average waves that occur in the Sandwich region, storm events dominate both the wave climate and the sediment transport in the region. The primary storm events that impact the Sandwich beaches are nor'easters.

Sandwich beaches have been starved of sand arriving from updrift sources (e.g. White Cliffs in Plymouth) so the major source of longshore transport has been eliminated. Now a large portion of the Sandwich beaches are now composed of coarse grained sands, gravel, and cobble within the intertidal area. The western end of the project has a hooked land spit that is created by large gravel/small cobble. This gravel/cobble sediment is also found on the beach up to the current dune line between the two most western groins of the project. West of the spit the rocky intertidal habitat is a cobble/ boulder mix with sand and pebbles (see Figure 4). The beach berm and upper intertidal areas changes from large gravel to smaller gravel/pebbles as you move east.

Grain size analysis was completed by the town of Sandwich in 2001 and USACE in 2014. The 2001 beach samples collected between the toe of the dunes and mid-tide consisted of greater than 71.5% sand (mostly coarse and medium sand), with the remainder consisting of cobbles and gravel, and no silt or clay (see Appendix B). Six sediment samples were taken in September 2014 between the toe of the dunes and mid tide area of Town Neck Beach. The samples consisted mostly of fine gravel and medium grained sand with some coarse and fine sand with less than 1 percent fines (silt/clay) (see Appendix B).

Coastal dune resources are present along most of the project footprint. They include natural hills, mounds or ridges of sediment landward of the coastal beach, that have been deposited by wind action, storm overwash or man-made dune restoration projects. Coastal dunes along the western end of the project site are narrower and lower in elevation than those along the eastern end of the site. The dunes provide protection for private properties in the Town Neck Hill area and for the extensive salt marsh ecosystem associated with Sandwich Harbor Inlet. There are currently 5.8 acres

of dunes within the larger project area, approximately 0.6 acres within the currently preferred placement area.

Coastal bank resources include the seaward face or side of any elevated landform, other than a dune, which lies at the landward edge of a coastal beach. Although most of the beach within the project area is backed by coastal dune, there is one section of the beach along White Cap Path that is backed by a coastal bank. The bank is approximately 295 ft long, extending in an easterly direction from the large groin. Significant erosion in this area over the past decade has exposed more and more of the bank. Sediments in the bank are composed of clay, silt, and sand.

Rocky intertidal shores at Sandwich are naturally occurring rocky and boulder-strewn areas, between the mean high water line and the mean lower low water line. Although much of the intertidal zone within the project area is composed of coarse sand and cobble, MassDEP has delineated two patches of rocky intertidal shore towards the western end of the project area. USACE mapped the nearshore rocky headline and differentiated the intertidal and subtidal rock areas as the gravel/cobble from cobble/boulder areas (Figure 4). There were 5.57 acres of mapped rocky intertidal shore within the project area, but due to erosion caused by storms some of this area is now subtidal and there is additional exposed rocky intertidal habitat within the project area. Currently the project area has 7.3 acres of intertidal rocky habitat of which 5.01 acres will be directly impacted by the project. There are 8.33 acres of subtidal rocky habitat (Figure 4). There is also tidepool habitat within the gravel/small cobble spit area and some of the rocky intertidal area where all but the large boulders are always submerged (Figure 5).

Figure 4. Map of placement area on Town Neck Beach, Sandwich, MA and with rock and eelgrass habitats. Eelgrass plotted on eastern end were plotted to be seen on the map, but are center points of 2 sparse beds so mapped areas appear larger than actual eelgrass areas (see descriptions in text).

Figure 5. Rocky habitat on the western end of project within tide pool area, only large boulders are exposed, most of the rock is always covered by water.

5.2 Biological Environment

5.2.1 Dredging Sites - Maintenance Dredging of Cape Cod Canal

The Cape Cod Canal waterway bisects the town of Bourne, with the eastern end of the canal in Sandwich. The Canal property includes 982 acres of project land situated along the 7.4 mile land cut. Overall, about 20 percent of the project area has been developed, which is defined as roads, buildings, parking areas, turf (lawn) and other areas without natural self sustaining plant communities. The remaining 80 percent of the land (885 acres) is undeveloped and primarily forested. About 85 percent of the undeveloped land is upland and 15 percent wetland. The project includes about 575 acres of subtidal habitat within the land cut and about 750 acres within the Buzzards Bay channel reaches. Land adjacent to government property near the canal varies from undeveloped forestland to heavily developed residential and commercial areas

The Canal main channel was originally sampled in the late 1960s by the Massachusetts Division of Marine Fisheries to characterize the biological community which is described in the 1977 Cape Cod Canal EIS (USACE, 1977). Generally the biological community is a mixture representative of a transitioning between two biogeographic regions, Cape Cod Bay (a Boreal community) and Buzzards Bay (a Virginian community). As would be expected of the Canal environment, the areas of the main channel closest to each end would probably be most representative of that respective community, with the areas closest to the midway point of the land cut being the most mixed.

Given the overall consistent hydrological regime of the canal, substrate conditions and temperatures, a transitional community reflecting both Cape Cod Bay and Buzzards Bay environments is still present in the main channel. It should be

mentioned that maintenance dredging at various times and locations within the channel has occurred during the last fifty years temporarily impacting benthic communities within these areas.

In March 1991 USACE surveyed the benthic habitat of the western end of the Canal in preparation for the realignment of the approach to the Cleveland Ledge channel that was completed in 1999-2000. Benthic and macrofaunal samples were taken in order to characterize the marine ecosystem. Appendix D, Figure D-1 outlines the station locations relative to the Cleveland Ledge Light. Divers observed no macrofauna at any of the stations. However, some minor epifaunal assemblages were observed on the rocks and boulders that occur sporadically within the area. Benthic samples were also collected by the divers. Dominant organisms included the polychaetes *Aricidea jefferysi*, *Amphitrite ornata*, and *Podarke obscura* as well as the amphipod crustaceans *Ampelisca abdita* and *Corophium acutum* (see Table D-1 of Appendix D).

Bournedale Herring Run's entrance, which is located about 1 mile west of the Sagamore Bridge, maintains access for Alewife and Blueback herring to travel up Herring River (formerly Monument River) to reach Great Herring Pond to spawn. Other fish species which may be found within or near the canal include: striped bass (*Morone saxatilis*), black sea bass (*Centropristis striata*), bluefish (*Pomatomus altatrix*), mackerel (*Scomber scrombrus*), bonito (*Sarda sarda*), tautog (*Tautoga onitis*), scup (*Stenotomus chrysops*), cod (*Gadus morhua*), summer flounder (Paralichthys dentatus), and winter flounder (*Pseduopleuronectes americanus*). Juvenile cod young of year were collected west of the canal and east of Sandwich Harbor by Massachusetts DMF Inshore Trawl Surveys between 1978 and 1999 during the spring collection. There were much lower numbers of juvenile cod collected from deeper waters in the autumn collections (1978-1999) (Howe *et al*., 2002). No sampling was completed in the waters adjacent to the project.

In general, the status of Atlantic horseshoe crab (*Limulus polyphemus*) populations along the Atlantic Seaboard is poorly understood due to the limited amount and inconsistency of information collected regarding stock levels. In late spring (May-June) adults migrate into warm and shallow waters to mate and lay eggs. Spawning adults prefer sandy beach areas within bays and coves that are protected from wave energy. The eggs are buried in sand or mud at the edge of the shore during the high spring tides and hatch within a few weeks at the next spring tide. There are recorded spawning sites within Buttermilk Bay, but none within the canal.

There is no eelgrass growing within the Cape Cod Canal Federal Navigation Project, but it may be found outside the channel near Hogs Island (Figure 6) on the western end of the canal.

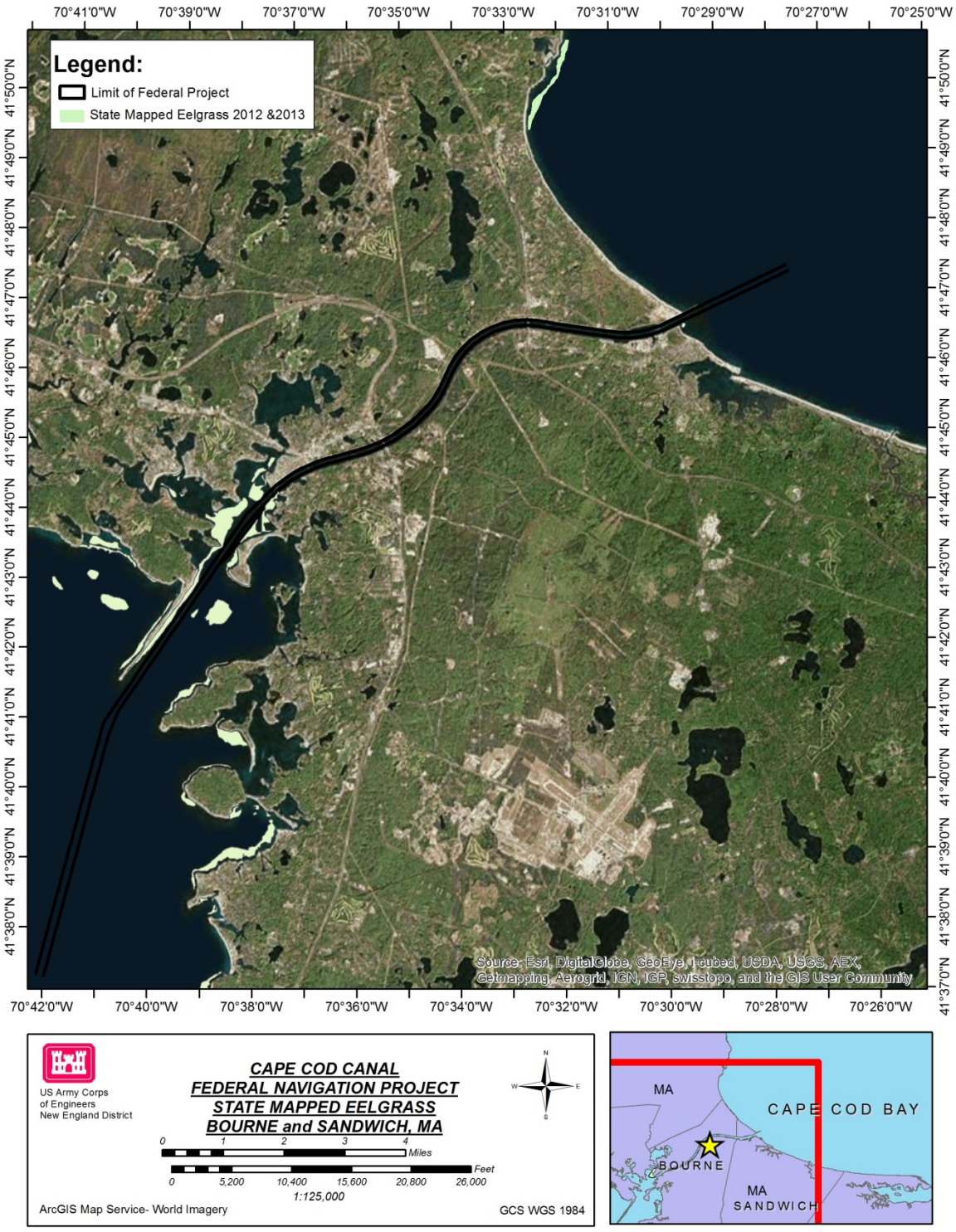

Figure 6. State mapped eelgrass in the areas surrounding the Cape Cod Canal.

5.2.2 Cape Cod Canal Disposal Site

The CCCDS was last used for disposal of canal maintenance material in 1990. The disposal site and nearby areas have been investigated over the past thirty years. In 1981, Massachusetts Coastal Zone Management funded a study to examine fisheries and document environmental conditions relative to dredge material disposal in Cape Cod Bay (Howe and Germano, 1982).

Site A of the Howe and Germano (1982) study was 1.4 nautical miles north of the CCCDS due to topographical features which impeded trawling within the CCCDS. A diver survey was conducted in 1984 (Terra Mar International Services, Inc., 1984) that described the site as being dominated by the starfish *Asterias vulgaris* and the sea anemone *Cerianthus borealis*. In addition, polychaetes *Myxicola infundibulum*; sea scallops, *Placopectin magellanicus*; jonah crabs, *Cancer borealis*; moon snails, *Lunatia heros*; and mysid shrimp, *Mysis mixta* were noted. Finfish that were observed during the diver survey included flounder, skate, pipefish, and hake. The 1984 (Terra Mar International Services, Inc) survey included fish caught by gill net. Species caught in the gill nets included: red hake, silver hake, butterfish, sea ravens, skates, grubby, cunner, pollock, cod, rock crabs and jonah crabs. In 1990 DAMOS monitoring (SAIC, 1993) conducted a sediment-profile imaging (SPI) survey in the region of a historic disposal mound at CCCDS created in 1980 with additional disposal in 1986. The center of the disposal mound only showed recolonization by Stage II infauna (deposit feeders). Ambient conditions were apparent at the western end of the survey transects with Stage III (head down, deep burrowing deposit feeders) assemblages at depth with Stage I (pioneering assemblages) infauna surface taxa (SAIC, 1993).

A more recent survey of the CCCDS was performed by USACE in September 2006 to characterize the benthic community with details of the analysis and maps of sampling locations presented in Appendix D of this report. Benthic analysis identified polychaetes as being the most prominent taxa followed by amphipods, bivalves, oligochaetes, cumaceans, nematodes, echinoderms, isopods, and nemerteans based on average abundance across the five stations. The number of individuals in the grabs ranged from 378 to 588 with species richness ranging from 27 to 40 species in a sample. Species evenness ranged from 0.74 to 0.85. Diversity indices were also generated for the data (see Appendix D, Tables D-2a & b). Underwater video transects of the disposal and reference site were also performed on 17 September 2006. Sea stars and various crab species were identified in all areas (see Appendix D for further details). A table of organisms identified in the 1984 diver survey (Terra Mar International Services, Inc., 1984) and 2006 underwater video survey can be found in Table D-1 (Appendix D).

5.2.3 Beach Placement- Town Neck Beach

Rocky intertidal shores on Sandwich beaches provide habitat for macroalgae (sea lettuce *Ulva lactuca,* rockweed *Fucus vesiculous,* red and green filamentous algae, encrusting algae) and marine invertebrates. These species are found in small scattered

patches within the rocky habitat. There are numerous common periwinkle (*Littorina littorea*) snails, common slipper shells (*Crepidula)*, crabs, and barnacles (*Balanus* sp) inhabiting these areas. The rocky habitat also provides protection and food sources for larger marine organisms such as crabs, lobsters, fish species, and various bird species such as the purple sandpiper (*Calidris maritima*).

Historically, surf clams (*Spisula solida*) were commercially harvested in the deeper waters north of Town Neck Beach along the 20 foot depth contours (Town of Sandwich Shellfish Constable). However, this ended in the early 1980s and there has been no significant harvesting since that time. The State GIS shellfish suitability maps show some potential blue mussel (*Mytilus edulis*) and surf clam habitat adjacent to the project area (see Figure 7). However, a shellfish survey conducted by the town of Sandwich (September 30- October 10, 2014) found no shellfish in the proposed project area. A few small sets of blue mussels were found on the boulders along the groin areas, but overall it was concluded that most of the habitat within the project area was not conductive for shellfish settlement (letter to Town from WHG, 2014, Appendix E). There are a few mussel clusters found on the cobble/boulders within the intertidal area with but of the few sets observed, many of the individuals were dead (personal observation, Sept 2014).

Any horseshoe crabs that travel into the Cape Cod Canal to reach their spawning sites will not be impacted by the proposed project since no dredging activities will occur during the spawning season. Even if dredging did occur when the horseshoe crabs were present it is unlikely that they would be buried into the bottom sediments due to the strong currents within the Canal.

Fish species are the same as those found in the eastern end of the canal (see Section 5.2.1). Also see the essential fish habitat discussion in Section 5.3 and Appendix F for additional information on fish species that may in the area.

Eelgrass (*Zostera marina*) has been mapped adjacent to the south jetty of the Canal since 1995. Small patches of eelgrass have also been identified seaward of the placement area. Eelgrass provides an important habitat for marine organisms. Eelgrass beds are highly productive components of the marine/estuarine environment. It is a grass-like flowering plant that propagates both by vegetative growth (spreading rhizomes), and by seed germination. Primarily a perennial plant, eelgrass may grow as an annual in areas of high scour, freezing and other stressful conditions (Thayer *et al.*, 1984). Eelgrass characteristics are as follows; a high rate of leaf growth; the leaves of which support large numbers of ephiphytes, which are grazed extensively upon and may be of comparable biomass to the leaves themselves; leaves which produce large quantities of organic material (detritus) for export and shoots that retard or slow currents which enhance sediment stability and increase the accumulation of organic and inorganic material; roots that bind sediment, reduce erosion and preserve sediment microflora; plants and detritus production that influence nutrient cycling between sediments and overlying waters which stabilize intertidal and subtidal habitat, thereby decreasing shoreline erosion and cycle essential nutrients (Thayer, *et al*., 1984).

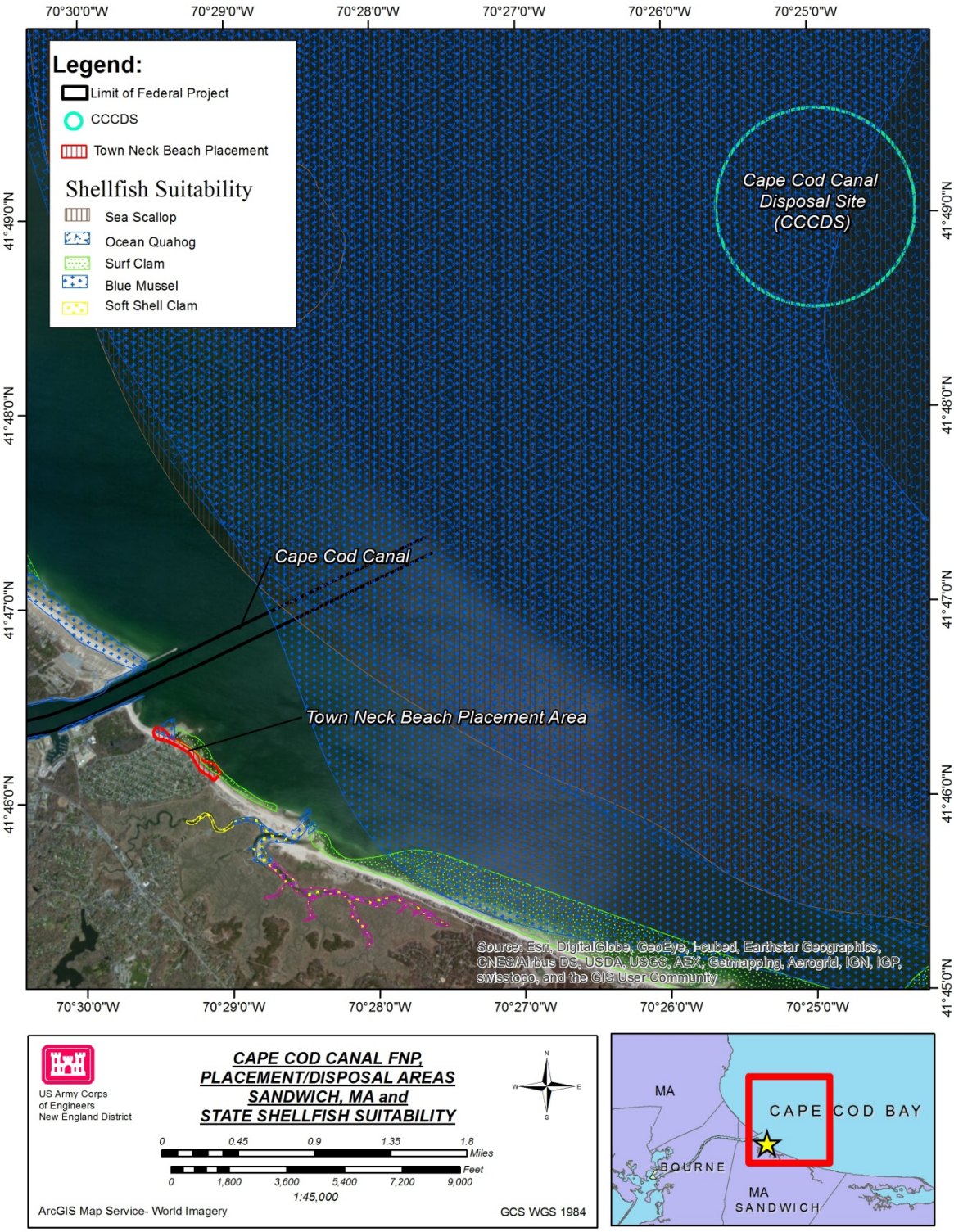

Figure 7. Cape Cod Bay end of the Canal with state mapped potential shellfish habitat identified.

Eelgrass blades can die in the fall however, the roots and rhizomes remain dormant through the winter. The diversity of organisms and overall abundance of both species and individuals is higher in eelgrass meadows than in adjacent unvegetated areas (Thayer, *et al*., 1984; Heck, *et al*., 1989; Hughes, *et al*., 2002). Eelgrass can successfully dominate areas that have sediments ranging from soft mud to coarse sand with average salinities of 10 to 30 parts per thousand (ppt) (Thayer, *et al*., 1984). Light availability is a primary factor limiting both depth and upstream estuary penetration of eelgrass within its temperature and salinity ranges (Thayer, *et al.*, 1984).

Eelgrass beds are known to play a nursery role for several commercially important fish species, although the nursery function is less obvious than in previously studied mid-Atlantic eelgrass meadows (Heck, *et al.* 1989). In general they provide a refuge for fish and invertebrates that retreat from exposed intertidal flats and estuarine marshes at low tide, and serving as a spawning and nursery area for numerous species of aquatic animals. Female Atlantic silversides lay their eggs at the base of eelgrass blades. Male nine-spine sticklebacks construct their nests and rear young among eelgrass blades. Juvenile cod use eelgrass as a refuge from predators, the blades are useful when the stem density is great enough ($\geq$720stems/m^2) (Gotceitas *et al*., 1997) or more often use rocks, shells and other debris within the bed as shelter (Tupper and Boutilier, 1995). Other juvenile fish, including herring, mummichogs and rainbow smelt, also seek refuge there. Large game fish like striped bass and blue fish swim through to feed on these small fish.

Eelgrass has been mapped in the water adjacent to Town Neck Beach near the Canal south jetty since 1995. The town of Sandwich conducted an eelgrass survey of the subtidal habitat (WHG, October 2014). A tidal pool area has formed near the western edge of the project area within the hooked spit. Within this tidal pool, which is protected from wave energy, an eelgrass bed (0.045 acres) extends approximately 100 feet along the western edge in water depths ranging from 2 to 4 feet (Figures 4 and 8A). Attached macroalgae (*Fucus*) is also found within the pool. Some small eelgrass patches were also identified on the eastern end of the project in subtidal waters seaward of the groin area. Eelgrass was also found growing in the sand patches between the rocks. Most of these patches were very sparse having only several blades over several inches of bottom. The center of the two larger patches (see Figure 8B), which are one to two feet in diameter, are plotted on Figure 4 (the areas marked do not show the extent of the eelgrass). All identified eelgrass is seaward of any sand placement and would not be directly impacted by the disposal of sandy dredged material.

Harbor seals (*Phoca vitulina*) may be found sitting on the large rocks seaward of mean lower low water at low tide.

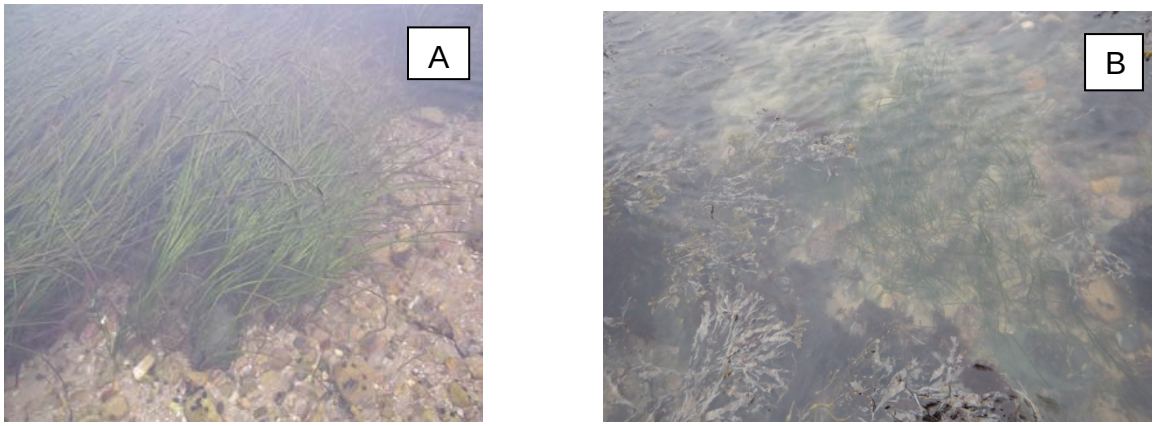

Figure 8. A. Eelgrass in the tidepool created by the spit. B. The largest patch of eelgrass seaward of the most eastern groin of the project.

5.3 Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act and amended by the Sustainable Fisheries Act of 1996, an Essential Fish Habitat (EFH) consultation is necessary for this project. EFH is broadly defined as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." The Cape Cod Canal, Town Neck Beach, and Cape Cod Canal Disposal Site all fall into this category and thus have the potential to provide habitat for fish species in the area (see Appendix F).

As stated in NMFS EFH designations (http://www.nero.noaa.gov/ro/doc/newefh.html), the dredge areas fall within two different 10' X 10' square areas bounded by coordinates, and 70° 20.0' W and 41° 40.0' N, and 70° 40.0' W, 41° 50.0' N. The placement/disposal sites are also within the same square as the most western end of the canal.

Twenty-seven federally managed species have the potential to occur within the project areas. These include: Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), pollock, (*Pollachius virens*), whiting (*Merluccius bilinearis*), red hake (*Urophycis chuss*), white hake (*Urophycis tenuis*), winter flounder (*Pseudopleuronectes americanus*), yellowtail flounder (*Pleuronectes ferruginea*), windowpane flounder (Scopthalmus aquosus), American plaice (*Hippoglossoides platessoides*), ocean pout (Macrozoarces americanus), Atlantic halibut (*Hippoglossus hippoglossus*), Atlantic sea scallop (Placopecten magellanicus), Atlantic sea herring (*Clupea harengus*), monkfish (*Lophius americanus*), bluefish (*Pomatomus saltatrix*), long finned squid (*Loligo pealei*), short finned squid (*Illex illecebrosus*), Atlantic butterfish (*Peprilus triacanthus*), Atlantic mackerel (*Scomber scombrus*), summer flounder *(Peprilus triacanthus*), scup (*Stenotomus chrysops*), black sea bass (*Centropristus striata*), spiny dogfish (*Squalus*

acanthias), bluefin tuna (*Thunnus thynnus*), little skate (*Leucoraja erinacea*), and winter skate (*Leucoraja ocellata*).

5.4 Threatened and Endangered Species and Species of Concern

The National Marine Fisheries Service has indicated seasonal movements of the endangered right whale, *Balaena glacialis*; the endangered Kemp's ridley turtle, *Lepidochelys kempi* and the threatened loggerhead turtle, *Caretta caretta* occur within Cape Cod Bay and as result may be present in the project area at certain times of the year. Also critical habitat for the right whale includes Cape Cod Bay. Previous coordination with the National Marine Fisheries Service has indicated that the migratory routes of these species can include areas in Buzzards Bay as well. In addition, other threatened and endangered whale and turtle species have been observed in these areas, i.e. humpback whales (*Megaptera novaeangliae*), finback whales, (*Balaenoptera physalus*), sei whale, (*Balaenoptera borealis*), leatherback sea turtles (*Dermochelys coriacea*), and green sea turtles (*Chelonia mydas*). Also the threatened/endangered Atlantic sturgeon (*Acipenser oxyrinchus*) may be in the project areas.

The US Fish and Wildlife Service (USFWS) indicated that Bird Island is an important nesting location for the Federally-endangered roseate tern (*Sterna dougallii*). Bird Island is located approximately 1 nautical mile west of the Cleveland Ledge Channel. Piping plovers (*Charadrius melodus)* are a federally listed threatened species that nests in open, sandy beaches close to the dunes and are recorded as nested on Sandwich, MA beaches. The red knot (*Calidris canutus rufa*) is listed as threatened and migrating birds may stop in nearby areas during migrations.

Also the USFWS website (http://www.fws.gov/newengland/pdfs/MA%20species%20by%20town.pdf) lists the sandplain gerardia (*Agalinis acuta*) plant found in open areas with sandy soils of the town of Sandwich. The plant is typically found in cemeteries with dry grasslands, so it would not be found in the project areas.

The State of Massachusetts lists the least tern as a species of special concern. It breeds along coastal and freshwater habitats of North America from Maine to Florida on dry, exposed unvegetated areas on sandbars, or beaches in areas between the drift line and upland. It is recorded as nesting on beaches in Sandwich, MA.

5.5 Historical and Archaeological Resources

5.5.1 Ocean Areas

Shipwreck files at New England District were reviewed for the existence of potentially significant cultural resources within the study area. Approximately twenty-three (23) wrecks of various types, sizes, and time periods were noted for the Cape Cod Canal, Cape Cod Bay, and Buzzards Bay vicinity. These shipwrecks are listed below:

1. Escort - Oil Screw - Lost 1945 cause unknown- Buzzards Bay, Dumpling Rock Light

2. Gov. Prence - Oil Screw - Built 1917 - Burned 1929 Cape Cod Canal
3. Helen G. King - Schooner - Built 1867 - Stranded 1916 Cape Cod Canal
4. Lawrence Murdock - Schooner - Built 1882 - Foundered 1924 Buzzards Bay, MA
5. Lizzie W. Hannum - Schooner - Lost 1895 - Great Ledge, Buzzards Bay
6. Mathew S. Greer - Schooner - Built 1910 - Stranded 1929 Buzzards Bay
7. Miss Pt. Judith - Oil Screw - Built 1959 - Collided 1961 Buzzards Bay entrance
8. Nahant - Barge - Burned 1952 Cape Cod Canal
9. Oakwoods - Schooner - Built 1880 - Collided 1919 w/American sub Cape Cod Canal
10. O'Keefe V - Oil Screw - Built 1953 - Burned 1966 Buzzards Bay Light Tower
11. Peter Howard - Barge - Built 1918 - Stranded 1922 Scusset Breakwater, Sandwich
12. Potomac - Barge - Lost 1909 cause unknown, South of Cape Cod Canal, MA
13. Pottstown - Barge - Built 1917 - Foundered 1944 - Cape Cod Canal breakwater
14. Radnor - Schooner - Built 1895 - Stranded 1921 Entrance to Cape Cod Canal
15. Ruth and Margaret - Built 1915 - Foundered 1948, Middle Ground, Buzzards Bay
16. S.S. Seranbon - Schooner - Lost 1894 cause unknown, Mishaum Point, Buzzards Bay
17. Seven-Oh-Two - Schooner - Lost 1932 cause unknown, Scusset Breakwater, MA
18. Sherwood - Barge - Built 1919 - Stranded 1947, Wilkes Ledge, Buzzards Bay
19. Stephen R. Jones - Steam screw - Built 1915 - Stranded 1942, Cape Cod Canal
20. Tohickon - Schooner Barge - Built 1913 - Stranded 1932, Buzzards Bay
21. USS Yankee - Cruiser - Lost 1908 cause unknown, Phinney Rock, Buzzards Bay
22. Vale Riyal - Barge - Built 1914 - Stranded 1942, Cape Cod Canal, Sandwich, MA
23. William Chisholm - Steam screw - Built 1884 - Stranded 1916, Cape Cod Canal

5.5.2 Land Areas

The archaeological record for the upper Cape region comes from a number of sources. Avocational collectors identified many of the known sites in the area, some during the first half of the twentieth century. Cultural resource management (CRM) surveys have added to the information available on pre-contact land use patterns in the region, and have provided data on sites in diverse environmental settings. Within the vicinity of the Cape Cod Canal, Town Neck, and Spring Hill beaches, surveys have been conducted along road and utility easements, residential and commercial developments, and at the former Camp Edwards (now Joint Base Cape Cod).

The database for the mid Cape and especially the upper Cape, however, is much less complete than that for the lower Cape. The upper Cape continues to be the least studied portion of the Cape, although the extant information indicates that it was intensively utilized by pre-contact peoples.

The earliest pre-contact sites from the PaleoIndian Period (12,000 – 10,000 B.P.) have not been positively identified on Cape Cod. This can be partially explained by the loss of the early Holocene (post glacial) shoreline and associated sites due to rising sea levels. Many coastal sites dating to the early pre-contact period may be submerged or eroded by marine inundation and wave activity. Evidence of *in situ* Early Archaic Period (10,000 – 7,500 B.P.) sites are also relatively rare as the environmental landscapes continued to change and the sea levels continued to rise. Sites from the Middle Archaic Period (7,500 – 5,000 B.P.) to the Contact Period (1500 – 1650 A.D.) are much more apparent in the pre-contact record. This is no doubt due to the stabilization of erosion

and inundation, as well as the recognition of particular landscapes as being archaeologically sensitive for certain sites.

Pre-contact sites have been identified in the vicinity of the eastern end of the canal, but are located further north (Buttermilk Bay area) and south (Pocasset/Cataumet area). The distribution of known sites should not be considered representative of pre-contact activity in the area, as most were identified by collectors and CRM surveys. It is likely that the entire Manomet River area could have been used by pre-contact populations. Sites identified in the area include a rockshelter, shell middens, lithic workshops, the Canal Village Site of Manomet, the Great Herring Pond Site, several burials and an ossuary. Any unidentified pre-contact sites present on or near Town Neck and Spring Hill beaches would likely be shell middens. Shell middens usually contain dense deposits of shell, usually quahog, but also, lithic debitage, projectile debitage, remnants of cooking vessels made of steatite or ceramics and sometimes burials.

The historic site potential in the general area of the Canal was considered to have been high prior to canal construction due to the presence of known Native American settlements and early European explorers and settlers. It is highly likely that most of the Native American and early European settlements were situated in close proximity to the shores of the Manomet and Scusset rivers. Impacts associated with the different phases of construction are likely to have destroyed most of these historic or post-contact sites.

Cape Cod was one of the first areas to be explored and settled by Europeans and as a result contemporary accounts record Native American settlements as well as interactions with European traders, explorers and settlers. In western Cape Cod, in proximity to the Canal, there was the reported Manomet Indian village of Comassakumkit, with other settlements near the Herring River and Pond, along the coast at Sandy Neck, and along the Manomet River. Europeans observed Native Americans in their seasonal moves to exploit available resources, including portage over the narrow isthmus between the Manomet and Scusset Rivers. The importance of trade prompted the building of the Aptuxcet Trading Post in Bourne in 1627. Native Americans and European settlers also shared resources such as a log weir along the Herring River. It is likely that many if not all of the fragile seventeenth to eighteenth century sites in this vicinity have been damaged or destroyed by canal, commercial, or residential development.

Later potential eighteenth and nineteenth sites are likely to reflect the development of the villages located in Bourne and Sandwich and the economic pursuits of the settlers. Likely historic period sites at Town Neck and Spring Hill beaches would be salt and bog iron works, earlier homesteads or farmsteads, and/or a small village center.

5.6 Air Quality and Noise

Ambient air quality is protected by Federal and state regulations. The U.S. Environmental Protection Agency (EPA) has developed National Ambient Air Quality Standards (NAAQS) for certain air pollutants, with the NAAQS setting concentration limits that determine the attainment status for each criteria pollutant. The six criteria air pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

The Commonwealth of Massachusetts used to be designated as a non-attainment area for ozone as part of the Northeast Ozone Transport Region which extended northeast from Maryland and includes all six New England states. The EPA currently designates only Duke County in Massachusetts as moderate non-attainment area for the 8-hour ozone standard. Barnstable County where the project is located is an attainment area for ozone (U.S. EPA, 2014).

5.7 Socioecononmic Environment

The Cape Cod Canal provides a safe and cost effective route for commercial ships serving New England. Economic resources of New England would more likely be negatively impacted by not maintaining adequate depths within the Canal in order to provide safe vessel passage rather than from maintenance dredging activities. Over 20,000 vessels of all types use the Canal annually. In addition to being a preeminent navigation project, the Cape Cod Canal offers a wide variety of recreational opportunities. Recreation facilities and programs operated by the Corps of Engineers include: a visitors center, interpretive services, parking areas and comfort stations at various access points to facilitate public use of the Canal for fishing, hiking, bicycling, picnicking, ship-watching, and other recreational pursuits such as camping.

The town of Bourne, MA is on the western end of the canal and Sandwich, MA on the eastern end. Since the proposed work involves the maintenance dredging of an existing channel, these towns are not likely to be affected by the dredging activities. The towns adjacent to the canal are essentially communities along a “highway” where there are no “exits”.

The town of Sandwich contains primarily suburban residential development, with clusters of commercial and retail development as well as areas of open space. The dredged material will potentially be placed on Town Neck Beach, a public beach in the Town. According to the US Census, in 2010 Sandwich had a population of 20,675, contained 9,476 housing units, and had a median household income of $82,917 (http://factfinder.census.gov). Based on information from the Massachusetts Division of Career Services, for August 2014 Sandwich had a labor force of 13,761 with 5.4 % unemployment (data not seasonally adjusted) while the state of Massachusetts had an unemployment rate of 6.0 (http://lmi2.detma.org/lmi/lmi_lur_b.asp?A=05&GA=000043&TF=2&Y=&Sopt=&Dopt=TEXT). The sandy sediments are to be used to build

up the dunes and beach berm on Town Neck Beach in front of the homes where there has been a large amount of erosion.

The town of Bourne is a medium-sized rural community at the gateway to Cape Cod. Bourne has numerous quiet harbors and inlets for boating and bathing. Shellfishing is popular in this area. Bourne is a quiet community that does not experience the significant fluctuations in populations during the summer months as found at other Cape communities. According to the US Census, in 2010 Bourne had a population of 19,754, contained 10,805 housing units, and had a median household income of $61,312. Based on data from the Massachusetts Division of Career Services for August 2014 Bourne had a labor force of 12,633 with 6.3 % unemployment (data not seasonally adjusted) while the state of Massachusetts had an unemployment rate of 6.0 (http://lmi2.detma.org/lmi/lmi_lur_b.asp?A=05&GA=000032&TF=2&Y=&Sopt=&Dopt=TEXT).

6.0 ENVIRONMENTAL CONSEQUENCES

6.1 Physical and Chemical Environment

6.1.1 No Action Alternative

Under the No Action Alternative the Cape Cod Canal Federal channel would continue to shoal resulting in decreasing water depths. As a result, the channel would become increasingly hazardous to navigate and would eventually prevent safe vessel passage. Also under the No Action Alternative, the town of Sandwich will need to find an alternative sand source for needed nourishment and protection of Town Neck Beach adjacent to the residential areas.

6.1.2 Dredge Sites

The material proposed to be dredged from the Cape Cod Canal shoal areas has been found to be suitable for beach placement and unconfined open water disposal, based upon grain size and lack of spills or known sources of contamination within the canal (see Appendix C). Chemical data generated from the analysis of sediment samples taken from the Cleveland Ledge area of the channel for the previous dredging (2002) event indicated that all the sediments tested were suitable for open water disposal. Therefore, it is expected that no significant impacts to water quality would occur as a result of dredging activities.

Dredging operations have the potential to temporarily increase turbidity in the project area. The extent and duration of these impacts are a function of the type of material to be dredged, the type of equipment used and the hydrologic regime of the dredging and disposal area. Turbidity impacts primarily affect the performance of visual predators such as fish and birds, the primary production of phytoplankton, growth and survival of benthic organisms (Karel, 1999), and impact other sensitive receptors (e.g. gill abrasion) on the organisms (Kurland *et al*., 1994). Turbidity can alter light regimes (reduce light) which has the potential to impact primary production, species distribution,

behavior, feeding ability and movements of fish especially larval fish (Berry *et al*., 2003). However, areas with increased turbidity are not always detrimental. The distribution of several species of juvenile marine fish common in estuaries was influenced by water turbidity (Cyrus and Blader, 1987). Some species prefer more turbid waters, possibly as protection from predators. In terms of dredging, the increases in turbidity over background are short-term (hours, days to months), but are usually not continuous due to project scheduling, dredge type or tidal regimes (based on data from water quality monitoring of dredging fine (silty/clayey) sediments from the Boston Harbor Navigation Improvement Project (ENSR, 2002) and Providence River and Harbor Maintenance Dredging Project (USACE, 2003)).

Coastal and estuarine organisms are exposed to suspended sediments from tidal flows, currents and naturally occurring storm events; therefore they have adaptive behavioral and physiological mechanisms for dealing with this feature of the habitat. Dredging related suspended sediments or turbidity plumes may differ in scope, timing, duration, and intensity from natural conditions (Clarke and Wilber, 2000). Major storms can displace larger amounts of sediments than dredging operations, and tend to occur one to three times a year. This is more frequent than most dredging operations at a particular area and dredging affects much smaller regions (i.e. a localization of impacts) than these major storms (Wilber and Clarke, 2001). The duration and concentration gradients of suspended sediment plumes from dredging are dependent on numerous factors, such as specific dredge plant, sediment characteristics, and environmental conditions (Collins, 1995).

However, the turbidity effects for this project are anticipated to be short-term and localized around the dredging area due to the sandy nature of the material to be removed from the Canal. Re-suspension of fine–grained material is usually restricted to the vicinity of the operation and decreases rapidly with increasing distance from the operation. The majority of resuspended sediments from a hopper dredge are due to overflow of the hoppers into surrounding waters. A hopper dredge without overflow could suspend 25-200 mg/l of silty sediments within 100 to 400 feet downcurrent of the dredge (Hayes, 1986). With overflow, these amounts increase to 250-700 mg/l within 100 to 400 feet downcurrent of the dredge (Hayes, 1986). Since the dredged material from the canal is sand, with low silt content, very little turbidity is expected. Although a much smaller hopper dredge than proposed for this project, when dredging sandy sediments with the dredge *Currituck*, suspended sediments levels above 150mg/l were only found within small volumes of the central portions of the plumes and concentrations above 50 mg/l were generally confined to within 300 feet of the active overflow (draft report Clarke *et al*).

The shoal areas of the canal typically involve high energy environments that are subject to wind and wave action, tidal influence, coastal storm events and heavy vessel traffic to which the benthic community has had to adapt. Organisms inhabiting these types of areas are highly capable of adapting to frequent disruptions (Miller *et al*., 2002). Also, sandy material is generally not associated with high levels organic carbon, and dredging the sandy material from the canal is not likely to result in the release of nutrients or decreases in dissolved oxygen.

6.1.3 Placement/Disposal Sites

6.1.3.1 Cape Cod Canal Disposal Site

The Cape Cod Canal Disposal Site (Figure 3) is a previously used open water disposal site. The material proposed to be dredged from the canal and disposed at the CCCDS is clean sand and similar to that of previous canal maintenance operations. Turbidity impacts to the water column should be short-term and of limited impact given the sandy nature of the material. There are three distinct phases when dredged material is released from a hopper or scow and descends through the water column as a dense fluid-like jet (Truitt, 1986). The three physical phases are 1) convective descent, 2) dynamic collapse, and 3) long-term or passive diffusion. Truitt (1986) concluded from an analysis of several studies concluding that the short-term impacts resulting from suspended sediment are confined to a well-defined layer near the bottom.

6.1.3.2 Town Neck Beach Placement

The clean sand to be placed on Town Neck Beach is compatible with the existing beach substrates of the gravel and sand. There are no fines (silt/clay) in the Canal sediments so runoff from any of the material placed on the beach should have minimal impacts on nearshore water quality given the sandy nature of the material. Any suspended sandy sediment would rapidly settle out of the water column. Any increase in turbidity as a result of these processes would be expected to be of relatively short duration and limited to the surf zone and adjacent nearshore areas. Given the nature of these clean sandy sediments which are not associated with high levels of organic carbon, there will be no release of nutrients or decreases in dissolved oxygen levels.

The project will place approximately 150,000 cy of material over about 15.49 acres on Town Neck Beach (see Figures 9A and B). In order to protect the homes and maintain the newly placed sand on the beach, the dune system will be built up to an elevation of 21.3 to 26.3 feet high and 20 feet wide with a slope of 5 horizontal to 1 vertical to the beach berm. The dunes will grow from an area of 0.56 acres to 5.27 acres by placing approximately 62,300 cy of material to renourish the dunes. The footprint of the beach berm between the toe of the dunes and mean high water (MHW) will increase by 0.66 acres and the MHW line will be moved seaward about 50 feet at the western end of the project to about 150 feet at the eastern end of the project covering approximately 5.36 acres of intertidal habitat. The mean lower low water (MLLW) line will only move in two sections of the project. It moves seaward approximately 100 ft for about 200 ft west of the fourth groin from the western end (1300-1500 ft into the project) and about 150 ft for the last 500 ft of the eastern end of the project. This will convert approximately 1.82 acres of subtidal habitat to intertidal habitat. The intertidal area will initially decrease from 7.88 acres to 4.34 acres, but this area is expected to increase as the beach equalizes and erodes. See Table 3 for a summary of the volumes and areas of the various habitats that are anticipated to be impacted by the project. The proposed project will create a beach similar to that previously existing in 1952.

Table 3: Changes to Town Neck Beach habitats due to sand placement.

Habitat	Current Conditions	After Project Conditions		Habitat Changes	Area
	(Acres)	(Acres)	(cy)		(Acres)
Dunes	0.564	5.27	65,600	Berm to dunes	4.706
Toe of Dunes to MHW	4.84	5.5	57,760	Intertidal to beach supratidal)	5.36
Intertidal	7.88	4.34	27,820	Subtidal to Intertidal	1.82
Subtidal	2.21	0.382	670		

The gravel/small cobble beach berm (0.668 acres) on the western end of the project will be covered by sand, and approximately 5 % (0.374 acres) of intertidal gravel/small cobble will also be covered by sand placement. Currently there are 7.11 acres of gravel/small cobble habitat in the intertidal habitat some of which is forming the spit and 5.32 acres in the subtidal habitat.

On and adjacent to the placement site on Town Neck Beach there is intertidal rock habitat. Many of the cobbles within the rocky intertidal area have been exposed due to erosion of the sand that originally covered the material. A small area of boulders (0.219 acre) is found on the gravel beach on the westernmost end of the placement site. Within the previously mapped intertidal rock area, only 3.47 acres of the 5.28 acres mapped from the center of the project was found to be intertidal rocky habitat. Previous mapping showed 0.292 acre of intertidal rock habitat on the eastern side of the project but erosion now has exposed 3.28 acres of intertidal rock. Placement of 150,000 cy of material on Town Neck Beach will directly impact most of the newly exposed rock (2.947 acres) on the eastern end, but not the small area previously mapped. Approximately 40% of the boulder area on the western end will be directly impacted (0.219 acres). In the central area about 53% of the intertidal rock (1.845 acres) will be directly impacted. As the beach equalizes sediments will move into the adjacent rocky areas by natural wave motion and as erosion occurs due to storm events additional movement will occur. Any sand placed directly into the intertidal zone should stay within the nearshore environment and any transport from the area should follow that of the local sand transport regime. Due to headland features identified by Lidar and historical aerial images of the area adjacent to the beach, best professional judgment by USACE coastal engineer predicts that only a thin layer of sand would impact the adjacent nearshore rocky habitat and that it would erode rapidly.

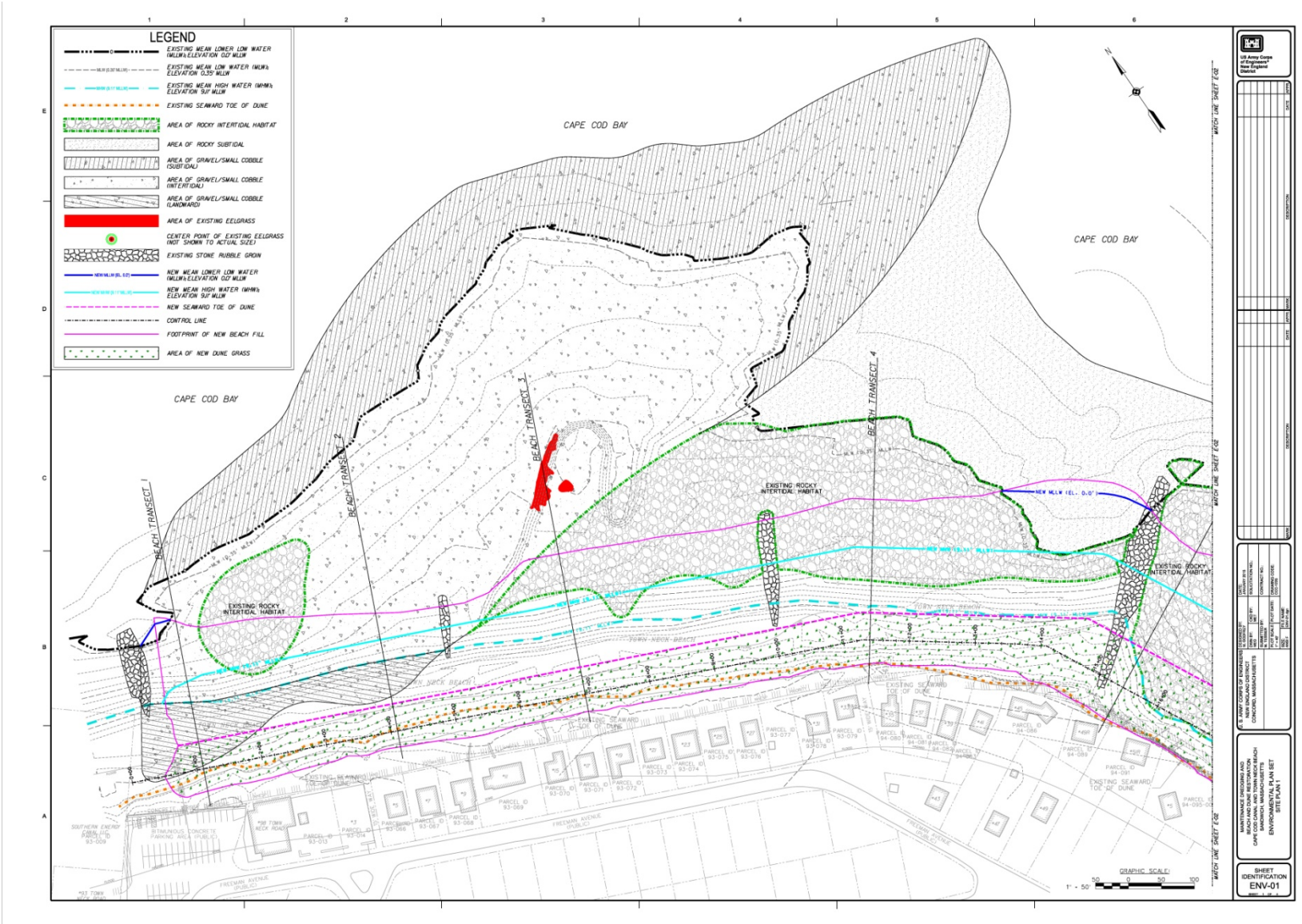

Figure 9A. Plan of western half proposed placement on Town Neck Beach, Sandwich, MA, with resources mapped.

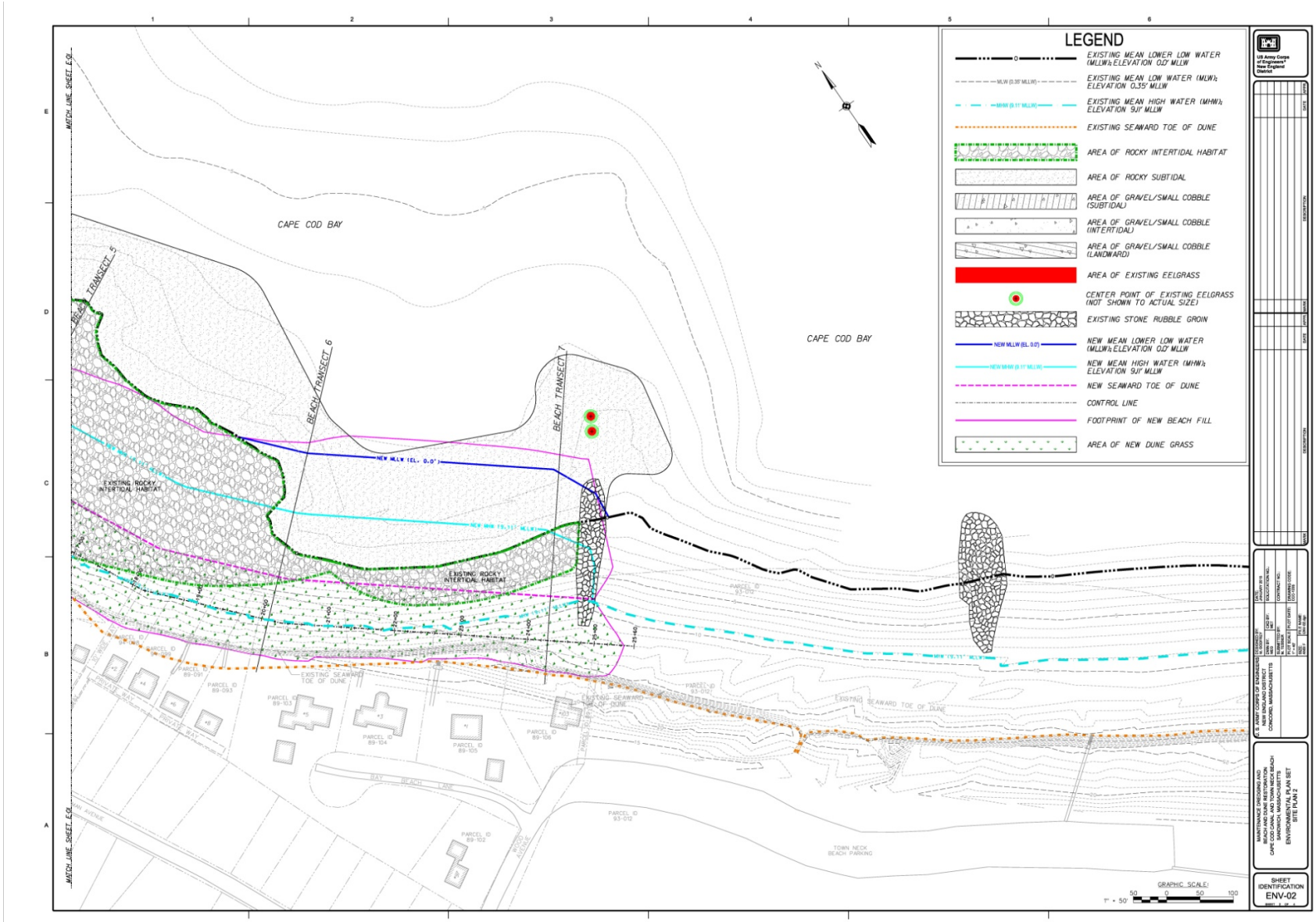

Figure 9B. Plan of eastern half of proposed placement on Town Neck Beach, Sandwich, MA with resources mapped.

The gravel/small cobble beach berm (0.668 acres) on the western end of the project will be covered by sand, and approximately 5 % (0.374 acres) of intertidal gravel/small cobble will also be covered by sand placement. Currently there are 7.11 acres of gravel/small cobble habitat in the intertidal habitat some of which is forming the spit and 5.32 acres in the subtidal habitat.

On and adjacent to the placement site on Town Neck Beach there is intertidal rock habitat. Many of the cobbles within the rocky intertidal area have been exposed due to erosion of the sand that originally covered the material. A small area of boulders (0.219 acre) is found on the gravel beach on the westernmost end of the placement site. Within the previously mapped intertidal rock area, only 3.47 acres of the 5.28 acres mapped from the center of the project was found to be intertidal rocky habitat. Previous mapping showed 0.292 acre of intertidal rock habitat on the eastern side of the project but erosion now has exposed 3.28 acres of intertidal rock. Placement of 150,000 cy of material on Town Neck Beach will directly impact most of the newly exposed rock (2.947 acres) on the eastern end, but not the small area previously mapped. Approximately 40% of the boulder area on the western end will be directly impacted (0.219 acres). In the central area about 53% of the intertidal rock (1.845 acres) will be directly impacted. As the beach equalizes sediments will move into the adjacent rocky areas by natural wave motion and as erosion occurs due to storm events additional movement will occur. Any sand placed directly into the intertidal zone should stay within the nearshore environment and any transport from the area should follow that of the local sand transport regime. Due to headland features identified by Lidar and historical aerial images of the area adjacent to the beach, best professional judgment by USACE coastal engineer predicts that only a thin layer of sand would impact the adjacent nearshore rocky habitat and that it would erode rapidly.

Also, after the initial disposal the coloration of the sand may not match the sand that is currently on the beach but it is expected that the material will bleach out and assume a similar appearance over time.

The Atlantic States Marine Fisheries Commission (2002) report on beach nourishment summarized physical changes to nourished beaches, these changes include: more compacted sand, increased shear resistance, altered dry density, change in moisture content, different grain size and shape, silt/clay composition changes, and altered placement of sand grains through the nourished area. Other physical changes can occur from beach bulldozing. Beach nourishment has the potential to alter sedimentology, compaction, and the nature of sands along the primary dunes, since wind typically forms the dunes by transporting the finer faction of beach sediments to build the dune system. Artificially created dunes by mechanical means such as bulldozer may contain sediment that is more poorly sorted and has a higher percentage of coarse sands and gravel-sized particles than naturally formed dunes (Lindquist and Manning, 2001). The dunes on Town Neck Beach have been eroded so they will be mechanically recreated and then planted with dune grass the following growing season. The sand will be pumped onto the beach and then distributed throughout the beach and dunes by a bulldozer. The beach profile will not be steepened as often happens on

bulldozed beaches (ASMFC, 2002), but will be designed to a specific profile (1:10) to mean lower low water and then will be graded by natural processes to obtain equilibrium.

6.2 Biological Environment

6.2.1 No Action Alternative

The No Action Alternative would allow the sediments to continue to build up in shoaled areas within the Cape Cod Canal Federal channel. These shoals form as sand waves and organisms inhabiting the shoal areas would have to cope with disturbances such as sediment resuspension caused by boat traffic and storm event impacts on a regular basis. Also under the No Action Alternative, the town of Sandwich beaches will continue to erode creating additional rocky habitat at the expense of sandy habitat, thereby eliminating the organisms that live in the sandy sediments while attracting those better suited for the rocky environments.

6.2.2 Dredge Sites

Dredging operations from the proposed maintenance dredging are not likely to have a significant impact on the biological resources of the area. Dredging would impact the existing benthic invertebrate community in dredged areas resulting in most sedentary organisms being killed. Most motile organisms, such as crabs and finfish, would likely have the ability to avoid the dredge and move from the area of impact. Recolonization of the dredged areas should take place within a short period of time by organisms in the surrounding areas and from seasonal recruitment. The post-dredging community should closely resemble the existing community since there will be no change in sediment structure. Newell *et al*. (2004) provided a time sequence of recovery of macrofauna in coastal marine deposits in an area of high energy after cessation of dredging activities. Initial colonization of small mobile species and larval recolonization was seen in as little as 7 days, but it took about 100 days for species diversity to be restored within 70-80% of that occurring in surrounding areas. At about 175 days, population density is restored to 60-80% of that in surrounding area. Restoration by growth of individuals or biomass takes about 2 to 3 years. The level of recolonization in the shoal areas of the canal will be dependent on how often dredging activities occur in the area. Frequent periodic dredging may prevent the development of stable long term communities found in the surrounding environments. However, these areas by their very nature are high energy unstable environments and as a result do not promote stable long-term benthic communities regardless of project activities, but a return to current pre-dredging conditions is expected for the canal.

Because the material to be dredged is sand, with extremely low silt content, only a localized area in the vicinity of the dredge site is likely to be impacted by elevated concentrations of suspended sediments, or sedimentation. The effects of increased suspended sediments on fish has been studied for more than 30 years, but currently most of the data concerning fish responses to suspended sediment doses is based on

salmonoid fish and less is known about estuarine fish. In general the concerns with increased suspended sediments include reduced egg and larval survival due to physical damage to the eggs through abrasion or adherence of silt, altered breeding behavior, reduced feeding efficiency, reduced growth rates, and interference with respiration (Bruton, 1985). Originally researchers only looked at the effects of exposure concentration. Newcombe and MacDonald (1991) recognized the importance of duration of exposure as well as concentration of exposure in determining the effects of suspended sediments on fish and invertebrates. Newcombe and Jensen (1996) generated tables where the biological response can be inferred from concentration and duration of suspended sediments. General reviews of the biological effects of suspended sediments on fish and shellfish (Wilber and Clarke, 2001) as well as corals and aquatic plants (Berry *et al*., 2003) have also been completed. After consolidating the available information, generalizations are difficult to make because biological response to increased suspended sediments varies with species and sediment characteristics.

In general for non-salmonid estuarine fish, the eggs and larvae exhibit some of the most sensitive responses to suspended sediment exposures for all taxa with available data (Wilber and Clarke, 2001). Durations of egg exposure would differ depending on the egg form; demersal adhesive eggs would have longer exposure to sediment plumes caused by dredging than semi-buoyant or pelagic eggs. Atlantic herring eggs were found to have earlier hatching and shorter hatching lengths when exposed to high concentrations of suspended sediments (Messieh *et al*., 1981). Behaviors of fish when exposed to increased levels of suspended sediments varied due to different foraging strategies for different species. Colby and Hoss (2004) found that prey availability interacts with total suspended sediment concentrations to affect fish feeding success on a species by species basis. See Wilber and Clarke (2001) for more details of sublethal and lethal effects from suspended sediments.

Finfish also have the ability to leave the area of disturbance. It is also expected that any larger motile organisms will temporarily move away from the area. The anadromous fish, alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), called river herring migrate upstream to spawn during the late winter through spring. The Bourndale Herring Run provides safe passage for the river herring between the Cape Cod Canal in Bourne, MA and Great Herring Pond in Bourne and Plymouth, MA. In order to minimize any potential impacts to fish using this herring run, dredging will not occur within 500 yards of the mouth of the Herring River, formerly known as the Monument River, between March 15 and July 30, the time of highest migration.

Submerged aquatic vegetation (SAV) can be impacted by suspended sediments due to the changes in underwater light penetration needed for photosynthesis. These effects may be difficult to separate from those associated with deposition of the sediments on the SAV (Germano and Cary, 2005). Although eelgrass does grow in the area of the Hog Island section of the channel (Buzzards Bay side of the canal), the eelgrass is approximately 100 feet away from the channel and associated side slope according to the MA GIS eelgrass maps. See Figure 6 for State generated map of

eelgrass. Any increase in suspended sediment concentrations resulting from dredging activities will be short-lived and would not alter light penetration over periods long enough to impact photosynthesis.

6.2.3 Placement/Disposal Areas

Placement or disposal of dredged material from the Cape Cod Canal has the potential to cause mortality to the existing benthic invertebrate community through burial by deposited sediments. It is possible that some burrowing organisms may survive these conditions by burrowing through the sediments given sufficient time between disposal events. Studies have shown that organisms such as the nut clam can successfully emerge from 20 inches of burial providing the deposited sediments are similar to the pre-existing sediments (Kranz, 1974). Although some organisms may be killed by direct burial (typically soft-bodied species), the affected area is usually recolonized rapidly through recruitment from adjacent areas. Therefore, any temporary reduction in invertebrate abundance and diversity at the sites would not be considered a significant long-term impact. Benthic organisms are used as a food source for finfish and other invertebrates, therefore short-term localized changes to benthic prey might occur. Turbidity impacts to the water column as a result of disposal activities would be short-lived and not significant given the sandy nature of the material.

6.2.3.1 Cape Cod Canal Disposal Area

The Cape Cod Canal Disposal Site is 1 nautical mile in diameter. Disposal of dredged material at a specified buoy in the disposal site will confine the impacts of disposal to a particular area of the site. Therefore impacts would be limited to a specific area only affecting a limited percentage of the benthic population and fish and other motile invertebrates that feed on the benthos within the disposal site. Sea stars, some scallops, and crabs may be buried by the disposal events along with the polychaetes and other benthos, but some of the motile individuals may be able to escape burial.

Any impacts from localized turbidity and sedimentation as a result of disposal activities would be similar to that at the dredge area. Finfish that cannot avoid the disposal area may be impacted, but most juveniles and adults would be expected to have the ability to move away from any disturbances. Bivalve larvae exposed to high concentrations of suspended sediments for durations of 10 days or more had negative effects, but lower concentrations (actual values depend on the species) resulted in increased growth (Wilber and Clarke, 2001). Adult bivalves are tolerant of suspended sediments, but sublethal effects such as reduced pumping rates and growth can be realized with concentrations seen under natural conditions such as storm related events. Scallops can be found at the CCCDS, but previous sampling did not reveal any evidence of significant aggregations. Scallop eggs are demersal and cling to the bottom sediments (heavier than seawater) and as a result may be impacted by burial. The larvae are planktonic (float in the water column), so they could be negatively impacted by abrasion during disposal events. Young juvenile scallops attach themselves to shells and bottom debris by byssal threads, any young juveniles in the area of disposal may

be buried. Older juveniles and adults can swim and therefore have the potential to leave the area of impact before burial. While no aggregations of scallops have been found during the USACE sampling, areas of CCCDS may be used by scallop fishermen, but no specific area has been identified (pers. com. Massachusetts Division of Marine Fisheries, Vincent Malkoski). Disposal events could be placed to avoid direct burial of any scallop beds if they are identified. Scallop dredging itself has a negative impact on the benthic environment similar to that of maintenance dredging (Thrush *et al*., 1995)

The impacts from suspended sediments have not been studied as intensively in crustaceans as fish and bivalves, but those tested exhibited detrimental responses only at dosages of suspended sediments that would be much higher than those expected from dredging projects (Wilber and Clarke, 2001).

6.2.3.2 Town Neck Beach Placement Site

Benthic organisms living in the sediments of the beach or the nearshore areas may be impacted during the placement process by being buried by the addition of sand. Settling of suspended sediments may indirectly impact any benthic organisms in adjacent areas. Benthic organisms inhabiting intertidal and surf zone areas are well adapted to and tolerant of considerable changes in their environment (Naqvi and Pullen, 1982). Mobile organisms living on the surface sediments would be displaced. As the beach has been eroding rapidly the past few years and changing from sand to gravel, the benthic habitat is already in a state of disturbance. However, once the placement activities are completed, the area would be recolonized in a short time by recruitment of opportunistic species and by organisms living in adjacent areas.

Within the intertidal area approximately 5.0 acres of rocky habitat will be covered by sand to some extent. Currently the rocky substrate provides crevices for organisms to hide and attachment sites for macroalgae, encrusting algae and sponges, barnacles, and other invertebrates. These organisms provide a food source for terrestrial animals at low tide and fish at high tide. Much of the macroalgae (*Fucus*) is found on the larger rocks so some of habitat created by this plant should survive after the sand placement. As the placed sand is expected to erode over the years following placement, the rocks will once again provide surface for attachment and crevices for hiding as the surrounding sand is transported to another area.

The nearshore environment is more stable than the surf zone or intertidal areas of the beach and typically supports higher abundances of benthic organisms (Vesar, 2004). Impacts to the sandy nearshore environment adjacent to Town Neck Beach will also be temporary and short-term. The material will be transported out into the nearshore environment by wave and current action allowing for a more gradual accumulation of sediments and greater potential for organism to borrow through the sediments. As with the intertidal areas, localized minimally elevated concentrations of suspended sediments are anticipated from the project. The patches of sandy material between the rocks provides habitat for infauna that serves as a food source for larger invertebrates and fish. Rocky habitat is also present within the nearshore environment. The addition of sand has the potential to cover some of the smaller rocks and decrease

or eliminate crevice hiding places as sand fills the space between rocks. The areas that have been rocky before the large increase in erosion rates will most likely return to a rocky habitat more rapidly than other areas due to the physical nature of the area. The return of the full resource use may take longer.

Most fish are quite tolerant of short-term exposure to elevated suspended sediment levels (see Stern and Stickle, 1978). Adult finfish can leave the area of disturbance. Recolonization by benthic species from adjacent areas and new recruitment is expected to occur in a relatively short period of time with no long-term negative impacts. Therefore, any temporary reduction in invertebrate abundance and diversity in the nearshore habitat adjacent to the beach is not considered to be significant. Benthic organisms are used as a food source for finfish and other invertebrates, therefore short-term localized changes to benthic prey might occur.

No deleterious impacts to intertidal or nearshore assemblages were identified in beach re-nourishment monitoring studies in New Jersey (USACE, 2001) or North Carolina (Versar, 2004) for sandy areas. Overall beach re-nourishment resulted in short-term declines in abundance, biomass and taxa richness. The response of surf zone fish has been localized attraction (northern Kingfish) or avoidance (bluefish) when pumping sand onto a beach (USACE, 2001) due to the increase in suspended sediments. The highly mobile nature of the fish community constrained the ability to detect impacts and recovery (Versar, 2004), but indicated the fish could move in and out of the areas impacted by re-nourishment activities. As this project will replace some rocky habitat with sandy habitat, there will be a shift of biota in these areas.

Fish such as juvenile Atlantic cod that use rocky substrate with vegetation could be negatively impacted by modifications to these habitats, if they use the intertidal areas. The Massachusetts Department of Marine Fisheries sampled the spatial distribution of age 0 and 1 Atlantic cod from 1978 through 1999. They collected the cod north and south of the project area but their sampling methods restricted access to the shallow depths, the <30 feet samples had a minimum depth of 16 feet and a mean depth of 27 feet (Howe *et al*., 2002). There is no data on the minimum depth for juvenile cod in Cape Cod Bay. In nearshore environments juvenile age 0 Atlantic cod feed on zooplankton by day and disperse to the bottom for more protective covering at the night and become less active (Grant and Brown, 1998a) showing diurnal activity. Grant and Brown (1998b) found age 0 cod to be localized and not moving more than a few hundred meters within shallow nearshore environments for several weeks after settling from a pelagic habitat and may remain localized during their first winter. Methven and Schneider (1998) found 4-7 meters to be the depth center of distribution for age 0 cod. Juvenile age 1 cod become more nocturnal with feeding on the benthos at night (Grant and Brown, 1998a). Habitat use of structurally complex bottoms containing seagrass, macroalgae, rocks and cobbles tend to be positively correlated with survival for young juvenile Atlantic cod (Tupper and Boutilier, 1995). At night age 0 cod disperse and cease foraging due to increased shoreward movement of 1 to 3 year old juvenile Atlantic cod. Juvenile cod were found to be capable of assessing the risk a predator represents and adjust their response accordingly (Gotceitas *et al*., 1995; Ryan *et al*., 2012). See Appendix F for more details on Atlantic cod.

Within the project areas there is limited eelgrass habitat that would provide any cover for juvenile cod and this eelgrass would not be directly impacted by the project, but sand may move through the area as the beach equilibrates. This project will temporarily decrease the amount of intertidal rock in the area and therefore, it will decrease potentially available hiding habitat for juvenile cod. As this habitat is not always available for the young juveniles to utilize as they seek shelter there must be suitable subtidal habitat available otherwise they would not be able to survive in the area. The literature refers to shallow habitat for resting not necessarily intertidal habitat.

Recovery of the intertidal or nearshore environments usually occurs in two to seven months (Nelson, 1993; USACE, 2001). Recovery takes longer if sediments do not match those currently on the beach especially if the new material contains silts or clays (ASMFC, 2002). The actual rate of recovery is also affected by the season of disturbance (Reilly and Bellis, 1983; Versar, 2004). Beaches dominated by organisms recruited from pelagic larval stock (e.g. mole crabs and coquina clams) placement impacts could be drastic, but ephemeral (Reilly and Belllis, 1983). If nourishment occurs during recruitment it might inhibit the recruitment effort. Slower recovery is expected from organisms that spend their entire life history (brood eggs and young) on the beach such as with some *Haustorius* species of amphipods (Reilly and Bellis, 1983). Also, monitoring has identified that some reductions in polychaete species were large natural variations in abundances (Vesar, 2004).

The concerns for this project are the change from rock to sand in the intertidal areas, although the areas were predominately sandy in the past before the sand transport to the area was disrupted. Eelgrass has been found to be growing near the western end of the project within the hook of the sand spit, as it is a protected tide pool area that is always submerged (see Figures 4 and 9A). There will be no direct impacts from beach nourishment, but there is the potential for sand to move into the area by local wave action. The subtidal area is much closer to shore on the western end of the project (see Figures 4 and 9) and seaward of the last groin small patches of eelgrass have been observed growing within the sand areas between the rocks. This eelgrass is sparse compared to that found in the tide pool. There will be no direct impacts from placement on the eelgrass in this area, but once again some indirect impacts may occur due to natural movement of the sediments. The sand may provide additional habitat for eelgrass to establish itself as long as the areas remain protected from the wave energy. Currently eelgrass growth is limited by the availability of suitable substrate in the nearshore environment. The far western end of Town Neck Beach near the Canal jetty contains a bed of eelgrass that has been mapped since 1995 and there will be no impacts to this bed from the proposed project.

Any seals in the water or on rocks in the areas adjacent to the project site would not be impacted by the placement of sand on the beach and in the intertidal zone.

6.3 Essential Fish Habitat

6.3.1 No Action Alternative

The No Action Alternative could have an impact on EFH due to a decrease in habitat depth over time. Overall the shoal areas in the canal are limited due to the strong currents, so it is not expected that any large area of EFH would be impacted by the No Action alternative. At the beach placement site, the No Action Alternative would allow for the continued erosion of sand habitat and more exposure of the rocky habitat.

6.3.2 Dredge Areas and Placement/Disposal Sites

The Canal is covered by two 10' by 10' squares of latitude and longitude and the placement/disposal sites are within the same square as the most western end of the canal. The only difference between the squares is that the more western square includes habitat for Atlantic sea herring eggs and juvenile dogfish.

The Essential Fish Habitat Assessment of the areas to be dredged within the Cape Cod Canal and areas to be impacted by placement of dredged sediments on Town Neck Beach has concluded that there will be no significant impacts to Essential Fish Habitat, as defined by the Magnuson-Stevens Fishery Conservation and Management Act and amended by the Sustainable Fisheries Act of 1996, with this project. "Essential fish habitat" is broadly defined to include "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." Impacts to essential fish habitat from this project include temporary increases in turbidity within the water column and the temporary loss of benthic organisms at the points of dredging and disposal. Return of sandy habitats to areas that have eroded and are now rocky. However, this project is not expected to significantly affect any managed species or habitat. There would be a decrease in rocky intertidal habitat for any fish that use the rocks for cover, but as this habitat is not always available to the fish, the adjacent subtidal habitat provide the same coverage and is still within shallow waters.

Appendix F contains the EFH assessment for potential impacts from both dredging and placement/disposal activities from the Cape Cod Canal maintenance dredging project.

6.4 Threatened and Endangered Species and Species of Concern

6.4.1. Marine Mammals

6.4.1.1 Right Whale (Baleana glacialis)

The endangered right whale has generally been found in Cape Cod Bay during the late winter and early spring. All of Cape Cod Bay has been established a critical habitat for the North Atlantic right whale since 1994. This whale has been most frequently sighted from late February through May with months of peak abundance

being March through late April (Coler & Colantonio and Battelle, 1996). In past years, an estimated 25 to 40 right whales, including a few mother/calf pairs and juveniles have entered Cape Cod Bay to feed at some time during the spring (Coler & Colantonio and Battelle, 1996), 199 individuals were recorded as visiting Cape Cod Bay in 2010 (Stamieszkin *et al*., 2010). Generally these whales leave Cape Cod Bay in April and May and move into the Great South Channel east of Cape Cod (Kenney *et al*., 1995). Right whales are surface and subsurface feeders skimming copepods and euphausids (small crustaceans) from the water column. Calanoid copepods, specifically *Calanus finmarchicus*, have been found to be one of the primary zooplankton forms consumed by the right whale. These can occur in dense swarms in the waters of Cape Cod Bay in the spring (Mayo and Marx, 1990). Generally right whales move out of the area in the spring, but in years when zooplankton is abundant, some right whales (in particular mother/calf pairs) may remain in the bay for the entire summer.

The Cape Cod Canal Disposal Site which may be used for the proposed dredging project is located only 3 nautical miles from the east entrance to the Cape Cod Canal. This area is relatively shallow (approximately 70 feet deep) compared to the more central waters of Cape Cod Bay (90 - 120 feet deep). Right whales in Cape Cod Bay have generally been found to be most abundant in eastern Cape Cod Bay, particularly south and southeast of Race Point (Coler & Colantonio and Battelle, 1996 and Stamieszkin *et al*., 2010). These data indicated very few right whale sightings in the proximity of the Cape Cod Canal and the Cape Cod Canal Disposal Site. A right whale may occasionally swim through the canal; on December 3, 2008 the canal was closed to maritime traffic for about 2½ hours as a whale swam from Cape Cod Bay to Buzzards Bay.

Based upon the above information, it is not likely that these mammals will appear in Cape Cod Bay in the vicinity of the dredge or disposal/placement areas, but during the late winter the possibility of right whales being in the vicinity of the disposal area is greater. Although the possibility of vessel interactions with resulting strikes that could injure or kill these mammals is low, during previous coordination, NMFS has requested that a qualified endangered species observer will be present aboard the disposal vessel(s) during daylight hours during the period from January 1 to May 31 of any year if the material is to be placed at CCCDS. Also, vessels operating between the Cape Cod Canal and the CCCDS during this time (January 1 - May 31) should not operate at speeds in excess of 5 knots after sunset, before sunrise, or in daylight conditions where visibility is less than one nautical mile. Also, NMFS has previously requested that the Corps adhere to all other requirements included in the special permit conditions developed between NMFS and the Corps for disposal at Massachusetts Bay Disposal Site.

The proposed dredging of the canal will include the removal of approximately 150,000 cubic yards of material. The material will be placed on Town Neck Beach or at the Cape Cod Canal Disposal Site. This material is primarily sand and gravel, with very little fines and as a result has been determined to be suitable for beach and open water disposal. Sandy material is generally not associated with high levels of organic carbon, and dredging of sandy material is not likely to result in the release of nutrients or

decreases in dissolved oxygen. Sand rapidly settles out of the water column and any effects on turbidity will be temporary and minimal.

If the material is placed on Town Neck Beach the sand would be placed within the dunes seaward into the intertidal zone. Any turbidity impacts to the intertidal and adjacent subtidal areas will occur in waters too shallow to have an impact on right whales or their foraging habitat.

The whales feed on zooplankton which inhabits the water column. The dredge material is sandy and will rapidly settle out to the bottom during disposal activities creating only a temporary water column impact. The Endangered Species Act Section 4(b)(2) Report for Critical Habitat for the North Atlantic Right Whale (NMFS, 2014) describes the effects from the discharge of dredge material in the open water as likely to be ephermeral since the currents would rapidly disperse sediment plumes at depths where the essential foraging features are not present. Therefore the cumulative effect of disposal of clean sand into right whale habitat should not have any adverse effects on right whale zooplankton food source or critical habitat.

In addition, during the times of anticipated right whale activity the Corps will adhere to the previously noted conditions. Therefore, if right whales occur in Cape Cod Bay during the project, the activity is not likely to adversely affect the species or critical habitat of the species, including the food source.

There is currently a proposal to expand the North Atlantic right whale critical habitat to include a larger area, but Cape Cod Bay will still be included with this critical habitat. The proposed project will not jeopardize the continued existence of the proposed species or result in the destruction or adverse modification of the proposed critical habitat.

In conclusion, the proposed maintenance dredging/disposal operations for the Cape Cod Canal is not likely to adversely affect the right whale or its critical habitat in Cape Cod Bay when adhering to the above specified conditions.

6.4.1.2 Humpback Whales (Megaptera novaeangliae)

Humpback whales enter New England waters every year to feed on small schooling fish, such as sand lance, capelin, herring, and mackerel (Volgenau and Kraus, 1992). Generally they are present in New England waters from April to November each year with peak abundance in May and June. They are most frequently observed in northern Cape Cod Bay in April and May. However, they have been known to occasionally feed throughout Cape Cod Bay when large schools of small schooling fish are present (Coler & Colantonio and Battelle, 1996). They are rarely observed in southern and western Cape Cod Bay including the areas through which dredged material transits to reach the disposal site (Coler & Colantonio and Battelle, 1996). Given the imposed vessel operational requirements for the right whale that will be adhered to, and the rarity with which this species occurs in the area of the dredge and

disposal sites, it is expected that the project operations will not likely affect the humpback whale or its habitat.

6.4.1.3 Fin Whales (Balaenoptera physalus)

Fin whales are more abundant in the western North Atlantic Ocean than right or humpback whales, but they are sighted rarely in any season in central and southern Cape Cod Bay (Coler & Colantonio and Battelle, 1996). Therefore, it is anticipated that neither the dredging nor the disposal operations will likely affect the fin whale or its habitat.

6.4.1.4 Sei Whale (Balaenoptera borealis)

Sei whales have been infrequently observed in Cape Cod Bay. Sei whales are usually found in deeper waters than those in the Cape Cod Bay, but have been observed feeding in the Stellwagen Banks area. Since it is rare that the sei whale is found in the project areas, it would be unlikely that dredging or disposal operations will affect this species or its habitat. Also as noted previously, a trained observer will be on board the vessel if transiting in Cape Cod Bay in order to prevent possible encounters with any whales.

6.4.2 Sea Turtles

The federally endangered leatherback turtle (*Dermochelys coriacea*) and the threatened Kemp's ridley turtle (*Lepidochely's kempi*), loggerhead turtle (*Carretta carretta*) and green sea turtle (*Chelonia mydas*) have been noted in Cape Cod Bay and Buzzards Bay. No turtles are anticipated to be affected by placement of sand on the beach and in the intertidal zone. They can avoid any disturbance cause by the placement activities if present in the general area.

6.4.2.1 Kemp's Ridley Turtle (Lepidochelys kempi)

This endangered reptile is known to inhabit Cape Cod Bay in late summer and fall and possibly Buzzards Bay. The adults reside in the Gulf of Mexico and are known to breed only on the southern coast of Tamaulipas, Mexico. The juveniles (25 to 30 cm) appear to actively swim or drift with the Gulf Stream to find forage areas in the estuarine marshes of southern New England. Each fall a few juvenile *Lepidochelys kempi* are discovered stranded along the Cape Cod Bay shoreline. A possible explanation may be correlated to an attempt at a southerly migration as water temperatures cool. If the turtles' presence in the bay is a result of passive movements through the canal or via the Gulf Stream, the migratory stimulus may encourage active southerly movements that would entrap the turtle against the north shore of Cape Cod. It is also thought that this stranding could be the result of cold stunning (NOAA, 1991: from Coler & Colantonio and Battelle, 1996). If water temperature drops too rapidly, the metabolic rate of these turtles may slow to the point where both swimming and digestion cannot

function. The animal will then become comatose and death will occur if not warmed quickly (Coler & Colantonio and Battelle, 1996).

The disposal of sandy dredged material may impact various benthic organisms that are a food source for Ridley turtles; especially shellfish (*Cancer borealis, Cancer irroatus, Homarus americanus, Placopectens magellanicus, Mytilus edulis* and *Modiolus modiolus*) that have been identified in the CCCDS area. The deposition of clean sand does not exert a significant impact on this disposal site except for the burial of some benthic species. This loss in benthic productivity is spatially and temporally limited to the site and frequency of disposal. Recolonization of the benthic species would be expected to occur from larval recruitment within a few months and nearby surrounding areas would not be impacted by the disposal events.

The primary forage area of Kemp's ridley sea turtles is theorized to be nearshore bottom areas with dense aggregations of shellfish, particularly mussel beds. The biological community of the CCCDS contains low densities of turtle prey items, and therefore is not anticipated to be a significant forage area for *Lepidochelys kempi*.

Much of the human induced mortality of the Kemp's ridley turtle is the result of entanglement in fishing gear, primarily shrimp nets (National Research Council, 1990). Lobster gear and pound nets can also cause death when Kemp's ridley turtles (being benthic feeders) become entangled in them as well as other miscellaneous bottom debris. It is therefore expected that disposal of clean sand/gravel which does not contain debris will not pose a significant hazard to the Kemp's ridley turtle.

In conclusion, the proposed maintenance dredging with disposal at the CCCDS is not likely to adversely affect the Kemp's ridley turtle.

While no turtles are expected to be impacted by beach nourishment, if any cold stun turtles are found in the surf or on the Town Neck Beach they would most likely be Kemp ridley turtles. If any turtles are sighted the contractors will contact the Wellfleet Bay Wildlife Sanctuary.

6.4.2.2 Loggerhead Turtle (Caretta caretta)

The loggerhead turtle is a threatened marine reptile that is sporadically encountered in Cape Cod Bay and Buzzards Bay. The spring and summer nesting habitats of adults are generally south of Cape Hatteras. Juveniles migrate northward in early summer to forage on the Continental Shelf. Cape Cod would be considered the most northerly expanse of their habitat. When water temperature falls to 10-15°C cold stunning or dormancy may occur. To avoid these temperatures the organisms may be induced to migrate south. The occasional loggerhead which has found itself (actively or passively) transported into Cape Cod Bay may become trapped against the north shore of Cape Cod and stranded.

The loggerhead turtles feed in deep water areas on crabs, molluscs and sponges generally found around wrecks, underwater structures and reefs. Conceivably the Cape Cod Canal Disposal Site could provide a forage area for this species. Sponges (*Surerites ficus, Cliona celata*); mollusks (*Lunatia heros*, *Placopecten magellanicus*, *Modiolus modiolus*) and crustaceans (*Cancer irroratus*, *Cancer borealis*, *Mysis mixta*, *Pagurus acadianus* and *Homarus americanus* are known to inhabit this disposal site. The disposal of dredged material at CCCDS may impact a temporally and spatially limited forage area for this species, but faunal recruitment will reestablish the food source. Forage areas similar to this site are not unique or limited in the bay. Loggerhead turtles seek areas of greater relief (wrecks, rock ledge, etc.) that attract higher densities of prey organisms than flat sandy disposal areas. Loggerhead turtles could forage in the CCCDS, but this is not a known forage area for these sea turtles.

In conclusion, the proposed disposal of dredged material at the Cape Cod Canal Disposal Site is not likely to adversely affect this species. Although an insignificant component of a possible forage area for a few individuals may be impacted, this action is not likely to adversely affect the loggerhead sea turtle.

6.4.2.3 Leatherback (Dermochelys coriacea)

The Federally endangered leatherback turtle is the second most common sea turtle along the eastern seaboard of the United States and is the most common sea turtle north of the 42ºN latitude. Leatherbacks forage in temperate and subpolar waters and nest on tropical beaches. They have a layer of subcutaneous fat and circulatory adaptations to reduce the rate of heat loss through their flippers (Greer *et al*., 1973), thus allowing them to survive and feed in colder temperate waters than other sea turtles.

Leatherback turtles are a largely pelagic, open ocean species. Adult leatherback turtles are common during the summer months in North Atlantic waters from Florida to Massachusetts (Goff and Lien, 1988). New England and Long Island Sound waters support the largest populations on the Atlantic coast during the summer and early fall (Lazell, 1980; Prescott, 1988; Shoop and Kenney, 1992). During the summer, leatherbacks move into fairly shallow coastal waters (but rarely into bays), apparently following their preferred jellyfish prey. In the fall, they move offshore and begin their migration south to the winter breeding grounds in the Caribbean (Payne *et al*., 1984).

In conclusion, the proposed disposal of dredged material at the CCCDS is not likely to adversely affect this species. Based on the low frequency of occurrence and the fact that leatherback sea turtles don't feed on the benthos that may be impacted by disposal activities, this action is not likely to adversely affect this species.

6.4.2.4 Green Turtle (Chelonia mydas)

The green turtle is the largest of the hard-shelled sea turtles. The species is distributed throughout the Caribbean Sea, the Gulf of Mexico, and in the western North

Atlantic from Florida to Massachusetts. Primary nesting sites are on the east coast of Florida. The number of nesting females in Florida is estimated at between 200 and 1,100 individuals. Current population trends are unavailable. However, since 1980, the number of green turtles nesting each year and the total population of green turtles in Florida waters appear to have increased gradually (Thompson, 1988; Steinback *et al*., 1999).

During the summer, small numbers of green turtles venture as far north as New England. Green turtles are herbivorous as adults and feed in shallow coastal waters on sea grasses and marine algae. Some green turtles become cold-stunned each year by falling water temperatures in the fall and winter, especially in northern waters (Morreale and Standora, 1992). Green turtles occasionally strand on Cape Cod beaches. Natural and anthropogenic disturbances affect green turtles at their nesting locations and in offshore waters. Nesting habitat is lost to erosion, shoreline fortification, and beach renourishment. Green turtles are also susceptible to entanglement in shrimp trawls and in other fishing gear. They also frequently ingest and become entangled in marine debris or may collide with vessels.

In conclusion, the potential does exist for a transient green turtle to cross the path of disposal operations. However, since they feed primarily in shallow areas, green turtles would not likely be found using the disposal sites as a feeding ground. While they feed in shallow areas, they should be able to avoid any disturbances associated with the placement of sand on Town Neck Beach. Dredging and disposal activities are not anticipated to adversely affect any Green sea turtles.

6.4.3 Fish

6.4.3.1 Atlantic Sturgeon (Acipenser oxyrinchus)

Atlantic sturgeon from any of the five Distinct Population Segments (DPS), (Gulf of Maine DPS is listed as threatened other four DPSs are listed as endangered), may be present in the project area. After emigration from the natal estuary, subadult and adult Atlantic sturgeon forage within the marine environment, typically in waters less than 50 meters depth (ASSRT, 2007). Atlantic sturgeons may be occasional visitors to the project area, most likely while making coastal migrations or while foraging for benthic invertebrates and small fish such as sand lance. In bays and harbors foraging often occurs at or near areas with submerged vegetation or shellfish resources. The project area does not provide suitable habitat for overwintering; so the presence of Atlantic sturgeon is likely limited to the warmer months. The nearest spawning rivers are the Kennebec River, Maine and the Hudson River, New York, so no eggs, larvae or juvenile Atlantic sturgeon are likely to occur in the project area.

The Cape Cod Canal is associated with high currents so it is not likely that the sturgeons would be foraging within the canal and the canal is not expected to be dredged during the warmer months, therefore no impingement or entrainment of Atlantic sturgeon are anticipated from dredging activities. The majority of placement of the material on Town Neck Beach would be above the mean lower low water and any

increases in turbidity would be localized and temporary, therefore we do not anticipate any impacts to Atlantic sturgeon foraging. Atlantic sturgeon may be feeding and/migrating through the Cape Cod Bay. Any vessel transiting to the CCCDS would be traveling at low speeds so a vessel strike to a sturgeon is unlikely. There is nothing about the CCCDS that would attract the sturgeons to the disposal site as compared to any other area so it is unlikely that a sturgeon would be feeding in the area directly under a scow that is about to release dredged material, therefore this project is not likely to affect any Atlantic sturgeons.

6.4.4 Birds

6.4.4.1 Roseate Tern (Sterna dougallii)

The roseate tern is a worldwide species that breeds in two discrete areas in North America, the northeastern population breeds along the Atlantic coast of the United States from North Carolina to Maine. Bird Island in Buzzards Bay is a known nesting location during the period of April 15th to September 15th. The terns forage throughout Buzzards Bay and the entrance to the Canal. Roseate terns are specialized feeders which prey on small schooling marine fish. The fish are caught by plunging vertically into the water and seizing them with their bills or by surface-dipping and contact-dipping (US FWS, 1998). In Massachusetts, the roseates feed primarily on American sand lance and clupeids such as Atlantic herring, or blueback herring, mackerel, small bluefish or anchovies. They feed in specialized situations over shallow sandbars shoals, tidal inlets or by following schools of predatory fish which drive smaller prey fish to the surface (C. S. Mostello, 2007). Roseate terns tend to return regularly to the same fishing areas, sometimes as far as 25 kilometers from the breeding colony.

The birds are not likely to be in the area during the proposed dredging activities, but even if they were, the dredge areas are relatively small especially in the areas of concern (Mashnee Flats). The material to be dredged is clean sand and gravel which will settle out rapidly in close proximity to the dredging areas and at the placement/disposal areas. In addition, the zones of impact are in relatively deep water and small when compared to the overall wide range of foraging habitat available to the roseate terns. Also no dredging will occur outside the Federally-designated navigation channel so there should be no direct impact to the nearby foraging areas. The proposed work will have minimal or no adverse impacts on the foraging behavior and success of the roseate terns.

6.4.4.2 Piping Plover (Charadrius melodus)

The piping plover is a federally listed threatened species that nests in open, sandy beaches with flat slopes close to the dunes. Piping plovers return to their breeding grounds in late March and early April and the nesting season may extend into late August although individual pairs may fledge young as early as July. Piping plovers are known to nest on Sandwich beaches, specifically the eastern end of Town Neck Beach seaward of the marsh area and along Spring Hill Beach.

Atlantic Coast plovers nest on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Breeding plovers feed on exposed wet sand in wash zones; intertidal ocean beach; wrack lines; washover passes; mud-, sand-, and algal flats; and shorelines of streams, ephemeral ponds, lagoons, and salt marshes by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening. Small sand dunes, debris, and sparse vegetation within adjacent beaches provide shelter from wind and extreme temperatures.

Although the piping plovers do not currently nest on the section of Town Neck Beach proposed for sand placement, the larger sandy beach might attract them. No placement of dredged material will occur during the nesting season of April 1 through August 31 to avoid any impacts to nesting birds or their young in the area. Also the town of Sandwich will work with Massachusetts Audubon Society to monitor any nesting plovers on the beach.

6.4.4.3 Red Knot (Calidris canutus rufa)

The US Fish and Wildlife Service lists the rufa red knot as threatened under the Endangered Species Act. The red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the southeast United States, the northwest Gulf of Mexico, northern Brazil and Tierra del Fuego at the southern tip of South America travelling up to 19,000 miles. During both the northbound (spring) and southbound (fall) migrations, groups of a few individuals to thousands of knots can be found anywhere along the coastal and inland U.S. migration corridors from Argentina to Canada. In the spring, key staging and stopover areas to rest and feed in suitable habitats include Patagonia, Argentina; eastern and northern Brazil; the southeast United States; the Virginia barrier islands; and Delaware Bay. In the fall, key migration stopovers include Hudson Bay, James Bay, St. Lawrence River, Mingan Archipelago and Bay of Fundy in Canada; Massachusetts and New Jersey coasts; Altamaha River in Georgia; the Caribbean; and the northern coast of South America from Brazil to Guyana.

A migrating the red knot could stop to feed in the nearby intertidal areas of Sandwich Harbor marsh or on the western side of the Cape Cod Canal, but there are no appearances recorded in ebird (www.ebird.org). During northward migrations individual birds are found in Massachusetts in late May and June. Southward migrations red knots appear on the Atlantic Coast of the U.S., especially at Cape Cod and mainland areas of Massachusetts late July and the numbers of adults increase steadily until early August. Monomoy National Wildlife Refuge is a known molting site of the birds and they can be found in the area through October (Niles *et al*., 2012). Dredging and placement of dredged material on Sandwich beaches would not occur between April 1 and August 31 to protect the nesting piping plovers, therefore there would be no impacts to migrating red knot from the proposed project.

6.4.4.4 Least Tern (Sterna antillarum)

The least tern is a Massachusetts State species of special concern. It breeds along coastal and freshwater habitats of North America from Maine to Florida. Least terns nest in dry, exposed unvegetated areas on sandbars, or beaches in areas between the drift line and upland on a mix of sand, pebbles, shells and fine grained sand. The Massachusetts Audubon Society's Coastal Waterbird Program monitors the birds along Sandwich beaches. The least terns nest on the eastern end of the Town Neck Beach adjacent to the channel at Sandwich Harbor Inlet.

No placement of dredged material will occur during the nesting season of May through August 31 to avoid any impacts to nesting piping plovers or their young which will also protect any least terns on the beach.

6.5 Historical and Archaeological Resources

6.5.1 No Action Alternative

There would be no impacts to any historical or archaeological resources if the Cape Cod Canal was not dredged.

6.5.2 Dredge and Placement/Disposal Areas

The maintenance dredging of portions of the Cape Cod Canal channel and basins will have no effect on historic properties as dredging will be confined to previously dredged areas.

The disposal of dredged material at the Cape Cod Canal Disposal site will have no effect on historic properties as this area was previously used for the disposal of dredged material.

Town Neck Beach has a severe erosion problem. It has been re-nourished in the past by the town. Placement of sand from the maintenance dredging of the Cape Cod Canal should have no effect on historic properties as it will have a protective effect on the bluffs and will temporarily stop the current erosion of the beach.

The Massachusetts State Historic Preservation Officer, the Massachusetts Board of Underwater Archaeological Resources and the THPO of the Wampanoag Tribe of Gay Head Aquinnah concurred with these determinations (see Appendix A, letters dated April 1, 2015, Feb 3, 2015, and September 16, 2014 respectively). Concurrence was assumed due to lack of response from the Mashpee Tribal Historic Preservation Officer (THPO).

6.6 Socioeconomic Environment

6.6.1 No Action Alternative

The No Action Alternative would not be beneficial to the area because further shoaling in the Canal, may cause some of the deep draft vessels to have to completely avoid the Canal and transit around Cape Cod. The reduction in available depth is significant and has the potential to cause tidal delays for some of the deep draft commercial vessels transiting the Canal. Transiting around Cape Cod would significantly increase the risk profile of these vessels, especially during the winter months and may have adverse economic impacts on the cost of products being delivered to and from the northeast region.

Without dredging the town of Sandwich needs to find an alternative sand source to renourish the dunes and beach. The dunes and beach help to protect the homes from storm damage and they have eroded to a point that each additional storm is a concern for these homeowners.

6.6.2 Dredge and Placement/Disposal Areas

The overall effect of the maintenance dredging project will be beneficial as it will accommodate the deep draft vessel traffic through the canal. This would alleviate any additional costs associated with the tidal delays or the need to circumvent the canal. Placement of the dredged material on Town Neck Beach would provide needed sediment for the renourishment of the beach to protect nearby homes from storm damage. The erosion of the beach is affecting the dunes located seaward of the homes and currently many of the homes are vulnerable to impacts from storm events. The placement of sand will provide some protection until a long-term solution to the lack of sand transport to the area is identified.

7.0 AIR QUALITY STATEMENT OF CONFORMITY REQUIRMENTS

U.S. Army Corps of Engineers guidance on air quality compliance is summarized in Appendix C of the Corps Planning Guidance Notebook (ER1105-2-100, Appendix C, Section C-7, pg. C-47). Section 176 (c) of the Clean Air Act (CAA) requires that Federal agencies assure that their activities are in conformance with Federally-approved CAA state implementation plans for geographic areas designated as non-attainment and maintenance areas under the CAA. The EPA General Conformity Rule to implement Section 176 (c) is found at 40 CFR Part 93.

Clean Air Act compliance, specifically with EPA's General Conformity Rule, requires that all Federal agencies, including Department of the Army, review new actions and decide whether the actions would worsen an existing violation of National Ambient Air Quality Standards (NAAQS), cause a new NAAQS violation, delay the State Implementation Plan (SIP) attainment schedule of the NAAQS, or otherwise contradict the State's SIP.

The State of Massachusetts is authorized by the EPA to administer its own air emissions permit program, which is shaped by its SIP. The SIP sets the basic strategies for implementation, maintenance, and enforcement of the National Ambient Air Quality Standards (NAAQS). The SIP is the federally enforceable plan that identifies how that state will attain and/or maintain the primary and secondary National Ambient Air Quality Standards (NAAQS) established by the EPA (U.S. Environmental Protection Agency, 2014). In Massachusetts, Federal actions must conform to the Massachusetts state implementation plan or Federal implementation plan. For non-exempt activities, the USACE must evaluate and determine if the proposed action (construction and operation) will generate air pollution emissions that aggravate a non-attainment problem or jeopardize the maintenance status of the area for ozone. When the total direct and indirect emissions caused by the operation of the Federal action/facility are less than threshold levels established in the rule (40 C.F.R. § 93.153), a Record of Non-applicability (RONA) is prepared and signed by the facility environmental coordinator.

7.1 General Conformity

The general conformity rule was designed to ensure that Federal actions do not impede local efforts to control air pollution. It is called a conformity rule because Federal agencies are required to demonstrate that their actions "conform with" (i.e., do not undermine) the approved SIP for their geographic area. However, this maintenance dredging project is exempt from performing a conformity review based on 40 CFR 93.153(c)(2) which states: "*The following actions which would result in no emissions increase or an increase in emissions that is clearly de minimis:* (ix) *Maintenance dredging and debris disposal where no new depths are required, applicable permits are secured, and disposal will be at an approved disposal site."*

8.0 ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" require federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its program, policies, and activities on minority and low-income populations in the U.S., including Native Americans. The proposed action will not have any disproportionately high or adverse impacts on minority or low-income populations, or any adverse short or long-term environmental justice impacts because the proposed action will be dredging a Federal channel located in the waters of Cape Cod Canal in Bourne and Sandwich, MA, with placement of the dredged material on a local beach in Sandwich, MA or disposed of at an open water site, the CCCDS in Cape Cod Bay. There are no environmental justice populations located in these areas.

Executive Order 13045, "Protection of Children From Environmental Health Risks and Safety Risks," requires federal agencies to identify and assess environmental

health risks and safety risks that may disproportionately affect children. The proposed action will not pose any significant or adverse short or long-term health and safety risks to children because the dredging will take place in waters of the Cape Cod Canal and the placement of clean sand will be on a local beach.

9.0 CUMULATIVE IMPACTS

Cumulative impacts are those resulting from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. Past and current activities in Cape Cod Canal include the maintenance dredging of the Federal channel and mooring basins, maintenance of the breakwaters, navigation through the channel, and recreational activities in the Canal. Reasonably foreseeable future actions include the continuation of the abovementioned activities. The effects of these previous, existing and future actions are generally limited to infrequent disturbances of the benthic communities in the dredged areas. Water quality, air quality, hydrology, and other biological resources are generally not significantly affected by these actions.

Cumulative impacts associated with placement/disposal of dredged material from the Cape Cod Canal at either Town Neck Beach or the CCCDS include burial of benthic organisms. The recovery time needed to establish a stable long term community in the area would be dependent on how often disposal actions occur. Town Neck Beach has areas of intertidal rock that have been exposed due to erosion and some of these areas will be buried by sand and even after the sand is eroded the habitat will not be fully functional until recruitment and growth of algae and epibenthic organisms. Any long-term solution to the lack of sediment transport along Town Neck Beach would negatively impact this habitat, but the project as proposed is only anticipated to cause a temporary impact to the rocky habitat as the sand is expected to erode from the area once again. Areas of CCCDS may be used by scallop fishermen, but no specific area has been identified. Disposal activities have the potential to bury some scallops, but would cause no additional overall impacts to the environment beyond what would be caused by the fishery.

Overall, at the dredged and placement/disposal areas, the direct effects of this project are not anticipated to add to negative impacts from other actions in the area. In the past thirty years the time period between individual maintenance dredging efforts has been two to nine years. The same level of effort is expected for future maintenance projects and it is expected that future dredging projects with disposal at CCCDS will not have a cumulative impact when taken together. Future beach nourishment projects will need to be reviewed as cumulative impacts to the intertidal rocky habitat that may remove some of the functionality of the habitat.

10.0 ACTIONS TAKEN TO MINIMIZE ADVERSE IMPACTS

The following actions would minimize potential adverse impacts associated with this project:

- Actions that will be taken to minimize potential impacts to threatened and endangered species (whales and sea turtles) include an observer on the disposal vessel to CCCDS from January 1 through May 31 and regulated vessel speeds near disposal areas during times of reduced visibility.

- If a hopper dredge is used, there will be no dredging between June and October to protect sea turtles until a formal consultation is conducted with NMFS Protected Resources to confirm the need for this window.

- No placement of sediments on Town Neck Beach will occur from April 1 through August 31 to protect nesting and fledging piping plovers.

- The town of Sandwich will be responsible for the monitoring of piping plovers on Town Neck Beach.

- Efforts will be made to complete dredging in the area of the Mashnee Flats (Onset shoal area) by May 1 (if material is to be disposed of at CCCDS) to protect the foraging habitat of the endangered roseate terns.

- If any cold stunned sea turtles are sighted during construction operations, the Wellfleet Bay Wildlife Sanctuary will be contacted.

- Other actions that will be taken to minimize impacts to wildlife include restrictions so that dredging will not occur within 500 yards of the mouth of the Herring River (Monument River) between March 15 and July 30 to protect the herring run.

11.0 COORDINATION

A Public Notice was released to the public on February 2, 2015 for a 30 day comment period. The following agencies were contacted. Agencies' concerns made known to the US Army Corps of Engineers are addressed in the Environmental Assessment.

FEDERAL

U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
NOAA- Fisheries
Habitat Conservation Division
Protected Resources Division

STATE

Massachusetts Coastal Zone Management Office
Massachusetts Department of Environmental Protection
Division of Wetlands and Waterways Regulations
Massachusetts Historical Commission

TRIBES

Mashpee Wampanoag Tribe
Wampanoag Tribe

LOCAL

Town of Sandwich, Town Manager
Town of Sandwich, Department of Natural Resources
Town of Sandwich, Conservation Commission

During the Public Notice period six letters were received from the general public, two in support of the project and five asking about placing some dredge material on Spring Hill Beach. Based on the coastal processes in the area, both beaches would best be served by the placing the limited amount of dredge material from the canal on Town Neck Beach. Responses to the public and original letters can be found in Appendix A. Comment letters were also received from Massachusetts Division of Fisheries and Wildlife, Massachusetts Division of Marine Fisheries and Mass Audubon.

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13.0 COMPLIANCE WITH ENVIRONMENTAL FEDERAL STATUES AND EXECUTIVE ORDERS

This section describes the Federal laws, regulations and programs that are relevant to the dredging and placement of maintenance material from the Cape Cod Canal Federal Navigation Project in Sandwich and Bourne, Massachusetts.

13.1 Federal Statutes

1. Archaeological Resources Protection Act of 1979, as amended, 16 USC 470 et seq.

Compliance: Issuance of a permit from the Federal land manager to excavate or remove archaeological resources located on public or Indian lands signifies compliance. Not applicable.

2. Preservation of Historic and Archeological Data Act of 1974, as amended, 16 U.S.C. 469 et seq.

Compliance: Project is been coordinated with the State Historic Preservation officer; project is not expected to require mitigation of historic or archaeological resources.

3. American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996.

Compliance: Must ensure access by Native Americans to sacred sites, possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. Not applicable.

4. Clean Air Act, as amended, 42 U.S.C. 7401 et seq.

Compliance: Public notice of the availability of this report to the Environmental Protection Agency is required for compliance pursuant to Section309 of the Clean Air Act. Record of Non Applicability of general conformity rule shows compliance with Section 176(c).

5. Clean Water Act of 1977 (Federal Water Pollution Control Act Amendments of 1972) 33 U.S.C. 1251 et seq.

Compliance: A Section 404(b)(1) Evaluation and Compliance Review have been incorporated into this report. A Water Quality Certification pursuant to Section 401 of the Clean Water Act has been received from the state.

6. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.

Compliance: A CZM consistency determination pursuant to Section 307 of the Coastal Zone Management Act to determine that the proposed project is consistent to the maximum extent possible with the MA Office of Coastal Zone Management program was provided to the State for review and concurrence. Concurrence was received on April 6, 2015.

7. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.

Compliance: Coordination is on going with the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) with the presumption that no formal consultation is required pursuant to Section 7 of the Endangered Species Act.

8. Estuary Protection Act, 16 U.S.C. 1221 et seq.

Compliance: Not applicable. This report is not being submitted to Congress.

9. Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-12 et seq.

Compliance: Public notice of availability of this report to the National Park Service (NPS) and Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

10. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 et seq.

Compliance: Coordination with the USFWS, NMFS, and Massachusetts Department of Marine Fisheries signifies compliance with the Fish and Wildlife Coordination Act.

11. Land and Water Conservation Fund Act of 1965, as amended, 16 U.S.C. 4601-4 et seq.

Compliance: Public notice of the availability of this report to the National Park Service (NPS) and the Office of Statewide Planning relative to the Federal and State comprehensive outdoor recreation plans signifies compliance with this Act.

12. Marine Protection, Research, and Sanctuaries Act of 1971, as amended, 33 U.S.C. 1401 et seq.

Compliance: Not applicable; project does not involve the transportation nor disposal of dredged material in ocean waters pursuant to Sections 102 and 103 of the Act, respectively.

13. National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.

Compliance: Coordination with the State Historic Preservation Office signifies compliance.

14. Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3000-3013, 18 U.S.C. 1170

Compliance: Regulations implementing NAGPRA will be followed if discovery of human remains and/or funerary items occur during implementation of this project.

15. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4321 et seq.

Compliance: Preparation of this Environmental Assessment signifies partial compliance with NEPA. Full compliance shall be noted at the time the Finding of No Significant Impact is signed.

16. Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.

Compliance: No requirements for USACE's projects or programs authorized by Congress. The proposed maintenance dredging has been Congressionally approved under the Continuing Authority program of the Rivers and Harbors Act.

17. Watershed Protection and Flood Prevention Act as amended, 16 U.S.C 1001 et seq.

Compliance: Floodplain impacts must be considered in project planning.

18. Wild and Scenic Rivers Act, as amended, 16 U.S.C 1271 et seq.

Compliance: Not applicable, project area is not a Wild or Scenic River.

19. Magnuson-Stevens Act, as amended, 16 U.S.C. 1801 et seq.

Compliance: Coordination with the National Marine Fisheries Service and preparation of an Essential Fish Habitat (EFH) Assessment signifies compliance with the EFH provisions of the Magnuson-Stevens Act. Response to the EFH conservation recommendation completes EFH compliance.

20*. Coastal Barrier Resources Act, as amended, 16 U.S.C. 3501 et seq*.

Compliance: The proposed placement site of Town Neck Beach is adjacent (just west of) to CBRS Town Neck Unit-14P (10/24/1990). This is an otherwise protected unit that no flood insurance can be issued for this area. Placement of material on the adjacent beach would have no impact on this unit.

13.2 Executive Orders

1. Executive Order 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971.

Compliance: Coordination with the State Historic Preservation Officer signifies compliance.

2. Executive Order 11988, Floodplain Management, 24 May 1977 amended by Executive Order 12148, 20 July 1979.

Compliance: Public notice of the availability of this report or public review fulfills the requirements of Executive Order 11988, Section 2(a) (2).

3. Executive Order 11990, Protection of Wetlands, 24 May 1977.

Compliance: Not applicable; project does not involve nor impact Federal wetlands.

4. Executive Order 12114, Environmental Effects Abroad of Major Federal Actions, 4 January 1979.

Compliance: Not applicable; project is located within the United States.

5. Executive Order 12898, Environmental Justice, 11 February 1994.

Compliance: Not applicable; project is not expected to have a disproportionate impact on minority or low income population, or any other population in the United States.

6. Executive 13007, Accommodation of Sacred Sites, 24 May 1996

Compliance: Not applicable unless on Federal lands, then agencies must accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and avoid adversely affecting the physical integrity of such sacred sites.

7. Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, 21 April 1997.

Compliance: Not applicable; the project would not create a disproportionate environmental health or safety risk for children.

8. *Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.*

Compliance: Consultation with Indian Tribal Governments, where applicable, and consistent with executive memoranda, DoD Indian policy, and Corps Tribal Policy Principals signifies compliance.

13.3 Executive Memorandum

1. Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA, 11 August 1980.

Compliance: Not applicable; project does not involve or impact agricultural lands.

2. White House Memorandum, Government-to-Government Relations with Indian Tribes, 29 April 1994.

Compliance: Consultation with Federally Recognized Indian Tribes, where appropriate, signifies compliance.

FINDING OF NO SIGNIFICANT IMPACT
Cape Cod Canal Maintenance Dredging Project
Buzzards Bay & Cape Cod Bay, Massachusetts

The Cape Cod Canal Federal navigation project provides for an open canal 32 feet deep mean lower low water (MLLW) for a width of 540 feet in the land cut, 500 feet in a straight channel in Buzzards Bay to Wings Neck and 700 feet wide beyond the Wings Neck. The latter portion of the channel, shown on coastal charts as ending in the vicinity of Cleveland Ledge, actually continues about 3,000 feet beyond the lighthouse to deep water. There are two mooring basins: the west mooring basin on the south side near Hog Island about 3,300 feet long, about 350 feet wide and 32 feet deep, and the east mooring basin on the north side of the channel at Sandwich, about 2,500 feet long, about 350 feet wide and 25 feet deep. Currently shoaling has occurred in several areas of the project (specifically the near the south jetty, east mooring basin and adjacent channel, adjacent to both sides of the Sagamore Bridge, and an area by Onset Point) and the controlling depth is now at 30 feet below Mean Lower Low Water. This reduction is substantial and has already caused tidal delays for some of the deep draft commercial vessels moving through the Canal. Shoaling in the east mooring basin limits the available space to moor vessels in emergencies (e.g. icing).

The proposed work involves maintenance dredging and advanced maintenance dredging of approximately 150,000 cubic yards of clean sand and gravel from six shoals within the 32 feet deep channel and the 25 feet deep east mooring basin. In order to extend the time between dredge events, advanced maintenance will be conducted to reduce the sand wave shoals. The East Mooring Basin will be dredged to -32 feet and the depth of the channel will vary from -34 to -38 feet deep MLLW all with an additional 2 feet allowable overdepth. A hydraulic hopper dredge will be used to perform the proposed work. The dredged material will be placed on Town Neck Beach, Sandwich, Massachusetts or disposed of at the previously used open water disposal site, the Cape Cod Canal Disposal Site (CCCDS). Town Neck Beach is located adjacent to the south breakwater of the canal, and the placement will occur on the section of the beach seaward of the houses. The CCCDS is located approximately 3 nautical miles northeast of Cape Cod Canal Buoy #1 in Cape Cod Bay with the coordinates of the center point at 41° 49’ 00” N, 70° 25’ 00”W. The urgency to remove the shoals from the canal for safety concerns with disposal at CCCDS will take precedence over any the beneficial use alternatives of the dredged material (beach nourishment). The possibility of using dredged material from the Cape Cod Canal beneficially as a sand source to replenish eroded areas on Town Neck Beach is highly contingent upon the schedule for completion of the Section 204 study or the town financing the entire cost over the costs to place the material at CCCDS. The proposed work will take approximately three to four months to complete.

Due to the clean nature of the material to be dredged, it is determined that dredging and placement/disposal operations will have no significant long-term adverse impacts upon water quality outside of temporary turbidity and sedimentation localized to

the immediate areas of dredging and placement/disposal activities. The material to be dredged has been determined to be suitable for beach nourishment or open water disposal.

Biological impacts of the proposed work would consist of a temporary loss of benthic community at the dredging and disposal sites. However, these organisms will be replaced by recolonization of species from adjacent areas. If the material is placed on Town Neck Beach some rocky intertidal habitat that has been exposed due to erosion will be covered by sand and the functional habitat will be temporarily lost until the rocks are exposed once again by erosion and there is recruitment of algae and benthic organisms.

I find that based on the evaluation of environmental effects discussed in this document, the decision on this application is not a major federal action significantly affecting the quality of the human environment. Under the Council on Environmental Quality (CEQ) NEPA regulations, "NEPA significance" is a concept dependent upon context and intensity (40 C.F.R. § 1508.27). When considering a site-specific action like the proposed project, significance is measured by the impacts felt at a local scale, as opposed to a regional or nationwide context. The CEQ regulations identify a number of factors to measure the intensity of impact. These factors are discussed below, and none are implicated here to warrant a finding of NEPA significance. A review of these NEPA "intensity" factors reveals that the proposed action would not result in a significant impact—neither beneficial nor detrimental--to the human environment.

Impacts on public health or safety: The project is expected to have no effect on public health and safety.

Unique characteristics: The Cape Cod Canal is 17 miles long and connects Cape Cod Bay to Buzzards Bay. It is used for recreation and passage by commercial vessels. There are no unique environmental characteristics in this area that would be impacted by maintenance dredging of the Federal channel or mooring basin. There are no unique characteristics at the CCCDS disposal site. Some rocky intertidal habitat will be temporarily impacted due to burial, but the sand is expected to erode due to natural wave processes and storms and expose the rock once again.

Controversy: The proposed project is not controversial. State and federal resource agencies agree with the USACE's impact assessment.

Uncertain impacts: The impacts of the proposed project are not uncertain; they are readily understood based on past experiences from this project and other similar USACE projects.

Precedent for future actions: The proposed project is maintenance of an authorized project and will not establish a precedent for future actions other than future maintenance activities.

Cumulative significance: As discussed in the EA, to the extent that other actions are expected to be related to project as proposed, the majority of these actions will provide little measurable cumulative impact. Additional placement of sediments on the rocky intertidal habitat beyond this project would need to be reviewed as this would impact the recovery of habitat, although the rock was originally covered by sand until the sand transport to the area was interrupted.

Historic resources: The project will have no known negative impacts on any pre-contact archaeological sites recorded by the State of Massachusetts.

Endangered species: The project will have no known adverse impacts on any State or Federal threatened or endangered species or designated critical habitat for such species. A marine mammal observer will be aboard vessels transiting between the Canal and CCCDS during the period of January 1 through May 31. If a hopper dredge is used, no work will occur between June 1 and October 31 to protect sea turtles. To protect the piping plovers no placement of dredged material on Town Neck Beach will occur between April 1 and August 31 and the town of Sandwich will be responsible for monitoring the beach during the nesting season. To protect the roseate tern foraging habitat efforts will be made to complete all work in the Onset shoal area near Mashnee Flats prior to May 1 if the material is to be brought to CCCDS.

Potential violation of state or federal law: This action will not violate federal or state laws.

Measures to minimize adverse environmental effects of the proposed action are discussed in Section 10 of the EA.

Based on my review and evaluation of the environmental effects as presented in the Environmental Assessment, I have determined that the Cape Cod Canal maintenance dredging project in Sandwich and Bourne, Massachusetts is not a major Federal action significantly affecting the quality of the human environment. This project, therefore, is exempt from requirements to prepare an Environmental Impact Statement.

4 MAY 15
Date

Christopher J. Barron
Colonel, Corps of Engineers
District Engineer

NEW ENGLAND DIVISION
U.S. ARMY CORPS OF ENGINEERS,
CLEAN WATER ACT
SECTION 404 (b)(1) EVALUATION

PROJECT: Maintenance Dredging of the Federal Navigation Project at the Cape Cod Canal, Cape Cod Bay and Buzzards Bay, Massachusetts

PROJECT MANAGERS: Bill Kavanaugh EXT. 978-318-8326
Michael Riccio EXT. 978-318-8685

FORM COMPLETED BY: Valerie Cappola EXT. 978-318-8067

PROJECT DESCRIPTION:

The Cape Cod Canal Federal navigation project provides for an open canal 32 feet deep mean lower low water (MLLW) for a width of 540 feet in the land cut, 500 feet in a straight channel in Buzzards Bay to Wings Neck and 700 feet wide beyond the Wings Neck. The latter portion of the channel, shown on coastal charts as ending in the vicinity of Cleveland Ledge, actually continues about 3,000 feet beyond the lighthouse to deep water. There are two mooring basins: the west mooring basin on the south side near Hog Island about 3,300 feet long, about 350 feet wide and 32 feet deep, and the east mooring basin on the north side of the channel at Sandwich, about 2,500 feet long, about 350 feet wide and 25 feet deep. Currently shoaling has occurred in several areas of the project (specifically the near the south jetty, east mooring basin and adjacent channel, adjacent to both sides of the Sagamore Bridge, and an area by Onset Point) and the controlling depth is now at 30 feet below Mean Lower Low Water. This reduction is substantial and has already caused tidal delays for some of the deep draft commercial vessels moving through the Canal. Shoaling in the east mooring basin limits the available space to moor vessels in emergencies (e.g. icing).

The proposed work involves maintenance dredging and advanced maintenance dredging of approximately 150,000 cubic yards of clean sand and gravel from six shoals within the 32 feet deep channel and the 25 feet deep east mooring basin. In order to extend the time between dredge events, advanced maintenance will be conducted to reduce the sand wave shoals. The East Mooring Basin will be dredged to -32 feet and the depth of the channel will vary from -34 to -38 feet deep MLLW all with an additional 2 feet allowable overdepth. A hydraulic hopper dredge will be used to perform the proposed work. The dredged material will be placed on Town Neck Beach, Sandwich, Massachusetts or disposed of at the previously used open water disposal site, the Cape Cod Canal Disposal Site (CCCDS). Town Neck Beach is located adjacent to the south breakwater of the canal, and the placement will occur on the section of the beach seaward of the houses. The CCCDS is located approximately 3 nautical miles northeast of Cape Cod Canal Buoy #1 in Cape Cod Bay with the coordinates of the

center point at 41° 49’ 00” N, 70° 25’ 00”W. The urgency to remove the shoals from the canal for safety concerns with disposal at CCCDS will take precedence over any the beneficial use alternatives of the dredged material (beach nourishment). The possibility of using dredged material from the Cape Cod Canal beneficially as a sand source to replenish eroded areas on Town Neck Beach is highly contingent upon the schedule for completion of the Section 204 study or the town financing the entire cost over the costs to place the material at CCCDS. The proposed work will take approximately three to four months to complete.

1. Review of Compliance (Section 230.10(a)-(d)).

	YES	NO
a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose.	X	
b. The activity does not appear to: 1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of Federally listed threatened and endangered species or their habitat; and 3) violate requirements of any Federally designated marine sanctuary.	X	
c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values.	X	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem.	X	

2. Technical Evaluation Factors (Subparts C-F).

		N/A	Not Significant	Significant
a.	Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			
	1) Substrate		X	
	2) Suspended particulates/turbidity		X	
	3) Water column impacts		X	
	4) Current patterns and water circulation	X		
	5) Normal water fluctuations	X		
	6) Salinity gradients	X		
b.	Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)			
	1) Threatened and endangered species		X	
	2) Fish, crustaceans, mollusks, and other organisms in the aquatic food web		X	
	3) Other wildlife (mammals, birds, reptiles, and amphibians)		X	
c.	Potential Impacts on Special Aquatic Sites (Subpart E).			
	1) Sanctuaries and refuges		X	
	2) Wetlands	X		
	3) Mud flats	X		

		N/A	Not Significant	Significant
	4) Vegetated shallows		X	
	5) Coral reefs	X		
	6) Riffle and pool complexes	X		
d.	Potential Effects on Human Use Characteristics (Subpart F).			
	1) Municipal and private water supplies	X		
	2) Recreational and commercial fisheries		X	
	3) Water-related recreation		X	
	4) Aesthetics impacts		X	
	5) Parks, national and historic monuments, national seashores, wilderness areas, research sites and similar preserves	X		

3. Evaluation and Testing (Subpart G).

a.	The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)	
	1) Physical characteristics	X
	2) Hydrography in relation to known or anticipated sources of contaminants	X
	3) Results from previous testing of the material or similar material in the vicinity of the project	X
	4) Known, significant sources of persistent pesticides from land runoff or percolation	
	5) Spill records for petroleum products or designated hazardous substances (Section 311 of CWA)	X
	6) Public records of significant introduction of contaminants from industries, municipalities, or other sources.	
	7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	
	8) Other sources (specify)	
	List appropriate references. See Environmental Assessment for Maintenance Dredging of the Cape Cod Canal, Cape Cod Bay and Buzzards Bay Massachusetts	

	YES	NO
b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredged material is not a carrier of contaminants or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to require constraints. The material meets the testing exclusion criteria.	X	

4. Disposal Site Delineation (Section 230.11(f)).

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)		
	1) Depth of water at disposal site	X
	2) Current velocity, direction, variability at disposal site	X
	3) Degree of turbulence	
	4) Water column stratification	
	5) Discharge vessel speed and direction	X
	6) Rate of discharge	X
	7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)	X
	8) Number of discharges per unit of time	
	9) Other factors affecting rates and patterns of mixing (specify)	
	List appropriate references. See Environmental Assessment for Maintenance Dredging of the Cape Cod Canal, Cape Cod Bay and Buzzards Bay Massachusetts.	

	YES	NO
b. An evaluation of the appropriate information factors in 4a above indicated that the disposal sites and/or size of mixing zone are acceptable.	X	

5. Actions to Minimize Adverse Effects (Subpart H).

	YES	NO
All appropriate and practicable steps have been taken, through application of recommendation of Section 230.70-230.77 to ensure minimal adverse effects of the proposed discharge.	X	

List actions taken

See Cape Cod Canal Maintenance Dredging Environmental Assessment

6. Factual Determination (Section 230.11).

A review of appropriate information, as identified in Items 2 – 5 above, indicates there is minimal potential for short or long term environmental effects of the proposed discharge as related to:		
	YES	**NO**
a. Physical substrate at the disposal site (review Sections 2a, 3, 4, and 5 above)	X	
b. Water circulation fluctuation and salinity (review Sections 2a, 3, 4, and 5)	X	
c. Suspended particulates/turbidity (review Sections 2a, 3, 4 and 5)	X	
d. Contaminant availability (review Sections 2a, 3, and 4)	X	
e. Aquatic ecosystem structure, function and organisms (review Sections 2b and 2c, 3, and 5)	X	
f. Proposed disposal site (review Sections 2, 4, and 5)	X	
g. Cumulative effects on the aquatic ecosystem	X	
h. Secondary effects on the aquatic ecosystem	X	

7. Findings of Compliance or Non-compliance

	YES	**NO**
The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines.	X	

4 MAY 05
Date

Christopher J. Barron
Colonel, Corps of Engineers
District Engineer

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, NORTH ATLANTIC DIVISION
FORT HAMILTON MILITARY COMMUNITY
302 GENERAL LEE AVENUE
BROOKLYN NY 11252-6700

CENAD-PD-OR

28 July 2014

MEMORANDUM FOR Commander New England District, U.S. Army Corps of Engineers, ATTN: William Scully, P.E., CENAE-DD-PM, 696 Virginia Road, Concord, MA 01742-2751

SUBJECT: Cape Cod Canal, Bourne and Sagamore, MA – Long Term Advance Maintenance Dredging Approval Request

1. References:

a. Memorandum, CENAE-PP-CN (11-20-240a), 16 Jun 14, subject: Cape Cod Canal, Bourne and Sagamore, MA – Long Term Advance Maintenance Dredging Approval Request.

b. ER 1130-2-520, Navigation and Dredging Operations and Maintenance Policies.

2. This office has reviewed your request to perform advanced maintenance dredging of the Cape Cod Canal, Federal Navigation Project, which consists of dredging approximately 120,000 cubic yards of material from the Canal channel and Eastern Mooring Basin, in accordance with the requirements of ER 1130-2-520, Navigation and Dredging Operations and Maintenance Policies (reference 1.b.).

3. Your request stated in paragraph 2 meets the requirements outlined in ER 1130-2-520 and is approved.

4. The POC for this action is Rich Thorsen, P.E., Navigation Program Manager, 347-370-4608.

GEORGE NIEVES
Chief
Operations and Regulatory Division