CAPE COD CANAL & SANDWICH BEACHES

SHORE DAMAGE MITIGATION STUDY

APPENDIX E

COST ENGINEERING REPORT

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Cape Cod Canal and Sandwich Beaches
Section 111 Shore Damage Mitigation Study
Cost Engineering Report

1. Cost Narrative

Corps of Engineers cost estimates for planning purposes are prepared in accordance with the following guidance:

- Engineer Technical Letter (ETL) 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 September 2008
- Engineer Regulation (ER) 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302, Civil Works Cost Engineering, 15 September 2008
- ER 1110-2-1150, Engineering and Design For Civil Works Projects, 31 August 1999
- ER 1105-2-100, Planning Guidance Notebook, 22 April 2000, as amended
- Engineer Manual (EM) 1110-2-1304 (Tables revised 30 March 2007), Civil Works Construction Cost Index System, 31 March 2013
- CECW-CP Memorandum For Distribution, Subject: Initiatives To Improve The Accuracy Of Total Project Costs In Civil Works Feasibility Studies Requiring Congressional Authorization, 19 Sep 2007
- CECW-CE Memorandum For Distribution, Subject: Application of Cost Risk Analysis Methods To Develop Contingencies For Civil Works Total Project Costs, 3 Jul 2007
- Cost and Schedule Risk Analysis Guidance, 17 May 2009

The goals of cost engineering for the Cape Cod Canal CAP Section 111 are to present a Total Project Cost (construction and non-construction costs) for the Recommended Plan at the current price level to be used for project justification/authorization and to project costs forward in time for budgeting purposes. In addition, the costing efforts are intended to produce a final product, or cost estimate, that is reliable and accurate and that supports the definition of the Government's and the non-Federal sponsor's obligations.

2. Project Description

The study area is located on the north shore of Cape Cod in the Town of Sandwich, Massachusetts, approximately 40 miles southeast of Boston and 18 miles south of Plymouth (Figure E1). The study area is the approximately 2.5 miles of directly impacted shoreline, including Scusset Beach, the east entrance to the Canal, Town Neck Beach, Old Sandwich Harbor and Springhill Beach. The study area also includes the neighboring areas of Great Marsh, Route 6A and Downtown Sandwich, which have not yet been directly impacted by the problem but can reasonably be expected to be impacted if the problem is left unaddressed. The study was primarily focused on the jetties maintaining the east entrance of the Canal, accretion of material along the updrift shoreline at Scusset Beach and erosion along the downdrift shoreline at Town Neck Beach and Springhill Beach (Figure E2).

Figure E1: Study Location

Figure E2: Study Area

In 1928 the U.S. Army Corps of Engineers (the Corps) was given authority to operate and improve the Cape Cod Canal (the Canal) as a Federal Navigation Project. The Canal is a 17.5-mile navigational channel in southeastern Massachusetts that connects Cape Cod Bay (to the north) with Buzzards Bay (to the south). It provides a shorter, more protected route to mariners who would otherwise travel an additional 135 miles around Cape Cod and the Islands of Martha's Vineyard and Nantucket. The alternative route would leave mariners fully exposed to the open ocean and its associated navigational hazards, which was particularly dangerous in 1909 when construction of the Canal first began. In order to maintain safe navigation into and out of the Canal, jetties were constructed at the east entrance to reduce wave energy and prevent shoaling of the channel itself. Unfortunately, as successful as the project has been for navigational safety purposes, the jetties at the east entrance interrupt natural longshore sediment transport through the littoral system, which has presumably been the cause of significant erosion along the downdrift shoreline in Sandwich, Massachusetts; specifically along Town Neck Beach and Springhill Beach. Due to the presumed cause-and-effect relationship between the jetties and erosion along the Sandwich shoreline, the Corps was authorized under Section 111 of the Continuing Authorities Program to investigate the problem and recommend a plan for mitigating damages directly attributable to the Canal Federal Navigation Project (FNP). After confirming and quantifying the extent of the impacts directly attributable to the Canal FNP, the second effort of the study was aimed at evaluating measures and alternatives for mitigating those impacts. Pursuant to Section 111 of the Continuing Authorities Program (CAP), a benefit to cost ratio was not required to justify the

recommend plan. Rather, the recommended plan is the least cost alternative that effectively accomplishes the project purpose. Measures and alternatives considered during this study included but were not limited to, property buy-outs, beach nourishment, jetty modifications, stone revetments and nearshore breakwaters.

Ultimately beach nourishment, when procured from a nearshore borrow area at neighboring Scusset Beach, was identified as the least cost alternative and the recommended plan includes the dredging, pumping and grading of approximately 388,000 cubic yards of beach compatible sediment onto Town Neck Beach. This alternative would restore a more robust and previously existing barrier beach and dune system and it would simultaneously reintroduce a substantial amount of material to the impacted littoral system. The recommended plan consists of placing and grading this beach compatible material on Town Neck Beach in order to create an engineering beach profile that includes a foreshore (intertidal beach), backshore (high tide beach), and dune with dune grass plantings (see Figure E3).

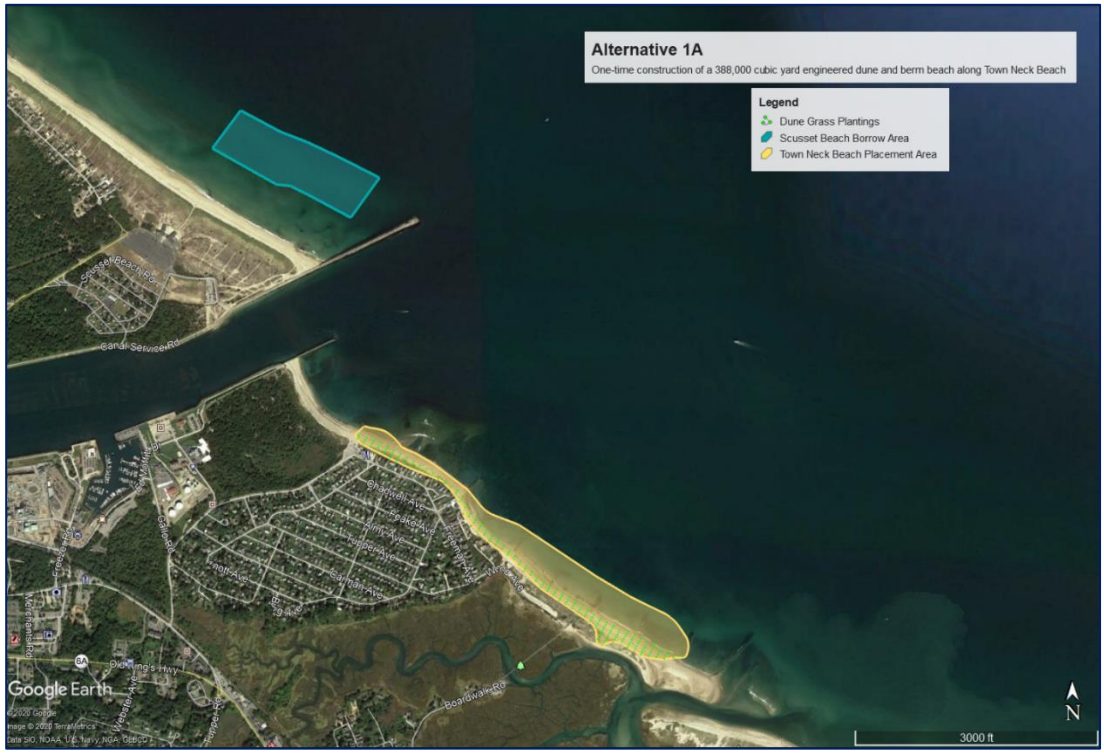

Figure E3: Recommended Plan

Based on the recommended plan, O&M for the project would include beach renourishment at a 9-year interval and a quantity of approximately 279,000 cubic yards which would be cost shared 50/50 between Federal/non-Federal. However, due to the high renourishment costs and the Federal expenditure limit associated with the Section 111 authority, there is no practical means of renourishing the beach throughout the life of the project. Consequently, the recommended plan calls for a one-time placement of material on the beach with no future renourishments.

3. Alternatives

The goal of the alternatives analysis under the Section 111 authority is to develop and identify the most cost effective method of mitigating shoreline damages attributable to the Canal FNP. The analysis was iterative in nature and included several refinements to both the list of alternatives and their respective costs. As mentioned previously, the alternatives analysis for a feasibility study conducted under Section 111 of the CAP program is unique in that it does not require a traditional economic analysis focused on identifying a National Economic Development plan or National Environmental Restoration plan. The alternatives analysis instead focuses on identifying the least costly, environmentally acceptable alternative for adequately mitigating damages. Consequently, this study considered the costs of each alternative, and their relative effectiveness, but benefits were not specifically monetized or otherwise quantified in economic/environmental terms. This section describes the nature of each iteration of the analysis, descriptions of the specific measures/alternatives considered, and an evaluation/comparison of those alternatives.

Alternative 1: Beach Nourishment

Alternative 1 (Figure E4) included the construction of a 388,000 cy engineered dune and berm beach along approximately 5,000 lf of Town Neck Beach. The alternative was broken down into sub-alternatives which considered the source of the sand material such as dredging the Scusset Beach borrow site, dredging the Cape Code Canal for shoaled material, and trucking from upload source(s). Additional sub-alternatives included different kinds of dredging such as mechanical dredging with pumpout, hydraulic pipeline dredging, and/or hopper dredging. The renourishment cycle was calculated assuming additional material would be required when 70% of the beach fill eroded. This resulted in renourishment period of 9 years, or 6 cycles over the 50-year project life.

Figure E4: Alternative 1 Overview

Alternative 2: Beach Nourishment with Dune Core Stabilization

Alternative 2 (Figure E5 and E6) included the same engineered dune and berm beach similar to Alternative 1 (to include the sub-alternatives for sand sources and dredging method) but also included the use of stabilization features built into the dune itself. Some of the beach fill material used to create the dune would be folded and stacked with coir fiber matting to create envelopes of material built into the dune. These semi-solid features would be more tolerant of wave energy than unconsolidated sand which would create a more resilient dune system. With the addition of the dune core stabilization, the renourishment cycle was extended to 11 years, or 5 cycles over the 50-year project life. Because the fiber matting is biodegradable, the sand envelopes themselves would also need to be replaced every 5 to 7 years in order remain effective; this results in 8 replacement cycles over the 50-year project life.

Figure E5: Alternative 2 Overview

Figure E6: Example of sand envelopes in place

Alternative 3: Beach Nourishment with Groin Modifications

Alternative 3 (Figure E7) included the construction of an engineered beach similar to Alternative 1 (including sub-alternatives for sand sources), but Alternative 3 also included the reconstruction/improvement of an existing groin field located along Town Neck Beach. Four (4) dilapidated shore-perpendicular stone groins exist along Town Neck Beach that are currently underperforming due to their state of disrepair. Under Alternative 3, those dilapidated groins would be reconstructed and enhanced in order to create four (4) 250 linear foot, notched groins in their place. The rebuilt groins would help retain the newly placed beach material as would typically be the case with shore-perpendicular structures, and each groin would also be designed to include a 50 linear foot notch that would allow for some material to pass through them and continue migrating eastward towards Springhill Beach. Such a design feature would prevent a complete interruption of the longshore sediment transport through the littoral system (similar to that currently associated with the Canal jetties). Similar to Alternatives 1 and 2, long term renourishment of the beach would also be needed in order for the project to continue performing over a 50-year period. Modeling demonstrated that reconstructing/enhancing the existing groin field along Town Neck Beach would significantly increase the life expectancy of the engineered beach profile relative to Alternative 1. Assuming that the beach would need to be renourished after 70% of the original material is lost, Alternative 3 would require renourishment every 13.5 years as opposed to every 9 years, resulting in a 50% increase in performance life. This would result in four (4) renourishments over a 50-year period.

Figure E7: Alternative 3 Overview

Alternative 4: Shorten the North Jetty

Alternative 4 (Figure E8) included shortening the north jetty at the east entrance of the Canal by 550 linear feet. Shortening the northern jetty would conceptually increase the potential for material to migrate around the Canal opening and reach the downdrift shoreline to stabilize the beach. Alternative 4 did not include any beach nourishment component.

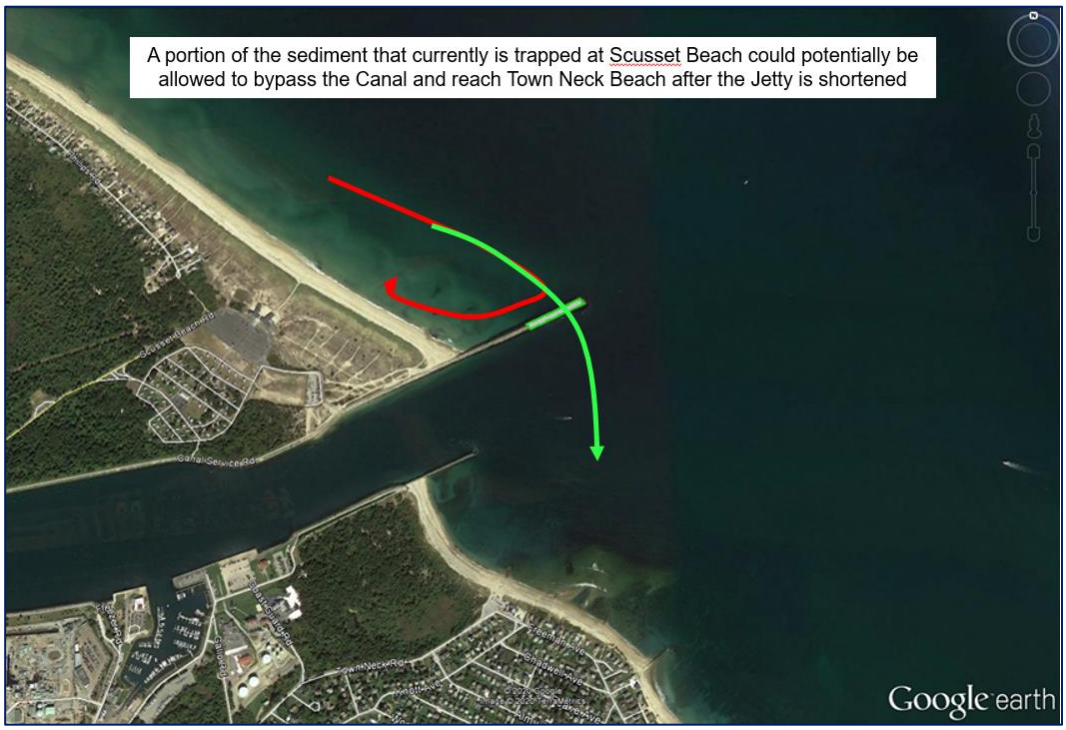

Figure E8: Alternative 4 Overview

Alternative 5: Lengthen the South Jetty

Alternative 5 (Figure E9) included lengthening the south jetty by 900 linear feet in order to prevent material from migrating back into the Canal, thereby increasing sand retention along the downdrift shoreline. Alternative 5 did not include any beach nourishment component.

Figure E9: Alternative 5 Overview

Alternative 6: Permanent Sand Bypass System

Alternative 6 (Figure E10) included the construction and operation of a permanent sand bypass system. The material accumulating updrift of the Canal makes for an ideal source of material, as it is material that would otherwise migrate naturally to the downdrift shoreline but for the interruption created by the jetties. A permanent sand bypass system would use a pump station located in the nearshore subtidal area at Scusset Beach to pump sediment through a pipeline under the Canal and onto the shoreline at Town Neck Beach. It would not necessarily include the grading of an engineered beach profile as Alternatives 1, 2 and 3 would. Rather, it would supply a smaller volume of material to the downdrift shoreline on a continual basis. This would effectively mimic natural sediment transport processes thereby helping to maintain a more robust littoral system and a more stable beach profile along the downdrift shoreline over time. Figure E11 depicts a similar system installed at the Indian River inlet in Delaware.

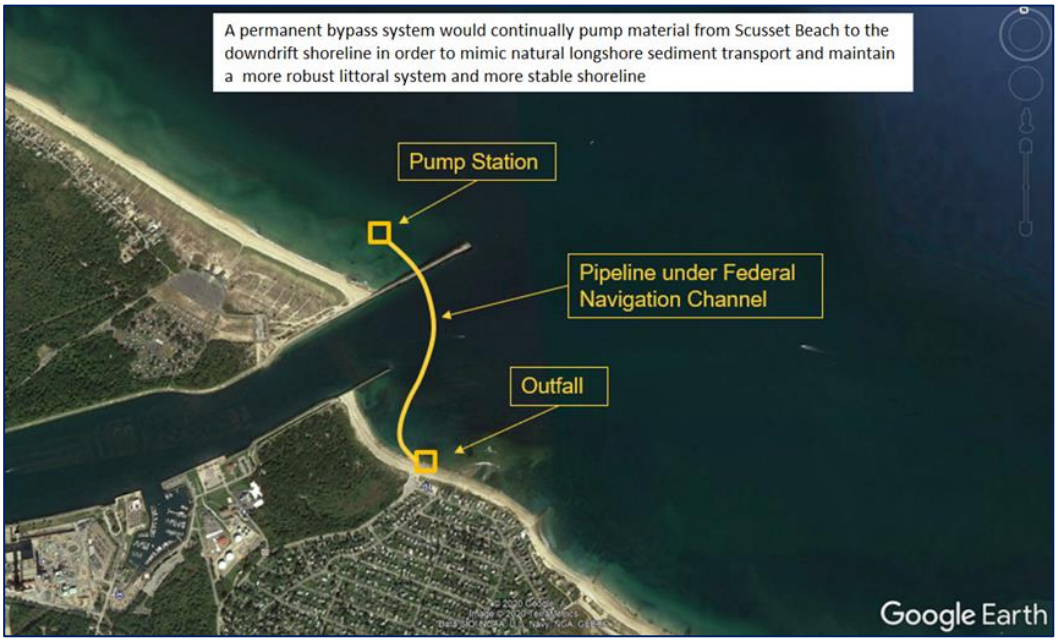

Figure E10: Alternative 6 Overview

Figure E11: Example of a Sand Bypass System in place in Delaware

4. Evaluation of Alternatives

A more in-depth discussion of the alternatives analysis can be found in the main report, but for the purpose of this document the alternatives evaluation can be summarized as follows. A combination of coastal modeling and rough order of magnitude costs estimates were used to screen the six alternatives and pare them down to a focused array of alternatives. Table E1 outlines the results of this process. Alternative 1 was the only alternative that demonstrated the potential to be refined into a feasible alternative. It should be noted that at this juncture, long-term renourishment in general was determined to be not feasible and the study focused on identifying a one-time placement beach nourishment alternative instead. Consequently, Alternative 1 was developed into a series of one-time placement beach nourishment alternatives that accounted for sediment quantity, sediment source, and dredge type. A second round of cost estimates was then prepared for that more refined list of alternatives in order to identify a recommended plan. Table E2 outlines the results of that process. Alternatives 1A and 1E were very similar in nature, with the only difference being the dredge type used to obtain the beach nourishment material. Alternative 1A included hydraulic dredging, while Alternative 1E included mechanical dredging. The estimated cost of these two alternatives was nominally different, but Alternative 1A was technically less expensive based on initial cost estimates, thus it was identified as the Recommended Plan.

Table E1: Initial Alternatives Analysis

Cape Cod Canal 111 Alternatives Analysis (Initial Array of Alternatives)										
	Alternative	Sand Volume	Initial Construction Cost	Renourishment Rate	Renourishement Cycles	Renourishment Costs	Repair Frequency	Repair Cycles	Repair/O&M Costs	Total Project Cost
1A	Beach Nourishment (Scusset)	388,000	$ 14,337,000	9 years	6	$ 182,614,000	N/A	N/A	N/A	**$ 196,951,000**
1B	Beach Nourishment (Scusset, Upland)	388,000	$ 26,701,000	9 years	6	$ 240,618,000	N/A	N/A	N/A	**$ 267,319,000**
1C	Beach Nourishment (Scusset, O&M, Upland)	388,000	$ 18,977,000	9 years	6	$ 176,429,000	N/A	N/A	N/A	**$ 195,406,000**
1D	Beach Nourishment (Upland)	388,000	$ 40,064,000	9 years	6	$ 468,857,000	N/A	N/A	N/A	**$ 508,921,000**
2A	Beach Nourishment w/ Core Envelopes (Scusset)	388,000	$ 23,304,000	11 years	5	$ 231,466,000	5.5 years	8	$ 306,891,000	**$ 561,661,000**
2B	Beach Nourishment w/ Core Envelopes (Scusset, Upland)	388,000	$ 35,668,000	11 years	5	$ 278,364,000	5.5 years	8	$ 306,891,000	**$ 620,923,000**
2C	Beach Nourishment w/ Core Envelopes (Scusset, O&M, Upland)	388,000	$ 27,944,000	11 years	5	$ 226,071,000	5.5 years	8	$ 306,891,000	**$ 560,906,000**
2D	Beach Nourishment w/ Core Envelopes (Upland)	388,000	$ 49,032,000	11 years	5	$ 472,079,000	5.5 Years	8	$ 306,891,000	**$ 828,002,000**
3A	Beach Nourishment w/ Groin Modifications (Scusset)	388,000	$ 18,803,000	13.5 years	4	$ 128,988,000	N/A	N/A	N/A	**$ 147,791,000**
3B	Beach Nourishment w/ Groin Modifications (Scusset, Upland)	388,000	$ 31,166,000	13.5 years	4	$ 163,035,000	N/A	N/A	N/A	**$ 194,201,000**
3C	Beach Nourishment w/ Groin Modifications (Scusset, O&M, Upland)	388,000	$ 23,443,000	13.5 years	4	$ 125,939,000	N/A	N/A	N/A	**$ 149,382,000**
3D	Beach Nourishment w/ Groin Modifications (Upland)	388,000	$ 44,529,000	13.5 years	4	$ 333,824,000	N/A	N/A	N/A	**$ 378,353,000**
4	Reduce Length of North Jetty	0	$ 16,388,000	N/A	N/A	N/A	N/A	N/A	N/A	**$ 16,388,000**
5	Increase Length of South Jetty	0	$ 43,182,000	N/A	N/A	N/A	N/A	N/A	N/A	**$ 43,182,000**
6A	Permanent Bypass System	0	$ 9,870,000	continual	N/A	N/A	varies	varies	$ 127,515,000	**$ 137,385,000**
6B	Permanent Bypass System (with beach nourishement)	224,000	$ 17,795,000	continual	N/A	N/A	varies	varies	$ 127,515,000	**$ 145,310,000**

Table E2: Focused Array of Alternatives

Cape Cod Canal 111 Alternatives Analysis (Focused Array of Alternatives)					
	Alternative	Sand Volume	Dredge Type	Performance Period	Total Project Cost
1A	Beach Nourishment (Scusset)	388,000	Hydraulic	9 years	$ 11,656,000
1E	Beach Nourishment (Scusset)	388,000	Mechanical	9 years	$ 11,669,000
1F	Beach Nourishment (Scusset)	388,000	Hopper	9 years	$ 16,737,000
1G	Beach Nourishment (Scusset)	224,000	Hydraulic	1 year	$ 7,925,000
1H	Beach Nourishment (Scusset)	224,000	Mechanical	1 year	$ 8,136,000
1I	Beach Nourishment (Scusset)	224,000	Hopper	1 year	$ 11,201,000
1J	Beach Nourishment (Scusset/Canal)	324,000	Hydraulic/Hopper	6 years	$ 13,427,000
1K	Beach Nourishment (Scusset/Canal)	324,000	Mechanical/Hopper	6 years	$ 14,029,000
1L	Beach Nourishment (Scusset/Canal)	324,000	Hopper/Hopper	6 years	$ 14,577,000
1M	Beach Nourishment (Scusset/Canal (O&M delta))	324,000	Hydraulic/Hopper	6 years	$ 10,094,000
1N	Beach Nourishment (Scusset/Canal (O&M delta))	324,000	Mechanical/Hopper	6 years	$ 10,435,000
1O	Beach Nourishment (Scusset/Canal (O&M delta))	324,000	Hopper/Hopper	6 years	$ 10,625,000

5. Recommended Plan

As noted above and described in more detail in the main report, Alternative 1A was identified as the Recommended Plan. This plan includes the one-time construction of a 388,000 cubic yard engineered dune and berm beach along Town Neck Beach, using material dredged from the nearshore area at Scusset Beach via hydraulic dredge. An overview of the recommended plan is shown again in Figure E12. A construction cost estimate was prepared for Alternative 1A.

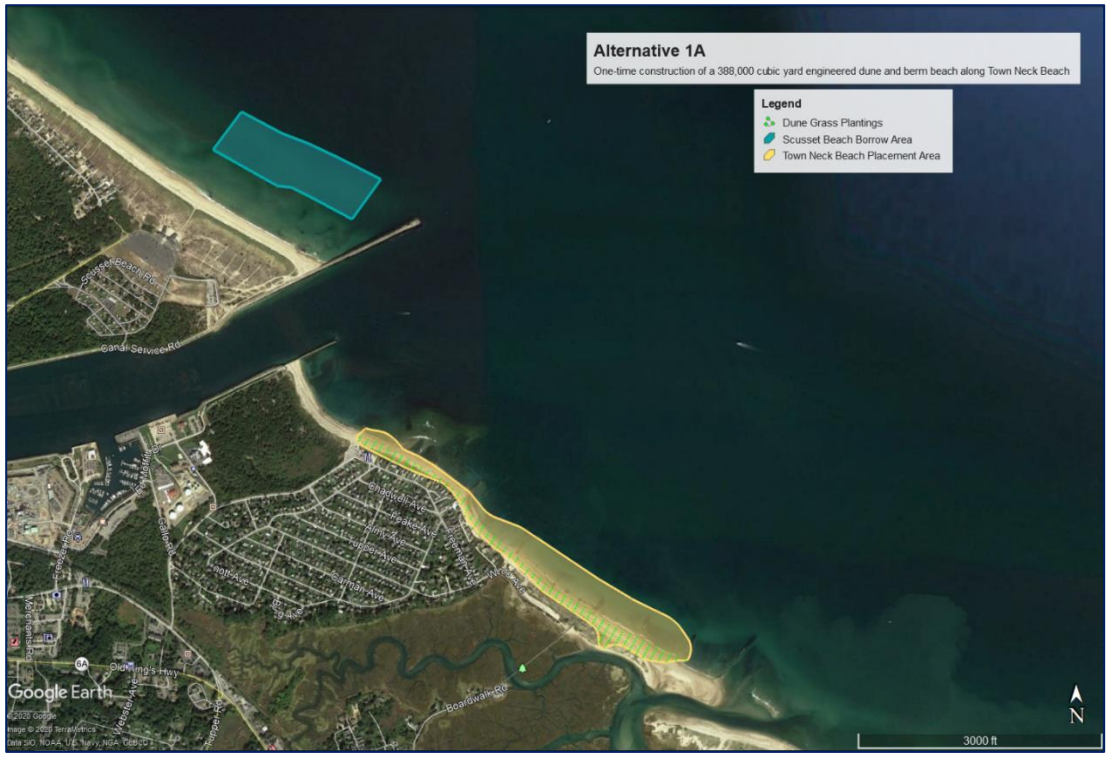

Figure E12: Recommended Plan

6. Basis of Cost Estimate

The construction cost estimate was developed using Micro-Computer Aided Cost Estimating System (MCACES), Second Generation (MII) using the appropriate Work Breakdown Structure (WBS). The quantity of sand to be obtained from the borrow site was provided by the Town of Sandwich. The town has been working with Woods Hole Group, Inc. for over a decade investigating the erosion problem downdrift of the Canal. In 2019, the town was able to obtain permits to dredge approximately 224,000 cy of material from the nearshore of Scusset Beach specifically for the purpose of nourishing Town Neck Beach. Additional analysis by the Coastal Engineering Section at NAE determined the ideal quantity of material for initial construction of the beach profile is 388,000 cy. This quantity was used to develop cost estimates for each feature of work utilizing cost resources such as RSMeans and the MII

Cost Libraries and are supported by the preferred labor, equipment, and crew/production breakdown. The size, or area, of the borrow site was determined by scaling the approximate location in Google Earth. The unit price for the dredge and disposal of the material from Scusset Beach to Town Neck Beach as well as the mobilization/demobilization cost for the dredge labor and equipment was obtained from the Pipeline Corps of Engineers Dredge Estimating Program (CEDEP) spreadsheet file dated 24Apr2020 ver 0. The Pipeline CEDEP used the volume and area of the borrow site, along with assumed average and maximum pipeline lengths scaled in Google Earth, to develop this unit price. The mobilization/demobilization cost was estimated using an assumed distance and durations for preparing, moving, and setting up the dredge and pipeline at the start of the project as well as breaking down, moving, and storing the dredge and pipeline at the end of the project. The dredging unit price and mob/demob cost was input into the MII file where it was combined with the assumed crew and productivity for the beach operations.

The labor rates were adjusted to the local and current prevailing wage determinations. The most current MII Cost Book (2016) and Equipment database, Region 1 (2018) were utilized in developing the cost estimate. The Equipment database is based on EP 1110-1-8, Construction Equipment Ownership and Operation Expense Schedule. It should be noted that due to the vintage of the equipment book, an escalation from FY18Q1 to current is included for the beach operations equipment. The direct costs are based on anticipated labor, equipment, and materials necessary to construct the project. This work was then applied to either the prime or a subcontractor. The contractor make-up assumes a prime dredging contractor with an earthwork subcontractor performing all beach operations and a landscaping subcontractor installing dune plantings. The material cost for, and installation of, dune plantings was quoted.

Sales tax at 6.5% was applied to materials for the project. The estimate assumes 2 shifts will be necessary for beach operations to grade the sand from the dredging operations and maintain the dredge pipeline. Overtime is assumed on both shifts at 2 hours per day Monday through Friday and 10 hours per day on Saturday and Sunday. The estimate also includes a global productivity reduction (93.75%) assuming the contractor loses 30 minutes every 8 hours due to the likely distant location of the laydown area at the start/stop of work and at break times.

Barnstable County, Massachusetts prevailing wage rates were obtained from GSA and used for all craft labor (General Decision Number: MA20200008 09/25/2020, Construction Type: Heavy and Marine). The base wage rate and taxable fringe were entered into MII and applied accordingly. The total labor rate was developed using the base wage, fringe benefits, FICA, FUTA, and Worker's Compensation rates for each labor class computed by MII based on project location and contractor type.

Contingency was developed using an Abbreviated Risk Analysis (ARA). See section E.7 CONTINGENCY DEVELOPMENT for additional details regarding the risk-based contingency development.

The civil works breakdown structure (CWBS) feature accounts associated with each contract were escalated to the program year and then to the mid-point of design or construction using the Civil Works Construction Cost Index System (CWCCIS) factors as contained in EM 1110-2-1304, dated 30 September 2020. See section E.10 TOTAL PROJECT COST SUMMARY for additional details.

7. Schedule

The total project schedule has been developed in Microsoft Excel using major construction activities and associated network logic to determine the project duration. The total project schedule is provided as Attachment 1 to this Cost Engineering Appendix.

8. Contingency Development

8.1. Purpose

The purpose of the Abbreviated Risk Assessment (ARA) is to identify potential events that could affect project cost and analyze their likelihood and impact.

8.2. Risk Analysis Process

The risk analysis process follows the USACE Headquarters requirements as well as the guidance provided by the Cost MCX. The abbreviated risk analysis process uses cost growth curves for seven predetermined categories (Project Scope Growth, Acquisition Strategy, Construction Elements, Quantities, Special Construction or Fabrication, Cost Estimate Assumptions, and External Risks). The growth curves are dependent on the selection of the Project Development Stage/Alternative and the Risk Category and the selections are Alternative Formulation, Feasibility (Alternatives), Feasibility (Recommended Plan), PED 60%, PED 90%, and Construction Period and Low Risk: Typical Construction, Simple, Moderate Risk: Typical Project Construction Type, and High Risk: Complex Project or Unique Type Construction, respectively. These selections change the growth curves from a shallower curve for a project at a more advanced stage and simpler construction to a much steeper curve for a project early in development with high risk or complex construction. This particular project selected Feasibility (Recommended Plan) for project development stage and Moderate Risk: Typical Project Construction Type for risk category.

8.3. Methodology

In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions, or events for which the occurrence (event risk) or impact (condition/variant risk) is uncertain and that experience suggests will likely result in additional costs being

incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept, the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The risk analysis uses an Excel form provided by the Cost MCX. The major features of work and their corresponding costs entered into the form which populates the risk register with these features in each of the risk categories.

Below is a brief step-by-step summary of the process performed during this analysis:

1. Development of Risk Register

In accordance with the PDT, a risk register was developed to identify the various risks associated with the project. Each feature of work was reviewed in each risk category to determine what, if any, risk events should be documented.

2. Determination of Risk

During the risk register meeting, these risk events were discussed and notated and conclusions made as to the impact and likelihood of occurrence. The impact and likelihood selections can be seen in Figure E13 below. These factors determined whether an event's risk level was 0, 1, 2, 3, 4, or 5.

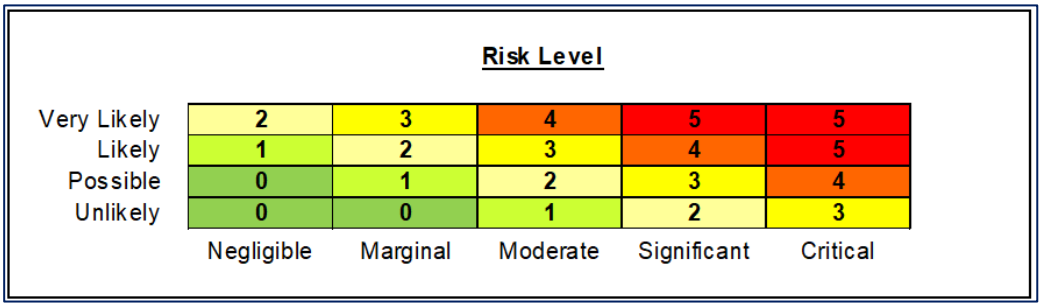

Figure E13: Risk Level Matrix

3. Cost Growth Curves

The risk level for each risk category was determined based on the inputs from the risk register and the inputs of project development and risk category which calculated a risk percentage for each risk category and each feature of work.

4. Summary of Results

The risk percentages for each category were summed to calculate a total contingency percentage for the construction portion of the project as well as a separate percentage for PED and S&A.

8.3.1. Identify and Assess Risk Factors

Identifying the risk factors via the PDT are considered a qualitative process that results in establishing a risk register that serves as the document for the further study in the risk model. Risk factors are events or conditions (variances) that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

Informal risk identification was initially performed by the cost engineering team member working through the base estimate and schedule development process. As scope uncertainty and constructability type issues were identified, they were submitted to a draft risk register to be presented to the larger team and presented in the formal PDT meetings.

A formal PDT meeting was held virtually on 5 May 2020 to discuss the risks/opportunities associated with the project. The meetings focused primarily on the identification, concerns, and discussions of the risk/opportunities along with some quantification of risks (best case, most likely, and worst-case thresholds) when appropriate. Additionally, numerous telephone calls, informal meetings, and coordination through email were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment. The PDT was represented by the following disciplines:

- Project management
- Civil engineering
- Coastal engineering
- Geotechnical engineering
- Structural engineering
- Construction support
- Cost engineering

Follow up meetings and/or discussions were also held to discuss risk thresholds and update the risk register. A full roster of participating team members at each risk meeting is included in Attachment 2.

8.3.2. Risk Register

The risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk models. The risk register and identified events are included in Attachment 2. The risk register documents the PDT risk identification and assessment.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the design, cost estimate, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

8.3.3. Risk Analysis Results

The Abbreviated Risk Analysis results calculated individual contingencies for the General Conditions/Mob & Demob, Dredge Operations (Hydraulic), and Beach Operations of 22%, 24%, and 24%, respectively, for Total Construction Estimate contingency of 23%. In addition, Planning, Engineering & Design contingency was calculated at 14% and the Construction Management contingency was calculated at 18%.

The PDT identified highly rated concerns in order to evaluate the proper means to mitigate and limit their effect on the project as follows:

- Bidding Competition – Bidding competition is a risk in all IFB procurements. It is possible there could be limited bidders which may have a moderate impact on the bid prices.

- Construction Mods & Claims - Bidding competition is a risk in all IFB procurements. It is possible there could be limited bidders which may have a moderate impact on the bid prices.

- Cost Estimate Products Assumptions – A vast majority of inputs to the cost estimate are determined by the cost engineer and are based on professional and historic experience. It is possible these inputs, which affect all aspects of the cost and features of work in the cost estimate, will have an impact on cost. Because the cost estimate products are built conservatively, the impact is expected to be moderate in the worst case.

9. Planning Engineering and Design

The costs were developed for all activities associated with the planning, engineering and design effort. The cost for this account includes the preparation of Design Documentation Reports and plans and specifications for each construction contract and engineering support during construction through project completion. It includes all the in-house labor based upon work-hour requirements, material and facility costs, travel and overhead. The percentage breakout in the Total Project Cost Summary (TPCS), was developed based with input from respective offices in accordance with the CWBS as well as historical prices.

10. Construction Management (S&A)

The costs were developed for all construction management activities from pre-award requirements through final contract closeout. These costs include the in-house labor based upon work-hour requirements, materials, facility costs, support contracts, travel and overhead. Costs were developed based on the input from the construction division in accordance with the CWBS and include, but are not limited to, anticipated items such as the salaries of the resident engineer and staff, survey men, inspectors, draftsmen, clerical, and custodial personnel; operation, maintenance and fixed charges for transportation and for other field equipment; field supplies; construction management, general construction supervision; project office administration, distributive cost of area office and general overhead charged to the project. The work items and activities would include, but not be limited to: the salaries of all supervisory, engineering, office and safety field personnel; all on site expenses.

11. Total Project Cost Summary

The Total Project Cost Summary (TPCS) addresses the inflation through project completion; accomplished by escalation to the mid-point of construction per CWCCIS as required by ER 1110-2-1302 and ETL 1110-2-573. The TPCS includes Federal and non-Federal costs for all construction features of the project, lands and damages, as well as PED and S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the CWWBS. The TPCS was prepared using the MCACES/MII cost estimate, contingencies developed by the ARA, the project design and construction schedule, and estimates of PED and S&A prepared by others. The TPCS is provided as Attachment 3 to this Cost Engineering Appendix.

Table E3: Total Project Cost Summary

CWBS	Feature Account	ESTIMATED COST	PROJECT FIRST COST	FULLY FUNDED COST
CONSTRUCTION				
17	BEACH REPLENISHMENT	$10,443,000	$10,443,000	$11,065,000
	CONSTRUCTION SUBTOTAL	**$10,443,000**	**$10,443,000**	**$11,065,000**
NON-CONSTRUCTION				
01	LANDS AND DAMAGES	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$291,000	$291,000	$305,000
31	CONSTRUCTION MANAGEMENT (S&A)	$247,000	$247,000	$266,000
	NON-CONSTRUCTON SUBTOTAL	**$538,000**	**$538,000**	**$571,000**
	TOTAL	$10,981,000	$10,981,000	$11,636,000

Attachment 1

Project Schedule

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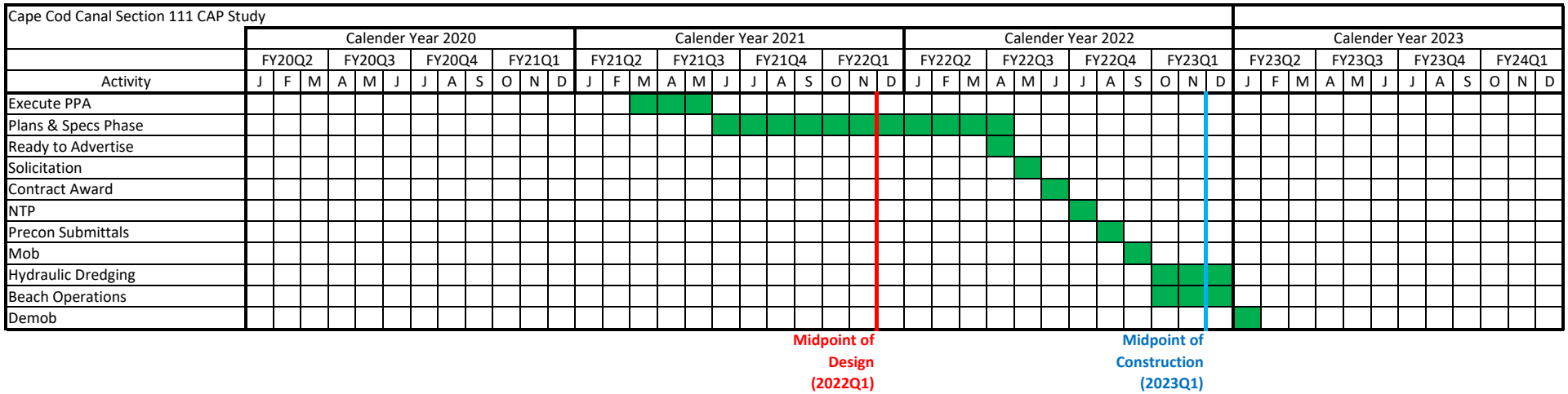
DESIGN AND IMPLEMENTATION SCHEDULE

Cape Cod Canal Section 111 CAP Study **Last Revised: 02 December 2020**



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Attachment 2

Cost & Schedule Risk Analysis

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Abbreviated Risk Analysis

Project (less than $40M): **Cape Cod Canal CAP Section 111** **Alternative: Alt 1A**

Project Development Stage/Alternative: **Feasibility (Recommended Plan)**

Risk Category: **Moderate Risk: Typical Project Construction Type** **Meeting Date: 5/5/2020**

Total Estimated Construction Contract Cost = **$ 8,490,168**

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0%	$ -	$ -
1	17 BEACH REPLENISHMENT	**General Conditions / Mob & Demob**	$ 2,018,910		22%	$ 440,839	$ 2,459,749
2	17 BEACH REPLENISHMENT	**Dredge Operations (Hydraulic)**	$ 2,687,764		24%	$ 639,953	$ 3,327,717
3	17 BEACH REPLENISHMENT	**Beach Operations**	$ 3,783,494		24%	$ 900,845	$ 4,684,339
4			$ -		0%	$ -	$ -
5			$ -		0%	$ -	$ -
6			$ -		0%	$ -	$ -
7			$ -		0%	$ -	$ -
8			$ -		0%	$ -	$ -
9			$ -		0%	$ -	$ -
10			$ -		0%	$ -	$ -
11			$ -		0%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 255,000		14%	$ 35,727	$ 290,727
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 209,000		18%	$ 36,856	$ 245,856
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ -	0%	$ -	$ -	
Total Construction Estimate	$ 8,490,168	23%	$ 1,981,637	$ 10,471,805	
Total Planning, Engineering & Design	$ 255,000	14%	$ 35,727	$ 290,727	
Total Construction Management	$ 209,000	18%	$ 36,856	$ 245,856	
Total Excluding Real Estate	**$ 8,954,168**	**23%**	**$ 2,054,219**	**$ 11,008,387**	
		Base	**50%**	**80%**	
Confidence Level Range Estimate ($000's)		$8,954k	$10,186k	$11,008k	

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Cape Cod Canal CAP Section 111 Alt 1A

Feasibility (Recommended Plan)

Abbreviated Risk Analysis

Meeting Date: 5-May-20

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**75%**
PS-1	General Conditions / Mob & Demob	None	None	Negligible	Unlikely	0
PS-2	Dredge Operations (Hydraulic)	Concern regarding scope creep and the need to place more sand on the beach when the project reaches PED phase.	The feasbility study reviewed several options for initial quantities to be placed on the beach. The recommended plan includes the largest of these quantities. The real risk is that the current borrow site is not currently approved for the quantity called for so ultimately the beach could be smaller resulting in a smaller project.	Negligible	Unlikely	0
PS-3	Beach Operations	Concern regarding scope creep and the need to place more sand on the beach when the project reaches PED phase.	The feasbility study reviewed several options for initial quantities to be placed on the beach. The recommended plan includes the largest of these quantities. The real risk is that the current borrow site is not currently approved for the quantity called for so ultimately the beach could be smaller resulting in a smaller project.	Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	Concern regarding scope creep and the need to place more sand on the beach when the project reaches PED phase.	With the largest quantity currently planned for beach placement, any smaller quantity will result in slightly LESS engineering necessary in PED phase.	Negligible	Unlikely	0
PS-14	Construction Management	Concern regarding scope creep and the need to place more sand on the beach when the project reaches PED phase.	With the largest quantity currently planned for beach placement, any smaller quantity will result in slightly LESS S&A necessary during construction.	Negligible	Unlikely	0
Acquisition Strategy				**Maximum Project Growth**		**30%**
AS-1	General Conditions / Mob & Demob	Concern regarding small business contractor acquisition in PED phase. Concern regarding competition during bidding.	The cost estimate has anticipated some sort of set-aside IFB utilizing a converative HOOH and Bond markup commensurate with a small business and have set up the contractor make-up to assume the prime is a dredging contractor and all beach work will be performed by an earthwork subcontractor. No risk modeled for this portion of the element. Bidding competition is a risk in all IFB procurements. It is possible there could be limited bidders which may have a marginal impact on the bid prices (impact is supported by the fact that only two dredging solicitations in the last 7 years have insufficient competition).	Marginal	Possible	1

AS-2	Dredge Operations (Hydraulic)	Concern regarding small business contractor acquisition in PED phase. Concern regarding competition during bidding.	The cost estimate has anticipated some sort of set-aside IFB utilizing a converative HOOH and Bond markup commensurate with a small business and have set up the contractor make-up to assume the prime is a dredging contractor and all beach work will be performed by an earthwork subcontractor. No risk modeled for this portion of the element. Bidding competition is a risk in all IFB procurements. It is possible there could be limited bidders which may have a marginal impact on the bid prices (impact is supported by the fact that only two dredging solicitations in the last 7 years have insufficient competition).	Marginal	Possible	1
AS-3	Beach Operations	Concern regarding small business contractor acquisition in PED phase. Concern regarding competition during bidding.	The cost estimate has anticipated some sort of set-aside IFB utilizing a converative HOOH and Bond markup commensurate with a small business and have set up the contractor make-up to assume the prime is a dredging contractor and all beach work will be performed by an earthwork subcontractor. No risk modeled for this portion of the element. Bidding competition is a risk in all IFB procurements. It is possible there could be limited bidders which may have a marginal impact on the bid prices (impact is supported by the fact that only two dredging solicitations in the last 7 years have insufficient competition).	Marginal	Possible	1
AS-13	Planning, Engineering, & Design	Concern regarding any acquisition strategy other than IFB or small business IFB (such as 8A or best value).	There are no requirements anticipated for this project that would necessitate an 8A or best value procurement. Dredging projects of this magnitute and complexity have been procured using IFB or set-aside IFB and have been most successful. No risk modeled for this element.	Negligible	Unlikely	0
AS-14	Construction Management	Concern regarding small business contractor acquisition in PED phase. Concern regarding competition during bidding.	The cost estimate has anticipated some sort of set-aside IFB utilizing a converative HOOH and Bond markup commensurate with a small business and have set up the contractor make-up to assume the prime is a dredging contractor and all beach work will be performed by an earthwork subcontractor. No risk modeled for this portion of the element. Bidding competition is a risk in all IFB procurements. It is possible there could be limited bidders which may have a marginal impact on the bid prices (impact is supported by the fact that only two dredging solicitations in the last 7 years have insufficient competition).	Marginal	Possible	1
Construction Elements				**Maximum Project Growth**		**25%**
CON-1	General Conditions / Mob & Demob	Concern regarding construction mods and claims.	Mods and/or claims are always possible on any construction project. It is possible there will be one or more on this contract and the impact could be moderate. It is limited to moderate as it's anticpated the permitting process will include borings and site investigation(s) to ensure the quantity of sand is available.	Moderate	Possible	2
CE-2	Dredge Operations (Hydraulic)	Concern regarding construction mods and claims.	Mods and/or claims are always possible on any construction project. It is possible there will be one or more on this contract and the impact could be moderate. It is limited to moderate as it's anticpated the permitting process will include borings and site investigation(s) to ensure the quantity of sand is available.	Moderate	Possible	2

CE-3	Beach Operations	Concern regarding construction mods and claims.	Mods and/or claims are always possible on any construction project. It is possible there will be one or more on this contract and the impact could be moderate. It is limited to moderate as it's anticpated the permitting process will include borings and site investigation(s) to ensure the quantity of sand is available.	Moderate	Possible	2
CE-13	Planning, Engineering, & Design	None	None	Negligible	Unlikely	0
CE-14	Construction Management	Concern regarding construction mods and claims.	Mods and/or claims are always possible on any construction project. It is possible there will be one or more on this contract and the impact could be moderate. It is limited to moderate as it's anticpated the permitting process will include borings and site investigation(s) to ensure the quantity of sand is available.	Moderate	Possible	2
Specialty Construction or Fabrication					**Maximum Project Growth**	**65%**
SC-1	General Conditions / Mob & Demob	None	No specialty construction or equipment is anticipated on this project.	Negligible	Unlikely	0
SC-2	Dredge Operations (Hydraulic)	None	No specialty construction or equipment is anticipated on this project.	Negligible	Unlikely	0
SC-3	Beach Operations	None	No specialty construction or equipment is anticipated on this project.	Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	None	No specialty construction or equipment is anticipated on this project.	Negligible	Unlikely	0
SC-14	Construction Management	None	No specialty construction or equipment is anticipated on this project.	Negligible	Unlikely	0
Technical Design & Quantities					**Maximum Project Growth**	**30%**
T-1	General Conditions / Mob & Demob	None	None	Negligible	Unlikely	0
T-2	Dredge Operations (Hydraulic)	Potential concern regarding current quantity calculation and beach design.	The quantity development was done by Woods Hole Group as part of the CCC Section 111 Feasbility Study. This quantity of sand maximizes volume on the beach without providing so much sand it would get more easily eroded during small storm events. The area of the beach is limited by the canal to the north and the Old Sandwich Harbor inlet to the south. The USACE PDT is confident in the development of the quantities done by the Woods Hole Group. It's unlikely there will be an increase in sand quantity and if there were, it would be a moderate impact as there is only so much space on the beach and so large a dune/berm system can be before it's ineffective vs the size.	Moderate	Unlikely	1

T-3	Beach Operations	Potential concern regarding current quantity calculation and beach design.	The quantity development was done by Woods Hole Group as part of the CCC Section 111 Feasbility Study. This quantity of sand maximizes volume on the beach without providing so much sand it would get more easily eroded during small storm events. The area of the beach is limited by the canal to the north and the Old Sandwich Harbor inlet to the south. The USACE PDT is confident in the development of the quantities done by the Woods Hole Group. It's unlikely there will be an increase in sand quantity and if there were, it would be a moderate impact as there is only so much space on the beach and so large a dune/berm system can be before it's ineffective vs the size.	Moderate	Unlikely	1
T-13	Planning, Engineering, & Design			Marginal	Possible	1
T-14	Construction Management			Negligible	Unlikely	0
Cost Estimate Assumptions				**Maximum Project Growth**		**35%**
EST-1	General Conditions / Mob & Demob	Assumptions in the cost estimate, risk anslysis, and TPCS can greatly affect the total project cost.	A vast majority of inputs to the cost estimate are determined by the cost engineer and are based on professional and historic experience. It is possible these inputs, which affect all asepcts of the cost and features of work in the cost estimate, will have an impact on cost. Because the cost estimate products are build conservatively, the impact is expected to be moderate in the worst case.	Moderate	Possible	2
EST-2	Dredge Operations (Hydraulic)	Assumptions in the cost estimate, risk anslysis, and TPCS can greatly affect the total project cost.	A vast majority of inputs to the cost estimate are determined by the cost engineer and are based on professional and historic experience. It is possible these inputs, which affect all asepcts of the cost and features of work in the cost estimate, will have an impact on cost. Because the cost estimate products are build conservatively, the impact is expected to be moderate in the worst case.	Moderate	Possible	2
EST-3	Beach Operations	Assumptions in the cost estimate, risk anslysis, and TPCS can greatly affect the total project cost.	A vast majority of inputs to the cost estimate are determined by the cost engineer and are based on professional and historic experience. It is possible these inputs, which affect all asepcts of the cost and features of work in the cost estimate, will have an impact on cost. Because the cost estimate products are build conservatively, the impact is expected to be moderate in the worst case.	Moderate	Possible	2
EST-13	Planning, Engineering, & Design	Assumptions in the cost estimate, risk anslysis, and TPCS can greatly affect the total project cost.	Fee estimates were obtained from various divisions, branches, and sections that will be involved in PED. It is unlikely these estimates will change dramatically from now the start of PED but if they do, the impact is expected to be marginal.	Marginal	Possible	1
EST-14	Construction Management	Assumptions in the cost estimate, risk anslysis, and TPCS can greatly affect the total project cost.	Fee estimates were obtained from various divisions, branches, and sections that will be involved in S&A. It is unlikely these estimates will change dramatically from now the start of PED but if they do, the impact is expected to be marginal.	Marginal	Possible	1
External Project Risks				**Maximum Project Growth**		**40%**

EX-1	General Conditions / Mob & Demob	Concern regarding the following topics: - Adverse Weather affecting dredging and beach placement operations - Potential market volitility and/or competition issues affecting bid price - Unanticipated inflation in key materials (fuel in this case)	- There will be a number of adverse weather delays included in the solicitation for each month the work is expected to occur. This will help to mitigate this risk. - There is also a possibility that increased severe storm damage (such as Sandy) will continue in the future and flood the dredging market with potential work. This could significantly impact the costs of all work features if there is reduced competition; however recent experience with the Sandy work has shown that an increased number of projects does not seem to limit competition (NAE continued to receive a healthy quantity of bids throughout the Sandy recovery period). - Fuel prices have been averaged and escalated to the midpoint of construciton, reducing the impact of the average rate of increase. There remains the possibility of increased fuel market volatility which can have a moderate impact on project cost. Overall, the likelihood of one or more of these events occuring is possible and the impact is expected to be marginal (the bidding competition risk is addressed in the acquisition strategy risk category).	Marginal	Possible	**1**
EX-2	Dredge Operations (Hydraulic)	Concern regarding the following topics: - Adverse Weather affecting dredging and beach placement operations - Potential market volitility and/or competition issues affecting bid price - Unanticipated inflation in key materials (fuel in this case)	- There will be a number of adverse weather delays included in the solicitation for each month the work is expected to occur. This will help to mitigate this risk. - There is also a possibility that increased severe storm damage (such as Sandy) will continue in the future and flood the dredging market with potential work. This could significantly impact the costs of all work features if there is reduced competition; however recent experience with the Sandy work has shown that an increased number of projects does not seem to limit competition (NAE continued to receive a healthy quantity of bids throughout the Sandy recovery period). - Fuel prices have been averaged and escalated to the midpoint of construciton, reducing the impact of the average rate of increase. There remains the possibility of increased fuel market volatility which can have a moderate impact on project cost. Overall, the likelihood of one or more of these events occuring is possible and the impact is expected to be marginal (the bidding competition risk is addressed in the acquisition strategy risk category).	Marginal	Possible	**1**

EX-3	Beach Operations	Concern regarding the following topics: - Adverse Weather affecting dredging and beach placement operations - Potential market volitility and/or competition issues affecting bid price - Unanticipated inflation in key materials (fuel in this case)	- There will be a number of adverse weather delays included in the solicitation for each month the work is expected to occur. This will help to mitigate this risk. - There is also a possibility that increased severe storm damage (such as Sandy) will continue in the future and flood the dredging market with potential work. This could significantly impact the costs of all work features if there is reduced competition; however recent experience with the Sandy work has shown that an increased number of projects does not seem to limit competition (NAE continued to receive a healthy quantity of bids throughout the Sandy recovery period). - Fuel prices have been averaged and escalated to the midpoint of construciton, reducing the impact of the average rate of increase. There remains the possibility of increased fuel market volatility which can have a moderate impact on project cost. Overall, the likelihood of one or more of these events occuring is possible and the impact is expected to be marginal (the bidding competition risk is addressed in the acquisition strategy risk category).	Marginal	Possible	**1**
EX-13	Planning, Engineering, & Design	None	None	Negligible	Unlikely	**0**
EX-14	Construction Management	None	None	Negligible	Unlikely	**0**

Cape Cod Canal CAP Section 111 Alt 1A
Feasibility (Recommended Plan)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$0
17 BEACH REPLENISHMENT	General Conditions / Mob & Demob	**0**	**1**	**2**	**0**	**0**	**2**	**1**	$2,019
17 BEACH REPLENISHMENT	Dredge Operations (Hydraulic)	**0**	**1**	**2**	**0**	**1**	**2**	**1**	$2,688
17 BEACH REPLENISHMENT	Beach Operations	**0**	**1**	**2**	**0**	**1**	**2**	**1**	$3,783
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
All Other	Remaining Construction Items	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	**0**	**0**	**0**	**0**	**1**	**1**	**0**	$255
31 CONSTRUCTION MANAGEMENT	Construction Management	**0**	**1**	**2**	**0**	**0**	**1**	**0**	$209
									$8,954
Risk		$ -	$ 619	$ 763	$ -	$ 133	$ 361	$ 178	**$2,054**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ -	$ 619	$ 763	$ -	$ 133	$ 361	$ 178	**$2,054**
								Total	**$11,008**

Attachment 3

Total Project Cost Summary

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

PROJECT: **Cape Cod Canal CAP Section 111**
PROJECT NO: P2 401862
LOCATION: Sandwich, MA

DISTRICT: New England District **PREPARED: 12/2/2020**
POC: CHIEF, COST ENGINEERING, Jeffrey Gaeta

This Estimate reflects the scope and schedule in report; Cape Cod Canal Section 111 Feasibility Study, December 2020

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
Recommended Plan (388kcy Initial Placement) Sand Source: Scusset Beach Placement Method: Hydraulic Dredging						Program Year (Budget EC): 2021 Effective Price Level Date: 1 OCT 20									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-20** ($K)	**TOTAL FIRST COST ($K)**	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***		***K***	***L***	***M***	***N***	***O***
17	BEACH REPLENISHMENT	$8,490	$1,953	23.0%	$10,443	0.0%	$8,490	$1,953	$10,443	$0	$10,443	6.0%	$8,996	$2,069	$11,065
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$8,490	$1,953		$10,443	0.0%	$8,490	$1,953	$10,443	$0	$10,443	6.0%	$8,996	$2,069	$11,065
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$255	$36	14.0%	$291	0.0%	$255	$36	$291	$0	$291	4.6%	$267	$37	$305
31	CONSTRUCTION MANAGEMENT	$209	$38	18.0%	$247	0.0%	$209	$38	$247	$0	$247	7.9%	$226	$41	$266
	PROJECT COST TOTALS:	$8,955	$2,026	22.6%	$10,981		$8,955	$2,026	**$10,981**	$0	**$10,981**	6.0%	$9,489	$2,147	$11,636

ESTIMATED TOTAL PROJECT COST:	**$11,636 (100% Federal)**
22 - FEASIBILITY STUDY (CAP STUDY COSTS):	**$615 (100% Federal)**
ESTIMATED FEDERAL COST OF PROJECT:	**$12,251**

______________________ **CHIEF, COST ENGINEERING, Jeffrey Gaeta**

______________________ **PROJECT MANAGER, Mike Riccio**

______________________ **CHIEF, REAL ESTATE, Gaelen Daly**

______________________ **CHIEF, PLANNING, John Kennelly**

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______________________ **CHIEF, CONSTRUCTION, Sean Dolan**

______________________ **CHIEF, CONTRACTING, Sheila Winston-Vincuillia**

______________________ **CHIEF, PM-PB, Janet Harrington**

______________________ **CHIEF, DPM, Scott Acone**

Filename: CAP CCC Section 111 TPCS Mar2020 02Dec2020
RecPlan (Initial Only)

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

**** CONTRACT COST SUMMARY ****

PROJECT: Cape Cod Canal CAP Section 111
LOCATION: Sandwich, MA
This Estimate reflects the scope and schedule in report; Cape Cod Canal Section 111 Feasbility Study, December 2020

DISTRICT: New England District
POC: CHIEF, COST ENGINEERING, Jeffrey Gaeta
PREPARED: 12/2/2020

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
Recommended Plan (388kcy Initial Placement) Sand Source: Scusset Beach Placement Method: Hydraulic Dredging		Estimate Prepared: 2-Dec-20				Program Year (Budget EC): 2021								
		Effective Price Level: 1-Oct-20		RISK BASED		Effective Price Level Date: 1 OCT 20								
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	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	INITIAL BEACH FILL													
17	BEACH REPLENISHMENT	$8,490	$1,953	23.0%	$10,443	0.0%	$8,490	$1,953	$10,443	2023Q1	6.0%	$8,996	$2,069	$11,065
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$8,490	$1,953	23.0%	**$10,443**		$8,490	$1,953	$10,443			$8,996	$2,069	$11,065
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.6%	Project Management	$47	$7	14.0%	$54	0.0%	$47	$7	$54	2022Q1	4.0%	$49	$7	$56
0.1%	Planning & Environmental Compliance	$10	$1	14.0%	$12	0.0%	$10	$1	$12	2022Q1	4.0%	$11	$2	$12
1.6%	Engineering & Design	$137	$19	14.0%	$156	0.0%	$137	$19	$156	2022Q1	4.0%	$142	$20	$162
0.1%	Reviews, ATRs, IEPRs, VE	$10	$1	14.0%	$11	0.0%	$10	$1	$11	2022Q1	4.0%	$10	$1	$12
0.1%	Life Cycle Updates (cost, schedule, risks)	$6	$1	14.0%	$7	0.0%	$6	$1	$7	2022Q1	4.0%	$6	$1	$7
0.2%	Contracting & Reprographics	$15	$2	14.0%	$17	0.0%	$15	$2	$17	2022Q1	4.0%	$16	$2	$18
0.1%	Engineering During Construction	$5	$1	14.0%	$6	0.0%	$5	$1	$6	2023Q1	7.9%	$5	$1	$6
0.2%	Planning During Construction	$15	$2	14.0%	$17	0.0%	$15	$2	$17	2023Q1	7.9%	$16	$2	$18
0.1%	Adaptive Management & Monitoring	$10	$1	14.0%	$11	0.0%	$10	$1	$11	2024Q1	11.9%	$11	$2	$13
0.0%	Project Operations	$0	$0	14.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
2.2%	Construction Management	$189	$34	18.0%	$223	0.0%	$189	$34	$223	2023Q1	7.9%	$204	$37	$241
0.0%	Project Operation:	$0	$0	18.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.2%	Project Management	$20	$4	18.0%	$24	0.0%	$20	$4	$24	2023Q1	7.9%	$22	$4	$25
	CONTRACT COST TOTALS:	$8,955	$2,026		$10,981		$8,955	$2,026	**$10,981**			$9,489	$2,147	**$11,636**

Filename: CAP CCC Section 111 TPCS Mar2020 02Dec2020
RecPlan (Initial Only)