

**NEW HAVEN HARBOR
CONNECTICUT
NAVIGATION IMPROVEMENT PROJECT**

**DRAFT INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL IMPACT STATEMENT**

**APPENDIX F
COST ENGINEERING**

New Haven Harbor, Connecticut Navigation Improvement Study

**Feasibility Report
August 2018**

**Appendix F
Cost Engineering**

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COST ENGINEERING

F.1.0 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 31 September 2017), 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 September 2007
- CECW-CE Memorandum For Distribution, Subject: Application of Cost Risk Analysis Methods To Develop Contingencies For Civil Works Total Project Costs, 3 July 2007
- Cost and Schedule Risk Analysis Guidance, 17 May 2009

The goal of the Cost Engineering Section for the New Haven Harbor Navigation Improvement Study for the shipping harbor located in New Haven, Connecticut is to present a Total Project Cost (construction and non-construction costs) for the National Economic Development (NED) and the NED Plan with Beneficial Use (NEDBU) at the current price level to be used for project justification and authorization. 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.

This study was conducted in accordance with the requirements of the "SMART Planning" process, also known as a 3X3X3 study. The level of analysis for cost, while shortened, was conducted to the appropriate level to determine a Tentatively Selected Plan. The cost engineering effort for the study also yielded a series of alternative plan formulation cost estimates for decision making. The cost estimates supporting the NED plan and the NEDBU plan (the Tentatively Selected Plan) are prepared in Micro-Computer Aided Cost Estimating System

version II (MCACES/MII) format to the Civil Works Work Breakdown Structure (CWWBS) sub-feature level. These estimates are supported by the preferred labor, equipment, materials and crew/production breakdown. During the evaluation of alternatives, a full Cost and Schedule Risk Analysis (CSRA) was performed for one alternative with the resulting contingency percentage applied to all alternatives. Additional CSRAs were performed on the NED and NEDBU plans that addresses project uncertainties and sets contingencies for each plan's cost items.

F.1.1 Selected Plans

The NED plan and NEDBU plan resulted directly from the plan formulation process described above. The Economics Appendix (Appendix C) fully describes the plan selection process based upon the plan that reasonably maximizes the net economic benefits while considering the significance of the change in cost between alternative plans. The NED plan selected by USACE is the 40-ft plan with "ordinary" material disposal at Central Long Island Disposal site (CLIS), Morris Cove Borrow Pit, a shellfish improvement area to the immediate north of the east breakwater, and the West River Borrow pit area and rock material disposal to the immediate south of the west breakwater. The NEDBU plan is the same 40-ft plan with the disposal options above but also includes "ordinary" material beneficial use disposal to the Sandy Point area for salt marsh creation purposes. The scopes of work for the NED plan and NEDBU plan can be found in the main report and Engineering Appendix (Appendix D). The MCACES/MII cost estimates are based on the scopes and are formatted in the CWWBS. The notes provided in the body of the estimate detail the estimate parameters and assumptions. These include pricing at the Fiscal Year 2019 price level (1 October 2018) as that is when the Chief's Report is expected to be signed.

The construction costs fall under the following feature codes:

- 12 Navigation Ports and Harbors

The non-construction costs fall under the following feature codes:

- 01 Lands and Damages
- 30 Planning, Engineering and Design
- 31 Construction Management

F.1.2 Construction Cost

Construction costs were developed in MCACES/MII and include all major project components categorized under the appropriate CWWBS to the sub-feature level. The

construction costs for dredging operations were developed using the Corps of Engineers Dredge Estimating Program (CEDEP) and then transferred into the MCACES/MII estimate. A Total Project Cost Summary on each plan contains contingencies that were determined as a result of the Cost and Schedule Risk Analyses.

F.1.3 Non-Construction Cost

Non-construction costs typically includes Lands and Damages (Real Estate), Planning, Engineering and Design (PED), and Construction Management (Supervision & Administration or S&A). These costs were provided by the PDT either as a lump sum cost or as a percentage of the total Construction Contract Cost. Lands and Damages cover the potential real estate temporary easement costs to provide the contractor with a laydown area for the salt marsh creation efforts at Sandy Point and a permanent road easement for future access to the site. A lump sum for the easements, contingency, Federal administration costs and non-Federal administration costs were provided by New England District Real Estate Division and are best described in the Real Estate Appendix (Appendix G). These Lands and Damages are only incurred in the NEDBU plan. PED costs include the preparation of design documentation reports and the contract plans and specification along with engineering support during construction through contract completion. These PED costs include additional field investigations and studies which were not performed during feasibility in accordance with the requirements of the SMART Planning methodology for feasibility studies. Construction Management costs are for all construction management activities from pre-award requirements through final contract closeout including the supervision and administration of the contract(s) required to perform the various aspects of construction required for this project and includes Project Management, Construction Quality Assurance, and Contract Administration costs.

In addition to the typical non-construction costs, the NEDBU plan also includes environmental monitoring costs for monitoring the Sandy Point salt marsh creation area. The environmental monitoring has been added to the non-construction costs of this project to cover the cost of site visits several times per year for a period of ten years to ensure the salt marsh creation has been successful.

F.1.4 Plan Formulation Cost Estimates

For the plan formulation cost estimates, unit prices for dredging-related work were developed in the Corps of Engineers Dredge Estimating Program (CEDEP) while unit prices for the rock removal work was estimated using a drill-and-blast spreadsheet then both were

entered into MCACES/MII. Unit prices for the remaining major or variable construction elements were developed in MCACES/MII. Design details and information and assumptions are provided in the notes of the MCACES/MII estimates for each alternative. Refer to the Economics Section in the main report for final plan formulation cost tables including the calculation of net benefits and benefit to cost ratios for the NED plan and the NEDBU plan.

F.1.5 Construction Schedule

Construction schedules for the NED plan and the NEDBU plan were prepared using Microsoft Excel utilizing input from the PDT and reflect all project construction components. The schedules consider not only durations of individual reaches but also timing of known environmental restriction windows. The schedule of each reach was combined with the project schedule to create an overall schedule that was used for the generation of the Total Project Cost Summaries.

The construction schedule presented within this appendix is a true construction schedule that incorporates simultaneous operations occurring in different areas of the project. It can be expected that drill-and-blast operations will be occurring concurrently with ordinary material mechanical dredging operations and, in the NEDBU plan, concurrently with the pipeline dredging operations for the salt marsh creation. This schedule is a real world approach as opposed to an extremely conservative method of a straight line where all operations occur in series.

The construction schedule will change as the project moves through the various project lifecycle phases. The overall project schedule for the NED plan and the NEDBU plan is provided in Section F.4.0 of this Appendix.

F.2.0 PLAN FORMULATION COST ESTIMATES

Cost estimates for all alternative plans were generated based on quantities derived from removal operations to reach the target depth plus any allowable overdepth. These quantities were used to derive cost estimates that are accurate for the conditions expected in each of the alternatives of this project.

F.2.1 Alternative 1 – 37-ft Plan

The MII estimate for this alternative is considered “For Official Use Only” (FOUO). Therefore, it is available to government personnel only upon request. This plan is based on

an authorized channel depth of 37-ft in all reaches and a 500-ft inner channel width, a 600-ft outer channel width, and a 700-ft wide bend at the breakwaters. Table F-1 below shows the expected type and quantity of dredges and quantities of material to be dredged.

Table F- 1 :: Project Characteristics of the 37-ft Plan

Channel Reach	Dredge Plant Type	# of Dredges	Dredge Quantity in Cubic Yards (CY)
Entrance Channel	Medium clamshell	1	180,000
Bend (Ordinary Material)	Medium clamshell	1	247,600
Bend (Rock)	Drill & Blast / Medium clamshell	1	6,600
Interior Channel	Medium clamshell	1	1,168,400
Maneuvering Area	Medium clamshell	1	276,900
Turning Basin	Medium clamshell	1	232,900
TOTAL			2,112,400

F.2.2 Alternative 2 – 38-ft Plan

The MII estimate for this alternative is considered “For Official Use Only” (FOUO). Therefore, it is available to government personnel only upon request. This plan is based on an authorized channel depth of 38-ft in all reaches and a 500-ft inner channel width, a 600-ft outer channel width, and a 700-ft wide bend at the breakwaters. Table F-2 below shows the expected type and quantity of dredges and quantities of material to be dredged.

Table F- 2 :: Project Characteristics of the 38-ft Plan

Channel Reach	Dredge Plant Type	# of Dredges	Dredge Quantity in Cubic Yards (CY)
Entrance Channel	Medium clamshell	1	260,500
Bend (Ordinary Material)	Medium clamshell	1	299,500
Bend (Rock)	Drill & Blast / Medium clamshell	1	16,100
Interior Channel	Medium clamshell	1	1,525,100
Maneuvering Area	Medium clamshell	1	431,100
Turning Basin	Medium clamshell	1	244,700
TOTAL			2,777,000

F.2.3 Alternative 3 – 40-ft Plan

The MII estimate for this alternative is considered “For Official Use Only” (FOUO). Therefore, it is available to government personnel only upon request. This plan is based on an authorized channel depth of 40-ft in all reaches and a 500-ft inner channel width, a 600-ft outer channel width, and a 700-ft wide bend at the breakwaters. Table F-3 below shows the expected type and quantity of dredges and quantities of material to be dredged.

Table F- 3 :: Project Characteristics of the 40-ft Plan

Channel Reach	Dredge Plant Type	# of Dredges	Dredge Quantity in Cubic Yards (CY)
Entrance Channel	Medium clamshell	1	461,500
Bend (Ordinary Material)	Medium clamshell	1	455,900
Bend (Rock)	Drill & Blast / Medium clamshell	1	32,700
Interior Channel	Medium clamshell	1	2,299,300
Maneuvering Area	Medium clamshell	1	750,600
Turning Basin	Medium clamshell	1	268,600
TOTAL			4,268,500

F.2.4 Alternative 4 – 42-ft Plan

The MII estimate for this alternative is considered “For Official Use Only” (FOUO). Therefore, it is available to government personnel only upon request. This plan is based on an authorized channel depth of 42-ft in all reaches and a 500-ft inner channel width, a 600-ft outer channel width, and a 700-ft wide bend at the breakwaters. Table F-4 below shows the expected type and quantity of dredges and quantities of material to be dredged.

Table F- 4 :: Project Characteristics of the 42-ft Plan

Channel Reach	Dredge Plant Type	# of Dredges	Dredge Quantity in Cubic Yards (CY)
Entrance Channel	Medium clamshell	1	612,080
Bend (Ordinary Material)	Medium clamshell	1	548,979
Bend (Rock)	Drill & Blast / Medium clamshell	1	45,815
Interior Channel	Medium clamshell	1	2,802,213
Maneuvering Area	Medium clamshell	1	997,514
Turning Basin	Medium clamshell	1	281,200
TOTAL			5,287,801

F.3.0 NED PLAN AND NEDBU PLAN (TENTATIVELY SELECTED PLAN) COST ESTIMATES

Subsequent to the Tentatively Selected Plan (TSP) milestone, additional study and analysis was conducted in the form of ship simulations and reevaluation of the Sandy Point salt marsh creation area perimeter and depth. These analyses resulted in changes to the quantities of various reaches of the TSP (the 40-ft plan) which resulted in changes to the Total Project Cost for the NED plan and the NEDBU plan. Table F-5 below shows the expected type and quantity of dredges and quantities of material to be dredged.

Table F- 5 :: Project Characteristics of the Refined TSP (40-ft plan)

Channel Reach	Dredge Plant Type	# of Dredges	Dredge Quantity in Cubic Yards (CY)
Entrance Channel	Medium clamshell	1	464,500
Entrance Channel Extension	Medium clamshell	1	53,800
Bend (Ordinary Material)	Medium clamshell	1	636,600
Bend (Rock)	Drill & Blast / Medium clamshell	1	43,500
Interior Channel	Medium clamshell	1	2,313,400
Manuevering Area	Medium clamshell	1	652,300
Turning Basin	Medium clamshell	1	158,100
TOTAL			4,322,200

The base cost estimates, in summary form, are contained in Table F-6 of this Appendix as shown below.

Table F- 6 :: Base Costs for NED Plan and NEDBU Plan (Tentively Selected Plan) for WBS Features

Feature	Base Cost Estimate (FY18 Price Level, Excluding Contingency)
NED Plan	
Navigation Ports & Harbors (Material Removal & Disposal)	\$49,278,000
Planning, Engineering & Design	\$2,464,000
Construction Management	\$2,464,000
TOTAL COST	\$54,205,000
NEDBU Plan (Tentively Selected Plan)	
Navigation Ports & Harbors (Material Removal & Disposal)	\$52,151,000
Lands and Damages	\$143,000
Planning, Engineering & Design	\$2,608,000
Environmental Monitoring	\$100,000
Construction Management	\$2,608,000
TOTAL COST	\$57,608,000

New England District and the vertical team are proposing the NED plan with the beneficial use of dredge material for salt marsh creation at the Sandy Point area, the NEDBU plan, as the Tentively Selected Plan (TSP).

F.4.0 SCHEDULE FOR NED and NEDBU PLAN (TSP)

The schedule for the NED plan and the NEDBU plan (Tentatively Selected Plan) is contained on the following page(s) of this Appendix.

PROJECT SCHEDULE

New Haven Harbor Navigation Improvement Study - NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

Activity	Calendar Year 2019				Calendar Year 2020				Calendar Year 2021				Calendar Year 2022				Calendar Year 2023																																																																																																						
	FY19Q2		FY19Q3		FY19Q4		FY20Q1		FY20Q2		FY20Q3		FY20Q4		FY21Q1		FY21Q2		FY21Q3		FY21Q4		FY22Q1		FY22Q2		FY22Q3		FY22Q4		FY23Q1		FY23Q2		FY23Q3		FY23Q4		FY24Q1																																																																																
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N
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Dredge Entrance Channel																																																																																																																							
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Dredge Bend (Rock)																																																																																																																							
Dredge Manuevering Area																																																																																																																							
Dredge Turning Basin																																																																																																																							
Demob (Year 2)																																																																																																																							

Midpoint of Planning, Engineering and Design
 Midpoint of Lands and Damages
 Midpoint of Construction

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

New Haven Harbor Navigation Improvement Study - NATIONAL ECONOMIC DEVELOPMENT PLAN WITH BENEFICIAL USE (NEDBU)

Activity	Calendar Year 2019				Calendar Year 2020				Calendar Year 2021				Calendar Year 2022				Calendar Year 2023																																																																																																						
	FY19Q2		FY19Q3		FY19Q4		FY20Q1		FY20Q2		FY20Q3		FY20Q4		FY21Q1		FY21Q2		FY21Q3		FY21Q4		FY22Q1		FY22Q2		FY22Q3		FY22Q4		FY23Q1		FY23Q2		FY23Q3		FY23Q4		FY24Q1																																																																																
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N
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Demob (Year 2)																																																																																																																							

Midpoint of Planning, Engineering and Design
 Midpoint of Lands and Damages
 Midpoint of Construction

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

F.5.0 RISK AND UNCERTAINTY ANALYSIS

A full Cost and Schedule Risk Analysis (CSRA) was performed on both the NED plan and NEDBU plan (Tentively Selected Plan) according to the procedures outlined in the manual entitled, “Cost and Schedule Risk Analysis Process” dated March 2008. The full CSRAs were used to develop the final project risk-based contingencies for each plan.

F.5.1 Risk Analysis Methods

The entire PDT participated in a cost risk analysis brainstorming session to identify risks associated with the NED plan and NEDBU plan (Tentively Selected Plan). The risks were listed in the risk register and evaluated by the PDT. Assumptions were made as to the likelihood and impact of each risk item, as well as the probability of occurrence and magnitude of the impact if it were to occur. Adjustments were made to the analysis accordingly and the final contingency was established for each plan. The contingency was applied to each plan estimate in order to obtain the Total Project Cost.

F.5.2 General Information

New Haven Harbor is Connecticut’s largest port, centrally located on the north shore of Long Island Sound, about mid-way between the cities of New York and Providence, Rhode Island. The study area includes New Haven Harbor, Long Island Sound, and the Port service area. The Port of New Haven serves a hinterland including the greater New Haven region, the state of Connecticut, and much of the American Northeast. The port is a crucial import location for refined petroleum products, which supplies demand within Connecticut and the broader Northeast region. The Northeast maintains a large refinery production/demand deficit and must rely heavily on imported volumes of petroleum products in order to meet demand. The current federally authorized New Haven Harbor navigation project includes the deep draft channel and turning basin, authorized at -35 feet MLLW, two shallow-draft anchorages, three shallow-draft river channels, a pile and stone T-dike, and three offshore stone breakwaters. While the project area includes several navigation features, the assessment is focused on the deep draft main channel and turning basin, as these are the areas requiring improvements. The purpose of the proposed Federal action is to improve navigation into and out of the port for the deep draft ships using the port now and in the future and to achieve transportation cost savings (increased economic efficiencies).

Navigational challenges have been identified as authorized depths do not meet the draft requirements of today’s fleet of Bulk and Tanker ships. Tide delays, light loading, lightering,

and other operational inefficiencies created by inadequate channel depth result in economic inefficiencies that translate into costs for the national economy. Commodities received at the port include petroleum and petroleum products and various bulk and break-bulk commodities. Oil and gasoline are the dominant imports at the port, generally making up over 80 percent of the total tonnages. Of the bulk and break-bulk commodities, the most common imports are steel, road salt.

F.5.3 Risk Analysis Results

A Cost and Schedule Risk Analysis, including the Monte Carlo based Crystal Ball analysis, was generated for the NED plan and the NEDBU plan (Tentively Selected Plan). Refer to the printouts of the CSRA for the NED plan and the NEDBU plan in this Appendix at the end of this section. In addition, the Risk Register for the NED plan and the NEDBU plan is contained as an attachment to this Appendix.

F.5.4 Summary of Findings

Table F-12 provides the cost contingency for the NED plan and the NEDBU plan calculated from the Cost and Schedule Risk Analyses using the Monte Carlo based Crystal Ball add-in for Excel. Contingency was quantified as approximately \$9.4 million and \$10.4 million for the NED plan and NEDBU plan, respectively. Table F-7 provides additional breakdown of the cost and contingency by the various project components.

Table F- 7 :: NED Plan and NEDBU Plan (Tentively Selected Plan) Contingency Dollars and Percentages

	Base Construction Cost	Contingency (\$)	Contingency (%)
NED Plan	\$49,277,632	\$9,362,750	19%
NEDBU Plan (TSP)	\$52,150,611	\$10,430,122	20%

The primary risks to the cost estimates and schedules indentified by the CSRA process are listed below. These risks include either/both direct cost impacts and/or schedule impacts.

Contract Modifications: Contract modifications are very likely in a project of this size and have the potential to effect both project cost and schedule. Differing site conditions and/or variations in estimated quantities are potential issues with this project. Developing a comprehensive set of plans and specifications with additional field work during design (such as survey and additional borings) as well as including a definitive responsibility criteria in the solicitation are ways to mitigate this risk.

Restricted Work Windows: There are numerous environmental time-of-year restrictions that the contractor will have to work around. The project schedule has the construction sequenced such that all features of work can be completed in a two-year construction period with little to no margin for error or float. Any additional restrictions or tighter restrictions than have been set to date has the potential to effect both project cost and schedule. A more defined or finalized project scope along with an updated schedule and more clarity in the environmental restrictions during design will better equip the PDT to determine if a third construction year or additional equipment will be necessary to complete the work in the window currently assumed.

Differing Site Conditions: There is a quantity of potentially unsuitable material in the Manuevering Area/Turning Basin area. The EPA is in the process of making a determination as to whether or not this material is eligible for disposal at CLIS. If the determination is made that this material is unsuitable, a CAD cell will need to be constructed for disposal. There is also a chance that further refinement of the channel and/or turning basin during design will encounter additional unsuitable material. These risks have the potential to effect both project cost and schedule.

Drill and Blast Estimation: New England District has a great deal of experience with dredging operations that involve removal of “ordinary” material. However, the amount of rock material removal in the New England area has been extremely limited. The assumptions of drill and blast operations and productivity could be different from those experienced when the work is actually done. This risk has the potential to effect both project cost and schedule. Favorably, before this project is in the Planning, Engineering and Design phase, two large rock removal projects, Boston Harbor and Portsmouth/Piscataqua, will have bid openings and the results can be compiled and used to refine this portion of the cost estimate.

Equipment Assumptions: There are multiple options that can be utilized when dredging a project of this size that will effect production rates and unit prices. Different assumptions will have the potential to effect project cost and schedule. New England District will continue to gather data at bid openings of similar projects to determine what equipment is being proposed for similar work and adjust the cost estimate for this project accordingly.

The base cost estimates with contingencies, in summary form, are contained in Table F-8 of this Appendix as shown below.

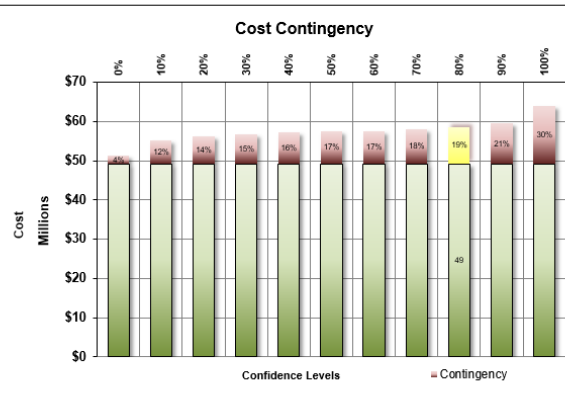
Table F- 8 :: Base Costs with Contingency for NED Plan and NEDBU Plan (Tentively Selected Plan) for WBS Features

Feature	Base Cost Estimate (FY18 Price Level, Excluding Contingency)	Recommended Contingency	Base Cost Estimate (FY18 Price Level, INCLUDING Contingency)
NED Plan			
Navigation Ports & Harbors (Material Removal & Disposal)	\$49,278,000	\$9,363,000	\$58,640,000
Planning, Engineering & Design	\$2,464,000	\$468,000	\$2,932,000
Construction Management	\$2,464,000	\$468,000	\$2,932,000
TOTAL COST	\$54,205,000	\$10,299,000	\$65,504,000
NEDBU Plan (Tentively Selected Plan)			
Navigation Ports & Harbors (Material Removal & Disposal)	\$52,151,000	\$10,430,000	\$62,581,000
Lands and Damages	\$143,000	\$14,000	\$157,000
Planning, Engineering & Design	\$2,608,000	\$522,000	\$3,129,000
Environmental Monitoring	\$100,000	\$20,000	\$12,0000
Construction Management	\$2,608,000	\$522,000	\$3,129,000
TOTAL COST	\$57,608,000	\$11,507,000	\$69,116,000

- PROJECT CONTINGENCY DEVELOPMENT - NED PLAN

INITIAL CONSTRUCTION Contingency Analysis

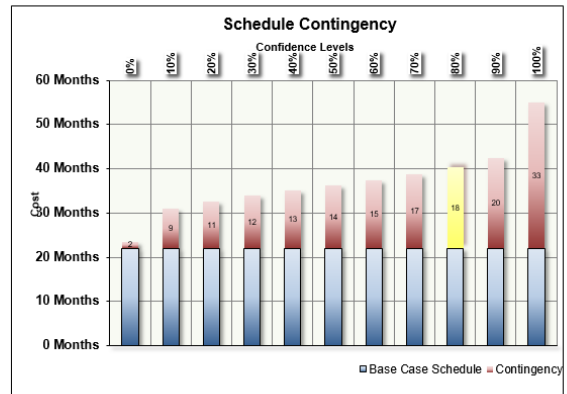
Base Case Estimate (Excluding 01)		\$49,277,632	
Confidence Level	Value	Contingency	
0%	1,971,105	4%	
10%	5,913,316	12%	
20%	6,898,868	14%	
30%	7,391,645	15%	
40%	7,884,421	16%	
50%	8,377,197	17%	
60%	8,377,197	17%	
70%	8,869,974	18%	
80%	9,362,750	19%	
90%	10,348,303	21%	
100%	14,783,290	30%	



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT - NED PLAN

INITIAL CONSTRUCTION Contingency Analysis

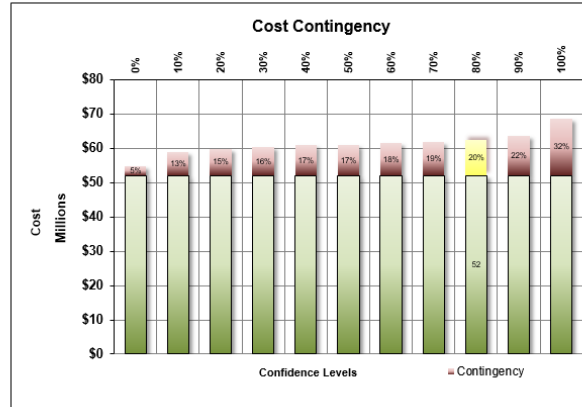
Base Case Schedule		22.0 Months	
Confidence Level	Value	Contingency	
0%	2 Months	7%	
10%	9 Months	41%	
20%	11 Months	48%	
30%	12 Months	54%	
40%	13 Months	60%	
50%	14 Months	65%	
60%	15 Months	70%	
70%	17 Months	76%	
80%	18 Months	83%	
90%	20 Months	93%	
100%	33 Months	150%	



- PROJECT CONTINGENCY DEVELOPMENT - NEDBU PLAN

**INITIAL CONSTRUCTION
Contingency Analysis**

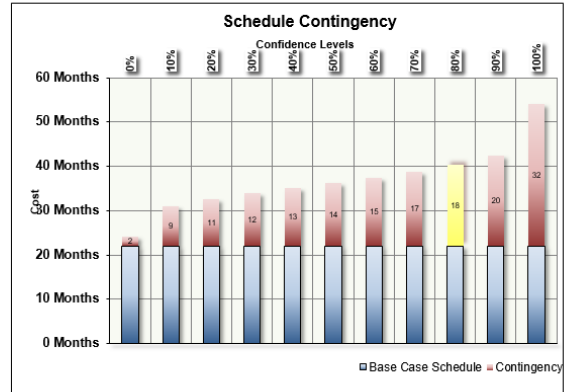
Confidence Level	Value	Contingency
0%	2,607,531	5%
10%	6,779,579	13%
20%	7,822,592	15%
30%	8,344,098	16%
40%	8,865,604	17%
50%	8,865,604	17%
60%	9,387,110	18%
70%	9,908,616	19%
80%	10,430,122	20%
90%	11,473,134	22%
100%	16,688,196	32%



- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT - NEDBU PLAN

**INITIAL CONSTRUCTION
Contingency Analysis**

Confidence Level	Value	Contingency
0%	2 Months	10%
10%	9 Months	41%
20%	11 Months	48%
30%	12 Months	54%
40%	13 Months	60%
50%	14 Months	65%
60%	15 Months	70%
70%	17 Months	76%
80%	18 Months	83%
90%	20 Months	93%
100%	32 Months	146%



F.6.0 TOTAL PROJECT COST SUMMARY

The Total Project Cost Summary (TPCS) addresses inflation through project completion; accomplished by escalation to the mid-point of construction per ER 1110-2-1302, Appendix C, Page C-2. The TPCS' are based on the scope of the NED plan and the NEDBU plan along with the project schedules. Due to the selection of the NEDBU plan as the Tentively Selected Plan, the TPCS for both the NED plan and the NEDBU plan are included in this Appendix. The TPCS' include Federal and non-Federal costs for Lands and Damages, all construction features, PED, S&A, and all other non-construction features along with the appropriate contingencies and escalation associated with each of these activities. The TPCS' are formatted according to the WBS and uses Civil Works Construction Cost Indexing System factors for escalation (EM 1110-2-1304) of all activities (including PED and S&A). The TPCS' were prepared using the MCACES/MII cost estimate on each of the plans as well as the contingencies developed in the CSRA and the project schedules. The TPCS' for the NED plan and the NEDBU plan (Tentively Selected Plan) are contained on the following pages.

F.7.0 COST MCX TPCS CERTIFICATION

The Cost MCX Total Project Cost Summary (TPCS) Certification is contained on the following page(s) with the TPCS for each plan following. The certification will be provided for the Final Report.

INSERT COST CERTIFICATION

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

PROJECT: New Haven Harbor Deep Draft Navigation Improvement Project
PROJECT NO: P2 xxxxxx
LOCATION: New Haven, CT

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Andrew Jordan

PREPARED: 8/30/2018

This Estimate reflects the scope and schedule in report; New Haven Harbor Improvements, CT Draft Integrated Feasibility Report/Environmental Impact Statement

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)					TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST (\$K) C	CNTG (\$K) D	CNTG (%) E	TOTAL (\$K) F	Program Year (Budget EC): Effective Price Level Date:				Spent Thru: 1-Oct-17 (\$K)	TOTAL FIRST COST (\$K) K	INFLATED (%) L	COST (\$K) M	CNTG (\$K) N	FULL (\$K) O
						ESC (%) G	COST (\$K) H	CNTG (\$K) I	TOTAL (\$K) J						
12	NAVIGATION PORTS & HARBORS Mob/Der	\$2,666	\$506	19.0%	\$3,172	2.0%	\$2,719	\$517	\$3,236	\$0	\$3,236	10.4%	\$3,002	\$570	\$3,572
12	NAVIGATION PORTS & HARBORS Entrance	\$3,935	\$748	19.0%	\$4,683	2.0%	\$4,014	\$763	\$4,777	\$0	\$4,777	10.4%	\$4,431	\$842	\$5,273
12	NAVIGATION PORTS & HARBORS Entrance	\$1,430	\$272	19.0%	\$1,702	2.0%	\$1,459	\$277	\$1,736	\$0	\$1,736	10.4%	\$1,611	\$306	\$1,917
12	NAVIGATION PORTS & HARBORS Bend (O)	\$3,939	\$748	19.0%	\$4,687	2.0%	\$4,018	\$763	\$4,781	\$0	\$4,781	10.4%	\$4,436	\$843	\$5,278
12	NAVIGATION PORTS & HARBORS Bend (R)	\$16,202	\$3,078	19.0%	\$19,281	2.0%	\$16,528	\$3,140	\$19,668	\$0	\$19,668	10.4%	\$18,245	\$3,467	\$21,712
12	NAVIGATION PORTS & HARBORS Interior C	\$15,310	\$2,909	19.0%	\$18,219	2.0%	\$15,618	\$2,967	\$18,585	\$0	\$18,585	10.4%	\$17,241	\$3,276	\$20,516
12	NAVIGATION PORTS & HARBORS Maneuve	\$4,864	\$924	19.0%	\$5,788	2.0%	\$4,961	\$943	\$5,904	\$0	\$5,904	10.4%	\$5,477	\$1,041	\$6,518
12	NAVIGATION PORTS & HARBORS Turning B	\$931	\$177	19.0%	\$1,108	2.0%	\$950	\$180	\$1,130	\$0	\$1,130	10.4%	\$1,049	\$199	\$1,248
CONSTRUCTION ESTIMATE TOTALS:		\$49,278	\$9,363		\$58,640	2.0%	\$50,267	\$9,551	\$59,818	\$0	\$59,818	10.4%	\$55,491	\$10,543	\$66,035
01	LANDS AND DAMAGES	\$0	\$0 -		\$0	-	\$0	\$0	\$0	\$0	\$0	-	\$0	\$0	\$0
30	PLANNING, ENGINEERING & DESIGN	\$2,464	\$468	19.0%	\$2,932	3.8%	\$2,558	\$486	\$3,044	\$0	\$3,044	5.8%	\$2,707	\$514	\$3,221
31	CONSTRUCTION MANAGEMENT	\$2,464	\$468	19.0%	\$2,932	3.8%	\$2,558	\$486	\$3,044	\$0	\$3,044	13.9%	\$2,914	\$554	\$3,467
PROJECT COST TOTALS:		\$54,205	\$10,299	19.0%	\$64,504		\$55,382	\$10,523	\$65,905	\$0	\$65,905	10.3%	\$61,112	\$11,611	\$72,723

CHIEF, COST ENGINEERING, Andrew Jordan

ESTIMATED TOTAL PROJECT COST: \$72,723

PROJECT MANAGER, Barbara Blumeris

CHIEF, REAL ESTATE, Vacant

CHIEF, PLANNING, John Kennelly

CHIEF, ENGINEERING, Alan Huntley

CHIEF, OPERATIONS, Eric Pedersen

CHIEF, CONSTRUCTION, Sean Dolan

CHIEF, CONTRACTING, Sheila Winston

CHIEF, PM-PB, Janet Harrington

CHIEF, DPM, Scott Acone

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

**** CONTRACT COST SUMMARY ****

PROJECT: New Haven Harbor Deep Draft Navigation Improvement Project
LOCATION: New Haven, CT

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Andrew Jordan

PREPARED: 8/30/2018

This Estimate reflects the scope and schedule in report; New Haven Harbor Improvements, CT Draft Integrated Feasibility Report/Environmental Impact Statement

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 30-Aug-18				Program Year (Budget EC): 2019								
		Effective Price Level: 1-Oct-17				Effective Price Level Date: 1 OCT 18								
		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	INFLATED (%)	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														
12	NAVIGATION PORTS & HARBORS Mob/Der	\$2,666	\$506	19.0%	\$3,172	2.0%	\$2,719	\$517	\$3,236	2022Q3	10.4%	\$3,002	\$570	\$3,572
12	NAVIGATION PORTS & HARBORS Entrance	\$3,935	\$748	19.0%	\$4,683	2.0%	\$4,014	\$763	\$4,777	2022Q3	10.4%	\$4,431	\$842	\$5,273
12	NAVIGATION PORTS & HARBORS Entrance	\$1,430	\$272	19.0%	\$1,702	2.0%	\$1,459	\$277	\$1,736	2022Q3	10.4%	\$1,611	\$306	\$1,917
12	NAVIGATION PORTS & HARBORS Bend (O	\$3,939	\$748	19.0%	\$4,687	2.0%	\$4,018	\$763	\$4,781	2022Q3	10.4%	\$4,436	\$843	\$5,278
12	NAVIGATION PORTS & HARBORS Bend (R)	\$16,202	\$3,078	19.0%	\$19,281	2.0%	\$16,528	\$3,140	\$19,668	2022Q3	10.4%	\$18,245	\$3,467	\$21,712
12	NAVIGATION PORTS & HARBORS Interior C	\$15,310	\$2,909	19.0%	\$18,219	2.0%	\$15,618	\$2,967	\$18,585	2022Q3	10.4%	\$17,241	\$3,276	\$20,516
12	NAVIGATION PORTS & HARBORS Maneuve	\$4,864	\$924	19.0%	\$5,788	2.0%	\$4,961	\$943	\$5,904	2022Q3	10.4%	\$5,477	\$1,041	\$6,518
12	NAVIGATION PORTS & HARBORS Turning B	\$931	\$177	19.0%	\$1,108	2.0%	\$950	\$180	\$1,130	2022Q3	10.4%	\$1,049	\$199	\$1,248
CONSTRUCTION ESTIMATE TOTALS:		\$49,278	\$9,363	19.0%	\$58,640		\$50,267	\$9,551	\$59,818			\$55,491	\$10,543	\$66,035
01	LANDS AND DAMAGES	\$0	\$0	0.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
30	PLANNING, ENGINEERING & DESIGN													
5.0%	Project Management	\$2,464	\$468	19.0%	\$2,932	3.8%	\$2,558	\$486	\$3,044	2020Q3	5.8%	\$2,707	\$514	\$3,221
0.0%	Planning & Environmental Compliance	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Engineering & Design	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Reviews, ATRs, IEPRs, VE	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Life Cycle Updates (cost, schedule, risks)	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Contracting & Reprographics	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Engineering During Construction	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Planning During Construction	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Adaptive Management & Monitoring	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Project Operations	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
31	CONSTRUCTION MANAGEMENT													
5.0%	Construction Management	\$2,464	\$468	19.0%	\$2,932	3.8%	\$2,558	\$486	\$3,044	2022Q3	13.9%	\$2,914	\$554	\$3,467
0.0%	Project Operation:	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Project Management	\$0	\$0	19.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
CONTRACT COST TOTALS:		\$54,205	\$10,299		\$64,504		\$55,382	\$10,523	\$65,905			\$61,112	\$11,611	\$72,723

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

PROJECT: **New Haven Harbor Deep Draft Navigation Improvement Project**
PROJECT NO: P2 xxxxxx
LOCATION: New Haven, CT

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Andrew Jordan

PREPARED: 8/30/2018

This Estimate reflects the scope and schedule in report; New Haven Harbor Improvements, CT Draft Integrated Feasibility Report/Environmental Impact Statement

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)					TOTAL PROJECT COST (FULLY FUNDED)				
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST (\$K) C	CNTG (\$K) D	CNTG (%) E	TOTAL (\$K) F	Program Year (Budget EC): Effective Price Level Date:				Spent Thru: 1-Oct-17 (\$K)	TOTAL FIRST COST (\$K) K	INFLATED (%) L	COST (\$K) M	CNTG (\$K) N	FULL (\$K) O
						ESC (%) G	COST (\$K) H	CNTG (\$K) I	TOTAL (\$K) J						
12	NAVIGATION PORTS & HARBORS Mob/Der	\$4,836	\$967	20.0%	\$5,803	2.0%	\$4,933	\$987	\$5,920	\$0	\$5,920	10.4%	\$5,446	\$1,089	\$6,535
12	NAVIGATION PORTS & HARBORS Entrance	\$3,935	\$787	20.0%	\$4,722	2.0%	\$4,014	\$803	\$4,817	\$0	\$4,817	10.4%	\$4,431	\$886	\$5,317
12	NAVIGATION PORTS & HARBORS Entrance	\$1,430	\$286	20.0%	\$1,716	2.0%	\$1,459	\$292	\$1,751	\$0	\$1,751	10.4%	\$1,611	\$322	\$1,933
12	NAVIGATION PORTS & HARBORS Bend (O)	\$3,939	\$788	20.0%	\$4,727	2.0%	\$4,018	\$804	\$4,822	\$0	\$4,822	10.4%	\$4,436	\$887	\$5,323
12	NAVIGATION PORTS & HARBORS Bend (R)	\$16,202	\$3,240	20.0%	\$19,443	2.0%	\$16,528	\$3,306	\$19,833	\$0	\$19,833	10.4%	\$18,245	\$3,649	\$21,894
12	NAVIGATION PORTS & HARBORS Interior C	\$16,013	\$3,203	20.0%	\$19,215	2.0%	\$16,334	\$3,267	\$19,601	\$0	\$19,601	10.4%	\$18,032	\$3,606	\$21,638
12	NAVIGATION PORTS & HARBORS Maneuve	\$4,864	\$973	20.0%	\$5,837	2.0%	\$4,961	\$992	\$5,954	\$0	\$5,954	10.4%	\$5,477	\$1,095	\$6,573
12	NAVIGATION PORTS & HARBORS Turning B	\$931	\$186	20.0%	\$1,117	2.0%	\$950	\$190	\$1,140	\$0	\$1,140	10.4%	\$1,049	\$210	\$1,258
CONSTRUCTION ESTIMATE TOTALS:		\$52,151	\$10,430		\$62,581	2.0%	\$53,198	\$10,640	\$63,837	\$0	\$63,837	10.4%	\$58,726	\$11,745	\$70,472
01	LANDS AND DAMAGES	\$143	\$14	9.7%	\$157	1.6%	\$145	\$14	\$160	\$0	\$160	4.0%	\$151	\$15	\$166
30	PLANNING, ENGINEERING & DESIGN	\$2,708	\$542	20.0%	\$3,249	3.8%	\$2,811	\$562	\$3,373	\$0	\$3,373	6.1%	\$2,983	\$597	\$3,579
31	CONSTRUCTION MANAGEMENT	\$2,608	\$522	20.0%	\$3,129	3.8%	\$2,707	\$541	\$3,248	\$0	\$3,248	13.9%	\$3,083	\$617	\$3,700
PROJECT COST TOTALS:		\$57,608	\$11,507	20.0%	\$69,115		\$58,860	\$11,757	\$70,617	\$0	\$70,617	10.3%	\$64,944	\$12,973	\$77,917

CHIEF, COST ENGINEERING, Andrew Jordan

ESTIMATED TOTAL PROJECT COST: \$77,917

PROJECT MANAGER, Barbara Blumeris

CHIEF, REAL ESTATE, Vacant

CHIEF, PLANNING, John Kennelly

CHIEF, ENGINEERING, Alan Huntley

CHIEF, OPERATIONS, Eric Pedersen

CHIEF, CONSTRUCTION, Sean Dolan

CHIEF, CONTRACTING, Sheila Winston

CHIEF, PM-PB, Janet Harrington

CHIEF, DPM, Scott Acone

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

**** CONTRACT COST SUMMARY ****

PROJECT: New Haven Harbor Deep Draft Navigation Improvement Project
LOCATION: New Haven, CT

DISTRICT: NAE District
POC: CHIEF, COST ENGINEERING, Andrew Jordan

PREPARED: 8/30/2018

This Estimate reflects the scope and schedule in report; New Haven Harbor Improvements, CT Draft Integrated Feasibility Report/Environmental Impact Statement

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 30-Aug-18		Effective Price Level: 1-Oct-17		Program Year (Budget EC): 2019		Effective Price Level Date: 1 OCT 18						
		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	INFLATED (%)	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														
12	NAVIGATION PORTS & HARBORS Mob/Der	\$4,836	\$967	20.0%	\$5,803	2.0%	\$4,933	\$987	\$5,920	2022Q3	10.4%	\$5,446	\$1,089	\$6,535
12	NAVIGATION PORTS & HARBORS Entrance	\$3,935	\$787	20.0%	\$4,722	2.0%	\$4,014	\$803	\$4,817	2022Q3	10.4%	\$4,431	\$886	\$5,318
12	NAVIGATION PORTS & HARBORS Entrance	\$1,430	\$286	20.0%	\$1,716	2.0%	\$1,459	\$292	\$1,751	2022Q3	10.4%	\$1,611	\$322	\$1,933
12	NAVIGATION PORTS & HARBORS Bend (O	\$3,939	\$788	20.0%	\$4,727	2.0%	\$4,018	\$804	\$4,822	2022Q3	10.4%	\$4,436	\$887	\$5,323
12	NAVIGATION PORTS & HARBORS Bend (R)	\$16,202	\$3,240	20.0%	\$19,443	2.0%	\$16,528	\$3,306	\$19,833	2022Q3	10.4%	\$18,245	\$3,649	\$21,894
12	NAVIGATION PORTS & HARBORS Interior C	\$16,013	\$3,203	20.0%	\$19,215	2.0%	\$16,334	\$3,267	\$19,601	2022Q3	10.4%	\$18,032	\$3,606	\$21,638
12	NAVIGATION PORTS & HARBORS Maneuve	\$4,864	\$973	20.0%	\$5,837	2.0%	\$4,961	\$992	\$5,954	2022Q3	10.4%	\$5,477	\$1,095	\$6,573
12	NAVIGATION PORTS & HARBORS Turning B	\$931	\$186	20.0%	\$1,117	2.0%	\$950	\$190	\$1,140	2022Q3	10.4%	\$1,049	\$210	\$1,258
CONSTRUCTION ESTIMATE TOTALS:		\$52,151	\$10,430	20.0%	\$62,581		\$53,198	\$10,640	\$63,837			\$58,726	\$11,745	\$70,472
01	LANDS AND DAMAGES	\$143	\$14	9.7%	\$157	2.0%	\$145	\$14	\$160	2020Q3	4.0%	\$151	\$15	\$166
30	PLANNING, ENGINEERING & DESIGN													
5.0%	Project Management	\$2,608	\$522	20.0%	\$3,129	3.8%	\$2,707	\$541	\$3,248	2020Q3	5.8%	\$2,865	\$573	\$3,437
0.0%	Planning & Environmental Compliance	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Engineering & Design	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Reviews, ATRs, IEPRs, VE	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Life Cycle Updates (cost, schedule, risks)	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Contracting & Reprographics	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Engineering During Construction	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Planning During Construction	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Adaptive Management & Monitoring	\$100	\$20	20.0%	\$120	3.8%	\$104	\$21	\$125	2022Q3	13.9%	\$118	\$24	\$142
0.0%	Project Operations	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
31	CONSTRUCTION MANAGEMENT													
5.0%	Construction Management	\$2,608	\$522	20.0%	\$3,129	3.8%	\$2,707	\$541	\$3,248	2022Q3	13.9%	\$3,083	\$617	\$3,700
0.0%	Project Operation:	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
0.0%	Project Management	\$0	\$0	20.0%	\$0	0.0%	\$0	\$0	\$0	0	0.0%	\$0	\$0	\$0
CONTRACT COST TOTALS:		\$57,608	\$11,507		\$69,116		\$58,860	\$11,757	\$70,617			\$64,944	\$12,973	\$77,917

**ATTACHMENT F-1 – RISK REGISTER FOR NEDBU PLAN
(TENTIVELY SELECTED PLAN)**

New Haven Harbor Improvement Dredging - General Investigation, CENAE Cost and Schedule Risk Register													
RT	Ref #	CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule			Risk Quantification Discussions	Risk Mitigation Measures
						Impact ©	Likelihood ©	Risk Level ©	Impact (\$)	Likelihood (\$)	Risk Level (\$)		
Contract Acquisition (CA)													
		CA1	Contract Acquisition	Risk of type of contract used to procure.	Other large dredging projects are using IFB, safe to assume same contract vehicle used for New Haven Harbor. There is nothing in this design significantly different from larger improvement dredging projects. Safe to assume similar contract vehicle. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		CA2	Availability of large contractors	Risk of insufficient contractors available for bid/construction of project.	Impossible to predict market conditions in 5 years. Historically this has not been an issue with large dredging projects. Boston Harbor Improvement Dredging project, which is 3x the size of this project, will be awarded prior to finalization of this risk register. Will be able to gauge current competition for a project of this magnitude. The likelihood is unlikely but the impact to project cost could be significant.	Significant	Unlikely	Medium			#N/A	The Boston Harbor Improvement Dredging contract had its bid opening. Ample competition was had (3 bidders) but the bids were extremely varied, from 50% lower and 50% higher than the IGE. It is possible competition and the desire to win the bid could drive construction costs 2% lower. On the contrary, limited competition could drive construction costs up to 10% higher.	An acquisition strategy meeting(s) will be held during design phase to determine the best course of action. There is nothing abnormal in this project that doesn't exist in other projects that have been, or will be, solicited by NAE already. Similar projects, both larger and smaller, have been awarded through IFB with no performance issues.
		CA3	Contract Modifications	Risk of mods during construction	Contract mods in a project of this size are very likely. Differing site conditions and variations in quantities will likely be issues with this project. The cost and schedule impacts are expected to be significant.	Critical	Very Likely	High	Critical	Very Likely	High	Contract modifications are nearly a given on a project of this size. NAE should expect a minimum of 2% of the construction cost in mods with a maximum of 10%. 5% is the likely value.	Developing a comprehensive set of plans and specifications and including a DRC in the solicitation can help to mitigate contract modification concerns.
		CA4	Separate contracts	Risk of using separate contracts for "ordinary" material and "hard" material.	Current assumption is one contract for all material removal. Significantly less rock in this project so one contract should be sufficient. The risk for 2nd contract is negligible but would have marginal impact to the cost (increase in PED costs for additional contract action) and a significant impact to the schedule depending on the timeline of ordinary material removal and hard material contract action/construction.	Negligible	Unlikely	Low	Significant	Unlikely	Medium	The quantification is based on anticipated costs/delays if a second contract action is put in place for the rock removal. These are based on a best value source selection as a worst-case.	Again, as the project moves into the design phase, the PDT will have a better handle on the quantity of rock to be removed and will determine if a separate contract is necessary for rock removal.
Lands and Damages (LD)													
		LD1	Shellfish leases	There are shellfish leases adjacent to the channel and at some of the anticipated disposal areas.	Shellfish lease areas are owned by the State. The State has sufficient time to settle lease issues with little expected impact to schedule (i.e. start of construction). Schedule impact would push midpoint of construction slightly which would impact project cost with a slight increase in escalation-related costs.	Marginal	Unlikely	Low	Negligible	Unlikely	Low	Cost quantification assumes a 6-month delay which results in a 1% escalation-related cost increase.	The PM will need to stay in contact with counterparts at the State level to ensure the shellfish leases are being dealt with.
Construction (CO)													
		CO1	restricted work windows		The proposed turning basin area dredging may be affected by winter flounder. No disposal between may-september. State has jurisdiction. Will likely need to sequence dredging/disposal throughout harbor. Blasting only allowed november through march. Forcing the contractor to sequence the work has the ability to affect the cost and schedule. The likelihood is very likely and the impact could be significant.	Significant	Very Likely	High	Significant	Very Likely	High	Time of year restrictions have been identified and a rough schedule of removal has been developed. It appears, with the information currently known, some dredging will be able to occur throughout most of the contract duration save for a one month window towards the back end of the anticipated schedule. A likely cost/schedule impact has been assumed at 2% and 6% of the construction cost and schedule, respectively. Minimum impacts of 1% and 5% and maximum impacts of 5% and 10% for the cost and schedule, respectively, are anticipated.	As permits are obtained during design, a more concrete schedule can be developed to determine if the contractor needs to be instructed as to certain sequencing of dredge areas.
		CO2	air quality		potential for issues with air quality. Will research further before final risk assessment is made.			#N/A			#N/A		
		CO3	weather		so many weather delays are allowed in the proposed contract duration. New haven is more susceptible to hurricanes (less common) and less susceptible to noreasters (more common). Assume risk of typical weather is mitigated in contract duration. Additional risk modeled in contract modification risk as well as acts of god risk for extremely severe weather events. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.

New Haven Harbor Improvement Dredging - General Investigation, CENAE Cost and Schedule Risk Register													
RT	Ref #	CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule			Risk Quantification Discussions	Risk Mitigation Measures
						Impact ©	Likelihood ©	Risk Level ©	Impact (\$)	Likelihood (\$)	Risk Level (\$)		
		CO4	contract duration	Assumed contract duration vs actual production/actual duration	PDT is assuming 18 month contract duration. Actual duration, based on anticipated/likely definitive responsibility criteria (DRC), should be easily completed in assumed contract duration. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		CO5	differing site conditions	Risk of additional unsuitable material and/or more rock than assumed.	Risk associated with rock quantity captured elsewhere. This item deals exclusively unsuitable material. Additional testing to be done during PED. Additional unsuitable material has potential to increase CAD cell size. The likelihood is possible and the cost and schedule impact is moderate.	Critical	Possible	High	Moderate	Possible	Medium	Cost and duration of excavating and disposing of material to create a CAD Cell has been determined. These values have been entered as the probable values. However, the exact quantity of unsuitable material has yet to be determined. The minimum impact has been entered as zero in the case were the EPA agrees all material is suitable for disposal at CLIS. The maximum impact has been estimated as twice the current quantity of potentially unsuitable material.	Additional sampling is scheduled for this summer with even more additional sampling to occur during design. The ERS at NAE is currently in discussions with the EPA to get a ruling on the suitability of the material that has been identified to date.
Cost and Schedule (ES)													
		ES1	Drill and Blast Estimation	Confidence in drill and blast estimation methodology	There is a concern that the drill and blast spreadsheet that NAE is using to estimate the drill and blast for rock removal is inaccurate. It is possible that this methodology is incorrect, but could be overestimating or underestimating. The impact could be moderate for both the cost and schedule.	Moderate	Possible	Medium	Moderate	Possible	Medium	The drill and blast spreadsheet has not been revised in quite a number of years. Recent contract actions have lumped this material in with other material types so no current data has been acquired to determine if our estimating methods are sound. The maximum impact has been estimated at 25% more than the current value while the minimum impact is 5% less than the current value.	Additional PED funds are being sought by the Cost Estimating Section in order to revise/update the drilling and blasting spreadsheet.
		ES2	CEDEP	Confidence in CEDEP estimation methodology	There is a concern that the CEDEP spreadsheet that NAE is using to estimate dredge material removal is inaccurate. This is mitigated by using the most up to date sheet distributed by the Cost MCX and using similar assumptions to dredging contract actions which have provided results on par with bid submissions. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		ES3	Schedule	Confidence in Schedule	The schedule is based on the production rates developed from CEDEP and restrictions due to numerous environmental windows. It is assumed rock removal can be accomplished in one season while "ordinary" material removal will take two dredge seasons. Two mob/demobs have been included for the mechanical dredging equipment. Risk has been adequately addressed in the cost estimate. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		ES4	Equipment Assumptions	Confidence in assumed equipment to complete project	There are numerous equipment sizes in both dredge and scow that will affect the unit price and production rate. It is likely the actual equipment used during construction will differ from the proposed, however the impact could increase or decrease the cost and schedule. This impact could be significant dependant on the contractors assumption on equipment.	Significant	Likely	High	Significant	Likely	High	It is estimated that using different equipment can swing the construction cost up to 1% lower and 4% higher than the current construction cost with an impact to schedule of 1 month shorter or 3 months longer.	The Cost Estimating Section will continue to gather information at bid openings of similar projects to determine what equipment is being proposed for similar work and adjust the cost estimate for this project accordingly.
Project & Program Management (PM)													
		PM1	Funding Issues	Risk of insufficient funding for design/construction start.	CT Port Authority has bonding capability and there are no issues anticipated with the federal share. Any delay with authorization of the project will push the start dates to the right resulting in additional escalation impacts. This is unlikely based on the assumed schedule and would have a moderate impact on the project cost.	Moderate	Unlikely	Low			#N/A	Maximum impact to project costs if delayed due to funding is anticipated at one year which represents a 2.5% increase in cost.	The PM will need to stay in contact with counterparts at the State level to ensure the funding is being requested in timely manner.
		PM2	Escalation exceeding CWCCIS		Rates in CWCCIS have been fairly steady (slight increase). Likelihood that CWCCIS will be lower than actual is possible, however impact is anticipated to be marginal. No schedule impact anticipated with this risk.	Moderate	Possible	Medium			#N/A	Maximum impact to project costs if CWCCIS escalation is incorrect has been estimated at a 2.5% increase in cost.	The estimate will be escalated using the most current CWCCIS during yearly updates to the TPCS in concert with PPMD requirements.
Regulatory & Environmental (RE)													

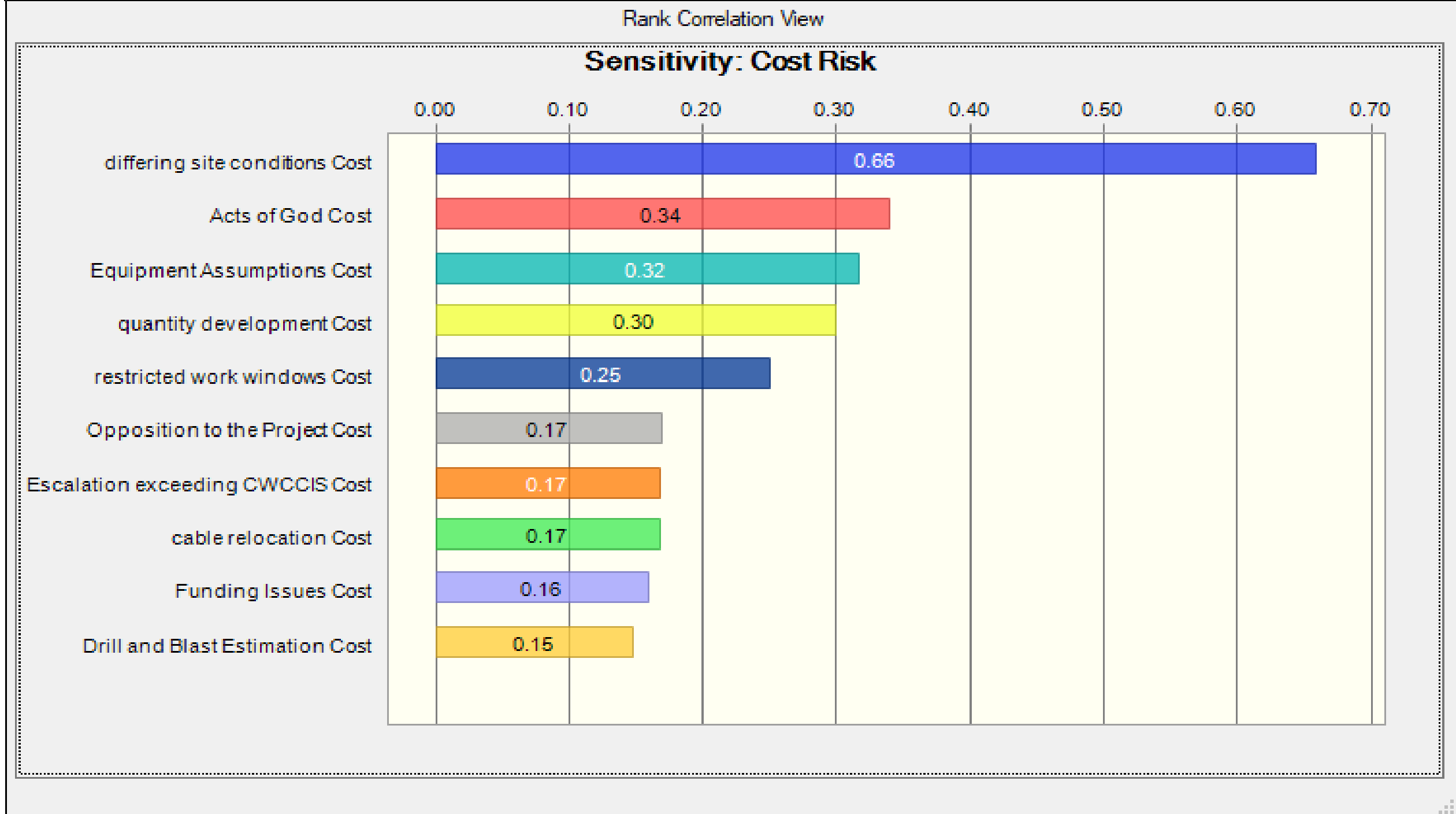
New Haven Harbor Improvement Dredging - General Investigation, CENAE Cost and Schedule Risk Register													
RT	Ref #	CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule			Risk Quantification Discussions	Risk Mitigation Measures
						Impact ©	Likelihood ©	Risk Level ©	Impact (\$)	Likelihood (\$)	Risk Level (\$)		
		RE1			most of regulatory issues will be resolved prior to end of feasibility. No endangered species issues. No risk associated with this item.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
Technical Design (TD) / Project Scope Growth													
		TD1	quantity development	Confidence in quantity development	Seperating maintenance materials from improvement materials. The only new area to be dredged is in the proposed turning basin. Quantity is limited from -35 to whatever depth is determined from feasibility study. There is no risk in the channel becoming wider and the depth will be determined during feasibility so the only real risk is in the rock quantity. Rock quantity development based on borings from 1988, 1977, and 2002 and PDT has high confidence where pinnacles are. Rock quantities are considered conservative and quantity may actually decrease depending on the depth of project and the actual spread of the rock material. PDT feels confident in rock quantities developed to date. An increase in rock quantity will affect project cost and schedule; while this is unlikely, the cost and schedule impact would be significant.	Significant	Unlikely	Medium	Significant	Unlikely	Medium	Rock removal is always the most expensive aspect of a dredge improvement project. Because of that, confidence in the rock quantity is of the utmost importance. It has been assumed the rock quantity may be 5% higher than actual or 10% lower. Minimum and maximum cost impacts have been estimated as 5% less and 10% more than the current rock removal costs, respectively.	There is potential for additional borings to be done during PED which would help to solidify the quantity of rock removal necessary for this project.
External													
		EX1	cable relocation	risk of cable not being moved prior to start of construction.	similar issue with Boston Harbor. Electric/fiber optic cable in channel is interfering with improvement dredging. Cable issue resolved in Boston Harbor through litigation. No impact expected in New Haven. USACE would litigate; cost/schedule impact limited to delays to start of construction (resulting in additional escalation impacts)	Moderate	Possible	Medium	Moderate	Possible	Medium	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 2.5% increase in construction costs.	
		EX2	Acts of God	Acts of God have the potential to impact the project.	Major hurricanes have the potential to impact construction. Delays caused by any acts of God will have cost and schedule impacts however these are expected to be marginal.	Significant	Possible	Medium	Marginal	Possible	Low	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 5% increase in construction costs.	
		EX3	Opposition to the Project		Risk in NY opposing the project. Mitigating risk by appealing NY with marsh creation. Further risk of NY being unhappy and elevating issue potentially delaying start of construction.	Moderate	Possible	Medium	Moderate	Possible	Medium	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 2.5% increase in construction costs.	
		EX4	Berth improvements	Purpose of the project is to provide access to berths in the harbor.	Risk of project beneficiaries (each terminal) being late in improving their own facilities. Requirements (i.e. these improvements) are necessary before the end of PED. Likelihood is low that berths aren't improved in a timely manner. Impact is delay of 1 year (ie additional escalation to project cost).	Moderate	Unlikely	Low			#N/A	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 2.5% increase in construction costs.	

New Haven Harbor Improvement Dredging - General Investigation

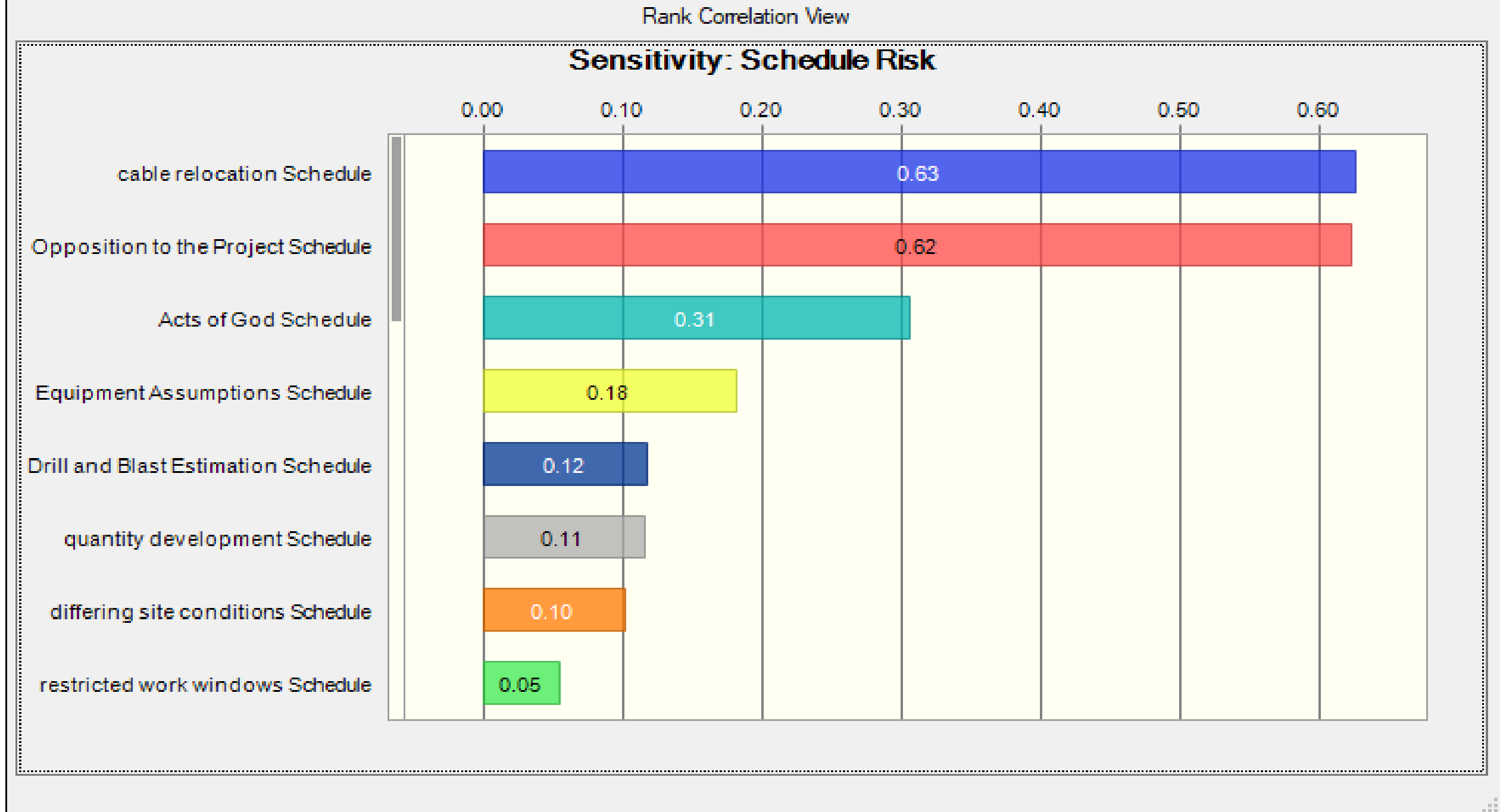
Contingency on Base Estimate		80% Confidence Project Cost	
Baseline Estimate Cost ->OCTOBER 1, 2017 PRICE LEVEL		\$49,277,632	19%
Baseline Estimate Cost Contingency Amount ->		\$9,362,750	
Baseline Estimate Construction Cost (80% Confidence) ->		\$58,640,382	

Contingency on Schedule		80% Confidence Project Schedule	
Project Base Schedule Duration ->		22.0 Months	83%
Schedule Contingency Duration ->		18.3 Months	
Project Schedule Duration (80% Confidence) ->		40.3 Months	

- Cost Outputs Distribution and Sensitivity - NED Plan



- Schedule Outputs Distribution and Sensitivity - NED Plan



New Haven Harbor Improvement Dredging - General Investigation, CENAE Cost and Schedule Risk Register													
RT	Ref #	CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule			Risk Quantification Discussions	Risk Mitigation Measures
						Impact ©	Likelihood ©	Risk Level ©	Impact (\$)	Likelihood (\$)	Risk Level (\$)		
Contract Acquisition (CA)													
		CA1	Contract Acquisition	Risk of type of contract used to procure.	Other large dredging projects are using IFB, safe to assume same contract vehicle used for New Haven Harbor. There is nothing in this design significantly different from larger improvement dredging projects. Safe to assume similar contract vehicle. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		CA2	Availability of large contractors	Risk of insufficient contractors available for bid/construction of project.	Impossible to predict market conditions in 5 years. Historically this has not been an issue with large dredging projects. Boston Harbor Improvement Dredging project, which is 3x the size of this project, will be awarded prior to finalization of this risk register. Will be able to gauge current competition for a project of this magnitude. The likelihood is unlikely but the impact to project cost could be significant.	Significant	Unlikely	Medium			#N/A	The Boston Harbor Improvement Dredging contract had its bid opening. Ample competition was had (3 bidders) but the bids were extremely varied, from 50% lower and 50% higher than the IGE. It is possible competition and the desire to win the bid could drive construction costs 2% lower. On the contrary, limited competition could drive construction costs up to 10% higher.	An acquisition strategy meeting(s) will be held during design phase to determine the best course of action. There is nothing abnormal in this project that doesn't exist in other projects that have been, or will be, solicited by NAE already. Similar projects, both larger and smaller, have been awarded through IFB with no performance issues.
		CA3	Contract Modifications	Risk of mods during construction	Contract mods in a project of this size are very likely. Differing site conditions and variations in quantities will likely be issues with this project. The cost and schedule impacts are expected to be significant.	Critical	Very Likely	High	Critical	Very Likely	High	Contract modifications are nearly a given on a project of this size. NAE should expect a minimum of 2% of the construction cost in mods with a maximum of 10%. 5% is the likely value.	Developing a comprehensive set of plans and specifications and including a DRC in the solicitation can help to mitigate contract modification concerns.
		CA4	Separate contracts	Risk of using separate contracts for "ordinary" material and "hard" material.	Current assumption is one contract for all material removal. Significantly less rock in this project so one contract should be sufficient. The risk for 2nd contract is negligible but would have marginal impact to the cost (increase in PED costs for additional contract action) and a significant impact to the schedule depending on the timeline of ordinary material removal and hard material contract action/construction.	Negligible	Unlikely	Low	Significant	Unlikely	Medium	The quantification is based on anticipated costs/delays if a second contract action is put in place for the rock removal. These are based on a best value source selection as a worst-case.	Again, as the project moves into the design phase, the PDT will have a better handle on the quantity of rock to be removed and will determine if a separate contract is necessary for rock removal.
Lands and Damages (LD)													
		LD1	Shellfish leases	There are shellfish leases adjacent to the channel and at some of the anticipated disposal areas.	Shellfish lease areas are owned by the State. The State has sufficient time to settle lease issues with little expected impact to schedule (i.e. start of construction). Schedule impact would push midpoint of construction slightly which would impact project cost with a slight increase in escalation-related costs.	Marginal	Unlikely	Low	Negligible	Unlikely	Low	Cost quantification assumes a 6-month delay which results in a 1% escalation-related cost increase.	The PM will need to stay in contact with counterparts at the State level to ensure the shellfish leases are being dealt with.
		LD2						#N/A			#N/A		
Construction (CO)													
		CO1	restricted work windows		The proposed turning basin area dredging may be affected by winter flounder. No disposal between may-september. State has jurisdiction. Will likely need to sequence dredging/disposal throughout harbor. Blasting only allowed november through march. Forcing the contractor to sequence the work has the ability to affect the cost and schedule. The likelihood is very likely and the impact could be significant.	Significant	Very Likely	High	Significant	Very Likely	High	Time of year restrictions have been identified and a rough schedule of removal has been developed. It appears, with the information currently known, some dredging will be able to occur throughout most of the contract duration save for a one month window towards the back end of the anticipated schedule. A likely cost/schedule impact has been assumed at 2% and 6% of the construction cost and schedule, respectively. Minimum impacts of 1% and 5% and maximum impacts of 5% and 10% for the cost and schedule, respectively, are anticipated.	As permits are obtained during design, a more concrete schedule can be developed to determine if the contractor needs to be instructed as to certain sequencing of dredge areas.
		CO2	air quality		potential for issues with air quality. Will research further before final risk assessment is made.			#N/A			#N/A		

New Haven Harbor Improvement Dredging - General Investigation, CENAE Cost and Schedule Risk Register													
RT	Ref #	CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule			Risk Quantification Discussions	Risk Mitigation Measures
						Impact @	Likelihood @	Risk Level @	Impact (\$)	Likelihood (\$)	Risk Level (\$)		
		CO3	weather		so many weather delays are allowed in the proposed contract duration. New haven is more susceptible to hurricanes (less common) and less susceptible to nor'easters (more common). Assume risk of typical weather is mitigated in contract duration. Additional risk modeled in contract modification risk as well as acts of god risk for extremely severe weather events. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		CO4	contract duration	Assumed contract duration vs actual production/actual duration	PDT is assuming 18 month contract duration. Actual duration, based on anticipated/likely definitive responsibility criteria (DRC), should be easily completed in assumed contract duration. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		CO5	differing site conditions	Risk of additional unsuitable material and/or more rock than assumed.	Risk associated with rock quantity captured elsewhere. This item deals exclusively unsuitable material. Additional testing to be done during PED. Additional unsuitable material has potential to increase CAD cell size. The likelihood is possible and the cost and schedule impact is moderate.	Critical	Possible	High	Moderate	Possible	Medium	Cost and duration of excavating and disposing of material to create a CAD Cell has been determined. These values have been entered as the probable values. However, the exact quantity of unsuitable material has yet to be determined. The minimum impact has been entered as zero in the case were the EPA agrees all material is suitable for disposal at CLIS. The maximum impact has been estimated as twice the current quantity of potentially unsuitable material.	Additional sampling is scheduled for this summer with even more additional sampling to occur during design. The ERS at NAE is currently in discussions with the EPA to get a ruling on the suitability of the material that has been identified to date.
Cost and Schedule (ES)													
		ES1	Drill and Blast Estimation	Confidence in drill and blast estimation methodology	There is a concern that the drill and blast spreadsheet that NAE is using to estimate the drill and blast for rock removal is inaccurate. It is possible that this methodology is incorrect, but could be overestimating or underestimating. The impact could be moderate for both the cost and schedule.	Moderate	Possible	Medium	Moderate	Possible	Medium	The drill and blast spreadsheet has not been revised in quite a number of years. Recent contract actions have lumped this material in with other material types so no current data has been acquired to determine if our estimating methods are sound. The maximum impact has been estimated at 25% more than the current value while the minimum impact is 5% less than the current value.	Additional PED funds are being sought by the Cost Estimating Section in order to revise/update the drilling and blasting spreadsheet.
		ES2	CEDEP	Confidence in CEDEP estimation methodology	There is a concern that the CEDEP spreadsheet that NAE is using to estimate dredge material removal is inaccurate. This is mitigated by using the most up to date sheet distributed by the Cost MCX and using similar assumptions to dredging contract actions which have provided results on par with bid submissions. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		ES3	Schedule	Confidence in Schedule	The schedule is based on the production rates developed from CEDEP and restrictions due to numerous environmental windows. It is assumed rock removal can be accomplished in one season while "ordinary" material removal will take two dredge seasons. Two mob/demobs have been included for the mechanical dredging equipment. Risk has been adequately addressed in the cost estimate. Risk not modeled.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		ES4	Equipment Assumptions	Confidence in assumed equipment to complete project	There are numerous equipment sizes in both dredge and scow that will affect the unit price and production rate. It is likely the actual equipment used during construction will differ from the proposed, however the impact could increase or decrease the cost and schedule. This impact could be significant dependant on the contractors assumption on equipment.	Significant	Likely	High	Significant	Likely	High	It is estimated that using different equipment can swing the construction cost up to 1% lower and 4% higher than the current construction cost with an impact to schedule of 1 month shorter or 3 months longer.	The Cost Estimating Section will continue to gather information at bid openings of similar projects to determine what equipment is being proposed for similar work and adjust the cost estimate for this project accordingly.
Project & Program Management (PM)													
		PM1	Funding Issues	Risk of insufficient funding for design/construction start.	CT Port Authority has bonding capability and there are no issues anticipated with the federal share. Any delay with authorization of the project will push the start dates to the right resulting in additional escalation impacts. This is unlikely based on the assumed schedule and would have a moderate impact on the project cost.	Moderate	Unlikely	Low			#N/A	Maximum impact to project costs if delayed due to funding is anticipated at one year which represents a 2.5% increase in cost.	The PM will need to stay in contact with counterparts at the State level to ensure the funding is being requested in timely manner.
		PM2	Escalation exceeding CWCCIS		Rates in CWCCIS have been fairly steady (slight increase). Likelihood that CWCCIS will be lower than actual is possible, however impact is anticipated to be marginal. No schedule impact anticipated with this risk.	Moderate	Possible	Medium			#N/A	Maximum impact to project costs if CWCCIS escalation is incorrect has been estimated at a 2.5% increase in cost.	The estimate will be escalated using the most current CWCCIS during yearly updates to the TPCS in concert with PMMD requirements.
Regulatory & Environmental (RE)													

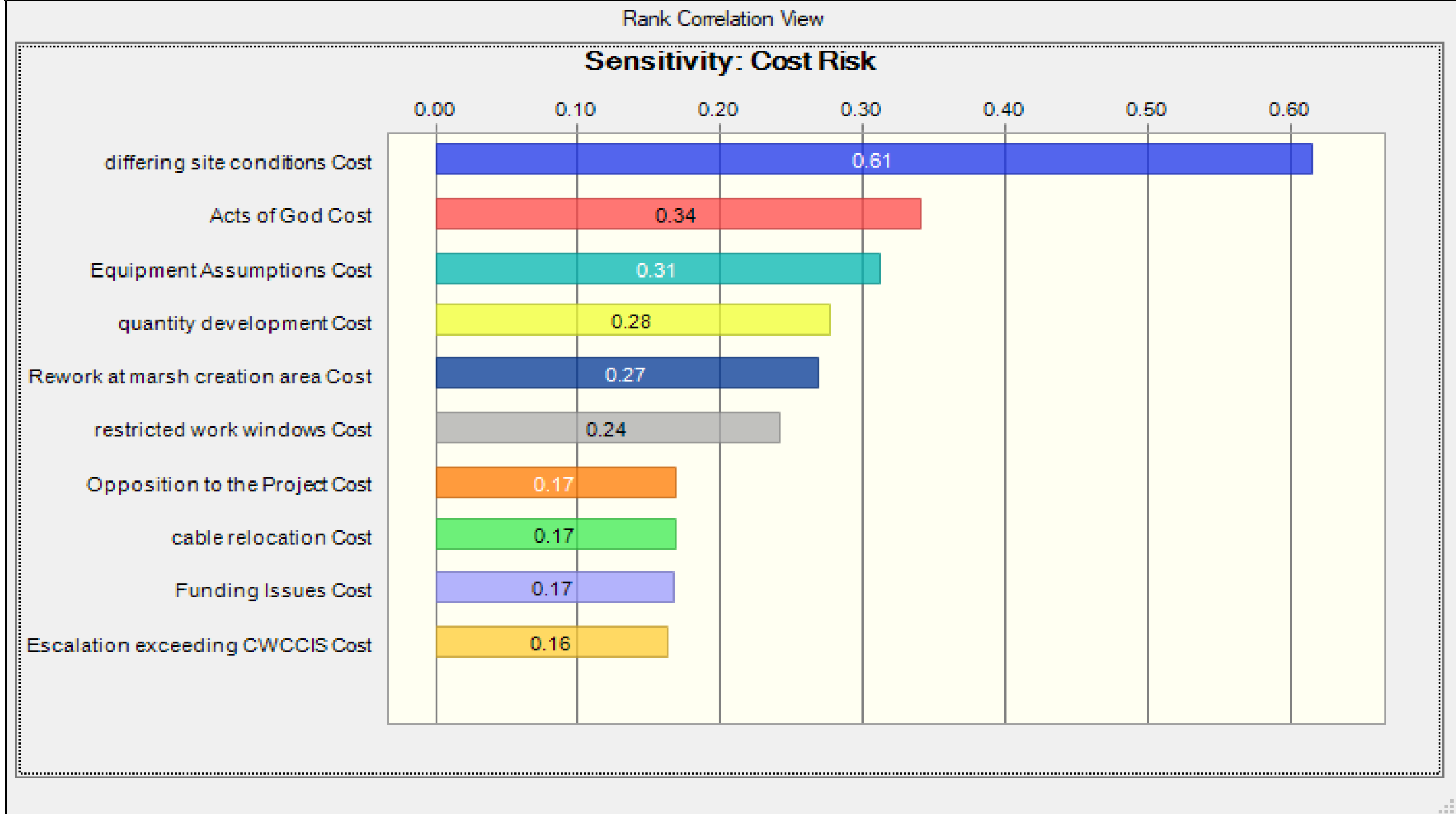
New Haven Harbor Improvement Dredging - General Investigation, CENAE Cost and Schedule Risk Register													
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						Impact @	Likelihood @	Risk Level @	Impact (\$)	Likelihood (\$)	Risk Level (\$)		
		RE1			most of regulatory issues will be resolved prior to end of feasibility. No endangered species issues. No risk associated with this item.			#N/A			#N/A	Risk not modeled.	Risk not modeled.
		RE2	Rework at marsh creation area	Settlement of the material or geotube barrier after the initial fill may require rework.	Rework of the salt marsh creation area in Year 2 of the contract may require additional mob/demob of the hydraulic dredge to fill additional geotubes and provide additional fill within the barrier.	Significant	Possible	Medium			#N/A		
Technical Design (TD) / Project Scope Growth													
		TD1	quantity development	Confidence in quantity development	Separating maintenance materials from improvement materials. The only new area to be dredged is in the proposed turning basin. Quantity is limited from -35 to whatever depth is determined from feasibility study. There is no risk in the channel becoming wider and the depth will be determined during feasibility so the only real risk is in the rock quantity. Rock quantity development based on borings from 1988, 1977, and 2002 and PDT has high confidence where pinnacles are. Rock quantities are considered conservative and quantity may actually decrease depending on the depth of project and the actual spread of the rock material. PDT feels confident in rock quantities developed to date. An increase in rock quantity will affect project cost and schedule; while this is unlikely, the cost and schedule impact would be significant.	Significant	Unlikely	Medium	Significant	Unlikely	Medium	Rock removal is always the most expensive aspect of a dredge improvement project. Because of that, confidence in the rock quantity is of the utmost importance. It has been assumed the rock quantity may be 5% higher than actual or 10% lower. Minimum and maximum cost impacts have been estimated as 5% less and 10% more than the current rock removal costs, respectively.	There is potential for additional borings to be done during PED which would help to solidify the quantity of rock removal necessary for this project.
External													
		EX1	cable relocation	risk of cable not being moved prior to start of construction.	similar issue with Boston Harbor. Electric/fiber optic cable in channel is interfering with improvement dredging. Cable issue resolved in Boston Harbor through litigation. No impact expected in New Haven. USACE would litigate; cost/schedule impact limited to delays to start of construction (resulting in additional escalation impacts)	Moderate	Possible	Medium	Moderate	Possible	Medium	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 2.5% increase in construction costs.	
		EX2	Acts of God	Acts of God have the potential to impact the project.	Major hurricanes have the potential to impact construction. Delays caused by any acts of God will have cost and schedule impacts however these are expected to be marginal.	Significant	Possible	Medium	Marginal	Possible	Low	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 5% increase in construction costs.	
		EX3	Opposition to the Project		Risk in NY opposing the project. Mitigating risk by appeasing NY with marsh creation. Further risk of NY being unhappy and elevating issue potentially delaying start of construction.	Moderate	Possible	Medium	Moderate	Possible	Medium	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 2.5% increase in construction costs.	
		EX4	Berth improvements	Purpose of the project is to provide access to berths in the harbor.	Risk of project beneficiaries (each terminal) being late in improving their own facilities. Requirements (i.e. these improvements) are necessary before the end of PED. Likelihood is low that berths aren't improved in a timely manner. Impact is delay of 1 year (ie additional escalation to project cost).	Moderate	Unlikely	Low			#N/A	Maximum cost impact to the project is represented by additional project costs incurred due to delays which result in additional escalation costs to the midpoint of construction. In this case, the maximum impact assumes a one-year delay to the schedule which results in a 2.5% increase in construction costs.	

New Haven Harbor Improvement Dredging - General Investigation

Contingency on Base Estimate		80% Confidence Project Cost	
Baseline Estimate Cost ->OCTOBER 1, 2017 PRICE LEVEL		\$52,150,611	20%
Baseline Estimate Cost Contingency Amount ->		\$10,430,122	
Baseline Estimate Construction Cost (80% Confidence) ->		\$62,580,733	

Contingency on Schedule		80% Confidence Project Schedule	
Project Base Schedule Duration ->		22.0 Months	83%
Schedule Contingency Duration ->		18.3 Months	
Project Schedule Duration (80% Confidence) ->		40.3 Months	

- Cost Outputs Distribution and Sensitivity - NEDBU Plan



- Schedule Outputs Distribution and Sensitivity - NEDBU Plan

