US Army Corps
of Engineers
Wilmington District®

Wilmington Harbor 403 Letter Report

Wilmington, North Carolina

Attachment 4 – Cost Appendix

09/05/2025

Draft

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1 INTRODUCTION

To support the development of the Wilmington Harbor Deepening Study, construction cost estimates were performed for a range of depths, to include: 44 feet, 45 feet, 46 feet, 47 feet and 48 feet. A determination was made that further investigation of project costs for two alternatives, the 46-foot and 47-foot depths, should be pursued.

Considering the conditional- congressional authorization of the -47 foot alternative, costs, uncertainties associated with adverse environmental impacts and mitigation requirements, the relatively small differences in net benefits and the screening criteria and process outlined in the EIS section 2, the USACE and NCSPA determined that the final array of alternatives would include the No Action Alternative/ Future without Project, Action Alternative 1 (AA1; -47 feet MLLW), and Action Alternative 2 (AA2; -46 feet MLLW). Further investigation of estimated dredging quantities, material characteristics, and project costs for two action alternatives was conducted.

The action alternatives being considered would deepen most of the Federal Navigation System (FNS) from its current authorized depth of -42 feet mean lower low water (MLLW) to a new depth of either -47 feet MLLW (AA1) or -46 feet MLLW (AA2). In both alternatives, the Entrance Channel reaches would be authorized an additional 2 feet of depth to account for ocean conditions. Furthermore, the proposed Federal action would also expand the width of several of the reaches and add an additional reach to the Entrance Channel, Baldhead Shoal Channel- Reach 4. The Entrance Channel extension would be approximately 9 miles long and would connect it to the closest naturally occurring desired depth. In addition to lengthening and deepening the existing FNS, the proposed action would widen all or parts of most reaches.

Construction cost estimates were developed for each AA1 and AA2. Estimated dredging quantities and material characteristics for the 47-foot alternative (AA1) and the 46-foot alternative (AA2) were further developed and provided to the cost engineering team, as the basis for updated construction costs estimates. For each of the two alternatives the channel deepening work extends over 24 reaches from the Atlantic Ocean at the mouth of the Cape Fear River, to the Wilmington Harbor Anchorage Basin. The identified project depth for each alternative is associated with the 16 inner reaches. For each alternative, the 8 outer reaches, those closer to the mouth of the river, include an additional 2 feet of channel depth to accommodate wave action.

Estimated dredging quantities and material characteristics for the AA1 and AA2 were further developed and provided to the cost engineering team, as the basis for updated construction costs estimates. Table 1-1 shows the estimated dredging quantities for the channel depth alternatives.

Table 1.1 Estimated Dredging Quantities for Channel Depth Alternatives

Alternative Channel Depths:	47 ft Alternative (AA1); 47ft– 49ft)	46 ft Alternative (AA2; 46ft – 48ft)
Sand Quantities – Considered as Maintenance: Includes 2 feet of allowable over-depth below existing channel. Removed by Hopper or Cutterhead Dredge	5,616,749	5,616,749
Sand Quantities – Considered as New Work: Required to deepen the channel to new authorized depth. Removed by Hopper or Cutterhead Dredge	24,892,934	20,818,819
Soft Unconsolidated Rock Hauled to Ocean Dredge Material Disposal Site (ODMDS) for Placement. Removed by Cutterhead Dredge	3,549,206	2,377,002
Hard Consolidated Rock Hauled to Wilmington Offshore Fisheries Enhancement Structure (WOFES) for Beneficial use placement. Removed by Blasting and Mechanical Dredge	1,142,602	882,658
Total Quantities for Dredging	35,201,491	29,695,229

* Dredging material quantities are in cubic yards. ** WOFES = Wilmington Offshore Fisheries Enhancement Structure.

2 PROJECT COST ESTIMATES

Cost estimates have been developed for the two alternative channel depths. Cost estimates include:

- Construction costs for dredging and material placement as new work.
- Dredging construction costs, including equipment mobilization and demobilization.
- Costs of required environmental mitigation actions.
- Construction management costs.
- Planning, engineering, and design costs.
- Risk-based contingencies for each alternative

2.1 Dredging Construction Costs

For the two action alternatives, estimates of dredging material characteristics and quantities were provided to the cost engineering team, as the basis for construction costs estimates.

A proposed sediment management plan was drafted and provided to the cost engineering team. The sand management plan identified dredged material quantities from selected channel reaches for placement on beaches, bird islands, and some shoreline areas.

Material that is required for removal from the channel, which is not identified in the beneficial use sediment management plan, would be dredged and hauled to the ocean dredged material disposal site (ODMDS).

For each alternative estimate, the dredging construction costs were calculated using the USACE cost engineering dredge estimating program (CEDEP).

The estimated dredging construction costs are based on the required dredging material quantities from each project reach, the geotechnical characteristics of the dredge material the required dredge type based on the material characteristics, the placement location, and the Wilmington District's records of historical dredging production rates.

The dredged material specified in the sand management plan for placement on beaches, bird islands, and shoreline areas would be dredged and placed using a cutterhead pipeline-type dredge.

It is expected that sediment removed from the channel, which is not identified in the beneficial use sediment management plan, would be dredged and hauled to the ODMDS.

It is expected in the outer project reaches, the unconsolidated material required for removal, which is not identified in the beneficial use sediment management plan, would be dredged and hauled to the ODMDS by medium sized hopper dredges.

In areas where consolidated rock must be removed from the channel, dredging and excavation requirements would depend on the material characteristics. Consolidated rock with lower Rock Quality Designation (RQD) values, thinner layer formations, or unconfined compressive strength below 4,300 psi is classified as soft rock. Soft rock can be dredged without blasting. Channel sections containing soft rock are anticipated to be excavated using a large 30-inch cutterhead-type dredge. The dredging operations would be supported by a spider barge and hauling plants.

The consolidated rock, with higher values of Rock Quality Designation (RQD), the thicker formations, or with unconfined compressive strength above 4,300 psi, is categorized as a hard rock. The hard rock is expected to be drilled, blasted, and removed for disposal by mechanical dredge. This rock occurs in four of the project reaches: Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick.

The consolidated hard rock that is required to be removed from the channels is identified in the sediment management plan for placement at the WOFES.

It is expected that the required dredging work and blasting needed for the removal of consolidated rock would be conducted within established environmental regulatory windows.

Dredging and placement of shoaled material above the current authorized channel depth, including 2 feet of allowable over-depth, is considered to be maintenance. Maintenance dredging costs are excluded from the project's construction budget and will be funded separately from the deepening project.

In estimating the dredging construction costs, consideration has been given to the on-going industry demand for large dredging equipment, and the possibility of difficulties with obtaining large capacity dredging and towing equipment. This has been captured in the project's cost schedule risk analysis and considered in the contingency calculations. Consideration has been given to minimizing impacts to port operations and shipping during the dredging activities.

2.2 Costs of Environmental Mitigation Actions

A conceptual level scope for required environmental mitigation actions has been drafted with the support of the A/E contractor, Stantec. The anticipated scope of work for the required environmental mitigation actions includes: construction of a bypass channel in the wetlands areas around Cape Fear Lock & Dam 01, construction of a rock / rapids fish passage below Cape Fear Lock & Dam 02, and construction actions to restore wetlands and remove invasive phragmites from the Eagle Island area. Preliminary plan drawings and a conceptual level construction cost estimate have been developed. It is assumed that required Environmental Mitigation actions would be completed concurrently, during the course of dredging construction. The cost estimate for completion of construction work for these three actions totals in the range of $60 million, and has been included under WBS-06 of the total project cost summary. At the feasibility stage of the project, there is some uncertainty in expected work site conditions, as well as, in the means and methods of construction. The uncertainty in implementation of the environmental mitigation actions has been identified in the project's Cost Schedule Risk Analysis (CSRA), and has been included in the risk based contingency calculations.

2.3 Planning, Engineering & Design Costs

Estimates of the project's planning, engineering, and design costs have been developed and included in the Total Project Cost Summary (TPCS) spreadsheet for each alternative. The estimated costs are expected to include: geotechnical analysis, bathymetric surveys, site inspections, environmental testing, analysis of soils for dredging, and the development of plans and specifications for construction. In developing the initial estimate for the project's planning, engineering, and design (PED) costs, a review was conducted of estimates for other recent USACE projects that are similar in scope, such as the Savannah Harbor Expansion Project and the Charleston Harbor Deepening Project. The planning, engineering, and design costs for this project are estimated in the range of 6.0% of the project's construction costs for the Action Alternative 2 (AA2) (46 foot), and, estimated in the range of 5.36% of the project's construction costs for Action Alternative 1 (AA1) (47-foot). For AA2, the 46- foot alternative, the project's PED costs are estimated in the range of $39,500,000. For AA1, the 47 foot alternative, the project's PED costs are estimated in the range of $42,000,000.

2.4 Construction Management Costs

Estimates of the project's construction management costs have been developed and included in the Total Project Cost Summary (TPCS) spreadsheet for each alternative. The estimated costs include staffing and field office costs to provide oversite for the implementation of the dredging and navigation channel deepening work. The estimated costs also include staffing and field office costs to provide oversite for the implementation of the environmental mitigation construction work. In developing the construction management cost estimate, a review was conducted of approved cost estimates for other recent USACE projects that are similar in scope, such as the Savannah Harbor Expansion Project and the Charleston Harbor Deepening Project. The construction management costs for this project are estimated in the range of 4.55% of the project's construction costs for the 46-foot alternative, and estimated in the range of 4.45% of the project's construction costs for the 47-foot alternative. For the 46-foot alternative the project's construction management costs are estimated in the range of $30,000,000. For the 47-foot alternative the project's construction management costs are estimated in the range of $35,000,000.

2.5 Construction Schedule

To support the cost estimates and Total Project Cost Summary development, an estimated dredging construction schedule was developed for each alternative. The estimated dredging construction schedules were developed based on: the quantities of material required to be removed from the channels by dredging, established environmental regulatory work windows, and dredging production rates that are based on historical records for channel deepening work. It is expected based on past practices that the blasting work, in those reaches where it is needed for the removal of hard rock formations, can be completed within the established environmental regulatory work windows. Table 2.1 shows detail the estimated construction schedules.

Table 2.1. June 2025 Estimated Dredging Construction Schedule for AA1 (47ft Depth).

Contract Year	Channel Reach Dredged	Dredge Equipment Strategy	Dredged Material Placement	Quan es (cubic yards)			Dura on (days)			
				Sand	Rock (Cu erhead)	Rock (Blas ng)	Hopper	Cu erhead	Blas ng Rig	Mechanical Dredge
CY 1	Entrance	Hopper Dredge 1st	Hopper - ODMDS	1,634,666	0	-	158	-	-	-
	Baldhead Shoal Reach 3	Hopper Dredges 2nd, 3rd, 4th Hydraulic Dredge-1st	Hopper - ODMDS	5,733,635	331,569	-	525	37	-	-
CY 2	Baldhead Shoal Reach 2	Hopper Dredge 1st Hydraulic Dredge-1st	Hopper - ODMDS; Pipeline Dredge to Beaches	1,096,108	0	-	64	33	-	-
	Baldhead Shoal Reach 1	Hopper Dredge 1st Hydraulic Dredge-1st	Hopper - ODMDS; Pipeline Dredge to Beaches	888,938	0	-	52	27	-	-
	Smith Island	Hydraulic Dredge-1st (Multiple Reaches)	Pipeline Dredge to Beaches	1,073,055	0	-	-	65	-	-
	Baldhead-Caswell	Hydraulic Dredge-1st (Multiple Reaches)	Pipeline Dredge to Beaches	172,654	0	-	-	10	-	-
CY 1	Southport	Hydraulic Dredge-1st (Multiple Reaches)	Pipeline Dredge to Beaches	550,107	2,478	-	-	35	-	-
	Battery Island	Hydraulic Dredge-1st (Multiple Reaches)	Cutterhead - ODMDS; Pipeline Dredge to Beaches	1,101,429	221,058	-	-	100	-	-
CY 2	Lower Swash	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands	1,861,207	245,125	-	-	140	-	-
	Snows Marsh	Hydraulic Dredge 3rd (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands	1,821,272	138,227	-	-	127	-	-
	Horseshoe Shoal	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands	783,188	0	-	-	47	-	-
	Reaves Point	Hydraulic Dredge 3rd (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands	953,750	0	-	-	58	-	-
CY 3	Lower Midnight	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands	986,874	0	-	-	60	-	-
	Upper Midnight	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands + Shoreline	1,710,712	0	-	-	104	-	-
	Lower Lilliput	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - Pipeline Dredge to Bird Islands + Masonboro Beach	1,870,183	69,934	-	-	121	-	-
	Upper Lilliput	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge Cutterhead - ODMDS	1,431,347	316,004	-	-	123	-	-
	Keg Island	Hydraulic Dredge 3rd (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	1,089,004	183,344	158,518	-	86	114	20

Contract Year	Channel Reach Dredged	Dredge Equipment Strategy	Dredged Material Placement	Quantities (cubic yards)			Duration (days)			
				Sand	Rock (Cutterhead)	Rock (Blasting)	Hopper	Cutterhead	Blasting Rig	Mechanical Dredge
CY 4	Lower Big Island	Hydraulic Dredge 1st (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	507,606	0	390,193	-	31	279	54
CY 5	Upper Big Island	Hydraulic Dredge 1st (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	390,552	0	427,286	-	24	306	60
CY 6	Lower Brunswick	Hydraulic Dredge 1st (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	1,167,708	222,654	166,605	-	96	120	25
CY 4	Upper Brunswick	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - ODMDS	781,440	149,979	-	-	64	-	-
CY 5	Fourth East Jetty	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - ODMDS	660,565	504,873	-	-	97	-	-
	Between	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - ODMDS	246,852	212,134	-	-	40	-	-
CY 6	Anchorage Basin Station 8+00 to 84+81	Hydraulic Dredges 2nd	Cutterhead - ODMDS	1,996,833	951,826	-	-	230	-	-
			Sub Total =	30,509,685	3,549,205	1,142,602	798	1755	819	159
				Total Material =	35,201,492	-	-	-	-	-

Table 2.2. June 2025 Estimated Dredging Construction Schedule for AA2 (46ft Depth).

Contract Year	Channel Reach Dredged	Dredge Equipment Strategy	Dredged Material Placement	Quantities (cubic yards)			Duration (days)			
				Sand	Rock (Cutterhead)	Rock (Blasting)	Hopper	Cutterhead	Blasting Rig	Mechanical Dredge
CY 1	Entrance	Hopper Dredge 1st	Hopper - ODMDS	966,118	0	-	100	-	-	-
	Baldhead Shoal Reach 3	Hopper Dredges 2nd, 3rd, 4th Hydraulic Dredge-1st	Hopper - ODMDS	4,939,878	238,340	-	452	26	-	-
CY 2	Baldhead Shoal Reach 2	Hopper Dredge 1st Hydraulic Dredge-1st	Hopper - ODMDS; Pipeline Dredge to Beaches	924,909	0	-	54	28	-	-
	Baldhead Shoal Reach 1	Hopper Dredge 1st Hydraulic Dredge-1st	Hopper - ODMDS; Pipeline Dredge to Beaches	752,719	0	-	44	23	-	-
	Smith Island	Hydraulic Dredge-1st (Multiple Reaches)	Pipeline Dredge to Beaches	928,204	0	-	-	56	-	-
	Baldhead-Caswell	Hydraulic Dredge-1st (Multiple Reaches)	Pipeline Dredge to Beaches	138,671	0	-	-	10	-	-
CY 1	Southport	Hydraulic Dredge-1st (Multiple Reaches)	Pipeline Dredge to Beaches	437,476	1,160	-	-	30	-	-
	Battery Island	Hydraulic Dredge-1st (Multiple Reaches)	Cutterhead - ODMDS; Pipeline Dredge to Beaches	1,044,525	147,385	-	-	85	-	-
CY 2	Lower Swash	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands	1,676,968	143,969	-	-	118	-	-
	Snows Marsh	Hydraulic Dredge 3rd (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands	1,548,519	76,074	-	-	103	-	-
	Horseshoe Shoal	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands	651,340	0	-	-	39	-	-
	Reaves Point	Hydraulic Dredge 3rd (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands	809,785	0	-	-	49	-	-
CY 3	Lower Midnight	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands	778,791	0	-	-	47	-	-
	Upper Midnight	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands + Shoreline	1,370,348	0	-	-	83	-	-
	Lower Lilliput	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - Pipeline Dredge Bird Islands + Masonboro Beach	1,630,847	28,180	-	-	102	-	-
	Upper Lilliput	Hydraulic Dredge 2nd (Multiple Reaches)	Cutterhead - Pipeline Dredge Cutterhead - ODMDS	1,287,919	225,834	-	-	104	-	-
	Keg Island	Hydraulic Dredge 3rd (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	1,007,427	129,081	105,575	-	75	76	15

Contract Year	Channel Reach Dredged	Dredge Equipment Strategy	Dredged Material Placement	Quan es (cubic yards)			Dura on (days)			
				Sand	Rock (Cu erhead)	Rock (Blas ng)	Hopper	Cu erhead	Blas ng Rig	Mechanical Dredge
CY 4	Lower Big Island	Hydraulic Dredge 1st (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	492,336	0	311,224	-	30	223	42
CY 5	Upper Big Island	Hydraulic Dredge 1st (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	368,925	0	334,325	-	22	239	45
CY 6	Lower Brunswick	Hydraulic Dredge 1st (Multiple Reaches) Drilling/Blasting Rig 1st (Multiple Reaches)	Cutterhead + Blasting + Mechanical	1,091,589	128,741	131,535	-	80	94	20
CY 4	Upper Brunswick	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - ODMDS	730,178	92,995	-	-	55	-	-
CY 5	Fourth East Jetty	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - ODMDS	639,820	324,374	-	-	76	-	-
	Between	Hydraulic Dredge 1st (Multiple Reaches)	Cutterhead - ODMDS	244,208	146,957	-	-	32	-	-
CY 6	Anchorage Basin Station 8+00 to 84+81	Hydraulic Dredges 2nd	Cutterhead - ODMDS	1,974,070	693,910	-	-	200	-	-
			Sub Total =	26,435,570	2,377,000	882,659	649	1473	632	122
				Total Material =	29,695,229	-	-	-	-	-

3 CONTRACTING STRUCTURE AND PROJECT SCHEDULE

The acquisition strategy for contracting out the implementation of the Cape Fear River channel deepening has not been determined. It is assumed that the dredging construction work would begin only after completion of the Planning, Engineering, and Design phase of the project, which is expected to last three years.

Estimated project construction schedules were developed based on the following assumptions:

1. The dredging construction would begin in the outermost reaches of the river channel and progress inwards towards the anchorage basin.
2. It is expected that requirements to minimize any adverse impact to river channel navigation, and requirements to maintain port operability, would place an upward limitation on the number of dredges in operation, and the number of reaches being excavated during each regulatory window.
3. The project construction schedule shows a maximum of three cutterhead dredges and one medium sized hopper dredge operating concurrently to deepen the project area reaches. It is expected that on-going industry demand may place a limitation on the number of large capacity dredges and the hauling equipment available for contracting.
4. It is expected that the dredging construction work would be preceded by three years of Planning, Engineering, and Design, PED.
5. The estimated quantities of material to be dredged were provided by design engineering. The quantities include two feet of allowable over-depth in all reaches.
6. Dredging production rates are based on historical records for the type of dredge and the characteristics of the material being removed.
7. The completion of deepening work for each channel reach would require the removal of the shoaled in material down to the currently authorized navigation channel depth and two feet of allowable over-depth, which has been categorized as maintenance dredging.
8. It is expected that required maintenance dredging work would be contracted and sequenced to immediately precede the dredging construction deepening work for each channel reach. It is expected that required maintenance dredging work would be funded separately from the project funded deepening work.
9. For each channel depth alternative evaluated, the dredging construction work is expected to begin in December of 2030 and is estimated to be completed in the Spring of 2036.
10. It is expected that the channel deepening work would be contracted concurrently, and in addition to, annual maintenance dredging contracts that are funded and

awarded separately for the removal of shoaled in material based on the North Carolina State Port recommendations.

4 TOTAL PROJECT COST SUMMARIES

The total project cost summaries include cost estimates for: dredging construction, environmental mitigation actions, real estate procurement, relocation work, planning, engineering, and design (PED), as well as, Construction Management (CM). Risk-based contingencies have been evaluated through a cost schedule risk analysis (CSRA) process and are included in the total project cost summaries.

At the time of development of the total project cost summaries, a conceptual level scope for required environmental mitigation actions has been drafted. The anticipated construction work for the required environmental mitigation actions includes: construction of a bypass channel in the wetlands areas around Cape Fear Lock & Dam 01, construction of a rock / rapids fish passage below Cape Fear Lock & Dam 02, and construction actions to restore wetlands and remove invasive phragmites from the Eagle Island area. A construction cost estimate has been developed for these activities, with completion of this construction work estimated in the range of $60M. Estimated costs for the environmental mitigation actions, are captured under WBS-06 of the total project cost summaries. It is expected that the construction work for the required environmental mitigation actions will be completed concurrently with the channel deepening dredging activities.

Estimates for relocation costs are captured under WBS-02 of the total project cost summaries. Four pipelines cross the project with three of them shallow enough to conflict with the proposed dredging depths. One pipeline, operated by Kinder Morgan, is expected to be relocated. Two pipelines are expected to be removed. Initial estimates of the costs for relocation and removal of the pipelines were sourced from the preceding Section 203 study. The estimated relocation pricing has been escalated from the date of the 203 Study to current dollars using the Civil Works Construction Costs Index System. Discussions with the Kinder Morgan and Exxon Mobile stakeholders have been conducted, and have indicated that the estimated pricing is considered within a reasonable range for the anticipated scope of work. Estimated costs for the Relocation of Aids to Navigation, also were sourced from the preceding Section 203 study and escalated to current dollars using the Civil Works Construction Costs Index System.

Purchases of land parcels for preservation are considered in this study as potential environmental mitigation actions. Estimated costs for land purchases were provided by the real estate team in May of 2025, and have been included under WBS-01 of the total project cost summaries.

Table 4.1 provides a summary of project costs for each alterative depth. Costs are shown by project feature in current dollars. The table also shows project first costs, and fully funded project costs escalated to the mid-point of construction.

Table 4.1. Estimated Project Costs for Each Depth Alternative (AA1 and AA2).

Alterna ve – Channel Depths:	AA1 (47 feet)	AA2 (46 feet)
WBS 12 Dredging Construction	$708,293,000	$584,526,000
WBS 06 Environmental Mitigation	$60,080,000	$60,080,000
WBS 01 Real Estate Costs	$8,355,000	$7,694,000
WBS 02 Relocations	$14,438,000	$14,438,000
WBS 30 Planning Engineering & Design	$41,920,000	$39,454,000
WBS 31 Construction Management	$34,835,000	$29,987,000
Total Project Cost – Current Dollars	$867,921,000	$736,179,000
Project First Cost – FY 2027 Dollars	$1,140,270,000	$968,199,000
Fully Funded Cost- Midpoint of Construction	$1,358,867,000	$1,153,740,000

1		2	3	4	5	6	8	9	10	11	13	14	15	16	17
PROJECT:	**Wilmington Harbor Deepening 403 Study**							**DISTRICT:**	**CESAW Wilmington District**				**PREPARED:**		**15-Jul-2025**
ALTERNATIVE:	**Harbor Deepening Alternative -Project Depth = 47 Feet.**							**POC:**	**CHIEF, COST ENGINEERING, Stephen Roman, PE**						
LOCATION:	**Wilmington, North Carolina**														
This Estimate Reflects:	Project Authorized Depths 47 Ft and 49Ft.		Wilmington Harbor Deepening 403 Study												

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
		Price Level: 1-Oct-24				Program Year (Budget EC): 2027									
						Effective Price Level Date: 1 OCT 26									
		Construction Cost								Spent Thru:	TOTAL FIRST				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	30-Dec-24 ($K)	**COST ($K)**	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
12	**NAVIGATION PORTS & HARBORS**	**$708,293**	$169,990	**24%**	$878,283	5.3%	$745,572	$178,937	$924,509	$0	$924,509	19.1%	$887,934	$213,104	$1,101,038
02	**RELOCATIONS**	**$14,438**	$3,465	**24%**	$17,904	5.3%	$15,198	$3,648	$18,846	$0	$18,846	14.4%	$17,393	$4,174	$21,567
06	**FISH & WILDLIFE FACILITIES**	**$60,080**	$14,419	**24%**	$74,499	5.3%	$63,242	$15,178	$78,420	$0	$78,420	17.4%	$74,256	$17,821	$92,077
07	POWER PLANT	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
08	ROADS, RAILROADS & BRIDGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
09	CHANNELS & CANALS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
10	BREAKWATER & SEAWALLS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
11	LEVEES & FLOODWALLS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$782,811	$187,875		$970,686	5.3%	$824,012	$197,763	$1,021,775	$0	$1,021,775	18.9%	$979,583	$235,100	$1,214,683
01	**LANDS AND DAMAGES (Real Estate)**	**$8,355**	$2,089	**25%**	$10,443	5.3%	$8,794	$2,199	$10,993	$0	$10,993	17.4%	$10,326	$2,581	$12,907
30	**PLANNING, ENGINEERING & DESIGN**	**$41,920**	$10,061	**24%**	$51,980	6.4%	$44,622	$10,709	$55,331	$6,191	$61,522	23.4%	$55,044	$13,211	$74,446
31	**CONSTRUCTION MANAGEMENT**	**$34,835**	$8,360	**24%**	$43,196	6.4%	$37,081	$8,899	$45,980	$0	$45,980	23.6%	$45,831	$11,000	$56,831
	PROJECT COST TOTALS:	$867,921	$208,385	24.0%	$1,076,305		$914,509	$219,570	**$1,134,079**	$6,191	**$1,140,270**	19.3%	$1,090,785	$261,892	$1,358,867

CHIEF, COST ENGINEERING, Stephen Roman, PE

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CHIEF, OPERATIONS, Daniel Brown, PE

CHIEF, CONSTRUCTION, Jeremy Smith

CHIEF, CONTRACTING, Jon Mayo

CHIEF, PM-PB, Robert Keistler

ESTIMATED TOTAL PROJECT COST:		**$1,358,867**
ESTIMATED FEDERAL COST:	75%	$1,019,151
ESTIMATED NON-FEDERAL COST:	25%	$339,717
22 - FEASIBILITY STUDY (CAP studies):		**$3,100**
ESTIMATED FEDERAL COST:		$3,100
ESTIMATED NON-FEDERAL COST:		$4,150
ESTIMATED FEDERAL COST OF PROJECT		**$1,017,607**

Figure 4.1. Total Project Cost Summary for AA1 (47 feet).

1	2	3	4	5	6	8	9	10	11	13	14	15	16	17

PROJECT: Wilmington Harbor Deepening 403 Study — **DISTRICT:** CESAW Wilmington District — **PREPARED:** 15-Jul-2025

ALTERNATIVE: **Harbor Deepening Alternative -Project Depth = 46 Feet.** — **POC:** CHIEF, COST ENGINEERING, Stephen Roman, PE

LOCATION: **Wilmington, North Carolina**

Wilmington Harbor Deepening 403 Study

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
		Price Level: 1-Oct-24				Program Year (Budget EC): 2027; Effective Price Level Date: 1 OCT 26									
		Construction Cost								Spent Thru:	TOTAL FIRST				
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	30-Dec-24 ($K)	COST ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J		K	L	M	N	O
12	**NAVIGATION PORTS & HARBORS**	**$584,526**	$140,286	**24%**	$724,813	5.3%	$615,291	$147,670	$762,961	$0	$762,961	19.1%	$732,974	$175,914	$908,888
02	**RELOCATIONS**	**$14,438**	$3,465	**24%**	$17,904	5.3%	$15,198	$3,648	$18,846	$0	$18,846	14.4%	$17,393	$4,174	$21,567
06	**FISH & WILDLIFE FACILITIES**	**$60,080**	$14,419	**24%**	$74,499	5.3%	$63,242	$15,178	$78,420	$0	$78,420	17.4%	$74,256	$17,821	$92,077
07	POWER PLANT	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
08	ROADS, RAILROADS & BRIDGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
09	CHANNELS & CANALS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
10	BREAKWATER & SEAWALLS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
11	LEVEES & FLOODWALLS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$659,045	$158,171		$817,215	5.3%	$693,731	$166,495	$860,227	$0	$860,227	18.9%	$824,623	$197,910	$1,022,533
01	**LANDS AND DAMAGES (Real Estate)**	**$7,694**	$1,924	**25%**	$9,618	5.3%	$8,099	$2,025	$10,124	$0	$10,124	17.4%	$9,510	$2,377	$11,887
30	**PLANNING, ENGINEERING & DESIGN**	**$39,454**	$9,469	**24%**	$48,923	6.4%	$41,998	$10,079	$52,077	$6,191	$58,268	23.3%	$51,786	$12,429	$70,406
31	**CONSTRUCTION MANAGEMENT**	**$29,987**	$7,197	**24%**	$37,183	6.4%	$31,920	$7,661	$39,580	$0	$39,580	23.6%	$39,447	$9,467	$48,915
	PROJECT COST TOTALS:	$736,180	$176,760	24.0%	$912,940		$775,748	$186,260	**$962,008**	$6,191	**$968,199**	19.3%	$925,366	$222,183	$1,153,740

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CHIEF, OPERATIONS, Daniel Brown, PE

CHIEF, CONSTRUCTION, Jeremy Smith

CHIEF, CONTRACTING, Jon Mayo

CHIEF, PM-PB, Robert Keistler

ESTIMATED TOTAL PROJECT COST:		**$1,153,740**
ESTIMATED FEDERAL COST:	75%	$865,305
ESTIMATED NON-FEDERAL COST:	25%	$288,435
22 - FEASIBILITY STUDY (CAP studies):		**$3,100**
ESTIMATED FEDERAL COST:		$3,100
ESTIMATED NON-FEDERAL COST:		$4,150
ESTIMATED FEDERAL COST OF PROJECT		**$868,405**

Figure 4.2. Total Project Cost Summary for AA2 (46 feet).

5 COST SCHEDULE RISK ANALYSIS (CSRA)

A cost schedule risk analysis was completed to assess the potential impact of known project risks on the estimated project costs and construction schedule.

Project design team meetings were conducted and multi-disciplinary input was solicited to identify potential risks to the project cost and schedule. A risk register model was developed. The Oracle Crystal Ball software was used to run a Monte Carlo based statistical analysis of the potential project risk impacts.

Contingencies for the project cost and schedule were calculated using the Cost Schedule Risk Analysis CSRA model to establish an 80% confidence level in the project's estimated costs and schedule.

The risks that were considered by the Project Development Team and included in the risk register model, are summarized as follows:

5.1 Project Risks Identified in the Cost Schedule Risk Analysis

1. Inadequate project funding, or delays in the appropriation of funding, could contribute to delays in the project construction schedule. This risk of inadequate or delayed project funding applies to both federal funding and funding provided by the project sponsor. This is considered as a risk to the project schedule.
2. The proposed construction schedule requires multiple large sized dredges brought to site for the construction each year. There are a limited number of contractors that can provide 30" cutterhead pipeline-type dredges. This equipment is expected to continue to be in demand. Limited availability of equipment is a known risk that could impact the project construction cost and schedule.
3. The market demand for dredging equipment is expected to be high. The market conditions risk accounts for a high dredging demand with limited equipment capable of completing the work. High market demand for dredging equipment could impact the competitiveness of contractor bids. The market demand risk could impact the project construction cost and schedule.
4. For large contracts that are issued, some dredging activities may be subcontracted. Dredging work that is subcontracted would increase construction costs for the project. The subcontracting risk could impact the project construction cost.
5. There are a limited number of contractors that can provide the large sized dredging equipment that would be needed for construction. The capacity of the dredging equipment that is available, and the production rates that can be achieved during construction, could impact the number of mobilization cycles required. If the contracted dredging capacity is lower than required, additional mobilizations for dredging equipment could be needed. The need for additional

mobilizations is a risk that could impact the project cost and the construction schedule.

6. There are known risks associated with the estimated quantities and expected geotechnical characteristics of the dredged material. There is a risk that some of the rock estimated to be dredged using a large cutterhead may be too hard to effectively use the cutterhead dredge, and blasting could be required for its removal. This risk could impact the project construction costs and the construction schedule.
7. There are known risks associated with the estimated quantities and expected geotechnical characteristics of the dredged material. There is a risk that some of the material estimated to be sand is actually a soft rock. Dredging of soft rock, instead of sand, with a cutterhead type dredge would lower productivity rates and increase production costs. This risk could impact the project construction costs and the construction schedule.
8. There is a risk that deepening of the channel may approach the side slopes in some areas, requiring stabilization measures to be implemented at the shore. The side slope stability risk could impact the project construction costs and the construction schedule.
9. The scope for the required environmental mitigation actions has been developed at a conceptual level. At the feasibility stage, there is some uncertainty in expected work site conditions, as well as, in the means and methods of construction. The work site conditions may have limited accessibility. Wetland locations may be found to be flooded. Storm events may impact the construction productivity. Adverse work site conditions could impact the project construction costs and the construction schedule.
10. In those areas where the river channel has not been previously dredged, such as areas of widening, the dredging construction effort may encounter wood debris. Wood debris may need to be screened during the dredging process, to be placed at a separate disposal site. The need to add screens during dredging could impact production rates. The risk of wood debris could impact the project costs and the schedule.
11. In some of the outer project reaches there are known to be foreign debris at the channel footprint edges. In the case of the Baldhead Shoal Reach 3 the foreign debris may be abandoned concrete blocks. If foreign debris extend into the project areas, cutterhead dredging production rates could be adversely impacted. The risk of foreign debris in the areas to be dredged could impact the project costs and the schedule.
12. Lower production rates for mechanical dredging of rock in the mid river reaches is a risk factor that could increase the construction costs. It is expected that blasting would be needed for the removal of hard rock in the reaches from Keg

Island Reach to Lower Brunswick. It is assumed that blasting of consolidated rock can be completed within existing environmental windows. Limits on the extent or duration when blasting may be conducted could also lower production rates. Risks associated with the estimated production rate for dredging rock, and the acceptable environmental windows for blasting and dredging rock, could impact the project costs and the schedule.

13. Increased fuel pricing is a known risk. Over recent years, fuel pricing has demonstrated volatility. There is a risk that fuel pricing increases may occur during the construction phase. Increases in fuel pricing could impact project construction costs.

14. Market conditions have demonstrated volatility in recent years. There is a risk that inflation rates experienced in future years may exceed those estimated by CWCCIS, in escalating project costs to the midpoint of construction. CWCCIS annual escalation rates for WBS-12 are in the range of 2.6%, for the future years, when the project construction is expected to occur. Published indices for annual inflation rates over the last years have been as high as 6.2%. The risk of higher inflation rates could impact the project construction costs.

15. Severe weather events such as storms are a known risk and could impact the project schedule.

16. It is recognized that the project must avoid, minimize, or mitigate adverse effects to historic properties that may be identified as cultural resources. Cultural resources that could be historically significant, including shipwrecks and associated artifacts, are expected to exist within dredging footprint. Requirements to preserve historic cultural resources that are located within the Cape Fear River could present a risk to the estimated project cost and schedule. There is uncertainty which prevents the USACE from finalizing the Area of Potential Effects (APE) and conducting the surveys necessary to identify historic properties prior to completing the appropriate NEPA documentation. Given this limitation, the USACE would enter into a Programmatic Agreement with the State Historic Preservation Office to comply with Section 106 of the National Historic Preservation Act. As such, the project must avoid, minimize, or mitigate adverse effects to historic properties identified through the PED surveys, to include, but not limited to submerged archeological and cultural resources.

5.2 Cost Schedule Risk Analysis Results

A statistical CSRA model was run using the Oracle Crystal Ball program, to assess the impacts of known project risks on the estimated project cost and project schedule (Figure 5.1 and Figure 5.2). The model calculations identified that in order to achieve an 80% confidence level in the project costs, a 24% cost contingency is required. The model calculations identified that to achieve an 80% confidence level in the estimated project schedule, an 18% schedule contingency is required. The risk analysis model outputs are included in the cost appendix, for reference. Mitigating actions to reduce project risk were identified in the course of developing the CSRA model. These actions are documented in the CSRA risk register and will be incorporated into the project scope going forward.

Project Contingency

Wilmington Harbor Deepening Study / Civil Works Section 403 Study June 2025

Confidence Level Being Reported ->	80%

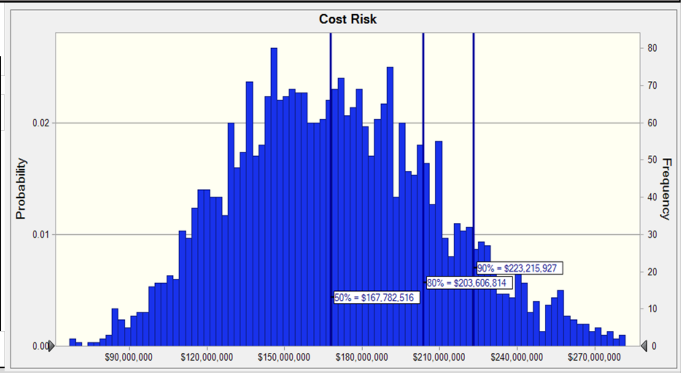
Contingency on Base Estimate	80% Confidence Project Cost	
Base Estimate	$867,920,737	
Estimate Contingency	$208,300,977	24%
Base Estimate w/ Contingency (80% Confidence)	$1,076,221,714	

Contingency on Base Schedule	80% Confidence Project Schedule	
Base Schedule Start Date	January 1, 2027	
Base Schedule Finish Date	February 1, 2036	
Base Schedule Duration	109.0 Months	
Schedule Contingency Duration	19.6 Months	18%
Base Schedule w/ Contingency (80% Confidence)	128.6 Months	
Base Finish Date w/ Contingency (80% Confidence)	September 20, 2037	

- PROJECT COST CONTINGENCY DEVELOPMENT -

Cost Contingency Analysis

Base Estimate	$867,920,737		
Confidence Level	Contingency Value	Contingency	Cost with Contingency
0%	$69,433,659	8%	$937,354,396
10%	$121,508,903	14%	$989,429,640
20%	$138,867,318	16%	$1,006,788,055
30%	$147,546,525	17%	$1,015,467,262
40%	$164,904,940	19%	$1,032,825,677
50%	$173,584,147	20%	$1,041,504,884
60%	$182,263,355	21%	$1,050,184,092
70%	$190,942,562	22%	$1,058,863,299
80%	$208,300,977	24%	$1,076,221,714
90%	$225,659,392	26%	$1,093,580,129
100%	$321,130,673	37%	$1,189,051,410



- PROJECT SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Schedule Contingency Analysis

Base Schedule Duration	109.0 Months		
Confidence Level	Contingency Value	Contingency	Duration with Contingency
0%	-1.1 Months	-1%	107.9 Months
10%	7.6 Months	7%	116.6 Months
20%	9.8 Months	9%	118.8 Months
30%	12.0 Months	11%	121.0 Months
40%	13.1 Months	12%	122.1 Months
50%	14.2 Months	13%	123.2 Months
60%	16.3 Months	15%	125.3 Months
70%	17.4 Months	16%	126.4 Months
80%	19.6 Months	18%	128.6 Months
90%	21.8 Months	20%	130.8 Months
100%	34.9 Months	32%	143.9 Months

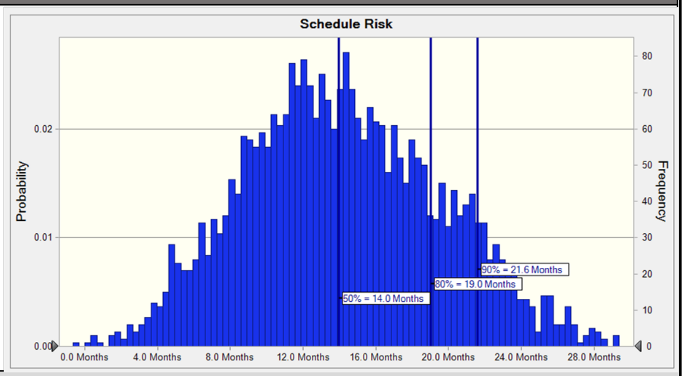


Figure 5.1. Cost Schedule Risk Analysis for AA1 (47 feet)

Project Contingency

Wilmington Harbor Deepening Study / Civil Works Section 403 Study June 2025

Confidence Level Being Reported ->	80%

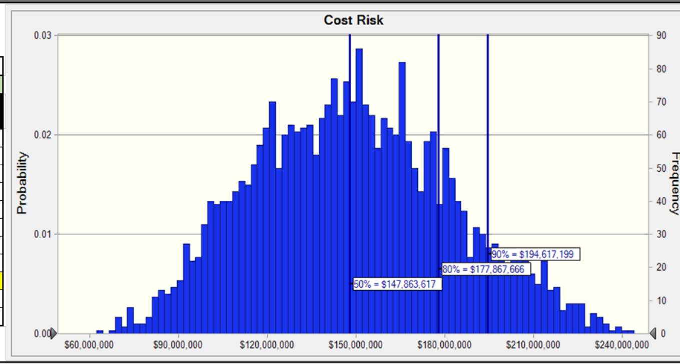
Contingency on Base Estimate	80% Confidence Project Cost	
Base Estimate	$736,179,790	
Estimate Contingency	$178,155,509	24%
Base Estimate w/ Contingency (80% Confidence)	$914,335,299	

Contingency on Base Schedule	80% Confidence Project Schedule	
Base Schedule Start Date	January 1, 2027	
Base Schedule Finish Date	February 1, 2036	
Base Schedule Duration	109.0 Months	
Schedule Contingency Duration	19.6 Months	18%
Base Schedule w/ Contingency (80% Confidence)	128.6 Months	
Base Finish Date w/ Contingency (80% Confidence)	September 20, 2037	

- PROJECT COST CONTINGENCY DEVELOPMENT -

Cost Contingency Analysis

Base Estimate		$736,179,790	
Confidence Level	Contingency Value	Contingency	Cost with Contingency
0%	$44,906,967	6%	$781,086,757
10%	$105,273,710	14%	$841,453,500
20%	$118,524,946	16%	$854,704,736
30%	$129,567,643	18%	$865,747,433
40%	$139,137,980	19%	$875,317,770
50%	$147,972,138	20%	$884,151,928
60%	$156,806,295	21%	$892,986,085
70%	$166,376,633	23%	$902,556,423
80%	$178,155,509	24%	$914,335,299
90%	$195,087,644	27%	$931,267,434
100%	$279,748,320	38%	$1,015,928,110



ENCY (DURATION) DEVELOPMENT -

Schedule Contingency Analysis

Base Schedule Duration		109.0 Months	
Confidence Level	Contingency Value	Contingency	Duration with Contingency
0%	-2.2 Months	-2%	106.8 Months
10%	8.7 Months	8%	117.7 Months
20%	10.9 Months	10%	119.9 Months
30%	12.0 Months	11%	121.0 Months
40%	13.1 Months	12%	122.1 Months
50%	14.2 Months	13%	123.2 Months
60%	16.3 Months	15%	125.3 Months
70%	17.4 Months	16%	126.4 Months
80%	19.6 Months	18%	128.6 Months
90%	21.8 Months	20%	130.8 Months
100%	34.9 Months	32%	143.9 Months

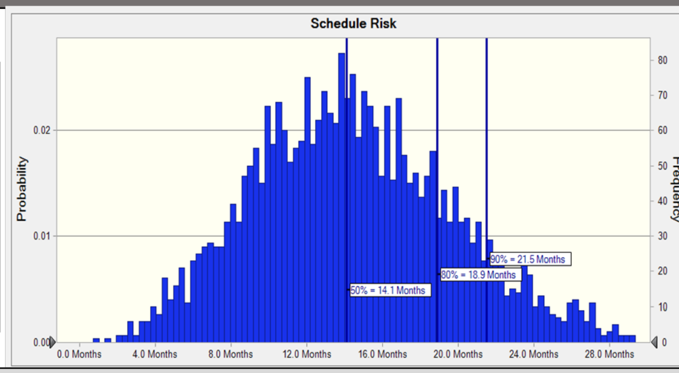


Figure 5.2. Cost Schedule Risk Analysis for AA2 (46 feet)

6 REFERENCES

US Army 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, 30 June 2016
- ER 110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
- Engineer Manual (EM) 1110-2-1304 (Tables Revised 30 September 2015), Civil Works Construction Cost Index System, 31 March 2000

7 ATR / COST CERTIFICATION