ST. JOHNS COUNTY, FLORIDA

South Ponte Vedra Beach, Vilano Beach, and Summer Haven Reaches

COASTAL STORM RISK MANAGEMENT PROJECT

DRAFT INTEGRATED FEASIBILITY STUDY AND ENVIRONMENTAL ASSESSMENT

APPENDIX B
Cost Engineering and Risk Analysis

December 2015

US Army Corps of Engineers
Jacksonville District

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

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ATTACHMENT TO APPENDIX B
ATTACHMENT A: COST AND SCHEDULE RISK ANALYSIS

B. COST ESTIMATES

B1. GENERAL INFORMATION

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 March 2009), Civil Works Construction Cost Index System, 31 March 2000
- 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 Process, March 2008

The goal of the cost estimates for the St. Johns County Shore Protection Project Feasibility Study is to present a Total Project Cost (construction and non-construction costs) for the Tenatively Selected Plan(s) at the current price level to be used for project justification/authorization and to escalate costs for budgeting purposes. In addition, the costing efforts are intended to produce a final product (cost estimate) that is reliable and accurate, and that supports the definition of the Government's and the non-Federal sponsor's obligations.

The cost estimating effort for the study also yielded a series of alternative plan formulation cost estimates for decision making. The final set of plan formulation cost estimates used for plan selection rely on construction feature unit pricing and are prepared in Civil Works Work Breakdown Structure (CWWBS) format to the sub-feature level. The cost estimate supporting the National Economic Development (NED) plan (Tenatively selected Plan/Locally Preferred Plan) is prepared in MCACES/MII format to the CWWBS sub-feature level. This estimate is supported by the preferred labor, equipment, materials and crew/production breakdown. A fully funded (escalated for inflation through project completion) cost estimate, the Baseline Cost Estimate or Total Project Cost Summary, has also been developed.

An abbreviated risk analysis was prepared that addresses project uncertainties and sets contingencies for the plan formulation cost estimates. A full cost and schedule risk analysis was performed to establish the project contingency for the Tenatively selected Plan's cost items.

B.1.1 Plan Formulation Cost Estimates

For the plan formulation cost estimates, unit prices for dredging related work were developed in CEDEP and then entered into MCACES/MII. Unit prices for the remaining major

or variable construction elements were developed in MCACES/MII based on input from the PDT. Design details, information and assumptions were provided in the Engineering Appendix. Plan formulation alternatives were run through Beach-Fx for calculation of the Benefit-to-Cost Ratio (BCR). Cost Engineering provided estimates for the initial construction on all alternatives that were input into Beach-Fx. An abbreviated risk analysis was completed in order to establish the contingency for each of the alternatives. Non-construction costs were included as percentages of the total construction contract cost for this level of comparison and screening.

Refer to Economics Section in the main report for final plan formulation cost tables.

B.1.2 Tenatively Selected Plan(s)

The Tenatively selected Plan or NED plan was chosen by the Project Delivery Team (PDT) according to the plan formulation described above. The Economics Appendix fully describes the plan selection. The scope of work for the Tenatively Selected Plan is found in Appendix A, Engineering. The MCACES/MII cost estimate for the Tenatively selected Plan (Section A3, below) is based on that scope and is 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 2016 price level (1 October 2015-30 September 2016). For project justification purposes, the estimate costs are categorized under the appropriate CWWBS code and include both construction and non-construction costs.

The construction costs fall under the following feature codes:

- 17 Beach Replenishment

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

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

B.1.3 Construction Cost

For the construction costs, unit prices for dredging related work were developed in the Cost Engineeing Dredge Estimating Program (CEDEP) and then entered into MCACES/MII. These costs include all major project components categorized under the appropriate CWWBS to the sub-feature level. The Total Project Cost Summary (TPCS) on the Tenatively selected Plan contains contingencies as noted in the estimate (below) and were determined as a result of the risk analysis which is covered under another paragraph.

B.1.4 Non-construction Cost

Non-construction costs typically include Lands and Damages (Real Estate), Planning Engineering & Design (PED) and Construction Management Costs (Supervision & Administration, 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 are provided by Real Estate and are best described in the Real Estate Appendix, Appendix D. PED costs are for the preparation of contract plans and specifications (P&S) and include itemized costs that were provided by the PDT, as well as costs for Post-Construction Monitoring costs and

percentages for Engineering During Construction (EDC) that were provided by the project manager. Construction Management costs are for the supervision and administration of a contract and include Project Management and Contract Admin costs. These costs were provided by the project manager and are included as a percentage of the total construction contract cost.

The main report details both cost allocation and cost apportionment for the Federal Government and the non-Federal Sponsor. Also included in the main report are the non-Federal Sponsor's obligations (items of local cooperation).

B.1.5 Construction Schedule

A construction schedule was prepared utilizing input from the PDT and reflects all project construction components. The schedule considers not only durations of individual components of construction, but also the timing of construction contracts based on funding and construction windows. The construction schedule was combined with the project schedule to create an overall schedule that was used for the generation of the TPCS. The construction schedule will change as the project moves through the various project lifecycle phases. The overall project schedule is provided below.

B.1.6 Total Project Cost Summary

The cost estimate for the Tenatively Selected Plan is prepared with an identified price level date and inflation factors are used to adjust the pricing to the project schedule. This estimate is known as the Fully Funded Cost Estimate or Total Project Cost Summary. It includes all Federal and non-Federal costs: Lands, Easements, Rights of Way and Relocations; construction features; Planning Engineering and Design; Construction Management; Contingency; and Inflation.

B2. PLAN FORMULATION COST ESTIMATES

There were several alternatives the PDT evaluated during plan formulation in order to identify the Tentatively Selected Plan (TSP). All alternatives that were evaluated at various stages in the study can be found in the Economics Appendix and are also outlined in the Main Report.

All dredging unit costs were calculated in CEDEP and transferred to MII to determine the total initial construction costs for each alternative. Real estate provided costs for the Lands and Damages by reach. The Planning, Engineering and Design (PED) costs, Engineering During Construction (EDC) costs and Supervision & Administration (S&A) costs were provided as a percentage of the total construction contract cost per the Project Manager.

A contingency was applied to each alternative. The contingency for the Real Estate costs was provided by RE Division. The contingencies for the construction and remaining non-construction costs were developed using an Abbreviated Risk Analysis. All major risk components were the same for each reach and alternative. Fluctuations in contingencies were mostly as a result of varying total initial construction costs. Site access, staging areas and dune crossovers were all identified as risk items that would require further consideration and refinement in the cost estimate.

Once the total initial construction costs for each alternative were developed in MII, the costs were broken down into a spreadsheet so that the PDT could input the cost information into BeachFx. The table listed the Mobilization & Demobilization costs separately and a Total Cost/Cubic Yard that consisted of the Dredging Cost, plus the non-Construction Costs (minus the Real Estate) since these were the two main cost inputs for BeachFx. The cost of the dune plantings and the Real Estate costs were listed separately and were added to the total project cost outside of BeachFx.

B3. TENATIVELY SELECTED PLAN (NED) COST ESTIMATE

The tenatively selected design covers approximately 2.6 miles of the study area extending from R-103.5 to R-106.5 with tapers extending approximately 1000 ft north of R-103.5 and approximately 1000ft south of R-106.5. The construction template consists of a 60 foot wide berm extension plus nourishment of the dune where necessary to maintain the existing (2015) dune profile.

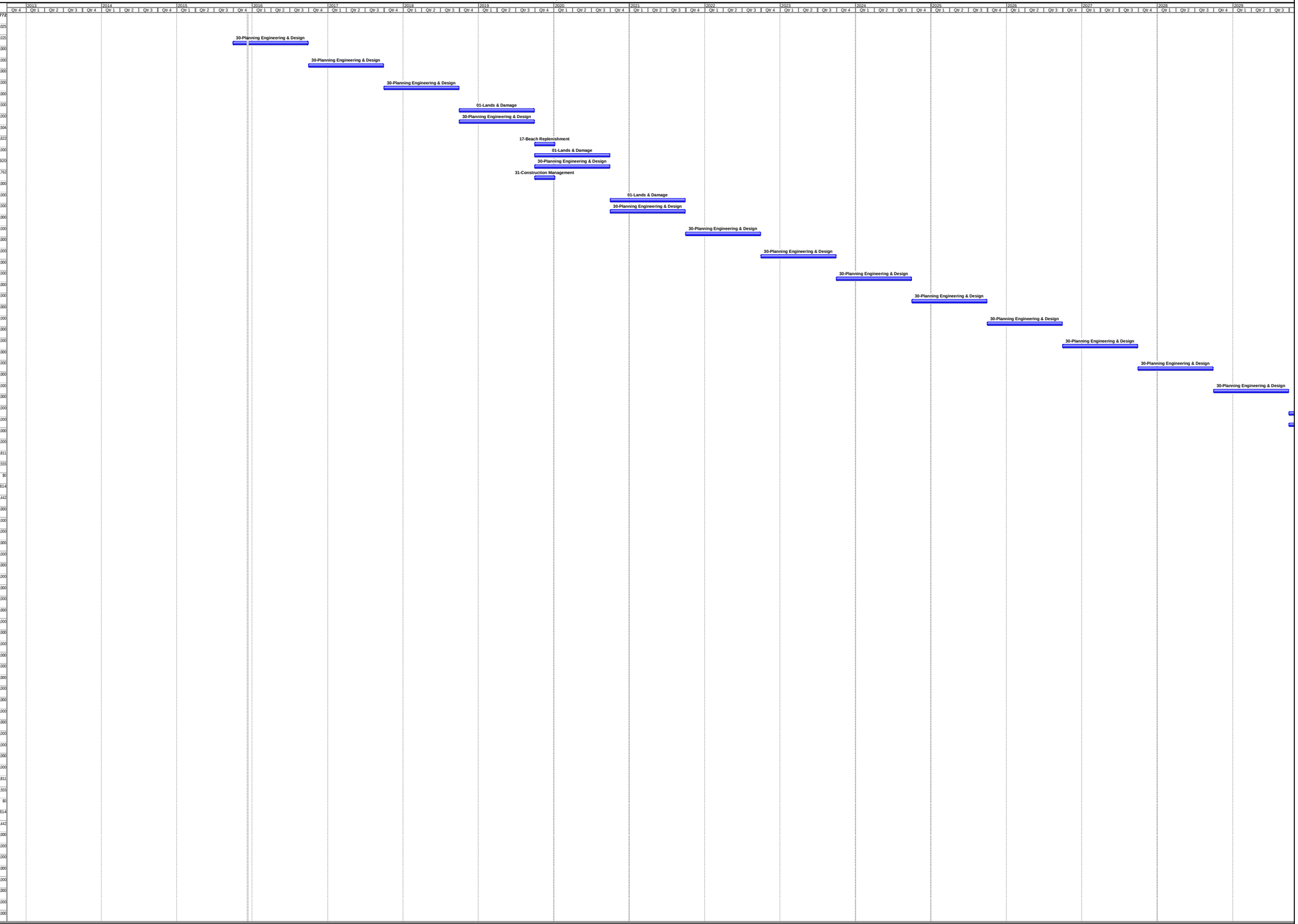
The Tenatively selected Plan estimate was prepared for the Total Project Cost, not just the initial construction costs.

B4. SCHEDULE

The project schedule covers the lifecycle phases of the tenatively selected plan (Planning Phase, Preconstruction, Engineering and Design (PED) Phase and the Construction Phase). Refer to the Schedule on the next page.

113174-St Johns County SPP

ID	Task Name	Duration	Start	Finish	Cost
1	**113174-ST JOHNS COUNTY SPP**	**12510 days**	**10/1/15**	**12/31/49**	**$50,620,772**
2	**2016**	**365 days**	**10/1/15**	**9/30/16**	$691,025
3	30-Planning Engineering & Design	365 days	10/1/15	9/30/16	$691,025
4	**2017**	**364 days**	**10/1/16**	**9/30/17**	$350,000
5	30-Planning Engineering & Design	364 days	10/1/16	9/30/17	$350,000
6	**2018**	**364 days**	**10/1/17**	**9/30/18**	$90,000
7	30-Planning Engineering & Design	364 days	10/1/17	9/30/18	$90,000
8	**2019**	**364 days**	**10/1/18**	**9/30/19**	$645,000
9	01-Lands & Damage	364 days	10/1/18	9/30/19	$25,000
10	30-Planning Engineering & Design	364 days	10/1/18	9/30/19	$620,000
11	**2020 - Initial Construction**	**365 days**	**10/1/19**	**9/30/20**	$10,677,504
12	17-Beach Replenishment	98 days	10/1/19	1/7/20	$9,556,822
13	01-Lands & Damage	365 days	10/1/19	9/30/20	$15,000
14	30-Planning Engineering & Design	365 days	10/1/19	9/30/20	$388,920
15	31-Construction Management	98 days	10/1/19	1/7/20	$716,762
16	**2021**	**364 days**	**10/1/20**	**9/30/21**	$100,000
17	01-Lands & Damage	364 days	10/1/20	9/30/21	$10,000
18	30-Planning Engineering & Design	364 days	10/1/20	9/30/21	$90,000
19	**2022**	**364 days**	**10/1/21**	**9/30/22**	$20,000
20	30-Planning Engineering & Design	364 days	10/1/21	9/30/22	$20,000
21	**2023**	**364 days**	**10/1/22**	**9/30/23**	$20,000
22	30-Planning Engineering & Design	364 days	10/1/22	9/30/23	$20,000
23	**2024**	**365 days**	**10/1/23**	**9/30/24**	$20,000
24	30-Planning Engineering & Design	365 days	10/1/23	9/30/24	$20,000
25	**2025**	**364 days**	**10/1/24**	**9/30/25**	$20,000
26	30-Planning Engineering & Design	364 days	10/1/24	9/30/25	$20,000
27	**2026**	**364 days**	**10/1/25**	**9/30/26**	$20,000
28	30-Planning Engineering & Design	364 days	10/1/25	9/30/26	$20,000
29	**2027**	**364 days**	**10/1/26**	**9/30/27**	$20,000
30	30-Planning Engineering & Design	364 days	10/1/26	9/30/27	$20,000
31	**2028**	**364 days**	**10/1/27**	**9/29/28**	$20,000
32	30-Planning Engineering & Design	364 days	10/1/27	9/29/28	$20,000
33	**2029**	**364 days**	**10/1/28**	**9/30/29**	$50,000
34	30-Planning Engineering & Design	364 days	10/1/28	9/30/29	$50,000
35	**2030**	**364 days**	**10/1/29**	**9/30/30**	$60,000
36	01-Lands & Damage	364 days	10/1/29	9/30/30	$10,000
37	30-Planning Engineering & Design	364 days	10/1/29	9/30/30	$50,000
38	**2031**	**364 days**	**10/1/31**	**9/29/32**	$630,000
39	30-Planning Engineering & Design	364 days	10/1/31	9/29/32	$630,000
40	**2032 - Renourishment 1**	**364 days**	**10/1/31**	**9/29/32**	$8,501,811
41	17-Beach Replenishment	77 days	10/1/31	12/17/31	$7,592,555
42	01-Lands & Damage	364 days	10/1/31	9/29/32	$0
43	30-Planning Engineering & Design	364 days	10/1/31	9/29/32	$339,814
44	31-Construction Management	77 days	10/1/31	12/17/31	$569,442
45	**2033**	**364 days**	**10/1/32**	**9/30/33**	$130,000
46	01-Lands & Damage	364 days	10/1/32	9/30/33	$10,000
47	30-Planning Engineering & Design	364 days	10/1/32	9/30/33	$120,000
48	**2034**	**364 days**	**10/1/33**	**9/30/34**	$20,000
49	30-Planning Engineering & Design	364 days	10/1/33	9/30/34	$20,000
50	**2035**	**364 days**	**10/1/34**	**9/30/35**	$20,000
51	30-Planning Engineering & Design	364 days	10/1/34	9/30/35	$20,000
52	**2036**	**365 days**	**10/1/35**	**9/30/36**	$20,000
53	30-Planning Engineering & Design	365 days	10/1/35	9/30/36	$20,000
54	**2037**	**364 days**	**10/1/36**	**9/30/37**	$20,000
55	30-Planning Engineering & Design	364 days	10/1/36	9/30/37	$20,000
56	**2038**	**364 days**	**10/1/37**	**9/30/38**	$20,000
57	30-Planning Engineering & Design	364 days	10/1/37	9/30/38	$20,000
58	**2039**	**364 days**	**10/1/38**	**9/30/39**	$20,000
59	30-Planning Engineering & Design	364 days	10/1/38	9/30/39	$20,000
60	**2040**	**364 days**	**10/1/39**	**9/29/40**	$20,000
61	30-Planning Engineering & Design	364 days	10/1/39	9/29/40	$20,000
62	**2041**	**364 days**	**10/1/40**	**9/30/41**	$50,000
63	30-Planning Engineering & Design	364 days	10/1/40	9/30/41	$50,000
64	**2042**	**364 days**	**10/1/41**	**9/30/42**	$60,000
65	01-Lands & Damage	364 days	10/1/41	9/30/42	$10,000
66	30-Planning Engineering & Design	364 days	10/1/41	9/30/42	$50,000
67	**2043**	**364 days**	**10/1/42**	**9/30/43**	$630,000
68	30-Planning Engineering & Design	364 days	10/1/42	9/30/43	$630,000
69	**2044 - Renourishment 2**	**364 days**	**10/1/43**	**9/29/44**	$8,501,811
70	17-Beach Replenishment	77 days	10/1/43	12/17/43	$7,592,555
71	01-Lands & Damage	364 days	10/1/43	9/29/44	$0
72	30-Planning Engineering & Design	364 days	10/1/43	9/29/44	$339,814
73	31-Construction Management	77 days	10/1/43	12/17/43	$569,442
74	**2045**	**364 days**	**10/1/44**	**9/30/45**	$130,000
75	01-Lands & Damage	364 days	10/1/44	9/30/45	$10,000
76	30-Planning Engineering & Design	364 days	10/1/44	9/30/45	$120,000
77	**2046**	**364 days**	**10/1/45**	**9/30/46**	$20,000
78	30-Planning Engineering & Design	364 days	10/1/45	9/30/46	$20,000
79	**2047**	**364 days**	**10/1/46**	**9/30/47**	$20,000
80	30-Planning Engineering & Design	364 days	10/1/46	9/30/47	$20,000
81	**2048**	**91 days**	**10/1/48**	**12/31/48**	$20,000



Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

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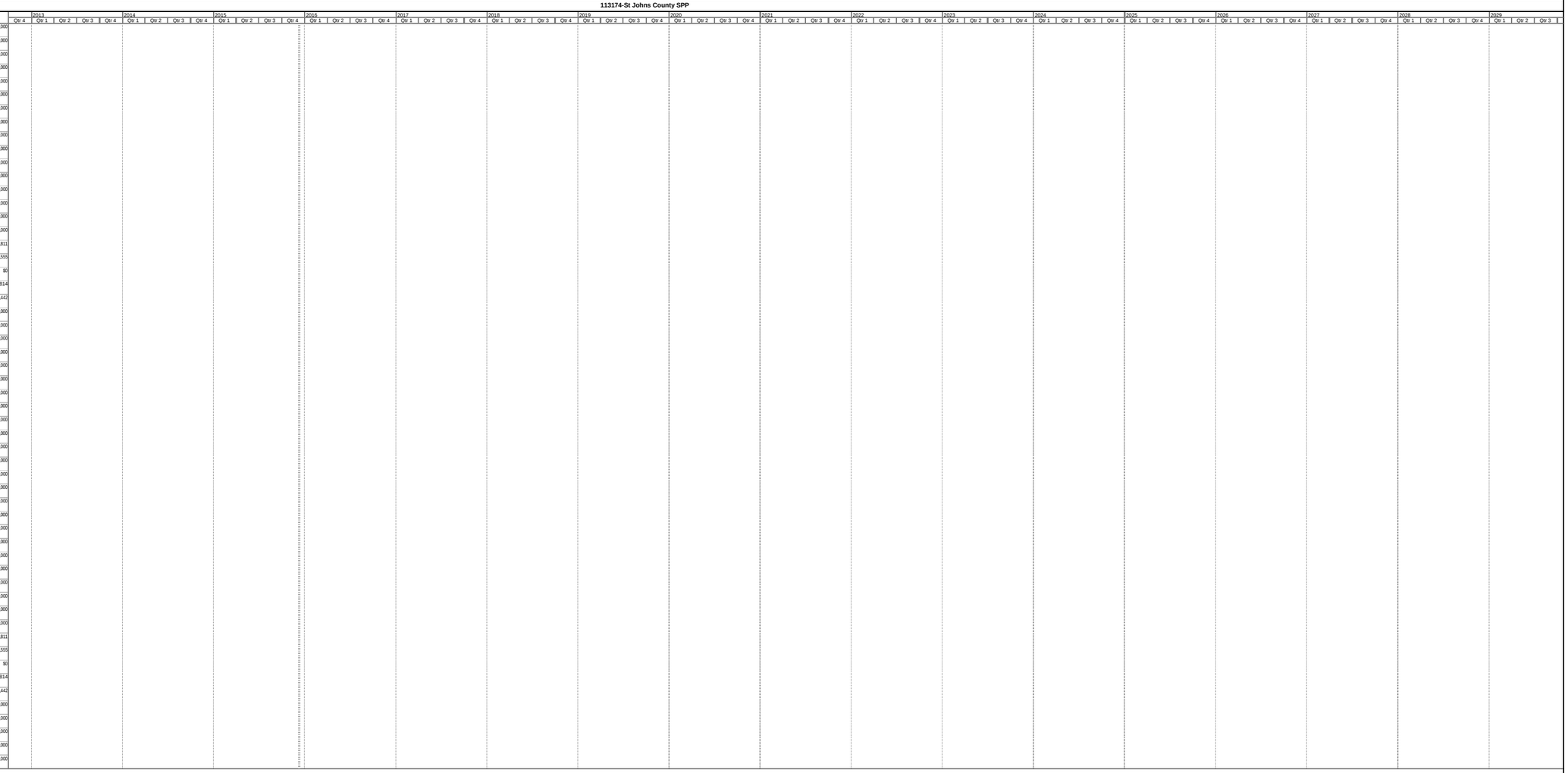
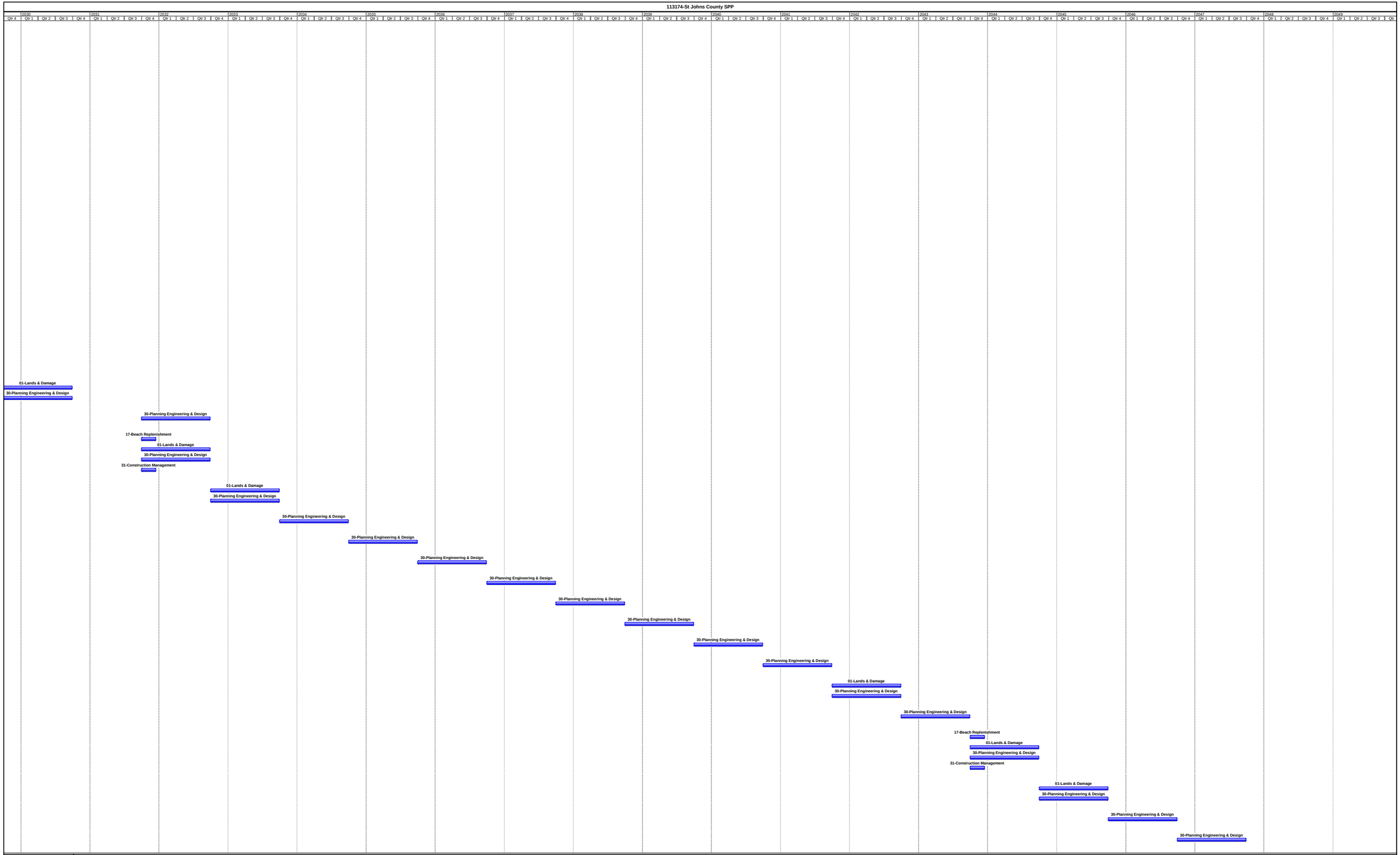
113174-St Johns County SPP

ID	Task Name	Duration	Start	Finish	Cost
82	30-Planning Engineering & Design	91 days	10/1/48	12/31/48	$20,000
83	**2049**	**91 days**	**10/1/49**	**12/31/49**	$20,000
84	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
85	**2050**	**91 days**	**10/1/49**	**12/31/49**	$20,000
86	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
87	**2051**	**91 days**	**10/1/49**	**12/31/49**	$20,000
88	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
89	**2052**	**91 days**	**10/1/49**	**12/31/49**	$20,000
90	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
91	**2053**	**91 days**	**10/1/49**	**12/31/49**	$50,000
92	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$50,000
93	**2054**	**91 days**	**10/1/49**	**12/31/49**	$60,000
94	01-Lands & Damage	91 days	10/1/49	12/31/49	$10,000
95	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$50,000
96	**2055**	**91 days**	**10/1/49**	**12/31/49**	$630,000
97	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$630,000
98	**2056 - Renourishment 3**	**91 days**	**10/1/49**	**12/31/49**	$8,501,811
99	17-Beach Replenishment	91 days	10/1/49	12/31/49	$7,592,555
100	01-Lands & Damage	91 days	10/1/49	12/31/49	$0
101	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$339,814
102	31-Construction Management	91 days	10/1/49	12/31/49	$569,442
103	**2057**	**91 days**	**10/1/49**	**12/31/49**	$130,000
104	01-Lands & Damage	91 days	10/1/49	12/31/49	$10,000
105	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$120,000
106	**2058**	**91 days**	**10/1/49**	**12/31/49**	$20,000
107	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
108	**2059**	**91 days**	**10/1/49**	**12/31/49**	$20,000
109	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
110	**2060**	**91 days**	**10/1/49**	**12/31/49**	$20,000
111	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
112	**2061**	**91 days**	**10/1/49**	**12/31/49**	$20,000
113	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
114	**2062**	**91 days**	**10/1/49**	**12/31/49**	$20,000
115	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
116	**2063**	**91 days**	**10/1/49**	**12/31/49**	$20,000
117	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
118	**2064**	**91 days**	**10/1/49**	**12/31/49**	$20,000
119	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000
120	**2065**	**91 days**	**10/1/49**	**12/31/49**	$50,000
121	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$50,000
122	**2066**	**91 days**	**10/1/49**	**12/31/49**	$60,000
123	01-Lands & Damage	91 days	10/1/49	12/31/49	$10,000
124	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$50,000
125	**2067**	**91 days**	**10/1/49**	**12/31/49**	$630,000
126	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$630,000
127	**2068**	**91 days**	**10/1/49**	**12/31/49**	$8,501,811
128	17-Beach Replenishment	91 days	10/1/49	12/31/49	$7,592,555
129	01-Lands & Damage	91 days	10/1/49	12/31/49	$0
130	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$339,814
131	31-Construction Management	91 days	10/1/49	12/31/49	$569,442
132	**2069**	**91 days**	**10/1/49**	**12/31/49**	$130,000
133	01-Lands & Damage	91 days	10/1/49	12/31/49	$10,000
134	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$120,000
135	**2070**	**91 days**	**10/1/49**	**12/31/49**	$20,000
136	30-Planning Engineering & Design	91 days	10/1/49	12/31/49	$20,000



Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

113174-St Johns County SPP



Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

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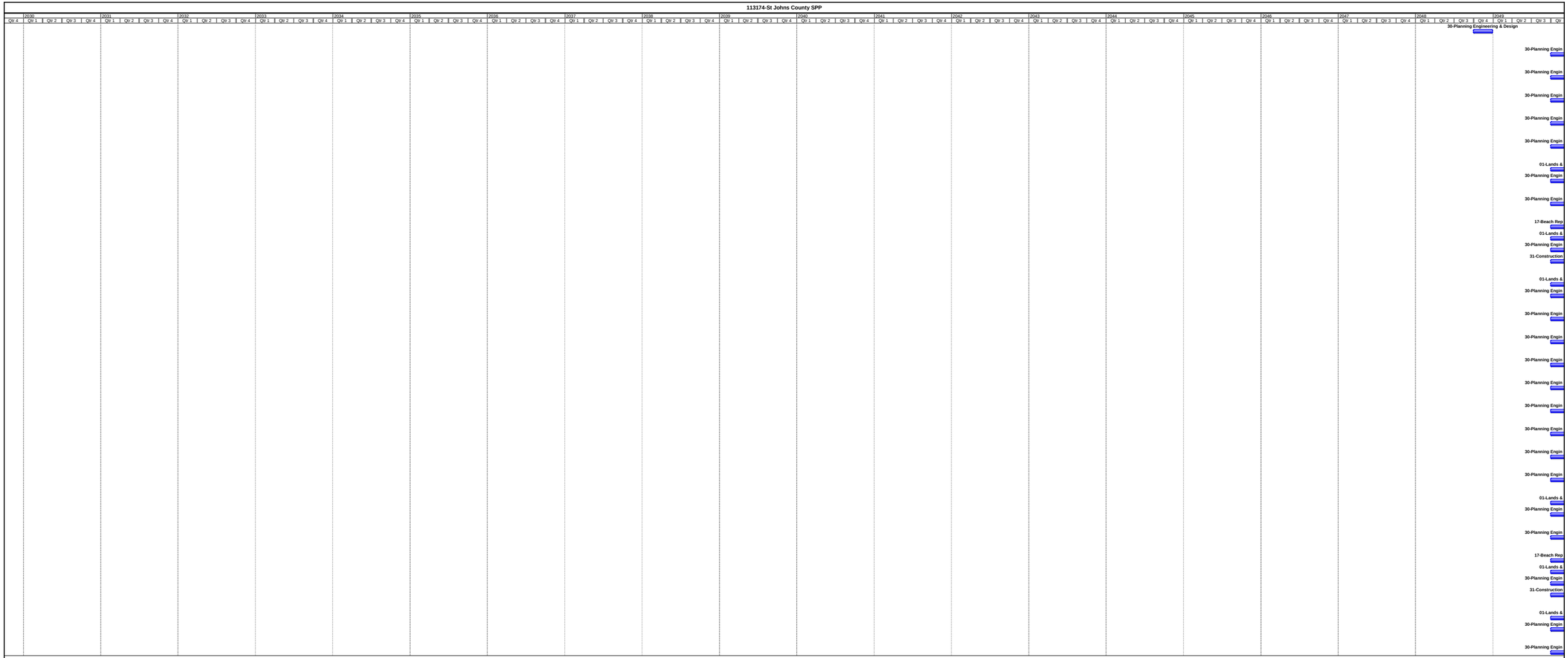

Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline

B5. RISK AND UNCERTAINTY ANALYSIS

A Cost and Schedule Risk Analysis was conducted according to the procedures outlined in the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.
- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.
- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

B.5.1 Risk Analysis Methods

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence.

The entire PDT participated in a risk analysis brainstorming session to identify risks associated with the Tenatively selected Plan. The risks were listed in the risk register, which is a tool commonly used in project planning and risk analysis, and evaluated by the PDT. The actual Risk Register is provided in Attachment A. 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. A risk model was then developed by Walla Walla in order to establish contingencies to apply to the project cost. Risks were evaluated for the following features of work:

- 01 Lands and Damages
- 17 Beach Replenishment
    - Mob, Demob & Preparatory Work
    - Hopper Dredging
    - Dune Planting
- 30 Planning, Engineering and Design
- 31 Construction Management

After the model was run, the results were reviewed and all parameters were re-evaluated by the PDT as a sanity check of assumptions and inputs. Adjustments were made to the analysis accordingly and the final contingency was established. The contingency was applied to the Tenatively Selected Plan estimate in the Total Project Cost Summary in order to obtain the Fully Funded Cost.

B.5.2 Risk Analysis Results

Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation.

Based on the risks that were assessed for the project, the resultant contingency was 24%. The complete breakdown of results can be viewed in the Cost and Schedule Risk Analysis report provided in Attachment A.

B6. TOTAL PROJECT COST SUMMARY

The Total Project Cost Summary (TPCS) addresses inflation through project completion (accomplished by escalation to mid-point of construction per ER 1110-2-1302, Appendix C, Page C-2). It is based on the scope of the Tenatively Selected Plan and the official project schedule. The TPCS includes Federal and non-Federal costs for Lands and Damages, all construction features, PED, S&A, along with the appropriate contingencies and escalation associated with each of these activities. The TPCS is formatted according to the CWWBS and uses Civil Works Construction Cost Indexing System (CWCCIS) factors for escalation (EM 1110-2-1304) of construction costs and Office of Management and Budget (EC 11-2-18X, 20 Feb 2008) factors for escalation of PED and S&A costs.

The Total Project Cost Summary was prepared using the MCACES/MII cost estimate on the Tenatively selected Plan, as well as the contingencies set by the risk analysis and the official project schedule.

B.6.1 Total Project Cost Summary Spreadsheet

Refer to the Total Project Cost Summary Spreadsheet on the next page.

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

PROJECT: **St Johns County Shore Protection Project**
PROJECT NO: P2 113174
LOCATION: St Johns County, FL

DISTRICT: Jacksonville District **PREPARED: 11/18/2015**
POC: CHIEF, COST ENGINEERING, Matthew Cunningham

This Estimate reflects the scope and schedule in report; St Johns County SPP Feasibility Report December 2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2016 Effective Price Level Date: 1 OCT 15									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **10/1/2015** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
17	BEACH REPLENISHMENT	$39,927	$9,582	24.0%	$49,510	0.0%	$39,927	$9,582	$49,510	$0	$49,510	67.5%	$66,890	$16,054	$82,944
	CONSTRUCTION ESTIMATE TOTALS:	$39,927	$9,582		$49,510	0.0%	$39,927	$9,582	$49,510	$0	$49,510	67.5%	$66,890	$16,054	$82,944
01	LANDS AND DAMAGES	$2,585	$620	24.0%	$3,205	0.0%	$2,585	$620	$3,205	$0	$3,205	7.7%	$2,784	$668	$3,452
30	PLANNING, ENGINEERING & DESIGN	$6,939	$1,665	24.0%	$8,605	0.0%	$6,939	$1,665	$8,605	$0	$8,605	223.6%	$22,457	$5,390	$27,847
31	CONSTRUCTION MANAGEMENT	$3,625	$870	24.0%	$4,494	0.0%	$3,625	$870	$4,494	$0	$4,494	83.6%	$6,656	$1,597	$8,253
	PROJECT COST TOTALS:	$53,076	$12,738	24.0%	$65,814		$53,076	$12,738	**$65,814**	$0	**$65,814**	86.1%	$98,787	$23,709	$122,495

CHIEF, COST ENGINEERING, Matthew Cunningham

PROJECT MANAGER, Brandon Burch

CHIEF, REAL ESTATE, Audrey Omerod

CHIEF, PLANNING, Eric Summa

CHIEF, ENGINEERING, Laurenn Borochaner

CHIEF, OPERATIONS, Jim Jeffords

CHIEF, CONSTRUCTION, Steve Duba

CHIEF, CONTRACTING, Carlos Clarke

CHIEF, PM-PB, Karen Smith

CHIEF, DPM, Tim Murphy

ESTIMATED FEDERAL COST:	**75%**	**$91,872**
ESTIMATED NON-FEDERAL COST:	**25%**	**$30,624**
ESTIMATED TOTAL PROJECT COST:		**$122,495**

Filename: Non-CAP_113174_TPCS Sep 2015 r0_R1
TPCS

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

**** CONTRACT COST SUMMARY ****

PROJECT: St Johns County Shore Protection Project
LOCATION: St Johns County, FL
This Estimate reflects the scope and schedule in report; St Johns County SPP Feasibility Report December 2015

DISTRICT: Jacksonville District
POC: CHIEF, COST ENGINEERING, Matthew Cunningham
PREPARED: 11/18/2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 16-Nov-15; Effective Price Level: 1-Oct-15				Program Year (Budget EC): 2016; Effective Price Level Date: 1 OCT 15								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	INITITAL CONSTRUCTION													
17	BEACH REPLENISHMENT	$9,557	$2,294	24.0%	$11,850	0.0%	$9,557	$2,294	$11,850	2018Q4	5.1%	$10,049	$2,412	$12,461
	CONSTRUCTION ESTIMATE TOTALS:	$9,557	$2,294	24.0%	**$11,850**		$9,557	$2,294	$11,850			$10,049	$2,412	$12,461
01	LANDS AND DAMAGES	$2,505	$601	24.0%	$3,106	0.0%	$2,505	$601	$3,106	2018Q4	5.1%	$2,634	$632	$3,266
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	$2,230	$535	24.0%	$2,765	0.0%	$2,230	$535	$2,765	2018Q4	11.0%	$2,475	$594	$3,069
1.0%	Planning & Environmental Compliance		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
15.0%	Engineering & Design		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Reviews, ATRs, IEPRs, VE		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Life Cycle Updates (cost, schedule, risks)		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Contracting & Reprographics		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
3.0%	Engineering During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Planning During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Project Operations		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$717	$172	24.0%	$889	0.0%	$717	$172	$889	2018Q4	5.3%	$755	$181	$936
2.0%	Project Operation:		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.5%	Project Management		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$15,009	$3,602		$18,611		$15,009	$3,602	$18,611			$15,912	$3,819	$19,731

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

**** CONTRACT COST SUMMARY ****

PROJECT: St Johns County Shore Protection Project
LOCATION: St Johns County, FL
This Estimate reflects the scope and schedule in report; St Johns County SPP Feasibility Report December 2015

DISTRICT: Jacksonville District
POC: CHIEF, COST ENGINEERING, Matthew Cunningham
PREPARED: 11/18/2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			16-Nov-15	Program Year (Budget EC):			2016					
		Effective Price Level:			1-Oct-15	Effective Price Level Date:			1 OCT 15					
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*
	RENOURISHMENT 1													
17	BEACH REPLENISHMENT	$7,593	$1,822	24.0%	$9,415	0.0%	$7,593	$1,822	$9,415	2028Q1	26.3%	$9,590	$2,302	$11,892
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$7,593	$1,822	24.0%	**$9,415**		$7,593	$1,822	$9,415			$9,590	$2,302	$11,892
01	LANDS AND DAMAGES	$20	$5	24.0%	$25	0.0%	$20	$5	$25	2028Q1	26.3%	$25	$6	$31
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	$1,330	$319	24.0%	$1,649	0.0%	$1,330	$319	$1,649	2028Q1	62.2%	$2,158	$518	$2,675
1.0%	Planning & Environmental Compliance		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
15.0%	Engineering & Design		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Reviews, ATRs, IEPRs, VE		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Life Cycle Updates (cost, schedule, risks)		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Contracting & Reprographics		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
3.0%	Engineering During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Planning During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Project Operations		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$569	$137	24.0%	$706	0.0%	$569	$137	$706	2028Q1	26.5%	$720	$173	$893
2.0%	Project Operation:		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.5%	Project Management		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$9,512	$2,283		$11,795		$9,512	$2,283	$11,795			$12,493	$2,998	$15,492

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

**** CONTRACT COST SUMMARY ****

PROJECT: St Johns County Shore Protection Project
LOCATION: St Johns County, FL
This Estimate reflects the scope and schedule in report; St Johns County SPP Feasibility Report December 2015

DISTRICT: Jacksonville District
POC: CHIEF, COST ENGINEERING, Matthew Cunningham
PREPARED: 11/18/2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			16-Nov-15	Program Year (Budget EC):			2016					
		Effective Price Level:			1-Oct-15	Effective Price Level Date:			1 OCT 15					
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*
	RENOURISHMENT 2													
17	BEACH REPLENISHMENT	$7,593	$1,822	24.0%	$9,415	0.0%	$7,593	$1,822	$9,415	2040Q1	60.2%	$12,163	$2,919	$15,082
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$7,593	$1,822	24.0%	**$9,415**		$7,593	$1,822	$9,415			$12,163	$2,919	$15,082
01	LANDS AND DAMAGES	$20	$5	24.0%	$25	0.0%	$20	$5	$25	2040Q1	60.2%	$32	$8	$40
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	$1,330	$319	24.0%	$1,649	0.0%	$1,330	$319	$1,649	2040Q1	189.9%	$3,855	$925	$4,780
1.0%	Planning & Environmental Compliance		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
15.0%	Engineering & Design		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Reviews, ATRs, IEPRs, VE		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Life Cycle Updates (cost, schedule, risks)		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Contracting & Reprographics		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
3.0%	Engineering During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Planning During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Project Operations		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$569	$137	24.0%	$706	0.0%	$569	$137	$706	2040Q1	60.4%	$913	$219	$1,132
2.0%	Project Operation:		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.5%	Project Management		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$9,512	$2,283		**$11,795**		$9,512	$2,283	$11,795			$16,963	$4,071	**$21,034**

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

**** CONTRACT COST SUMMARY ****

PROJECT: St Johns County Shore Protection Project
LOCATION: St Johns County, FL
This Estimate reflects the scope and schedule in report; St Johns County SPP Feasibility Report December 2015

DISTRICT: Jacksonville District
POC: CHIEF, COST ENGINEERING, Matthew Cunningham
PREPARED: 11/18/2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			16-Nov-15	Program Year (Budget EC):			2016	FULLY FUNDED PROJECT ESTIMATE				
		Effective Price Level:			1-Oct-15	Effective Price Level Date:			1 OCT 15					
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*
	RENOURISHMENT 3													
17	BEACH REPLENISHMENT	$7,593	$1,822	24.0%	$9,415	0.0%	$7,593	$1,822	$9,415	2052Q1	103.2%	$15,426	$3,702	$19,128
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$7,593	$1,822	24.0%	**$9,415**		$7,593	$1,822	$9,415			$15,426	$3,702	$19,128
01	LANDS AND DAMAGES	$20	$5	24.0%	$25	0.0%	$20	$5	$25	2052Q1	103.2%	$41	$10	$50
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	$1,330	$319	24.0%	$1,649	0.0%	$1,330	$319	$1,649	2052Q1	426.5%	$7,002	$1,680	$8,682
1.0%	Planning & Environmental Compliance		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
15.0%	Engineering & Design		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Reviews, ATRs, IEPRs, VE		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Life Cycle Updates (cost, schedule, risks)		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Contracting & Reprographics		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
3.0%	Engineering During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Planning During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Project Operations		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$569	$137	24.0%	$706	0.0%	$569	$137	$706	2052Q1	103.4%	$1,158	$278	$1,436
2.0%	Project Operation:		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.5%	Project Management		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$9,512	$2,283		**$11,795**		$9,512	$2,283	$11,795			$23,626	$5,670	**$29,296**

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

**** CONTRACT COST SUMMARY ****

PROJECT: St Johns County Shore Protection Project
LOCATION: St Johns County, FL
This Estimate reflects the scope and schedule in report; St Johns County SPP Feasibility Report December 2015

DISTRICT: Jacksonville District
POC: CHIEF, COST ENGINEERING, Matthew Cunningham
PREPARED: 11/18/2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			16-Nov-15	Program Year (Budget EC):			2016	FULLY FUNDED PROJECT ESTIMATE				
		Effective Price Level:			1-Oct-15	Effective Price Level Date:			1 OCT 15					
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*
	RENOURISHMENT 4													
17	BEACH REPLENISHMENT	$7,593	$1,822	24.0%	$9,415	0.0%	$7,593	$1,822	$9,415	2064Q2	159.0%	$19,662	$4,719	$24,381
							$0							
	CONSTRUCTION ESTIMATE TOTALS:	$7,593	$1,822	24.0%	**$9,415**		$7,593	$1,822	$9,415			$19,662	$4,719	$24,381
01	LANDS AND DAMAGES	$20	$5	24.0%	$25	0.0%	$20	$5	$25	2064Q2	159.0%	$52	$12	$64
30	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	$720	$173	24.0%	$893	0.0%	$720	$173	$893	2064Q2	868.2%	$6,969	$1,673	$8,642
1.0%	Planning & Environmental Compliance		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
15.0%	Engineering & Design		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Reviews, ATRs, IEPRs, VE		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Life Cycle Updates (cost, schedule, risks)		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Contracting & Reprographics		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
3.0%	Engineering During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Planning During Construction		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Project Operations		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$1,199	$288	24.0%	$1,487	0.0%	$1,199	$288	$1,487	2064Q2	159.2%	$3,109	$746	$3,856
2.0%	Project Operation:		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.5%	Project Management		$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$9,532	$2,288		**$11,819**		$9,532	$2,288	$11,819			$29,792	$7,150	**$36,942**

B7. COST MCX TPCS CERTIFICATION

The recommended plan estimate, formal cost and schedule risk analysis and total project cost summary spreadsheet underwent cost review and certification by the Walla Walla Mandatory Center of Expertise.

ATTACHMENT A
COST AND SCHEDULE RISK ANALYSIS

US Army Corps
of Engineers®

St. Johns County - Shore Protection Project (SPP)
113174
St Johns County, Florida
Feasibility Report
Project Cost and Schedule Risk Analysis (CSRA) Report

Prepared by:

U.S. Army Corps of Engineers
Jacksonville District
Cost Engineering Section

December 2015

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EXECUTIVE SUMMARY

The CSRA was developed by CESAJ-ENTC with support by the Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works. The CSRA was reviewed by the MCX during Agency Technical Review (ATR) and during subsequent coordination between the MCX and Jacksonville District Cost Engineering. This report presents a recommendation for the total project cost and schedule contingencies for the St. Johns County SPP Feasibility Report. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost.

Specific to the St. Johns County SPP, the most likely total project cost (at current price level) is approximately $65.8 Million. Based on the results of the analysis, the Jacksonville District recommends a contingency value of $12.7 Million, or 24%. This contingency includes $10.1Million (19%) for risks related to cost and $2.6 Million (5%) for the effect of schedule delay on overall project costs.

The Jacksonville District performed the risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers. This has been reviewed, as required, by the MCX, Walla Walla District.

The following table portrays the development of contingencies (25% overall). The contingency is based on an 80% confidence level, as per USACE Civil Works guidance.

Table ES-1. Contingency Analysis Table

Base Cost Estimate	**$53,076,000**	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$60,023,532	13%
50%	$63,333,305	19%
80%	**$65,784,332**	**24%**
95%	$67,704,598	28%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis are CA1 (Acquisition Strategy), ET2 (Quantity Estimates), REG3 (Environmental Restrictions), PR5 (Fuel Prices), PR1 (Bidding Climate) and TL4 (Character of Materials), which together contribute over 75 percent of the statistical cost variance.

- Acquisition Strategy captures the risk to the cost of the possibility of multiple contracts which could increase cost.
- Quantity Estimates captures the risk to the cost of quantity variations due to multiple factors over the 50 year project life.
- Environmental Restrictions captures the risk to the cost associated with required dredging windows and environmental restrictions.
- Fuel Prices captures the risk to the cost due to increase in fuel costs greater than the predicted escalation.
- Bidding Climate captures the risk to the cost associated with severe economic swings that could decrease the number of potential bidders.
- Character of Materials captures the risk to the cost due to the lack of geotechnical investigations which leads to uncertainty regarding the yield of suitable material from the borrow site.

An additional moderate cost risk that should be closely monitored is T-3 (Availability of Sand).

- Availability of Sand captures the risk to cost caused a possible shortage in the amount of borrow material available for the life of the project. Depletion prior to project life end would result in a need to find another borrow source, triggering, at least, a Limited Reevaluation Report and Geotechnical study.

The key schedule risk drivers identified through sensitivity analysis are PM2 (Funding Stream), REG3 (Environmental Restrictions), REG1 (Environmental Impacts), and PR1 (Bidding Climate), which together contribute over 75 percent of the statistical schedule variance.

- Funding Stream captures the impacts to the schedule of not receiving funding in a timely manner.
- Environmental Restrictions captures the impacts to the schedule associated with required dredging windows and environmental restrictions.

- Environmental Impacts captures the impacts to the schedule associated with the possibility of cultural resources at the project site or borrow area which would require additional investigation, coordination and permitting.
- Bidding Climate captures the impacts to the schedule associated with severe economic swings that could decrease the number of potential bidders.

Additional moderate schedule risks that should be closely monitored are ET5 (Dredge Size/Type), PM1 (Scope Definition), and ET2 Quantity Estimates.

- Dredge Size/Type captures the risk to the schedule associated with the similarity of the equipment used in the estimate and what the contractor offers.
- Scope Definition captures the risk to the schedule of a poorly defined scope.
- Quantity Estimates captures the risk to the schedule of quantity variations due to multiple factors over the 50 year project life.

Recommendations, as detailed within the main report, include the implementation of cost and schedule contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

This report presents a recommendation for the total project cost and schedule contingencies for the St. Johns County SPP Feasibility Report.

2.0 BACKGROUND

The St. Johns County SPP addresses the 2.6 mile TSP shoreline between FDEP monuments R-104 and R-116. Initial construction is expected to include the placement of about 1.3 million cubic yards (CY) and 866,000 CY during re-nourishment every 12 years. The sand source for the project will be the ebb shoal of the St. Augustine Inlet.

It is likely that the contracts will be acquired using the district's most appropriate acquisition process. The construction schedule for the initial construction is approximately 98 days in duration and approximately 77 days in duration for each re-nourishment. Both schedules include 30 days for mobilization.

As a part of this effort, Jacksonville District requested that the USACE Cost Engineering MCX provide an ATR of the CSRA.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the baseline Micro Computer Aided Cost Estimating System (MCACES) cost estimate, schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The project technical scope, estimates and schedules were developed and presented by the Jacksonville District. Consequently, these documents serve as the basis for the risk analysis.

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering MCX.

- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008.

- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Jacksonville District performed the Cost and Schedule Risk Analysis, conducting a risk identification meeting on October 15, 2015 with the Project Delivery Team (PDT) to produce a risk register that served as the framework for the risk analysis. Participants in the risk identification meeting included the following:

Section	Title
CESAJ-PD-D	Dan Abecassis, Economist
CESAJ-PD-D	Courtney Jackson, Economist
CESAJ-EN-WC	Marty Durkin, Coastal Engineer
CESAJ-EN-Q	Autumn Ziegler, Value Engineering Officer
CESAJ-PD-PN	Matt Schrader, Planning Technical Lead
CESAJ-EN-WC	Kevin Hodgens, Coastal Engineer
CESAJ-PM-WN	Brandon Burch, Project Manager
CESAJ-EN-GG	Barbara Nist, Geotechnical Engineer
CESAJ-PD-EC	Aubree Hershorin, Biologist
CESAJ-EN-WC	Jason Engle, Coastal Engineer
CESAJ-PD-PN	Ashleigh Fountain, Biologist
CESAJ-EN-GG	Jennifer Coor, Geotechnical Engineer
CESAJ-CD-NJ	Mike Lyons, Construction Engineer
CESAJ-PD-D	Colin Rawls, Economist

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Per regulation and guidance, the P80 confidence level (80% confidence level) is the normal and accepted cost confidence level. District Management has the prerogative to select different confidence levels, pending approval from Headquarters, USACE.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as

compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

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

A formal PDT meeting was held for the purposes of identifying and assessing risk factors. The meeting included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, geology, and coastal engineering.

The initial formal meetings focused primarily on risk factor identification using brainstorming techniques, but also included some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings focused primarily on risk factor assessment and quantification.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions) because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the Broward County – Segment III project.

a. The Jacksonville District completed the MII MCACES (Micro-Computer Aided Cost Estimating Software), serving as the basis for the cost and schedule risk analyses, on November 16, 2015.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. Schedules are analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay. Specific to the St. Johns County SPP, the schedule was analyzed only for impacts due to residual fixed costs.

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, State Adjustment Factor for the State of Florida is 0.93, meaning that the average inflation for the project area is assumed to be 7% lower than the national average for inflation. Therefore, it is assumed that the project inflations experienced are similar to OMB inflation factors for future construction. Based on this information, the risk analysis accounted for a slight escalation adjustment over and above the national average.

e. The assumed overhead percentage for Prime Contractors and Subcontractors ranges from 8-10%. For this project, 10% has been assumed to calculate impacts to the P80 schedule and cost contingencies within the risk model.

f. The Cost MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

g. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list”.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

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

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

6.2 Cost Contingency and Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $10.1 Million at the P80 confidence level (19% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 15% and 27% of the baseline cost estimate, respectively.

Table 1. Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate	Total Contingency[1,2] ($)	Total Contingency (%)
50% Confidence Level			
Project Cost	$53,076,000	$7,961,400	15%
80% Confidence Level			
Project Cost	$53,076,000	$10,084,440	19%
100% Confidence Level			
Project Cost	$53,076,000	$14,330,520	27%

Notes:
1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. Opportunities that have a potential to reduce project cost are shown with a negative sign; risks are shown with a positive sign to reflect the potential to increase project cost. A longer bar in the sensitivity analysis chart represents a greater potential impact to project cost.

Figure 1 presents a sensitivity analysis for cost growth risk from the high level cost risks identified in the risk register. Likewise, Figure 2 presents a sensitivity analysis for schedule growth risk from the high level schedule risks identified in the risk register.

6.3 Schedule and Contingency Risk Analysis

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 48 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)
50% Confidence Level		
Project Duration	600	7
80% Confidence Level		
Project Duration	600	8
100% Confidence Level		
Project Duration	600	11

Notes:
1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 2.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of “unknown unknowns”) makes 100% confidence a theoretical impossibility.

Figure 1. Cost Sensitivity Analysis

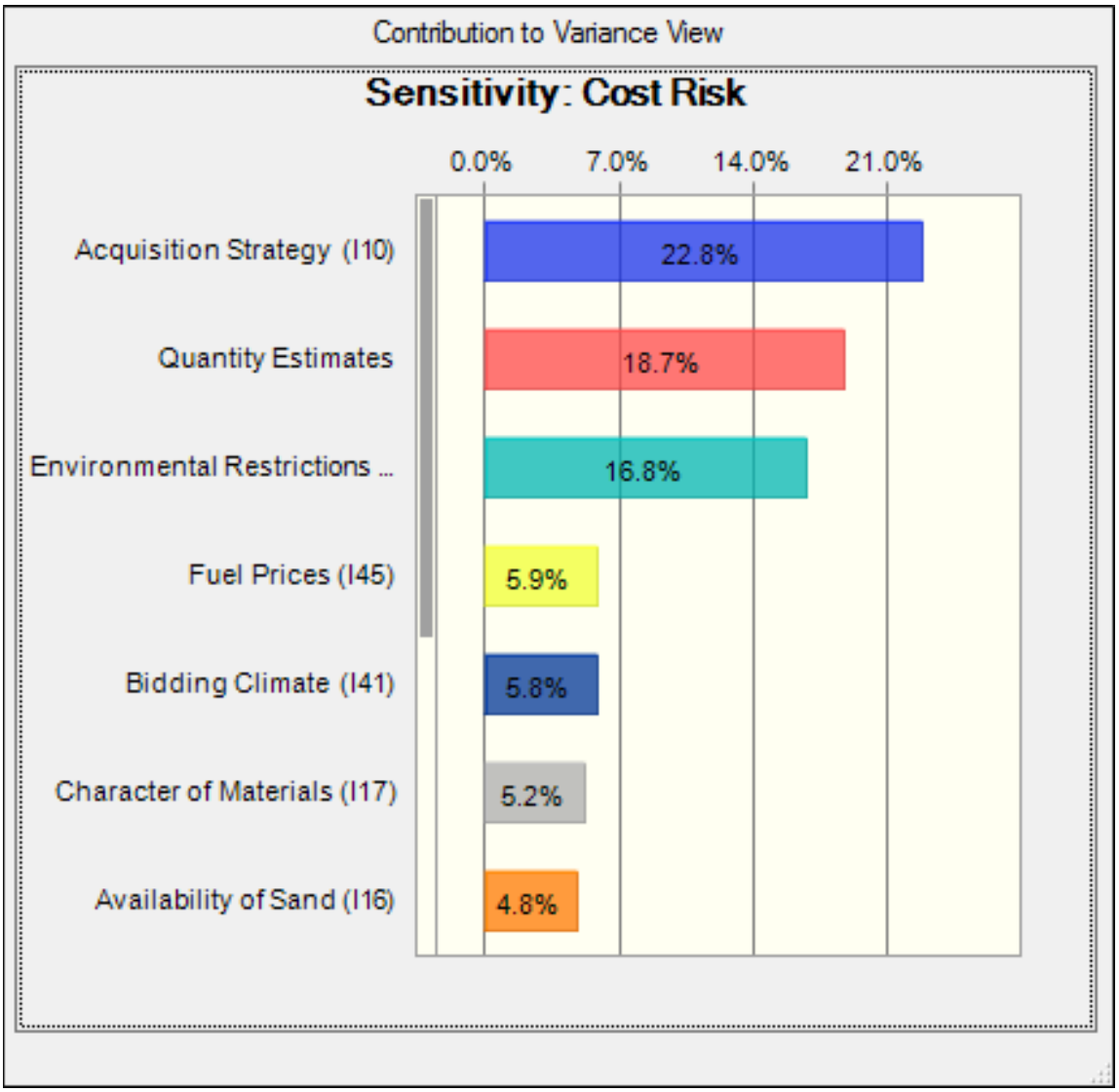
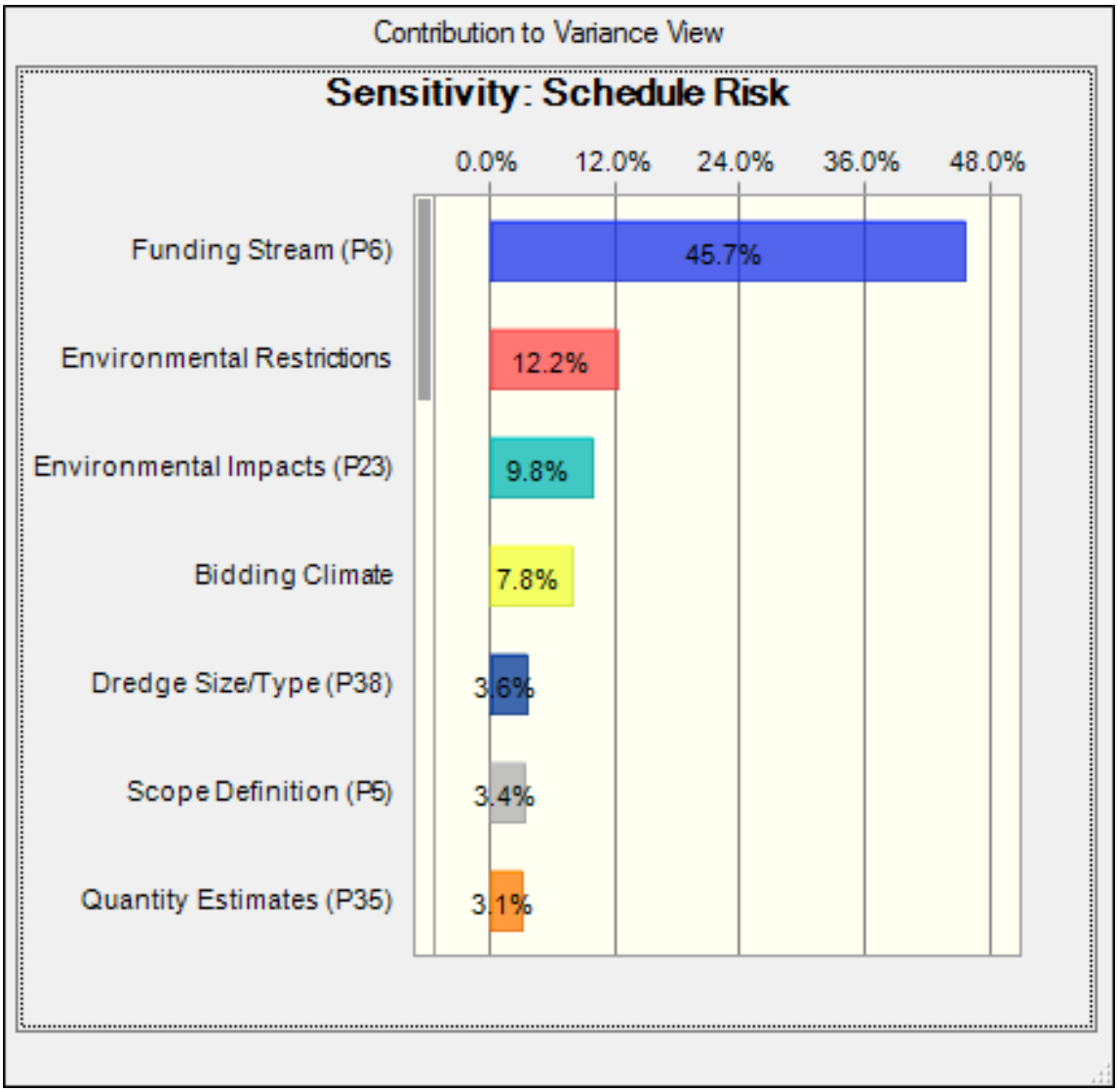


Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost comparison summaries are provided in Table 3 and Figure 3. Additional major findings and observations of the risk analysis are listed below.

1. The key cost risk drivers identified through sensitivity analysis are CA1 (Acquisition Strategy), ET2 (Quantity Estimates), REG3 (Environmental Restrictions), PR5 (Fuel Prices), PR1 (Bidding Climate) and TL4 (Character of Materials), which together contribute over 75 percent of the statistical cost variance.

2. An additional moderate cost risk that should be closely monitored is T-3 (Availability of Sand).

3. The key schedule risk drivers identified through sensitivity analysis are PM2 (Funding Stream), REG3 (Environmental Restrictions), REG1 (Environmental Impacts), and PR1 (Bidding Climate), which together contribute over 75 percent of the statistical schedule variance.

4. Additional moderate schedule risks that should be closely monitored are ET5 (Dredge Size/Type), PM1 (Scope Definition), and ET2 (Quantity Estimates).

Table 3. Project Cost Comparison Summary (Uncertainty Analysis)

Confidence Level	Project Cost ($)	Contingency ($)	Contingency (%)
0%	$53,076,000	$4,168,519	**8%**
5%	$53,076,000	$6,947,532	**13%**
10%	$53,076,000	$7,478,292	**14%**
15%	$53,076,000	$8,337,039	**16%**
20%	$53,076,000	$8,867,799	**17%**
25%	$53,076,000	$8,867,799	**17%**
30%	$53,076,000	$9,398,559	**18%**
35%	$53,076,000	$9,398,559	**18%**
40%	$53,076,000	$10,257,305	**19%**
45%	$53,076,000	$10,257,305	**19%**
50%	$53,076,000	$10,788,065	**20%**
55%	$53,076,000	$10,788,065	**20%**
60%	$53,076,000	$11,318,825	**21%**
65%	$53,076,000	$11,318,825	**21%**
70%	$53,076,000	$11,646,812	**22%**
75%	$53,076,000	$12,177,572	**23%**
80%	$53,076,000	$12,708,332	**24%**
85%	$53,076,000	$13,036,318	**25%**
90%	$53,076,000	$13,567,078	**26%**
95%	$53,076,000	$14,628,598	**28%**
100%	$53,076,000	$17,938,371	**34%**

Figure 3. Project Cost Summary (Uncertainty Analysis)

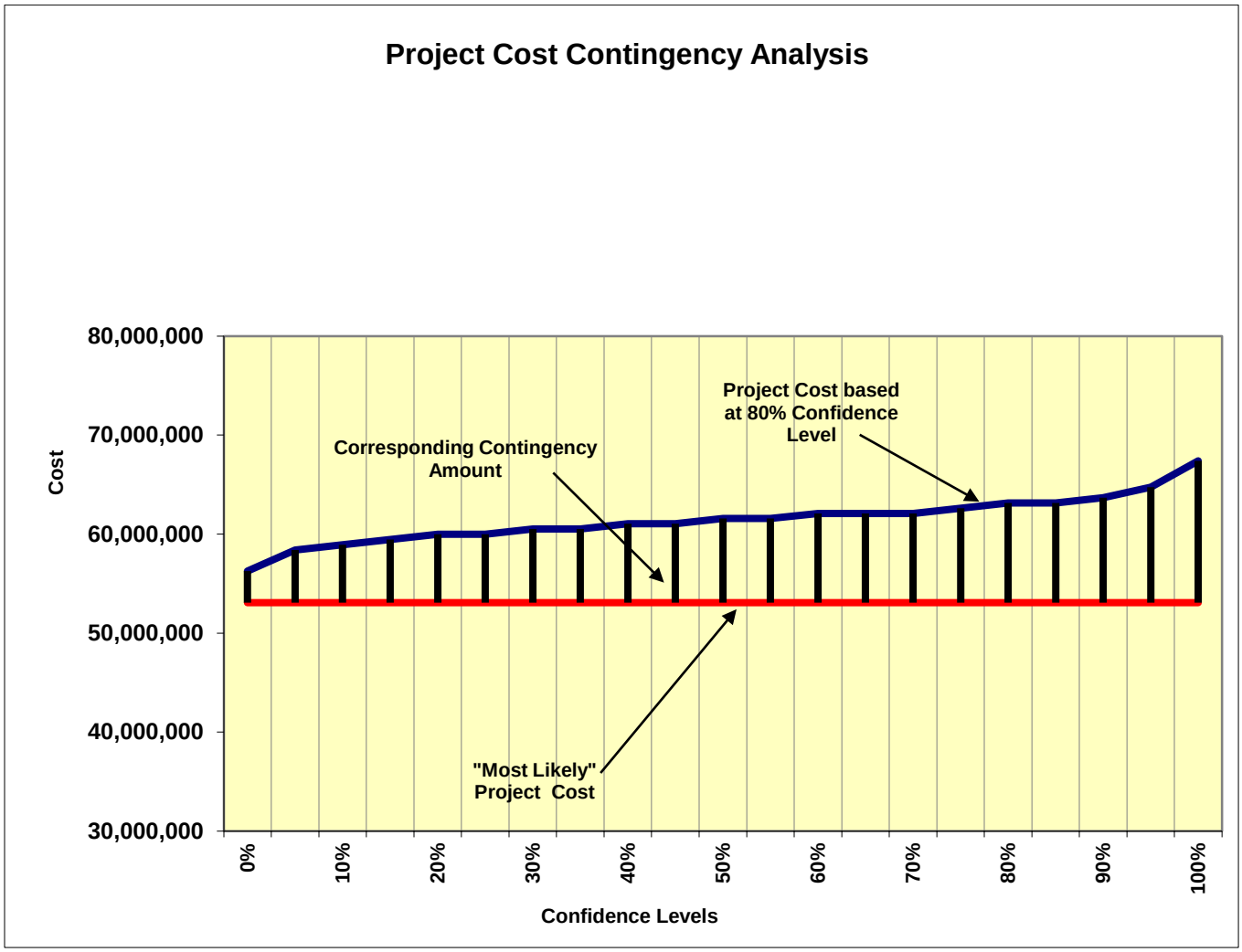
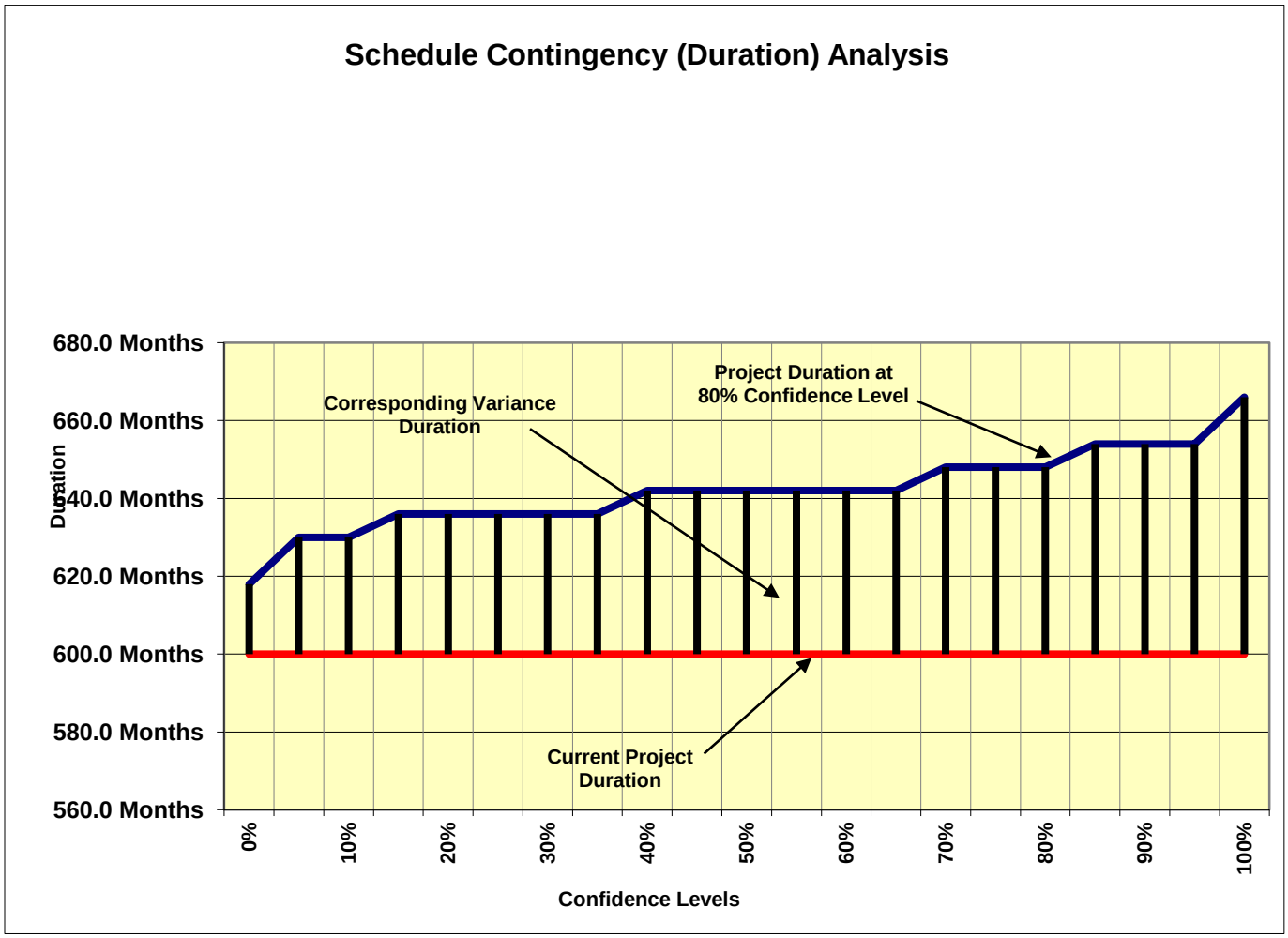


Figure 4. Project Duration Summary (Uncertainty Analysis)



7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The CSRA produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis are CA1 (Acquisition Strategy), ET2 (Quantity Estimates), REG3 (Environmental Restrictions), PR5 (Fuel Prices), PR1 (Bidding Climate) and TL4 (Character of Materials), which together contribute over 75 percent of the statistical cost variance.

a) Acquisition Strategy: The possibility of multiple contracts to complete a single construction effort (initial or re-nourishment) exists. The PDT should coordinate this work with other projects in the district to minimize this risk.

b) Quantity Estimates: There could be some variation quantity due to multiple factors during the 50 year project life. The PDT should actively monitor the project requirements and adjust the work effort to help offset additional project costs.

c) Environmental Restrictions: Restrictions such as required dredging windows could require additional or larger equipment. The PDT should structure the construction contract to eliminate or minimize these possible effects.

d) Fuel Prices: The cost risk due to increase in fuel costs greater than the predicted escalation cannot be controlled. The PDT should monitor this issue and keep management up to date.

e) Bidding Climate: Severe economic swings could decrease the number of potential bidders when there is an abundance of work available. The PDT should monitor the state of the industry and schedule construction when maximum contractor participation is likely.

f) Character of Materials: The risk to the cost due to the lack of geotechnical investigations can be managed by appropriate investigations as soon as possible.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis are PM2 (Funding Stream), REG3 (Environmental Restrictions), REG1 (Environmental Impacts), and PR1 (Bidding Climate), which together contribute over 75 percent of the statistical schedule variance.

a) Funding Stream: The funding appears solid for this project at this time. However, if a delay occurs, it would have a significant impact to cost and schedule. Project Management needs to stay aware of the current project cost and schedule and ensure that estimates are updated yearly and economics verified on a routine basis until the project receives appropriations.

b) Environmental Restrictions: Restrictions such as required dredging windows could require additional or larger equipment. The PDT should structure the construction contract to eliminate or minimize these possible effects.

c) Environmental Impacts: Cultural resources in either the beach disposal area or borrow site could delay the construction. The PDT should complete all surveys in a timely manner to mitigate this risk.

d) Bidding Climate: Severe economic swings could decrease the number of potential bidders when there is an abundance of work available. The PDT should monitor the state of the industry and schedule construction when maximum contractor participation is likely.

3. Risk Management: Project leadership should use the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a

minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

113174-St. Johns County SPP

Risk Matrix

Likelihood of Occurrence	Impact or Consequence of Occurrence: Negligible	Marginal	Significant	Critical	Crisis
Certain	Moderate	Moderate	High	High	High
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	Moderate

Overall Project Scope

Tentatively Selected Plan is the 0P60B alternative (60' berm extension) from R-104 t therefore includes any sand placement necessary, and dune vegetation, to reconstr

SEE ASSUMPTIONS TAB FOR COST VALUE RANGES DEVELOPMNENT

Negligible--- *Less than*		**$265,380**		
Marginal ---*between*	**$265,381**	**$1,061,520**		**18 Months**
Significant ---*between*	**$1,061,521**	**$1,592,280**		**30 Months**
Critical--- *between*	**$1,592,281**	**$2,653,800**		**60 Months**
Crisis ---*Over*	**$2,653,801**			**120 Months**

Risk No.	Risk/Opportunity Event	Concerns	PDT Risk Conclusions, Justification	Project Cost: Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Project Schedule: Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)	Variance Distribution
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)												
	PROJECT & PROGRAM MGMT											
PM1	Scope Definition	Poorly defined scope could lead to higher costs and impacts to the schedule	The TSP defines the placement area and borrow source. Scope not expected to change.	Unlikely	Significant	MODERATE	$1,000,000	Unlikely	Negligible	LOW	8 Months	Triangular
PM2	Funding Stream	Receipt of funding in a timely manner could affect the cost and schedule	Sponsor support is strong and non-federal funding is expected, but not gurarantee, to be timely.	Likely	Negligible	LOW	$100,000	Likely	Significant	HIGH	24 Months	Triangular
PM3	PPA Issues	Delay in an agreement could delay the project	Design agreement is required prior to PPA execution, delay is not expected.	Unlikely	Negligible	LOW	$100,000	Unlikely	Negligible	LOW	0 Months	Triangular
PM4	Review & Authorization Delays	Delayed reviews and authorization could impact the schedule	CWRB is scheduled for January 2017. Delays are not expected as the project is straightforward and not controversial.	Unlikely	Negligible	LOW	$100,000	Unlikely	Negligible	LOW	0 Months	Triangular
	CONTRACT ACQUISITION RISKS											
CA1	Acquisition Strategy	Multiple contracts possible which could increase cost.	Relatively small SPP contract of 900k to 1,300 CY will be a single contract requiring 2.5 to 3.5 months respectively. There is possibility of combining contract with SPP work south of inlet.	Very Unlikely	Crisis	HIGH	$4,000,000	Very Unlikely	Marginal	LOW	6 Months	Uniform
CA2	Acquisition Plan	Multiple CT methods available (MATOC, IFB, RFP, IDIQ, 8A), which represents uncertainty in contract cost and schedule. Impacts effort in award; some contract vehicles more conducive to lower cost	Initial contract 2020 - MATOC 1st choice, if not available IFB would be acceptable.	Unlikely	Marginal	LOW	$400,000	Unlikely	Negligible	LOW	0 Months	Triangular
CA3	Acquisition Delays	Bid opening could be delayed due to amendments, permit receipt, etc. which could affect schedule	Issuance of multiple amendments could delay bid due date and subsequently award of the contract. Contract duration ranges from 2.5 to 3.5 months could still be accomplished within same FY.	Likely	Negligible	LOW	$100,000	Likely	Negligible	LOW	0 Months	Triangular
	TECHNICAL RISKS											
TL1	Volume Variations	Beach fill volumes may vary throughout the project lifecycle as monitoring information is collected and shorelines stabilize	Beach Fx takes into consideration natural variabilty in renourishment volume.	Likely	Marginal	MODERATE	$400,000	Likely	Negligible	LOW	2 Months	Triangular
TL2	Dredging Cycles	Dredging cycles could change based on storm events and funding availability	Storm events could be financed via alternate funding sources such as FCCE.	Very Unlikely	Significant	LOW	$1,000,000	Very Unlikely	Negligible	LOW	0 Months	Triangular
TL3	Availability of Sand	There could be a shortage in the amount of borrow material available for the life of the project	Projections, based on monitoring results, indicate sufficient material will be available for the life of the project.	Unlikely	Critical	MODERATE	$2,000,000	Unlikely	Negligible	LOW	6 Months	Triangular
TL4	Character of Materials	Lack of geotech investigations or presence of rock leads to uncertainity regarding the yield of suitable material from the borrow site	It is expected that all material from the ebb shoal, channel, flood shoal, and Porpoise Point will be beach quality IAW FDEP sand rule.	Unlikely	Critical	MODERATE	$2,000,000	Unlikely	Negligible	LOW	6 Months	Normal

	LANDS AND DAMAGES RISKS											
LD1	Site Access	Availability of access areas	Site access for dredging operation is from waterside. Limited landside access is readily available.	Unlikely	Marginal	LOW	$400,000	Unlikely	Negligible	LOW	0 Months	Triangular
LD2	Staging Areas	Availability of staging areas	Staging areas will be available within and adjacent to work area.	Unlikely	Marginal	LOW	$400,000	Unlikely	Negligible	LOW	0 Months	Triangular
LD3	Easements	Need to obtain perpetual easements prior to construction.	New project with dune feature will require homeowners granting perpertual easement.	Very Unlikely	Critical	LOW	$1,000,000	Very Unlikely	Negligible	LOW	0 Months	Triangular
	REGULATORY AND ENVIRONMENTAL RISKS										0 Months	
REG1	Environmental Impacts	Could be impacts to cultural resources at the project site or borrow area which would require additional investigation, coordination and permitting	Significant work to date has resulted in low degree of concern that significant cultural resources will be encountered.	Unlikely	Critical	MODERATE	$1,600,000	Unlikely	Significant	MODERATE	24 Months	Triangular
REG2	Environmental Monitoring & Mitigation	Monitoring and mitigation requirements as a result of hardbottom or reef impacts could impact cost and schedule	No hardbottoms or reefs in project area.	Very Unlikely	Critical	LOW	$1,600,000	Very Unlikely	Significant	LOW	24 Months	Triangular
REG3	Environmental Restrictions	Required dredging windows and environmental restrictions could impact project cost and schedule	No dredging window for beach placement.	Very Unlikely	Crisis	HIGH	$3,200,000	Very Unlikely	Significant	LOW	24 Months	Triangular
REG4	Environmental Delays	Turtle takes and other wildlife impacts could delay the contract	Turtle takes not expected as cutter suction dredge most likely to be used. Shorebirds and beach mice are a consideration, but additional requirements unlikely and would be minimal	Very Unlikely	Significant	LOW	$800,000	Very Unlikely	Significant	LOW	24 Months	Triangular
REG5	Permit Delays	Permit coordination	Time required for permit issuance is considerable, but permits planned to be received before initial construction.	Very Unlikely	Marginal	LOW	$400,000	Very Unlikely	Significant	LOW	24 Months	Triangular
REG6	NEPA	Project changes could require changes to NEPA document	EA included in Report and should cover all NEPA considerations.	Very Unlikely	Significant	LOW	$1,000,000	Very Unlikely	Significant	LOW	12 Months	Triangular
	CONSTRUCTION RISKS											
CO1	Mods and Claims	There could be modifications and claims that impact cost and schedule.	Mods are common - new borrow area may include rock and most SPP contracts vary based on erosion rates.	Likely	Significant	HIGH	$1,000,000	Likely	Negligible	LOW	8 Months	Triangular
CO2	Staging Areas	Contractor must be able to secure adequate staging areas for the contract.	Good staging area @ south end but not as work goes north. May build south to north.	Unlikely	Marginal	LOW	$400,000	Unlikely	Negligible	LOW	8 Months	Triangular
CO3	Safety Issues	Safety incidents could occur that would impact the cost and schedule of the contract.	The Construction representative agreed there always exists the possibility of safety incident occurring on a dredging contract that are normally not very serious.	Unlikely	Marginal	LOW	$800,000	Unlikely	Negligible	LOW	4 Months	Triangular
	ESTIMATE AND SCHEDULE RISKS											
ET1	Production Estimates	Actual production could vary from what was assumed and 'thin' fill may increase shore crew requirements.	Production data is based on similar contracts within county so production should be okay. Design fill of 66 & 96 CY/LF and 60' berm width slightly above 'thin' fill threshold.	Very Unlikely	Significant	LOW	$1,000,000	Very Unlikely	Negligible	LOW	8 Months	Triangular
ET2	Quantity Estimates	Quantity variations over time could affect cost & schedule.	The initial construction is scheduled for 2020 and renourishments are every 13 years thereafter. Quantities changes could result between renourishments due to severe weather, sea level rise, changes in erosion rates, etc. The greater quantity variance risks would likely be in the out years.	Likely	Crisis	HIGH	$3,200,000	Likely	Marginal	MODERATE	12 Months	Triangular
ET3	Contract Markups	Contractor markups could exceed the rates used in the construction estimates.	Estimate markups are based on similar work over many years. However market conditions could cause bid markups to vary.	Unlikely	Critical	MODERATE	$1,600,000	Unlikely	Negligible	LOW	0 Months	Triangular
ET4	Subcontracting Plan	A Subcontracting plan different than the assumed could affect cost & schedule.	Estimate subcontracting assumptions are based on similar work over may years of experience and not likely to vary.	Unlikely	Significant	MODERATE	$1,000,000	Unlikely	Negligible	LOW	0 Months	Triangular

ET5	Dredge Size/Type	The equipment used in the estimate, including the dredge type, might not be similar to what contractor's offer.	Based on historic records this type of project could esperience cost and schedule impacts due to non-availability of the most efficient dredge type to perform the work.	Likely	Marginal	MODERATE	$800,000	Likely	Marginal	MODERATE	12 Months	Triangular
ET6	Haul/Pumping Distance	A variation in haul distance could affect the cost and schedule.	Dredging cost is based on specific distances which should not change as the beach disposal site and borrow sites are fixed.	Very Unlikely	Critical	LOW	$1,600,000	Very Unlikely	Negligible	LOW	8 Months	Triangular
	Programmatic Risks	(External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)										
PR1	Bidding Climate	Severe economic swings could increase / decrease number of potential bidders and affect cost & schedule.	At this time the MATOC provides a known pool of equipment & availability; future renourishments might need to have flexible schedules to accommodate equipment availability.	Likely	Crisis	HIGH	$3,200,000	Likely	Marginal	MODERATE	24 Months	Triangular
PR2	Bid Protests	There is inherent risk of protests from the industry.	MATOC contracts < $15M not available for protest. Other contracts could be protested.	Unlikely	Significant	MODERATE	$1,000,000	Unlikely	Marginal	LOW	16 Months	Triangular
PR3	Court Injunctions	Legal actions could have an effect on cost & schedule.	Project has strong local support and legal actions are not anticipated.	Very Unlikely	Significant	LOW	$1,000,000	Very Unlikely	Marginal	LOW	24 Months	Triangular
PR4	Political Support/Opposition	Delays due to political ramifications are possible and could delay the work.	Project has strong local support and political opposition is not anticipated.	Very Unlikely	Marginal	LOW	$400,000	Very Unlikely	Marginal	LOW	24 Months	Triangular
PR5	Fuel Prices	Fluctuation in fuel costs could impact the contract cost	The current annual fuel price tren has been somewhat stable the few years but history has shown increases that outpace escalation.	Unlikely	Critical	MODERATE	$1,600,000	Unlikely	Negligible	LOW	0 Months	Triangular
PR6	Labor Availability	Labor availability and labor rate increases could cause cost impacts greater than assumed.	Labor availability is subject to bidding climate and labor Prices are fixed by Davis Bacon wage rates.	Unlikely	Marginal	LOW	$800,000	Unlikely	Negligible	LOW	0 Months	Triangular
PR7	Equipment Availability	Industry demand can have an effect on the available equipment; Dredge may have to come from further away, increasing mobilization costs.	This project is based on a cutter suction dredge but other types could do the work. The absence of environmental windows should increase equipment availability.	Unlikely	Marginal	LOW	$800,000	Unlikely	Negligible	LOW	8 Months	Triangular
PR8	Weather	Severe weather causing damage to project during construction could cause schedule delays.	Project duration is less than four months and not likely to sustain significant damage during construction.	Very Unlikely	Significant	LOW	$1,000,000	Very Unlikely	Negligible	LOW	4 Months	Uniform
PR9	Sea Level Rise	Sea Level Rise could impact the scope and schedule	Sea level rise (SLR) is considered in the Beach FX model used to establish quantities. SLR could impact constrcition efforts, mostly related to quantity variations with the out years most at risk. Time impacts are low since the contracts are small annual events. Quantity variations are covered under ET2-Quantity Estimates.	Unlikely	Marginal	LOW	$0	Unlikely	Negligible	LOW	0 Months	Triangular

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** The likelihood of the event will be the same for both Cost and Schedule, regardless of impact.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may vary in severity from impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to the matrix located at top of page.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal c of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) for action, monitoring, or information on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.