JUPITER CARLIN SEGMENT
PALM BEACH COUNTY
SHORE PROTECTION PROJECT

Final Integrated Section 934 Report and Environmental Assessment

APPENDIX B
Cost Engineering and Risk Analysis

August 2018

US Army Corps
of Engineers
Jacksonville District

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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, 30 June 2016
- ER 1110-2-1150, Engineering and Design For Civil Works Projects, 31 August 1999
- ER 1105-2-100, Planning Guidance Notebook, Appendix G, dated 30 June 2004
- Engineer Manual (EM) 1110-2-1304, Civil Works Construction Cost Index System, dated 31 March 2017
- CECW-CP Memorandum For Distribution, Subject: Initiatives To Improve The Accuracy Of Total Project Costs In Civil Works Feasibility Studies Requiring Congressional Authorization, 19 Sep 2007
- CECW-CE Memorandum For Distribution, Subject: Application of Cost Risk Analysis Methods To Develop Contingencies For Civil Works Total Project Costs, 3 July 2007
- Cost and Schedule Risk Analysis Process, October 2010

The goal of Cost Engineering for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project Section 934 Report is to present the Total Project Cost (construction and non-construction costs) for the recommended plan at the current price level. This information will be used to determine if an extension of federal participation in cost-sharing of the authorized Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is economically justified. 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 was coordinated with the economic effort to determine the appropriate nourishment interval based upon annualized costs and benefits. The final cost estimate included in the report was based on construction feature unit pricing and are prepared in Civil Works, Work Breakdown Structure (CWWBS) format to the sub-feature level. This cost estimate supports the National Economic Development (NED) plan (Recommended Plan). 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.
A risk analysis was prepared that addresses uncertainties in and sets contingencies for the Recommended Plan cost items. The Cost and Schedule Risk Analysis (CSRA) Report, will be reviewed by the Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works. The MCX is located at the Walla Walla District Cost Engineering Branch.

B.1.1. Project Information

The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is located just south of Jupiter Inlet at the northern end of Palm Beach County, Florida between DNR Reference monuments R-13 and R-19. The beach fill material for initial construction and the periotic will come from the previously designated offshore borrow site (PB2-R2 or Jupiter Carlin A). The next scheduled beach fill contract for the Jupiter Carlin Segment of the Palm Beach County Shore

Protection Project is scheduled to take place in 2020 and is considered to be another initial construction event. This is based upon USACE PDT and Vertical Team coordination taking into consideration the current condition of the beach and the fact that federal participation in the authorized project will be extended until 2045. The initial construction in 2020 will use approximately 191,900 cubic yards of material, with the 2026 and 2032 requiring 193,300 cubic yards from the offshore borrow site, and the final periodic renourishment in 2038 using 225,500 cubic yards also from the offshore borrow area taking into account for the additional year. This anticipated timeline for renourishments is tentative and subject to change based upon availability of funding, impacts to the beach segments overtime, and performance of the beach profile. According to the Project Manager, the 934 Study is expected to be approved in a timeframe that may allow for possible FY18 Work Plan Funds. However, in the event the project does not receive funds in FY18 the cost have also been estimated with the second initial construction event occurring in FY19 assuming receipt of funding in the FY19 Budget. All subsequent renourishments were shifted by one year. The quantity for the initial construction was adjusted in the FY19 estimate to account for one additional year of erosion to the project segment. Within the Cost Appendix both potential funding scenarios have been presented in the form of two Total Project Cost Summary files. The risk analysis output was only presented for the FY18 scenario since no significant change in risk analysis contingency was experienced between scenarios. The first initial construction of the approved project was completed in 1995. The Federal participation in the project allowed non-federal construction and renourishment with subsequent reimbursement of the federal share of project cost for a period of 10 years following initial construction. The first renourishment was performed in 2002. Currently the nourishment interval is set at an average interval of 6 years based upon project cost and benefits. The project limits remain the same and have not changed.

B.1.2. Recommended Plan

The final Recommended Plan (NED) was chosen previously by the Project Delivery Team (PDT) according to Cost Effectiveness/Incremental Cost Analysis procedures resulting directly from plan formulation. The project has since been constructed in 1995 and renourished in 2002. The Economics Appendix fully describes the basis for the development of the project benefits. The scope of work for the project cost estimates can be found in the study engineering appendix. The Micro-Computer Aided Cost Estimating System (MCACES/MII) cost estimate for the Recommended Plan is based on the scope provided in the main report 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 2017 price level (01 October 2016-30 September 2017). For project identification purposes the estimated costs are categorized under the appropriate CWWBS code and include both construction and non-construction costs.

The construction costs fall under the following feature code:

- 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

Cost estimates were completed and updated for this study to account for adjustments resulting from District Quality Control and Agency Technical Review. Unit prices for each major or variable construction element were developed in the MCACES/MII software. The latest MCACES/MII Cost Book Libraries covering Region III Equipment and Labor adjusted for the project location, have been used for the construction cost estimate. This included use of the latest FCCM rate and past five year average fuel prices (in accordance with current Cost MCX guidance). Refer to the Economics Attachment of the report for the final Plan Formulation cost tables.

B.1.3. Construction Cost

The MCACES/MII estimate, located in Addendum 1 below, on the Recommended Plan contains no contingency as noted in the estimate. Construction costs for the initial and the periodic renourishments have been captured under the 17 Beach Replenishment account and include mobilization, demobilization, site work and preparatory work for a hopper dredging with pumpout capability, beach fill, and other associated general construction items. Associated general items include construction vibration controls and monitoring, beach tilling, turbidity monitoring, and a contracting officer's field office. Endangered species and Environmental monitoring has also been accounted for within the estimate.

The project limits extend from R-13 to R-19. The 17 Beach Replenishment account is to be cost shared between the Federal Government and the Non-Federal Sponsor. Additional information regarding separation in the project cost share structure can be found in the main report and the Economic Appendix.

The contingency was determined as a result of the risk analysis. Contingency has been applied within the Total Project Cost Summary Report located in Addendum D. Additional information is available in Addendum C: Risk Report regarding the risk analysis and major risk factors.

B.1.2. Non-Construction Cost

Non-construction costs include Real Estate, Planning, Engineering and Design (PED), and Construction Management (Supervision and Administration or S&A). Real Estate costs were provided by the Jacksonville District Real Estate Division. They include administrative costs and are to account for coordination of beach access prior to contract advertisement. Risk associated with lands and damages were considered during the Cost and Schedule Risk Analysis (CSRA). PED costs are itemized accounting for Project Management, Planning and Environmental Compliance, Engineering and Design, Life Cycle Updates, and Project Operations. Project Operations accounts for the physical monitoring requirements associated with this project. PED costs were provided by the Project Manager based upon submitted fiscal year budgets. Construction Management costs were acquired from Construction-Operations Division and coordinated with the Project Manager as suggested by the guidance.

A percentage of the construction contract cost is used as the rate for Construction Management costs for the Recommended Plan cost estimate. This percentage is based on actual funds spent for construction management on past contracts.

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.1.3. Construction Schedule

A construction schedule was prepared with input from the PDT. The primary construction schedule considered not only durations of individual components but also timing of construction contracts. This schedule was coupled with the project schedule in preparation for the generation of the Total Project Cost Summary as well as for the completion of the risk analysis. The construction schedule will change as design of the project proceeds into the plans and specifications phase. It will change again when the contract is awarded and the contractor provides their official schedule, which may be based on multiple crews with shift work and overtime. The estimate project schedule is provided below as Addendum B.

B2. RISK ANALYSIS

B.2.1 Risk Analysis Methods

A risk analysis was conducted according to the procedure outlined in the manual entitled; 'Cost and Schedule Risk Analysis Process' dated October 2016 and downloaded from the Corps' Cost Center of Expertise website. First, members of the PDT met to identify risk items, in both the construction cost estimate and the construction schedule. Then, the Risk Register was completed. Following this, the Risks were analyzed using a full Cost and Schedule Risk Analysis (CSRA). The likelihood and impacts were adjusted for each risk element in order to generate project contingencies. The results from the CSRA are shown in the Project Cost and Schedule Risk Analysis Report.

For the features costed by the Corps, it is assumed that the work will be performed by a prudent contractor at a fair and reasonable cost. While the cost estimate analyzed in the risk analysis may contain adjustments due to quotations on direct and indirect costs, it contains no separate adjustment due to competitiveness or bid strategies (ETL 1110-2-573, 30 Sep 2008). Market conditions such as the current price of fuel are included in the estimate.

The appropriate contingencies were then applied to the MCACES/MII estimate for the NED Plan, producing the 'After Risk Analysis' cost estimate contained in Addendum C. Upon completion, the Total Project Cost Summary (TPCS) was prepared incorporating escalation

B.2.2 Risk Analysis Results

The Final CSRA Report was produced by Jacksonville District with assistance by the Cost Engineering MCX for Civil Works. This report is appended to this attachment as Addendum C. The CSRA resulted in project contingencies for dredging at 24.62 percent. Additional details of this risk analysis results are provided in Addendum C.

B3. TOTAL PROJECT COST

B.3.1. Total Project Cost Summary

The Total Project Cost Summary 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 Recommended Plan and the anticipated project schedule. The TPCS includes Federal and non-Federal costs for lands and damages, all construction features, PED, and S&A, along with the appropriate contingencies and escalation associated with each of these activities.

The TPCS also includes cost spent on the project through 30 September 2016, all construction features, PED and S&A. These amounts were provided by the project budget analyst in the form of the project PB3 report. The TPCS is formatted according to the CWWBS and uses Civil Works Construction Cost Indexing System 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 TPCS includes contingency developed as a result of the CSRA. The cost estimate for the Recommended Plan is prepared with an identified price level date. Inflation factors are used to adjust the pricing based upon the project schedule. This estimate is known as the Fully Funded Cost Estimate or TPCS. The TPCS is located below in Addendum D. The CSRA based contingences mentioned above in the paragraph titled "Risk Analysis Results" have been applied within the Total Project Cost Summary.

ADDENDUMS TO APPENDIX B

ADDENDUM A: Recommended Plan Cost Estimate – No Contingency

Based on latest Beach Fx analysis the 30' Berm Extension Alternative has been identified as the revised TSP for the final Draft Report. This will consist of initial construction in FY20 using Dredging for the initial and subsequent renourishments for placement of beach quality material based on three 6-year renourishment intervals per the Draft Report Engineering Appendix.

Estimated by	CESAJ-EN-TC
Designed by	CESAJ-EN
Prepared by	R. Stallings
Preparation Date	6/23/2017
Effective Date of Pricing	3/31/2017
Estimated Construction Time	Days

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A cost certification has not been obtained for this project.

Library Properties i

Project Cost Summary Report 1

JUPITER CARLIN SEGMENT - 934 STUDY 1

934 Study (2018 - 19) 1

Dredging - 30 Ft Berm Ext - - Initial (2020) 1

Dredging - 30 Ft Berm Ext - Periodic Year 5 (2026) 1

Dredging - 30 Ft Berm Ext - Periodic Year 10 (2032) 1

Dredging - 30 Ft Berm Ext - Periodic Year 15 (2038) 1

Designed by
CESAJ-EN

Estimated by
CESAJ-EN-TC

Prepared by
R. Stallings

Design Document	Draft 934 Report & Revised SOW
Document Date	6/28/2017
District	Jacksonville District
Contact	Ricardo Stallings, 904-232-3093
Budget Year	2018
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
CEDEP
OTHER
MISC

Timeline/Currency

Preparation Date	6/23/2017
Escalation Date	10/1/2016
Eff. Pricing Date	3/31/2017
Estimated Duration	0 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB15EngA: MII English Cost Book 2015 Rev A

Labor : User Labor Library_Miami Dade County, FL

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP14R03: MII Equipment 2014 Region 03
Note: Used 5 yr average for diesel off-road.

03 SOUTHEAST

Sales Tax	6.00
Working Hours per Year	1,530
Labor Adjustment Factor	0.88
Cost of Money	2.50
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.095
Gas	2.660
Diesel Off-Road	2.734
Diesel On-Road	2.601

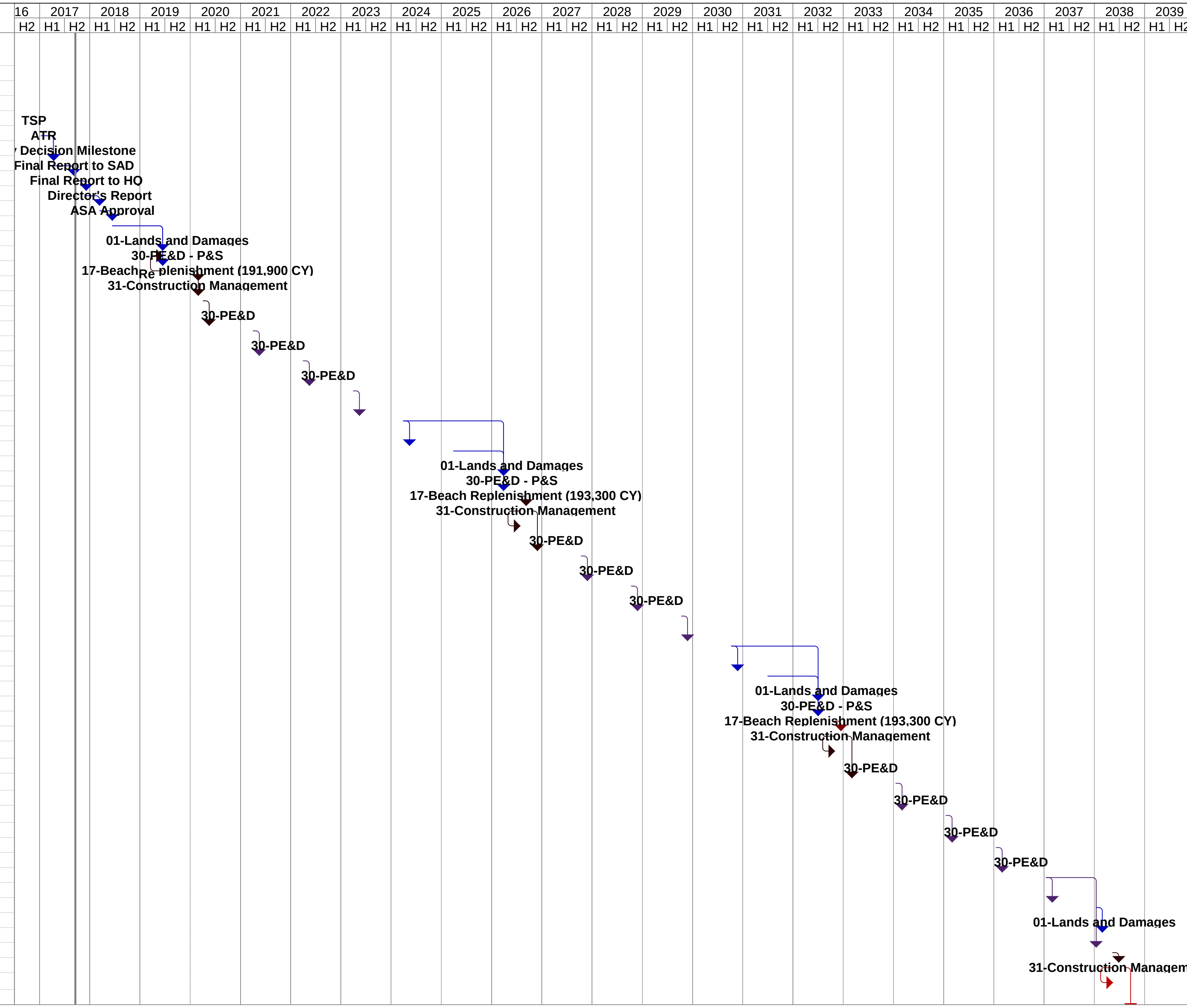
Shipping Rates

Over 0 CWT	16.27
Over 240 CWT	14.82
Over 300 CWT	12.69
Over 400 CWT	10.64
Over 500 CWT	5.85
Over 700 CWT	5.85
Over 800 CWT	9.79

Description	Quantity	UOM	ContractCost	Escalation	Contingency	SIOH	ProjectCost
Project Cost Summary Report			**37,293,162**	**0**	**0**	**0**	**37,293,162**
JUPITER CARLIN SEGMENT - 934 STUDY	**1.000**	**LS**	**37,293,162**	**0**	**0**	**0**	**37,293,162**
934 Study (2018 - 19)	**1.000**	**LS**	**300,000**	**0**	**0**	**0**	**300,000**
Non-Contruction	**1.000**	**LS**	**300,000**	**0**	**0**	**0**	**300,000**
30 Planning, Engineering, and Design	**1.000**	**LS**	**300,000**	**0**	**0**	**0**	**300,000**
Dredging - 30 Ft Berm Ext - - Initial (2020)	**1.000**	**LS**	**9,109,922**	**0**	**0**	**0**	**9,109,922**
Construction	**1.000**	**LS**	**8,044,922**	**0**	**0**	**0**	**8,044,922**
17 Beach Replenishment	**1.000**	**LS**	**8,044,922**	**0**	**0**	**0**	**8,044,922**
Non-Construction Cost	**1.000**	**LS**	**1,065,000**	**0**	**0**	**0**	**1,065,000**
01 Lands and Damages	**1.000**	**LS**	**30,000**	**0**	**0**	**0**	**30,000**
30 Planning, Engineering, and Design	**1.000**	**LS**	**835,000**	**0**	**0**	**0**	**835,000**
31 Construction Management	**1.000**	**LS**	**200,000**	**0**	**0**	**0**	**200,000**
Dredging - 30 Ft Berm Ext - Periodic Year 5 (2026)	**1.000**	**LS**	**9,111,604**	**0**	**0**	**0**	**9,111,604**
Construction Cost	**1.000**	**LS**	**8,046,604**	**0**	**0**	**0**	**8,046,604**
17 Beach Replenishment	**1.000**	**LS**	**8,046,604**	**0**	**0**	**0**	**8,046,604**
Non-Construction Cost	**1.000**	**LS**	**1,065,000**	**0**	**0**	**0**	**1,065,000**
01 Lands and Damages	**1.000**	**LS**	**30,000**	**0**	**0**	**0**	**30,000**
30 Planning, Engineering, and Design	**1.000**	**LS**	**835,000**	**0**	**0**	**0**	**835,000**
31 Construction Management	**1.000**	**LS**	**200,000**	**0**	**0**	**0**	**200,000**
Dredging - 30 Ft Berm Ext - Periodic Year 10 (2032)	**1.000**	**LS**	**9,111,604**	**0**	**0**	**0**	**9,111,604**
Construction Cost	**1.000**	**LS**	**8,046,604**	**0**	**0**	**0**	**8,046,604**
17 Beach Replenishment	**1.000**	**LS**	**8,046,604**	**0**	**0**	**0**	**8,046,604**
Non-Construction Cost	**1.000**	**LS**	**1,065,000**	**0**	**0**	**0**	**1,065,000**
01 Lands and Damages	**1.000**	**LS**	**30,000**	**0**	**0**	**0**	**30,000**
30 Planning, Engineering, and Design	**1.000**	**LS**	**835,000**	**0**	**0**	**0**	**835,000**
31 Construction Management	**1.000**	**LS**	**200,000**	**0**	**0**	**0**	**200,000**
Dredging - 30 Ft Berm Ext - Periodic Year 15 (2038)	**1.000**	**LS**	**9,660,031**	**0**	**0**	**0**	**9,660,031**
Construction Cost	**1.000**	**LS**	**8,580,031**	**0**	**0**	**0**	**8,580,031**
17 Beach Replenishment	**1.000**	**LS**	**8,580,031**	**0**	**0**	**0**	**8,580,031**
Non-Construction Cost	**1.000**	**LS**	**1,080,000**	**0**	**0**	**0**	**1,080,000**
01 Lands and Damages	**1.000**	**LS**	**30,000**	**0**	**0**	**0**	**30,000**
30 Planning, Engineering, and Design	**1.000**	**LS**	**850,000**	**0**	**0**	**0**	**850,000**
31 Construction Management	**1.000**	**LS**	**200,000**	**0**	**0**	**0**	**200,000**

ADDENDUM B: Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**PALM BEACH CO. - JUPITER CARLIN SEGMENT- PRELIMINARY TSP**	**8345 days**	**Sat 10/1/16**	**Sun 8/7/39**	
2	**FY 2017-19**	**622 days**	**Sat 10/1/16**	**Fri 6/15/18**	
3	**934 Study**	**622 days**	**Sat 10/1/16**	**Fri 6/15/18**	
4	**Draft Report Completed by PDT**	**152 days**	**Sun 10/16/16**	**Fri 3/17/17**	
5	TSP	103 days	Sat 10/1/16	Thu 1/12/17	
6	ATR	36 days	Wed 1/25/17	Thu 3/2/17	
7	Agency Decision Milestone	1 day	Tue 4/11/17	Wed 4/12/17	5,6
8	Final Report to SAD	1 day	Thu 9/7/17	Fri 9/8/17	7
9	Final Report to HQ	1 day	Wed 12/6/17	Thu 12/7/17	8
10	Director's Report	1 day	Mon 3/12/18	Tue 3/13/18	9
11	ASA Approval	1 day	Thu 6/14/18	Fri 6/15/18	10
12	**FY 2020 - Initial Construction (Dredging)**	**319 days**	**Fri 6/15/18**	**Tue 4/30/19**	
13	01-Lands and Damages	214 days	Sat 6/15/19	Wed 1/15/20	14SS,11
14	30-PE&D - P&S	214 days	Sat 6/15/19	Wed 1/15/20	11
15	17-Beach Replenishment (191,900 CY)	80 days	Wed 1/15/20	Sat 4/4/20	14
16	31-Construction Management	80 days	Wed 1/15/20	Sat 4/4/20	14
17	**FY 2021**	**364 days**	**Sat 4/4/20**	**Sat 4/3/21**	
18	30-PE&D	364 days	Sat 4/4/20	Sat 4/3/21	16
19	**FY 2022**	**364 days**	**Sat 4/3/21**	**Sat 4/2/22**	
20	30-PE&D	364 days	Sat 4/3/21	Sat 4/2/22	18
21	**FY 2023**	**364 days**	**Sat 4/2/22**	**Sat 4/1/23**	
22	30-PE&D	364 days	Sat 4/2/22	Sat 4/1/23	20
23	**FY 2024**	**364 days**	**Sat 4/1/23**	**Sat 3/30/24**	
24	30-PE&D	364 days	Sat 4/1/23	Sat 3/30/24	22
25	**FY 2025**	**364 days**	**Sat 3/30/24**	**Sat 3/29/25**	
26	30-PE&D	364 days	Sat 3/30/24	Sat 3/29/25	24
27	**FY 2026 - Renourishment 1 (Dredging)**	**201 days**	**Sun 3/29/26**	**Fri 10/16/26**	
28	01-Lands and Damages	120 days	Sun 3/29/26	Mon 7/27/26	26
29	30-PE&D - P&S	120 days	Sun 3/29/26	Mon 7/27/26	24
30	17-Beach Replenishment (193,300 CY)	80 days	Tue 7/28/26	Fri 10/16/26	29FS+1 day
31	31-Construction Management	80 days	Tue 7/28/26	Fri 10/16/26	30SS
32	**FY 2027**	**364 days**	**Fri 10/16/26**	**Fri 10/15/27**	
33	30-PE&D	364 days	Fri 10/16/26	Fri 10/15/27	30
34	**FY 2028**	**364 days**	**Fri 10/15/27**	**Fri 10/13/28**	
35	30-PE&D	364 days	Fri 10/15/27	Fri 10/13/28	33
36	**FY 2029**	**364 days**	**Fri 10/13/28**	**Fri 10/12/29**	
37	30-PE&D	364 days	Fri 10/13/28	Fri 10/12/29	35
38	**FY 2030**	**364 days**	**Fri 10/12/29**	**Fri 10/11/30**	
39	30-PE&D	364 days	Fri 10/12/29	Fri 10/11/30	37
40	**FY 2031**	**264 days**	**Fri 10/11/30**	**Wed 7/2/31**	
41	30-PE&D	264 days	Fri 10/11/30	Wed 7/2/31	39
42	**FY 2032 - Renourishment 2 (Dredging)**	**202 days**	**Fri 7/2/32**	**Thu 1/20/33**	
43	01-Lands and Damages	121 days	Fri 7/2/32	Sun 10/31/32	41
44	30-PE&D - P&S	121 days	Fri 7/2/32	Sun 10/31/32	39
45	17-Beach Replenishment (193,300 CY)	80 days	Mon 11/1/32	Thu 1/20/33	44FS+1 day
46	31-Construction Management	80 days	Mon 11/1/32	Thu 1/20/33	45SS
47	**FY 2033**	**364 days**	**Thu 1/20/33**	**Thu 1/19/34**	
48	30-PE&D	364 days	Thu 1/20/33	Thu 1/19/34	45
49	**FY 2034**	**364 days**	**Thu 1/19/34**	**Thu 1/18/35**	
50	30-PE&D	364 days	Thu 1/19/34	Thu 1/18/35	48
51	**FY 2035**	**364 days**	**Thu 1/18/35**	**Thu 1/17/36**	
52	30-PE&D	364 days	Thu 1/18/35	Thu 1/17/36	50
53	**FY 2036**	**364 days**	**Thu 1/17/36**	**Thu 1/15/37**	
54	30-PE&D	364 days	Thu 1/17/36	Thu 1/15/37	52
55	**FY 2037**	**364 days**	**Thu 1/15/37**	**Thu 1/14/38**	
56	30-PE&D	364 days	Thu 1/15/37	Thu 1/14/38	54
57	**FY 2038 - Renourishment 3 (Dredging)**	**206 days**	**Thu 1/14/38**	**Sun 8/8/38**	
58	01-Lands and Damages	120 days	Thu 1/14/38	Fri 5/14/38	56
59	30-PE&D - P&S	120 days	Thu 1/14/38	Fri 5/14/38	54
60	17-Beach Replenishment (225,500 CY)	85 days	Sat 5/15/38	Sun 8/8/38	59FS+1 day
61	31-Construction Management	85 days	Sat 5/15/38	Sun 8/8/38	60SS
62	**FY 2039**	**364 days**	**Sun 8/8/38**	**Sun 8/7/39**	
63	30-PE&D	364 days	Sun 8/8/38	Sun 8/7/39	60



Project: Miami Harbor Ph 3 - CONST S
Date: Mon 9/18/17

Task	Rolled Up Critical Task	External Tasks	Inactive Milestone	Manual Summary Rollup	Progress
Critical Task	Rolled Up Milestone	Project Summary	Inactive Summary	Manual Summary	Deadline
Milestone	Rolled Up Progress	Group By Summary	Manual Task	Start-only	
Rolled Up Task	Split	Inactive Task	Duration-only	Finish-only	

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ADDENDUM C: Risk Report

US Army Corps of Engineers®

Palm Beach County, Jupiter Carlin, Florida

Section 934 Report

Project Cost and Schedule Risk Analysis Report

Prepared by:

U.S. Army Corps of Engineers,
Jacksonville District

Supported by:

U.S. Army Corps of Engineers,
Cost Engineering Mandatory Center of Expertise (MCX) for Civil Works

OCTOBER 2017

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EXECUTIVE SUMMARY

This Cost and Schedule Risk Analysis (CSRA) Report has been completed by the US Army Corps of Engineers (USACE), Jacksonville District. The CSRA was developed 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) as part of the Life Cycle Update and FY17 Budget Submission. The CSRA has been modified in response to ATR comments and subsequent revisions. This report presents a recommendation for the total project cost and schedule contingencies for the Palm Beach County Shore Protection Project, Jupiter Carlin, Florida. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016, a formal risk analysis study was conducted. 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 and project schedule.

Specific to the Palm Beach County, Jupiter Carlin project, the most likely total project cost (at current price level) is approximately $37.3 million. With $9.1 million accounting for initial, 2026 and 2032 periodic renourishments construction cost and $9.7 million accounting for the final periodic renourishment in 2038. Based on the results of the analysis, the Jacksonville District recommends a contingency value of approximately $9.2 million, or 25%, this percentage value has been rounded from the exact output of the risk analysis for the initial construction and periodic renourishments. These costs and contingencies can be seen within the Total Project Cost Summary (TPCS) sheet within the Cost Engineering Appendix.

The Jacksonville District Cost Engineering Section performed the risk analysis for this project and the risk analysis has been reviewed, as required, by the MCX, Walla Walla District. A *Monte Carlo* technique was used, producing the aforementioned contingencies and identifying key risk drivers.

The following tables portray the development of the contingencies. The contingency is based on an 80% confidence level, as per USACE Civil Works guidance. The costs presented are rounded and the 80% confidence value may not match the final TPCS. The models developed were based upon the total cost associated with each renourishment including construction costs, PED costs, construction management costs, and annual monitoring and life cycle costs. Cost estimates fluctuate over time. During this period of study, minor cost fluctuations can and have occurred. For this reason, contingency reporting is based in cost and percentage values. Should cost vary to a slight degree with similar scope and risks, contingency percentage values will be reported, cost values rounded. Cost may vary slightly throughout the report based upon rounding and minor changes during the study.

Table 1. Contingency Analysis Table

Most Likely Cost Estimate	$37,293,000	
Confidence Level	**Value ($$)**	**Contingency (%)**
5%	$42,261,000	13.34%
50%	$44,805,000	20.14%
80%	**$46,474,000**	**24.62%**
95%	$48,146,000	29.10%

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

For future periodic renourishments, the key cost risk drivers identified through sensitivity analysis were Acquisition Type/Bidding Climate and Quantity Estimates, which combined contribute 70.5% of the statistical cost variance. These items are discussed in Section 7.1 Major Findings/Observations.

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 Palm Beach County, Jupiter Carlin project.

2.0 BACKGROUND

Specific to the Palm Beach County, Jupiter Carlin Shore Protection project; located just south of Jupiter Inlet at the northern end of Palm Beach County, Florida between DNR Reference monuments R-13 and R-19. The planning level estimate is for the placement of beach quality material on the beach from R-13 to R-19. This estimate has been through several variations of placement methods and has concluded on the use of a large hopper dredge with pumpout for initial construction and periodic renourishments. The updated 30-foot berm design assumes all material for construction beach fill for initial construction and periodic renourishments will come from an offshore borrow source. The project will use approximately 191,900 cubic yards for initial construction, 193,300 cubic yards for the 2026 and 2032 periodic renourishments, and 225,500 cubic yards for the 2038 periodic renourishment. The project was initially constructed in 1995.

The dredging unit costs were developed based on historical production from previous dredging contracts at this same location.

As a part of this effort, Jacksonville District has provided an MII estimate and schedule to the MCX for review. An ATR of the cost estimate and schedule for the authorized project has been completed. As part of the ATR, a review of the risk analysis was completed to establish the resulting contingencies.

3.0 REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80% 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, dated June 30, 2016
- Engineer Technical Letter (ETL) 1110-2-573, Construction Cost Estimating Guide for Civil Works, dated September 30, 2008.

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 most likely 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 (ETL)1110-2-573,.

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 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.
- (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated June 30, 2016.
- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Jacksonville Cost Engineer facilitated a risk identification and qualitative analysis meeting the Jacksonville PDT on July 12, 2016. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the framework for the risk analysis. The Jacksonville District Cost Engineer assisted in the creation of the cost and schedule risk analysis models. Cost MCX during ATR provided input and guidance towards the final risk analysis and resulting contingency.

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

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT was obtained using creative processes such as brainstorming or other facilitated risk assessment meetings.

A formal PDT was held for the purposes of identifying and assessing risk factors. The initial formal meeting conducted on September 12, 2016 included the following PDT members:

Table 2. PDT Members

No.	Name	Section	Title
1	Ricardo Stallings	EN-TC	Cost Estimator
2	Matthew Miller	PD-EC	Environmental Water Quality
3	Marty Durkin	EN-WC	Coastal Engineer
4	Brandon Burch	PM-WN	Project Manager
5	Troy Mayhew	EN-GG	Geologist
6	Lori Hadley	EN-WC	Coastal Engineer
7	Lynn Zediak	RE-A	Real Estate
8	Ashleigh Fountain	PD-PN	Planning
9	Courtney Jackson	PD-ES	Economist
10	James Lagrone	EN-DW	Engineering Technical Lead
11	Griselle Gonzalez	EN-CT	Supv Contracting Officer
12	Paul Stodola	PD-EC	Biologist
13	Robin Moore	PD-ES	Archeologist
14	Daniel Bates	N/A	Sponsor (Palm Beach County)
15	Clint Thomas	N/A	Sponsor (Palm Beach County)
16	Tracy Logue	N/A	Sponsor (Palm Beach County)

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. A final meeting was held with the project management and planning on July 31, 2017 to further evaluate and finalize the risk on the revised scope of work. In addition, discussions with the project field office were conducted on the risk associated with this project.

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 the *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 with- and without-project conditions.

a. The MII MCACES (Micro-Computer Aided Cost Estimating Software) file: "JC_934-FY18PFC_Dredge_04AUG17" was the basis for the cost and schedule risk analyses.

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. The schedule was analyzed for impact to the project cost in terms of both uncaptured escalation (variance from OMB factors and the local market) and monthly recurring costs (unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay).

d. Per the CWCCIS Historical State Adjustment Factors in EM 1110-2-1304, Amd8 dated 31 March 2016, State Adjustment Factor for Florida is 0.88, meaning that this project is not susceptible to differential between the local market and OMB inflation factors for future construction.

e. The Cost MCX guidance generally focuses on the 80% level of confidence (P80) for cost contingency calculation. For this risk analysis, the 80% 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.

f. 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" for further monitoring and evaluation.

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

Table 3 provides the raw 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 $9.2 million at the P80 confidence level (20% of the baseline cost estimate).

Table 3. Base Cost Contingency Summary

Most Likely Cost Estimate	$37,293,000		
	-	-	-
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
5%	**$41,768,000**	**$4,475,000**	**12.00%**
50%	**$44,006,000**	**$6,713,000**	**18.00%**
80%	**$45,497,000**	**$8,204,000**	**22.00%**
100%	**$50,718,000**	**$13,425,000**	**36.00%**

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 the *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 life cycle. 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 and 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 total 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 4 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 approximately 39.1 months for each renourishment activity based on the P80 level of confidence. This contingency was used to calculate the projected monthly recurring 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 monthly recurring costs.

Table 4. Base Schedule Contingency Summary

Most Likely Schedule Duration	**341.0 Months**			
Confidence Level	**Baseline w/ Contingency**	**Contingency Amount (Months)**	**Schedule Contingency Dollar Amount**	**Contingency %**
5%	**360.8 Months**	**23.5 Months**	**$501,000**	**1.34%**
50%	**372.5 Months**	**37.5 Months**	**$800,000**	**2.14%**
80%	**380.1 Months**	**45.8 Months**	**$976,000**	**2.62%**
100%	**402.5 Months**	**69.4 Months**	**$1,480,000**	**3.97%**

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 4.

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. Sensitivity Analysis (Baseline Estimate)

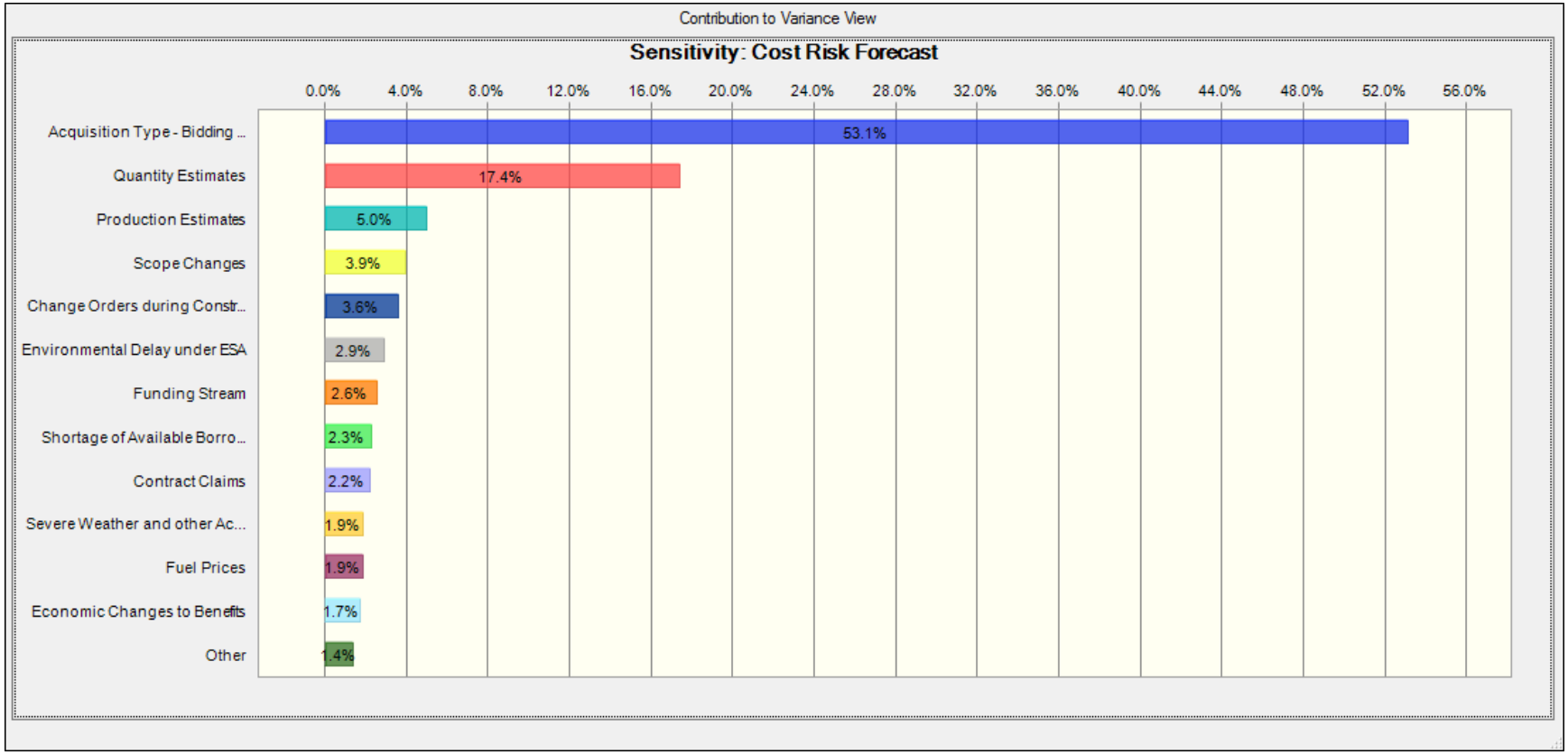
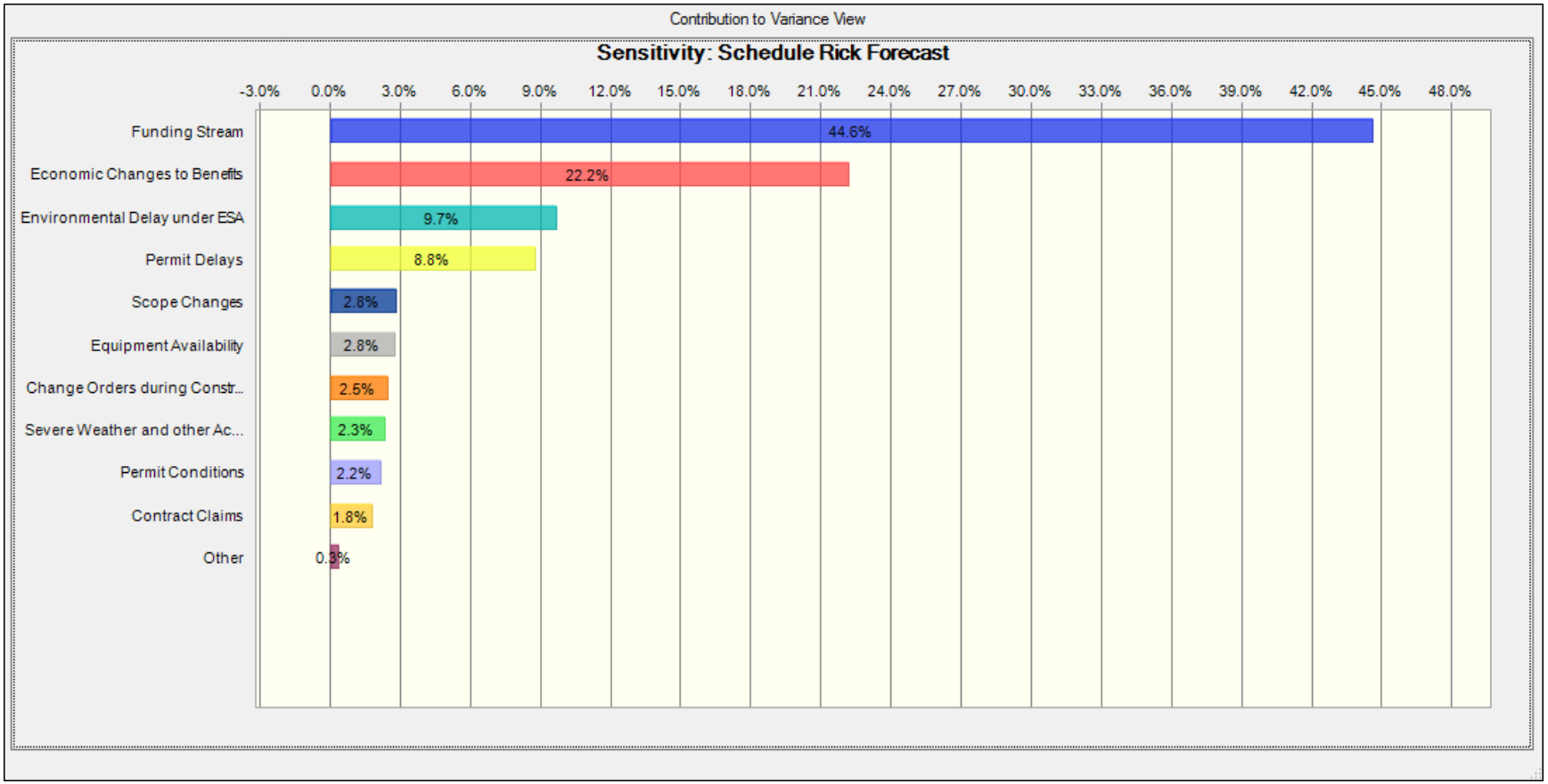


Figure 2. Sensitivity Analysis (Baseline Schedule)



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

Total project cost comparison summaries are provided in Table 3 and Figures 3 and 4. Additional major findings and observations of the risk analysis are listed below. Refer to the sensitivity chart for a complete list of risk items evaluated and their impact. In addition, the risk registers for each analysis are at the end of this report.

For the renourishments, the key cost risk drivers identified through sensitivity analysis were Acquisition Type/Bidding Climate, Severe Weather and Quantity Estimates, which combined contribute 74.9% of the statistical cost variance. These items are discussed in further detail within Section 7.2 Recommendations below.

In addition to these key cost risk drivers the following risk item was evaluated as an additional moderate risk:

- Change Orders: This risk item represents the concern that changes in scope/design could cause delays to the project during construction.

The key schedule risk drivers identified through sensitivity analysis are Funding Stream, Environmental Delays and Economic Changes to Benefits which combined contribute 71.1% percent of the statistical schedule variance. Details identifying the concerns associated with each of these risk drivers and information on how each risk item was modeled is explained in Section 7.2 Recommendations below.

In addition to key schedule risk drivers the following risk items were evaluated as additional moderate risks:

- Permit Delays - This risk item represents the concern for the schedule that could be affected by any permitting delays. Permits are for periods of 10 years with a possible two year extension. An extension would be required and an additional permit for the remainder of the project life. The schedule allows for ample time to acquire permit extensions. This is also unlikely for the schedule, but could be significant if delays are experienced.

Table 5. Project Cost Comparison Summary

Most Likely Cost Estimate	$37,293,000		
Confidence Level	**Project Cost**	**Contingency**	**Contingency %**
0%	**$40,593,000**	**$3,300,000**	**8.85%**
5%	**$42,269,000**	**$4,976,000**	**13.34%**
10%	**$42,704,000**	**$5,411,000**	**14.51%**
15%	**$43,120,000**	**$5,827,000**	**15.63%**
20%	**$43,534,000**	**$6,241,000**	**16.74%**
25%	**$43,935,000**	**$6,642,000**	**17.81%**
30%	**$43,963,000**	**$6,670,000**	**17.89%**
35%	**$44,361,000**	**$7,068,000**	**18.95%**
40%	**$44,383,000**	**$7,090,000**	**19.01%**
45%	**$44,780,000**	**$7,487,000**	**20.08%**
50%	**$44,805,000**	**$7,512,000**	**20.14%**
55%	**$45,204,000**	**$7,911,000**	**21.21%**
60%	**$45,228,000**	**$7,935,000**	**21.28%**
65%	**$45,625,000**	**$8,332,000**	**22.34%**
70%	**$46,029,000**	**$8,736,000**	**23.42%**
75%	**$46,432,000**	**$9,139,000**	**24.50%**
80%	**$46,474,000**	**$9,181,000**	**24.62%**
85%	**$46,889,000**	**$9,596,000**	**25.73%**
90%	**$47,695,000**	**$10,402,000**	**27.89%**
95%	**$48,146,000**	**$10,853,000**	**29.10%**
100%	**$52,199,000**	**$14,906,000**	**39.97%**

Notes:

1) Table taken from Crystal Ball software. Values have been rounded and may not match when calculated.

Figure 3. Project Cost Summary

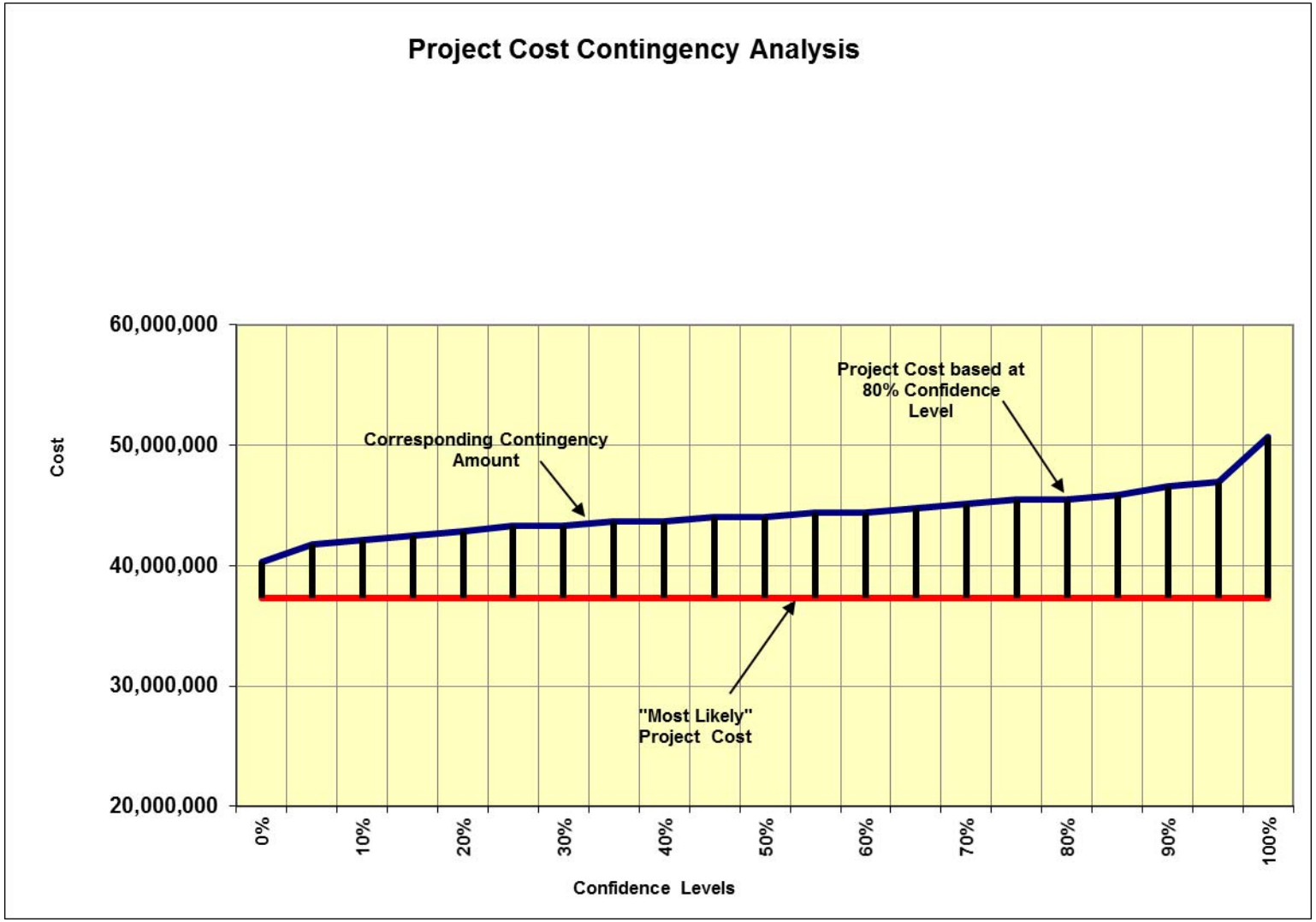
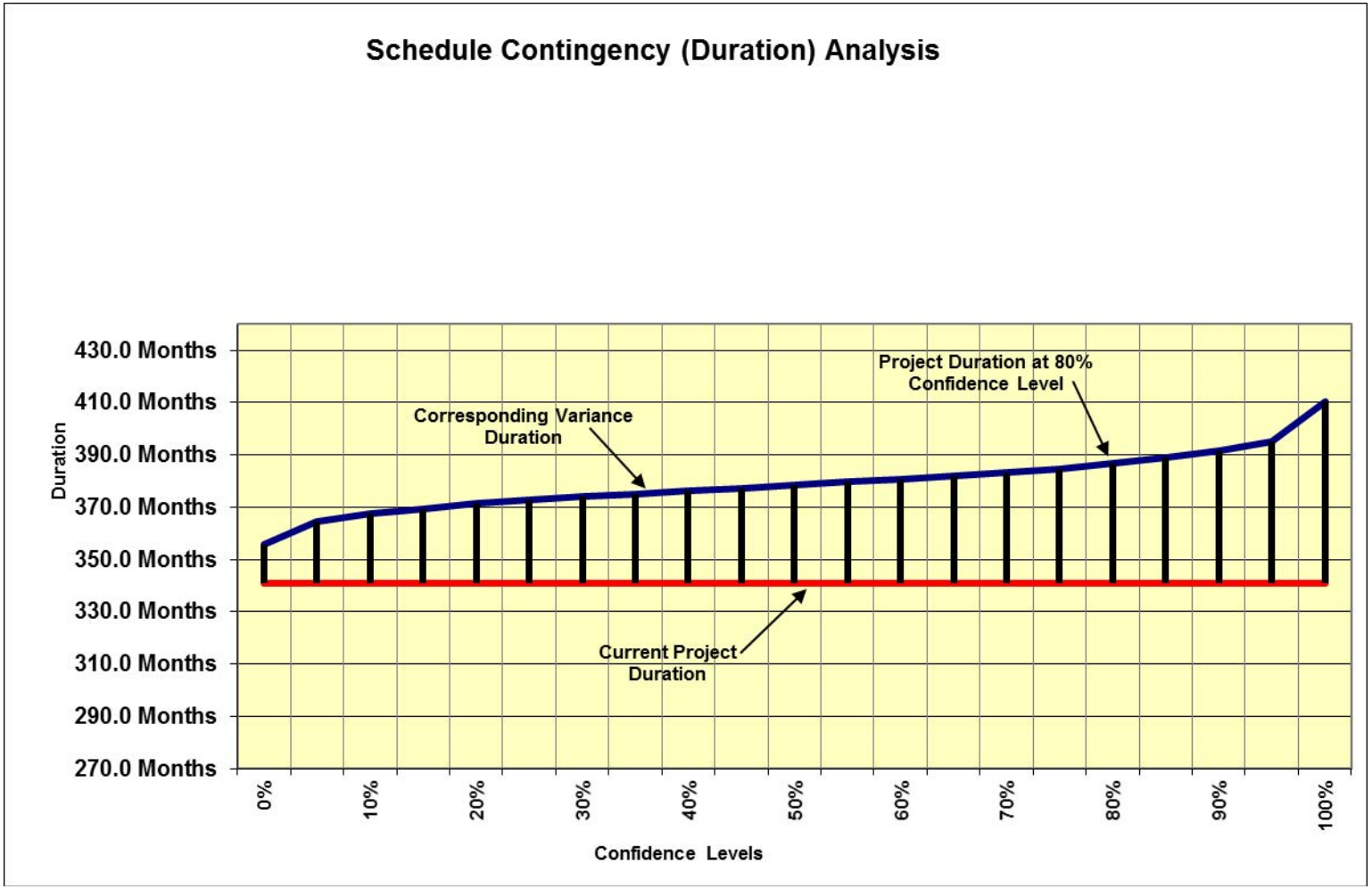


Figure 4. Project Schedule Summary



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 proactive management of risks does 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 were, Acquisition Type/Bidding Climate and Quantity Estimates.

    a. Acquisition Type/Bidding Climate: This risk item represents the concern that multiple contracting methods available could represent uncertainty in contract cost. Also, any risk to cost due to severe economic swings, which could increase/decrease the number of potential bidders. The state of the economy could also impact how that pool of potential bidders prices the project.

    b. Quantity Estimates: This risk item represents the concern that quantities could vary based upon losses during or prior to construction. Quantities changes could result between renourishments due to severe weather, sea level changes, change in erosion rate, etc. The greater quantity variance risks would likely be in the out-years.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis are Funding Stream, Economic Changes to Benefits and Environmental Delays.

    a. Funding Stream: Increasing the difficulty in obtaining funds in a timely manner could have an impact to cost.

    b. Economic Changes to Benefits: This risk identifies the concern that BC Ratio could affect priority for receiving needed funds. This is unlikely because of long interval between events funding can be coordinated well in advance. However, if total funding is not provided, additional sponsor coordination may be needed.

    c. Environmental Delays: This risk item represents the concern for the schedule that could be affected by any environmental delays. Sea Turtle and Bird monitoring restrictions could increase

over time causing impact to the schedule. This is also unlikely for the schedule, but could be significant if delays are experienced.

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. Risk Register

113167: Jupiter Carlin Segment Hurricane Storm Damage Reduction (HSDR) Project

Risk Matrix

Likelihood 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

The Palm Beach County Shore Protection Project, authorized by Section 110 of the Rivers and Harbors Act (Public Law 87-874) on October 23, 1962, provides for beach fill extending from the Martin County line to Lake Worth Inlet and South Lake Worth Inlet to the Broward County line. The 1994 Addendum to the 1987 General Design Memorandum supersedes the original authorized project dimensions and calls for restoring approximately 1.1 miles of beach between Florida Department of Environmental Protection reference monuments R-13 and R-19. The fill restores the October 1989 mean high water shoreline and provides additional material to offset erosive losses for seven years between each subsequent renourishment. Federal participation in the project allowed non-federal construction and renourishment with subsequent reimbursement of the federal share of project cost for a period of 15 years following initial construction. Palm Beach County constructed the initial project in 1995 and renourished the beach in 2002. Federal participation in the project expired in 2010. Section 934 of the 1986 Water Resource Development Act (Public Law 99-662) provides discretionary authority to the Secretary of the Army, acting through the U.S. Army Corps of Engineers Office of the Chief of

SEE ASSUMPTIONS TAB FOR COST VALUE RANGES DEVELOPMNENT

Negligible--- *Less than*			$186,465		2 Months
Marginal ---*between*	$186,466	and	$745,860	2 Months	and 7 Months
Significant ---*between*	$745,861	and	$2,983,440	7 Months	and 17 Months
Critical--- *between*	$2,983,441	and	$7,458,600	17 Months	and 34 Months
Crisis ---*Over*	$7,458,601			34 Months	

Cost Risk Model (LINK)	Base Cost Summary (LINK)
Schedule Risk Model (LINK)	FORECAST EXTRACTS TAB (LINK)

Project Continency (LINK)

Risk No.	Risk/Opportunity Event	Concerns	PDT Risk Conclusions, Justification	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Project Cost: Rough Order Impact ($)	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Project Schedule: Rough Order Impact (mo)	Variance Distribution	Correlation to Other(s)	Responsibility / POC	Affected Project Component
	Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)														
	PROJECT & PROGRAM MGMT														
PM1	Funding Stream	Receipt of Federal Funding is anticipated but unsure due to future funding constraints.	PM is optimisitic funds for construction will either be provided in the FY prior to construction or FY of construction. However, despite increasing difficulty obtaining funds that could have an impact to cost and schedule (1yr-3%), the funding is being accumulated by the Sponsor on an annual basis and appears solid for both renourishments.	Likely	Marginal	MODERATE	3%	Likely	Significant	HIGH	24 Months	Uniform		PM/PDT	Project Cost & Schedule
PM2	Schedule Delay - Staffing and Priorities	Priorities of PDT members may cause a slip in schedule.	Projects in design and construction phases may take higher priority over the 934 Study. This is common and likely to occur but the impact is thought to be negilgible to cost and schedule.	Likely	Negligible	LOW	0%	Likely	Negligible	LOW	0 Months	N/A		PDT	Project Schedule
PM3	Economic Changes to Benefits	Will the project benefits change as the project life continues?	BC Ratio could effect priority for receiving needed funds. This is unlikely because of long interval between events funding can be coordinated well in advance.	Unlikely	Significant	MODERATE	2%	Unlikely	Significant	MODERATE	18 Months	Uniform		PDT	Project Cost & Schedule
PM4	PPA Issues	Delay in the agreement could delay the project.	PPA is current. Should be no issues therefore unlikely likelihood of occurrence. It this were to occur this could have a marginal impact.	Unlikely	Marginal	LOW	1%	Unlikely	Negligible	LOW	0 Months	N/A		PM	Project Cost & Schedule
PM5	Sponsor Support	Delay in the agreement could delay the project.	PDT assumption that the design template will be restored prior to initial construction. This is non-Federal responsibility, and the use of the 934 authority is contingent on the Sponsor maintaining this berm.	Unlikely	Marginal	LOW	1%	Likely	Significant	HIGH	12 Months	N/A		PM	Project Schedule
	CONTRACT ACQUISITION RISKS														
CA1	Acquisition Type - Bidding Climate	Acquisition Strategy affects contract prices and competition.	Multiple CT methods available (IFB, RFP), which represents uncertainty in contract cost and schedule. Impacts effort in award; some contract vehicles more conducive to lower cost. Based on past contract experience including the LS's contracts and recent SAJ bids, sand placement contracts have had good competition with favorable outcomes. Due to industry heavy workload, prices could still come in high.	Likely	Significant	HIGH	10%	Unlikely	Marginal	LOW	1 Months	Uniform		PDT	Project Cost & Schedule
CA2	Acquisition Delays	Based on recent experience numerous amendments are issued prior to receipt of bids/proposals.	Issuance of multiple amendments could delay the solicitation due date and subsequently award of the contract.	Likely	Negligible	LOW	0%	Very Likely	Negligible	LOW	0 Months	N/A		PDT	Project Cost & Schedule

	TECHNICAL RISKS														
TL1	Scope Changes	What is the likelyhood that the project scope could be changed for the remaining renourishments.	Scope is well defined and not expected to change. However, dredging is still a potential option which could have a marginal impact.	Likely	Marginal	MODERATE	4%	Very Likely	Marginal	MODERATE	6 Months	Triangular		Technical Lead	Project Cost & Schedule
TL2	Permit Conditions	Could future permits affect the design and construction of the Sand Key segment	This project segment was last renourished in 2013 and the FDEP permit is good through 2028. Future impacts unlikely.	Unlikely	Marginal	LOW	0%	Likely	Marginal	MODERATE	6 Months	Triangular		Environmental	Project Cost & Schedule
TL3	Character of Materials	Confidence in the material quality.	since material is assumed to be coming from an offshore borrow source, this source has sufficient volume of material in accordance with current specifications for beach quality fill. The PDT has confirmed and therefore this is thought to be an unlikely risk.	Unlikely	Marginal	LOW	0%	Unlikely	Marginal	LOW	0 Months	N/A		Geotechnical/Civil Design	Project Cost & Schedule
TL5	Availability of Borrow Material for the Project at time of construction	Is there enough volume of material available in the upland sand sources to support the project?	The currently assumed offshore borrow source is estimated to contain approximately 5m cubic yards of suitable material. This is based upon the 934 Goetech Appendix. The current scope of the remaining project requires less than 1m cubic yards of material. As a result, this is assumed to be a unlikely risk with a significant cost impact if an LRR is nessesary to local alternative sources.	Unlikely	Significant	MODERATE	0%	Unlikely	Significant	MODERATE	3 Months	Triangular	TL-6	Technical Lead	Project Cost & Schedule
TL6	Erosion Rate Changes	Could there be changes to the current shoreline erosion rates that could alter the project design?	Ample historic erosion rates and survey data are available to support the erosion rate determined. Any fluctuation is anticipated to be minor since the project has been peforming very well. Large storm events typically have a short term impact or an impact for one renourishment but the project in the out years is expected to perform similarily to its historic perofrmance.	Unlikely	Negligible	LOW	0%	Unlikely	Negligible	LOW	0 Months	N/A		Technical Lead	Project Cost & Schedule
	LANDS AND DAMAGES RISKS														
LD1	Site Access, Staging Areas & Construction Easements	Have all access and staging areas been established?	Since the project has been previously constructed and renourished beach access and staging areas are available. Minor coordination required to reuse areas.	Unlikely	Marginal	LOW	0%	Unlikely	Marginal	LOW	0 Months	N/A		Real Estate	Project Cost & Schedule
	REGULATORY AND ENVIRONMENTAL RISKS														
REG3	Environmental Restrictions	Could environmental restrictions change such that they could delay the project or interrupt construction?	There is a nesting sea turtle window and bird monitoring window. These restriction could increase with time. Sea turtle nesting is likely, however, as nesting occurs nest are buffered for and monitoring is required in the contract. This is captured in the base line estimate, and any cost and schedule fluctuations are considered marginal and unlikely. No negative impacts to regulations as a result of storms are anticipated since the beach renourishment projects typically provide critical nesting habitat for sea turtles and birds.	Unlikely	Marginal	LOW	0%	Unlikely	Marginal	LOW	0 Months	N/A		Environmental	Project Cost & Schedule
REG4	Permit Delays	Changes in Permit requirements	The permit would have to be reissued multiple times for remainder of project life. The schedule allows for ample time to acquire permits. So this is considered to be unlikely and marginal for cost. This is also unlikely for schedule, but could be significant if delays are experienced.	Likely	Marginal	MODERATE	2%	Likely	Significant	HIGH	12 Months	Triangular		Environmental	Project Cost & Schedule
REG5	NEPA	Public Comments	Significant public concern about the project could delay the NEPA process.	Very Unlikely	Negligible	LOW	0%	Very Unlikely	Marginal	LOW	0 Months	N/A		Environmental	Project Cost & Schedule
REG6	Environmental Delay under ESA	Section 7 Consultations under ESA	Consultation with the USFWS could be lengthy, depending on the backlog of the reviewer.	Unlikely	Significant	MODERATE	3%	Unlikely	Significant	MODERATE	12 Months	N/A		Environmental	Project Schedule
REG7	Environmental Delays under MSFCMA	Essential Fish Habitat Consultations under the MSFCMA	Consultation with the NMFS could be lengthy, depending on the backlog of the reviewer.	Very Unlikely	Negligible	LOW	0%	Very Unlikely	Marginal	LOW	0 Months	N/A		Environmental	Project Schedule
	CONSTRUCTION RISKS														
CO1	Change Orders during Construction	Will change orders be issued during construction that could adjust the cost and schedule of the contract?	Construction representatives agreed that change orders will most likely be issued based on our experience administering dredging contracts.	Very Likely	Marginal	MODERATE	2%	Very Likely	Marginal	MODERATE	6 Months	Triangular		Construction	Contract Cost & Project Schedule
CO2	Safety Issues	Could safety incidents occur that would impact the cost and schedule of the contract?	The Construction representative agreed there always exist the possibility of safety incidents occurring on a dredging contract that are normally not very serious.	Very Unlikely	Negligible	LOW	0%	Very Unlikely	Marginal	LOW	0 Months	N/A		Construction	Project Schedule
CO3	Construction Staging Areas	Will the contractor be able to secure adequate staging areas for the contract?	According to the LS this has not been an issue or concern on previous contracts.	Very Unlikely	Negligible	LOW	0%	Very Unlikely	Marginal	LOW	0 Months	N/A		Construction	Project Schedule
CO4	Contract Claims	Could there be claims submitted by the contractor that could impact the cost of the contract?	Construction representatives indicated that measurement and payment surveys are an expected area of disagreement on dredging contracts.	Likely	Marginal	MODERATE	3%	Unlikely	Marginal	LOW	6 Months	Triangular	CON-1	Construction	Contract Cost

	ESTIMATE AND SCHEDULE RISKS														
EST1	Production Estimates	Is production estimate supported by historical contract data and is it dependable for the scope of work in the Recommended Plan?	There is existing production data available on this project from a previously administered contract with the same overall scope of work. However, since this is only from one previous contract this could likely result in cost or schedule impacts. This could be significant if changes to assumed production occur as additional contracts are performed.	Unlikely	Significant	MODERATE	5%	Unlikely	Marginal	LOW	3 Months	N/A	EST-3	Cost Engineering	Contract Cost & Project Schedule
EST2	Quantity Estimates	Estimates are largely based on quantities which could change, especially over time.	The total quantities for beach fill include estimated losses that could vary somewhat during construction. Quantities changes could result between renourishments due to severe weather, sea level changes, etc. Storm impacts would likely impact the next upcoming renourishment and not the erosion rate. These impacts if above $1M could be coverd by FCCE funding (ER 500-1-1) otherwise it would need to be cost shared by the project. The greater quantity variance risks would likely be in the out-years.	Likely	Critical	HIGH	15%	Unlikely	Marginal	LOW	0 Months	Triangular		Cost Engineering	Contract Cost
EST3	Equipment Availability	Will the equipment used in the estimate including the dredge type be available to bid the contract? Low bid competition and availablility could also cause delays.	Equipment neccesary for a dredging operation typically include Hopper or Pipeline dredges. This type of equipment is usually available pending current wheather conditions (storms, etc.). Therefore, this is thought to be an unlikely and marginal to cost and unlikely and negligable to schedule.	Unlikely	Marginal	LOW	0%	Unlikely	Negligible	LOW	6 Months	Triangular		Cost Engineering	Contract Cost & Project Schedule
EST4	Fuel Prices	Will there be fuel price increases at the time of the contracts that could impact the cost of the project?	The annual fuel price trend has been somewhat stable the last 3-4 years. The market has experienced some declines recently but some increases are expected in the future. To take a more conservative approach, rather than using the current fuel price a five year average has been utilized based upon coordination with the Cost MCX. This has resulted in an increase in the baseline cost but is reflected in a moderate risk assumption within the CSRA from what was previously conisdered. This risk event is more likely to affect delivery cost since no dredging is involved.	Unlikely	Significant	MODERATE	0%	Unlikely	Negligible	LOW	0 Months	Triangular		Cost Engineering	Contract Cost
EST5	Labor Cost	Will labor rate increases exceed anticipated rises that could impact the cost of the project.	Labor rates for heavy construction industry have been stable over the pasyt several years and expected to continue in the future.	Unlikely	Marginal	LOW	0%	Very Unlikely	Negligible	LOW	0 Months	N/A		Cost Engineering	Contract Cost
EST6	Contract Markups	Could contractor markups exceed the rates used in the construction estimates?	We have used average large dredging contractor markups for many years but the actual markups bid for the contracts could vary from this.	Unlikely	Marginal	LOW	0%	Very Unlikely	Negligible	LOW	0 Months	N/A		Cost Engineering	Contract Cost
	Programmatic Risks	(External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)													
PR1	Court Injunctions	Could the project be challenged in court prior to construction by the public?	According to the LS there public is currently very supportive of the project and they do not anticipate any significant objection to the project in the future.	Very Unlikely	Critical	LOW	0%	Very Unlikely	Critical	LOW	0 Months	Uniform		Office of Counsel	Project Schedule
PR2	Severe Weather and other Acts of God	Could the project be interrupted by a severe storm system including hurricanes during construction?	The PDT agrees that construction will try to avoid hurricane season. However, receipt of funding dictates the window for work completion. If PED work starts at the beginning of the budget year then work would likely be completed during hurricane season.	Likely	Marginal	MODERATE	0%	Unlikely	Marginal	LOW	6 Months	Uniform		N/A	Project Cost
PR3	Sea Level Rise	Sea Level Rise could cause change to project and contract conditions.	The sea level risk could impact construction efforts, mostly related to quantity variations. The farther into the out-year contracts, the greater quantity variability. Time impact is low since the contracts are small annual events. Sea Level risk is covered under the EST-2 Quantities.	Unlikely	Marginal	LOW	0%	Unlikely	Marginal	LOW	1Months	Uniform		Hydrology/Hydraulic Design	Project Cost

*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 distribution. A risk item for which the PDT has little data or probability 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.

ADDENDUM D: Total Project Cost Summary with Cost Risk Analysis, Contingency and Schedule Analysis Escalation

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

SAJ - PN 113167
Palm Beach County, FL – Jupiter Carlin Segment
Shore Protection Project

The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project presented by the Jacksonville District has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scopes, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of August 25, 2017, the Cost MCX certifies the estimated total project cost:

FY18 Remaining Costs:	$ 47,551,000 (Cost ATR Certified)
FY16 Spent Costs:	$ 9,042,000 (From SAJ Programs & PM)
FY18 Project First Cost:	$ 56,593,000 (Including Spent Costs)
Fully Funded Costs:	$ 71,325,000 (Including Spent Costs)

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

CALLAN.KIM.C.1231558221

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

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

PROJECT: **Jupiter Carlin Segment 934 Study**
PROJECT NO: P2 113167
LOCATION: Palm Beach County, FL

DISTRICT: **SAJ District** **PREPARED:** **8/25/2017**
POC: **CHIEF, COST ENGINEERING, Matt Cunningham**

This Estimate reflects the scope and schedule in report; 934 Study Report

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2018 Effective Price Level Date: 1 OCT 17									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-16** ($K)	**TOTAL FIRST COST** ($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	$32,718	$8,180	25.0%	$40,898	1.9%	$33,326	$8,331	$41,657	$7,280	$48,937	27.1%	$42,371	$10,593	$60,243
06	FISH & WILDLIFE FACILITIES	$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
	CONSTRUCTION ESTIMATE TOTALS:	$32,718	$8,180		$40,898	1.9%	$33,326	$8,331	$41,657	$7,280	$48,937	27.1%	$42,371	$10,593	$60,243
01	LANDS AND DAMAGES	$120	$30	25.0%	$150	1.9%	$122	$31	$153	$0	$153	24.3%	$152	$38	$190
30	PLANNING, ENGINEERING & DESIGN	$3,655	$914	25.0%	$4,569	3.1%	$3,768	$942	$4,710	$1,669	$6,379	57.2%	$5,925	$1,481	$9,075
31	CONSTRUCTION MANAGEMENT	$800	$200	25.0%	$1,000	3.1%	$825	$206	$1,031	$93	$1,124	67.2%	$1,379	$345	$1,817
	PROJECT COST TOTALS:	$37,293	$9,323	25.0%	$46,616		$38,041	$9,510	**$47,551**	$9,042	**$56,593**	31.0%	$49,827	$12,457	$71,325

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CHIEF, COST ENGINEERING, Matt Cunningham

ESTIMATED TOTAL PROJECT COST: **$71,325**

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PROJECT MANAGER, Lacy Pfaff

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ACTING CHIEF, REAL ESTATE, Tori White

CHIEF, PLANNING, Eric Summa

CHIEF, ENGINEERING, Laureen Borochaner

CHIEF, OPERATIONS, Carol Bernstein

CHIEF, CONSTRUCTION, Steve Duba

CHIEF, CONTRACTING, Timothy Black

CHIEF, PM-PB, Karen Smith

CHIEF, DPM, Tim Murphy

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

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

PROJECT: Jupiter Carlin Segment 934 Study
LOCATION: Palm Beach County, FL
This Estimate reflects the scope and schedule in report; 934 Study Report

DISTRICT: SAJ District
POC: CHIEF, COST ENGINEERING, Matt Cunningham
PREPARED: 8/25/2017

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 4-Aug-17 Effective Price Level: 1-Oct-16				Program Year (Budget EC): 2018 Effective Price Level Date: 1 OCT 17								
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*
	Finalize Report FY18													
17	BEACH REPLENISHMENT	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$0	$0	0.0%	**$0**		$0	$0	$0			$0	$0	$0
01	LANDS AND DAMAGES	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Planning & Environmental Compliance	$300	$75	25.0%	$375	3.1%	$309	$77	$387	2018Q1	0.0%	$309	$77	$387
	Engineering & Design	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Life Cycle Updates	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Contracting & Reprographics	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
2.0%	Engineering During Construction	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
1.0%	Planning During Construction	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	Legal	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$300	$75		$375		$309	$77	$387			$309	$77	$387

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

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

PROJECT: Jupiter Carlin Segment 934 Study
LOCATION: Palm Beach County, FL
This Estimate reflects the scope and schedule in report; 934 Study Report

DISTRICT: SAJ District
POC: CHIEF, COST ENGINEERING, Matt Cunningham
PREPARED: 8/25/2017

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			**4-Aug-17**	Program Year (Budget EC):			2018					
		Effective Price Level:			1-Oct-16	Effective Price Level Date:			1 OCT 17					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Initial (Dredging) FY20													
17	BEACH REPLENISHMENT	$8,045	$2,011	25.0%	$10,056	1.9%	$8,194	$2,049	$10,243	2020Q3	5.1%	$8,615	$2,154	$10,769
	CONSTRUCTION ESTIMATE TOTALS:	$8,045	$2,011	25.0%	**$10,056**		$8,194	$2,049	$10,243			$8,615	$2,154	$10,769
01	LANDS AND DAMAGES	$30	$8	25.0%	$38	1.9%	$31	$8	$38	2019Q3	3.1%	$31	$8	$39
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2019Q1	3.9%	$48	$12	$60
	Planning & Environmental Compliance	$100	$25	25.0%	$125	3.1%	$103	$26	$129	2019Q1	3.9%	$107	$27	$134
	Engineering & Design	$300	$75	25.0%	$375	3.1%	$309	$77	$387	2019Q1	3.9%	$321	$80	$402
	Life Cycle Updates	$50	$13	25.0%	$63	3.1%	$52	$13	$64	2019Q1	3.9%	$54	$13	$67
	Contracting & Reprographics	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2019Q1	3.9%	$48	$12	$60
2.0%	Engineering During Construction	$165	$41	25.0%	$206	3.1%	$170	$43	$213	2020Q1	8.2%	$184	$46	$230
1.0%	Planning During Construction	$85	$21	25.0%	$106	3.1%	$88	$22	$110	2020Q1	8.2%	$95	$24	$119
	Legal	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2019Q1	3.9%	$48	$12	$60
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$200	$50	25.0%	$250	3.1%	$206	$52	$258	2020Q1	8.2%	$223	$56	$279
	CONTRACT COST TOTALS:	$9,110	$2,277		$11,387		$9,292	$2,323	$11,615			$9,775	$2,444	**$12,219**

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

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

PROJECT: Jupiter Carlin Segment 934 Study
LOCATION: Palm Beach County, FL
This Estimate reflects the scope and schedule in report; 934 Study Report

DISTRICT: SAJ District
POC: CHIEF, COST ENGINEERING, Matt Cunningham
PREPARED: 8/25/2017

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 4-Aug-17 Effective Price Level: 1-Oct-16				Program Year (Budget EC): 2018 Effective Price Level Date: 1 OCT 17								
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 - FY26 (Dredging)													
17	BEACH REPLENISHMENT	$8,047	$2,012	25.0%	$10,058	1.9%	$8,196	$2,049	$10,245	2026Q3	18.4%	$9,704	$2,426	$12,130
	CONSTRUCTION ESTIMATE TOTALS:	$8,047	$2,012	25.0%	**$10,058**		$8,196	$2,049	$10,245			$9,704	$2,426	$12,130
01	LANDS AND DAMAGES	$30	$8	25.0%	$38	1.9%	$31	$8	$38	2025Q3	16.1%	$35	$9	$44
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2025Q1	32.6%	$62	$15	$77
	Planning & Environmental Compliance	$100	$25	25.0%	$125	3.1%	$103	$26	$129	2025Q1	32.6%	$137	$34	$171
	Engineering & Design	$300	$75	25.0%	$375	3.1%	$309	$77	$387	2025Q1	32.6%	$410	$103	$513
	Life Cycle Updates	$50	$13	25.0%	$63	3.1%	$52	$13	$64	2025Q1	32.6%	$68	$17	$85
	Contracting & Reprographics	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2025Q1	32.6%	$62	$15	$77
2.0%	Engineering During Construction	$165	$41	25.0%	$206	3.1%	$170	$43	$213	2026Q1	38.3%	$235	$59	$294
1.0%	Planning During Construction	$85	$21	25.0%	$106	3.1%	$88	$22	$110	2026Q1	38.3%	$121	$30	$152
	Legal	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2025Q1	32.6%	$62	$15	$77
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$200	$50	25.0%	$250	3.1%	$206	$52	$258	2026Q1	38.3%	$285	$71	$357
	CONTRACT COST TOTALS:	$9,112	$2,278		**$11,390**		$9,294	$2,323	$11,617			$11,181	$2,795	**$13,977**

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

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

PROJECT: Jupiter Carlin Segment 934 Study
LOCATION: Palm Beach County, FL
This Estimate reflects the scope and schedule in report; 934 Study Report

DISTRICT: SAJ District
POC: CHIEF, COST ENGINEERING, Matt Cunningham
PREPARED: 8/25/2017

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			**4-Aug-17**	Program Year (Budget EC):			2018					
		Effective Price Level:			1-Oct-16	Effective Price Level Date:			1 OCT 17	FULLY FUNDED PROJECT ESTIMATE				
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 - FY32 (Dredging)													
17	BEACH REPLENISHMENT	$8,047	$2,012	25.0%	$10,058	1.9%	$8,196	$2,049	$10,245	2032Q3	33.3%	$10,928	$2,732	$13,660
	CONSTRUCTION ESTIMATE TOTALS:	$8,047	$2,012	25.0%	**$10,058**		$8,196	$2,049	$10,245			$10,928	$2,732	$13,660
01	LANDS AND DAMAGES	$30	$8	25.0%	$38	1.9%	$31	$8	$38	2031Q3	30.7%	$40	$10	$50
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2031Q1	72.5%	$80	$20	$100
	Planning & Environmental Compliance	$100	$25	25.0%	$125	3.1%	$103	$26	$129	2031Q1	72.5%	$178	$44	$222
	Engineering & Design	$300	$75	25.0%	$375	3.1%	$309	$77	$387	2031Q1	72.5%	$534	$133	$667
	Life Cycle Updates	$50	$13	25.0%	$63	3.1%	$52	$13	$64	2031Q1	72.5%	$89	$22	$111
	Contracting & Reprographics	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2031Q1	72.5%	$80	$20	$100
2.0%	Engineering During Construction	$165	$41	25.0%	$206	3.1%	$170	$43	$213	2032Q1	80.7%	$307	$77	$384
1.0%	Planning During Construction	$85	$21	25.0%	$106	3.1%	$88	$22	$110	2032Q1	80.7%	$158	$40	$198
	Legal	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2031Q1	72.5%	$80	$20	$100
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$200	$50	25.0%	$250	3.1%	$206	$52	$258	2032Q1	80.7%	$373	$93	$466
	CONTRACT COST TOTALS:	$9,112	$2,278		**$11,390**		$9,294	$2,323	$11,617			$12,847	$3,212	**$16,059**

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

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

PROJECT: Jupiter Carlin Segment 934 Study
LOCATION: Palm Beach County, FL
This Estimate reflects the scope and schedule in report; 934 Study Report

DISTRICT: SAJ District
POC: CHIEF, COST ENGINEERING, Matt Cunningham
PREPARED: 8/25/2017

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			**4-Aug-17**	Program Year (Budget EC):			2018					
		Effective Price Level:			1-Oct-16	Effective Price Level Date:			1 OCT 17	FULLY FUNDED PROJECT ESTIMATE				
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 - FY38 (Dredging)													
17	BEACH REPLENISHMENT	$8,580	$2,145	25.0%	$10,725	1.9%	$8,739	$2,185	$10,924	2038Q3	50.2%	$13,123	$3,281	$16,404
	CONSTRUCTION ESTIMATE TOTALS:	$8,580	$2,145	25.0%	**$10,725**		$8,739	$2,185	$10,924			$13,123	$3,281	$16,404
01	LANDS AND DAMAGES	$30	$8	25.0%	$38	1.9%	$31	$8	$38	2037Q3	47.2%	$45	$11	$56
30	PLANNING, ENGINEERING & DESIGN													
	Project Management	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2037Q1	129.9%	$107	$27	$133
	Planning & Environmental Compliance	$100	$25	25.0%	$125	3.1%	$103	$26	$129	2037Q1	129.9%	$237	$59	$296
	Engineering & Design	$300	$75	25.0%	$375	3.1%	$309	$77	$387	2037Q1	129.9%	$711	$178	$889
	Life Cycle Updates	$50	$13	25.0%	$63	3.1%	$52	$13	$64	2037Q1	129.9%	$119	$30	$148
	Contracting & Reprographics	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2037Q1	129.9%	$107	$27	$133
2.0%	Engineering During Construction	$175	$44	25.0%	$219	3.1%	$180	$45	$226	2038Q1	141.8%	$436	$109	$545
1.0%	Planning During Construction	$90	$23	25.0%	$113	3.1%	$93	$23	$116	2038Q1	141.8%	$224	$56	$280
	Legal	$45	$11	25.0%	$56	3.1%	$46	$12	$58	2037Q1	129.9%	$107	$27	$133
31	CONSTRUCTION MANAGEMENT													
	Construction Management	$200	$50	25.0%	$250	3.1%	$206	$52	$258	2038Q1	141.8%	$499	$125	$623
0.0%	Project Operation:	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Management	$0	$0	25.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$9,660	$2,415		**$12,075**		$9,852	$2,463	$12,316			$15,714	$3,928	**$19,642**