Appendix D

Princeville, North Carolina Flood Risk Management Integrated Feasibility Report and Environmental Assessment

Cost Appendix

December 2015

Appendix D: Cost Engineering

PRINCEVILLE, NC
FLOOD RISK REDUCTION
FEASIBILITY REPORT
Edgecombe County, North Carolina

1. The Cost Engineering Appendix was prepared to describe the Current Working Estimate (CWE) for Selected Plan for the Princeville Flood Risk Reduction Plan, Princeville, North Carolina – Feasibility Report.

The Selected Plan chosen was based on a balance of and consideration of cost-effectiveness, minimization of impacts to the physical environment, cultural, and historical values.

2. The Selected Plan for the Princeville Flood Risk Reduction Project is summarized by 4 segments listed below. All four segments are identified in Figure 1.4 of the DESIGN APPENDIX (All elevations are NAVD 88). The existing alignment of the existing dike is shown in Figure 1.2 of the DESIGN APPENDIX.

Segment 1: Extend Existing Levee Alignment by raise/elevate existing road surface of NC 33 highway at its intersection with ramps for HWY 64-WEST – See Figures 1.5 & 1.6 of Design Appendix

Intersection Raise-

- ~ Final elevation 47 ft
- ~Demo of existing alphalt pavement
- ~6,000 CY Earthwork Fill
- ~4,700 SY Asphalt Pavement
- ~300 LF of 24 inch diameter pipe
- ~2 Flap Gates for existing box culverts and pipe

Segment 2: Construct a new shoulder levee alignment west side of US HWY 64 by constructing new roadside levee along and offset from US HWY 64-WEST (northwest of intersection with NC 33 highway) - See Figures 1.7 & 1.8 of Design Appendix

US HWY 64 Shoulder Levee -

- Final elevation 47 ft
- ~61,500 CY Earthwork Fill
- ~2,000 LF various diameter 24 to 60 inch Drainage Pipes
- ~8 Flap gates for existing and new pipe locations

Segment 3: There are no revisions for the existing levee in the proposed plan. - See Figure 1.9 of Design Appendix

Segment 4: Short raise/elevate extension of existing levee and road surface of US 258 (NC 122) highway; and, then construct new earthen levee beginning, and intersect, south of US 258 (NC 122) heading southwest about 3,400 linear feet (across existing farm land) until reaching NC 111. Then raise/elevate existing road surface of NC 111 highway, approximately 2-3 feet for about 4,300 linear feet southeast thru the intersection of NC 111 with NC 1523 (Shiloh Farm Road). - See Figures 1.10, 1.11 & 1.14 of Design Appendix

Highway US 258, New Earthen Country Levee, NC 111, & NC 1523 (Shiloh Farm Road) -

- Final elevation 49 ft
- ~ 80,000 CY Earthwork Fill
- ~ 32,000 CY undercut excavation for new earthen levee
- ~ 16,000 SY Demo existing asphalt pavement
- ~ 27,000 SY New Asphalt Pavement
- ~ 2,500 SY Asphalt Driveways
- ~ 3,300 LF Drainage Ditches/Swales
- Drainage Pipe and Flap Gates
- ~ 2,700 SY of Temporary Access Road

A suitable borrow area for earthwork fill has been investigated and identified about 4 miles southeast of the project at intersection of highways US 64 at Chinquapin Road (SR 1524). Borrow area is shown in Figure 7.7 of Main Report.

3. Construction period anticipated is for three separate contracts as follows: Contract #1 – US HWY 64 Shoulder Levee (Segment 2), 15 months; Contract #2 – US 258 and Earthen Country Levee (part of segment 4), 15 months; and Contract #3 - Intersection at NC HWY 33 (Segment 1) and HWY 64 ramps; plus NC 111 and NC 1523 (Shiloh Farm Road), 22 months. Contract #3 construction will require traffic control sequenced to reduce interruption of traffic at 3 intersects. Noting that there may be a 5 month manufacturing lead time for large diameter flap gates has to be evaluated when considering each segment construction time periods.

4. After completion of the segment construction, operation and maintenance costs for annual inspection of dikes, mowing vegetation twice per year ($17,325), and video inspection of all pipes/culverts every 5 years ($57,750) will be required to assure integrity of the project.

5. The TOTAL CURRENT WORKING ESTIMATE (CWE) for the selected plan is $16,140,000 October 2014 pricing ($21,180,000 with contingency). The Project First Cost October 2015 is estimated to be $21,540,000 with 31% contingency. The CWE

fully funded to midpoint of construction is $ 27,080,000 with contingency. These costs are shown in the Total Project Cost Summary attached to this appendix.

Operation and Maintenance costs for visual inspection, mowing 2 times per year and video tape of pipe/culverts every 5 years are estimated to be $2,888,000 with 25% contingency for 50 years ($57,760/year avg).

6. All construction CWE's, OCT 1, 2014 price level, are summarized in the Total Project Cost Summary attached to this appendix. The summary sheets are formatted into a Code of Accounts framework for reporting. The costs included under each Code of Accounts are described below.

The Cost Estimates were prepared under guidance given in the Corps of Engineers Regulation ER 1110-2-1302 : Civil Works Cost Engineering, ER 1110-2-1150 : Engineering and Design for Civil Works Projects, and ETL 1110-2-573 : Construction Cost Estimating Guide for Civil Works.

7. CODE OF ACCOUNTS

CODE OF ACCOUNT 01 – LANDS AND DAMAGES: The estimated costs for temporary permits, right of entry and any land payments were prepared and furnished by the Real Estate Division, Savannah District as discussed in the Real Estate Appendix E. This account also includes minor construction costs for private driveway reconstruction effected by any adjacent main highway construction changes from the project. A 35% contingency was assigned by the Real Estate Division, Savannah District.

CODE OF ACCOUNT 02 – RELOCATIONS: The estimated costs for relocation agreements were prepared and furnished by the Real Estate Division, Savannah District as discussed in the Real Estate Appendix E. This account also includes relocation construction costs for pavement, guardrails, striping, signage, utility relocations, and drainage effected by new construction project features. A 31% contingency was assigned to ACCOUNT 30 based on the formal CSRA, using Crystal Ball software, developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

CODE OF ACCOUNT 11 – LEVEES AND FLOODWALLS: This account includes project costs for mobilization and demobilization, temporary construction, clearing and grubbing, demolition of existing asphalt, embankment fill, new levees, traffic control, project overhead, and vegetation.

Emphasis was placed on accuracy of costs to develop the Selected Plan. The location and features of all areas in relation to the project are described in detail in the Engineering Design Appendix.

a. Evaluation of availability and suitability of construction labor, equipment and materials considered direct costs were based on similar work and production for embankments and highway construction. Project specific crews have been developed for use in estimating

the direct costs of construction and compared to items using quotes or historical cost information where applicable. Crew members consist of selected compliments of labor classifications and equipment assembled to perform specific tasks. Productivity has been assigned to each crew reflective of the expected output per unit of measure for the activities listed in the cost estimate. Quantity takeoffs were developed and provided by the Project Development Team (PDT) members. Quantities were checked and sub-quantities for the project were developed by the engineering section.

All costs were developed to reflect an October 2014 price level.

b. A contingency was included to represent unanticipated conditions and uncertainties not known at the time the estimate was developed. For current recommended plan, construction features have a better level of confidence for geotechnical investigations of borrows areas, similarities of other embankment fill projects, and the historical costs for highway construction. A contingency was assigned from a formal COST SCHEDULE RISK ANALYSIS (CSRA), using Crystal Ball software, completed during development of the baseline cost of the recommended plan. The detailed Cost Schedule and Risk Analysis (CSRA) was developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

Details of the CSRA include Risk Register identification, project cost forecast range (+/-) of pricing to identify major risks are shown in the attached Risk Report for contingencies.

Major risks of uncertainty identified for the current selected plan were inadequate or limited project funding (multiple contract years contracts), contract acquisition sequencing, final survey data (versus LIDAR data) to confirm final quantities, confirming existing roadway base suitability for levee operation, and general/typical risks for any contract such as pricing of materials, fuel, labor market fluctuations, etc.

The risk potential for added flow depth, and extent, in portions of the study area outside of Princeville has not been fully evaluated. There is no certainty of the potential for induced flooding and whether or not it would be significant enough to warrant mitigation or additional costs. It should be noted that many of the areas in question are already inundated during floods of large magnitude. The Project Delivery Team will thoroughly evaluate and identify design measures to mitigate for effects as needed, during the following Pre-construction Engineering and Design (PED) phase. Supplemental NEPA evaluation and documentation will be prepared if appropriate. Projected cost for mitigation measures (if required) will be evaluated to determine impact to available project funds.

The cost risk register acknowledges the potential for substantial project risk and the possibility for additional budgetary reports. However, given the uncertain likelihood of occurrence and inability to confidently predict mitigation requirements, the decision was made to not include additional cost contingency. This risk-based decision was vetted at the MSC and HQ levels for concurrence.

CODE OF ACCOUNT 30 – PLANNING, ENGINEERING AND DESIGN: The costs included in this account were based discussions with those responsible for performing activities prior to construction through contract award. This account includes plans and specifications, field investigations and surveys, cost estimates, environmental monitoring, contract acquisition, and project management. A 31% contingency was assigned to ACCOUNT 30 based on the formal CSRA, using Crystal Ball software, developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

CODE OF ACCOUNT 31 – CONSTRUCTION MANAGEMENT – The costs included in this account were based on a percentage of construction costs as discussed with those responsible for performing each activity. This account includes supervision and administration of the contracts by construction management, engineering during construction, project management, and contracting personnel during construction. A 31% contingency was assigned to ACCOUNT 31 based on the formal CSRA, using Crystal Ball software, developed through coordination with the Cost Center of Expertise in Walla Walla, Washington.

Princeville Flood Damage_Increment 4--JULY 16-20, 2015LEVEL2--AUG 5

Alternative/Increment No. 4 - has 4 segments: ------This Estimate is the SELECTED PLAN. This increment includes the installation of flap gates included in Segment No. 1, 2, & 4 as well as the construction of dike/raising of roadways to Elevation 47 ft for Segments 1 (NC33); & 47 ft for Segment 2 (US 64 SHOULDER DIKE); and 49 ft elevation raise for Segment 4 (construction of Earthen Courtry Levee, raising of NC 1523 (SHILLOH FARM RD), raising of NC 111 roadway, and US 258 ROADWAY. More detail data can be found in the Engineering Design Appendix and the excel spreadsheet for cost estimating quantity takeoffs. Cost estimate relects OCT 2014 price level estimate. Segment 3 is the existing dike which requires no work.

Estimated by	JOHN C. CALDWELL
Designed by	CE-SAW WILMINGTON
Prepared by	John C. Caldwell
Preparation Date	8/5/2015
Effective Date of Pricing	10/1/2014
Estimated Construction Time	Days

Labor ID: NC- 2015 EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.2

Description **Page**

Date	Author	Note
7/20/2015	JOHN C CALDWELL	New Project Note - See Cost Engineering Appendix for narratives

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
Project Cost Summary Report			**16,140,547**	**0**	**16,140,547**
01 LANDS & DAMAGES	**1**	**LS**	**907,018**	**0**	**907,018**
02 RELOCATIONS	**1**	**LS**	**3,376,759**	**0**	**3,376,759**
06 FISH & WILDLIFE FACILITIES	**1**	**LS**	**266,139**	**0**	**266,139**
11 LEVEES AND FLOODWALLS	**1**	**LS**	**6,840,632**	**0**	**6,840,632**
30 PLANNING ENGINEERING & DESIGN	**1**	**LS**	**3,250,000**	**0**	**3,250,000**
31 SUPERVISION AND ASSURANCE	**1**	**LS**	**1,500,000**	**0**	**1,500,000**

Labor ID: NC- 2015 EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.2

Description	Quantity	UOM	ContractCost	Contingency	ProjectCost
Contract Cost Summary Report			**16,140,547**	**0**	**16,140,547**
01 LANDS & DAMAGES	**1.00**	**LS**	**907,018**	**0**	**907,018**
01 01 Aquisitions, Temporary Permits, Licenses, ROE	**1.00**	**LS**	**907,018**	**0**	**907,018**
02 RELOCATIONS	**1.00**	**LS**	**3,376,759**	**0**	**3,376,759**
02 01 Relocations, Agreements, Utilities	**1.00**	**LS**	**3,376,759**	**0**	**3,376,759**
06 FISH & WILDLIFE FACILITIES	**1.00**	**LS**	**266,139**	**0**	**266,139**
06 01 Mitigation of Wetlands	**1.00**	**LS**	**266,139**	**0**	**266,139**
11 LEVEES AND FLOODWALLS	**1.00**	**LS**	**6,840,632**	**0**	**6,840,632**
11 01 LEVEES	**1.00**	**LS**	**6,840,632**	**0**	**6,840,632**
30 PLANNING ENGINEERING & DESIGN	**1.00**	**LS**	**3,250,000**	**0**	**3,250,000**
30 23 Design & Construction Documents	**1.00**	**LS**	**3,250,000**	**0**	**3,250,000**
31 SUPERVISION AND ASSURANCE	**1.00**	**LS**	**1,500,000**	**0**	**1,500,000**
31 21 Construction Q/A, Project Mgt, & EDC	**1.00**	**LS**	**1,500,000**	**0**	**1,500,000**

Labor ID: NC- 2015 EQ ID: EP14R03 Currency in US dollars TRACES MII Version 4.2

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)											
	PROJECT & PROGRAM MGMT		**Princeville Flood Damage Reduction Feasibility Report**								
PPM-1	High Visibility Project	Project has high level interest and local sponsor is supportive of project.	Overall due to fiscal risk below this risk is considered as generally neutral in cost and schedule effects. High interest may make project more likely to receive partial funding when all things being equal it may have not received any funding	Likely	Negligible	LOW			Likely	Marginal	MODERATE
PPM-2	Project funding	Federal and sponsor funds may be limited due to current economic conditions.	Project is currently schedule as one concurrent project. There are no separable elements as far as benefits of flood risk reduction however there are some logical splits in the construction that could be made to split up project into smaller separable contracts. AS OF JUNE 2015 PROJECT IS BEING VEIWED AS 3 SEPARATE CONTRACTS BECAUSE OF POTENTIAL FUNDING ISSUES AND SCHEDULING ISSUES FOR TRAFFIC.	Very Likely	Significant	HIGH			Very Likely	Significant	HIGH
PPM-3	Potential listing of structures on National registry	There are several structures in the proposed area to be protected that are listed as historically significant.	More structures in the proposed area to be protected could help justification and speed project funding.	Likely	Marginal	MODERATE			Unlikely	Marginal	LOW
PPM-4	Coordination with DOT	Formal coordination with DOT for design and construction will be required.	Informal coordination with DOT has been conducted as of JUNE 2015 BUT MORE COORDINATIN WILL BE REQUIRED. Basic DOT standards already coordinated into design. Time for DOT coordination and plan review was added to schedule.	Very Likely	Negligible	LOW			Very Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
	CONTRACT ACQUISITION RISKS		**Princeville Flood Damage Reduction Feasibility Report**								
CA-1	Borrow Source	We have an anticipated borrow area defined for the project, however, it has not yet been determined if this site is feasible. There are numerous other areas in the vicinity that could provide the borrow within similar haul distances.	Real Estate is working to develop the anticipated cost of acquiring borrow area for use of fill. There are multiple potential sources in the local area and it is not foreseen to be a problem obtaining borrow at a reasonable cost.	Likely	Negligible	LOW			Likely	Negligible	LOW
CA-2	Contract Acquisition	Project is assumed as one large contract and sequenced accordingly. JUNE 2015 the baseline project has been divided into 3 contracts.	Base estimate includes items that are split up as subcontracted. There are opportunities for SBA contractors in project with this approach. Earthwork assumed prime. Pavement subcontracted. Work could be split into three or more contracts relatively easily. AS OF JUNE 2015 PROJECT HAS 3 PRIME CONTRACTORs YET some SBA contract work could add to MARKUPS FOR THESE SMALLER CONTRACTORS AND REFLECTED IN BIDS FOR THE PROJECT. A SUBCONTRACTOR FOR PAVING HAS BEEN ADDED IN JUNE 2015 ESTIMATE BUT NO SBA CONTRACT %.	Likely	Marginal	MODERATE			Likely	Marginal	MODERATE
	TECHNICAL RISKS		**Princeville Flood Damage Reduction Feasibility Report**								
TL-1	~~Floodwall Tie ins~~ Floodwall is no longer a part of project as of JUNE 2015 shoulder levee.	~~Minor concerns regarding the location of the floodwall and how it ties to the existing project features. US 258 floodwall design may need some additional design.~~	~~It is anticipated that majority of construction issues will be addressed during the design phase of the project, however, the possibility exists the contractor will need to modify the design to fit unforeseen site conditions.~~ DOES NOT APPLY ANY MORE	Likely	Negligible	LOW			Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
TL-2	Road base used as Levee	Existing road base and fill is used as levee. Pavement and material/compaction factors need to be finalize. Preliminary discussions with NCDOT and geotech discussions have reduced this risk to be marginal rather than originally thought to be significant.	As design progresses, further discussions with NC DOT are likely and will help establish the pavement criteria at that time. it is likely that even if we decided on a pavement section now - it is likely to change by the time plans and specifications are in place. PDT has done their best to estimate what will be required based on similar projects in the area. However there could be some changes or unknown crossings in some areas. **DISCUSSIONS WITH NCDOT have taken place and risk is not as much crisis but could still be MODERATE result based on**	Likely	Marginal	MODERATE			Likely	Negligible	LOW
TL-4	Seepage	Some areas may need some additional measure(segment3) to alleviate seepage. FOR THIS LOCATION TOE BERM NOT REQUIRED as DETERMINED IN JUNE 2015.	Some investigations will be required, BUT there are no known issues known with embankment. **EVALUATIONS OF TOE BERM FOR SEGMENT 3 HAVE BEEN DETERMINED NOT TO BE RQUIRED AND SEG 3 IS NO LONGER A PART OF PROJECT.**	Unlikely	Marginal	LOW			Unlikely	Marginal	LOW
TL-4a	Earthen Country Levee	Foundation conditions along alignment I (new country levee) needs subsurface investigations to determine excact design parameters. With more detail plans as of JULY 2015 impact should be marginal.	Additional subsurface investigation will be required along alignment I. The result may have an impact on project dimensions (EG top width, bottom width, need for stability berm or seepage berms) Cost for additional investigations have been included in PED phase. AS OF JUNE 2015 - Three (3) feet of undercut has been included for COUNTRY EARTHEN LEVEE but may still include some construction risks as MODERATE.	Likely	Marginal	MODERATE			Unlikely	Marginal	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
TL-5	Segment 3 Levee	~~Roadway dips in some areas along three and will require a levee.~~ SEGMENT 3 is no longer a part of recommended plan based new US 64 SHOULDER LEVEE BEING ON WEST SIDE OF US 64.	~~New levee construction required I section 3 vice doing" interstate highway improvement. Interstate 64 will be underwater now during a flood event. NCDOT may want Levee on West side of 64 vice East side. Cost would increase exponentially if it had to go on the west side.~~ **ISSUE ADDRESSED BY MOVEMENT OF SHOULDER LEVEE TO RIVERSIDE OF HWY 64.**	Unlikely	Marginal	LOW			Unlikely	Significant	MODERATE
TL-6	Nothing in plan will "reduce protection"	Any work on road in INCREMENT 4 will be an improvement as it is currently below grade.	Scheduling just needs to be watched so that say you don't put the flapper valves on in segment 4 until the excavation done in internal drainage area. Segment 1 can be done anytime.	Likely	Negligible	LOW			Very Likely	Marginal	MODERATE
TL-7	Drainage/Survey Data	Scope of work is defined for exterior drainage structures, however - where that line exists between exterior and interior drainage features/runoff, discharges, etc. is undefined until accurate survey can be completed. Quantities made from LIDAR topographic data. With more detail plans as of JULY 2015 impact should be marginal.	Detailed survey should be completed during the plans and specifications stage of design. There is the potential that additional drainage measures may be discovered upon analysis of the survey. It is likely that additional design work will be necessary. Quantities are accurate to about +/- 6 inches. There is some raw data in lidar contract provisions. But the impression is that generally they should be accurate.	Likely	Marginal	MODERATE			Likely	Marginal	MODERATE
TL-8	Existing culverts under newly proposed segment of HWY 64	Conditions and construction methodology of culverts and as builts are unknown for west side of US 64 hwy.	Condition of culverts should be verified to determine whether repairs would be required. JUNE 2015 culverts have been extended and included in estimate. Should be a marginal risk if ground truth shows some revisions necessary. There may be revisions for culvert flapgates or sluice gate platforms.	Likely	Marginal	MODERATE			Unlikely	Negligible	LOW
TL-9	Shoulder Levee	Construction methodology of shoulder levee for access to site and subsurface investigations are needed.	Low level of concern for constructability based on construction of HWY 64 and geotech investigation costs during PED have been included. Access should not be a problem for construction or ROW.	Unlikely	Marginal	LOW			Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
	LANDS AND DAMAGES RISKS		**Princeville Flood Damage Reduction Feasibility Report**								
LD-1	~~Flood Walls (previously called Retaining Walls)~~ This issue is no longer a concern since shoulder levee moved to western side of US 64 HWY.	~~Concern is that more real estate may be required to obtain 'desirable' retaining wall alignment.~~	~~Stakeholders and Local sponsors (NC DOT) may generate concerns with regard to location of the retaining wall and this will require minor adjustments to be made to the alignment.~~ **THIS ISSUE HAS BEEN RESOLVED BY MOVEMENT OF THE SHOULDER LEVEE TO THE WESTERN SIDE OF US 64 HWY. RETAINING WALL IS NO LONGER A PART OF THIS PROJECT.**	Very Unlikely	Negligible	LOW			Unlikely	Negligible	LOW
LD-2	Utility Locations	There may be unknown utility crossings in some areas	There has been good coordination with DOT and utility crossings as the majority of the roads currently serve as levees. Known utilities appear to be installed to USACE standards. Existing roadway already part of levee system- district has good account of what has gone through roadway. preliminary thought is low risk. Segment 2 and Segment 3 we may have some unknown crossings	Unlikely	Marginal	LOW			Unlikely	Negligible	LOW
LD-3	Land Acquisition	Limited acquisitions of properties are required for selected alternative and need to assure included in RE updated costs.	Majority of project is in NCDOT Right of Way. Some right of way will need to be obtained across a farmers field along what appears to be an existing irrigation ditch. AS OF JUNE 2015 REAL ESTATE HAS BEEN UPDATED FOR BASELINE PROJECT DESIGN.	Unlikely	Negligible	LOW			Unlikely	Negligible	LOW
LD-4	Temporary access roads	Temporary access roads in estimate approx 16' wide included should be included in RE cost updates.	Right of way admin costs needs to included in RE costs as basic construction costs for temp accessory acquisition etc. - AS OF JUNE 2015 REAL ESTATE HAS BEEN UPDATED.	Very Likely	Negligible	LOW			Very Likely	Negligible	LOW
LD-5	RR crossing	One RR crossing is in the selected alternative. It is already at design height but may add additional costs if impacted.	May need repair work. Scope not included in recommended plan as it is an O&M cost.	Unlikely	Negligible	LOW			Very Likely	Negligible	LOW
LD-6	Repairs on Driveways	of many driveways and additional construction costs as well as	Revised alignment minimized driveways affected.	Very Likely	Negligible	LOW			Very Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
LD-8	~~Age of Appraisal~~	~~Age of real estate estimate -~~ SEE RE-1 RISK EVENT - REAL ESTATE HAS BEEN UPDATED AS OF JUNE 2015.	~~Appraisals are old and values need to be updated from 2007 but real estate prices down or leveled off 25% AND MOSTLY BASED ON LAND COSTS. Real estate costs have been updated as may 2015.~~	Very Unlikely	Marginal	LOW			Likely	Marginal	MODERATE
LD-9	Objections to ROW Appraisals	Landowners may object to ROW appraisals and cause delays in construction beginning if ROW not completed.	HIGHLY LIKELY THERE ARE OBJECTIONS TO FAIR MARKET VALUE but GENERALLY AGREE TO APPRAISALS after shown methodology. Not anticipated to be a large cost - SEE RE-1 AND RE-2 BELOW.	Very Likely	Negligible	LOW			Very Likely	Significant	HIGH
LD-10	Relocations	Pipeline crossings may require additional land acquisition or pipe size changes.	One pipeline to be relocated but if more different location and land acquisition --headwall not relocated …. If the pipe size is changed there could be additional costs. None expected … all is within NCDOT relocation	Unlikely	Negligible	LOW			Unlikely	Negligible	LOW
LD-11	Revised alignment skirts irrigation ditch.	Revised project alignment in NE corner of protected area skirts a farmers field that appears to have remnant irrigation ditches.	Estimate has culvert and reconstruction included, Aerial photos of the area may indicate that the water table is close to the surface in this area and the levee construction may need some additional stabilization. Based on thee projected final height this is most likely a small cost.	Likely	Negligible	LOW			Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
	REGULATORY AND ENVIRONMENTAL RISKS		**Princeville Flood Damage Reduction Feasibility Report**								
REG-1	Proximity to wetlands and river ecosystem	No Wetlands of significance or Tar River standoff implications in recommend plan. AS OF JUNE 2015 WETLANDS HAVE BEEN INVESTIGATED FOR US 64 SHOULDER LEVEE AND COUNTRY EARTHEN LEVEE.	Area involved in project does not appear to be above thresholds that would cause additional administrative action. If it does require additional action it would delay the project. **AS OF JUNE 2015 THERE IS A GOOD IDEA OF THE WETLANDS AND MITIGATION COSTS THAT WILL BE IMPACTED BY THE PROJECT. THESE COSTS HAVE BEEN INCLUDED AND IT IS UNLIKELY MANY MORE WILL BE IN WETLAND AREAS.**	Unlikely	Marginal	LOW			Unlikely	Significant	MODERATE
REG-2	Endangered Species	~~Certain land parcels~~, access and egress might be compromised if certain endangered species are found or migrate thru the project boundaries. Plan "B" parcels may be needed. However this is currently not anticipated to be an impact	Due to proximity of existing roadway over the majority of the area it is not anticipated that any endangered/protected species will be encountered.	Very Unlikely	Marginal	LOW			Very Unlikely	Significant	LOW
	CONSTRUCTION RISKS		**Princeville Flood Damage Reduction Feasibility Report**								
CON-1	Traffic flow during construction	Limited access in segment 4 ~~and 5. THERE IS NO SEGMENT 5 AS OF JUNE 2015~~	Segment 4 ~~and Segment 5~~ may cause issues. Currently Jersey barriers AND FLAGGERS only in estimate. Additional costs may need to be added for staging inefficiencies, flagging, pilot cars etc. NCDOT REQUIREMENTS MAY MORE TRAFFIC CONTROL CONSIDERATIONS.	Likely	Marginal	MODERATE			Very Unlikely	Negligible	LOW
CON-2	Cultural Resources	Cultural studies may be incomplete. There may be potential for encountering unknown cultural resources that could impact project access, staging and project boundaries.	Majority of project is in existing floodplain that has been disturbed previously by road construction. It is not thought to be a significant likelihood of encountering cultural resources.	Unlikely	Marginal	LOW			Very Unlikely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
CON-3	Long lead items	Lead time on gates for 7x6 box culverts 22 weeks	Generally most materials are readily available with the backflow gates for box culverts. (22 weeks DELIVERY). Could potentially increase contract time and downtime of building US 64 shoulder dike.	Very Likely	Marginal	MODERATE			Very Unlikely	Negligible	LOW
CON-4	River height and culvert installation.	Box culverts may need some temporary dewatering/sheet pile, especially in rainy season.	33 culverts- many are located high in relation to river. Box Culvert has flow through and tail water from river can back up to structure.(culvert 2 area 1)	Unlikely	Critical	MODERATE			Unlikely	Critical	MODERATE
CON-5	Staging areas	No defined staging areas beyond right of way Not an issue because of large areas for staging in nearby country fields.	Not anticipated to be an issue. There are large areas near the 33 interchange in the right of way that can be used for staging	Very Likely	Negligible	LOW			Very Unlikely	Negligible	LOW
CON-6	Construction claims and modifications	~~Work is generally typical of~~ highway construction but could have claims or modifications because of unique raising of roadway by a few feet.	There is always some risk of modifications and claims.	Very Likely	Marginal	MODERATE			Very Unlikely	Negligible	LOW
CON-7	Road Repair and Resurfacing	Construction Traffic could damage surface streets and highways resulting in the need for road repairs.	Some amount of street repairs will be required and should include contingency for some stone and asphalt repair.	Very Likely	Marginal	MODERATE			Very Unlikely	Negligible	LOW
	ESTIMATE AND SCHEDULE RISKS		**Princeville Flood Damage Reduction Feasibility Report**								
~~EST-1~~	~~Retaining Wall locations~~	~~Retaining wall will be required along some areas of roadway raise.~~ RETAINING WALL IS NO LONGER IN THE PROEJCT.	~~Locations of retaining wall and respective heights have been based on the latest publically available topographic data, not detailed survey of the project. Therefore, the overall square footage and type of retaining wall may change after such survey and geotechnical analysis are complete - presumably during plans and specifications phase of design.~~ - **Retaining Wall is NO LONGER PART OF PROJECT AS OF JUNE 2015**	Very Unlikely	Negligible	LOW			Very Likely	Negligible	LOW

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
EST-2	Construction Access	Temporary access off of US 258 could impact construction contractor efficiency.	ROM plan may not be adequate to provide access and maintain efficiency. Traffic control will need to be added. 85% productivity applied. Local traffic only will be allowed on certain segments. Productivity lowered to 78% and traffic control costs have been incorporated as of JUNE 2015.	Very Likely	Negligible	LOW			Very Likely	Negligible	LOW
EST-3	Fuels	Large portion of work is in earthwork. The price of fuel could adversely impact the construction cost increases.	Variations in fuel cost is generally a factor in large earthwork jobs	Very Likely	Marginal	MODERATE			Very Likely	Negligible	LOW
EST-4	Asphalt and binder price	There is a significant portion of the project cost in repaving the raised roadbeds after the raise.	The future price of asphalt should be studied to adequately cover normal price increases as well as anticipated thickness etc. Variations of material pricing was increased to 2012 pavement pricing and wherein fuel was closer to $3.40/gallon and is currently $2.45/gallon off road.	Very Likely	Marginal	MODERATE			Very Likely	Negligible	LOW
	Real Estate Risks		**Princeville Flood Damage Reduction Feasibility Report**								
RE-1	**Age of Appraisal**	Age of real estate estimate should be updated and were updated to JUNE 2015.	Appraisals were old and values have been updated from 2007 to 2015 but real estate prices down or leveled off 25% AND MOSTLY BASED ON LAND COSTS.	Likely	Negligible	LOW			Likely	Marginal	MODERATE
RE-2	**Objections to ROW Appraisals**	Landowners may object to ROW appraisals/value and cause delays to project construction beginning.	HIGHLY LIKELY THERE ARE OBJECTIONS TO FAIR MARKET VALUE but GENERALLY AGREE TO APPRAISALS after shown methodology. Not anticipated to be a large cost may be 15% of 52 parcels at $15,000 per parcel = 7 x $15,000 = $105,000.	Likely	Negligible	LOW			Very Likely	Significant	HIGH

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions & Conclusions	Project Cost					Project Schedule		
				Likelihood *	Impact*	Risk Level*	Rough Order Impact ($)		Likelihood *	Impact*	Risk Level*
	Programmatic Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)										
PR-1	Hurricane or another 100year plus event	Another significant flood event could change the inhabitants perspective or political climate supporting the project.	Beyond the scope of the team to model or effect.	Unlikely	Significant	MODERATE			Unlikely	Crisis	HIGH
PR-2	Induced Flooding	The hydrologic and hydraulic analyses used to generate water surface elevations and extent, for various flood frequencies used in this study, utilized the Corps' currently certified and "approved-for-use" HEC-RAS 4.1 model. During final design of the recommended plan, an "interior/exterior" levee relationship was developed. A new two-dimensional flow model HEC-RAS 5.0 Beta was used to expedite this calculation; however, this Beta version of the model is not yet released for use by the USACE Hydraulic Engineering Center and is still being tested.	The risk potential for added flow depth, and extent, in portions of the study area outside of Princeville has not been fully evaluated. There is no certainty of the potential for induced flooding and whether or not it would be significant enough to warrant mitigation or additional costs. It should be noted that many of the areas in question are already inundated during floods of large magnitude. The Project Delivery Team will thoroughly evaluate and identify design measures to mitigate for effects as needed, during the following Pre-construction Engineering and Design (PED) phase. Supplemental NEPA evaluation and documentation will be prepared if appropriate. Projected cost for mitigation measures (if required) will be evaluated to determine impact to available project funds.	Likely	Significant	HIGH			Likely	Marginal	MODERATE
			Princeville Flood Damage Reduction Feasibility Report								

*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 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.

US Army Corps
of Engineers®

Princeville, North Carolina Flood Risk Reduction
Feasibility Report
Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Wilmington District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Technical Center of Expertise, Walla Walla, WA

August 25, 2015

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EXECUTIVE SUMMARY

The US Army Corps of Engineers (USACE), Wilmington District, presents this cost and schedule risk analysis (CSRA) report regarding the risk findings and recommended contingencies for the Princeville, North Carolina Flood Risk Reduction Project. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a *Monte-Carlo* based risk analysis was conducted by the Project Development Team (PDT) on remaining costs. The purpose of this risk analysis study is to present the cost and schedule risks considered, those determined and respective project contingencies at a recommended 80% confidence level of successful execution to project completion.

The Town of Princeville is located along the Tar River south of Tarboro in eastern North Carolina. It is situated at a bend in the River and has historically been subjected to flooding. Authority to construct the Princeville Dike, Tar River Flood Control Project was granted in 1964 by the Chief of Engineers under Section 205 of the 1948 Flood Control Act as amended.

The project began construction in 1967 and consisted of a levee system running parallel to the river between the river and the Town of Princeville. It included two segments of levee and a segment of U.S. Highway 64.

The existing levees performed well providing protection for lesser, more frequent flood events. However, in 1999, the area was hit with Hurricanes Dennis and Floyd causing historic volumes in the Tar River. Hurricane Floyd was a magnitude greater than a 0.2 percent chance storm event. Flood waters backed up within the river basin entering the town from the south thru the N.C. Highway 33 overpass beyond the southern segment of levee. As the flood waters rose, water began to enter from the northeast beyond the northern segment of existing levee and eventually topped portions of the northern segment and U.S. Highway 64.

As a result of the catastrophic flooding and historical significance of the town, then-President Clinton issued *Executive Order 13146*. The executive order directed to "*repair and rebuild Princeville, and to the extent practical, protect Princeville from future floods.*" As a result of the Executive Order, the scope of the study included a hydraulic and hydrologic model which evaluated the flood elevations for Princeville and Tarboro. It was determined that Princeville is subject to flooding during lesser, more frequent flood events than even the 1.0 percent annual chance exceedance flood event.

Based on the flooding observed during Floyd and current levee design guidelines, various improvement measures are being purposed for the Princeville, North Carolina Flood Risk Reduction Project.

Specific to the Princeville Project, the current project base cost estimate, pre-contingency, approximates $15.2M and is expressed in FY 2015 dollars. This CSRA study included all estimated construction costs, Planning, Engineering, Design and Construction Management costs. It excluded Real Estate Costs, where contingencies were provided by the Real Restate office. Based on the results of the analysis, the Cost Engineering Mandatory Center of Expertise for Civil Works (MCX located in Walla Walla District) recommends a contingency value of $4.7M or approximately 31% of base project cost at an 80% confidence level of successful execution.

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 per cent values. Should cost vary to a slight degree with similar scope and risks, contingency per cent values will be reported, cost values rounded.

Table ES-1. Construction Contingency Results

Base Case Construction Cost Estimate	**$15,234,000 ***		
Confidence Level	**Construction Value ($$) w/ Contingencies**	**Contingency (%)**	**Contingency $**
50%	$18,737,000	23%	$3,504,000
80%	**$19,956,000**	**31%**	**$4,723,000 ***
90%	$20,413,000	34%	$5,332,000

* Excludes 01 – Lands and Damages Costs, Provided by Others

KEY FINDINGS/OBSERVATIONS/ASSUMPTIONS & RECOMMENDATIONS

The PDT worked through the risk register on two separate occasions: June 2013 and again in June 2015. That period of time allowed improved project scope definition, investigations, design and cost information, and resulted in reduced costs and risks in certain project areas. The key risk drivers identified through sensitivity analysis suggest a cost contingency of $4.7M and schedule risks adding another potential of 19 months, both at an 80% confidence level.

Cost Risks: From the CSRA, the key or greater Cost Risk items of include:

- PPM2 – Project Funding – Federal and sponsor funds may be limited due to current economic conditions. There are no separable elements as far as benefits of flood risk reduction however there are some logical splits in the construction that could be made to split up project into smaller separable contracts.

Moderate risks, when combined, can also become a cost impact.

- TL7 – Drainage Survey Data – Quantities made from LIDAR topographic data. Quantities are accurate to about +/- 6 inches.
- TL2 – Road Base used as Levee – Existing road base and fill is used as levee. Pavement and material/compaction factors need to be finalized.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The greatest risk is:

- PPM2 – Project Funding – Federal and sponsor funds may be limited due to current economic conditions. There are no separable elements as far as benefits of flood risk reduction however there are some logical splits in the construction that could be made to split up project into smaller separable contracts.

Moderate risks, when combined, can also become a time and resulting cost impact.

- PPM1 - High Visibility Project - Project has high level interest and local sponsor is supportive of project. Overall due to fiscal risk below this risk is considered as generally neutral in cost and schedule effects. High interest may make project more likely to receive partial funding when all things being equal it may have not received any funding. [OPPORTUNITY]
- CON4 – River Height and Culvert Installation – Some 33 culverts are located in the floodplain and may need some temporary dewatering/sheet pile, especially in rainy season or schedules could be impacted.
- TL7 – Drainage Survey Data – Quantities made from LIDAR topographic data. Quantities are accurate to about +/- 6 inches.
- CA2 – Contract Acquisition – There are some logical splits in the construction that could be made to split up project into smaller separable contracts.

Key Assumptions: The hydrologic and hydraulic analyses used to generate water surface elevations and extent, for various flood frequencies used in this study, utilized the Corps' currently certified and "approved-for-use" HEC-RAS 4.1 model. During final design of the recommended plan, an "interior/exterior" levee relationship was developed. A new two-dimensional flow model HEC-RAS 5.0 Beta was used to expedite this calculation; however, this Beta version of the model is not yet released for use by the USACE Hydraulic Engineering Center and is still being tested.

The risk potential for added flow depth, and extent, in portions of the study area outside of Princeville has not been fully evaluated. There is no certainty of the potential for induced flooding and whether or not it would be significant enough to warrant mitigation or additional costs. It should be noted that many of the areas in question are already inundated during floods of large magnitude. The Project Delivery Team will thoroughly evaluate and identify design measures to mitigate for effects as needed, during the following Pre-construction Engineering and Design (PED) phase. Supplemental NEPA evaluation and documentation will be prepared if appropriate.

Projected cost for mitigation measures (if required) will be evaluated to determine impact to available project funds.

The cost risk register acknowledges the potential for substantial project risk and the possibility for additional budgetary reports. However, given the uncertain likelihood of occurrence and inability to confidently predict mitigation requirements, the decision was made to not include additional cost contingency. This risk-based decision was vetted at the MSC and HQ levels for concurrence.

Recommendations: The CSRA study serves as a “road map” towards project improvements and reduced risks over time. The PDT must include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and update of the risk analysis throughout the project life-cycle is important in support of remaining within an approved budget and appropriation.

MAIN REPORT

1.0 PURPOSE

Within the authority of the US Army Corps of Engineers (USACE), Wilmington District, this report presents the efforts and results of the cost and schedule risk analysis for the Princeville, North Carolina Flood Risk Reduction Project. The report includes risk methodology, discussions, findings and recommendations regarding the identified risks and the necessary contingencies to confidently administer the project, presenting a cost and schedule contingency value with an 80% confidence level of successful execution.

2.0 BACKGROUND

The Town of Princeville is located along the Tar River south of Tarboro in eastern North Carolina. It is situated at a bend in the River and has historically been subjected to flooding. Authority to construct the Princeville Dike, Tar River Flood Control Project was granted in 1964 by the Chief of Engineers under Section 205 of the 1948 Flood Control Act as amended.

The project began construction in 1967 and consisted of a levee system running parallel to the river between the river and the Town of Princeville. It included two segments of levee and a segment of U.S. Highway 64.

The existing levees performed well providing protection for lesser, more frequent flood events. However, in 1999, the area was hit with Hurricanes Dennis and Floyd causing historic volumes in the Tar River. Hurricane Floyd was a magnitude greater than a 0.2 percent chance storm event. Flood waters backed up within the river basin entering the town from the south thru the N.C. Highway 33 overpass beyond the southern segment of levee. As the flood waters rose, water began to enter from the northeast beyond the northern segment of existing levee and eventually topped portions of the northern segment and U.S. Highway 64.

As a result of the catastrophic flooding and historical significance of the town, then-President Clinton issued *Executive Order 13146*. The executive order directed to "*repair and rebuild Princeville, and to the extent practical, protect Princeville from future floods.*" As a result of the Executive Order, the scope of the study included a hydraulic and hydrologic model which evaluated the flood elevations for Princeville and Tarboro. It was determined that Princeville is subject to flooding during lesser, more frequent flood events than even the 1.0 percent annual chance exceedance flood event.

Based on the flooding observed during Floyd and current levee design guidelines, various improvement measures are being purposed for the Princeville, North Carolina Flood Risk Reduction Project.

3.0 REPORT SCOPE

The scope of the risk analysis report is to identify cost and schedule risks with a resulting recommendation for contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for construction features. The CSRA excludes Real Estate Borel Conduit Measures costs and 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 Micro Computer Aided Cost Estimating System (MCACES) cost estimate, project schedule, and funding profiles using Crystal Ball software to conduct a *Monte Carlo* simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

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

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

3.2 USACE Risk Analysis Process

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

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted

concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting and scheduling.

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

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

4.0 METHODOLOGY / PROCESS

The Cost Engineering MCX performed the Cost and Schedule Risk Analysis, relying on local Wilmington District staff to provide expertise and information gathering. The Wilmington PDT conducted initial risk identification via meetings with the Walla Walla Cost Engineering MCX facilitator in June 2013. The initial risk identification meeting also included qualitative analysis to produce a risk register that served as the draft framework for the risk analysis.

Participants in the risk identification meeting in June 2013 included:

Name	Office	Representing
Elana Sattin	Program Manager	Wilmington - SAW
Tomma Barnes	Environmental Engineer	Wilmington - SAW
Teresa Bullard	Environmental Engineer	Wilmington - SAW
Christopher Graham	Planning	Wilmington - SAW
Belinda Estabrook	Real Estate	Wilmington - SAW
Lee Danley	Design	Wilmington - SAW
Mitch Hall	Geotechnical Engineer	Wilmington - SAW
John Caldwell	Cost Engineer	Wilmington - SAW
Brooke Lamson	Office of Council	Wilmington - SAW
Mike Jacobs	Risk Facilitator	Walla Walla - NWW

Since the initial project development, the PDT has continued to improve project scope definition, investigations, design and cost information, and resulted in reduced costs and risks in certain project areas. A follow-on meeting occurred June 24, 2015, resulting in a revision of the identified risks and the current known impacts (Appendix A). Key PDT members included:

Name	Office	Representing
Pam Castens	Program Manager	Wilmington - SAW
Jenny Owens	Environmental Engineer	Wilmington - SAW
Teresa Bullard	Environmental Engineer	Wilmington - SAW
Christopher Graham	Planning - Economics	Wilmington - SAW
Belinda Estabrook	Real Estate	Wilmington - SAW
Elden Gatwood	Planning	Wilmington - SAW
Mitch Hall	Geotechnical Engineer	Wilmington - SAW
John Caldwell	Cost Engineer	Wilmington - SAW
Brooke Lamson	Office of Council	Wilmington - SAW
Carl Banard	Geotechnical Engineer	Wilmington - SAW
Wes Brown	Hydrology	Wilmington - SAW

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

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

The Cost MCX guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

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

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

4.1 Identify and Assess Risk Factors

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

A formal PDT meeting was held with the District office for the purposes of identifying and assessing risk factors. The meeting included capable and qualified representatives from multiple project team disciplines and functions, including project management, cost engineering, design, environmental compliance, and real estate

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. Additionally, numerous conference calls and informal meetings were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment. An update meeting was held for finalization of the risk register, resulting CSRA model, findings and results.

4.2 Quantify Risk Factor Impacts

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

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

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty

- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

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

4.3 Analyze Cost Estimate and Schedule Contingency

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

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

5.0 PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the project.

a. The hydrologic and hydraulic analyses used to generate water surface elevations and extent, for various flood frequencies used in this study, utilized the Corps' currently certified and "approved-for-use" HEC-RAS 4.1 model. During final design of the recommended plan, an "interior/exterior" levee relationship was developed. A new two-dimensional flow model HEC-RAS 5.0 Beta was used to expedite this calculation; however, this Beta version of the model is not yet released for use by the USACE Hydraulic Engineering Center and is still being tested.

The risk potential for added flow depth, and extent, in portions of the study area outside of Princeville has not been fully evaluated. There is no certainty of the potential for induced flooding and whether or not it would be significant enough to warrant mitigation

or additional costs. It should be noted that many of the areas in question are already inundated during floods of large magnitude. The Project Delivery Team will thoroughly evaluate and identify design measures to mitigate for effects as needed, during the following Pre-construction Engineering and Design (PED) phase. Supplemental NEPA evaluation and documentation will be prepared if appropriate.

Projected cost for mitigation measures (if required) will be evaluated to determine impact to available project funds.

The cost risk register acknowledges the potential for substantial project risk and the possibility for additional budgetary reports. However, given the uncertain likelihood of occurrence and inability to confidently predict mitigation requirements, the decision was made to not include additional cost contingency. This risk-based decision was vetted at the MSC and HQ levels for concurrence.

b. The Wilmington District provided MII MCACES (Micro-Computer Aided Cost Estimating Software) files electronically. The MII and CWE files transmitted and on July 30, 2015 and resulting independent review, served as the basis for the final cost and schedule risk analyses.

c. 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 of design.

d. Schedules are analyzed for impact to the project cost in terms of delayed funding, uncaptured escalation (variance from OMB factors and the local market) and unavoidable fixed contract costs and/or languishing federal administration costs incurred throughout delay.

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

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”.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide

decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

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

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

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

6.2 Cost Contingency and Sensitivity Analysis

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

Table 1 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P5, P50 and P90 confidence levels are also provided for illustrative purposes only.

Cost contingency for the Construction risks (including schedule impacts converted to dollars) was quantified as approximately $20.0 Million at the P80 confidence level (31% of the baseline construction cost estimate).

Table 1. Construction Cost Contingency Summary

Base Case Construction Cost Estimate	**$15,234,000 ***		
Confidence Level	**Construction Value ($$) w/ Contingencies**	**Contingency (%)**	**Contingency $**
50%	$18,737,000	23%	$3,504,000
80%	**$19,956,000**	**31%**	**$4,723,000 ***
90%	$20,413,000	34%	$5,332,000

* Excludes 01 – Lands and Damages Costs, Provided by Others

6.2.1 Sensitivity Analysis

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

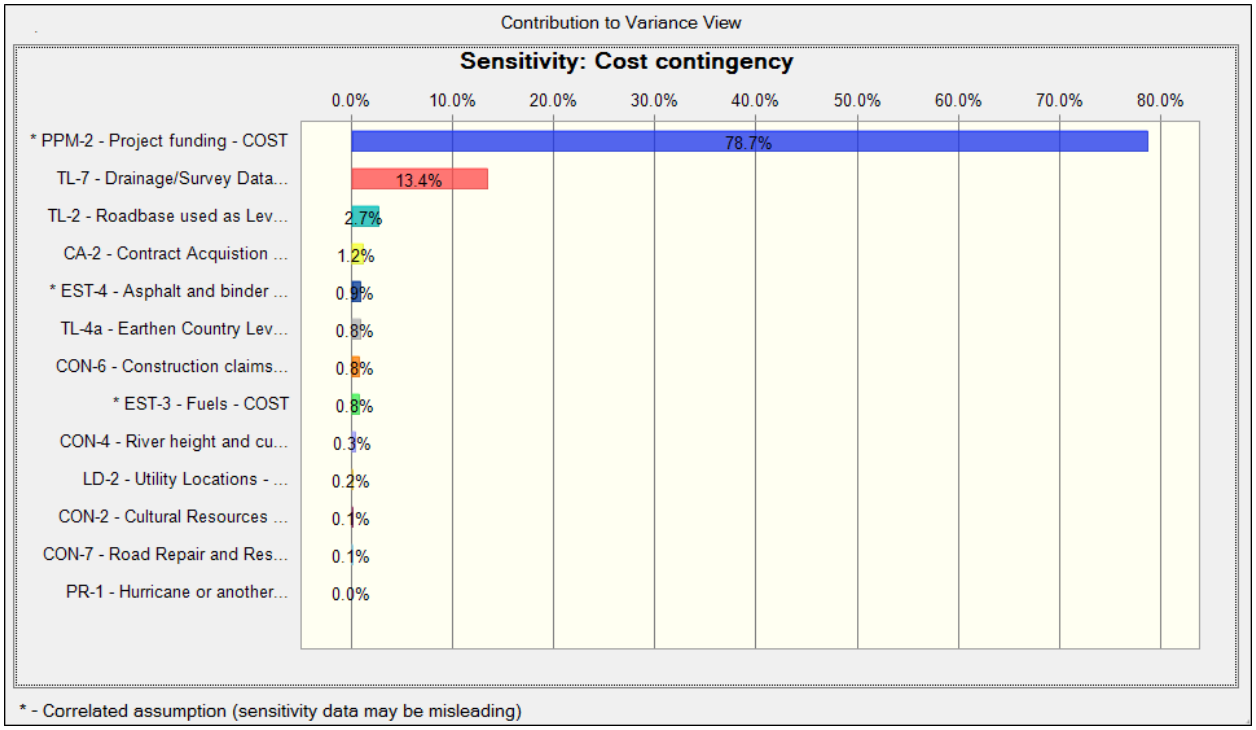
Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used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

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers and the respective value variance 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 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.

Figure 1. Cost Sensitivity Analysis



6.3 Schedule and Contingency Risk Analysis

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

Table 2 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P90 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 19 months based on the P80 level of confidence. These contingencies were used to calculate the projected residual fixed cost impact of project delays that are included in the Table 1 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

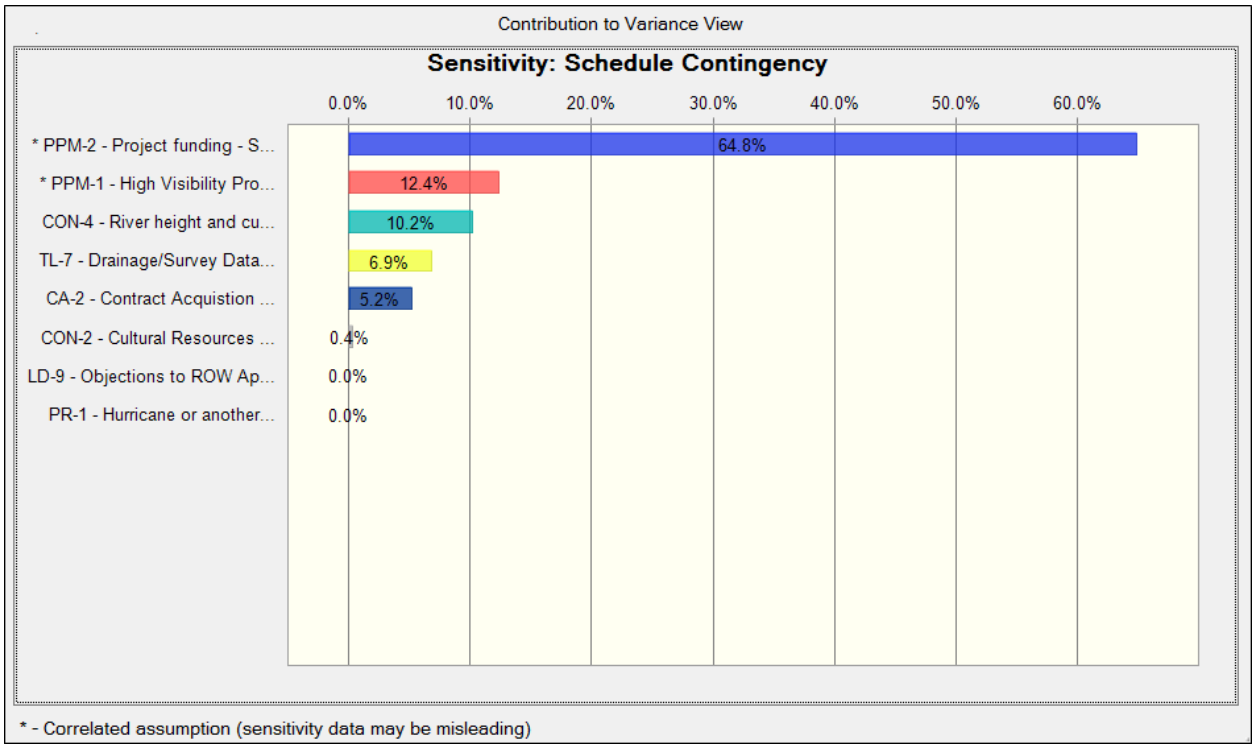
The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule

contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected residual fixed costs.

Table 2. Schedule Duration Contingency Summary

Risk Analysis Forecast (base schedule of 24 months)	Duration w/ Contingencies (months)	Contingency[1] (months)
50% Confidence	36	12
80% Confidence	43	19
90% Confidence	47	23

Figure 2. Schedule Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/RECOMMENDATIONS

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

reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

7.1 Major Findings/Observations

Project cost and schedule comparison summaries are provided in Table 3 and Table 4 respectively. Additional major findings and observations of the risk analysis are listed below.

The PDT worked through the risk register on two separate occasions: June 2013 and again in June 2015. That period of time allowed improved project scope definition, investigations, design and cost information, and resulted in reduced costs and risks in certain project areas. The key risk drivers identified through sensitivity analysis suggest a cost contingency of $4.7M and schedule risks adding another potential of 19 months, both at an 80% confidence level.

Cost Risks: From the CSRA, the key or greater Cost Risk items of include:

- PPM2 – Project Funding – Federal and sponsor funds may be limited due to current economic conditions. There are no separable elements as far as benefits of flood risk reduction however there are some logical splits in the construction that could be made to split up project into smaller separable contracts.

Moderate risks, when combined, can also become a cost impact.

- TL7 – Drainage Survey Data – Quantities made from LIDAR topographic data. Quantities are accurate to about +/- 6 inches.
- TL2 – Road Base used as Levee – Existing road base and fill is used as levee. Pavement and material/compaction factors need to be finalized.

Schedule Risks: The high value of schedule risk indicates a significant uncertainty of key risk items, time duration growth that can translate into added costs. Over time, risks increase on those out-year contracts where there is greater potential for change in new scope requirements, uncertain market conditions, and unexpected high inflation. The greatest risk is:

- PPM2 – Project Funding – Federal and sponsor funds may be limited due to current economic conditions. There are no separable elements as far as benefits of flood risk reduction however there are some logical splits in the construction that could be made to split up project into smaller separable contracts.

Moderate risks, when combined, can also become a time and resulting cost impact.

- PPM1 - High Visibility Project - Project has high level interest and local sponsor is supportive of project. Overall due to fiscal risk below this risk is considered as

generally neutral in cost and schedule effects. High interest may make project more likely to receive partial funding when all things being equal it may have not received any funding. [OPPORTUNITY]

- CON4 – River Height and Culvert Installation – Some 33 culverts are located in the floodplain and may need some temporary dewatering/sheet pile, especially in rainy season or schedules could be impacted.
- TL7 – Drainage Survey Data – Quantities made from LIDAR topographic data. Quantities are accurate to about +/- 6 inches.
- CA2 – Contract Acquisition – There are some logical splits in the construction that could be made to split up project into smaller separable contracts.

Table 3. Construction Cost Comparison Summary (Uncertainty Analysis)

PROJECT FIRST COST BASE ESTIMATE	$15,233,530		
Confidence Level	Project First Cost	Contingency	Contingency %
0%	$15,142,129	($91,401)	-1%
5%	$16,604,548	$1,371,018	9%
10%	$17,061,554	$1,828,024	12%
15%	$17,366,224	$2,132,694	14%
20%	$17,518,560	$2,285,030	15%
25%	$17,823,230	$2,589,700	17%
30%	$17,975,565	$2,742,035	18%
35%	$18,280,236	$3,046,706	20%
40%	$18,432,571	$3,199,041	21%
45%	$18,584,907	$3,351,377	22%
50%	$18,737,242	$3,503,712	23%
55%	$19,041,913	$3,808,383	25%
60%	$19,194,248	$3,960,718	26%
65%	$19,346,583	$4,113,053	27%
70%	$19,651,254	$4,417,724	29%
75%	$19,803,589	$4,570,059	30%
80%	**$19,955,924**	**$4,722,394**	**31%**
85%	$20,260,595	$5,027,065	33%
90%	$20,565,266	$5,331,736	35%
95%	$20,869,936	$5,636,406	37%
100%	$22,697,960	$7,464,430	49%

Table 4. Construction Schedule Comparison Summary (Uncertainty Analysis)

Base Schedule Duration	24.0 Months		
Confidence Level	**Duration**	**Contingency**	**Contingency %**
0%	**9.5 Months**	**-14.5 Months**	**-60%**
5%	**21.4 Months**	**-2.6 Months**	**-11%**
10%	**25.2 Months**	**1.2 Months**	**5%**
15%	**26.6 Months**	**2.6 Months**	**11%**
20%	**27.8 Months**	**3.8 Months**	**16%**
25%	**28.8 Months**	**4.8 Months**	**20%**
30%	**29.8 Months**	**5.8 Months**	**24%**
35%	**31.0 Months**	**7.0 Months**	**29%**
40%	**32.2 Months**	**8.2 Months**	**34%**
45%	**33.8 Months**	**9.8 Months**	**41%**
50%	**36.2 Months**	**12.2 Months**	**51%**
55%	**37.9 Months**	**13.9 Months**	**58%**
60%	**39.1 Months**	**15.1 Months**	**63%**
65%	**40.3 Months**	**16.3 Months**	**68%**
70%	**41.3 Months**	**17.3 Months**	**72%**
75%	**42.2 Months**	**18.2 Months**	**76%**
80%	**43.2 Months**	**19.2 Months**	**80%**
85%	**44.6 Months**	**20.6 Months**	**86%**
90%	**46.6 Months**	**22.6 Months**	**94%**
95%	**51.4 Months**	**27.4 Months**	**114%**
100%	**68.4 Months**	**44.4 Months**	**185%**

7.2 Recommendations

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

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

The Cost and Schedule Risk Analysis (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.

The CSRA study serves as a “road map” towards project improvements and reduced risks over time. The PDT must include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and update of the risk analysis throughout the project life-cycle is important in support of remaining within an approved budget and appropriation.

Risk Management: Project leadership should use of 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.

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).

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW CONDITIONAL CERTIFICATION STATEMENT

For Project No. 113918
SAW – Princeville Flood Damage Reduction

The Princeville Flood Damage Flood Reduction Study, as presented by Wilmington District, has received a Conditional Cost ATR Certification.

The referenced project, Princeville community cost estimate, 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 scope, report, cost estimates, schedules, escalation, and risk-based contingencies. Areas of concern result from the uncertainties related to potential induced flooding to surrounding communities, further study and potential cost impact to be determined during design phase. The reported project costs exclude the increased scope and cost potential at this time, per MSC and HQ direction.

As of November 13, 2015, the Cost MCX conditionally certifies the estimated total project cost of:

FY 2016 Price Level: $21,540,000
Fully Funded Amount: $27,080,000

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.

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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CALLAN.KIM.C.1231558221
Date: 2015.11.13 11:31:50 -08'00'

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

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

PROJECT: PRINCEVILLE FLOOD DAMAGE REDUCTION
PROJECT NO: PN 113918
LOCATION: EDGECOMBE COUNTY, NORHT CAROLINA

DISTRICT: CESAW WILMINGTON PREPARED: 6/22/2015
POC: CHIEF, COST ENGINEERING, Stephen Roman, PE

This Estimate reflects the scope and schedule in report; PRINCEVILLE FLOOD DAMAGE REDUCTION STUDY - 2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
		Estimate Prepared FEB 4, 2015 Effective Price Level OCT 1, 2014				Program Year (Budget EC): 2016 Effective Price Level Date: 1 OCT 15									
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 10/1/2014 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K) M	CNTG ($K) N	FULL ($K) O
11	LEVEES & FLOODWALLS	$6,841	$2,121	31%	$8,962	1.5%	$6,941	$2,152	$9,092	$0	$9,092	22.1%	$8,474	$2,627	$11,100
02	RELOCATIONS	$3,376	$1,047	31%	$4,423	1.5%	$3,425	$1,062	$4,487	$0	$4,487	24.8%	$4,274	$1,325	$5,599
06	FISH & WILDLIFE FACILITIES	$266	$82	31%	$348	1.5%	$270	$84	$354	$0	$354	14.4%	$309	$96	$404
	CONSTRUCTION ESTIMATE TOTALS:	$10,483	$3,250	31%	$13,733	1.5%	$10,635	$3,297	$13,932	$0	$13,932	22.8%	$13,056	$4,047	$17,103
01	LANDS AND DAMAGES	$907	$317	35%	$1,224	1.5%	$920	$322	$1,242	$0	$1,242	15.6%	$1,063	$372	$1,436
30	PLANNING, ENGINEERING & DESIGN	$3,250	$1,008	31%	$4,258	2.3%	$3,325	$1,031	$4,355	$0	$4,355	26.5%	$4,207	$1,304	$5,511
31	CONSTRUCTION MANAGEMENT	$1,500	$465	31%	$1,965	2.3%	$1,535	$476	$2,010	$0	$2,010	50.7%	$2,313	$717	$3,029
	PROJECT COST TOTALS:	$16,140	$5,040	31%	$21,180		$16,415	$5,125	$21,540	$0	$21,540	25.7%	$20,639	$6,441	$27,080

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CHIEF, COST ENGINEERING, Stephen Roman, PE

PROJECT MANAGER, Pam Castens

CHIEF, REAL ESTATE, Ralph Werthmann SAS

CHIEF, PLANNING, Elden Gatwood

CHIEF, ENGINEERING, Greg Williams, PE

CHIEF, OPERATIONS, Daniel Brown

CHIEF, CONSTRUCTION, Dennis Lynch, PE

CHIEF, CONTRACTING, Jon Mayo

CHIEF, PM-PB, ~~Sam Celella~~ Jim McDLOCK

CHIEF, DPM, Christine Brayman

ESTIMATED FEDERAL COST:	65%	$17,602
ESTIMATED NON-FEDERAL COST:	35%	$9,478
ESTIMATED TOTAL INITIAL PROJECT COST:		**$27,080**
SPENT COSTS		$0

Mowing embankments twice per year and video tape culverts/pipes every 5 years

O&M OUTSIDE OF TOTAL PROJECT COST:	**$2,310**
25% CONTINGENCY	**$578**
TOTAL for 50 Years 2028 THRU 2078	**$2,888**

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

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

PROJECT: PRINCEVILLE FLOOD DAMAGE REDUCTION
LOCATION: EDGECOMBE COUNTY, NORHT CAROLINA
This Estimate reflects the scope and schedule in report: PRINCEVILLE FLOOD DAMAGE REDUCTION STUDY - 2015

DISTRICT: CESAW WILMINGTON PREPARED: 6/22/2015
POC: CHIEF, COST ENGINEERING, Stephen Roman, PE

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
	CONTRACT #1 OF 3	Estimate Prepared: 8/5/2015 Effective Price Level: 10/1/2014				Program Year (Budget EC): 2016 Effective Price Level Date: 1 OCT 15								
WBS NUMBER	INITIAL NOURISHMENT 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	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	RIVERSIDE LEVEE CONTRACT #1of 3													
11	LEVEES & FLOODWALLS - RIVERSIDE	$2,378	$737	31%	$3,113	1.5%	$2,411	$747	$3,158	2024Q3	17.9%	$2,842	$881	$3,722
02	RELOCATIONS-RIVERSIDE Contract #1	$242	$75	31%	$317	1.5%	$246	$76	$322	2024Q3	17.9%	$289	$90	$379
06	FISH & WILDLIFE FACILITIES - Mitigation	$265	$82	31%	$348	1.5%	$270	$84	$354	2023Q1	14.4%	$309	$96	$404
	CONSTRUCTION ESTIMATE TOTALS:	$2,884	$894	31%	$3,778		$2,926	$907	$3,833			$3,440	$1,066	$4,506
01	LANDS AND DAMAGES OCT 2021-OCT 2023	$907	$317	35%	$1,224	1.5%	$920	$322	$1,242	2023Q3	15.6%	$1,063	$372	$1,436
30	PLANNING, ENGINEERING & DESIGN													
	PED OCT 2018 - OCT 2021 STUDIES	$1,250	$388	31%	$1,638	2.3%	$1,279	$396	$1,675	2020Q3	18.9%	$1,520	$471	$1,991
	PED for REAL ESTATE APR 2021 Contract #1	$1,175	$364	31%	$1,539	2.3%	$1,202	$373	$1,575	2021Q3	23.6%	$1,486	$461	$1,947
	PED for Contract #1 FEB 2023	$275	$85	31%	$360	2.3%	$281	$87	$369	2023Q2	32.6%	$373	$116	$489
31	CONSTRUCTION MANAGEMENT													
	Construction Mgt OCT 2023 - OCT 2025	$500	$155	31%	$655	2.3%	$512	$159	$670	2024Q3	39.6%	$714	$221	$936
	CONTRACT COST TOTALS:	$6,991	$2,203		$9,194		$7,120	$2,244	$9,364			$8,597	$2,707	**$11,304**

Filename: Princeville TPCS-Nov 13 2015 - MCX CHECK.xlsx
TPCS

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

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

PROJECT: PRINCEVILLE FLOOD DAMAGE REDUCTION
LOCATION: EDGECOMBE COUNTY, NORHT CAROLINA
This Estimate reflects the scope and schedule in report: PRINCEVILLE FLOOD DAMAGE REDUCTION STUDY - 2015

DISTRICT: CESAW WILMINGTON PREPARED: 6/22/2015
POC: CHIEF, COST ENGINEERING, Stephen Roman, PE

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
	CONTRACT #2 OF 3 INITIAL NOURISHMENT	Estimate Prepared: 8/5/2015 Effective Price Level: 10/1/2014				Program Year (Budget EC): 2016 Effective Price Level Date: 1 OCT 15								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT #2 OF 3													
11	LEVEES & FLOODWALLS-Country Levee-258	$2,013	$624	31%	$2,637	1.5%	$2,042	$633	$2,675	2026Q3	22.6%	$2,505	$776	$3,281
02	RELOCATIONS - US 258	$417	$129	31%	$546	1.5%	$423	$131	$554	2026Q3	22.6%	$519	$161	$680
	CONSTRUCTION ESTIMATE TOTALS:	$2,430	$753	31%	$3,183		$2,465	$764	$3,230			$3,024	$937	$3,961
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
	PED	$275	$85	31%	$360	2.3%	$281	$87	$369	2025Q2	44.0%	$405	$126	$531
31	CONSTRUCTION MANAGEMENT													
	Construction Mgt OCT 2025 - OCT 2027	$500	$155	31%	$655	2.3%	$512	$159	$670	2026Q3	52.0%	$777	$241	$1,018
	CONTRACT COST TOTALS:	$3,205	$994		$4,199		$3,258	$1,010	$4,268			$4,206	$1,304	$5,510

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TPCS

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

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

PROJECT: PRINCEVILLE FLOOD DAMAGE REDUCTION
LOCATION: EDGECOMBE COUNTY, NORHT CAROLINA
This Estimate reflects the scope and schedule in report; PRINCEVILLE FLOOD DAMAGE REDUCTION STUDY - 2015

DISTRICT: CESAW WILMINGTON PREPARED: 6/22/2015
POC: CHIEF, COST ENGINEERING, Stephen Roman, PE

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
	CONTRACT #3 OF 3 INITIAL NOURISHMENT	Estimate Prepared: Effective Price Level:			8/5/2015 10/1/2014	Program Year (Budget EC): Effective Price Level Date:			2016 1 OCT 15					
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Mid-Point Date P	ESC (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
11	LEVEES & FLOODWALLS-NC33-211-SHILOH	$2,452	$760	31%	$3,212	1.5%	$2,488	$771	$3,259	2027Q4	25.7%	$3,127	$970	$4,097
02	RELOCATIONS-RIVERSIDE	$2,717	$842	31%	$3,559	1.5%	$2,757	$855	$3,611	2027Q4	25.7%	$3,465	$1,074	$4,540
	CONSTRUCTION ESTIMATE TOTALS:	$5,169	$1,602	31%	$6,771		$5,244	$1,626	$6,870			$6,593	$2,044	$8,637
01	LANDS AND DAMAGES	$0	$0	0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN PED Contract #3	$275	$85	31%	$360	2.3%	$281	$87	$369	2026Q2	50.3%	$423	$131	$554
31	CONSTRUCTION MANAGEMENT Construction Management Contract #3	$500	$155	31%	$655	2.3%	$512	$159	$670	2027Q4	60.5%	$821	$254	$1,075
	CONTRACT COST TOTALS:	$5,944	$1,843		$7,787		$6,037	$1,871	$7,909			$7,837	$2,429	$10,266