Costal Storm Risk Management (CSRM)

Flood Risk Management (FRM)

NON-STRUCTURAL

COST ENGINEERING APPENDIX (121423)

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Cost Estimate

Section 1. Description of Work

CSRM:

The levee and floodwall system would consist of a total of approximately 18.5 miles (97,700 ft) of earthen levee and floodwall which includes approximately 15 miles (79,500 ft) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 ft) of separate (non-continuous) segments of a floodwall. Construction of the levee alignment would impact approximately 521 acres of permanent ROW and it would require approximately 7,079,000 cubic yards of fill, including fill material required for future levee lifts (estimates include a 30 percent contingency).

FRM:

The proposed work would consist of approximately 21 acres of channel that would be cleared and grubbed prior to mechanical dredging. The mechanical dredging would consist of a maximum of 130,000 cubic yards of fill dredged from the channel. For the channel improvements, approximately 38.8 acres of permanent ROW would be needed. This area would include 25 ft on each side of the Mile Branch channel. Included in the 38.8 acres, there would be 4.8 acres for a staging area that would become a backwater area after construction is complete. Mile Branch improvements would include seven (7) bridge replacements and 1 Pedestrian Bridge. The FRM portion of the project was removed from the project.

The increases in the cost leading to the screening of Mile Branch was due to two factors: an ATR reviewer's comment and recommendation on the prepared cost estimate for the measure and the incorporation of the cost of the required compensatory mitigation. The ATR reviewer recommended that it is common cost engineering practice to model the third interval in the Cost Risk Analysis (CSRA) for triangular distributions at a lower percentage. The third interval in the risk register for all risk were reduced from 100% to 90%. This increased the contingency on the Mile Branch implementation cost estimate by 11%. The other increase to the cost for the Mile Branch measure was due to the addition of the required compensatory mitigation cost increasing by roughly $4 million.

Non-Structural:

The St. Tammany Parish Feasibility Study incorporates Nonstructural (NS) as part of the Tentatively Selected Plan (TSP). NS measures, reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from NS measures is accomplished by changing the use of the floodplains, or by accommodating existing uses to the flood hazard. NS measures differ from structural measures in that they focus on reducing the consequence of flooding for a specific structure rather than reducing the probability of flooding in that area (for example elevating a structure in an area that is flooded to reduce damages rather than reducing the flooding source). NS measures including floodproofing and structure raising to reduce damages from the flood hazard were considered for the entire parish in areas of documented flood damage.

Section 2. Cost estimate development

General:

The project cost estimate was developed in the TRACES MII cost estimating software and used the standard approaches for a feasibility estimate structure regarding labor, equipment, materials, crews, unit prices, quotes, sub- and prime contractor markups. This philosophy was taken wherever practical within the time constraints. It was supplemented with estimating information from other sources where necessary such as quotes, bid data, and A-E estimates. The intent was to provide or convey a "fair and reasonable" estimate that which depicts the local market conditions. The estimates assume a typical application of tiering subcontractors. Given the long time over which this project/program is to be constructed and the unknown economic status during that time, demands from non-governmental civil works projects were not considered to dampen the competition and increase prices.

CSRM:

Levees involves clearing and grubbing, borrow pit development, Silt fence, Embankment, Fertilizer, Seeding Mulching, and Access roads. Borrow Pit Development.

1. The mobilization and demobilization cost are assumed to be 5% of the cost of prime.
2. The borrow pit was assumed to have a 16' depth and to have a waste depth of 2'.
3. The silt fence price was quoted as an install price from J.C. Cheek Construction Co.
4. Embankment used an average haul distance of 8 miles (provided by Planning). A standard production rate of 125 CY/HR was used. This production rate was taken from the field data and is an average. The dirt conversion factors are 10 BCY of borrow material = 12 LCY hauled = 8 ECY compacted.
5. Access Roads were assumed to be roughly 700'. Road construction consisted of geotextile separate and crushed stone to be placed and removed.
6. Fertilizing, Seeding and Mulching price was quoted as an install price from J.C. Cheek Construction Co.
7. Quantity Take offs calculations followed the MVN Geotechnical guidance.

Floodwall involves clearing and grubbing, excavation, driving PZ-22 and 18" x 1/2" pipe pile, installation of stabilization slab, base slab, and stem, transitions, and fertilizing, seeding and mulching.

1. The mobilization and demobilization cost are assumed to be 5% of the cost of prime.
2. Assume heavy clearing and grubbing from google earth. The clearing and grubbing assumes the width of the Right of Way (ROW)
3. The excavation was calculated from the dimensions of the slab plus 1' around the perimeter to allow forming operations.
4. The depth of the sheet is 30'. Assume 4 piles/hr (Typical production) * 30 LF/Pile = 120 LF/HR.
5. Battered Pipe Piles Production Rate was based on .67 piles per hour. 1 Pile = 101 Ft; therefore, production rate is 101 *.67= roughly 68 ft/hr
6. Reinforcement Concrete: Production Rate used for Rebar, Forming, Concrete placement, and Stripping are typical for MVN District Rebar Quantity: Used a typical section that represented the average size of all Floodwall. The rebar was calculated into a lbs/cy. Concrete Strength for Stem and Base: 4,000 psi. Concrete Strength for Stabilization Slab: 2000 psi

7. Fertilizing, Seeding and Mulching price was quoted as an install price from J.C. Cheek Construction Co

Pumping Station: The work includes the construction of pump stations and drainage structures (sluice gates structures) with intake and discharge channels, inverted T-walls, sheet pile transitions with scour protection, concrete wing walls, bridges, draw bridge and navigation (boat way) gate, levees, roads, ramps, parking areas, fences, and associated work. Each pump station includes sluice gates.

1. The design used for pump stations is reserve canal pump on the WSLP project.
2. The estimate used was the 65% done by an A/E and had already gone through comment review.

Non-Structural: The proposed work would consist of 5583 home raises and 827 commercials dry floodproofing.

1. The home raises are based on information for Patterson Shoring, Jefferson Parish Government and St. Tammany Parish Government quotes. Patterson Shoring quote was a very high quote compared to the other quotes and was considered and outlier. Since the job was in St. Tammany Parish, there quote was used. See vendor tab in Non-Structural Estimate for more details.
2. Dry floodproofing was based on a Flood Plank System. See price quote folder for more information. An installation quote was received from Territory Manager NJ NY PA. Assumed a prime contractor would subcontract Territory Manager NJ NY PA to complete flood plank system and any foundation work would be done by prime.

Section 3. Estimate Structure:
The estimates are structured to reflect the projects performed. The estimates have been subdivided by USACE feature codes.

Section 4. Bid competition:
It is assumed that there will not be an economically saturated market and that bidding competition will be present.

Section 5. Contract Acquisition Strategy:
General:
There are no declared contract acquisition plan/types at this time. Although it has not been declared, it is anticipated to be Hubzone or 8a small business.

Section 6. Labor Shortages:
It is assumed there will be a normal labor market.

Section 7. Labor Rates:
Local labor market wages are above the local Davis-Bacon Wage Determination and actual rates have been used. This is based upon local information and payroll data received from the New Orleans District Construction Representatives and estimators with experiences in past years. Latest 2023 Labor Library was used in MII.

Section 8. Materials:

General:

Cost quotes are used on major construction items. Material prices quotes were also taken from previous job or historical data.

CSRM:

1. Materials will be purchased as part of the construction contract. The estimate does not anticipate government furnished materials. Prices include delivery of materials.
2. Concrete - will be purchased from commercial batch plants.
3. Borrow Material and Haul. Haul distances were determined by planning division (8 Mile). All borrow material is assumed Government furnished as it is a local sponsor responsibility. No contractor furnished borrow source are used. A risk for contractor furnished borrow has been included in the CSRA.
4. Steel Piles has been updated with most recent price quotes from Skyline. Assumed truck delivered.

Non-Structural:

1. All Quotes were installed prices or taken from the Costbook 2022.

Section 9. Equipment:

Rates used are based from the latest (2022) USACE EP-1110-1-8, Region III. Adjustments are made for fuel and facility capital cost of money (FCCM). Judicious use of owned verses rental rates was considered based on typical contractor usage and local equipment availability. Only a few select pieces of marine \ marsh equipment are considered rental. Full FCCM/Cost of Money rate is latest available; Mii program takes EP recommended discount, no other adjustments have been made to the FCCM.

Section 10. Fuel:

Fuels (gasoline, on and off-road diesel) were based on local market prices for on-road and off-road for the Gulf Coast area. The Team found that fuels fluctuate irrationally; thus, used the current price and placed a risk on the risk register.

Section 11. Crews:

General.

Major crew and productivity rates were developed and studied by senior USACE estimators familiar with the type of work. All of the work is typical to the New Orleans District. The crews and productivities were checked by local MVN estimators, discussions with contractors and comparisons with historical cost data. Major crews include haul, earthwork, clearing and snagging, piling and concrete.

CSRM:

1. Crew work hours are assumed to be 10 hrs 6 days/wk which is typical to the area.

2. Truck haul crew were based on truck haul program to determine number of trucks.
3. Embankment, Reinforcement Concrete, Pile crews are based on typical crews used in Louisiana.
4. Pumping station crew were based on WSLP 114 A/E 65% estimate after review.

Non-Structural:
1. Received mostly installed price quotes for home raised and dry floodproofing. Foundation preparation for dry floodproofing used crews from 2022 Costbook.

Section 12. Unit Prices:
The unit prices found within the various project estimates will fluctuate within a range between similar construction units such as concrete, earthwork, and piling. Variances are a result of differing haul distances, material inflation, small or large business markups, subcontracted items, designs and estimates by others.

Section 13. Relocation Cost:
General:
Relocation costs are defined as the relocation of public roads, bridges, railroads, and utilities required for project purposes. In cases where potential significant impacts were known, costs were included within the cost estimate.

CSRM:
All utilities quantities were provided by relocation section and were based off google earth.

Non-Structure:
N/A

Section 14. Mobilization:
Contractor mobilization and demobilization are based on the assumption that most of the contractors will be coming from within the Gulf Coast/Southern region. Mob/demob costs are based on historical studies of detailed Government estimate mob/demobs which averaged 5% of the construction costs. With undefined acquisition strategies and assumed individual project limits for the large number of potential contracts in this program, the estimate utilizes a more comprehensive approx. 5% value applied at each contract rather than risking minimizing mob/demob costs by detailing costs based on an assumed number of contracts. The 5% value also matches well with the 5% value previously prescribed by Walla Walla District, which has studied historical rates. The Non-Structural cost estimate used a 2%.

Section 15. Field Office Overhead:
The estimate used a field office overhead rate based on the average of relevant jobs. The reason this was done is because similar work is being done and the job office overhead should also be similar.

Section 16. Overhead assumptions may include:
Superintendent, office manager, pickups, periodic travel, costs, communications, temporary offices (contractor and government), office furniture, office supplies, computers and software,

as-built drawings and minor designs, tool trailers, staging setup, camp and kitchen maintenance and utilities, utility service, toilets, safety equipment, security and fencing, small hand and power tools, project signs, traffic control, surveys, temp fuel tank station, generators, compressors, lighting, and minor miscellaneous.

Section 17. Home Office Overhead:
Estimate percentages range based upon consideration of 8(a), small business and unrestricted prime contractors. The rates are based upon estimating and negotiating experience, and consultation with local construction representatives. Different percents are used when considering the contract acquisition strategy regarding small business 8(a), competitive small business and large business, high to low respectively. This project will assume an acquisition strategy of small business and assume a Home Office Overhead of 9%.

Section 18. Taxes:
Local taxes will be applied, using an average between the parishes that contain the work. Reference the LA parish tax rate website: http://www.laota.com/pta.htm

Section 19. Bond:
Bond is assumed 1% applied against the prime contractor, assuming large contracts. No differentiation was made between large and small businesses.

Section 20. E&D and S&A:
USACE Costs to manage design (PED) and construction (S&A) are based on New Orleans District Programmatic Cost Estimate guidance:

i. The PED cost includes such costs as project management, engineering, planning, designs, investigations, studies, reviews, value engineering and engineering during construction (EDC). Historically a rate of approximately 12% for E&D plus small percentages for other support features is applied against the estimated construction costs. Other USACE civil works districts such as St. Paul, Memphis, and St. Louis have reported values ranging from 10-15% for E&D. Additional support features might include project management, engineering, planning, designs, investigations, studies, reviews, and value engineering. A PED rate of 20.5% was applied for this project. Non-Structural – PED used 14%. This was taken from historical data. The risk register taken into account a PED increase.

ii. Supervision & Administration (S&A): Historically, New Orleans District used a range from 5% to 15% depending on project size and type applied against the estimated construction costs. Other USACE civil works districts such as St. Paul, Memphis and St. Louis report values ranging from 7.5-10%. Consideration includes that a portion of the S&A effort could be performed by contractors. Based on discussions with MVN Construction Division, an S&A cost based on contract durations was developed. Specific S&A costs were originally calculated and then that same percentage (11%) was carried forward on all future updates. Non-Structural – S&A used 8%. This was taken from historical data.

Section 21. Contingencies:
Contingencies were developed using the USACE Cost and Schedule Risk Analysis (CSRA) process and the Crystal Ball software that evaluates schedule and cost related risks. The contingency for is 51% (CSRM) and 43% (Non-Structure). For more information see risk report.

Section 22. Escalation:
Escalation used in the TPCS is based upon the US Army Corps of Engineers Engineering Manual (EM) 1110-2-1304 Civil Works Construction Cost Index System (CWCCIS) revised 30 Sept 2023.

Section 23. HTRW:
The estimate includes no costs for any potential Hazardous, Toxic, and Radioactive Waste (HTRW) concerns.

Section 24. Schedule
The project schedule was developed based on the construction of the individual features of work to include the entire CSRM alignment and Non-Structural which includes construction of Pumping Plants, Floodwalls, Levees, Sector Gates, Sluice Gates, Access Gates, Relocation, raise houses and dry floodproofing commercial buildings.

US Army Corps
of Engineers®

Coastal Storm Risk Management (CSRM)

Flood Risk Management (FRM)
Mile Branch

NON-STRUCTURAL
Feasibility Level

Feasibility Level
Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers
Mississippi Valley Division
New Orleans District

Prepared by:

New Orleans District

Date: 14-DEC-2023

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EXECUTIVE SUMMARY

The United States Army Corps of Engineers (USACE), Mississippi Valley Division (MVD), New Orleans District (CEMVN), Regional Planning and Environment Division South (RPEDS), prepared this revised draft Integrated Feasibility Report and Environmental Impact Statement (RDIFR-EIS). The RDIFR-EIS (collectively the "report") reflects the collaboration of the Non-Federal Sponsor (NFS), cooperating agencies, stakeholders, and members of the public. The Tentatively Selected Plan (TSP), or Proposed Action, is supported by the NFS.

The purpose of the St. Tammany Parish, Louisiana Feasibility Study (study) is to investigate flood risk management (FRM) and coastal storm risk management (CSRM) solutions to reduce flood damages caused by rainfall and coastal storm flooding in St. Tammany Parish (study area). The NFS is the State of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB). A Feasibility Cost Share Agreement (FCSA) was executed between the Department of the Army and the NFS on 14 January 2020. The study is funded through the Bipartisan Budget Act of 2018 (P.L. 115-123), Division B, Subdivision 1, Title IV, and is 100 percent federally funded up to $3,000,000.

The CEMVN determined that an exemption to the Section 1001 of WRRDA 2014, requirements that established a 3-year study duration and a $3 million federal study cost, were necessary to complete the feasibility study of this complexity and scale to further reduce risk and address policy and legal, public, ATR and IEPR comments received.
The study meets the following four factors to be considered a study that is too "complex" under applicable USACE guidance and WRRDA 2014, as amended, to be completed within three years and the $3 million federal study cost limit:

1. The type, size, location, scope and overall cost of the project;
2. There is a significant public dispute as to the nature of effect of the project;
3. There is a significant public dispute as to the environmental and economic costs and benefits of the project.
4. Significant action needed by Federal, State, or Local Agencies

The Exemption was approved by the Assistant Secretary of the Army for Civil Works ASA(CW) in April 2022 and provides for an additional $1.77M and 16 months to complete critical tasks to inform the decision on the Recommended Plan.

CSRM:
The levee and floodwall system would consist of a total of approximately 18.5 miles (97,700 ft) of earthen levee and floodwall which includes approximately 15 miles (79,500 ft) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 ft) of separate (non-continuous) segments of a floodwall. Construction of the levee alignment would impact approximately 521 acres of permanent ROW and it would

require approximately 7,079,000 cubic yards of fill, including fill material required for future levee lifts (estimates include a 30 percent contingency).

FRM:
The Mile Branch channel improvements would start at the intersection of Mile Branch and Highway 190, crossing Highway 190 Business, and ending at the intersection of Mile Branch and the Tchefuncte River.

The proposed work would consist of approximately 21 acres of channel that would be cleared and grubbed prior to mechanical dredging.

The mechanical dredging would consist of a maximum of 130,000 cubic yards of fill dredged from the channel. For the channel improvements, approximately 38.8 acres of permanent ROW would be needed. This area would include 25 ft on each side of the Mile Branch channel. Included in the 38.8 acres, there would be 4.8 acres for a staging area that would become a backwater area after construction is complete. Mile Branch improvements would include seven (7) bridge replacements and 1 pedestrian bridge.

The increases in the cost leading to the screening of Mile Branch was due to two factors: an ATR reviewer's comment and recommendation on the prepared cost estimate for the measure and the incorporation of the cost of the required compensatory mitigation. The ATR reviewer recommended that it is common cost engineering practice to model the third interval in the Cost Risk Analysis (CSRA) for triangular distributions at a lower percentage. The third interval in the risk register for all risk were reduced from 100% to 90%. This increased the contingency on the Mile Branch implementation cost estimate by 11%. The other increase to the cost for the Mile Branch measure was due to the addition of the required compensatory mitigation cost increasing by roughly $4 million.

Non-Structural:
The St. Tammany Parish Feasibility Study incorporates Nonstructural (NS) as part of the Tentatively Selected Plan (TSP). NS measures, reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from NS measures is accomplished by changing the use of the floodplains, or by accommodating existing uses to the flood hazard. NS measures differ from structural measures in that they focus on reducing the consequence of flooding for a specific structure rather than reducing the probability of flooding in that area (for example elevating a structure in an area that is flooded to reduce damages rather than reducing the flooding source). NS measures including floodproofing and structure raising to reduce damages from the flood hazard were considered for the entire parish in areas of documented flood damage. The standalone comprehensive NS alternative was screened out in favor of the combined structural and NS alternative which will provide more net benefits. A combined structural and NS measure based was carried forward and included in the draft TSP presented in the 2021 Draft Integrated Feasibility Report.

The CSRA process for CSRM project includes an analysis on the Relocations, Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates features. The CSRA process for FRM includes an analysis on the Relocations, Bridges, and Channels features. The CSRA process for this project includes an analysis on the Buildings, Grounds, and Utilities feature. The results of the analyses are determined by qualifying and quantifying all potential cost risks and running a Monte Carlo simulation to produce the frequency spectrum and probability range for the applied risk costs. The cost contingency is obtained from the 80-percent contingency as determined by this analysis.

Initial Risk Register considered over 57 (CSRM) and 14 (Non-Structure) risk items. A total of 17 (CSRM) and 7 (Non-Structure) potential risk items for the Relocations, Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates features were developed by the CSRA PDT team and applied to a risk registry for analysis. Assumptions were made for each risk item before running the Monte Carlo simulation. The result of the simulation gave a 51% (CSRM) and 43% (Non-Structure) percent (rounded) contingency respectively at the 80-percent confidence level.

The contingency cost for this project was utilized for a Micro Computer Aided Cost Estimating System (MCACES) estimation of the costs associated with the Costal Storm Risk Management project. The potential cost risks developed during this analysis also serve as an indicator of how to avoid unforeseen escalation of project costs throughout project implementation and therefore, may be used as a valuable tool in all future aspect of the project study, design, and construction planning and estimation.

The major contributors for the CSRM to the resulting total project cost contingency for the Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates Features were:

- Contract Acquisition Impacts
- Construction Contract Modification
- Escalation

The major contributor for the CSRM to the resulting total project contingency for the Schedule feature was:

- Civil/Geotechnical Uncertainty
- Civil/Geotechnical Uncertainty # 2

The major contributors for Non-Structural to the resulting total project cost contingency for the Buildings, Grounds, and Utilities Features were:

- Scope Maturity
- Contract Acquisition
- Assumed Average Structure Size

The major contributors for Non-Structural to the resulting total project contingency for the Schedule feature was:

- Intermittent Funding
- PED and S&A Cost
- Contract Acquisition

The corresponding Total Cost including contingency (cost & schedule) for the CSRM, and Non-structural are presented on table 1.1 and 1.2

Table 1.1 Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates Features Contingency Analysis Table

INITIAL CONSTRUCTION
Contingency Analysis

Base Estimate ->	$1,872,920,650	
Confidence Level	**Contingency Value**	**Contingency**
0%	18,729,207	1%
10%	449,500,956	24%
20%	543,146,989	29%
30%	618,063,815	33%
40%	692,980,641	37%
50%	749,168,260	40%
60%	805,355,880	43%
70%	880,272,706	47%
80%	**955,189,532**	**51%**
90%	1,067,564,771	57%
100%	1,554,524,140	83%

Table 2.2 Structures and Levee/All other Features Contingency Analysis Table

INITIAL CONSTRUCTION

Contingency Analysis

Base Estimate ->	$1,975,234,594	
Confidence Level	**Contingency Value**	**Contingency**
0%	237,028,151	12%
10%	493,808,649	25%
20%	553,065,686	28%
30%	612,322,724	31%
40%	651,827,416	33%
50%	691,332,108	35%
60%	750,589,146	38%
70%	790,093,838	40%
80%	**849,350,875**	**43%**
90%	928,360,259	47%
100%	1,382,664,216	70%

The rounded contingency percentage for CSRM, FRM, and Non Structural features are **(51.0%, CSRM) and (43.0%, Non-Structural),** were transferred to the TPCS for final calculation of total contingency and cost. Lands and Damages cost and contingency are not included in the above. (NOTE: The rounding of the contingencies causes the totals on the TPCS to be slightly higher than and not add up to exactly the costs above.)

1. PURPOSE

The purpose of the St. Tammany Parish, Louisiana Feasibility Study (study) is to investigate flood risk management (FRM) and coastal storm risk management (CSRM) solutions to reduce flood damages caused by rainfall and coastal storm flooding in St. Tammany Parish (study area). The NFS is the State of Louisiana, acting by and through, the Coastal Protection and Restoration Authority Board of Louisiana (CPRAB). A Feasibility Cost Share Agreement (FCSA) was executed between the Department of the Army and the NFS on 14 January 2020. The study is funded through the Bipartisan Budget Act of 2018 (P.L. 115-123), Division B, Subdivision 1, Title IV, and is 100 percent federally funded up to $3,000,000.

2. BACKGROUND

The study area encompasses all of St. Tammany Parish, which is approximately 1,124 square miles and located in southeastern Louisiana (see Figure ES-1). St. Tammany Parish is home to over approximately 258,110 residents and 2,500 businesses. The parish is uniquely located at the crossroads of three interstates, I-10, I-12, and I-59, and transportation waterways to the Gulf of Mexico. The hydrology is complex and communities experience repeated damages from flooding, including, but not limited to storm surge from coastal events, localized heavy rainfall, and riverine flooding.

The Pearl River runs along the Mississippi-Louisiana state line and is the eastern boundary of the study area. Lake Pontchartrain, one of the largest estuaries in the United States, serves as the southern border. Tangipahoa Parish is located along the western boundary, and Washington Parish is located along the northern boundary. There are 36 hydrologic sub-basins, as defined by the United States Geological Survey (USGS) 12- digit hydrologic unit delineations (WBDHUC12) within the study area.

3. REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for both cost and schedule risks for all project features.

3.1. Project Scope

Engineering Circular Bulletin (ECB) 2007-17, Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs (Sept. 10, 2007) requires that a formal risk analysis be prepared for all decision documents requiring Congressional authorization whose total costs are in excess of forty million dollars. In addition, to broadly defined risk analysis standards and recommended practices, a risk

analysis is to be 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 Directory of Expertise for Civil Works (Cost Engineering Dx), dated May 17, 2009.
- Engineer Regulation (ER) 1110-2-1302 Civil Works Cost Engineering, dated Sept. 15, 2008.
- Engineer Technical Letter (ETL) 1110-2-573 Construction Cost Estimating Guide for Civil Works, dated Sept. 30, 2008.

The study is authorized to investigate both CSRM problems and solutions. CEMVN considered past, current, and future management and flood resilience studies and projects by USACE, and other Federal, state, and local agencies and identified and evaluated a full range of reasonable alternatives, including the No Action Alternative, to reduce flood damages from rainfall and storm surge events in St. Tammany Parish. Both structural and nonstructural measures were considered in the study process. The CEMVN performed these overarching efforts:

- **Assess the study area's problems, opportunities, and future without project condition (FWOP) for a 50-year time period called the period of analysis. The period of analysis for this study is 2032-2082 which is the period used to consider the benefits and impacts of an action. The time it takes to conduct the study and implement the plan is not part of the period of analysis. For this study it was assumed that the study and design and initial construction activities would not be completed until 2032.**

- **Evaluate the feasibility of implementing site-specific solutions, including structural, nonstructural, and natural and nature-based measures, or possibly a combination thereof.**

The report includes the project technical scope, estimates, and schedules as developed and presented by USACE New Orleans District. Consequently, these documents serve as the basis for the risk analysis. In general terms, the construction scope consists of the following:

Lands and Damages
Relocations
Fish and Wildlife Facilities
Levee and Flood Walls
Pump Plant
Floodway Control & Diversion Structure
Buildings, Grounds, & Utilities
Cultural Resource Preservation
Planning, Engineering and Design
Construction Management

3.2. USACE Risk Analysis Process

The risk analysis process follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering DX). The risk analysis process reflected within the risk analysis report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. The risk analysis results are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. 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 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 analyses 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, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

ER 1110-2-1150, Engineering and Design for Civil Works Projects.
ER 1110-2-1302, Civil Works Cost Engineering.
ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works.
Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Engineering DX.
Memorandum from Major General Don T. Riley (U.S. Army Director of Civil Works), dated July 3, 2007.
Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.

4. METHODOLOGY/PROCESS

The Project Delivery Team is composed of various USACE New Orleans District branches including Project Management, Real Estate, Planning, Contracting, Structures and Levee Design, Hydrologic and Geotechnical and Cost Engineering Offices.

This CSRA outcome is pending approval by Agency Technical Review (ATR).

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 any desired level of cost confidence. A parallel process is also used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) 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 Engineering DX 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 adverse 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 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. Because Crystal Ball is an Excel add-in, the schedules for each option are recreated in an Excel format from their native format. 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 would be provided in section 6.

4.1. Identify and Assess Risk Factors

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

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

A formal PDT meeting was held in USACE New Orleans HQ for the purposes of identifying and assessing risk factors. The meeting held on Nov 4, 2020 – Nov 11, 2021 included representatives from multiple project team disciplines and functions including:

Project/program managers.
Economist.
Contracting/acquisition.
Real Estate.
Environmental.
Civil, structural, geotechnical, and hydraulic design.
Cost and schedule engineers.
Construction.

This meeting focused primarily on risk factor identification using brainstorming techniques, but also facilitated discussions based on risk factors common to projects of similar scope and geographic location. Individual meetings were realized with each disciplines branch primarily for risk factor assessment and quantification.

4.2. Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are 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 involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The probabilistic distribution functions are used to describe the characteristic population (tendencies) of the risk factor inputs. The following elements of each risk factor were addressed in the risk factor quantification process:

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.

In this example, the risk discussions focused on the various project features as presented within the USACE Civil Works Work Breakdown Structure for cost accounting purposes. It was recognized that the various features carry differing degrees of risk as related to cost, schedule, design complexity, and design progress. The example features under study are presented in table 2:

Table 2. Work Breakdown Structure by Feature

01	LANDS AND DAMAGES
02	RELOCATIONS
06	FISH & WILDLIFE FACILITIES
08	ROADS, RAILROADS & UTILITIES
09	CHANNELS & CANALS
11	LEVEES AND FLOODWALLS
13	PUMPING PLANT
15	FLOODWAY CONTROL AND DIVERSION STRUCTURES
18	CUTURAL RESOURCE PRESERVATION
19	BUILDINGS, GROUNDS & UTILITIES
30	PLANNING, ENGINEERING & DESIGN
31	CONSTRUCTION MANAGEMENT

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 are meant to 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 base 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.

For schedule contingency analysis, the option schedule contingency is calculated as the difference between the P80 option duration forecast and the base schedule duration. These contingencies are then used to calculate the time value of money impact of project delays that are included in the presentation of total cost contingency in section 6. The resulting time value of money, or added risk escalation, is then added into the contingency amount to reflect the USACE standard for presenting the "total project cost" for the fully funded project amount.

Schedule contingency is analyzed only on the basis of each option and not allocated to specific tasks. Based on Cost Engineering DX guidance, only critical path and near critical path tasks are considered to be uncertain for the purposes of contingency analysis.

5. KEY ASSUMPTIONS

Key assumptions are those that are most likely to significantly affect the determinations and/or estimates of risk presented in the risk analysis. The key assumptions are important to help ensure that project leadership and other decision makers understand the steps, logic, limitations, and decisions made in the risk analysis, as well as any resultant limitations on the use of outcomes and results.

The following are examples of key assumptions for the risk analysis that could be identified by the PDT and risk analyst.

Level of Design: The cost comparisons and risk analyses performed and reflected within this report are based upon design scope and estimates that are considered to be well developed and designed.
Design Scope: The prescribed scope satisfies the requirements of this acquisition given that it is an economic update.
Operation and Maintenance: Operation and maintenance activities were not included in the cost estimate or schedules
Contract Acquisition Strategy: Consistent with cost estimate and schedule assumptions, it is assumed that the contract acquisition strategy is predominately firm fixed price.
Confidence Levels: The Walla Walla Cost Engineering Dx guidance generally focuses on the eighty-percent level of confidence (80%) for cost contingency

calculation. For this risk analysis, the eighty-percent level of confidence (80%) was used. It should be noted that the use of 80% as a decision criteria is a moderate risk aversion approach, generally resulting in higher cost contingencies. However, the 80% level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to completely capture actual project costs.
Only moderate and high risk levels were applied for the purposes of the CSRA analysis.

The following list identifies the key risk analysis assumptions and limitations within the context of the St. Tammany Parish Feasibility Study CSRA. For each item, the context is first provided and then followed by the key assumption or limitation.

- *Unknown Decisions or Decision Makers:* The CSRA was prepared using a framework to generate contingency information that is appropriate for use by State of Louisiana and USACE decision makers for scheduling, budgeting, and project control purposes. The framework may generate results that are appropriate for use by a wide variety of decision makers or stakeholders; however, the assumed use of CSRA results is limited to scheduling, budgeting, and project control. Other uses by unknown decision makers may not be appropriate.
- *Dynamic Risks:* Risk events are dynamic, not static, and should be evaluated regularly through all phases of design, construction and O&M (if required). The CSRA is based on the identification and assessment of risks as of the date of this document. Reduced utility of current CSRA results should be assumed if the likelihood and impact of risks change over time.
- *Causal Relationships:* With the exception of risk events identified as correlated in the risk register, it is assumed that the impacts of risks are independent and that the realization of one risk does not cause the realization of another. Significant variance of the risk model results from actual project costs and schedules may be experienced if significant causal relationships exist between risks assumed to be independent.
- *Conservation of Market Pricing Risk:* The CSRA assumes that market pricing risks are not created or destroyed but can only be transferred or shared *at a price* as a result of various contract acquisition strategies. As an example, it is assumed that a contractor will add a level of contingency to a fixed price bid, relative to a cost reimbursable bid, that is reflective of the risk transferred contractually from the Government to the contractor. Other aspects of contract acquisition strategies not related to market pricing, such as the management cost of modifications or claims, are not included in this assumption. Any contract acquisition strategy that actually transfers market pricing risk to a contractor *at no cost* to the Government is not reflected in the CSRA.
- *Unknown Unknown* and *Unknowable Risks*: The Cynefin Framework describes decision-making contexts, in part, by characteristic types of uncertainty. Simple, complicated, complex and chaotic contexts within the framework are respectively associated with *known known*, *known unknown*, *unknown unknown* and

unknowable uncertainties. The CSRA process focuses on *known known* and *known unknown* risks and is not intended to quantify the impacts of *unknown unknown* or *unknowable* risks. Significant variance of the risk model results from actual project costs and schedules may be experienced if *unknown unknowable* risks, as defined in the Cynefin Framework, are realized.

6. RISK ANALYSIS RESULTS

The following sections discuss the risk register, cost risk analysis results, schedule risk analysis results, and the combined cost and schedule risk analysis results.

6.1. Risk Register

A risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk studies and Crystal Ball risk models. A summary risk register that includes typical risk events studied (high and moderate levels) is presented in a table in this section. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. The complete detailed risk register is attached as Appendix A. The detailed risk registers in Appendix A include low level and unrated risks, as well as additional information regarding the specific nature and impacts of each risk. A condensed version of the Risk Register of modeled risk items can be seen in Appendix C.

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 risk analysis feedback and project control input.
Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

Table 3. Risk Register – Modeled Items

See Appendix C

6.2. Cost Risk Analysis - Cost Contingency Results

A cost risk models was run for the CSRM and Non-Structural Features of construction work. As shown in Appendix C, there were a total of 17 (CSRM) and 7 (Non-Structure) risks used in the modeling for the risk analyses which had a cost impact of moderate or high. Some risks applied only to one feature set and some applied to both. The risk was analyzed using the low, most likely, and high estimates for each risk item and the items associated variance distribution. The analysis produced a sensitivity chart of the risk items and confidence levels from 0 to 100% and the associated contingency amount.

The cost sensitivity chart for the CSRM and Non-Structural features are shown in Figure 1.1 and 1.2. The sensitivity chart shows the influence of each risk items on the resulting cost contingency. The risk items are ranked according to their importance to the cost contingency. As shown in the Cost Sensitivity Charts:

The major contributors for the CSRM to the resulting total project cost contingency for the Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates Features were:

- Contract Acquisition Impacts
- Construction Contract Modification
- Escalation

The major contributors for Non-Structural to the resulting total project cost contingency for the Buildings, Grounds, and Utilities Features were:

- Scope Maturity
- Contract Acquisition
- Assumed Average Structure Size

Figure 1.1 **Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates Cost Sensitivity Chart**

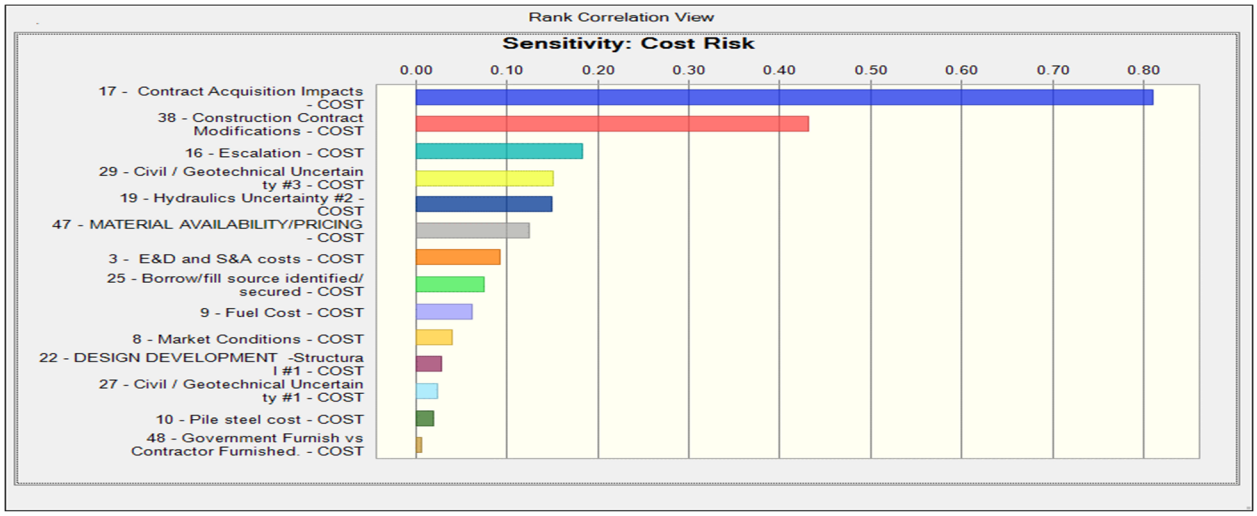
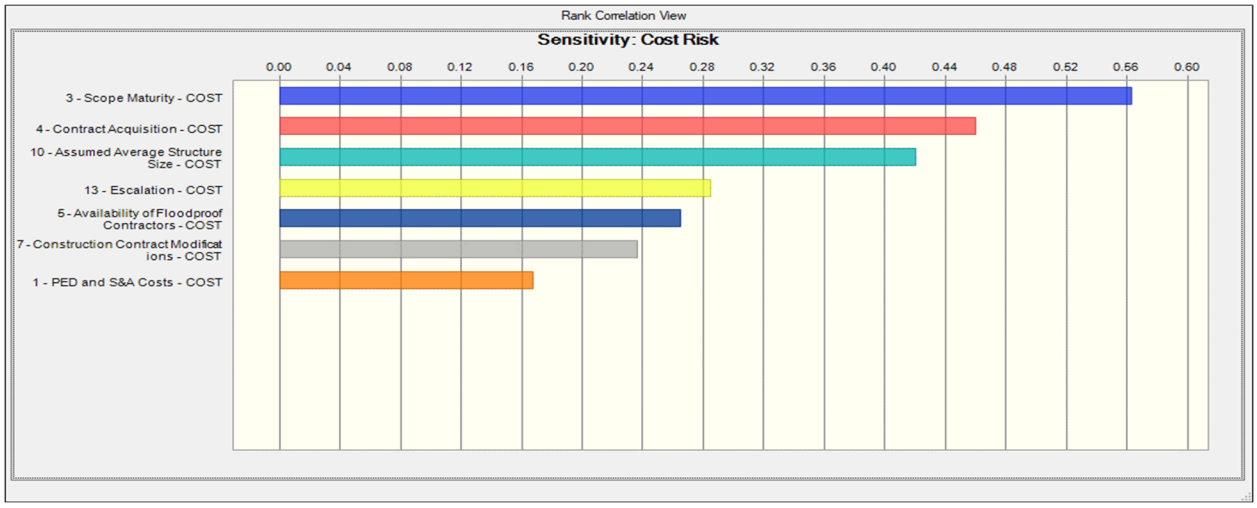


Figure 2.2 Buildings, Grounds, and Utilities Cost Sensitivity Chart



The cost risk analysis also produced a confidence table in ten percent increments of project confidence associated with contingency dollars. The confidence levels are shown in Tables 4.1 and 4.2. As seen in the table, all but one of the associated contingency dollar amounts are positive. The contingency dollar amounts ranges from $18.7 Million to $1.55 Million (CSRM) and $237 Million to $1.38 Million (Non-Structural). The recommended cost contingency amount for the are $955,189,532(CSRM) and $849,350,875 (Non Structural).

Table 4.1 Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates Cost Confidence Table

INITIAL CONSTRUCTION

Contingency Analysis

Base Estimate ->	$1,872,920,650	
Confidence Level	**Contingency Value**	**Contingency**
0%	18,729,207	1%
10%	449,500,956	24%
20%	543,146,989	29%
30%	618,063,815	33%
40%	692,980,641	37%
50%	749,168,260	40%
60%	805,355,880	43%
70%	880,272,706	47%
80%	**955,189,532**	**51%**
90%	1,067,564,771	57%
100%	1,554,524,140	83%

Table 4.2 Buildings, Grounds, and Utilities Cost Confidence Table

INITIAL CONSTRUCTION

Contingency Analysis

Base Estimate ->	$1,975,234,594	
Confidence Level	**Contingency Value**	**Contingency**
0%	237,028,151	12%
10%	493,808,649	25%
20%	553,065,686	28%
30%	612,322,724	31%
40%	651,827,416	33%
50%	691,332,108	35%
60%	750,589,146	38%
70%	790,093,838	40%
80%	**849,350,875**	**43%**
90%	928,360,259	47%
100%	1,382,664,216	70%

6.3. Schedule Risk Analysis - Schedule Contingency Results

A schedule risk analysis was conducted on 2 risks (CSRM) and 3 risks (Non-Structural) of the risk register, shown in Figure 3, which had a schedule impact of moderate or high. The project Risk Register originally considered over 57 (CSRM) and 14 (Non-Structure) items but only 2 risks (CSRM) and 4 risks (Non-Structural) risks were determined to have an impact on the overall program schedule. The risk was analyzed using the low, most likely, and high estimates for each risk item and the items associated variance distribution. The analysis produced a sensitivity chart of the risk items and confidence levels from 0 to 100% and the associated contingency amount.

The schedule sensitivity chart is shown in Figure 2.1 and 2.2 below. The sensitivity chart shows the influence of each risk items on the resulting schedule contingency. It is important to note again that the schedule is for a Program rather than a Single Project and therefore very few items or no items were considered to be a High risk to the program and did not significantly affect the overall schedule.

The major contributor for the CSRM to the resulting total project contingency for the Schedule feature was:

- Civil/Geotechnical Uncertainty
- Civil/Geotechnical Uncertainty # 2

The major contributors for Non-Structural to the resulting total project contingency for the Schedule feature was:

- Intermittent Funding
- PED and S&A Cost
- Contract Acquisition

Figure 2.1: CSRM

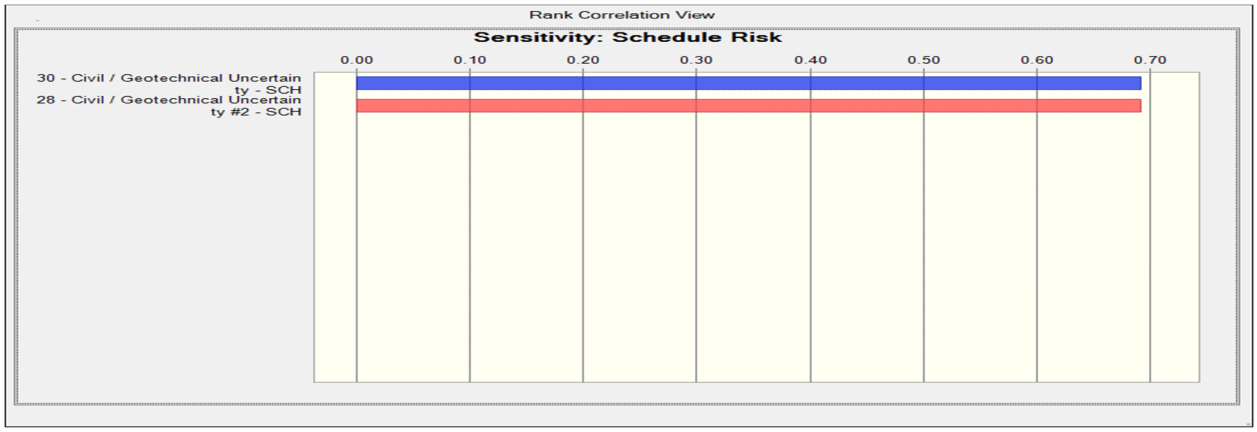
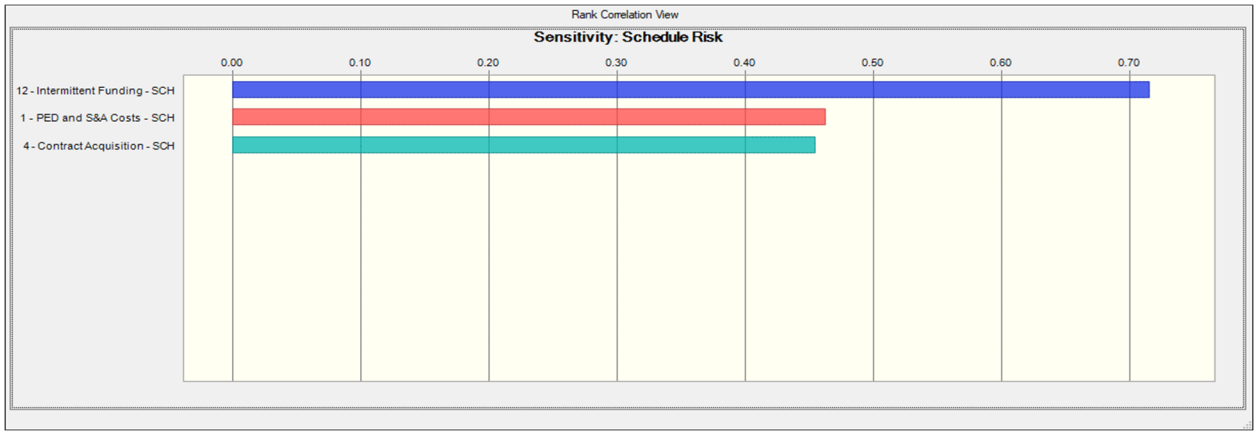


Figure 2.2: Non-Structural



The schedule risk analysis also produced a confidence table in ten percent increments of project confidence associated with contingency months. The confidence table is shown in Table 5.1 and 5.2 below. As seen in the table, all the associated contingency month amounts are positive. The contingency month amounts range from 6 months to 98 months (CSRM), and 1.6 months to 89 months (Non-Structural). The recommended schedule contingency amount is 55.1 months (CSRM) and 49.9 months (Non-Structural). Note that these results reflect only those contingencies established from the schedule risk analysis.

Table 5.1 CSRM Schedule Confidence Table

Contingency Analysis

Base Schedule Duration ->	612.0 Months	
Confidence Level	**Contingency Value**	**Contingency**
0%	6.1 Months	1%
10%	18.4 Months	3%
20%	24.5 Months	4%
30%	24.5 Months	4%
40%	30.6 Months	5%
50%	36.7 Months	6%
60%	42.8 Months	7%
70%	49.0 Months	8%
80%	**55.1 Months**	**9%**
90%	61.2 Months	10%
100%	97.9 Months	16%

Table 5.2 Non-Structural Schedule Confidence Table

Contingency Analysis

Base Schedule Duration ->	156.0 Months	
Confidence Level	**Contingency Value**	**Contingency**
0%	1.6 Months	1%
10%	18.7 Months	12%
20%	23.4 Months	15%
30%	28.1 Months	18%
40%	31.2 Months	20%
50%	35.9 Months	23%
60%	40.6 Months	26%
70%	45.2 Months	29%
80%	**49.9 Months**	**32%**
90%	57.7 Months	37%
100%	88.9 Months	57%

From the table, a confidence bar chart was also established that shows the relationship of percent confidence with contingencies in months. That bar chart is shown in Figure 3.1 and 3.2. Due to not many risk modeled, all confidence levels show a steady increase in the contingency amount.

Figure 3.1 CSRM Schedule Confidence Curve

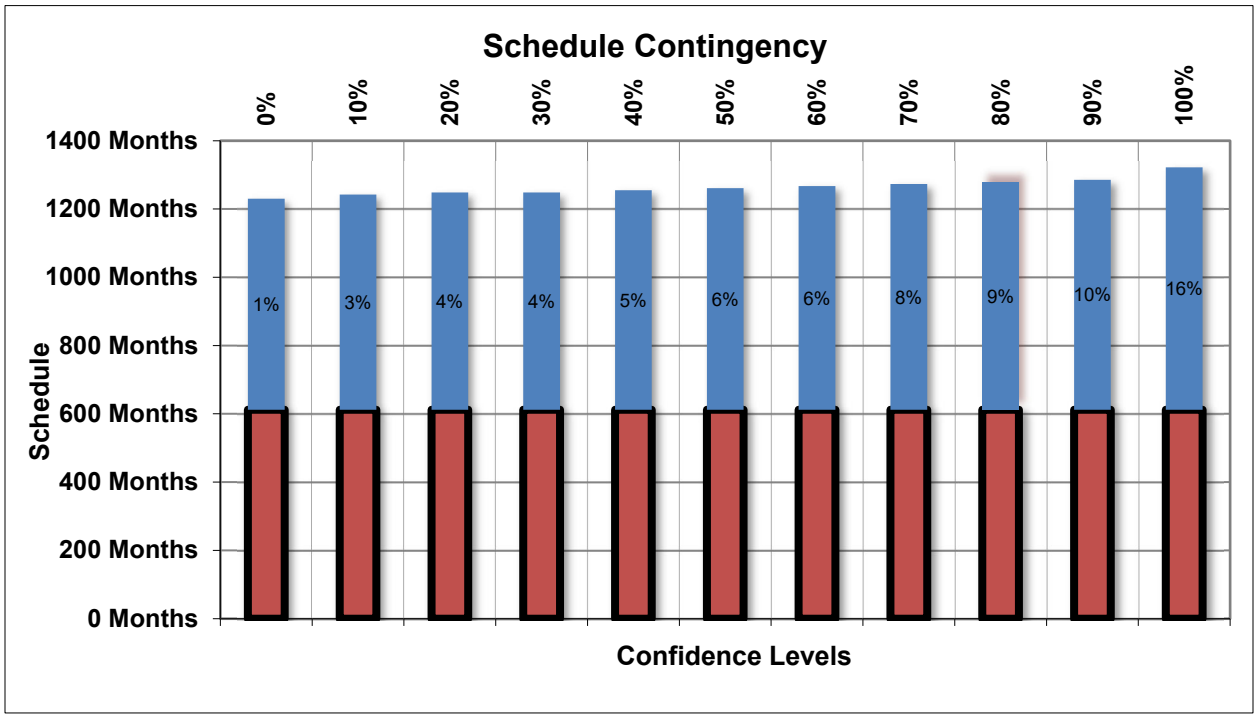
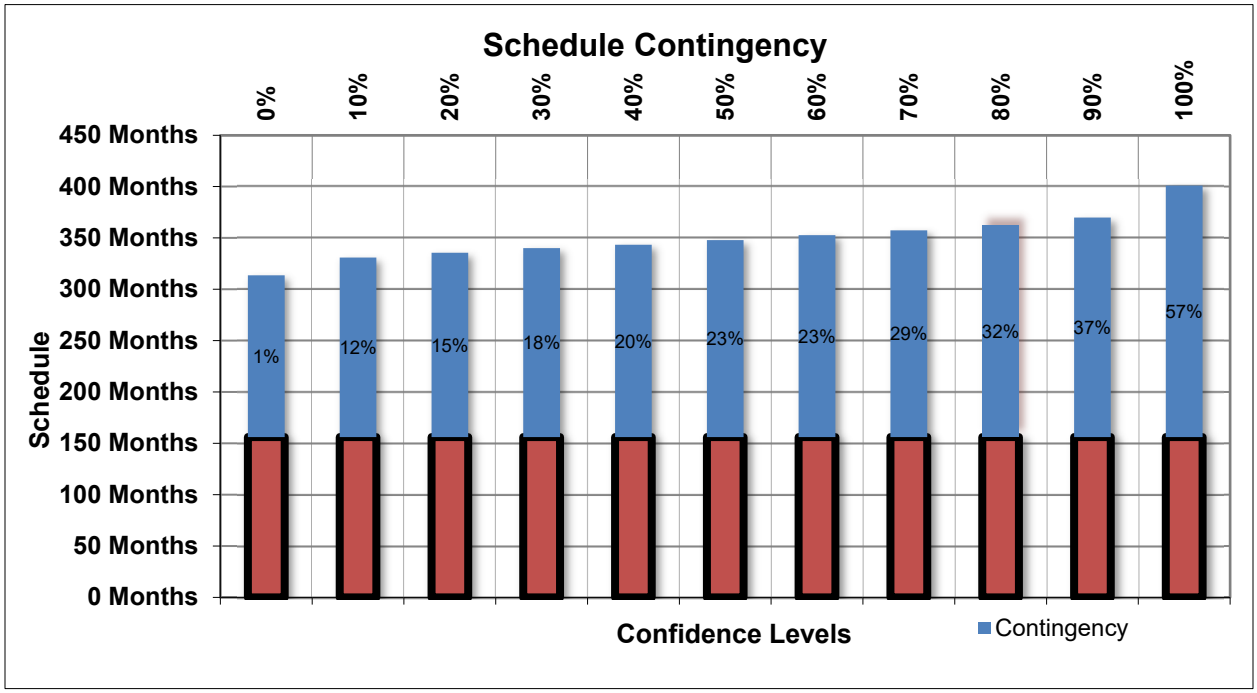


Figure 3.3 Non-Structural Schedule Confidence Curve



MAJOR FINDINGS/OBSERVATIONS

The cost and schedule risk analysis resulted in a recommended combined cost contingency of $955,189,532 (CSRM) and $849,350,875 (Non Structural) and a schedule recommended contingency of 55.1 months (CSRM) and 49.9 months (Non-Structural). The project construction costs for confidence levels 0 to 100% are shown below. Table 6.1 and 6.2 presents construction costs, which include base cost-plus cost and schedule contingencies. Lands and Damages cost and contingency are not included. Figure 4.1 and 4.2 illustrates the construction cost risk analysis confidence bar chart. The recommended contingency are **(51.0%, CSRM and (43.0%, Non-Structural)**, based on the 80% confidence level. These contingencies were applied to the detailed estimate for the tentatively selected plan for the Costal Storm Risk Management project. The rounded contingency percentages for **(51.0%, CSRM) and (43.0%, Non-Structural)** where transferred to the TPCS for final calculation of Total Contingency and Total Cost. Lands and Damages cost and contingency are not included in the above numbers.

CSRM:

Contingency Summary Table - Cost

PROJECT CONTINGENCY (BASELINE ESTIMATE)	Percentile	Baseline w/ Contingency	Contingency %
	0%	**$1,891,649,857**	**1%**
	10%	**$2,322,421,606**	**24%**
	20%	**$2,416,067,639**	**29%**
	30%	**$2,490,984,465**	**33%**
	40%	**$2,565,901,291**	**37%**
	50%	**$2,622,088,910**	**40%**
	60%	**$2,678,276,530**	**43%**
	70%	**$2,753,193,356**	**47%**
	80%	**$2,828,110,182**	**51%**
	90%	**$2,940,485,421**	**57%**
	100%	**$3,427,444,790**	**83%**

Contingency Summary Table - Schedule

PROJECT CONTINGENCY (BASELINE SCHEDULE)	Percentile	Baseline w/ Contingency	Contingency %
	0%	**618.1 Months**	**1%**
	10%	**630.4 Months**	**3%**
	20%	**636.5 Months**	**4%**
	30%	**636.5 Months**	**4%**
	40%	**642.6 Months**	**5%**
	50%	**648.7 Months**	**6%**
	60%	**654.8 Months**	**7%**
	70%	**661.0 Months**	**8%**
	80%	**667.1 Months**	**9%**
	90%	**673.2 Months**	**10%**
	100%	**709.9 Months**	**16%**

Table 6.1 Project Contingencies (Base Cost plus Contingency)

Non-Structural

Contingency Summary Table - Cost

PROJECT CONTINGENCY (BASELINE ESTIMATE)	Percentile	Baseline w/ Contingency	Contingency %
	0%	**$2,212,262,745**	**12%**
	10%	**$2,469,043,243**	**25%**
	20%	**$2,528,300,280**	**28%**
	30%	**$2,587,557,318**	**31%**
	40%	**$2,627,062,010**	**33%**
	50%	**$2,666,566,702**	**35%**
	60%	**$2,725,823,740**	**38%**
	70%	**$2,765,328,432**	**40%**
	80%	**$2,824,585,469**	**43%**
	90%	**$2,903,594,853**	**47%**
	100%	**$3,357,898,810**	**70%**

Contingency Summary Table - Schedule

PROJECT CONTINGENCY (BASELINE SCHEDULE)	Percentile	Baseline w/ Contingency	Contingency %
	0%	**157.6 Months**	**1%**
	10%	**174.7 Months**	**12%**
	20%	**179.4 Months**	**15%**
	30%	**184.1 Months**	**18%**
	40%	**187.2 Months**	**20%**
	50%	**191.9 Months**	**23%**
	60%	**196.6 Months**	**26%**
	70%	**201.2 Months**	**29%**
	80%	**205.9 Months**	**32%**
	90%	**213.7 Months**	**37%**
	100%	**244.9 Months**	**57%**

Table 6.2 Project Contingencies (Base Cost plus Contingency)

The above costs do not include 01 Lands and Damages and rounding of the contingency used when transferred to the TPCS and therefore will not match the TPCS exactly.

Figure 4.1 CSRM Project Confidence Curve

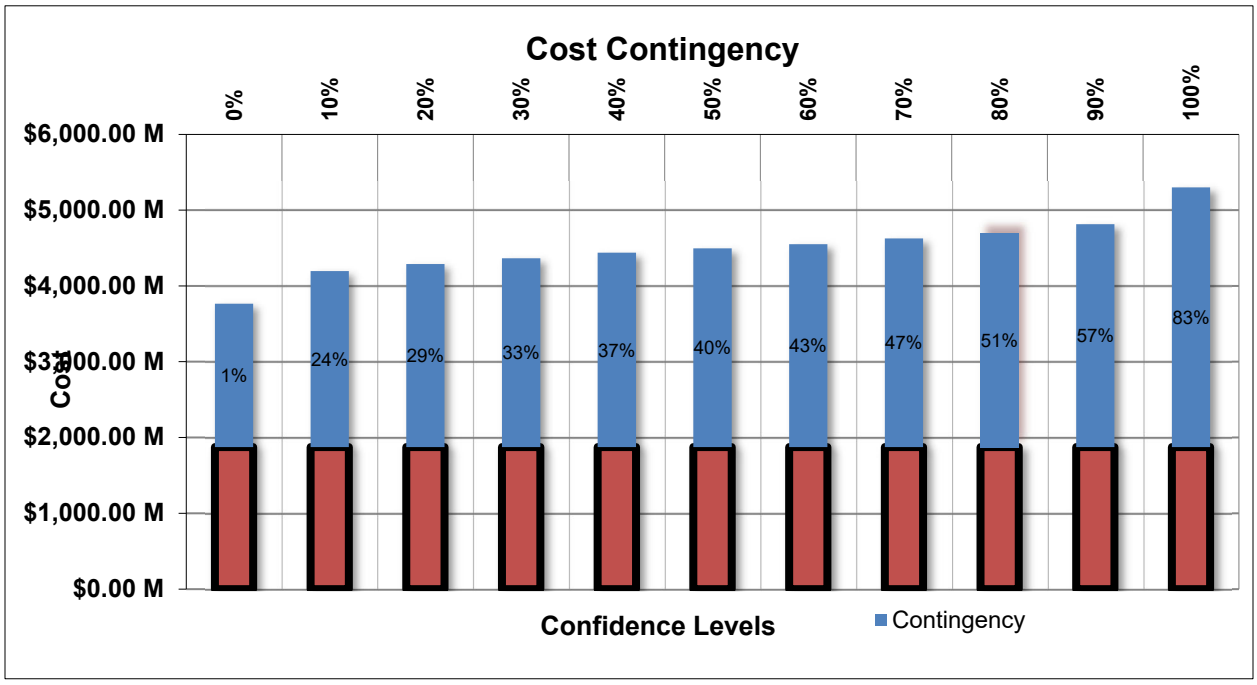
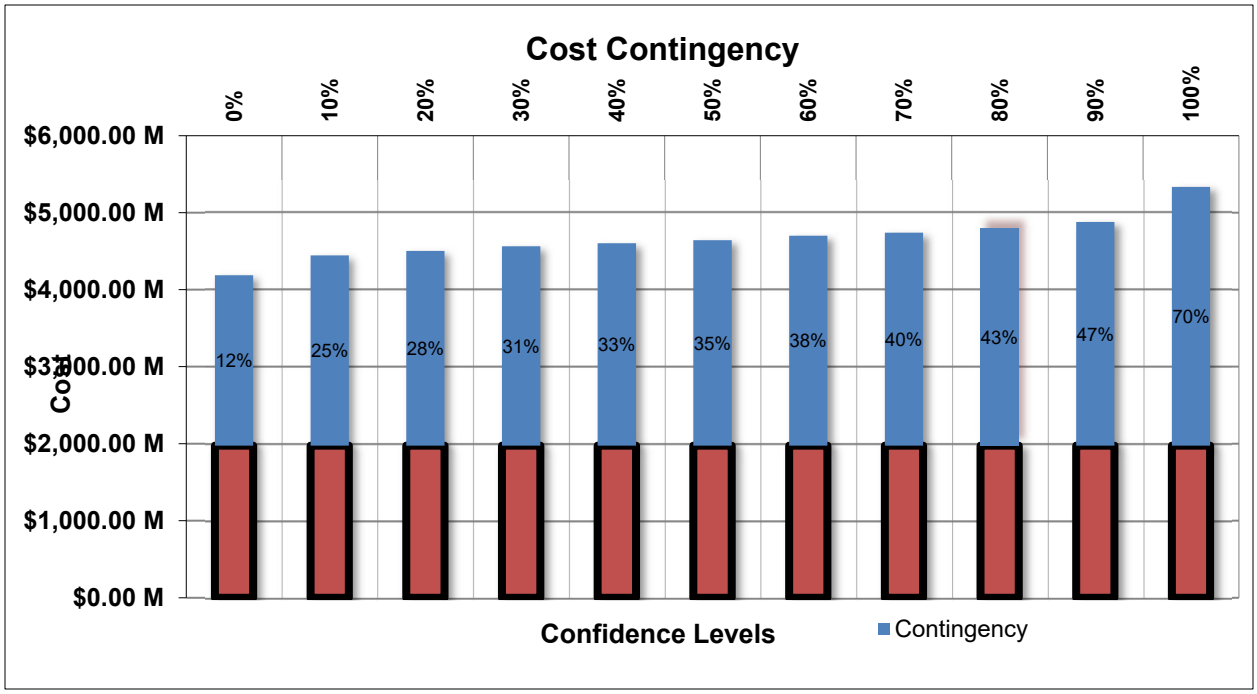


Figure 4.2 Non-Structural Project Confidence Curve



The major contributors for the CSRM to the resulting total project cost contingency for the Floodwalls and Levees, Pumping Plants, Sector Gates and Sluice Gates Features were:

- Contract Acquisition Impacts
- Construction Contract Modification
- Escalation

The major contributor for the CSRM to the resulting total project contingency for the Schedule feature was:

- Civil/Geotechnical Uncertainty
- Civil/Geotechnical Uncertainty # 2

The major contributors for Non-Structural to the resulting total project cost contingency for the Buildings, Grounds, and Utilities Features were:

- Scope Maturity
- Contract Acquisition
- Assumed Average Structure Size

The major contributors for Non-Structural to the resulting total project contingency for the Schedule feature was:

- Intermittent Funding
- PED and S&A Cost
- Contract Acquisition

These items are discussed in more detail in the Mitigation Recommendations section.

Lands and Damages are not included in the CSRA because it was not considered to be an overall program risk by the PDT. Lands and Damages is a very small project cost and any schedule delay in a specific location would not significantly affect the midpoint of the overall program. The Local Sponsor is responsible for LERRDs and in order to serve as the Non-Federal sponsor must have the authority to appropriate (take) property

The above 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. These conclusions were reached by identifying and assessing risk items for use in the risk analysis. These quantitative impacts of these risk items are then analyzed using a combination of professional judgment, empirical data, and analytical techniques. The total project cost contingency is then analyzed using the Crystal Ball software. *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.

7. MITIGATION RECOMMENDATIONS

See Appendix D

Total Project Cost Summary (TPCS)

Appendix A

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

PROJECT: **St. Tammany Parish Feasibility Study**
PROJECT NO: P2 477554
LOCATION: Slidell, LA

DISTRICT: MVN **PREPARED:** **11/9/2023**
POC: CHIEF, COST ENGINEERING, Robert Guichet

This Estimate reflects the scope and schedule in report; St. Tammany Main Report

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2024									
						Effective Price Level Date: 1 OCT 23									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-23** ($K)	**TOTAL FIRST COST** ($K)	NFLATEI (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
02	RELOCATIONS	$21,299	$10,863	51.0%	$32,162	0.0%	$21,299	$10,863	$32,162	$0	$32,162	34.7%	$28,683	$14,628	$43,311
06	FISH & WILDLIFE FACILITIES	$45,108	$23,005	51.0%	$68,114	0.0%	$45,108	$23,005	$68,114	$0	$68,114	11.7%	$50,365	$25,686	$76,051
06	FISH & WILDLIFE FACILITIES	$12,312	$6,279	51.0%	$18,591	0.0%	$12,312	$6,279	$18,591	$0	$18,591	80.9%	$22,277	$11,361	$33,638
11	LEVEES & FLOODWALLS	$142,687	$72,770	51.0%	$215,457	0.0%	$142,687	$72,770	$215,457	$0	$215,457	20.3%	$171,608	$87,520	$259,128
11	LEVEES & FLOODWALLS	$49,572	$25,282	51.0%	$74,853	0.0%	$49,572	$25,282	$74,853	$0	$74,853	33.1%	$65,969	$33,644	$99,613
11	LEVEES & FLOODWALLS	$54,980	$28,040	51.0%	$83,020	0.0%	$54,980	$28,040	$83,020	$0	$83,020	62.4%	$89,271	$45,528	$134,799
11	LEVEES & FLOODWALLS	$47,106	$24,024	51.0%	$71,131	0.0%	$47,106	$24,024	$71,131	$0	$71,131	131.0%	$108,798	$55,487	$164,284
11	LEVEES & FLOODWALLS	$33,863	$17,270	51.0%	$51,132	0.0%	$33,863	$17,270	$51,132	$0	$51,132	281.2%	$129,099	$65,840	$194,939
11	LEVEES & FLOODWALLS	$284,115	$144,899	51.0%	$429,013	0.0%	$284,115	$144,899	$429,013	$0	$429,013	17.6%	$334,245	$170,465	$504,710
11	LEVEES & FLOODWALLS	$41,989	$21,415	51.0%	$63,404	0.0%	$41,989	$21,415	$63,404	$0	$63,404	34.5%	$56,490	$28,810	$85,300
13	PUMPING PLANT	$604,016	$308,048	51.0%	$912,064	0.0%	$604,016	$308,048	$912,064	$0	$912,064	17.0%	$706,699	$360,417	$1,067,116
15	FLOODWAY CONTROL & DIVERSION STRUCTURE	$87,227	$44,486	51.0%	$131,713	0.0%	$87,227	$44,486	$131,713	$0	$131,713	15.3%	$100,576	$51,294	$151,869
08	ROADS, RAILROADS & BRIDGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
09	CHANNELS & CANALS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
19	BUILDINGS, GROUNDS & UTILITIES	$1,605,522	$690,374	43.0%	$2,295,896		$1,605,522	$690,374	$2,295,896		$2,295,896	22.9%	$1,973,496	$848,603	$2,822,099
18	CULTURAL RESOURCE PRESERVATION	$13,523	$5,815	43.0%	$19,338		$13,523	$5,815	$19,338		$19,338	22.9%	$16,623	$7,148	$23,770
	CONSTRUCTION ESTIMATE TOTALS:	$3,043,319	$1,422,569	47%	$4,465,888	0.0%	$3,043,319	$1,422,569	$4,465,888	$0	$4,465,888	26.8%	$3,854,198	$1,806,431	$5,660,629
01	LANDS AND DAMAGES	$193,226	$48,307	25.0%	$241,533	0.0%	$193,226	$48,307	$241,533	$0	$241,533	20.3%	$232,434	$58,108	$290,542
30	PLANNING, ENGINEERING & DESIGN	$518,642	$246,374	47.5%	$765,017	0.0%	$518,642	$246,374	$765,017	$0	$765,017	33.8%	$693,225	$330,326	$1,023,551
31	CONSTRUCTION MANAGEMENT	$286,194	$135,597	47.4%	$421,791	0.0%	$286,194	$135,597	$421,791	$0	$421,791	39.9%	$399,548	$190,502	$590,051
	PROJECT COST TOTALS:	$4,041,382	$1,852,847	45.8%	$5,894,229		$4,041,382	$1,852,847	**$5,894,229**	$0	**$5,894,229**	28.3%	$5,179,405	$2,385,368	$7,564,774

GUICHET.ROBERT.LEE.JR.1230840470 Digitally signed by GUICHET.ROBERT.LEE.JR.1230840470 Date: 2024.02.01 13:53:27 -06'00'
CHIEF, COST ENGINEERING, Robert Guichet

ESTIMATED TOTAL PROJECT COST: **$7,564,774**

DIXON.AMY.ASKEGREN.1572555557 Digitally signed by DIXON.AMY.ASKEGREN.1572555557 Date: 2024.02.01 14:38:20 -06'00'
PROJECT MANAGER, Amy Dixon

KLOCK.TODD.MICHAEL.1266412467 Digitally signed by KLOCK.TODD.MICHAEL.1266412467 Date: 2024.02.02 08:32:18 -06'00'
CHIEF, REAL ESTATE, Judith Gutierrez

CONSTANCE.TROY.GERARD.1230833415 Digitally signed by CONSTANCE.TROY.GERARD.1230833415 Date: 2024.02.09 15:15:42 -06'00'
CHIEF, PLANNING, Troy Constance

Digitally signed by DUNN.CHRISTOPHER.LESLIE.1244566185 Date: 2024.02.20 10:29:18 -06'00'
CHIEF, ENGINEERING, Christopher Dunn

CHIEF, OPERATIONS, Michael Park

WAITS.STUART.SHANE.1120942170 Digitally signed by WAITS.STUART.SHANE.1120942170 Date: 2024.02.14 11:39:58 -06'00'
CHIEF, CONSTRUCTION, Stuart Waits

CHIEF, CONTRACTING,Cynthia Hall

CHIEF, PM-PB, Brad Inman

CHIEF, DPM, Mark Wingate

Mii Cost

Appendix B

St. Tammany Parish - West Slidell and South Slidell Ring Levee Combination

Description of Work:

The levee and floodwall system would consist of a total of approximately 18.5 miles (97,700 ft) of earthen levee and floodwall which includes approximately 15 miles (79,500 ft) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 ft) of separate (non-continuous) segments of a floodwall. Construction of the levee alignment would impact approximately 521 acres of permanent ROW and it would require approximately 7,079,000 cubic yards of fill, including fill material required for future levee lifts (estimates include a 30 percent contingency).

Properties: See property notes for more documentation and quantity take offs used in this estimate.

1. Latest Labor template was used.
2. Latest Equipment template was used. MII Equipment 2022 Region 03.
3. Latest Cost Book was used. 2022 MII English Cost Book
4. Average of Fuel Prices Quotes for the last year.
5. CMR: 4.875
6. Sales Tax: 8.7%

Estimated by	Steven Lowrie
Designed by	MVN
Prepared by	Steven Lowrie
Preparation Date	11/7/2023
Effective Date of Pricing	10/25/2023
Estimated Construction Time	Days

Labor ID: NOLA2023 EQ ID: EP22R03 Currency in US dollars TRACES MII Version 4.4

Description	Quantity	UOM	ProjectCost
IGE Format			**1,467,178,258.57**
01 Real Estate	**1**	**JOB**	*42,904,000.00* **42,904,000.00**
06 Fish and Wildlife Facilities	**1**	**JOB**	*45,108,396.65* **45,108,396.65**
A-1 West Slidell	**1**	**EA**	*713,553,406.49* **713,553,406.49**
1 Western Extension	**1**	**JOB**	*16,922,030.38* **16,922,030.38**
2 West Terminus to Bayou Paquet	**1**	**JOB**	*51,109,055.03* **51,109,055.03**
3 Bayou Paquet to Bayou Liberty	**1**	**JOB**	*181,451,810.79* **181,451,810.79**
4 Bayou Liberty to Bayou Bonfouca	**1**	**JOB**	*362,792,473.99* **362,792,473.99**
5 Bayou Bonfouca South Bank	**1**	**JOB**	*101,278,036.29* **101,278,036.29**
A-2 South Slidell	**1**	**EA**	*665,612,455.44* **665,612,455.44**
6 Oak Harbor Extension	**1**	**JOB**	*83,828,305.67* **83,828,305.67**
7 Slidell Ring I-10 to HWY 433	**1**	**EA**	*58,716,598.39* **58,716,598.39**
8 Old Spanish Trail Extention	**1**	**JOB**	*29,525,913.41* **29,525,913.41**
9 Hwy 433 to Kings Point	**1**	**JOB**	*168,539,605.29* **168,539,605.29**
10 Kings Point to HWY 190B	**1**	**EA**	*45,691,668.91* **45,691,668.91**
11 Substation Enclo. near HWY 190B	**1**	**JOB**	*38,480,103.34* **38,480,103.34**
12 Eastern Extention	**1**	**JOB**	*240,830,260.42* **240,830,260.42**

Labor ID: NOLA2023 EQ ID: EP22R03 Currency in US dollars TRACES MII Version 4.4

STPFS Non Structural Estimate

Estimated by	
Designed by	
Prepared by	Steven Lowrie
Preparation Date	11/9/2023
Effective Date of Pricing	10/31/2023
Estimated Construction Time	Days

Description	Quantity	UOM	ProjectCost
IGE Format			**1,769,367,149.21**
			150,322,400.00
01 Real Estate	**1**	**JOB**	**150,322,400.00**
			13,523,219.00
18 Cultural Resource Preservation	**1**	**JOB**	**13,523,219.00**
			1,605,521,530.21
19 Buildings, Grounds & Utilities	**1**	**JOB**	**1,605,521,530.21**
			112,100.00
Mobile Homes - Raised Structures	**417**	**EA**	**46,745,700.00**
			234,650.00
1 STY Pier - Raised Structures	**1,506**	**EA**	**353,382,900.00**
			223,250.00
2 STY Pier - Raised Structures	**296**	**EA**	**66,082,000.00**
			234,650.00
1 STY Slab - Raised Structures	**1,276**	**EA**	**299,413,400.00**
			247,000.00
2 STY Slab - Raised Structures	**2,088**	**EA**	**515,736,000.00**
			324,161,530.21
Dry Floodproofing	**1**	**JOB**	**324,161,530.21**

Labor ID: NOLA2023 EQ ID: EP22R03 Currency in US dollars TRACES MII Version 4.4

Cost and Schedule Risk Analysis (CSRA) Risk Register

Appendix C

ST. TAMMANY FEASIBILITY STUDY - DD1391-CSRM

April 2023

					Project Cost			Project Schedule		
REF	**Risk Type**	**Risk/Opportunity Event**	**Risk Event Description**	**PDT Discussions on Impact and Likelihood**	**Likelihood (C)**	**Impact (C)**	**Risk Level (C)**	**Likelihood (S)**	**Impact (S)**	**Risk Level (S)**
1	1 - Project & Program Management (PM)	Project Priority	Project competing with other projects, funding and resources. Experienced staff will not be available for this project because of other higher-priority project requirements. If additional budget is required, additional funds may be difficult to obtain if there are competing project priorities.	$4 Billion dollar project will have high priority. Since multiple high priority projects are occurring, It is possible that experienced staff will not be available causing delays. It is possible that we can attain help for other districts and A/Es to complete work. It is possible that due to competing high priority projects funding will be difficult to obtain. The engagement of the congressional delegation indicates high priority status for funding. Cost will have a negligible impact. The schedule will possibly be affect but the impact will be negligible due to outsourcing.	Unlikely	Negligible	**Low**	Possible	Marginal	**Low**
2	1 - Project & Program Management (PM)	Project Personnel Resources	Gov't personnel resources for project management and execution may be insufficient during peak periods of PED and Procurement.	Do not feel will be an issue. Personnel turnover and reassignments have been relatively low. Project will be a priority.	Unlikely	Negligible	**Low**	Unlikely	Marginal	**Low**
3	1 - Project & Program Management (PM)	E&D and S&A costs	Typical E&D and S&A percentages measured against construction were assumed. Actual costs could be different.	Template E&D and S&A percentage used. Actual costs could be vary from the assumed. This would be, in part, due to changed efforts related to project design changes, extended years resulting in more product updates and contracts. Policy are being made in order for less design issue during PED.	Possible	Critical	**High**	Possible	Marginal	**Low**
4	1 - Project & Program Management (PM)	Scope Maturity	Based on the current level of design and data available, the project scope/features could vary based upon results of further detailed investigation of the proposed sites.	Multiple discussion have occurred and it is very likely that scope maturity will occur. The risks have been accounted for in individual risk below.	Very Likely	Negligible	**Low**	Very Likely	Negligible	**Low**
5	1 - Project & Program Management (PM)	Accelerated schedule	Pressure to deliver project on an accelerated schedule	The present program does not have significant pressure to have an accelerated schedule. Risk remains low.	Possible	Marginal	**Low**	Possible	Marginal	**Low**
6	4 - External Risks (EX)	Funding Availability	Project has not been authorized but not has been appropriate for construction. Design and construction delays could occur pending funding, resulting in increased escalation costs.	Delay in funding availability is unlikely to affect to program schedule. Assumed that any delays caused by funding issues will be covered under regular annual inflation adjustments.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
7	4 - External Risks (EX)	Bid Protest Potential	Bid protests causing issues with award	Large project with significant profit potential may increase likelihood of bid protest. This may result in award to "less than" lowest price and/or impact/delay the schedule. However, given the long duration of the overall project, any 1 contract delay would have little overall impact. Bid protest in LA for civil works projects are unlikely. PDT Discussion.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
8	4 - External Risks (EX)	Market Conditions	Construction Market and bidding competition	To project market conditions 50 years into the future is difficult. Competition of levee and structures work has been robust in recent years. Do not foresee an issue in the future but due to the length of program durations, the project could experience worsening market conditions. Since worsening market conditions could happen, a medium risk was assumed. Low 0% High 2%.	Possible	Moderate	**Medium**	Possible	Negligible	**Low**
9	4 - External Risks (EX)	Fuel Cost	Potential for escalating fuel prices	If fuel prices escalate dramatically with global recovery, could increase costs of constructing project, especially levees with much of it truck hauled.	Possible	Moderate	**Medium**	Unlikely	Negligible	**Low**
10	4 - External Risks (EX)	Pile steel cost	Potential for escalating steel prices (H-Pile, Pipe Pile and Sheet pile)	H-Piles and sheet pile prices have fluctuated significantly. Assume High 10% increase.	Likely	Marginal	**Medium**	Likely	Negligible	**Low**
11	4 - External Risks (EX)	Concrete Cost	Potential for escalating Concrete	Concrete Material Prices have increased continuous in the couple of years. There is a possibility that it can increase more. Assume a likely 10% increase.	Possible	Negligible	**Low**	Possible	Negligible	**Low**
12	4 - External Risks (EX)	Sponsor Funding	Sponsor is responsible for LERRDS and cost share.	Sponsor funding should not be an issue. Project is a typical cost sharing, sponsor is responsible for LERRDS.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
13	4 - External Risks (EX)	Environmental Community	Lawsuits have been filed previously over project impacts.	USACE has successfully defended lawsuits in the past through full disclosure of impacts in the EIS. Future litigation will likely also not result in changes to the project. Project work continued during previous litigation and would likely be able to continue during any future litigations. Overall Lawsuit Risk is considered Low.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
14	4 - External Risks (EX)	Political factors change at local, state or federal	Gov't Turnover	Turnover at any level government can affect priority of project and potential affect funding stream. Possibly affect authorization date and then we would not be able to construction because of lack of funding. Due to the project being high priority it is unlikely that a huge delay in schedule will occur due gov't turnover.	Possible	Marginal	**Low**	Possible	Marginal	**Low**
15	4 - External Risks (EX)	Hurricane Risk	Hurricane Effects	Hurricane often occur and a process is already in place. Cost and Schedule changes will be taken into account under the construction risk category item mods.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
16	4 - External Risks (EX)	Escalation	The New Orleans area experiences escalation at a higher rate than what is included in the CWCCIS	Because the New Orleans area escalates at a higher rate than the CWCCIS, the project is undervalued when escalated to the midpoint of construction. Given this information, the CSRA includes the additional 1.2%/year escalation as the WC.	Likely	Critical	**High**	Likely	Negligible	**Low**
17	5 - Contract Acquisition Risks (CA)	Contract Acquisition Impacts	Acquisition strategy	Acquisition strategy not yet defined. D/B/B, not in time crunch, could be small business and possibly 8a. Estimate already assumes small business/set-a-side consistent with MVN goals (levees). Estimate assumes typical sub-contracting. If other acquisition strategies are used on any one/or selected projects, would have small impact on overall project cost and little or no impact on overall schedule but since the program is over 50 years, change is possible	Possible	Critical	**High**	Possible	Negligible	**Low**
18	7 - General Technical Risk (TR)	Hydraulics Uncertainty #1	Confidence in hydraulic models. ADCIRC Model - Coastal Modeling	ADCIRC Modeling was performed and the 100 year storm was selected to determine elevations for the West and South Slidell alignment. If the alignment does not change, risk of elevations changing are unlikely using the results with the 2021 CHS ADCIRC mesh from ERDC. In the event ERDC updates the ADCIRC mesh in the coming years (factoring in future subsidence and SLR) then there is a greater risk of future year design elevations changing. Uncertainty factor in model has been accounted for; but it is possible elevation change can occur. Due to embankment quantities having a 30% contingency (from Civil) (review with PDT team) impact is negligible. Will discuss with planning and see how high the risk for alignment change and structure to move to another body of water. Alignment change - risk is low.	Possible	Marginal	**Low**	Possible	Negligible	**Low**

ST. TAMMANY FEASIBILITY STUDY - DD1391-CSRM
April 2023

					Project Cost			Project Schedule		
REF	Risk Type	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood (C)	Impact (C)	Risk Level (C)	Likelihood (S)	Impact (S)	Risk Level (S)
19	8 - General Technical Risk (TR)	Hydraulics Uncertainty #2	Confidence in hydraulic models. HEC-RAS Model - Riverine Modeling	The HEC-RAS model was used to size pumping stations and drainage gates along the alignment using the 10-year frequency event. Due to lack of surveyed bathymetry data (estimated bathymetry was used in the model terrain), pumping capacity estimates and drainage gates sizes are anticipated to change along the West and South Slidell Levee alignment. Moderate differences between the surveyed bathymetry and what was estimated may result in a significant change in pumping capacity and drainage gate sizes. It has been determined that a 25% increase in cost of all sluice gates, sector gates and pumping stations adequately captures the posed risk of changes to sizes once representative surveys are integrated into the HEC-RAS model. Hydraulics preformed limited coastal overtopping analysis and given there were several transects used in determining wave run up in setting the top of levee, there is a minimal overtopping risk, and it is included in the 25%.	Possible	Critical	**High**	Possible	Negligible	**Low**
20	7 - General Technical Risk (TR)	Hydraulics Uncertainty #3	Confidence in hydraulic models. HEC-HMS Model - Hydrology Modeling	The HEC-HMS model was used to compute the precipitation boundary condition for the HEC-RAS model. The loss methodology along with the basin model domain used to compute the precipitation boundary condition are both elements of the HMS model that may be overestimating hydrologic runoff in the study area.	Unlikely	Marginal	**Low**	Unlikely	Negligible	**Low**
21	8 - General Technical Risk (TR)	Hydraulics Uncertainty #4	Swales along Levee footprint	A detailed analysis of the levee landside drainage was not performed except where the line of protection intersects major existing waterways and drainage features. The West and South Side Levee alignments are primarily in undeveloped areas with natural open water features which would offset the need of interior drainage features. Risk for additional drainage features is low, some local drainage swales along the toe maybe needed in the limited sections within developed areas. It is possible that swales be needed in the south and western portion of the	Possible	Marginal	**Low**	Possible	Negligible	**Low**
22	7 - General Technical Risk (TR)	DESIGN DEVELOPMENT - Structural #1	What level of design? Confidence in scope, investigations, design and critical qtys..	The go-by steel design for sluice and access gate did not consider surge in design; therefore, it is likely that the steel quantity will increase by 10% to 15%. The go by steel design for sluice and access gates scaled to account for the different sizes. Some of them were scaled to a much large gate. This would cause the members to become thicker and this was not take into account in scaled quantities. It is likely that the steel quantity will increase by 10%to 15%.	Likely	Marginal	**Medium**	Likely	Negligible	**Low**
23	7 - General Technical Risk (TR)	DESIGN DEVELOPMENT - Structural #2	Site conditions Change: Lidar vs Surveys and Hydraulic Change	The access gate and sluice gates will have minimal change due receiving survey but could have significant change if hydraulics Has model has risk. See REF 19.	Likely	Negligible	**Low**	Likely	Negligible	**Low**
24	7 - General Technical Risk (TR)	DESIGN DEVELOPMENT - Levee	What level of design? Confidence in scope, investigations, design and critical qtys.	Civil Discussion: Confident in levee quantities comes from the 30% contingency alrighty added to the quantity. The 30% take into account a possible change in alignment, accurate elevation (need confirmation from hydraulics) and change in levee slope (steepness or width of levee section). Since the alignment has changed several time, it is possible that the alignment can change and likely become longer.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
25	7 - General Technical Risk (TR)	Borrow/fill source identified/secured	Are borrow sources identified? Are the borrow sources secured?	Estimate assumes an average of 8 mile haul to proposed borrow pits. Also if the borrow sources is not secured then it is possible that a borrow source will not be occupied and another pit may be needed which could increase haul distance.	Possible	Critical	**High**	Possible	Negligible	**Low**
26	7 - General Technical Risk (TR)	Adequate access for Constructability	Access to Wildlife Refuge from a railroad	Access Wildlife Refuge is over a railroad track. Due to the railroad traffic and the one access to Bayou Bonfouca South Bank the typical embankment production rate will need to be decreased. See Ref 43	Likely	Negligible	**Low**	Likely	Negligible	**Low**
27	7 - General Technical Risk (TR)	Civil / Geotechnical Uncertainty #1	What level of design? Confidence in scope, investigations, design and critical qtys..	The West Slidell Alignment is an underdeveloped area which makes up approximately 9 miles of the 15 miles of levee in the project alignment. The only borings in the alignment are 16 in the Oak Harbor reach which is in a developed area along an existing embankment. This foundation is not indicative of the rest of the alignment and therefore would not result in reasonable assumptions for foundation design for the entire project. HSDRRS design standards require geotechnical explorations every 500 feet for flood risk management projects. The current study has investigations that are woefully deficient with respect to this criteria. Given the limited information, designers were only able to make conservative assumptions which resulted in a wide levee footprint with stability berms and geotextile reinforcement to meet 2032 elevations. The uncertainties related to the limited geotechnical investigations result in high risk. Due to the limited geotechnical investigations, the the high probability of poor subsurface conditions, and lessons learned in WSLP project, it was determined to add a 6' sand layer for 9 miles of the levee aligment.	Likely	Moderate	**Medium**	Possible	Marginal	**Low**
28	7 - General Technical Risk (TR)	Civil / Geotechnical Uncertainty #2	Width of ROW Changes	The study assumed a 300' ROW will be required based on the limited data and the uncertainity in the levee design. The final levee footprint may be wider than what was predicted in the feasibility study, therefore additional ROW beyond 300' maybe needed in order to construct the final levee section after PED. 20% increase in embankment quantity only on the initial lift. Due to the increase in quantity, schedule can be affect due maintaining invervals of settlement. It is possible that the project can be extended roughly 3 years passed the 50 year stated project time.	Likely	Marginal	**Medium**	Possible	Critical	**High**
29	7 - General Technical Risk (TR)	Civil / Geotechnical Uncertainty #3	Potential for Piles Length Changes	As with the embankment design, there is significant uncertanty in the foundation design (i.e., pile capacity curves) for this project given the lack of subsurface investigations (i.e., number of borings, boring locations, and depths of existing borings). Therefore, little confidence exists for the theoretical pile capacity curves developed as a part of this study. Due to this, designers assumed similar pile sizes and lengths based on those established from the WSLP designs (given the similar foundation conditions). This results in Medium risk for changes in pile sizes and lengths during PED. Due to the lack of information, it is assumed that the pile lengths will increase by 20% to 30%. Pile load test are likely to occur on this project and will increase confidence in actual pile capacity during construction.	Likely	Critical	**High**	Likely	Negligible	**Low**

ST. TAMMANY FEASIBILITY STUDY - DD1391-CSRM
April 2023

REF	Risk Type	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule		
					Likelihood (C)	Impact (C)	Risk Level (C)	Likelihood (S)	Impact (S)	Risk Level (S)
30	7 - General Technical Risk (TR)	Civil / Geotechnical Uncertainty	Geotech Change cross-section Change of Shape, Width, or berm	Given the limited information, designers were only able to make conservative assumptions which resulted in a single levee design west of Oak Harbor with wide stability berms and geotextile reinforcement to meet 2032 elevations. In feasibility, there is a limited number of design reaches which will likely increase significantly during PED. Due to limited number of design reaches and lesson learn from WSLP (quantity doubled), it was determined to add 20% embankment quantity to the initial lift in addition to the 30% added in Ref. 23. Due to the increase in quantity, schedule can be affect due maintaining invervals of settlement. It is possible that the project can be extended roughly 3 years passed the 50 year stated project time.	Very Likely	Marginal	**Medium**	Possible	Critical	**High**
31	7 - General Technical Risk (TR)	Civil / Geotechnical Uncertainty #4	Ground Surface Elevation Across Alignment	Surveys were not taken as part of the study and design information was based on lidar data. With full ground surveys taken during PED, the ground surface will likely prove to be different than what was assumed during the feasibility study. This results in 5% increase in embankment quantity.	Possible	Marginal	**Low**	Possible	Negligible	**Low**
32	7 - General Technical Risk (TR)	Civil / Geotechnical Uncertainty #5	ROW Change and Geotech Information – South and East Slidell Alignment	The ROW for South Slidell alignment is 160' and considers the existing cross-section without an interior drainage canal. If the levee sponsor is unable to acquire the necessary ROW for the levee footprint related to the current design assumptions, this would require redesign of the levee utilizing more costly construction methods. The final levee cross section may change based on a more detailed interior drainage analysis to identify levee toe drainage features (swales) which may be required in developed areas. Please see Ref # 21.(Mitigation Methods include deep mixing methods, vertical and horizontal wick drains, increase length pile etc.). The risk of the levee sponsor acquiring the needed ROW is unlikely. (Need to speak with environmental, real estate and PM) Due to the difficulty of sponsor acquiring ROW due to the existing infrastructure, it possible that required ROW will not be attained and longer Piles (20 %) will be needed for Floodwalls.	Possible	Critical	**High**	Possible	Negligible	**Low**
33	9 - Lands and Damages Risk (RE)	Real Estate Plan	Do we have a RE plan?	We have the RE plan. No real property acquisition have been done or authorized. # of affected landowners has been estimated. Real estate cost will be very small % of total project cost. Environmental mitigation has been identified. Mitigation included in project plan. LERDs is a Local Sponsor responsibility. (Non voluntary acquisition) We have some documentation from USFWS indicating they are amenable to the proposed plan. Only issue is timing of proposed land exchange. Delays to schedule possible but team is assuming that land exchange can be done concurrent with PED. The impact to the schedule is likely negligible.	Unlikely	Negligible	**Low**	Possible	Negligible	**Low**
34	9 - Lands and Damages Risk (RE)	Relocation Plan	Do we have a plan? Have the owners been contacted and provided input?	Cannot currently access all potential reaches in the proposed alignment. We are using 3 available databases for locating pipeline utilities etc. There is a small degree of uncertainty because while the owners have been contacted, they have provided little information. At this point most relocation plans are assumptions. Compensability report will be included, most will likely be compensable. Locals are building in these areas now.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
35	9 - Lands and Damages Risk (RE)	Induced Flooding - Areas Outside of Levees	May require a takings analysis	The team utilized hydraulic modeling and looked at flooding affects/water level with project in place and the increase to areas outside of the system were negligible. However, full analysis to be competed in PED. The chances of the need for more property rights due to flooding affects is negligible.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
36	9 - Lands and Damages Risk (RE)	Acquisition Costs and Schedule	Acquisition costs and schedule could be impacted if eminent domain proceedings are required.	If it is necessary to acquire through condemnation proceedings, the schedule and costs could be impacted. The project is generally supported by the Non Federal Sponsors. It is unlikely that the project schedule will be delayed due to condemnation proceedings. The real estate plan includes a contingency for possible extra condemnations. Cost impact is negligible.	Possible	Negligible	**Low**	Unlikely	Negligible	**Low**
37	10 - Relocations (RL)	unknown Utilities	Unknown utilities due to lack information	The lack of information could cause the identification of relocations to be missed. Relocations took worst case scenarios. Assumed it's likely to have unidentified utilities which would case a moderate impact to the relocation cost. Assume 15% to 20% relocation cost impact.	Likely	Negligible	**Low**	Likely	Negligible	**Low**
38	13 - Construction (CO)	Construction Contract Modifications	construction contract modifications can impact construction cost and schedule growth.	Technical complexities and site conditions could result in increased risk of contract modifications. Will impact costs, but little overall impact to larger project timeline. Cost Impact: Best Case - 5%, Likely - 9.8% and Worst Case - 17%. (From Construction Division)	Very Likely	Critical	**High**	Very Likely	Negligible	**Low**
39	13 - Construction (CO)	Alignment Revisions	Alignment revisions can impact Lands and Damages, Real Estate, Relocations, Environmental Mitigation and Utilities.	Staying on authorized alignment.	Unlikely	Marginal	**Low**	Unlikely	Negligible	**Low**
40	13 - Construction (CO)	WEATHER	impacts to project	Long overall project schedule so flexibility included. Typical conditions are already included in the schedule and costs. Levee affect by rain only 39% schedule. -Minor delays will not affect the overall program.	Likely	Negligible	**Low**	Likely	Negligible	**Low**
41	13 - Construction (CO)	ACCELERATED CONTRACT SCHEDULE	will jobs be rushed	Schedule will be mainly driven by funding.	Unlikely	Marginal	**Low**	Unlikely	Negligible	**Low**
42	13 - Construction (CO)	Unknown Utilities	Unknown utilities may impact costs.	Investigations done with all available databases. Could Schedule delays if unknown utilities are found. Schedule is on a overall 50 year program. Low Risk Cost would be handle in the modification,	Possible	Negligible	**Low**	Possible	Negligible	**Low**
43	13 - Construction (CO)	Work location/ site condition	Marshy area. Work will be over/on water	Common South LA work condition, water related work already assumed in costs and schedule. It's possible that the production could decrease for embankment due to marshy conditions (only initial construction excluding existing ring levee). Production Rate to 1000 CY/DAY.	Possible	Negligible	**Low**	Possible	Negligible	**Low**
44	13 - Construction (CO)	Poor Performing Contractor	Poor performing contractors can significantly delay individual contracts.	Individual contracts will be impacted by poor performing contractors. Overall program schedule is not likely to be impacted. Contracts are independent. Program Risk is low and not modeled.	Possible	Marginal	**Low**	Possible	Marginal	**Low**
45	13 - Construction (CO)	Site Access and Site Constraints	Bayou Bonfouca South Bank Alignment has 1 access and railroad tracks on the access. Conflicts with other contracts	Other access roads can be mitigated at a low cost.	Possible	Marginal	**Low**	Possible	Negligible	**Low**
46	14 - Estimate and Schedule Risks (ES)	LABOR & equipment AVAILABILITY/PRICING	Labor shortages and increase rates	National economy is in a slump, lots of available local labor	Unlikely	Marginal	**Low**	Unlikely	Negligible	**Low**
47	14 - Estimate and Schedule Risks (ES)	MATERIAL AVAILABILITY/PRICING	Material shortages and increased cost	Projects are using standard materials, quotes for all major materials, long overall project timeline - no rush.	Likely	Significant	**High**	Likely	Negligible	**Low**

ST. TAMMANY FEASIBILITY STUDY - DD1391-CSRM

April 2023

					Project Cost			Project Schedule		
REF	**Risk Type**	**Risk/Opportunity Event**	**Risk Event Description**	**PDT Discussions on Impact and Likelihood**	**Likelihood (C)**	**Impact (C)**	**Risk Level (C)**	**Likelihood (S)**	**Impact (S)**	**Risk Level (S)**
48	14 - Estimate and Schedule Risks (ES)	Government Furnish vs Contractor Furnished.	Changing from Government to Contractor furnished	It possible that portion of the Government furnish borrow will be converted to Contractor Furnished. Assume 20%.	Likely	Marginal	**Medium**	Likely	Negligible	**Low**
49	15 - Estimate and Schedule Risks (ES)	Allowances in MII estimate	275 Allowances	275 Allowances for $31.4 M. Price could be higher since estimate was done in 2022. Assume 5% increase.	Likely	Negligible	**Low**	Likely	Negligible	**Low**
50	16 - Estimate and Schedule Risks (ES)	Rebar	Concern rebar price attained is low	Concern that the price quote is low because it may not include detailing (shop drawings), bending, shearing and tagging. Price was confirmed.	Likely	Negligible	**Low**	Likely	Negligible	**Low**
51	21 - Environmental & Cultural/Historical Resources (EC)	Impacts to High Value Habitats	Impacts to High Value Habitats (incl Essential fish habitat)	Pine Savannah and Fresh Intermediate Marsh will be impacted by the alignment. Overall cost impacts to the project are small. A more refined model will be done for Pine Savannah during PED. Any changes will be captured in the existing contingency withing provide cost. After the running the model it is possible that more mitigation will be needed. The addition of mitigation is included in the contingencies mentioned above. Alignment changes can impact cost but are minimal unless a dramatic change in alignment occurs. Fresh Intermediate Marsh Unless alignment changes or bigger, the WVA model would not need to	Possible	Marginal	**Low**	Possible	Negligible	**Low**
52	21 - Environmental & Cultural/Historical Resources (EC)	HAZARDOUS WASTE SITE ANALYSIS	HTRW Phase I site assessment is already completed.	Avoiding all HTRW issues. Nothing in alignment triggered Phase II investigation. As long as alignment doesn't change, there is a low likelihood of triggering HTRW. Without right of entry, a drive by occurred and personnel got as close as possible to assess the area that are in the subject right of way. When right of entry is granted, HTRW assumption can be confirmed.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
53	21 - Environmental & Cultural/Historical Resources (EC)	NEPA	more NEPA required?	If there are changes to the project than addition NEPA will be conducted during PED. It is likely based on design changes which are very likely to occur.	Very Likely	Negligible	**Low**	Very Likely	Negligible	**Low**
54	21 - Environmental & Cultural/Historical Resources (EC)	endangered species	Redcocaded Woodpecker	If the project alignment changes on the refuge there could be averse impacts to the RCW. More impacts to the RCW = more mitigation. Additional mitigation already in contingency discussed in habit impacts. Additional NEPA for PED will be need but the impact is negligible.	Possible	Negligible	**Low**	Possible	Negligible	**Low**
55	21 - Environmental & Cultural/Historical Resources (EC)	Section 106 (NHPA) Compliance	Study requires the negotiation of a Programmatic Agreement (PA).	CEMVN has initiated Section 106 consultation and has developed a PA in consultation with the NFS, LA SHPO, Advisory Council on Historic Preservation (ACHP), federally-recognized tribes, and other interested parties, that will establish procedures to satisfy the agency's Section 106 responsibilities pursuant to 36 CFR Part 800.14(b). As of October 2022, the final PA is with OC for review. CEMVN may not proceed with issuing a ROD in compliance with NEPA and Section 106 of the NHPA without the successful execution of the PA.	Unlikely	Negligible	**Low**	Unlikely	Negligible	**Low**
56	21 - Environmental & Cultural/Historical Resources (EC)	Inability to avoid and/or minimize adverse effects to potential historic properties	A significant amount of the study area has not been surveyed for cultural resources. Cultural resources assessment uses existing data and information only since survey will be completed in PED.	CEMVN has developed a Programmatic Agreement (PA) to fulfill its Section 106 procedures. The PA outlines the steps needed to identify and evaluate cultural resources and make determinations of effects. If direct adverse effects to cultural resources are identified and cannot be avoided or minimized, such impacts would be mitigated through the procedures outlined in the PA.	Possible	Marginal	**Low**	Possible	Negligible	**Low**
57	21 - Environmental & Cultural/Historical Resources (EC)	Inadvertent discovery of cultural resources during construction	Cultural resources or historic properties may unexpectedly be encountered during project construction based on the project location or type of work. These unforeseen finds are called an inadvertent discovery, which could increase project construction costs, delay construction schedule, or require modifications to the project.	Discoveries of previously unidentified historic properties or unanticipated adverse effects to known historic properties are not anticipated; however, if there is an inadvertent discovery or unanticipated effect, CEMVN will ensure the stipulations in the Programmatic Agreement (PA) will be fulfilled.	Possible	Marginal	**Low**	Possible	Negligible	**Low**

STPFS - Non-Structural - Design
November 2023

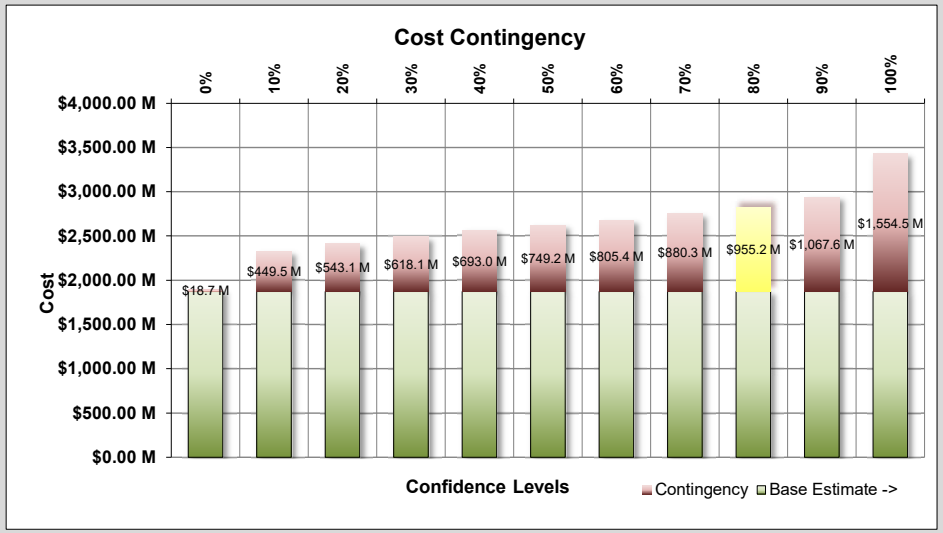
REF	Risk Type	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Project Cost			Project Schedule		
					Likelihood (C)	Impact (C)	Risk Level (C)	Likelihood (S)	Impact (S)	Risk Level (S)
1	1 - Project & Program Management (PM)	PED and S&A Costs	Project assumes the Fed Gov't will perform high level administration. The PDT's concern is that the Fed Gov't may have to implement a more robust administration/ inspection/approval process for the program.	It is still unclear exactly how this program willl be implemented / administered; but it was assumed that the Federal Govt will administer at a high level. If the Govt has to implement a full administration plan to the lowest levels, it would add considerable administrative costs - PED and S&A.	Likely	Critical	**High**	Likely	Critical	**High**
2	1 - Project & Program Management (PM)	Inventory of Eligible Structures	The PDT's concern is that the structure inventory could vary significantly from the current inventory. However, implementation of other similar projects has proven that the inventory generally reduces as a project moves from feasibility to implementation.	This risk item considers the accuracy of the inventory of structures eligible for the nonstructural program. The inventory, which is the basis for the nonstructural cost estimate, was developed in 2020 and considered conservative. Basis for the inventory is the National Structure Inventory. The foundation heights of the structures were developed through a stratified random sample of a visual inspection. It is assumed structures constructed after this survey would not be eligible nor have a need for this project because they would have been built to the new code. Assume that risk of inventory increasing is unlikely.	Unlikely	Marginal	**Low**	Unlikely	Negligible	**Low**
3	1 - Project & Program Management (PM)	Scope Maturity	Concern that unanticipated items of work could be added as part of the program as it is developed. Total number structures being raised and dry floodproofing within a year may extended schedule. May not be able to raise enough homes/year to maintain an appropriate schedule.	This item is to address the concern that due to the early program development stage, extended period of completion, number of structures and political pressure of dealing directly with the public, there could be un-anticipated items of work that could be added/required and extend to schedule.	Likely	Critical	**High**	Likely	Negligible	**Low**
4	5 - Contract Acquisition Risks (CA)	Contract Acquisition	limited competition during contract procurement could increase bid prices.	The base estimate assumes open and competitive bidding which is the traditionally employed contract procurement method. However, often competition will be limited due to certain small business objectives, using small groups of pre-approved contractors, or with the intent of improving overall quality of construction (best-value procurements). The house elevating costs are based on the limited pool available in the LA area, so some limited competition could be considered to already be built into the costs. There is a risk not knowing the exact implementation plan could cause increased levels of tiered subcontracting and/or limit the pool of contractors.	Likely	Critical	**High**	Likely	Critical	**High**
5	13 - Construction (CO)	Availability of Floodproof Contractors	The concern is that the contracting pool could not be sufficient to support this project thereby reducing production, quality, and competitive market.	The base estimate assumes that there is no issue in obtaining capable contractors to perform the construction associated with the nonstructural floodproofing efforts. There is the risk that if you were to flood the market with a robust budget in a given time period and had a limited pool of contractors you could greatly increase contractor prices.	Likely	Critical	**High**	Likely	Marginal	**Medium**
6	13 - Construction (CO)	Unknown Cultural Resources	cultural resources might be encountered.	Work is on existing property/structures.	Unlikely	Moderate	**Low**	Unlikely	Moderate	**Low**
7	13 - Construction (CO)	Construction Contract Modifications	concern that construction contract modifications/claims could impact cost and schedule.	Dealing with the public, occupied structures, and unknown site conditions could result in increased risk of contract modifications/claims. Will impact costs, but little overall impact to larger project timeline.	Likely	Critical	**High**	Likely	Negligible	**Low**
8	14 - Estimate and Schedule Risks (ES)	Required Raise Height	The concern is that assumed ground elevations may not be accurate and could result in a higher "required" raise amount.	The existing ground elevation was taken from 2017 LIDAR which is considered to be reasonably accurate for this level of detail. The calculated "raise" height was rounded UP based on efficiencies in the cost estimate. The Std deviation is less than 1 ft based on the check surveys of LIDAR data. A one foot difference in elevation costs the same in many cases. Raise height calculations considered conservative.	Likely	Negligible	**Low**	Likely	Negligible	**Low**
9	14 - Estimate and Schedule Risks (ES)	Temporary Relocation of Residents	temporary relocation assistance during residential house elevating is NOT currently allowed for homeowners.	Due to public outrage Gov't may be forced to provide relocation assistance during construction on residential structures. Based on available information, avg outage is approximately 45 days. Add 15 days due the robust amount of contractor that may be needed to complete home raise. Cost will be included in Real Estate cost.	Possible	Negligible	**Low**	Possible	Negligible	**Low**
10	14 - Estimate and Schedule Risks (ES)	Assumed Average Structure Size	concern that the "average" structure size by occupancy type used in the claculations may not truly represent the total of the actual sizes affected and therefore under-represent the project cost.	Due to large volume there is no way to estimate using individual dimensions, so they were averaged into an "average" structure for the various types. Accuracy of the size data method could result in variations from the actual sizes and cause the total cost to increase. Sizes were determined from aerial photographs but a field recon was also performed.	Likely	Critical	**High**	Likely	Negligible	**Low**
11	4 - External Risks (EX)	Owner Participation Rate	This item is perceived by the PDT to potentially be a significant opportunity. Historical participation rates in other programs have varied widely from project to project (ex. LRH's nonstructural program ranging from a low of about 5% to a high of about 80 with an average of about 56%).	The nonstructural program involves voluntary participation on the part of individuals at risk due to flooding. A 100% participation rate has been conservatively assumed in the cost estimate. Therefore, no chance of cost increases, only cost decrease. This risk element is negative so it is likely to have a cost reduction effect. Due to recommendation from ATR reviewer: "Owner participation simulates an opportunity, as many homeowners may not wish to participate. However, benefits have been calculated assuming 100% participation. Recommend removing this risk as an opportunity." The risk was removed.	Very Likely	Negligible	**Low**	Very Likely	Negligible	**Low**
12	4 - External Risks (EX)	Intermittent Funding	Receiving inadequate Federal or State funds will result in inefficient effort and contract procurements. The overall implementation of the project could be affected, exposing the project to greater risk of inflation.	This is one of the most difficult risk to quantify and yet has the potential to negatively affect the project's final cost and schedule. The PDT has little or no influence over this risk item. The project is fully supported by the State. Intermittant funding could result in increased construction schedule resulting in construction cost escallation.	Likely	Negligible	**Low**	Likely	Critical	**High**
13	4 - External Risks (EX)	Escalation	The New Orleans area experiences escalation at a higher rate than what is included in the CWCCIS	Because the New Orleans area escalates at a higher rate than the CWCCIS, the project is undervalued when escalated to the midpoint of construction. Given this information, the CSRA includes the additional 1.2%/year escalation as the WC.	Very Likely	Critical	**High**	Unlikely	Negligible	**Low**
14	7 - General Technical Risk (TR)	Technical / Design Changes	possible design changes/ technical requirements for implementation	This item is to address the concern that due to the extended period of completion, there could be future design / technical changes to design criteria or hydraulic analysis that would result in increased requirements and cost. H&H models could change height as design matures but height increase has minimal affect on cost.	Likely	Negligible	**Low**	Likely	Negligible	**Low**

Mitigation

Appendix D

Project: ST. TAMMANY FEASIBILITY STUDY-CSRM **Overall Risk Level** Cost: High Schedule: Medium

Location: SLIDELL, LA



Contingency on Base Estimate	80% Confidence Project Cost
	51%

Contingency on Base Schedule	##########
Base Schedule Start Date -> August 8, 2025	
Base Schedule Finish Date -> August 8, 2076	
Base Schedule Duration -> 612.0 Months	9%
Schedule Contingency Duration -> 55.1 Months	
Base Schedule w/ Contingency (80% Confidence) -> 667.1 Months	
Base Finish Date w/ Contingency (80% Confidence) -> March 11, 2081	

Project Description

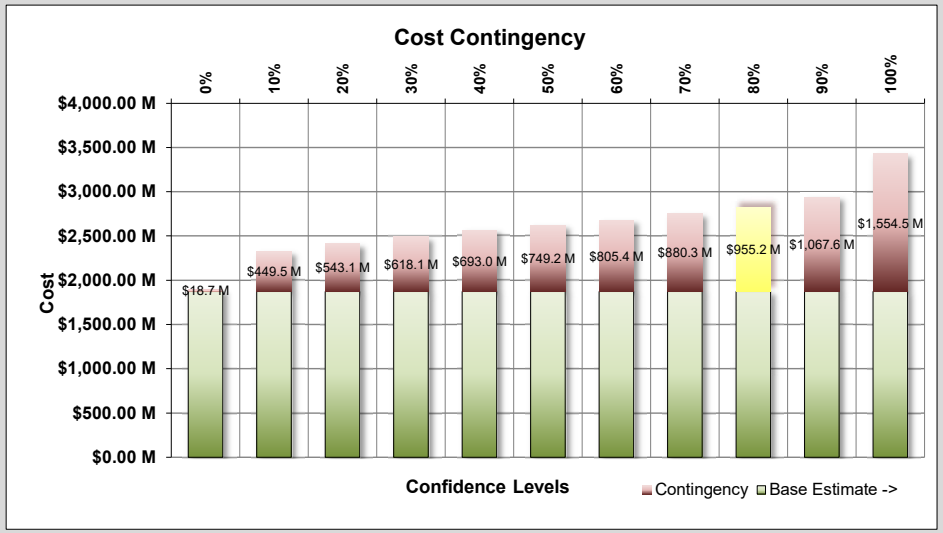
The levee and floodwall system would consist of a total of approximately 18.5 miles (97,700 ft) of earthen levee and floodwall which includes approximately 15 miles (79,500 ft) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 ft) of separate (non-continuous) segments of a floodwall. Construction of the levee alignment would impact approximately 521 acres of permanent ROW and it would require approximately 7,079,000 cubic yards of fill, including fill material required for future levee lifts (estimates include a 30 percent contingency).

CSRM TOP COST RISKS

Risk/Opportunity Event		Risk Event Description	PDT Discussions on Impact and Likelihood	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share,
				Cost	Schedule	
17	Contract Acquisition Impacts	Acquisition strategy	Acquisition strategy not yet defined. D/B/B, not in time crunch, could be small business and possibly 8a. Estimate already assumes small business/set-a-side consistent with MVN goals (levees). Estimate assumes typical sub-contracting. If other acquisition strategies are used on any one/or selected projects, would have small impact on overall project cost and little or no impact on overall schedule but since the program is over 50 years, change is possible	High	Low	Contract acquistion is determine by district goals, program manager, and contracting officers. This risk needs to be monitored as breaking the project into smaller pieces will result in a larger overall cost. Although baseline estimate includes indirect cost for small businesses it does not take into account the addition time and mob/demob cost. This risk will be monitored throughout the project. Cost will be adjusted as the design matures.
38	Construction Contract Modifications	construction contract modifications can impact construction cost and schedule growth.	Technical complexities and site conditions could result in increased risk of contract modifications. Will impact costs, but little overall impact to larger project timeline. Cost Impact: Best Case - 5%, Likely - 9.8% and Worst Case - 17%. (From Construction Division)	High	Low	Modification are typical for most projects. This risk occurs during construction and is usually due to differing site conditions. This will monitored by project manager, construction, contracting officer, and the technical lead. Although all efforts will be made to identify site existing conditions, there is still a risk that mods will occur.
16	Escalation	The New Orleans area experiences escalation at a higher rate than what is included in the CWCCIS	Because the New Orleans area escalates at a higher rate than the CWCCIS, the project is undervalued when escalated to the midpoint of construction. Given this information, the CSRA includes the additional 1.2%/year escalation as the WC.	High	Low	This risk models the possibility the inflation maybe different from CWCCIS. The trigger will be cost updates to the estimate over time. If this happens either a LRR or GRR will occur depending on project maturity. The risk owner is the program manager and the economist who will monitor this risk. There is not much that can be done to this risk except to monitor and accept.

Project: ST. TAMMANY FEASIBILITY STUDY-CSRM **Overall Risk Level** Cost: High Schedule: Medium

Location: SLIDELL, LA



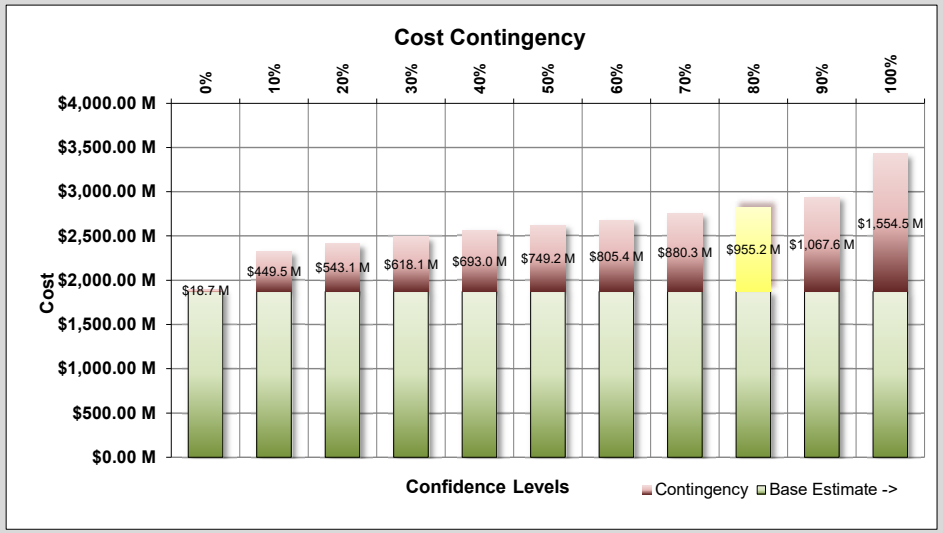
Project Description

The levee and floodwall system would consist of a total of approximately 18.5 miles (97,700 ft) of earthen levee and floodwall which includes approximately 15 miles (79,500 ft) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 ft) of separate (non-continuous) segments of a floodwall. Construction of the levee alignment would impact approximately 521 acres of permanent ROW and it would require approximately 7,079,000 cubic yards of fill, including fill material required for future levee lifts (estimates include a 30 percent contingency).

29	Civil / Geotechnical Uncertainty #3	Potential for Piles Length Changes	As with the embankment design, there is significant uncertanty in the foundation design (i.e., pile capacity curves) for this project given the lack of subsurface investigations (i.e., number of borings, boring locations, and depths of existing borings). Therefore, little confidence exists for the theoretical pile capacity curves developed as a part of this study. Due to this, designers assumed similar pile sizes and lengths based on those established from the WSLP designs (given the similar foundation conditions). This results in Medium risk for changes in pile sizes and lengths during PED. Due to the lack of information, it is assumed that the pile lengths will increase by 20% to 30%. Pile load test are likely to occur on this project and will increase confidence in actual pile capacity during construction.	High	Low	Currently no soil borings exist in the majority of the project. As the project matures additional design work will be performed along with soil borings. This risk will be monitored by the project manager, geotechnical engineering and the technical lead. Soil borings will affect many aspects of the project and will be closely monitored.
19	Hydraulics Uncertainty #2	Confidence in hydraulic models. HEC-RAS Model - Riverine Modeling	The HEC-RAS model was used to size pumping stations and drainage gates along the alignment using the 10-year frequency event. Due to lack of surveyed bathymetry data (estimated bathymetry was used in the model terrain), pumping capacity estimates and drainage gates sizes are anticipated to change along the West and South Slidell Levee alignment. Moderate differences between the surveyed bathymetry and what was estimated may result in a significant change in pumping capacity and drainage gate sizes. It has been determined that a 25% increase in cost of all sluice gates, sector gates and pumping stations adequately captures the posed risk of changes to sizes once representative surveys are integrated into the HEC-RAS model. Hydraulics preformed limited coastal overtopping analysis and given there were several transects used in determining wave run up in setting the top of levee, there is a minimal overtopping risk, and it is included in the 25%.	High	Low	As the project matures additional design will be done. H&H models may change requiring different pumping capacities and locations. This risk will be monitored collectively by the project manager, H&H and the technical lead.
47	MATERIAL AVAILABILITY/PRICING	Material shortages and increased cost	Projects are using standard materials, quotes for all major materials, long overall project timeline - no rush.	High	Low	The possibility that a material shortage could happen are low but material violitity is possible. This risk will be monitor by the cost engineer and updates to material cost will occur every 2 years.

Project: ST. TAMMANY FEASIBILITY STUDY-CSRM **Overall Risk Level** Cost: High Schedule: Medium

Location: SLIDELL, LA



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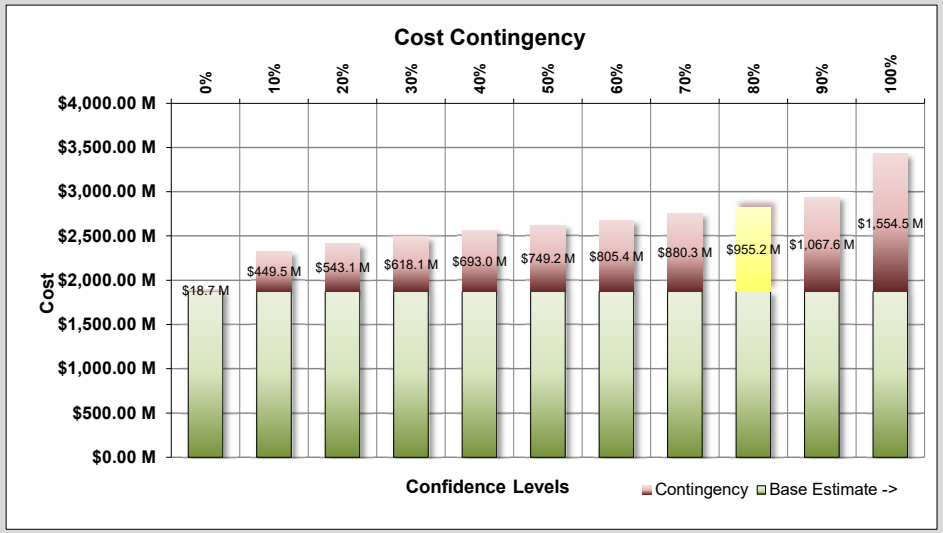
3	E&D and S&A costs	Typical E&D and S&A percentages measured against construction were assumed. Actual costs could be different.	Template E&D and S&A percentage used. Actual costs could be vary from the assumed. This would be, in part, due to changed efforts related to project design changes, extended years resulting in more product updates and contracts. Policy are being made in order for less design issue during PED.	High	Low	
25	Borrow/fill source identified/secured	Are borrow sources identified? Are the borrow sources secured?	Estimate assumes an average of 8 mile haul to proposed borrow pits. Also if the borrow sources is not secured then it is possible that a borrow source will not be occupied and another pit may be needed which could increase haul distance.	High	Low	
9	Fuel Cost	Potential for escalating fuel prices	If fuel prices escalate dramatically with global recovery, could increase costs of constructing project, especially levees with much of it truck hauled.	Medium	Low	
8	Market Conditions	Construction Market and bidding competition	To project market conditions 50 years into the future is difficult. Competition of levee and structures work has been robust in recent years. Do not foresee an issue in the future but due to the length of program durations, the project could experience worsening market conditions. Since worsening market conditions could happen, a medium risk was assumed. Low 0% High 2%	Medium	Low	

Project: ST. TAMMANY FEASIBILITY STUDY-CSRM **Overall Risk Level** Cost: High Schedule: Medium

Location: SLIDELL, LA



Contingency on Base Estimate	80% Confidence Project Cost
	51%

Contingency on Base Schedule	##########
Base Schedule Start Date -> August 8, 2025	
Base Schedule Finish Date -> August 8, 2076	
Base Schedule Duration -> 612.0 Months	9%
Schedule Contingency Duration -> 55.1 Months	
Base Schedule w/ Contingency (80% Confidence) -> 667.1 Months	
Base Finish Date w/ Contingency (80% Confidence) -> March 11, 2081	

Project Description

The levee and floodwall system would consist of a total of approximately 18.5 miles (97,700 ft) of earthen levee and floodwall which includes approximately 15 miles (79,500 ft) of levees constructed in separate (non-continuous) segments, and 3.5 miles (18,200 ft) of separate (non-continuous) segments of a floodwall. Construction of the levee alignment would impact approximately 521 acres of permanent ROW and it would require approximately 7,079,000 cubic yards of fill, including fill material required for future levee lifts (estimates include a 30 percent contingency).

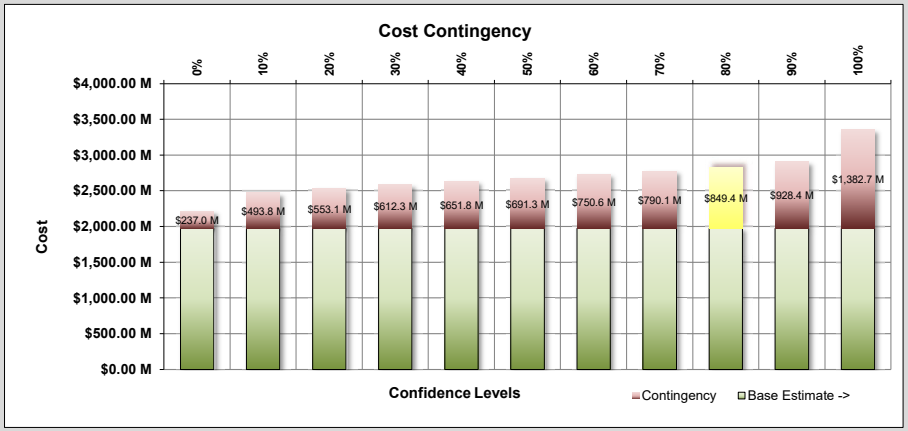
TOP SCHEDULE RISKS

Risk/Opportunity Event		Risk Event Description	PDT Discussions on Impact and Likelihood	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share,
				Cost	Schedule	
30	Civil / Geotechnical Uncertainty	Geotech Change cross-section Change of Shape, Width, or berm	Given the limited information, designers were only able to make conservative assumptions which resulted in a single levee design west of Oak Harbor with wide stability berms and geotextile reinforcement to meet 2032 elevations. In feasibility, there is a limited number of design reaches which will likely increase significantly during PED. Due to limited number of design reaches and lesson learn from WSLP (quantity doubled), it was determined to add 20% embankment quantity to the initial lift in addition to the 30% added in Ref. 23. Due to the increase in quantity, schedule can be affect due maintaining invervals of settlement. It is possible that the project can be extended roughly 3 years passed the 50 year stated project time.	Medium	High	Currently no soil borings exist in the majority of the project. As the project matures additional design work will be performed along with soil borings. This risk will be monitored by the project manager, geotechnical engineering and the technical lead. Soil borings will affect many aspects of the project and will be closely monitored.
28	Civil / Geotechnical Uncertainty #2	Width of ROW Changes	The study assumed a 300' ROW will be required based on the limited data and the uncertainity in the levee design. The final levee footprint may be wider than what was predicted in the feasibility study, therefore additional ROW beyond 300' maybe needed in order to construct the final levee section after PED. 20% increase in embankment quantity only on the initial lift. Due to the increase in quantity, schedule can be affect due maintaining invervals of settlement. It is possible that the project can be extended roughly 3 years passed the 50 year stated project time.	Medium	High	Currently no soil borings exist in the majority of the project. As the project matures additional design work will be performed along with soil borings. This risk will be monitored by the project manager, geotechnical engineering and the technical lead. Soil borings will affect many aspects of the project and will be closely monitored.

Project: STPFS - Non-Structural

Location: Slidell

Overall Risk Level — Cost: **High** | Schedule: **Medium**



Project Description

The proposed work would consist of 5583 home raises and 827 commercials dry floodproofing.

TOP COST RISKS

	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Risk Level		Suggested Risk Reduction Measures (Avoid, Escalate, Exploit, Transfer/Share, Mitigate/Enhance, or Accept)
				Cost	Schedule	
3	Scope Maturity	Concern that unanticipated items of work could be added as part of the program as it is developed. Total number structures being raised and dry floodproofing within a year may extended schedule. May not be able to raise enough homes/year to maintain an appropriate schedule.	This item is to address the concern that due to the early program development stage, extended period of completion, number of structures and political pressure of dealing directly with the public, there could be un-anticipated items of work that could be added/required and extend to schedule.	High	Low	This risk models the the unanticipated item of work that could be added. As more guidance is received, the implementation plan and cost associated with the implementation plan will become more refined and adjustments will be made. This risk will be monitored throughout the project.
4	Contract Acquisition	limited competition during contract procurement could increase bid prices.	The base estimate assumes open and competitive bidding which is the traditionally employed contract procurement method. However, often competition will be limited due to certain small business objectives, using small groups of pre-approved contractors, or with the intent of improving overall quality of construction (best-value procurements). The house elevating costs are based on the limited pool available in the LA area, so some limited competition could be considered to already be built into the costs. There is a	High	High	Contract acquistion is determine by district goals, program manager, and contracting officers. As project matures, the implementation plan will become more clear and adjustments will be made as project moves forward. This risk will be monitored throughout the project. Cost will be adjusted as the plan matures.
10	Assumed Average Structure Size	concern that the "average" structure size by occupancy type used in the claculations may not truly represent the total of the actual sizes affected and therefore under-represent the project cost.	Due to large volume there is no way to estimate using individual dimensions, so they were averaged into an "average" structure for the various types. Accuracy of the size data method could result in variations from the actual sizes and cause the total cost to increase. Sizes were determined from aerial photographs but a field recon was also performed.	High	Low	The risk models the assumed average structure size. As more information is attained through preliminary investigation of homes and commericial building, the structure size will become more evident. This risk will be monitored by program manager and economist.
13	Escalation	The New Orleans area experiences escalation at a higher rate than what is included in the CWCCIS	Because the New Orleans area escalates at a higher rate than the CWCCIS, the project is undervalued when escalated to the midpoint of construction. Given this information, the CSRA includes the additional 1.2%/year escalation as the WC.	High	Low	This risk models the possibility the inflation maybe different from CWCCIS. The trigger will be cost updates to the estimate over time. If this happens either a LRR or GRR will occur depending on project maturity. The risk owner is the program manager and the economist who will monitor this risk.
5	Availability of Floodproof Contractors	The concern is that the contracting pool could not be sufficient to support this project thereby reducing production, quality, and competitive market.	The base estimate assumes that there is no issue in obtaining capable contractors to perform the construction associated with the nonstructural floodproofing efforts. There is the risk that if you were to flood the market with a robust budget in a given time period and had a limited pool of contractors you could greatly increase contractor prices.	High	Medium	The risk models the availability of floodproof contractors. With the possibility of other projects aside from St. Tammany Feasibility Study being constructions and the number of structures to be flood proofed, it is a concern that the floodproofing market could be strained. This risk will be monitored by program manager and economist.
7	Construction Contract Modifications	concern that construction contract modifications/claims could impact cost and schedule.	Dealing with the public, occupied structures, and unknown site conditions could result in increased risk of contract modifications/claims. Will impact costs, but little overall impact to larger project timeline.	High	Low	
1	PED and S&A Costs	Project assumes the Fed Gov't will perform high level administration. The PDT's concern is that the Fed Gov't may have to implement a more robust administration/ inspection/approval process for the program.	It is still unclear exactly how this program willl be implemented / administered; but it was assumed that the Federal Govt will administer at a high level. If the Govt has to implement a full administration plan to the lowest levels, it would add considerable administrative costs - PED and S&A.	High	High	This risk models the additional PED and S&A that can occur due to Fed Gov't performing high level of administration. As the implentation plan changes are confirmed, Fed Gov't may use lower admisitration methods due to the type of work being done. This risk will be monitored by program manager.
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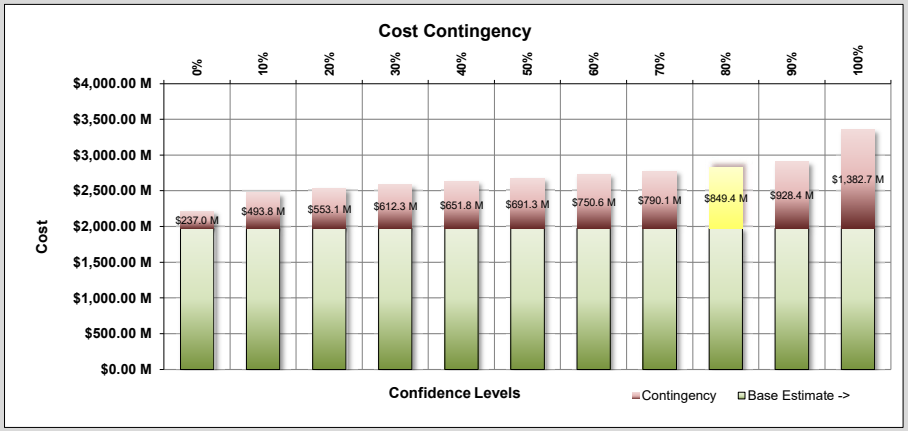
Project: STPFS - Non-Structural

Overall Risk Level — Cost: **High** | Schedule: **Medium**

Location: Slidell



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TOP SCHEDULE RISKS

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12	Intermittent Funding	Receiving inadequate Federal or State funds will result in inefficient effort and contract procurements. The overall implementation of the project could be affected, exposing the project to greater risk of inflation.	This is one of the most difficult risk to quantify and yet has the potential to negatively affect the project's final cost and schedule. The PDT has little or no influence over this risk item. The project is fully supported by the State. Intermittant funding could result in increased construction schedule resulting in construction cost escallation.	Low	High	This risk models intermittend funding and it's dependence on the support of the State. There is not much that can be done except monitor risk. This risk will be monitored by program manager and economist.
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