

## EXHIBIT B

### Scope of Work

#### Semi-Quantitative Risk Assessment (SQRA) for the National Flood Insurance Program (NFIP)

#### Clark Fork Area V Federal Levee Missoula, Montana

**Title:** National Flood Insurance Program (NFIP) Evaluation of the Clark Fork Area V Levee System

**Program:** Accelerated levee system evaluation under Section 3014(b) of the Water Resources Reform and Development Act of 2014

## BACKGROUND INFORMATION

### PROJECT DESCRIPTIONS:

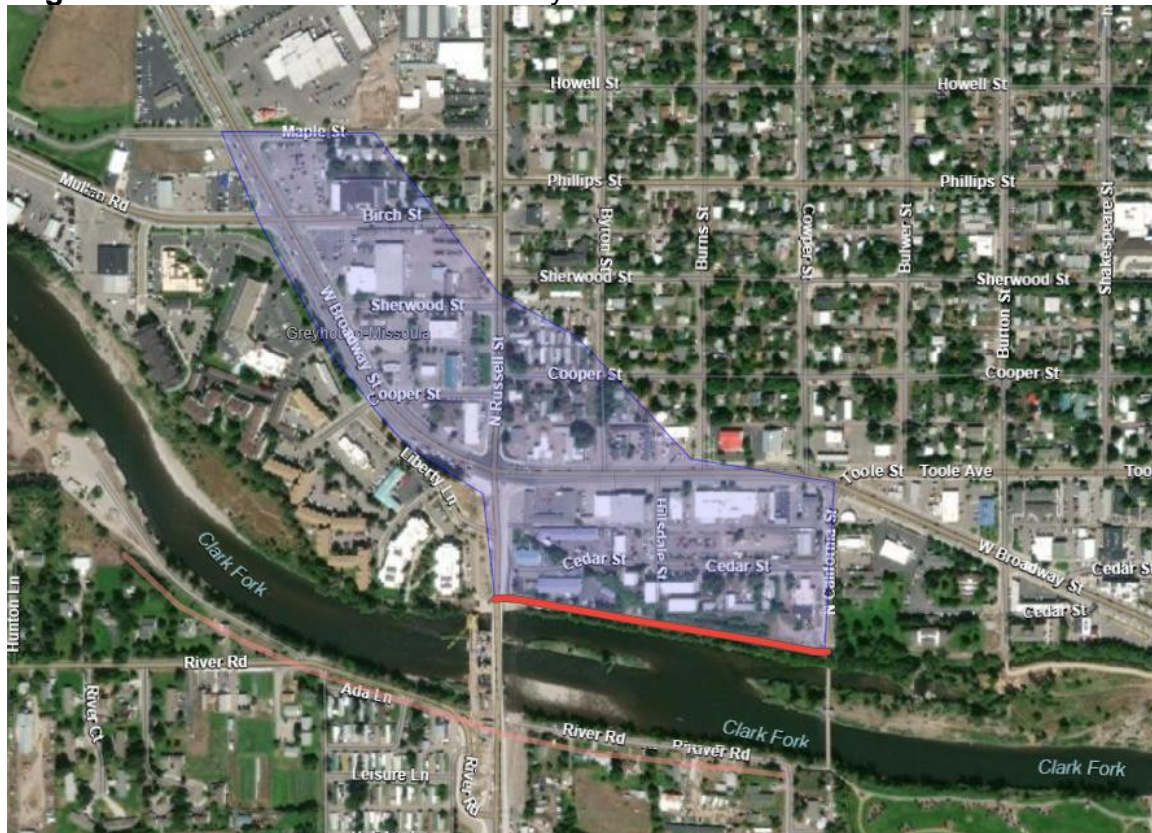
The Clark Fork Area V levee system is a federally authorized and non-federally operated and maintained complete levee system located in Missoula, Montana. At approximately 1,200 feet in length, the upstream end of the levee ties into the California Street Bridge and the downstream end of the levee ties into the Russell Street Bridge. The levee crown is covered by an asphalt pedestrian path with riprap armoring on the riverward side. The Clark Fork Area V levee protects mostly commercial and residential property with no critical infrastructure identified. There is a high density population due to the urban setting. Construction on the Clark Fork Area V Levee was completed between June 1963 and January 1964 after the levee system was authorized by the 1950 Flood Control Act approved on May 17, 1950. The Clark Fork Area V flood control project was designed to protect against a 100-year event with 3-feet of freeboard protecting a flood event. The Clark Fork Area V levee has never overtopped, breached, and no major modifications or rehabilitation measures have been made to this levee. Additionally, the Flynn Irrigation Ditch could potentially allow flooding to affect an area outside of the primary protection area. If this were to occur, flows would be immediately limited by downstream culvert constrictions, resulting in low likelihood of large impact due to inundation.

The City of Missoula, MT is requesting to enter into a cost share agreement with the U.S. Army Corps of Engineers under Section 3014(b) of the Water Resources Reform and Development Act of 2014, to conduct a levee system evaluation and to provide a levee system accreditation recommendation for the purposes of mapping for the National Flood Insurance Program (NFIP).

To aid in preparation of this scope of work, the Project Delivery Team (PDT) has reviewed the requirements outlined in ER 1110-2-1156, Engineering and Design, Safety of Dams – Policy and Procedures, and in the Engineering & Construction Bulletin (ECB) No. 2019-11, *Transition Guidance for Levee System Evaluation for the National Flood*

*Insurance Program (NFIP), Appendix B – USACE Criteria for an NFIP Levee Accreditation Recommendation Using a SQRA or QRA.*

**Figure 1 - Clark Fork Area V Levee System**



This Scope of Work establishes the basis for managing the Clark Fork Area V Levee System Risk Assessment (RA). The RA will be performed assuming a Semi-Quantitative Risk Assessment (SQRA) for prior to overtopping failure modes with overtopping possibly requiring a Quantitative Risk Assessment (QRA). The PDT will consist of USACE, Seattle District, (NWS) personnel, the Non-Federal Sponsor's representative, and the RA will be conducted by a Facilitator and Risk Cadre approved by the USACE Risk Management Center (RMC). The RMC's role is to advise and provide quality assurance on the risk products.

## PURPOSE AND OBJECTIVE

The purpose of this risk assessment effort is to determine if a positive National Flood Insurance Program (NFIP) recommendation can be made through the risk assessment framework. Since this effort will be cost-shared between Federal and Local Sponsor funding, a decision point will be included following the Data Preparation and Risk Assessment session for the levee system to ensure that prudent investments are made towards the ultimate goal of NFIP recommendation. If it is found that a positive NFIP recommendation is not likely, the PDT and the City of Missoula would decide a path

forward to either put the risk assessment on hold to continue at a later date or terminate the effort altogether. If a positive outcome is determined, then the risk assessment can continue as scoped in this document, ultimately resulting in a final report which includes a levee accreditation recommendation.

The risk assessment will not make a determination regarding capacity of the interior drainage system. These efforts will need to be conducted by the local community as needed, in order to apply for accreditation. An evaluation of the levee sponsor's formally adopted Operations and Maintenance manual and Emergency Action Plan will be performed in conjunction with assessment of potentials failure modes and consequences.

## SUMMARY OF TASKS TO BE PERFORMED

The proposed scope of work has been split into the following major tasks. The details for each task are presented below. In some instances there may be sub-tasks associated with each task.

### Task 1- PROJECT MANAGEMENT

- 1a Project Management
- 1b Work Plan Development
- 1c Review Plan Development and Approval
- 1d Cost Share Agreement- Sponsor Funding
- 1e Monthly Reporting

### Task 2- DATA PREPARATION

- 2a Assemble Existing Data
- 2b Review Existing Data
- 2c Prepare Background (Chapter 2)
- 2d Hydrologic Hazard Estimate (report Chapter 4)
- 2e Seismic Hazard Estimate (report Chapter 5)
- 2f Engineering Analysis
- 2g Prepare Draft Chapters for PFMA/SQRA
- 2h Site Visit
- 2i PFMA
- 2j Consequences- Run HEC-LifeSim (Chapter 6)

### Task 3- RISK ASSESSMENT

- 3a Risk Assessment/Elicitation
- 3b Risk Calculation
- 3c Post SQRA District and RMC Vertical Team Briefing

### Task 4- DRAFT REPORT

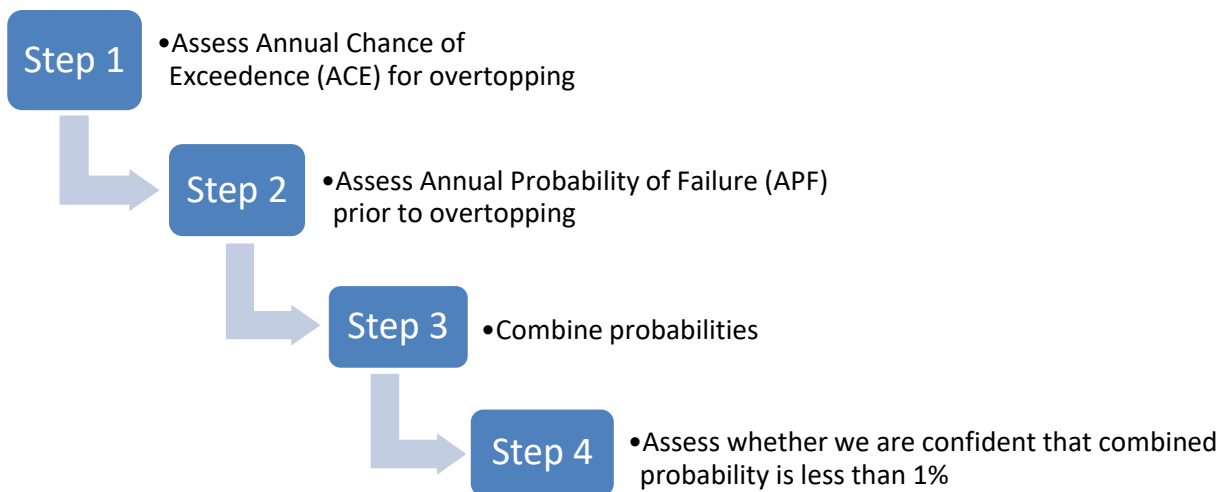
- 4a Risk Assessment Documentation
- 4b Summary and Findings
- 4c Appendices

- 4d Internal Team QC
- 4e Prepare Draft Levee Safety Oversight Group (LSOG) Presentation

#### Task 5- REVIEW AND APPROVAL

- 5a DQC/Advisor Review
- 5b Agency Technical Review (ATR) and Quality Assurance Review
- 5c Finalize Presentation and Report for LSOG Presentation
- 5d LSOG Meeting
- 5e Finalize Report
- 5f Report Approval

**Figure 3.** NFIP Evaluation Process



### Task 1: Project Management

Includes all tasks related to control of the project from initiation through closeout. Includes monthly reporting and tracking of project expenditures as well as development and approval of all control documents such as the PMP, Work Plan, Review Plan and Cost Share documents.

#### Task 1a: Project Management

The NWS Project Manager will manage the government/sponsor funds and approvals for requested labor codes as well as create and obtain approval of the Review Plan. The District Lead Engineer will establish meetings and coordinate project completion with the PDT. The NWS Levee Safety Program Manager (LSPM) will coordinate with the RMC to ensure engagement throughout the process. The project manager will coordinate the reporting efforts with the LSPM, Tech Lead, and Facilitator and will coordinate with the Risk Management Center (RMC).

**Task 1b: Workplan Development**

NWS Project Manager with input from the Cadre lead will develop and seek approval for a workplan outlining project tasks, timeline, budget, team membership and team roles/responsibilities.

**Task 1c: Review Plan Development and Approval**

The review plan will be prepared to ensure quality and proper scale and scope of anticipated reviews. The approval authority for this Review Plan is the Northwestern Division (NWD). The Commander's approval reflects vertical team input (involving the Seattle NWS District, NWD, RMC and HQUSACE members) as to the appropriate scope and level of review for the study and endorsement by the RMC.

**Task 1d: Cost Share Agreement – Sponsor Funding**

The risk assessment is cost-shared between the USACE Seattle District (NWS) and the City of Missoula, the local sponsor. A cost share agreement will be negotiated and executed. The cost share is 50/50 with funds from the local sponsor coming as cash.

**Task 1e: Monthly Reporting**

The project will require monthly reporting on status to the RMC and within the Seattle District. The Cadre may also have reporting requirements. Quarterly reporting to the local sponsor as part of the cost share is also anticipated.

**Task 2: Data Preparation**

Data collection and organization from the local sponsor, Seattle District and the Cadre will be required for a successful risk analysis and report approval. The NWS team will lead the effort to assemble and make available for the Cadre all existing materials necessary to support a risk analysis and elicitation for the project. This task includes all actions leading up to the risk assessment including a site visit, all technical analysis, preliminary development of the report outline, the PFMA and completion of initial consequence modeling.

**Task 2a: Assemble Existing Data**

The purpose of this task is to locate, assemble and organize existing data for the project and prepare the information needed to perform the risk assessment. The primary source for most of the information will be taken from risk assessment guidance, prior periodic inspections, design memorandums and construction documents. Data available for use may include:

- Historic photographs
- Design documents
- Record drawings
- Standard operating procedures
- Emergency action plan
- Instrumentation records
- Previous risk assessments



- Periodic inspections
- Levee Penetration Inspections
- Previous hydrologic, hydraulic, or seismic study documents
- Previous geotechnical or geologic data collection documents
- Previous floodwall study documents
- Geotechnical, hydrologic, and structural instrumentation and monitoring data
- Previous flood reports and photos
- Reports/videos from conduit inspections

Since a large part of the design and construction of the levee was carried out by the Non-Federal sponsor the above referenced data should be requested from and provided by the Non-Federal sponsor before initiation of the assessment. This task includes effort and funds to gather, collect, and inventory existing data and if necessary, digitize it. ProjectWise will be used as a repository for materials obtained.

#### **Task 2b: Review Existing Data**

This task allows the project team time to review all of the data assembled in Task 2a. The Seattle District, Cadre and RMC Advisors will review the materials provided in support of the risk assessment and evaluate whether adequate information exists to continue with the PFMA and preparations for risk assessment.

A specific review of hydraulic and hydrologic data will include all previous and pertinent design documentation and analysis from the recently conducted a Flood Inundation Mapping (FIM) project on the Clark Fork. This mapping will include a review of all relevant models for use in the Missoula Risk Assessment.

#### **Task 2c: Prepare Background**

After the team has completed a review of existing data, the team will prepare a draft background chapter (Chapter 2 of the RA Report) summarizing and documenting key investigation, design, construction and performance data that will inform the team during the risk assessment.

#### **Task 2d: Hydrologic Hazard Estimate**

The hydrologic hazard will include the development of water surface profiles to compare to the levee profile, flow and stage-frequency curves to estimate the frequency of loading, stage-duration curves to estimate the duration of loading, and pertinent Hydrologic & Hydraulic (H&H) data relevant to the system. The team will review to ensure adequate information is available to continue with the risk assessment. If critical information is not available, a decision would be made to move to a quantitative risk assessment requiring new data collection or

terminate the project. This task also includes time to prepare a draft of the Hydrologic and Hydraulic (chapter 4) section of the report.

The H&H section of the report include the following tasks.

- A review and finalization of the existing HEC-RAS model of the Clark Fork River through Missoula to better suit the data needs of the risk assessment.
- Identifying of levee overtopping locations.
- Development of flow frequency curves, water surface profiles and stage-frequency curves.
- Determination of system overtopping capacity

#### **Task 2e: Seismic Hazard Estimate**

The seismic hazard will include the development of a site classification based on existing data. If site specific data is not available to determine a site classification, the team will estimate one using engineering judgement. A seismic hazard curve will be developed using the latest USGS seismic hazard information to help inform the probability of a seismic-related breach.

#### **Task 2f: Engineering Analyses**

This task includes performing a variety of engineering analysis (e.g. seepage, stability, erosion, etc.) to help inform the risk assessment. The analyses may include RMC toolboxes, WinDAM, Geoslope, or other applicable software and will utilize existing data. These analyses will be scaled to the level of study (SQRA versus QRA). H&H engineering analysis will build upon the existing modeling done for previous work on the Clark Fork. Ongoing support will be needed for utilizing existing HEC-RAS modeling for risk assessment. Additionally, sediment and/or erosion analysis to assess levee stability may be needed.

#### **Task 2g: Prepare Draft Chapters for PFMA/SQRA**

Initial outline and background information will be drafted as part of other activities. This task compiles those efforts and establishes a framework for the risk assessment chapters to facilitate the PFMA/SQRA and post risk assessment report writing. The Cadre will lead the report development task. The Seattle District will support Chapter 2 preparation and support data/graphic details as needed at this initial stage. Final draft report preparation will occur after the SQRA.

#### **Task 2h: Site Visit**

A one-day site visit will be conducted by the PDT to familiarize members with the system layout, configuration, etc., and to visit potential sites of interest related to potential risk-driving failure modes.

#### **Task 2i: Potential Failure Mode Analysis (PFMA)**

Following the site visit, the NWS, Cadre and RMC advisors will convene to discuss potential failure modes. The discussion will include use of all pertinent data encountered on the site visit and discovered during the background review.

### **Task 2j: Consequences**

The development of the consequences will include breach and non-breach scenarios modeled in HEC-RAS and HEC-LifeSim. The modeling will follow the standard operating procedure (SOP) outlined by the Mapping, Modeling, and Consequence Production Center (MMC).

### **Task 3: Risk Assessment**

The Risk Facilitator, District Personnel, and the Local Sponsor representatives will meet to conduct the Risk Assessment. The PDT will consist of an approved RMC facilitator, Risk Cadre, NWS District personnel and Non-Federal Sponsor representatives.

**Task 3a: Risk Assessment/Elicitation** This effort will involve discussing the overtopping failure mode and any additional risk-driving failure modes. Should the overtopping failure exceed tolerable risk levels, the project may require additional H&H analysis to determine failure at various loading levels. This will depend on the first decision point after completion of Task 2. The additional failure modes will follow the SQRA format by eliciting probabilities of failure based on a critical loading to obtain order of magnitude estimates. The team will also estimate the magnitude of consequences related to each of these failure modes and will estimate the confidence in the estimates

### **Task 3b: Risk Calculation**

This effort will involve using RMC-QRAcalcs to calculate the annual probability of inundation. The results will be compiled and presented in the Post-RA Brief. If this study continues to the Quantitative Risk Assessment (QRA) phase, RMC-QRAcalcs will be used to estimate Total Risk and annual probability of inundation.

### **Task 3c: Post-Risk Assessment Brief**

Following the RA session for the levee system, the team will brief the RA findings to the USACE vertical team consisting of District, Division, RMC, and HQUSACE personnel within 30 days of the RA. The team will receive feedback on the findings and recommendations from the risk assessment and get concurrence or guidance on the path forward. In the event of a potentially unfavorable recommendation, a decision point will be offered to the Sponsor to continue.

### **Task 4: Draft Report**

This task includes finalizing the background chapters (Chapters 2, 4, 5 & 6) and completing Chapters 1 (Findings and Recommendations), 7 (Risk Assessment), the Executive Summary and all appendices of the final report.



#### **Task 4a: Risk Assessment Documentation**

This task includes writing the risk assessment chapter (Chapter 7) for the overall report. This section includes the write-ups for risk driving failure modes to include background information, a likelihood determination, and estimated consequences.

#### **Task 4b: Summary and Findings**

For this task, an executive summary and findings and recommendations chapter will be drafted within the overall draft report. These chapters include a detailed summary of the outcome of the risk assessment as well as detail any major findings and recommendations for the levee systems.

#### **Task 4c: Appendices**

The appendices will include excluded failure modes, pertinent photos and drawings, supporting calculations for analysis, and the risk estimate calculations. The team's effort will be primarily writing the excluded failure modes. There will be a minor effort to compile all of the calculation documents.

#### **Task 4d: Quality Control of Draft Report**

This task is for a short review of the report for prior to entering the review and approval phase. Review of the various chapters will take place as they develop. This task is to ensure that the draft is complete and formatted for the review phase. Advisor and peer to peer review of report sections for technical adequacy, coherence, and case made to support risk assessment.

#### **Task 4e: Preparation of Draft Levee Safety Senior Oversight Group (LSOG) Presentation**

This task includes the initial development of the presentation which will be presented to LSOG. It is a required element as part of the submittal for Agency Technical Review. The presentation will include all elements found in the report and follow the current RMC provided template.

### **Task 5: Review & Approval**

Reviews include District personnel providing the District Quality Control (DQC) review, RMC personnel providing Agency Technical Review (ATR), and Northwestern Division (NWD) personnel providing a Quality Assurance (QA) review. All review comments will be included as an appendix to the main report. Design Review and Checking System (DrChecks) will be utilized for DQC and ATR comment and response tracking. All comments will follow the 4-part comment structure as delineated in current Civil Works review policy. The reviews will include the reports and appendices for both levee systems.

#### **Task 5a: DQC/Advisor Review**

The DQC review will be performed by personnel from NWS that were not involved in the development of the risk assessment report. The advisor will

provide review of the overall report concurrently with the DQC. The review is estimated to require a 6-week duration for comments and responses to be incorporated within the report.

#### **Task 5b: Agency Technical Review & Quality Assurance Review**

The ATR will consist of a qualified multidisciplinary team provided by the RMC. Concurrently with the ATR, NWD will provide a QA review. These reviews will require approximately 2 months duration.

#### **Task 5c: LSOG Briefing**

Following the reviews, the completed assessments will be presented to the Levee Safety Oversight Group (LSOG). The presentation will conclude with LSOG discussion, which will include LSOG concurrence on the NFIP recommendation and of the results of the risk assessment.

#### **Task 5d: Finalize Report**

To finalize the report, revisions may have to be made following the LSOG briefing. Once revisions are made and approved, a final Risk Characterization memo will be signed and provided to the team.

#### **Task 5e: Report Approval**

This task represents the final completion and approval for the documented assessment and recommendations.

### **OTHER DIRECT COSTS AND CONTINGENCY**

The Clark Fork Area V levee risk assessment is a 50/50 cost-shared effort between the USACE-Seattle District and the City of Missoula. Contingency costs at a rate of 10% are included in the overall budget to account for variables and risks associated with the project. In addition to contingency and labor costs, the project includes other direct costs (ODC) to cover travel, vehicles, per diem and other project related expenses required to complete the risk assessment. Both contingency and ODC are included in the budget estimate.

### **PROJECT DELIVERY TEAM COMPOSITION**

Role	Discipline	Name	Org	Phone
<b>Seattle District PDT</b>				
District LSPM	Geologist	Charles Ifft	G3L0DF0	(206) 764-6938
District Eng (Tech) Lead	Geotechnical Eng	Sailish Koirala	G3L0DF0	(206) 316-3355
District PM	Project Mgr	Jeff Dillon	G3H4G00	206 764 6174
District Economist	Economist	Charyl Barrow	G3H4T00	
District Geologist	Geotechnical Eng	Brian Stenejiem	G3L0DF0	(206) 316-3951
District Hydrologist	Hydraulic Engineer	Courtney Moore	G3LOW00	(206) 316-3005
District Structural	Structural Eng	Jacob McCarty	G3L0DA1	206-764-3364

District Hydrologist	Hydraulic Engineer	Courtney Moore	G3LOW00	(206) 316-3005
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Role	Discipline	Name	Org	Phone
<b>NWD-W Risk Cadre</b>				
Cadre Lead	Hydraulic Eng	Sharon Schulz	CENWP-ENC-HY	503-913-8778
Cadre Co-Lead	Geologist	Amy LeFebvre	CENWS-ENT-G	(206) 764-7209
Cadre Geotech	Geotech Eng	Nick Barbato	CENWP-ENC-DG	(503) 808-4982
Cadre Structural	Structural Eng	Carl Harris	CENWP-ENC-DS	(503) 808-3751
Cadre Consequences Specialist	Economist	Ricky Oskey	CESPK-PDW-E	(916) 557-7496
Cadre H&H	Hydraulic Eng	Reuben Sasaki	CESPL-ED-HH	(213) 452-3672

Role	Discipline	Name	Org	Phone
<b>RMC Risk Cadre</b>				
RMC Advisor	Geologist	Damien Gonsman	CEIWR-RMC-W	(303) 963-4552
RMC Regional Hydrology Lead	Hydraulic Engineer	Carolyn Pearson	CEIWR-RMC-WD	303-963-4531

## Budget and Schedule

The NFIP Evaluation is estimated to cost \$329,500 and take approximately 29 months to complete. Federal funding is needed over a period of three fiscal years, FY21 through FY23. As required by Federal law and in accordance with Section 3014(b) of the Water Resources Reform and Development Act of 2014, the study cost would be divided 50% Federal and 50% non-Federal Sponsor. Sponsor contributions will be via cash. The study cost estimate, list of activities and schedule are provided in Table 1.

**Table 1.** Cost Estimate, List of Activities and Schedule

Tasks	Activities	Budget	Schedule
Project Management		\$33,433	NOV 2020-MAR 2023
1a	Project Management	\$17,114	
1b	Work Plan Development	\$6,261	
1c	Review Plan Development and Approval	\$1,655	

1d	Cost Share Agreement- Sponsor Funding	\$2,106	
1e	Monthly Reporting	\$6,297	
Data Preparation		\$126,929	NOV 2020- JAN 2022
2a	Assemble Existing Data	\$2,313	
2b	Review Existing Data	\$17,408	
2c	Prepare Background (Chapter 2)	\$9,152	
2d	Hydrologic Hazard Estimate (Chapter 4)	\$7,372	
2e	Seismic Hazard Estimate (Chapter 5)	\$1,637	
2f	Engineering Analysis	\$23,017	
2g	Prepare Draft Chapters for PFMA/SQRA	\$10,335	
2h	Site Visit	\$25,672	
2i	PFMA	\$24,477	
2j	Consequences Estimate- Run HEC-LifeSim (Chapter 6)	\$5,546	
Risk Assessment		\$42,151	JAN 2022- APR 2022
3a	Risk Assessment/Elicitation	\$31,189	
3b	Risk Calculation	\$7,684	
3c	Post Risk Assessment Brief	\$3,278	
Draft Report		\$38,334	APR 2022- JUL 2022
4a	Risk Assessment Documentation	\$6,439	
4b	Summary and Findings	\$5,232	
4c	Appendices	\$6,009	
4d	Internal Team QC	\$14,082	
4e	Prepare draft Levee Safety Oversight Group (LSOG) Presentation	\$6,571	
Review and Approval		\$42,327	JUL 2022- MAR 2023
5a	DQC/Advisor Review	\$17,745	
5b	Agency Technical Review (ATR) and Quality Assurance Review	\$10,112	
5c	Finalize Rpt for LSOG Presentation	\$6,383	
5d	LSOG Meeting	\$2,432	
5e	Finalize Report	\$4,586	
5f	Report Approval	\$1,069	
ODC/Contingency		\$46,357	
	Travel and Misc	\$16,400	
	Project Contingency	\$29,957	
Total		\$329,531	29 Months

### Federal/Non-Federal Funds Allocation (Rounded)

Funding Source	FY21 (55%)	FY22 (40%)	FY23 (5%)	Total Project Cost
Federal (50%)	\$90,750	\$66,000	\$8,250	\$165,000
Non-Federal (50%)	\$90,750	\$66,000	\$8,250	\$165,000
<b>Total</b>	<b>\$181,500</b>	<b>\$132,000</b>	<b>\$16,500</b>	<b>\$330,000</b>

### ASSUMPTIONS AND RISKS

The following conditions were assumed:

- A decision to change the path forward at any point in the process will result in a change to the budget and schedule. Any changes from the above described tasks will be coordinated through the PDT, LSPM, PM and Non-Federal sponsor.
- There is an understood risk of this approach to obtain an NFIP Recommendation that the Local Sponsor may have to address issues either through further investigation or remediation before a Risk Assessment can be used to inform the NFIP recommendation. The risk assessment may identify risk driving failure modes that would require further investigation and/or possible remediation.
- Sponsor will provide all known existing information at the outset of the study.
- Data recovered at an interim point during the RA may change the recommended path forward.

### LIST OF ACRONYMS

ACE	Annual Chance Exceedance
APF	Annual Probability of Failure
ATR	Agency Technical Review
RMC-QRAcalcs	Risk Analysis Engine
DQC	District Quality Control
DrChecks	Design Review and Checking System
HEC-FDA	Hydrologic Engineering Center's Flood Damage Reduction Analysis
HEC-RAS	Hydrologic Engineering Center's River Analysis System
H&H	Hydrologic & Hydraulic
HEC-LifeSim	Life loss and direct damage estimation software
LSOG	Levee Safety Senior Oversight Group
MMC	Mapping, Modeling, and Consequence Production Center
NWD	Northwestern Division
NWS	Seattle District (i.e., U.S. Army Corps of Engineers, Seattle District)
NFIP	National Flood Insurance Program
PDT	Project Delivery Team
PFMA	Potential Failure Mode Analysis
QRA	Quantitative Risk Assessment



RA  
RMC  
SQRA

Risk Assessment  
Risk Management Center  
Semi Quantitative Risk Assessment