



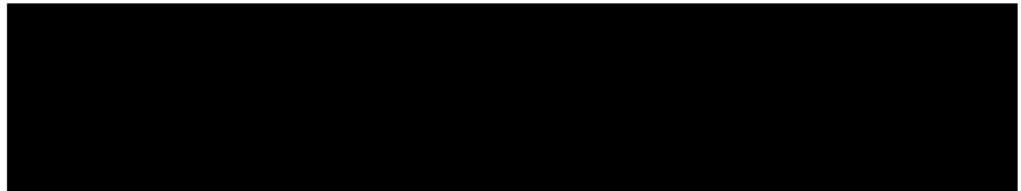
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Prepared by:
MVS District
MVD Division

Wappapello Lake (MO30204)

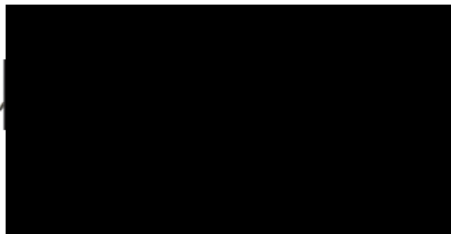
Review Plan- IES

PREPARED
BY:



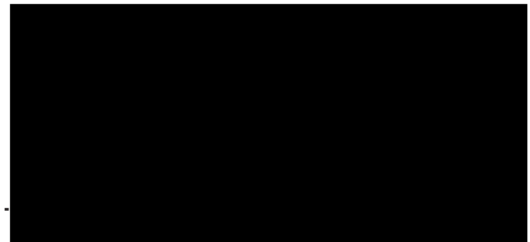
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USACE, St. Louis District

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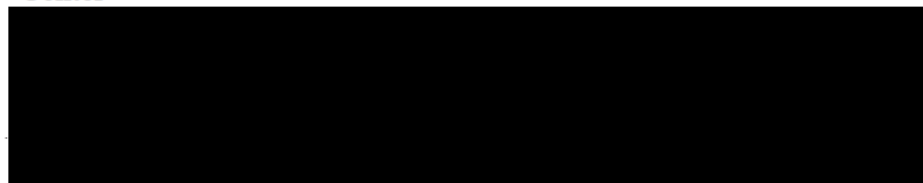
Chief, Eastern Division

USACE, Risk Management
Center



Chief, Engineering and Construction
Division
USACE, Mississippi Valley Division

APPROVED
BY:



Director, Regional Business
USACE, Mississippi Valley Division

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Prepared by:

**MVS District
MVD Division**

MSC Approval Date: *(Pending)*

Last Revision Date: *15 September 2020*

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Purpose and Requirements

1.1 Purpose

Section 1

This Review Plan for Wappapello Lake Dam Issue Evaluation Study (IES), (MO30204) will ensure a quality-engineering product is developed by the Corps of Engineers in accordance with EC 1165-2-217, "Review Policy for Civil Works". The Review Plan shall layout a value added process and describe the scope of review for the IES.

1.2 References

- EC 1165-2-217, Review Policy For Civil Works, 20 February 2018
- ER 1110-1-12, Quality Management, 31 Mar 2011
- ER 1110-2-1156, Safety of Dams – Policy and Procedure, 31 Mar 2014
- ECB 2019-15, Interim Approach for Risk-Informed Designs for Dam and Levee Projects, 08 October 2019
- ER 1105-2-100, Planning Guidance Notebook
- DPM 2019-01, Director's Policy Memorandum
- Wappapello Lake SPRA, 2005
- Wappapello Lake PA #1, 2012

1.3 Requirements

This RP was developed in accordance with EC 1165-2-217, which establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products. This RP will be provided to Project Delivery Team (PDT), District Quality Control (DQC), Hydrologic Hazards and Loading Curve Reviewer, Agency Technical Review (ATR) Teams, and Quality Control and Consistency Review (QCC) Teams.

1.4 Review Management Organization

The USACE Risk Management Center (RMC) is the Review Management Organization (RMO) for this project. This Review Plan will be updated for additional project phases.

Project Background and Information

2.1 Project Background

Section 2
The purpose of this issue evaluation study is to ensure the risks associated with the failure of the Wappapello Lake are appropriately categorized and documented.

Wappapello Dam is located on the St. Francis River (Mile 309) in Sections 2 and 3, Township 26 north, Range 7 east, in the Ozark Uplands of Wayne County, Missouri. It is 16 miles northeast of Poplar Bluff, Missouri, and 1-mile southwest of Wappapello, Missouri.



Figure 2.1 Project Location



Figure 2.2 Project Overview

The dam is an approximately 73-foot-high by 2,700-foot-long rolled earth fill. The embankment was constructed between 1938 and 1941. The maximum height is 109 feet above the streambed. Solid rock underlies the abutting hill to the south, where the outlet control structure is located. The dam is underlain by up to 145 feet of clayey to gravelly recent alluvium and older alluvium. Towards the center of the dam, the alluvium includes about 40 feet of sandy/silty Young Point Bar deposits directly beneath the embankment. The crest at elevation 419.74 FT NGVD is 30 feet wide and carries a highway 22 feet wide. Upstream and downstream slopes have riprap stone protection. The side slopes of the dam are as follows:

- 1 on 2.5 between elevations 419.74 and 404.74
- 1 on 4.0 between elevations 404.74 and 378.49
- 1 on 5.0 between elevations 378.49 and 366.74
- 1 on 8.0 between elevations 366.74 and 346.74

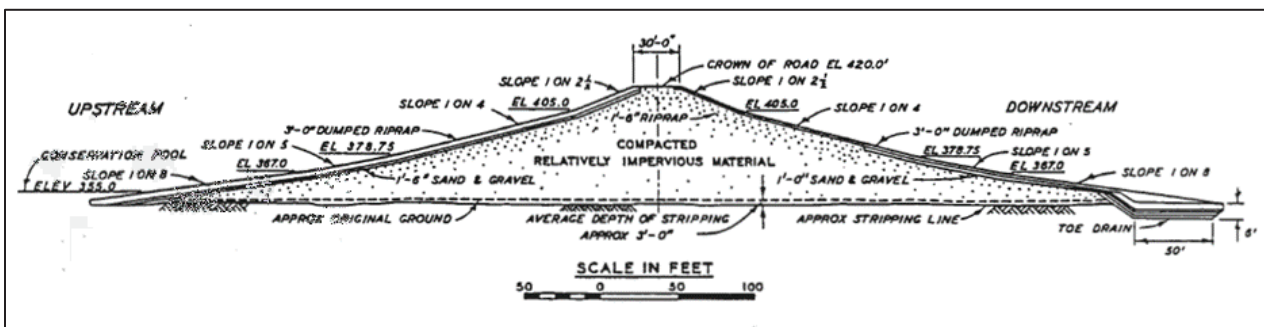


Figure 2.3 Typical Cross Section

The control structure for regulation of the normal outflow of the reservoir is located 400 feet south of the right abutment of the dam. Generally, it is a reinforced concrete structure with all portions founded on rock, except for the approach channel and outlet channel.

The uncontrolled spillway is located in a natural saddle about 1,200 feet south of the southwesterly end of the embankment. The concrete gravity ogee section, founded on bedrock, has a 740-foot long spillway with a crest elevation of 394.74 ft. The embedment depth was increased during construction to ensure that sound bedrock was reached.

2.2 Project Sponsor

Products and analyses provided by non-Federal sponsors as in-kind services are subject to DQC, ATR, and policy and legal compliance reviews. Sponsor Peer Review of In-Kind Contributions - There will not be in-kind contributions for this effort.

District Quality Control

3.1 Requirements

All work products (including supporting data, analyses, reports, etc.) shall undergo DQC in accordance EC 1165-2-217. As a part of DQC, the RMC Senior Advisor and Technical Advisor will review the IES report prior to submission for ATR to ensure completeness. Finally, a certification document will be signed to confirm completion of the DQC. The DQC comments with resolutions and the certification document will be included in appendix K of the final report.

See Attachment 1, Table 5 DQC Reviewers for the DQC Lead, reviewers, and reviewer's disciplines.

3.2 Documentation

3.3 The DQC team shall document comments, concerns, and recommendations, in written format using Microsoft Word or DrChecksSM, and shall confirm comments have been adequately addressed in the report using approved back-checking procedures.
DQC Schedule and Estimated Cost

Although DQC is always seamless, the following reviews are scheduled in Table 1. The cost for DQC is approximately \$20,000.

Project Phase/Submittal	Review Start Date	Review End Date
Final IES Report	12/1/2020	12/30/2020

Table 1 DQC Schedule

Agency Technical Review

4.1 Requirements

Section 4

All civil works products (including supporting data, analyses, environmental compliance documents, water control manuals, etc.) shall undergo ATR in accordance with EC 1165-2-217. ATR reviews will occur seamlessly, including early involvement of the ATR team for key decisions, and at the scheduled milestones as shown in Table 2 ATR Schedule. ATR Reviews will be scaled to the appropriate level of technical effort required to evaluate the project findings and recommendations based on the complexity of the project and the level of risk assessment that was conducted. A site visit will not be scheduled for the ATR Team.

4.1.1 ATR Requirements for Hydrologic Hazards and Loading Curves

The Hydrologic Hazards Assessment and Loading Curve will undergo an Agency Technical Review by an RMC Hydrology and Hydraulic (H&H) Advisor or designated Alternate prior to the Risk Assessment Elicitation, or as directed by the RMC. The reviewer will provide advance review of this work product to avoid unnecessary delays to the completion of the risk analysis and IES report. Ideally, this reviewer will serve as the H&H ATR team member for the IES Report. The reviewer is shown in Attachment 1.

4.1.2 ATR Requirements for IES Reports

ATR for Issue Evaluation Studies conducted using semi-quantitative risk methodology will consist of a review of the technical products by an independent team of USACE dam safety professionals who have past experience with dam safety projects and work products. The team shall be selected by the RMO, and team members will have specialized experience in the analysis and assessment of the deficiencies and risk driver that were identified in the report. The IES Program Manager will select the IES ATR members.

ATR for Issue Evaluation Studies conducted using quantitative risk methodology will consist of a review of the technical products by an independent ATR team of USACE dam safety professionals who have past experience with dam safety projects and work products. The ATR Team Lead and ATR team shall be selected by the RMO.

Due to the diverse backgrounds and levels of experience of the cadres and PDT's preparing these reports, and the scope of the ATR team to ensure the quality and credibility of the government's scientific information, an independent panel of senior-level, highly experienced experts from USACE, other agencies, and private industry, shall supplement the ATR by performing a quality and consistency review (QCC) of the risk assessment findings for quantitative risk assessments. While the ATR Team is given wide latitude to confirm that the technical data, analysis, and methodology meets current agency and state of the practice standards, the scope of the QCC review is more focused and defined by providing written responses to very specific questions that convey the panels professional and technical opinions on the major findings and understandings, the estimated levels of risk and risk reduction, and the appropriateness of the recommendations. The QCC Review findings provide a technical basis to resolve differences of opinion between the PDT and ATR teams, and helps USACE ensure recommended actions are appropriate and applied consistently across the USACE national portfolio of dams. The ultimate decisions concerning the risks and appropriate actions remain with the USACE vertical team.

4.2 Documentation of ATR

4.2.1 Documentation of Hydrologic Hazards Review

Hydrologic Hazards review comments are documented in the form of a Word document or DrChecks, as specified below. After resolution of the comments, the reviewer will sign the ATR completion form and this is to be included in the Wappapello Lake Dam IES review documentation. This signature will ensure all comments have been addressed during ATR and signify concurrence.

4.2.2 Documentation of IES ATR

The ATR team shall document comments, concerns, and recommendations, in written format using Microsoft Word or DrChecksSM, and shall confirm comments have been adequately addressed in the report using approved back-checking procedures. Four-part comment structure should be used or comments should be provided in a similar manor as directed by the ATR Lead.

The scope of the QCC Panel, if applicable, is to review the draft documents, submit written draft comments that address a series of charge questions, attend a panel discussion with the PDT and ATR Lead to collaborate their major findings and understandings of the project, and submit updated responses to the charge questions following the panel discussion as a deliverable. Documentation of the review findings shall be in written format and in accordance with the A-E contract or Agency Scope of Work. The Panel's responses to the charge questions will be included in the final ATR documentation of the IES Report.

4.3 Products to Undergo ATR

The ATR will review the IES report and accompanying appendices.

4.4 Required Team Expertise and Requirements

4.4.1 IES ATR Team

ATR teams will be established in accordance with EC 1165-2-217. The following disciplines will be required for ATR of the IES:

ATR Lead: The ATR team leader will be a senior USACE dam safety professional and will have experience leading and conducting ATR for similar projects and work products. The ATR lead will direct the scope and focus of the review efforts by each discipline. The ATR team leader will be from outside the home MSC and will have the necessary skills and experience to lead a virtual team through the ATR process. The ATR Lead may also serve as a reviewer for a specific discipline,

Geotechnical Engineer - The geotechnical engineer will have experience in the design, construction, and evaluation of embankment dams, potential failure mode analysis, and dam safety risk analysis. The geotechnical engineer will have experience in subsurface investigations, rock and soil mechanics, internal erosion evaluation, slope stability evaluation, and earthwork construction.

Engineering Geologist - The engineering geologist will have experience in assessing the geologic setting, bedrock geology, unconsolidated deposits, and hydrogeology and correlating the performance of foundations with the significant engineering properties. The engineering geologist will have specialized experience with embankment dams founded on glacial outwash and alluvium.

Hydrology and Hydraulic (H&H) Engineer – The H&H engineer will have experience in the analysis and design of hydraulic structures for dams and will be knowledgeable and experienced with the routing of inflow hydrographs through multipurpose flood control reservoirs utilizing multiple discharge devices, evaluation of extreme flood events (e.g., PMF), development of the flood hazard/loading (i.e., stage-frequency and duration relationships), USACE hydrologic and hydraulic modeling, and breach and non-breach inundation for dam safety risk analysis. (This may be two separate reviewers and will be split if needed)

Structural Engineer – The structural engineer will have experience evaluating the design, construction, and evaluation of hydraulic structures for dams (including gates/closure structures, flood walls, and penetrations), potential failure mode analysis, and dam safety risk analysis.

Consequences (Economist) – The economist (or consequence specialist) will have experience evaluating flood risk management projects in accordance with ER 1105-2-100 and USACE models and techniques to estimate population at risk, life loss, and economic damages for dam safety risk analysis.

Climate Change Reviewer – The climate change reviewer will have experience in performing climate change assessments and have an understanding of how this would impact the risk based design for dams. The reviewer will be knowledgeable and experienced with the most current climate change policies, literature, and tools used to perform the assessments. The reviewer will be familiar with the Climate Hydrology Assessment Tool, Non-stationarity Detection Tool, and Vulnerability Assessments. The reviewer will review the climate change assessment report that is prepared to summarize the impacts for IES and IES Phase 2 risk reports that will progress towards a dam safety modification study.

4.4.2 IES QCC Panel

The panel will consist of Senior Technical Experts from A-E firms and/or Technical Specialists from USACE. It is anticipated that three to four panel members from any of these groups will be selected by the RMC to review the report. The panel members selected for the project will be referred to as the QCC Panel. The ATR Lead will be invited to attend the QCC review.

4.5 Statement of Technical Review Report

4.5.1 IES Review Report

All comments and their resolutions, along with a review certification sheet, will be added to the review documentation appendix of the IES report. If there were any significant issues the ATR lead will document those in the comments. The report will be prepared in accordance with EC 1165-2-217. At the conclusion of the QCC, the review facilitator will prepare a memo for RMC Directors Signature that summarizes what issues must be addressed prior to presentation to DSOG.

4.6 ATR Schedule and Estimated Cost

The preliminary ATR schedule is listed in Table 2. The cost for the ATR is approximately \$20,000.

Project Phase/Submittal	Review Start Date	Review End Date
Final IES Report	January 2021	April 2021

Table 2 ATR Schedule

DSOG Review

5.1 Requirements

Section 5
All IES work products will be reviewed by the Dam Safety Senior Oversight Group (DSOG). The DSOG is provided an advanced copy of the final report approximately four weeks prior to the DSOG Panel Discussion, or as directed by the Program Manager. The PDT will prepare DSOG Briefing Slides summarizing the project Risk, the report findings and recommendations. These slides will be reviewed by the Program Manager prior to presentation to DSOG for clarity and conciseness.

5.2 Documentation

At the conclusion of the DSOG briefing, a memo will be prepared by the DSOG Chairperson that summarizes the risk characterization of the dam, confirms or adjusts the recommended DSAC, proposes Dam Safety and Operations and Maintenance (O&M) actions to reduce risk, and is signed by the Headquarters Dam Safety Officer.

Section 6 Policy and Legal Compliance Review

All IES products will be reviewed throughout the study process for their compliance with law and policy. Guidance for policy and legal compliance reviews is addressed in Appendix H, ER 1105-2-100 and Director's Policy Memorandum 2019-01 – Policy, and Legal Compliance Review, issued 09 January 2019 and Chapter 8 of ER 1110-2-1156. These reviews culminate in determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority by the home MSC Commander. DQC and ATR augment and complement the policy review processes by addressing compliance with pertinent published Army policies, particularly policies on analytical methods and the presentation of findings in decision documents. Initial and final policy compliance reviews will be conducted concurrently by the MSC and HQUSACE.

Section 7 Public Posting of Review Plan

As required by EC 1165-2-217, the approved Review Plan will be posted on the District public website (<https://www.mvs.usace.army.mil/Missions/Programs-Project-Management/Plans-Reports/I/>). This is not a formal comment period and there is no set timeframe for the opportunity for public comment. If and when comments are received, the PDT will consider them and decide if revisions to the Review Plan are necessary.

Review Plan Approval and Updates

The MSC Commander, or delegated official, is responsible for approving this RP. The Commander's approval reflects vertical team input (involving the District, MSC, and RMC) as to the appropriate scope, level of review, and endorsement by the RMC. The RP is a living document, all changes made to the approved RP will be documented in Attachment 3, Table 8 RP Revisions. Re-approval of review plans by the MSC, with re-endorsement by the RMO, will be required when there are significant changes. Some projects with small changes will not require re-approval and re-endorsement. The latest version of the RP, along with the Commanders' approval memorandum, will be posted on the District's webpage and linked to the HQUSACE webpage. The approved RP should be provided to the RMO.

Section 8

Engineering Model Certification and Approval

Section 9

The use of certified or approved engineering models is required for all activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. The responsible use of well-known and proven USACE developed and commercial engineering software will continue and the professional practice of documenting the application of the software and modeling results will be followed. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC and ATR. Where such validations have not been completed, appropriate independent checks of critical calculations will be performed and documented as part of DQC. The following engineering models, software, and tools are anticipated to be used:

Model Name	Validation Date
HEC-RAS	HH&C CoP preferred
HEC-ResSim	HH&C CoP preferred
RMC-RFA	HH&C CoP preferred
HEC-LifeSim	HH&C CoP preferred
USACE risk analysis spreadsheet tool	Validation in progress
USACE internal erosion spreadsheet tool	Validation in progress

Table 3 Models and Status

Section 10

Review Plan Points of Contact

Title	Organization	Email/Phone
Project Manager	CEMVS	314-331-8407
Dam Safety Program Manger	CEMVS	314-331-8413
Senior Reviewer	CEIWR-RMC	304-399-5217

Table 4 RP POC's