Independent External Peer Review of the Three Rivers Study, Southeast Arkansas Integrated Feasibility Report and Environmental Assessment

Final Report
23 JUNE 2017

Prepared by: Analysis Planning and Management Institute & Logistics Management Institute

Prepared for: Department of the Army
US Army Corps of Engineers
Flood Risk Management Center of Expertise
Little Rock District

APMI Subcontract/Release No: 1525/17

The views, opinions, and/or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.
Executive Summary

This report provides the results of an Independent External Peer Review (IEPR) that assessed the documents associated with the Three Rivers Study, Southeast Arkansas Integrated Feasibility Report and Environmental Assessment prepared by the Little Rock District of the US Army Corps of Engineers (USACE).

Project Background

The Three Rivers Study area is located at the confluence of the Mississippi, White, and Arkansas rivers in Desha and Arkansas counties, in southeast Arkansas, along the McClellan-Kerr Arkansas River Navigation System (MKARNS). The decision document is an integrated feasibility report and an environmental assessment developed under the National Environmental Policy Act (NEPA). The integrated report documents the USACE’s evaluation of alternatives that provide long-term environmentally sustainable navigation on the MKARNS, prevent lost navigation during large-scale repairs, and address the continuing short-term maintenance costs of the existing structures in the Three Rivers area. A Draft Integrated Feasibility Report and Environmental Assessment (DIFR/EA) was developed and released for public comment and provided to the IEPR Panel for review. For consistency, the decision document evaluated in this IEPR review will be referred to as a DIFR/EA or the Study throughout this report.

DIFR/EA analyzes alternatives that would inhibit cutoff development (i.e., breach) and recommends a long-term solution that allows for continued safe, economic, and environmentally sustainable use of the MKARNS. The Study presents a unique solution for a very complex hydrologic system in an environmentally sensitive area and includes infrastructure construction in, or affecting, a large federal wildlife refuge and a state wildlife management area. The Study has significant interagency interest and will require close coordination with the US Fish and Wildlife Service (USFWS) and multiple Arkansas state resource agencies. The effort focuses on navigation and modifications, and does not involve significant threat to human life and safety assurance. The cost-sharing, non-federal sponsor is the Arkansas Waterways Commission.

Independent External Peer Review

The LMI Team, consisting of Logistics Management Institute (LMI) and Analysis Planning and Management Institute (APMI), conducted an IEPR of DIFR/EA. The IEPR Panel (the Panel) was charged with providing a broad technical evaluation of the material contained in the documents reviewed for Three Rivers. The review was conducted to analyze the adequacy and acceptability of methods modeling, data, and analyses used. The review focused on a technical review and did not involve policy review. The IEPR was conducted in accordance with the procedures described in the Department of the Army, USACE Engineer Circular No. 1165-2-214, Civil Works Review dated 15 December 2012, as amended in the Engineering and Construction Bulletin 2016-9, dated 4 March 2016.
Summary of the IEPR Results

The Three Rivers Southeast Arkansas DIFR/EA documents the efforts to develop navigation rehabilitation alternatives within the MKARNS in the Study area between the White River and Arkansas River near their confluence with the Mississippi River. The project is focused upon the development of alternatives to arrest erosion and sediment transport issues that have resulted in the loss of navigation benefits and, if not alleviated, could result in a catastrophic breach and navigation closure. The USACE has developed two alternatives to alleviate current issues and prevent future problems. The current Study heavily relied on the analysis and conclusions of the Arkansas/White Cutoff (Ark White) Study, which was performed in 2009, and the USACE performed additional analyses to aid with the evaluation of current problems and the development of reasonable solutions. The Panel recognizes the significant efforts of USACE in conducting this Study.

The Panel performed a review of the DIFR/EA in the areas of biology and environment, geotechnical, hydraulics and hydrology (H&H), and planning and economics. The Panel comments are summarized in the following paragraphs (see Section 4.2 for complete comments and recommendations).

Biological Resource and Environmental Law Compliance

The DIFR/EA was developed in close coordination with the USFWS and the US Environmental Protection Agency, which address many requirements of NEPA. These initiatives have resulted in minimal concerns expressed by these agencies and the public in general as evident in the number and nature of public comments received. The DIFR/EA relies heavily on the analysis and results of the Ark White study performed in 2009, which was not available to the Panel or the public. Providing the Ark White study and summarizing the information extracted from it in the DIFR/EA would provide the rationale and justify some of the conclusions reached in the current Study. Technical editing of the DIFR/EA would improve the overall quality, readability, and accuracy of the document.

Civil/Geotechnical Engineer

The Study did not include any geotechnical exploration or evaluation. All three of the evaluated alternatives included a significant cost element to address an assumed seepage condition as evidenced by two recent occurrences of sinkholes in the historic cutoff structure. In particular, the addition of a sheet pile cutoff with a length of over a mile is expected to add an estimated $20 million to the cost of the “No Action” alternative. The report did not provide any analysis or evaluations to verify that the observed sinkhole conditions were attributable to under-seepage. The Study further assumed that a sheet pile cutoff extending to elevation 110 would be required for all alternatives to address the assumed seepage condition. There was no analysis or justification that this configuration of a sheet pile cutoff was either needed or sufficient to address the assumed seepage condition.

Hydrology and Hydraulic Engineer

The Panel has completed a detailed review of the DIFR/EA H&H studies and has developed a list of review comments for USACE consideration that aim to further optimize the project. Overall, the H&H Hydraulic Engineering Center’s River Analysis System (HEC-RAS) modeling was well done and mostly complete. The two-dimensional (2D) River Analysis System (RAS) model covers the entire Study area, and
includes existing flow/stage gauges for use in setting boundary conditions, as well as for comparison with simulated RAS results as part of the calibration effort. However, the H&H efforts could be substantially improved by further clarification and completion of additional work. There are several important issues that require resolution.

While the overall model calibration effort seems substantial based upon a review of stage hydrograph plots presenting both observed stages and simulated stages, the actual calibration, goodness-of-fit statistics, are not provided. Also, a narrative discussion of “risk and uncertainty” issues resulting from the model has not been completed. This effort is very important to better understand the alternative performance measures used to help select between two project alternatives. The risk and uncertainty analysis typically includes some discussion of model weaknesses and opportunities for future improvement during the Planning, Engineering, and Design studies.

Lastly, there are limited engineering analyses, calculations, discussion, or assumptions presented in the main report or appendices. This observation is especially apparent regarding the selection of armor stone size, thickness, and bedding requirements. The H&H appendix or Civil Engineering appendix should provide some preliminary calculations and drawing details in order to better support the alternative cost estimates.

Civil Works Planner/Economist

The planning and economics analysis presented in the DIFR/EA is generally well conceived and presented. Nevertheless, the Panel has identified the importance of describing the expert elicitation process that USACE underwent to determine the probability of a cutoff. The small number of experts elicited and the large variation of responses introduces significant uncertainty regarding the skewing of data and direct impact on the selection of alternatives. A better description of the expert elicitation process complimented by an uncertainty analysis of the data would address these concerns and minimize the project risk. Separately, the Panel has identified the need for USACE to provide additional justification and supporting methods regarding how the USACE determined that the integrity of the affected structures should not fall below 70 percent for either the Jim Smith or Melinda Corridors. Other comments from the Panel focused mostly on the need for more clarity and support for statements made throughout the text.
Summary of Panel Comments

Presented below are the Panel comments grouped by the level of significance. There were one High, three Medium High, seven Medium, three Medium Low, and no Low comments. Section 4 of this report includes the definitions of comment significance levels.

<table>
<thead>
<tr>
<th>No.</th>
<th>Panel Comment</th>
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<tbody>
<tr>
<td></td>
<td><strong>Significance: High</strong></td>
</tr>
<tr>
<td>1</td>
<td>All of the alternatives considered in the report include costly provisions to address concerns related to assumed under-seepage, which do not have a demonstrated technical basis.</td>
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<tr>
<td></td>
<td><strong>Significance: Medium High</strong></td>
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<tr>
<td>2</td>
<td>The time period used to estimate operational and maintenance (O&amp;M) sunk costs for the study area is too short.</td>
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<td>3</td>
<td>The hydraulics and hydrology analysis does not include a discussion of risk and uncertainty.</td>
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<tr>
<td>4</td>
<td>The report should provide additional information regarding the USACE expert elicitation process used to determine the probability of a cutoff.</td>
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<td></td>
<td><strong>Significance: Medium</strong></td>
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<tr>
<td>5</td>
<td>There is no supporting evidence/rationale for how USACE determined that the integrity of the structures should not fall below 70 percent for either the Jim Smith or Melinda Corridors, or for concluding that the Owens Lake structure is structurally sound.</td>
</tr>
<tr>
<td>6</td>
<td>The <em>Civil Engineering</em> appendix provides no design basis in support of armor stone size selection, thickness, or slope.</td>
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<td>7</td>
<td>There is no discussion of the potential error embedded in the HEC-RAS 2D mesh resulting from stitching together 12 different topographic elevation and hydrographic elevation datasets.</td>
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<tr>
<td>8</td>
<td>The discussion of HEC-RAS model calibration is incomplete.</td>
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<tr>
<td>9</td>
<td>The overall quality and readability of the report should be improved to ensure a clear understanding of analyses, assumptions, and results.</td>
</tr>
<tr>
<td>10</td>
<td>There is no supporting evidence for the methods used to elicit opinions and measures from the shipping industry.</td>
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<tr>
<td>11</td>
<td>The 2009 Ark White study, which provides the basis for much of the analysis performed and conclusions made in the current report, and a few other important reports, are not adequately summarized, referenced, or made available to the reader or public.</td>
</tr>
<tr>
<td>Significance: Medium Low</td>
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<td>--------------------------</td>
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<tr>
<td>12</td>
<td>It is not clear how the USACE arrived at the conclusion that 75 percent of commercial barge traffic will choose least-cost alternative modes and routes during a cutoff event.</td>
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<tr>
<td>13</td>
<td>It is not clear in the report how filled and impacted wetlands will return to their previous hydrological state.</td>
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<tr>
<td>14</td>
<td>The recreational and ecological benefits and costs are not integrated into the NED analysis.</td>
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<table>
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<th>Significance: Low</th>
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<tbody>
<tr>
<td>No comments.</td>
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1 Introduction

1.1 Overview

This Independent External Peer Review (IEPR) Final Report provides the results of an IEPR of the documents associated with the Three Rivers Study, which is being conducted by the Little Rock District of the US Army Corps of Engineers (USACE). The objective of this IEPR is to review the Three Rivers Study, Southeast Arkansas Integrated Feasibility Report and Environmental Assessment. The IEPR has been conducted in accordance with the procedures described in the Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, Civil Works Review, dated 15 December 2012 as amended in Engineering and Construction Bulletin 2016-9, dated 4 March 2016.¹

The USACE lifecycle review strategy for civil works projects provides a review of project documents from initial planning through the project phases of design and construction, as well as operation, maintenance, repair, replacement, and rehabilitation. The strategy provides procedures for ensuring the quality and credibility of USACE decision, implementation, and operations and maintenance (O&M) documents, in addition to work products. Peer reviews, such as this IEPR, are one of the important procedures used to ensure that the quality of USACE published information meets the standards of the scientific and technical community.

This IEPR was conducted by a group of independent experts under the auspices of Analysis Planning and Management Institute (APMI) as a subcontractor to Logistics Management Institute (LMI). Both organizations meet the requirements of USACE and the Water Resources Development Act of 2007 as amended in 2014, in addition to EC 1165-2-214, as an Outside Eligible Organization (OEO). Specifically, each of the two organizations has experience in establishing and administering peer review panels, is qualified as an Internal Revenue Code Section 501(C)(3), is an independent science and technology organization, free from conflicts of interest (COIs), and does not carry out or advocate for or against federal water resources projects. Both organizations and the Panel members for this IEPR have not been involved in any capacity with the Study. Consistent with EC 1165-2-214, OEO in this report refers to the combined efforts of LMI and APMI.

1.2 Project Background

The Three Rivers Study area (Figure 1) is located at the confluence of the Mississippi, White, and Arkansas rivers in Desha and Arkansas counties, in southeast Arkansas, along the McClellan-Kerr Arkansas River Navigation System (MKARNS). The decision document is an integrated Feasibility Report and an Environmental Assessment (EA) developed under the National Environmental Policy Act of 2007 as amended in 2014, in addition to EC 1165-2-214, as an Outside Eligible Organization (OEO). Specifically, each of the two organizations has experience in establishing and administering peer review panels, is qualified as an Internal Revenue Code Section 501(C)(3), is an independent science and technology organization, free from conflicts of interest (COIs), and does not carry out or advocate for or against federal water resources projects. Both organizations and the Panel members for this IEPR have not been involved in any capacity with the Study. Consistent with EC 1165-2-214, OEO in this report refers to the combined efforts of LMI and APMI.

¹ Engineering and Construction Bulletin No. 2016-9 provides interim civil works review policy for continued use of EC 1165-2-214, which was expired in 2014, with the exception of few specific changes from the Water Resources Reform and Development Act of 2014. These changes do not affect the process for conducting Type I IEPRs.
document evaluated in this IEPR review will be referred to as a DIFR/EA, or the Study, throughout this report.

The study analyzes alternatives that would inhibit cutoff development and recommends a long-term solution that allows for continued safe, economic, and environmentally sustainable use of the MKARNS. The study presents a unique solution for a very complex hydrologic system in an environmentally sensitive area and includes infrastructure construction in, or affecting, a large federal wildlife refuge and a state wildlife management area. The study has significant interagency interest and will require close coordination with the US Fish and Wildlife Service (USFWS) and multiple Arkansas state resource agencies. The resulting project focuses on navigation and modifications and does not involve significant threat to human life and safety assurance. The cost-sharing, non-federal sponsor is the Arkansas Waterways Commission.

Figure 1: Three Rivers Study Area
2 Independent External Peer Review Process

This section summarizes the process for conducting this IEPR. Details of the review were documented in various intermediate work products provided to USACE during the course of this effort.

2.1 Managing the Review

The OEO developed and executed a Work Plan to define and manage the process for conducting the IEPR. The Work Plan described the process for screening and selecting independent reviewers, communicating and meeting with the USACE project team, maintaining the IEPR task schedule and quality control, compiling and disseminating the independent reviewers’ comments, and project management and administration.

The OEO established an organizational structure for managing the IEPR to assure the independence of the review. This was accomplished by the OEO organizing and mediating all interactions between the Panel and USACE in accordance with the procedures described in EC 1165-2-214.

![Figure 2: Organization for Managing the IEPR](image)

2.2 Selecting the Panel

The OEO identified experts who met and exceeded the technical expertise required for this IEPR. We identified any potential COI issues that potential Panel members could have with the Study following the standards of the National Academy of Sciences (NAS) and Office of Management and Budget M-05-03, Final Information Quality Bulletin for Peer Review. The following criteria were considered in the screening of the candidates:

- **Expertise**: Ensuring the selected reviewer has the knowledge, experience, and skills necessary to perform the review.
- **Independence**: Confirming the reviewer was not involved with projects for Three Rivers or in producing the documents to be reviewed.
- **Conflict of interest**: Identifying any financial or other interest that conflicts with the service of an individual on the Panel because it could impair the individual’s objectivity or could create an unfair competitive advantage for a person or organization.
- **Availability**: Assessing the candidates’ availability to meet the schedule for this effort.
With our selective candidate determination process, we are able to identify the most qualified candidates who were available to serve on the IEPR Panel while ensuring balanced representation of perspectives from academia, industry, and government. Additional details for each Panel member may be found in Section 3.1 and Appendix A.

2.3 Performing the Review

The USACE provided the OEO the documents to be reviewed by the IEPR Panel. Table 1 includes the list of the documents used in this review. These documents were then distributed to the Panel along with the charge questions. These charge questions established the general boundaries for the IEPR and served as general guidelines. In addition, the Panel used the charge questions as guidance for identifying relevant information and developing their comments and recommendations. The full list of charge questions for this IEPR is located in Appendix B.

Table 1: IEPR Documentation

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<tr>
<th>Documents for Review</th>
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<tbody>
<tr>
<td>Three Rivers Feasibility Study Draft Report</td>
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<tr>
<td>Appendix A: Economics</td>
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<td>Appendix B: H&amp;H</td>
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<td>Appendix C: Civil Engineering</td>
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<td>Appendix D: Compliance</td>
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<td>Appendix E: Biological Evaluation</td>
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<td>Appendix F: Cost Engineering</td>
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<td>Appendix G: Real Estate</td>
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<td>Appendix H: Correspondence</td>
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<td>Appendix I: HGM (Hydro geomorphic Analysis)</td>
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<td>Appendix J: Coordination Act Report</td>
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<td>Appendix K: Cultural Resources</td>
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<table>
<thead>
<tr>
<th>Documents for Reference Only</th>
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<tr>
<td>Public Comments</td>
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</table>

Furthermore, the OEO provided the Panel with templates and instructions for preparing their comments to ensure proper coverage of all important issues and consistency in preparing the IEPR comments. The Panel was also instructed that the OEO would be the conduit for information exchange between the Panel and USACE throughout the execution of IEPR in order to preserve the independence of the review.

This IEPR involved reviewing the IEPR documentation to analyze the adequacy and acceptability of engineering methods, models, data, and analyses. The review focused on conducting a technical review and did not involve policy issues.
2.4 Developing Comments

After completing the review, individual Panel members submitted a draft of their comments to the OEO. We collated the Panel comments and confirmed they were complete and responsive to the charge. We identified overall themes that were presented by multiple peer reviewers or repeated by one reviewer, comments that indicated conflicting peer review opinions, and other noteworthy comments. The OEO ensured that the Panel comments focused on performing a technical review of the documents and did not comment on policy-related issues.

Subsequently, the OEO coordinated with the Panel to reach consensus on the comments, identified and consolidated any overlapping comments, resolved any contradictions, and finalized the significance rating of all comments. The final comments were included in the final IEPR Report presented here. Following the guidelines of EC 1165-2-214, the OEO also entered the comments into the Design Review and Checking System (DrChecks)\(^2\) for USACE internal tracking of the Final Panel Comments and recommendations.

\(^2\) Hosted on the USACE’s PROJect extraNET (ProjNet), a web service that allows secure exchange of information.
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3 Qualification and Experience

The OEO assembled a Panel of experts that met the qualifications set forth by the USACE in the Performance Work Statement for the task. We supported and assisted the Panel in carrying out its review and served as the intermediary for communications and information exchange between the Panel and USACE during the IEPR process.

3.1 Panel

Listed below in Table 2 are the individual Panel members who participated in this IEPR. Panel member’s full qualifications and resumes are located in Appendix A.

Table 2: Summary of Panel Member Qualifications by Discipline for this IEPR

<table>
<thead>
<tr>
<th>Panel Qualifications</th>
<th>Dr. Samuel Brody</th>
<th>Dr. Chris Brown</th>
<th>Mr. Paul Looney</th>
<th>Mr. Doug Spaulding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Degree</td>
<td>PhD</td>
<td>PhD</td>
<td>MS</td>
<td>MS</td>
</tr>
<tr>
<td>Years of Experience</td>
<td>20+</td>
<td>27+</td>
<td>23+</td>
<td>48+</td>
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<tr>
<td>Past Experience with USACE</td>
<td>I</td>
<td>D</td>
<td>I</td>
<td>D</td>
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<td>(Direct [D], Indirect [I],</td>
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<td>and none [N])</td>
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<tr>
<td>Subject Matter Expertise</td>
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<tr>
<td>Biological Resource and</td>
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<td>Environmental Law Compliance</td>
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<tr>
<td>Civil/Geotechnical Engineer</td>
<td></td>
<td>✓</td>
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<tr>
<td>Civil Works Planner/Economist</td>
<td>✓</td>
<td></td>
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<tr>
<td>Hydrology and Hydraulic</td>
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<td></td>
<td>✓</td>
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<tr>
<td>Engineer</td>
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Dr. Samuel Brody

Dr. Brody is a Regents Professor and holder of the George P. Mitchell ’40 Chair in Sustainable Coasts in the departments of Marine Sciences and Landscape Architecture and Urban Planning at Texas A&M University. He is also the Director of the Center for Texas Beaches and Shores. Dr. Brody’s research focuses on flood mitigation, environmental planning, and economic analysis. He has published over 100 scientific works on flood planning and mitigation, and recently authored the book, *Rising Waters: The causes and consequences of flooding in the United States* published by Cambridge University Press. Dr. Brody teaches graduate courses in environmental planning and coastal resiliency. He has worked extensively in both the public and private sectors to help federal, state, and local communities to adopt environmental and flood mitigation policies. For more information, please visit [www.tamug.edu/ctbs](http://www.tamug.edu/ctbs).

Dr. Chris Brown

Dr. Brown is an Associate Professor at the University of North Florida (UNF) teaching civil engineering, fluid mechanics, hydraulics, senior design, and engineering geology. He earned his Doctor of Philosophy (PhD) in Civil Engineering in 2005 from the University of Florida, his Master’s degree from Villanova University in 1997, and his Bachelor of Science (BS) in Civil Engineering from Temple University in 1991.
He has over 25 years of experience working on public works projects for the City of Philadelphia, Waste Management, USACE, and for Golder Associates, Inc. as a private consultant for various complex civil engineering projects. While working for USACE, he worked within the Planning, Engineering, and Construction divisions. He was consistently recognized for his excellent technical skills, including being awarded “engineer of the year” twice over a 16-year period with USACE.

Dr. Brown is familiar with, and has participated in, the design of floodwalls and gated structures, as well as non-structural flood mitigation solutions (e.g., buy-out or minor flood proofing). Specific project examples of direct design experience include Molly Ann’s Brook project (included t-walls, l-walls, underpinning of buildings, levee, bridge modification), Portugués Dam (included access road, foundation prep, arch dam, drainage gallery, rock bolts), and City of Savannah storm sewer upgrade (included new conduit, cut/fill construction, utility relocation and hardening, vibration monitoring). Dr. Brown was also a key designer for the F. E. Walter Dam access road replacement (on design team and field inspection) as well as for the design of new bridges across Everglades National Park along the Tamiami Trail in Florida. Dr. Brown has also been involved in other large civil works projects including the C&D Canal Deepening Project in Maryland and Delaware and the Delaware Main Channel Deepening Project in Pennsylvania and New Jersey.

Mr. Paul Looney

Mr. Looney has 37 years of professional experience and has worked as an ecologist since 1990. He has extensive NEPA experience with transportation and federal government projects throughout the southeast United States and Puerto Rico. Throughout his career, he has completed projects while working as a Project Administrator, Project Manager, Field Team Leader, Agency Liaison, and Site Investigator. His areas of expertise include marine biology, fisheries ecology, coastal processes, seagrass ecology, river ecology, botany, plant ecology, ecosystem management, wetlands ecology, marine and freshwater wetlands restoration, mitigation banking, wetland restoration planning, aquatic weed control, and remote sensing, including aerial and satellite imagery interpretation.

His environmental project experience includes: wetland delineations, wetland permitting, and wetland creation and restoration; investigations of threatened and endangered wildlife and vegetation species; coastal ecosystem restoration; coastal zone management investigations; Section 7 consultations and biological assessments; essential fish habitat assessments; NEPA documentation including Environmental Impact Statements (EISs), EAs; and Categorical Exclusions. He also has expertise in performing environmental regulatory compliance evaluations. Mr. Looney has completed numerous Clean Water Act Section 404 permits for the USACE, the Florida Department of Environmental Protection, the Southwest Florida Water Management District (WMD), the St. John’s River WMD, the Suwannee River WMD, and the Northwest Florida WMD. He has permitting and project experience with seven USACE districts (Jacksonville, Mobile, New Orleans, Ft. Worth, Galveston, Puerto Rico, and Charleston).

Mr. Looney has extensive experience in riverine systems. He developed and ran the Deadhead Logging permitting program for the Florida Department of Environmental Protection in the rivers of Northwest Florida (Escambia, Perdido, Yellow, Shoal, Choctawhatchee, Apalachicola, Chipola, and Ochlocknee as well as the Dead Lakes area). The permitting included performing ecological surveys for each river system concerning threatened and endangered fish and mussel species. This included extensive research on the Gulf sturgeon.
He completed an EIS in the Mobile River system for the creation of a container port in the City of Mobile under direction from the Alabama Port Authority. He also provided Section 7 documentation for the Alabama River as part of an EIS for the extension of I-85 from Montgomery to the Mississippi state line. Additional river experience includes IEPR studies within the American and Sacramento Rivers in California, the Savannah River in Georgia, and the Chesapeake Bay system in Maryland and Virginia.

**Mr. Doug Spaulding**

Mr. Spaulding has over 48 years of experience in the design, evaluation, and inspection of water retaining structures such as dams, levees, and floodwalls. Mr. Spaulding has a Master of Science (MS) in Civil Engineering degree in geotechnical engineering and is currently a registered professional engineer in four states. His experience includes 10 years with the USACE where he served as Chief of the Levee & Channel Design Section for the St. Paul District. He also has worked as an independent consultant conducting inspections and evaluations, and has designed more than 70 flood control and hydroelectric dams throughout the United States. His recent experience includes serving as a facilitator for the Federal Energy Regulatory Commission (FERC) Potential Failure Mode Evaluation for more than 70 dams located throughout the United States. He has served on several IEPR Panels for projects located throughout the United States and has provided design services, project management, and peer review for over 18 local flood protection projects located throughout the country. These projects have included earth-levee systems, diversion channels, concrete channels, floodwalls, gate wells, and pumping stations. The foundation conditions for these projects have ranged from soft lacustrine clay deposits to stratified granular deposits requiring seepage berms and relief well design. The majority of the projects were located in urban areas and involved analyses of trade-offs between right-of-way costs and structural costs. Mr. Spaulding’s career includes evaluation of risks associated with the long-term performance and design of water-retaining structures and conveyance facilities. This process requires evaluating appropriate analytical procedures, making appropriately conservative assumptions, and obtaining sufficient geotechnical data to describe the subsurface profiles and performance characteristics. Each project is unique and must be viewed and evaluated without preconceived concepts of risk or performance.

### 3.2 OEO Key Personnel

The OEO consisted of the following members:

**Doug Wheeler, PMP, CCP, RMP, Program Manager (LMI)**

Mr. Wheeler is an industrial and mechanical engineer with more than 20 years of experience in strategic process engineering and financial analysis including work for USACE, Department of Energy (DOE), and General Services Administration (GSA). For USACE, he led a consultant and client team in a business process reengineering effort for the Navigation Locks and Dams High-Performing Organization. He also led project teams in a variety of tasks to provide reengineering services to the USACE information technology function. He led the review of the USACE MKARNS maintenance activity and supported the USACE Inland Marine Transportation System. Because of this work, Mr. Wheeler understands USACE’s water navigation business area and supporting projects. He has also focused on real property and lease-related projects for the GSA as well as economic assessments of infrastructure projects for DOE. Mr. Wheeler will apply LMI’s COI process by reviewing each Task Order Performance Work Statement and using LMI’s process to ensure that each LMI business unit manager is aware of the task order scope and can raise organizational COI issues before LMI responds. He currently is focused on LMI’s project cost
engineering practice, privatization, and competitive sourcing services. Mr. Wheeler holds a Master’s in Business Administration and a BS in Mechanical Engineering from Columbia University and an MS in Industrial Engineering from Arizona State University.

Ahmad Faramarzi, PE, PMP, Project Manager (APMI)

Mr. Faramarzi supervised project personnel and communicated policies, procedures, and goals to the IEPR Team. In coordination with Mr. Wheeler, Mr. Faramarzi maintained regular contact with USACE and was responsible for the overall project plan, project performance, and client satisfaction for this project, as well as future tasks for USACE. He also has multiple technical and administrative staff as direct reports. Mr. Faramarzi is a registered Professional Engineer and a Certified Project Management Professional with 36 years of experience providing managerial and technical expertise to private sector and government clients, including the USACE, Office of the Secretary of Defense, the US Army, the US Air Force, and Defense Nuclear Facilities Safety Board. He has organized and managed several important and highly visible standing expert panels in response to recommendations by the NAS. Mr. Faramarzi has a Post-Masters applied scientist/engineer degree from the George Washington University in Aerospace and Mechanical Engineering (fluid mechanics), an MS in Thermofluid Engineering from Northeastern University, and a BS in Nuclear Engineering for Oklahoma University. He has extensive experience with nodal and multi-dimensional fluid flow models, and is on the Board of Directors of the Washington, DC, Section of the American Society of Mechanical Engineers and an active member of the Fluid Dynamics branch.

Scott West, Task Leader (APMI)

Mr. West was a criminal investigator for the US Environmental Protection Agency (USEPA), Criminal Investigation Division, for almost 20 years. He served as the Special Agent-in-Charge for three different USEPA regions where he was the senior environmental crimes expert. He supervised a staff of criminal investigators, scientists, attorneys, and support personnel. USEPA Criminal Investigation Division Special Agents investigate criminal violations of all federal environmental laws and are quite familiar with the full federal environmental regulatory framework. For the past 9 years, Mr. West has been actively engaged in marine conservation issues worldwide. He experienced the March 2011, 9.0 earthquake and resulting tsunami in Otsuchi, Iwate Prefecture, Japan. He now is the Executive Director for a non-profit organization dedicated to saving the critically endangered Southern Resident Killer Whales (Puget Sound). Mr. West earned a Bachelor’s of Social Work, Cum Laude, from Virginia Commonwealth University in 1983, and a Masters of Divinity from the General Theological Seminary in 1987.

Barbara Batson, Project Coordinator (APMI)

Ms. Batson has over 20 years of experience with project management and facilitation with both government and corporate clients where she was responsible for ensuring that project quality was maintained and schedules were completed on time. She has worked on projects for the Department of Defense, Department of Education, US Treasury, Social Security Administration, and the DOE. Her project responsibilities included managing global projects with aggressive schedules and facilitating team members on multiple continents. Her experience with project management will ensure this task stays on schedule and all milestones are met.
4 Panel Comments

The IEPR Panel completed a detailed technical review of the Three Rivers Study prepared by the USACE Little Rock District. The review included the following areas: biology and environment, geotechnical, hydraulics and hydrology (H&H), and planning and economics.

4.1 Summary of Comments

The Three Rivers Southeast Arkansas DIFR/EA documents the efforts to develop navigation rehabilitation alternatives within the MKARNS in the Study area between the White River and Arkansas River near their confluence with the Mississippi River. The project is focused upon the development of alternatives to arrest erosion and sediment transport issues that have resulted in the loss of navigation benefits and, if not alleviated, could result in a catastrophic breach and navigation closure. The USACE has developed two alternatives to alleviate current issues and prevent future problems. The current Study heavily relied on the analysis and conclusions of the Arkansas/White Cutoff (Ark White) Study, which was performed in 2009, and the USACE performed additional analyses to aid with the evaluation of current problems and the development of reasonable solutions. The Panel recognizes the significant efforts of USACE in conducting this Study.

The Panel performed a review of the DIFR/EA in the areas of biology and environment, geotechnical, H&H, and planning and economics. The Panel comments are summarized in the following paragraphs (see Section 4.2 for complete comments and recommendations).

Biology and Environment

The DIFR/EA was developed in close coordination with the USFWS and the USEPA, which address many requirements of NEPA. These initiatives have resulted in minimal concerns expressed by these agencies and the public in general as evident in the number and nature of public comments received. The DIFR/EA relies heavily on the analysis and results of the Ark White study performed in 2009, which was not available to the Panel or the public. Providing the Ark White study and summarizing the information extracted from it in the DIFR/EA would provide the rationale and justify some of the conclusions reached in the current Study. Technical editing of the DIFR/EA would improve the overall quality, readability, and accuracy of document.

Geotechnical

The Study did not include any geotechnical exploration or evaluation. All three of the evaluated alternatives included a significant cost element to address an assumed seepage condition as evidenced by two recent occurrences of sinkholes in the historic cutoff structure. In particular, the addition of a sheet pile cutoff with a length of over a mile is expected to add an estimated $20 million to the cost of the “No Action” alternative. The report did not provide any analysis or evaluations to verify that the observed sinkhole conditions were attributable to under-seepage. The Study further assumed that a sheet pile cutoff extending to elevation 110 would be required for all alternatives to address the assumed seepage condition. There was no analysis or justification that this configuration of a sheet pile cutoff was either needed or sufficient to address the assumed seepage condition.
Hydraulics and Hydrology

The Panel has completed a detailed review of the DIFR/EA H&H studies and has developed a list of review comments for USACE consideration that aim to further optimize the project. Overall, the H&H Hydraulic Engineering Center’s River Analysis System (HEC-RAS) modeling was well done and mostly complete. The two-dimensional (2D) River Analysis System (RAS) model covers the entire Study area and includes existing flow/stage gauges for use in setting boundary conditions, as well as for comparison with simulated RAS results as part of the calibration effort. However, the H&H efforts could be substantially improved by further clarification and completion of additional work. There are several important issues that require resolution.

While the overall model calibration effort seems substantial based upon a review of stage hydrograph plots presenting both observed stages and simulated stages, the actual calibration, goodness-of-fit statistics, are not provided. Also, a narrative discussion of “risk and uncertainty” issues resulting from the model has not been completed. This effort is very important to better understand the alternative performance measures used to help select between two project alternatives. The risk and uncertainty analysis typically includes some discussion of model weaknesses and opportunities for future improvement during the Planning, Engineering, and Design studies.

Lastly, there are limited engineering analyses, calculations, discussion, or assumptions presented in the main report or appendices. This observation is especially apparent regarding the selection of armor stone size, thickness, and bedding requirements. The H&H appendix or Civil Engineering appendix should provide some preliminary calculations and drawing details in order to better support the alternative cost estimates.

Planning and Economics

The planning and economics analysis presented in the DIFR/EA is generally well conceived and presented. Nevertheless, the Panel has identified the importance of describing the expert elicitation process that USACE underwent to determine the probability of a cutoff. The small number of experts elicited and the large variation of responses introduces significant uncertainty regarding the skewing of data and direct impact on the selection of alternatives. A better description of the expert elicitation process complimented by an uncertainty analysis of the data would address these concerns and minimize the project risk. Separately, the Panel has identified the need for USACE to provide additional justification and supporting methods regarding how the USACE determined that the integrity of the affected structures should not fall below 70 percent for either the Jim Smith or Melinda Corridors. Other comments from the Panel focused mostly on the need for more clarity and support for statements made throughout the text.

4.2 Full Panel Comments and Recommendations

This section contains the complete set of comments of the IEPR Panel and recommendations. Each comment consists of four parts:

- **Comment**: A clear statement of the concern.
- **Basis for Comment**: A narrative describing the cause for the concern.
• **Significance:** A significance rating of the concern, as well as a statement supporting this significance rating.

• **Recommendation[s] for Resolution:** Recommended actions necessary to resolve the concern to include a description of any additional research that would appreciably influence the conclusions.

Comments were rated to indicate the general significance related to the project impact using the following definitions:

- **High:** Comment describes a fundamental problem with the project that could affect the recommendation or justification of the project.

- **Medium High:** Comment affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

- **Medium:** Comment affects the completeness or overall understanding of the recommendation or justification of the project.

- **Medium Low:** Comment affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project. However, the Panel does not have sufficient information to determine the effect on project implementability.

- **Low:** Comment affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project, but there is limited concern regarding project implementability.

In the sections below are a detailed list of the Panel comments grouped by their significance as determined during the IEPR.

### 4.2.1 Significance: High

<table>
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<tr>
<th>Comment 1</th>
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<tbody>
<tr>
<td>All of the alternatives considered in the report include costly provisions to address concerns related to assumed under-seepage, which do not have a demonstrated technical basis.</td>
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<tr>
<th>Basis for Comment</th>
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<td>Section 6.1.1 of the report states that, “Since 2014, two sinkholes have formed in the existing Historic Cutoff structure which requires remediation to insure that the structure does not fail in the future”. The report assumes that the occurrence of the sinkholes is due to a seepage condition without any supporting studies or geotechnical evaluations. To address this assumed condition, the “No Action Alternative” includes a 5,625-foot-long cutoff consisting of sheet pile driven from Elevation 170 to Elevation 110 (a depth of 60 feet). The estimated cost of this will be approximately $20 million. Alternative No. 1 includes a sheet pile cutoff 1,500 feet long with a depth of 30 feet, estimated by the Panel to cost approximately $2.25 million. Alternative No. 2 assumes a 2,700 feet long cutoff with a depth of 30 feet, for which the Panel estimates a cost of approximately $4 million will be required. The Panel developed these cost estimates because the report did not include a detailed cost breakdown. All of the alternatives assume cost items to resolve a problem that may or may not exist and include remedial measures without any technical basis. The occurrence of sinkholes could be related to the</td>
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decay of buried organic material or other non-seepage related phenomena. If, however, the occurrence of sinkholes is related to seepage conditions, there is no technical basis to assume that a sheet pile cutoff driven to Elevation 110 would address the problem or whether other methods such as deeper cutoffs or seepage control berms could be required. The use of seepage control berms could reduce the project costs but would increase the footprint of impacted areas.

**Significance — High**

The inclusion of the cost for sheet pile cutoff, which does not have any demonstrated technical basis, is a significant part of the costs of all of the alternatives.

**Recommendation for Resolution**

Recommendation 1: Conduct a geotechnical evaluation including one or more borings to determine the cause of the sinkholes and to provide a reliable basis for remedial measures to be included in the proposed alternatives.

Recommendation 2: Revise the estimated costs of the alternatives to reflect the results of the evaluation.

### 4.2.2 Significance: Medium High

**Comment 2**

The time period used to estimate operational and maintenance (O&M) sunk costs for the study area is too short.

**Basis for Comment**

As indicated in the Draft Report, the MKARNS has been difficult to manage between the White River and Arkansas River near their confluence with the Mississippi River due to river meandering, erosion, and significant head differentials. The USACE has spent about $22 million from 1989 to 2017 installing and maintaining structures to keep the river systems separated. For the “without project condition”, these O&M expenses are likely to continue to be needed. Alternatives 1 and 2 are presented as an opportunity to reduce future O&M costs. The reduction of these costs is counted as one source of project benefits. However, it appears that the annual costs presented along these lines (e.g., only related to O&M costs not breach costs) in Tables 10 to 13 in the Draft Report were projected forward in time based upon costs expended during the recent 1989 to 2017 period only. However, the project has been at its full, current navigation depth since 1971. Therefore, while O&M costs in the study area may have been considerably different (probably lower) from 1971 to 1989, the actual average O&M costs in the study area should be calculated from 1971 to 2017 and then projected forward in time. The Panel believes if this is done, the resulting O&M costs will be somewhat different than what is currently presented in the Draft Report.

**Significance — Medium High**

Resolution of the issue determines if it is a fundamental problem with the project or not.

**Recommendation for Resolution**

Recommendation 1: Update the O&M costs: (a) review O&M records and federal investments from 1971 to 1989 for the project, (b) add these costs to the totals from 1989 to 2017, (c), recalculate the average annual O&M costs spent during the entire period of record from 1971 to 2017, weighing more recent costs more heavily if USACE believes that is appropriate, (d) using revised costs calculated in Item “c”, project O&M costs forward in time for the “without project condition” and alternatives 1 and 2, and (e) revise report text and tables as appropriate, including Tables 10 to 13.
**Comment 3**

The hydraulics and hydrology analysis does not include a discussion of risk and uncertainty.

**Basis for Comment**

Many USACE projects use models to evaluate potential hydrologic changes to a system in order to estimate project benefits, as well as impacts. Typically, a “risk and uncertainty” analysis is completed to document and assess the range of potential hydrologic effects, which usually are connected to associated economic benefits and project justification. There are many sources of uncertainties that need to be documented but they can usually be grouped into model uncertainties and “natural” uncertainties. The combination of these is examined to determine the possible effect on the plan formulation and project justification.

**Significance — Medium High**

Resolution of the issue determines if it is a fundamental problem with the project or not.

**Recommendation for Resolution**

Recommendation 1: Inventory key sources of hydrologic uncertainty in the report due to model itself and natural conditions in the study area.

Recommendation 2: Assess the effect these uncertainties have on proclaimed project improvements or benefits (e.g., reduction in flooding, increased inundation time, water velocities, potential for erosion or breach).

Recommendation 3: Add a summary of the risk and uncertainty evaluation to the Draft Report and a more detailed discussion in Appendix B: H&H.

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**Comment 4**

The report should provide additional information regarding the USACE expert elicitation process used to determine the probability of a cutoff.

**Basis for Comment**

The USACE utilized an expert elicitation process to determine the probability of a cutoff (breach). It is not clear how the experts were selected, if they represented a broad set of opinions, and how they reached their conclusions. In addition, there is large variation in the experts’ responses, skewing the mean values upon which the analysis was made. Given the wide scattering of data, it is likely another group of seven experts could have derived a completely different set of cutoff probabilities that would lead to selecting a different alternative for the project.

**Significance — Medium High**

Resolution of the issue determines if it is a fundamental problem with the project or not.

**Recommendation for Resolution**

Recommendation 1: Include a discussion of the expert elicitation process used. The discussion and evaluation should provide information such as how the Panel was selected; the number, areas of expertise, and experience; the information, data, and analyses provided to the experts to elicit opinions; quantification of the opinions and statistical distribution used; interpreting the results of collective opinions of the experts; and a discussion of the uncertainty or confidence level analysis.
4.2.3 Significance: Medium

**Comment 5**

There is no supporting evidence/rationale for how USACE determined that the integrity of the structures should not fall below 70 percent for either the Jim Smith or Melinda Corridors, or for concluding that the Owens Lake structure is structurally sound.

**Basis for Comment**

There is no justification for how District personnel decided that a 70 percent threshold of structural integrity should be assigned to the Jim Smith or Melinda Corridors. If a quantitative threshold is being used for decision-making, it is important to provide ample evidence and justification for how the level is derived.

With respect to Owens Lake, the report gives the impression that the same experts visited the structure just after it was built and then again in 2006 to measure its change in structural integrity. Based on verbal discussions with the USACE this may not have been the case.

**Significance — Medium**

Comment affects the completeness or overall understanding of the recommendation or justification of the project.

**Recommendation for Resolution**

Recommendation 1: Provide analysis and rationale for why USACE determined that it should not allow the integrity of the structures to fall below 70 percent for either the Jim Smith or Melinda Corridors.

Recommendation 2: Expand and clarify the process that the expert team used to assess and quantify the degree to which the Owens Lake structure is sound.

**Comment 6**

The *Civil Engineering* appendix provides no design basis in support of armor stone size selection, thickness, or slope.

**Basis for Comment**

Appendix C: *Civil Engineering* includes short narrative discussions of the “No Action Plan” and Alternatives 1 and 2. It also includes 6 charts and drawing sheets in total. However, no engineering calculations are included at all to support the narrative or engineering drawings. This is especially true for various structures and new channels where armor stone is recommended. Appendix C provides no analyses to support the median size of the proposed armor stone, the required minimum thickness, slope, or type/thickness of bedding stone required. Also, no analyses or evaluations are provided to determine if a filter layer or geotextile is required below the armor stone. Since the exact cause of reported onsite sinkholes is unknown, poor foundation conditions, localized settlement, or seepage piping should be considered as well.

**Significance — Medium**

Comment affects the completeness or overall understanding of the recommendation or justification of the project.

**Recommendation for Resolution**

Recommendation 1: Revise Appendix C to include preliminary engineering calculations supporting armor stone size, thickness, slope, and foundation requirements.
Recommendation 2: Revise cost estimate as necessary if calculations result in change in quantities or median armor stone size.

Comment 7
There is no discussion of the potential error embedded in the HEC-RAS 2D mesh resulting from stitching together 12 different topographic elevation and hydrographic elevation datasets.

Basis for Comment
As part of development of the 2D HEC-RAS model of the study area, USACE combined 12 different datasets to form a continuous terrain model. The datasets included land survey data, Lidar-derived topographic data, and hydrographic survey data. The data were collected from 2002 to 2015 by many different agencies and USACE elements. Appendix B: H&H provides no discussion of the vertical elevation error inherent with each individual dataset. Typically, Lidar data can have errors as large as 1 foot. In addition, according to Appendix C, some Lidar data may have further issues related to “high water conditions” where data may be entirely faulty. In addition, the horizontal resolution of the data collected varies greatly as well. In developing a 2D mesh from survey data, the modeler must be careful not to devise finer resolution than appropriate based upon the input data.

Significance — Medium
Comment affects the completeness or overall understanding of the recommendation or justification of the project.

Recommendation for Resolution
Recommendation 1: Provide a discussion of the “terrain data stitching” methodology in Appendix B, including estimation of vertical elevation errors in each dataset and the resulting errors included in the 2D mesh.
Recommendation 2: Assess the model derived stages and velocities to determine if the survey errors result in any significant uncertainty in the model output. Discuss the range of these uncertainties in Appendix B.

Comment 8
The discussion of HEC-RAS model calibration is incomplete.

Basis for Comment
The USACE used a HEC-RAS model to assess the hydrologic changes expected in the study area under the “No Action” scenario or with implementation of two possible project alternatives. The HEC-RAS model represents the primary basis for the plan formulation, as well as the assessment of potential ecological impacts and benefits. However, there is only limited text discussion of the model calibration effort and methodology. Stage hydrographs of existing data versus simulated data are provided, but are not linked to any text or discussion. Also, although the “visual fit” of the model stage hydrographs looks reasonable, no actual goodness-of-fit statistics (e.g., coefficient of determination, Nash-Sutcliffe Efficiencies) are provided in Appendix B. Lastly, as conservation of mass or water flow is very important when considering sediment transport and erosion, the standard of practice also requires providing calibration criteria for conservation of mass purposes; that is, show that the model water flow at various gauges is the same or close to the same as the actual estimated flows.
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<th><strong>Significance — Medium</strong></th>
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<th><strong>Recommendation for Resolution</strong></th>
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<tr>
<td>Recommendation 1: Calculate goodness-of-fit statistics for model stage hydrographs as compared to actual stage hydrographs and present them in Appendix B.</td>
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<tr>
<td>Recommendation 2: Compare the simulated conservation of mass (water flow) to the actual conservation of mass for available stream gauges and present that data in Appendix B.</td>
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<tr>
<td>Recommendation 3: Provide an extended discussion of the calibration process and the results, including summary tables of all calibration criteria.</td>
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<tr>
<td>Recommendation 4: In areas of the model where calibration criteria are low, provide a discussion of model weaknesses.</td>
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<th><strong>Comment 9</strong></th>
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<tr>
<td>The overall quality and readability of the report should be improved to ensure a clear understanding of analyses, assumptions, and results.</td>
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<th><strong>Basis for Comment</strong></th>
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<tr>
<td>The documentation includes multiple typographical errors, missing words, incorrect cross-referencing, and in some cases inaccurate information, making it difficult to fully understand the analyses and issues. The Panel held several internal discussions to understand certain concepts that were not clear in the report. Subsequently, many of these issues were clarified during verbal discussions with the USACE during the mid-point teleconference. The following are some examples:</td>
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<tr>
<td>a) The explanation of how the alternatives were selected mentions wetland and wildlife resource impacts as well as the National Economic Development (NED). However, it seems that NED was the basis for the selection of alternatives, with no consideration of environmental and ecological impacts.</td>
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<tr>
<td>b) A statement about water quality subsequent to construction was not adequately supported or explained.</td>
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<td>c) The discussion of Hazardous, Toxic, and Radioactive Waste in the text dismissed the potential for shipped materials to have an impact on the Project area.</td>
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<td>d) Benzal Road is visible on aerial photography available on the web but not included in the documentation and there is no discussion of public safety during flooding events.</td>
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<td>e) A statement is made that there are “toxic algal blooms” as a result of sea level changes, which is not possible in a flowing riverine system. It seems the intent was to identify “harmful” not “toxic” algal blooms.</td>
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<tr>
<td>The documentation can also be improved by providing roadmaps and tables of contents to help the reader (e.g., Appendix E: Biological Evaluation).</td>
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<th><strong>Significance — Medium</strong></th>
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<tr>
<td>Recommendation 1: Improve the overall quality and readability of the documentation by providing additional information, correcting editorial errors, and facilitating navigation of the documentation.</td>
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Comment 10

There is no supporting evidence for the methods used to elicit opinions and measures from the shipping industry.

**Basis for Comment**

The study relies on a survey of 33 shipping firms for some of its conclusions, but the research methods and elicitation process is not clearly explained. Missing details include sampling frame, sample selection, response rates, validity of the sample, analysis of the responses, etc.

**Significance — Medium**

Comment affects the completeness or overall understanding of the recommendation or justification of the project.

**Recommendation for Resolution**

Recommendation 1: Discuss the methods used to survey the shipping industry and justification for the validity of the responses.

Comment 11

The 2009 Ark White study, which provides the basis for much of the analysis performed and conclusions made in the current report, and a few other important reports, are not adequately summarized, referenced, or made available to the reader or public.

**Basis for Comment**

The 2009 Ark White study is referenced extensively throughout the report and provides a foundation for the analyses in the current report and many of its conclusions. In the absence of such information and context, it is difficult for the reader to fully understand the current analysis and conclusions. There are several other reference documents—such as the Texas Transportation Institute Study and the USEPA report on climate change from which tables and figures were extracted and included in the study—that should be characterized and provided to the reader and public.

**Significance — Medium**

Comment affects the completeness or overall understanding of the recommendation or justification of the project.

**Recommendation for Resolution**

Recommendation 1: Summarize the 2009 Ark White study and its major findings in more detail at the outset of the current report.

Recommendation 2: Adequately reference the 2009 Ark White study and incorporate sufficient information to provide context when the information in that study is used to perform additional analysis or draw conclusions and findings in the current study.

Recommendation 3: Reference and adequately describe the information extracted from all other externally relied-upon reports. For example, the shipping study discussed on the bottom of page 52 needs proper reference.

4.2.4 **Significance: Medium Low**

Comment 12

It is not clear how the USACE arrived at the conclusion that 75 percent of commercial barge traffic will choose least-cost alternative modes and routes during a cutoff event.
**Basis for Comment**
In determining economic impacts of a potential cutoff, it is important to quantify the effects on the shipping industry. The study does not adequately describe or justify how the 75 percent figure was derived.

**Significance — Medium Low**
Comment affects the completeness or overall understanding of the recommendation or justification of the project.

**Recommendation for Resolution**
Recommendation 1: Provide description, clarity, and justification in the text for the percentage of commercial barge traffic that will choose least-cost modes and routes during a cutoff event in the study area.

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**Comment 13**
It is not clear in the report how filled and impacted wetlands will return to their previous hydrological state.

**Basis for Comment**
On page 79 of the report, the distinction between temporary and permanent impacts to wetlands is not clearly explained. Also, it is not clear which wetlands will be mitigated, how, and where.

**Significance — Medium Low**
Resolution of the issue determines the degree of expected impacts to naturally occurring wetlands.

**Recommendation for Resolution**
Recommendation 1: Re-write the paragraph under the subsection *Clean Water Act* to provide clarification and more detail on which wetlands are expected to return to their previous hydrologic state and which are to be mitigated to compensate for permanent wetlands loss.

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**Comment 14**
The recreational and ecological benefits and costs are not integrated into the NED analysis.

**Basis for Comment**
The introduction of the report describes the recreational and ecological value of the study area. But these values are not formally incorporated into the NED analysis. If there are no benefits or costs to recreational or ecological values for various alternatives, then the text should say that. Otherwise, the NED analysis seems incomplete.

**Significance — Medium Low**
Comment affects the completeness of the benefit-cost analysis for the project.

**Recommendation for Resolution**
Recommendation 1: Provide rationale and justification for the exclusion of recreational and ecological benefits in the NED analysis.

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**4.2.5 Significance: Low**
No comments.
Appendix A  Qualifications of the Review Panel Members

The detailed qualifications and experience of each IEPR Panel member (in alphabetical order) is provided below.

A.1  Dr. Samuel Brody

Role: Civil Works Planner/Economist

Dr. Brody is a Regents Professor and holder of the George P. Mitchell ’40 Chair in Sustainable Coasts in the departments of Marine Sciences and Landscape Architecture and Urban Planning at Texas A&M University. Dr. Brody is the Director of the Center for Texas Beaches and Shores and a research fellow at the Rice University Kinder Institute, SSPEED Center, Texas A&M Hazards Reduction and Recovery Center, and the Bush School Institute for Science, Technology, and Public Policy. He has over 20 years of experience as a practitioner and researcher in the fields of environmental planning, flood mitigation, and socioeconomic analysis of the built environment.

Dr. Brody earned a PhD in City and Regional Planning from the University of North Carolina at Chapel Hill in 2002, an MS from University of Michigan in 1996, and Bachelor of Arts degree from Bowdoin College in 1992. He has been at Texas A&M University for the last 15 years, during which time he has received over $8 million in funding from federal, state, and local organizations to research flood mitigation and environmental policies and interventions. These grants include a National Science Foundation CAREER award and a Program for International Research and Education award. Dr. Brody has also consulted with numerous agencies and organizations to better understand the impacts of specific projects and how to reduce the cost of flooding at the local level.

Dr. Brody is best known for his work examining the effectiveness of structural and non-structural mitigation practices. His book, *Rising Waters: The causes and consequences of flooding in the United States* published by Cambridge University Press, has received many accolades from both academics and practitioners. Specifically, he employs statistical models using observational data to assess which practices reduce the extent and economic impact of flooding as well as maintain key ecological functions. He has many years of experience conducting planning analysis, benefit-cost analysis, spatial and Geographic Information System (GIS) modeling, and machine-learning modelling.

Dr. Brody’s research and methodological advances have directly informed policy at the Federal Emergency Management Agency, Department of Homeland Security, USACE, and NAS. Currently, he is directing a major project on flood risk reduction on the upper Texas coast. This project entails assessing the economic impacts of multiple mitigation strategies related to flood loss reduction to residential and industrial facilities. The study brings together research from five institutions across a range of disciplines, from engineering to economics. At a local level, he is coordinating data and findings with the USACE Galveston District, the Texas General Land Office, and multiple localities and private firms. The project is expected to make advancements in how to most effectively reduce flood impacts and facilitate the development of more resilient communities over the long term.

Aside from the Texas flood risk reduction project, Dr. Brody has been involved in multiple assessments along the Gulf of Mexico coast (Texas, Louisiana, and Florida) as well as internationally. Over the last
couple of years, he has travelled to and advised government personnel on structural and planning projects in Japan, Italy, England, and the Netherlands.

A.2 Dr. Chris Brown

Role: Hydrology and Hydraulic Engineer

Dr. Brown is an Associate Professor at UNF teaching civil engineering, fluid mechanics, hydraulics, senior design, and engineering geology. He earned his PhD in Civil Engineering in 2005 from the University of Florida, his Master’s degree from Villanova University in 1997, and his BS degree in Civil Engineering from Temple University in 1991. He has over 25 years of experience working on public works projects for the City of Philadelphia, Waste Management, USACE, and for Golder Associates Inc. as a private consultant for various complex civil engineering projects. While employed at the USACE, he worked within the Planning, Engineering, and Construction divisions. He was consistently recognized for his excellent technical skills, including being awarded “engineer of the year” twice over a 16-year period with USACE. He was also recently recognized for excellence in teaching and mentoring with the award of several teaching accolades at UNF and the national Bliss Medal from the Society of American Military Engineers.

Dr. Brown is a registered Professional Engineer in both Pennsylvania and Florida. During his career, Dr. Brown has worked on flood-risk management structures, including dams, levees, retaining walls, gates, closure structures, etc., looking at both geotechnical and general civil engineering aspects. Specific project examples include the Prompton Dam spillway modification project, Molly Ann’s Brook flood mitigation project, Portugués Dam design, Everglades Agricultural Area Reservoir project, C-111 levees, and many others. Dr. Brown has extensive experience on public works projects for the City of Philadelphia, City of Savannah, City of Jacksonville, USEPA, USACE, State of Florida, and Commonwealth of Puerto Rico. Dr. Brown has also designed projects that met requirements outlined in Engineering Manual 1110-2-1913. As an expert peer reviewer, Dr. Brown has been involved with review projects in eight USACE districts over a period of 8 years.

Dr. Brown has worked on the geotechnical side of water resources and the hydrologic modeling side of design and modeling projects. Dr. Brown has conducted stability studies using various models, including SLOPE/W and UTEXAS and seepage studies using SEEP/W, SEEP2D, and MODFLOW. Dr. Brown has used reliability and stochastic analysis studies on all types of water resources projects dating back to version 1.0 of @Risk software. Dr. Brown served on the first Corps of Engineers ad hoc committee on levee assessment, which included the initial development of the current USACE fragility curve/risk management design approach.

Dr. Brown has extensive knowledge of USACE cost-estimating systems, with direct experience using Micro-Computer Aided Cost-Estimating System and working knowledge of MII. Dr. Brown has also developed his own risk-based cost estimates using both @Risk and Crystal Ball. He is experienced in developing estimated construction costs and is knowledgeable regarding construction methods related to large civil works projects, including levee design, floodwall design, box culverts, bridge pier modifications, utility relocations, and drainage structure design. Dr. Brown has acted as cost-estimating IEPR reviewer on some of USACE’s largest civil works projects, including the most expensive lock and dam replacement in USACE history.
Dr. Brown is familiar with and has participated in the design of floodwalls and gated structures, as well as non-structural flood mitigation solutions (e.g., buy-out or minor flood proofing). Specific project examples of direct design experience include Molly Ann’s Brook project (included t-walls, l-walls, underpinning of buildings, levee, bridge modification), Portugués Dam (included access road, foundation prep, arch dam, drainage gallery, rock bolts), and City of Savannah storm sewer upgrade (included new conduit, cut/fill construction, utility relocation and hardening, vibration monitoring). Dr. Brown was also a key designer for the F. E. Walter Dam access road replacement (on design team and field inspection) as well as the design of new bridges across Everglades National Park along the Tamiami Trail in Florida. Dr. Brown has also been involved in other large civil works projects, including the Chesapeake and Delaware Canal Deepening Project in Maryland and the Delaware and the Delaware Main Channel Deepening Project in Pennsylvania and New Jersey.

A.3 Mr. Paul Looney

Role: Biological Resource and Environmental Law Compliance

Mr. Looney has 37 years of professional experience, including 28 years as an ecologist. He graduated in 1980 from Pennsylvania State University, State College, PA, with a BS in Biology. In 1992, he graduated from the University of West Florida, Pensacola, FL, with an MS in Biology with a concentration on Coastal Zone Studies. Mr. Looney has completed numerous NEPA projects for transportation, port authority, and Department of Defense projects throughout the southeast and Puerto Rico. He has completed IEPR projects for the USACE in California, Georgia, Texas, and Virginia. His environmental project experience includes: Section 7 consultations and Biological Assessments; Essential Fish Habitat Assessments; NEPA Documentation, including EISs, EAs, and Categorical Exclusions. Mr. Looney has performed ecological investigations in Europe (Germany and Spain) for the US Air Force Center for Environmental Excellence (AFCEE), and Naval Facilities Engineering Command Atlanta Division.

Mr. Looney also possess several professional registrations:

- Certified Environmental Professional #05040349 (2005) — Academy of Board Certified Environmental Professionals
- Professional Wetland Scientist #1206 (1999; 2013) — Society of Wetlands Scientists

As previously mentioned, Mr. Looney has participated and led many projects over the years, including but not limited to:

- Project Ecologist and NEPA Independent Peer Review for USACE. Mr. Looney completed four IEPR studies for the USACE (Sacramento, Houston, Savannah, and Baltimore).
- Project Ecologist for Habitat Conservation Plan, and Dune Restoration and Management Plan, Gulf State Park, Gulf Shores, AL. For the Alabama Department of Conservation and Natural Resources, Mr. Looney completed fieldwork and documentation for a Habitat Conservation Plan for the Alabama Beach Mouse as part of a Section 10 Consultation with the USFWS. The project was part of the State of Alabama Deepwater Horizon National Resource Damage Assessment settlement. Mr. Looney worked with federal and state agency personnel to develop a final dune management
plan that provided improvement to the Alabama Beach Mouse Critical Habitat, and the restoration of degraded dune systems. A total of 50 acres of dune habitat restoration is in the plan.

- **Natural Resource Team Leader for the Choctaw Point Container Terminal Project EIS and Record of Decision, Mobile, AL — Alabama State Port Authority.** Mr. Looney led the environmental team for this project to delineate, evaluate, and mitigate impacts to coastal marsh wetlands within the freshwater and saltwater habitats associated with the Mobile River Delta and Mobile Bay. He worked with 10 state and federal agencies to develop a wetland evaluation method based on hydrogeomorphic-based methods. He was also instrumental in the design and specifications for the mitigation plan, which included wetland creation and enhancement of degraded wetlands. The degraded wetland area was transformed into a local environmental destination and is used for education of local students in the importance of wetland habitat.

- **Project Ecologist responsible for the development of a Section 7 consultation Biological Assessment for the EIS to extend Interstate 85 between Selma and Montgomery, AL.** The Biological Assessment dealt with determining the life history and current conditions present in the river systems impacted for aquatic species (8 endemic mussel species and their designated critical habitat, the Alabama Sturgeon and its critical habitat, and the Alabama shad).

- **Project Ecologist for the restoration of Little Bay, Bayou LaBatre, AL.** Mr. Looney was responsible for the ecological design, planting plan, and environmental monitoring protocols for a project that restored 31 acres of tidal marsh. The marsh was protected behind a 5,200 feet wave attenuation module breakwater. The marsh was created using 140,000 cubic yards of previously dredged maintenance material from the Bayou LaBatre channel. The construction of the project also increased essential fish habitat and shellfish habitat in the coastal area and is protecting actively growing seagrass habitat that existed prior to the breach.

- **Project biologist for the NEPA EIS analysis of the proposed alternative alignments for the Mobile River Bridge project across Mobile Bay as part of the I-10 corridor.** Mr. Looney was responsible for surveys of natural resource impacts, including to wetlands and threatened and endangered species.

- **Project Manager for Water Quality Based Effluent Limitation (WQBEL) Plans of Study and Final Study Report for three Wastewater Treatment Plants (WWTP) in Pensacola, FL, for the Emerald Coast Utility Authority and Naval Air Station, Pensacola.** The first WQBEL study was performed for the Emerald Coast Utility Authority Pensacola Beach WWTP. The second project was completed for the Pensacola Main Street WWTP and included consideration of the effluent discharge from the WWTP at Naval Air Station, Pensacola. The initial WQBEL requirements for all three facilities were to perform a Level II analysis. Mr. Looney, provided a historic study of the water bodies in question (Santa Rosa Sound and Pensacola Bay) by using already existing data and limiting the requirement for water quality modeling to the larger estuarine environment. Dramatic cost and time savings were realized.

- **Project Manager for the EA and Finding of No Significant Impact (FONSI) for SR 30E from North of Test Site D3A Entrance to Coastline Drive, Gulf County, FL, for the Florida Department of Transportation District 3.** The project is located in the western portion of Gulf County on the St. Joseph Peninsula, which has been designated as an area of critical erosion in the state of Florida. The project’s purpose was to reach a decision on the type, design, and location of needed improvements for a 2-mile section of SR 30E that would meet NEPA requirements and reduce the potential for damage while providing a better evacuation route to the residents and visitors. SR
30E provides the only access to properties along the Peninsula. The final EA had two preferred alternatives and was approved by Federal Highway Administration without comment.

- Project Manager for EA/FONSI for widening State Road 87 from near the Whiting Field Gate to the Alabama State line, Santa Rosa County, FL, for Florida Department of Transportation District 3. The 22-mile project proposed the addition of two travel lanes to a two-lane rural road. The project was the first Efficient Transportation Decision Making project in District 3. Mr. Looney was responsible for the completion of the following project documents: Wildlife and Habitat Report, Air Screening Evaluation, Contamination Evaluation Report, Essential Fish Habitat Assessment and an EA and FONSI.

- Environmental Project Manager for the replacement of the Bayou Barataria Bridge in Jean Lafitte, Jefferson Parish, for the Louisiana Department of Transportation and Development. The project consisted of an EIS to replace a historic bridge with a bridge that allowed improved traffic between towns along Bayou Barataria. Mr. Looney was responsible for field reconnaissance and documentation of natural resource features. Mr. Looney managed and coordinated the completion of the EIS and the associated ancillary reports. Mr. Looney’s efforts were instrumental in the completion of the project and the EIS within budget and under 24 months to the Record of Decision.

- Project Manager of a Biotope Survey for the AFCEE at Ramstein Air Base, Germany. Complete biotope surveys were conducted for air base properties totaling approximately 4,500 acres. The project required a full year of seasonal sampling of all undeveloped habitats for the entire Air Base and the six satellite installations. Biotope survey data were integrated into a GIS database for the Air Base and six satellite installations and integrated into the existing Ramstein Air Base GIS database. The ecological and environmental information obtained and researched for the project were included as part of the Integrated Natural Resource Management Plan for Ramstein Air Base. Mr. Looney was responsible for the supervision of a four-person team of German ecologists, liaison with the onsite Air Force Environmental Flight and the German Federal Forestry officials as well as the AFCEE Project Manager located in San Antonio, TX.

### A.4 Mr. Doug Spaulding

**Role: Civil/Geotechnical Engineer**

Mr. Spaulding is a registered engineer with over 40 years of experience specializing in geotechnical design, local flood protection, dam inspection, dam rehabilitation, Part 12 inspections, and Potential Failure Mode Analysis (PFMA) facilitation. He holds an MS in Civil Engineering in Geotechnical Engineering from Purdue University and a BS in Civil Engineering from Valparaiso University. He is affiliated with the American Society of Civil Engineers, Minnesota Geotechnical Society, Society of American Military Engineers; a member of the American Arbitration Association, and on the Construction Claims Panel, Minneapolis, MN.

He served 10 years with the USACE, which included serving as Chief of the Levee Design Section and Program Manager for the National Dam Safety Program in Wisconsin and Minnesota. Duties included project management, feasibility and siting studies, economic analyses, regulatory coordination, and management of final design for flood control and navigation structures.
Mr. Spaulding has served on several independent peer reviews including:

- Currently serving on FERC Board of Consultants for the design of the 24 W Lake Livingston Hydroelectric Project in Texas.
- Currently serving on the FERC Board of Consultants for the design of the 400 MW Gordon Butte pumped storage project.
- Served as geotechnical representative on External Peer Review to evaluate the USACE $190 million seepage control upgrade project in East St. Louis, MO. Evaluation included review design for relief wells, slurry trenches, and seepage berms.
- Fargo Moorhead Flood Control Project: Served on IEPR Panel to review USACE feasibility study for flood protection for the Fargo Moorhead area. Alternatives plans included levees, floodwalls, and two diversion alternatives. The recommended diversion plan involves a 35-mile-long channel with an estimated cost of $1.3 billion.
- Evaluation of Levee Cracking: Geotechnical Engineer for study and evaluation of the cause of cracking in USACE earth levees located throughout the Red River of the North. Investigations include literature review, field inspection, subsurface investigations, and evaluation of potential causes of cracking.
- Eau Pleine Dam, Mosinee, WI: This project was part of a program to upgrade the discharge capacity and increase the stability of the downstream embankment slopes. Project included the use of transient finite element analyses to evaluate the potential for sudden drawdown failures and stability analyses to determine the configuration of a sloping drain and stability berm section.
- Byllesby Dam, Dakota County, MN: Studies at the Lake Byllesby Dam included stability of Ambursen Dam and the rock spillway. This included core holes to identify the character of bedrock at depth and recommendations regarding potential remediation. The work at Byllesby Dam included a sensitivity study to evaluate potential for sliding along the bedrock/concrete contact using CSLIDE (USACE’s Sliding stability of concrete structures program).
- Breckenridge Flood Control Stage 1: The project involved design of 7-mile long, 20-foot deep flood diversion channel in western Minnesota. Services included evaluation of stability and utilization of clay fill material. The value engineering study on project resulted in $1.5 million cost savings.
- Seneca Falls Hydroelectric Project, Seneca Falls, NY: Project included stability analysis using a sensitivity analysis for this 50-foot high gravity structure and implementation of an exploration program to investigate soluble voids and foundation of powerhouse. Onsite work included dye testing, preliminary grout testing, and down-the-hole photography.
- Served as FERC approved independent consultant on more than 60 Part 12 inspections for projects located nationwide.
- Lorella Pumped Storage Project: Served as project manager for the development of the preliminary design of this $1 billion pumped storage project. Design included an underground powerhouse and evaluation of 80-foot-high embankments founded on soft clay deposits in addition to design of a 170-foot-high rock fill dam. The upper reservoir utilized an asphaltic concrete membrane to control seepage and reservoir losses in the upper portion of this project.
• Baldhill Dam: Evaluation of project alternatives to increase the spillway capacity at the USACE Baldhill Dam. Project included preliminary structural and geotechnical design, earthwork layout, and quantity estimates. Also responsible for design of remedial measures to stop earth movements in the discharge channel area.

• Highway 75 Dam: Developed geotechnical and civil designs for the USACE Highway 75 Dam near Odessa, MN. Design elements for this 3.5-mile-long structure included embankments, outlet channels, two outlet works and related access roads, and other features. Project included stability evaluation for 25-foot-high dam founded on soft clay.

• High Falls Embankment Stabilization, Crivitz, WI: Project required design of a downstream berm to increase the embankment stability and to provide a seepage control system for emerging seepage.

Mr. Spaulding was responsible for development and implementation of training programs for operators at both the USACE dams (1981–2011) and electric utility owned structures (1995 and 2008). Training included program on identification of potential harmful conditions. He is an approved facilitator for the FERC’s PFMA program and has served as facilitator for PFMA evaluations on 45 projects in a nine-state area. He served on the “Development of the Lower St. Anthony Falls Hydroelectric Project” HydroVision (2010) and “Computing Sliding Factors of Safety for Concrete Structures” HydroVision (2004).
Appendix B  Charge Questions

At the beginning of the review process, The OEO provided the charge questions to the Panel. The Panel used these charge questions to guide their review. Working with the Panel, the OEO ensured that all charge questions were appropriately addressed. Below is the list of charge questions that were used for this IEPR that were provided to the Panel.

Three Rivers Study, Southeast Arkansas
Integrated Feasibility Report and Integrated Environmental Assessment

Little Rock District
INDEPENDENT EXTERNAL PEER REVIEW DRAFT REVIEW CHARGE

The following Review Charge to Reviewers outlines the objectives of the Independent External Peer Review (IEPR) for the subject study and identifies specific items for consideration for the IEPR Review Panel.

The objective of the IEPR is to obtain an independent evaluation of whether the interpretations of analysis and conclusions based on analysis are reasonable for the subject study. The IEPR Review Panel is requested to offer a broad evaluation of the overall study decision document in addition to addressing the specific technical and scientific questions included in the Review Charge. The Review Panel has the flexibility to bring important issues to the attention of decision makers, including positive feedback or issues outside those specific areas outlined in the Review Charge. The Review Panel can use all available information to determine what scientific and technical issues related to the decision document may be important to raise to decision makers. This includes comments received from agencies and the public as part of the public review process.

The Panel review is to focus on scientific and technical matters, leaving policy determinations for USACE and the Army. The Panel should not make recommendations on whether a particular alternative should be implemented or present findings that become “directives” in that they call for modifications or additional studies or suggest new conclusions and recommendations. In such circumstances the Review Panel would have assumed the role of advisors as well as reviewers, thus introducing bias and potential conflict in their ability to provide objective review.

Panel review comments are to be structured to fully communicate the Panel’s intent by including the comment, why it is important, any potential consequences of failure to address, and suggestions on how to address the comment. The IEPR Performance Work Statement provides additional details on how comments should be structured. The Review Panel is asked to consider the following items as part of its review of the decision document and supporting materials.

Broad Evaluation Review Charge Questions
1. Is the need for and intent of the decision document clear?
2. Does the decision document adequately address the stated need and intent relative to scientific and technical issues?
Given the need for and intent of the decision document, assess the adequacy and acceptability of the following:

3. Project evaluation data used in the study analyses;
4. Economic, environmental, and engineering assumptions that underlie the study analyses;
5. Economic, environmental, and engineering methodologies, analyses, and projections;
6. Models used in the evaluation of existing and future without-project conditions and of economic or environmental impacts of alternatives;
7. Methods for integrating risk and uncertainty;
8. Formulation of alternative plans and the range of alternative plans considered;
9. Quality and quantity of the surveys, investigations, and engineering sufficient for conceptual design of alternative plans, and;
10. Overall assessment of significant environmental impacts and any biological analyses.

Further,

11. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable, and;
12. Assess the considered and tentatively selected alternatives from the perspective of systems, including systemic aspects being considered from a temporal perspective, including the potential effects of climate change.
## Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>2D</td>
<td>Two Dimensional</td>
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<tr>
<td>AFCEE</td>
<td>Air Force Center for Environmental Excellence</td>
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<td>APMI</td>
<td>Analysis Planning and Management Institute</td>
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<td>BS</td>
<td>Bachelor of Science</td>
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<tr>
<td>COI</td>
<td>Conflict of Interest</td>
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<tr>
<td>DOE</td>
<td>Department Of Energy</td>
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<tr>
<td>DIFR/EA</td>
<td>Draft version of the Integrated Feasibility Report and Environmental Assessment</td>
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<tr>
<td>EA</td>
<td>Environmental Assessment</td>
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<td>EC</td>
<td>Engineering Circular</td>
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<td>EIS</td>
<td>Environment Impact Statement</td>
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<td>FERC</td>
<td>Federal Energy Regulatory Commission</td>
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<td>FONSI</td>
<td>Finding of No Significant Impact</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<td>GSA</td>
<td>General Services Administration</td>
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<td>HEC-RAS</td>
<td>Hydraulic Engineering Center’s River Analysis System</td>
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<td>H&amp;H</td>
<td>Hydraulics and Hydrology</td>
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<td>Independent External Peer Review</td>
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<td>Logistics Management Institute</td>
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<td>MKARNS</td>
<td>McClellan-Kerr Arkansas River Navigation System</td>
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<td>Outside Eligible Organization</td>
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<td>Potential Failure Model Analysis</td>
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<td>WQBEL</td>
<td>Water Quality Based Effluent Limitation</td>
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