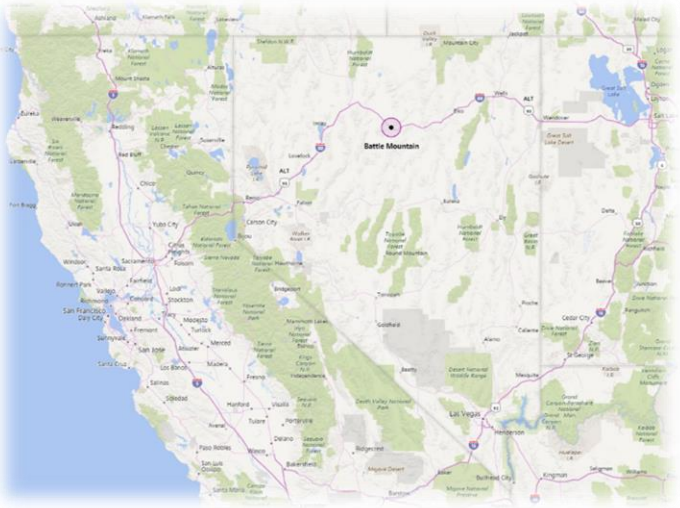
APMI-TR-2016-COE-002

Independent External Peer Review for the Battle Mountain, Nevada, Detailed Project Report Update

Final Report

January 15, 2016



Prepared by: Analysis, Planning, and Management Institute

Prepared for: Department of the Army
US. Army Corps of Engineers, Baltimore District
Flood Risk Management Center of Expertise

LMI Contract/Delivery Order No: W912HQ-15-R-0002/0003
APMI Sub-Contract/Release No: 1552/003

APM Institute
101 E. Culpeper St. Suite 150
Culpeper, VA 22701

LMI
7940 JONES BRANCH DRIVE
TYSONS, VA 22102

This Page Intentionally Blank

Executive Summary

Project Background and Purpose

This report presents the results of an independent external peer review (IEPR) of the Battle Mountain Detailed Project Report (DPR) Update prepared by the Sacramento District of the US Army Corps of Engineers (USACE). The DPR Update was prepared as part of efforts started in the 1960s to design and implement flood protection measures for Battle Mountain, NV. The Town of Battle Mountain is located on I-80 in north central Nevada and approximately 400 miles north of Las Vegas and 200 miles northeast of Reno.

Battle Mountain is subject to flooding from the Humboldt River, Reese River basin, and adjacent areas of the Great Basin. Flooding can result from rain or snow in the winter, snowmelt in the spring, and cloudburst rain events in the summer. Battle Mountain experienced the most devastating flood in February 1962 when warm rain on snow-packed frozen ground, unusual conditions, flooded most of town to a depth of about 5 feet. In 1968, a USACE' Flood Risk Management (FRM) project finished construction of a series of levee reaches[1] to reduce the flood risk of the town. In 1997, a Detailed Project Report (DPR) presented results of studies on flood problems, which continue, along the Reese River at Battle Mountain and identified a Selected Plan to resolve those problems, which included increasing the height of one of the levees.[2]

In 2015, an update to the DPR[3] was conducted to ensure the project continues to meet the planning criteria as applicable in accordance with USACE Engineer Regulations.[4] The DPR Update also reanalyzes the 1997 National Economic Development (NED) Approved Plan (i.e., the 1997 DPR) to confirm its validity and includes a review of the existing conditions and technical analyses.

The objective for the effort reported here is to conduct an IEPR of the USACE's DPR Update. The purpose of the IEPR is to assess the adequacy and acceptability of economic, engineering, and environmental methods, models, and analyses used to conduct the DPR Update and to provide findings of the assessment.

Independent External Peer Review Process

The LMI Team of the Logistics Management Institute (LMI) and the Analysis, Planning, and Management Institute (APMI) was tasked by the USACE to conduct the IEPR of the DPR Update. Under the guidance of LMI, APMI performed the IEPR 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. The IEPR review was conducted by a panel of Subject Matter Experts (SMEs) with the following relevant

1 A continuous length of a levee system to which a single analysis (and mapping) procedure may be applied. In this case, there were three levee reaches under consideration at Battle Mountain.

2 "*Battle Mountain Nevada, Section 205, Detailed Project Report for Flood Control and Environmental Assessment*", USACE, July 1997

3 "*Battle Mountain, Nevada, Section 205, Continuing Authorities Program, Update to the 1997 Detailed Project Report*", USACE, 2015

4 USACE Engineering Regulation (ER) 1105-2-100, *Planning Guidance Notebook, Appendix G*, Amendment 2, para. G-11.c

expertise and experience: Economics/Planning, Environmental Law Compliance and Biological Resources, Civil/Structural/Cost Engineer, Hydrology and Hydraulic Engineer, and Geotechnical Engineer. The panel was "charged" with providing a broad technical evaluation of the material contained in the Battle Mountain DPR Update (with appendices). In addition, each of the members had experience with the USACE's Continuing Authorities Program (CAP) Section 205, Flood Control Act of 1948 (PL 80-858), as amended, for flood control.

Results of the Independent External Peer Review

The IEPR panel recognizes the significant amount of USACE effort, analysis, and documentation that went into preparing the Battle Mountain DPR Update. The panel acknowledges the USACE for its sustained support of this project, and the local community, as well as the systematic approach to conducting the Update of the feasibility study with the many scientific, technical, and engineering analyses and studies that are required to develop an effective plan to reduce the flood risk to this rather complex area. The DPR update, and its associated design changes, was an obvious necessity given the original DPR was from 1997, 18 years ago. The information available is more comprehensive and the methodologies available are more advanced. In addition, the approach to improving Reach 2 appears reasonable.

However, the Review Panel has some concerns with certain aspects of the adequacy and acceptability of the 2015 Battle Mountain, Nevada, DPR Update, resulting in 39 total final comments from their review. Of these, 7 are identified as having High significance, 4 as Medium/High significance, 14 as Medium significance, 4 as Medium/Low significance, and 10 of Low significance. The following paragraphs provide a narrative assessment by the panel in the specific areas of engineering, environment, and economics. The Panel recommends that the USACE make significant revisions to the DPR Update before its final adoption.

Economics

The Panel's review of the 2015 DPR Update reveals contradictory information and numerous inconsistencies. Some of the inconsistencies should not affect the recommended actions or justification of the project or plan. However, other inconsistencies and contradictory information affect the technical quality and acceptability of the report regarding the Recommendation Plan and the justification for the project, but the panel does not have sufficient information to challenge the effect on the report's findings. The document states that future years were assumed equal to existing conditions, and that equivalent annual damages are the same as expected annual damages, the primary reason given for this assumption was the tepid historical and expected pace of development in the floodplain. The document then reports a five-fold increase in project benefits from the 1997 DPR to the 2015 DPR Update based on a 50% increase in the number of single and multifamily structures in the floodplain and a 27% increase in population from the 2000 to the 2010 census. In addition, the costs presented in the report are not the same as the costs presented in the cost estimate from the Micro-Computer Aided Cost Estimating System (MCACES) and the Cost Risk Analysis provided was for the Recommended Plan in the 1997 DPR, instead of the Recommended Plan in 2015 DPR Update. As a result, the panel urges that the substantial inconsistencies in the document be corrected before moving forward with the report.

Environmental

Upon review, the DPR Update appears to lack sufficient documentation of the methods to analyze project impacts. Important specifics regarding habitat assessment and other areas critical to the justification and implementation of the project are not included or adequately discussed. This includes specific issues with regard to the Hazardous, Toxic, and Radioactive Waste (HTRW) risk assessment, air/water/endangered species impacts that are not sufficiently addressed in the materials provided for review, and others. Additionally, the DPR Update does not provide sufficient detail regarding compliance with environmental justice requirements. The panel recommends changes to improve the document clarity and to address issues pertinent to meaningful analysis in these regards.

Engineering

The Panel has concluded that the DPR is lacking the sufficient engineering detail necessary to support the updated plan. No updated civil, structural, or geotechnical engineering has been performed for the DPR Update. Instead, the USACE analyses rely upon data, modeling, and efforts completed in the original 1996-97 DPR, which are now likely out of date. During this IEPR, the USACE reported that it intends to collect new geotechnical data in 2016. The Panel applauds this decision but the information to be gathered may not be included in the current DPR Update. The hydrologic and hydraulic modeling efforts have been updated for the DPR but the methods used and approach taken are not well supported in the main report of the DPR. Following the IEPR Midpoint conference call between the Panel and USACE, a considerable volume of supplemental data regarding the hydrologic modeling was provided to the Panel. Much of this information is very valuable, but at this time, is not included in the review package provided to the Panel or integrated into the DPR Update. Of a major concern to the IEPR Team is the lack of observed data (stream flows and water surface levels, among others) to support predictions made by the TUFLOW model, which was used in the design of the affected levees and culverts. Many of the questions submitted by the review panel at the Midpoint meeting addressed this lack of data, and seemed to have generated some positive reaction and interest from USACE, but will probably require additional policy decisions to resolve.

The Cost Engineering appendix and the Micro-Computer Aided Cost Estimating System (MCACES) cost estimate is detailed and provides an updated 2015 cost for the 1997 approved NED plan that is adjusted for risk and uncertainty as required by USACE current guidance. However, the 2015 “Revised Plan”, which is the new USACE recommended plan, has not been estimated in the same manner as used for the 1997 DPR. In addition, the Panel uncovered various errors in the primary project cost table (e.g., Table 4) as compared to the cost estimate, such as, inconsistent inclusion of the sunk planning, engineering, and design (PED) costs. Ultimately, the lack of updated engineering data and analyses combined with erroneous costs result in a DPR Update that is not adequate in its current form.

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Introduction and Report Overview

The study area is in Battle Mountain, Nevada, which is approximately 400 miles north of Las Vegas and 200 miles northeast of Reno is subject to flooding from the Humboldt River, Reese River basin, and adjacent areas of the Great Basin from rain or snow, spring snowmelt, and summer cloudbursts. In 1968, a Corps' Flood Risk Management (FRM) project was completed consisting of a series of levee reaches to reduce the flood risk of the town. In 1997, a Detailed Project Report (DPR) presented results of studies on flood problems along the Reese River at Battle Mountain, Nevada and identified a Selected Plan to resolve those problems.[1]

In 2015, an update to the DPR[2] was conducted to ensure the project continues to meet the Planning criteria as applicable in accordance with USACE Engineer Regulations.[3] The Update also reanalyzes the 1997 National Economic Development (NED) Approved Plan to confirm its validity and includes a review of the existing conditions and technical analyses.

The objective for this effort is to conduct an IEPR of the USACE's DPR Update. The purpose of the IEPR is to assess the adequacy and acceptability of economic, engineering, and environmental methods, models, and analyses used. The LMI Team, consisting of the Logistics Management Institute (LMI) and the Analysis, Planning, and Management Institute (APMI), performed an Independent External Peer Review (IEPR) for the U.S. Army Corps of Engineers (USACE) of the Battle Mountain Detailed Project Report (DPR) Update.

1.2 IEPR Overview

The USACE lifecycle review strategy for Civil Works products provides for a review of all Civil Works projects from initial planning through the project phases of design; construction; and operation, maintenance, repair, replacement and rehabilitation (OMRR&R). The strategy provides procedures for ensuring the quality and credibility of USACE decisions, implementation, and operations and maintenance documents and work products.

Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

---

1 "*Battle Mountain Nevada, Section 205, Detailed Project Report for Flood Control and Environmental Assessment*", USACE, July 1997

2 "*Battle Mountain, Nevada, Section 205, Continuing Authorities Program, Update to the 1997 Detailed Project Report*", USACE, 2015

3 USACE Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, Appendix G, Amendment 2, para. G-11.c

The USACE conducts IEPRs as part of implementing the USACE review strategy described previously. Using IEPRs in the review process is called for and described in Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, *Civil Works Review*, dated 15 December 2012.

1.3 IEPR Objective

The USACE lifecycle review strategy for Civil Works products provides for a review of all their projects from initial planning through design, construction, and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R). It provides procedures for ensuring the quality and credibility of USACE decisions, implementation, and operations and maintenance (O&M) documents and work products. Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. It typically evaluates the clarity of hypotheses, the validity of the research design, the quality of data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, the extent to which the conclusions follow from the analysis, and the strengths and limitations of the overall product.

The objective for this effort is to conduct an IEPR of the Battle Mountain, Nevada, Updated Detailed Project Report (DPR). This work is done in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers Engineer Circular (EC) No. 1165-2-214, Civil Works Review, dated 15 December 2012, and the Office of Management and Budget Final Information Quality Bulletin for Peer Review released 16 May 2004.

The purpose of the IEPR is to assess the adequacy and acceptability of economic, engineering, and environmental methods, models, and analyses used for the Battle Mountain, Nevada DPR Update. The IEPR will be limited to a technical review and will not involve a policy review. The IEPR will be conducted by subject matter experts (SMEs) (i.e., IEPR panel members) with extensive experience with the Corps and the planning, engineering, economics, and environmental issues relevant to the project.

The panel is "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-214, Appendix D, reviewers should identify, explain, and comment upon the assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. The panel assessed whether the assumptions are sound and whether or not the conclusions are appropriate and logically follow from the stated problems, opportunities, objectives, constraints, screening, and alternatives evaluation. The panel also focused on the data, methods, and models used. The panel also offered their opinions as to whether there are sufficient analyses upon which to base the Recommended Plan.

1.4 LMI Team Qualifications

Both LMI and APMI are not-for-profit science and technology organizations that provide impartial, in-dependent assistance free of conflict of interest with federal government organizations. These organizations have not performed or advocated for or against any federal water resources projects and have no real or perceived conflict of interest for conducting IEPRs. LMI, APMI, and the IEPR panel for this IEPR review have not been involved in any capacity with the projects documented in the Battle Mountain DPR Update. The LMI Team is free from conflict of interest (COI) with the USACE and any other national, regional, or local public, private, or nonprofit entities regarding water management or with interests and possible litigation relating to water management in the Battle Mountain, NV, area.

This Page Intentionally Blank

2 Project Description

The Detailed Project Report (DPR) Update revises the Battle Mountain DPR titled, *Battle Mountain Nevada, Section 205, Detailed Project Report for Flood Control and Environmental Assessment, July 1997.* The purpose of the Update is to ensure the project continues to meet the Planning criteria as applicable in accordance with USACE Engineer Regulation (ER) 1105-2-100, Appendix G, Amendment 2, para. G-11.c. The Update reanalyzes the 1997 National Economic Development (NED) Approved Plan to confirm its validity and includes a review of the existing conditions and technical analyses.

The study area is in Battle Mountain, Nevada, which is approximately 400 miles north of Las Vegas and 200 miles northeast of Reno. Flooding in the Humboldt River, Reese River basin, and adjacent areas of the Great Basin primarily results from (1) winter rain on snow and/or low elevation snowmelt, (2) spring snowmelt with high elevation rain, and (3) summer cloudbursts. The area can experience flooding from rain or snow, spring snowmelt, and summer cloudbursts. The February 1962 flood was the most devastating in history to the community. Flood damages were estimated at over $500,000 based on 1962 price levels. Flooding was caused by warm rain falling on the snow-packed frozen ground. At that time, USACE estimated that 95% of the town was flooded with depths up to 5 feet. The entire population in the flooded area was evacuated. In 1968, a Corps' Flood Risk Management (FRM) project was completed consisting of a series of levee reaches to reduce the flood risk of the town.

A reconnaissance study was authorized by House Resolution 2362 dated May 21, 1991. Completed in August 1994, that study recommended proceeding under Section 205 of the USACE Continuing Authorities Program (CAP) authorized in the Flood Control Act of 1948. The 1997 Battle Mountain DPR presented the analyzed flood problems and the opportunities to address those problems along the Reese River at Battle Mountain, Nevada. It identified the NED Plan of raising existing Federal levees to reduce flood risk. Since the DPR was completed 18 years ago, the 1997 DPR has been reviewed and updated to determine if the approved NED Plan is still technically feasible and economically justified.

The DPR Update shows that the 1997 approved NED Plan continues to be justified. However, the updated incremental justification of the NED Plan, which consisted of Reach 2 and Reach 3, shows that only Reach 2 is incrementally justified as part of the NED Plan. The DPR Update proposes that the 2015 Revised Plan is to construct the levee raise and other measures in Reach 2.

For more details see Table 1 on page 12, which describes the changes to the scope of the 1997 approved NED Plan to the 2015 Revised Plan. Also, refer to Figure 1 on page 13, which shows a visual depiction of the 2015 Revised Plan.

Table 1 – Changes to the Scope of the 1997 NED Approved Plan

1997 NED-Approved Plan		2015 Revised Plan	
Reach 2	Raise the existing Federal levee (2,800 feet) between I-80 and Highway 40 up to 1 foot and add a slurry cutoff trench at the waterside toe.	Reach 2	Raise the existing Federal levee (2,800 feet) between I-80 and Highway 40 with a maximum height of 9 feet.①
Reach 2	Raise 200 feet of Highway 40 about 1 foot where the highway crosses the levee alignment.	Reach 2	Raise 200 feet of Highway 40 about 1 foot where the highway crosses the levee alignment.
Reach 2	Raise 600 feet of existing levee between Highway 40 and the SPRR about 4 feet.	Reach 2	Raise 600 feet of existing levee between Highway 40 and the former Southern Pacific Railroad (SPRR) now referred to as the Union Pacific Railroad (UPRR) about 4 feet.
Reach 2	Construct a floodgate structure at the SPRR.	Reach 2	Construct a floodgate structure at the UPRR.
Reach 2	Raise about 300 feet of the existing levee downstream from the SPRR a maximum.	Reach 2	Raise about 300 feet of the existing levee downstream from the UPRR a maximum of 5 feet at the UPRR.
Reach 2	Placing sandbags across I-80 under current flood threat conditions.②	Not included in 2015 Revised Plan	
Reach 3③	Construct a 6,800-foot extension to the levee upstream from I-80 with a maximum height of 9 feet.	Not included in 2015 Revised Plan	

Notes:

① The top of the levee height is to be determined in the final design phase.

② Under the 1997 NED Plan, I-80 was overtopped and there was no flood fighting. The 2015 Revised Plan lowers the water surface elevation so that I-80 will not overtop.

③ Reach 3 was part of the 1997 approved NED Plan, but is not incrementally justifiable; therefore, it is no longer included in the 2015 Revised Plan.

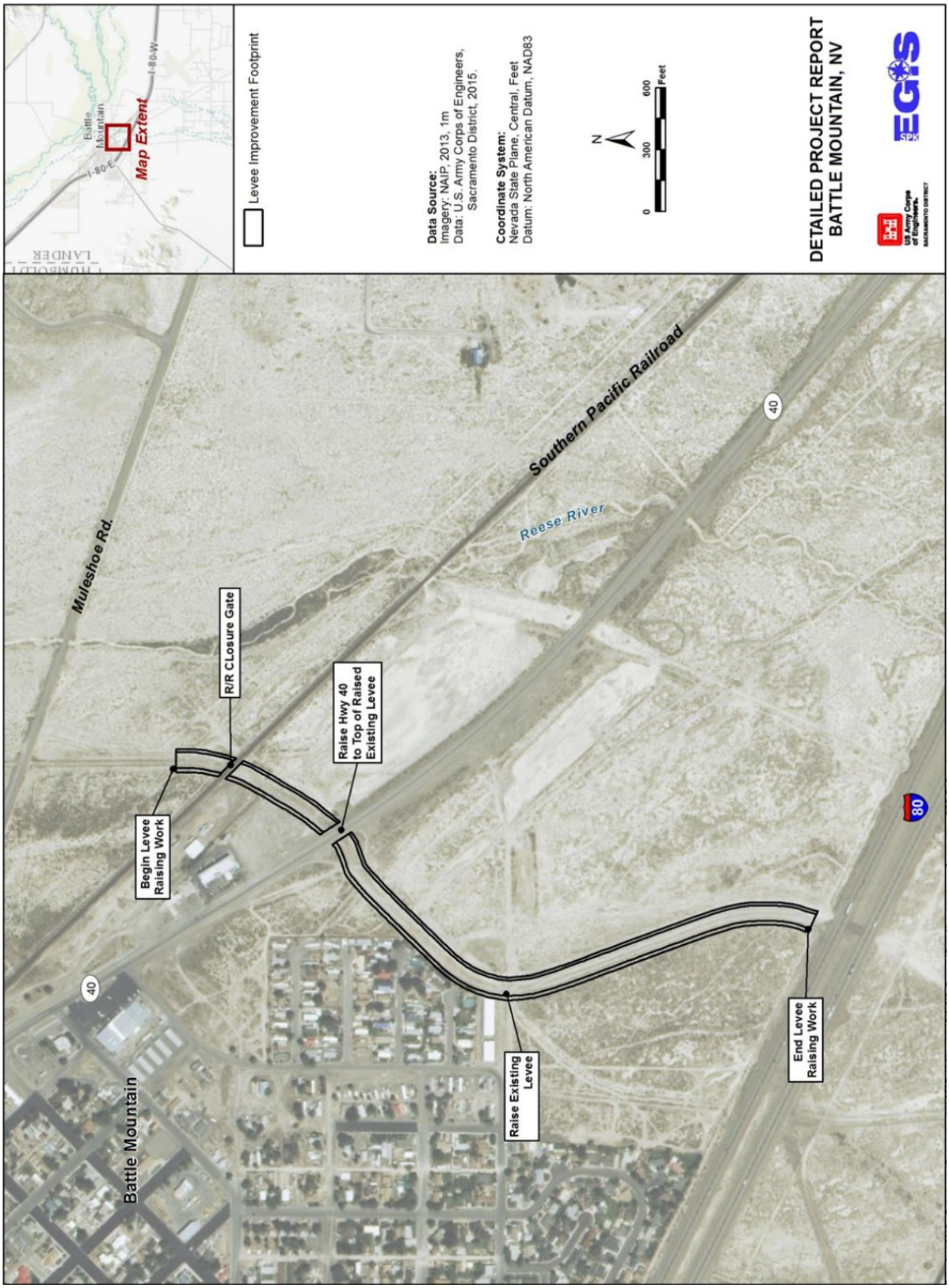


Figure 1 – Map of the 2015 Revised Plan

This Page Intentionally Blank

3 IEPR Process

This section summarizes the process for conducting the IEPR. Figure 2 below shows the overall.

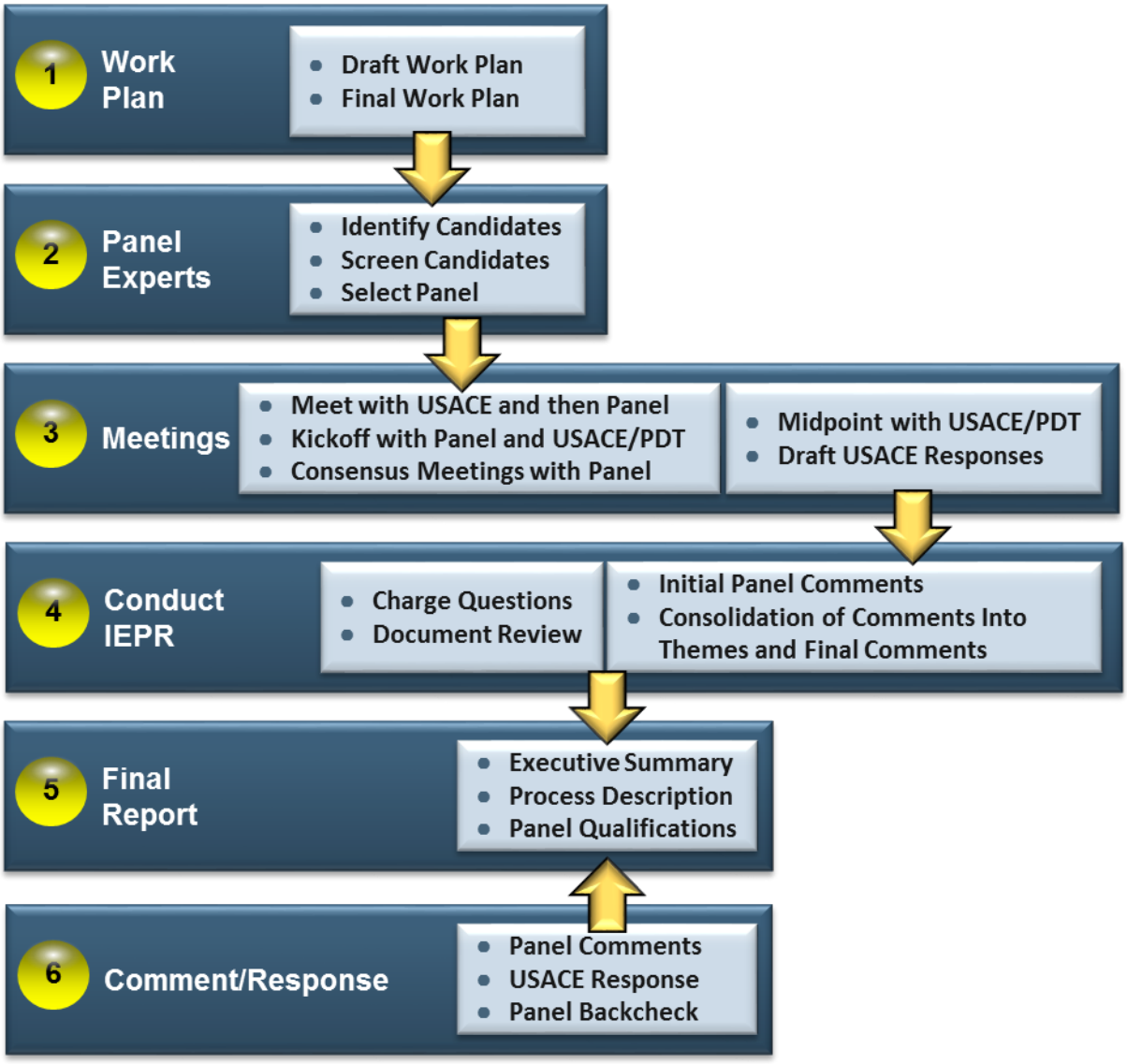


Figure 2 – Summary of the Independent External Peer Review (IEPR) Process

3.1 Project Management

To manage this effort and meet the project schedule, APMI prepared a draft and final Work Plan to define and manage the process for conducting the IEPR.[1] The work plan included the process for screening and selecting independent reviewers, communicating and meeting with the USACE project team,

[1] A Revision was made to account for modification to the schedule as well as changes to the review documentation (see §B.1 on page 68).

maintaining the project schedule and quality control, compiling and disseminating the independent reviewers' comments, and project management and administration. The work plan included the schedule for conducting the IEPR review.

APMI developed a schedule that would meet USACE's goal of completing the IEPR as efficiently as possible in accordance with the Performance Work Statement (PWS). The schedule of activities was agreed upon by APMI and USACE. Table 2 below shows the major milestones and deliverables for the IEPR.

APMI provided USACE with project status reports on a bimonthly basis to communicate the status of the project. The project status reports included details of each task and noted any schedule changes.

Table 2 – IEPR Schedule

Activity	Attendees	Date
Notice to Proceed		2015-09-20
Initial Protocol Meeting	PCX and APMI	2015-10-06
Introductory Meeting	Panel and APMI	2015-10-15
Kickoff meeting	Panel, APMI, LMI, PCX, PDT	2015-10-20
In-Progress Review Meetings	Panel and APMI	Multiple
Midpoint Review Meeting①	Panel, APMI, LMI, PCX, PDT	2015-11-20
Final IEPR panel report submitted to USACE		2016-01-15

① *Purpose is for panel members to ask USACE clarifying questions and get additional information needed to complete review and finalize comments.*

3.2 Selection of Panel

Reaching out to its various pools of experts, APMI identified experts who met and exceeded the technical expertise and requirements of this IEPR. APMI provided potential candidates with a scope of work, which included the required expertise and project schedule, and conducted informal and formal discussions to identify any technical expertise concerns or potential conflict of interest issues. Consistent with the guidelines of the US Office of Management and Budget's (OMB's) Final Information Quality Bulletin for Peer Review (M-05-03), issued December 16, 2004, the following 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 –** The reviewer was not involved with the projects in Battle Mountain, NV, or in producing the documents to be reviewed.

- **Conflict of interest –** Identification of any financial or other interest that conflicts with the service of an individual on the review panel because it could impair the individual's objectivity or could create an unfair competitive advantage for a person or organization.
- **Availability –** Candidates' availability to meet the project schedule.

After screening candidates to exclude those with inadequate expertise or potential Conflict of Interest (COI) issues in accordance with the requirements and guidelines of the National Academy of Sciences (NAS) and OMB M-05-03, several candidates were selected for further screening and evaluation to ensure they met or exceeded the requirements of this task. The list was then narrowed down to identify the most qualified candidates that would be available to serve on the IEPR panel. APMI provided the list of selected panelists along with their detailed résumés to the USACE to determine if any had a potential COI based on USACE knowledge of the individual's past involvement with the project. USACE acknowledged the proposed panel members' experience relative to the requirements of the IEPR and that there were no perceived COI issues. Information on the panel members is provided in §4 on page 19.

3.3 Preparation and Charge for IEPR Panel

The USACE provided APMI the documents to be reviewed by the IEPR panel. APMI provided these documents to the panel members as well as final charge questions. These charge questions, which were developed and approved by USACE, established the general boundaries for the IEPR. The charge questions are shown in Appendix B on page 71.

APMI and the panel had an introductory meeting via teleconference during which APMI outlined the steps of the IEPR process, identified the overall schedule and deadlines, and instructed the IEPR panel members on how to access the documentation and to undertake the review.

Subsequent to a cursory review of the documents by the panel, but prior to the actual detailed IEPR, a kickoff meeting was held via teleconference with the USACE Product Delivery Team (PDT) to familiarize the IEPR panel members with the technical aspects of the project. As part of this meeting, the PDT provided a detailed project briefing, reviewed project features and requirements, and provided the opportunity to exchange technical information among the panel and USACE technical staff.

Following the kickoff meeting, the panel began a detailed review of the documents provided. APMI provided them with instructions and guidance for preparing their comments to ensure proper coverage of all important issues and consistency in the development of the IEPR comments. APMI remained as the conduit for information exchange between the panel and USACE throughout the project in order to ensure a truly independent review.

3.4 Performing the IEPR

The USACE provided APMI the documents to be reviewed by the IEPR panel and additional supporting documents as background material for panel reference. APMI provided these documents to the panel.

The final charge questions were provided to the panel members. These charge questions, which were developed and approved by USACE, established the general boundaries for the IEPR. The charge questions are shown in Appendix B on page 71.

APMI and the panel had an introductory meeting via teleconference during which APMI outlined the steps of the IEPR process, identified the overall schedule and deadlines, and instructed the IEPR panel members on how to access the documentation and to undertake the review.

Subsequent to a cursory review of the documents by the panel, but prior to the actual detailed IEPR, a kickoff meeting was held via teleconference with the USACE Product Delivery Team (PDT) to familiarize the IEPR panel members with the technical aspects of the project. As part of this meeting, the PDT provided a detailed project briefing, reviewed project features and requirements, and provided an opportunity to exchange technical information among the panel and USACE technical staff.

Following the kickoff meeting, the panel began a detailed review of the documents provided. APMI provided the Panel with instructions and guidance for preparing their comments to ensure proper coverage of all important issues and consistency in the development of the IEPR comments. APMI remained as the conduit for information exchange between the panel and USACE throughout the project in order to ensure a truly independent review.

3.5 Finalization of the Panel Comments

After completing the review, the IEPR panel members submitted their draft final comments to APMI. APMI collated the panel comments and ensured they were complete and responsive to the charge. APMI ensured that the panel focused on performing a technical review of the documents and did not comment on policy-related issues.

APMI convened a panel consensus meeting via teleconference with the panel members to discuss the panel's comments. This meeting provided a forum for reviewers to reach consensus on the comments, identify any overlapping comments, and resolve any contradictions. Further refinement and consolidation of the comments occurred via email exchange following the meeting. The panel discussion resulted in the final IEPR comments that were submitted to USACE. The final IEPR comments are presented in Appendix A on page 27.

Each IEPR panel member comment consisted of four parts:

1) **Comment –** A clear statement of the concern
2) **Basis for Comment –** A narrative basis for the concern
3) **Significance –** A significance rating of the concern (the importance of the concern with regard to project implementability) as well as a statement supporting this significance rating. Comments are rated as "high", "medium/high", "medium", "medium/low", or "low" to indicate the general significance the comment has to project implementability.
4) **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.

APMI 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.

Minor editorial changes were not included in the final set of comments unless they affected the understanding of the technical content.

3.6 USACE Responses to IEPR Comments

Following the submittal of this IEPR report, APMI will hold a teleconference with USACE to discuss the process for clarifying the final IEPR comments, delivering the final PDT evaluator responses, and providing the concluding backcheck comments by the Panel. APMI will conduct a teleconference with USACE and the IEPR panel to seek any needed clarification on the IEPR comments as well as discuss the USACE draft evaluator responses provided to APMI and the panel prior to the meeting.

Following the teleconference, USACE will submit the final USACE evaluator responses to the IEPR comments. In response to the IEPR panel recommendation for resolution, USACE will include a statement to "adopt" or "not adopt" for each recommendation, along with a response describing where documentation will or will not be expanded, revised, or changed. After the submittal of the final evaluator responses, APMI will meet with the Panel to discuss the responses and the approach for preparing the Panel's concluding backcheck comments. The backcheck comments will provide panel concurrence or non-concurrence with the USACE responses and indicate whether the responses adequately address the Panel's identified concerns.

After APMI inputs the panel backcheck comments to each USACE evaluator response, APMI will provide USACE with the final IEPR comments, the final USACE evaluator responses to those comments, and the Panel's concluding backcheck comments.

4 Panel Organization

APMI assembled a panel of experts that met the qualifications set forth by the USACE in the PWS for the task, which was to conduct the IEPR and provide independent comments. APMI supported and assisted the panel in carrying out its review and served as the intermediary for communications between the panel and USACE during the IEPR process. The core team, IEPR panel members, and their roles and responsibilities will be shown pictorially in Figure 3 below and their capabilities, as well as roles and responsibilities, will be summarized below.

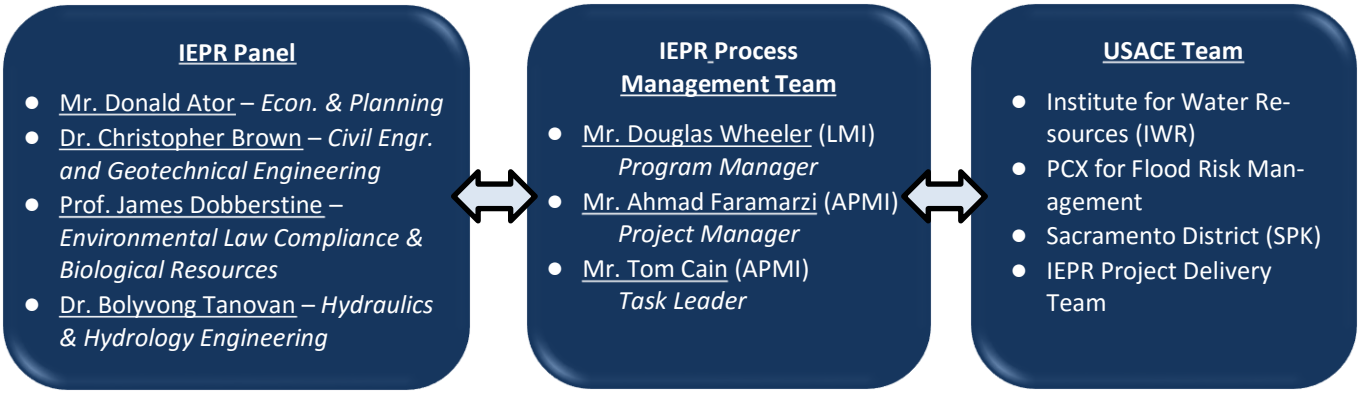


Figure 3 – APMI Core Team for the Battle Mountain IEPR

4.1 IEPR Panel Description

APMI selected four panel members who were collectively qualified in the five required areas of expertise called for by the USACE:

- Economics & Planning
- Civil Engineering
- Environmental Law Compliance and Biological Resources
- Hydrology and Hydraulic
- Geotechnical Engineering

The panel members met and exceeded the minimum requirements for each of the specified areas of expertise. The panel represented a balanced mix of individuals from academia and individual consultants as well as those with direct past experience with USACE. Table 3 below depicts how the panel members meet the specific USACE requirements specified for this IEPR review. In some cases, such as Hydrology and Hydraulic Engineering, the Panel had multiple members meeting the requirements identified in Table 3, but the table identifies the Panel Member assigned those duties.

Table 3 – Summary of Panel Member Qualifications by Discipline

Subject Matter Expertise	Requirements	Prof. Donald Ator	Dr. Christopher Brown	Prof. James Dobberstine	Dr. Bolyvong Tanovan
Summary	Highest Degree	MS	PHD	MS	PhD/ MS
	Years of Experience	36	24	22	46
	Experience with USACE (Direct, Indirect, None)	Dir.	Dir.	Indir.	Dir.
Civil/ Structural/ Cost Engineering	Registered professional engineer having a minimum of 20 years' experience in levee and flood control structures		✓		
	Have working familiarity of USACE cost estimating systems and USACE design regulations for Civil Works project		✓		
	Have experience in public works projects and have a thorough understanding of the USACE levee standards of practice, USACE EM 1110-2-1913, *Design and Construction of Levees*, dated 2000		✓		
	Familiar with structural design and install flood gate structures, be familiar with common nonstructural flood control measures, and design and construction of roads and bridges		✓		
	Have expertise in utilities relocation and culvert design		✓		

Subject Matter Expertise	Requirements	Prof. Donald Ator	Dr. Christopher Brown	Prof. James Dobberstine	Dr. Bolyvong Tanovan
Economics/ Planning	15-years demonstrated experience in economics, with a minimum bachelor's degree or higher in economics.	✓			
	Have expertise in flood risk management evaluating and conducting complex multi-objective public works projects with high public and interagency interest.	✓			
	Familiar with the USACE flood risk management analysis, economic benefit calculations, and expertise in economic analysis for flood risk management, specifically with acceptable methodologies for estimating damages, and use of Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA 1.2) and Institute for Water Resources (IWR) Plan version 3.3.	✓			
	Familiar with USACE plan formulation process, procedures, and standards as it relates to flood risk management. The panel member shall have a minimum of five years' experience directly dealing with the USACE six-step planning process, which is governed by ER 1105-2-100, Planning Guidance Notebook.	✓			
	Have direct experience working for or with USACE (preferred but not required)	✓			
Environmental Law Compliance and Biological Resources	Have at least 15-years' experience directly related to water resource environmental evaluation or review and National Environmental Policy Act (NEPA) compliance (as it relates to Environmental Assessment/Finding of No Significant Impact), with a minimum MS degree or higher in a related field			✓	
	Have experience in assessing the consequences of altering environmental conditions.			✓	
	Familiar with the habitat, and fish and wildlife species that may be affected by the project alternatives in this study area			✓	
	Familiar and have experience with U.S. Fish and Wildlife Service Habitat Evaluation Procedure (HEP) (USFWS, 1980), Clean Water Act, Endangered Species Act (ESA), and essential fish habitat (EFH).			✓	
Geotechnical Engineering	Experienced registered civil engineer with a minimum of 10-years' experience in geotechnical engineering with an emphasis on flood risk management earth structures projects including levees and dams.		✓		
	Have general sound design, construction, subsurface explorations, soil properties, seepage and stability modeling/analysis,		✓		

Subject Matter Expertise	Requirements	Prof. Donald Ator	Dr. Christopher Brown	Prof. James Dobberstine	Dr. Bolyvong Tanovan
	risk and reliability analysis and fragility curves as applied to the USACE practice for levees.				
	Have a MS degree or higher in engineering; reviewer should be familiar with USACE applications of standard USACE hydrologic and hydraulic computer models.		✓		
	Have experience in geotechnical risk and fragility analysis		✓		
Hydrology and Hydraulic Engineering	Registered professional engineer with a minimum of 15-years' experience in hydrologic and hydraulic engineering.				✓
	Experienced with all aspects of hydrology and hydraulic engineering including: statistical frequency analysis, desert hydrology, rural and urban hydrology and hydraulics, open channel systems, detention reservoirs, diversion tunnels, effects of management practices and low impact development on hydrology, use of non-structural systems as they apply to flood proofing, warning systems, and evacuation				✓
	Familiar with Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA 1.2) and TUFLOW				✓
	Have a thorough understanding of two-dimensional modeling products, levee breach modeling and inundation mapping; FEMA FIS update process and design of hydraulic structure				✓

4.2 IEPR Panel Members

Summaries of the panel member's qualifications are presented below.

Prof. Donald Ator

Role: Economics/ Planning
Affiliation: Louisiana State University, Department of Agriculture, Economics, and Agribusiness

Mr. Ator has over 30 years' experience conducting economic analyses for more than 450 water resources planning projects nationwide. He has specialized experience conducting the economic analysis that determines a project's benefits. The large capital investment projects he has worked on have required the economic analysis of benefits and costs on a common time basis. He has discounted the economic value of the project's benefits and costs over the period of analysis using the appropriate interest rate to develop benefits to costs ratios indicating the project's economic efficiency.

Mr. Ator has worked as an economist for the USACE Vicksburg District, Gulf South Research Institute, and three Architect-Engineer firms conducting water resources economic evaluations. He has extensive experience with the USACE planning process as outlined in ER-1105-2-100, *Planning Guidance Notebook*, especially with regard to Flood Risk Management (FRM) studies, and has worked with the USACE Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA), Computerized Agricultural Crop Flood Damage Assessment System (CACFDAS), @RISK, and IWR-PLAN software programs. Mr. Ator's detailed qualifications are shown in §D.1 on page 77.

Dr. Christopher Brown

Role: Civil/Structural/Cost Engineering
Geotechnical Engineering
Affiliation: University of North Florida (UNF)

Dr. Brown has been in civil engineering practice since 1988 and has worked on a wide variety of projects including water resources, hazardous waste remediation, wetland restoration, geotechnical engineering, and groundwater supply. He has worked in both the private sector and the public sector, and he teaches full-time for the University of North Florida. Currently, Dr. Brown provides teaching to undergraduate and graduate students as well as provides consulting services through the university. Dr. Brown is an expert on aquifer, storage, and recovery (ASR), numerical modeling for hydrology and groundwater as well as the sequestration of carbon dioxide underground. He is a professional engineer in Pennsylvania and Florida. Dr. Brown's detailed qualifications are shown in §D.2 on page 79.

Prof. James Dobberstine

Role: Environmental Law Compliance and Biological Resources
Affiliation: Lee College, Baytown, Texas

Prof. Dobberstine is an environmental scientist focusing on wetlands and other sensitive habitats. He is experienced with the complex regulatory framework affecting projects that potentially impact natural habitats. He has experience working with ecologic models as they relate to adaptive management and resource use planning. He is currently engaged in grant-funded ecosystem studies examining the effect of restoration technique on aquatic ecosystem function, to be used toward adaptive management of ongoing ecosystem restoration. He has experience assessing aquatic habitats using the Sediment Triad/Maximum Likelihood Estimation (MLE) method (toxicology, chemistry, biologic community), and a background with a wide range of aquatic and riparian habitats and biologic communities. Prof. Dobberstine also has extensive experience with habitat conservation and restoration, including project development, implementation, monitoring, and adaptive management.

Prof. Dobberstine is frequently called on to serve as an advisor on projects and panels, currently serving on the Monitoring and Research Subcommittee of the Galveston Bay Council (Galveston Bay Estuary Program), on the Harris County Flood Control District (HCFCD) Memorial Park Demonstration Project Vegetation Advisory Workgroup, on the Boards of Directors of the Texas Association of Environmental Professionals (President 2010–present) and the South Central Regional Chapter of Society for Environmental Toxicology and Chemistry (as President 2013–2015), and as an Advisory Board Member of the Galveston Bay Foundation. Prof. Dobberstine's qualifications are shown in §D.3 on page 80.

Dr. Bolyvong Tanovan

Role: Hydrology and Hydraulic (H&H) Engineering
Affiliation:

Dr. Tanovan is a hydraulic engineer specializing in water quality modeling and monitoring, water resource planning, hydropower modeling and operational planning. He is an expert in river hydraulics, fish passage modeling, watershed modeling and optimization, profile modeling of water surface, and storm water management. Mr. Tanovan spent over 45 years in water resources engineering in Switzerland, Laos, Thailand, and the United States. Dr. Tanovan retired from the USACE in November 2008, after 26 years of service dedicated to the management of the Federal Columbia River System. While with the USACE, Dr. Tanovan led annual operational planning for the 31 major USACE and other Treaty dams on the Columbia River System. In this capacity, he maintained regional coordination with federal and non-federal project owners and operators in the Pacific Northwest, and managing the Hydropower Analysis Center of expertise tasked with performing hydropower studies for USACE projects across the nation, and for hydro projects in several foreign countries. He also served as Chief of the Fish and Water Quality Section, and member of the USACE National Water Quality Committee. Dr. Tanovan MS in Civil Engineering and PhD. in Hydrologic Engineering, Federal Institute of Technology, Lausanne, Switzerland and is a licensed/registered professional engineer (PE) since 1977. Tanovan's detailed qualifications are shown in §D.4 on page 81.

4.3 IEPR Process Management Team

The IEPR process management team were the following members.

Mr. Douglas Wheeler (LMI)

As the Program Manager, Mr. Wheeler was responsible for the overall implementation of the IEPR process in compliance with contractual requirements as well as overall quality of the review. Mr. Wheeler has more than 20 years of experience in strategic process engineering and financial analysis for various government agencies, including the USACE. He has managed and provided subject matter expertise on more than 40 consulting projects over more than 10 years, utilizing my background in Industrial engineering, process improvement, business, and project management. Mr. Wheeler holds an MBA and a BS in mechanical engineering from Columbia University and an MSE in industrial engineering from Arizona State University.

Mr. Ahmad Faramarzi (APMI)

Ahmad Faramarzi, PE, PMP – As the Project Manager, Mr. Faramarzi was responsible for the execution of this IEPR. He assigned and supervised project personnel and communicated policies, procedures, and goals to the IEPR Team. Mr. Faramarzi maintained regular contact with the USACE and was responsible for the overall project planning, performance, quality, and personnel assignment to this task. Mr. Faramarzi is a registered PE and a certified PMP with 35 years of experience providing managerial and technical expertise to government agencies and congressionally mandated Review Boards, including the management of several high profile expert panel efforts for the OSD, the Army, and the National Academy of Sciences. He holds an Applied Scientist Degree from The George Washington University in Aerospace and Mechanical engineering (fluid mechanics), an MS in Fluids Engineering, and a BS in Nuclear

Engineering. He is on the Board of Directors of the Washington DC Section of the American Society for Mechanical Engineers (ASME) and is an active member of the Fluid Dynamics branch.

Mr. Tom Cain (APMI)

Mr. Tom Cain, Senior Principal Chemical/Process Engineer (APMI) – Mr. Cain was the task leader for this project. He maintained regular contact with the Panel Members and was responsible for the overall Battle Mountain task objectives and performance. Mr. Cain is a Chemical Engineer with over 30 years of experience providing managerial and technical expertise to government clients, including the USACE, Office of the Secretary of Defense (OSD), the U.S. Army, the U.S. Air Force, the Department of Justice (DoJ), and other government agencies. He has organized and managed and/or participated several important and highly visible expert panels and conducted numerous studies in response to recommendations by the National Academy of Sciences (NAS). Mr. Cain has experience with environmental regulations, including the National Environmental Policy Act (NEPA) process, and with analyzing the environmental impacts of a wide variety of types of federal projects, particularly the technical aspects. Mr. Cain has routinely applied his engineering, scientific, and analytical skills to unclassified, sensitive, and classified government programs. Mr. Cain holds a BS in Chemical Engineering.

5 Summary of the Independent External Peer Review (IEPR) Findings

The IEPR panel recognizes the significant amount of USACE effort, analysis, and documentation that went into preparing the Battle Mountain DPR Update. The panel acknowledges the USACE for its sustained support of this project, and the local community, as well as the systematic approach to conducting the Update of the feasibility study with the many scientific, technical, and engineering analyses and studies that are required to develop an effective plan to reduce the flood risk to this rather complex area. The DPR update, and its associated design changes, was an obvious necessity given the original DPR was from 1997, 18 years ago. The information available is more comprehensive and the methodologies available are more advanced. In addition, the approach to improving Reach 2 appears reasonable.

However, the Review Panel has some concerns with certain aspects of the adequacy and acceptability of the 2015 Battle Mountain, Nevada, DPR Update, resulting in 39 total final comments from their review. Of these, 7 are identified as having High significance, 4 as Medium/High significance, 14 as Medium significance, 4 as Medium/Low significance, and 10 of Low significance. The following paragraphs provide a narrative assessment by the panel in the specific areas of engineering, environment, and economics. The Panel recommends that the USACE make significant revisions to the DPR Update before its final adoption.

Economics

The Panel's review of the 2015 DPR Update reveals contradictory information and numerous inconsistencies. Some of the inconsistencies should not affect the recommended actions or justification of the project or plan. However, other inconsistencies and contradictory information affect the technical quality and acceptability of the report regarding the Recommendation Plan and the justification for the project, but the panel does not have sufficient information to challenge the effect on the report's findings. The document states that future years were assumed equal to existing conditions, and that equivalent annual damages are the same as expected annual damages, the primary reason given for this assumption was the tepid historical and expected pace of development in the floodplain. The document then reports a

five-fold increase in project benefits from the 1997 DPR to the 2015 DPR Update based on a 50% increase in the number of single and multifamily structures in the floodplain and a 27% increase in population from the 2000 to the 2010 census. In addition, the costs presented in the report are not the same as the costs presented in the cost estimate from the Micro-Computer Aided Cost Estimating System (MCACES) and the Cost Risk Analysis provided was for the Recommended Plan in the 1997 DPR, instead of the Recommended Plan in 2015 DPR Update. As a result, the panel urges that the substantial inconsistencies in the document be corrected before moving forward with the report.

Environmental

Upon review, the DPR Update appears to lack sufficient documentation of the methods to analyze project impacts. Important specifics regarding habitat assessment and other areas critical to the justification and implementation of the project are not included or adequately discussed. This includes specific issues with regard to the Hazardous, Toxic, and Radioactive Waste (HTRW) risk assessment, air/water/endangered species impacts that are not sufficiently addressed in the materials provided for review, and others. Additionally, the DPR Update does not provide sufficient detail regarding compliance with environmental justice requirements. The panel recommends changes to improve the document clarity and to address issues pertinent to meaningful analysis in these regards.

Engineering

The Panel has concluded that the DPR is lacking the sufficient engineering detail necessary to support the updated plan. No updated civil, structural, or geotechnical engineering has been performed for the DPR Update. Instead, the USACE analyses rely upon data, modeling, and efforts completed in the original 1996-97 DPR, which are now likely out of date. During this IEPR, the USACE reported that it intends to collect new geotechnical data in 2016. The Panel applauds this decision but the information to be gathered may not be included in the current DPR Update. The hydrologic and hydraulic modeling efforts have been updated for the DPR but the methods used and approach taken are not well supported in the main report of the DPR. Following the IEPR Midpoint conference call between the Panel and USACE, a considerable volume of supplemental data regarding the hydrologic modeling was provided to the Panel. Much of this information is very valuable, but at this time, is not included in the review package provided to the Panel or integrated into the DPR Update. Of a major concern to the IEPR Team is the lack of observed data (stream flows and water surface levels, among others) to support predictions made by the TUFLOW model, which was used in the design of the affected levees and culverts. Many of the questions submitted by the review panel at the Midpoint meeting addressed this lack of data, and seemed to have generated some positive reaction and interest from USACE, but will probably require additional policy decisions to resolve.

The Cost Engineering appendix and the Micro-Computer Aided Cost Estimating System (MCACES) cost estimate is detailed and provides an updated 2015 cost for the 1997 approved NED plan that is adjusted for risk and uncertainty as required by USACE current guidance. However, the 2015 “Revised Plan”, which is the new USACE recommended plan, has not been estimated in the same manner as used for the 1997 DPR. In addition, the Panel uncovered various errors in the primary project cost table (e.g., Table 4) as compared to the cost estimate, such as, inconsistent inclusion of the sunk planning, engineering, and design (PED) costs. Ultimately, the lack of updated engineering data and analyses combined with erroneous costs result in a DPR Update that is not adequate in its current form.

Appendix A Final Panel Comments

This Appendix provides the comments of the IEPR panel members on the Sabine Pass DIFR-EIS. The comments cover a range of issues that pertain to the technical aspects of the documents reviewed.

Each comment consists of four parts that include the following:

1. Clear statement of the concern
2. Basis for the concern
3. Significance of the concern
4. Recommended actions necessary to resolve the concern.

Comments are rated to indicate the general significance the comment has to the project implementability. The significance ratings are defined as follows:

- **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.

The comments are arranged in order of significance. Of the final 39 total comments, 7 were identified as having high significance, 4 as Medium/High significance, 14 as Medium significance, 4 as Medium/Low, and 10 of Low significance.

A.1 Summary of Comments

Table 4 on page 28 provides a summary list of all IEPR comments organized by their significance from high to low. The summary tabular list is followed by a List of Panel Comments, providing the page numbers for each of the comments.

Table 4 – Summary of Final Panel Comments Identified by the IEPR Panel

Final Panel Comment
Significance – High
Panel Comment 1 – High **(Civil/Structural/Cost Engineering)** The total first cost shown on Table 4 in the Detailed Project Report (DPR) Update for the "Revised Plan" (Reach 2 features only) does not include planning, engineering, and design (PED) sunk costs of $1,612,000.
Panel Comment 2 – High **(Civil/Structural/Cost Engineering)** The total first cost shown on Table 4 in the Detailed Project Report (DPR) Update for the "Revised Plan" (Reach 2 features only) does not include cost adjustments resulting from the January 20, 2015 "*abbreviated cost risk study*".
Panel Comment 3 – High **(Geotechnical Engineering)** Geotechnical site characterization and design analysis is not included in the Detailed Project Report (DPR) Update.
Panel Comment 4 – High **(Hydrology & Hydraulic Engineering)** No observed stream flow data are available for Reese River, which is a critical part of the study area. This critical data gap is usually not a very common practice at this point in the project.
Panel Comment 5 – High **(Hydrology & Hydraulic Engineering)** Comparison between FLO-2D and TUFLOW capability to estimate discharge through the culvert during the period of peak-flow conditions needs more supporting information. In addition, flooding depth predictions by HEC-2 and TUFLOW are expected to be different and deserve to be documented.
Panel Comment 6 – High **(Hydrology & Hydraulic Engineering)** Battle Mountain is a challenging situation to handle, due to the lack of stream flow and flooding data, and 2D unsteady flow conditions. The study steps that have been performed and the tools that were used (or are still needed), need to be discussed for the record in order to support and complement current findings, in case they need to be revived later.

Final Panel Comment

Panel Comment 7 – High
(Hydrology & Hydraulic Engineering)

The challenge here is to support the prediction capability of each of the models, starting with model calibration results. The need to provide proof of performance has been one of the Panel's most pressing recommendations.

Besides recommending justifications for the study H&H assumptions that are more detailed, the Panel is also calling for additional ways to minimize the uncertainties caused by the use of limited observed data.

These new tools would not necessarily change the conclusions of the study with regard to the heights and locations of the levees and embankments, but would greatly enhance the level of confidence in the hydrologic and hydraulic predictions used in the current design criteria.

Significance – Medium/High

Panel Comment 8 – Medium/High
(Civil/Structural/Cost/Engineering)

Civil and structural design analysis is not included in the Detailed Project Report (DPR) Update.

Panel Comment 9 – Medium/High
(Environmental Law Compliance and Biological Resources)

It is not clear from the Detailed Project Report (DPR) Update whether environmental justice has been considered.

Panel Comment 10 – Medium/High
(Hydrology & Hydraulic Engineering)

The TUFLOW Memo described hydraulic analysis model development in better detail, but offered limited explanations on how accurately the model was calibrated.

Panel Comment 11 – Medium/High
(Hydrology & Hydraulic Engineering)

The effect of upstream irrigation diversions on actual flood events is not clear in the DPR Update to the extent that hydrograph estimates could be overestimated. Such an overestimation could mean that the recommended plan is too conservative.

Panel Comment 12 – Medium
(Environmental Law Compliance and Biological Resources)

It is not clear from the Detailed Project Report (DPR) Update whether the Hazardous, Toxic, and Radioactive Waste (HTRW) analysis has been reviewed or updated.

Final Panel Comment
Significance – Medium
Panel Comment 13 – Medium **(Environmental Law Compliance and Biological Resources)** The Detailed Project Report (DPR) Update is unclear regarding habitat impact determination and mitigation.
Panel Comment 14 – Medium **(Environmental Law Compliance and Biological Resources)** It is not clear from the Detailed Project Report (DPR) Update whether the increases in population and infrastructure noted in the document may have resulted in a change in hydrology behind the levee (i.e., the city side) (perhaps from increases in impervious surface upslope from the project site) that might result in drainage impoundment and flooding during high runoff events.
Panel Comment 15 – Medium **(Hydrology & Hydraulic Engineering)** Rock Creek flow data were used to estimate Reese River stream flows, based on a presumably high correlation between the two streams. However, limited information was provided to support the "high correlation".
Panel Comment 16 – Medium **(Hydrology & Hydraulic Engineering)** It is not clear why the updated 2% hydrograph has a lower peak and volume than the 1996 Feasibility 2% hydrograph.
Panel Comment 17 – Medium **(Hydrology & Hydraulic Engineering)** It is not clear why the threshold of 1,000 cubic feet per second (CFS) was used to remove flows as part of the Humboldt River versus Rock Creek correlation analysis.
Panel Comment 18 – Medium **(Hydrology & Hydraulic Engineering)** The use of only a single snow gage at Huntington Creek for the snowmelt simulations does not provide adequate geographic coverage in the study area to provide a reasonable snowmelt factor.
Panel Comment 19 – Medium **(Hydrology & Hydraulic Engineering)** The statement about the following assumption could be misleading, "*Rock Creek 3-day flow volume is close in value to Reese River's 3-day flow volume",* is only possible if flows occur in both streams for the same event. Since Rock Creek is a perennial stream and Reese River is an ephemeral stream, the similarity in 3-day flow volume can only be assumed during a storm event.

Final Panel Comment

Panel Comment 20 – Medium
(Hydrology & Hydraulic Engineering)

It is not clear why a fixed coincident flow of 170 cubic feet per second (CFS) (rather than a flow range) was selected for all peak flood events on the Reese River. Incorrect assumptions could lead to under (or over) estimated flows used in sizing the levees and culverts, resulting in potential failure to manage flows.

Panel Comment 21 – Medium
(Hydrology & Hydraulic Engineering)

The With-Project Conditions memo provided only limited details on how the Humboldt River coincident flow was determined (using historical flows recorded for Humboldt and the Reese rivers).

Panel Comment 22 – Medium
(Hydrology & Hydraulic Engineering)

The Detailed Project Report (DPR) Update, Appendix C provided no specific justification for the use of the non-USACE TUFLOW model, other than stating that it, "*contains the necessary tools to analyze all* [the] *features of the Battle Mountain project*". Some of that information had already been described in the earlier, 12 January 2015 memo, and should have been summarized in the 10 February 2015 memo. (Acknowledging that the missing information can be found in the TUFLOW Model report.)

Panel Comment 23 – Medium
(Hydrology & Hydraulic Engineering)

Based on the complicated hydrologic system of the project area the statement in the DPR Update, "*the floodplain at the confluence of Reese River and Humboldt River is affected by the Peak Flows of the Reese River, Humboldt River, or a coincident combination of both*", deserves explanations that are more detailed.

Panel Comment 24 – Medium
(Hydrology & Hydraulic Engineering)

The Hydrology Technical Memo mentioned that, "*Although the Reese River basin is greater than 2,000 square miles, only parts of the watershed contributed flow to the outlet*". Summit Engineering's model likely underestimated the peak flow and overestimated the volume since these conditions were not taken into consideration.

Panel Comment 25 – Medium
(Hydrology & Hydraulic Engineering)

Calibration of the TUFLOW model seems to be more focused on sensitivity analysis of Manning's "n" values than on meeting observed flows or observed water surface profiles during the calibration phase.

Significance – Medium/Low

Panel Comment 26 – Medium/Low
(Economics/Planning)

The 2015 DPR Update is contradictory about expected future development within the floodplain.

Final Panel Comment

Panel Comment 27 – Medium/Low
(Economics/Planning)

The 2015 Cost Estimate for Reach 2 Revised Plan Total Project First Cost in Table 4 – Change in Estimated Cost of the 1997 Approved NED Plan of $3,503,000 is not the same as the Project First Cost in the MCASES Cost Estimate of $3,670, 000.

Panel Comment 28 – Medium/Low
(Environmental Law Compliance and Biological Resources)

Updated documentation regarding endangered species, 401(b)(1) water quality analysis, and air quality are not clearly presented in the Detailed Project Report (DPR) Update.

Panel Comment 29 – Medium/Low
(Hydrology & Hydraulic Engineering)

The With-Project Conditions memo provided some details on how the Humboldt River coincident flow was determined (using historical flows recorded for Humboldt and the Reese rivers), but no comparison of the data that is needed to illustrate the differences.

Significance – Low

Panel Comment 30 – Low
(Economics/Planning)

The Detailed Project Report (DPR) Update should include the USACE guidance for making changes to uncompleted authorized projects.

Panel Comment 31 – Low
(Economics/Planning)

The Detailed Project Report (DPR) Update does not include a description of the full range of alternatives that were considered in the plan formulation process and the reasons they were eliminated from further consideration.

Panel Comment 32 – Low
(Economics/Planning)

Additional Cash Adjustment Subtotal Row for 2015 Revised Plan adds up to $3,141,850 instead of the $3,503,000 shown in Table 11, Changes in Cost Apportionment.

Panel Comment 33 – Low
(Environmental Law Compliance and Biological Resources)

Information regarding the Categorical Exclusion (CatEx) as it applies to the proposed project (as updated) should be more prominent within the DPR Update.

Panel Comment 34 – Low
(Hydrology & Hydraulic Engineering)

Summit Engineering's hydrologic model memorandum should be included in the final, revised DPR.

Final Panel Comment

Panel Comment 35 – Low
(Hydrology & Hydraulic Engineering)

The DPR contains conflicting statements regarding the selected use of 3-day flow volumes to correlate flows between the Reese River and Rock Creek.

Panel Comment 36 – Low
(Hydrology & Hydraulic Engineering)

The discussion regarding peak flows during the 1962 and 1976 floods in Rock Creek and the Humboldt River is not clear.

List of Panel Comments

A.2 Panel Comments – Significance High

Panel Comment 1 – High (Civil/Structural/Cost Engineering)

The total first cost shown on Table 4 in the Detailed Project Report (DPR) Update for the "Revised Plan" (Reach 2 features only) does not include planning, engineering, and design (PED) sunk costs of $1,612,000.

Basis for Comment

Sunk PED costs must be included in all alternative plans presented. In the current version of Table 4 the sunk PED costs are only included in the updated total first cost of the "Approved Plan". If the sunk costs are properly reported for the "Revised Plan", the total first cost is more than $5,000,000.

Significance – High

Since the total first cost is incorrect for the Revised Plan, calculations for incremental costs, benefit-to-cost ratios, and cost-sharing totals with the local sponsor also need to be revised. This omission represents a fundamental problem with the project that could affect the recommendation or justification of the project alternatives.

Recommendation for Resolution

The Panel has devised a number of recommendations related to this comment as follows:

1. Revise the total first cost in Table 4 for the Revised Plan.
2. Revise Table 7 – Incremental Benefit of Select Alternatives.
3. Revise Table 8 – Annual Benefit of Select Alternatives.
4. Revise Section 14 – Benefit-Cost Ratio.
5. Revise Table 10 – Economic Analysis at October 2015 price levels (Reach 2 only).
6. Revise Table 11 – Changes in Cost Apportionment.

Panel Comment 2 – High (Civil/Structural/Cost Engineering)

The total first cost shown on Table 4 in the Detailed Project Report (DPR) Update for the "Revised Plan" (Reach 2 features only) does not include cost adjustments resulting from the January 20, 2015 "*abbreviated cost risk study*".

Basis for Comment

Risk-adjusted costs should be presented in the Revised Plan as well as the Approved Plan. At present, the cost-engineering appendix only includes an abbreviated cost risk analysis of the Approved Plan, which is projected to cost $18,354,585 at the 80% confidence interval per ER-1110-2-1302. This is about 58% greater than the total first cost for the Approved Plan shown in Table 4 of the DPR. If the Revised Plan included similar risk adjustments (and missing PED sunk costs noted in a previous comment), the cost could increase to more than $8,000,000 or more than twice what is currently presented in Table 4.

Literature Cited:

ER 1110-2-1302, "*Engineering and Design, Civil Works Cost Engineering"*, Department of the Army, U.S. Army Corps of Engineers (USACE), Washington, DC, 2008, 31 p.

Significance – High

Since the total first cost is incorrect for the Revised Plan, calculations for incremental costs, benefit-to-cost ratios, and cost-sharing totals with the local sponsor also need to be revised. This omission represents a fundamental problem with the project that could affect the recommendation or justification of the project alternatives.

Recommendation for Resolution

The Panel has devised a number of recommendations related to this comment as follows:

1. Update the Cost Engineering Appendix and conduct cost-risk study of the Revised Plan (Reach 2 only).
2. Revise the total first cost in Table 4 for the Revised Plan.
3. Revise Table 7 – Incremental Benefit of Select Alternatives.
4. Revise Table 8 – Annual Benefit of Select Alternatives.
5. Revise Section 14 – Benefit-Cost Ratio.
6. Revise Table 10 – Economic Analysis at October 2015 price levels (Reach 2 only).
7. Revise Table 11 – Changes in Cost Apportionment.

Panel Comment 3 – High (Geotechnical Engineering)

Geotechnical site characterization and design analysis is not included in the Detailed Project Report (DPR) Update.

Basis for Comment

The engineering completed as part of the DPR does not satisfy the requirements for a feasibility report (USACE, 1999) and as the DPR is updating the 1997 Feasibility Study, it should comply with appropriate guidance. The additional geotechnical work recommended and briefly discussed during the Midpoint conference call could reveal significant issues that have substantial impact on the project design, cost, and schedule. The engineering requirements not satisfied include:

- Development of an updated geologic model of the site;
- Development of an updated levee foundation study including soil characteristics along the levee centerline as well as perpendicular to the levee right-of-way;
- Slope stability analyses of the levee design (none completed to date);
- Development of an updated seepage model of the levee foundation; and,
- Settlement analyses of levee footprint.

Literature Cited:

- (USACE, 1990). Engineering Manual (EM) 1110-1-1904, "*Engineering and Design—Settlement Analysis",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1990-09-30.
- (USACE, 1999). Engineer Regulation (ER) 1110-2-1150, "*Engineering and Design—Plans and Specifications for Civil Works Projects",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1999-08- 31.
- (USACE, 2000). Engineer Manual (EM) 1110-2-1913, "*Engineering and Design—Design and Construction of Levees",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 2000-04-30.
- (USACE, 2003). Engineer Manual (EM) 1110-2-1902, "*Engineering and Design—Slope Stability",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 2003-10-31.

Significance – High

The lack of updated geotechnical site characterization and geotechnical analyses (e.g., seepage, slope stability, settlement), as required by ER 1110-2-1150 (USACE, 1999), affects the updated evaluation of project alternatives, the estimated project cost, and the projected construction schedule.

Recommendation for Resolution

The Panel has devised a number of recommendations related to this comment as follows:

1. Complete investigations, testing, analyses, and design as outlined in ER 1110-2-1150 (USACE, 1999) and EM-1110-2-1913 (USACE, 2000) to allow refinement of project features.
2. Develop a geologic model as outlined in EM 1110-2-1913 (USACE, 2000) and ER 1110-2-1150 (USACE, 1999).
3. Complete subsurface investigations to identify the foundation conditions including extent of both cohesive soils (e.g., clays) and cohesionless soils (e.g., gravels and sands) so these materials can be accurately evaluated through the use of seepage, settlement, and slope stability analyses.
4. Test in situ soils along the levee alignment to verify the estimated range of material properties, including hydraulic conductivity, used in the 1997 Feasibility Study.
5. Evaluate and account for any change resulting from embankment loading from the existing 1968 levee as some consolidation of onsite clays and strength improvement (clays and possibly sands) may have occurred.
6. Use the simulated TUFLOW flood hydrograph as an input for seepage and stability models to assess if the levee becomes saturated, if so, determine how the pore pressures will change during the flood event, and after the flood wave crests.
7. Consider the use of feasibility-stage levee side slopes of 5H:1V as recommended in EM 1110-2-1913 (USACE, 2000) in areas where no slope stability analyses have been completed. Of course, the final DPR would be better served through the inclusion of the necessary geotechnical data from the pending field investigations.

Panel Comment 4 – High (Hydrology & Hydraulic Engineering)

No observed stream flow data are available for Reese River, which is a critical part of the study area. This critical data gap is usually not a very common practice at this point in the project.

Basis for Comment

Rock Creek and Reese River share many physical and climatologic similarities, but also do have some dissimilarities. Information that is more detailed is required, ideally directly pertaining to Reese River, to support the validity of the assumptions made. While correlation with other similar, nearby watersheds, subject to the same type of weather conditions, is sometimes used, more direct stream flow measurements at Reese River itself provide the most accurate data. A map showing rainfall and snow areal distribution over the catchment area would be helpful.

Literature Cited:

- DPR Update, Appendix C – 2015-01-12, MFR "*Battle Mountain Hydraulic Analysis for the Without Project Conditions*", CESPK-ED-HD, §5, Hydrology

Significance – High

Observed, real-time stream flows are the most critical data needed to support the validity of the assumed relationships between Reese River and Rock Creek flows. Incorrect assumptions could lead to under (or over) estimated flows used in sizing the levees and culverts, resulting in potential failure to manage flows.

Recommendation for Resolution

In the long term, setting up a stream gauging station for Reese River near Battle Mountain would seem unavoidable. In the interim, the following temporary justifications are recommended:

1. Add a more detailed summary on Reese River and Rock Creek hydrology and climatology
2. Add an isohyet map showing how mean annual precipitation and snow are distributed spatially and timely over the Reese River basin.

Panel Comment 5 – High (Hydrology & Hydraulic Engineering)

Comparison between FLO-2D and TUFLOW capability to estimate discharge through the culvert during the period of peak-flow conditions needs more supporting information. In addition, flooding depth predictions by HEC-2 and TUFLOW are expected to be different and deserve to be documented.

Basis for Comment

The TUFLOW model development memo indicated that the FLO-2D model underestimated the culvert capacity, while TUFLOW was said to have results that match the **hand calculations** extremely well. The words "hand calculations" need to be clarified. More importantly, were those "hand calculations" able to replicate actually measured culvert capacities?

Results that differ between HEC-2 and TUFLOW were casually noted in several documents. More discussions on the acceptability and reasonableness of the results are needed, including some discussions on the range of the flood depth predictions. This information must be made available and further evaluated.

Literature Cited:

- DPR Update, Appendix C – 2015-08-12, MFR "*Development of TUFLOW Model for Hydraulic Analysis of Battle Mountain Flood Reduction Plan*", CESPK-ED-HD

Significance – High

Parameters selected for model calibration affect the overall model accuracy and, hence, the validity of the levee and culvert design process.

Recommendation for Resolution

1. Define the steps involved in the "hand calculations" and clarify why those steps were not followed in FLO-2D.
2. Document the changes in flood depth predictions by HEC-2 and TUFLOW (based on Figure 7 for HEC-2, and Figures 8 and 9 for TUFLOW, as shown in Battle Mountain Sec. 205 CAP Update to the DPR).
3. Discuss the need for and feasibility of a small-scale physical model to support TUFLOW modeling prediction accuracy.

Panel Comment 6 – High (Hydrology & Hydraulic Engineering)

Battle Mountain is a challenging situation to handle, due to the lack of stream flow and flooding data, and 2D unsteady flow conditions. The study steps that have been performed and the tools that were used (or are still needed), need to be discussed for the record in order to support and complement current findings, in case they need to be revived later.

Basis for Comment

Many of the project challenges have been addressed. Lack of actual stream flow records was addressed through correlation with other streams; determination of flood peaks was based on coincidental occurrences of peaks of two streams subjected to different flood conditions; and 2D flow propagation was addressed using a new 2D model. Flood control management measures (non-structural, flood detention storage, channel improvements, levee and floodwall closures, etc.) were also discussed in the July 1997 Battle Mountain Base Document.

Literature Cited:

- Bulletin 17B, "*Guidelines for Determining Flood Frequency*", Hydrology Committee, March 1982, page 5, "*Comparison with similar watersheds*"
- DPR Update, "*Flood Control Management Measures*", page 26-36
  - Nonstructural Measures, Raising Structures, Flood Proofing, Temporary Evacuation, Permanent Evacuation, Ring Levees
  - Flood Detention Storage
  - Channel Improvements
  - Levees/Floodwalls/and Closures

Significance – High

Alternative tools would increase confidence in the model predictions and lead to results that are more accurate. In addition, it is important to show the full picture of the study efforts conducted to date, with enough details on both preventive and curative measures, in case they need to be quickly updated.

Recommendation for Resolution

1. Keep feasible flood control measures in reserve. Flood control options that had been evaluated and temporarily shelved might become more attractive under different flood scenarios.
2. Keep developing runoff data and improving prediction tools.
3. Significant advances have been made in the development of HEC-RAS 1D/2D model and this model has been officially released for use. For final design of Battle Mountain project, consider using HEC-RAS 1D/2D model to facilitate the application for FEMA levee certificate to be performed by the Sponsor, as TUFLOW has not been approved by FEMA.
4. Consider complementary tools and/or steps:
   - Install stream gages for Reese River, and Humboldt River upstream and downstream of their confluence,
   - Develop a snow melt and rainfall-runoff model to predict daily flows for Reese River and Humboldt River, and determine rarer frequencies flood peaks at Battle Mountain, and
   - Show applicable data from nearby, similar watersheds. Those alternatives deserve continuing discussions.

Panel Comment 7 – High (Hydrology & Hydraulic Engineering)

The challenge here is to support the prediction capability of each of the models, starting with model calibration results. The need to provide proof of performance has been one of the Panel's most pressing recommendations.

Besides recommending justifications for the study H&H assumptions that are more detailed, the Panel is also calling for additional ways to minimize the uncertainties caused by the use of limited observed data.

These new tools would not necessarily change the conclusions of the study with regard to the heights and locations of the levees and embankments, but would greatly enhance the level of confidence in the hydrologic and hydraulic predictions used in the current design criteria.

Basis for Comment

The Battle Mountain Project is a long-term project that might take many more years to complete. Many local, State, and Federal actors subject to different pressures and priorities are also involved. From the H&H standpoint, which plays a critical role in the design phase, the most pressing need is to come up with reliable data and accurate and verifiable prediction tools, in addition to reaching a good understanding of the rainfall/snowmelt runoff process.

The IEPR Team fully recognizes the great amount and high level of efforts dedicated over almost the past two decades on Battle Mountain's hydrologic and hydraulics issues.

The project area is a relatively complex hydrologic system, due to the combined effects of streams that are subject to different storm conditions. What makes the issues even more challenging is the lack of observed stream flows on the Reese River, the stream that runs through the town of Battle Mountain creates flooding upstream and downstream from its confluence with Humboldt River, while being crisscrossed by multiple culverts under Highway Interstate 80 that affect its capacity. The flows of Reese River are also subject to irrigation diversions that influence the magnitude and timing of its stream flows in the lower part of the drainage basin.

To work around the lack of data, correlation of Reese River with other nearby streams, like Rock Creek, was attempted, which leaves some of the results open to questions because of differences in drainage areas, stream flow conditions, and flooding elements uncertainties. Estimates of peak discharges and flood hydrograph curves for storms of various occurrence frequencies had to be based on hydrologic assumptions that require as detailed clarifications as possible.

To cope with all those challenges, mathematical models had been used over the years for this Project, including a rainfall-runoff model (used by Summit Engineering), the HEC-2 water surface profile model, the FEMA-approved FLO-2D hydraulic and hydrologic model for flood routing, and more, recently, the TUFLOW model that simulates 1D and 2D flow regime over levees and embankments.

Significance – High

Increasing the reliability of model predictions using observed data is critical to the successful, and timely and economical completion of the Project.

Recommendation for Resolution

1. Add a mean annual precipitation map and small-scale topographic (with contour lines) map to delineate the watershed boundaries more clearly.
2. Set up a stream gage for Reese River to support hydrologic assumptions.

3. Develop an appropriate rainfall/snowmelt-runoff model to derive complementary flood hydrographs for rare storm events.
4. Consider using selected small-scale physical model to back up TUFLOW predictions.

A.3 Panel Comments – Significance Medium/High

Panel Comment 8 – Medium/High (Civil/Structural/Cost/Engineering)

Civil and structural design analysis is not included in the Detailed Project Report (DPR) update.

Basis for Comment

The engineering completed as part of the DPR does not satisfy the requirements for a feasibility report (USACE, 1999; USACE, 2007) and as the DPR is updating the 1997 Feasibility Study, it should comply with appropriate guidance. The additional survey could reveal significant issues that have substantial impact on the project design, cost, and schedule. The engineering requirements not satisfied include:

- Development of a final updated topographic model of the site.

Literature Cited:

- (USACE, 1999). Engineer Regulation (ER) 1110-2-1150, "*Engineering and Design—Plans and Specifications for Civil Works Projects*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1999-08-31.
- (USACE, 2007). Engineer Manual (EM) 1110-1-1005, "*Engineering and Design—Control and Topographic Surveying*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 2007-01-01.

Significance – Medium/High

The lack of updated topographic data affects the updated evaluation of project alternatives, the estimated project cost, and the projected construction schedule since USACE will have to rely upon topographic data procured in the 1997 timeframe. The use of the older data may result in an increase in project costs as well as an extended construction duration. The omission of the updated data may represent a fundamental problem with the project.

Recommendation for Resolution

The Panel has devised a number of recommendations related to this comment as follows:

1. Develop a topographic model for use in geotechnical evaluation that is suitable for engineering analysis and design (USACE 2007), as recommended by ER 1110-2-1150 (USACE, 1999).

Panel Comment 9 – Medium/High (Environmental Law Compliance and Biological Resources)

It is not clear from the Detailed Project Report (DPR) Update whether environmental justice has been considered.

Basis for Comment

The DPR Update and 1997 Environmental Assessment (EA) seem to exclude environmental justice as a consideration. It is not clear why this is the case, or whether environmental justice considerations, including identification of minority and low-income populations and potential impacts, have been made for the project and are just not clearly evident.

Information was provided by the USACE in response to the question posed by the panel at the Independent External Panel Review (IEPR) midpoint meeting with the USACE on 11/20/2015. This information suggests that this does not need to be addressed because there is no sensitive land in the construction area (including the new borrow area) that would be negatively affected, and that positive short-term benefits to the local economy could occur. However, a review of the current aerial photography of the area indicates numerous structures adjacent to the levee between Interstate 80, State Highway 305, and Front Street (State Highway 304). Additionally, some impacts (i.e., air pollutants, noise, vibration, increased traffic congestion, etc.) can extend some distance from the immediate footprint of the construction.

From our understanding, Executive Order (EO) 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law. It is not clear from either the 1997 EA or the 2015 DPR Update whether that requirement has been met for the proposed project.

Literature Cited:

Executive Order 12898, "*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*", POTUS, 1994-02-11

Significance – Medium/High

The current level of documentation in the DPR Update does not provide sufficient information to describe the assessment fully, which affects the completeness and 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.

Recommendation for Resolution

Include a section discussing environmental justice in the DPR Update, noting whether or not the project complies with Executive Order 12898.

Panel Comment 10 – Medium/High (Hydrology & Hydraulic Engineering)

The TUFLOW Memo described hydraulic analysis model development in better detail, but offered limited explanations on how accurately the model was calibrated.

Basis for Comment

A hydraulic (1D and 2D) modeling is normally calibrated using observed flow and water surface data. The challenge in this case has been the absence of real-time observations. As cited in the MFR, the objective was downgraded to "*qualitatively confirm the average flood depth and the extent of flooding*". The only reference seems to be the 1962 flood. Also, it is not explained how the maximum water surfaces, east side of existing levee, and those upstream and downstream of Interstate 80, were collected, when, and by whom.

Literature Cited:

- DPR Update, Appendix C – 2015-08-12, MFR "*Development of TUFLOW Model for Hydraulic Analysis of Battle Mountain Flood Reduction Plan*", CESPK-ED-HD, Figure 10, Case 1

Significance – Medium/High

Model calibration accuracy is reflective of model prediction accuracy. The better calibration represents the present, the more reliable it will predict the future. Only limited discussions regarding model calibration are included in the DPR Update. The lack of this information reduces the overall confidence one has with the model simulation results.

Recommendation for Resolution

1. Provide more details on actual flood depth and extent of flooded area. Strengthen the statements used for Case 1 (1962 Flood Figures 7 through 9) to depict the photos of the historic 1962 flood event. It was estimated that 95% of the town flooded; depths were up to 5 ft. About half of the homes were flooded above the level of the first floor. Capture these numbers in the model or provide rational as to why they are not.
2. Continue to look for ways to support the accuracy TUFLOW results.

Panel Comment 11 – Medium/High (Hydrology & Hydraulic Engineering)

The effect of upstream irrigation diversions on actual flood events is not clear in the DPR Update to the extent that hydrograph estimates could be overestimated. Such an overestimation could mean that the recommended plan is too conservative.

Basis for Comment

The report states, "*The Reese River flows in the upper watershed do not normally reach the basin outlet because of irrigation diversions upstream of the river and high soil infiltration*". This crucial statement seems to indicate the need for using different drainage area values for Reese River, depending on the season. If that were the case, one would need to redefine those seasons based on real stream flow data to use for Reese River.

Another, related issue for this complicated hydrologic system is how to assign storm event frequencies to Humboldt and Reese rivers during a given flood. Storm frequencies at Point A on a tributary (Reese River), Point B on the main stem (Humboldt River) before the tributary junction, and at Point C below the confluence during any flood may correspond to different return periods. How to deal with coincidental formulation would not be very straightforward unless stream flow data are available at all 3 points. Hence, the high need for a real-time stream flow-recording gage at one or more sites (upper and lower parts) of Reese River. This situation must be documented in detail in the revised DPR Update. In addition, consideration should be given to installation of new stream gages during PED.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Medium/High

Assumptions on coincidental flows are critical to the project design and justification. Incorrect incorporation of irrigation diversions could result in unrealistic estimates of flood stages and flows, which would impact the selection of the With-Project optimal plan.

Recommendation for Resolution

1. Clarify the drainage area values for Reese River for various seasons due to irrigation diversions.
2. Define the realistic assumptions made on coincidental frequencies more clearly.
3. Add further explanation regarding the uncertainty in the simulated flood stages due to incorrect assumptions regarding irrigation diversions.
4. Demonstrate that inclusion of irrigation diversions (with reduction in upstream flows possible) is not critical to the determination of accurate flood stages.

A.4 Panel Comments – Significance Medium

Panel Comment 12 – Medium (Environmental Law Compliance and Biological Resources)

It is not clear from the Detailed Project Report (DPR) Update whether the Hazardous, Toxic, and Radioactive Waste (HTRW) analysis has been reviewed or updated.

Basis for Comment

It is not clear from the document whether the HTRW analysis has been reconsidered and/or updated since the 1997 Environmental Assessment (EA). The update notes significant increases in population and associated infrastructure. As the original HTRW determination is now 20 years old, it would be helpful to include a current evaluation in the DPR Update. Alternatively, there should be some justification made in the document why that would not be necessary.

Additionally, under Environmental Compliance (Section 16), Current Compliance Efforts (pp. 29-30), the DPR Update notes that, "*There is construction to an existing structure and the environmental staff for the Corps has made a determination of insignificant effects associated with portions of the added borrow area to be used for modifying the existing central levee… …the disturbed areas of an ephemeral stream provide low habitat value for wildlife except when there is runoff and water is flowing on the surface.*" It would seem advisable to include any potential borrow area for construction in the HTRW analysis discussion in the DPR Update, and that a notation be made that any disturbed soils used as borrow for construction would be assessed to verify their suitability for the intended use (including that they are free of any potential HTRW contaminants) before construction/placement. This may be of heightened importance where storm or surface runoff water flows and collects routinely through swales or streams, as these flows can be a significant source of non-point source pollutants from within the watershed.

Significance – Medium

The current level of documentation in the DPR Update does not provide sufficient information to describe assessment of HTRW analysis fully, which affects the completeness or overall understanding of the recommendation or justification of the project.

Recommendation for Resolution

Include a current discussion on HTRW in the DPR Update.

Panel Comment 13 – Medium
(Environmental Law Compliance and Biological Resources)

The Detailed Project Report (DPR) Update is unclear regarding habitat impact determination and mitigation.

Basis for Comment

Under Environmental Compliance (Section 16), Current Compliance Efforts (p. 29-30), the Detailed Project Report (DPR) Update notes, "*This work does not result in significant effects because the majority of the upland vegetation (area is not inundated long enough nor is the depth of groundwater shallow enough to sustain riparian vegetation) found within the flood plain has been previously disturbed by earlier levee work. Subsequently, the disturbed areas of an ephemeral stream provide low habitat value for wildlife except when there is runoff and water is flowing on the surface.*"

The document lacks specificity regarding whether this assessment has been updated since the 1997 Environmental Assessment (EA), and if so, how this determination was made. It would be helpful (for clarity) if the 2015 DPR update included more substantive discussion regarding habitat assessment within the project area, including details of how habitat was assessed (method) and when that assessment was conducted, in order to better understand the impact assessment and findings.

In addition, under Changes in Cost Apportionment (Section 15), Table 11 (p. 28) indicates that costs for mitigation have been revised to $0 under the 2015 revision. However, Appendix D, Table 2 (p. 4 of 7) indicates there will be costs for Fish and Wildlife Facilities ($444K Total Cost) related to Reach 1 of the project. This question was posed by the panel at the Independent External Panel Review (IEPR) midpoint meeting with the USACE on 11/20/2015. The USACE indicated that "Fish and Wildlife Facilities" refers to mitigation plantings that are planned to compensate for the effects to the salt desert scrub plant community found in the new proposed borrow area. However, no additional details are evident to describe this proposed action.

Based on the limited information provided for review, it would be helpful if the 2015 DPR Update included more substantive discussion regarding habitat impact determination (methods and findings) and the proposed mitigation for project effects.

Significance – Medium

The current level of documentation in the DPR Update does not provide sufficient information to describe referenced habitat assessment or mitigation fully, which affects the completeness or overall understanding of the recommendation or justification of the project.

Recommendation for Resolution

1. Include information that is more detailed regarding the habitat impact assessment of the project site in the DPR Update.
2. Include information that is more detailed regarding the mitigation for those impacts in the DPR Update. Including the justification provided by the USACE in responses to the questions posed

on these subjects by the panel at the Independent External Panel Review (IEPR) midpoint meeting with the USACE on 11/20/2015 in the DPR Update may be sufficient.

Panel Comment 14 – Medium (Environmental Law Compliance and Biological Resources)

It is not clear from the Detailed Project Report (DPR) Update whether the increases in population and infrastructure noted in the document may have resulted in a change in hydrology behind the levee (i.e., the city side) (perhaps from increases in impervious surface upslope from the project site) that might result in drainage impoundment and flooding during high runoff events.

Basis for Comment

The DPR Update notes that population increased 27% between 2000 and 2010, with concurrent increases in structure and content values by 32% since the 1997 Environmental Assessment (EA) (Appendix B) was completed. It is noted in the text that much of the increase in structural value was attributable to an increase in residential homes (and a subsequent decrease in mobile homes). It seems plausible that there might be a substantive, commensurate increase in impervious surface that could impact hydrology behind the levee. It is not clear from the DPR Update whether this has been considered and/or assessed, and whether this might pose a risk. The USACE noted in the Independent External Panel Review (IEPR) midpoint meeting on 11/20/2015 that conditions for flooding are not prevalent behind the levee due to soil condition, rainfall patterns, etc., but this information does not appear to be clearly presented in the DPR Update. A review of the current aerial photography of the area indicates numerous structures adjacent to the levee between Interstate 80, State Highway 305, and Front Street (State Highway 304). Upstream changes in impervious surface may elevate risk for flooding in areas of impoundment under some circumstances.

Significance – Medium

The current level of documentation in the DPR Update does not provide sufficient information to describe the assessment fully, which affects the completeness or overall understanding of the recommendation or justification of the project.

Recommendation for Resolution

Provide discussion in the DPR Update whether hydrology behind the levee has changed substantively in the period since the 1997 Environmental Assessment (EA) was developed and whether that change could pose a subsequent increase in risk associated with flood events.

Panel Comment 15 – Medium (Hydrology & Hydraulic Engineering)

Rock Creek flow data were used to estimate Reese River stream flows, based on a presumably high correlation between the two streams. However, limited information was provided to support the "high correlation".

Basis for Comment

Since no stream gauge data (flow or stage) is available for the downstream portions of the Reese River, the USACE chose to simulate an adjacent watershed (e.g., Rock Creek) that contains an active stream gauge. The USACE then provides a discussion on similarities between the two watersheds and some correlation between peak flows during the 1962 flood event. Although the Panel recognizes the technical difficulties in the study area in regards to hydrologic modeling, the Panel believes this approach is not fully supported by the DPR Update, Appendix C. A number of alternative approaches could have been taken but were not, including the actual installation of some new stream gauges in the Reese River or Humboldt River both upstream and downstream of the confluence with Reese River. In addition, simulation of the Reese River, Rock Creek, and portions of the Humboldt River (simultaneously) could have been considered as well.

However, it must be acknowledged that the 1962 flood event was an unusual event that resulted from rain on frozen ground; this event was the largest since 1910 on the Reese River and the largest in 72 years along Rock Creek. Understanding the relationship between these two watersheds for this event was potentially more revealing to large flows than any other rainstorm flood.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Medium

The lack of technical details regarding the chosen modeling approach does not currently provide adequate justification and confidence in the model outcomes and conclusions. Therefore, the selection of the optimal With-Project alternative may be incorrect.

Recommendation for Resolution

The IEPR Panel has devised some recommendations that would help improve the clarity in the DPR and provide a higher degree of confidence in the chosen modeling approach. These include:

1. Provide further graphical charts and/or figures to demonstrate "good correlation" between the Reese River and Rock Creek.
2. Provide a discussion of other simulation approaches considered and why these were ultimately rejected.

3. Consider the installation of new stream gauges in the Reese River as part of further project planning, engineering and design (PED) efforts.
4. The USACE should provide details regarding their successful and unsuccessful correlations at the site.

Panel Comment 16 – Medium (Hydrology & Hydraulic Engineering)

It is not clear why the updated 2% hydrograph has a lower peak and volume than the 1996 Feasibility 2% hydrograph.

Basis for Comment

Overall, there may be a number of legitimate technical reasons to explain the hydrograph differences, but some clarification is necessary. A number of uncertainties are possible, as well as the best professional judgment that was used.

Literature Cited:

- DPR Update. Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Medium

This issue affects the accuracy of %ACE flood hydrographs, which in turn, affects the overall With-Project justification.

Recommendation for Resolution

The IEPR Panel has devised some recommendations regarding this comment that would provide further clarity in the DPR. These include:

1. Confirm what caused the peak estimate difference between the two hydrographs.
2. Explore other comparable data measured in the region, as suggested in Bulletin 17B of the Hydrology Committee: "*Comparison with information at stations in the immediate region should be made, particularly at gaging stations upstream and downstream, to promote regional consistency and help prevent gross errors*".
3. Fully explain adjustments and corrections performed on the 1962 flood hydrograph to match the 3-day volume based estimates.
4. Explain what, if any, effect these various adjustments could have had on earlier conclusions from other modeling efforts.
5. The USACE should try to be as clear as possible on what was done and why, to avoid future inquiries, while also keeping the recommended steps under consideration for future studies.

Panel Comment 17 – Medium (Hydrology & Hydraulic Engineering)

It is not clear why the threshold of 1,000 cubic feet per second (CFS) was used to remove flows as part of the Humboldt River versus Rock Creek correlation analysis.

Basis for Comment

This approach appears technically justified based upon provisions of EM 1110-2-1415 (USACE, 1993). However, it is not clear why a different threshold was not equally plausible.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH
- Engineer Manual (EM) 1110-2-1415, "*Hydrologic Frequency Analysis*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1993-03-05

Significance – Medium

Removing 1,000 CFS (or 2,000 CFS) from existing flow data could impact flood peak projections used in the levee design and affect the alternative analysis, resulting in different levee and culvert sizes.

Recommendation for Resolution

1. Provide the basis for removing flows less than 1,000 CFS from the analysis,
2. Add some discussion regarding the consideration of alternative thresholds instead of 1,000 CFS.

Panel Comment 18 – Medium (Hydrology & Hydraulic Engineering)

The use of only a single snow gage at Huntington Creek for the snowmelt simulations does not provide adequate geographic coverage in the study area to provide a reasonable snowmelt factor.

Basis for Comment

This is a helpful topic but only applies to one location—Huntington Creek. To provide a general picture of the regional variability of the snowmelt factor, analysis of data from other nearby snow gages is necessary.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Medium

The use of several snow gages for the snowmelt analysis, instead of one single gage, is necessary to provide a more accurate snowmelt factor, covering a larger and more diverse geographic area. Without such an analysis, the modeling results may be biased or not representative of the actual snowmelt factors, which may result in unrealistic flows and/or stages in the Reese River and/or Humboldt River.

Recommendation for Resolution

1. Produce comparable curves for nearby snow gages to provide further justification that the snowmelt factor used in the model simulations is realistic and representative.
2. Provide rationale for the gage selection.

Panel Comment 19 – Medium (Hydrology & Hydraulic Engineering)

The statement about the following assumption could be misleading, "*Rock Creek 3-day flow volume is close in value to Reese River's 3-day flow volume",* is only possible if flows occur in both streams for the same event. Since Rock Creek is a perennial stream and Reese River is an ephemeral stream, the similarity in 3-day flow volume can only be assumed during a storm event.

Basis for Comment

This (probably correct) statement needs to be complemented by real data and/or observations. The words, "Storm event", need to be qualified. In fact, all three assumptions need to be supported by real data.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Medium

Assumptions on the adopted 3-day flow volumes are critical to determining flow volume frequency. Any other durations would have led to a different flow volume thus resulting in perhaps poor estimates for the without-project and/or with-project simulations and, hence, to under- or over-estimated levees and culverts.

Recommendation for Resolution

1. Specify/qualify what storm event the 3-day flow volumes at Reese River and Rock Creek would start to be close to each other.

Panel Comment 20 – Medium (Hydrology & Hydraulic Engineering)

It is not clear why a fixed coincident flow of 170 cubic feet per second (CFS) (rather than a flow range) was selected for all peak flood events on the Reese River. Incorrect assumptions could lead to under (or over) estimated flows used in sizing the levees and culverts, resulting in potential failure to manage flows.

Basis for Comment

Absent an actual gauging station for Reese River, some assumptions had to be made to estimate Reese River flows based on data from nearby streams, like Rock Creek. The issues relate to what is the selected value of the coincident flow based on, how reliable is that selection, and whether a range of flows (instead of a fixed amount) might not have been more appropriate.

Literature Cited:

- DPR Update, Appendix C – 2015-01-12, MFR "*Battle Mountain Hydraulic Analysis for the Without Project Conditions*", CESPK-ED-HD

Significance – Medium

The use of a different coincident flow will affect the design data and, hence, the sizes of the final levees and culverts, resulting in potential failure to manage flows.

Recommendation for Resolution

1. Provide more details on selection of the value of coincident flow.
2. Discuss the validity of using a discharge range (instead of a unique discharge) and provide estimates of impacts on the design phase.

Panel Comment 21 – Medium (Hydrology & Hydraulic Engineering)

The With-Project Conditions memo provided only limited details on how the Humboldt River coincident flow was determined (using historical flows recorded for Humboldt and the Reese rivers).

Basis for Comment

Some graphical representation of the results are needed to illustrate the differences as well as the correlation between the data that were analyzed for the two streams.

Literature Cited:

- DPR Update, Appendix C – 2015-02-10, MFR "*Battle Mountain Hydraulic Analysis for the With-Project Conditions*", CESPK-ED-HD

Significance – Medium

Providing the full picture of the hydrologic conditions in this hydrology report, given the unique analysis approach taken by USACE, will ensure stronger confidence in the model simulations and resulting project recommendations.

Recommendation for Resolution

1. Add the missing summary description of basic runoff conditions prior to flooding, including topography, mean annual rainfall and snow precipitation, soil coverage, stream flow gauging system location, stream flow records, weather, etc. The text provided in the July 1997 Base Documents (Existing Conditions, Physical Conditions) could be used for this purpose.
2. Plot hydrographs to show time occurrence of Humboldt and Reese Rivers peak flows.

Panel Comment 22 – Medium (Hydrology & Hydraulic Engineering)

The Detailed Project Report (DPR) Update, Appendix C provided no specific justification for the use of the non-USACE TUFLOW model, other than stating that it, "*contains the necessary tools to analyze all* [the] *features of the Battle Mountain project*". Some of that information had already been described in the earlier, 12 January 2015 memo, and should have been summarized in the 10 February 2015 memo. (Acknowledging that the missing information can be found in the TUFLOW Model report.)

Basis for Comment

There are several USACE models capable of handling the features specific to the Battle Mountain project, but for the reasons already explained in the referenced document, a non-USACE commercial model was selected instead. Since this is an unusual model selection, it would be helpful to summarize those reasons. The document, USACE, Sacramento District, MFR Battle Mountain TUFLOW Model Development, 22 October 2013" is not directly available for the IEPR review (and was later provided by CESPK at the Review Panel's request). As mentioned above, some the desired answers were provided in the 12 January 2015 memo. The bottom line is that few, commercial, non-USACE models have been used in USACE hydrologic studies.

Literature Cited

- DPR Update, Appendix C – 2015-02-10, MFR "*Battle Mountain Hydraulic Analysis for the With-Project Conditions*", CESPK-ED-HD

Significance – Medium

TUFLOW fully controls the design of the levees and culvert. Detailed and easily accessible justifications for the use of such a relatively new, non-USACE hydraulic model are critical to ensure full user confidence in that model.

Recommendation for Resolution

1. Provide a summary of the limitations of the model previously used for this project and describe how TUFLOW was able to address those gaps.
2. More information is needed on how TUFLOW was set up; how good was the model calibration; and what kind of culverts, evacuation channels, gates, etc., were included. Would also like to see the model predictions for levee improvement for the With- and Without-Project conditions. (This type of information, listed later in the August 2015 MFR, should also be mentioned here).

Panel Comment 23 – Medium (Hydrology & Hydraulic Engineering)

Based on the complicated hydrologic system of the project area the statement in the DPR Update, "*the floodplain at the confluence of Reese River and Humboldt River is affected by the Peak Flows of the Reese River, Humboldt River, or a coincident combination of both*", deserves explanations that are more detailed.

Basis for Comment

The coincidental possibility is an important issue to clarify. The 100-year flood peak at Battle Mountain is located below the confluence of Humboldt River and Reese River and does not necessarily occur when both Humboldt and Reese peak flows are of that same 100-year magnitude. More explanations on the coincidence assumptions would be helpful.

Literature Cited:

- DPR Update, Appendix C – 2015-02-10, MFR "*Battle Mountain Hydraulic Analysis for the With-Project Conditions*", CESPK-ED-HD, §4, Hydrology

Significance – Medium

Coincident frequency analysis involving computation of the exceedance frequency relationship for a variable that is a function of two other variables is critical to the hydraulic design calculation. If a different coincident frequency were selected, this could have led to a different design flow and, hence, different levees and culvert sizes, potentially undersized.

Recommendation for Resolution

1. Summarize the steps used in the coincident frequency analysis and how the validity of the results was assessed for each of the following scenarios:
    a. Reese River and a coincident flow on the Humboldt River, and
    b. Humboldt River and a coincident flow on Reese River.

Detailed discussion on the above two subjects were separately included in Reference D.

Panel Comment 24 – Medium (Hydrology & Hydraulic Engineering)

The Hydrology Technical Memo mentioned that, "*Although the Reese River basin is greater than 2,000 square miles, only parts of the watershed contributed flow to the outlet*". Summit Engineering's model

likely underestimated the peak flow and overestimated the volume since these conditions were not taken into consideration.

Basis for Comment

Normally, larger basins show larger values for both peak flow and runoff volume than smaller basins. Therefore, this rather unusual situation needs to be accounted for and/or explained in more detail than provided.

Literature Cited:

- DPR Update, Appendix C – 2015-12-16, "*Battle Mountain Reese River Hydrology Technical Memorandum*", Department of the Army, U.S. Army Corps of Engineers (USACE)

Significance – Medium

The selection of peak flow and runoff volume affects the design flows and, hence, the sizing of the levees and the culverts, potentially undersized.

Recommendation for Resolution

Explain this rather unusual situation in more details, including:

1. Discuss why "*only parts of the watershed contributed flow to the outlet*",
2. Explain how and why did Summit Engineering treat the watersheds, and
3. Discuss what is being done to address the reduced watershed contribution.

Panel Comment 25 – Medium (Hydrology & Hydraulic Engineering)

Calibration of the TUFLOW model seems to be more focused on sensitivity analysis of Manning's "n" values than on meeting observed flows or observed water surface profiles during the calibration phase.

Basis for Comment

Figures 21 through 24 in the DPR Update, Appendix C, show the comparison of maximum water surface elevations for Manning's "n" values equal to 0.04, 0.06, and 0.08 for Cases 3, 4 and 5 at observation sections A-A, B-B, C-C, and D-D, respectively. As shown in Figure 21, the freeboard upstream of Interstate 80 was more than 4 ft for all three cases. At Section C-C (through the existing levee), the available freeboard was less than 2 ft. The difference in the computed water surface elevations was

less than 0.6 ft between the low n-value of 0.04 and the high n-value of 0.08. The computed water surface elevations were not very sensitive to the roughness of the terrain. It was therefore decided to use Manning's n-values equal to 0.08 for all future with project condition simulations. (This reflects differences due to n-values, not observed water surfaces.

In addition, Figure 32 only shows the model-predicted water surfaces for three different n-values, without any signs of actual water surface profiles.

Literature Cited:

- DPR Update, Appendix C – 2015-08-12, MFR "*Development of TUFLOW Model for Hydraulic Analysis of Battle Mountain Flood Reduction Plan*", CESPK-ED-HD, Figures 21 through 24 and Figure 32

Significance – Medium

Discussions on some of the model parameters, unless clearly explained, can be misleading and confusing to the user and ultimately affects his/her confidence in the model's predictions and, hence, in the entire levee and culvert design.

Recommendation for Resolution

1. Focus more on actual model calibration (predicted vs. observed) and less on parameter sensitivity.
2. Provide information supporting the accuracy of the model related to the 1962 flood event.

A.5 Panel Comments – Significance Medium/Low

Panel Comment 26 – Medium/Low (Economics/Planning)

The 2015 DPR Update is contradictory about expected future development within the floodplain.

Basis for Comment

The 2015 DPR Update notes that since a future year was assumed equal to existing conditions, equivalent annual damages are the same as expected annual damages. No future year was evaluated because future hydrologic and hydraulic conditions are expected to be the same as existing conditions. A primary reason for this is tepid historical and expected pace of development within the floodplain.

However, later the report states that from the 1997 DPR to the 2015 DPR Update there was:

- "A five-fold increase" in project benefits
- A 50% increase in the number of single and multi-family structures in the floodplain

- A 27% increase in population between the 2000 and 2010 census

Literature Cited:

Battle Mountain, Nevada, Section 205, Continuing Authorities Program, Update to the 1997 Detailed Project Report, Battle Mountain, Nevada, Detailed Project Report Update 2015

Significance – Medium/Low

The technical quality and believability of the report is undermined by the presentation of contradictory information related to the recommendation and justification of the project, but the panel does not have sufficient information to determine the effect on the report's findings.

Recommendation for Resolution

Remove the statement regarding "*tepid historical and expected pace of development within the floodplain*" as the a primary reason that "*a future year was assumed equal to existing conditions, equivalent annual damages are the same as expected annual damages*" and provide an accurate explanation.

Panel Comment 27 – Medium/Low (Economics/Planning)

The 2015 Cost Estimate for Reach 2 Revised Plan Total Project First Cost in Table 4 – Change in Estimated Cost of the 1997 Approved NED Plan of $3,503,000 is not the same as the Project First Cost in the MCASES Cost Estimate of $3,670, 000.

Basis for Comment

Comparison of Project First Cost in Table 4 – Change in Estimated Cost of the 1997 Approved NED Plan and the MCASES Project First Cost.

Literature Cited:

- Battle Mountain, Nevada, Section 205, Continuing Authorities Program, Update to the 1997 Detailed Project Report, Battle Mountain, Nevada, Detailed Project Report Update 2015
- MCASES Cost Estimate

Significance – Medium/Low

This type of error calls into question the technical quality and accuracy of the decision analysis presented in the 2015 DPR Update based on the presentation of inconsistent information related to the

recommendation and justification of the project, but the panel does not have enough information to determine the effects on the project in achieving the project purpose.

Recommendation for Resolution

Correct the error.

Panel Comment 28 – Medium/Low (Environmental Law Compliance and Biological Resources)

Updated documentation regarding endangered species, 401(b)(1) water quality analysis, and air quality are not clearly presented in the Detailed Project Report (DPR) Update.

Basis for Comment

Under Environmental Compliance (Section 16), Current Compliance Efforts, the DPR Update notes, (p. 29): "*In meeting current compliance requirements for the Endangered Species Act, no Section 7 consultation is needed based on recent review of updated species list. An endangered species list has been obtained and no endangered species have been identified. An updated list serves as verification before final revisions to the Categorical Exclusion is completed. In meeting compliance requirements for the Clean Water Act, a 404(b)(1) water quality analysis has been completed. In meeting compliance requirements for the Clean Air Act, the effects to air quality are below de minimus levels*."

The document indicates that the updated endangered species list has been provided by the USFWS and that a Section 7 consultation is not needed. Additionally, it states that the 404(b)(1) water quality analysis is complete. However, these documents are not clearly included in the DPR Update, nor is it evident how the determination regarding air quality has been completed for the update. It would be helpful (for clarity) if the 2015 DPR Update included copies of the updated Endangered Species list and 404(b)(1) documents referenced in the text.

With regard to the 404(b)(1) certification, information provided by the USACE in response to the question posed by the panel at the Independent External Panel Review (IEPR) midpoint meeting with the USACE on 11/20/2015 suggests that the certification may have been completed as part of the original 1997 Environmental Assessment (EA). However, it is not clear from the document whether that is the case, nor is it clear whether conditions may have changed enough since the certification was completed that revisions or updates may be warranted.

Additionally, some discussion would be helpful regarding how the determination for air quality was made and whether it has been updated since the 1997 EA, perhaps including information regarding any Best Management Practices (BMP) that might be employed to help ensure air quality standards are met during construction.

Significance – Medium /Low

The current level of documentation in the DPR Update does not provide sufficient information to describe the assessment fully, which 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.

Recommendation for Resolution

Provide additional documentation or information in the DPR Update as follows:

1. Updated USFWS Endangered Species List or description of changes compared to the previous 1997 list.
2. Updated 404(b)(1) water quality analysis or informative reference to existing analysis if it is still appropriate for existing conditions.
3. Short discussion regarding how and when air-quality determinations were made and any steps recommended (including BMPs that might be employed) during construction to help ensure air quality standards are met during construction, particularly regarding areas adjacent to residential neighborhoods.

Panel Comment 29 – Medium/Low (Hydrology & Hydraulic Engineering)

The With-Project Conditions memo provided some details on how the Humboldt River coincident flow was determined (using historical flows recorded for Humboldt and the Reese rivers), but no comparison of the data that is needed to illustrate the differences.

Basis for Comment

Some graphical representation of the results would be helpful to illustrate the differences as well as the correlation between the data that were analyzed.

Literature Cited:

- DPR Update, Appendix C – 2015-02-10, MFR "*Battle Mountain Hydraulic Analysis for the With-Project Conditions*", CESPK-ED-HD
- DPR Update, Appendix C – 2015-01-12, MFR "*Battle Mountain Hydraulic Analysis for the Without Project Conditions*", CESPK-ED-HD, §5, Hydrology
- "*Guidelines for Determining Flood Flow Frequency*", Bulletin 17B of the Hydrology Subcommittee, USGS, March 1982 (source: http://water.usgs.gov/osw/bulletin17b/dl_flow.pdf

Significance – Medium/Low

Graphical illustration of the analysis results are necessary to allow the user to evaluate the information.

Recommendation for Resolution

Provide graphical illustration of the analysis results.

1. Plot hydrographs to show time occurrence of Humboldt and Reese Rivers peak flows
2. Graphically illustrate the correlation between Rock Creek and Humboldt River annual peak flows.

A.6 Panel Comments – Significance Low

Panel Comment 30 – Low (Economics/Planning)

The 2015 Detailed Project Report (DPR) Update should include the USACE guidance for making changes to uncompleted authorized projects.

Basis for Comment

The 2015 DPR Update does not explain that it is not a change in scope of the authorized project because "*Changes in the value of outputs (benefits) resulting from price level changes, or from other purely economic phenomena, are not considered changes in scope*".

Literature Cited:

- Engineer Regulation (ER) 1105-2-100, "*Planning Guidance Notebook*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, Appendix G, Section III – Post Authorization Changes, Amendment #1, para. G-12.c, 2004-06-30

Significance – Low

The significance is deemed low because the omission is not a fundamental problem with the project that could affect the recommendation or justification of the recommended plan.

Recommendation for Resolution

Add an explanation that the 2015 DPR Update does not involve a change in scope because "*the changes in the value of outputs (benefits) result from price level changes, and other purely economic phenomena*," in the first paragraph of the Summary and include the definition for "Changes in Scope" from ER 1105-2-100, Appendix G, Amendment 1, Para. G-12.c.

Panel Comment 31 – Low (Economics/Planning)

The 2015 DPR Update does not include a description of the full range of alternatives that were considered in the plan formulation process and the reasons they were eliminated from further consideration.

Basis for Comment

Reasonable alternatives not mentioned in the 2015 DPR Update include nonstructural, flood detention storage, channel modifications, and bridge modifications. USACE Guidance states: "*A range of alternative plans shall be identified at the beginning of the planning process and screened and refined in subsequent iterations throughout the planning process*".

Literature Cited:

- Engineer Regulation (ER) 1105-2-100, "*Planning Guidance Notebook*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, Chapter 2 Planning Principles, para. c. Step 3 – Formulation of Alternative Plans, 2000-04-22

Significance – Low

Not presenting the alternatives considered but screened from further consideration, and the reasons for their elimination during plan formulation, affects the technical quality and understanding of the project, but there is little concern regarding the recommended plan accomplishing the project purpose.

Recommendation for Resolution

Include the plan formulation that was done in the 1997 DPR in the 2015 DPR Update.

Panel Comment 32 – Low (Economics/Planning)

Additional Cash Adjustment Subtotal Row for 2015 Revised Plan adds up to $3,141,850 instead of the $3,503,000 shown in Table 11, Changes in Cost Apportionment.

Basis for Comment

Adding the numbers in the table does not produce the total shown in the table.

Literature Cited:

- Battle Mountain, Nevada, Section 205, Continuing Authorities Program, Update to the 1997 Detailed Project Report, Battle Mountain, Nevada, Detailed Project Report Update 2015

Significance – Low

The significance of this error is judged low because while it does affect the technical quality of the report the error does not affect the recommendation or justification of the project.

Recommendation for Resolution

Correct the error.

Panel Comment 33 – Low
(Environmental Law Compliance and Biological Resources)

Information regarding the Categorical Exclusion (CatEx) as it applies to the proposed project (as updated) should be more prominent within the DPR Update.

Basis for Comment

The DPR Update does not include any discussion on Public Notice and does not present rationale for the proposed CatEx until rather deep into the document. Information provided by the USACE in response to the question posed by the panel at the Independent External Panel Review (IEPR) midpoint meeting with the USACE on 11/20/2015 indicates that the proposed project changes may fall under a categorical exclusion based on the decrease in anticipated impacts as a result of the reduced project scope. However, pending geotechnical work may result in the need for a Supplemental Environmental Assessment (EA).

It would be helpful to make the short summary regarding the CatEx more prominent within the DPR Update. Additionally, some information regarding the potential for a Supplemental EA, and subsequent public notice, would be helpful to include in the discussion.

Significance – Low

The current level of documentation in the DPR Update does not provide sufficient information to describe the rationale for public notice fully as it applies to the DPR Update. This 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.

Recommendation for Resolution

Revise the DPR Update as noted regarding the CatEx and pending geotechnical work, which might result in a Supplemental EA. The justification provided by the USACE in response to the question posed on this subject by the panel at the Independent External Panel Review (IEPR) midpoint meeting with the USACE on 11/20/2015 may be sufficient in the DPR Update.

Panel Comment 34 – Low (Hydrology & Hydraulic Engineering)

Summit Engineering's hydrologic model memorandum should be included in the final, revised DPR.

Basis for Comment

Summit Engineering was the first team to look at the hydrology of Battle Mountain, using procedures and assumptions that were later updated. Although more details are provided at separate places, very limited information is provided on how Summit Engineering originally approached the hydrology of Battle Mountain, where and which historical records were collected and used, and how/why those earlier efforts had to be later updated by USACE in-house staff.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Low

Summit Engineering's work is important to include in the DPR Update in order to be thorough and complete, even though it apparently does not impact any engineering decisions.

Recommendation for Resolution

1. Provide as much information as possible on the basic hydrologic questions related to the Project. USACE recognizes "*that previous studies were deemed insufficient because the documentation was sparse",* and is prepared "*to share Summit Engineering's hydrology-hydraulic report, as well as the 1993 USACE Recon Report and 1976 Humboldt River Report"* for potential independent review. USACE is also willing, "*under Previous Studies in their current report, to add a general description of previous reports; including a description of the 1976 Humboldt River Report (this report described the frozen ground conditions with-in Humboldt Basin during the 1962 storm)"*. The additional steps would definitely address the identified knowledge gap.

Panel Comment 35 – Low (Hydrology & Hydraulic Engineering)

The DPR contains conflicting statements regarding the selected use of 3-day flow volumes to correlate flows between the Reese River and Rock Creek.

Basis for Comment

The following two statements invite further details. Statement 1 reads, "*In this study, 3-day volumes are used to determine a flow relationship between Rock Creek and Reese River*". Conversely, statement 2 reads, "*the Reese River watershed shape affects the peak flow dynamics within the basin. There is no physical parameter that accounts for basin shape; thus, determining a peak flow relationship between Rock Creek and Reese River is not done for this study*". In addition, there are several possible volume durations to use in determining flow relationships. The 3D volumes were picked for a specific reason that deserves to be clarified. The statement regarding the absence of physical parameters to account for the shape of the watershed can be misleading (and needs to be clarified).

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Low

It is critical that technical assumptions and justifications are consistent in the DPR. Otherwise, the model results will not have a high degree of confidence, thus rendering the overall project justification questionable.

Recommendation for Resolution

1. Explain the selection of the 3D volumes
2. Explain why other physical parameters were not used to establish relationship between Reese River and Rock Creek.
3. Remove the statement about the absence of a shape physical parameter and add clarification statements on selecting the 3-day flow.

Panel Comment 36 – Low (Hydrology & Hydraulic Engineering)

The discussion regarding peak flows during the 1962 and 1976 floods in Rock Creek and the Humboldt River is not clear.

Basis for Comment

To support this generally helpful description, selected hydrograph plots for those two streams (if available) would best illustrate the time lag between the flood peaks at the two gages. Also, discuss availability of more recent (post-1976) stream flow data.

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH

Significance – Low

Graphical plots are helpful to facilitate understanding of the process and provide stronger demonstrations regarding differences in time lag. Peak discharges are critical to levee and culvert sizing.

Recommendation for Resolution

1. Add hydrograph plots for the 1962 and the 1976 floods for the Rock Creek and the Humboldt River (if available).
2. Discuss availability of more recent (post-1976) stream flow data
3. Summarize what observed stream flow data are telling us.
4. The above issues include both the coincident analysis and the report in general.

Panel Comment 37 – Low (Hydrology & Hydraulic Engineering)

Table 13 in Appendix C of the DPR Update, provides the area and mean annual precipitation values used for calculating the factor equation, when Table 15 is more appropriate for this information.

Basis for Comment

Referring to Table 13 (Observed 1-day Maximum and Peak Flow at Huntington Gage) could be misleading. Table 15 seems more correct, since it is labeled, "*Area and Mean Annual Precipitation above 6,000 feet Elevation*".

Literature Cited:

- DPR Update, Appendix C – 2014-12-16, "*Battle Mountain Reese River Hydrology*", CESPK-ED-HH, Tables 13 and 15

Significance – Low

Mislabeled tables should be avoided to prevent inaccuracies and confusion in the results.

Recommendation for Resolution

1. Correct the information between Tables 13 with Table 15 in Appendix C of the DPR Update.

Panel Comment 38 – Low (Hydrology & Hydraulic Engineering)

In its introduction, the CESPK memo made no mention of the Without-Project Conditions, when it should have. It should also have mentioned that the Without-Project scenario had already been discussed in their TUFLOW memo.

Basis for Comment

The memo introduced an updated study. This automatically invites the question, where and how are the Without-Project (base) conditions defined?

Literature Cited:

- DPR Update, Appendix C – 2015-02-10, MFR "*Battle Mountain Hydraulic Analysis for the With-Project Conditions*", CESPK-ED-HD
- DPR Update, Appendix C – 2015-08-12, MFR "*Development of TUFLOW Model for Hydraulic Analysis of Battle Mountain Flood Reduction Plan*", CESPK-ED-HD

Significance – Low

An updated study should reference the initial study it was supposed to complement for completeness sake.

Recommendation for Resolution

1. Mention that the Without-Project scenario had already been discussed in the 12 January 2015 memo.
2. Recap relevant results pertaining to the base conditions.

Panel Comment 39 – Low (Hydrology & Hydraulic Engineering)

The With-Project Conditions memo provided no detailed justifications for the "new study".

Basis for Comment

Since the 2015 DPR Update is based on a previous study, it is important to cite the reasons why the new study is needed, what information gaps existed, what are the new objectives, etc. (That information can only be found in the report covering TUFLOW Model, in the August 2015 MFR).

Literature Cited:

- DPR Update, Appendix C – 2015-02-10, MFR "*Battle Mountain Hydraulic Analysis for the With-Project Conditions*", CESPK-ED-HD

Significance – Low

Depending on the project background, justification criteria used for the new study could be different.

Recommendation for Resolution

1. Add a short summary of the new study's objectives—like what was done in the TUFLOW model development report.

Appendix B Charge for the Panel

The general charge produced by the USACE to support the Independent External Peer Review is reproduced below. APMI provided this charge to the IEPR panel to guide its review.

B.1 Documents Provided

Table 5 below lists the documents reviewed by the IEPR panel. During the course of this review, a change in the review documentation for this IEPR was made. The scope of the effort was changed to focus the review on the adequacy of the 2015 documentation developed in order to determine whether the 2015 documentation was providing sufficient information, as a standalone documentation packet, to support the decision made in support of selected alternatives without the need to reference to the original 1997 documentation. Since the panel had already reviewed some of the original 1997 documents and had identified several important comments, it was decided not to lose the valuable panel insights. Instead, they were captured in the final panel comments either directly, if they related to the 2015 DPR Update, or indirectly, by making a recommendation to resolve a comment in order to bridge the gap between the state of art knowledge in the 1997 documentation and the project modifications in the DPR Update. This decision was the result of a proposal made by APMI, which was accepted by the panel members and the USACE.

Table 5 – IEPR Documentation for the DPR Update

Report Title ①	PDF Page Count
1. Battle Mountain Sec 205 CAP Update to the DPR (2015)	32
2. Appendix A - Prior Studies and Related Projects (2015)②	4
3. Appendix B - Battle Mountain CAP Economic Appx (2015)	30
4. Appendix C - Engineering Technical Appendix (2015)	69
5. Appendix D - Gov't Cost Estimate (2015)	7
Total PDF Pages	**142**

① – File names updated for clarity/accuracy
② – For Reference Only. Panel Members were not to comment on this document (this is a list of references).

B.2 Final Charge Questions and Relevant Sections

Objectives

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 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 charge. The 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 charge.

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 USACE policy or 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. This includes opinions from named USACE personnel or others outside of USACE. In such circumstances, the panel may 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 communicate the panel's full intent by including the comment, why it is important, any potential consequences of failure to address, and suggestions on how to address the comment.

Broad Evaluation Charge Questions

1. Is the need for and intent of the decision document clearly stated?
2. Does the decision document adequately address the stated need and intent relative to scientific and technical information?

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.

Specific Technical and Scientific Charge Questions

13. Are the design assumptions adequate and consistent to support the engineering analysis?

14. Are the hydrologic and hydraulic updates and model sufficient in the determination of the necessary flood events and flood plain maps?
15. Are the 1997 Probable Non-failure Point (PNP) and Probable Failure Point (PFP) probabilities adequate to determine updated fragility curves for model input?

This Page Intentionally Blank

Appendix C Organizational Conflict of Interest (COI) Forms

C.1 LMI COI Form

Conflicts of Interest Questionnaire

Independent External Peer Review

Battle Mountain, NV, Detailed Project Report Update IEPR

The purpose of this document is to help the U.S. Army Corps of Engineers identify potential organizational conflicts of interest on a task order basis as early in the acquisition process as possible. Complete the questionnaire with background information and fully disclose relevant potential conflicts of interest. Substantial details are not necessary; USACE will examine additional information if appropriate. Affirmative answers will not disqualify your firm from this or future procurements.

NAME OF FIRM: _Logistics Management Institute_____
REPRESENTATIVE'S NAME: _Susan D. Ford_____
TELEPHONE: _(703) 917-7524_____
ADDRESS: _7940 Jones Branch Drive, McLean, VA 22102_____
EMAIL ADDRESS: __susan.ford@lmi.org_____

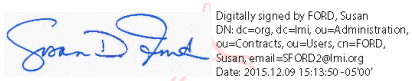
I. INDEPENDENCE FROM WORK PRODUCT. Has your firm been involved in any aspect of the preparation of the subject study report and associated analyses (field studies, report writing, supporting research etc.) X No Yes (if yes, briefly describe):

II. INTEREST IN STUDY AREA OR OUTCOME. Does your firm have any interests or holdings in the study area, or any stake in the outcome or recommendations of the study, or any affiliation with the local sponsor? X No Yes (if yes, briefly describe):

III. REVIEWERS. Do you anticipate that all expert reviewers on this task order will be selected from outside your firm? No X Yes (if no, briefly describe the difficulty in identifying outside reviewers):

IV. AFFILIATION WITH PARTIES THAT MAY BE INVOLVED WITH PROJECT IMPLEMENTATION. Do you anticipate that your firm will have any association with parties that may be involved with or benefit from future activities associated with this study, such as project construction? X No Yes (if yes, briefly describe):

V. ADDITIONAL INFORMATION. Report relevant aspects of your firm's background or present circumstances not addressed above that might reasonably be construed by others as affecting your firm's judgment. Please include any information that may reasonably: impair your firm's objectivity; skew the competition in favor of your firm; or allow your firm unequal access to nonpublic information.



Susan D. Ford, Senior Contracts Manager 9/1/15
YOUR SIGNATURE DATE

C.2 APMI COI Form

Conflicts of Interest Questionnaire

Independent External Peer Review

(Battle Mountain IEPR)

The purpose of this document is to help the U.S. Army Corps of Engineers identify potential organizational conflicts of interest on a task order basis as early in the acquisition process as possible. Complete the questionnaire with background information and fully disclose relevant potential conflicts of interest. Substantial details are not necessary; USACE will examine additional information if appropriate. Affirmative answers will not disqualify your firm from this or future procurements.

NAME OF FIRM: **Analysis Planning and Management Institute, Inc. (APM Institute)**
REPRESENTATIVE'S NAME: **Ahmad Faramarzi**
TELEPHONE: **703-304-8072**
ADDRESS: **21087 Zachary Taylor Highway; Culpeper, VA 22701-7832**

EMAIL ADDRESS: **ahmad.faramarzi@apm-inst.org**

I. INDEPENDENCE FROM WORK PRODUCT. Has your firm been involved in any aspect of the preparation of the subject study report and associated analyses (field studies, report writing, supporting research etc.) (No) Yes (if yes, briefly describe):

II. INTEREST IN STUDY AREA OR OUTCOME. Does your firm have any interests or holdings in the study area, or any stake in the outcome or recommendations of the study, or any affiliation with the local sponsor? (No) Yes (if yes, briefly describe):

III. REVIEWERS. Do you anticipate that all expert reviewers on this task order will be selected from outside your firm? No (Yes) (if no, briefly describe the difficulty in identifying outside reviewers):

IV. AFFILIATION WITH PARTIES THAT MAY BE INVOLVED WITH PROJECT IMPLEMENTATION. Do you anticipate that your firm will have any association with parties that may be involved with or benefit from future activities associated with this study, such as project construction? (No) Yes (if yes, briefly describe):

V. ADDITIONAL INFORMATION. Report relevant aspects of your firm's background or present circumstances not addressed above that might reasonably be construed by others as affecting your firm's judgment. Please include any information that may reasonably: impair your firm's objectivity; skew the competition in favor of your firm; or allow your firm unequal access to nonpublic information.

None

Ahmad Faramarzi Digitally signed by AhmadFaramarzi DN: cn=AhmadFaramarzi, o=APMI, ou, email=ahmad.faramarzi@apm-inst.org, c=US Date: 2015.12.08 19:23:02 -07'00'

YOUR SIGNATURE

August 2, 2015

DATE

Appendix D Review Panel Members' Qualifications

The summary qualifications for each Panel member are provided below to show their qualifications for this project.

D.1 Mr. Donald W. Ator

Role: Economics and Planning Subject Matter Expert
Affiliation: Louisiana State University

Mr. Ator is a Research Associate, Professor, and Undergraduate Advisor in the Department of Agriculture Economics and Agribusiness at Louisiana State University. Mr. Ator's responsibilities include research, grant writing and proposal development, extension and outreach, undergraduate advising and teaching Agricultural Commodity Marketing and Risk Management. His current research is in financial resiliency planning for local governments in Louisiana, Texas, Alabama, Mississippi, Florida, Georgia, Kentucky, and Nebraska.

Mr. Ator has over 35 years of demonstrated experience in public works planning, working with project teams to identify and evaluate measures and alternatives using appropriate planning methodologies to reduce life safety risk. He earned his MS in economics and agricultural economics and has an MBA in finance and accounting from Louisiana State University. He has worked with 22 different USACE districts nationwide, as well as with the Bureau of Land Management, Bureau of Reclamation, and the Department of Commerce. He was the associate director and senior economist for the Gulf South Research Institute and project/program manager and senior economist at three private engineering firms. He has conducted more than 500 Civil Works projects nationwide that required the development of relevant and credible socioeconomic information and analysis, and performed the quality assurance review for all economic aspects of these projects. He is experienced in determining the scope and appropriate methodologies for impact assessment and analyses for a variety of projects and programs with high public and interagency interests. His scope includes: Economic Evaluation of Benefits from Beneficial Use Disposal Alternatives of Dredged Material for Consistency with State of Texas Coastal Management Plan, Texas (USACE, Galveston District); Missouri River Authorized Purposes Study (MRAPS) Project Management Plan (USACE, Omaha and Kansas City Districts); and the Municipal and Industrial Water Use Forecast, Southwest Florida Feasibility Study, Florida (USACE, Jacksonville District).

Mr. Ator's experience has made him intimately familiar with the USACE plan formulation process, procedures, and standards as they relate to flood risk management. He has demonstrated proficiency in the USACE six-step planning process as evidenced by development of a template for preparing Project Management Plans for feasibility studies for USACE Regional Planning and Environment Division South, Mississippi Valley Division in 2011 and field testing the template in 2012. Most recently, he worked with the USACE New Orleans District Project Delivery Team to develop the Project Management Plan for the West Shore Lake Pontchartrain Flood and Storm Damage Risk Reduction Project. In 2010, Mr. Ator served as a team leader while embedded in the Plan Formulation Branch USACE New Orleans District directing plan formulation activities of three plan formulators and providing project oversight and review to ensure compliance with USACE guidelines.

Mr. Ator is familiar with the USACE structural flood-risk management analysis and economic benefit calculations and standard USACE computer programs, including HEC-FDA. He has conducted structure

inventory surveys for flood damage reduction studies, developed content-to-structure value relationships for urban flood control economic analyses, and has prepared Section 905(b) flood damage reduction and ecosystem restoration reconnaissance reports. A majority of the projects he has conducted have required use of the HEC-FDA computer program. He attended a USACE-sponsored workshop on the model certified version of HEC-FDA in March of 2010 hosted by the Mississippi Valley Division. His related project experience includes the Structure and Content Depth Damage Relationship Surveys, Ouachita Parish, Louisiana (USACE, Vicksburg District); the Development of Content to Structure Value Relationships for Urban Flood Control Economic Analysis, Cypress Creek, Texas (USACE, Galveston District.); and the Orleans Parish, Louisiana, Urban Flood Control Feasibility Study, Structure Inventory (USACE, New Orleans District).

Mr. Ator's experience with National Economic Development analysis procedures, particularly as they relate to flood risk management, includes serving as a team leader in 2010 while embedded in the Plan Formulation Branch (USACE, New Orleans District). His responsibilities included directing plan formulation activities, and providing project oversight and review to ensure compliance with USACE guidelines. In this capacity, he worked closely with Project Delivery Teams to identify and evaluate measures and alternatives using appropriate planning methodologies on 13 projects to reduce life safety risk, all of which included a combination of flood risk management, life-loss probability analysis, population at risk, residual risk, and vulnerability analysis. For example, Mr. Ator's work on the Greens Bayou Residual Flood Plain Properties Buyout Analysis, Texas (USACE, Galveston District) included flood risk management, population at risk, residual risk, and vulnerability analysis. In addition, the Donaldsonville to the Gulf - Flood Damage Risk Reduction Feasibility Study, Louisiana (USACE, New Orleans District) included flood risk management, life loss probability analysis, population at risk, residual risk, and vulnerability analysis.

In Mr. Ator's 35+ years of experience, he has worked on social effects evaluation of large Civil Works projects for hundreds of NEPA compliance documents, including experience with community cohesion/identity, cultural and historical value, low-income population, economic vitality of the community, and vulnerability of the population. For example, he contributed to a social impact assessment for the Little Colorado River in Holbrook, Arizona (USACE, Los Angeles District) and an environmental impact statement for U.S. Navy Home Porting Projects (USACE, Galveston District), both of which dealt with community cohesion and identity. His work on the Historic American Building Survey Documentation for the Perry Creek Flood Control Project in Sioux City, Iowa (USACE, Omaha District) and on screening the cultural and historic features at the Di-Lane Plantation, Georgia (USACE, Savannah District) illustrates his experience with evaluating cultural and historical value. He gained experience working with low-income populations through assessing the socioeconomic impacts from flooding and flood control measures in the Yazoo Delta, Mississippi (USACE, Vicksburg District) and through the development of an initial job training program for the Community Impact Mitigation Plan for the Inner Harbor Navigation Canal Lock in New Orleans, Louisiana (USACE, New Orleans District). Mr. Ator has experience with the economic vitality of the community through working on the Memphis Riverfront Development Project (USACE, Memphis District) and on an analysis of economic development benefits from the construction of a floodwall and levee system along the Greenbrier River and Knapp Creek in Marlinton, West Virginia (USACE, Huntington District). Finally, he is familiar with the vulnerability of the population through his work on a social impact assessment for the Kissimmee River Upper Basin Restoration Project (USACE, Jacksonville District) and from the Environmental Impact Statement for the proposed widening of the Pascagoula Lower Sound/Bayou Casotte Channel (USACE, Mobile District).

D.2 Dr. Christopher J. Brown, PhD., P.E.

Role: Civil Engineering and Geotechnical Engineering Subject Matter Expert
Affiliation: University of North Florida, Jacksonville, FL

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 Ph.D. in civil engineering in 2005 from the University of Florida, his Master's Degree from Villanova University in 1997, and his B.S. 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, U.S. Army Corps of Engineers (USACE), and for Golder Associates Inc. as a private consultant for various complex civil engineering projects. While working for the USACE, he worked within the Planning, Engineering, and Construction Divisions during his tenure. He was consistently recognized for his excellent technical skills including award of "engineer of the year" twice over 16 years with USACE. He has also recently been recognized for excellence in teaching and mentoring with award of several teaching accolades at UNF and the national Bliss Medal from the Society of American Military Engineers (SAME).

Dr. Brown is a registered professional engineer to 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, EAA 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, EPA, USACE, State of Florida, and Commonwealth of Puerto Rico. Dr. Brown has also designed projects that were designed per requirements outlined in EM 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 completed both stability studies using 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 MCACES and working knowledge of M2. 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 the largest civil works projects in USACE 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 C&D Canal Deepening Project in MD and DE and the Delaware Main Channel Deepening Project in PA and NJ.

D.3 James Dobberstine, M.S., M.S.

Role: Biologic Resources and Environmental Law Compliance Subject Matter Expert
Affiliation: Lee College, Department of Environmental Science, Baytown, TX

Prof. Dobberstine currently serves as chair of the Math, Engineering, and Sciences Division (MES) at Lee College, in Baytown, Texas, where he is responsible for all operational aspects of the MES Division, including oversight of three departments (Mathematics, Biological Sciences, and Physical Sciences) and associated laboratories, approximately 30 faculty and staff, and departmental budgets. He teaches Environmental Science and Biology and is engaged in ecosystem studies in the Galveston Bay estuary with his students, the results of which have been featured through organizations including Restore America's Estuaries (RAE), among others. Prof. Dobberstine holds a B.A. in Life Sciences (Biology/Chemistry; Concordia University), an M.S. in Environmental Management (Environmental Policy and Law, including NEPA, CWA, ESA, and other regulatory; University of Houston-Clear Lake), and an M.S. in Environmental Science (Biology and Environmental Toxicology; University of Houston- Clear Lake). He also holds certificates in USACE wetland delineation (Texas A&M University) and water quality improvement using constructed wetlands (Clemson University) and has completed numerous professional development courses, including GIS Techniques in Environmental Assessment (University of North Texas), Probabilistic Ecological Risk Assessment (Texas Tech University), Application of Adaptive Management to Address Climate Change Related Challenges (NOAA Coastal Service Center and the PBS&J Ecosystem Restoration Division), Benthic Mapping Techniques (EPA, USDA-NRCS, and the University of Rhode Island), Sampling Benthic Sediments: Methods, Analyses, and Judgments (University of North Texas Institute of Applied Sciences), and Conserving Land with Conservation Easements (National Land Trust Alliance Land Conservation Leadership Program).

As an Environmental Scientist focusing on wetlands and other aquatic habitats, Prof. Dobberstine is experienced with the complex regulatory framework affecting projects that potentially impact coastal habitat. He has evaluation experience with NEPA impact and cumulative effects analyses on projects with high public and interagency interest within sensitive aquatic habitats, including wetlands. Prof. Dobberstine has extensive research experience with many aspects of aquatic and riparian habitats, including aquatic habitat characterization, the effect of adjacent land use on in-stream water and sediments, and ecosystem function. This includes experience assessing aquatic habitats using the Sediment Triad method (toxicology, chemistry, and biologic community). Data collected as part of a 2004-2007 study is part of the baseline aquatic habitat data being applied to an EPA superfund (CERCLA) project on the Houston Ship Channel (HSC- Patrick Bayou). He also has ongoing grant-funded (Texas Coastal Management Program/NOAA and the Galveston Bay Estuary Program/EPA) research gathering data to be used for adaptive management of ecosystem restoration in aquatic habitats in lower Galveston Bay, comparing the functional aspects of the biologic communities across different habitat restoration designs. The data are being gathered and managed under criteria developed for the EPA/TCEQ required Quality Assurance Program Plan (QAPP). Prof. Dobberstine is also studying the biologic community characteristics

associated with small-scale shoreline restoration (Living Shorelines) in comparison to natural reference marshes and traditionally armored (bulkhead) shorelines in estuarine and freshwater ecosystems. He has experience associated with adaptive management strategy development with the GBEP Freshwater Inflows Group and the Harris County Flood Control District (HCFCD) Memorial Park Demonstration Project/Buffalo Bayou shoreline stabilization/habitat restoration project. Prof. Dobberstine is also experienced with risk assessment for restoration projects in mixed urban/industrial environments where potential toxicant/exposure concerns contrast with significant cultural and environmental benefits including community education and recreation opportunities, and ecosystem enhancement. He is familiar with habitat and lifecycle requirements for many species of fish and wildlife endemic to rivers and watersheds in many areas of the U.S., including threatened and endangered species.

Prof. Dobberstine has worked in the area of habitat conservation with the Galveston Bay Foundation, where he led several programs including the Living Shorelines, Land Conservation, and Permit Review Programs. He has extensive experience with conservation easements including the development of habitat assessments, project cost models, and contract development. He was responsible for overseeing more than 2,500 acres of protected coastal habitat. He has extensive experience with aquatic habitat restoration projects including project development, planning, permitting, risk assessment and ecotoxicology, fundraising and grant development, project implementation, management, and monitoring. He has a working knowledge of coastal, riparian, and floodplain ecology, and methodologies for evaluation, including research, work on design and grant development for restoration projects (including beneficial uses of dredge material), and permit development and evaluation. He has successfully raised grant funds for projects from partners including the USFWS Coastal Program, the Texas Coastal Management Program, the Texas Coastal Assistance Program, the Galveston Bay Estuary Program, and others.

Prof. Dobberstine is frequently called on to serve as an advisor on projects and panels, currently serving on the Advisory Council to the Arthur Temple College of Forestry and Agriculture at Stephen F. Austin State University, and formerly as a curriculum review advisor to the Environmental Management Program at the University of Houston-Clear Lake. He also serves as a member of the Memorial Park Demonstration Project Vegetation Advisory Workgroup, the Moody Gardens ACUC (Conservation) Committee, and on the Monitoring and Research Subcommittee of the Galveston Bay Council. Prof. Dobberstine is a member of the National Association of Environmental Professionals. He also currently serves on the Boards of Directors of the Texas Association of Environmental Professionals (President 2010–present) and the South Central Regional Chapter of Society for Environmental Toxicology and Chemistry (as President 2013–2015), and as a former Trustee and current Advisory Board Member of the Galveston Bay Foundation. Prof. Dobberstine has served on several IEPRs for USACE projects in the areas of biologic resources and environmental law compliance. IEPR experience includes infrastructure projects (dam safety and flood risk reduction), ecologic modeling, and water management.

D.4 Dr. Bolyvong Tanovan, PhD, PE

Role: Hydraulics & Hydrology (H&H) Engineering Subject Matter Expert
Affiliation: Independent Consultant

River Operations Manager and Planner – Dr. Tanovan has 25-years' experience in planning and managing the operations of the Columbia River multi-project river system for flood control, hydropower, water supply, water quality, recreation, navigation, and fish and wildlife. He worked in senior planning or engineering roles as USACE, Northwestern Division Water Quality Section chief, from 1983-99, and

Power Branch chief, from 1999-2008. As Chief of Water Management Power Branch, he lead annual operational planning for the 31 major Corps and other Treaty dams on the Columbia River System. In this capacity, he maintained regional coordination with federal and nonfederal project owners and operators in the Pacific Northwest, and managing the Hydropower Analysis Center of expertise tasked with performing hydropower studies for Corps projects across the nation, and for hydro projects in several foreign countries. He coordinated activities with other federal agencies, state river basin authorities, regional planning commissions, and hydropower utilities involved in the large, complex civil works projects in the Columbia River basin. This position had high public, interagency, and regional/international interests (challenged by the Endangered Species Act, the Clean Water Act, the Columbia River Treaty with Canada, and the Pacific Northwest Coordination Agreement for hydropower generation). Dr. Tanovan was actively involved in planning and actual daily reservoir system operations in the Columbia River Reservoir Control Center and Interagency Technical Management Team to meet water quality standards and the mainstem fish passage survival goal while optimizing system hydropower generation. As Chief of the Fish & Water Quality Section (1983-99), Dr. Tanovan supervised planning and operation of environmental projects for the Northwestern Division of the Corps of Engineer, member of the Corps of Engineers' National Water Quality Committee.

Water Resources Engineer – He is experienced in building and using rules-based reservoir simulation models such as HEC-ResSim (and HEC-5) to analyze alternatives for operation of Columbia River multi-project and multipurpose river systems. Dr. Tanovan was deeply involved in hydropower, anadromous fish passage, and water quality operations and analyses, using HEC-5Q and other water quality models (e.g., CE-QUAL-R1 and R2) to analyze water quality interactions in both lake (e.g., Grand Coulee, Dworshak, and Libby) and river systems (Columbia-Snake Rivers). He has 25 years of demonstrated experience in system operational planning and managing the water quality and fish passage program for the large, complex Columbia River system civil works projects with high public and interagency interests. Dr. Tanovan performed as tri-agency Water Quality work group leader in the multi-million dollar Columbia River System's Operation Review; Technical Lead in initial phase of Columbia Treaty Review.

Prior to the USACE, Dr. Tanovan worked on basin and land-use planning; flood insurance studies for the Federal Emergency Management Agency (FEMA); and watershed and dam-break modeling for Oregon counties. He also developed basin-wide SSARR-based Upper Mekong flood forecast model, and SOGREAH-based Mekong Delta model, and prepared long-term indicative hydropower basin development plans. Dr. Tanovan MS in Civil Engineering and PhD. in Hydrologic Engineering, Federal Institute of Technology, Lausanne, Switzerland and is a licensed/registered professional engineer (PE) since 1977.

Bibliography

Cited References

Engineering Regulation (ER) 1110-2-1302, "*Engineering and Design, Civil Works Cost Engineering"*, Department of the Army, U.S. Army Corps of Engineers (USACE), Washington, DC, 2008, 31 p.

Engineering Manual (EM) 1110-1-1904, "*Engineering and Design—Settlement Analysis",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1990-09-30.

Engineer Regulation (ER) 1110-2-1150, "*Engineering and Design—Plans and Specifications for Civil Works Projects",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1999-08- 31.

Engineer Manual (EM) 1110-2-1913, "*Engineering and Design—Design and Construction of Levees",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 2000-04-30.

Engineer Manual (EM) 1110-2-1902, "*Engineering and Design—Slope Stability",* Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 2003-10-31.

Engineer Regulation (ER) 1105-2-100, "*Planning Guidance Notebook*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, Appendix G, Section III – Post Authorization Changes, Amendment #1, 2004-06-30

Engineer Regulation (ER) 1105-2-100, "*Planning Guidance Notebook*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, Chapter 2, Planning Principles, 2000-04-22

Executive Order 12898, "*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*", POTUS, 1994-02-11

Engineer Manual (EM) 1110-2-1415, "*Hydrologic Frequency Analysis*", Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1993-03-05

Glossary of Selected Terms and Acronyms

The following is a glossary of selected terms and acronyms, some with descriptions.

Press "Ctrl+(Letter)" to jump to respective glossary section.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Symbols & Numerical

~ ..... about
% ..... percent

A

↟ Back to Menu ↟

APMI ..... Analysis Planning and Management Institute, www.APM-Inst.org
ASME ..... American Society of Mechanical Engineers
Authorized Project ..... An authorized project is defined as a project specifically authorized by Congress for construction, generally, through language in an authorization or appropriation act, or a project authorized pursuant to Section 201 of the Flood Control Act of 1965 (ER 1105-2-100, Appendix G).

B

↟ Back to Menu ↟

Base Flood ..... The regulatory standard under the NFIP for a flood having a one percent chance of being equaled or exceeded in any given year. It is also referred to as the 100-year flood. The base flood is the national standard used by the NFIP and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. BFEs are typically shown on FIRMs.

C

↟ Back to Menu ↟

CAP ..... Continuing Authorities Program (USACE)
Channel ..... A natural or artificial watercourse of perceptible extent with a definite bed and banks to confine and conduct continuously or periodically flowing water (ER 1165-2-26).
COI ..... conflict of interest
Critical Action ..... Any activity for which even a slight chance of flooding would be too great. The critical action flood plain is defined as the 500-year flood plain (0.2% chance flood plain) (ER 1165-2-26).

D

↟ Back to Menu ↟

DA ..... Department of the Army

E

↟ Back to Menu ↟

EA ..... Environmental Assessment
EC ..... Engineers Circular (USACE)
EIS ..... Environmental Impact Statement
EP ..... Engineering Pamphlet (USACE)
ER ..... Engineering Regulation (USACE)

F

↟ Back to Menu ↟

FDA ..... Flood Damage Reduction Analysis

G ↟ Back to Menu ↟

General Reevaluation ..... A general reevaluation is a study to affirm, reformulate, or modify a plan, or portions of a plan, under current planning criteria. This study may be similar to a feasibility study (ER 1105-2-100).

H ↟ Back to Menu ↟

HQ..... Headquarters

I ↟ Back to Menu ↟

IEPR..... Independent External Peer Review

J ↟ Back to Menu ↟

K ↟ Back to Menu ↟

L ↟ Back to Menu ↟

Limited Reevaluation ..... A study to provide an evaluation of a specific portion of a plan under current policies, criteria, and guidelines, and it may be limited to economics or environmental effects (ER 1105-2-100).

LMI..... Logistics Management Institute, www.LMI.org

M ↟ Back to Menu ↟

Minimize ..... To reduce to the smallest possible amount or degree (ER 1165-2-26).

N ↟ Back to Menu ↟

NAS ..... National Academy of Sciences; www.NAS.edu

Natural and Beneficial Values .... Include but are not limited to water resources values (natural moderation of floods, water quality maintenance, and ground water recharge), living resource values (fish, wildlife and plant resources), cultural resource values (open space, natural beauty, scientific study, outdoor education and recreation) and cultivated resource values (agriculture, aquaculture and forestry) (ER 1165-2-26).

NED..... National Economic Development

NEPA ..... National Environmental Policy Act

NFIP ..... National Flood Insurance Program

Nonstructural Approaches ..... Nonstructural approaches to flood proofing are intended to reduce damage from encroaching floodwater by altering the property. These include acquiring and/or relocating a building, preparing emergency measures, such as sandbagging, and flood proofing structures.

O ↟ Back to Menu ↟

OMB..... Office of Management and Budget

OMRR&R ..... Operation, Maintenance, Repair, Replacement, and Rehabilitation

OSD ..... Office of the Secretary of Defense

P ↟ Back to Menu ↟

PAC ..... Post-Authorization Change (report). Recommended changes to authorized but unconstructed projects may require a PAC report. Guidance on PAC reports are in Appendix G, Section III, of ER 1105-2-100.

PAL ..... Provisionally Accredited Levee (System).The PAL designation may be used for a levee system that FEMA has previously accredited with providing one-percent-annual-chance flood protection on an effective

	FIRM/DFIRM, and for which FEMA is awaiting data and or documentation that will show the levee system is compliant with 44 CFR 65.10. Before FEMA will apply the PAL designation to a levee system, the community or levee owner will need to sign and return an agreement indicating the data and documentation required will be provided within a specified timeframe.
PCX	Planning Center of Excellence (USACE)
PDT	Product Delivery Team
PE	Professional Engineer
PFP	Probable Failure Point
PM	Program Manager
PMP	Project Management Professional
PNP	Probable Non-failure Point
POC	Point of Contact
POTUS	President of the United States
Practicable	Capable of being done within existing constraints. The test of what is practicable depends upon the situation and includes consideration of the pertinent factors, such as, environment, cost, or technology (ER 1165-2-26).
Preserve	To prevent adverse modification to the existing flood plain environment or to maintain it (ER 1165-2-26).
PWS	Performance Work Statement

Q

↟ Back to Menu ↟

QA	Quality Assurance

R

↟ Back to Menu ↟

Regulatory Floodway	The area regulated by Federal, state or local requirements. It is the channel of a river or other watercourse and the adjacent land areas that must be reserved in an open manner, i.e., unconfined or unobstructed either horizontally or vertically to provide for the discharge of the base flood so the cumulative increase in water surface elevation from encroachment does not exceed one foot as set by the National Flood Insurance Program (ER 1165-2-26).
Residual Risk	The flood risk that remains if a proposed flood damage reduction project is implemented. Residual risk includes the consequence of capacity exceedance as well (ER 1105-2-101).
Restore	To reestablish a setting or environment in which the natural functions of the flood plain can again operate (ER 1165-2-26).
Risk Analysis	An approach to evaluation and decision making that explicitly and, to the extent practical, analytically incorporates considerations of risk and uncertainty in a flood damage reduction study (ER 1105-2-101).
Risk	The measure of the probability and severity of undesirable consequences. Risk = (Frequency of an event) x (Probability of occurrence) x (Consequences) (EC 1110-2-6067).
ROD	Record of Decision

S

↟ Back to Menu ↟

SAR	Safety Assurance Review

SMART	S: Specific; M: Measurable; A: Attainable; R: Risk Informed; T: Timely (See http://planning.usace.army.mil/toolbox/smart.cfm)
SME	subject matter expert
SOP	Standing Operating Procedure
SOW	Statement of Work
Structural Approaches	Flood proofing intended to prevent flooding by altering the flow of floodwater; these include constructing levees or dams, or modifying a waterway's channel.

T ↟ Back to Menu ↟

TBD	To Be Determined
TO	Task Order

U ↟ Back to Menu ↟

Uncertainty	A measure of imprecision of knowledge of parameters and functions used to describe the hydraulic, hydrologic, geotechnical and economic aspects of a project plan (ER 1105-2-101).
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

V ↟ Back to Menu ↟

W ↟ Back to Menu ↟

X ↟ Back to Menu ↟

Z ↟ Back to Menu ↟

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Press "Ctrl+(Letter)" to jump to respective glossary section.

End of Document