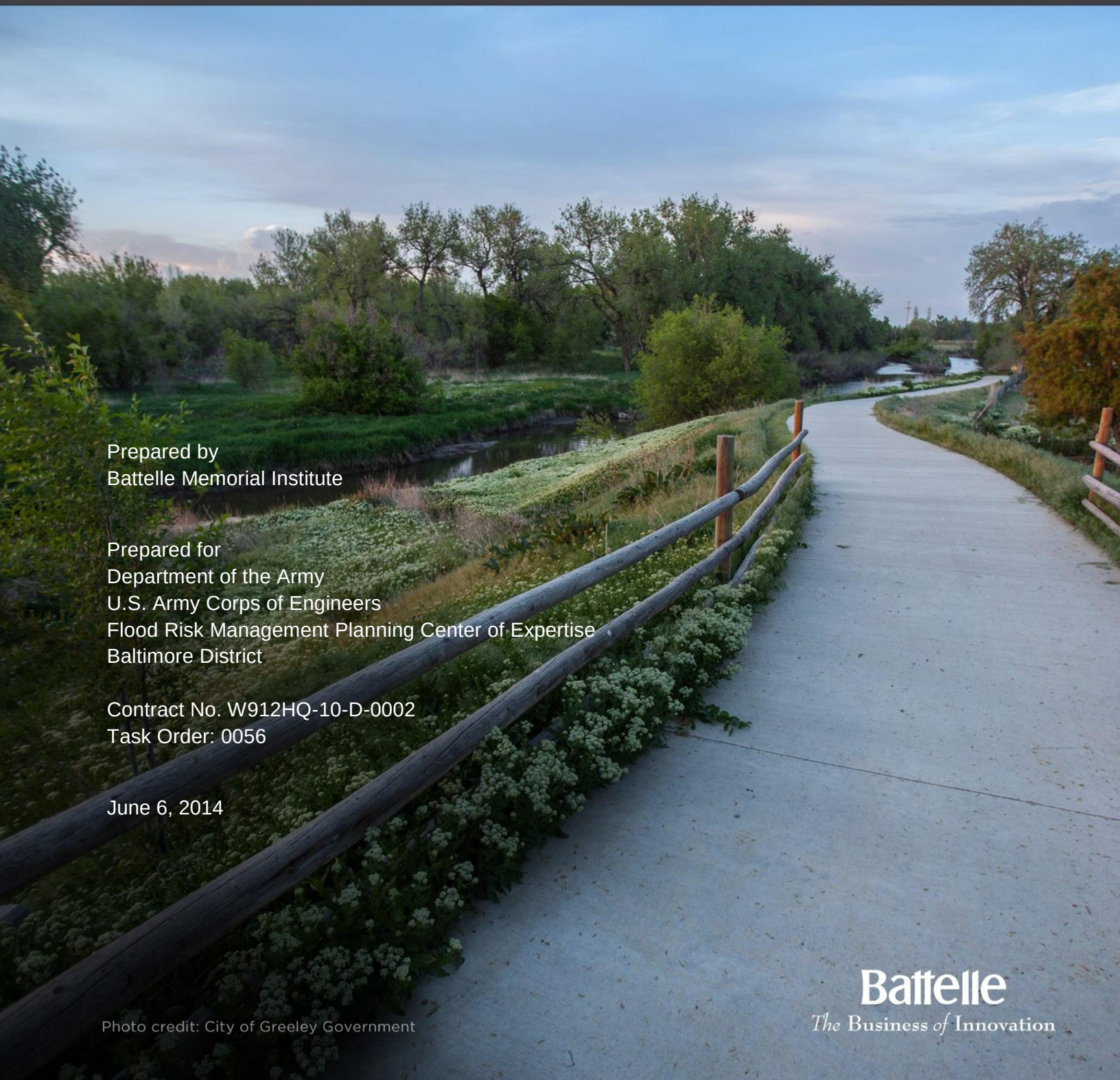
Final Independent External Peer Review Report
Cache la Poudre at Greeley, Colorado
General Investigation Feasibility Study



Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Flood Risk Management Planning Center of Expertise
Baltimore District

Contract No. W912HQ-10-D-0002
Task Order: 0056

June 6, 2014

Photo credit: City of Greeley Government

Battelle
The Business of Innovation

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
06 JUN 2014		**00-00-2014 to 00-00-2014**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Final Independent External Peer Review Report Cache la Poudre at Greeley, Colorado General Investigation Feasibility Study	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Battelle,505 King Avenue,Columbus,OH,43201**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**72**	

This page is intentionally left blank.

CONTRACT NO. W912HQ-10-D-0002
Task Order: 0056

Final Independent External Peer Review Report
Cache la Poudre at Greeley, Colorado
General Investigation Feasibility Study

Prepared by

Battelle
505 King Avenue
Columbus, Ohio 43201

for

Department of the Army
U.S. Army Corps of Engineers
Flood Risk Management Planning Center of Expertise
Baltimore District

June 6, 2014

This page is intentionally left blank.

Final Independent External Peer Review Report
Cache la Poudre at Greeley, Colorado
General Investigation Feasibility Study

Executive Summary

PROJECT BACKGROUND AND PURPOSE

The Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study is being undertaken to determine and evaluate alternatives related to flood risk management (FRM) and ecosystem restoration (ER) within the Cache la Poudre River near Greeley, Colorado. Preliminary project costs are in the range of $35 to 50M.

The Cache la Poudre study reach is located in and around Greeley on the high plains of northeastern Colorado as noted in Figure 1. The Cache la Poudre River is a left bank tributary to the South Platte River and rises in the Front Range of the Rocky Mountains before exiting onto the plains at Ft. Collins, upstream of Greeley. While the main stem of the Cache la Poudre is considered a wild and scenic river in the Rocky Mountains, irrigation and gravel mining have impacted the river between Ft. Collins and its confluence with the South Platte near Greeley. Flooding has been a major problem in Greeley, with the most recent damaging flood occurring in 1999. An even more damaging flood occurred in 1983.

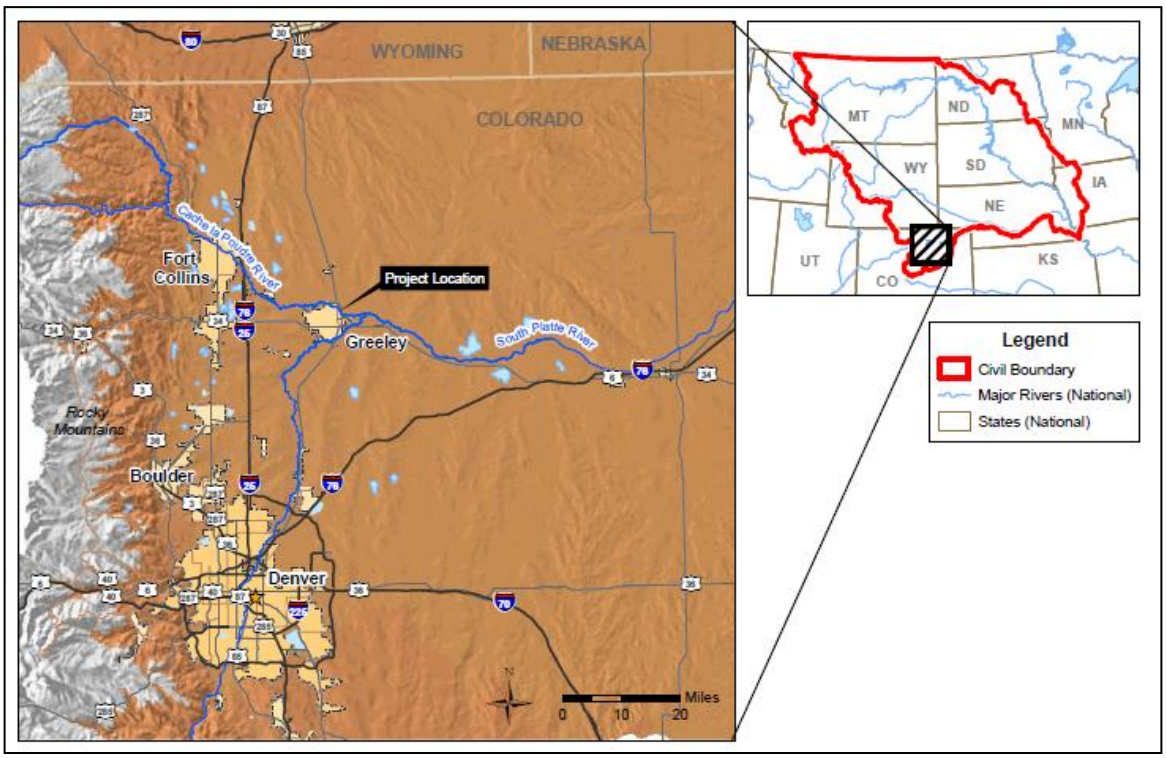


Figure 1. Location of the project in the U.S. and northeastern Colorado

The City of Greeley is the local sponsor, and they have received funding from the State of Colorado, via the Colorado Water Conservation Board, to pursue solutions to the flood damage problem and improvements to the degraded riverine ecosystem. The feasibility study has focused on defining FRM solutions in a three-mile reach of the Cache la Poudre River and includes both structural and nonstructural measures. ER efforts include riparian restoration along the channel and related ecosystem improvements in the flood plain. A goal was to provide habitat to native and migratory species in a region where habitat of this type is increasingly scarce. ER methods were formulated during this initial phase and an interim report was written that incorporated potential methods to improve the riparian habitat. The value of the riparian corridor in the semi-arid high plains to indigenous and migratory species was also evaluated.

The ability to leverage combined FRM/ER solutions is limited somewhat by the lack of flood risk benefits that can be derived by widening the channel of the Cache la Poudre River. The reason for this is that transportation corridors that cut laterally across the floodway create a series of stair step pools during major floods, with road embankments acting as low head dams, the bridge openings as “principal spillways,” and the weir flow across the embankments acting as ”emergency spillways.”Thus a widened channel largely produces only deeper ponding areas behind roadways, rather than improving flood conveyance and dropping water surface elevations significantly, as the stage is mostly controlled by the weir flow over the roadways at the 100-year event. The bridges are relatively new, and would be costly to replace in pursuit of more “principal spillway” capacity.

The reduction of the flood threat is directed toward reducing the risk of flood damages to property, which are relatively frequent. Historically, floods from the Cache la Poudre at Greeley have been characterized by long warning times and relatively shallow flood depths. Major floods are caused by a combination of snow melt and thunderstorm runoff over a relatively large watershed, so overbank flows are not “flashy” in occurrence. As noted in Figure 1, Greeley is well east of the Rocky Mountains and the Cache la Poudre flowing through the high plains has a modest, rather than a steep channel gradient, resulting in moderate river flow velocities. In addition, while runoff from severe local storms can cause extensive property damage on tributary streams and via storm sewer backup, the storms do not produce sufficient volume to cause a damaging riverine flood.

Independent External Peer Review Process

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. The U.S. Army Corps of Engineers (USACE) is conducting an Independent External Peer Review (IEPR) of the Cache la Poudre at Greeley Colorado General Investigation Feasibility Study (hereinafter: Greeley IEPR). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, is free from conflicts of interest (COIs), and meets the requirements for an Outside Eligible Organization (OEO) per guidance described in USACE (2012). Battelle has experience in establishing and administering peer review panels for USACE and was engaged to coordinate the Greeley IEPR. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2012) and OMB (2004). This final report presents the Final Panel Comments of the IEPR Panel (the Panel). Details regarding the IEPR (including the process for selecting panel members, the panel members’ biographical information and expertise, and the charge submitted to the Panel to guide its review) are presented in appendices.

Based on the technical content of the Greeley review documents and the overall scope of the project, Battelle identified candidates for the Panel in the following key technical areas: planning and economics;

environmental sciences; structural, geotechnical, and civil engineering; hydrologic and hydraulic (H&H) engineering. USACE was given the list of candidate panel members, but Battelle made the final selection of the four members of the Panel.

The Panel received electronic versions of the 576 pages of Greeley review documents, along with a charge that solicited comments on specific sections of the documents to be reviewed. USACE prepared the charge questions following guidance provided in USACE (2012) and OMB (2004), which were included in the draft and final Work Plans.

The USACE Project Delivery Team (PDT) briefed the Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties. Other than Battelle-facilitated teleconferences, there was no direct communication between the Panel and USACE during the peer review process.

IEPR panel members reviewed the Greeley review documents individually, and produced individual comments in response to the charge questions. The panel members then met via teleconference with Battelle to review key technical comments and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium/high, medium, medium/low, or low); and (4) recommendations on how to resolve the comment. Overall, 14 Final Panel Comments were identified and documented. Of these, 10 had a medium significance and four had medium/low significance.

Results of the Independent External Peer Review

The panel members agreed on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2012; p. D-4) in the Greeley review documents. Table ES-1 lists the Final Panel Comment statements by level of significance. The full text of the Final Panel Comments is presented in Section 4.2 of this report. Based on the Panel's review, the report is well-written, organized, and easy to understand; however, the Panel identified project elements that required revision or additional evaluation as well as documentation that should be clarified. The following summarizes the Panel's findings.

Planning/Economics: The FRM optimization to select the most economically efficient level of protection (i.e., 2%, 1%, and 0.2%) and the individual structures that were economically beneficial to provide the level of protection was a rigorous and fine scale analysis. Use of Census Tract data for the project area also represented a fine level of spatial resolution; however, Environmental Justice issues are not analyzed in sufficient detail. In particular, a rationale needs to be provided for not incorporating structural and non-structural measures into the recommended plan that limit the risks of flood damage to minority and low-income residences in the project area. It should be determined whether structural or non-structural measures for the FRM are reasonable under Environmental Justice concerns. The Panel believes this issue could be addressed by investigating whether additional pre-flood preparedness and evacuation preparation programs targeted at mobile home park residents are warranted as a mitigating measure. The Panel also noted the assumption of no increase in future development in the FRM area appears at odds with other statements about the future development made in the DFR/EA, and results in an underestimation of future benefits from project alternatives. This assumption should be re-evaluated by using trends in development in the project area and, based on the results of the re-evaluation, future

national economic development (NED) benefits of structural measures should be recalculated, as needed.

Environmental: The environmental models, assumptions, and analyses used for this study are consistent with generally accepted methods. The identified problems, opportunities, objectives, and constraints appear to reflect a systems, watershed, and/or ecosystem approach, addressing a geographic area large enough to ensure that plans address cause-and-effect relationships among affected resources and activities pertinent to achieving the study objectives. However, the Panel noted that as-built soil profiles, critical to documenting baseline conditions and determining the long-term success of constructed wetlands, are not mentioned in monitoring plans. Documenting baseline soil conditions is a minimal cost investment that greatly benefits understanding the progress and ultimate success of the project's wetland or construction efforts. The Panel also noted the potential for the invasion or re-invasion of undesirable cattail and reed canary grass in the restored emergent wetlands, but the methods for controlling these species are not discussed. The extent and composition of these undesirable plant species should be determined, and the potential need for herbicide applications and precautions if herbicides are applied should be included. In addition, infestation by the emerald ash borer could alter the habitat structure and eliminate one of the tree species considered important to the planned restoration. A description of the potential impact of the emerald ash borer on green ash should be provided along with a contingency plan in the event an infestation occurs.

H&H Engineering: The H&H sections are well-written, the evaluation procedures are well-defined, and the model development and potential shortcomings are adequately described. The structural flood mitigation alternatives are comprehensive and evaluated in a consistent and thorough manner, but the evaluation of damages, alternatives, and the effectiveness of nonstructural measures is incomplete if potential future encroachment in the flood fringe is not accounted for. This potential flood fringe encroachment should be discussed in appropriate sections of the report and hydraulic information, such as floodway surcharge, should be provided. The Panel found the hydrologic assumptions used for the project to be appropriate for FRM, but may not be appropriate for ER and may be insufficient to ensure project success during periods of drought. The Panel recommends the ER analyses and design be reviewed to accommodate possible drought and low water conditions.

Finally, the Panel found that additional detail on interior drainage systems and the benefits of levees would help clarify whether the costs and benefits of these systems were adequately evaluated. Without a discussion of concurrent flooding and possible interior drainage systems such as ponding areas and pumps in addition to the "minimum facilities" concept, it is difficult for the Panel to determine whether the costs and benefit of the levees and interior drainage systems were addressed adequately. The with-project interior flood levels or the with-project interior floodplain relative to without-project conditions that were used to assess the benefits of the levee alternatives should also be provided.

Structural/Geotechnical/Civil Engineering: The assumptions underlying the civil, structural, and geotechnical aspects of the structural and nonstructural alternatives appear to be complete and sound. Risk and uncertainty have been satisfactorily addressed with respect to the structural and nonstructural alternatives. Any uncertainty in geotechnical (spoil banks, levees, or foundations) or structural (flood proofing) aspects is not expected to affect the alternatives analyses and outcomes. The geotechnical effort is very thorough and complete relative to the feasibility study phase (more so than other feasibility studies). The Panel noted the ER Monitoring and Adaptive Management Plan (MAMP) and Operation and Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) plans have not been developed with clear, consistent goals, objectives, and defined actions and responsibilities to guide USACE and the local

sponsor during the 5-year monitoring period and beyond. The plans should be clear about who is responsible for monitoring, what corrective actions may be taken, who is responsible for taking those actions, and who will pay for them.

Table ES-1. Overview of 14 Final Panel Comments Identified by the Greeley IEPR Panel

No.	Final Panel Comment
Medium – Significance	
1	The Environmental Justice concerns do not fully consider structural and nonstructural measures for flood risk management.
2	The potential for increases in future flood stages as a result of encroachment in the flood fringe has not been addressed.
3	The assumption that future without-project conditions will be equivalent to current conditions does not appear to account for future increases in development, therefore underestimating future damages avoided.
4	Post-construction soil profiles, which provide baseline conditions for measuring long-term success of constructed wetlands, are not discussed.
5	The potential for the invasion or re-invasion of undesirable cattail and reed canary grass in the restored emergent wetlands and the methods for controlling these species are not discussed.
6	A description of the potential impact of the emerald ash borer on green ash *(Fraxinus pennsylvanica)* plantings is not provided, and the disruption to planned riparian habitat restoration from a potential infestation is not considered.
7	The Ecosystem Restoration MAMP and OMRR&R plans have not been developed with clear, consistent goals, objectives, and defined actions and responsibilities to guide USACE and the local sponsor during the 5-year monitoring period and beyond.
8	Hydrologic risks have been identified and assumptions have been made that are appropriate for flood risk management, but inappropriate for ecosystem restoration, and may be insufficient to ensure project success during periods of drought.
9	The evaluation of levee alternatives does not consider an interior drainage system in addition to the “minimum facilities” concept or explain how concurrent river and flooding events are accounted for.
10	Public safety and loss of life due to flash flooding are not addressed in the future without-project condition or project alternatives.
Medium/Low – Significance	
11	Natural reference areas and their use in the design and monitoring phases of the project are not discussed.

12	Irrigation requirements do not appear to have been considered in the establishment of newly planted trees and shrubs.
13	Various types of active management actions have not been included in the ecosystem restoration to mitigate unanticipated changes in environmental or hydrologic conditions.
14	The NED benefits attributed to the structural measures may not fully account for potential emergency costs and infrastructure damages avoided.

Table of Contents

List of Figures

List of Tables

This page is intentionally left blank.

LIST OF ACRONYMS

AAHU	average annual habitat unit
ACE	annual chance of exceedance
ATR	Agency Technical Review
COI	Conflict of Interest
CWRB	Civil Works Review Board
DFR	Draft Feasibility Report
DrChecks	Design Review and Checking System
EA	Environmental Assessment
EC	Engineer Circular
ER	ecosystem restoration
ERDC	Engineer Research and Development Center
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
FRM	flood risk management
FWCA	Fish and Wildlife Coordination Act
H&H	hydrologic and hydraulic
HEC-FDA	Hydrologic Engineering Center-Flood Damage Reduction Analysis
HEC-HMS	Hydrologic Engineering Center-Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HEP	Habitat Evaluation Procedures
HSI	Habitat Suitability Index
IEPR	Independent External Peer Review
IWR	Institute for Water Resources
MAMP	Monitoring and Adaptive Management Plan
NED	national economic development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NFIP	National Flood Insurance Program
OEO	Outside Eligible Organization
OMB	Office of Management and Budget

OMRR&R	Operation and Maintenance, Repair, Replacement, and Rehabilitation
PDT	Project Delivery Team
SAR	Safety Assurance Review
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Services
WRDA	Water Resources Development Act

1. INTRODUCTION

The Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study is being undertaken to determine and evaluate alternatives related to flood risk management (FRM) and ecosystem restoration (ER) within the Cache la Poudre River near Greeley, Colorado. Preliminary project costs are in the range of $35 to 50M.

The Cache la Poudre study reach is located in and around Greeley on the high plains of northeastern Colorado as noted in Figure 1. The Cache la Poudre River is a left bank tributary to the South Platte River and rises in the Front Range of the Rocky Mountains before exiting onto the plains at Ft. Collins, upstream of Greeley. While the main stem of the Cache la Poudre is considered a wild and scenic river in the Rocky Mountains, irrigation and gravel mining have impacted the river between Ft. Collins and its confluence with the South Platte near Greeley. Flooding has been a major problem in Greeley, with the most recent damaging flood occurring in 1999. An even more damaging flood occurred in 1983.

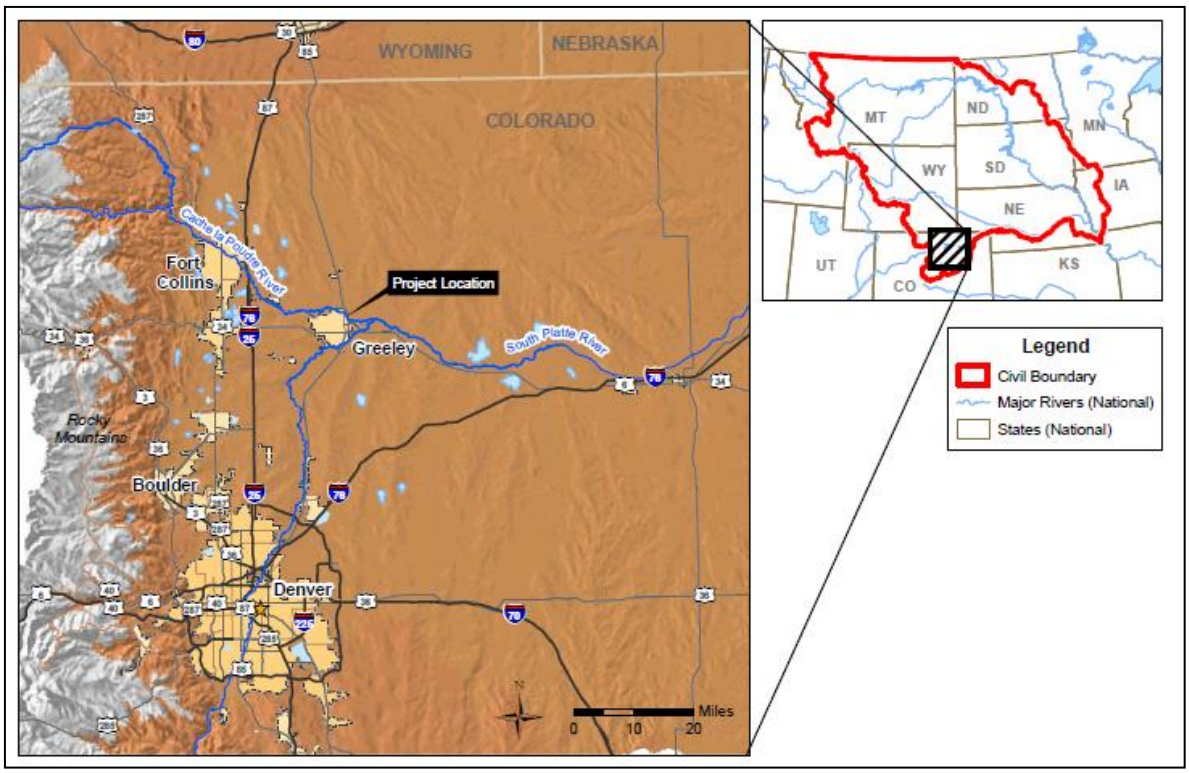


Figure 1. Location of the project in the U.S. and northeastern Colorado

The City of Greeley is the local sponsor, and they have received funding from the State of Colorado, via the Colorado Water Conservation Board, to pursue solutions to the flood damage problem and improvements to the degraded riverine ecosystem. The feasibility study has focused on defining FRM solutions in a three-mile reach of the Cache la Poudre River and includes both structural and nonstructural measures. ER efforts include riparian restoration along the channel and related ecosystem improvements in the flood plain. A goal was to provide habitat to native and migratory species in a region where habitat of this type is increasingly scarce. ER methods were formulated during this initial phase

and an interim report was written that incorporated potential methods to improve the riparian habitat. The value of the riparian corridor in the semi-arid high plains to indigenous and migratory species was also evaluated.

The ability to leverage combined FRM/ER solutions is limited somewhat by the lack of flood risk benefits that can be derived by widening the channel of the Cache la Poudre River. The reason for this is that transportation corridors that cut laterally across the floodway create a series of stair step pools during major floods, with road embankments acting as low head dams, the bridge openings as “principal spillways,” and the weir flow across the embankments acting as ”emergency spillways.” Thus a widened channel largely produces only deeper ponding areas behind roadways, rather than improving flood conveyance and dropping water surface elevations significantly, as the stage is mostly controlled by the weir flow over the roadways at the 100-year event. The bridges are relatively new, and would be costly to replace in pursuit of more “principal spillway” capacity.

The reduction of the flood threat is directed toward reducing the risk of flood damages to property, which are relatively frequent. Historically, floods from the Cache la Poudre at Greeley have been characterized by long warning times and relatively shallow flood depths. Major floods are caused by a combination of snow melt and thunderstorm runoff over a relatively large watershed, so that overbank flows are not “flashy” in occurrence. As noted in Figure 1, Greeley is well east of the Rocky Mountains and the Cache la Poudre flowing through the high plains has a modest, rather than a steep channel gradient, resulting in moderate river flow velocities. In addition, while runoff from severe local storms can cause extensive property damage on tributary streams and via storm sewer backup, the storms do not produce sufficient volume to cause a damaging riverine flood.

Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of Cache la Poudre at Greeley, Colorado General Investigation Feasibility Study (hereinafter: Greeley IEPR) in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers (USACE), Engineer Circular (EC) *Civil Works Review* (EC 1165-2-214) (USACE, 2012) and the Office of Management and Budget (OMB) *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

This final report presents the Final Panel Comments of the IEPR Panel (the Panel) on the engineering, economic, environmental, and plan formulation analyses contained in the Greeley IEPR documents (Section 4). Appendix A describes in detail how the IEPR was planned and conducted. Appendix B provides biographical information on the IEPR panel members and describes the method Battelle followed to select them. Appendix C presents the final charge to the IEPR panel members for their use during the review; the final charge was submitted to USACE on March 12, 2014.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (2012).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the engineering, economic, environmental, and plan formulation analyses of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

In this case, the IEPR of the Greeley study was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC 1165-2-214). Battelle, a 501(c)(3) organization under the U.S. Internal Revenue Code, has experience conducting IEPRs for USACE.

3. METHODS FOR CONDUCTING THE IEPR

The methods used to conduct the IEPR are briefly described in this section; a detailed description can be found in Appendix A. Table 1 presents the major milestones and deliverables of the Greeley IEPR. Due dates for milestones and deliverables are based on the award/effective date of February 11, 2014. Note that the work items listed under Task 6 occur after the submission of this report. Battelle anticipates submitting the pdf printout of the USACE's Design Review and Checking System (DrChecks) project file (the final deliverable) on July 15, 2014. The actual date for contract end will depend on the date that all activities for this IEPR, including Civil Works Review Board (CWRB) preparation and participation, are conducted.

Table 1. Major Milestones and Deliverables of the Greeley IEPR

Task	Action	Due Date
1	Award/Effective Date	2/11/2014
	Review documents available	4/15/2014
2	Battelle submits list of selected panel members	3/6/2014
	USACE confirms the panel members have no COI	3/10/2014
3	Battelle convenes kick-off meeting with USACE	3/3/2014
	Battelle convenes kick-off meeting with USACE and panel members	4/10/2014
4	Panel members complete their individual reviews	5/7/2014
	Panel members provide draft Final Panel Comments to Battelle	5/19/2014

Table 2. Major Milestones and Deliverables of the Greeley IEPR (continued)

Task	Action	Due Date
5	Battelle submits Final IEPR Report to USACE	6/6/2014
6[a]	Battelle convenes Comment-Response Teleconference with panel members and USACE	7/2/2014
	Battelle submits pdf printout of DrChecks project file to USACE	7/15/2014
	CWRB Meeting (Estimated Date)[b]	9/4/2014
	Contract End/Delivery Date	2/28/2015

[a] *Task 6 occurs after the submission of this report.*

[b.] *The CWRB meeting was listed in the Performance Work Statement under Task 3 but was relocated in this schedule to reflect the chronological order of activities.*

Battelle identified, screened, and selected four panel members to participate in the IEPR based on their expertise in the following disciplines: planning and economics; environmental sciences; structural, geotechnical, and civil engineering; hydrologic and hydraulic (H&H) engineering. The Panel reviewed the Greeley document and produced 14 Final Panel Comments in response to 47 charge questions provided by USACE for the review. The charge included two questions added by Battelle that seek summary information from the IEPR Panel. Battelle instructed the Panel to develop the Final Panel Comments using a standardized four-part structure:

1. Comment Statement (succinct summary statement of concern)
2. Basis for Comment (details regarding the concern)
3. Significance (high, medium/high, medium, medium/low, or low; in accordance with specific criteria for determining level of significance)
4. Recommendation(s) for Resolution (at least one implementable action that could be taken to address the Final Panel Comment).

Battelle reviewed all Final Panel Comments for accuracy, adherence to USACE guidance (EC 1165-2-214, Appendix D), and completeness prior to determining that they were final and suitable for inclusion in the Final IEPR Report. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Panel's findings are summarized in Section 4.1; the Final Panel Comments are presented in full in Section 4.2.

4. RESULTS OF THE IEPR

This section presents the results of the IEPR. A summary of the Panel's findings and the full text of the Final Panel Comments are provided.

4.1 Summary of Final Panel Comments

The panel members agreed on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2012; p. D-4) in the Greeley review documents.

Based on the Panel's review, the report is well-written, organized, and easy to understand; however, the Panel identified project elements that required revision or additional evaluation as well as documentation that should be clarified. The following summarizes the Panel's findings.

Planning/Economics: The FRM optimization to select the most economically efficient level of protection (i.e., 2%, 1%, and 0.2%) and the individual structures that were economically beneficial to provide the level of protection was a rigorous and fine scale analysis. Use of Census Tract data for the project area also represented a fine level of spatial resolution; however, Environmental Justice issues are not analyzed in sufficient detail. In particular, a rationale needs to be provided for not incorporating structural and non-structural measures into the recommended plan that limit the risks of flood damage to minority and low-income residences in the project area. It should be determined whether structural or non-structural measures for the FRM are reasonable under Environmental Justice concerns. The Panel believes this issue could be addressed by investigating whether additional pre-flood preparedness and evacuation preparation programs targeted at mobile home park residents are warranted as a mitigating measure. The Panel also noted the assumption of no increase in future development in the FRM area appears at odds with other statements about the future development made in the DFR/EA, and results in an underestimation of future benefits from project alternatives. This assumption should be re-evaluated by using trends in development in the project area and, based on the results of the re-evaluation, future national economic development (NED) benefits of structural measures should be recalculated, as needed.

Environmental: The environmental models, assumptions, and analyses used for this study are consistent with generally accepted methods. The identified problems, opportunities, objectives, and constraints appear to reflect a systems, watershed, and/or ecosystem approach, addressing a geographic area large enough to ensure that plans address cause-and-effect relationships among affected resources and activities pertinent to achieving the study objectives. However, the Panel noted that as-built soil profiles, critical to documenting baseline conditions and determining the long-term success of constructed wetlands, are not mentioned in monitoring plans. Documenting baseline soil conditions is a minimal cost investment that greatly benefits understanding the progress and ultimate success of the project's wetland or construction efforts. The Panel also noted the potential for the invasion or re-invasion of undesirable cattail and reed canary grass in the restored emergent wetlands, but the methods for controlling these species are not discussed. The extent and composition of these undesirable plant species should be determined, and the potential need for herbicide applications and precautions if herbicides are applied should be included. In addition, infestation by the emerald ash borer could alter the habitat structure and eliminate one of the tree species considered important to the planned restoration. A description of the potential impact of the emerald ash borer on green ash should be provided along with a contingency plan in the event an infestation occurs.

H&H Engineering: The H&H sections are well-written, the evaluation procedures are well-defined, and the model development and potential shortcomings are adequately described. The structural flood mitigation alternatives are comprehensive and evaluated in a consistent and thorough manner, but the evaluation of damages, alternatives, and the effectiveness of nonstructural measures is incomplete if potential future encroachment in the flood fringe is not accounted for. This potential flood fringe encroachment should be discussed in appropriate sections of the report and hydraulic information, such as floodway surcharge, should be provided. The Panel found the hydrologic assumptions used for the project to be appropriate for FRM, but may not be appropriate for ER and may be insufficient to ensure

project success during periods of drought. The Panel recommends the ER analyses and design be reviewed to accommodate possible drought and low water conditions.

Finally, the Panel found that additional detail on interior drainage systems and the benefits of levees would help clarify whether the costs and benefits of these systems were adequately evaluated. Without a discussion of concurrent flooding and possible interior drainage systems such as ponding areas and pumps in addition to the “minimum facilities” concept, it is difficult for the Panel to determine whether the costs and benefit of the levees and interior drainage systems were addressed adequately. The with-project interior flood levels or the with-project interior floodplain relative to without-project conditions that were used to assess the benefits of the levee alternatives should also be provided.

Structural/Geotechnical/Civil Engineering: The assumptions underlying the civil, structural, and geotechnical aspects of the structural and nonstructural alternatives appear to be complete and sound. Risk and uncertainty have been satisfactorily addressed with respect to the structural and nonstructural alternatives. Any uncertainty in geotechnical (spoil banks, levees, or foundations) or structural (flood proofing) aspects is not expected to affect the alternatives analyses and outcomes. The geotechnical effort is very thorough and complete relative to the feasibility study phase (more so than other feasibility studies). The Panel noted the Ecosystem Restoration Monitoring and Adaptive Management Plan (MAMP) and Operation and Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) plans have not been developed with clear, consistent goals, objectives, and defined actions and responsibilities to guide USACE and the local sponsor during the 5-year monitoring period and beyond. The plans should be clear about who is responsible for monitoring, what corrective actions may be taken, who is responsible for taking those actions, and who will pay for them.

4.2 Final Panel Comments

This section presents the full text of the Final Panel Comments prepared by the IEPR panel members.

Final Panel Comment 1

The Environmental Justice concerns do not fully consider structural and nonstructural measures for flood risk management.

Basis for Comment

According to the Draft Feasibility Report and Environmental Assessment (DFR/EA) (p. 24) and Economic Appendix (p. 10), 67% of the population in the Flood Risk Management (FRM) action area, especially Census Tract #6, is Hispanic. The DFR/EA (p. 24) reports that the median household income in the FRM area, especially Census Tract #6, is about half the state average, and the poverty rate is three times that of the State of Colorado (35% of households). For purposes of Environmental Justice analysis, the populations in the FRM area are considered minority and low income. Despite the above average percentage of Hispanic residents and below average income in the FRM area, no structural or non-structural measures are proposed to protect these minority and low income populations from flood damage.

In addition, no data are provided on the percentage of Hispanic residents or the household income of the residents in the mobile home park located on 11th Avenue adjacent to the Poudre River. If the residents are predominately Hispanic, the Panel questions why the mobile home park was screened out of consideration for nonstructural measures (flood proofing of structures or buyout) and receives no flood risk reduction despite being located along the Poudre River (DFR/EA, p. 70). Also, no flood risk reduction measures specific to the mobile home park (e.g., aggressive pre-flood preparedness or evacuation preparation) are discussed in the DFR/EA.

Significance – Medium

A rationale needs to be provided for not incorporating structural and nonstructural measures into the recommended plan that limit the risks of flood damage to minority and low income residences in the project area.

Recommendations for Resolution

1. Determine whether structural or nonstructural measures for the FRM action area (especially the mobile home park) are justified under Environmental Justice concerns.
2. If nonstructural measures are not applicable, investigate whether additional pre-flood preparedness and evacuation preparation programs targeted at mobile home park residents are warranted as a mitigating measure.

Final Panel Comment 2

The potential for increases in future flood stages as a result of encroachment in the flood fringe has not been addressed.

Basis for Comment

Plate 16 of Appendix B (Hydraulics) illustrates that a Federal Emergency Management Agency (FEMA) defined floodway has been established by the community's Flood Insurance Study (FIS). A relatively wide flood fringe (floodplain area outside of floodway) is also shown in the high damage reach.

National Flood Insurance Program (NFIP) regulations allow encroachment and filling of the flood fringe. Local zoning ordinances also typically allow such encroachment and the floodway can be defined to allow this encroachment with a surcharge of up to 1 foot (unless state standards are more restrictive).

Section 6.3 of the DFR/EA mentions that future encroachments on the channel from bank spoil levees and channel stabilizations could result in higher future flood stages. However, this section does not mention encroachment in the flood fringe as having the potential to increase future flood stages.

Section 2.2 of Appendix B states that hydraulic modeling of future conditions considered future channel deposition trends and expected future flood discharges. This section also does not mention flood fringe encroachment or use of a "with floodway" model to consider future flood fringe encroachment.

Although the DFR/EA states that no floodplain re-development was assumed (Section 6.15.2), it is possible that development or re-development of the flood fringe could result in fill being placed in the fringe, which would increase the flood profile for upstream areas. This type of re-development may occur as part of a private effort to remove properties from the floodplain by elevating the ground surface. This fill placement would increase the flood profile and result in higher damage estimates than stated in the DFR/EA.

The FRM includes nonstructural measures to elevate or protect structures. These measures are based on flood levels that do not account for potential flood fringe encroachment and therefore the structures within the floodplain will have less protection than stated in the DFR/EA.

Significance – Medium

The evaluation of damages, alternatives, and the effectiveness of nonstructural measures is incomplete if potential future encroachment in the flood fringe is not accounted for.

Recommendations for Resolution

1. Discuss potential encroachment of the flood fringe in appropriate sections of the report.
2. Provide hydraulic information, such as floodway surcharge, to demonstrate potential impacts of future flood fringe encroachment.
3. Consider using the "with floodway" hydraulic model to determine the level of protection for structural and nonstructural alternatives or encourage measures that will prevent encroachment such as local floodplain zoning restrictions or buyouts.

Final Panel Comment 3

The assumption that future without-project conditions will be equivalent to current conditions does not appear to account for future increases in development, therefore underestimating future damages avoided.

Basis for Comment

The assumption in the DFR/EA (p. 24) and Economic Appendix (p.13) that the existing conditions are equal to the future without-project conditions for the next 25 years is unsupported by data and statements in the DFR/EA and Economic Appendix.

The DFR/EA has several references to future conditions along the Poudre River, Greeley and Weld County, that indicate the risk of flooding will increase in the future:

- "[F]looding is expected to increase in both frequency and severity in the future." (DFR/EA, p. 5)
- "The area has been urbanizing rapidly and is projected to continue developing which will increase the frequency of flooding from rainfall events." (DFR/EA, p. 26)
- "Also, future urbanization in the county could increase risk of flash flooding along the river." (DFR/EA, p. 70)

Data supporting these statements about future growth come, in part, from the data showing that population growth in Weld County is increasing at about 20% per decade (Economic Appendix, p. 8).

Furthermore, project alternatives have a 50-year economic life. However, the City of Greeley 2020 Comprehensive Plan, signed in 2000, only covers the period 2000 to 2025, and does not provide guidance for the other 25 years.

Significance – Medium

The assumption of no increase in future development in the FRM area results in an underestimation of future benefits from project alternatives.

Recommendations for Resolution

1. Re-evaluate the assumption that future without-project conditions equal current conditions by using trends in development in the project area (e.g., prior decade's growth in infill development, potential infill development land, and land use intensification).
2. Recalculate future NED benefits of structural measures based on the results of the re-evaluation stated above.
3. Document all assumptions regarding the future without-project condition that are likely in the second 25 years of the project time period.

Final Panel Comment 4

Post-construction soil profiles, which provide baseline conditions for measuring long-term success of constructed wetlands, are not discussed.

Basis for Comment

The monitoring plans in the DFR/EA do not require the collection of as-built soil profiles. The Panel's opinion is that collecting as-built but pre-operation (i.e., before water is put on the site) soil profile samples creates a baseline point of comparison so that long-term success in the development of hydric soil conditions can be determined for constructed wetlands. These soil profiles should be the first step in the monitoring process shortly after earthwork is completed, but before water is allowed onto the newly constructed locations. With this baseline documentation, it now becomes possible to determine whether the presence, type, size, abundance, and location of redoximorphic features observed in monitored soils of constructed wetlands are new features, indicating that the planned hydrology is successful and that the soils are functioning in a natural manner, or whether the observed features pre-existed the constructed hydrologic regime. Documenting post-construction baseline soil conditions is a minimal cost investment that greatly benefits understanding the progress and ultimate success of the project's wetland or construction efforts.

Significance – Medium

The establishment of baseline soil conditions by collecting post-construction as-built soil profiles is a critical tool for gauging the success of the constructed wetlands during subsequent monitoring.

Recommendations for Resolution

1. Require descriptions of soil profiles immediately after completion of earthwork to establish baselines for the as-built constructed wetlands prior to introducing water at these sites to facilitate project success during the monitoring period.

Final Panel Comment 5

The potential for the invasion or re-invasion of undesirable cattail and reed canary grass in the restored emergent wetlands and the methods for controlling these species are not discussed.

Basis for Comment

An invasion by undesirable species can displace a planned plant community in constructed or restored wetlands. Two invasive (i.e., undesirable) species, Reed canary grass (*Phalaris arundinacea*) and cattails (*Typha* spp.), dominate wetland locations in the study area. Both species are aggressive invaders that tend to dominate sites once introduced (Waggy, 2010; SEWISC, 2014). They have proven to be tenacious and very difficult to eliminate. If the plants are removed, there is a high potential for re-invasion if a source of propagules (live roots or seeds) exists upstream in the main channel or in tributaries. Both reed canary grass and cattails propagate easily when mineral soils are disturbed and propagules are released; upstream, upslope, or upwind presence of a seed source sets up a constant threat for re-invasion.

Eradication of reed canary grass and cattails is difficult. Most management methods, even vigorously applied (e.g., mowing and manually pulling the plants), fall short of controlling these species unless managers resort to herbicide application (SEWISC, 2014; Gucker, 2008; MDNR, 2014; WSDE, 2014). The DFR/EA (p. 46 and Table 14) and Appendix E-1 do not provide enough detail on threats posed by these species or on the management needed to remove and prevent the return of these species. There is no mention of the potential or probable need for chemical control and for precautions necessary if chemicals are required in a flowing stream system (e.g., type of herbicide; methods of, timing for, and weather conditions for application; possible public perception challenges).

Significance – Medium

The control of undesirable species is critical to the project's success and the methods for controlling these species should be described.

Recommendations for Resolution

1. Determine the extent of established undesirable plant species currently growing in the study area and if they provide a potential propagule source for re-invasion of constructed wetlands.
2. Discuss the potential need for herbicide applications and precautions that will be taken if herbicides are applied.
3. Provide detail on the methods that will be applied over the long term to prevent re-invasion by undesirable aggressive plant species.

Literature Cited:

Waggy, Melissa, A. (2010). Phalaris arundinacea. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
http://www.fs.fed.us/database/feis/plants/graminoid/phaaru/all.html

SEWISC (2014). Narrow-leaved Cattail. Southeastern Wisconsin Invasive Species Consortium, Inc. [Online].
http://sewisc.org/invasives/invasive-plants/82-narrow-leaved-cattail

Gucker, Corey L. (2008). Typha latifolia. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
http://www.fs.fed.us/database/feis/plants/graminoid/typlat/all.html

MDNR (2014). Reed canary grass (*Phalaris arundinacea*). Minnesota Department of Natural Resources [Online].
http://www.dnr.state.mn.us/invasives/terrestrialplants/grasses/reedcanarygrass.html

WSDE (2014). Non-native Invasive Freshwater Plants: Reed Canarygrass (*Phalaris arundinacea*). Washington State Department of Ecology [Online].
http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua011.html

Final Panel Comment 6

A description of the potential impact of the emerald ash borer on green ash *(Fraxinus pennsylvanica)* plantings is not provided, and the disruption to planned riparian habitat restoration from a potential infestation is not considered.

Basis for Comment

Infestations of the emerald ash borer *(Agrilus planipennis)*, an Asian beetle, were first found in North America in ash trees (genus *Fraxinus*) near Detroit, Michigan in 2002 and has since spread throughout the Northeast United States. By 2013, infestation by the borer was confirmed in Colorado (EAB website).

A substantial component (20 percent) of the riparian forest tree plantings is appropriately devoted to the native green ash *(Fraxinus pennsylvanica)*, as shown in Appendix E-1. An infestation by the emerald ash borer could potentially kill or severely damage the planned ash tree plantings, yet there does not appear to be a contingency plan to deal with this possibility. Review of nearby reference areas may suggest an additional native tree species that inhabits the Colorado plains riparian habitat that could supplement the percentage of planting devoted to green ash in the event the ash does not survive. If a yet unlisted, suitable native species is not found, the percentage of one or more of the native species already listed would have to substitute, if needed.

Significance – Medium

Infestation by the emerald ash borer could alter the habitat structure and eliminate one of the tree species considered important to the planned restoration.

Recommendations for Resolution

1. Assess the incidence of emerald ash borer in the project area and its potential for negatively impacting the project.
2. Include a contingency plan in the event infestation occurs.

Literature Cited:

EAB website. Emerald Ash Borer [Online].
http://emeraldashborer.info/index.cfm#sthash.NSfwkCcW.dpbs

Final Panel Comment 7

The Ecosystem Restoration MAMP and OMRR&R plans have not been developed with clear, consistent goals, objectives, and defined actions and responsibilities to guide USACE and the local sponsor during the 5-year monitoring period and beyond.

Basis for Comment

The goals, objectives, actions, and responsibilities of the Monitoring and Adaptive Management Plan (MAMP) (DFR/EA, Section 12.5.1) and the Operation and Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) Plan (DFR/EA, Sections 11.6 and 12.7) have not been developed to guide USACE and the local sponsor. As described, the plans overlap and lack clear direction in the following areas:

- Potential events during the 5-year monitoring period that may trigger adaptive management activities or, alternatively, require OMRR&R activities. For instance, unanticipated events like flash floods may alter channel course and deposit significant sediment or debris. This will alter hydraulics and damage vegetation, and require MAMP activities, such as replanting and excavation and modification of hydraulic structures, or OMRR&R activities, such as excavation and cleanout of sediment and debris removal. These events could adversely affect the project as planned.
- Supplemental guidance for routine operations and maintenance activities beyond the 5-year monitoring period. For instance, to maximize opportunities for increased benefits, a design basis, guidebook, or roadmap is useful for facilitating future environmental restoration and recreation improvements on project or adjacent lands undertaken by the local sponsor and other public or private entities (e.g., U.S. Fish and Wildlife Service, Colorado Parks and Wildlife, Colorado Water Conservation Board, The Nature Conservancy, Ducks Unlimited).

Significance – Medium

Development and implementation of clear and consistent MAMP and OMRR&R plans is necessary to ensure both the short- and long-term success of the project.

Recommendations for Resolution

1. Develop the MAMP and OMRR&R plans in concert with the local sponsor to include clear, consistent goals and objectives as a basis for monitoring and response during the 5-year monitoring period, and provide guidance for long-term activities to maximize future benefits. The plans should be clear about who is responsible for monitoring, what corrective actions may be taken, who is responsible for taking those actions, and who will pay for them.

Final Panel Comment 8

Hydrologic risks have been identified and assumptions have been made that are appropriate for flood risk management, but inappropriate for ecosystem restoration, and may be insufficient to ensure project success during periods of drought.

Basis for Comment

The hydrologic assumptions used, which are based on trending analyses and forecasts of above average rainfall and runoff over the last 30 years, are appropriate for FRM, but may be inappropriate for ER. Engineering and design for flood risk management and flow maintenance (e.g., flood water height, channel and culvert sizing) are based on high water events (i.e., FEMA base flood – 1% or 100-year flood). In contrast, design for ecosystem restoration and wetlands should account for low water conditions, ensuring there will be enough water during drought conditions to enable survival of the wetland.

Data plots in the DFR/EA (Appendix B) show the last 30 years was a period of above average rainfall and runoff, which recovered a significant deficit in rainfall and runoff that occurred during a period of below average rainfall and runoff between 30 and 100 years ago. The cumulative plots indicate a possible 100-plus-year cycle of below normal rainfall and runoff. ER project design based on above average rainfall and runoff is inappropriate and leads to an optimistic prediction for ecosystem restoration and wetland success. ER projects require design that will also accommodate low water conditions (i.e., ensures there will be enough water to meet a minimum hydrologic standard).

Revisions in the trending analyses and forecasts to account for periods of below average rainfall and runoff may not affect the project alternatives or outcomes. However, additional consideration should be given to the drought conditions and the low water effects on the ecosystem restoration and constructed wetlands (USACE, 2010).

Significance – Medium

Hydrological risk associated with low water and drought conditions has not been fully considered in ER project design.

Recommendations for Resolution

1. Review the ER analyses and design to accommodate possible drought and low water conditions.

Literature Cited:

USACE (2010). Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0). ERDC/EL TR-10-01. Wetlands Regulatory Assistance Program, U.S. Army Corps of Engineers, U.S. Army Engineer Research and Development Center, Vicksburg, MS. March.
http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/gp_supp.pdf

Final Panel Comment 9

The evaluation of levee alternatives does not consider an interior drainage system in addition to the "minimum facilities" concept or explain how concurrent river and flooding events are accounted for.

Basis for Comment

Plate 1 of DFR/EA Appendix A shows levee alternatives that seek to protect structures from flooding in the high damage reach.

DFR/EA Appendix A (p. a-23) indicates that the levees were designed per USACE "minimum facilities" concept. DFR/EA Section 8.4.4 states that the "…drainage structures were sized to not significantly increase expected annual damages from interior flooding compared to without project conditions." As expected, the flood risk management system does not increase damages; however, there is no mention of whether the system, including the interior drainage system (pumps, ponding area, drainage structures), seeks to decrease damages. If the objective of the system is to "not increase damages," it would not necessarily provide a measurable benefit over without-project conditions.

DFR/EA Appendix A describes that a ponding area or pump may be used for the interior drainage system. It is unclear to what extent a ponding or pump system might help reduce damages and what level of interior flooding was assumed to calculate the with-project damages.

If the interior drainage system is not properly assessed, the benefits of the levee system could be underestimated. It would be helpful to understand the potential benefits of these levee systems if an interior drainage system were to eliminate all interior flooding rather than just consider the "minimal facilities" concept. In addition, there is no discussion of what hydrologic conditions or concurrent flooding was, or should be, considered in evaluating the interior drainage systems.

The DFR/EA (p. 33) further states: "Subsequent findings regarding interior drainage requirements indicate that those initial costs would need to be adjusted upward substantially, and levees would be even less feasible than originally estimated." It is unclear from this sentence which costs were not considered.

Significance – Medium

Additional detail on interior drainage systems and the benefits of levees would help clarify whether the costs and benefits of these systems were adequately evaluated.

Recommendations for Resolution

1. Provide with-project interior flood levels or the with-project interior floodplain relative to without-project conditions that were used to assess the benefits of the levee alternatives.
2. Provide maps or a tabulation of the potential benefits of levee systems if the interior drainage systems eliminated all interior flooding.
3. Provide more information on what concurrent flooding conditions were considered in this evaluation or how that might affect the results.
4. Explain what subsequent findings related to interior drainage costs were not considered or provide these costs in the appropriate report sections.

Final Panel Comment 10

Public safety and loss of life due to flash flooding are not addressed in the future without-project condition or project alternatives.

Basis for Comment

The DFR/EA (p. 26) states that more than 1,000 residents and 250 homes are located in the 1 percent annual chance of exceedance (ACE) floodplain, and that flash flooding from rainfall events will "...increase the potential for flash flooding particularly along the tributaries."

Inundation of roads can significantly limit or prevent access to residents by emergency vehicles, and can make evacuation by personal vehicles hazardous. According to the FIS map (Appendix B, Plate 16), the roadways across the Cache la Poudre River are inundated during a 100-year (1 percent ACE) flood event. This presents a life safety issue, particularly if all crossings over the river are inundated. According to Figure 20 (Appendix A), the 100-year flood hydrograph could have a flow near the peak discharge for several days. While the road closures are briefly mentioned in the DFR/EA (p. 26), their impacts on public safety have not been considered in the evaluation of structural alternatives.

Significance – Medium

The evaluation of alternatives with regard to public safety and loss of life is incomplete given the increasing risk of flash flooding in the future and the potential for all roadways to be affected by 100-year floods for an extended period of time.

Recommendations for Resolution

1. Calculate the number of people that would be at risk from flooding in the future without-project condition and for each structural alternative.
2. Include the results of these calculations in the DFR/EA (calculations could be done by Census Tract for the future without-project and for each project structural alternative).

Final Panel Comment 11

Natural reference areas and their use in the design and monitoring phases of the project are not discussed.

Basis for Comment

Ecologically based wetland construction or restoration projects depend on the documentation derived from the study of reference areas (USDA NRCS, 2008; EPA, 2000). Reference areas are locations of similar habitat (usually natural rather than man-made) that provide a design template for the wetland construction or restoration project and for its subsequent monitoring. By studying several reference areas of the same habitat type, a range of natural variability is established by which the project proponents can design and build a site that will have the correct (i.e., within the range of natural variability) hydrograph, elevations and planting zones, and species composition. The use of reference areas is necessary to characterize natural habitats and to identify specific, realistic restoration targets needed to simulate the natural habitats and to monitor success in reaching those targets.

The lack of reference areas can undermine a project by creating:

- a hydrograph that does not compare with those of the target (or any natural) habitat
- a plant community adapted to the resulting hydrograph but not necessarily a natural one
- an undesirable plant community
- an inability to convincingly demonstrate that the constructed habitat is functioning within the range of variability of targeted natural communities.

The DFR/EA lacks a discussion of reference areas or their use, as well as documentation on how design standards for the targeted habitat types were chosen. The document also does not explain whether the targeted performance standards fall within the range of natural variation for the habitat types selected.

Significance – Medium/Low

It is important to document the reference areas used as the template for the designs to set realistic restoration goals.

Recommendations for Resolution

1. Provide locations of the natural reference sites used to plan habitats for the ecological restoration component of the project.
2. Explain how data from the natural reference sites were used in the design process.
3. Explain how data from the natural reference sites were used to design the monitoring plan.

Literature Cited:

USDA NRCS (2008). Part 650. Engineering Field Handbook. Chapter 13—Wetland Restoration, Enhancement, or Creation. U.S. Department of Agriculture, National Resources Conservation Services. April. pp. 13-21.
http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17765.wba

EPA (2000). Guidance Principles for Constructed Treatment Wetlands: Providing for Water Quality and Wildlife Habitat. EPA-843-B-00-003. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. Washington, D.C. October.
p. 14.
http://water.epa.gov/type/wetlands/constructed/upload/guiding-principles.pdf

Final Panel Comment 12

Irrigation requirements do not appear to have been considered in the establishment of newly planted trees and shrubs.

Basis for Comment

Tree and shrub plantings are significant factors in habitat restoration plans (DFR/EA, pp. 16-18; Appendix E-1). All but one of the 16 tree and shrub species selected are native and appropriate for the riparian restoration habitats. Though listed, *Salix reticulate* is not native to Colorado; *Cornus* (*stolonifera*) *alba* is a native that could likely serve as a successful substitute. However, these plantings must survive in order for the planned restoration to succeed.

Greeley, Colorado is in an area of low average annual precipitation (11-12 inches per year). In areas of low annual precipitation, it may be necessary to provide irrigation for the first several years to enable the newly planted trees and shrubs to develop root systems deep enough to reach a dependable, natural water source (e.g., a persistent water table). If the newly establishing roots dry out, the saplings die.

The DFR/EA does not address several key issues:

- the need to irrigate the newly planted trees and shrubs
- how to irrigate them (e.g., drip irrigation) until they become established and self-sustaining, which often takes 3 to 5 years
- management of any needed irrigation systems until the trees and shrubs are successfully established
- removal of the irrigation equipment once the trees and shrubs are successfully established.

Significance – Medium/Low

If irrigation is needed and not established, restoration of significant portions of the desired plant communities will not succeed.

Recommendations for Resolution

1. Determine if irrigation is required for the establishment of planned tree and shrub plantings.
2. Describe the plan for providing irrigation, if needed, including details for operating and maintaining the irrigation system, and for the removal of the irrigation equipment after the plantings are established.

Final Panel Comment 13

Various types of active management actions have not been included in the ecosystem restoration to mitigate unanticipated changes in environmental or hydrologic conditions.

Basis for Comment

Ecosystem restoration is passive; it is self-sustaining and does not require active management such as hydraulic controls or pumping (i.e., gate or weir adjustments). Ecosystem restoration, including habitat outcomes, depends on hydrology and climate (rainfall and temperature) occurring within predicted limits (i.e., forecasts based on rainfall and runoff records). Should hydrology and climate occur outside the predicted limits, active management actions will be required.

However, ecosystem restoration projects can experience unanticipated changes in environmental conditions that can threaten the success of a project. Examples include unpredicted changes in hydrology, river conditions, groundwater level, or shifts in plant species composition. Environmental changes of this magnitude require extensive active management (e.g., replanting, removal of invasive species, pumping or irrigating during prolonged dry periods). These types of active management actions are costly, sometimes exceeding anticipated budgets, and even when applied, may not be sufficient to ensure project success.

Significance – Medium/Low

Successful ecosystem restoration depends upon timely implementation of possible active management actions, including any necessary responses to environmental and hydrologic changes that might be outside the assumed basis for design.

Recommendations for Resolution

1. As part of the ecosystem restoration, include potential active management actions (supplemental watering, replanting, hydraulics controls and structures) that may be necessary to ensure project success and maximize benefits.

Final Panel Comment 14

The NED benefits attributed to the structural measures may not fully account for potential emergency costs and infrastructure damages avoided.

Basis for Comment

The DFR/EA (p. 35) found that all the structural measures did not have NED benefits greater than costs (i.e., benefit-cost ratios were less than one). However, it is not clear to the Panel whether the NED benefit categories included in the NED analysis included emergency costs and infrastructure damages that would be avoided by the structural measures. Omission of emergency costs and infrastructure damages avoided underestimates the NED benefits of the structural measures, which may result in rejecting otherwise economically feasible structural measures prematurely.

The DFR/EA identifies structural measures that were considered for providing flood risk management benefits (Section 8.3, pp. 29-30 and Section 8.4, p. 30). The City of Greeley water pollution control facility is within the 1 percent ACE floodplain (Plate 16, Appendix B). If this facility is inundated, the damages and cost of service disruptions could be relatively large. Table 15 (Appendix F) lists without-project damages that could affect commercial/industrial facilities, emergency/disaster relief, highways/roads, mobile homes, public facilities, and residential structures. However, the table does not appear to reflect potential impacts on the water pollution control facility, so the benefit of structural measures may not be fully accounted for.

The DFR/EA also presents flood risk management measures that were considered for preliminary screening and more detailed assessment (Sections 8.2 and 8.3, pp. 28-30). It is not clear which NED benefits were considered in this screening. In particular, infrastructure protection is not mentioned for some alternatives such as bridge replacement, channel widening, or the upstream diversion. Thus it is not known whether these alternatives could provide a benefit for emergency/disaster relief, highways/roads, public facilities, or infrastructure. If they could provide such benefits, then exclusion from further screening may not have been warranted.

The DFR/EA indicates that individual structural flood protection measures were found to be ineffective and "were not carried forward" (Section 8.3, pp. 29-30). Combinations of structural measures might prove to be effective, but appear not to have been studied or considered in the NED analysis.

Significance – Medium/Low

Details on current costs related to emergency costs or infrastructure damages are required to determine if the benefits of structural measures were adequately considered.

Recommendations for Resolution

1. Discuss the flooding potential of the City of Greeley water pollution control facility and other critical infrastructure. Also discuss whether the structural alternatives have the potential to reduce the impacts of flooding on these features.
2. Provide more discussion on without-project damages to public facilities and infrastructure and discuss and tabulate what costs were considered.
3. Provide more discussion and a tabulation of the potential project benefits that were considered

during the screening and a more detailed assessment of structural alternatives.

4. Consider combinations of structural features in the NED analysis.

5. REFERENCES

EAB website. Emerald Ash Borer [Online].
http://emeraldashborer.info/index.cfm#sthash.NSfwkCcW.dpbs

EPA (2000). Guidance Principles for Constructed Treatment Wetlands: Providing for Water Quality and Wildlife Habitat. EPA-843-B-00-003. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, D.C. October.
p. 14.
http://water.epa.gov/type/wetlands/constructed/upload/guiding-principles.pdf

Gucker, Corey L. (2008). Typha latifolia. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
http://www.fs.fed.us/database/feis/plants/graminoid/typlat/all.html

MDNR (2014). Reed canary grass (*Phalaris arundinacea*). Minnesota Department of Natural Resources [Online].
http://www.dnr.state.mn.us/invasives/terrestrialplants/grasses/reedcanarygrass.html

OMB (2004). Final Information Quality Bulletin for Peer Review. Executive Office of the President, Office of Management and Budget, Washington, D.C. Memorandum M-05-03. December 16.

SEWISC (2014). Narrow-leaved Cattail. Southeastern Wisconsin Invasive Species Consortium, Inc. [Online].
http://sewisc.org/invasives/invasive-plants/82-narrow-leaved-cattail

The National Academies (2003). Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports. The National Academies (National Academy of Science, National Academy of Engineering, Institute of Medicine, National Research Council). May 12.

USACE (2010). Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0). ERDC/EL TR-10-01. Wetlands Regulatory Assistance Program, U.S. Army Corps of Engineers, U.S. Army Engineer Research and Development Center, Vicksburg, MS. March. http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/gp_supp.pdf

USACE (2012). Water Resources Policies and Authorities: Civil Works Review. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Circular (EC) 1165-2-214. December 15.

USDA NRCS (2008). Part 650. Engineering Field Handbook. Chapter 13—Wetland Restoration, Enhancement, or Creation. U.S. Department of Agriculture, National Resources Conservation Services. April. pp. 13-21.
http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17765.wba

Waggy, Melissa, A. (2010). Phalaris arundinacea. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
http://www.fs.fed.us/database/feis/plants/graminoid/phaaru/all.html

WSDE (2014). Non-native Invasive Freshwater Plants: Reed Canarygrass (*Phalaris arundinacea*). Washington State Department of Ecology [Online].
http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua011.html

APPENDIX A

IEPR Process for the Greeley Project

This page is intentionally left blank.

A.1 Planning and Conduct of the Independent External Peer Review (IEPR)

Table A-1 presents the schedule followed in executing the Cache la Poudre at Greeley, Colorado General Investigation Feasibility Study Independent External Peer Review (hereinafter: Greeley IEPR). Due dates for milestones and deliverables are based on the award/effective date of February 2, 2014. The review documents were provided by U.S. Army Corps of Engineers (USACE) on April 15, 2014. Note that the work items listed under Task 6 occur after the submission of this report. Battelle will enter the 14 Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle. Battelle will provide USACE and the Panel a pdf printout of all DrChecks entries, through comment closeout, as a final deliverable and record of the IEPR results.

Table A-1. Greeley Complete IEPR Schedule

Task	Action	Due Date
1	Award/Effective Date	2/11/2014
	Review documents available	4/15/2014
	Battelle submits draft Work Plan[a]	2/28/2014
	USACE provides comments on draft Work Plan	3/5/2014
	Battelle submits final Work Plan[a]	3/10/2014
	Battelle submits revised final Work Plan[a]	3/12/2014
2	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	2/27/2014
	USACE provides comments on COI questionnaire	3/3/2014
	Battelle submits list of selected panel members[a]	3/6/2014
	USACE confirms the panel members have no COI	3/10/2014
	Battelle completes subcontracts for panel members	3/24/2014
3	Battelle convenes kick-off meeting with USACE	3/3/2014
	Battelle sends review documents to panel members	4/17/2014
	Battelle convenes kick-off meeting with panel members	4/10/2014
	Battelle convenes kick-off meeting with USACE and panel members	4/10/2014
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE	4/25/2014
4	Panel members complete their individual reviews	5/7/2014
	Battelle provides panel members with talking points for Panel Review Teleconference	5/9/2014
	Battelle convenes Panel Review Teleconference	5/12/2014
	Battelle provides Final Panel Comment templates and instructions to panel members	5/13/2014

Table A-1. Greeley Complete IEPR Schedule (continued)

Task	Action	Due Date
4	Panel members provide draft Final Panel Comments to Battelle	5/19/2014
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	5/20-5/28/2014
	Panel finalizes Final Panel Comments	5/29/2014
5	Battelle provides Final IEPR Report to panel members for review	6/4/2014
	Panel members provide comments on Final IEPR Report	6/5/2014
	Battelle submits Final IEPR Report to USACE[a]	**6/6/2014**
6[b]	Battelle inputs Final Panel Comments to DrChecks and provides Final Panel Comment response template to USACE	6/10/2014
	Battelle convenes teleconference with USACE to review the Post-Final Panel Comment Response Process	6/10/2014
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process	6/10/2014
	USACE provides draft Project Delivery Team (PDT) Evaluator Responses to Battelle	6/20/2014
	Battelle provides the panel members the draft PDT Evaluator Responses	6/24/2014
	Panel members provide Battelle with draft BackCheck Responses	6/27/2014
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	6/30/2014
	Battelle convenes Comment-Response Teleconference with panel members and USACE	7/2/2014
	USACE inputs final PDT Evaluator Responses to DrChecks	7/9/2014
	Battelle provides final PDT Evaluator Responses to panel members	7/10/2014
	Panel members provide Battelle with final BackCheck Responses	7/14/2014
	Battelle inputs the Panel's final BackCheck Responses in DrChecks	7/15/2014
	Battelle submits pdf printout of DrChecks project file[a]	7/15/2014
	CWRB Meeting (Estimated Date)[c]	9/4/2014
	Contract End/Delivery Date	2/28/2015

a Deliverable.

b Task 6 occurs after the submission of this report

c The CWRB meeting was listed in the Performance Work Statement under Task 3 but was relocated in this schedule to reflect the chronological order of activities.

At the beginning of the Period of Performance for the Greeley IEPR, Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan. In addition, 47 charge questions were

provided by USACE and included in the draft and final Work Plans. Battelle added two questions that seek summary information from the IEPR Panel. The final charge also included general guidance for the Panel on the conduct of the peer review (provided in Appendix C of this final report).

Prior to beginning their review and within 13 days of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel. Battelle planned and facilitated a second kick-off meeting via teleconference during which USACE presented project details to the Panel. Before the meetings, the IEPR Panel received an electronic version of the final charge as well as the Greeley review documents and reference materials listed below. The documents and files in bold font were provided for review; the other documents were provided for reference or supplemental information only.

- **Cache La Poudre River at Greeley, Colorado Draft Feasibility Report and Environmental Assessment (109 pages)**
- **Cache La Poudre River Greeley, Colorado General Investigation Study Draft Feasibility Report Appendices (467 pages)**
- Greeley, CO General Investigation Study Feasibility Study Appendix B – Hydraulics (99 pages)
- Risk Register (6 pages)
- USACE guidance Civil Works Review, (EC 1165-2-214) dated 15 December 2012
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

About halfway through the review of the Greeley IEPR documents, a teleconference was held with USACE, the Panel, and Battelle so that USACE could answer any questions the Panel had concerning either the review documents or the project. Prior to this teleconference, Battelle submitted 13 panel member questions to USACE. USACE was able to provide responses to all the questions during the teleconference or within a week via email.

A.2 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a charge question response table provided by Battelle. At the end of the review period, the Panel produced individual comments in response to the charge questions/discussion points. Battelle reviewed the comments to identify overall recurring themes, areas of potential conflict, and other overall impressions. At the end of the review, Battelle summarized the individual comments in a preliminary list of 17 overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

A.3 IEPR Panel Teleconference

Battelle facilitated a 4-hour teleconference with the Panel so that the panel members could exchange technical information. The main goal of the teleconference was to identify which issues should be carried forward as Final Panel Comments in the Final IEPR Report and decide which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the Final IEPR Report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative

comments, added any missing issues of significant importance to the findings, and merged any related individual comments. At the conclusion of the teleconference, Battelle reviewed each Final Panel Comment with the Panel, including the associated level of significance, and confirmed the lead author for each comment.

At the end of these discussions, the Panel identified 15 comments and discussion points that should be brought forward as Final Panel Comments.

A.4 Preparation of Final Panel Comments

Following the teleconference, Battelle prepared a summary memorandum for the Panel documenting each Final Panel Comment (organized by level of significance). The memorandum provided the following detailed guidance on the approach and format to be used to develop the Final Panel Comments for the Greeley IEPR:

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.

- Directive to the Lead: Each lead was encouraged to communicate directly with the other panel member as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.

- Format for Final Panel Comments: Each Final Panel Comment was presented as part of a four-part structure:

    1. Comment Statement (succinct summary statement of concern)

    2. Basis for Comment (details regarding the concern)

    3. Significance (high, medium/high, medium, medium/low, and low; see description below)

    4. Recommendation(s) for Resolution (see description below).

- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
    1. **High:** Describes a fundamental issue with the project that affects the current recommendation or justification of the project, and which will affect its future success, if the project moves forward without the issue being addressed. Comments rated as high indicate that the Panel determined that the current methods, models, and/or analyses contain a “showstopper” issue.

    2. **Medium/High:** Describes a potential fundamental issue with the project, which has not been evaluated at a level appropriate to this stage in the Planning process. Comments rated as

medium/high indicate that the Panel analyzed or assessed the methods, models, and/or analyses available at this stage in the Planning process and has determined that if the issue is not addressed, it could lead to a "showstopper" issue.

3. **Medium:** Describes an issue with the project, which does not align with the currently assessed level of risk assigned at this stage in the Planning process. Comments rated as medium indicate that, based on the information provided, the Panel identified an issue that would raise the risk level if the issue is not appropriately addressed.

4. **Medium/Low:** Affects the completeness of the report at this time in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium/low indicate that the Panel does not currently have sufficient information to analyze or assess the methods, models, or analyses.

5. **Low:** Affects the understanding or accuracy of the project as described in the report, but will not affect the recommendation or justification of the project. Comments rated as low indicate that the Panel identified information that was mislabeled or incorrect or that certain data or report section(s) were not clearly described or presented.

- Guidelines for Developing Recommendations: The recommendation section was to include specific actions that USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. During the Final Panel Comment development process, the Panel determined that two of the Final Panel Comments could be merged into other Final Panel Comments; therefore, the total Final Panel Comment count was reduced to 14. At the end of this process, 14 Final Panel Comments were prepared and assembled. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in the main report.

This page is intentionally left blank.

APPENDIX B

Identification and Selection of IEPR Panel Members for the Greeley Project

This page is intentionally left blank.

B.1 Panel Identification

The candidates for the Cache la Poudre at Greeley, Colorado General Investigation Feasibility Study (hereinafter: Greeley IEPR) Panel were evaluated based on their technical expertise in the following key areas: planning and economics; environmental sciences; structural, geotechnical, and civil engineering; hydrologic and hydraulic engineering. These areas correspond to the technical content of the Greeley review documents and overall scope of the Greeley project.

To identify candidate panel members, Battelle reviewed the credentials of the experts in Battelle's Peer Reviewer Database, sought recommendations from colleagues, contacted former panel members, and conducted targeted Internet searches. Battelle evaluated these candidate panel members in terms of their technical expertise and potential conflicts of interest (COIs). Of these candidates, Battelle chose the most qualified individuals, confirmed their interest and availability, and ultimately selected four experts for the final Panel.

The four selected reviewers constituted the final Panel. The remaining candidates were not proposed for a variety of reasons, including lack of availability, disclosed COIs, or lack of the precise technical expertise required.

The candidates were screened for the following potential exclusion criteria or COIs.[1] These COI questions serve as a means of disclosure and to better characterize a candidate's employment history and background. Providing a positive response to a COI screening question did not automatically preclude a candidate from serving on the Panel. For example, participation in previous USACE technical peer review committees and other technical review panel experience was included as a COI screening question. A positive response to this question could be considered a benefit.

- Previous and/or current involvement by you or your firm[2] in the Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study.
- Previous and/or current involvement by you or your firm[2] in flood control, and ecosystem restoration in or around in the City of Greeley on the high plains of northeastern Colorado, or the Cache la Poudre River.
- Previous and/or current involvement by you or your firm[2] in the Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study related projects.

[1] Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See OMB (2004, p. 18), "….when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

[2] Includes any joint ventures in which a panel member's firm is involved and if the firm serves as a prime or as a subcontractor to a prime.

- Previous and/or current involvement by you or your firm[2] in the conceptual or actual design, construction, or operation and management of any projects in the Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study related projects.
- Current employment by the USACE.
- Previous and/or current involvement with paid or unpaid expert testimony related to Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study.
- Previous and/or current employment or affiliation with members of the cooperating agencies or local sponsors: City of Greeley, Colorado; Colorado Water Conservation Board (for pay or *pro bono*).
- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse or your children related to, or in and around the City of Greeley on the high plains of northeastern Colorado, or the Cache la Poudre River.
- Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Omaha District.
- Previous or current involvement with the development or testing of models that will be used for, or in support of, the Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study project.
- Current firm[2] involvement with other USACE projects, specifically those projects/contracts that are with the Omaha District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please also clearly delineate the percentage of work you personally are currently conducting for the Omaha District. Please explain.
- Any previous employment by USACE as a direct employee, notably if employment was with the Omaha District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Any previous employment by USACE as a contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the Omaha District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning ecosystem review, or flood management projects, and include the client/agency and duration of review (approximate dates).
- Pending, current, or future financial interests in Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study related contracts/awards from USACE.
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts.
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years from contracts with the non-Federal sponsor (City of Greeley, Colorado; Colorado Water Conservation Board).

- Any publicly documented statement (including, for example, advocating for or discouraging against) related to Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study
- Participation in relevant prior and/or current Federal studies relevant to this project and/or Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study
- Previous and/or current participation in prior non-Federal studies relevant to this project and/or Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study
- Is there any past, present, or future activity, relationship, or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project?

Other considerations:

- Participation in previous USACE technical review panels
- Other technical review panel experience.

B.2 Panel Selection

In selecting the final members of the Panel, Battelle chose experts who best fit the expertise areas and had no COIs. One of the four final reviewers is affiliated with a university; the other three reviewers are affiliated with consulting firms. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. USACE was given the list of candidate panel members, but Battelle selected the final Panel.

An overview of the credentials of the final four members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table B-1. More detailed biographical information regarding each panel member and his area of technical expertise is presented in Section B.3.

Table B-1. Greeley IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criterion	Loomis	Newling	McCaskie	Kalmes
Planning/Economics				
Minimum 15 years of experience in economics	X			
Minimum 15 years of experience in flood risk management analysis and benefits calculations	X			
Direct experience working for or with USACE	X			
Familiarity with USACE plan formulation process, procedures, and standards as they relate to flood risk management	X			
Minimum 5 years of experience directly dealing with the USACE six-step planning process, which is governed by ER 1105-2-100, Planning Guidance Notebook	X			
Familiarity with USACE flood risk management analysis and economic benefit calculations, including the use of standard USACE computer programs such as Hydrologic Engineering Center (HEC) - Flood Damage Reduction Analysis (FDA), and Institute for Water Resources (IWR) Planning suite.	X			
Experience evaluating socio-economic and environmental justice issues	X			
Active participation in related professional societies	X			
B.A. degree or higher in economics	X			
Environmental				
Minimum 15 years of experience directly related to assessing environmental impacts, ecosystem restoration studies and National Environmental Policy Act (NEPA) compliance		X		
Experience calculating ecosystem restoration benefits (average annual habitat units, AAHUs)		X		
Familiar with Habitat Suitability indices (HSI) and Habitat Evaluation Procedures (HEP) for riparian and wetland models		X		
Expertise in environmental laws		X		
Expertise in cultural resource compliance		X		
Expertise in National Ecosystem Restoration (NER) Plan identification		X		
Expertise in Fish and Wildlife Coordination Act (FWCA) requirements		X		
Familiarity with IWR planning suite		X		
Experience in the Colorado Front Range area		X		
Familiarity with USACE guidance documents associated with flood risk management		X		
M.S. degree in a related field		X		

Table B-1. Greeley IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criterion	Loomis	Newling	McCaskie	Kalmes
Structural/Geotechnical/Civil Engineering				
Registered professional engineer with a minimum 15 years of engineering experience whose mission includes nonstructural flood risk management (i.e., flood proofing)			X	
Experience in nonstructural flood proofing including elevating of buildings and dry and wet flood proofing of buildings			X	
Experience in structural flood risk management measures and levees			X	
Experience with closure structures			X	
Experience with interior drainage structures			X	
Experience with all phases of alternatives development and evaluation			X	
Experience in/ability to address USACE Safety Assurance Review (SAR) aspects of all projects			X	
Familiarity with USACE engineering and design criteria and guidance documents associated with flood risk management			X	
Active participation in related professional engineering and scientific societies			X	
M.S. degree or higher in civil engineering			X	
Hydrology and Hydraulic Engineering				
Registered professional engineer with a minimum 15 years of engineering experience in hydrologic and hydraulic engineering				X
Familiarity with interior drainage basin analysis				X
Familiarity with drainage structures/pumping plant sizing				X
Knowledgeable in flood proofing of residential and nonresidential buildings				X
Knowledgeable in structural and nonstructural flood risk reduction				X
Knowledgeable in ecosystem restoration measures				X
Proficient with HEC models in particular HEC-Hydrologic Modeling System (HMS) and HEC- River Analysis System (RAS)				X
Experience in/ability to address USACE SAR aspects of all projects				X
Familiarity with USACE engineering and design criteria and guidance documents associated with flood risk management				X
Active participation in related professional engineering and scientific societies				X
M.S. degree or higher in engineering				X

B.3 Panel Member Qualifications

John Loomis, Ph.D.

Role: Planner/Economics expertise.

Affiliation: Colorado State University

Dr. Loomis is a professor of economics in the Department of Agricultural and Resource Economics at Colorado State University (CSU), where he earned his Ph.D. in economics in 1983. He has taught courses in economics at the University of California-Davis and CSU for more than 20 years. For more than 30 years, Dr. Loomis has conducted economic water resource evaluations, and has 20 years of experience in flood risk management analysis and benefits calculation. He has taught graduate-level courses in water resource economics (including estimating the benefits of reducing flood risk and flood damages) and has evaluated several major USACE flood control projects for recent IEPRs. He also is co-author of a forthcoming book (to be published in 2014) titled, *Determining the Economic Value of Water*, one chapter of which is devoted to measuring the economic benefits of reducing flood risk.

Dr. Loomis has direct experience working with USACE and is familiar with USACE planning process, guidance, and economic evaluation techniques. From 1980 to 1985, he served as a lead economics trainer for the U.S. Fish and Wildlife Service (USFWS). During that time, he collaborated with USACE Waterways Experiment Station economists to teach a course on U.S. Water Resources Council (USWRC) *Principles and Guidelines* that focused on National Economic Development (NED) benefit-cost procedures. More recently, as a subcontracting economist to USACE's Walla Walla District on the Lower Snake River dam removal feasibility study and environmental impact statement (EIS) (1998-2001), he evaluated dam removal for salmon and contributed to the NED analysis. In addition, he has served on six USACE IEPRs since 2010, including the Chatfield Dam enlargement project in Denver, Colorado.

Dr. Loomis is familiar with USACE plan formulation processes, procedures, and standards as they relate to flood risk management. Specifically, his forthcoming book discusses how to calculate the benefits of reducing flood risk and provides an overview of USACE procedures for flood risk management. His recent experience on four IEPRs for USACE projects in the New Orleans area demonstrates his familiarity with USACE standards for formulating plans that employ both structural and nonstructural techniques. His familiarity includes Specific, Measurable, Attainable, Risk Informed, Timely (SMART) plan formulation involving screening of alternatives to arrive at the Tentatively Selected Plan.

Since 2008, Dr. Loomis has worked on IEPRs directly dealing with USACE's six-step planning process. Those planning steps must be consistent with the USWRC *Principles and Guidelines* planning process, which Dr. Loomis has taught in his water resource economics course since 1993. In addition, because the USACE six-step planning process is in some ways similar to the National Environmental Policy Act (NEPA) analysis process, his experience with EIS preparation (as a USFWS employee, as a consultant to USACE on the Lower Snake River feasibility report, and as a contributor for several other EISs with the Bureau of Land Management, Bureau of Reclamation, and USFWS) demonstrates his longstanding familiarity with planning principles that ultimately support USACE's six-step planning process.

Dr. Loomis has more than five years of experience using the Hydrologic Engineering Center-Flood Damage Reduction Analysis (HEC-FDA) model for several IEPRs dealing with flood risk reduction. With the HEC-FDA model, he reviewed details of depth-damage relationships, calculated resulting damages to structures, and developed contents-to-structure value ratios and depreciated replacement costs for structures, contents, and vehicles. He is familiar with the principles for incorporating uncertainty into this model by using standard deviations or distributions of damages, then applying Monte Carlo analysis. He is also familiar with the Institute for Water Resources (IWR) Planning suite that includes cost effectiveness/incremental cost analysis, which is particularly relevant for selecting "best buy" restoration plans under National Ecosystem Restoration planning principles. The chapter in the forthcoming book *Determining the Economic Value of Water* has a chapter that discusses how to calculate the economic benefits of flood damage reduction.

Dr. Loomis has 30 years of experience evaluating socioeconomic issues on numerous EISs for a variety of government agencies. In addition, he was the lead author for an article in *Ecological Economics* on the economic benefits of restoring a section of the South Platte River in northern Colorado, not far from its confluence with the Poudre River near Greeley. He is familiar with the Executive Order requiring environmental justice analysis and has conducted research on the development of quantitative methods for assessing whether low-income and minority groups would be disproportionately affected by proposed government projects. He also has published two journal articles and one book chapter on evaluating environmental justice issues.

Dr. Loomis has been an officer in the Association of Environmental and Resource Economists, first as a Board Member in 1993-1995, and then as a Vice President in 2000-2001. In 2013, he was elected a Fellow of this association. He is a member of other professional societies such as the Western Agricultural Economics Association (where he is a Distinguished Scholar) and the American Agricultural Economics Association. He regularly presents papers at these associations' annual conferences and has published over 200 journal articles in their flagship journals.

Charles Newling, PWS, CWB, CWD

Role: Environmental expertise.
Affiliation: Wetland Science Applications, Inc.

Mr. Newling is senior wetland regulatory scientist and senior vice president of Wetland Science Applications, Inc., and the Wetland Training Institute, Inc. He earned his M.S. in zoology (wildlife ecology) from Southern Illinois University in 1975. His 39-year career has focused on environmental evaluation of water resources (primarily wetlands) in both the public and private sectors for compliance with the Clean Water Act and NEPA. His expertise includes evaluating ecosystem restoration technologies for mitigation of potential impacts from proposed projects. He has a strong knowledge of the ecology of wetlands, wet prairies, streams, and interconnected habitat, having conducted functional analyses of these environments since 1975.

Mr. Newling has more than 14 years of experience working for the USACE New England Division Regulatory Branch and the USACE Waterways Experiment Station Environmental Laboratory. His USACE work involved evaluation and long-term monitoring of habitat development projects. From 1981 to 1989, he was the technical coordinator for USACE wetland training, including evaluation of wetland functions and values, and he has organized, conducted, and served as primary instructor in hundreds of

wetland-related training courses. His consulting expertise has focused on wetland delineation, wetland construction and restoration, the assessment of wetland functions and values, mitigation monitoring, and wetland mitigation banking. He has also provided rapid response assistance to USACE District offices nationwide on technical matters of wetland delineation and restoration.

Mr. Newling has experience calculating average annual habitat units (AAHUs) and applying the calculations to determine mitigation or restoration needs (or to determine whether those needs have been satisfied). He is familiar with the development and use of habitat suitability indices (HSIs) and with various assessment models, including habitat evaluation procedures (HEPs) for riparian and wetland habitats, Hydrogeomorphic (HGM) Approach, Wetland Evaluation Technique (WET), State of Washington Function Assessment Methods (WFAM), and other assessment methods. He also has taught some of these methods and was contracted by the State of Washington Department of Ecology to teach the State Wetland Rating System. In addition, he contributed to the development of the USACE Wetland Delineation Manual and supported efforts to develop and standardize evaluation of wetlands and related habitat.

Mr. Newling has specialized knowledge of a broad array of environmental laws, with a strong focus on the requirements of the Clean Water Act, NEPA, the Rivers and Harbors Act, the Fish and Wildlife Coordination Act, and the Endangered Species Act. He is familiar with cultural resource review requirements, which have applied to virtually all of the permits on which he has worked, and is aware of the need to comply with applicable regulations. Several recent projects have involved National Ecosystem Restoration (NER) plan identification, and virtually all of the Federal projects on which he has worked (e.g., USACE planning projects, private sector applications for Federal permits, etc.) have required interaction with the U.S. Fish and Wildlife Service under requirements of the Fish and Wildlife Coordination Act. He also has used the Institute for Water Resources (IWR) Planning Suite on several recent projects. Mr. Newling's field work has been conducted throughout the United States, including the West. Specifically, he has worked on projects and taught field-oriented courses in the Front Range area. He also has gained knowledge of USACE documentation associated with flood risk management while working on several recent projects.

Mr. Newling is a member of The Wildlife Society, Association of State Wetland Managers, Society of Ecological Restoration, and Wisconsin Wetlands Association and has served on the Board of Directors for the Society of Wetland Scientists as Liaison to its National Certification Program. He is a Professional Wetland Scientist, Certified Wildlife Biologist, and Certified Wetland Delineator.

Stephen McCaskie, P.E., G.E.

Role: Structural/geotechnical/civil engineering expertise.
Affiliation: Hanson Professional Services Inc.

Mr. McCaskie, project manager/senior geotechnical engineer for Hanson Professional Services Inc., earned his M.S. in civil engineering (geotechnical engineering) in 1980 from Carnegie-Mellon University. He has 36 years of experience in project management, engineering, design, permitting, and construction of flood protection, water resource, port and harbor, inland waterway, and transportation projects; planning, implementation, and supervision of subsurface explorations, condition surveys/evaluations/ assessments, safety inspections, alternatives analyses and value engineering, civil and geotechnical analysis and design, and construction monitoring and inspection; operations and maintenance; flood

monitoring and response; and specialized foundation analyses, earth dam/levee and embankment design, instrumentation and monitoring, data collection and analyses, soil-structure interaction, and earthquake engineering. A registered professional engineer in nine states (including Colorado) and registered civil engineer and geotechnical engineer in California, he has extensive experience in flood risk management including flood mitigation and flood damage reduction. This includes both structural solutions involving levees, floodwalls (I-wall, T-wall), and closure structures; and nonstructural solutions involving riverine and upland wetlands restoration, stream restoration and bank stabilization, storm water detention/retention facilities, diversion channels and off-channel flood storage, and flood proofing, for large and small flood protection projects.

Mr. McCaskie's experience includes the design, construction, operation and maintenance, and flood monitoring and response of small to large flood protection drainage/levee districts, with high private, public, and interagency interests. Relevant USACE projects include the Devils Lake Flood Risk Management project (North Dakota) and three urban flood protection levee systems in Missouri: Monarch-Chesterfield Levee System, Riverport Levee, and Lakeside 370 Levee. For Devils Lake, Mr. McCaskie served as both project manager and/or lead geotechnical engineer (responsible for preliminary designs and for design documentation reports, plans, specifications, cost estimates, schedules, and engineering services during construction) responsible for completion of plans and specifications, and other supporting documents for the Roads Acting as Dams and City of Devils Lake Embankments projects. For the Missouri levee projects, he served as District Engineer (1993-2007) providing engineering services (engineering evaluations, analyses, flood protection and interior drainage system, permitting, operation and maintenance, and inspection and monitoring) for flood protection systems involving earthen levees, closure structures, floodwalls, relief wells, and pump stations. He also conducted alternatives studies, including alternatives development, analysis and design, constructability and construction sequencing for Devils Lake, the Missouri projects mentioned above, and the Missouri Bottoms levee project.

Mr. McCaskie has experience conducting geotechnical and/or civil engineering reviews for USACE IEPRs and providing Safety Assurance Review (SAR) support. His IEPR experience includes three Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS) Lake Pontchartrain and Vicinity (LPV) 18.2, 109.2a, and 111.01 IEPRs involving floodwall and gate, levee enlargement, and levee raise design and analysis; the West Bank and Vicinity WBV 14C.2 New Westwego Pump Station to Orleans Village IEPR; the Navigation and Ecosystem Sustainability Program Lock and Dam #22 Fish Passage IEPR (USACE St. Louis District); and the South Florida Water Management District L-33, -35, -35A, -36, and -37 Levee IEPR, Broward County. He also supported the SAR for the Devils Lake Flood Risk Management project (USACE St. Paul District).

As project manager and/or lead geotechnical engineer on the design and construction of large, complex Civil Works projects, Mr. McCaskie has gained a thorough familiarity with USACE engineering and design criteria and guidance documents associated with flood risk management. Relevant projects include the Stratton Lock and Dam Improvements project and Olmsted Locks and Dam project (both in Illinois); the Devils Lake flood risk reduction project; and the Monarch-Chesterfield levee project.

Mr. McCaskie is an active member of the Society of American Military Engineers, American Society of Civil Engineers, Earthquake Engineering Research Institute, American Council of Engineering Companies United States Society on Dams, Association of State Dam Safety Officials, Missouri Structural Assessment and Visual Evaluation Coalition, and the International Society for Soil Mechanics and Foundation Engineering. He also is an independent consultant for Inspection of Dams (Subpart D Part 12, Title 18, Code of Federal Regulations) for the Federal Energy Regulatory Commission.

Arthur Kalmes, P.E., CFM

Role: Hydrology and hydraulic engineering expertise.
Affiliation: Barr Engineering Company

Mr. Kalmes is Vice President and Senior Civil Engineer with Barr Engineering Company. He earned his M.S. in civil engineering from the University of Missouri-Columbia in 1988. A registered professional engineer in four states and Saskatchewan, Alberta, Canada and certified floodplain manager, he has 27 years of civil and water resources experience with a significant focus on hydrologic and hydraulic (H&H) studies. During his career, he has managed the preliminary design for 33 interior drainage systems for the Mouse River flood protection system in Minot, North Dakota, as part of a preliminary engineering study. He also has been involved in the design or technical review of interior drainage for five levee systems. Mr. Kalmes has evaluated and designed dozens of drainage structures and pump stations ranging from small variable frequency drive pump stations (30 gallons per minute) to structures and pump stations that serve drainage areas covering several square miles.

Mr. Kalmes has provided flood proofing design or evaluation services for five residential building projects and several nonresidential projects, including retrofitting of the City of Northfield, Minnesota, Emergency Services Building. He has worked on over 100 floodplain evaluations, many involving flood risk reduction practices. In addition, he has designed structural flood protection systems (levees, channelizations, floodwalls, reservoirs, elevating structures) and nonstructural measures such as watershed controls. He also has developed education programs, emergency preparedness assistance, and recommendations for zoning restrictions.

Mr. Kalmes' knowledge of ecosystem restoration measures stems from his contribution to the design of a dozen stream restoration/slope stabilization projects that used bioengineering. He also designed several low-impact development systems for infiltration of stormwater and stormwater volume control. He has been involved in over 100 floodplain studies, nearly all of which were completed using the Hydrologic Engineering Center-River Analysis System (HEC-RAS) (or HEC-2) modeling software. He has used HEC-Hydrologic Modeling System (HEC-HMS) (or HEC-1) on dozens of floodplain or hydrologic studies.

Mr. Kalmes's experience in preparing and reviewing levee and dam safety reviews for over 20 structures represents a foundation for safety assurance that is conceptually similar to USACE SARs. In addition, he routinely uses, and manages projects that follow, USACE guidelines (engineer manuals) for civil engineering designs, including riprap, hydraulic structures, filter systems, seepage control, and interior drainage. Mr. Kalmes has been involved in the certification of two levee systems that are part of the USACE levee program. He recently led engineering efforts for the investigation, design, and construction oversight of five projects that involved the construction of 13 miles of dyke and placement of approximately 4 million cubic yards of compacted soil.

Mr. Kalmes has attended conferences and made presentations at civil engineering and floodplain management societies.

APPENDIX C

Final Charge to the IEPR Panel
Submitted to USACE on March 12, 2014, for the Greeley Project

This page is intentionally left blank.

CHARGE QUESTIONS AND GUIDANCE TO THE PANEL MEMBERS FOR THE IEPR OF THE CACHE LA POUDRE AT GREELEY, COLORADO GENERAL INVESTIGATION FEASIBILITY STUDY

BACKGROUND

The Cache la Poudre River at Greeley, Colorado General Investigation Feasibility Study is being undertaken to determine and evaluate alternatives related to flood risk management and ecosystem restoration within the Cache la Poudre River near Greeley, Colorado. Preliminary project costs are in the range of $35 to 50M.

The Cache la Poudre study reach is located in and around Greeley on the high plains of northeastern Colorado as noted in Figure 1. The Cache la Poudre River is a left bank tributary to the South Platte River and rises in the Front Range of the Rocky Mountains before exiting onto the plains at Ft. Collins, upstream of Greeley. While the main stem of the Cache la Poudre is considered a wild and scenic river in the Rocky Mountains, irrigation and gravel mining have impacted the river between Ft. Collins and its confluence with the South Platte near Greeley. Flooding has been a major problem in Greeley, with the most recent damaging flood occurring in 1999. An even more damaging flood occurred in 1983.

The City of Greeley is the local sponsor, and they have received funding from the State of Colorado, via the Colorado Water Conservation Board, to pursue solutions to both the flood damage problem and improvements to the degraded riverine ecosystem. The feasibility study has focused on defining flood risk management solutions in a three-mile reach of the Cache la Poudre River that include both structural and nonstructural measures. Ecosystem restoration efforts include riparian restoration along the channel and related ecosystem improvements in the flood plain. A goal was to provide habitat to native and migratory species in a region where habitat of this type is increasingly scarce.

Ecosystem restoration methods were formulated during this initial phase and an interim report was written that incorporated potential methods to improve the riparian habitat. The value of the riparian corridor in the semi-arid high plains to indigenous and migratory species was also assessed.

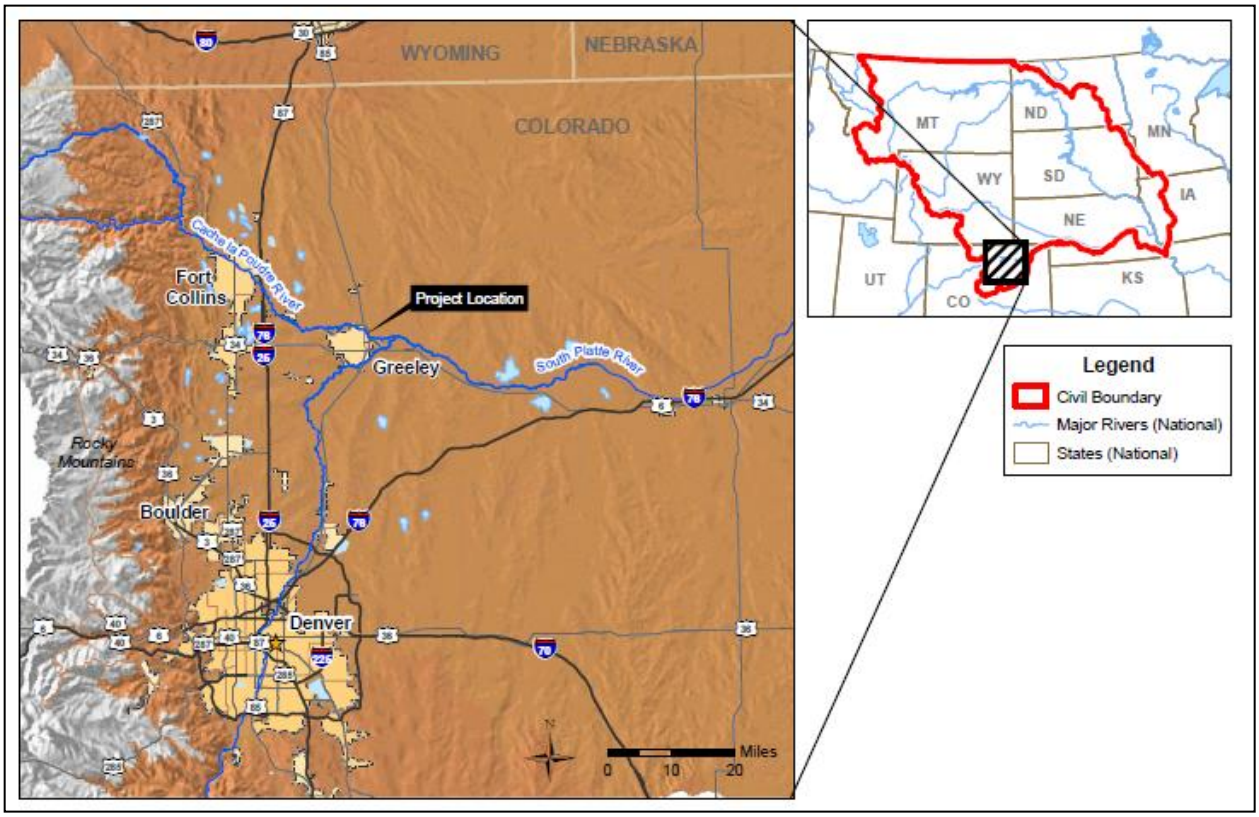


Figure 1. Location of the project in the U.S. and northeastern Colorado

The ability to leverage combined flood risk/ecosystem restoration solutions is limited somewhat by the lack of flood risk benefits that can be derived by widening the channel of the Cache la Poudre River. The reason for this is that transportation corridors that cut laterally across the floodway create a series of stair step pools during major floods, with road embankments acting as low head dams, the bridge openings as "principal spillways" and the weir flow across the embankments acting as "emergency spillways." Thus a widened channel largely produces only deeper ponding areas behind roadways, rather than improving flood conveyance and dropping water surface elevations significantly, as the stage is mostly controlled by the weir flow over the roadways at the 100-year event. The bridges are relatively new, and would be costly to replace in pursuit of more "principal spillway" capacity.

The reduction of the flood threat is directed toward reducing the risk of flood damages to property, which are relatively frequent. Historically, floods from the Cache la Poudre at Greeley have been characterized by long warning times and relatively shallow flood depths. Major floods are caused by a combination of snow melt and thunderstorm runoff over a relatively large watershed, so that overbank flows are not "flashy" in occurrence. As noted in Figure 1, Greeley is well east of the Rocky Mountains and the Cache la Poudre flowing through the high plains has a modest, rather than a steep channel gradient resulting in moderate river flow velocities. In addition, while runoff from severe local storms can cause extensive property damage on tributary streams and via storm sewer backup, those storms do not produce sufficient volume to cause a damaging riverine flood.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the Cache la Poudre at Greeley Colorado General Investigation Feasibility Study (hereinafter: Greeley IEPR) in accordance with the Department of the Army, U.S. Army Corps of Engineers (USACE), Water Resources Policies and Authorities' *Civil Works Review* (EC 1165-2-214, December 15, 2012), and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (December 16, 2004).

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.

The purpose of the IEPR is to assess the "adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (EC 1165-2-214; p. D-4) for the Greeley documents. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in planning/economics, environmental, structural/geotechnical/civil engineering, and hydrologic and hydraulic engineering issues relevant to the project. They will also have experience applying their subject matter expertise to flood risk management.

The Panel will be "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, review panels should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. Review panels should be able to evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable. Reviews should focus on assumptions, data, methods, and models. The panel members may offer their opinions as to whether there are sufficient analyses upon which to base a recommendation.

DOCUMENTS PROVIDED

The following is a list of documents, supporting information, and reference materials that will be provided for the review.

Documents for Review

The following documents are to be reviewed by designated discipline:

Title	Approx. No. of Pages
Feasibility Report	100
Hydrology and Hydraulics Appendix	35
Geotechnical Engineering Appendix	35
Cultural Appendix	10

Title	Approx. No. of Pages
Non Structural Measures Appendix	40
Economics Appendix	60
Environmental Appendix	180
Recreation Appendix	10
Real Estate Appendix	25
Cost Engineering	25
Hazardous, Toxic and Radioactive Waste Appendix	40
Public and Agency Comments	50
Total Page Count	**720**
Supplemental Reference Documents	**Approx. No. of Pages**
U.S. Army Corps of Engineers. "Greeley, CO, G.I. Study, Feasibility Study, Appendix B – Hydraulics." September 2008 (Phase 1 report).	100
Risk Register	6

Documents for Reference

- USACE guidance *Civil Works Review*, (EC 1165-2-214) 15 December 2012
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review,* December 16, 2004.

SCHEDULE

This final schedule is based on the April 1, 2014, receipt of the final review documents.

Task	Action	Due Date
Conduct Peer Review	Battelle sends review documents to panel members	4/3/2014
	Battelle convenes kick-off meeting with panel members	4/7/2014
	Battelle convenes kick-off meeting with USACE and panel members	4/7/2014
	Battelle convenes mid-review teleconference for panel members to ask clarifying questions of USACE	4/21/2014
	Panel members complete their individual reviews	4/24/2014

Task	Action	Due Date
Prepare Final Panel Comments and Final IEPR Report	Battelle provides panel members with talking points for Panel Review Teleconference	4/28/2014
	Battelle convenes Panel Review Teleconference	4/29/2014
	Battelle provides Final Panel Comment templates and instructions to panel members	4/30/2014
	Panel members provide draft Final Panel Comments to Battelle	5/6/2014
	Battelle provides feedback to panel members on draft Final Panel Comments; panel members revise Final Panel Comments	5/7-5/14/2014
	Panel finalizes Final Panel Comments	5/15/2014
	Battelle provides Final IEPR Report to panel members for review	5/19/2014
	Panel members provide comments on Final IEPR Report	5/21/2014
	Battelle submits Final IEPR Report to USACE	5/23/2014
Comment/ Response Process	Battelle inputs Final Panel Comments to DrChecks and provides Final Panel Comment response template to USACE	5/28/2014
	Battelle convenes teleconference with Panel to review the Post-Final Panel Comment Response Process (if necessary)	5/28/2014
	USACE provides draft PDT Evaluator Responses to Battelle	6/9/2014
	Battelle provides the panel members the draft PDT Evaluator Responses	6/11/2014
	Panel members provide Battelle with draft BackCheck Responses	6/16/2014
	Battelle convenes teleconference with panel members to discuss draft BackCheck Responses	6/17/2014
	Battelle convenes Comment-Response Teleconference with panel members and USACE	6/18/2014
	USACE inputs final PDT Evaluator Responses to DrChecks	6/25/2014
	Battelle provides PDT Evaluator Responses to panel members	6/26/2014
	Panel members provide Battelle with final BackCheck Responses	6/30/2014
	Battelle inputs the panel members' final BackCheck Responses to DrChecks	7/1/2014
	Battelle submits pdf printout of DrChecks project file	7/1/2014

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the Greeley IEPR documents are credible and whether the conclusions are valid. The Panel is asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The Panel is being asked to provide feedback on the economic, engineering, environmental

resources, and plan formulation. The panel members are not being asked whether they would have conducted the work in a similar manner.

Specific questions for the Panel (by report section or Appendix) are included in the general charge guidance, which is provided below.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the Greeley IEPR documents. Please focus your review on the review materials assigned to your discipline/area of expertise and technical knowledge. Even though there are some sections with no questions associated with them, that does not mean that you cannot comment on them. Please feel free to make any relevant and appropriate comment on any of the sections and appendices you were asked to review. In addition, please note the following guidance. Note that the Panel will be asked to provide an overall statement related to 2 and 3 below per USACE guidance (EC 1165-2-214; Appendix D).

1. Your response to the charge questions should not be limited to a "yes" or "no." Please provide complete answers to fully explain your response.

2. Assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, and any biological opinions of the project study.

3. Assess the adequacy and acceptability of the economic analyses, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, and models used in evaluating economic or environmental impacts of the proposed project.

4. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation.

5. Identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.

6. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable.

7. Please focus the review on assumptions, data, methods, and models.

Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision making. Comments should be provided based on your professional judgment, **not** the legality of the document.

1. If desired, panel members can contact one another. However, panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Agency Technical Review (ATR).

2. Please contact the Battelle Project Manager (Julian DiGialleonardo, digialleonardoj@battelle.org) or Program Manager (Karen Johnson-Young (johnson-youngk@battelle.org) for requests or additional information.

3. In case of media contact, notify the Battelle Program Manager, Karen Johnson-Young (johnson-youngk@battelle.org) immediately.

4. Your name will appear as one of the panel members in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Julian DiGialleonardo, **digialleonardoj@battelle.org**, no later than April 24, 2014, 5 pm ET.

IEPR of the Cache la Poudre at Greeley, Colorado General Investigation Feasibility Study

CHARGE QUESTIONS AND RELEVANT SECTIONS AS SUPPLIED BY USACE

General

1. Is the need for and intent of the decision document(s) clearly described?
2. Does the decision document(s) adequately address the stated need and meet the intent?
3. Were all models used in the analyses, including the models assessing the hazards, used in an appropriate manner?
4. Are the models used sufficiently discriminatory to support the conclusions drawn from them (i.e., identify meaningful differences between alternatives)?
5. Are the assumptions that underlie the various analyses sound?
6. Have risks and uncertainties been sufficiently considered?
7. Are potential life safety issues accurately and adequately described under existing, future without-project, and future with-project conditions?
8. Is the quality and quantity of the surveys, investigations, and engineering sufficient for a concept design?
9. Are the assumptions made for the hazards appropriate?
10. Does the analysis adequately address the uncertainty and residual risk given the consequences associated with the potential for loss of life for this type of project?
11. In your opinion, are there sufficient analyses upon which to base the recommendation?

Problem, Opportunities, Objectives, and Constraints

12. Are the problems, opportunities, objectives, and constraints adequately and correctly defined? Are there any gaps or overstatements?
13. Do the identified problems, opportunities, objectives, and constraints reflect a systems, watershed, and/or ecosystem approach, addressing a geographic area large enough to ensure that plans address the cause-and-effect relationships among affected resources and activities that are pertinent to achieving the study objectives (i.e., evaluate the resources and related demands as a system)?
14. In describing the criteria, goals, and objectives of the study, were the resources and issues important to the decision making process clearly identified? Did the study address those resources and issues?

Existing and Future Without Project Resources

15. Has the character and scope of the study area been adequately described and is the identified study area appropriate in terms of undertaking a flood risk management investigation?

16. Do you agree with the general analyses of the existing social, financial, and natural resources within the study area?

17. For your particular area of expertise, provide an in-depth review of whether the analyses of the existing social, financial, and natural resources within the project area are sufficient to support the estimation of impacts of the array of alternatives.

18. Given your area of expertise, does this section appropriately address the existing conditions of all resources pertinent to the study?

19. Were the surveys conducted to evaluate the existing social, financial, and natural resources adequate? If not, what types of surveys should have been conducted?

20. Were socioeconomic conditions adequately addressed? Were specific socioeconomic issues not addressed?

21. Was the hydrology discussion sufficient to characterize current baseline conditions and to allow for evaluation of how forecasted conditions (with and without proposed actions) are likely to affect hydrologic conditions? Is the discussion complete on the relationship between subsurface hydrology and the hydrodynamics of the project area?

22. Was the discussion of natural resources sufficient to characterize current baseline conditions and to allow for evaluation of forecasted conditions (with and without proposed actions)?

23. Were the assumptions used as the basis for developing the most probable future without-project conditions reasonable? Were adequate scenarios effectively considered (applied during analyses where relevant and/or reasonably investigated)? Were the potential effects of climate change addressed?

24. Are the future conditions expected to exist in the absence of a Federal project logical and adequately described and documented?

25. Please comment on the conclusion of the most probable future without-project condition. Do you envision other potential probable outcomes?

26. Please comment on the adequacy and reasonableness of the analyses of the condition of, and effectiveness as, a comprehensive system of existing flood control projects and of recommendations pertaining to them.

Plan Formulation / Alternative Development

27. Was a reasonably complete array of possible measures considered in the development of alternatives?

28. Did the formulation process follow the requirement to avoid, minimize, and then mitigate adverse impacts on resources?

29. Does each alternative meet the formulation criteria of being effective, efficient, complete, and acceptable?

30. Were the assumptions made for use in developing the future with-project conditions for each alternative reasonable? Were adequate scenarios considered? Were the assumptions reasonably consistent across the range of alternatives and/or adequately justified where different?

31. Have system perspectives been considered in the formulation of alternatives?

32. Are the changes between the without- and with-project conditions adequately described for each alternative?

33. Is there sufficient information presented to identify, explain, and comment on the assumptions that underlie the engineering analyses?

34. Are the uncertainties inherent in our evaluation of benefits, costs, and impacts, and any risk associated with those uncertainties, adequately addressed and described for each alternative?

35. Are future Operation, Maintenance, Repair, Replacement, and Rehabilitation efforts adequately described and are the estimated costs of those efforts reasonable for each alternative?

36. Please comment on the screening of the proposed alternatives. Are the screening criteria appropriate? In your professional opinion, are the results of the screening acceptable? Were any measures or alternatives screened out too early?

37. Were the engineering, economic, and environmental analyses used for this study consistent with generally accepted methodologies? Was public safety adequately considered?

38. Does any alternative include identified separable elements (a portion of a project that is physically separable, and produces hydrologic effects or physical or economic benefits that are separately identifiable from those produced by other portions of the project)? If so, is each identified separable element independently justified and are the benefits, costs, and effects of the separable elements correctly divided?

39. Are cumulative impacts adequately described and discussed? If not, please explain.

Recommended Plan

40. Comment on whether you agree or disagree with how the selected alternative was formulated and selected. Comment on the plan formulation. Does it meet the study objectives and avoid violating the study constraints?

41. Are there any unmitigated environmental impacts not identified and, if so, could they impact plan selection?

42. Please comment on the likelihood that the recommended plan will achieve the expected outputs.

43. Please comment on the completeness of the recommended plan (i.e., will any additional efforts, measures, or projects be needed to realize the expected benefits?).

44. Please comment on the appropriateness of location, sizing, and design of plan features.

45. Are residual risks adequately described and is there a sufficient plan for communicating the residual risk to affected populations?

OVERVIEW QUESTIONS AS SUPPLIED BY BATTELLE

46. Please identify the most critical concerns (up to five) you have with the project and/or review documents. These concerns can be (but do not need to be) new ideas or issues that have not been raised previously.

47. Please provide positive feedback on the project and/or review documents.

Battelle
The Business *of* Innovation