

Final Independent External Peer Review Report Puyallup River Basin, WA, Flood Risk Management General Investigation Draft Integrated Feasibility Report and Environmental Impact Statement

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Prepared by: Analysis Planning and Management Institute, Inc.

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Executive Summary

Project Background and Purpose

This report presents the results of an independent external peer review (IEPR) of the Puyallup (*pew-AL-əp*) River Basin, WA, Flood Risk Management General Investigation Draft Integrated Feasibility Report and Environmental Impact Statement (DIFR/EIS). The DIFR/EIS was prepared by the Seattle District of the U.S. Army Corps of Engineers. The USACE is undertaking the DIFR/EIS feasibility study to identify, evaluate and recommend to decision-makers an appropriate, coordinated, implementable solution to the identified flood risk problems and opportunities in the Puyallup River Basin, located in western Washington, south of Seattle.

The study area focuses on the Puyallup River and two major tributaries—the White River and the Carbon River. Major flooding occurs during the winter season from November through February, mainly as a result of the heavy rainfall and rain-on-snow events. Flooding can be localized within sub-basins or widespread throughout the entire basin. Recent flooding has adversely impacted multiple communities in the basin including Sumner, Fife, Puyallup, and Tacoma.

In general, the extent of inundation and the associated flood damages in the study area can be related to insufficient conveyance capacity due to high sediment buildup, at-risk structures in the 1% Annual Chance Exceedance floodplain, insufficient protection of structures in the floodplain, obstructions to the flow including vegetation, and uncontrolled runoff from unregulated portions of the basin.

The USACE has identified the Levee Modification Alternative as the Tentatively Selected Plan (TSP) that would modify the existing levee system to manage flood risk by setting back an existing levee, increasing existing levee heights, improving existing levee reliability, or constructing new levees or floodwalls.

Officials from the USACE and Pierce County, Washington, collected comments on the DIFR/EIS through stakeholder engagement. Comments were received from the general public, businesses, and federal, state, local, and tribal entities. These comments were considered by the IEPR panel members during their review.

Independent External Peer Review Process

The LMI Team of the Logistics Management Institute (LMI) and the Analysis, Planning, and Management Institute (APMI) was tasked by the US Army Corps of Engineers (USACE) to conduct the IEPR of the DIFR/EIS. Under the guidance of LMI, APMI performed the IEPR in accordance with the procedures described in the Department of the Army, USACE Engineer Circular (EC) No. 1165-2-214, *Civil Works Review*, dated 15 December 2012. The IEPR review was conducted by a panel of Subject Matter Experts (SMEs) with the following relevant expertise and experience:

- Civil Works Planning/Economics
- Geotechnical Engineering
- Biological Resources and Law Compliance
- Hydrology & Hydraulics Engineering
- Civil/Structural Engineering

The panel was “charged” with providing a broad technical evaluation of the material contained in the DIFR/EIS, as well as supporting documentation.

Independent External Peer Review Comments

The IEPR Panel was complimentary of how generally thorough and well-written the Puyallup DIFR/EIS was. The Panel acknowledges the significant challenge of managing flood risk in the study area with the drainage from the 1,000 square mile Puyallup basin (and the many challenges associated with managing flood risk in this area), the impacts on the Puget Sound and beyond, the numerous towns and cities, as well as the broad stakeholder interests.

However, the Panel has some concerns with certain aspects of the adequacy and acceptability of the Puyallup DIFR/EIS, resulting in 26 total final comments from their review as shown in the table below. The following paragraphs provide a narrative assessment by the Panel’s specific disciplines.

Comment Significance	Quantity
High	6
Medium/High	10
Medium	7
Medium/Low	1
Low	2
Total	26

Civil Works Planning/Economics

The decision document adequately addresses the stated need and intent relative to scientific and technical information; however, it is lacking in certain areas. There appear to be errors in the application of the hydro-economic model used to develop the Expected Annual Damages and the Equivalent Annual Damages for the Without-Project condition. This leads to inaccurate determination of the project flood damage reduction benefits of the alternatives and consequently incriminates selection of the TSP. The Plan Formulation Appendix should include a summary of the initial measures, final management measures, and the initial array of alternatives considered and why they were eliminated from consideration. Failure to do so makes the Plan Formulation Appendix incomplete. Chapter 4, “*Affected Environment and Environmental Consequences*”, discusses the effects of the project on the environment, but does not distinguish between direct and indirect effects, and does not identify and describe the other projects expected to be implemented in the reasonably foreseeable future when describing the cumulative effects. The resolution to this comment will determine the impact, but given the information to date, these could be significant.

Geotechnical Engineering

The geotechnical and geologic evaluations presented in the DIFR/EIS are generally thorough and well done with a few exceptions discussed herein. The discussion and analysis regarding geomorphology and regional geologic setting appear reasonable and based upon sound engineering data and judgment. The Panel also appreciates the in-depth review of historic levee performance in the project study area. This

insight is very valuable and provides some ground-truth to engineering analysis of slope stability, erodibility, and seepage issues within the watershed. The assessment of possible levee failure modes is consistent with the current state-of-practice. Unfortunately, the geotechnical evaluations do suffer from a few shortcomings. The shortcomings can be grouped into two primary categories including poor/inaccurate field data and lack of detailed field investigations, especially in the White River portion of the project.

Slug tests were the primary source of horizontal hydraulic conductivity data for the study. These data were supplemented by crude estimates developed using the Hazen equation, which relates soil grain-size to horizontal hydraulic conductivity. The Panel commends USACE for including slug tests as part of the DIFR geotechnical investigations as these usually provide better estimates of hydraulic conductivity than Hazen estimates; unfortunately, 7 of the completed tests provided faulty or unreliable hydraulic conductivity estimates. The reason for this is that the actual in-situ tests were completed in the unsaturated aquifer zone instead of the saturated aquifer zone assumed in the analytical data evaluation methodology (e.g., Hvorslev slug test). Therefore, these tests do not meet the requirements for the Hvorslev method. This means that 4 out of 10 tests are definitely not valid (e.g., Old Soldiers Home, Leach Road, Sportsmen, and Puyallup Authorized Right Bank) while 3 others (e.g., Bridge Street, Alward, and Riddell) are probably unreliable as a portion of the well screen was in the unsaturated zone. Therefore, any engineering analysis that relied upon these data may also be faulty or unreliable.

The second geotechnical shortcoming identified by the Panel is the lack of detailed field data for such a large study area. It is particularly evident in the White River portion of the project where no USACE explorations were completed. Instead, the USACE relied upon field data gathered by others in the general vicinity of proposed project levees. Although, some data is better than none, it is certainly preferable to have data gathered in the actual locations of management measures that are included in the TSP.

Biological Resources and Environmental Law Compliance

The DIFR/EIS includes some appropriate methods for analyzing project impacts under the USACE SMART Planning Initiative for this stage of development of the document. However, the panel recommends changes to the document to address issues pertinent to meaningful analyses. Key project impacts and important specifics regarding mitigation and monitoring plans critical to the justification and implementation of the project are not included or adequately discussed in a number of areas as discussed below.

Elements of the study area selection and alternative formulation are not clearly presented in the DIFR/EIS. It is not clear how or why the study area was specifically selected to address the flood protection effort that the USACE is attempting to resolve, which appears to be largely tied to sediment management within the entire Puyallup River Basin. Also, the selection of alternatives and inclusion and/or exclusion of specific measures within the alternatives is unclear, raising the question of whether the formulation of alternatives and selection of the TSP has resulted in the most effective plan to address the flooding issues the USACE is attempting to resolve.

Also, the DIFR/EIS does not sufficiently address key issues regarding biological resources that could be affected by the TSP (or other alternatives). This includes consideration of control and management of invasive species, which is currently lacking in sufficient detail. Also, important ecologic community interactions that might be disrupted by the proposed project, potentially impacting important biologic and

cultural resources, needs additional consideration. Most critically, the DIFR/EIS does not appear to consider, nor align with, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) recovery plans for threatened and endangered species, including Chinook salmon and Bull trout.

In addition, it is not clear from the DIFR/EIS whether floodplain protection has been adequately considered at this stage of development. Further, the document does not substantively address how the TSP would affect, support, or interfere with other regional plans regarding flood protection and floodplain management.

Furthermore, the DIFR/EIS does not appear to fully address issues related to indirect and cumulative impacts that might result from the project. These include secondary development behind the proposed flood protection infrastructure, and associated indirect and cumulative impacts from increased impervious surface, stormwater runoff pollutants, etc. As a result, it is also unclear whether the mitigation plan would include consideration of these impacts in its formulation.

Finally, the DIFR/EIS does not sufficiently address potential impacts to minorities and low-income populations that could be affected as a result of impacts from the project.

The panel recognizes that the limited detail presented in some areas of the DIFR/EIS is in part associated with the strategy employed under the USACE SMART Planning Initiative, and that more detailed information to support the assessment of environmental impacts and mitigation approaches will be added to the FIFR/EIS.

Hydrology & Hydraulics Engineering

The hydrology and hydraulics evaluations presented in the DIFR/EIS are generally thorough and well done with a few exceptions discussed herein. The discussion and hydraulic computational modeling approach appear reasonable and, with noted exceptions, based upon sound engineering data and judgment. The USACE documentation that was presented for the hydrology and hydraulic analyses should address the following issues.

The HEC-RAS hydrologic model was stated to be calibrated using observed flow data from U.S. Geological Service (USGS) gauge sites along the White and Puyallup river systems. The simulated model hydrographs were “visually” compared against observed hydrographs and model calibration parameters (e.g., Manning “n”-value) were adjusted to find the most satisfactory visual fit. This method of model calibration is generally considered the lowest level used in the state-of-the-practice today; though it is the primary method described in the HEC-RAS User Manual updated in February 2016. The modeled error, as measured by statistical analysis, should be minimized by the calibration process. Since the overall project size and cost is so large, it would be best to improve the model calibration in this manner to have a higher degree of confidence in the model results. Secondly, adjustment of Manning’s coefficients had a 75% range of adjustment (+60% to a -15%) to calibrate the models, which is significant, tends to indicate other erroneous data, and is beyond any normal procedure used by hydrologists. Further, there are explanations of the modeling using the storage areas and lateral weir coefficients that indicate that there was little to no information available to use to fine tune the models. Perhaps this is an area where model calibration needs to be reexamined rather than adjusting relatively known observations to determine Manning coefficients that result in a model(s) that match existing data.

The future “With-Project” and “Without-Project” conditions do not include design considerations to account for the predicted increases in watershed sedimentation rates, nor consideration of sediment reduction opportunities, which could be significant and increase. However, the USACE PDT was instructed to discount the possible climate change effects in development of the TSP. Sedimentation management measures should be considered within the national park boundaries where a significant amount of the downstream sedimentation is produced, rather than just “handling” the deposition in the traditional manner. It is not clear whether the USACE has considered working with federal partners in the Forest Service in this manner. There were a number of management measures for sediment reduction that were not initially screened out, but did not find inclusion in the three considered alternatives. However, it is not clear whether any of these measures could be added to the TSP measures. Increased sedimentation rates make the long-term Project sustainability questionable.

Finally, usage of Mud Mountain Dam (MMD) to limit flows to a zero discharge under certain conditions is unclear and uncertain. It is unclear as to whether MMD always has sufficient storage to be able to hold back releases during high flow events, and there is little discussion about sequential repetitive storm events that do not allow the time for MMD to drawdown to provide additional storage. If there is sufficient storage in MMD to maintain a *zero discharge during high frequency storms* and *zero discharge for repetitive storm events* so as not to combine with downstream unregulated flows that statement should be clearly stated. Both of these scenarios would result in unpredicted flooding and potential higher water surfaces resulting in additional damage and/or death.

Civil/Structural Engineering

The hydrology and hydraulics evaluations presented in the DIFR/EIS are generally thorough and well done with a few exceptions discussed herein. The discussion and hydraulic computational modeling approach appear reasonable and, with noted exceptions, based upon sound engineering data and judgment.

The most significant civil/structural (also a Hydrological & Hydraulics Engineering concern) identified in the report and appendices is that the report does not contain any discussion, description, or planning for interior drainage management measures (i.e., gate structures or pump stations or other structural elements). Though the USACE stated that these areas are only located in lower Clear Creek and that the local sponsor is addressing this issue; most areas where a levee is considered, there would be interior drainage on the landward side of the levee. FEMA requires that communities address interior drainage as a part of their participation in the National Flood Insurance Program (NFIP) where levees are provided to reduce the risk of flooding, generally with the use of gate structures, and/or pumping stations with designated 1% ponding areas on the landward side of the levee to discourage development within the Special Flood Hazard Area (SFHA). Regardless of who is responsible for the issue, Interior Drainage needs to be addressed in the report.

Under non-flood conditions, precipitation runoff occurring on the landward side of the flood structural measures will need to be conveyed by a gravity drainage system through the flood barrier alignment by gated structures (gatewells) to the river. Typically, gatewells will be closed under flood conditions to prevent backflow into the protected area. Accommodating interior drainage may require alterations or extensions of existing stormwater drainage systems. In addition, precipitation events that occur under flood conditions with blocked gravity discharge could require ponding areas and or pumping stations to

prevent flooding on the interior of the flood barrier. The occurrence of precipitation events when the river level is high and gravity drainage is prevented, is a likely event.

An additional civil/structural concern is related to whether future design efforts could employ modified levee sections utilizing rock fill that could reduce the length of a costly floodwall. It was also noted that the final profile of the various reaches of the flood barrier should be designed such that an overtopping event would flood the protected area from the downstream end of the reach rather than allowing higher velocity overtopping flows to proceed in an upstream to downstream direction through the protected area.

Closing

The above narratives summarize the IEPR panel comments, all of which are included in Appendix A of this report. These summaries are organized by technical disciplines relevant to this IEPR.

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1 Introduction

1.1 Introduction and Report Overview

This Independent External Peer Review (IEPR) Report provides the results of the IEPR of documents associated with the Draft Integrated Feasibility Report and Environmental Impact Statement (DIFR/EIS) prepared as part of the Puyallup River Basin General Investigation.

This IEPR report contains the comments of the IEPR panel convened to review the assigned documents prepared by the US Army Corps of Engineers (USACE). The IEPR report also contains a description of the IEPR objectives and process, an overview of the Puyallup River Basin and watershed, and a summary of the IEPR panel members' expertise.

Section 1 of the IEPR Report provides a description of the objectives of this effort, general background information on the IEPR, and a brief introduction to the team of Logistics Management Institute (LMI) and Analysis Planning and Management Institute (APMI) that managed the IEPR process and supported and assisted the IEPR panel. Section 2 on page 13 provides an overview of the Puyallup River Basin and risk reduction measure activities to date. Section 3 on page 19 summarizes the process followed to perform the IEPR. Section 4 on page 25 describes the IEPR panel composition and the panel members' expertise. Section 5 on page 35 presents a summary of the IEPR panel comments. Appendix A on page 41 provides the final IEPR panel comments and Appendix B on page 73 reproduces the "charge" provided by the Corps to guide the IEPR panel to the IEPR panel to guide its review. Appendix C on page 77 contains the completed organizational conflict of interest forms completed by LMI and APMI. Appendix D on page 79 provides short resumes for the IEPR panel members. Cited References are listed on page 87 and a Glossary of Selected Terms and Acronyms is provided on page 89.

1.2 IEPR Overview

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

The purpose of the IEPR is to assess the adequacy and acceptability of economic, engineering, and environmental methods, models, and analyses used for the Puyallup River Basin, Washington, Flood Risk Management General Investigation and documented in the DIFR/EIS. The IEPR has been conducted by subject matter experts (i.e., IEPR Panel Members) with extensive experience in USACE planning, engineering, economics, and environmental issues relevant to the project.

1.3 IEPR Objective

The objective for this effort was to conduct a Type I IEPR of the DIFR/EIS. This IEPR is in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers (USACE) peer review policy, Engineer Circular (EC) No. 1165-2-214, "Civil Works Review", dated December 15, 2012,

and the Office of Management and Budget, “*Final Information Quality Bulletin for Peer Review*”, released December 16, 2004.

The IEPR was limited to technical review and did not involve policy review. The review was conducted by subject matter experts (SME) with extensive experience in engineering, economic, and environmental issues associated with dam safety considerations. The review panel did not make recommendations on whether a particular alternative should be implemented, as the Chief of Engineers is ultimately responsible for the final decision on USACE work products.

The Review Panel Members were “charged” with responding to specific technical questions listed in §Appendix B on page 73 as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-214, Appendix D, reviewers were to identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. The Review Panel assessed whether the assumptions of the planning analysis are sound and whether or not the conclusions based on the planning analysis are appropriate and logically follow from the stated problems, opportunities, objectives, constraints, screening, and alternatives evaluation. Reviews focused on assumptions, data, methods, and models. The Review Panel members were allowed to offer their opinions as to whether there are sufficient analyses upon which to base the Tentatively Selected Plan (TSP).

1.4 The LMI Team Qualifications and Characteristics

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

2 Project Description

The USACE is undertaking the Puyallup River Basin, Washington, Flood Risk Management General Investigation feasibility study to identify, evaluate and recommend to decision-makers an appropriate, coordinated, implementable solution to the identified flood risk problems and opportunities in the Puyallup River Basin, located in western Washington, south of Seattle. The preliminary TSP cost estimate is \$341 million, based on concept-level designs.

2.1 Background

2.1.1 Overview

The Puyallup River Basin Flood Risk Management General Investigation is a single-purpose flood risk management feasibility study to address flood risks in the Puyallup River Basin in Washington. The non-Federal sponsor for this study is Pierce County, Washington.

The intent of Federal action is to reduce flood risks, life safety threats, and damages in the Puyallup River Basin as a result of flooding. The action is needed because the basin experiences frequent flooding, resulting in damages to both rural and urban areas throughout the basin.

The purpose of the Puyallup River Flood Risk Management General Investigation Study is to identify, evaluate, and recommend an appropriate, coordinated, implementable solution to the identified flood risk problems and opportunities in the basin.

2.1.2 About the Puyallup River Basin

The Puyallup River Basin drains approximately 1,000 square miles of western-central Washington and originates on the glaciers of Mount Rainier in the Cascade mountain range and flows in a northwesterly direction to Commencement Bay on Puget Sound. The Basin is diverse, comprising three glacially-fed rivers—the Puyallup River and its tributaries, the White River, and the Carbon River. Each of these major river systems originates on the northern slopes of Mount Rainier and join together upstream of Tacoma before draining into Puget Sound.

A majority of the Puyallup River watershed and its major tributaries are located in Pierce County, Washington, with the exception of a small portion north of the main stem White River located in King County. The Puyallup River Basin encompasses numerous towns and cities including Tacoma, the state's third largest city. In addition to two Federal authorized levees, the Basin contains a patchwork of locally constructed and maintained levee systems on each of the tributaries and the mainstem river. Most of the non-Federal levees were constructed during a period between the 1910s and the 1930s and many have been repaired, realigned, or otherwise modified in the ensuing decades. The existing levee systems have experienced significant and repetitive damages increasing overall flood risks. Portions of the basin are subject to channel constrictions caused by levees, revetments, and bridges, which limit channel capacity, thereby increasing flood risks.

2.1.3 The Puyallup River Basin General Investigation Study

The study area focuses on the Puyallup River and two major tributaries—the White River and the Carbon River (see Figure 1 on page 15 and Figure 2 on page 16). Major flooding occurs during the

winter season from November through February, mainly as a result of the heavy rainfall and rain-on-snow events. Flooding can be localized within sub-basins or widespread throughout the entire basin. Recent flooding has adversely impacted multiple communities in the basin including Sumner, Fife, Puyallup, and Tacoma.

In general, the extent of inundation and the associated flood damages in the study area can be related to insufficient conveyance capacity due to high sediment buildup, at-risk structures in the 1% Annual Chance Exceedance (ACE) floodplain, insufficient protection of structures in the floodplain, obstructions to the flow including vegetation, and uncontrolled runoff from unregulated portions of the basin.

This is a complex study; some of the challenges are:

- Large sediment transport from river flow down a volcano (Mt. Rainier)
- Glacial impacts
- Seasonal flows that are difficult to predict
- Existing system of levees
- Large amount of development to include the flood plain, industry, tribal lands (two tribes)
- Railroad properties, critical infrastructure, waste water treatment plants, and USACE flood control dam operations

2.1.4 The Draft Integrated Feasibility Report and Environmental Impact Statement

The USACE has prepared a DIFR/EIS as the study decision document and National Environmental Policy Act (NEPA) document. The DIFR/EIS presents the results of the study to date.

This DIFR/EIS documents the plan formulation process to identify a TSP, along with environmental, engineering, and cost details of the TSP at the concept level, which will allow additional design and construction to proceed following approval of the DIFR/EIS. The DIFR/EIS also documents the environmental consequences analysis of the final array of alternatives per requirements of NEPA.

The study follows the USACE Planning process defined in ER 1105-2-100 (Planning Guidance Notebook) and the USACE SMART Planning initiative, which incorporates risk-informed evaluation with less detailed information to reach decision points more efficiently, and includes greater Vertical Team coordination throughout the study.

Although one of the objectives of IEPR is to evaluate whether sufficient information was available or technical analyses were completed, the IEPR must be completed within the context of the risk-informed decision-making process.

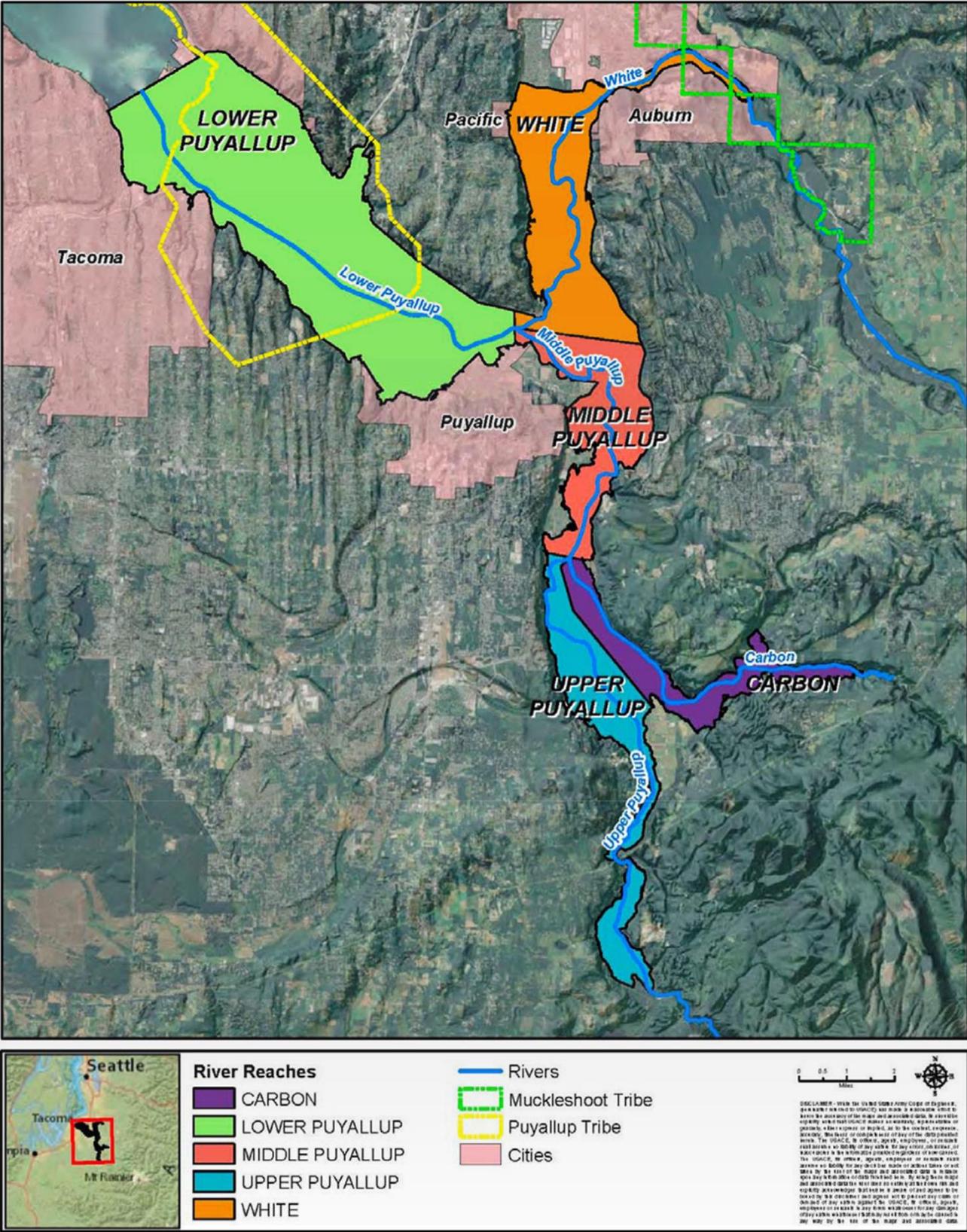


Figure 1- Puyallup River Basin General Investigation River Reaches - Study Area

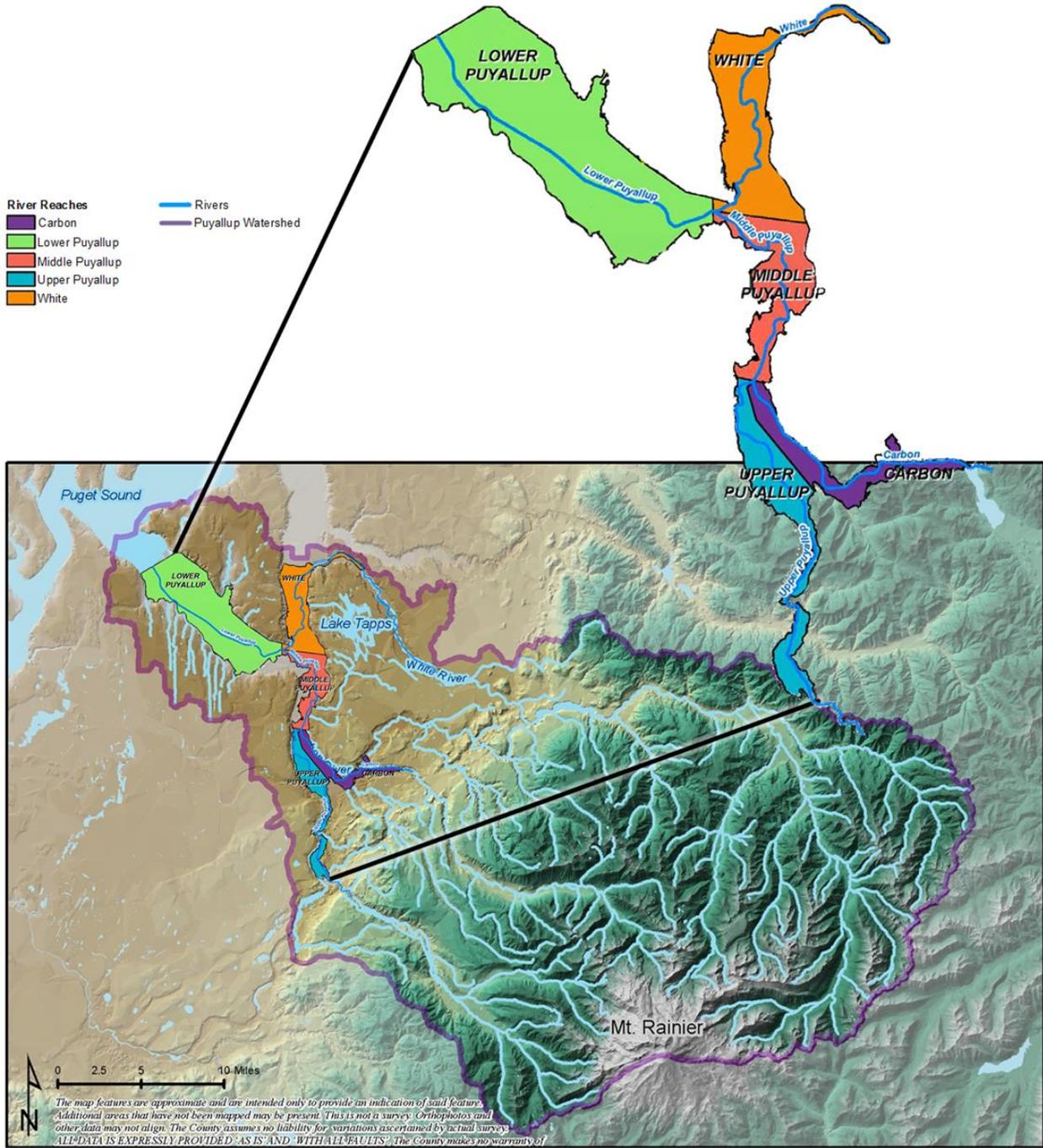


Figure 2 – Puyallup River Basin General Investigation River Reaches Overlaid on the Overall Puyallup Watershed

2.1.5 About the Tentatively Selected Plan

The USACE has identified the Levee Modification Alternative as the TSP that would modify the existing levee system to manage flood risk by setting back an existing levee, increasing existing levee heights,

improving existing levee reliability, or constructing new levees or floodwalls. The proposed levee modifications would be the primary flood risk management measure within this alternative and would work with other flood risk management measures in the alternative to reduce flood risk in the basin. This is a passive approach to managing sediment, in which levees are modified in order to accommodate the sediment deposition expected over the planning period of analysis.

The TSP includes approximately 11.2 total miles of new levee and/or floodwall construction and approximately 8.7 total miles of modification to existing features, including a levee setback (Figure 3 on page 18). Actual levee alignments and alternative measures will be refined during feasibility-level design analysis. Details of the plan formulation process and the TSP are included in the DIFR/EIS. The DIFR/EIS documents the planning process for flood risk management in the Puyallup River Basin, to demonstrate consistency with USACE planning policy and to meet the regulations that implement NEPA.

2.1.6 Public Involvement

Officials from the USACE and Pierce County, Washington, sought public comments on the DIFR/EIS. The 45-day public comment period was extended by 15 days and went from March 25 to May 23, 2016. The USACE hosted a public meeting to provide project updates and accept public comments on the DIFR/EIS and the TSP on April 19, 2016 at the Puyallup Activity Center. Public comments will be considered as the Corps and Pierce County work toward completing a basin-wide flood risk management plan. These public comments were provided to the IEPR Panel for consideration in their review.

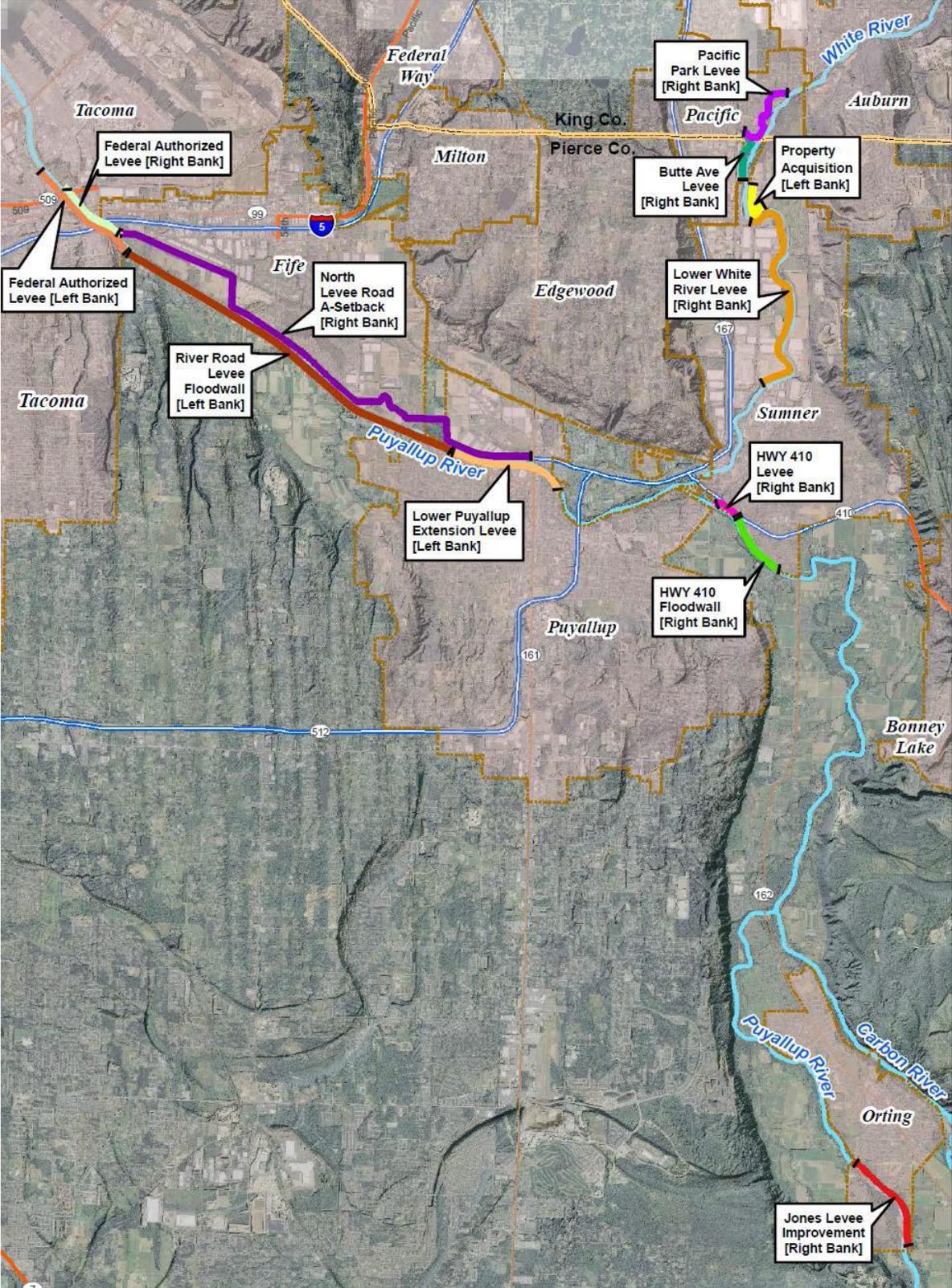


Figure 3 – Puyallup River Basin, Tentatively Selected Plan – Levee Modification Alternative

3 IEPR Process

This section summarizes the process for conducting the IEPR. Figure 4 below shows the overall process.

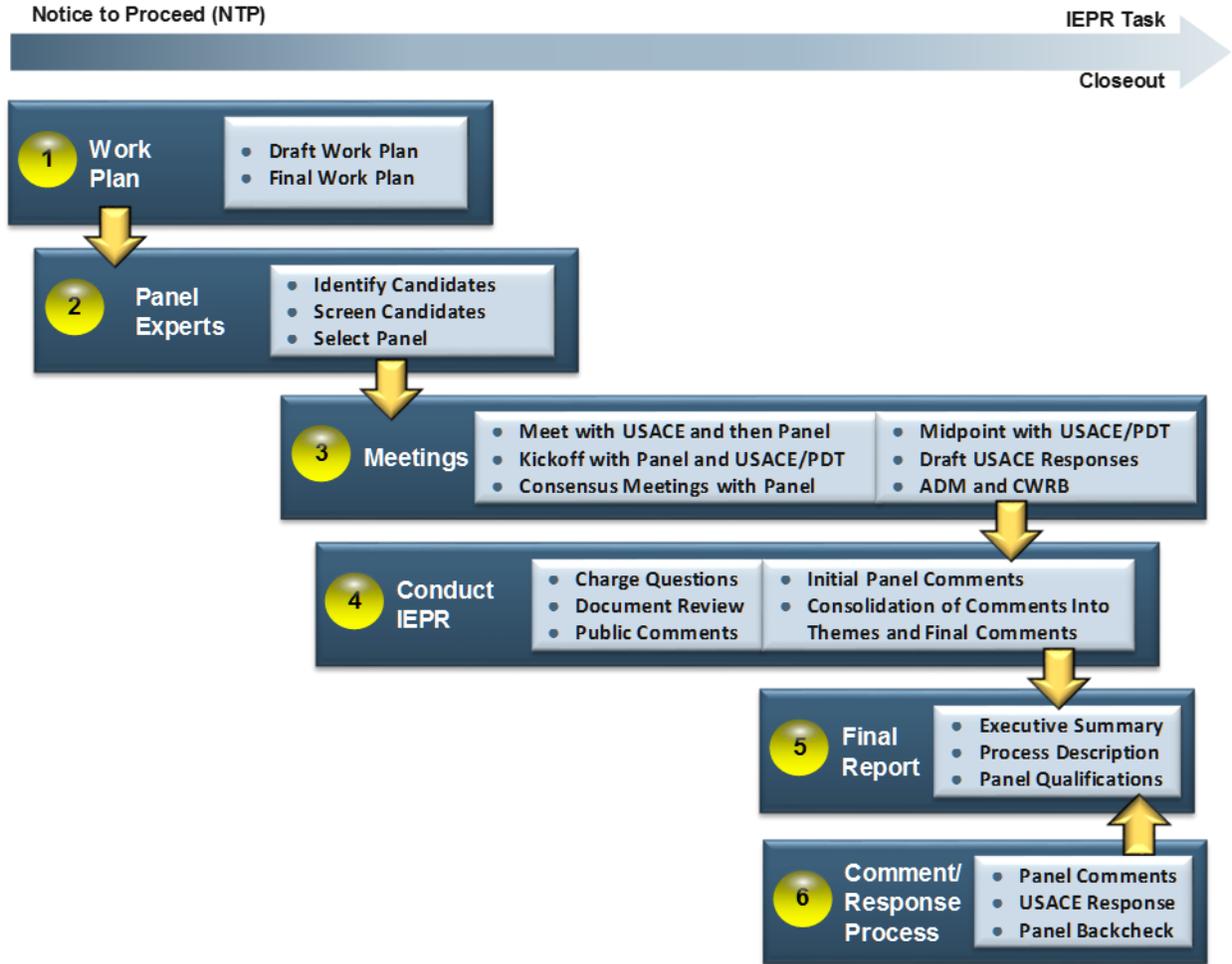


Figure 4 – Summary of the Independent External Peer Review Process

3.1 Project Management

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

¹ A Revision was made to account for modification to the schedule as well as changes to the review documentation (see §Table 1 on page 20).

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

APMI developed a schedule that would meet USACE’s goal of completing the IEPR as efficiently as possible in accordance with the Performance Work Statement (PWS). The schedule of activities was agreed upon by APMI and USACE. Table 1 below shows the major milestones and deliverables for the IEPR.

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

Table 1 – IEPR Schedule

Activity	Meeting Attendees	Date
Notice to Proceed		Mar 25, 2016
Initial Protocol Meeting	PCX and APMI	Mar 31, 2016
Kickoff meeting	Panel, APMI, LMI, PCX, PDT	Apr 20, 2016
Midpoint Review Meeting	Panel, APMI, LMI, PCX, PDT	May 12, 2016
In-Progress Review Meetings	Panel and APMI	May 27, 2016
Final IEPR panel report submitted to USACE		Jun 8, 2016

3.2 Selection of Panel

Reaching out to its various pools of experts, APMI identified experts who met and exceeded the technical expertise and requirements of this IEPR. APMI provided potential candidates with a scope of work, which included the required expertise and project schedule, and conducted informal and formal discussions to identify any technical expertise concerns or potential conflict of interest issues. Consistent with the guidelines of the US Office of Management and Budget’s (OMB’s) Final Information Quality Bulletin for Peer Review (M-05-03), issued December 16, 2004, the following were considered in the screening of the candidates:

- **Expertise** – Ensuring the selected reviewer has the knowledge, experience, and skills necessary to perform the review.
- **Independence** – The reviewer was not involved with the projects in the Puyallup River Basin, or in producing the documents to be reviewed.
- **Conflict of interest** – Identification of any financial or other interest that conflicts with the service of an individual on the review panel because it could impair the individual’s objectivity or could create an unfair competitive advantage for a person or organization.
- **Availability** – Candidates’ availability to meet the project schedule.

After screening candidates to exclude those with inadequate expertise or potential Conflict of Interest (COI) issues in accordance with the requirements and guidelines of the National Academy of Sciences (NAS) and OMB M-05-03, several candidates were selected for further screening and evaluation to ensure they met or exceeded the requirements of this task. The list was then narrowed down to identify the most qualified candidates that would be available to serve on the IEPR panel. APMI provided the list of selected panelists along with their detailed résumés to the USACE to determine if any had a potential COI based on USACE knowledge of the individual's past involvement with the project. USACE acknowledged the proposed panel members' experience relative to the requirements of the IEPR and that there were no perceived COI issues. Information on the panel members is provided in §4 on page 25.

3.3 Conducting the IEPR

The USACE provided APMI the documents to be reviewed by the IEPR panel and additional supporting documents as background material for panel reference. Since APMI did not have any comments or changes to draft charge questions, final charge questions were subsequently issued. The charge questions are shown in Appendix B on page 73. The IEPR panel members used the charge questions as guidance for identifying relevant information and developing their comments and recommendations.

Before starting, each Panel member must receive proper Operational Security training. Once complete, APMI provided orientation with the general scope and background information of the project, outlined the steps of the IEPR process, identified the overall schedule and deadlines, and instructed the IEPR panel members on how to access the documentation and to undertake the review. The Panel was provided document review assignments, the charge questions, and a comment response template. APMI maintained contact with the Panel to ensure proper coverage of all important issues and consistency in the development of the IEPR comments.

A kickoff teleconference with the USACE Product Delivery Team (PDT) was conducted to further familiarize the IEPR panel members with the technical aspects of the project. As part of this meeting, the PDT provided a detailed project briefing, reviewed project features and requirements, and provided the opportunity to exchange technical information among the panel and USACE technical staff. Following the kickoff meeting, the panel continued its detailed review of the documents provided.

APMI coordinated a teleconference with the panel members and the USACE at the approximate midpoint of the review process so that the panel members could ask clarifying questions of the USACE and request any additional information related to panel concerns. Subsequently, USACE provided additional information to APMI for dissemination to the panel.

The public comments were received late in the Panel's review period due to an extension in the submittal period, as allowed by NEPA. APMI extracted comments from statements of fact and assigned themes to these, tabulating them by commenter to assist the Panel in their review. These were promptly provided to the Panel to consider in their review. APMI conducted a telecon with the Panel to discuss the public comments, which were very useful in providing the Panel with an alternate perspective on the USACE's project, as well as non-federal projects, and showed that some stakeholders in this project have similar concerns.

APMI remained as the conduit for information exchange between the panel and USACE throughout the project in order to ensure a truly independent review.

3.4 Finalization of the Panel Comments

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

APMI coordinated with the panel members to reach consensus on the comments, identify any overlapping comments, and resolve any contradictions. Further refinement and consolidation of the comments occurred via email exchange. The Panel's comments are provided in Appendix A on page 41.

Each IEPR panel member comment consisted of four parts:

1. **Comment** – A clear statement of the concern
2. **Basis for Comment** – A narrative basis for the concern
3. **Significance** – A significance rating of the concern (the importance of the concern with regard to project implementability) as well as a statement supporting this significance rating. Comments are rated as “high”, “medium/high”, “medium”, “medium/low”, or “low” to indicate the general significance the comment has to project implementability.
4. **Recommendation[s] for Resolution** – Recommended actions necessary to resolve the concern to include a description of any additional research that would appreciably influence the conclusions.

APMI identified overall themes that were presented by multiple peer reviewers or repeated by one reviewer, comments that indicated conflicting peer review opinions, and other noteworthy comments. Minor editorial changes were not included in the final set of comments unless they affected the understanding of the technical content.

3.5 USACE Responses to IEPR Comments

Following the submittal of the IEPR final report, APMI will enter the comments on the USACE's PRO-ject extraNet's (PROJNet)¹, Design Review and Checking System (DrChecks) for permanent tracking and formal response by the USACE and backcheck by the Panel. These Final Panel Comments (FPC) will be reviewed by the USACE who will either “Concur” or “Non-Concur” with each FPC and will “Adopt” or “Not Adopt” each recommendation provided with that FPC and will draft written evaluator response(s).

Once the USACE's draft evaluator responses are complete, the Panel will review them with the intent to ensure that there is a clear understanding on the part of the PDT on the panel comments. Subsequently, APMI will hold a meeting between the Panel and the USACE evaluators so that the Panel and USACE to discuss the draft evaluator responses and ensure there is a clear understanding of the intent of original panel comments. After this meeting, the USACE will finalize their responses on DrChecks. The USACE's responses usually indicate whether documentation will or will not be expanded, revised, or changed.

¹ <https://www.projnet.org/projnet/binKornHome/index.cfm?strKornCob=HomeAboutProjNet>

After the submittal of the final evaluator responses, APMI will meet with the Panel, as needed, to discuss the responses and the approach for preparing the Panel's Backcheck. As part of a Backcheck process, the Panel will "Concur" or "Non-Concur" with each final evaluator response and provide comments to indicate whether each response adequately addresses the Panel's identified concerns.

After APMI inputs the panel Backcheck comments to each USACE evaluator response into DrChecks, we will provide the USACE with a record of the final IEPR comments, the final USACE evaluator responses to those comments, and the Panel's concluding backcheck comments.

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4 Panel Organization

APMI assembled a panel of experts that met the qualifications set forth by the USACE in the Performance Work Statement for the task, which was to conduct the IEPR and provide independent comments. APMI supported and assisted the panel in carrying out its review and served as the intermediary for communications between the panel and USACE during the IEPR process. The core team, IEPR panel members, and their roles and responsibilities are shown pictorially in Figure 5 below. As depicted in the table below, two panel members had expertise in more than one area which resulted in a significant enhancement of the review process.

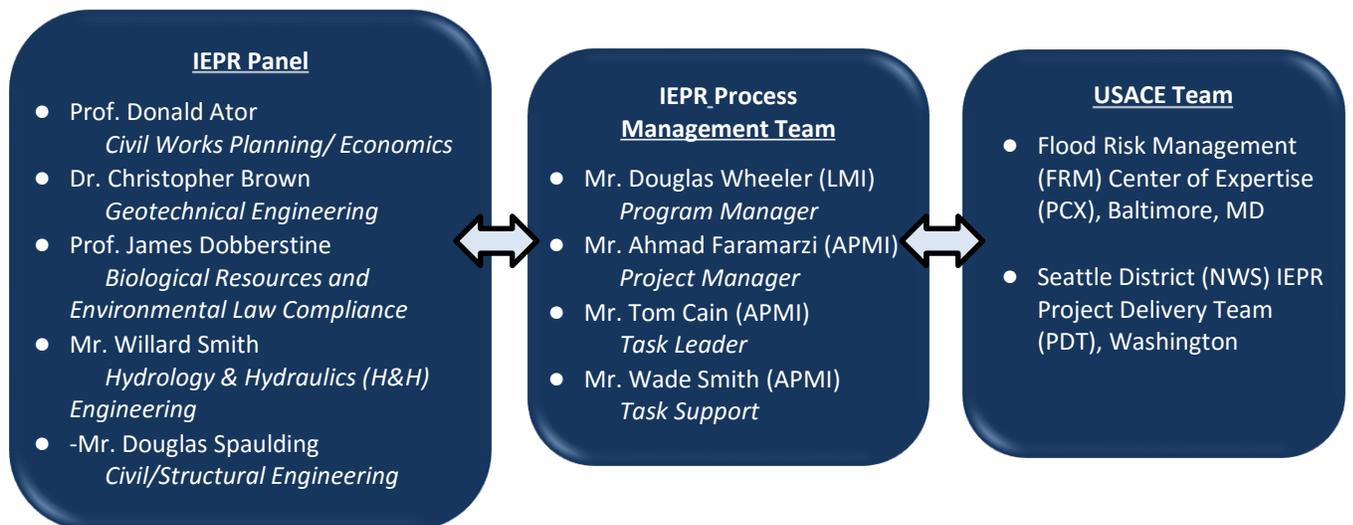


Figure 5 – Core Team for the Puyallup IEPR

4.1 IEPR Panel Description

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

- Civil Works Planning/Economics
- Geotechnical Engineering
- Biological Resources and Environmental Law Compliance
- Hydrology & Hydraulics Engineering
- Civil/Structural Engineering

The panel members met and exceeded the minimum requirements for each of the specified areas of expertise. The panel represented a balanced mix of individuals from industry, academia, and independent consultants including some with direct past experience with USACE. Table 2 on page 26 depicts how the panel members meet the specific USACE requirements specified for this IEPR review. In some cases, such as Geotechnical Engineering and Hydrology and Hydraulic Engineering, the Panel had multiple members meeting the requirements identified in Table 2.

Table 2 – Summary of Panel Member Qualifications by Discipline

Discipline	Requirements	Prof. Ator	Dr. Brown	Prof. Dobberstine	Mr. Smith	Mr. Spaulding
General Qualifications	Highest Degree	MBA	PhD	MS	BS	MS
	Years of Experience	35+	25+	23	40+	40+
	USACE Experience (Direct (D), Indirect (I), and none (N))	D	D	I	I	D
Biological Resources and Environmental Law Compliance	The Panel Member must be a scientist from academia, a public agency, a non-governmental entity, or an Architect-Engineer or Consulting Firm.			✓		
	The Panel Member must have at least 15 years’ experience directly related to water resource environmental evaluation or review and NEPA compliance, with a minimum MS degree or higher in a related field.			✓		
	Panel Member must have extensive experience working with Pacific Northwest biology with specific knowledge of salmonid species (spawning, rearing, freshwater migration, critical habitat, and mitigation), Environmental Species Act (ESA), wetlands, riparian habitats, riverine systems, and mitigation.			✓		
	The panel member shall have expertise in all environmental laws, Section 106 cultural resources compliance, as well as tribal cultures, laws and rights, and tribal coordination.			✓		
	Panel Member shall be familiar with Institute for Water Resources (IWR) planning suite, HEP methodology and HIS models.			✓		
Civil/ Structural Engineer	The panel member must be a registered professional engineer from academia, a public agency whose mission includes flood risk management, or an Architect- Engineer or consulting firm, having a minimum of 15 years’ experience in civil engineering.					✓
	Must have experience and thorough understanding of levee design, construction, flood proofing, and relocations.					✓

Discipline	Requirements	Prof. Ator	Dr. Brown	Prof. Dobberstine	Mr. Smith	Mr. Spaulding
	Must be familiar with design and construction of flood walls and other flood risk management structures and how they interact, knowledge of dam structures for flood risk management, general knowledge of flood risk management projects.					✓
	Active participation in related professional engineering and scientific societies is encouraged.					✓
Civil Works Planner/ Economist	The Panel Member must be from academia, a public agency, a non-governmental entity, or an Architectural-Engineering or Consulting Firm with a minimum of 15 years demonstrated experience in economics, with a minimum MS degree or higher in economics.	✓				
	The Panel Member must have a minimum of 15 years' expertise in flood risk management analysis, cost effectiveness analysis and benefit calculations, including experience evaluating both structural and nonstructural measures. Direct experience working for or with USACE is highly preferred but not required.	✓				
	Panel Member must be very familiar with USACE plan formulation process, procedures, and standards as it relates to flood risk management.	✓				
	The Panel Member shall have a minimum of 5 years' experience directly dealing with the USACE six-step planning process, which is governed by ER 1105-2-100, Planning Guidance Notebook.	✓				
	Active participation in related professional societies is encouraged.	✓				
Geotechnical Engineer	The panel member must be a registered professional engineer from academia, a public agency whose mission includes flood damage prevention, or an Architect- Engineer or consulting firm, having a minimum of 15 years' experience in geotechnical / soils engineering and geomorphology with a minimum MS degree or higher in engineering.		✓			✓

Discipline	Requirements	Prof. Ator	Dr. Brown	Prof. Dobberstine	Mr. Smith	Mr. Spaulding
	The Panel Member shall have demonstrated experience in performing geotechnical evaluation and geo-civil design for all phases of flood risk management projects in the Pacific Northwest.		✓			✓
	The Panel Member shall have experience in levees, culverts, channel stability, levee design, Engineering Technical Letter (ETL) standards and variations, construction and modification of new levees, and construction, bridge design and construction, as well as design and construction for detention/retention basins, utility relocations, positive closure requirements, interior drainage requirements, and application of nonstructural flood risk management measures.		✓			✓
	Candidate shall be familiar with and have demonstrated experience related to Corps of Engineers geotechnical practices associated with flood management channels, construction, and soil engineering.		✓			✓
Hydrology and Hydraulic Engineer	The panel member must be a licensed professional engineer with a minimum of 15 years' experience in hydrologic and hydraulic engineering in the Pacific Northwest region with a minimum MS degree or higher in engineering.		✓		P ^①	
	Active participation in related professional societies is encouraged.		✓		✓	
	The Panel member should have a specialized experience in river engineering, sediment transport, and familiarity with rivers with water control structures and dredging projects.		✓		✓	
	The team member must be familiar with the Hydraulic Engineering Center (HEC) models, including HEC-RAS, and Bureau of Reclamation (BOR) modeling.		✓		✓	

① – Partial

4.2 IEPR Panel Members

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

- Civil Works Planning/Economics – Prof. Donald W. Ator
- Geotechnical Engineering – Dr. Christopher Brown
- Biological Resources and Environmental Law Compliance – Prof. James Dobberstine
- Hydrology & Hydraulics Engineering – Mr. Willard B. Smith
- Civil/Structural Engineering – Mr. Douglas Spaulding

Prof. Donald W. Ator

Role: Civil Works Planning/Economics

Affiliation: Louisiana State University, Baton Rouge, LA

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

Prof. Ator has worked as an economist for the USACE Vicksburg District, Gulf South Research Institute, and three Architect-Engineer firms conducting water resources economic evaluations. He has extensive experience with the USACE planning process as outlined in ER-1105-2-100, *Planning Guidance Notebook*, especially with regard to Flood Risk Management (FRM) studies, and has worked with the USACE Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA), Computerized Agricultural Crop Flood Damage Assessment System (CAFIDAS), @RISK, and IWR-PLAN software programs. Prof. Ator's detailed qualifications are shown in §D.1 on page 79).

Dr. Christopher Brown

Role: Geotechnical Engineering

Affiliation: University of North Florida, Jacksonville, FL

Dr. Brown is an Associate Professor at the University of North Florida (UNF) teaching civil engineering, fluid mechanics, hydraulics, senior design, and engineering geology. He earned his Ph.D. in civil engineering in 2005 from the University of Florida, his Master's Degree from Villanova University in 1997, and his B.S. degree in civil engineering from Temple University in 1991. He has over 25 years of experience working on public works projects for the City of Philadelphia, Waste Management, U.S. Army Corps of Engineers (USACE), and for Golder Associates Inc. as a private consultant for various complex civil engineering projects. While working for the USACE, he worked within the Planning, Engineering, and Construction Divisions during his tenure. He was consistently recognized for his excellent technical skills including award of "engineer of the year" twice over 16 years with USACE. He has also recently been recognized for excellence in teaching and mentoring with award of several teaching accolades at UNF and the national Bliss Medal from the Society of American Military Engineers (SAME).

Dr. Brown is a registered professional engineer to both Pennsylvania and Florida. During his career, Dr. Brown has worked on flood-risk management structures including dams, levees, retaining walls, gates, closure structures, etc., looking at both geotechnical and general civil engineering aspects. Specific

project examples include the Prompton Dam spillway modification project, Molly Ann's Brook flood mitigation project, Portugués Dam design, EAA Reservoir project, C-111 levees, and many others. Dr. Brown has extensive experience on public works projects for the City of Philadelphia, City of Savannah, City of Jacksonville, EPA, USACE, State of Florida, and Commonwealth of Puerto Rico. Dr. Brown has also designed projects that were designed per requirements outlined in EM 1110-2-1913. As an expert peer reviewer, Dr. Brown has been involved with review projects in eight USACE districts over a period of 8 years.

Dr. Brown has worked on the geotechnical side of water resources and the hydrologic modeling side of design and modeling projects. Dr. Brown has completed both stability studies using Slope/W and UTEXAS and seepage studies using SEEP/W, Seep2D, and MODFLOW. Dr. Brown has used reliability and stochastic analysis studies on all types of water resources projects dating back to version 1.0 of "@Risk" software. Dr. Brown served on the first Corps of Engineers Ad-hoc committee on levee assessment, which included the initial development of the current USACE fragility curve/risk management design approach.

Dr. Brown has extensive knowledge of USACE cost estimating systems with direct experience using MCACES and working knowledge of M2. Dr. Brown has also developed his own risk-based cost estimates using both @Risk and Crystal Ball. He is experienced in developing estimated construction costs and is knowledgeable regarding construction methods related to large civil works projects including levee design, floodwall design, box culverts, bridge pier modifications, utility relocations, and drainage structure design. Dr. Brown has acted as cost-estimating IEPR reviewer on some of the largest civil works projects in USACE including the most expensive lock and dam replacement in USACE history.

Dr. Brown is familiar with, and has participated in, the design of floodwalls and gated structures, as well as non-structural flood mitigation solutions (e.g., buy-out or minor flood proofing). Specific project examples of direct design experience include Molly Ann's Brook project (included t-walls, l-walls, underpinning of buildings, levee, bridge modification), Portugués Dam (included access road, foundation prep, arch dam, drainage gallery, rock bolts), and City of Savannah storm sewer upgrade (included new conduit, cut/fill construction, utility relocation and hardening, vibration monitoring). Dr. Brown was also a key designer for the F. E. Walter Dam access road replacement (on design team and field inspection) as well as the design of new bridges across Everglades National Park along the Tamiami Trail in Florida. Dr. Brown has also been involved in other large civil works projects including C&D Canal Deepening Project in MD and DE and the Delaware Main Channel Deepening Project in PA and NJ. Mr. Brown's detailed qualifications are shown in §D.2 on page 81)

Prof. James Dobberstine

Role: Biological Resources and Environmental Law Compliance

Affiliation: Lee College, Baytown, TX

Prof. Dobberstine currently serves as chair of the Math, Engineering, and Sciences Division at Lee College. He is responsible for all operational aspects of the Mathematics, Engineering, and Science Division. He holds a BA in Life Sciences from Concordia University, an MS in Environmental Management from the University of Houston-Clear Lake, and an MS in Environmental Science from the University of Houston, Clear Lake. Prof. Dobberstine teaches Environmental Science and Biology and is engaged in ecosystem studies in the Galveston Bay, TX estuary with his students, the results of which have been featured through organizations including Restore America's Estuaries (RAE), among others.

Prof. Dobberstine holds certificates in USACE wetland delineation (Texas A&M University) and water quality improvement using constructed wetlands (Clemson University). He has also completed numerous professional development courses, including GIS Techniques in Environmental Assessment (University of North Texas), Probabilistic Ecological Risk Assessment (Texas Tech University), Application of Adaptive Management to Address Climate Change Related Challenges (NOAA Coastal Service Center and the PBS&J Ecosystem Restoration Division), Benthic Mapping Techniques (EPA, USDA-NRCS, and the University of Rhode Island), Sampling Benthic Sediments: Methods, Analyses, and Judgments (University of North Texas Institute of Applied Sciences), and Conserving Land with Conservation Easements (National Land Trust Alliance Land Conservation Leadership Program).

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

Prof. Dobberstine is frequently called on to serve as an advisor on projects and panels. He currently serves on the Advisory Council to the Arthur Temple College of Forestry and Agriculture at Stephen F. Austin State University and formerly served as a curriculum review advisor to the Environmental Management Program at the University of Houston-Clear Lake. He serves on the Memorial Park Demonstration Project Vegetation Advisory Workgroup, a project led by the Harris County Flood Control District to stabilize the shoreline of Houston's Buffalo Bayou while enhancing riparian habitat. He serves on the Monitoring and Research Subcommittee of the Galveston Bay Council (Galveston Bay Estuary Program), on the Boards of Directors of the Texas Association of Environmental Professionals (President 2010–present) and the South Central Regional Chapter of Society for Environmental Toxicology and Chemistry (as President 2013–2015), and as a former Trustee and current Advisory Board Member of the Galveston Bay Foundation.

Prof. Dobberstine has served on several Independent External Peer Review (IEPR) panels for USACE projects in the areas of biologic resources and environmental law compliance. IEPR experience includes infrastructure projects (dam safety and flood risk reduction), ecologic modeling, and water management. Prof. Dobberstine's detailed qualifications are shown in §D.3 on page 82.

Mr. Willard B. Smith

Role: Hydrology & Hydraulics Engineering

Affiliation: Hydropower International Services Inter-National Consultancy, LLC, Mannford, OK

Mr. Smith is President of Hydropower International Services Inter-National Consultancy, LLC, a private consulting firm. He has extensive expertise in providing engineering services for hydroelectric generating projects, and other hydrologic, hydraulic, and floodplain management projects. He is a graduate of the Missouri School of Mines with a BS in Civil Engineering specializing in hydrology and hydraulics.

Mr. Smith was President of the National Hydropower Association (NHA) from 1988-1989 and an active member of NHA's Board of Directors for over five years (1984-1989). He also served as Vice President, Creator and Chairman of both the Federal Energy Regulatory Commission (FERC) Committee and the International Committee and represented NHA as a technical specialist on Trade Missions throughout the world from 1989 to 1994. He is the recipient of the NHA 2008 *Dr. Kenneth Henwood Lifetime Achievement Award*. In Oct 2009, along with Dr./Ms. Linda Church Ciocci, he was recognized by the International Water Power & Dam Construction's list as one of the 60 most influential people who have helped shape the course of the global hydropower and dam business in the world over the past 60 years. Mr. Smith is also a Past Chair of the Oklahoma Floodplain Managers Association for 2007-2008 and remains active in the Association coordinating a Disaster Response Team, Training Cadre, and is the current Vice Chair (2nd time).

Mr. Smith has conducted independent reviews of dams over the past 25 years as a FERC Independent Part 12D Inspection Consultant. He has experience with using the USACE HEC HMS and HEC RAS computer programs regularly in performing floodplain management and stormwater design projects. He has designed non-federal hydropower projects such as USACE navigation locks and dams and prepared designs in accordance with USACE design standards. Mr. Smith has been designated as the Chief Dam Safety Engineer for FERC Licensed Hydropower Projects by two of his clients in accordance with the requirements of dam safety for FERC projects. Mr. Smith's detailed qualifications are shown in §D.4 on page 83

Mr. Douglas Spaulding

Role: Civil/Structural Engineering

Affiliation: Spaulding Consultants, Golden Valley, MN

Mr. Spaulding has over 47 years of experience in the design, evaluation and inspection of water retaining structures such as dams, levees, and flood walls. His experience includes 10 years with the Corps of Engineers where he served as Chief of the Levee & Channel Design Section for the USACE's St. Paul District. He also has worked as an Independent Consultant conducting inspections, evaluation, and design of over 70 flood control and hydroelectric dams throughout the United States. His recent experience includes serving as a facilitator for the FERC's Potential Failure Mode Evaluation for over 70 dams located throughout the U.S. Mr. Spaulding has an MSCE degree in geotechnical engineering and is currently a registered professional engineer in four states. He has served on seven IEPR panels for projects located throughout the US and has provided design services, project management, and peer review for over 18 local flood protection projects located throughout the United States. These projects have included earth levee systems, diversion channels, concrete channels, floodwalls, gate wells and pumping stations. The foundation conditions for these projects have ranged from soft lacustrine clay deposits to stratified granular deposits requiring seepage berms and relief well design. The majority of the projects were located in urban areas, which involved analyses of trade-offs between right away costs and structural costs. Mr. Spaulding's career includes evaluation of risks associated with the long term performance and design associated with water retaining structures and conveyance facilities. This process requires evaluating appropriate analytical procedures, making appropriately conservative assumptions and obtaining sufficient geotechnical data to both describe the subsurface profiles and performance characteristics. Each project is unique and must be viewed and evaluated without preconceived concepts of risk or performance. Mr. Spaulding's detailed qualifications are shown in §D.5 on page 85.

4.3 IEPR Process Management Team

The IEPR process management team consisted of the following members.

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

Mr. Wheeler is an industrial and mechanical engineer with more than 20 years of experience in strategic process engineering and financial analysis including work for USACE, DOE, and GSA. For USACE, he led a consultant and client team in a business process reengineering effort for the Navigation Locks and Dams High-Performing Organization. He also led project teams in a variety of tasks to provide reengineering services to the USACE IT function. Because of his work leading the review of the USACE MKARNS maintenance activity and his support for the USACE IMTS, Mr. Wheeler understands the USACE's water navigation business area and supporting projects. He has also focused on real property and lease-related projects for GSA as well as economic assessments of infrastructure projects for DOE. Mr. Wheeler applies LMI's COI process by reviewing each TO RFP with LMI's management team. LMI's process ensures that each LMI business unit manager is aware of TO scope and can raise organizational COI issues before LMI responds. He currently is focused on LMI's project cost engineering practice, privatization, and competitive sourcing services. Mr. Wheeler holds an MBA and a BS in mechanical engineering from Columbia University and an MSE in industrial engineering from Arizona State University.

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

Mr. Faramarzi supervised project personnel and communicated policies, procedures, and goals to the IEPR Team. In coordination with Mr. Wheeler, Mr. Faramarzi maintained regular contact with USACE and was responsible for the overall project plan, project performance, and client satisfaction on this as well as future tasks for USACE. He also had multiple technical and administrative staff as direct reports. Mr. Faramarzi is a registered professional engineer and a certified project management professional with 35 years of experience providing managerial and technical expertise to government clients, including the USACE, OSD, the U.S. Army, the U.S. Air Force, and DNFSB. He has organized and managed several important and highly visible expert panels in response to recommendations by the NAS. Mr. Faramarzi has a Post-Masters applied scientist/engineer degree from The George Washington University in Aerospace and Mechanical engineering (fluid mechanics), an MS in Thermofluid Engineering, and a BS in Nuclear Engineering. He is on the Board of Directors of the Washington, DC Section of ASME and an active member of the Fluid Dynamics branch.

Other technical and support staff were assigned to this IEPR team as appropriate.

Tom Cain, Principal Investigator (APMI)

Mr. Cain is a Principal Chemical/Process Engineer with over 30 years of experience providing managerial and technical expertise to government clients, including the USACE, Office of the Secretary of Defense (OSD), the U.S. Army, the U.S. Air Force, the Department of Justice (DoJ), and other government agencies. He has organized and managed and/or participated on several important and highly visible expert panels and conducted numerous studies in response to recommendations by the National Academy of Sciences (NAS). Mr. Cain has experience with environmental regulations, including the National Environmental Policy Act (NEPA) process, and with analyzing the environmental impacts of a wide variety

of types of federal projects, particularly the technical aspects. Mr. Cain has routinely applied his engineering, scientific, and analytical skills to unclassified, sensitive, and classified government programs. Areas of expertise primarily related to the Chemical, Biological, Radiological, Nuclear, and high-yield Explosive (CBRNE) field with particular subject matter expertise in chemical and explosives areas. Roles range from team contributor to technical lead to task/project/program manager while working across multiple disciplines and organizations to solve challenges, collaborate in research, and share expert knowledge.

Wade H. B. Smith, Ph.D., Task Support (APMI)

Dr. Smith is an ecologist and environmental scientist who received his Ph.D. in environmental engineering sciences from the University of Florida. He has over 30 years of experience with environmental regulations, including the National Environmental Policy Act (NEPA) process, and with analyzing the environmental impacts of a wide variety of types of federal projects. Examples include dredging and dredged material disposal, offshore oil and gas exploration and production, domestic and industrial wastewater disposal, operation of electric power generating stations, construction and operation of coastal recreational developments, pipeline construction and operation, realignment and re-stationing of military forces, closing of military installations, operation of chemical munitions destruction facilities, and dismantling of chemical warfare agent production facilities. Dr. Smith is experienced in working on scientific and engineering issues involving complex and controversial projects. He has participated in all aspects of the NEPA process. He has prepared programmatic and site-specific Environmental Impact Statements (EISs), Environmental Assessments (EAs), and subject-specific environmental analyses. Dr. Smith has been responsible for all elements of analysis of the physical, biological, and socioeconomic environments. He has participated in all NEPA phases—scoping, draft EIS, public hearings, response to public comments, final EIS, and record of decision. Dr. Smith has also prepared NEPA and environmental analysis guidance documents to be used by federal environmental managers and planners.

5 Summary of the Independent External Peer Review Findings

Civil Works Planning/Economics

The decision document adequately addresses the stated need and intent relative to scientific and technical information; however, it is lacking in certain areas. There appear to be errors in the application of the hydro-economic model used to develop the Expected Annual Damages and the Equivalent Annual Damages for the Without-Project condition. This leads to inaccurate determination of the project flood damage reduction benefits of the alternatives and consequently incriminates selection of the TSP. The Plan Formulation Appendix should include a summary of the initial measures, final management measures, and the initial array of alternatives considered and why they were eliminated from consideration. Failure to do so makes the Plan Formulation Appendix incomplete. Chapter 4, “*Affected Environment and Environmental Consequences*”, discusses the effects of the project on the environment, but does not distinguish between direct and indirect effects, and does not identify and describe the other projects expected to be implemented in the reasonably foreseeable future when describing the cumulative effects. The resolution to this comment will determine the impact, but given the information to date, these could be significant.

Geotechnical Engineering

The geotechnical and geologic evaluations presented in the DIFR/EIS are generally thorough and well done with a few exceptions discussed herein. The discussion and analysis regarding geomorphology and regional geologic setting appear reasonable and based upon sound engineering data and judgment. The Panel also appreciates the in-depth review of historic levee performance in the project study area. This insight is very valuable and provides some ground-truth to engineering analysis of slope stability, erodibility, and seepage issues within the watershed. The assessment of possible levee failure modes is consistent with the current state-of-practice. Unfortunately, the geotechnical evaluations do suffer from a few shortcomings. The shortcomings can be grouped into two primary categories including poor/inaccurate field data and lack of detailed field investigations, especially in the White River portion of the project.

Slug tests were the primary source of horizontal hydraulic conductivity data for the study. These data were supplemented by crude estimates developed using the Hazen equation, which relates soil grain-size to horizontal hydraulic conductivity. The Panel commends USACE for including slug tests as part of the DIFR geotechnical investigations as these usually provide better estimates of hydraulic conductivity than Hazen estimates; unfortunately, 7 of the completed tests provided faulty or unreliable hydraulic conductivity estimates. The reason for this is that the actual in-situ tests were completed in the unsaturated aquifer zone instead of the saturated aquifer zone assumed in the analytical data evaluation methodology (e.g., Hvorslev slug test). Therefore, these tests do not meet the requirements for the Hvorslev method. This means that 4 out of 10 tests are definitely not valid (e.g., Old Soldiers Home, Leach Road, Sportsmen, and Puyallup Authorized Right Bank) while 3 others (e.g., Bridge Street, Alward, and Riddell) are probably unreliable as a portion of the well screen was in the unsaturated zone. Therefore, any engineering analysis that relied upon these data may also be faulty or unreliable.

The second geotechnical shortcoming identified by the Panel is the lack of detailed field data for such a large study area. It is particularly evident in the White River portion of the project where no USACE explorations were completed. Instead, the USACE relied upon field data gathered by others in the general

vicinity of proposed project levees. Although, some data is better than none, it is certainly preferable to have data gathered in the actual locations of management measures that are included in the TSP.

Biological Resources and Environmental Law Compliance

The DIFR/EIS includes some appropriate methods for analyzing project impacts under the USACE SMART Planning Initiative for this stage of development of the document. However, the panel recommends changes to the document to address issues pertinent to meaningful analyses. Key project impacts and important specifics regarding mitigation and monitoring plans critical to the justification and implementation of the project are not included or adequately discussed in a number of areas as discussed below.

Elements of the study area selection and alternative formulation are not clearly presented in the DIFR/EIS. It is not clear how or why the study area was specifically selected to address the flood protection effort that the USACE is attempting to resolve, which appears to be largely tied to sediment management within the entire Puyallup River Basin. Also, the selection of alternatives and inclusion and/or exclusion of specific measures within the alternatives is unclear, raising the question of whether the formulation of alternatives and selection of the TSP has resulted in the most effective plan to address the flooding issues the USACE is attempting to resolve.

Also, the DIFR/EIS does not sufficiently address key issues regarding biological resources that could be affected by the TSP (or other alternatives). This includes consideration of control and management of invasive species, which is currently lacking in sufficient detail. Also, important ecologic community interactions that might be disrupted by the proposed project, potentially impacting important biologic and cultural resources, needs additional consideration. Most critically, the DIFR/EIS does not appear to consider, nor align with, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) recovery plans for threatened and endangered species, including Chinook salmon and Bull trout.

In addition, it is not clear from the DIFR/EIS whether floodplain protection has been adequately considered at this stage of development. Further, the document does not substantively address how the TSP would affect, support, or interfere with other regional plans regarding flood protection and floodplain management.

Furthermore, the DIFR/EIS does not appear to fully address issues related to indirect and cumulative impacts that might result from the project. These include secondary development behind the proposed flood protection infrastructure, and associated indirect and cumulative impacts from increased impervious surface, stormwater runoff pollutants, etc. As a result, it is also unclear whether the mitigation plan would include consideration of these impacts in its formulation.

Finally, the DIFR/EIS does not sufficiently address potential impacts to minorities and low-income populations that could be affected as a result of impacts from the project.

The panel recognizes that the limited detail presented in some areas of the DIFR/EIS is in part associated with the strategy employed under the USACE SMART Planning Initiative, and that more detailed information to support the assessment of environmental impacts and mitigation approaches will be added to the FIFR/EIS.

Hydrology & Hydraulics Engineering

The hydrology and hydraulics evaluations presented in the DIFR/EIS are generally thorough and well done with a few exceptions discussed herein. The discussion and hydraulic computational modeling approach appear reasonable and, with noted exceptions, based upon sound engineering data and judgment. The USACE documentation that was presented for the hydrology and hydraulic analyses should address the following issues.

The HEC-RAS hydrologic model was stated to be calibrated using observed flow data from U.S. Geological Service (USGS) gauge sites along the White and Puyallup river systems. The simulated model hydrographs were “visually” compared against observed hydrographs and model calibration parameters (e.g., Manning “n”-value) were adjusted to find the most satisfactory visual fit. This method of model calibration is generally considered the lowest level used in the state-of-the-practice today; though it is the primary method described in the HEC-RAS User Manual updated in February 2016. In the written comments provided to the USACE, the process of calibration is discussed in detail. The primary goal of the calibration process is to match the simulation results to the observed gauge data as closely as possible. The modeled error, as measured by statistical analysis, should be minimized by the calibration process. The three most common statistical measures that are used include the correlation coefficient, the coefficient of determination, and the Nash-Sutcliffe efficiency coefficient. Better calibration could be realized through the use of one or more of these quantitative “goodness-of-fit” statistics. Since the overall project size and cost is so large, it would be best to improve the model calibration in this manner to have a higher degree of confidence in the model results.

Relating to the use of adjustment of Manning’s coefficients to calibrate the model, adjustments of Manning’s coefficients with a +60% to a –15% range were made to calibrate the models. This is significant and tends to indicate other erroneous data. By physical observation, Manning’s coefficients should be set at the beginning of a modeling process and only be used with slight modifications in final calibration. A 75% swing in adjustment is beyond any normal procedure used by hydrologists. Further, there are explanations of the modeling using the storage areas and lateral weir coefficients that indicate that there was little to no information available to use to fine tune the models. Perhaps this is an area where model calibration needs to be reexamined rather than adjusting relatively known observations to determine Manning coefficients that result in a model(s) that match existing data.

The future “With-Project” and “Without-Project” conditions do not include design considerations to account for the predicted increases in watershed sedimentation rates nor consideration of sediment reduction opportunities. Studies indicate that future runoff in the watershed will be up to 18% while sediment loads could increase 30 to 50%. However, the USACE PDT was instructed to discount the possible climate change effects (e.g., increased runoff and sedimentation rates) in development of the TSP. The current TSP relies upon extrapolation of current sedimentation rates into the future. This approach seems to ignore the state-of-the-art scientific understanding of likely future conditions and likely underestimates the future water surface profiles in the watershed.

A significant amount of downstream sedimentation is produced within the national park boundaries where there is normally no manmade development. Thus the use of large sedimentation basins could be developed in conjunction with the ecological features of the area, to capture the glacial material at its source before it enters the downstream White and Puyallup river systems, and thus would minimize the deposition in the developed reaches, and the leveed reaches of the lower basin.

When considering future deposition with magnitudes of ½-million to over 1-million cubic yards of deposition on any single reach of the rivers, an alternative approach to just “handling” the deposition in the traditional manner may be warranted. It is not clear whether the USACE has considered working with federal partners in the Forest Service to reduce these loads as part of the overall sediment management plan for the basin, as suggested above. There were a number of management measures for sediment reduction that were not initially screened out, but did not find inclusion in the three considered alternatives. However, it is not clear whether any of these measures could be added to the TSP measures. Increased sedimentation rates make the long-term Project sustainability questionable.

The ability of usage storage in Mud Mountain Dam (MMD) to limit flows to a zero discharge under certain conditions is unclear and uncertain in the report. As discussed during the Midpoint Conference, additional explanation is warranted so the capacity of MMD is not misconstrued. It is unclear as to whether MMD always has sufficient storage to be able to hold back releases during high flow events, and there is little discussion about sequential repetitive storm events that don’t allow the time for MMD to drawdown to provide additional storage. With the projection of Climate Change in the basin translating a current 1% event to a 20-yr storm the capacity of MMD will be critical. If there is sufficient storage in MMD to maintain a *zero discharge during high frequency storms* and *zero discharge for repetitive storm events* so as not to combine with downstream unregulated flows that statement should be clearly stated. Both of these scenarios would result in unpredicted flooding and potential higher water surfaces resulting in additional damage and/or death.

Background Hydrology was confirmed during the Midpoint Conference to be performed by Northwest Hydraulic Consultants (NHC). It is unclear in the report that the USACE based their TSP and alternatives on hydrology data and analyses located in a previous report prepared by NHC and that background information for this report is not appended. It is recommended that the USACE provide a specific reference to the source document for the hydrologic analyses both in the report narrative and in the reference section.

Civil/Structural Engineering

The hydrology and hydraulics evaluations presented in the DIFR/EIS are generally thorough and well done with a few exceptions discussed herein. The discussion and hydraulic computational modeling approach appear reasonable and, with noted exceptions, based upon sound engineering data and judgment.

The most significant civil/structural (also a Hydrological & Hydraulics Engineering concern) identified in the report and appendices is that the report does not contain any discussion, description, or planning for interior drainage management measures (i.e., gate structures or pump stations or other structural elements). Though the USACE stated that these areas are only located in lower Clear Creek and that the local sponsor is addressing this issue; most areas where a levee is considered, there would be interior drainage on the landward side of the levee. FEMA requires that communities address interior drainage as a part of their participation in the National Flood Insurance Program (NFIP) where levees are provided to reduce the risk of flooding, generally with the use of gate structures, and/or pumping stations with designated 1% ponding areas on the landward side of the levee to discourage development within the Special Flood Hazard Area (SFHA). Regardless of who is responsible for the issue, Interior Drainage needs to be addressed in the report.

Under non-flood conditions, precipitation runoff occurring on the landward side of the flood structural measures will need to be conveyed by a gravity drainage system through the flood barrier alignment by gated structures (gatewells) to the river. Typically, gatewells will be closed under flood conditions to prevent backflow into the protected area. Accommodating interior drainage may require alterations or extensions of existing stormwater drainage systems. In addition, precipitation events that occur under flood conditions with blocked gravity discharge could require ponding areas and or pumping stations to prevent flooding on the interior of the flood barrier. The occurrence of precipitation events when the river level is high and gravity drainage is prevented, is a likely event.

An additional civil/structural concern is related to whether future design efforts could employ modified levee sections utilizing rock fill that could reduce the length of a costly floodwall. It was also noted that the final profile of the various reaches of the flood barrier should be designed such that an overtopping event would flood the protected area from the downstream end of the reach rather than allowing higher velocity overtopping flows to proceed in an upstream to downstream direction through the protected area.

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Appendix A Final Panel Comments

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

Each comment consists of four parts that include the following:

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

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

- **High** – Comment describes a fundamental problem with the project that could affect the recommendation or justification of the project.
- **Medium/High** – Comment affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.
- **Medium** – Comment affects the completeness or overall understanding of the recommendation or justification of the project.
- **Medium/Low** – Comment affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project. However, the panel does not have sufficient information to determine the effect on project implementability.
- **Low** – Comment affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project, but there is limited concern regarding project implementability.

The comments are arranged in order of significance. The number of each is as follows:

Comment Significance	Quantity
High	6
Medium/High	10
Medium	7
Medium/Low	1
Low	2
Total	26

A.1 Summary of Comments

Table 3 below provides a summary list of all IEPR comments organized by their significance from high to low. The summary tabular list is followed by a List of Panel Comments, providing the page numbers for each of the comments.

Table 3 – Summary of Final Panel Comments Identified by the IEPR Panel

Final Panel Comments (FPC)
Significance – High
Comment 1 – The hydraulic conductivity data used for the seepage evaluations and then, indirectly, in the slope stability studies, is largely faulty or unreliable.
Comment 2 – It is not clear from the DIFR whether the TSP is compatible with the recovery goals for threatened and endangered fish in the basin, or with regional floodplain, water quality, and habitat planning and management efforts under implementation.
Comment 3 – It does not appear that minority and low-income populations have been adequately considered in the DIFR/EIS.
Comment 4 – Mitigation for project impacts to aquatic resources and habitats should clearly calculate and include compensation for unavoidable direct, indirect, and cumulative impacts.
Comment 5 – The Hydrologic Engineering Center’s River Analysis System (HEC-RAS) model used for Without-Project and With-Project evaluations has a low level of calibration. The statement in Appendix B, <i>Hydrology and Hydraulics</i> , Page 24 that adjustments of Manning’s coefficients with a +60% to a –15% range were made to calibrate the models is significant and tends to indicate other erroneous data.
Comment 6 – The requirements for interior drainage facilities such as gatewells, pumping stations, and ponding areas have not been identified or evaluated in developing the alternative plans.
Significance – Medium/High
Comment 7 – There appear to be errors in the application of the hydro-economic model used to develop the Expected Annual Damages and the Equivalent Annual Damages for the Without-Project condition.
Comment 8 – In the Chapter 4, <i>Affected Environment and Environmental Consequences</i> , the cumulative impacts sections do not identify and describe the other projects expected to be implemented in the reasonably foreseeable future.
Comment 9 – The future “With Project” and “Without Project” conditions do not include design considerations to account for predicted increases in watershed sedimentation rates, nor consideration of sediment reduction opportunities.

Final Panel Comments (FPC)
<p>Comment 10 – The evaluation criteria in Table 3-5, <i>Criteria, Metrics and Rating Scale for Evaluation of Initial Array of Alternative Plans</i>, do not match the criteria presented in Table 3-6, <i>Evaluation of Initial Array of Alternative Plans</i>; it is not clear whether this may have affected the alternative selection as a result.</p>
<p>Comment 11 – The DIFR/EIS does not sufficiently address invasive species in relation to the project study area and alternatives.</p>
<p>Comment 12 – Additional discussion of Hazardous, Toxic, and Radioactive Waste (HTRW) may be warranted within the DIFR/EIS.</p>
<p>Comment 13 – The DIFR/EIS needs a more robust discussion regarding the structure of, and potential impacts to, the biologic community within the study area.</p>
<p>Comment 14 – It is not clear from discussion on cumulative effects whether either of the considered alternatives might spur additional development behind the flood protection improvements, thereby increasing stressors on the aquatic system and organisms.</p>
<p>Comment 15 – It is not clear whether the TSP (or other alternatives) adequately considered protection of the floodplain and wetlands in the scoping, formulation, and selection processes.</p>
<p>Comment 16 – It is not clear from the DIFR/EIS if the selected study area is sufficient in scope to fully address the magnitude of the problem the USACE is attempting to resolve.</p>
<p>Significance – Medium</p>
<p>Comment 17 – Only limited geotechnical site characterization was completed (by others) for the White River segment of the TSP even though this portion of the plan appears to provide a majority of the economic benefits presented in the DIFR/EIS.</p>
<p>Comment 18 – Background Hydrology was performed by Northwest Hydraulic Consultants (NHC) but that data source is not clearly defined in report.</p>
<p>Comment 19 – The ability of usage storage in Mud Mountain Dam (MMD) to limit flows to a zero discharge under certain conditions as described in Appendix B, <i>Hydrology and Hydraulics</i> (page 39, §5.2.4, last bullet), is unclear and uncertain. As discussed during the Midpoint Conference, additional explanation is warranted so the capacity of MMD is not misconstrued.</p>
<p>Comment 20 – Since a significant amount of sediment is produced within the national park boundaries, consideration could be made to create a “sedimentation basin(s)” within in the national park to capture the sedimentation prior to it entering the White and Puyallup river systems.</p>
<p>Comment 21 – Consideration should be given to utilizing modified levee sections along River Road to decrease the length of a costly floodwall.</p>
<p>Comment 22 – Consideration should be given to increasing the design height of the concrete floodwall sections above the height of the earth levee sections.</p>

Final Panel Comments (FPC)	
	Comment 23 – Consideration should be given to decreasing the height of the flood barrier on the downstream end of each reach of floodwall, or levee, such that if the barrier overtops the protected area will be inundated by floodwater flowing upstream rather than water flowing through the protected area at high velocities.
Significance – Medium/Low	
	Comment 24 – It is not clear how the management measures considered during plan formulation were assembled into the considered alternative plans; it appears that measures may have been omitted from the final array of alternatives based on which alternative they were including, rather than their efficacy in addressing the project goals, potentially affecting both the range of alternatives analyzed and the final selection (TSP).
Significance – Low	
	Comment 25 – In Chapter 4, <i>Affected Environment and Environmental Consequences</i> , no distinction is made as to whether the expected environmental effects of alternatives are direct or indirect effects
	Comment 26 – The <i>Civil Engineering</i> design appendix (Appendix E) should include a cross section of the proposed floodwall along River Road showing the relationship of the floodwall to the road and to the adjacent river slope.

A.2 Panel Comments – Significance High

Comment 1	
	The hydraulic conductivity data used for the seepage evaluations and then, indirectly, in the slope stability studies, is largely faulty or unreliable.
Basis for Comment	
	A portion of the slug test data used for levee seepage and stability evaluations is faulty in that actual in-situ tests were completed in the unsaturated aquifer zone, instead of the saturated aquifer zone assumed in the analytical data evaluation methodology (e.g., Hvorslev slug test). Wylie & Wood (1990) provide a good summary of the important assumptions and requirements for the 1949/50 Hvorslev-type slug test and most of the USACE (completed by URS) tests do not meet the requirements. This means that 4 out of 10 tests are definitely not valid (e.g., Old Soldiers Home, Leach Road, Sportsmen, and Puyallup Authorized RB) while 3 others (e.g., Bridge Street, Alward, and Riddell) are probably unreliable as a portion of the well screen was in the unsaturated zone.

Significance – High

Since the slug test data is mostly compromised, any engineering evaluations that relied upon the same data are also compromised. This may, in turn, affect the evaluation of project alternatives, levee fragility studies, the estimated project cost, and the projected construction schedule.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Complete new slug tests using appropriate well screen elevations (e.g., below the water table) in 7 project locations where previous tests were faulty.
2. Once the new slug test data is collected, redo levee analyses that were used to develop levee fragility curves.
3. Reassess levee slopes and dimensions as required to ensure that levee slopes are safe with appropriate factors of safety regarding slope stability and seepage.

Literature Cited:

Wylie, A., Wood, T., (1990). *A Program to Calculate Hydraulic Conductivity Using Slug Test Data, Ground Water*, 28(5):783-786.

Comment 2

It is not clear from the DIFR whether the TSP is compatible with the recovery goals for threatened and endangered fish in the basin, or with regional floodplain, water quality, and habitat planning and management efforts under implementation.

Basis for Comment

It is not clear from the DIFR/EIS whether the TSP is consistent with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS), U.S. Fish and Wildlife Service (USFWS), and State of Washington recovery plans for Chinook salmon (*Oncorhynchus tshawytscha*), Bull trout (*Salvelinus confluentus*), and related species. The 2015 USFWS Coastal Recovery Unit Draft Implementation Plan for Bull Trout Recovery notes that one of the primary threats to recovery in the Puyallup river includes flood control efforts and the resulting poor structural complexity of the aquatic habitat. One of the primary goals and actions of the USFWS plan has been the acquisition of habitat (over 8,000 acres in western Washington, according to the plan). The NOAA-NMFS Puget Sound Salmon Recovery Plan likewise identifies impaired riparian functions, fragmentation, loss of off-chan-

nel habitat, and channelization in the Puyallup river as significant factors limiting Chinook salmon recovery, and notes property acquisition and restoration efforts using (in part) local funds. A striking comment from the NOAA-NMFS Puget Sound Salmon Recovery Plan reads:

“Setback opportunities from critical areas and floodways are lost as new developments proceed in Orting, Sumner, Puyallup, and other areas. It is critical to protect remaining habitat and preserve options for restoration, especially in areas pressured by growth and development in the lower river, floodplain and estuary.”

It is not clear whether the limitations on vegetation, combined with the additional levees and floodwalls would be compatible with long-term recovery goals for Bull trout and Chinook salmon within the Puyallup basin. A significant portion of the reach of the proposed new levees along the Puyallup and White rivers do not appear at the conceptual level to include substantive setback (see Table 3-8 and Figure 3-2), which would seem to further channelize the river, isolating it from the floodplain and simplifying the habitat necessary for Bull trout and Chinook salmon recovery. The DIFR/EIS also notes that ETL 1110-2-583 limits vegetation on and adjacent to the levee and floodwall placement. Additionally, one of the issues threatening these species appears to be associated with declining water quality, including increasing temperature, dissolved oxygen, and bacteria. Thus, actions that would further simplify habitat for these species, or further impair water quality would likely have the effect of further impairing Bull trout and Chinook salmon recovery (and potentially and number of other, related species within the food web/biologic community and human populations dependent on these species.

As the above noted recovery plans include real expenditures for plan actions such as purchases of critical habitats using grant funds through the program, it seems advisable that flood protection planning be clearly coordinated with state and federal recovery plans/actions. Further, the panel understands that there are locally sponsored efforts toward buyouts and levee setbacks, and regionally commissioned watershed level assessment reports that would suggest local interest in these objectives. One of the five goals for the project noted by the USACE is to *“optimize use of natural floodplain for conveyance and storage”* (Section 3.1.1); it seems like this would be aligned with the recovery effort for threatened fish.

Comments received from the EPA and Muckleshoot Tribe during the 2011 Public Scoping Process (Appendix I) and the USFWS Fish and Wildlife Coordination Act Report (Appendix G) suggest substantive concerns related to the effects of the proposed project alternatives on fishery habitat, and made suggestions toward measures including additional levee setbacks, etc. Additionally, FEMA (Region 10) seems to suggest in their Cooperating Agency Letter (Appendix I) the importance of consistency with the NMFS Biological Opinion Reasonable and Prudent Alternative Element 5 for the National Flood Insurance Program (State of Washington), which states, in part:

“A. The FEMA shall not recognize levees that are certified by the COE utilizing COE vegetation standards unless it is demonstrated that the standard will not adversely affect species or their habitat.”

and

“D. Recognize new levees and floodwalls only if they include all of the following features:

- *the natural channel migration pattern remains intact (or if presently confined, is allowed to expand to its natural pattern),*
- *bioengineering methods are used to stabilize the banks,*
- *large wood is incorporated into the levee setback area,*

- *riparian vegetation is included in the design, and*
- *no increase occurs to upstream and downstream flood levels, volumes and velocities.”*

It is not evident from the DIFR/EIS whether or not coordination along these lines is incorporated into the USACE’s planning effort. It may be advisable at this stage of development to investigate additional opportunities to align the project with the fishery recovery goals as noted above, and regional planning efforts for habitat, floodplain, and water quality management. This might include pursuing exceptions to the Corps levee vegetation rules for all or portions of the levees in the areas identified as critical to this recovery effort, additional setbacks for new levee construction, or further investigation of buyouts as an alternative in areas where additional levee/floodwall construction is proposed (perhaps in partnership with other federal, state, local, and/or tribal entities). In the event that coordination with the applicable recovery plans for Bull trout and native salmon, along with regional floodplain, water quality, and habitat planning and implementation efforts are in fact a component of the flood protection planning effort by the USACE, the DIFR/EIS would benefit from a robust, prominent discussion in the main report to this effect.

Significance – High

Compatibility with management goals for threatened and endangered species is a fundamental issue 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.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Revise the DIFR/EIS to further consider plan action impacts on T&E species, including Bull trout and Chinook salmon, specifically discussing how the TSP and other alternatives align with the federal recovery efforts already underway, and noting specifically where they do not align or where the TSP might undermine the federal recovery efforts.
2. Revise the TSP to better incorporate recommendations from the federal recovery plans where practicable, including opportunities for acquisition/buyouts (potentially through partnerships) and additional levee setbacks.
3. Revise the TSP to demonstrate consideration and practicable coordination with regional habitat, floodplain, and water quality management planning and implementation efforts.

Literature Cited:

NMFS (2007). *Puget Sound Salmon Recovery Plan Vol. I*. Prepared by the Shared Strategy for Puget Sound Development Committee, Seattle Washington. Adopted by the NMFS, January 2007.

NMFS (2008). *Endangered Species Act Section 7 Formal Consultation Final Biologic Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation: Implementation of the National Flood Insurance Program in the State of Washington Phase One Document – Puget Sound Region*. Prepared by National Marine Fisheries Service Northwest Region, September 2008.

State of Washington (2008). *Salmon Recovery Plan Implementation: A Report on High-Priority State and Federal Actions Needed to Implement Salmon Recovery Plans*. Prepared by the Governor's Salmon Recovery Office, December 2008.

USACE (2014). *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures*. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C., April 30, 2014.

USFWS (2015). *Draft Coastal Recovery Unit Implementation Plan for Bull Trout Recovery*. Prepared by U.S. Fish and Wildlife Service Washington Fish and Wildlife Office Lacey, Washington and Oregon Fish and Wildlife Office Portland, Oregon, June 2015.

Comment 3

It does not appear that minority and low-income populations have been adequately considered in the DIFR/EIS.

Basis for Comment

Scoping comments by the EPA and Muckleshoot Indian Tribe Fisheries Division highlighted the importance of treaty protected tribal fishery access, resources, and lands, which may have both cultural and economic value to these populations. Section 4.19 attempts to address consideration of environmental justice (minority and low-income) populations within the study area.

However, as there are likely to be direct, secondary, and cumulative impacts to salmonid populations and potentially traditional tribal fishing areas as a result of actions under the TSP or Alternative 3, as identified throughout the DIFR/EIS, it is not clear how the USACE has arrived at the conclusion regarding the TSP and Alternative 3 that, *“Overall impacts from this alternative would not disproportionately affect low-income and minority populations. There appears to be no correlation between areas of transferred risk and low income and minority populations.”* Access to and sustainability of traditional fishing areas, vitality of important biologic populations (i.e., salmonids), and the cultural/economic importance of subsistence fishing to tribal and low-income populations affected by the proposed project seem to suggest otherwise.

Impacts to salmonid populations, water quality, further channelization and disconnection to the associated floodplain, and other environmental effects are likely to affect the populations that depend on them directly disproportionately to the general population in the study area. The EIS must address this issue more substantively than currently presented in the DIFR/EIS. It is highly advisable that the USACE continue to work to coordinate this effort with the affected populations moving forward, and that those efforts and USACE sensitivity to these concerns are clearly and substantively demonstrated in subsequent revisions to the EIS.

Significance – High

Failure to adequately consider impacts (direct, indirect, cumulative) to minority and low-income populations represents 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.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Revise Section 4.19 of the DIFR/EIS to better describe and analyze impacts to minority and low-income populations as a result of the project alternatives considered.
2. In the event that impacts to these populations are not adequately resolved or reduced within the scope of the considered alternatives, the alternatives should be revised or additional alternatives developed such that impacts to these populations do not disproportionately impact these communities.

Comment 4

Mitigation for project impacts to aquatic resources and habitats should clearly calculate and include compensation for unavoidable direct, indirect, and cumulative impacts.

Basis for Comment

Final determination for mitigation in the DIFR/EIS should be inclusive of all impacts associated with direct, secondary, and cumulative impacts to aquatic resources and habitats. While it is clear that the USACE is following their SMART Planning initiative, and that not all of the direct, indirect, and cumulative impacts have been determined, the conceptual mitigation proposal in Section 5.2 does not clearly address indirect or cumulative impacts associated with the project, rather than simply direct impacts. Inclusion of mitigation for indirect and cumulative impacts will be important for the accurate calculation of the final mitigation. It is doubly important given the biologic, cultural, and economic importance of many aquatic species that are represented in the aquatic community of the Puyallup River Basin.

Significance – High

Thorough demonstration of mitigation for all unavoidable impacts (i.e., direct, indirect, and cumulative) is a fundamental issue 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.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Revise the EIS to clearly demonstrate mitigation for all unavoidable impacts, including direct, indirect, and cumulative.

Comment 5

The Hydrologic Engineering Center's River Analysis System (HEC-RAS) model used for Without-Project and With-Project evaluations has a low level of calibration. The statement in Appendix B, *Hydrology and Hydraulics*, Page 24 that adjustments of Manning's coefficients with a +60% to a -15% range were made to calibrate the models is significant and tends to indicate other erroneous data.

Basis for Comment

The HEC-RAS hydrologic model was calibrated using observed flow data from U.S. Geological Service (USGS) gauge sites along the river system. The simulated model hydrographs were "visually" compared against observed hydrographs and model calibration parameters (e.g., Manning n-value) were adjusted to find the most satisfactory visual fit. This method of model calibration is generally considered the lowest level used in the state-of-the-practice today. Also, it appears that the n-value required significantly large adjustments (e.g., +60% in some cases) in order to arrive at a satisfactory visual calibration fit. This is somewhat concerning and could indicate issues with other model variables.

The process for calibration includes:

- Establishing the model parameters, determining those that will be changed for calibration, and reasonable range of parameter changes,
- Defining the observed values and locations to which the model results should reproduce,
- Determining statistical goals for the model to be considered "calibrated", and
- Performing iterative solutions and adjustment of parameters (within previously established ranges) until the calibration goals have been met.

The primary goal of the calibration process is to match the simulation results to the observed gauge data as closely as possible. The modeled error, as measured by statistical analysis, should be minimized by the calibration process. For calibration and validation efforts, several different quantitative statistics are often used to assess the overall "goodness-of-fit" between simulated discharge and observed discharge. Three of the most common statistical measures that are used include the correlation coefficient, the coefficient of determination and the Nash-Sutcliffe efficiency coefficient.

Better calibration could be realized through the use of one or more of these quantitative "goodness-of-fit" statistics. Since the overall project size and cost is so large, it would be best to improve the model calibration in this manner to have a higher degree of confidence in the model results.

By physical observation, Manning's coefficients should be set at the beginning of a modeling process and only be used with slight modifications in final calibration. A 75% swing in adjustment is beyond any normal procedure used by hydrologists. Further, there are explanations of the modeling using the storage areas and lateral weir coefficients that indicate that there was little to no information available to use to fine tune the models. Perhaps this is an area where model calibration needs to be focused rather than adjusting relatively known observations to determine Manning coefficients.

Significance – High

When calibrating a model there may be a variety of factors that are needed to be adjusted to match specific storm events or flood elevations. Using that range of Manning's factors indicates a probably issue in other related data. Even though the USACE stated in the Midpoint Conference that the final range of values was 0.03-0.10 the technique for calibration using an adjustment range Manning's coefficients from +60% to -15% is not justified. The low level of hydrologic model calibration may lead to erroneous simulation results possibly leading to overestimated or underestimated flood levels. The poorly estimated flood levels may affect the determination of project alternatives, costs, and benefits.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Further investigation into the cause of the difficulty of calibrating the models should be considered and return the Manning's coefficients to the values that were initially set based on field investigations and observations, with only minor adjustments for the final calibration.
2. On Appendix B, Page 76 (§6.2.2 Hydraulic Roughness Coefficients (Manning's "n")), it states that the factors vary the base "n" values by no more than 25%; yet as stated in the comment another section of the report states the "n" values were adjusted with a +60% to a -15% range were made to calibrate the models. The two statements seem to conflict and should be coordinated in the report.
3. Consider improving the hydrologic model calibration and validation through the adoption of one or more quantitative calibration statistics.
4. Once recalibration/validation effort is complete, reassess project alternatives, costs, and benefits.

Comment 6

The requirements for interior drainage facilities such as gatewells, pumping stations, and ponding areas have not been identified or evaluated in developing the alternative plans. This is a very important issue that can affect life and property.

Basis for Comment

The report and appendices do not contain any discussion or description of interior drainage facilities. The lack of interior drainage design features was confirmed during the Midpoint Conference call with the USACE. It was further stated that these areas are only located in lower Clear Creek and that the local sponsor is addressing this issue. Not only when precipitation falls is the interior drainage when the flood level is high and gravity drainage is prevented an issue, but there were descriptions of the levees' overtopping and flooding the interior drainage areas, both of which appear to be likely events. On page 17 of Appendix B-2, Figure 2 states that on Clear Creek, impounded floodwater has caused significant inundation of developed areas during the last few large flood events.

Under non-flood conditions, precipitation runoff occurring on the landward side of the flood protection will need to be conveyed by a gravity drainage system through the flood barrier alignment to the river. Typically, interior drainage is conveyed through the flood barrier via a gatewell that can be closed under flood conditions to prevent backflow into the protected area. The report does not identify the need or locations of gatewells needed to convey interior drainage nor does the report address any modifications required to existing stormwater systems to connect to the gatewells. Accommodating interior drainage can often require alterations or extensions of existing stormwater drainage systems. In addition, precipitation events that occur under flood conditions with blocked gravity discharge could require ponding areas and or pumping stations to prevent flooding on the interior of the flood barrier. The occurrence of precipitation events when the river level is high and gravity drainage is prevented, is a likely event. USACE local flood protection projects typically address this by the use of pumping stations and ponding areas.

FEMA requires that communities address interior drainage as a part of their participation in the National Flood Insurance Program (NFIP) where levees are provided to reduce the risk of flooding, generally with the use of gate structures, and pumping stations with designated 1% ponding areas on the upstream side of the levee to restrict development within the Special Flood Hazard Area (SFHA). Regardless of who is responsible for the issue of interior drainage, it needs to be clarified in the report.

Significance – High

The cost of interior drainage facilities for local flood protection projects has been a significant part of the project cost for many urban flood control projects. It is not clear that the need for interior drainage facilities has been evaluated or has the cost of such facilities been included in the evaluation of project alternatives. The inclusion of the cost of interior drainage facilities could have an impact on the feasibility of the proposed alternatives.

It is the responsibility of all parties, whether directly responsible for a solution or aware of a solution, to address local drainage in the report. Not only is the cost of remediation of interior drainage significant, the more important issue is the protection of life and property. If Interior Drainage is not addressed it is very possible for it to be forgotten.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. The USACE should first confirm that there are no other interior drainage issues on any of the other levees in the system.
2. The USACE should coordinate directly with whatever local partners are addressing the issue of local drainage and provide a summary in the report that states specifically what entity is responsible and what action is being proposed. It is possible that there is no funding available for the local sponsor to address the issue. FEMA Hazard Mitigation Grant funding that could be used for this issue is being reduced as a result of the National Budget Issue through FEMA; perhaps there is a cost share that can be addressed in this Project.
3. A plan should be developed for each segment of the flood barrier to accommodate interior drainage under normal conditions and under flood conditions. This plan should involve an evaluation of the existing stormwater drainage system and the provisions needed to connect the existing system with gatewells located along the flood barrier alignment. The frequency of precipitation events under flood conditions that would cause interior flooding should also be evaluated and the need for ponding areas and or pumping stations should be determined.
4. Based on the interior drainage plan, the project cost estimates should include provisions for the cost of interior drainage facilities.
5. Costs do need to be included as this is a priority, yet appears to be an ancillary item and is not addressed in the USACE TSP.

A.3 Panel Comments – Significance Medium/High

Comment 7

There appear to be errors in the application of the hydro-economic model used to develop the Expected Annual Damages and the Equivalent Annual Damages for the Without-Project Condition.

Basis for Comment

In Table 6-10 in Appendix C, *Economics*, Equivalent Annual Damages for the Without-Project Condition for the Carbon River Reach are higher than the Without-Project Future Condition Expected Annual Damages in Table 6-8. In addition, the Equivalent Annual Damages for the Upper Puyallup Reach are more than half of the Expected Annual Damages.

Comparison of the difference between the Equivalent Annual Damages and Expected Annual Damages for the five reaches shows the following:

Reach	Total Expected Annual Damages	Total Equivalent Annual Damages	Difference	% Difference
Carbon River	\$132	\$141	+\$9	+6.8%
Lower Puyallup	\$17,303	\$12,465	-\$4,838	-30%
Middle Puyallup	\$3,455	\$2,659	-\$796	-23%
Upper Puyallup	\$8,494	\$3,736	-\$4,758	-56%
White River	\$45,276	\$34,231	-\$11,045	-24%

Significance – Medium/High

This comment affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Revisit the assignment of the storage areas into economic damage reaches and the assigning of structure centroids to storage areas or river cross sections and the development of hydro-logic hydraulic inputs to the economic modeling.

Comment 8

In the Chapter 4, *Affected Environment and Environmental Consequences*, the cumulative impacts sections do not identify and describe the other projects expected to be implemented in the reasonably foreseeable future.

Basis for Comment

A cumulative impact is, *“the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.”* (40 CFR 1508.7).

Other projects (i.e., state, local, tribal, etc.) are planned and ongoing within the study area, yet it is unclear if all these projects have been accounted for as a cumulative impact with the TSP. It seems that other flood-control projects are planned and ongoing yet do not appear to have been addressed. The resolution of the uncertainties associated with these activities are expected to be notable.

Significance – Medium/High

Not identifying and describing the other projects considered in assessing the cumulative effects of the project affects the completeness or overall understanding of the recommendation or justification of the project. The resolution will determine the impact, but given the information to date, these could be significant.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Identify and describe the other projects expected, particularly other flood-control projects, to be implemented in the reasonably foreseeable future.

Comment 9

The future “With Project” and “Without Project” conditions do not include design considerations to account for predicted increases in watershed sedimentation rates, nor consideration of sediment reduction opportunities.

Basis for Comment

Studies by the University of Washington and the United States Geologic Survey indicate that future runoff in the watershed will be up to 18% while sediment loads could increase 30 to 50%. However, the USACE PDT was instructed to discount the possible climate change effects (e.g., increased runoff and sedimentation rates) in development of the TSP. The current TSP relies upon extrapolation of current sedimentation rates into the future. This approach seems to ignore the state-of-the-art scientific understanding of likely future conditions and likely underestimates the future water surface profiles in the watershed.

Additionally, it does not appear that the considered alternatives fully reflect opportunities for sediment management through reduction efforts. For example, in Section 4.11, *Aquatic Habitat*, the DIFR/EIS notes that, “...*high sediment load was also identified as a significant habitat factor in the Greenwater River and Huckleberry Creek. Poor road management leading to increased runoff was indicated as a large contributor (Pierce County 2012a).*” While these areas are higher up in the system, it seems plausible that eventually these inputs would contribute to the overall sediment loads in the system. However, it is not clear whether the USACE has considered working with federal partners in the Forest Service to reduce these loads as part of the overall sediment management plan for the basin.

Section 3, Table 3-2, includes a number of management measures for sediment reduction that were not initially screened out, but that did not find inclusion in the three considered alternatives. However, it is not clear whether any of these measures could be added to the TSP measures. Also, there may be sediment management and/or reduction measures available in the upper portion of the watershed that have not been considered, but that might provide (individually or in combination with other measures) sediment management and reduction opportunities valuable for consideration in the overall scope of measures considered.

The DIFR/EIS should be revised to include sediment transport modeling of current conditions and future conditions including likely climate change effects, additional levee super-elevation as required to

account for increased sedimentation rates in the watershed, and consideration of sediment reduction opportunities where practicable.

Significance – Medium/High

By excluding the likely effects from climate change in the watershed, the project design levee elevations may be underestimated leading to higher residual risk of catastrophic failures than is presented in relation to the current TSP.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Proceed with, and complete, sediment transport modeling of current conditions and future conditions including likely climate change effects.
2. Include additional levee super-elevation as required to account for increased sedimentation rates in the watershed.
3. Include a more robust discussion of potential sediment reduction measures and opportunities.

Comment 10

The evaluation criteria in Table 3-5, *Criteria, Metrics and Rating Scale for Evaluation of Initial Array of Alternative Plans*, do not match the criteria presented in Table 3-6, *Evaluation of Initial Array of Alternative Plans*; it is not clear whether this may have affected the alternative selection as a result.

Basis for Comment

Main Report, Section 3.2.3, *Evaluation and Screening of Initial Array of Alternative Plans*: The listed evaluation criteria and scoring in Table 3-5, *Criteria, Metrics and Rating Scale for Evaluation of Initial Array of Alternative Plans*, do not match the results presented in Table 3-6, *Evaluation of Initial Array of Alternative Plans*. For example, “Implementation Cost” and “Operation & Maintenance (O&M) Cost” scores listed in Table 3-5 do not appear to be considered in Table 3-6.

Significance – Medium/High

The presentation of the evaluation criteria and scoring affects the completeness or overall understanding of the justification of the project. Inconsistency as presented between the criteria and scoring implies that there were additional steps not described in the DIFR/EIS or that there is a significant flaw in the evaluation/scoring, potentially having led to an alternative that would not otherwise be justified. Resolution of the issue will determine if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Revise the Tables and related text in Section 3.2.3 of the Main Report, to show that the evaluation and scoring criteria were in fact the same, without omissions.
2. In the event the criteria are not consistent as described in recommendation 1, revise the supporting text to detail and provide rationale for any inconsistencies between the criteria captured in Table 3-5 and Table 3-6 of the Main Report.

Comment 11

The DIFR/EIS does not sufficiently address invasive species in relation to the project study area and alternatives.

Basis for Comment

There are numerous invasive species of plants and animals common to the Pacific Northwest (e.g., English ivy (*Hedera helix*), largemouth bass (*Micropterus salmoides*), and others) that may pose concerns for the project. While some of these are identified, DIFR/EIS does not sufficiently address potential issues regarding invasive species in relation to the TSP. Invasive species can thrive under circumstances where there is recent disturbance (i.e., post-construction), and outcompete native species for resources such that native species may be diminished or displaced by the proliferation of invasive species, resulting in the functional and/or physical loss of biologically or culturally important species and their services from the system.

As Alternatives 2 (TSP) and 3 would both result in substantive disturbance due to project related activities, further consideration regarding invasive species is warranted. The DIFR/EIS should better identify steps to avoid proliferation of these species during construction, and steps for monitoring and control post-construction.

Significance – Medium/High

Consideration of invasive species identification, control, and monitoring as it relates to project alternatives affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Revise the DIFR/EIS to include substantive plans for monitoring and control of invasive species during and post-construction.

Comment 12

Additional discussion of Hazardous, Toxic, and Radioactive Waste (HTRW) may be warranted within the DIFR/EIS.

Basis for Comment

There are several areas within the Puyallup and White rivers adjacent to proposed new levee/flood-wall development in the TSP (Alternative 2) and Alternative 3 that are listed on the state 303d list for contaminants including arsenic, lead, zinc, and mercury. The DIFR/EIS notes, “*Per ER 1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects, HTRW includes any material listed as a “hazardous substance” under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq. (CERCLA).*”

However, the document does not appear to fully address these extant, legacy pollutants at this stage of development. It would not be entirely unexpected to find elevated levels of these toxicants in upslope soils and sediments adjacent to the contaminated instream sediments. As this section of the DIFR/EIS develops, it would be helpful to expand the discussion on legacy pollutants to be more inclusive of heavy metals noted in the 303d list, particularly in areas where disturbance of the streambed sediments and/or adjacent floodplain soils is likely as a result of construction activities or changes in hydrology associated with the project.

Significance – Medium/High

Lack of comprehensive information on legacy pollutants associated with the Puyallup river system affects the completeness and overall understanding of the recommendation and justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Expand discussion regarding HTRW to include additional information regarding metals of concerns in the study area adjacent to construction and/or areas where disturbance of sediments/soils within river and floodplain is likely.

Comment 13

The DIFR/EIS needs a more robust discussion regarding the structure of, and potential impacts to, the biologic community within the study area.

Basis for Comment

The DIFR/EIS contains some information regarding the biologic community in, and adjacent to, the Puyallup and White rivers, but needs additional depth of discussion regarding community-level biology of the system, including interactions/important relationships between species, and impacts associated with the TSP that might interfere with these interspecific relationships. While the EIS notes a number of fish and benthic organisms present in the system (Main Report, Section 4.12, *Fish and Wildlife*), it fails to identify substantive links between these different populations and what the long-term effects of losses or population shifts to benthic and demersal populations on the system might be.

For example, what might be the result to the biologic community as whole if increased scour and sedimentation were to “...change invertebrate communities to more tolerant taxa like snails and fly larvae and decrease optimal taxa like mayflies, caddisflies, and stoneflies”? Could this negatively impact species of concern (i.e., salmon, Bull trout, etc.) either directly or indirectly? If so, how and to what likely degree?

Additionally, it is not clear from the EIS whether the study area supports native species of freshwater mussels, whether impacts to these species might be expected, the potential effects, and any steps to avoid/mitigate impacts to these species.

Additional depth of discussion in regard to population level interactions within the biologic community of the system is necessary to provide insight regarding secondary and cumulative effects of the proposed action. This is also the case with the riparian and floodplain communities, which are currently summarized with too much brevity to provide meaningful insight.

This is extremely important, as many populations within the greater biologic community are ESA listed species (i.e., salmonids, others) and/or have special importance to tribal communities and economic interests in the region. Interestingly, the 2008 NMFS Biological Opinion for the National Flood Insurance Program (State of Washington) notes that reduction to salmonid populations would result in secondary effects to the Southern Resident Killer Whale populations (also ESA listed). As community level interactions are of substantive importance to individual populations within a biologic community, and the abundance, regional importance, and recovery status of many of the populations in the study area community are notably important, a critical, robust analysis and discussion in the DIFR/EIS is warranted and encouraged.

Significance – Medium/High

Lack of comprehensive information on the community biology of the system and effects of the TSP (secondary and cumulative) affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Revise the DIFR/EIS to provide more in-depth discussion of the community biology of the aquatic system, including interactions/important relationships between species, and any secondary and/or cumulative effects related to potential impacts to populations within the resident communities that might result from actions initiated under the TSP and other alternatives.

Literature Cited:

NMFS (2008). *Endangered Species Act Section 7 Formal Consultation Final Biologic Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation: Implementation of the National Flood Insurance Program in the State of Washington Phase One Document – Puget Sound Region*. Prepared by National Marine Fisheries Service Northwest Region, September 2008.

Comment 14

It is not clear from discussion on cumulative effects whether either of the considered alternatives might spur additional development behind the flood protection improvements, thereby increasing stressors on the aquatic system and biologic community.

Basis for Comment

Development and improvement to infrastructure often leads to secondary development associated with those improvements, resulting in increased impervious surfaces, runoff volume, nonpoint pollutant inputs, proliferation of invasive species, etc. While the cumulative effects discussion in the EIS (i.e., Section 4.18.4, others) notes the potential for additional development restrictions and current restriction on development within the floodplain, it is not clear whether the improved infrastructure could reasonably encourage additional development (i.e., commercial, industrial, and/or residential) that in combination with the projected growth in Pierce and King counties might lead to indirect or cumulative impacts as a result.

Further, it is a concern whether the proposed levees might inadvertently exacerbate potential issues during a flood event in the event of a levee failure by protecting infrastructure developed in the floodplain prior to these improvements due to continued sediment accretion in the river and resultant flow velocities, and impoundment behind the levees/floodwalls. Protection of vulnerable infrastructure through the placement of levees/floodwalls versus other methods in light of the projected sediment loads anticipated by the USGS may result in increased vulnerability and recovery costs in the future.

As secondary and cumulative impacts in this system have the potential to affect ESA-listed species, minority and low-income populations, cultural resources (i.e., tribal interests), and economic inter-

ests, a robust analysis of these issues becomes critical to fully evaluating the proposed project alternatives, and could affect the alternatives analysis and selection of the TSP. This is also important to demonstrate compliance with EO 11988 and ER 1165-2-26.

Significance – Medium/High

Robust discussion regarding secondary (indirect) and cumulative impacts/effects affects the completeness and overall understanding of the recommendation and justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

- 1. Revise the DIFR/EIS to address the above noted concerns.

Literature Cited:

Executive Order (EO) 11988, *Floodplain management*, May 24, 1977, 42 FR 26951, 3 CFR, 1977 Comp., p. 117, Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

Engineering Regulation (ER) 1165-2-26, *Water Resources Policies and Authorities, Implementation of Executive Order 11988 on Flood Plain Management*, USACE, 30 March 1984

Comment 15

It is not clear whether the TSP (or other alternatives) adequately considered protection of the floodplain and wetlands in the scoping, formulation, and selection processes.

Basis for Comment

Section 5.9 provides an overview of EO 11988 and ER 1165-2-26, but does not adequately address the specific measures under the TSP that would protect floodplain values nor does it make an attempt to demonstrate any evaluation or documentation of the 8-step process described in the EO that would have been tentatively developed to date. Rather, Section 5.9 concludes by stating:

“The feasibility-level design analysis and optimization of TSP features for National Economic Development (NED) will include evaluation and documentation of the eight-step process to comply with the EO. The approach will include an evaluation of potentially developable land in the floodplain for the No Action Alternative and refined NED Plan.

Economic drivers such as population projections and development demand will also be considered as part of this analysis. Impacts to life safety, evacuation routes and critical infrastructure will also be documented in support of this analysis in the final FR/EIS.”

The DIFR/EIS should contain a more substantive analysis of compliance of the TSP with this EO, rather than displacing this to the FIFR-EIS. Even with the understanding that the USACE SMART Planning initiative incorporates less detailed information to reach decision points more efficiently than in the past, the DIFR/EIS should at least include a tentative effort to outline the developable land in the floodplain and secondary development as a result of proposed flood protection infrastructure, population projections, etc. This is particularly true given the scoping comments provided by the EPA and tribal representatives during public scoping in 2011, the USFWS Fish and Wildlife Coordination Act Report provided in 2014, and the plethora of local and federal watershed level coordination efforts and reports, fishery recovery plans, etc., that have been developed and are under implementation within the Puyallup River Basin. It is also odd, given one of the five objectives for the project noted by the USACE is to “optimize use of natural floodplain for conveyance and storage” (Section 3.1.1), suggesting that this would be an important consideration and design element of the TSP.

Failure to adequately incorporate this information at this stage of development may preclude substantive review of the TSP and other alternatives sufficient to provide additional information or input toward the FIFR-EIS, and suggests that there may not have been adequate consideration of this issue during plan formulation and selection of the TSP.

Significance – Medium/High

Failure to adequately address specific measures under the TSP that would protect floodplain values affects the completeness or overall understanding of the recommendation or justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Revise the EIS to include substantive discussion regarding how the TSP does or does not meet the objectives of EO 11988, including clear, detailed evaluation and documentation.
2. In the event that the TSP does not substantively meet the four directives under EO 11988, the EIS should clearly and substantively document why the TSP is the only practicable alternative, or be subsequently reevaluated and revised to comply the goals of the directives.

Comment 16

It is not clear from the DIFR/EIS if the selected study area is sufficient in scope to fully address the magnitude of the problem the USACE is attempting to resolve.

Basis for Comment

It is not clear from the DIFR/EIS of supporting documents whether the selected study area is sufficient to address the system-level management issues that are under investigation. As the Puyallup River Basin appears to be highly affected by events and sediments originating in the upper portion of the watershed, the determination to develop solution exclusively within the lower reach of the system may not prove to be effective over the study period. This is exacerbated by the likely increases in sediment supply noted by the USGS in relation to effects of climate change.

The EIS should better describe the decision making that has gone into the determination of the study area, in an effort to determine whether there may be opportunities for additional or alternative measures within the system that are currently precluded by the restricted study area. There may be opportunities to manage sediment in the upper portion of the watershed that are not evident in the current study, that may also allow for further reduction to impacts in the lower watershed, potentially providing an overall plan that better addresses the objectives set out in Section 3.1.1 of the EIS.

Significance – Medium/High

Consideration and discussion of the selected study area affects the completeness and overall understanding of the recommendation and justification of the project. Resolution of the issue determines if it is fundamental problem with the project or not.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Additional discussion should be added to the EIS describing the selection/determination process for the selected study area.
2. The study area should be reevaluated to determine whether a larger study area might offer more options for sediment management and flood protection that might be incorporated into the TSP while further reducing impacts to aquatic habitat (or even improving aquatic habitat) and better aligning with T&E fishery recovery plans previously noted.

A.4 Panel Comments – Significance Medium

Comment 17

Only limited geotechnical site characterization was completed (by others) for the White River segment of the TSP even though this portion of the plan appears to provide a majority of the economic benefits presented in the DIFR/EIS.

Basis for Comment

The engineering completed as part of the DIFR for the White River portion of the project does not satisfy the requirements for a feasibility report (USACE, 1999). The additional geotechnical work recommended could reveal significant issues that have substantial impact on the project design, cost, and schedule. The engineering requirements not satisfied for the White River portion of the project include:

- Completion of appropriate geotechnical explorations in the area of proposed new levee segments along the White River;
- Development of an updated geologic model of the site;
- Development of an updated levee foundation study including soil characteristics along the levee centerline as well as perpendicular to the levee right-of-way;
- Slope stability analyses of the levee design using the appropriate field data;
- Development of an updated seepage model of the levee foundation using appropriate field data; and,
- Settlement analyses of levee footprint.

Significance – Medium

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

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Complete the required field investigations and testing as outlined in ER 1110-2-1150 (USACE, 1999) and EM-1110-2-1913 (USACE, 2000) to allow appropriate design of project features.
2. Develop a geologic model as outlined in EM 1110-2-1913 (USACE, 2000) and ER 1110-2-1150 (USACE, 1999).
3. Complete additional subsurface investigations at the proposed levee sites to identify the foundation conditions including extent of both cohesive soils (e.g., silt) and cohesionless soils (e.g., gravels and silty-sands) so these materials can be accurately evaluated through the use of seepage, settlement, and slope stability analyses.
4. Test in situ soils along the levee alignment to verify the estimated range of material properties, including hydraulic conductivity.
5. Consider the use of feasibility-stage levee side slopes of 5H:1V as recommended in EM 1110-2-1913 (USACE, 2000) in areas where only preliminary slope stability analyses have been completed based upon gross parameter assumptions instead of site-specific parameters.

Literature Cited:

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

Comment 18

Background Hydrology was performed by Northwest Hydraulic Consultants (NHC) but that data source is not clearly defined in report.

Basis for Comment

After reading the reports it was not clear until the Midpoint Conference that the USACE based their TSP and alternatives on hydrology data and analyses located in a previous report prepared by NHC and that background information for this report is not appended.

Significance – Medium

The basis of the original data needs to be provided and/or referenced for use by the reviewer when reviewing the document.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Provide a specific reference to the source document for the hydrologic analyses both in the report narrative and in the reference section.

Comment 19

The ability of usage storage in Mud Mountain Dam (MMD) to limit flows to a zero discharge under certain conditions as described in Appendix B, *Hydrology and Hydraulics* (page 39, §5.2.4, last bullet), is unclear and uncertain. As discussed during the Midpoint Conference, additional explanation is warranted so the capacity of MMD is not misconstrued.

Basis for Comment

In Appendix B, *Hydrology and Hydraulics*, (page 39, §5.2.4, last bullet), it states, “for return intervals where the local and unregulated flow is greater than 50,000 cfs, no Mud Mountain flow is added. Presumably Mud Mountain discharge would be zero during the peak.” of the downstream unregulated watershed. Our question during the Midpoint Conference was whether there is always sufficient storage to be able to hold back releases during high flow events? What about sequential repetitive storm events that don’t allow the time for MMD to drawdown to have additional storage? The explanation on Page 53 of Appendix B assumes that there are subsequent storm events; however, tracking storm events is not uncommon and so there could still be a coincident peak. On Page 6 of the Appendix B-2, it states that Climate Change in the region is expected to have more frequent storm events. These could align to be considered as “tracking” storms. With the projection of Climate Change in the basin translating a current 1% event to a 20-yr storm the capacity of MMD will be critical.

Significance – Medium

If there is sufficient storage in MMD to maintain a zero discharge during high frequency storms so as not to combine with downstream unregulated flows that is unexpected. If there is sufficient storage in MMD to maintain zero discharge for repetitive storm events so as not to combine with downstream unregulated flows that is highly unlikely. The result of not being able to maintain the conditions of the statements results in higher discharges from MMD combined with unregulated downstream flows resulting in unpredicted flooding and potential higher water surfaces resulting in additional damage and/or death.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. As discussed during the Midpoint Conference call, additional investigation into the Northwest Hydraulic Consultants (NHC) hydrology model report and review of the regulatory scheme is warranted, resulting in either confirmation of the statements in the Appendix B, *Hydrology and Hydraulics*, or revision of the wording to accurately represent the determined results.

Comment 20

Since a significant amount of sediment is produced within the national park boundaries, consideration could be made to create a “sedimentation basin(s)” within in the national park to capture the sedimentation prior to it entering the White and Puyallup river systems.

Basis for Comment

On Page 7 of Appendix B-2, it states, “A significant amount of sediment can be produced from within the national park boundaries”.

Significance – Medium

It would seem that if a significant amount of sediment is created in the national park areas, where there is normally no manmade development, the use of large sedimentation basins could be considered to capture the glacial material at its source before it enters the study reaches of the rivers and thus would minimize the deposition in the developed reaches and the leveed reaches of the lower basin. When considering future deposition with magnitudes of ½-million to over 1-million cubic yards of deposition on any single reach of the rivers (Appendix B-2, Table 2, Page 12), an alternative approach to just “handling” the deposition in the traditional manner may be warranted.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. With the anticipated projected level of deposition and dredging required in the lower reaches under the existing river basin operating scenario, a concept of capturing the glacial material before it enters the river systems might be considered.

Comment 21

Consideration should be given to utilizing modified levee sections along River Road to decrease the length of a costly floodwall.

Basis for Comment

The report indicates that the River Road floodwall varies from 3 to 6 feet in height. For these relatively low heights, other projects have utilized rock fill with a 1V:1 1/2H riverward slope, in combination with a 10-foot top width and an impervious zoned landside section with a 1V to 3H slope. The use of this type of a levee section would reduce the width of the section and may allow levee construction along parts of River Road, thereby reducing the length of a costly floodwall. An impervious downstream levee slope would prevent significant steady-state seepage to develop under the short-term flood loading conditions.

Significance – Medium

The use of a modified levee section would reduce the overall project cost without sacrificing the functioning of the flood barrier.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. During the feasibility design stage, a review of the alignment of the flood barrier along River Road should be conducted to evaluate potential locations where alternate levee sections can be utilized to replace the proposed floodwall. This review should include consideration of whether the placement of rock fill along the riverward levee slope would significantly decrease the channel capacity and thereby have a significant effect on the flood profile.

Comment 22

Consideration should be given to increasing the design height of the concrete floodwall sections above the height of the earth levee sections.

Basis for Comment

The design profile for the flood barrier is based upon a flood event with a 100-year frequency. The design profile includes an evaluation of both hydrologic events and the impact of future sediment deposition on flood level profiles. Construction of a flood protection system will serve to encourage development and increased hazard potential in the protected areas landward of the flood barrier. In the event of a flood event that exceeds the design frequency, it is likely that emergency flood fighting would occur to raise the level of the protection. This could be accomplished on the levee section by the use of sandbags or increased earth fill. The concrete floodwall sections however could not be effectively raised in the face of flood events that exceed the design height of the wall. Increasing the design height of the floodwall section by 1 foot +/- relative to the levee sections would allow for an emergency increase in the flood protection for more extreme flood events and would decrease the likelihood of damages due to overtopping of the flood barrier.

Significance – Medium

Increasing the height of the floodwall sections of the flood barrier by approximately 1 foot would provide the opportunity for a future flood fighting efforts for floods that exceed the anticipated design events

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. During the feasibility design stage, consideration should be given to increasing the height of the floodwall sections of the flood barrier as compared to the levee sections. The allowable factors of safety for the design of the floodwall for extreme flood events could be decreased since the walls would only be loaded under an extreme emergency event.

Comment 23

Consideration should be given to decreasing the height of the flood barrier on the downstream end of each reach of floodwall, or levee, such that if the barrier overtops the protected area will be inundated by floodwater flowing upstream rather than water flowing through the protected area at high velocities.

Basis for Comment

The level of flood protection provided by the project can be exceeded by extreme flood events with return periods greater than 100 years. Developing a flood barrier profile such that an overtopping event will not create harmful, high-velocity flows through the inundated area will serve to minimize damages under an overtopping event.

Significance – Medium

Minimizing the hazard and damage potential created by a flood event that overtops the flood barrier is a prudent design consideration.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Consideration should be given to development of a flood barrier profile that insures that an extreme flood event will not allow overtopping flows to inundate protected areas by flowing through the formerly protected areas in a downstream direction.

A.5 Panel Comments – Significance Medium/Low

Comment 24

It is not clear how the management measures considered during plan formulation were assembled into the considered alternative plans; it appears that measures may have been omitted from the final array of alternatives based on which alternative they were including, rather than their efficacy in addressing the project goals, potentially affecting both the range of alternatives analyzed and the final selection (TSP).

Basis for Comment

To ensure that sound decisions are made with respect to the development of alternatives the guidance for conducting Corps Civil Works planning studies, ER 1105-2-100, *Planning Guidance Notebook*, requires the systematic formulation of alternative plans.

Section 3.1 indicates that the USACE identified 29 initial management measures (Table 3-2) to address the 5 project objectives. The measures were either carried forward or screened out from further consideration based on the screening criteria presented in Table 3-1. In a few instances, measures were screened out, but considered for inclusion as features in other measures (i.e., hardened vegetative buffer and installation of stream gage measures). Measures carried forward were sited and subsequently assembled into eight initial alternative plans.

It is at this point that the process becomes somewhat unclear as it is presented in the DIFR/EIS. The management measures appear to have been assembled into the initial alternatives based on “measure type” in the siting process (Table 3-3). Thus, the initial alternatives included measures that are “clustered” based on whether the measure fits a category (i.e., nonstructural, sediment management, etc.). Some management measures are duplicated between alternatives, while others are unique to a given alternative.

Subsequently, it is not clear whether there might be individual management measures that were screened out based on the alternative in which they were included but may benefit the TSP (or other alternatives) by their inclusion. Table 3-7 indicates this would be the case for the sediment trap measure, but does not do so for other measures (i.e., creek management, overbank storage, bank stabilization) that might have added value for other alternatives (including the final array of alternatives), or may have been combined into a new (additional) alternative that has not been considered as a result. The exclusion of specific management measures may be tied to the cost/benefit of the respective measure vs. other plan measures, but the text should include a more robust discussion in this regard.

Significance – Medium/Low

This affects the technical quality and understanding of the project based on the presentation of information related to the recommendation or justification of the project. However, the panel does not have sufficient information to determine the effect on project implementability.

Recommendation for Resolution

The Panel has devised the following recommendations related to this comment:

1. Provide more thorough clarification in the text regarding individual management measure inclusion or removal from the TSP.
2. Provide a summary of the initial measures, final management measures, and initial array of alternatives considered and why they were eliminated from consideration in the Plan Formulation Appendix prior to the Evaluation/Comparison of the Final Array of Alternatives.

A.6 Panel Comments – Significance Low

Comment 25

In Chapter 4, *Affected Environment and Environmental Consequences*, no distinction is made as to whether the expected environmental effects of alternatives are direct or indirect effects.

Basis for Comment

Council for Environmental Quality (CEQ) regulations state that direct effects “*are caused by the action and occur at the same time and place*” (40 CFR 1508.8) while indirect effects “*...are caused by the action and are later in time and farther removed in distance, but still reasonably foreseeable*”.

Significance – Low

Not making a distinction between direct and indirect effects affects the technical quality and understanding/clarity of the project based on the presentation of information related to the recommendation or justification of the project, but there is limited concern regarding project implementability.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Indicate whether the environmental effects identified are direct or indirect effects of the project.

Comment 26

The Civil Engineering design appendix (Appendix E) does not include a cross section of the proposed floodwall along River Road showing the relationship of the floodwall to the road and to the adjacent

river slope, which would provide a better understanding of the configuration of one of the more costly segments of the overall project.

Basis for Comment

One of the costliest segments of flood barrier in the project is the 4.3-mile-long floodwall along River Road in the Lower Puyallup segment of the project. Appendix E contains numerous levee sections but does not show the configuration of the floodwall along the river bank. Although Appendix D (structural) contains numerous cross-sections of the structural configuration of the floodwall, there is no information on how the floodwall relates to the adjacent roadway and the channel on the river word side of the floodwall. It would be helpful if these types of cross-sections could be provided and also included in the final report.

Significance – Low

The inclusion of a complete flood barrier cross section would provide a better understanding of the configuration of one of the more costly segments of the overall project.

Recommendation for Resolution

The Panel has devised the following recommendation related to this comment:

1. Include one or two cross-sections located along the river road floodwall segment of the flood barrier in Appendix E of the report.

Appendix B Charge for the Panel

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

“Puyallup River Basin, Pierce County, Washington, Flood Risk Management General Investigation, Draft Integrated Feasibility Report and Environmental Impact Statement”, USACE, March 2016

“Appendix A, Plan Formulation”, USACE, March 2016

“Appendix B, Hydrology and Hydraulics”, USACE, March 2016

“Appendix C, Economic Analysis”, USACE, March 2016

“Appendix D, Structural Engineering”, USACE, March 2016

“Appendix E, Civil Engineering”, USACE, March 2016

“Appendix F, Geotechnical Engineering”, USACE, March 2016

“Appendix G, Environmental and Cultural Resources”, USACE, March 2016

“Appendix H, Hazardous, Toxic and Radioactive Waste Assessment”, USACE, March 2016

“Appendix I, Public Involvement”, USACE, March 2016

Public comments from the NEPA Public Review of the DIFR/EIS, (USACE) compiled 23 May 2016, 118 pages

B.1 Final Charge Questions and Relevant Sections

The following Charge to Reviewers outlines the objective of the Independent External Peer Review (IEPR) for the subject study and the specific advice sought from the IEPR panel.

The objective of the IEPR is to obtain an independent evaluation of whether the interpretations of analysis and conclusions based on analysis are reasonable for the subject study. The IEPR panel is requested to offer a broad evaluation of the overall study decision document in addition to addressing the specific technical and scientific questions included in the charge. The panel has the flexibility to bring important issues to the attention of decision makers, including positive feedback or issues outside those specific areas outlined in the charge.

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

Panel review comments are to be structured to fully communicate the panel’s intent by including the comment, why it is important, any potential consequences of failure to address, and suggestions on how to address the comment. The IEPR Performance Work Statement provides additional details on how comments should be structured.

Broad Evaluation Charge Questions

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

Given the need for and intent of the decision document, assess the adequacy and acceptability of the following:

3. Project evaluation data used in the study analyses,
4. Economic, environmental, and engineering assumptions that underlie the study analyses,
5. Economic, environmental, and engineering methodologies, analyses, and projections,
6. Models used in the evaluation of existing and future without-project conditions and of economic or environmental impacts of alternatives,
7. Methods for integrating risk and uncertainty,
8. Formulation of alternative plans and the range of alternative plans considered: Were the processes and methodologies used to evaluate and compare alternatives and to select the tentatively selected plan adequately described and within the study constraints?
9. Quality and quantity of the surveys, investigations, and engineering sufficient for conceptual design of alternative plans and identified risks, and

Further,

10. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable, and
11. Assess the considered and tentatively selected alternatives from the perspective of systems, including systemic aspects being considered from a temporal perspective, including the potential effects of climate change.
12. Within the context of risk-informed decision making, are the quality and quantity of the surveys, investigations, and engineering sufficient for a concept design and to support the models and assumptions made for determining the hazards?
13. Have the hazards and risks that affect the flood management structures been adequately documented and described?
14. Are the models used to assess hazards appropriate?
15. Are the assumptions made for the hazards appropriate?
16. 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?
17. Are potential life safety issues accurately and adequately described under existing, future without project, and future with project conditions?
18. From a public safety perspective, is the proposed alternative reasonable?

For the tentatively selected plan, assess whether:

19. The models used to assess life safety hazards are appropriate,
20. The assumptions made for the life safety hazards are appropriate,

21. The quality and quantity of the surveys, investigations, and engineering are sufficient for a concept design considering the life safety hazards and to support the models and assumptions made for determining the hazards, and
22. The analysis adequately addresses the uncertainty and residual risk given the consequences associated with the potential for loss of life for this type of project.

Specific Technical and Scientific Charge Questions

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

Environmental Considerations

24. Does the environmental documents and analysis satisfy the requirements of NEPA? Were adequate considerations given to significant resources by the project?
25. Are mitigation measures clearly described and discussed?
26. Are the scope and detail of the potential adverse effects that may arise as a result of project implementation sufficiently described and supported?
27. Are cumulative impacts adequately described and discussed?

Geotechnical Engineering

28. Is the description and assumptions of the geomorphic and physiographic setting of the proposed project area accurate and comprehensive?
29. Were the geotechnical analyses adequate and appropriate for the current level of design as presented in the report documentation?
30. Has the basin's levee system been characterized adequately, especially in the context of levee fragility, for the determination of necessary levee improvement alternatives?

Hydrology and Hydraulics

31. Within the context of risk-informed decision making, are the assumptions sufficient to support sound engineering analyses?
32. Were all models and methods used in the H&H analyses developed and used appropriately?
33. Are the design assumptions appropriate in developing the alternative plan conceptual designs?
34. Was the hydrology and hydraulic discussion sufficient to characterize current baseline conditions and future conditions?
35. Are the residual risks adequately described and discussed?

Economics

36. Were the methods to develop the depth-damage relationships appropriate and were the generated results applicable to the study area?
37. Is the methodology to determine structure and content to structure value appropriate?
38. Within the context of risk informed decision making, are the assumptions sufficient to support sound economic analyses?

39. Were the benefit categories used, flood damages assessment, flood damage reduction assessment adequate to calculate the benefits and annual expected damages for each alternative?
40. Were risk and uncertainty adequately considered in relation to future development?

Cost Engineering

41. Is the tentatively selected plan's total project cost reasonably identified and justified to support the benefit cost analysis?

Design

42. Have the design and engineering considerations and assumptions been clearly presented?

Appendix C Organizational Conflict of Interest (COI) Forms

C.1 LMI COI Form

Conflicts of Interest Questionnaire

Independent External Peer Review

PUYALLUP RIVER BASIN, WA,

FLOOD RISK MANAGEMENT GENERAL INVESTIGATION

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

NAME OF FIRM: Logistics Management Institute
REPRESENTATIVE'S NAME: Stephanie White
TELEPHONE: 571-766-9923
ADDRESS: 7940 Jones Branch Drive, Tysons, VA 22012
EMAIL ADDRESS: swhite@lmi.org

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

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

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

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

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


YOUR SIGNATURE

10 Feb 2016
DATE

C.2 APMI COI Form

Conflicts of Interest Questionnaire
Independent External Peer Review

**PUYALLUP RIVER BASIN, WA,
FLOOD RISK MANAGEMENT GENERAL INVESTIGATION**

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

NAME OF FIRM: Analysis Planning and Management Institute
REPRESENTATIVE'S NAME: Ahmad Faramarzi
TELEPHONE: 540-321-4888
ADDRESS: 101 E. Culpeper Street, Suite 150, Culpeper VA 22701
EMAIL ADDRESS: ahmad.faramarzi@apm-inst.org

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

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

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

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

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

Ahmad Faramarzi
YOUR SIGNATURE

Digitally signed by Ahmad Faramarzi
DN: cn=Ahmad Faramarzi, o=APMI,
ou, email=ahmad.faramarzi@apm-
inst.org, c=US
Date: 2016.02.10 16:11:08 -0500

2/10/16
DATE

Appendix D Review Panel Members' Qualifications

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

D.1 Prof. Donald Ator

Position: Research Associate, Professor, and Undergraduate Advisor

Affiliation: Louisiana State University, Baton Rouge, LA

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

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

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

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

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

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

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

D.2 Dr. Christopher Brown

Position: Associate Professor

Affiliation: University of North Florida, Jacksonville, FL

Dr. Brown is an Associate Professor at the University of North Florida (UNF) teaching civil engineering, fluid mechanics, hydraulics, senior design, and engineering geology. He earned his Ph.D. in civil engineering in 2005 from the University of Florida, his Master's Degree from Villanova University in 1997, and his B.S. degree in civil engineering from Temple University in 1991. He has over 25 years of experience working on public works projects for the City of Philadelphia, Waste Management, U.S. Army Corps of Engineers (USACE), and for Golder Associates Inc. as a private consultant for various complex civil engineering projects. While working for the USACE, he worked within the Planning, Engineering, and Construction Divisions during his tenure. He was consistently recognized for his excellent technical skills including award of "engineer of the year" twice over 16 years with USACE. He has also recently been recognized for excellence in teaching and mentoring with award of several teaching accolades at UNF and the national Bliss Medal from the Society of American Military Engineers (SAME).

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

Dr. Brown has worked on the geotechnical side of water resources and the hydrologic modeling side of design and modeling projects. Dr. Brown has completed both stability studies using Slope/W and UTEXAS and seepage studies using SEEP/W, Seep2D, and MODFLOW. Dr. Brown has used reliability and stochastic analysis studies on all types of water resources projects dating back to version 1.0 of "@Risk" software. Dr. Brown served on the first Corps of Engineers Ad-hoc committee on levee assessment, which included the initial development of the current USACE fragility curve/risk management design approach.

Dr. Brown has extensive knowledge of USACE cost estimating systems with direct experience using MCACES and working knowledge of M2. Dr. Brown has also developed his own risk-based cost estimates using both @Risk and Crystal Ball. He is experienced in developing estimated construction costs and is knowledgeable regarding construction methods related to large civil works projects including levee design, floodwall design, box culverts, bridge pier modifications, utility relocations, and drainage structure design. Dr. Brown has acted as cost-estimating IEPR reviewer on some of the largest civil works projects in USACE including the most expensive lock and dam replacement in USACE history.

Dr. Brown is familiar with, and has participated in, the design of floodwalls and gated structures, as well as non-structural flood mitigation solutions (e.g., buy-out or minor flood proofing). Specific project examples of direct design experience include Molly Ann's Brook project (included t-walls, l-walls, underpinning of buildings, levee, bridge modification), Portugués Dam (included access road, foundation prep,

arch dam, drainage gallery, rock bolts), and City of Savannah storm sewer upgrade (included new conduit, cut/fill construction, utility relocation and hardening, vibration monitoring). Dr. Brown was also a key designer for the F. E. Walter Dam access road replacement (on design team and field inspection) as well as the design of new bridges across Everglades National Park along the Tamiami Trail in Florida. Dr. Brown has also been involved in other large civil works projects including C&D Canal Deepening Project in MD and DE and the Delaware Main Channel Deepening Project in PA and NJ.

D.3 Prof. James Dobberstine

Position: Chair of the Math, Engineering, and Sciences Division (MES); Community ecologist, wildlife biologist, ecological modeler

Affiliation: Lee College, Department of Environmental Science, Baytown, TX

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

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

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

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

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

D.4 Mr. Willard B. Smith

Position: Hydrology and Hydraulic (H&H) Engineering

Affiliation: Hydropower International Services Inter-National Consultancy (HISINC), LLC, Mannford, OK

Mr. Smith has over 41 years of experience as a hydrologist. He has used this expertise on many hydroelectric, water resource development, and stormwater/floodplain projects. Mr. Smith received his

Bachelor of Science in Civil Engineering from the University of Missouri (Rolla) in 1974, his AAS in Mechanical Technology from S.U.N.Y. at Morrisville in 1968, and became a Certified Floodplain Manager in 2004. He is a registered Civil Engineering in Oklahoma, Arkansas, Kansas, Missouri, Colorado, and Wyoming.

Mr. Smith was President of the National Hydropower Association (NHA) from 1988-1989 and was an active member of NHA's Board of Directors for over five years (1984-1989). He served as Vice President, Creator, and Chairman of both the FERC Committee and the International Committee. Mr. Smith was chosen to represent the National Hydropower Association as a technical specialist on CORECT Trade Missions to the Caribbean Basin (1987), to the Pacific Rim (1990, 1991, and 1993) and to Panama (1994).

Mr. Smith has been involved in many hydropower projects both domestic and international, including: Arkansas River Lock and Dam Nos. 2-6, 9, and 13; Mississippi River Locks and Dams; Red River Lock and Dam Nos. 1 and 2; Lake Eucha Dam; W. D. Mayo Lock and Dam, Jigüey-Aguacate dam complex, Dominican Republic, Hidro Jones Dam, Guatemala. He has also worked on dam design projects including: Phillips Refinery Stormwater Project; River Parks Low Water Dam, Caney River Water Supply Intake Dam, and the Arkansas River Corridor Study. Dam safety projects include Chimney Rock Dam, Robert S. Kerr Dam, Pensacola Dam, Warrenton Dam, Lee Creek Dam (Ft Smith), New Dam/Lake Project in Okmulgee County, Oklahoma, and Mosul Dam - Iraq. Mr. Smith is a FERC Part 12D Independent Consultant and a FERC Trained PFMA Facilitator.

Mr. Smith was presented the 1996 Newsmaker Award from Engineering News Record and was listed in International Who's Who of Professionals in 1995. Mr. Smith was awarded the Dr. Kenneth Henwood Lifetime Achievement Award from the National Hydropower Association in April 2008. In September 2009, he was awarded the Charles Don Ellison Memorial Award from the Oklahoma Floodplain Managers Association in recognition of long-term contributions of leadership and support to the advancement of floodplain management in Oklahoma. In November 2009, Mr. Smith was recognized by the International Water Power & Dam Construction's list as one of the 60 most influential people who have helped shape the course of the global hydropower and dam business in the world over the past 60 years.

He is the current Past Chair of the Oklahoma Floodplain Managers Association (2008-2009), and was previously Chair (2007-2008), Vice Chair (2006-2007) and Mitigation Committee Chair (2004-2006). Smith is also currently the coordinator of the Oklahoma Floodplain Managers Association (OFMA) Disaster Response Team (DRT) which provides support to communities, counties, and Indian Tribes in Oklahoma during disasters affecting the Special Flood Hazard Area.

Mr. Smith has two recent publications: "Remediating a Scour Hole Beneath the Dam No. 2 Powerhouse" Civil Structures, Hydro Review, April 2005, and "Stroking the Compulsion – Workaholism", AuthorHouse, 2007 OFMA Disaster Response Team (DRT) Program, October 2008.

He has also participated in the following workshop presentations:

- "Hydrology 101", Oklahoma Floodplain Managers Association, Training Session, Fall Conference 2005
- "OFMA Basic Training for Floodplain Administrators", Oklahoma Floodplain Managers Association, Statewide Training Course, 2005-2007
- Facilitator – "Managing the NFIP in Oklahoma" – August 27-Sept. 1, 2006, on behalf of Oklahoma Water Resources Board (OWRB) and OFMA.

- “Hydraulics 101”, Oklahoma Floodplain Managers Association, Training Session, 202 Workshops – Periodic throughout each year.
- “Hydrology and Hydraulics 202”, Oklahoma Floodplain Managers Association, Training Session, 202 Workshops – Periodic throughout each year.
- “Hydrology and Hydraulics for Map Mod”, Oklahoma Floodplain Managers Association, Training Session, Advanced Workshops – Periodic throughout each year.
- “Disaster Response Team (DRT) Program” – Oklahoma Floodplain Managers Association, Special Project – In Progress (Presented at 2008 OFMA Annual Conference and to be presented as The Association of State Floodplain Managers (ASFPM) National Conference in Orlando – June 2009)

D.5 Mr. Douglas Spaulding

Role: Civil/Structural Engineering

Affiliation: Spaulding Consultants, Golden Valley, MN

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

He served 10 years with the US Army Corps of Engineers, which included serving as Chief of the Levee Design Section and Program Manager for the National Dam Safety Program in Wisconsin and Minnesota. Duties included project management, feasibility and siting studies, economic analyses, regulatory coordination, and management of final design for flood control and navigation structures.

Mr. Spaulding has served on several independent peer reviews including:

- Currently serving on FERC Board of Consultants for the design of the 24 MW Lake Livingston Hydroelectric Project in Texas
- Currently serving on the FERC Board of Consultants for the design of the 400 MW Gordon Butte pumped storage project.
- Served as geotechnical representative on External Peer Review to evaluate the Corps of Engineers \$190 million seepage control upgrade project in East St. Louis Mo. Evaluation included review design for relief wells, slurry trenches and seepage berms
- Fargo Moorhead Flood Control Project - Served on IEPR panel to review Corps of Engineers feasibility study for flood protection for the Fargo Moorhead area. Alternatives plans included levees, floodwalls and two diversion alternatives. The recommended diversion plan involves a 35-mile-long channel with an estimated cost of \$1.3 billion.
- Evaluation of Levee Cracking - Geotechnical Engineer for study and evaluation of the cause of cracking in Corps of Engineers earth levees located throughout the Red River of the North. Investigations include literature review, field inspection, subsurface investigations and evaluation of potential causes of cracking.
- Eau Pleine Dam, Mosinee Wisconsin – This project was part of a program to upgrade the discharge capacity and increase the stability of the downstream embankment slopes. Project included the use

of transient finite element analyses to evaluate the potential for sudden drawdown failures and stability analyses to determine the configuration of a sloping drain and stability berm section.

- Byllesby Dam, Dakota County MN – Studies at the Lake Byllesby Dam included stability of Ambursen Dam and the rock spillway. This included core holes to identify the character of bedrock at depth and recommendations regarding potential remediation. The work at Byllesby Dam included a sensitivity study to evaluate potential for sliding along the bedrock/concrete contact using “CSLIDE”.
- Breckenridge Flood Control Stage 1 – The project involved design of 7-mile long, 20-foot deep flood diversion channel in western Minnesota. Services included evaluation of stability and utilization of clay fill material. The value engineering study on project resulted in \$1.5 million cost savings.
- Seneca Falls Hydroelectric Project, Seneca Falls, New York – The Seneca Falls project included stability analysis using a sensitivity analysis for this 50-foot high gravity structure and implementation of an exploration program to investigate soluble voids and foundation of powerhouse. Onsite work included dye testing, preliminary grout testing and down the hole photography.
- Served as FERC approved independent consultant on over 60 Part 12 inspections for projects located nationwide.
- Lorella Pumped Storage Project – Served as project manager for the development of the preliminary design of this \$1 billion pumped storage project. Design included an underground powerhouse and evaluation of 80-foot-high embankments founded on soft clay deposits in addition to design of a 170-foot-high rock fill dam. The upper reservoir utilized an asphaltic concrete membrane to control seepage and reservoir losses in the upper portion of this project.
- Baldhill Dam – Evaluation of project alternatives to increase the spillway capacity at the Corps of Engineers Baldhill Dam. Project included preliminary structural and geotechnical design, earthwork layout and quantity estimates. Also responsible for design of remedial measures to stop earth movements in the discharge channel area.
- Highway 75 Dam – Developed geotechnical and civil designs for the Corps of Engineers Highway 75 Dam near Odessa, Minnesota. Design elements for this 3.5-mile-long structure included embankments, outlet channels, two outlet works and related access roads and other features. Project included stability evaluation for 25-foot-high dam founded on soft clay.
- High Falls Embankment Stabilization, Crivitz Wisconsin – Project required design of a downstream berm to increase the embankment stability and to provide a seepage control system for emerging seepage.

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

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Glossary of Selected Terms and Acronyms

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

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

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

- ~about
- %percent

A

- ADMAgency Decision Milestone
- APMIAnalysis Planning and Management Institute, www.APM-Inst.org

B

C

- CCPCertified Compensation Professional
- COIconflict of interest

D

- DPRDetailed Project Report

E

- EAEnvironmental Assessment
- ECEngineers Circular (USACE)
- EISEnvironmental Impact Statement
- EPEngineering Pamphlet (USACE)
- EREngineering Regulation (USACE)

F

G

H

- HECHydrologic Engineering Center
- HQHeadquarters

I

- IEPRIndependent External Peer Review

J

K

L

- LMILogistics Management Institute, www.LMI.org

M

- MRMMinimum Requirements Matrix

MSE.....Master of Science in Engineering

N

NASNational Academy of Sciences; www.NAS.edu
NEDNational Economic Development
NEPANational Environmental Policy Act
NFIPNational Flood Insurance Program
NOAnotice of award

O

P

PDTProduct Delivery Team
PE.....Professional Engineer
PMProgram Manager
PMPProject Management Professional
PWSPerformance Work Statement

Q

R

Risk Analysis.....An approach to evaluation and decision making that explicitly and, to the extent practical, analytically incorporates considerations of risk and uncertainty in a flood damage reduction study (ER 1105-2-101).
RiskThe measure of the probability and severity of undesirable consequences. Risk = (Frequency of an event) x (Probability of occurrence) x (Consequences) (EC 1110-2-6067).
RMPRisk Management Professional

S

SME.....subject matter expert

T

TBDTo Be Determined
TOTask Order
TSP.....Tentatively Selected Plan

U

USACEU.S. Army Corps of Engineers

V

W, X, Y, Z

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