



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

CECW-SWD

MAY 8 2014

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

SUBJECT: White Oak Bayou, Texas, Flood Damage Reduction Project – Final USACE Response to Independent External Peer Review

1. Independent External Peer Review (IEPR) was conducted for the subject project in accordance with Section 2034 of the Water Resources Development Act of 2007, EC 1165-2-209, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review (2004).
2. The IEPR was conducted by Battelle Memorial Institute. The IEPR panel consisted of four members with technical expertise in planning, environmental processes, hydrology and hydraulics engineering, and economics. The IEPR panel reviewed the August 2010 Draft General Reevaluation report and Draft Environmental Assessment.
3. I approve the final written responses to the IEPR contained in the enclosed document. The IEPR Report and USACE responses will be posted on the Internet, as required in EC 1165-2-209.
4. Please direct questions to Ms. Sandy Gore, Deputy Chief, Southwestern Division Regional Integration Team, at (202) 761-5237.

STEVEN L. STOCKTON, P.E.
Director of Civil Works

Encl

**White Oak Bayou, Texas Flood Damage Reduction Project
General Reevaluation Report and Environmental Assessment**

FINAL

**U.S. Army Corps of Engineers Response to
Independent External Peer Review
April 2014**

Independent External Peer Review (IEPR) was conducted for the subject project in accordance with Section 2034 of WRDA 2007, EC 1165-2-209, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review (2004).

The goal of the U.S. Army Corps of Engineers (USACE) Civil Works program is to always provide scientifically sound, sustainable water resources solutions for the nation. The USACE review processes are essential to ensuring project safety and quality of the products USACE provides to the American people. Battelle Memorial Institute (Battelle), a non-profit science and technology organization with experience in establishing and administering peer review panels for the USACE, was engaged to conduct the IEPR of the White Oak Bayou Flood Damage Reduction Project General Reevaluation Report and Environmental Assessment.

The Battelle IEPR panel reviewed the Draft General Reevaluation Report (DGRR) and Draft EA, as well as supporting documentation. The Final IEPR Battelle Report was issued in January 2011.

Overall, 14 comments were identified and documented; one was identified as having high significance, ten were identified as having medium significance and three were identified as having low significance. The following discussions present the Final Response to the 14 comments.

Based on the technical content of the White Oak Bayou review documents and the overall scope of the project, Battelle identified candidates for the panel in the field of Civil Works Planning, National Environmental Policy Act (NEPA) and Biology, Hydrology and Hydraulics Engineering, and Economics. Four panel members were selected for the IEPR from seven candidates identified.

1. IEPR Comment - *High Significance*: The presentation of alternatives and the selection of the National Economic Development (NED) Plan using risk analysis within the HEC-FDA framework do not follow USACE guidance.

This comment includes one recommendation for resolution, which was adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR Panel recommended that the team provide tabular presentations with the mean and standard deviation of annual damages, net benefits and the B/C ratio for each alternative and the NED Plan that are consistent with guidance. In response, Tables 21a, 21b, and 21c of Appendix B (Economic Analysis) were added and include the requested information as well as probabilities that the net benefits are positive for each of the final alternatives.

2. IEPR Comment - *Medium Significance*: The documentation and explanation provided for the development of the existing and future without project conditions do not meet the requirements of ER 1105-2-100.

The comment includes two recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) providing a more detailed explanation and basis for how the future without project hydrologic conditions would be equal to the existing without project hydrologic conditions. In response, three factors were identified explaining why the existing and future hydrologic conditions were the same: a) There is very little area in the study area (less than 10 percent) left to be developed, b) Flood control detention and flood plain management regulations control impacts of future development on flow conditions, and c) Significant future redevelopment during the 50-year period of analysis is unlikely and would be controlled. These three factors are discussed in more detail in Section 4.3 of the GRR and in Section 2.2 of Appendix A (H&H Analysis). The IEPR panel also recommended (2) removing inconsistencies in the watershed build-out conditions (percentage developed) in the GRR, Appendix A (H&H Analysis) and Appendix B (Economic Analysis). The build-out percentage is 90 percent, and in response the discrepancies regarding the percentage noted in Appendix A (H&H Analysis), Section 2.0 and in Appendix B (Economic Analysis), Section 7.0 were corrected.

3. IEPR Comment - *Medium Significance*: The boundaries and constituents of the White Oak Bayou study area are not consistent in the GRR, Environmental Assessment, and supporting documentation.

The comment includes three recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) providing a definition and map of the study area for the engineering, economic, and recreation components of the analysis early in the White Oak Bayou GRR and discussing why any of the areas are different from other components of the analysis. In response, definitions and a map were provided as well as clarifications in Section 2.2 of the GRR and related appendices. Exhibit 1-1 of the GRR was also modified to provide further explanation. The IEPR panel also recommended (2) providing a definition and map of the boundaries for the proposed project and the Buffalo Bayou and Lower White Oak Bayou Project. In response, a description of these various project boundaries was provided in Section 2.2 of the GRR. Exhibit 1-1 of the GRR was also modified to provide further explanation. The IEPR panel also recommended (3) providing a rationale for including flood damage reduction in the lower reaches of White Oak Bayou as part of the benefits analysis for the proposed project. In response, clarification was added to the GRR in Section 1.4 that these reaches are part of the authorized study area and it was appropriate to consider these reductions in determining the economic benefits resulting from the Recommended Plan.

4. IEPR Comment - *Medium Significance*: Alterations in the watershed that may have occurred between 1998 and 2010, unrelated to the construction of NED Plan components, such as changes in land use, bridge modifications, and more critically, subsidence, are not discussed.

The comment includes two recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) providing an updated discussion of subsidence and its impact on the hydraulic and hydrologic analyses conducted as part of the White Oak Bayou GRR in Section 2.1. In response, the requested discussion was added in Section 2.1 of the GRR. The conclusion of the discussion is that subsidence would not impact the results presented in the GRR. The IEPR also recommended (2) providing a discussion supporting the assumption that 2001 LIDAR is an appropriate basis for hydraulic modeling of 2010 conditions. In response, the discussion was added in Section 2.1 of the GRR and Section

2.1 of Appendix A (H&H Analysis) detailing the fact that there are no known significant changes in topography and hydraulic conditions that are not reflected in the 2001 LIDAR data.

5. IEPR Comment - *Medium Significance*: The relative value of residential properties included in the flood damage assessments have not been reevaluated to account for changes in flood risk perceptions that have occurred since 2002.

The comment includes four recommendations for resolution; one was adopted and three were not adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) revising the White Oak Bayou GRR and Appendix B (Economic Analysis) to clearly state that the evaluation of alternative plans was based only on 2002 property value data and that the relative values of properties in different reaches may have changed since 2002. In response, the White Oak Bayou GRR (Sections 4.3.2) and Appendix B (Economic Analysis, Section 8.2) were modified to state that the initial evaluation of alternative plans was based on 2002 property value data that was updated to 2009 and subsequently to 2011 values based on the methodology explained in Attachment 3 of Appendix B (Economic Analysis).

USACE Response: Not Adopted

Action Taken: The IEPR panel also recommended (2) reevaluating the property value analysis described in Attachment 3 of Appendix B (Economic Analysis) to determine if there were changes in relative values by reach within the study area. In response, the 2002 property data was updated to 2009 and subsequently to 2011 values for the evaluation of final alternatives. These updates addressed the concern described in the comment but a separate analysis was not performed. The changes in values from 2002 to 2009 were not considered to be large enough to warrant a reach-by-reach comparison. The IEPR panel also recommended (3) expanding the existing analysis in Attachment 3 of Appendix B (Economic Analysis) to include properties with changes in land use and/or improvements across reaches to determine the impact of flood risk perceptions on property values and future land uses. In response, the team evaluated opportunities to capture the impact of flood risk perceptions on property values, but determined that the factors that impact value are too numerous and it would require a great deal of additional analysis to quantify an effect which would have minimal bearing on determination of the NED Plan. The analysis was modified to identify properties that experienced changes in the structure or land use but no additional analysis was included. The IEPR panel also recommended (4)

providing an analysis to determine whether changes in property values across reaches would change the evaluation of the alternatives and the selection of the NED Plan. In response, as indicated from the results discussed for (2) and (3) above, the 2002 property value data was updated in 2009 and subsequently in 2011 for the evaluation of final alternatives. These updates addressed the concern described in the comment but did not perform a separate analysis as suggested.

6. IEPR Comment - *Medium Significance*: The discussion of the flood damages and expected damage reductions by reach does not provide sufficient detail to determine if the analytical methods were constructed or used appropriately.

The comment includes five recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) providing a discussion of the role of risk and uncertainty analysis. In response, additional discussion was added in Section 8.5 of Appendix B (Economic Analysis) to expand on the role of risk and uncertainty analysis. The IEPR panel also recommended (2) presenting the estimated without-project expected annual damages using the with and without uncertainty assumptions. In response, additional discussion was added to Section 11.2 of Appendix B (Economic Analysis) to explain the differences in the “with uncertainty” and “without uncertainty” results presented in Table 6 of Appendix B (Economic Analysis). The expected annual damages without uncertainty are \$34.6 million and with uncertainty are \$60.0 million. The IEPR panel also recommended (3) providing a more detailed discussion in Appendix B (Economic Analysis) of the risk and uncertainty parameters in the HEC-FDA model. In response, additional discussion was added to Section 8.5 of Appendix B (Economic Analysis) to explain the uncertainty parameters and probability distribution function types used in HEC-FDA for the study. Explanation of the hydrologic, hydraulic, and economic risks was added along with how the risk factors are included in the models. The IEPR panel also recommended (4) providing an analysis of the relative significance of the risk and uncertainty parameters in determining the range of flood damages reduced across the different reaches. In response, a discussion was added to Section 8.5 of Appendix B (Economic Analysis) to highlight the most significant sources of risk and uncertainty in the study area and how these sources of risk and uncertainty influence the expected annual damages across the different reaches. Uncertainties related to stage-discharge and first floor elevations were found to make the largest contributions to uncertainty in the HEC-FDA model. The IEPR panel also recommended (5) providing more discussion on the sampling procedures and selected sample sizes for structure

values to use in the uncertainty analysis. In response, the sampling procedure and methodology are described in Section 8.3 of Appendix B (Economic Analysis). Additional explanation was provided concerning the sample size and methodology used to select the sample sets.

7. IEPR Comment - *Medium Significance*: The assumptions and procedures used in flood damage estimation for structure and content damages are inconsistent and may have affected the results of the analysis.

The comment includes three recommendations for resolution; two were adopted and one was not adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) describing the assumptions used for the content to structure value ratios and ensuring that the same assumptions are represented in the text and tables. In response, the content values in Tables 4 and 20 of Appendix B (Economic Analysis) were changed to be consistent with the economic calculations. This information was included in Section 8.5 of Appendix B (Economic Analysis). The IEPR panel also recommended (2) verifying that the damage estimates using the HEC-FDA that are reported in the GRR are consistent with the assumptions used in the analysis. In response, the damage estimates were reviewed and it was determined that the estimates used in the HEC-FDA model runs are consistent with the assumptions stated in the report.

USACE Response: Not Adopted

The IEPR panel also recommended (3) developing a procedure to estimate replacement of structures within the flood plain over the life of the project and the expected reductions in flood damage in the without project condition. In response, based on experience in similar, primarily single-family residential areas throughout Harris County, it is not expected that during the 50-year period of analysis significant redevelopment would occur within the major subdivisions and developments within the upper White Oak Bayou watershed. Moreover, the likelihood of redevelopment should be reduced due to the flood damage reduction resulting from the Recommended Plan.

8. IEPR Comment - *Medium Significance*: The Recreation Plan does not provide sufficient detail to evaluate the estimated recreational demand and the benefit-cost ratio for the Plan.

The comment includes six recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) documenting existing recreational use of facilities within the study area to the extent that usage data would be available in the study area and surrounding area. In response, a review was made but no existing recreation attendance data was found to be available for existing sites within the study area and surrounding areas. Due to the lack of local data, recreational usage data from other similar locations and studies was used in the Recreation Plan. The IEPR panel recommended (2) justifying the studies selected to transfer recreational use estimates and discussing the potential errors associated with transferring the use estimates to the study area. In response, a fuller description of the studies relied upon for the development of per capita use rates and the value for path usage was incorporated in Section 4.1.1 of Appendix F (Recreation Plan). The IEPR panel also recommended (3) discussing the expected carrying capacity of the proposed facilities and expected impacts on usage from inundation events. In response, an analysis of carrying capacity and inundation impacts was incorporated into Section 4.1.5 of Appendix F (Recreation Plan). The IEPR panel also recommended (4) justifying the Unit Day Values (UDV) and the benefit transfer analysis from the Forest Service model. In response, the Recreation Plan incorporated in Sections 4.1.1, 4.1.3, and 4.1.4 of Appendix F (Recreation Plan) includes greater detail regarding the basis for the UDV and Forest Service transfer values. The IEPR panel also recommended (5) revising the benefit-cost ratio that accounts for the uncertainty associated with the recreational use estimates, projected future use, and the benefit estimates. In response, the benefit-cost ratio was revised according to changes to the benefits and costs. The IEPR panel also recommended (6) documenting public involvement in the development of the Recreation Plan. Public involvement has included publication and distribution of the Recreation Plan through the public review process associated with the GRR and Environmental Assessment, and discussions within Harris County Precinct 4 regarding the precinct's participation as Local Sponsor for the Recreation Plan. In addition, the proposed trail system has been coordinated with the City of Houston Bikeway Program. In response, this information was added to Sections 3.2 and 3.3 of Appendix F (Recreation Plan).

9. IEPR Comment - *Medium Significance*: Further justification for the placement of trails and play/practice fields within detention basins is needed because the described recreational facilities do not appear to be compatible with detention basins.

The comment includes two recommendations for resolution which were adopted.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) justifying the placement of recreational facilities within detention basins as a viable and beneficial use of the open land. In response, a brief discussion of the use of detention basins for recreation in Harris County was added to Section 3.1 of Appendix F (Recreation Plan). The IEPR panel also recommended (2) discussing the amount of time in a normal year that each retention basin can expect to see inundation and estimate the amount of time it will not be available for public use. In response, a discussion of the expected times that the basins will not be usable for recreation and the impact on recreation benefits was added to Section 4.1.5 of Appendix F (Recreation Plan). The basins are designed to start flooding at a 5-year (20 percent) recurrence interval. On an expected annual basis, the basins would not be usable two days per year due to flood waters.

10. IEPR Comment - *Medium Significance*: The White Oak Bayou GRR provides for protection and maintenance of existing prairie dawn flower populations, but does not address methods for increasing growth and expansion of the species.

The comment includes two recommendations for resolution; one was adopted and one was not adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) discussing how mitigation measures that imitate prairie disturbance, including fire, will be incorporated in the management of prairie dawn flower populations. In response, as a local agency, HCFCD will continue to coordinate with USFWS regarding the management plan for the Texas prairie dawn flower in the Fairbanks-North Houston and Hollister basins. Prescribed burns are not proposed in either of these areas due to their proximity to homes and businesses. Discussion of mitigation measures and the management plan is presented in Sections 3.2 and 4.0 of Appendix B, Biological Assessment of the Environmental Assessment.

USACE Response: Not Adopted

The IEPR panel recommended (2) providing a plan for developing additional habitat that would encourage the spread of the prairie dawn flower population. Aside from activities to offset impacts to significant resources and preventing adverse impacts to threatened and endangered

species, activities to increase habitat are outside the scope of the authorized flood damage reduction study.

11. IEPR Comment - *Medium Significance*: Impacts from flooding of the recreational areas may not have been fully accounted for in the derivation of Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) costs.

The comment includes two recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) ensuring that the OMRR&R cited in the GRR is the same as the OM&R cited in Appendix F (Recreation Plan, Unnumbered Table in Section 4.3), and make appropriate changes to all project documents (i.e., GRR, Appendix C (Cost Estimates), and EA). In response, a consistent abbreviation (OMRR&R) was provided throughout the GRR and the appendices. The IEPR panel also recommended (2) providing a discussion in Appendix F (Recreation Plan) that includes OMRR&R activities in addition to mowing. In response, a review of the operating and maintenance costs for the Recreation Plan was made to ensure that these costs are reasonable, and the costs were increased by 100 percent to account for flood maintenance costs. A discussion was added to the end of Section 4.2 of the Recreation Plan.

12. IEPR Comment - *Low Significance*: It appears that portions of the hydrology and hydraulics analysis were done at different times and it is not clear that they were integrated into the overall project analysis.

The comment includes two recommendations for resolution, which were adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) confirming that the HEC-RAS models provided are from the same modeling exercise associated with the White Oak Bayou GRR or provide appropriate models. In response, the models were reviewed and verified that they are the latest models. The IEPR panel also recommended (2) revising the Hydrology and Hydraulics Appendix A (H&H Analysis - e.g., Table 21 and Exhibits A-24 through A-35) to include results from the same modeling exercise associated with the White Oak Bayou GRR. In response,

Table 21 and Exhibits A-24 through A-35 in Appendix A (H&H Analysis) were updated based on the current model set.

13. IEPR Comment - *Low Significance*: The actual cost of current property acquisitions and displacements associated with all examined feasible alternatives are difficult to confirm because of conflicting presentations of “current” conditions in the GRR and the appendices.

The comment includes three recommendations for resolution; two were adopted and one was not adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (2) providing a complete accounting of properties that have been built and which still need to be acquired to complete the project, and correlate with updated aerial photographs. In response, Section 5.1.5 of the GRR documents the construction status of the Recommended Plan components. Additionally, a review of the properties yet to be acquired was made to ensure that no changes in usage have occurred that were not considered in the economic analysis. No changes in land use were found that would impact the economic analysis and plan formulation. The IEPR panel also recommended (3) ensuring consistency of text and exhibits between the main report and the appendices. In response, a consistency review was made of the GRR, appendices, and EA text and exhibits. The inconsistencies that were found were small differences in acreage values used in the GRR and EA, primarily due to inconsistent rounding to tenths or hundredths in different portions of the report. These were corrected throughout the report.

USACE Response: Not Adopted

The IEPR panel recommended (1) updating all aerial photography in the various reports and appendices. In response, a review was made to determine what aerial photography should be updated for clarity and completeness of the GRR. No updating of the aerial photo exhibits in Appendix D Engineering was considered to be necessary because the land use changes that had occurred did not impact the Recommended Plan.

14. IEPR Comment - *Low Significance*: Documentation of public involvement in the White Oak Bayou project since 2004 is not provided, but is required to fully understand the project benefits, especially as they affect residents and businesses that have moved into the project area since 2004.

The comment includes six recommendations for resolution; five were adopted and one was not adopted, as discussed below.

USACE Response: Adopted

Action Taken: The IEPR panel recommended (1) providing figures and tables specifically needed to describe the public input to the project through 2010. In response, the requested information was added to Section 2.3 of the Public Involvement Appendix concerning communications through the HCFCD website, meetings with the affected municipalities, and direct communication with affected residents and land owners. Also information regarding communications with affected residents and land owners during 2013 was added to Sections 3.3 and 3.4 of the Public Involvement Appendix. The IEPR panel also recommended (2) providing information in the EA on the public outreach meetings held throughout the entire project development period and discuss how the public comments were resolved. In response, the requested information discussed above in response to recommendation (1) above, the requested information was added to Section 6.2 and Appendix F of the EA. The IEPR panel also recommended (3) documenting the number of displacements from 1998 to date and the others (e.g., residential/building purchases, etc.) that will be required to complete the project. This should include development that occurred since the 2002 aerial photographs were taken. In response, the number of displacements required for the plan, 18 residential and two commercial, is presented in Section 2.9 of Appendix E (Real Estate). None of these displacements have occurred yet. The IEPR panel also recommended (4) discussing how the displacements have been documented and presented to the affected residents and businesses. In response, the requested information was added to Section 2.3 of the Public Involvement appendix. The IEPR panel also recommended (5) documenting actual and expected current (i.e., 2009 or 2010) displacements of residents and businesses, describing current conditions, and illustrating each drainage basin. In response, the number of displacements required for the plan, 18 residential and two commercial, is presented in Appendix E (Real Estate), Section 2.9. None of these displacements have occurred yet. There are no known changes to the conditions within the displacement properties required for the plan that were not considered during the plan development.

USACE Response: Not Adopted

The IEPR panel also recommended (6) ensuring that all new information has been properly referenced on the aerial photography by either caption or map-based marking with suitable

definition. In response, existing records were reviewed and no new information was identified for inclusion.