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

REPLY TO
ATTENTION OF

OCT 14 2009

CECW-MVD

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

SUBJECT: Mississippi Coastal Improvements Program - 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 WRDA 2007, EC 1105-2-410, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review (2004).

2. The IEPR was conducted by the Battelle Memorial Institute through their contract with the Army Research Office. The IEPR panel consisted of seven individuals selected by Battelle with technical expertise in engineering (civil and geotechnical); geology/geomorphology; hydrology; hydraulics; coastal environmental science, water quality/resource management; floodplain management; meteorology/hurricanes; socioeconomics; real estate; risk assessment; and modeling.

3. The final written responses to the IEPR report are hereby approved. The enclosed document contains the final written responses of the Chief of Engineers to the issues raised and recommendations contained in the IEPR report. The IEPR report and USACE responses have been coordinated with the vertical team and will be posted on the Internet, as required in EC 1105-2-410.

4. If you have any questions on this matter, please contact Joseph Redican, MVD-RIT Planner at 202-761-4523.

FOR THE COMMANDER:

Encl

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

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Mississippi Costal Improvements Program (MsCIP)
Hancock, Harrison, and Jackson Counties, Mississippi
Comprehensive Plan and Integrated Programmatic Environmental Impact Statement

USACE Response to Independent External Peer Review
September 2009

Independent External Peer Review (IEPR) was conducted for the subject project in accordance with Department of the Army, USACE, guidance *Peer Review of Decision Documents* (EC 1105-2-410) dated August 22, 2008, CECW-CP Memorandum dated March 30, 2007, and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

In the Third Emergency Supplemental to the Defense Appropriations Act, 2006 (Dec 2005), Congress directed the U.S. Army Corps of Engineers (USACE) to conduct an analysis and design for comprehensive improvements or modifications to existing improvements for the coastal Mississippi region. This analysis and design is required to address hurricane and storm damage reduction, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and other related water resource purposes. The MsCIP Comprehensive Plan contains final recommendations on these topics. The report consists of an integrated main report/environmental impact statement and supporting appendices that describe an integrated system of structural, nonstructural, and environmental measures.

Battelle Memorial Institute, a non-profit science and technology organization with experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of the MsCIP Comprehensive Plan. The IEPR panel consisted of seven individuals selected by Battelle with technical expertise in engineering (civil and geotechnical); geology/geomorphology; hydrology; hydraulics; coastal environmental science, water quality/resource management; floodplain management; meteorology/hurricanes; socioeconomics; real estate; risk assessment; and modeling.

The Final Report from the IEPR was issued by Battelle on November 7, 2008. Overall, the report contained 14 comments. The report presented the 14 comments in categories with four identified as having high significance, eight identified as having medium significance, and two identified as having low significance. Further details on each comment, such as the basis for the comment and comments cross-reference were also included.

The following discussions present the USACE Final Response to the 14 IEPR comments.

1. IEPR Comment - High Significance: More refined analysis is recommended in certain areas before design and build can be conducted.

USACE Response: Adopted.

A refined analysis including specific levee height and rainfall and runoff analysis has been conducted for improvements to the existing Forrest Heights Levee, the only structural option recommended for construction at this point. These analyses are included in the Final MsCIP Comprehensive Report. All other structural options, i.e. new levee systems around specific populated areas, were evaluated at a reconnaissance level. The new levees are recommended for further feasibility level study.

USACE regulations (ER-1105-2-100) specifically require that, "the period of analysis shall be the same for each alternative plan. The period of analysis shall be the time required for implementation plus the lesser of: (1) the period of time over which any alternative plan would have significant beneficial or adverse effects, (2) a period not to exceed 50-years except for major multiple purpose reservoir projects, or, (3) a period not to exceed 100 years for major multiple purpose reservoir projects". In addition to following the guidance, the performance of measures, their reliability and resilience, and sensitivity to change in regards to longer term factors such as potential sea level rise and redevelopment was considered utilizing scenario testing as described in Section 5.3.1 of the Economic appendix.

A 'risk' framework was utilized in which higher to lower levels of risk were assigned to the range of inundation footprints, and relating those in public forums to the probability of inundation during, for example, the length of one's mortgage payout. We believe this to be consistent with the intent of inundation maps but builds upon them to communicate the risk associated with specific areas along the coast and to deal with the misconceptions associated with the use of inundation maps.

Modeling results summarized the data utilized in the modeling effort necessary to support the recommendation. Specific information is included in the Engineering, Environmental, and Economic Appendices and is available in the open source literature.

The use of surge gates as part of long linear levee systems was eliminated from further study due to cost and lack of local support. All other structural options, i.e. levee systems around specific populated areas, which were evaluated at a reconnaissance level, are recommended for further feasibility level study. As studies are initiated on these structural options the more refined analysis discussed including evaluation of risk reduction with different levee heights or nonstructural options, rainfall and runoff analysis and storm surge and transport modeling would be undertaken in detail.

2. IEPR Comment - High Significance: The preliminary evaluations of the Hurricane Storm Damage Reduction, erosion control, and ecosystem restoration need more explanation. For example it is unclear if dynamic habitat models and geomorphic evolution are considered.

USACE Response: Adopted

USACE has designed the environmental restoration efforts based on a holistic framework of the changes which have occurred in the past to natural landscapes in coastal Mississippi over the past 50 years, plus an estimation of what the landscape will look in the future with and without the implementation of the MsCIP or other ongoing programs. Damage to the Mississippi natural landscape has been caused in large part by man's development within the fragile coastal ecosystems and by the extensive introduction of exotic species following storm events. In developing this framework, the USACE incorporated the work by A. D. Manning, et al. (2006), Landscape Fluidity, specifically anticipatory restoration concepts. This concept focuses on change, landscape trajectories and climate adaptation, highlighting the need to anticipate the future requirements of organisms. In addition to conventional restoration activities, 'anticipatory restoration' efforts may seek to create certain conditions in anticipation of further changes in the future. The report has been modified in numerous areas to further discuss the anthropogenic and geomorphic processes which are shaping the Mississippi coast (e.g. Barrier Island Appendix Chapters 3 and 6).

USACE also recognizes the importance of sea level change and the resultant gradual shifts in community composition within the natural landscape features of coastal Mississippi. The goal of the restoration program is not to create static habitat types but to assist in the recovery of naturally functioning landscape units that will be most able to adapt to climate change and sea level rise.

A systemwide and regional approach has been taken in investigating water resources issues along the northern Gulf coast, including freshwater diversion and sedimentation issues. The MsCIP Comprehensive Plan is designed such that all features will complement each other and there would be no conflict as elements are added at a later date.

USACE concurs with the value and need for an adaptive management plan and has included the concepts of monitoring and adaptive management in the Final Report. A specific plan will be developed in the ensuing phases as the Comprehensive Plan is further developed. The adaptive management plan will be a living document that would be revised as implementation proceeds and we learn from the initial projects implemented. This plan will include all of the above information, as necessary, and will be jointly developed by all the partners in the MsCIP including State and Federal agencies and interested local stakeholders.

3. IEPR Comment - High Significance: The redevelopment scenarios should include a range of possible outcomes for the economy.

USACE Response: Adopted in Part

The range of redevelopment scenarios utilized in the MsCIP are consistent with the actual redevelopment that has occurred along the northern Gulf coast following major disasters beginning with Hurricane Frederic in 1979 and continuing through Hurricane Ivan in 2004. In addition, the scenarios were developed with a consideration of local politics and land use restrictions. USACE has modified the report to better document the assumptions utilized in developing the 6 scenarios that were utilized. Specific revisions have been made in the Economic Appendix, Section 5.3.2 and Section 5.3.3. As additional studies are undertaken to further define the Comprehensive Plan, additional scenarios will be developed specific to the areas under study.

USACE believes this approach to be realistic in nature and does not believe that the evaluation of additional scenarios such as lack of full development appropriately considers the future risk to the area.

4. IEPR Comment - High Significance: Adaptive management processes should be a more integral part of the Comprehensive Plan and must include a strong monitoring and feedback mechanism.

USACE Response: Adopted

USACE concurs with the value and need for an adaptive management plan and has included the concepts of monitoring and adaptive management in the Final Report. The plan will be developed further during the ensuing phases of implementation of the MsCIP Comprehensive Plan. Hence, the adaptive management plan will be a living document that would be revised as implementation proceeds and we learn from the initial projects implemented. This plan will be jointly developed by all the partners in the MsCIP including State and Federal agencies and interested local stakeholders.

5. IEPR Comment - Medium Significance: The extent of inclusion of recommendations from the public and agency engagement process into the plan, and whether major controversies regarding the program plan exist, is unclear.

USACE Response: Adopted.

USACE has summarized the public and agency participation associated with the development of the Comprehensive Plan. This is due to the extent of participation, which included over 50 public involvement events. The events included public meetings, workshops, on-line auditoria and website-based activities. Also summarized was the close coordination among the

government agencies (e.g. Federal Emergency Management Agency, National Park Service, US Geological Survey etc.) in developing the comprehensive plan. It is not practicable to include specific data on all of these events or to gauge the quality of the public feedback.

USACE made every effort to ensure that all affected parties were invited to participate. Event advertisements were provided in print, television, radio and internet media. Multiple meetings were held on different dates and in different locations. Additionally, the opportunity for on-line participation was made to accommodate those parties relocated by the storm. Presentations were made to church groups, garden clubs, civic organizations and other non-governmental organizations.

Public acceptance of the program has been formally solicited through the public review process as part of the National Environmental Policy Act compliance activities. The majority of the comments received during the recently completed public review of the draft document were in favor of implementation of the Plan. These comments and USACE responses are included in Appendix L of the Final Report.

Public input and preference are mentioned throughout the document and were utilized extensively in the plan formulation process (e.g. problem identification, alternative evaluation), as discussed in the Plan Formulation Appendix and Main Report. USACE has documented public preferences in the System of Accounts tables included in the Main Report.

6. IEPR Comment - Medium Significance: There needs to be a more in-depth discussion of the municipal and industrial waste and the future impact to the treatment facilities.

USACE Response: Adopted.

Issues related to the release of contaminants from municipal and industrial waste facilities in coastal Mississippi from the Hurricane Katrina surge were not significant as compared to Louisiana. With the exception of central Jackson County coastal Mississippi is predominately residential and light commercial. The major concerns dealt with public water and wastewater facilities and these are being considered, for the six-county coastal area, by a state-commissioned consortium formed from existing utility boards in the wake of the hurricane. USACE did specifically evaluate the future siting of these facilities in developing what was called Line of Defense 5 or the "maximum probable intensity" storm surge line (i.e., maximum probable surge-plain). In addition, the acquisition of lands within the high hazard area (low elevations) will reduce the need for public water and wastewater facilities near the coast and possibly contribute to the regionalization of facilities outside the floodplain. The existing industrial facilities fared rather well during Katrina with only minor discharges from one facility.

The U.S. Environmental Protection Agency is utilizing data and mapping generated by the MsCIP study effort to support re-location and/or permitting of facilities in the future along the coastline, as a spill risk minimization measure. As the Comprehensive Plan is further developed additional consideration of risk reduction for municipal and industrial waste facilities will be included.

7. IEPR Comment - Medium Significance: Human adaptation, as it relates to economic activities, needs more detail.

USACE Response: Adopted in Part.

USACE has modified the report to better document the assumptions put forth in developing the 6 scenarios that were utilized. Specific revisions have been made in the Economic Appendix, Section 5.3.2 and Section 5.3.3. It is also assumed that redevelopment will occur as per the criteria associated with the National Flood Insurance Program (NFIP). It is conceded that at some point, the NFIP premiums could increase to a point that would cause a shift in the typical consumers' inclination to rebuild. However past precedent in other areas of the Northern Gulf Coast shows, the effects of major hurricanes (i.e. cost, time to rebuild, risk, etc.) has not appeared to impact the utility of water front and near-water living. Rather than speculating on what may occur, USACE used a range of redevelopment scenarios that are reflective of the actual occurrences along the northern Gulf coast following major disasters. This time period begins with Hurricane Frederic in 1979 and continues through Hurricane Ivan in 2004. As additional studies are undertaken to further define the Comprehensive Plan, additional scenarios will be developed specific to the areas under study.

Further modifications have been made in Chapter 3 of the Economic Appendix to clarify the assumptions and data utilized in the Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) modeling effort.

USACE did not calculate damages for recreation losses except on the barrier islands. These recreational damages were not related to the redevelopment scenario, but were based on pre-storm recreation visits to the National Park Service facilities on the barrier islands. Damage curves were not used to calculate these recreation losses. Instead they are based on a comparison of the future with and future without scenarios.

USACE does not agree that an additional technical appendix would improve or change the recommendations made in the report.

8. IEPR Comment - Medium Significance: The effects of relative sea level rise need to be explained more explicitly, taking into account local effects in addition to global effects and incorporating recent studies.

USACE Response: Adopted

USACE has modified the report to include a discussion of why the Mississippi inferred subsidence rates are much lower than those in Louisiana. This is due mainly to differing geology but another overlooked and under-evaluated reason is perhaps the long-term, large-scale oil extraction off of the Louisiana and Texas coasts. This observation applies not only to Mississippi, but also the entire gulf coasts of Alabama, and Florida. This is can be readily inferred from the long term tide gage records in these states. Long term Mississippi gage data (a

continuous record of over 225 years at Biloxi, MS) were used for the Mississippi relative sea level rise analysis.

USACE did not disregard the 2007 IPCC (Intergovernmental Panel on Climate Change) report but considered all appropriate information in determining the role of potential sea level rise. This included local and global effects, in development of the Comprehensive Plan. Unlike the 1987 NRC (National Research Council) and 2001 IPCC reports, the 2007 IPCC report provides a discrete prediction for eustatic sea level rise for a vaguely defined time period (not quite 100 years), as opposed to continuous predictions over time into the future. The magnitude of future sea level rise given in the 2007 IPCC report varies according to scenarios but in general are substantially less than reported in the NRC and 2001 reports over the same time period, except at the low-end of the predicted range, which in any case was not considered for MsCIP purposes. Nonetheless, in the analysis of sea level rise on various alternatives considered in the MsCIP study, a rate of sea level rise similar to that proposed by IPCC 2007 was used to evaluate impacts on long-term performance, reliability, and resilience

USACE is presently revising its internal sea level rise guidance. Sea level rise analysis and predictive methods may be refined for future work. As additional studies are undertaken to further define the Comprehensive Plan, local subsidence and compaction due to weight of structures will be considered in more detail.

9. IEPR Comment - Medium Significance: It is unclear how relative sea level rise (RSL) is incorporated.

USACE Response: Adopted.

USACE has modified the report to better describe how scenario testing was utilized to evaluate relative sea level rise (RSL) on project performance in HEC-FDA (Hydrologic Engineering Center – Flood Damage Analysis) (see Scenario Testing Methodology Section 5.3.3, Economic Appendix). The potential effects of sea level rise are also displayed for each of the final array of alternatives, in the System of Accounts tables (Factor F.1.d), in Table 3-11 of Chapter 3 of the Main Report (Vol.1). Future relative sea level rise was employed in the economic flood damage analysis exercise. These exercises were conducted using HEC-FDA (inundation damage) and BEACH-FX (Life Cycle Risk Analysis of Shore Protection Projects) (shoreline erosion related damage).

While it is granted that wave characteristics vary according to a number of factors (proximity to coast, local slope, roughness elements, water depth, etc.), the flood damage problem in this context is simplified to one of the still water elevation. Accordingly, in consultation with the Corps' Hydrologic Engineering Center and Engineering Research and Design Center, it was stated that it would indeed be reasonable to shift the stage-frequency curve by the amount of predicted sea level rise over the period of analysis in order to obtain an estimate of expected annual damage due to sea level rise when employing the HEC-FDA inundation tool, and the effects of sea level rise on the order of one meter are appropriately captured for present purposes.

The recommended plans provide for adaptive management to respond to changes in time due to relative sea level rise. USACE is leading the collaborative research effort on the effect of relative sea level rise (RSLR) referred to by the reviewers. The results of this work and the inclusion of the knowledge from this research effort will be considered in adaptive management during the implementation of the Comprehensive Plan.

10. IEPR Comment - Medium Significance: All of the physics-based models used need a better explanation, including inputs, outputs and assumptions.

USACE Response: Adopted in Part

The report and supporting appendices provide summary information documenting the methodology and models applied. The Engineering Appendix includes descriptions of the physics-based models, including model inputs and output, and application methodology. Citations are also given where the reader can go to get more information on the models and their application.

USACE has modified the Engineering Appendix to provide additional details on how barriers such as levees and road systems are incorporated in the ADCIRC (Advanced Circulation Model) mesh and the STWAVE (Steady-State Spectral Wave Model) and COULWAVE (Cornell University Long and Intermediate Wave Model) grids (Sec 2.8.2). The appendix has also been modified to discuss the level of uncertainty that is inherent in any modeling exercise due to model errors and uncertainty in model inputs (Sec 2.4.1). Additional references have been added to Section 2.4.1.1 of the appendix.

The purpose of the comprehensive barrier island restoration is to enhance the sustainability of the Mississippi Sound estuary and the critical ecosystem functions that it provides through the restoration of the sediment budget of the islands. There is a detailed evaluation of the environmental benefits which would accrue from the restoration and future sustainability of the island/estuarine system. The report clearly states that there are incidental benefits to the mainland shoreline, primarily in the reduction of wave climate that is provided via the sheltering effect the barrier islands provide. Should the islands continue to erode, there would be increased wave energy on the mainland shoreline which would increase damages to existing infrastructure. Additional documentation of the wave reduction benefits of the barrier islands will be generated as part of the additional studies described in the Barrier Island Appendix.

11. IEPR Comment - Medium Significance: The decision factors involved in using the models selected needs to be described. In some cases, updated modeling tools should be used.

USACE Response: Adopted in Part

Summary information on the models utilized in the development of the comprehensive plan is presented in the Main Report. The technical appendices include detailed descriptions of the models including the governing equations, inputs, and sample output from the models.

USACE has modified the report and appendices to include additional information with respect to the incorporation of Lines of Defense (LOD) 3 and 4 and uncertainty (Engineering Appendix Sections 2.5 – 2.8) and the use of the SLOSH (Sea, Lake and Overland Surges from Hurricanes) model for delineating the study area into sub-units and the use of ADCIRC and HEC-FDA for analysis of economic risk (Economic Appendix Section 1.3.3 and Chapter 3). Additional references with details on model validation have been added to the Engineering Appendix.

The review seems to specifically be concerned with the application of the parametric TC96 PBL model. USACE understands the comments pertaining to the atmospheric model selection, but in the confines of the project, the value added through the use of atmospheric models with increased resolution is limited because these models:

- do not have verification/validation history in the estimation of tropical systems;
- require boundary condition information from global atmospheric models requiring additional (potentially erroneous) assumptions;
- require an increase in computational resources that are at the minimum two to three orders of magnitude larger.

USACE concurs that wind input is an important factor contributing to the uncertainty in storm surge models and performed a comprehensive analysis to assess the implication of applying the PBL in the work conducted following Hurricane Katrina. The analysis performed showed only slight variations in the resulting surge and wave fields, based on inter-comparisons of "best-wind" applications (i.e. H-Winds as the construct for the tropical system core) versus the use of the PBL TC96. See *Interagency Performance Evaluation Task Force, 2007, "Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, Volume VIII – Engineering and Operational Risk and Reliability Analysis, Appendix 8" U.S. Army Corps of Engineers, Washington, D.C., https://ipet.wes.army.mil/* for details on limited impact on surge. The wave field analysis is included in a yet-unpublished FEMA report. Information from that report including plots measuring wave data with wave model estimates using "best-winds" from OWI and winds from the PBL for Hurricane Katrina shows that good estimates are obtained with the PBL wind fields. The results for Katrina are similar to those obtained for Hurricanes Betsy, Rita, Camille, Ivan, and Andrew. USACE has included reference to this work as well as to the uncertainty associated with the PBL model in the Final Report Engineering Appendix Section 2.4.1).

12. IEPR Comment - Medium Significance: Need to explain the rationale for selecting the oyster as a surrogate for other species.

USACE Response: Adopted

The USACE view is guided by an environmental framework built upon knowledge of the dynamic and changing ecosystem of the coast and the need for restoration of habitats in such a manner as to be adaptive to future environmental influences. Many of the coastal habitats, such as submerged aquatic vegetation, emergent tidal marsh and wet pine savannah, have been heavily influenced by development (direct and indirect) in the last 50 to 100 years. Although the geomorphic process is impacted by large catastrophic storm events causing drastic and dramatic

changes on the local ecosystems, such as erosion of islands/mainland and colonization by exotic species, developmental pressures on these ecosystems were noted as a primary concern.

Specifically, it is recognized that as sea level changes there will be gradual shifts in community compositions within the natural landscape features of coastal Mississippi. USACE has utilized the oysters as the surrogate species only for the freshwater diversion of Mississippi River water into western Mississippi Sound. This is appropriate, since the primary purpose of the diversion project is to introduce historic freshwater flows from spring flood events into this area of Mississippi Sound that have been lost due to levees being constructed along the Mississippi River outflow into the Gulf of Mexico. Other surrogate species or communities were utilized in the design of the tidally emergent and wet pine savannah restoration projects. As additional efforts are initiated as part of this comprehensive effort other species or communities may be identified as appropriate keystone species to guide habitat restoration in other community types.

13. IEPR Comment - Low Significance: The stated goal of the project to reduce loss of life by 100% is unrealistic.

USACE Response: Adopted In Part.

The stated goal of the MsCIP Comprehensive Plan is the development of a resilient Mississippi coast which would have the goal of no loss of life in the future. While USACE recognizes that this goal may not be achievable, all efforts are being made in the Comprehensive Plan to reduce residual risk to the maximum. The focus on risk reduction through nonstructural means, ecosystem restoration and risk communication stressing floodplain management, evacuation planning, and building codes are examples contained in the plan to clearly identify the residual risks to the coastal population. Communication of that risk to Federal, State, and local decision makers and the general public through the use of the system of accounts tables and other educational awareness programs, will continue to be an factor during the implementation of the Comprehensive Plan and as additional studies are undertaken with the overall goal of further reduction in risk in the coastal area.

14. IEPR Comment - Low Significance: The process for weighting metrics is unclear.

USACE Response: Adopted.

USACE has modified the Final Report to include a discussion of risk and how the information gained through the Risk Informed Decision Framework was utilized in the development of the Comprehensive Plan. USACE is acutely aware as to the problems posed by the use of MCDA (Multi-Criteria Decision Analysis) and agrees that methods of eliciting weights, framing, ordering, and choice of metrics all had an effect on outcomes. Different stakeholder sessions were meant to refine and improve this process; however, the methodology in actual application for civil works planning remains flawed. USACE chose, therefore, to use MCDA as an information tool rather than a selection tool, for the same reasons the IEPR team found the application problematic. Additional effort in developing the proper tools of risk evaluation for use in Corps Planning Studies is being undertaken.