INDEPENDENT EXTERNAL PEER REVIEW PANEL

for the

CHARLESTON PENINSULA COASTAL FLOOD RISK MANAGEMENT STUDY SOUTH CAROLINA

The U.S. Army Corps of Engineers submits the following information per requirements in the Water Resources Reform and Development Act of 2014, Section 1044(c)(4)(B).

Entity Conducting the Review	
Outside Eligible Organization:	Battelle 505 King Avenue Columbia, OH 43201
Dates of Review	
Review Initiation:	20 April 2020
Type I IEPR Final Report Submittal:	19 June 2020
Reviewer Names and Qualifications	
Marvin Feldman	**Planning Formulator/Economist**

Dr. Feldman, an independent consultant and principal economist at Resource Decisions, has more than 39 years of experience in water resource and environmental economics. He earned his M.S. in water resource management in 1969 and a Ph.D. in natural resource economics in 1979 from the University of Wisconsin.

Dr. Feldman is experienced in the evaluation and conduct of complex multi-objective public works projects with high public and interagency interests, including flood risk analysis. For the U.S. Department of Energy, he worked on developing a multi-attributable site selection model for evaluating risks of alternative sites for the Preliminary Nevada High-level Nuclear Waste Siting Analysis. For the Smith Lake Improvement and Stakeholder Association (SLISA), Alabama, he provided economic evaluation of alternative costs and benefits of municipal and industrial, navigation, recreation, and hydroelectric water uses and non-power evaluations for recreation, property values flood control, navigation, and erosion control to support SLISA's negotiations with the Federal Energy Regulatory Commission and Alabama Power. As a member of IEPR teams, he reviewed Civil Works flood planning and economic issues related to the projects throughout the United States and reviewed the G2CRM model before its use in projects. Dr. Feldman is familiar with the USACE plan formulation process, procedures, and standards as they relate to flood risk management and has more than 10 years of demonstrable experience dealing directly with the USACE six-step planning process, governed by Engineer Regulation (ER) 1105-2-100, Planning Guidance Notebook. Most notably, he applied the six-step process to his work on the USACE/Bureau of Reclamation Central Arizona Water Control Study.

Dr. Feldman has experience related to the economic evaluation of traditional National Economic Development plans, including his participation in a University of Wisconsin test team that helped develop the original U.S. Water Resources Council Principles and Guidelines. In conjunction with the USACE/Bureau of Reclamation Central Arizona Water Control Study, he designed a multi-attribute utility analysis framework for selecting preferred alternatives. This framework included flood risk management and National Ecosystem Restoration (NER) attributes and structured the tradeoffs among hundreds of alternative plans with regard to these and other attributes. The framework allowed the specification of minimum and maximum acceptable attribute values. Identification of attributes and the importance of weighting these attributes was a key aspect of the public involvement program. By focusing the public involvement on NER and flood control, as well as other key attributes, the plan selection process was more cooperative and less competitive. While working as a consultant to the USACE Sacramento District, he developed and applied a methodology for the cost-effectiveness and incremental analysis of alternative mitigation measures to enhance the habitat of the endangered winter-run salmon on the Sacramento River.

Dr. Feldman has a strong working knowledge of USACE economic benefit calculations. Throughout his career, he has conducted studies requiring economic benefit analysis for flood risk management. He served as planner/economics reviewer in the IEPR for the Institute for Water Resources (IWR) Planning Suite II as part of its certification process. He evaluated the state-of-the-art municipal and industrial water conservation benefit evaluation techniques for the California Urban Water Conservation Council (CUWCC) and identified promising methods for application by CUWCC member water agencies in evaluating their conservation options. His advanced expertise and extensive experience in flood damage analysis and in risk and decision analysis is reflected in his work on such studies as the Smith Lake-Black Warrior River (Alabama) benefit-cost analysis of lake levels, the calculation of cost-benefit tradeoffs for the North Fork of the Feather River (Pacific Gas and Electric, California), and an economic analysis of agricultural diversion alternatives for the Glenn-Colusa Irrigation District (California).

Dr. Feldman is also familiar with methodologies for estimating damages, including the Hydrologic Engineering Center (HEC) Flood Damage Analysis (FDA) software. His familiarity with HEC-FDA includes his knowledge of inputs, assumptions, calculations, and results attributed to the program. He has applied his knowledge of USACE flood risk management and damage calculations/analysis in his work as economist/planner on the USACE/Bureau of Reclamation Central Arizona Water Control Study. This study was a flood control and dam safety study involving the consideration of feasibility alternatives and the selection of preferred alternatives. Other studies requiring the assessment of risk and damage included the aforementioned Preliminary Nevada High-level Nuclear Waste Siting Analysis and the SLISA studies.

Alane Young **Environmental Law Compliance Specialist**

Ms. Young is a project manager/senior geologist at Covington Civil & Environmental, LLC. She earned her M.S. in geology from Mississippi State University in 1986. She has 34 years of experience in managing environmental projects. Her key responsibilities through her career have been preparing National Environmental Policy Act (NEPA) environmental documentation, including categorical exclusions (CXs) and environmental assessments (EAs), and assisting in the preparation of environmental impact statements (EISs). Her expertise also includes performing Phase I and Phase II environmental site assessments (ESAs), site characterizations, soil and groundwater remediation projects, wetland delineations, and environmental permitting.

Ms. Young is an expert in compliance with environmental laws, policies, and regulations. She served as the environmental science/NEPA expert for the Integrated Draft Feasibility Study and Environmental Impact Statement (FS/EIS), Pearl River Basin, Mississippi, Federal Flood Risk

Management Project, Hinds and Rankin Counties, Mississippi, in 2018. She also served as the environmental law compliance specialist for the USACE IEPR of the Bartons Creek Watershed, Lebanon, Tennessee, Continuing Authorities Program (CAP), Section 205, Flood Risk Management Feasibility Report in 2019. Her responsibility for both projects was to review the draft FS/EIS and the Feasibility Report for compliance with Council on Environmental Quality (CEQ) regulations for implementing NEPA, and specifically compliance with all pertinent acts and executive orders.

Ms. Young has experience with water resource environmental evaluation and review. She worked as a hydrogeologist in the Beaufort office of the South Carolina Water Resources Commission, as part of a team studying the impacts of salt-water intrusion into the Floridan aquifer. She has been integrally involved in ecosystem and water resource project development, planning, permitting, implementation, management, and monitoring of Mississippi's Natural Resource Damage Assessment (NRDA) Early Restoration Phases I, III, and IV projects, with over $100 million in projects funded. She works with the Mississippi DWH Trustee Implementation Group to develop NRDA restoration projects for NRDA settlement monies in accordance with the Programmatic Damage Assessment and Restoration Plan and Programmatic EIS. Following Hurricane Katrina in 2005, Ms. Young was responsible for NEPA compliance for 21 Hurricane Katrina disaster recovery projects (funded by the Federal Emergency Management Agency and the U.S. Department of Housing and Urban Development) across the Mississippi Gulf Coast, and she was task lead for NEPA environmental compliance for the Galveston County (Texas) Housing Assistance Program Round 2 for Hurricane Ike. These disaster recovery projects required preparation of NEPA EAs and in some cases included Phase I ESAs, Phase II ESAs, and environmental remediation.

Ms. Young is familiar with U.S. Fish and Wildlife Service (USFWS) Habitat Evaluation Procedures and other methods of determining non-monetary values of fish and wildlife resources and evaluating suitability, assessing habitat impacts, and formulating mitigation. Ms. Young was actively involved in the development of the Grand Bay National Estuarine Research Reserve/National Wildlife Refuge Land Acquisition and Habitat Management project. The project consisted of acquisition of up to 8,000 acres and land management of up to 17,500 acres. Historic project development included Habitat Equivalency Analysis (HEA) to determine the marsh benefits from acquisition and management actions. Monitoring data were collected to assess project success using the USFWS Rapid Assessment Metrics to Enhance Wildlife Habitat and Biodiversity within Southern Open Pine Ecosystems, which includes metrics on wet longleaf and slash pine flatwoods and savannas.

Ms. Young was also actively involved in the development of the Hancock County Marsh Living Shoreline Project, which includes the construction of approximately 6 miles of breakwater (Living Shoreline) and the creation of 46 acres of subtidal reef and 46 acres of marsh. Project development included HEA to determine marsh benefits resulting from reduced shoreline erosion and the creation of marsh. Project development also included Resource Equivalency Analysis to determine the biomass of secondary productivity that will result from the colonization of the breakwater, establishment of the living shoreline/reef, and colonization of the subtidal reef. Monitoring data will be collected to assess project success.

David Leone	**H&H/Coastal Engineer**

Mr. Leone is a civil engineer with GZA GeoEnvironmental, Inc. who specializes in flood hazard analysis, hazard risk management, and hydrodynamic modeling. He has over 20 years of experience, is a licensed professional engineer in four states (New York, Massachusetts, Connecticut, and Rhode Island), and is a Certified Floodplain Manager. Mr. Leone earned a M.S. in civil engineering from the University of Massachusetts - Lowell in 1998 and his B.S. from Worcester Polytechnic Institute in 1996.

Mr. Leone's flood hazard assessment and hazard risk management expertise includes hazard vulnerability assessments focusing on surface water hydrology, statistical hydrologic analysis for risk-informed decision making, open-channel hydraulics, and two- and three-dimensional hydrodynamics. He has extensive experience with analysis of both riverine and coastal environments, including the combined effects of stormwater, groundwater, and riverine and coastal flood mechanisms. For energy utilities responding to the Nuclear Regulatory Commission (NRC), Mr. Leone was the Principal-in-Charge for the conduct of flood hazard assessment and mitigation studies for 35% of the U.S. nuclear power fleet, including riverine sites in New York, Vermont, Pennsylvania, Virginia, Illinois, Mississippi, Louisiana, and Arkansas. Coastal site locations were also studied throughout the Northeast (New England and New York), Mid-Atlantic (New Jersey to Virginia), Gulf Coast (Louisiana), and Great Lakes (Lake Ontario, Lake Michigan). Similar to all climate change and flood hazard studies, this project involved (a) evaluation of the climate regime, sea level rise, and meteorological storm parameters; (b) flood characterization and inundation modeling for coastal and riverine flood hazards and development of flood duration, flow velocities, hydrodynamic, and hydrostatic impact loads; (c) vulnerability assessment (comparison of reevaluated hazards to current design bases), and (d) development of mitigation strategy concepts and stakeholder communication.

For the NRC flood risk assessment noted above, Mr. Leone evaluated coastal sites along the U.S. Atlantic and Gulf of Mexico coastlines using a combination of deterministic and probabilistic techniques to estimate the re-evaluated flood hazards. This included 2-D modeling using the SWAN+ADCIRC coupled circulation and wave models. Computer simulations used high-performance cluster computer centers. Probabilistic analyses were applied for certain sites to support a risk-informed flood re-evaluation approach, through annual exceedance probabilities of 1E-06. In performing these probabilistic storm surge analyses, Mr. Leone also applied USACE and other industry-standard methods to quantify risk and estimate error and uncertainty. Mr. Leone was co-author of the presentation, "Assessment of Epistemic Uncertainty for Probabilistic Storm Surge Hazard Assessment using a Logic Tree Approach," presented at the 4th Annual Probabilistic Flood Hazard Assessment Workshop sponsored by the NRC.

Mr. Leone's expertise includes simulation of rainfall/runoff and hydrodynamic processes, hydraulic structures, and mapping using state-of-the-practice computer software and geographic information systems (GIS). Mr. Leone is well-versed in several hydrologic computer applications, including the HEC-Hydrologic Modeling System (HMS), HEC-River Analysis System (RAS), ADvanced CIRCulation (ADCIRC) model, SWAN, EPA's Storm Water Management Model (SWMM), and FLO-2D, and has also developed site-specific computer models for both watershed and reservoir-specific water balance simulation.

As part of the Lower Manhattan Coastal Resiliency project, Mr. Leone is leading the development of a coastal hydrodynamic modeling and H&H analysis, as well as preparing a coastal risk assessment, to justify the top elevation of a proposed rehabilitated wharf/sea wall in Battery Park.

Robert Chantome	**Civil/Structural Engineer**

Mr. Chantome has worked for 29 years as a geotechnical and structural engineer. His experience includes development of geotechnical investigation programs; geotechnical design of slopes and foundations; structural design of retaining walls, floodwalls, hydraulic structures, and gates; and geotechnical and seismic design of slopes and foundations. In addition, he performs foundation analyses, scour potential evaluations, and seismic engineering services. He is well-versed in the use of a variety of computer software programs, including AutoCAD, GROUP, GEOPAK, and InRoads. Mr. Chantome holds both a B.S. (1989) and M.S. (1990) in civil engineering from the University of Illinois-Urbana, and is a professional engineer in Kentucky, Iowa, and Missouri. In Illinois, he is a registered structural engineer.

Mr. Chantome served as the structural/geotechnical engineer for a flood protection system for the West Side Phase I project in Cedar Rapids, Iowa, during which he completed structural and foundation design for 850 feet of permanent T-type floodwall founded on battered H-piles with a sheet pile cutoff wall. He also completed constructability assessments for a wall under an arch bridge with 1-inch clearance between the low chord and the top of the wall.

For the Nature Conservancy's Emiquon Preserve Water Control Structure Planning, Design and Construction Services in Illinois, Mr. Chantome was the lead structural engineer responsible for design of a water control structure within the net levee section, pedestrian bridge, and appurtenant sampling structures, which included the design of pump discharge penetrations and the riser structure wall, outlet channel improvements, integrated foundations for cranes on top of the water control structure, and sheetpile cut-off walls and numerous other components to enhance the management of the 5,200-acre wetlands/fisheries restoration project. The wetland restoration area is surrounded by a 20-foot-high levee, and the water control structure and pump station are critical for managing water levels for the aquatic ecosystem.

For USACE's New Orleans District's Task Force Guardian Hurricane Protection Restoration project, Mr. Chantome provided geotechnical engineering expertise for monitoring and recording quality control and quality assurance (QA/QC) test results on multiple levee and flood gate construction projects in Plaquemines Parish, Louisiana. Also, for the USACE New Orleans District, he was a geotechnical/structural engineer for the West Closure Complex, Plaquemines Parish, providing design, review, and QA to the support team. Further, for the USACE New Orleans District's Task Force Hope Cost Estimate Study, Mr. Chantome served as a geotechnical engineer on a multidisciplinary team responsible for preparing a cost estimate of all Hurricane Protection System projects in Southeast Louisiana following Hurricane Katrina and also served on a Lake Pontchartrain and Vicinity Levee Value Engineering Workshop. He was the geotechnical engineer on a multidisciplinary team that proposed value engineering alternatives for four levee and floodwall projects along the south shore of Lake Pontchartrain.

For the Illinois Department of Natural Resources Stratton Lock and Dam project, Mr. Chantome served as the lead structural engineer for the lock wall extension and as civil/structural engineer for the replacement flow control gate structure. The project improved three main components of the existing lock and dam facility: the boat lock was extended in the downstream direction on the river to double the current locking capacity; a new flow control gate structure upstream replaced the existing structure; and the berm on the west side of the Fox River was rehabilitated to correct erosion problems. The new gate structure required staged construction with temporary and permanent channel modifications to maintain the flow of the Fox River throughout construction, reducing the risk of upstream flooding.

For USACE, St. Paul District, Mr. Chantome provided geotechnical and civil engineering support for the design documentation report (design and analysis computations) for 8 miles of roads adjacent to Devil's Lake, North Dakota, that were impounding water due to the flooding of Devil's Lake. He completed the design of the alignments and features and documented the design analysis, including designing an embankment to minimize future construction costs. Mr. Chantome also assisted in developing standards for utility and infrastructure features crossing the embankments.