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Final Independent External Peer Review Report for the Savannah Harbor Expansion Project General Reevaluation Report

Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Deep Draft Navigation Planning Center of Expertise
Mobile District

Contract No. W91278-11-C-0002

February 11, 2011

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for the
Savannah Harbor Expansion Project
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by

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505 King Avenue
Columbus, OH 43201

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General Reevaluation Report

EXECUTIVE SUMMARY

Savannah Harbor is a deep draft navigation harbor located on the South Atlantic U.S. coast, 75 statute miles south of Charleston Harbor, South Carolina, and 120 miles north of Jacksonville Harbor, Florida. The harbor comprises the lower 21.3 miles of the Savannah River (which, with some of its tributaries, forms the boundary between Georgia and South Carolina along its entire length of 313 miles) and 11.4 miles of channel across the ocean bar to the Atlantic Ocean.

The currently authorized deep draft navigation channel is 44 feet deep and 600 feet wide from deep water in the ocean (River Mile 11.4B) to the channel between the jetties (River Mile 2.6B), thence 42 feet deep and 500 feet wide to the harbor entrance (River Mile 0.0). From River Mile 0.0 to the upstream end of the Kings Island Turning Basin (River Mile 19.5), the channel is 42 feet deep and 500 feet wide. The channel is 36 feet deep and 400 feet wide from River Mile 19.5 to the upstream end of the Argyle Island Turning Basin (River Mile 19.9). The upper end of the harbor from River Mile 19.9 to its upstream limit at River Mile 21.3 is maintained at 30 feet deep and 200 feet wide.

In the 1999 Water Resources Development Act (WRDA), the U.S. Congress conditionally authorized deepening the Savannah Harbor Navigation Project to a maximum controlling depth of 48 feet (14.6 meters) within the river channel contingent upon the completion of a Savannah Harbor Expansion Project (SHEP) General Reevaluation Report (GRR) and a Tier II Environmental Impact Study (EIS), a final mitigation plan, and an incremental analysis of the channel depths from 42 to 48 feet.

The U.S. Army Corps of Engineers (USACE) is conducting an Independent External Peer Review (IEPR) of the SHEP GRR and Tier II EIS, as well as Public Comments and a Chloride Model associated with the project. Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of all of the documents. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2010), USACE (2007), and OMB (2004). To meet the aggressive schedule for this IEPR, this project was conducted in three phases under two contracts (a U.S. Army Research Office (ARO) Scientific Services Program Contract and a USACE Savannah District contract (current contract)). Under the ARO Contract (Phases 1 and 2), activities included identification of panel members and their selection, an onsite Orientation visit, a pre-IEPR review by two economists and a cost engineer, a kick-off teleconference, and review of the SHEP GRR and Tier II EIS. The pre-IEPR review (Phase 1) was described in a report

submitted on August 25, 2010. The remaining activities under the ARO Contract (Phase 2) were summarized in a report submitted on December 30, 2010. Work under the Savannah District Contract (Phase 3) included conducting a teleconference to determine the Final Panel Comments, development of the Final Panel Comments, review of Public Comments on the SHEP GRR and Tier II EIS, and review of a Chloride Model by the Water Quality Engineer Panel Member. This final report details the entire IEPR process, including the Final Panel Comments generated from the SHEP GRR and Tier II EIS, a summary of the Public Comment Review, and Final Panel Comments on the Chloride Model.

Nine panel members were selected for the IEPR from more than 50 identified candidates. Based on the technical content of the SHEP GRR and Tier II EIS and the overall scope of the project, the final panel members were selected for their technical expertise in the following key areas: hydraulic engineering, civil engineering, economics, plan formulation, coastal environmental engineering, environmental resources and compliance engineering, real estate, cost engineering, and water quality engineering. Although the Panel was disclosed to USACE, Battelle made the final decisions on selecting the Panel.

The Panel received electronic versions of the SHEP GRR and Tier II EIS documents, totaling more than 7,000 pages to be reviewed (supporting information included more than 1,000 additional pages), along with a charge that solicited comments on the documents to be reviewed. The charge was prepared by Battelle to assist USACE in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). USACE was given the opportunity to provide comments and revisions, and subsequently approved the final charge questions.

The USACE Project Delivery Team (PDT) briefed six of the seven IEPR panel members (one panel member was not available) and Battelle during an onsite meeting in August 2010 and the entire Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review in November 2010. The IEPR panel members then reviewed the SHEP GRR and Tier II EIS documents individually. The Panel produced more than 365 individual comments in response to 72 charge questions. Under the current contract with the Savannah District, the panel members then met via teleconference with Battelle to review key technical comments, discuss charge questions for which there were conflicting responses, and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium, or low); and (4) recommendations on how to resolve the comment. Overall, 19 Final Panel Comments were identified and documented. Of these, 6 were identified as having medium significance and 13 had low significance. None of the comments were identified as having a high level of significance. The Final Panel Comments from this review are provided in Appendix A.

After concluding their review of the SHEP GRR and Tier II EIS documents, Battelle received just over 1,000 pages of Public Comments for the Panel to review. Battelle reviewed and organized the Public Comments to ensure that the Panel used its limited amount of time focusing on the comments related to the panel members' technical review areas. The Panel focused its review on determining whether any additional significant technical concerns were raised by the

Public that USACE should address, given its previous review of the documents. A summary of the Panel's findings from the Public Comment review is provided in Appendix B.

In addition to the other reviews, USACE requested that the Water Quality Engineer review the Chloride Model prepared specifically for this project. The Water Quality Engineer Panel Member reviewed the provided documents using 17 Charge Questions specifically selected by Battelle from the original SHEP GRR and Tier II EIS charge document (see Section 3.8). The five Final Panel Comments (three were identified as having medium significance and two had low significance) from this review are provided in Appendix C. Following is a summary of the findings of each review.

SHEP GRR and Tier II EIS Review

The Panel agreed on its "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2010; p. D-4) in the SHEP GRR and Tier II EIS document. Overall, the Panel believes that, when all of the SHEP GRR, Tier II EIS, and supporting documents are taken into account, a very thorough assessment of the economic, engineering, and environmental impacts and benefits of the SHEP was prepared. The Panel recognizes that a great deal of work has been conducted and that the project is well designed. However, the Panel noted that the SHEP GRR and Tier II EIS main documents currently lack clear linkages to much of the information contained in the appendices and to the assumptions used throughout; such linkages would facilitate the reader's understanding of the documents. The following statements summarize the Panel's findings, which are described in more detail in the Final Panel Comments (Appendix A).

Plan Formulation Rationale: The Panel found that, in general, the SHEP GRR and Tier II EIS development followed a systematic and sustainable plan formulation approach. The appropriate level of detail regarding the development of the documents was provided. The Panel determined that in one area - the process for selecting the various plans - additional documentation was needed.

Economics: The Panel found the economics evaluation to be fairly complete. However, several places were noted where corrections, clarifications, and additional information are needed. For instance, the commodity movement forecast would benefit from additional documentation and more recent data that captures the economic downturn. In other areas, such as the socioeconomic resources, and analysis of regional economic development benefits, additional resources should be consulted. Also, the Panel is concerned about the application of a 25% contingency to different portions of the same alternative.

Engineering: In general, the Panel was satisfied with most of the engineering analyses. However, some of the documentation regarding the models employed, beneficial uses of dredged material, and design assumptions is incomplete making it difficult to determine whether all aspects of the project have been taken into account. The Panel identified several areas of uncertainty and risk that are potential concerns.

Environmental: The Panel found that, overall, USACE took into consideration the environmental issues noted throughout the SHEP project area. It was noted during the review of

the hydrodynamic, salinity, and oxygen modeling that some issues could affect the overall credibility and accuracy of the models. In addition, concerns were raised about the mitigation for dissolved oxygen (DO) and its potential impact upon fish.

Table ES-1 summarizes the Final Panel Comments by level of significance from the SHEP GRR and Tier II EIS review. Detailed information on each comment is contained in Appendix A of this report.

Table ES-1. Overview of 19 Final Panel Comments Identified by the SHEP GRR and Tier II EIS IEPR Panel

Significance – Medium	
1	The currently chosen open water boundary condition for salinity for the Environmental Fluid Dynamics Code (EFDC) hydrodynamic model is located in an area that is potentially impacted by discharge from the Savannah River, which could result in an inadequate representation of the cause-effect relationship between river discharge and ocean salinity that affects salinity and the affected resources in Savannah Harbor.
2	The current plan for mitigation of low DO conditions - using direct injection of pure oxygen into the water column - does not appear to take into account the resulting supersaturated river water that could kill fish species passing through, entrained within, or captured by the injection “plume.”
3	The review documents do not sufficiently describe, justify, and validate the respective models employed and do not contain the information needed to verify whether the models accounted for the extra dredge depths specific to over-dredging and advanced maintenance.
4	Documentation of assumptions used throughout the analyses in the SHEP GRR and Tier II EIS are incomplete and need further explanation to support the conclusions.
5	The conceptual model for water quality interactions in Savannah Harbor needs additional explanation and justification to support the exclusion of the benthic release of ammonia as a source term for ammonia in the water quality model.
Significance – Low	
6	The EFDC hydrodynamic model setup for the open water boundary condition and representation of the southeast boundary line offshore from Tybee Island has not been defined, causing an infinitely high barrier in the ocean that does not allow flow and mass transport across the southeast boundary.
7	Beneficial uses of dredged materials from the Inner Harbor are not fully evaluated in the SHEP GRR, Tier II EIS, or Dredged Material Management Plan (DMMP).
8	Impacts to Tybee Island from the existing navigation channel and future navigation channel, including downdrift impacts, need further explanation.
9	Design assumptions in the SHEP GRR need further clarification to explain risk and uncertainty to project cost and schedule.
10	The conceptual model for water quality interactions in Savannah Harbor needs additional explanation and justification to support the exclusion of algae as a state variable in the water quality model.
11	The discussion of the process for selecting the various plans is unclear.

Table ES-1. Overview of 19 Final Panel Comments Identified by the SHEP GRR and Tier II EIS IEPR Panel continued

Significance – Low	
12	Documentation regarding commodity movement data is insufficient to support the commodity movement projections presented in the analysis.
13	The socioeconomic resources are not described in sufficient detail.
14	The commodity movement model and analysis needs to be strengthened by including data for 2008, 2009, and even 2010 to capture the economic downturn.
15	The application of a 25% contingency to different portions of the same alternative may result in artificially increased cost projections.
16	Predictions regarding the lack of future increases in overall cargo amounts require further explanation.
17	The approach to measuring Regional Economic Development (RED) impacts does not appear to follow the Water Resources Council Economic and Environmental Principles and Guidelines (P&Gs) for Water and Related Land Resources Implementation Studies.
18	The report should address the current status of, and any impacts of delays in, the Panama Canal deepening.
19	Potential effects of future climate change are not fully described and addressed.

Public Comment Review

The Panel reviewed the technical comments provided by various agencies, stakeholders, and members of the public. General support, opposition, and comments related to policy compliance were not reviewed by the Panel. In addition, many issues that are not technical in nature were repeatedly noted within the comments. These public comments are outside the directed focus of the Panel's charge, and therefore were not noted by the Panel.

The Panel found several Public concerns that deserve further investigation and documentation within the SHEP GRR and Tier II EIS. The Public concerns are described in a Final Panel Summary in Appendix B; however, the Panel notes that the Public Comments should be directly examined regarding the details of each concern. Topics include, but are not limited to, selection of sites studied for shoreline erosion; mitigation of impacts to wetlands and short-nosed sturgeon; DO deficiencies; potential for high levels of chloride at the water intake on Abercorn Creek that will cause corrosion problems for the City of Savannah and industrial water users; and proposed monitoring activities. Additional concerns were noted by the public parallel some of the Panel's concerns written up in its Final Panel Comments; the Panel did not repeat these concerns within the Public Comment Review summary.

Chloride Model Review

The Water Quality Engineer agreed that in general the Chloride Model was adequate and acceptable for the project. The expected impacts, however, are not minimal since the Chloride Model results indicate a significant increase in chloride levels under low-flow hydrologic conditions (as noted in the SHEP Chloride Impact Evaluation Report, page 11) that can increase corrosivity in industrial and residential plumbing systems and increase costs of operations for the

City of Savannah and local industrial water users. Portions of the Chloride Model had discrepancies that could affect the overall credibility and accuracy of the final output on the assessment of the impact of channel deepening scenarios and mitigation options. Table ES-2 summarizes the Final Panel Members Comments from the Chloride Model review by level of significance. Detailed information on each comment is contained in Appendix C of this report.

Table ES-2. Overview of Five Final Panel Member Comments Identified by the SHEP Chloride Model IEPR Panel Member

Significance – Medium	
CL-1	The currently chosen open water boundary condition for salinity for the EFDC hydrodynamic model is located in an area that is potentially impacted by discharge from the Savannah River, which could result in an inadequate representation of the cause-effect relationship between river discharge and ocean salinity that affects salinity and the affected resources in Savannah Harbor.
CL-2	Grid cell coordinates and the design of the curvilinear grid scheme for the extended grid model of Savannah Harbor and the initial condition for salinity may cause mass balance problems for the hydrodynamic model
CL-3	A discrepancy between the volume of the EFDC model domain and the actual volume of a high-resolution Digital Elevation Model (DEM) for the Savannah, Georgia, area can result in potential errors in the simulations of the impact of channel deepening and mitigation scenarios on salinity intrusion in tidal fresh wetlands and chlorides at the City of Savannah water intake.
Significance – Low	
CL-4	The EFDC hydrodynamic model setup for the open water boundary condition and representation of the southeast boundary line offshore from Tybee Island has not been defined, causing an infinitely high barrier in the ocean that does not allow flow and mass transport across the southeast boundary.
CL-5	Data and information related to the withdrawal flow for the City of Savannah water intake, used to represent the impact of pumping at the water intake on chloride levels in the modeling analysis, is not correctly documented, and may not be correctly assigned in the setup of the hydrodynamic model.

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LIST OF ACRONYMS

ADDAMS	Automated Dredging and Disposal Alternatives Management System
AIWW	Atlantic Intercoastal Waterway
ANN	Artificial Neural Network
ARO	U.S. Army Research Office
ASCE	American Society of Civil Engineers
ATM	Applied Technology and Management
ATR	Agency Technical Review
Caro-COOPS	Carolinas Coastal Ocean Observing and Prediction System
CBOD	Carbonaceous Biochemical Oxygen Demand
CEDEP	Cost Estimating Dredge Engineering Program
COI	Conflict of Interest
DEM	Digital Elevation Model
DMMP	Dredged Material Management Plan
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DOI	Department of Interior
DrChecks	Design Review and Checking System
EA	Environmental Assessment
EC	Engineer Circular
EFDC	Environmental Fluid Dynamics Code
EIS	Environmental Impact Study
EPA	Environmental Protection Agency
ER	Engineer Regulation
ERDC	Engineer Research and Development Center
ETL	Engineering Technical Letter
GEC	Gulf Engineers & Consultants
GRR	General Reevaluation Report
GVC	Generalized Vertical Coordinate
I&D	Industrial and Domestic
IEPR	Independent External Peer Review
LPP	Locally Preferred Plan
LTMS	Long-Term Management Strategy
mg/l	Milligrams per Liter
MGD	Million gallons per day
NED	National Economic Development
NEPA	National Environmental Policy Act
NGDC	National Geophysical Data Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NPDES	National Pollutant Discharge Elimination System
NTP	Notice to Proceed
O&M	Operations and Maintenance
OMB	Office of Management and Budget

P&Gs	Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (Water Resources Council)
PCX	Planning Center of Expertise
PDT	Project Delivery Team
PMEL	Pacific Marine Environmental Laboratory
RED	Regional Economic Development
SAB	South Atlantic Bight
SABSOON	South Atlantic Bight Synoptic Offshore Observational Network
SCDHEC-OOCRM	South Carolina Department of Health and Environmental Control- Office of Ocean and Coastal Resource Management
SHEP	Savannah Harbor Expansion Project
SOD	Sediment Oxygen Demand
SOW	Scope of Work
SRMC	Savannah River Maritime Commission
USACE	United States Army Corps of Engineers
UTM	Universal Transverse Mercator
WASP	Water Analysis Simulation Program
WRDA	Water Resources Development Act

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1. INTRODUCTION

Savannah Harbor is a deep draft navigation harbor located on the South Atlantic U.S. coast, 75 statute miles south of Charleston Harbor, South Carolina, and 120 miles north of Jacksonville Harbor, Florida. The harbor comprises the lower 21.3 miles of the Savannah River (which, with some of its tributaries, forms the boundary between Georgia and South Carolina along its entire length of 313 miles) and 11.4 miles of channel across the ocean bar to the Atlantic Ocean.

The currently authorized deep draft navigation channel is 44 feet deep and 600 feet wide from deep water in the ocean (River Mile 11.4B) to the channel between the jetties (River Mile 2.6B), thence 42 feet deep and 500 feet wide to the harbor entrance (River Mile 0.0). From River Mile 0.0 to the upstream end of the Kings Island Turning Basin (River Mile 19.5), the channel is 42 feet deep and 500 feet wide. The channel is 36 feet deep and 400 feet wide from River Mile 19.5 to the upstream end of the Argyle Island Turning Basin (River Mile 19.9). The upper end of the harbor from River Mile 19.9 to its upstream limit at River Mile 21.3 is maintained at 30 feet deep and 200 feet wide.

In the 1999 Water Resources Development Act (WRDA), the U.S. Congress conditionally authorized deepening the Savannah Harbor Navigation Project to a maximum controlling depth of 48 feet (14.6 meters) within the river channel contingent upon the completion of a Savannah Harbor Expansion Project (SHEP) General Reevaluation Report (GRR) and a Tier II Environmental Impact Statement (EIS), a final mitigation plan, and an incremental analysis of the channel depths from 42 to 48 feet.

The Savannah District of the U.S. Army Corps of Engineers (USACE) has developed the SHEP GRR to determine the feasibility of improvements to the current Savannah Harbor Navigation Project. The SHEP GRR and accompanying Tier II EIS were developed to fulfill the conditions of the conditional authorization granted by Congress in 1999. The SHEP GRR and Tier II EIS provide documentation of the technical and plan formulation analyses conducted in the development of a recommended plan for navigation improvement and environmental mitigation. The SHEP GRR includes a final mitigation plan and an incremental analysis of alternative channel depths from 42 to 48 feet.

The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the SHEP GRR and Tier II EIS in accordance with procedures described in the Department of the Army, USACE Engineer Circular *Civil Works Review Policy* (EC No. 1165-2-209) (USACE, 2010), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to coordinate the IEPR of the SHEP GRR and Tier II EIS. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

This IEPR was conducted in three phases to accommodate USACE requests for additional reviews, implement an aggressive project schedule, and address contracting limitations. A pre-

IEPR (Phase 1) was conducted under a previous U.S. Army Research Office (ARO), Scientific Services Program contract (W911NF-07-D-0001, Task Control Number 08-258, Delivery Order 0502), which was awarded in September 2008. Phase 1, involving cost engineering and economics, was conducted in August 2010 at USACE's request, for which a separate final report was submitted to USACE on August 25, 2010. The pre-IEPR report outlines the panel members who participated in the pre-IEPR review and their final comments on the pre-IEPR documents provided (included here as Appendix A).

Phase 2 of the IEPR, also conducted under the ARO contract, was the actual review of the SHEP GRR and Tier II EIS by the entire Panel. This phase ended with the review of the documents because contracting limitations of the ARO contract, which ended September 30, 2010, did not allow additional time and funds to be added to this project, which would have completed the IEPR.

Phase 3 of the IEPR is being conducted under the Savannah District Contract. This work includes the identification and development of Final Panel Comments, review and summarization of findings from the review of the Public Comments received on the SHEP GRR and Tier II EIS, review of the Chloride Model used for the project, and comment and response process for the IEPR.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (2010) and USACE (2007).

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

In this case, the IEPR of the SHEP GRR and Tier II EIS was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization under Section 501(c)(3) of the U.S. Internal Revenue Code with experience conducting IEPRs for USACE.

3. METHODS

This section describes the method followed in selecting the members for the IEPR Panel (the Panel) and in planning and conducting the IEPR. Some of this work was conducted under a previous contract, but is described here for completeness. The IEPR was conducted following procedures described by USACE (2010) and in accordance with USACE (2007) and OMB (2004) guidance. Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

3.1 Planning and Schedule

As previously noted, this work was conducted under two separate contracts. To provide a complete documentation of what has occurred in support of this IEPR, the activities conducted under the previous contract are summarized along with the work conducted under this contract.

ARO, Scientific Services Program Contract W911NF-07-D-0001 (Phases 1 and 2)
Battelle received the notice to proceed (NTP) on September 9, 2008. USACE delayed the start of the project so USACE could revise the review documents and provide completed review documents to the IEPR panel. During this period, Battelle kept in contact with the Planning Center of Expertise (PCX) and scheduled the conduct of IEPR activities based on the PCX's understanding of when the documents would be ready for review. To ensure a comprehensive peer review was conducted, while being responsive to the needs of USACE PCX and Project Delivery Team (PDT) as they evolved, nine contract modifications were instituted on the ARO contract, which included extending the period of performance, changing the overall SOW, revising the IEPR Panel, and providing additional funding. Activities conducted under the ARO contract included:

- Work plan development (December 2009)
- Panel charge development (December 2009, November 2010)
- USACE/Battelle kick-off meeting (February 2010)
- Panel recruiting (December 2009 – November 2010)
- Site Visit and On-Site Meeting (August 2010)
- Pre-IEPR review of the Transportation Cost Savings Model and Cost Engineering estimates (August 2010; see Final Report submitted August 25, 2010)
- Kick-off teleconference with USACE and Panel for SHEP GRR and Tier II EIS review (November 2010)
- Panel review of the SHEP GRR and Tier II EIS documents (November – December 2010)
- Final report summarizing activities under the ARO contract (January 2011)

Additional information on the panel recruitment, kick-off teleconference and review tasks are provided in Sections 3.2 through 3.4 below. Additional information on the other tasks can be found in the final report summarizing activities under the ARO contract. Due to the contract modifications to accommodate the 2-day on-site trip and pre-IEPR, and the ARO contract funding and period of performance limitations, the remainder of the IEPR is being conducted under USACE Savannah District Contract W91278-11-C-0002 (this contract).

USACE Savannah District Contract W91278-11-C-0002 (Phase 3)
Under this contract, the panel comments developed from the SHEP GRR and Tier II EIS review conducted under the ARO contract were reviewed by Battelle to identify key issues. A teleconference with the Panel was conducted to discuss the key issues, and Final Panel Comments were developed. Note that the work items listed in Table 1 under Task 5 occur after the submission of this report. Battelle will enter the 19 Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the

Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle.

In addition to the review of the SHEP GRR and Tier II EIS, USACE requested that the Panel review the Public Comments, and that the Water Quality Engineer review the Chloride Model associated with the project. Additional information on these activities is provided in Sections 3.5 through 3.8 below. Table 1 provides dates of key actions relative to the IEPR conducted under Phase 3 that occurred from the NTP of this contract to project closeout.

Table 1. Key Actions Relative to the SHEP GRR and Tier II EIS IEPR (Phase 3)

TASK	ACTION	DUE DATE
1	NTP	November 19, 2010
	Review documents available	November 19, 2010
	*Battelle submits draft Work Plan	December 7, 2010
	USACE provides comments on draft Work Plan	December 9, 2010
	*Battelle submits final Work Plan	December 13, 2010
2	*Battelle submits list of previously selected panel members	December 7, 2010
	USACE reapproves previously selected panel members	December 8, 2010
	Battelle completes subcontracts for panel members	December 13, 2010
3	Battelle convenes panel review teleconference	December 20, 2010
	Panel members provide draft Final Panel Comments to Battelle	January 5, 2011
4	*Battelle submits Final IEPR Report to USACE	February 11, 2011
5	Battelle inputs Final Panel Comments from the review of the SHEP GRR and Tier II EIS, Public Comments, and Chloride Model into DrChecks; Battelle provides Final Panel Comment response template to USACE	February 11, 2011
	USACE provides draft Evaluator Responses and clarifying questions to Battelle	February 24, 2011
	Battelle facilitates teleconference between Battelle, IEPR Panel, and USACE to discuss Final Panel Comments, draft responses, and clarifying questions	March 7, 2011
	USACE inputs final Evaluator Responses in DrChecks	March 14, 2011
	Battelle inputs the Panel's BackCheck Responses in DrChecks	March 24, 2011
	*Battelle submits pdf printout of DrChecks project file	March 25, 2011
6	Civil Works Review Board	March 24, 2011 (Tentative)
7	Review of Chloride Model	January 2011
8	Review of Public Comments from Public Review of the Draft SHEP GRR and Tier II EIS	January 2011
	Project Closeout	May 30, 2011

[a] Deliverable

3.2 Identification and Selection of IEPR Panel Members (Conducted under ARO Contract)

The initial SOW for the IEPR included five reviewers: two engineers (with experience in hydraulic dredging and confined dredged material disposal), an economist, a biologist (with experience in environmental and coastal processes), a cost engineer, and a plan formulator. Subsequent contract modifications removed the cost engineer and added two panel members: a real estate panel member and an environmental resources and compliance engineer. The Cost Engineer was ultimately added back to the Panel, along with a new panel member (a Water Quality Engineer) for a total of nine panel members. These areas correspond to the technical content of the SHEP GRR and Tier II EIS and overall scope of the SHEP.

To identify candidate panel members, Battelle reviewed experts in Battelle's Peer Reviewer Database, sought recommendations from colleagues, contacted former panel members, and conducted targeted Internet searches. Recruiting began in December 2009, but due to the changes in required panel members, four rounds of recruiting occurred, with the full panel under subcontract by November 2010. Battelle identified more than 50 candidates for the Panel, evaluated their technical expertise, and inquired about potential COIs. Of these, Battelle chose 15 of the most qualified candidates and confirmed their interest and availability. Of the 15 candidates, 9 were proposed for the final Panel and 6 were proposed as backup reviewers. Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to USACE for feedback. Battelle made the final selection of panel members according to the selection criteria described in the Work Plan.

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

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

1. Involvement by you or your firm in any part of the Savannah Harbor Expansion Project General Reevaluation Report or Tier II Environmental Impact Statement.
2. Involvement by you or your firm in any work related to the Savannah River and the Port

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

of Savannah.

3. Current employment by the USACE.
4. Involvement with paid or unpaid expert testimony related to the Savannah Harbor Expansion Project.
5. Current or previous employment or affiliation with members of the cooperating agencies or local sponsors, including the U.S Environmental Protection Agency (EPA) – Region 4, the National Marine Fisheries Service – Southeast Regional Office, the U.S. Fish and Wildlife Service – Southeast Region, the Georgia Ports Authority, the South Carolina Department of Health and Environmental Control, the Georgia Department of Natural Resources (DNR) Coastal Resources Division, Georgia DNR Wildlife Resources Division, Georgia DNR Environmental Protection Division, and the City of Savannah and currently working on the Savannah Harbor Expansion Project -related projects (for pay or pro bono).
6. Current or previous employment or affiliation with Center For A Sustainable Coast, Coastal Georgia Center For Sustainable Development, South Carolina Coastal Conservation League, National Wildlife Federation, or South Carolina Wildlife Federation. Affiliation can include serving as a contractor (either as an individual or through your firm) within the last 10 years, notably if those projects/contracts are related to the Savannah Harbor Expansion Project.
7. Past, current or future interests or involvements (financial or otherwise) by you, your spouse or children related to the Savannah Harbor Expansion Project.
8. Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, Engineer Research and Development Center (ERDC), etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Savannah District.
9. Current firm involvement with other USACE projects, specifically those projects/contracts that are with the Savannah District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.
10. Previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm) within the last 10 years, notably if those projects/contracts are with the Savannah District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
11. Other USACE affiliation [e.g., scientist employed by USACE (except as described in NAS criteria, see EC 1105-2-410 section 8d)].
12. Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning deep draft navigation, and include the client/agency and duration of review (approximate dates).
13. Pending, current or future financial interests in Savannah Harbor Expansion Project-related contracts/awards from USACE.
14. A significant portion (i.e., greater than 50%) of personal or firm revenues within the last

3 years came from USACE contracts.

15. Any publicly documented statement (including, for example, advocating for or discouraging against) related to the Savannah Harbor Expansion Project.
16. Participation in relevant prior Federal studies/programs relevant to this project:
    a. Savannah Harbor Deepening Feasibility Report, 1991
    b. Savannah Harbor Deepening Feasibility Report (Section 203) and Tier I EIS 1998
    c. Savannah Harbor Dredged Material Management Plan (Update) 2007
    d. Environmental Improvement (Section 1135) Study
    e. Savannah Harbor Long Term Management Strategy
    f. Lower Savannah River Basin Environmental Restoration Project
17. Is there any past, present or future activity, relationship or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project? If so, please describe.

In selecting the final members of the Panel from the list of candidates, Battelle chose experts who best fit the expertise areas and had no COIs. The nine final reviewers were either affiliated with academic institutions or consulting companies or were independent engineering consultants. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. Although the Panel was disclosed to USACE, Battelle made the final decision on selecting the Panel. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within 2 days of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference, planned and facilitated by Battelle, to review the IEPR process, the schedule, communication, and other pertinent information for the Panel.

3.3 Kick-off Meetings (Conducted Under the ARO Contract)

In January 2010, Battelle held a project kick-off meeting with the USACE PCX and PDT members to discuss the process for moving forward. Then, at USACE's request, in August 2010, Battelle and six of the panel members participated in a site visit and onsite meeting in Savannah, Georgia. Because three of the final panel members were not part of the onsite kick-off meeting, Battelle subsequently planned and facilitated a final kick-off meeting (November 17, 2010) via teleconference just prior to the start of the review, during which USACE presented project details to the entire Panel.

3.4 Preparation of the Charge and Conduct of the IEPR (Conducted Under the ARO Contract)

Battelle drafted a preliminary charge document, including specific charge questions and discussion points. The charge was prepared by Battelle to assist USACE in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). The draft charge was submitted to USACE for evaluation as part of the draft Work Plan. Due to an additional delay in the receipt of documents and the addition of two panel members who were not under consideration in December 2009 (when initial recruiting

began), the draft charge was revised based upon the SHEP GRR and Tier II EIS documents (totaling over 7,000 pages to be reviewed and over 1,000 pages of supporting documents). It was resubmitted to USACE just prior to the IEPR in November 2010. USACE accepted the revised draft charge, which was used as the final charge. In addition to a list of 72 charge questions/ discussion points, the final charge included general guidance for the Panel on the conduct of the peer review (provided in Appendix D of this final report).

The IEPR Panel received an electronic version of the SHEP GRR and Tier II EIS documents and the final charge. The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle. At the end of the review period, the Panel produced approximately 365 individual comments in response to the charge questions/discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

3.5 IEPR Panel Teleconference (Conducted Under this Contract)

Battelle facilitated a 4-hour teleconference with the Panel so that the panel experts, many of whom are from diverse scientific backgrounds, could exchange technical information. The main goal of the teleconference was to identify which issues should be carried forward as Final Panel Comments in the IEPR report and decide which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the final IEPR report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative comments, added any missing issues of high-level importance to the findings, and merged any related individual comments. In addition, Battelle confirmed each Final Panel Comment's level of significance to the Panel.

The Panel also discussed responses to nine specific charge questions where there appeared to be disagreement among panel members. The conflicting comments were resolved based on the professional judgment of the Panel, and all sets of comments were determined not to be conflicting. Each comment was either incorporated into a Final Panel Comment, determined to be consistent with other Final Panel Comments already developed, or determined to be a non-significant issue.

At the end of these discussions, the Panel identified 22 comments and discussion points that should be brought forward as Final Panel Comments.

3.6 Preparation of Final Panel Comments (Conducted Under this Contract)

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

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary

detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.

- Directive to the Lead: Each lead was encouraged to communicate directly with other IEPR panel members as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.
- Format for Final Comments: Each Final Panel Comment was presented as part of a four-part structure:
  1. Comment Statement (succinct summary statement of concern)
  2. Basis for Comment (details regarding the concern)
  3. Significance (high, medium, low; see description below)
  4. Recommendation for Resolution (see description below).
- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
  1. High: Describes a fundamental problem with the project that could affect the recommendation, success, or justification of the project. Comments rated as high indicate that the Panel analyzed or assessed the methods, models, and/or analyses and has determined that there is a "showstopper" issue.
  2. Medium: Affects the completeness of the report in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium indicate that the Panel does not have sufficient information to analyze or assess the methods, models, or analyses.
  3. Low**:** Affects the understanding or accuracy of the project as described in the report, but will not affect the recommendation or justification of the project. Comments rated as low indicate that the Panel identified information (tables, figures, equations, discussions) that was mislabeled or incorrect or that there were data or report section not clearly described or presented.
- Guidance for Developing the Recommendation: The recommendation was to include specific actions that the USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

As the Panel began preparing the Final Panel Comments, several comments were dropped as further investigation determined that the issues were addressed in the review documents. In addition, another issue was identified as a Final Panel Comment. At the end of this process, 19 Final Panel Comments were prepared and assembled. Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in Appendix A of this report.

3.7 Review of the Public Comments (Conducted Under this Contract)

On January 26, 2011, USACE supplied the Public Comments to Battelle. Just over 1,000 pages of comments were received. Battelle performed a cursory review of the Public Comments from January 26 to 29, 2011, to supply to the Panel a table identifying which pages of the Public Comments should be reviewed given the limited amount of time provided. The table focused the Panel on reading those pages where technical issues related to each panel member's discipline, and pertinent to the IEPR, were noted. Comments regarding policy or changes to specific sections of the SHEP GRR and Tier II EIS were not reviewed. In addition, general support and opposition letters were not reviewed, as they did not provide the Panel with any technical issues to consider. Each panel member was asked to review specific pages of public comments and provide Battelle statements on any new issues they believed were important enough for USACE to consider. Any issues already brought up as part of the original IEPR or Chloride Model review were not repeated in this summary. Due to the limited time available, there may be additional issues within the Public Comments that the Panel could not address. The Summary of Panel findings is presented in Appendix B of this report.

3.8 Review of the Chloride Model (Conducted Under this Contract)

The Water Quality Engineer panel member reviewed a Chloride Model developed for SHEP. The following document filenames were reviewed:

- Chloride Analysis 12-17-2010.docx
- EFDC Chloride Modeling Report, FINAL (App A).docx
- SCM_Appendix_RV1.doc
- SHEP Chloride Modeling Report_RV2.docx
- ATR Report12_20.pdf
- Updated EFDC input files and the efdc.exe file that were developed for the extended grid scheme and the new chloride analysis

The following charge questions, which are a subset of the final charge questions developed by Battelle for the IEPR review, were provided to the Water Quality Engineer to focus the review.

1. Are the assumptions that underlie the engineering, environmental, and hydrologic analyses sound?
2. Comment on the adequacy and acceptability of the engineering and environmental methods, models, and analyses used.
3. Are the models used sufficiently discriminatory to support the conclusions drawn from them (i.e., identify meaningful differences between alternatives)?
4. Were risk and uncertainty sufficiently considered?
5. In your opinion, are there sufficient analyses upon which to base the recommendation?
6. Has the character and scope of the study area been adequately described and is the identified study area appropriate in terms of undertaking a systems/watershed/ecosystem-based investigation?

7. For your particular area of expertise, provide an in-depth review of whether the analyses of the existing natural resources within the project area are sufficient to support the estimation of impacts of the array of alternatives.
8. Was the hydrology discussion sufficient to characterize current baseline conditions and to allow for evaluation of how forecasted conditions (with and without proposed actions) are likely to affect hydrologic conditions?
9. Were the assumptions used as the basis for developing the most probable future without project conditions reasonable?
10. Were adequate scenarios effectively considered (applied during analyses where relevant and/or reasonably investigated)?
11. Comment on the ability of the proposed mitigation plans to address adverse impacts from the project.
12. In general, are the aquatic habitat impacts anticipated under the various harbor deepening alternatives reasonable and adequately described? If not, explain.
13. Comment on the assessment that minimal impacts are expected to water at the City of Savannah's water intake on Abercorn Creek from the proposed harbor deepening alternatives.
14. Comment on the hydrodynamic model ability to predict any significant changes in impacts based on the alternatives and mitigation measures.
15. Comment on the scope and suitability of the proposed monitoring plan.
16. Comment on the adequacy of the environmental impact and mitigation uncertainties discussion.
17. Based on your area of expertise, are there any additional problems that should be considered when deepening this harbor that have not been identified for this project? If so, what and why?

The Water Quality Engineer developed five Final Panel Member Comments relating to the Chloride Model, which are presented in Appendix C of this report.

4. PANEL DESCRIPTION

Candidates for the Panel were identified using Battelle's Peer Reviewer Database, targeted Internet searches using key words (e.g., technical area, geographic region), searches of websites of universities or other compiled expert sites, and referrals. Battelle prepared a draft list of primary and backup candidate panel members (who were screened for availability, technical background, and COIs), and provided it to USACE for feedback. Battelle made the final selection of panel members.

An overview of the credentials of the final nine primary members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table 2. More detailed biographical information regarding each panel member and his or her area of technical expertise is presented in the text that follows the table.

Table 2. SHEP GRR and Tier II EIS IEPR Panel: Technical Criteria and Areas of Expertise

	Hayes	Lally	Greene	Casavant	Poff	Looney	Vann	Fowler	Stoddard
Hydraulic Engineer (Dredging Expert)	**X**								
At least 10 years of experience from academia or an architect/engineering/ consulting firm	X	X			X		X	X	X
Demonstrated experience in deep draft navigation channel design	X	X					X	X	
Demonstrated experience in dredging	X	X			X		X	X	
Demonstrated experience in coastal currents	X	X			X				X
Demonstrated experience in channel modifications	X	X			X		X	X	
Registered Professional Engineer	X	X			X		X	X	
Civil Engineer (Dredged Material Disposal Expert)		**X**							
At least 10 years of experience from academia or an architect/engineering/ consulting firm		X			X		X		
Demonstrated experience in dredged material disposal		X			X		X	X	
Demonstrated experience in dredging		X			X		X	X	
Demonstrated experience in confined disposal areas		X			X		X		
Demonstrated experience in erosion		X			X		X	X	
Registered Professional Engineer		X			X		X	X	

	Hayes	Lally	Greene	Casavant	Poff	Looney	Vann	Fowler	Stoddard
Economics				X					
At least 10 years of experience in economic analysis			X	X					
At least 10 years of project experience evaluating and conducting multi-objective public works projects OR			X	X	X			X	
At least 10 years of project experience evaluating and conducting transportation-related projects			X	X				X	
Experience with deep-draft navigation			X	X			X		
Experience directly working for or with USACE			X	X	X		X	X	
Plan Formulation				X					
At least 10 years of experience with plan formulation				X				X	
At least 10 years of demonstrated experience analyzing, evaluating, and comparing alternative plans for USACE				X				X	
Coastal Environmental Engineer					X				
At least 10 years of demonstrated experience in environmental, estuarine, and coastal and estuarine processes		X			X	X			X
Understanding of ecological responses to shoreline erosion		X			X	X			
Experience and understanding of environmental impacts associated with dredging		X			X	X	X		

	Hayes	Lally	Greene	Casavant	Poff	Looney	Vann	Fowler	Stoddard
Environmental Resources and Compliance Engineer						X			
At least 10 years of demonstrated experience in fisheries, water quality, and wetlands					X	X			X
Understanding of ecological responses to shoreline erosion					X	X			
Experience and understanding of environmental compliance requirements associated with the National Environmental Policy Act (NEPA) and USACE projects					X	X			
Real Estate							X		
At least 10 years of demonstrated experience in analyzing Federal real estate requirements associated with dredging of deep draft navigation channels							X		
Cost Engineering								X	
At least 10 years of demonstrated experience with deep draft navigation projects and cost engineering evaluations related to mitigation (specifically when mitigation is a significant portion of project costs)								X	
Familiarity with similar large-scope projects across the U.S. and related Cost Engineering procedures					X			X	

	Hayes	Lally	Greene	Casavant	Poff	Looney	Vann	Fowler	Stoddard
Experience in associated contracting procedures, total cost growth analysis and related cost-risk analysis					X			X	
Familiarity with the construction industry and practices used in the Southeastern United States					X			X	
Minimum of M.S. degree(s) in civil engineering								X	
Water Quality Engineer									**X**
At least 10 years of demonstrated experience in the ability to evaluate and assess chloride impacts on industrial/municipal water intake									X
Familiarity with assumptions and outputs of both the Environmental Fluid Dynamics Code (EFDC) Hydrodynamic model and an Artificial Neural Network (ANN)									X
Knowledge of industrial water supply									X
Experience working directly for or with USACE								X	X
Minimum of M.S. degree in chemistry or related field									X

Dr. Donald F. Hayes, P.E., D.E.E.

Role: This panel member was chosen primarily for his hydraulic engineering experience and expertise.
Affiliation: University of Louisiana

Dr. Donald Hayes is Co-Director of the Institute for Coastal Ecology and Engineering, University of Louisiana at Lafayette. He has over 20 years of experience, is a registered professional engineer, and member of the American Society of Civil Engineers (ASCE) and Western Dredging Association. He has a Ph.D. in Civil Engineering from Colorado State University. Research interests include: (1) contaminated sediments - environmental impacts of dredging, managing contaminated sediments, sediment treatment options; (2) coastal restoration and protection - engineering design of wetlands restoration projects, use of dredged sediments for restoration, water quality considerations, sediment quality; (3) surface water quality - fate and transport of suspended sediments and toxic constituents, total maximum daily load assessment, watershed management; and (4) systems analysis applications - reservoir operations, stormwater management, water quality implications. He has authored numerous technical reports and journal publications and refereed conference publications. He serves on several engineering committees and societies. He is also the author of several Automated Dredging and Disposal Alternatives Management System modules (software distributed by USACE to manage dredging projects and dredged material placement). Dr. Hayes has delivered presentations to the international community and is recognized as an expert in the remediation of contaminated sediments and dredged material management as indicated by his consulting work and testimony for industry and government.

John E. Lally, P.E.

Role: This panel member was chosen primarily for his civil engineering experience and expertise.
Affiliation: Lally Consulting L.L.C.

John E. Lally has over 20 years of project experience in waterway engineering, consulting, and construction, specializing in dredging, remediation of contaminated sediments, and coastal engineering. He has participated in over 100 different dredging projects, including deep-draft navigation channel projects (Columbia River Channel Improvements, Kings Bay Entrance Channel). He has consulted on dredge project design, construction, and operations, including dredge prism design, dredge equipment selection and optimization, offloading facilities, dike construction, water management, dewatering, and management and disposal of dredged sediments via hydraulic pipeline, barge, truck, and rail. Mr. Lally has conducted site geomorphology studies, numerical modeling, and empirical measurement of waves and currents, geotechnical analysis, and engineering design of beach restoration, wetland management, shoreline erosion control, and jetty projects using structural and soft engineering approaches. He also is experienced in hydrographic surveys, dredge production engineering, environmental monitoring, and project/program management. Mr. Lally has co-authored more than 20 publications and presentations for USACE, EPA, and other national and international journals, conferences, and workshops. He is a member of the Western Dredging Association, ASCE Coasts, Oceans, Ports and Rivers Institute, International Navigation Association, Sediment

Management Work Group, Restore America's Estuaries, National Program Committee (2006), and ASCE Dredging 2012 Conference Technical Steering Committee. He is a registered Professional Engineer in Washington.

Gretchen Greene, Ph.D.

Role: This panel member was chosen primarily for her economics experience and expertise.
Affiliation: Environ International Corporation

Dr. Gretchen Greene is a senior economist with Environ International Corporation, specializing in water resources, benefit-cost analysis, regulatory analysis, and litigation support. She earned her Ph.D. in food and resource economics from the University of Florida in 1998. Dr. Greene has over 15 years of experience related to water resource economics, focusing on environmental valuation, economic development, socioeconomic analysis, recreation demand, cost-benefit analysis, regulatory analysis, population projections, and urban water demand forecasting. Dr. Greene has extensive experience with economic analysis of water resource development, having worked on numerous Indian water rights litigation cases that hinge on benefit-cost analyses following the principles and guidelines (P&Gs) for water resource development (Water Resources Council, 1983), using the National Economic Development (NED) approach. She also led the Dredged Material Management Study "Risk-Based Analysis of the Lewiston Levee" (part of a dredged material management EIS for the Snake River system), in which Dr. Greene estimated flood damage reduction benefits of the Lewiston Levee system. Dr. Greene prepared a benefit-cost economic analysis of various dredge plans, levee alterations, and dredged material disposal options for the Walla Walla District of USACE. For this effort, she estimated flood damage reduction benefits using the USACE HEC-FDA model. Environmental benefits and costs were evaluated separately. The model and results were operated and presented in a manner consistent with USACE Engineer Manual 1110-2-1619, *Risk Based Analysis for Flood Damage Reduction Studies* (USACE, 1996). Dr. Greene has more than 5 years of experience working with USACE. For the USACE Savannah District, she worked on a Water Supply Reallocation Report for the City of Thomson, Georgia (Chasman & Associates). Dr. Greene has reviewed and completed several navigation benefit analyses for the Columbia River system, including an analysis of the socioeconomic implications of developing of an additional marine terminal at the Port of Portland. She has also studied marine transportation as part of the economic analysis of rules that currently govern the transfer of oil within Washington State waters. This effort focused on the costs and benefits associated with changes in oil transfer safety procedures affecting vessels and four different types of marine facilities that transfer oil on or over state waters.

Kenneth L. Casavant, Ph.D.

Role: This panel member was chosen primarily for his plan formulation experience and expertise. He also served as a backup economics reviewer.
Affiliation: Washington State University

Dr. Ken Casavant is currently a Professor and Economist at the School of Economic Sciences at Washington State University and Director of the Freight Policy Transportation Institute. He has also served as an Adjunct Professor at the Upper Great Plains Transportation Institute, North Dakota State University since 2002, specializing in Agricultural Transportation Economics and

Policy, Agricultural Marketing, Agricultural Economics and Management. He earned his Ph.D. in Economics from Washington State University in 1971. Dr. Casavant has more than 40 years of experience as an economist, with expertise in transportation economics and planning. He has served as an economic consultant detailing the tradeoffs necessary on several public works projects, most recently on studies of the deep draft national and international maritime industry. Dr. Casavant also has over 10 years' of experience in plan formulation, evaluation and comparison of alternative plans for numerous ecosystem restoration projects, navigation studies, and feasibility studies, including his technical reviews of the Port of Iberia Channel Deepening Project, the Lower Columbia River Channel Deepening Project, and the Upper Mississippi and Illinois Navigation Study. These USACE projects were large-scale civil works projects with significant public and interagency interests. He is familiar with USACE standards and procedures and has knowledge of the Institute for Water Resources Planning Suite methodologies, with a focus on ecological output per dollar of relevant expenditure for alternative project formulations. His expertise has been sought out by the federal government (including Senate and House testimonies), state governments, regional institutes, universities, commodity organizations, railroad/ truck/marine firms, and legal institutions/firms on issues regarding the needs and policy alternatives for agricultural and system transportation, ranging from development of intelligent transportation systems' applications to logistical designs for port physical distribution systems, and competitive impacts from investments in infrastructure and regulatory changes. He is a member of numerous professional associations, including the Transportation Research Board - National Research Council, Transportation Research Forum, International Agricultural Economics Association, and the Logistics and Physical Distribution Association.

Michael Poff, P.E.

Role: This panel member was chosen primarily for his coastal environmental experience and expertise.
Affiliation: Coastal Engineering Consultants

Michael Poff has over 20 years of engineering experience with civil, coastal, survey, and environmental projects. He has provided project management, civil design, coastal engineering design, environmental permitting, and marine survey services throughout the Gulf coast states. His design experience includes beach, dune, and marsh fill layouts; borrow area geometry; inlet and navigation channel dredge templates; channel markers; coastal structures such as groins, jetties, and revetments; beachfront stormwater drainage; and dune vegetation. As part of the Barataria Basin Barrier Shoreline Restoration Feasibility Study, Mr. Poff served as principal engineer for the Engineering Appendix of the USACE Plan Formulation Phase for the restoration of the Caminada Headland. Specific duties include overseeing the beach, dune, and marsh restoration design and coastal processes modeling. As part of the Terrebonne Basin Barrier Island Shoreline Restoration Feasibility Study, Mr. Poff is serving as principal engineer for the USACE Decision Document under its 6-Step Planning Process to restore the barrier islands within Terrebonne Basin. Specific tasks include overseeing the beach, dune, and marsh restoration design; borrow area design; coastal processes modeling; cost estimating; habitat acres computations; incremental cost analysis; and serving as a stakeholder/USACE liaison. Mr. Poff is familiar with the USACE application of risk and uncertainty analyses in coastal damage reduction and is using it as part of the Terrebonne Feasibility Study. Specific modeling

experience includes ADCIRC, which predicts water level elevations using measured data to calibrate the forcing function coefficients (including storm surge); SBEACH, which predicts storm-induced cross-shore sediment transport; and STWAVE, which predicts wave refraction/diffraction patterns over varying bathymetry (including the simulation of response to structures or borrow areas). Mr. Poff also oversees the development of endangered species protection plans and environmental surveys. He is a member of the Florida Shore and Beach Preservation Association, American Shore and Beach Preservation Association, and the Florida Engineering Society/Florida Institute of Consulting Engineers Leadership Institute. He is a registered Professional Engineer in Florida and Louisiana.

Paul Looney, PWS, CEP, CSE

Role: This panel member was chosen primarily for his environmental resources and compliance engineering experience and expertise.
Affiliation: Volkert, Inc.

Paul Looney is a Certified Environmental Professional with an M.S. in coastal zone studies and biology with 30 years of professional experience, including 22 years as an ecologist. He is currently a Certified Senior Ecologist and senior project manager with Volkert, Inc. in Mobile, Alabama. Mr. Looney's master's research examined the environmental impacts related to deposition of dredge material in a coastal environment. His involvement in various projects, including an environmental assessment (EA) on the replacement of a roadway in a coastal environment along Florida's most eroding coastline, demonstrates his experience and understanding of ecological responses to shoreline erosion. Mr. Looney has authored or co-authored several peer-reviewed publications, including seven examining the ecological effects of dredge material deposition on existing barrier island vegetation. He has additional environmental project experience with performing wetland delineations, threatened and endangered species, vegetation, and wildlife investigations, coastal zone management investigations, Section 7 Formal Consultations, Biological Assessments, Essential Fish Habitat Assessments, and NEPA documentation such as EISs, EAs, and environmental regulatory compliance evaluations. His experience with large public works projects has included being the project biologist for the EIS analysis of the proposed alternative alignments for the Mobile River Bridge project across Mobile Bay (part of the I-10 corridor). He was responsible for natural resource impact surveys to nearby wetlands and to threatened and endangered species. He prepared NEPA documentation for a Florida Department of Transportation traffic flow improvement project in Panama City.

Ronald G. Vann, P.E.

Role: This panel member was chosen primarily for his real estate experience and expertise.
Affiliation: OAS, Waterways Surveys and Engineering, RMG

Ronald G. Vann is currently a licensed professional civil engineer and private consultant with OAS, Waterways Surveys and Engineering, and RMG, specializing in environmental analysis and navigation improvement studies. Prior to his private consulting, he was with the Chief of Operations Branch of the USACE Norfolk District, responsible for the budget, engineering, environmental analysis, and scheduling for the District's complex Civil Works dredging and operations program. He worked as a civil and environmental engineer with USACE for over 38

years, holding positions as Chief of Survey Branch, Chief Special Projects, Military Section, Chief of Regulatory Functions, Assistant Chief of Engineering Division, Chief of Dredging Management Branch, and Chief of Civil Programs Branch. As Chief of Planning and Chief of Operations, Mr. Vann developed an accomplished understanding of the environmental analysis and real estate requirements associated with USACE navigation improvement studies and was responsible for defining all real estate requirements for over 60 of the District's complex Civil Works navigation dredging and operations programs, such as the Craney Island and Port Expansion Project, and the Dam Neck Ocean Placement Site for Norfolk District USACE. Mr. Vann has been a U.S. Delegate for two U.S./Japan and one U.S./Netherlands meetings of the Experts on Management of Toxic Bottom Sediments, a U.S. Representative of Environmental Commission of PIANC, and a Field Review Group member for both the Coastal Engineering and Dredging Research Centers. Since his retirement from the USACE, Mr. Vann has provided senior engineering consulting services for all aspects of dredging. Some of his clients include Corps Districts, Port Authorities, Environmental agencies, and municipalities.

C. Deane Fowler, P.E., PgMP

Role: This panel member was chosen primarily for his design and construction cost engineering experience and expertise.
Affiliation: Independent Consultant

Deane Fowler is an independent consultant specializing in program, project, facilities, and construction contract management. He earned his M.S. in construction management from the University of Florida in 1986. He has over 34 years of experience in civil engineering and construction contract management and is a licensed professional engineer in Florida and Virginia. Mr. Fowler has over 20 years of experience in the development of cost estimates, general inspection, and feasibility studies for dredging, water resource, flood control, and hurricane protection projects. As a project manager for the USACE New Orleans District, he was responsible for seven hurricane protection and water resource based projects. Duties included updating the Primavera Schedule with resources, Mii Cost Estimate, the Form 2101, the Form 17, and risk assessment analysis for tracking project costs and budget for each project. He oversaw more than 40 flood control projects in the Commonwealth of Puerto Rico during all phases of planning, design, and construction; he aided in the development of cost estimates for all projects. Mr. Fowler is skilled in the use of many USACE economic and design models and is familiar with the latest version of MCACES (3.01 version 2.0), having utilized it most recently when reviewing the alternative analysis for the Morganza to the Gulf Hurricane Protection Project. Mr. Fowler is well versed in the cost analysis of multiple alternatives, design reviews of levee and navigation locks, hydraulic and wave modeling analysis oversight, review of economic storm damage analysis and projections, and coordination between in-house and outside design organizations. He has provided the breadth of program/project management activities that consisted of providing services for administering the completion of tasks, determining current resources, developing roles and responsibilities, establishing team meetings, setting agendas, administering change management, managing milestones and schedules, coordinating requirements between multiple projects/clients/development teams, briefing senior staff, etc. He is experienced with the IEPR process and has participated on previous team reviews for two USACE Jacksonville District projects as a civil design/cost engineering panelist. He is a Life Member and Fellow of the Society of American Military Engineers, Life Member of Chi

Epsilon, a National Program Management Professional, a National Construction Documents Technologist, and a member of Project Management Institute.

Andrew Stoddard, Ph.D.

Role: This panel member was chosen primarily for his design and water quality engineering experience and expertise.
Affiliation: Dynamic Solutions, LLC

Dr. Andrew Stoddard is a nationally recognized environmental engineer with Dynamic Solutions, LLC, specializing in hydrologic, hydrodynamic, water quality, and chemical fate modeling. He earned his Ph.D. in environmental engineering and science at the University of Washington, Seattle, Washington in 1983. He received his doctoral training in the physical, chemical, and biological oceanography program at Brookhaven National Laboratory in New York and has over 35 years of related experience. Dr. Stoddard's experience includes the application of innovative approaches to evaluate the effectiveness of regulatory controls for water pollution on surface water quality. He received academic training in municipal and industrial water supply as an environmental engineer, served as a commissioned officer with the U.S. Public Health Service assigned to the Water Supply Section (1970-1973), and was the lead author of *Municipal Wastewater Treatment: Evaluating Improvements in National Water Quality* (2002). Dr. Stoddard is experienced in the assessment of chloride impacts on industrial and/or municipal water intakes and has conducted numerous consulting projects evaluating salinity and chloride distributions and impacts in rivers, reservoirs, and coastal waters. He supported development of hydrodynamic models of tidal circulation and mixing in the Caloosahatchee Estuary and St. Lucie Estuary (Florida) using the Environmental Fluid Dynamics Code (EFDC) and hydrodynamic models to evaluate impacts of freshwater flow releases from Lake Okeechobee on salinity distributions in biologically critical habitat areas of the estuaries for oysters and submersed aquatic vegetation for USACE (Jacksonville District). His expertise includes the application of public domain surface water models (EFDC, WASP, HSPF, QUAL2E) and he has over 10 years experience with the development and utilization of EFDC models for reservoirs (Lake Houston, Texas, Thunderbird Lake, Oklahoma); estuaries (Caloosahatchee, Florida; St. Lucie Estuary, Florida; Indian River Lagoon, Florida; Dickinson Bayou, Texas); and coastal waters (St Croix, U.S. Virgin Islands). Dr. Stoddard also has over 10 years of experience with the development and application of the WASP model for estuaries (Norwalk Harbor, Connecticut; Peconic Bay, New York; the Caloosahatchee estuary, Florida; and rivers (Upper and Middle Potomac River). Dr. Stoddard also developed pre- and post-processing software to support the application of the WASP to a national-scale water quality model (the National Water Pollution Control Assessment Model Version 2.0) for EPA Office of Water assessments of the water quality and economic benefits of water pollution control policies and regulations. Dr. Stoddard has applied his surface water quality modeling expertise to a range of environmental policy and regulatory assessments conducted for EPA, National Oceanic and Atmospheric Administration (NOAA), USACE, state agencies and other clients. His experience working with USACE includes projects for the New York Bight (USACE Waterways Experiment Station), Caloosahatchee and St. Lucie estuaries (Jacksonville District), and the Sacramento-San Joaquin-Delta (Sacramento District). Dr. Stoddard was appointed a part-time faculty member and lecturer with the Johns Hopkins University Whiting School of Engineering and Applied Science Programs for Professionals. He holds professional memberships in the

ASCE, Coastal and Estuarine Research Federation, Water Environment Federation, American Association for the Advancement of Science, and American Water Resources Association.

5. SUMMARY

Under the previous ARO contract, Battelle conducted a pre-IEPR of the Transportation Cost Savings Model and Cost Engineering estimates, and assembled a panel of nine experts to review the SHEP GRR and Tier II EIS. The Panel received electronic versions of the SHEP GRR and Tier II EIS documents, totaling more than 7,000 pages to be reviewed (and over 1,000 additional pages of supporting information), along with a charge that solicited comments on the documents to be reviewed. The IEPR panel members then reviewed the SHEP GRR and Tier II EIS documents individually. The Panel produced more than 365 individual comments in response to 72 charge questions. Under the Savannah District Contract, the individual comments were reviewed to identify key issues. Two additional reviews, the Public Comment Review and the Chloride Model Review, were also requested under this current contract. The results of all three reviews are provided below.

SHEP GRR and Tier II EIS Review

Under this contract, the IEPR panel members agreed on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2010; p. D-4) in the SHEP GRR and Tier II EIS. The following statements summarize the Panel's findings, which are described in the Final Panel Comments (Table 3) and discussed in more detail in Appendix A.

Overall, the Panel believes that, when all of the SHEP GRR, Tier II EIS, and supporting documents are taken into account, a very thorough assessment of the economic, engineering, and environmental impacts and benefits of the SHEP was prepared. The Panel recognizes that a great deal of work has been conducted and that the project is well designed. However, the Panel noted that the SHEP GRR and Tier II EIS main documents currently lack clear linkages to much of the information contained in the appendices and to the assumptions used throughout; such linkages would facilitate the reader's understanding of the documents. The following statements summarize the Panel's findings, which are described in more detail in the Final Panel Comments (Appendix A).

Plan Formulation Rationale: The Panel found that, in general, the SHEP GRR and Tier II EIS development followed a systematic and sustainable plan formulation approach. The appropriate level of detail regarding the development of the documents was provided. The Panel determined that in one area - the process for selecting the various plans - additional documentation was needed.

Economics: The Panel found the economics evaluation to be fairly complete. However, several places were noted where corrections, clarifications, and additional information are needed. For instance, the commodity movement forecast would benefit from additional documentation and more recent data that captures the economic downturn. In other areas, such as the socioeconomic resources, and analysis of regional economic development benefits, additional

resources should be consulted. Also, the Panel is concerned about the application of a 25% contingency to different portions of the same alternative.

Engineering: In general, the Panel was satisfied with most of the engineering analyses. However, some of the documentation regarding the models employed, beneficial uses of dredged material, and design assumptions is incomplete making it difficult to determine whether all aspects of the project have been taken into account. The Panel identified several areas of uncertainty and risk that are potential concerns.

Environmental: The Panel found that, overall, USACE took into consideration the environmental issues noted throughout the SHEP project area. It was noted during the review of the hydrodynamic, salinity, and oxygen modeling that some issues could affect the overall credibility and accuracy of the models. In addition, concerns were raised about the mitigation for dissolved oxygen (DO) and its potential impact upon fish.

Table 3 summarizes the Final Panel Comments from the SHEP GRR and Tier II EIS review by level of significance. Detailed information on each comment is contained in Appendix A of this report.

Table 3. Overview of 19 Final Panel Comments Identified by the SHEP GRR and Tier II EIS IEPR Panel

Significance – Medium	
1	The currently chosen open water boundary condition for salinity for the Environmental Fluid Dynamics Code (EFDC) hydrodynamic model is located in an area that is potentially impacted by discharge from the Savannah River, which could result in an inadequate representation of the cause-effect relationship between river discharge and ocean salinity that affects salinity and the affected resources in Savannah Harbor.
2	The current plan for mitigation of low DO conditions - using direct injection of pure oxygen into the water column - does not appear to take into account the resulting supersaturated river water that could kill fish species passing through, entrained within, or captured by the injection “plume.”
3	The review documents do not sufficiently describe, justify, and validate the respective models employed and do not contain the information needed to verify whether the models accounted for the extra dredge depths specific to over-dredging and advanced maintenance.
4	Documentation of assumptions used throughout the analyses in the SHEP GRR and Tier II EIS are incomplete and need further explanation to support the conclusions.
5	The conceptual model for water quality interactions in Savannah Harbor needs additional explanation and justification to support the exclusion of the benthic release of ammonia as a source term for ammonia in the water quality model.
Significance – Low	
6	The EFDC hydrodynamic model setup for the open water boundary condition and representation of the southeast boundary line offshore from Tybee Island has not been defined, causing an infinitely high barrier in the ocean that does not allow flow and mass transport across the southeast boundary.

7	Beneficial uses of dredged materials from the Inner Harbor are not fully evaluated in the SHEP GRR, Tier II EIS, or Dredged Material Management Plan (DMMP).
8	Impacts to Tybee Island from the existing navigation channel and future navigation channel, including downdrift impacts, need further explanation.
9	Design assumptions in the SHEP GRR need further clarification to explain risk and uncertainty to project cost and schedule.
10	The conceptual model for water quality interactions in Savannah Harbor needs additional explanation and justification to support the exclusion of algae as a state variable in the water quality model.
11	The discussion of the process for selecting the various plans is unclear.
12	Documentation regarding commodity movement data is insufficient to support the commodity movement projections presented in the analysis.
13	The socioeconomic resources are not described in sufficient detail.
14	The commodity movement model and analysis needs to be strengthened by including data for 2008, 2009, and even 2010 to capture the economic downturn.
15	The application of a 25% contingency to different portions of the same alternative may result in artificially increased cost projections.
16	Predictions regarding the lack of future increases in overall cargo amounts require further explanation.
17	The approach to measuring Regional Economic Development (RED) impacts does not appear to follow the Water Resources Council Economic and Environmental Principles and Guidelines (P&Gs) for Water and Related Land Resources Implementation Studies.
18	The report should address the current status of, and any impacts of delays in, the Panama Canal deepening.
19	Potential effects of future climate change are not fully described and addressed.

Public Comment Review

The Panel reviewed the technical comments provided by various agencies, stakeholders, and members of the public. General support, opposition, and comments related to policy compliance were not reviewed by the Panel. In addition, many issues that are not technical in nature were repeatedly noted within the comments. These public comments are outside the focus of the Panel's charge, and therefore were not noted by the Panel.

The Panel found several Public concerns that deserve further investigation and documentation within the SHEP GRR and Tier II EIS. The Public concerns are described in a Final Panel Summary in Appendix B; however, the Panel notes that the Public Comments should be directly examined regarding the details of each concern. Topics include, but are not limited to, selection of sites studied for shoreline erosion; mitigation of impacts to wetlands and short-nosed sturgeon; DO deficiencies; potential for high levels of chloride at the water intake on Abercorn Creek that will cause corrosion problems for the City of Savannah and industrial water users; and proposed monitoring activities. Additional concerns were noted by the public parallel some of the Panel's concerns written up in its Final Panel Comments; the Panel did not repeat these concerns within the Public Comment Review summary.

Chloride Model Review

The Water Quality Engineer agreed that in general the Chloride Model was adequate and acceptable for the project. The expected impacts, however, are not minimal since the Chloride Model results indicate a significant increase in chloride levels under low-flow hydrologic conditions (as noted in the SHEP Chloride Impact Evaluation Report, page 11) that can increase corrosivity in industrial and residential plumbing systems and increase costs of operations for the City of Savannah and local industrial water users. Portions of the Chloride Model had discrepancies that could affect the overall credibility and accuracy of the final output on the assessment of the impact of channel deepening scenarios and mitigation options. Table 4 summarizes the Final Panel Members Comments from the Chloride Model review by level of significance. Detailed information on each comment is contained in Appendix C of this report.

Table 4. Overview of Five Final Panel Member Comments Identified by the SHEP Chloride Model IEPR Panel Member

Significance – Medium	
CL-1	The currently chosen open water boundary condition for salinity for the EFDC hydrodynamic model is located in an area that is potentially impacted by discharge from the Savannah River, which could result in an inadequate representation of the cause-effect relationship between river discharge and ocean salinity that affects salinity and the affected resources in Savannah Harbor.
CL-2	Grid cell coordinates and the design of the curvilinear grid scheme for the extended grid model of Savannah Harbor and the initial condition for salinity may cause mass balance problems for the hydrodynamic model
CL-3	A discrepancy between the volume of the EFDC model domain and the actual volume of a high-resolution Digital Elevation Model (DEM) for the Savannah, Georgia, area can result in potential errors in the simulations of the impact of channel deepening and mitigation scenarios on salinity intrusion in tidal fresh wetlands and chlorides at the City of Savannah water intake.
Significance – Low	
CL-4	The EFDC hydrodynamic model setup for the open water boundary condition and representation of the southeast boundary line offshore from Tybee Island has not been defined, causing an infinitely high barrier in the ocean that does not allow flow and mass transport across the southeast boundary.
CL-5	Data and information related to the withdrawal flow for the City of Savannah water intake, used to represent the impact of pumping at the water intake on chloride levels in the modeling analysis, is not correctly documented, and may not be correctly assigned in the setup of the hydrodynamic model.

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APPENDIX A

Final Panel Comments

on the

SHEP GRR and Tier II EIS IEPR

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Comment 1:
The currently chosen open water boundary condition for salinity for the Environmental Fluid Dynamics Code (EFDC) hydrodynamic model is located in an area that is potentially impacted by discharge from the Savannah River, which could result in an inadequate representation of the cause-effect relationship between river discharge and ocean salinity that affects salinity and the affected resources in Savannah Harbor.
Basis for Comment:
The primary objective of the hydrodynamic model component of the Savannah Harbor Expansion Project (SHEP) study is to evaluate how the salinity regime in the Savannah River estuary might be further impacted by implementation of the (a) alternatives for navigation channel deepening and (b) plans for mitigation of the adverse impacts of the project. A technically credible representation of the cause-effect interaction of river discharge and ocean salinity on salinity and resources in the Savannah River is therefore a critical component for development of the hydrodynamic model. As documented in the *Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project* report for the SHEP General Reevaluation Report (GRR), the offshore boundary of the EFDC model domain is located within the inner shelf (about 17 miles offshore from River Mile 0.0 near Oysterbed Island). However, inner shelf salinity is known to be influenced by freshwater discharge from the Savannah River and other rivers in the South Atlantic Bight (SAB) (Atkinson et al., 1983; Blanton et al., 2003). The hydrodynamic model domain does not address a geographic area of the continental shelf that is large enough for a system-wide investigation to ensure that Savannah Harbor expansion plans adequately address the cause-effect relationships among river discharge, cross-shelf salinity, and the affected resources and activities that are pertinent to achieving the study objectives. As discussed in the *Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project* report for the SHEP GRR in Section 4.4.1 (pages 30-31), the open water boundary condition for salinity was assigned for the Savannah Harbor model based on three data sources: (1) Skidaway Institute of Oceanography South Atlantic Bight Synoptic Offshore Observational Network (SABSOON) offshore towers; (2) Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS); and (3) offshore data collected by MACTEC as part of the long-term biological oxygen demand study on September 24, 2003. Based on these limited data sets and comparisons of preliminary model results to observed salinity, the open ocean boundary condition for salinity was assigned as a constant 32.5 parts per thousand at the surface and 35.0 parts per thousand at the bottom. The SAB of the continental shelf extends from Cape Hatteras [North Carolina] to Cape Canaveral [Florida]. Within the SAB, coastal circulation and distributions of salinity and water temperature are influenced by river discharge, wind forcing, tidal mixing, and interaction with the Gulf Stream. Numerical model investigations of the SAB have focused on the influence of river discharges on the transport of low-salinity water to better understand shelf-wide distributions for pollutants derived from coastal runoff (Kourafalou et al., 1996). Using 1950-1999 station data available from National Oceanic and Atmospheric Administration's (NOAA) National Oceanographic Data Center (NODC), studies of temperature and salinity distributions

over the SAB (Atkinson et al., 1983; Blanton et al., 2003) identify cross-shelf hydrographic regimes characterized by (a) inner shelf (0- to 20-meter [m] isobath), (b) mid-shelf (20- to 40-m isobath) and (c) outer shelf (40- to 75-m isobath) regions. These studies have shown that a coastal plume of low-salinity water is a prominent hydrographic feature of the inner shelf that is attributed to tides, winds, and freshwater input from the Savannah River and other rivers of the SAB. Circulation over the mid-shelf, in contrast to the inner shelf, is controlled by tides, winds, density forcing, and interaction with the Gulf Stream. These studies clearly show that different physical mechanisms control the cross-shelf distribution of salinity within the SAB. This knowledge and data need to be incorporated into the Savannah Harbor EFDC model setup for the open water ocean boundary conditions for salinity.

Under the existing EFDC model setup, the technical credibility of the hydrodynamic model is weakened by assigning the open water boundary for the model domain within the inner shelf region, where salinity is known to be influenced by river discharge. The technical credibility of the model can be strengthened by moving the open ocean boundary location farther offshore out into the mid-shelf region, where salinity is known to not be influenced by river discharge.

Although this is a technical weakness for the conceptual model of hydrodynamics for Savannah Harbor, it is unlikely that the project recommendation, based on the overall evaluations of the adverse impacts and the effectiveness of mitigation options, would be affected by this issue.

Significance – Medium:

The present model setup for the open ocean boundary weakens the technical credibility of the hydrodynamic model because the simulated salinity distributions in Savannah Harbor are controlled by the assignment of observed inner shelf salinity as open water boundary conditions, which are, in turn, influenced by freshwater discharge from the Savannah River and other coastal rivers in the SAB.

Recommendation(s) for Resolution:

1. Extend the curved arc of the offshore boundary farther offshore into the mid-shelf region (20- to 40-m isobath). The open boundary location should be extended to ensure that observed salinity data used to assign the open boundary condition are not influenced by discharge from the Savannah River and other rivers within the SAB.
2. Instead of the limited data sets that were used to assign open boundary salinity, use monthly composite NOAA NODC data that are representative of the mid-shelf region (20- to 40-m isobath) as compiled by Blanton et al. (2003) and Atkinson et al. (1983) to assign open water boundary conditions for surface/bottom salinity and water temperature. Aggregation of NOAA NODC station data at 0.5-degree blocks (30-minute squares) would provide a reasonable spatial resolution to assign open water boundary conditions for the mid-shelf region.

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Comment 2:
The current plan for mitigation of low dissolved oxygen (DO) conditions - using direct injection of pure oxygen into the water column - does not appear to take into account the resulting supersaturated river water that could kill fish species passing through, entrained within, or captured by the injection "plume."
Basis for Comment:
Normal good marine water quality for DO is usually in the range of 6.0 to 10.0 milligrams per liter (mg/l). Generally, fish that are adapted to most marine environments survive in this range. Saturation is dependent on atmospheric pressure and temperature. Natural oxygen saturation is usually considered to be around 10 mg/l. Once water becomes supersaturated (i.e., the oxygen concentration exceeds concentrations that can occur under natural conditions), the ability of fish to breathe is a concern. Online research by the Panel (Charrnet, 2004; Fidler and Miller, 1994; Person-Le Ruyet et al., 2002; Woodbury, 1942) indicates that in highly oxygenated water, the oxygen bubbles will cling to fish gills and the fish will stop breathing. SHEP GRR Appendix C Report 1.1.4 is the Oxygen Injection Design Report. The report addresses several aspects of the need for increasing DO levels in the Savannah Harbor project. The SHEP Tier II Environmental Impact Statement (EIS) Appendix C (Mitigation Planning) specifically lists 25 potential techniques studied by MACTEC during an early attempt to determine the possible solution to seasonal low DO. Section 5.2.2 of the SHEP Tier II EIS discusses the results of these studies and states "oxygen injection is the most cost-effective method for raising DO levels in the harbor." Report 1.1.4 contains several figures (Figures 6-2 through 6-4) depicting the plume for the injected oxygen. Additionally, Table 6-1 (page 22 of Report 1.1.4) indicates that the design parameters for injection would result in oxygen concentrations of 150 mg/l at the point of discharge. The DO concentration is shown to be greater than 10 mg/l at a distance of 15 meters downgradient and from -15 meters depth to -8 meters. This plan appears to substitute the toxicity of low to zero oxygen concentration in the harbor waters to a similarly toxic environment by supersaturating the water column with DO over 10 times higher than normal levels. The Panel believes that this intense gradient can be toxic to fish that encounter it. While the engineering documents appear to be well researched for engineering principles, it would appear that the oxygen injection system proposed (Speece Cones) could have lethal impacts to fish species. Impacts to threatened and endangered species, such as short-nosed sturgeon, American shad, and striped bass, would be of special concern. The panel is concerned that once in operation, the oxygen injection system will result in fish mortality and potentially result in a failed mitigation effort once compliance monitoring determines the cause as supersaturation of fish.

Significance – Medium:
The proposed mitigation for seasonal low DO appears to have the potential for being lethal to fish and other marine biota. None of the reports (Tier II EIS, GRR, and their appendices) specifically detail biotic impact from pure oxygen plumes in the water column. The potential toxicity could negate the reason for proposing pure oxygen injection as a mitigation plan.
Recommendation(s) for Resolution:
1. Provide information on the DO tolerance ranges for the threatened and endangered fish species as well as all other expected fish species. 2. Provide information in the SHEP Tier II EIS sections and within the appendices cited that describes the decision-making process for arriving at oxygen injection using Speece Cones, and discuss what considerations were used concerning biota (fish species in particular). 3. Provide an analysis of cost efficiency in the project review documents that either supports or challenges the assertion (Section 5.2.2 of the SHEP Tier II EIS) that "oxygen injection is the most cost-effective method for raising DO levels in the harbor."

Literature Cited

Charrnet (2004). Aquafarmer: The farming of Arctic charr. March 8. http://www.holar.is/aquafarmer/node131.html#SECTION00154270000000000000.

Fidler, L.E., and S.B. Miller (1994). British Columbia Water Quality Guidelines for Dissolved Gas Supersaturation. Prepared for British Columbia Ministry of Environment, Canada Department of Fisheries and Oceans. September. http://www.env.gov.bc.ca/wat/wq/BCguidelines/tgp/index.html#TopOfPage.

Person-Le Ruyet, J., K. Pichavant, C. Vacher, N. Le Bayon, A. Sévère, and G. Boeuf (2002). Effects of O_2 supersaturation on metabolism and growth in juvenile turbot (*Scophthalmus maximus* L.) Aquaculture, 205(3-4): 373-383. March 11. http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T4D-458NF7R-D&_user=10&_coverDate=03%2F11%2F2002&_rdoc=12&_fmt=high&_orig=browse&_origin=browse&_zone=rslt_list_item&_srch=doc-info(%23toc%234972%232002%23997949996%23287570%23FLA%23display%23Volume)&_cdi=4972&_sort=d&_docanchor=&view=c&_ct=17&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=295896d0e9a3b363b0b68a473ca18d65&searchtype=a

Woodbury, L.A. (1942). A Sudden Mortality of Fishes Accompanying a Supersaturation of Oxygen in Lake Waubesa, Wisconsin. Trans. Am. Fish. Soc., 71: 112-117. http://afsjournals.org/doi/abs/10.1577/1548-8659%281941%2971%5B112%3AASMOFA%5D2.0.CO%3B2?journalCode=fitr

Comment 3:
The review documents do not sufficiently describe, justify, and validate the respective models employed and do not contain the information needed to verify whether the models accounted for the extra dredge depths specific to over-dredging and advanced maintenance.
Basis for Comment:
The main difference in the various model setups to evaluate potential impacts from the different dredge depths is the alteration of the bathymetric surface (model input) to represent increasing dredge depths. It is unclear within several of the model reports whether the analyses accounted for the varying dredge depths specific to over-dredging and advanced maintenance. It is unclear if the models included the additional advanced maintenance quantity associated with the discontinued use of the sedimentation basin and correlating assumption that the operation and maintenance (O&M) dredge volume is constant. The application of the models enabled U.S. Army Corps of Engineers (USACE) to determine the potential impacts from the project. By not accounting for the full dredge depth, it is possible that the impacts were underestimated and that additional mitigation may therefore be required. In Section 4.2 of the SHEP GRR, Appendix 1.1.5 "Development of the Hydrodynamic and Water Quality Models January 2006," Figure 4-1 shows the bathymetry for the EFDC model grid that was used for the model calibration, confirmation, and sensitivity analyses. The same model bathymetry grid is also presented in the GRR "Engineering Appendix" as Figure 7.3.1 (page 104). The model setup, as shown in the bathymetry grid map, is for the existing "baseline" navigation channel depth of 42 feet. Summaries of the salinity and DO impacts that were generated with the EFDC and Water Analysis Simulation Program (WASP7) models for the alternative deepening scenarios of 44-, 45-, 46-, 47-, and 48-foot channel depths are presented in a number of tables and charts in the SHEP GRR "Engineering Appendix." However, none of the SHEP GRR reports present information documenting the model domain volumes under the (a) existing "baseline" 42-foot depth condition; (b) each scenario of 44- to 48-foot channel depth; and (c) historical conditions before construction of the navigation channel for Savannah Harbor. The additional data would improve the report by documenting the baseline and changes in harbor volume for each depth. The model reports should provide sufficient model description, justification for selecting the model employed, and calibration and validation steps in accordance with industry standards. It is noted that many of the reports do provide some of this information; however, several of the model reports do not (examples referenced below). Examples: (Habitat Impacts, Eng. App. Attachment 1.1.6, Water Quality Modeling, Eng. App. Attachment 1.1.8) • Unclear if the over-dredge tolerances and advanced maintenance dredge depths were included.

(Wave and Current Modeling for Navigation Study, Eng. App. Attachment 1.1.13)

- Does not provide sufficient detail on justifying the model selected, calibration and validation, and inputs.
- Indicates the wave modeling component was still in preparation. The Panel could not find this reference in the materials provided. Therefore, the Panel cannot comment on the adequacy of the wave and current modeling that was relied upon for the ship simulation study.
- Only evaluated the maximum deepening depth of 6 feet; no other alternatives were evaluated. Because USACE concluded no significant impacts from the deepest alternative, it is assumed that USACE did not model shallower depth alternatives because the findings would be the same.
- Unclear if the over-dredge tolerances and advanced maintenance dredge depths were included.

(Impacts on Waves, Currents, Sediment Transport, Eng. App. Attachment 1.1.14)

- Only evaluated the maximum deepening depth of 6 feet; no other alternatives were evaluated. Because USACE concluded no significant changes to waves, currents, and sediment transport patterns from the deepest alternative, it is assumed that USACE did not model shallower depth alternatives because the findings would be the same.
- Unclear if the over-dredge tolerances and advanced maintenance dredge depths were included.

(Hurricane Surge Modeling, Eng. App. Attachments 1.1.21 and 1.1.30)

- Do not provide sufficient detail on justifying the model selected, calibration and validation of the model, and uncertainties expected with the results. The attachments do refer to an Applied Technology & Management (ATM) report, so it may be that USACE utilized the inputs from that report. Another possibility is that USACE used the Tetra Tech January 2006 model development, in which case extensive calibration and validation was accomplished. Use of neither the ATM report nor the Tetra Tech report are described or appropriately referenced in either attachment.
- Unclear if the over-dredge tolerances and advanced maintenance dredge depths were included.

(Eng. App. Attachments 1.1.17, 1.1.24, and 1.1.25)

- Provide insufficient detail on the methods and models (e.g., selection, justification, calibration) used to conclude that of the total measured average shoreline erosion of 3.1 feet, 3.0 feet is attributed to natural processes, leaving the 0.1 foot attributed to the channel deepening.
- Unclear if the over-dredge tolerances and advanced maintenance dredge depths were included.

Significance – Medium:

To assess the full impacts of the project and verify that the proposed mitigation plan sufficiently offsets the full impacts, the review documents need to account for the complete dredge depths in each channel segment, including the design dredge depth, overdredge tolerance, and advanced maintenance.

Recommendation(s) for Resolution:
1. Provide a detailed model description and justification for why the model was chosen. 2. Specify the vertical datum, noting that due to magnitude of the work completed and varying Corps District offices that participated, the vertical datum varies. 3. Present the results of the calibration and validation steps. If the model was not calibrated and validated, state why not and either provide a qualitative discussion to identify potential additional impacts or revise the risk and uncertainty analysis and resulting outcomes (e.g. contingencies, level of mitigation) to include the extra level of risk associated with not calibrating and validating the model. 4. State what depths were evaluated, including dredge depth, advanced maintenance, and overdredge tolerance for each channel segment. 5. If the model did not account for the extra depths associated with advanced maintenance and / or overdredge tolerance, as well as the additional advanced maintenance quantity associated with the discontinued use of the sedimentation basin, state why the extra depths were not included and either provide a qualitative discussion to identify potential additional impacts or revise the risk and uncertainty analysis and resulting outcomes (e.g., contingencies, level of mitigation) to include the extra level of risk associated with not addressing these potential impacts. 6. The SHEP GRR "Engineering Appendix" and Attachment 1.1.5 "Development of the Hydrodynamic and Water Quality Models January 2006" should document the model domain volumes under the (a) existing "baseline" 42-foot depth condition and (b) each scenario for the 44- to 48-foot channel depths. The total volume of the model domain can be computed either for the initial condition assigned for water surface elevation or a benchmark elevation of mean sea level (MSL=0). Present the additional data in the reports as a series of bathymetry grid cell maps and a summary table to clearly document how the volume of the model domain changes for each channel depth scenario. It would also be helpful to document the volume of the model domain under historical bathymetric conditions as a benchmark of harbor volume before any navigation channel deepening projects were initiated in Savannah Harbor. Present data in the summary tables to identify the volume of the model domain associated with the (a) discontinued use of the sedimentation basin and (b) overdredging.

Comment 4:
Documentation of assumptions used throughout the analyses in the SHEP GRR and Tier II EIS are incomplete and need further explanation to support the conclusions.
Basis for Comment:
The assumptions presented in the engineering, environmental, and hydrologic analyses seem reasonable although limited; however, the documents do not synthesize all of the important assumptions into a single location or highlight them as the analysis is presented. In many instances, justifications need to be provided to support statements made. For example: The SHEP Tier II EIS (Section 3, page 3-28) states, "Since the channel already captures ALL of the sediment that enters the harbor…" (emphasis added). This statement is not substantiated with facts and could have a significant impact on future dredging scenarios in that more material than originally planned would have to be removed. While there is some cross-referencing within the SHEP GRR and Tier II EIS, the documents should index or coordinate the basic assumptions so there is consistency among the documents. **Plan Formulation** SHEP GRR contains a regional analysis of the ports within the South Atlantic Division. The analysis takes a comprehensive look at which port(s) should be expanded. An additional question is then raised: Should this analysis have been extended to the entire eastern seaboard? The extent of the regional analysis should be delineated in the SHEP GRR. In considering a systems approach, the trade projections should be compared to other sources of trade data on commerce, and those comparisons should be presented in the text. The fact that the PIERS (export trade) data were so heavily discounted by the SHEP GRR suggests different findings from that data series that may not have agreed with the projections from IHS Global Insight. If this discrepancy is not a problem, it should be analyzed or explained to eliminate concerns. **Operations and Maintenance** (SHEP GRR, page 31, and EIS, Section 3.01). The SHEP GRR assumes that the maintenance dredge quantity will remain constant into the future with project condition. Further, USACE states that 100% of the sediment coming down the river is captured, concluding that all the alternatives have the same O&M. Outside influences and factors (including, but not limited to, sea level change [e.g., relative sea level rise], increase in runoff from urban development into the project area watershed, and increase in both storm frequency and intensity) all have the potential to increase sedimentation, leading to increased maintenance dredge volume and related costs and dredge material management needs. The assumption that the sediments in the proposed deeper cuts (including advanced maintenance and overdredge tolerance) are exactly the same as the sediments typically dredged

as part of the current project's maintenance dredging has not been supported. Further, the assumption that the side slopes will remain the same as the current project (thus requiring no increase in side slope adjustment/infilling for the future) is unsupported. Should the sediments in the proposed cut vary, then it is likely the side slopes will adjust accordingly. Therefore, more analyses/real estate may be needed to assess the increase in dredging.

Cost Estimates

Extensive supplemental cost estimates and analyses were provided that successfully resolved much of the uncertainty raised by the SHEP GRR and Tier II EIS; however, any review of the reports without including the information in the supplemental files makes the documents incomplete. USACE has spent considerable effort developing the Current Working Estimate and following Engineering Regulation (ER) 1110-2-1150 (USACE, 1999), ER 1110-2-1302 (USACE, 2008a), and Engineering Technical Letter (ETL) 1110-2-573 (USACE, 2008b). However, if the documentation used to estimate the costs, including a list of assumptions, were included in the SHEP GRR, the specifics of USACE's cost assessment would have been better understood. By codifying the assumptions, the process can be repeated and reproduced. A short discussion in Section 13.3 (Assumptions and Schedule) provided some insight as to the sequence of planned work; however, it did not provide sufficient information to reconstruct the cost estimate on its own.

Risk Analysis

The SHEP GRR outlined the development of a cost-risk analysis that had a broad and sweeping range, making it difficult to understand the rationale for selecting the Locally Preferred Plan (LPP) over the National Economic Development (NED) Plan. Although the Panel understands that professional judgment is used to develop the SHEP GRR cost estimates, a detailed project-specific list of engineering and cost-estimating assumptions is standard protocol within USACE and is considered "the industry standard" for supporting the estimating process. Without those assumptions, the ability to audit "the numbers" is compromised, and it becomes difficult to ensure that one cost comparison category does not have overlap with another category. As a result, the SHEP GRR did not clearly identify the reasoning and logic for the recommended selection.

Real Estate

SHEP GRR-Appendix-Real Estate Plan-P1-46. A major assumption in this appendix – i.e., that the existing side slopes for the channel deepening can be used to avoid environmental impacts – warrants validation.

Significance – Medium:

It is not possible to verify the validity of the facts and analyses supporting the SHEP GRR and Tier II EIS without an understanding of the assumptions used.

Recommendation(s) for Resolution:

1. Include a project-specific detailed list of civil engineering, environmental, and cost-estimating assumptions (for example, assumed haul distances, type of equipment to be used, compaction factors for soil, etc.) in a centralized location and an index to assist the reader.

2. Provide a list describing the rationale for selecting the risk analysis and cost contingency projections.
3. Explain the reasoning behind the selection of the LPP over the other alternatives.

Literature Cited

USACE (1999). Engineering and Design: Engineering and Design for Civil Works Projects. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Regulation (ER) No. 1110-2-1150. August 31.

USACE (2008a). Engineering and Design: Civil Works Cost Engineering. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Regulation (ER) No. 1110-2-1302. September 15.

USACE (2008b). Engineering and Design: Construction Cost Estimating Guide for Civil Works. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Technical Letter (ETL) No. 1110-2-573. September 30.

Comment 5:
The conceptual model for water quality interactions in Savannah Harbor needs additional explanation and justification to support the exclusion of the benthic release of ammonia as a source term for ammonia in the water quality model.
Basis for Comment:
This comment refers to information contained in the SHEP GRR, Engineering Appendix, Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project, Section 8.4.3, Page 73. The kinetic components of the WASP water quality model represent the effect of carbonaceous biochemical oxygen demand (CBOD) decay, nitrification, sediment oxygen demand (SOD), and atmospheric reaeration on the DO balance of the Savannah Harbor model. SOD rates assigned as input to the model (see Section 8.4.3, page 73) are based on 1999 field measurements in Savannah Harbor and appear to be reasonable parameter values with the highest rates for depositional areas (sediment basin and turning basin) and lower rates for other areas of the model domain. Inspection of the WASP input files (**99-wasp.wif** and **97-wasp.wif**) shows, however, that the benthic flux rate of ammonia was not represented in the model setup. The implied assignment of a benthic flux rate of zero for ammonia is not an appropriate conceptual model assumption for the Savannah Harbor model because the benthic release of ammonia is stoichiometrically related to the Redfield carbon:nitrogen ratio to SOD (Di Toro, 2000). The implicit exclusion of the benthic flux of ammonia thus ignores a well-known component of an ammonia source term to the bottom layer of Savannah Harbor. The exclusion of this source term for ammonia across the sediment-water interface has implications for the calibration of ammonia and oxygen because the oxygen demand from nitrification may be underestimated. Ideally, the SOD-related benthic flux rate of ammonia would be incorporated in the conceptual model and in the setup of the water quality model. ATM (2003) noted that sediment flux data collected in 1985 showed that paired measurements of the benthic release of ammonia and SOD were consistent with the Redfield ratio of carbon:nitrogen. ATM (2003) then indicated that these data should be "… useful for quantifying ammonia release from the sediment in the present water quality model" (page 8-3). The exclusion of the benthic release term as a source of ammonia to the Savannah Harbor model is warranted only if it can be documented that the magnitude of the ammonia load from benthic release is small in comparison to the ammonia loads contributed by upstream river flow, National Pollutant Discharge Elimination System (NPDES) dischargers, and releases from adjacent marshes. Although this is a technical issue for the credibility of the conceptual model of DO, it is unlikely that the project recommendation based on the overall evaluations of the adverse impacts and the effectiveness of mitigation options would be affected by this issue.

Significance – Medium:
The conceptual model for water quality should account for benthic release of ammonia as a source term that contributes to both the ammonia balance and the oxygen balance in Savannah Harbor.
Recommendation(s) for Resolution:
1. Estimate segment-dependent benthic release rates for ammonia (as mg/m^2-day) from the assigned SOD rates and Redfield stoichiometric ratios for oxygen-to-carbon and carbon-to-nitrogen (Di Toro, 2000). 2. Estimate total system-wide loading rate of ammonia (as kg/day) from the benthic release of ammonia for comparison to ammonia loads (as kg/day) contributed by the upriver flow boundary, NPDES sources, and the marshes. 3. Revise the section of the hydrodynamic and water quality modeling reports to (a) present data compiled under Recommendations #1 and #2; (b) present the rationale for excluding benthic release of ammonia as a source term; and (c) discuss the possible implications of omitting benthic release of ammonia on the calibration of ammonia and the oxygen demand from nitrification.

Literature Cited:

ATM (2003). Characterization of the Dissolved Oxygen Environment of the Lower Savannah River Estuary. Tech. report prepared by Applied Technology & Management (ATM), Mt. Pleasant, SC, for Georgia Ports Authority, Savannah, GA. April.

Di Toro, D.M. (2000). *Sediment Flux Modeling*. Wiley-Interscience, New York, NY.

Comment 6:
The EFDC hydrodynamic model setup for the open water boundary condition and representation of the southeast boundary line offshore from Tybee Island has not been defined, causing an infinitely high barrier in the ocean that does not allow flow and mass transport across the southeast boundary.
Basis for Comment:
As documented in the *Development of the Hydrodynamic and Water Quality Models for the* SHEP report for the SHEP GRR, the offshore boundary of the EFDC model domain, located about 17 miles offshore from River Mile 0.0 near Oysterbed Island, covers the existing and proposed extension of the navigation channel. As shown in Figure 4-1 (page 22), the open water boundary includes a wide curved offshore arc and an onshore-offshore transect along a southeast line extending from Tybee Island. One issue that has been identified in relation to the ocean boundary condition for the EFDC model is related to the model setup for the open water boundary along the southeast line from Tybee Island. Using the visualization capabilities of EFDC_Explorer5 (Craig, 2010), inspection of the **efdc.inp** input files used for the 1997 and 1999 model runs shows that the open water boundaries assigned for the EFDC model are defined only by the curved arc boundary. An open water boundary has not been defined for the southeast line from Tybee Island. Figure 1, prepared with EFDC_Explorer5, shows the flow boundary conditions (marked by black squares) and the open water boundary condition (marked by S) assigned for the EFDC model. The grid cell map clearly shows the south [S] open water boundary along the curved arc of the model domain. The grid cell map also clearly shows that an open water boundary has not been defined for the southeast line from Tybee Island. The impact of the existing EFDC model setup is that an infinitely high barrier in the ocean is implicitly defined that does not allow flow and mass transport across the southeast boundary line. Although this is a technical issue for the credibility of the model setup, it is unlikely that the project recommendation based on the overall evaluations of the adverse impacts and the effectiveness of mitigation options would be affected by this issue.

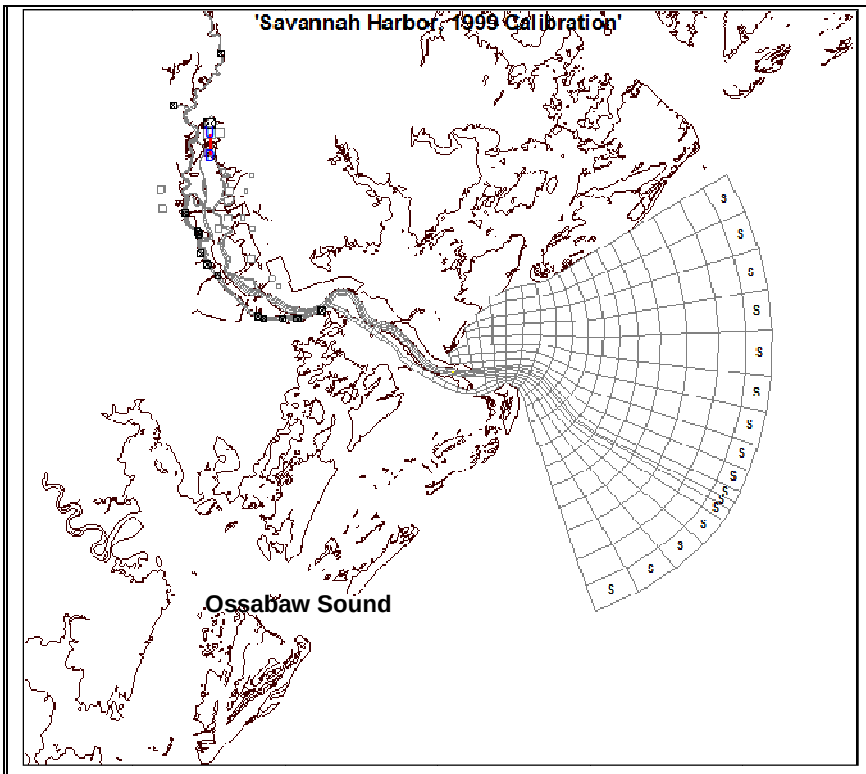

Figure 1. EFDC Model Domain and Boundary Condition Locations. Source of map: EFDC_Explorer5 (Craig, 2010)

Significance – Low:

The error in the model setup affects the technical credibility of the hydrodynamic model because it is not consistent with other estuarine/coastal hydrodynamic models where the offshore coastal boundary is often defined with a wide arc that intersects both "upcoast" and "downcoast" areas of the coastline.

Recommendation(s) for Resolution:

1. Extend the existing curved arc to a location south of the Savannah River in the vicinity of Ossabaw Sound (see Figure 1).

Literature Cited

Craig, P.M. (2010). User's Manual for EFDC_Explorer5: Pre/Post-Processor for the Environmental Fluid Dynamics Code, Dynamic Solutions, LLC, Knoxville, TN.

Comment 7:

Beneficial uses of dredged materials from the Inner Harbor are not fully evaluated in the SHEP GRR, Tier II EIS, or Dredged Material Management Plan (DMMP).

Basis for Comment:

It is important to recognize the large volumes and types of materials (sands, silts, clays) that the SHEP will generate as valuable resources. All dredged materials should be considered for beneficial use to optimize the benefit-cost ratio of the project and/or mitigate the environmental impacts of the project.

Opportunity numbers 1, 4, and 6 of Appendix O - Formulation of Alternatives (page 6) describes beneficial use of dredged materials as part of the Federal objective and the specific study planning objectives. While the SHEP GRR, Tier II EIS, and DMMP describe plans to beneficially use Outer Harbor sediments for nearshore placement at two Tybee Island locations and for fish habitat mounds along the bar channel, the reports and studies do not explicitly describe opportunities to beneficially use Inner Harbor sediments.

Reasonable and prudent beneficial use opportunities that could be explored include:

- Creating and sustaining threatened and endangered species habitats (e.g., shorebird nesting habitat);
- Restoring and protecting the riverine shoreline to offset natural impacts (predominant cause of shoreline erosion) as well as minor impacts predicted for the proposed deepening;
- Creating new tidal marsh to offset indirect impacts to either saltmarsh or freshwater wetlands versus purchasing/preserving significant acres of bottomland hardwoods;
- Creating new wetlands to offset the reported significant number of wetland acres lost from the project area each year;
- Capping cadmium-impacted sediments;
- Raising dikes; or
- Producing bricks using clays (Cousins et al., 1997)

While these options may prove to be unachievable or cost-prohibitive, they should be analyzed and the results provided in the SHEP GRR, Tier II EIS, and DMMP to satisfy the stated plan formulation objectives. Further, most of these opportunities are listed as conceptual mitigation actions in the EIS (Appendix C – Mitigation Planning).

Significance – Low:

Identifying beneficial uses of SHEP Inner Harbor sediments would satisfy project planning objectives and would balance the discussion regarding the value of Inner and Outer Harbor sediments.

Recommendation(s) for Resolution:
1. Describe and fully analyze in the SHEP GRR, Tier II EIS, and DMMP the potential beneficial uses of Inner Harbor sediments for environmental mitigation and enhancement (i.e., tidal marsh creation, bird islands within dredged material containment areas), engineering uses (i.e., capping material and dike raisings), and product uses (i.e., brick production from clays).

Literature Cited

Cousins, L., F. Beason, and J. Shuman (1997.) "Brick manufacture from dredged material, a reality!" Proceedings: International Workshop on Dredged Material Beneficial Uses. Unnumbered U.S. Army Corps of Engineers document, Waterways Experiment Station, Vicksburg, MS.

Comment 8:
Impacts to Tybee Island from the existing navigation channel and future navigation channel, including downdrift impacts, need further explanation.
Basis for Comment:
Impacts to Tybee Island are addressed in multiple locations within the documents; however, it is not clear in these locations (1) why the SHEP project will result in no further impacts to Tybee Island, or (2) that the Federal Shore Protection Project already offsets impacts to Tybee Island from the existing navigation channel. During the August 5, 2010, site visit, it was stated that prior studies concluded that the existing Federal Navigation Channel interrupts 100% of the net littoral transport of sediment, which under natural conditions would nourish Tybee Island. The SHEP GRR and Tier II EIS conclude that the project cannot cause additional impacts because the sediment bypassing is already completely intercepted. Some statements in the Engineering Appendix could be construed to support the above statement; however, they could also be construed differently.
Significance – Low:
The role of the existing Federal Channel regarding impacts to Tybee Island is not clear, and ongoing mitigation efforts are not fully explained. This affects the understanding of the project as described in the reports; however, it will not affect the recommendation or justification of the project.
Recommendation(s) for Resolution:
1. Explain the role of the existing navigation channel in intercepting littoral transport in greater detail and cite appropriate studies. 2. For the Federal Shore Protection Project, describe the mitigation efforts of Tybee Island impacts and cite appropriate references.

Comment 9:
Design assumptions in the SHEP GRR need further clarification to explain risk and uncertainty to project cost and schedule.
Basis for Comment:
The GRR does not currently include a discussion of cost and schedule risks. Section 12.2 notes that a cost-risk analysis will be included when final documentation becomes available. The cost-risk analysis to be included in the GRR should address certain minimum design assumptions. Only general project design assumptions appear to be documented in the cost estimates; however, supplemental information, including the USACE Cost Estimating Dredge Engineering Program (CEDEP) estimates provided to the Independent External Peer Review (IEPR) Panel, does contain some detailed assumptions. It also appears that detailed assumptions used to develop the cost estimates are not provided in either the *Engineering Investigation*s report (Sections 12 and 13) or the *Attachment 2 -MCACES-MII Cost Estimate Summary*. Section 15 of the *Engineering Investigations* report deals exclusively with risk and uncertainty. Cost risks are accounted for with an overall 25% contingency; however, it is difficult to evaluate the cost estimates without supporting documentation of assumptions. *Attachment 4 - Project Cost and Schedule Risk Analysis Report* presents a formal risk analysis, to develop a contingency(ies) on the total project cost. The report summarizes the cost and schedule impacts of project uncertainties with respect to likely contract categories (i.e., real estate, fish and wildlife, navigation, etc.). Key risk events are identified, including fuel price volatility, competitive bid environment, change in/other O&M quantities to be removed, and construction contract schedules. The risk events of increased quantities for removal, and additional time to remove those quantities, in particular, may warrant a greater percent volatility. These concerns are related to potential for stiffer materials (necessitating mechanical dredging equipment), expanded shoaling areas/volumes, unanticipated debris and structure removal, and lower dredge production rates.
Significance – Low:
Because the SHEP GRR indicates that a cost-risk analysis will be included in the final documentation, and preliminary review of contingencies in the supporting documents appear adequate to the IEPR Panel, this comment is assigned Low significance.
Recommendation(s) for Resolution:
1. Incorporate additional information, including labor, production rates, sediment characterization, debris characterization, equipment selection, and other detailed assumptions, into the SHEP GRR (Section 12), with the caveat that these cost estimate details will not be used as a basis for future construction contracts or the independent government estimates used for negotiation with contractors. The incorporation of the assumptions listed in the CEDEP estimates will help the reader better understand cost and schedule risk in the SHEP GRR and related attachments. 2. Clarify risk potential more thoroughly in the SHEP GRR, Section 12.2, related to (at a minimum) expanded shoaling areas, potential for stiffer materials (necessitating

mechanical dredging equipment), unanticipated debris and structure removal, and lower dredge production rates.

Comment 10:
The conceptual model for water quality interactions in Savannah Harbor needs additional explanation and justification to support the exclusion of algae as a state variable in the water quality model.
Basis for Comment:
This comment refers to information contained in the SHEP GRR, Engineering Appendix, Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project, Section 8.0, Page 58. The Savannah Harbor application of the WASP water quality model was simplified by considering only CBOD (three classes), ammonia, nitrate, and DO as state variables of the model. Algae, Organic-N, Organic-P, detritus, suspended solids, and phosphate were not considered in the model. The rationale given for excluding algae as a state variable was that U.S. Environmental Protection Agency (EPA) Region 4 had determined that nutrients in the harbor were not an issue and that algal activity and primary production were limited in the harbor. The exclusion of algae as a component of the oxygen balance in a water quality model is not typical of most estuarine water quality models that have been developed over the past 10 to 20 years. EFDC-WASP applications for the Neuse estuary (Wool et al., 2003a) and Mobile Bay (Wool et al., 2003b), for example, were developed to represent algae as a state variable of the WASP model. Even though it is likely that algal productivity is light-limited in Savannah Harbor rather than nutrient-limited, the exclusion of algae from the water quality model is questionable because inspection of the observed data sets for surface oxygen clearly shows a wide range at many stations in the lower (FR-02, Figure P-1) and middle (FR-04, Figure P-3) regions of the estuary. In an estuarine system, variability in surface oxygen usually indicates diel periodicity resulting from both tidal forcing and algal production and respiration. Fluctuations between low and high tide are certainly responsible for some portion of the observed variability in surface oxygen. However, algae production and respiration also likely contribute to the observed variability of oxygen. The water quality model calibration and confirmation results do not reproduce the observed wide range of temporal variability for oxygen at several stations. If algae are, in fact, a contributing factor for the oxygen balance, then the water quality model scenario results for channel deepening and the mitigation options may not provide adequate information to evaluate either the impact of the deepening alternatives or the effectiveness of the mitigation options. The exclusion of algae from the Savannah Harbor model as a state variable is warranted only if it can be documented, using representative summer/fall observed data sets, that the magnitude of the algae production and respiration components of the total oxygen balance are, in fact, very small in comparison to the oxygen balance terms from atmospheric reaeration, CBOD decay, nitrification, and SOD that are included in the water quality model.

Although water quality interactions and state variables are technical issues for the conceptual model, it is unlikely that the project recommendation based on the overall evaluations of the adverse impacts and the effectiveness of mitigation options would be affected by this issue. If, based on an analysis of summer/fall field data, the algal component of the oxygen balance is not small in relation to the terms that are included in the model, then the water quality model setup should be revised to account for algae as a state variable that contributes to the oxygen balance in Savannah Harbor.
Significance – Low:
The water quality model calibration and confirmation results do not reproduce the observed wide range of temporal variability for oxygen at several stations. If algae are, in fact, a contributing factor for the oxygen balance, then the water quality model scenario results for channel deepening and the mitigation options may not provide adequate information to evaluate either the impact of the deepening alternatives or the effectiveness of the mitigation options.
Recommendations for Resolution:
1. Compile summer/fall budget for CBOD, nitrification, reaeration, and SOD contributions to oxygen balance that are included as terms in the water quality model. 2. Compile summer/fall budget for algae production and respiration contribution to oxygen balance to justify exclusion of algae as a state variable in the water quality model. 3. Time-average all data over the summer/fall simulation period to present the oxygen budget terms at representative locations in the lower, middle, and upper estuary as well as the nearshore coastal waters. Express all the oxygen budget terms in consistent units as either volumetric units (mg/L-day) or area-based units (gm/m^2-day).

Literature Cited

Wool, T.A., S.R. Davie, and H.N. Rodriguez (2003a). Development of Three-Dimensional Hydrodynamic and Water Quality Models to Support Total Maximum Daily Load Decision Process for the Neuse River Estuary, North Carolina. ASCE, Jour. Water Resources Planning and Management, 129(4): 295-306.

Wool, T.A., S.R. Davie, Y.M. Plis, and J. Hamrick (2003b). The Development of a Hydrodynamic and Water Quality Model to Support TMDL Determinations and Water Quality Management of a Stratified Shallow Estuary: Mobile Bay, Alabama. Proc. of the Water Environment Federation, National TMDL Science and Policy 2003, pp. 378-392(15), Water Environment Federation, Alexandria, VA.

Comment 11:
The discussion of the process for selecting the various plans is unclear.
Basis for Comment:
This comment refers to information contained in the SHEP GRR, Table 11-3, page 191; Section 11.5, page 212; Section 15, page 264. The SHEP GRR and Tier II EIS compared environmental, engineering, and cost criteria in the selection of the various alternatives. However, it was unclear why the LPP (48-foot or Max Authorized Plan) was selected as the tentatively recommended plan subject to approval by the other federal resource agencies as outlined in Section 11.5.1-11.7.1. Further, there is a lack of consistency concerning plan names throughout the SHEP GRR, resulting in a moderate level of confusion as to which plan is being discussed in numerous parts of the analysis. Finally, the Recommendation in Section 15 did not explicitly identify which alternative was the tentatively recommended plan (NED Plan). The only way to determine which plan was the NED plan was to compare the stated costs to the alternatives.
Significance – Low:
Stating which alternative is the tentatively recommended plan would eliminate confusion and assist in understanding the rationale in the SHEP GRR.
Recommendation(s) for Resolution:
1. Clearly delineate which alternative is the tentatively recommended plan in Section 15 of the SHEP GRR. 2. Be consistent in the names used for the alternatives throughout the SHEP GRR, appendices, and Tier II EIS. 3. Elaborate on the specifics of the tentatively recommended plan to eliminate any ambiguity or confusion.

Comment 12:
Documentation regarding commodity movement data is insufficient to support the commodity movement projections presented in the analysis.
Basis for Comment:
The current commodity movement data are not well documented. Much of the information is for different time periods and is difficult to follow. Documentation is lacking, along with explanations of the charts in some cases. Some adjustments have been made to the forecast developed by IHS Global Insight, but it is difficult to follow all of the estimates and to see when and where an adjustment has been made to all analyses. For example, the initial discussion of the adjustments (SHEP GRR Chapter 5, pages 77 and 78, and SHEP Tier II EIS Economic Appendix, pages 39-41) does not explain why the SHEP forecast departs from the IHS Global Insight forecasts. If the work was updated in light of new data, the documents (both SHEP GRR and SHEP Tier II EIS) should state so and then explain whether the original forecasts fell short (or overshot). If the original work did not foresee the global economic downturn, the documents should state so and point out that Savannah Harbor did not experience as great a downturn as other ports in the United States and worldwide. The projections should be presented with comment on the current slowdown in trade and world economy, specifically relative to the percentage growth over time. During the pre-IEPR of the transportation cost model and early drafts of documents related to this project conducted by two of the panel members, similar concerns about this analysis were raised about a shortcoming in the description of the projection sourcing. This newer draft has improved the documentation somewhat in the economic appendix and attachments, but more explanation of the projection methodology would lessen concerns and strengthen the document.
Significance – Low:
The SHEP commodity projection methodology is not clearly stated, and the baseline data used in the projection are not consistent throughout the many documents. This detracts from the technical quality of the reports.
Recommendation(s) for Resolution:
1. Present the 2009 and preliminary 2010 actual trade data in Figures 8 and 9 of the Economic Appendix (pages 13 and 14) as these are discussed in the text. 2. Extend Figure 4-2 in the SHEP GRR to include the actual 2008 and 2009 twenty-foot equivalent unit volumes listed in Table 4-7 (page 53). 3. Clearly explain the forecast evolution in Section 5.4.2 of the SHEP GRR (pages 75-80). 4. Compare the recent years of trade data with the forecast developed prior to the economic downturn, and calculate the percent departure from the forecast. Discuss the degree to which the global slowdown in trade may affect the Savannah Harbor. Evaluate Savannah Harbor's slowdown in trade and compare it to slowdowns at other ports.

Comment 13:
The socioeconomic resources are not described in sufficient detail.
Basis for Comment:
The socioeconomic resources are not well explained. For example, in the SHEP Tier II EIS, just one page is devoted to socioeconomics, and the dated information provided describes an unemployment rate of 5.2 percent for the City of Savannah, while the Georgia Labor Market Explorer (Georgia Department of Labor, 2011) shows that unemployment in the City of Savannah has not been below 9 percent in over a year (SHEP Tier II EIS, page 4-82). The analysis of socioeconomic resources in the SHEP Tier II EIS (Chapter 4, page 81) project area is not sufficient to assess impacts. As mentioned above, the information is out of date. The impact section of the SHEP Tier II EIS (Chapter 5, pages 5-144) is very short and states, "Some temporary jobs may be available during construction." These construction jobs could be more than "some," and this might be important. Further, in addition to the construction jobs, the money spent on the project will have a stimulative effect on the economy in sectors outside of construction and this will create additional jobs. The SHEP GRR/Tier II EIS do not provide a specific forecast of the number of jobs that would or could be generated as a direct result of the harbor expansion and as an indirect result of the proposed project. Without presenting this information, the SHEP Tier II EIS fails to adequately document all relevant project impacts.
Significance – Low:
The technical quality of the socioeconomic resource description is not adequate and needs more detail.
Recommendation(s) for Resolution:
1. Update and expand the socioeconomic resources section of the SHEP Tier II EIS. 2. Evaluate the number of jobs created during construction, and comment on how this might create a stimulative effect in a recovering economy.

Literature Cited

Georgia Department of Labor (2011). Georgia Labor Market Explorer. Online at: http://explorer.dol.state.ga.us/ga_unemployment_rate/Default.aspx

Comment 14:
The commodity movement model and analysis needs to be strengthened by including data for 2008, 2009, and even 2010 to capture the economic downturn.
Basis for Comment:
The current commodity movement data are not well documented as to sourcing or timing of the data. Data from 2009 are mentioned (SHEP GRR Section 4, page 53), but this information is not carried throughout the rest of the document (e.g., Figure 4-2 on page 52). Much of the information could be enhanced by including trade and port traffic data from 2008, 2009, and possibly 2010, as available. This is a unique opportunity to strengthen the analysis and refine the implications of the project. Load factors, Savannah port share, percentage growth over time, and overall trade volume are among the assumptions that could be strengthened with the new data. It is not clear if these new data were considered by the firms making the projections for the USACE. Because at least 2 new years of data are now available, these new real-time data years should be used to test the accuracy of the projections. It may be that the modification (SHEP projections) was developed by comparing the GI base with actual 2009 data (or partial 2010 data), but this should be clarified. This study has spanned enough time that the new data would be useful to test the correctness of the early projections offered in the Transportation Cost Savings Model analysis. Real-time data can help support the projects or improve them if changes need to be made. Variance between the projections could be used to fine-tune the projections and the resultant benefit flow over time. Sensitivity analysis could then be used to test the vulnerability of the projections/benefits to impacts based on recent years of data. Little impact on the benefit stream is expected, but it should be tested, or explained why it was not done.
Significance – Low:
The new data may or may not cause at least marginal adjustments in the traffic and trade projections, but the effect of the economic downturn should be incorporated in the analysis so that confidence, currency, and clarity are increased
Recommendation(s) for Resolution:
1. Examine the new years' data relative to the Gulf Engineers & Consultants (GEC) analysis on port demand, in both the cost analysis and the multiport analysis. Note any differences and discuss them in the components of the Transportation Cost Savings Model, the Economic Appendix, and the SHEP GRR. 2. If the new data suggest significant shifts from the original, revise the initial projections development. 3. Use the new information to determine which projections of annual traffic growth (for example, in the sensitivity analyses) should be used and relied upon. Add this finding to the discussion on sensitivity of the assumptions.

Comment 15:
The application of a 25% contingency to different portions of the same alternative may result in artificially increased cost projections.
Basis for Comment:
Section 13.2 of the SHEP GRR states there is a 25% contingency for each of the Code of Accounts (Lands and Damages (01), Fish and Wildlife Facilities (06), etc.) while the Mii Summary Page states there is a 25% contingency on the 47-foot and 48-foot alternatives as a whole. This implies that a double contingency is applied to the alternatives with a contingency for each account and then one for the overall alternative.
Significance – Low:
The supplemental information provides the specific details on the contingency and how it is used; however, the SHEP GRR and Tier II EIS confuses this and requires further clarification.
Recommendations for Resolution:
1. Elaborate on the statements in Section 13.2 concerning the Code of Accounts vs. the broad summary statements in the Mii Cost Estimate with respect to the 25% contingency on the 47-foot and 48-foot alternatives. 2. Expand on the explanations within the Mii concerning how the 25% contingency is applied to each alternative.

Comment 16:
Predictions regarding the lack of future increases in overall cargo amounts require further explanation.
Basis for Comment:
The Panel is concerned with the statement that overall cargo amounts will not increase with increases in vessel size over time. Increased channel depth would imply that there will be an increase in vessel size, quantity of vessels, and total amount of cargo being received at the Port over time. The SHEP GRR does not justify USACE's assertion that no increase in overall cargo throughput would occur over time under future conditions (even under "with project" conditions). This assertion is contrary to industry opinion. Although it is not known whether the channel deepening will alter the quantity of throughput at the port, it is both possible that the project might bring more cargo to the port (as shippers switch from shallower ports), and that no project might result in a decline in market share for the Savannah Harbor. This should be explained along with the discussion of the global economic downturn.
Significance – Low:
The impact of potential increases in cargo has significant relevance to the justification of the "with" project condition and the Mitigation Plan as currently stated in the Tier II EIS and GRR.
Recommendation(s) for Resolution:
1. Elaborate on the statements concerning the justification for no increase in cargo volume with the project in place. 2. Provide additional discussion points on the rationale for increased channel capacity resulting in increased vessel size without the commensurate increase in cargo volume over time.

Comment 17:

The approach to measuring Regional Economic Development (RED) impacts does not appear to follow the Water Resources Council Economic and Environmental Principles and Guidelines (P&Gs) for Water and Related Land Resources Implementation Studies.

Basis for Comment:

The RED Impact Analysis (in Section 8 of the Economic Appendix, page 174) does not appear to follow the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (referred to as P&Gs) (Water Resources Council, 1983). Indirect and induced impacts to the local economy are expected and should be included in the RED analysis (see P&Gs, page 11). These impacts are known as income and employment transfers to a region and are typically measured with use of an input-output model such as IMPLAN. They represent the degree to which increases in income and employment (the NED benefits) "ripple" through the local economy. These are not measured.

Although it is not clear whether a RED analysis is required in this case, if it is required, or has "material bearing on the decisionmaking process" (P&Gs, page 8), then it should be completed following the generally accepted practices. The analysis of alternatives should focus on how the different alternatives will impact the regional economy. However, the current econometric analysis presented in Section 8 focuses only on the relationship between income and tonnage at the Port of Savannah, even though the tonnage is not expected to change with the different alternatives. Consequently, this analysis does not capture the potential differences between alternatives.

The regression analysis has questionable significance due to the many potentially correlated factors that are not included in the analysis. For example, at the same time that tonnage increased, the population or the number of tourists visiting the area may have increased; the economy of the state may have experienced shifts that impact the region; and/or other sectors of the economy may have improved.

During the pre-IEPR of the transportation cost model and early drafts of documents related to this project conducted by two of the panel members, similar concerns about this analysis were raised. Although improvement is seen since the earlier comment, additional improvement will bring greater consistency to the document. For example, the current draft does include the role of the commodities in job creation (SHEP GRR on page 58), but this information does not appear in the RED analysis, where it may also belong.

Significance – Low:

The approach used departs from Federal guidelines and introduces confusion because it is not well explained.

Recommendation(s) for Resolution:

1. Assess whether a RED analysis is required in this case, and explain why and how such an analysis might have material bearing on the decision-making process.
2. If an analysis is needed, explain why the approach selected is an effective way to complete the analysis.

3. If an analysis is needed, explain why a traditional input-output analysis (such as the one cited in the SHEP GRR, page 58) is not a feasible approach.
4. If a RED analysis is not needed, delete that portion of the Economic Appendix.

Literature Cited

Water Resources Council (1983). *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. March 1983. http://www.usace.army.mil/CECW/PlanningCOP/Documents/library/Principles_Guidelines.pdf.

Comment 18:
The report should address the current status of, and any impacts of delays in, the Panama Canal deepening.
Basis for Comment:
Much of the benefits of the transportation cost savings model arise because of the new and larger ship design that has occurred and can be expected to occur. These new ships arise in the future conditions because of the deepening of the Panama Canal. It is possible that the construction and deepening of the Canal, like all major projects, could be delayed. If the deepening is delayed, some unidentified impact on commodity flows can be expected; such a traffic flow change would have a corresponding delaying effect on the benefit stream from the project and a resultant decrease, to some unknown magnitude, in the magnitude of the expected benefits. The report does not address this potential impact on the benefit stream. If such analyses were done, the confidence in the benefit/cost ratio would be increased. Further, it would support the decision that the "Susan Maersk" was the appropriate expected design vessel.
Significance – Low:
An improved and up-to-date description of the potential impact of delay in Panama Canal deepening would increase confidence in the benefit stream from the Savannah Harbor project. The overall impact might be small, and little effect on the benefit-cost ratio is expected.
Recommendations for Resolution:
1. Review and incorporate the current status of the deepening of the Panama Canal as part of the current early discussion and description in the GRR. 2. Implement and include sensitivity analyses, similar to the excellent section in the current version of the GRR, in the report, ranging over various lengths of delay in the construction. This could be added in the sensitivity analysis section. 3. Derive and evaluate implications on the benefit stream and the current benefit/cost ratio, probably in (and as done in) the current sensitivity section for the other issues.

Comment 19:

Potential effects of future climate change are not fully described and addressed.

Basis for Comment:

The SHEP GRR (Sections 5.7.2 and 12.4; Engineering Appendix Section 7.5.2.2 and Table 15.2) discusses potential sea level rise impacts in adequate detail, following the guidance provided in Engineer Circular (EC) No. 1165-2-211 (USACE, 2009). The SHEP Tier II EIS (page 5-12) includes a limited discussion about potential sea level rise impacts to the project. No discussions, however, were found on other potential climate change impacts to the project (e.g., changes in storm frequency, intensity, and duration; increasing flow extremes [maximum and minimum]; and modified rainfall patterns).

Hydrologists are currently learning how river discharges may be altered as a consequence of climate change in the coming decades. In the southeastern United States, for example, a recent study has shown that abnormally low and high river discharge can be attributed to the effects of global warming (Li et al., 2010). Regional (Lettenmaier et al., 1999, and Thomson et al., 2005) and global (Arnell et al., 2006) climate/hydrologic runoff models have also documented changes in river discharge that may be associated with climate change scenarios in North America. The Savannah River basin, in particular, was evaluated as one of six case studies by Lettenmaier et al. (1999). If climate change results in prolonged periods of increased drought conditions, then increased salinity intrusion may threaten tidal fresh wetlands that are currently expected to be untouched by salinity intrusion under existing conditions.

Although future climate change impacts on Savannah River basin runoff were not explicitly considered in the evaluations of future salinity and oxygen conditions that might result from implementation of channel deepening scenarios, the hydrodynamic model projections based on the existing statistics of hydrologic conditions for the Savannah River appear to be adequate to support the evaluations of the project alternatives for channel deepening. A more rigorous sensitivity analysis of upstream river flow could be performed, however, if required, to consider the expected ranges of climate-induced changes in river runoff. Climate change impacts on river runoff in the southeast United States could be obtained either from the literature or directly from the climate change research teams. Although hydrologic changes from global warming were not considered in the model evaluations, climate change issues related to sea-level rise were considered in the hydrodynamic model evaluations based on simulations of 25-centimeter and 50-centimeter rises in sea level.

Significance – Low:

A comprehensive understanding of the potential impact of other climate change effects on the project is necessary to justify that the project objectives can be met.

Recommendation(s) for Resolution:

1. Discuss the spectrum of conditions that might result from climate change. Sea level rise is one issue; changes in the extremes of Savannah River runoff is a separate issue.
2. Identify how these new conditions might impact the proposed project and evaluate the potential extent of these impacts.

3. If sea level rise is indeed the only climate change condition of concern, provide full justification for this conclusion prior to the existing discussions in Section 5.7.2 of the SHEP GRR and page 5-12 of the SHEP Tier II EIS.
4. The sensitivity analysis for the effect of river flow that is presented in the SHEP GRR was based on a +/- 10% change in the existing flow conditions. Compare the projections of low and high flow extremes for the Savannah River from climate change research to the +/- 10% range of flows considered in the sensitivity analysis, and document the results of the comparison in the sensitivity analysis and in climate change sections of the reports.
5. If the projected climate change extremes of river flow are much larger than the +/- 10% change in river flow used for the sensitivity analysis, simulate the effect of additional climate change scenarios on salinity intrusion with the hydrodynamic model as 2-by-2 combinations of low/high river flow and low/high sea level rise scenarios. The worst-case scenario for salinity intrusion is low river flow and high sea level rise. Evaluate the effects of salinity intrusion on inundation of tidal fresh wetlands and chloride levels at the municipal water intake on Abercorn Creek.

Literature Cited

Arnell, N.W. (2006). Climate change and water resources: a global perspective. *Avoiding Dangerous Climate Change*. Schellnhuber, H.J., Cramer, W., Nakicenovic, N., Wigley, T., and Yohe, G. (eds). Cambridge University Press, Cambridge 167-175. http://www.fco.gov.uk/en/global-issues/climate-change/priorities/science/water-availability

Lettenmaier, D.P., A.W. Wood, R.N. Palmer, E.F. Wood, and E.Z. Stakhiv (1999). Water Resources Implications of Global Warming: A U.S. Regional Perspective. Clim. Change, 43(3): 537-579. November.

Li, Wenhong, Laifang Li, Rong Fu, Yi Deng, Hui Wang (2010). Changes to the North Atlantic Subtropical High and Its Role in the Intensification of Summer Rainfall Variability in the Southeastern United States**.** J. Climate; 101022145653051 doi: 10.1175/2010JCLI3829.1

Thomson, A.M., R.A. Brown, N.J. Rosenberg, R. Srinivasan, and R.C. Izaurralde (2005). Climate Change Impacts for the Conterminous USA: An Integrated Assessment Part 4. Water Resources. Clim. Change 69(1): 67-88. doi:10.1007/s10584-005-3610-y.

USACE (2009). Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Circular (EC) No. 1165-2-211. July 1.

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APPENDIX B

Final Panel Summary

on the

Savannah Public Comments

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Public Comment Review Summary
Several concerns noted in the Public Comments on the Savannah Harbor Expansion Project (SHEP) General Reevaluation Report (GRR) and Tier II Environmental Impact Statement (EIS) should be further analyzed and documented.
Basis for Comment:

During review of the Public Comments, the Panel found that the following issues raised by agencies, stakeholders, and members of the public deserve further investigation and documentation within the SHEP GRR and Tier II EIS. The Panel has summarized below the most significant technical concerns identified by the Public. The Panel notes, however, that the Public Comments should be directly examined regarding the details of each concern. To assist USACE in locating where these concerns were noted, the Panel has provided, in parentheses, those submissions that identified each concern.

- Use of a fish ladder as a viable mitigation for impacts to the short-nosed sturgeon needs to be further researched and documented (See U.S. Department of Interior (DOI); U.S. Department of Commerce National Marine Fisheries Service (NMFS), Georgia Department of Natural Resources [GA DNR], and other letters).
- Removal of the New Savannah Bluff Lock and Dam needs to be further discussed, as it appears to be the preferred mitigation measure for short-nosed sturgeon and is noted as an economically viable option by at least one commenter (See DOI and NMFS letters).
- Placement of dredge material on shore and in the near shore environment of Tybee Island may have adverse impacts on recreation and the environment, which could pose human health and economic impacts. The following impacts of this placement should be researched and documented:
    - Adverse affects to coastal processes (e.g. wave energy, longshore currents)
    - Creation of rip currents
    - Safety concerns for swimmers, anglers, etc.
    - Adverse effects to surfing
    - Impacts to recreational use of the beach
    - Negative impact on economy (tourism)
    - Impacts on Tybee Island's future source of sand for renourishment by the location of a nearshore dredged material placement site overlapping an approved borrow area for Tybee Island Beach Project. (See City of Tybee Island, Surf Rider, and general public letters)
- Determination methods regarding the suitability of the dredge material being placed on Tybee Island need to be better documented to allow the public to understand the rigorous requirements that the U.S. Army Corps of Engineers (USACE) follows. (See Savannah River Maritime Commission (SRMC), South Carolina Department of Natural Resources (SC DNR), Georgia Coastal Management Program)
- The effectiveness of several of the proposed mitigation monitoring periods needs to be further discussed. Currently, several agencies are stating they will require longer monitoring for the implementation of adaptive management procedures. (See DOI, City of Savannah, SRMC)

- Te most recent (revised) chloride model results that became available as of December 15, 2010 need to be included in the SHEP GRR and Tier II EIS documentation. Increased chloride levels remain a significant concern with regards to aquifer intrusion (general public) and the surface water intake on Abercorn Creek (See City of Savannah, International Paper, Weyerhaeuser). The major concern is that increased chlorides will result in increased corrosion for residential and industrial plumbing systems and increased cost of operations. Increased residential corrosion may result in violations of EPA drinking water criteria for lead and copper at the tap. According to the City of Savannah's letter, the EPA water quality criteria of 250 mg/L or less for human consumption of drinking is not a relevant target for the evaluation of the impact of channel deepening because of the operational costs and public health issues related to increased corrosion from increased chloride levels in Abercorn Creek. (see City of Savannah letter)
- Air quality, noise, environmental justice, and cumulative impacts have not been fully evaluated. (See Keck School of Medicine, University of Southern California.)
- Economic calculations for each alternative should include the cost of adjusting U.S. Coast Guard Aids to Navigation. (See U.S. Coast Guard.)
- Additional information on the steps USACE will take to ensure that mitigation is conducted needs to be documented in the SHEP GRR and Tier II EIS. According to several agencies and members of the public, there is a lack of reasonable assurance that the mitigation proposed will be completed as planned (e.g., the fish ladder and the oxygen injection system). (See SRMC, SC DNR, South Carolina Department of Health and Environmental Control - Office of Ocean and Coastal Resource Management [SCDHEC-OOCRM].)
- Hydrodynamic and water quality modeling used in the Adaptive Management Plan appears not to have considered ecological performance measures to evaluate the effectiveness of the proposed mitigation. (See DOI.)
- Uncertainties regarding the proposed mitigation for dissolved oxygen (DO) deficiencies remain due to the findings of a U.S. Geological Survey peer review of a supporting study prepared for USACE. (See DOI and NMFS.)
- Because in-kind mitigation of adverse impacts to tidal freshwater wetlands is not possible, some agencies are suggesting that the neither the National Economic Development (NED) plan nor the Locally Preferred Plan (LPP) be chosen. (See DOI.)
- Impacts of dredged soil treatment and disposal, traffic projections, and terminal capacity resulting from potential development of the Jasper Ocean Terminal have not been addressed. (See SRMC, South Carolina State Ports Authority, and SCDHEC-OOCRM.)
- Maritime landside transportation developments necessary to handle future traffic relative to traffic through the port should be fully addressed. (See SRMC.)
- The selection of shoreline segments for inclusion in the shoreline and bank erosion/stability studies should be explained, and these sections should be included in the monitoring plan. (See SRMC.)
- That the channel, as designed, does not meet the USACE standards for fully loaded post-panamax ships should be explained. (See SRMC.)

• The only terminal considered in the development of alternatives was Garden City; the exclusion of other terminals should be documented. (See SRMC.) Additional concerns noted by the public parallel the Panel's concerns identified during the Independent External Peer Review (IEPR) of the SHEP GRR and Tier II EIS documents. Because these concerns were documented in Final Panel Comments, the Panel did not repeat the concerns in this summary.
Significance – Medium:
Clarification to address concerns raised throughout the Public Comments would make the document more complete.
Recommendation(s) for Resolution:
1. Conduct additional investigations, provide documentation, and carry out further consultation on the issues noted above as suggested.

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APPENDIX C

Final Panel Member Comments

on the

Chloride Model Review

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Comment CL–1:
The currently chosen open water boundary condition for salinity for the Environmental Fluid Dynamics Code (EFDC) hydrodynamic model is located in an area that is potentially impacted by discharge from the Savannah River, which could result in an inadequate representation of the cause-effect relationship between river discharge and ocean salinity that affects salinity and the affected resources in Savannah Harbor.
Basis for Comment:
The primary objective of the hydrodynamic model component of the Savannah Harbor project is to evaluate how the salinity regime in the Savannah River estuary might be further impacted by implementation of the (a) alternatives for navigation channel deepening and (b) plans for mitigation of the adverse impacts of the project. A technically credible representation of the cause-effect interaction of river discharge and ocean salinity on salinity and resources in the Savannah River is therefore a critical component for development of the hydrodynamic model. As documented in the *Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project* January 2006 report for the Savannah Harbor Expansion Project (SHEP) General Reevaluation Report (GRR), the offshore boundary of the EFDC model domain is located within the inner shelf about 17 miles offshore from Oysterbed Island. However, inner shelf salinity is known to be influenced by freshwater discharge from the Savannah River and other rivers in the South Atlantic Bight (SAB) (Atkinson et al., 1983; Blanton et al., 2003). The hydrodynamic model domain does not address a geographic area of the continental shelf that is large enough for a system-wide investigation to ensure that Savannah Harbor expansion plans adequately address the cause-effect relationships among river discharge, cross-shelf salinity, and the affected resources and activities that are pertinent to achieving the study objectives. As discussed in the *Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project* report for the SHEP GRR in Section 4.4.1 (pages 30-31), the open water boundary condition for salinity was assigned for the Savannah Harbor model based on evaluation and analysis of three data sources: (1) Skidaway Institute of Oceanography South Atlantic Bight Synoptic Offshore Observational Network (SABSOON) offshore towers; (2) Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS); and (3) offshore data collected by MACTEC as part of the long-term biological oxygen demand study on September 24, 2003. Although the Chloride Modeling Report dated 15 December 2010 does not document the open boundary condition for salinity used for the 2001-2009 chloride modeling study, inspection of the boundary condition file for salinity (sser.inp) shows that salinity is assigned a constant vertical gradient from 33.0 parts per thousand at the surface to 36.0 parts per thousand for the bottom layer. Chloride (dser.inp) is assigned a constant value of 20,000 milligrams per liter (mg/L) for all five layers. The SAB of the continental shelf extends from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Within the SAB, coastal circulation and distributions of salinity and water temperature are influenced by river discharge, wind forcing, tidal mixing, and interaction with the Gulf Stream. Numerical model investigations of the SAB have focused on the influence of river discharges on the transport of low-salinity water to better understand shelf-wide distributions for pollutants derived from coastal runoff (Kourafalou et al., 1996). Using several

decades of station data available from the National Oceanic and Atmospheric Administration's (NOAA) National Oceanographic Data Center (NODC), studies of temperature and salinity distributions over the SAB (Atkinson et al., 1983; Blanton et al., 2003) have identified cross-shelf hydrographic regimes characterized by (a) inner shelf (0- to 20-meter [m] isobath), (b) mid-shelf (20- to 40-m isobath) and (c) outer shelf (40- to 75-m isobath) regions. These studies have shown that a coastal plume of low-salinity water is a prominent hydrographic feature of the inner shelf that can be attributed to tides, winds, and freshwater input from the Savannah River and other rivers of the SAB. Circulation over the mid-shelf, in contrast to the inner shelf, is controlled by tides, winds, density forcing, and interaction with the Gulf Stream. These studies clearly show that different physical mechanisms control the cross-shelf distribution of salinity within the SAB. This knowledge, and data, should be incorporated into the Savannah Harbor EFDC model setup for the open water ocean boundary conditions for salinity.

The impact of the existing EFDC model setup is that the technical credibility of the hydrodynamic model is weakened by assigning the open water boundary for the model domain within the inner shelf region where salinity is known to be influenced by river discharge. In a draft report prepared to document the development of the EFDC model of Savannah Harbor (Tetra Tech, 2004), data are presented, and included in this comment, to illustrate the effect of river flow discharging to the SAB on coastal salinity. Figure 1 shows the location of SABSOON Station R2, and Figure 2 shows the time series response of salinity at this station to Savannah River flow from 1999-2002. If sufficient time series observations were available to describe the variability of surface and bottom layer salinity in the vicinity of the open water boundary for the chloride model time frame of 2001-2009, such as is seen in the SABSOON data set shown in Figure 2, then the existing open boundary location would be technically defensible since actual salinity data, dependent on changes in river flow, would be used for input to the model. Since sufficient time series observations for salinity are, however, not available in the vicinity of the open water boundary, aggregate composite data sets that are not influenced by river discharge must be used to assign the open boundary condition.

The technical credibility of the Savannah Harbor model can be strengthened by moving the open ocean boundary location further offshore out into the mid-shelf region. It would then be appropriate to assign either composite monthly salinity or a constant salinity as a reasonable approximation to mid-shelf coastal ocean forcing for the salinity model of Savannah Harbor and estuary. Although this is a technical weakness for the conceptual model of hydrodynamics for Savannah Harbor, it is unlikely that the project recommendation, based on the overall evaluations of the adverse impacts and the effectiveness of mitigation options, would be affected by this issue.

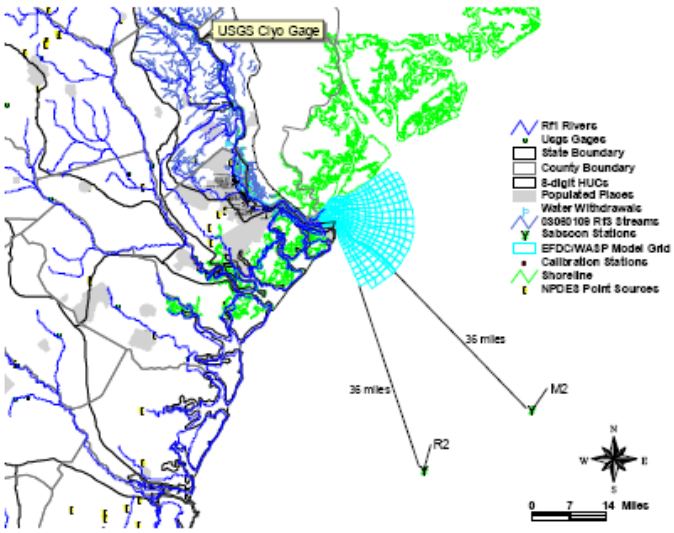

Figure 1- Location of SABSOON stations (Source: Tetra Tech, 2004)

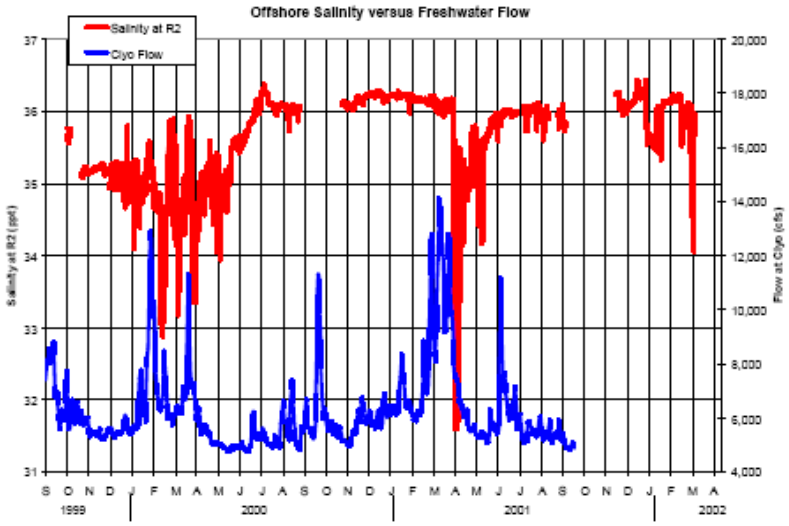

Figure 2- Time series of SABSOON Salinity Data from Station R2 Located 55 miles offshore (Source: Tetra Tech, 2004)

Significance – Medium:

The present model setup for the open ocean boundary weakens the technical credibility of the hydrodynamic model because the simulated salinity distributions in Savannah Harbor are controlled by the assignment of observed inner shelf salinity as open water boundary conditions which, as shown in Figure 2, are, in turn, influenced by freshwater discharge from the Savannah River and other coastal rivers in the SAB.

Recommendation(s) for Resolution:
1. Extend the curved arc of the offshore boundary further offshore into the mid-shelf region (20- to 40-m isobath). Extend the open boundary location to ensure that observed salinity data used to assign the open boundary condition are not influenced by discharge from the Savannah River and other rivers within the SAB. 2. Instead of the limited data sets that were used to assign open boundary salinity, base the open water boundary conditions for surface/bottom salinity and water temperature on monthly composite NOAA NODC data that are representative of the mid-shelf region (20- to 40-m isobath) as compiled by Blanton et al. (2003) and Atkinson et al. (1983). Aggregation of NOAA NODC station data at 0.5-degree blocks (30-minute squares) would provide a reasonable spatial resolution to assign open water boundary conditions for the mid-shelf region.

Literature Cited

Atkinson, L.P., T.N. Lee, J.O. Blanton, and W.S. Chandler (1983). Climatology of the Southeastern United States Continental Shelf Waters. J. Geophys. Res., 88(C8):4705-4718.

Blanton, J.O., A. Aretxabaleta, F.E. Werner, and H. Seim (2003). Monthly climatology of the continental shelf waters of the South Atlantic Bight. J. Geophys. Res., 108(C8):3264-3283.

Kourafalou, V.H., T.N. Lee, L.Y. Oey, and J.D. Wang (1996). The fate of river discharge on the continental shelf 2. Transport of coastal low-salinity waters under realistic wind and tidal forcing. J. Geophys. Res., 101(C2):3435-3455.

Tetra Tech (2004). Development of the EFDC Hydrodynamic Model for the Savannah Harbor. Technical report prepared by Tetra Tech, Inc, Atlanta, Georgia, for USACE-Savannah District, Savannah, Georgia, and U.S. EPA Region 4, Atlanta, Georgia. March 4.

Comment CL–2:
Grid cell coordinates and the design of the curvilinear grid scheme for the extended grid model of Savannah Harbor and the initial condition for salinity may cause mass balance problems for the hydrodynamic model
Basis for Comment:
As documented in Section 4.3 of the Chloride Model Development for the Savannah Harbor and River Estuary, the EFDC grid, as developed for the 2006 report, has been extended from the earlier version of the grid by including Abercorn Creek, Little Abercorn Creek, Bear Creek, and Little Collis Creek. These creeks were added to the grid to improve the representation of hydrodynamic flow and salinity intrusion in the vicinity of the City of Savannah water intake on Abercorn Creek. In reviewing the EFDC input files and maps of the revised grid with EFDC_Explorer5 (Craig, 2009), issues have been identified related to: (a) mapping of grid cell coordinates outside the model domain; (b) orthogonality of the curvilinear grid; (c) initial conditions assigned for salinity; and (d) Z-grid representation of vertical layers for the extended grid and the coastal area of the model domain. <u>Mapping of Extended Grid Cell Coordinates</u>. The center coordinates of the EFDC grid cells are available in the lxly.inp input file, and the length, width, and curvilinear rotation coefficients are available in the dxdy.inp input file. EFDC_Explorer5 (Craig, 2010) was used to display the grid cell (I, J) coordinates for the coastal ocean area and the interior of the model domain. The coastal area is shown in Figure 1A and the interior area of the domain is shown in Figure 1B. As can be clearly seen in Figure 1A, several grid cell locations are mapped in the ocean to the east of the open boundary of the model domain. Furthermore, numerous grid cells are mapped to the north of Savannah Harbor outside of the model domain (Figure 1B). In addition to the grid cells shown in Figure 1, EFDC_Explorer5 (Craig, 2010) was used to display the location of the grid cell for the upstream boundary at Clyo, Georgia. The upstream boundary at Clyo, shown with the red box in Figure 2A, is clearly not mapped at the most upstream location of the upper river, as seen in Figure 2B. The location of the XY Universal Transverse Mercator (UTM) coordinates assigned for the Clyo upstream boundary cell is incorrect, as are the XY UTM coordinates of many other grid cells as shown in Figures 1A and 1B. <u>Orthogonality of Curvilinear Grid</u>. An orthogonal curvilinear coordinate system allows the design of a numerical grid system for a physical domain that is defined by complex shoreline geometry such as Savannah Harbor. The irregularities of the physical grid are represented by mapping coefficients and mathematical transformations of XY coordinates from the physical grid to the computational grid. An orthogonal curvilinear grid system preserves right angles between the two coordinates at every point of interest in the grid domain. The measure of the deviation from numerical orthogonality in a curvilinear grid is the angular error for a grid cell, which should be a small value. An angular deviation error of 3 degrees or less is considered acceptable for a curvilinear orthogonal grid to prevent mass balance errors in the simulation (Delft Hydraulics, 2010). EFDC_Explorer5 (Craig, 2010) was used to compute, and generate a map display of, the angular deviation from orthogonality for each grid cell using the cell centroid XY UTM coordinates. As shown in Figure 3A, the extended EFDC grid developed for the chloride model of Savannah Harbor is described by an overall angular deviation from orthogonality of 15.79 degrees with a range of -89 to +86 degrees. The deviation of the

extended grid from orthogonality is considerably larger than the previous version of the EFDC model used for the 1999 calibration, where the deviation was 4.3 degrees with a range of -42 to +18 degrees (Figure 3B).

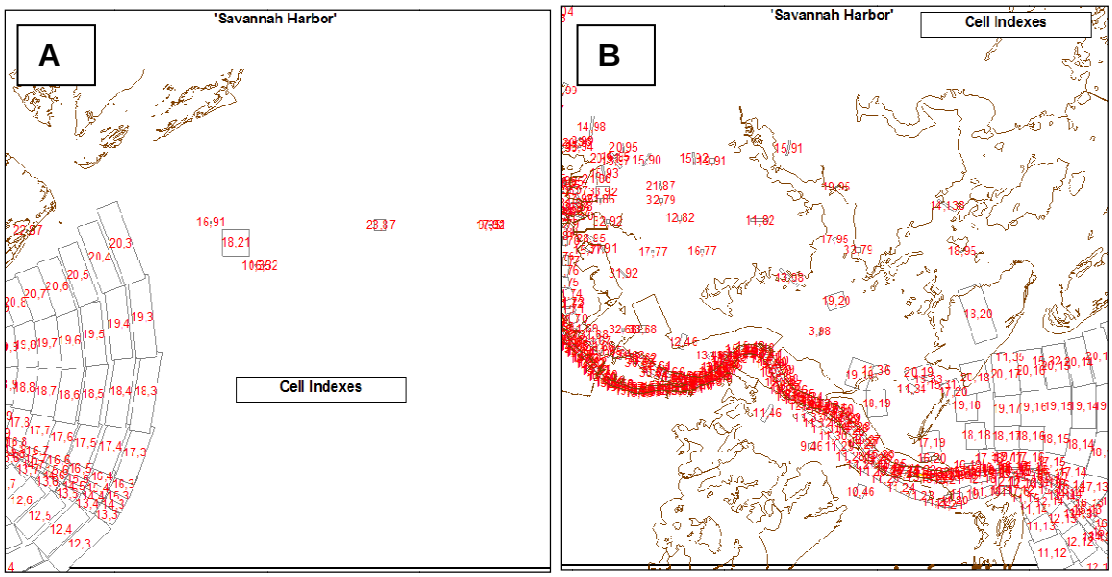

Figure 1 - Mapped Locations of grid cells that are outside the extended grid model domain for the (A) coastal domain and (B) interior domain. Source of map: EFDC_Explorer5 (Craig, 2010)

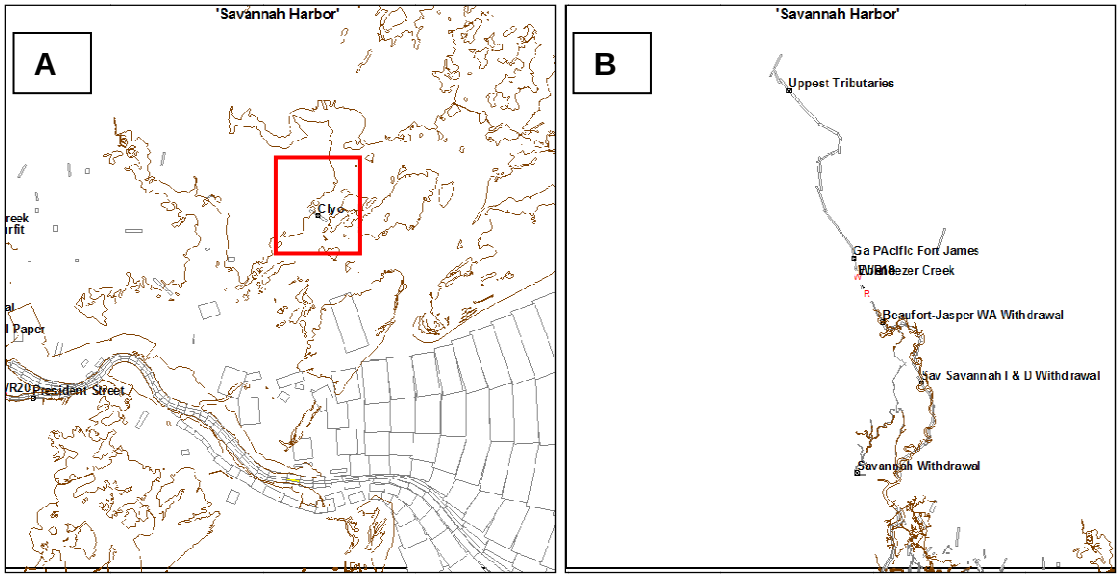

Figure 2 - Mapped Locations of (A) Clyo upstream boundary grid cell and (B) upper river flow boundary locations. Source of map: EFDC_Explorer5 (Craig, 2010)

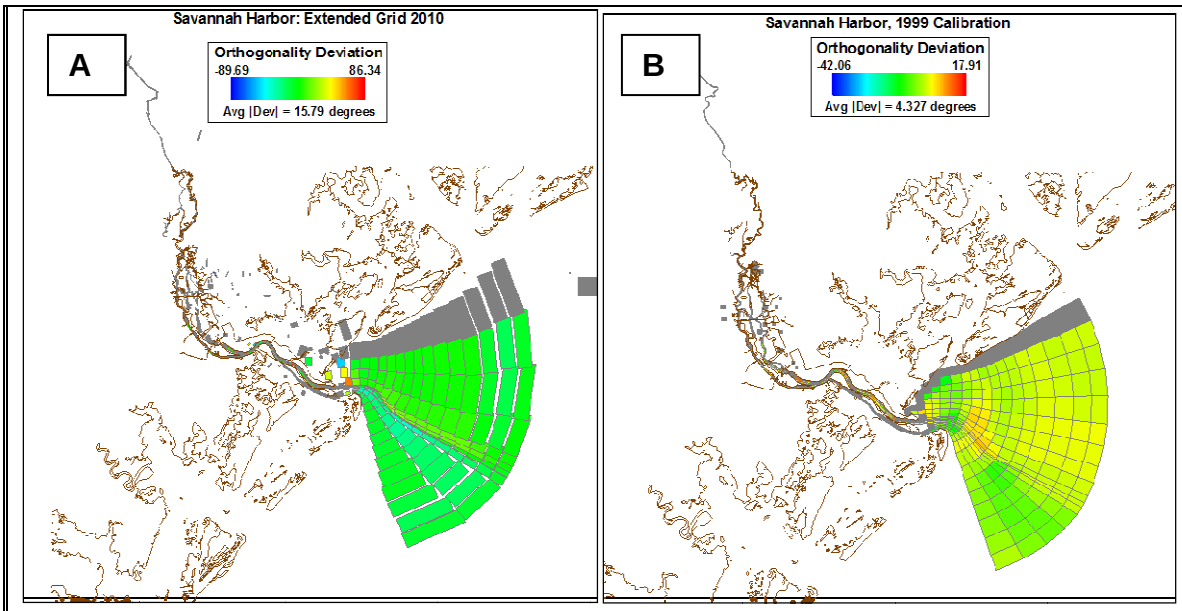

Figure 3 - Angular deviation from orthogonality for Savannah Harbor EFDC model for (A) extended grid used for 2001-2009 chloride modeling and (B) grid used for calibration (1999) and validation (1997) from 2006 report. Source of map: EFDC_Explorer5 (Craig, 2010)

Initial Conditions Assigned for Salinity and Chlorides. Initial conditions are assigned for the hydrodynamic model for water elevation, salinity, chlorides (as dye tracer), and water temperature. Initial conditions are typically based on a spatial interpolation of observed station data to estimate an appropriate initial value for each grid cell and each layer of a model domain. As can be seen in Figure 4 for the initial bottom layer distribution of salinity and chlorides, the grid cells colored in blue identify initial values of zero for salinity and chloride (dye). Similar erroneous distributions for salinity and chloride are also set up for the other layers of the model. Salinity levels of zero for the coastal ocean are clearly not correct.

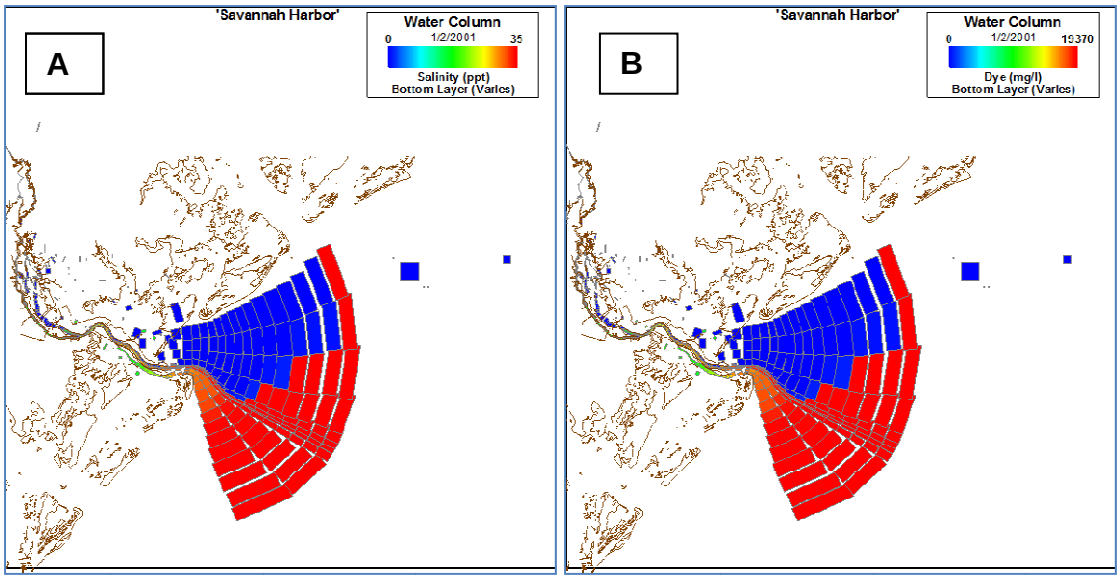

Figure 4 - Bottom layer initial conditions assigned for (A) salinity and (B) chlorides (dye) in the extended grid EFDC model. Source of map: EFDC_Explorer5 (Craig, 2010)

Z-Grid Representation of Vertical Layers. As noted in the Chloride Model report on page 6, the extended grid of the model domain was represented using a single vertical layer in the Generalized Vertical Coordinate (GVC) Z-Grid representation. As shown in Figure 5A, Abercorn Creek and the other creeks in the extended grid are represented by red cells in the Z-grid that mark 5 layers. Figure 5B shows that the grid cells for the upper river are represented by blue cells in the Z-grid with a single layer. In terms of the technical basis of the model setup, this representation of the Z-grid is not necessarily a problem. The problem, however, is that the information presented in the report on page 6 is inconsistent with the actual setup of the Z-grid vertical layers of the extended model as identified with the EFDC input files. The information presented in the report should be consistent with the data used for the model setup.

As shown by the red cells in Figure 6, five layers are used to define stratified conditions for the coastal ocean model domain. The blue, green, and yellow cells identify coastal ocean cells defined by two to four layers rather than five layers. An explanation is needed in the report to document why this area of the coastal domain is represented by fewer than five layers since this is inconsistent with the model representation of coastal stratification.

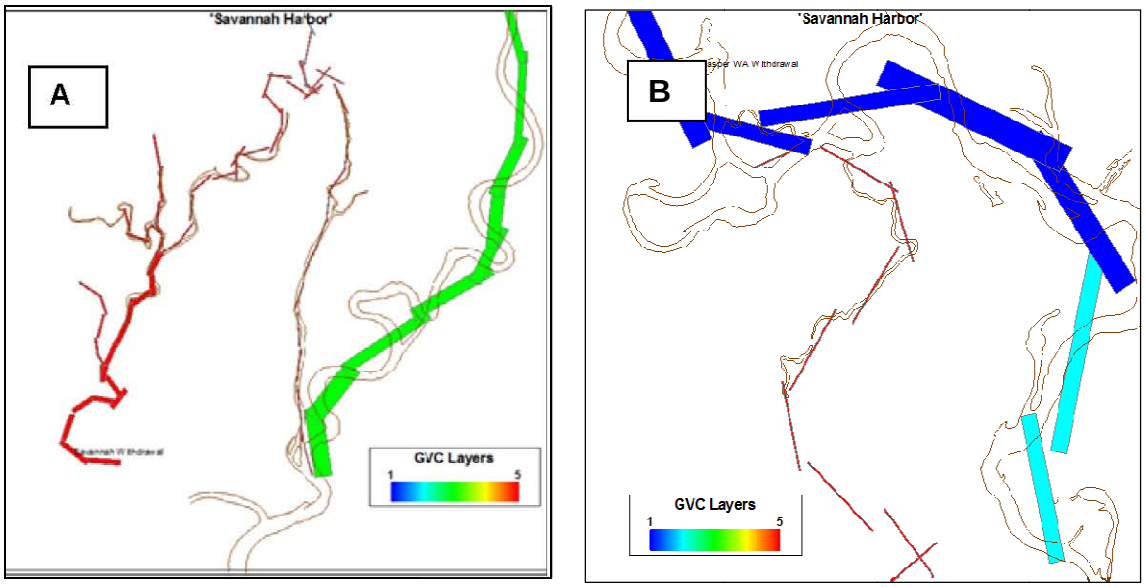

Figure 5 - GVC layers setup for (A) extended grid domain of Abercorn Creek and (B) domain of Upper Savannah River. Source of map: EFDC_Explorer5 (Craig, 2010)

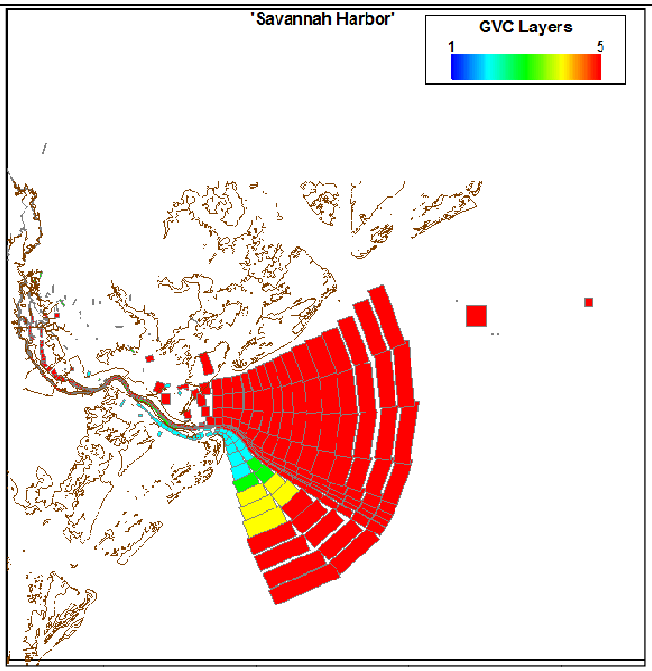

Figure 6 - GVC layers setup for coastal area of model domain. Source of map: EFDC_Explorer5 (Craig, 2010)

The issues discussed in this comment are technical weaknesses for the setup of the extended grid hydrodynamic model for the Savannah Harbor project that could impact the mass balance requirement for the solution of the deterministic EFDC model. Because the computation of angular deviation is based on cell centroid coordinates, it is likely that the mapping errors identified with the XY UTM coordinates for many grid cells are the cause of the 15.79-degree deviation from orthogonality computed for the extended grid. The grid design is an important component of the hydrodynamic model because a deviation from orthogonality larger than the criterion of 3 degrees can affect the accuracy of the mass balance computations in the numerical solution of the model. The grid issues identified in this comment are problems because mass balance errors could be introduced into the model results due to (a) the erroneous initial condition of zero for coastal salinity and chlorides and (b) the large angular deviation from the 3-degree criterion for orthogonality of the curvilinear grid.

Significance – Medium:

Errors in the accuracy of the mass balance computations in the numerical solution of the model could result in either an overestimate, or an underestimate, of the potential impact of the deepening scenarios and mitigation options on chloride levels at the City of Savannah water intake.

Recommendation(s) for Resolution:

1. Check the XY UTM coordinate data for grid cells to ensure that the data used to define the curvilinear grid are accurate.
2. Revise the grid to ensure that the overall deviation from orthogonality satisfies the 3-degree criterion for curvilinear grid design.
3. Revise the initial conditions for salinity and chloride to represent a realistic non-zero coastal ocean salinity field from surface to bottom.

4. Revise the report to present descriptive information about the Z-grid for the extended model grid that is consistent with the actual Z-grid layers used for the model setup.
5. Either revise the report to explain why a small area of the coastal domain is represented by fewer than five layers or revise the Z-grid so that all coastal grids are assigned five layers for a consistent model representation of coastal stratification.

Literature Cited

Craig, P.M. (2010). User's Manual for EFDC_Explorer5: Pre/Post-Processor for the Environmental Fluid Dynamics Code. Dynamic Solutions, LLC, Knoxville, Tennessee.

Delft Hydraulics (2010). Delft3D-RGFGRID, Generation and manipulation of curvilinear grids for Delft3D-FLOW and Delft3D-WAVE, User Manual. Version 4.00, Revision 11003. Deltares, Delft Hydraulics, Delft, The Netherlands. 13 April.

Comment CL–3:
A discrepancy between the volume of the EFDC model domain and the actual volume of a high-resolution Digital Elevation Model (DEM) for the Savannah, Georgia, area can result in potential errors in the simulations of the impact of channel deepening and mitigation scenarios on salinity intrusion in tidal fresh wetlands and chlorides at the City of Savannah water intake.
Basis for Comment:
The hydrodynamic model of Savannah Harbor and the Savannah River/Estuary has been developed to provide the U.S. Army Corps of Engineers (USACE) with a tool that can support evaluations of the potential impact of navigation channel deepening alternatives and mitigation measures on salinity in the tidal fresh wetlands of the estuary and on chlorides at the City of Savannah water intake. The principal objective of the study is to develop a technically credible hydrodynamic model framework that can be used to simulate the effect of changes in existing navigation channel depth on the distribution of salinity in the estuary. Historical data show that deepening of the navigation channel over the decades has resulted in progressive upriver intrusion of salinity into once tidal fresh areas of the estuary. The key physical factors that control the salinity distribution in the harbor and estuary are (a) dilution of salinity by upstream freshwater discharge from the Savannah River and other streams in the watershed; (b) tidal forcing of salinity from the ocean; (c) shoreline and bathymetry; and (d) tidal forcing of circulation and volume of the harbor and estuary. On pages 8 through 22 of Section 4.4 of the 15 December 2010 report *Chloride Model Development for the Savannah Harbor and River Estuary*, model results are presented for comparison to observed data sets for water level, salinity, chlorides, and flow at selected stations in the estuary and at the water intake on Abercorn Creek. In general, model performance for these state variables is consistent with model performance reported previously (Tetra Tech, 2006) for calibration (1999) and confirmation (1997). The model results presented in Section 4.4 appear to provide a reasonable agreement with the new observed data sets collected in 2009. Inspection of the model results for water level shows that the model consistently predicts a tidal range that is somewhat larger than that observed at Houlihan Bridge on the Front River (Figure 4-6), I-95 Bridge on the Savannah River (Figure 4-8), and the water intake on Abercorn Creek (Figure 4-10). Inspection of the model results for salinity at Houlihan Bridge (Figure 4-12) shows that simulated salinity is somewhat higher than observed levels of salinity. The model results for flow at the Houlihan Bridge on the Front River (Figure 4-14) and the Middle River (Figure 4-16) also show a small discrepancy between observed and simulated flow, particularly on the incoming high tide when flow is positive. The discrepancies between model results and observed data for salinity, water level, and flow suggest that the bathymetry and volume of the model domain may be somewhat underestimated in comparison to actual bathymetry and tidally forced volume of the harbor and estuary. Documentation of bathymetry data sources and development of the model domain grid used for calibration and confirmation of the previous version of the EFDC model is presented in Section 4.2 of the technical appendix to the SHEP GRR *Development of the Hydrodynamic and Water Quality Models for the Savannah Harbor Expansion Project* (Tetra Tech, 2006). In

this report, bathymetric data were presented to compare bottom elevation along a longitudinal section of the Savannah River navigation channel (Figure 4-4, page 25) with cross-sections of the river at selected locations near Fort Pulaski (Figure 4-6, page 26) and the New Channel Bend (Figure 4-7, page 27). Although selected bathymetric data were presented to illustrate data sources and model bathymetry of the navigation channel, data were not presented by USACE to show how the volume of the model domain would vary under specific water level conditions such as mean sea level, mean low water, or mean high water. In the development of a model of a lake or reservoir, for example, a comparison of model grid volume-elevation to an observed volume-elevation curve is an accepted critical step in designing the computational grid. A sequence of iterative small adjustments to grid cell bathymetry is typically needed to develop a model grid that is able to provide good agreement with the observed volume-elevation data for the waterbody. It is not clear from the discussion in the GRR technical appendix for development of the EFDC model if this procedure was used to develop either the original computational grid or the revised extended grid for the Savannah Harbor model.

The design of the computational grid for the Savannah Harbor model, based on shoreline and bathymetry data, is, literally, the critical foundation for the development of a technically credible hydrodynamic model, particularly because the model will be applied to evaluate the salinity and water quality impact of changes in volume resulting from channel depth scenarios. Since the grid will determine changes in salinity and chlorides because of changes in the volume of the model domain that are controlled primarily by freshwater flow inputs and tidal forcing, it is essential that the bathymetry and volume of the model grid be confirmed (and revised, if needed) by comparison to a high-resolution DEM of the study area. A discrepancy between the volume of the EFDC model domain and the actual volume of a high-resolution DEM can result in a less-than-acceptable calibration of model results to observed water levels, flow, salinity, and chlorides. If a discrepancy is identified in the model volume, then the predicted impacts of channel deepening and mitigation scenarios on salinity intrusion and chloride levels at the City of Savannah water intake may not be as accurate as possible. The technical credibility of the Savannah Harbor model, and the ability of the model to accurately represent the impact of channel deepening and mitigation scenarios on salinity and chlorides, will be greatly strengthened if USACE is able to present documentation showing a good comparison of volume computed from the model grid and volume computed from a high-resolution topographic and bathymetric DEM.

A high-resolution DEM for Savannah, Georgia, was developed in December 2006 by NOAA's National Geophysical Data Center (NGDC). The DEM was developed to support NOAA's Center for Tsunami Research at the Pacific Marine Environmental Laboratory (PMEL) (http://nctr.pmel.noaa.gov/). The 1/3 arc-second coastal DEM, shown in Figure 1, is used as input to a tsunami model developed by NOAA's PMEL. A summary of the data sources and the methodology used to develop the Savannah DEM is given in Taylor et al. (2008). The URL link to the site for accessing the Savannah Georgia DEM is: http://www.ngdc.noaa.gov/dem/showdem.jsp?dem=Savannah&state=GA&cell=1/3%20arc-second&vdat=MHW

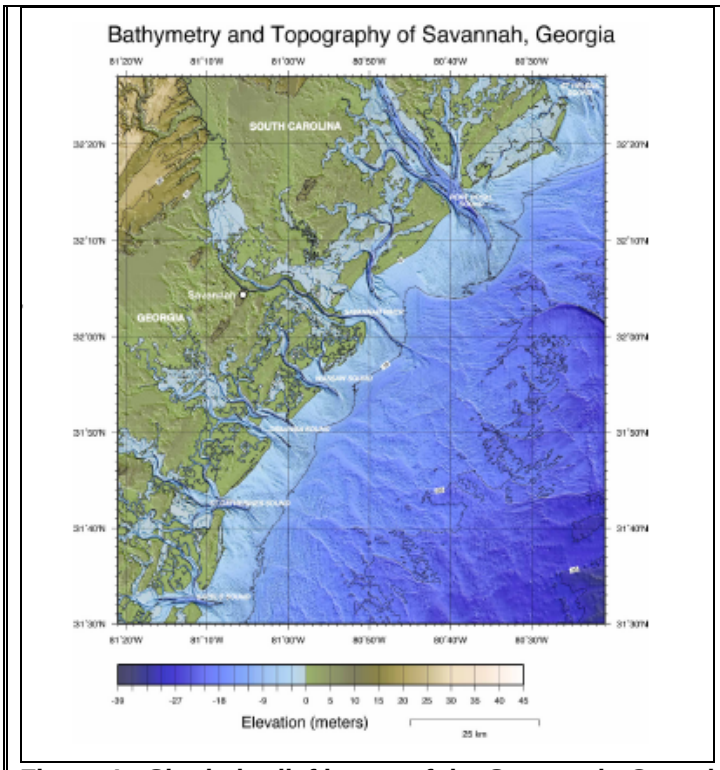

Figure 1 - Shaded-relief image of the Savannah, Georgia, region. Contour interval (referenced to mean high water): 10 meters. Source: Taylor et al. (2008)

Significance – Medium:

An error in the model volume affects model performance based on observed data sets and could result in either an overestimate or an underestimate of the potential impact of the deepening scenarios and mitigation options on (a) chloride levels at the City of Savannah water intake and (b) salinity intrusion in tidal fresh wetlands.

Recommendation(s) for Resolution:

1. Following typical engineering practice used to develop lake and reservoir models, compare the current version of the EFDC grid for the Savannah Harbor model to the high-resolution DEM for Savannah, Georgia (available from NOAA NGDC) and revise the model grid, if needed, to achieve good agreement between them.

Literature Cited

Taylor, L.A., B.W. Eakins, K.S. Carignan, R.W. Warnken, T. Sazonova, D.C. Schoolcraft, and G.F. Sharman (2008). Digital Elevation Model of Savannah, Georgia: Procedures, Data Sources and Analysis. NOAA National Geophysical Data Center, Marine Geology and Geophysics Division, Boulder, Colorado. NOAA Technical Memorandum NESDIS NGDC-6. January.

Comment CL–4:
The EFDC hydrodynamic model setup for the open water boundary condition and representation of the southeast boundary line offshore from Tybee Island has not been defined, causing an infinitely high barrier in the ocean that does not allow flow and mass transport across the southeast boundary.
Basis for Comment:
As documented in the Chloride Modeling Report, the offshore boundary of the EFDC model domain, located about 17 miles offshore from River Mile 0.0 near Oysterbed Island, includes the existing channel, and proposed extension of the navigation channel. As shown in Figure 4-2 (page 8), the extended grid retains the open water boundary including a wide curved offshore arc and an onshore-offshore transect along a southeast line extending from Tybee Island. An issue that has been identified for the chloride modeling analysis is related to the model setup for the open water boundary along the southeast line from Tybee Island. Using the visualization capabilities of EFDC_Explorer5 (Craig, 2010), inspection of the EFDC input files used for the 2001-2009 extended grid model shows that the open water boundary assigned for the EFDC model is defined only by the curved arc boundary. An open water boundary has not been defined for the southeast line from Tybee Island. Figure 1, prepared with EFDC_Explorer5, shows the flow boundary conditions (marked by labels and black squares) and the open water boundary condition (marked by S) that have been assigned for the EFDC model. The grid cell map clearly shows the south [S] open water boundary along the curved arc of the model domain. The grid cell map also clearly shows that an open water boundary has not been defined for the southeast line in the ocean from Tybee Island. The impact of the existing EFDC model setup is that an infinitely high barrier in the ocean is implicitly defined that does not allow flow and mass transport across the southeast boundary line. Although this is a technical issue for the credibility of the model setup, it is unlikely that the project recommendation based on the overall evaluations of the adverse impacts and the effectiveness of mitigation options would be affected by this issue.

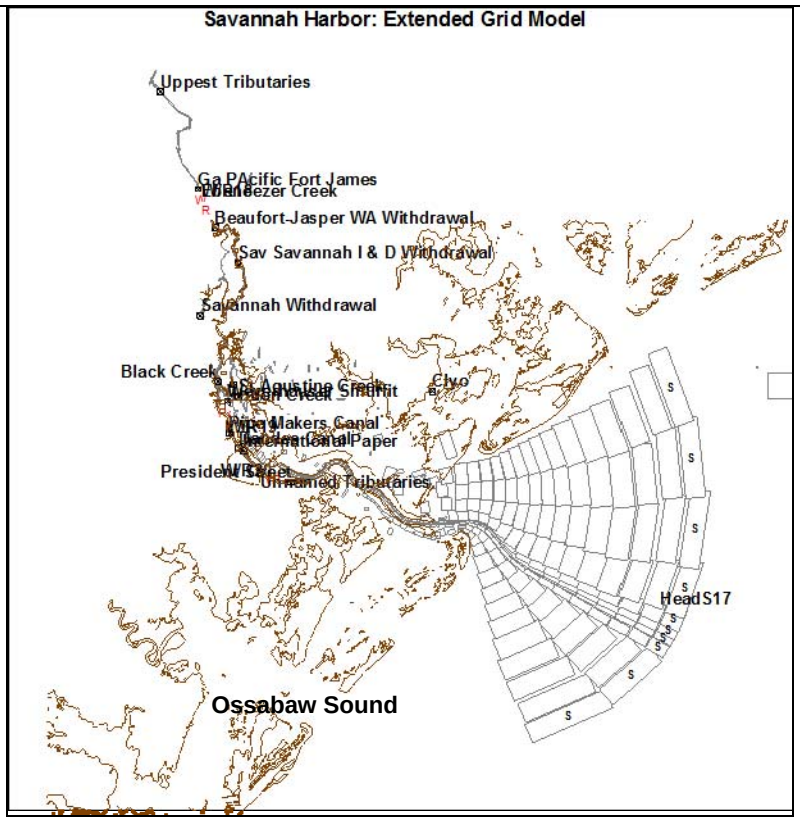

Figure 1. EFDC extended model domain and boundary condition locations. Source of map: EFDC_Explorer5 (Craig, 2010)

Significance – Low:

The error in the model setup affects the technical credibility of the hydrodynamic model because it is not consistent with other estuarine/coastal hydrodynamic models, where the offshore coastal boundary is often defined with a wide arc that intersects both "upcoast" and "downcoast" areas of the coastline.

Recommendation(s) for Resolution:

1. Extend the existing curved arc to a location south of the Savannah River in the vicinity of Ossabaw Sound (see Figure 1).

Literature Cited

Craig, P.M. (2010). User's Manual for EFDC_Explorer5: Pre/Post-Processor for the Environmental Fluid Dynamics Code, Dynamic Solutions, LLC, Knoxville, TN.

Comment CL–5:
Data and information related to the withdrawal flow for the City of Savannah water intake, used to represent the impact of pumping at the water intake on chloride levels in the modeling analysis, are not correctly documented, and may not be correctly assigned in the setup of the hydrodynamic model.
Basis for Comment:
The chloride model analysis was required because of concerns expressed by the City of Savannah about the potential increase of chlorides at the water intake on Abercorn Creek that could result from deepening of the navigation channel and from related mitigation plans to maintain freshwater conditions in the tidal fresh marshes of the Savannah estuary. Information presented in the reports and data used to represent the water intake withdrawal from Abercorn Creek need to be accurate to ensure that the EFDC simulation results for salinity and chloride levels at the water intake are technically defensible. The first issue related to the flow rate data used to represent the water intake in the extended grid model is the data presented in the report as the maximum capacity of the facility and the absence of documentation of the data source used to assign withdrawal data in the model for the water intake. In Section 2.0 of the Chloride Modeling Report, the existing maximum capacity of the City of Savannah Industrial and Domestic (I&D) water treatment plant is reported as 75 million gallons per day (MGD). The report also states that the capacity of the water treatment plant was 35 MGD when the facility was constructed in 1947. In comments dated 24 January 2011, submitted to the USACE, the City of Savannah informs USACE of the distinction between the actual production volume and maximum capacity of the plant. The City states that the production volume is “roughly 30 MGD,” while the “capacity of the plant has been 62.5 MGD since its expansion in 1998”. The withdrawal data used in the EFDC model to represent the water intake on Abercorn Creek, shown in Figure 1, suggests that the average withdrawal rate of 1.57 cubic meters/second (equivalent to 35.8 MGD) is, perhaps, based on the 35-MGD capacity of the original plant rather than the existing production volume of 30 MGD. A second extended grid model issue related to the flow data used to represent the City of Savannah water intake is the assignment of a flow boundary identified as Savannah I&D Withdrawal on the Savannah River. Flow boundary locations are provided in the EFDC input files for the extended grid model. EFDC_Explorer5 (Craig, 2010) was used to display the flow boundaries in the vicinity of Abercorn Creek. Figure 2, prepared with EFDC_Explorer5, shows the correct location of the Savannah Withdrawal on Abercorn Creek. Figure 2, however, also shows a location for a flow boundary identified as Savannah I&D Withdrawal on the Savannah River. Figure 3, prepared with EFDC_Explorer5, shows the time series data assigned for the Savannah I&D Withdrawal. It appears that there is an error in the model setup, since the withdrawal that is located on the Savannah River is most certainly not the Savannah I&D withdrawal on Abercorn Creek.

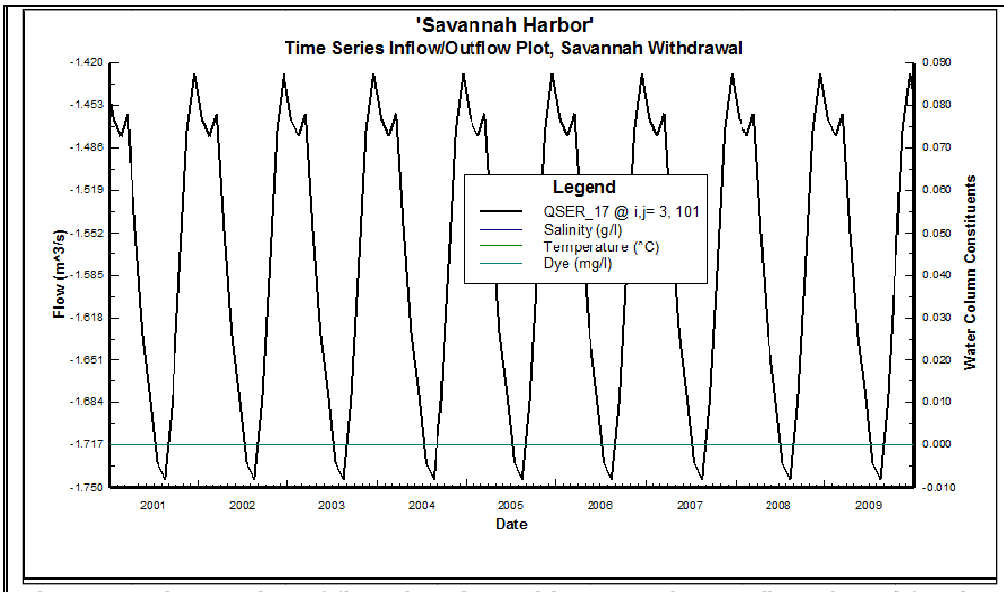

Figure 1 - Time series of flow data (as cubic meters/second) assigned for the Savannah Withdrawal in the EFDC extended grid model to represent the City of Savannah water intake. Flow boundary data plotted with EFDC_Explorer5 (Craig, 2010).

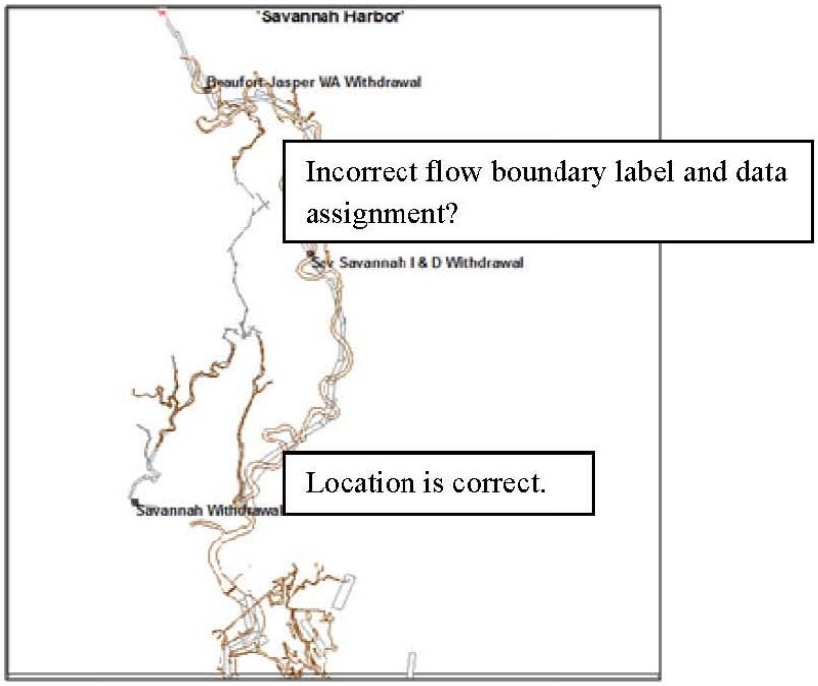

Figure 2 - Locations of Savannah Withdrawal on Abercorn Creek and Savannah I&D Withdrawal on the Savannah River. Flow boundary locations mapped with EFDC_Explorer5 (Craig, 2010).

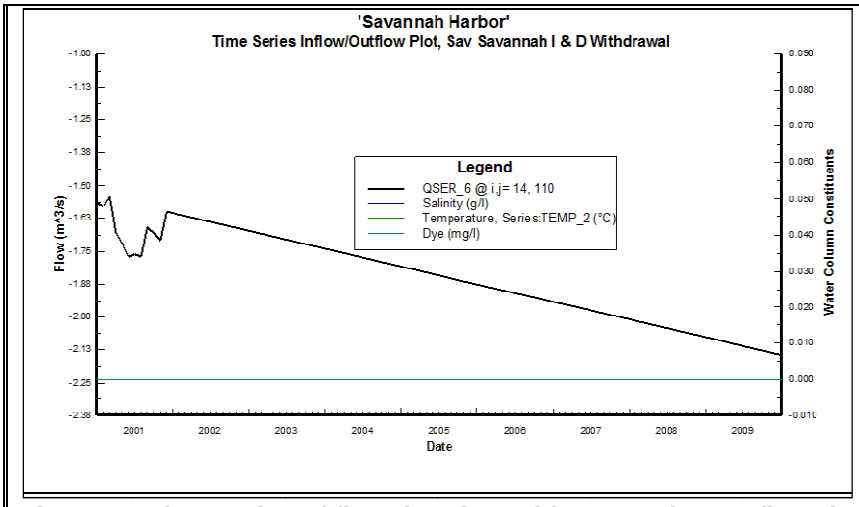

Figure 3 - Time series of flow data (as cubic meters/second) assigned for the Savannah I&D Withdrawal in the EFDC extended grid model. Flow boundary data plotted with EFDC_Explorer5 (Craig, 2010).

Significance – Low:

The technical credibility of the chloride modeling analysis, findings, and conclusions is affected because the data used to represent the impact of the water intake on chloride levels in the modeling analysis are not correctly documented and may not be correctly assigned as a withdrawal flow in the model setup.

Recommendation(s) for Resolution:

1. Revise the information and data presented in Section 2.0 of the Chloride Modeling Report to clearly document, and distinguish, the existing maximum capacity of the plant and the actual production volume recorded at the plant during the model simulation period of 2001-2009. Document the source of the data shown for the time series withdrawal flows (Figure 1) in the report.
2. Either delete the apparently erroneous Savannah I&D withdrawal location on the Savannah River from the model setup or replace it with the correct label and flow data for the flow boundary at this location.

Literature Cited

Craig, P.M. (2010). User's Manual for EFDC_Explorer5: Pre/Post-Processor for the Environmental Fluid Dynamics Code, Dynamic Solutions, LLC, Knoxville, TN.

APPENDIX D

Final Charge to the Independent External Peer Review Panel
as
Submitted to USACE on November 11, 2010

on the

SHEP GRR and Tier II EIS

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Final Charge Guidance and Questions to the Panel Members
for the
Savannah Harbor Expansion Project General Reevaluation Report
and Tier II Environmental Impact Statement

BACKGROUND

Savannah Harbor is a deep draft navigation harbor located on the South Atlantic U.S. coast, 75 statute miles south of Charleston Harbor, South Carolina, and 120 miles north of Jacksonville Harbor, Florida. The harbor comprises the lower 21.3 miles of the Savannah River (which, with certain of its tributaries, forms the boundary between Georgia and South Carolina along its entire length of 313 miles) and 11.4 miles of channel across the bar to the Atlantic Ocean.

Within the harbor limits, the Savannah River is generally divided into two channels by a series of islands. From the Atlantic Ocean to River Mile 10 where the river converges, the harbor is separated into South and North Channels. Within this area, the navigation channel is maintained in the North Channel. After divergence of the river into Front and Back Rivers at River Mile 11, the navigation channel is maintained in Front River and passes by the business district of the City of Savannah. The navigation channel is maintained in Front River to the upper limits of the harbor at River Mile 21.3. The Atlantic Intracoastal Waterway (AIWW) crosses the navigation channel approximately 5.5 miles upstream of the entrance to the harbor. The Savannah River Below Augusta Project, which is a shallow draft navigation channel authorized for 9 feet deep and 90 feet wide, extends upstream from the harbor (River Mile 21.3) to River Mile 202.6 at Augusta, Georgia.

The currently authorized deep draft navigation channel is 44 feet deep and 600 feet wide from deep water in the ocean (River Mile 11.4B) to the channel between the jetties (River Mile 2.6B), thence 42 feet deep and 500 feet wide to the harbor entrance (River Mile 0.0). From River Mile 0.0 to the upstream end of the Kings Island Turning Basin (River Mile 19.5) the channel is 42 feet deep and 500 feet wide. The channel is 36 feet deep and 400 feet wide from River Mile 19.5 to the upstream end of the Argyle Island Turning Basin (River Mile 19.9). The upper end of the harbor from River Mile 19.9 to its upstream limit at River Mile 21.3 is maintained at 30 feet deep and 200 feet wide.

In the 1999 Water Resources Development Act (WRDA), the U.S. Congress conditionally authorized deepening the Savannah Harbor Navigation Project to a maximum controlling depth of 48 feet (14.6 meters) within the river channel contingent upon the completion of a Savannah Harbor Expansion Project (SHEP) General Reevaluation Report (GRR) and a Tier II Environmental Impact Study (EIS), a final mitigation plan, and an incremental analysis of the channel depths from 42 to 48 feet.

Prior to the SHEP GRR, a Long-Term Management Strategy (LTMS) study for Savannah Harbor was conducted in response to House Report 102-555, submitted June 11, 1992, by the House of Representatives' Committee on Appropriations, and Senate Report 102-344, submitted on July 27, 1992, by the Senate Committee on Appropriations. Both of those reports refer to the Energy

and Water Resources Appropriations for Fiscal Year 1993, Report of the Senate House Committee on Appropriations, P.L. 104-303. As part of the Savannah Harbor LTMS Study, USACE Savannah District analyzed ongoing management practices to determine if a need existed to modify those practices to improve the economic benefits that the harbor provides to the state and nation or to reduce the environmental impacts of the harbor's operation. An EIS documented the environmental analyses that were performed as components of the Savannah Harbor LTMS Study. After public review of the Draft EIS, it was finalized based on an evaluation of the comments received during review of the Draft EIS. The Savannah Harbor Navigation Project continues to be operated and maintained in accordance with the LTMS.

The Savannah District of the U.S. Army Corps of Engineers has developed the SHEP GRR to determine the feasibility of improvements to the current Savannah Harbor Navigation Project. This GRR and accompanying Tier II Environmental Impact Study (EIS) have been developed to fulfill the conditions of the conditional authorization granted by Congress in 1999. This GRR and Tier II EIS provide documentation of the technical and plan formulation analyses conducted in the development of a recommended plan for navigation improvement and environmental mitigation. The GRR includes a final mitigation plan and an incremental analysis of alternative channel depths from 42 to 48 feet.

Potential navigation improvements considered in the SHEP GRR include deepening and widening of navigational channels, turning basin expansion, and expanded channel wideners. The purpose of these potential improvements is to increase the efficiency of cargo vessel operations and to accommodate larger container ships, which are projected to use Savannah Harbor in larger numbers in the very near future. The SHEP GRR identifies and evaluates alternatives that will:

- reduce congestion in the river channel;
- accommodate recent and anticipated future growth in containerized cargo and container ship traffic;
- improve the efficiency of operations for container ships within the Savannah Harbor Navigation Project; and
- allow larger and more efficient container ships to use the Port.

Potential environmental mitigation actions and environmental improvements considered in the SHEP GRR include addressing adverse impacts to tidal wetlands (including freshwater, brackish, and salt marshes), increasing levels of dissolved oxygen in the harbor, enhancing endangered Short-nose sturgeon habitat, Striped bass spawning and nursery areas, and reducing chloride levels at a City of Savannah water intake. Additionally, a cultural resource mitigation plan is included for the CSS Georgia wreck site, which is listed on the National Register of Historic Places.

OBJECTIVES

The objective of this work is to conduct an Independent External Peer Review (IEPR) of the Savannah Harbor Expansion Project (SHEP) GRR and appendices and the Tier II EIS, in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers guidance, *Review of Decision Documents* Engineering Circular (EC 1105-2-410) and the Office of Management and Budget (OMB) *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

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

The purpose of the IEPR is to analyze the adequacy and acceptability of economic, engineering and environmental methods, models, data and analyses performed for the SHEP GRR and the Tier II EIS. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by panel members with extensive experience in engineering, economics and environmental issues relevant to the project.

The panel members will be "charged" with responding to specific technical questions as well as providing a broad technical (engineering, economic, and environmental) evaluation of the overall project. The panel members will identify, recommend, and comment upon assumptions underlying the analyses as well as evaluate the soundness of models and planning methods. The panel members will evaluate whether the interpretations of analyses and conclusions are technically sound and reasonable, provide effective review in terms of both usefulness of results and of credibility, and have the flexibility to bring important issues to the attention of decision makers. The panel members may offer opinions as to whether there are sufficient technical analyses upon which to base the ability to implement the project. The panel members will address factual inputs; data; the use geotechnical, hydrologic, and hydraulic models; analyses; assumptions; and other scientific and engineering tools/methodologies to inform decision-making.

As a 501(c)(3) nonprofit science and technology organization with experience in establishing and administering peer review panels for USACE, Battelle was engaged to conduct the IEPR of the SHEP GRR and Tier II EIS. Independent review ensures the quality and credibility of USACE decision documents. The IEPR will follow the procedures described in USACE (2008); USACE CECW-CP Memorandum dated March 30, 2007 (USACE, 2007); and OMB (2004).

To accomplish the IEPR, panel members will be recruited to participate in the peer review panel. Candidates for the peer review panel will be screened for availability, interest, and technical experience in defined areas of expertise and any actual or perceived conflicts of interest (COIs) will be determined. Ultimately, no more than nine panel members will be selected for the final

IEPR panel using predetermined criteria related to technical expertise and credentials in the subject matters related to the documents and materials to be reviewed.

DOCUMENTS PROVIDED

The following is a list of documents and reference materials that will be provided for the draft and draft final reviews. All other documents are provided for reference.

a. Savannah Harbor Expansion Project Draft General Reevaluation Report
b. Tier II Environmental Impact Statement
c. Economic Appendix
d. Engineering Appendix
e. Real Estate Appendix

SCHEDULE

TASK	ACTION	DUE DATE
Conduct Peer Review	Review documents sent to panel members	11/15/2010
	Battelle/panel Kick-off Meeting	11/17-18/2010
	USACE/Battelle/panel Kick-off Meeting with panel members	11/17-18/2010
	Battelle convenes mid-review teleconference for panel to ask clarifying questions of USACE	11/302010
	External panel members complete their review	12/8/2010
Prepare Final Panel Comments and Final IEPR Report	Battelle provides panel members merged individual comments and talking points for panel review teleconference	12/10/2010
	Convene panel review teleconference	12/13/2010
	Battelle provides Final Panel Comment directive to panel	12/14/2010
	External panel members provide Final Panel Comments to Battelle	12/21/2010
	Battelle provides feedback to panel members on Final Panel Comments/panel provides revised Final Panel Comments per Battelle feedback	Not Applicable
	Final Panel Comments finalized	1/4/2011
	Battelle provides Final IEPR report to panel for review	1/6/2011
	Panel provides comments on Final IEPR report	1/7/2011
	*Submit Final IEPR Report	1/12/2011
Comment/ Response Process	Input final panel comments to DrChecks	1/14/2011
	USACE PDT provides draft Evaluator responses and clarifying questions to Battelle	1/20/2011
	Battelle provides panel members the draft Evaluator responses and clarifying questions	1/25/2011
	Panel members provide Battelle with draft BackCheck responses	1/28/2011

TASK	ACTION	DUE DATE
	Teleconference with Battelle and panel members to discuss panel's draft BackCheck responses	1/28/2011
	Final Panel Comment Teleconference between Battelle, IEPR team, and PDT to discuss final panel comments, draft responses and clarifying questions	1/31/2011
	USACE inputs final Evaluator responses in DrChecks	2/7/2011
	Battelle provides Evaluator responses to panel members	2/8/2011
	Panel members provide Battelle with BackCheck responses	2/9/2011
	Battelle inputs BackCheck responses in DrChecks	2/17/2011
	*Battelle submits .pdf printout of DrChecks project file	2/18/2011
Civil Works Review Board	Civil Works Review Board Meeting Attendance (2 panel members)	3/17/2011

Deliverables are noted with an asterisk

CHARGE FOR PEER REVIEW

As part of the IEPR review, members of this peer review panel are asked to determine whether the technical approach and scientific rationale presented in the SHEP GRR and Tier II EIS are credible and whether the conclusions are valid. The reviewers are asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The panel is being asked to provide feedback on the economic, engineering, environmental resources, real estate, and plan formulation. The reviewers are not being asked whether they would have conducted the work in a similar manner.

Specific questions relating to the IEPR review, are listed by report section, Annex, or Appendix, are included in the general charge guidance, which is provided below.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the SHEP GRR and Tier II EIS. Please focus on your areas of expertise and technical knowledge. Even though there are some sections with no questions associated with them, that does not mean that you cannot comment on them. Please feel free to make any relevant and appropriate comment on any of the sections and appendices you were asked to review. Assess the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analysis used.

1. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation for construction, authorization, or funding.
2. Identify, explain, and comment on assumptions that underlie economic, engineering, environmental, hydrologic, real estate, and plan formulation analyses.
3. Evaluate whether the interpretations of analysis and conclusions are reasonable.

4. Please focus the review on scientific information, including factual inputs, data, the use and soundness of models, analyses, assumptions, and other scientific and engineering matters that inform decision makers.
5. Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision making.
6. Please **do not** provide editorial comments or suggest revisions to report sections (e.g., Executive Summary) to improve readability.
7. If desired, panel members conducting the IEPR review can contact one other.
8. **No panel member should** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Independent Technical Review.
9. Please contact the Battelle deputy project manager (Lynn McLeod, mcleod@battelle.org) or project manager (Karen Johnson-Young, johnson-youngk@battelle.org) for requests or additional information.
10. In case of media contact, notify the Battelle project manager immediately.
11. Your name will appear as one of the panel members in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Lynn McLeod, mcleod@battelle.org**, no later than December 8, 2010, 10 pm ET.**

Savannah Harbor Expansion Project General Reevaluation Report
and Tier II Environmental Impact Statement
Independent External Peer Review

Final Charge Questions

General Questions

1. Are the assumptions that underlie the economic, engineering, environmental, hydrologic, real estate, and plan formulation analyses sound?
2. Comment on the adequacy and acceptability of the economic, engineering, and environmental methods, models and analyses used.
3. In general terms, are the planning methods used in the analyses used in the appropriate manner?
4. Are the models used sufficiently discriminatory to support the conclusions drawn from them (i.e. identify meaningful differences between alternatives)?
5. Were risk and uncertainty sufficiently considered?
6. In your opinion, are there sufficient analyses upon which to base the recommendation?

Problem, Needs, Constraints, and Opportunities

7. Are the problems, needs, constraints, and opportunities adequately and correctly defined?
8. Do the identified problems, needs, constraints, and opportunities reflect a systems, watershed, and/or ecosystem approach, addressing a geographic area large enough to ensure that plans address the cause and effect relationships among affected resources and activities that are pertinent to achieving the study objectives; i.e., evaluate the resources and related demands as a system?
9. Did the study address those resources identified during the scoping process as important in making decisions relating to the study?

Existing and Future Without Project Resources

10. Has the character and scope of the study area been adequately described and is the identified study area appropriate in terms of undertaking a systems/watershed/ ecosystem based investigation?
11. Do you agree with the general analyses of the existing social, financial, and natural resources within the study area?
12. For your particular area of expertise, provide an in-depth review of whether the analyses of the existing social, financial, and natural resources within the project area are sufficient to support the estimation of impacts of the array of alternatives.
13. Given your area of expertise, does this section appropriately address the existing conditions of all resources pertinent to the study?

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

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

16. Was the hydrology discussion sufficient to characterize current baseline conditions and to allow for evaluation of how forecasted conditions (with and without proposed actions) are likely to affect hydrologic conditions.

17. Please comment on the completeness of the discussion on the relationship between subsurface hydrology and the hydrodynamics of the project area.

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

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

20. Were the assumptions used as the basis for developing the most probable future without project conditions reasonable?

    a. Were adequate scenarios effectively considered (applied during analyses where relevant and/or reasonably investigated)?

    b. Were the potential effects of climate change addressed?

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

22. Comment on the assessment that the increased salinity in the Savannah River and the reduced thickness of the confining layer will not significantly affect the timing of breakthrough of chlorides along the navigation channel in to the Upper Floridian aquifer.

23. Comment on the ability of the proposed mitigation plans to address adverse impacts from the project.

24. In general, are the aquatic habitat impacts anticipated under the various harbor deepening alternatives reasonable and adequately described? If not, explain.

25. Comment on whether the cumulative effects of the project and other previous and future projects in the area have been accurately described. What, if any, additional information should be included?

Plan Formulation / Evaluation

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

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

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

29. Were the assumptions made for use in developing the future with project conditions for each alternative reasonable?

    a. Were adequate scenarios considered?

    b. Were the assumptions reasonably consistent across the range of alternatives and/or adequately justified where different?

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

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

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

33. Comment on the completeness of the analysis of the evaluation criteria for the alternative terminal locations.

34. Discuss whether the conclusions drawn on the viability of each alternative are supported by the analysis.

35. Comment on whether in your professional judgment the design measures taken to mitigate the concerns associated with filling the Sediment Basin were sufficient to alleviate the potential problems.

36. Comment on the adequacy of information addressing lost operational and maintenance capacity due to deposition of new work materials.

37. In your professional opinion was sufficient credence given to the current and future riverine shoreline erosion issues?

38. Comment on the overall adequacy and reasonableness of the detailed cost estimates.

39. Discuss the appropriateness of the explicit or implicit assumptions that are included in the cost estimates and whether assumptions are adequately addressed.

40. Comment on the extent to which the cost summary is complete and consistent with the detailed analyses shown in this section.

41. Discuss the adequacy of the assumptions used to determine that water quality impacts on estuarine emergent, palustrine emergent, and forested wetlands in the project area are not significant.

42. Comment on the whether the notations of no adverse impact have been adequately justified

43. Was the concern about cadmium-enriched sediment and subsequent proposal to handle this sediment adequately described? If not, what additional information should be included?

44. Comment on the assessment that minimal impacts are expected to water at the City of Savannah's water intake on Abercorn Creek from the proposed harbor deepening alternatives.

45. Comment on the relevance and detail of information regarding the potential impacts of the various types of dredging operations on marine resources.

46. Comment on the hydrodynamic model ability to predict any significant changes in impacts based on the alternatives and mitigation measures.

47. Please comment on the screening of the proposed alternatives.

    a. Are the screening criteria appropriate?

    b. In your professional opinion, are the results of the screening acceptable?

    c. Were any measures or alternatives screened out too early?

Recommended Plan

48. Comment on whether you agree or disagree with how the selected alternative was formulated and selected.

    a. Comment on the plan formulation.

    b. Does it meet the study objectives and avoid violating the study constraints?

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

50. Please comment on the likelihood of the recommended plan to achieve the expected outputs.

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

52. Please comment on the appropriateness of location, sizing, and design of plan features. Comment on the completeness of the Dredged Material Management Plan (DMMP) developed for the Savannah Harbor Navigation Project.

53. Comment on whether the information regarding other channel modifications is sufficient to not include other modifications of the river as a component of alternative channel designs.

54. Comment on the whether, in your professional judgment, the incremental approach used in mitigation planning would identify an optimal combination of potential mitigation projects.

55. Comment on the conclusion that the proposed fishway will provide suitable habitat and passage for sturgeon as well as other anadromous fish species.

56. Comment on the suitability of using existing side slopes for channel deepening to avoid environmental impacts due to channel design.

57. Are the conclusions regarding the type and projected magnitude of adverse impacts to wetland resources within the study area reasonable?

58. Comment on the scope and suitability of the proposed monitoring plan.

59. Based on your experience, is the construction schedule adequate for completion of the recommended activities?

60. Discuss the extent to which uncertainty associated with the costs and benefits are adequately addressed.

61. Comment on the adequacy of the environmental impact and mitigation uncertainties discussion.

62. Based on your experience on other projects, are the conclusions regarding the type and projected magnitude of adverse impacts reasonable? What additional information, if any, should be included?

Navigation

63. Do the existing and historical conditions accurately describe the current commodity movements through the study area?

64. Are the assumptions regarding future commodity and ship movements through the study area reasonable and supported?

65. Are the benefits claimed national in nature and supported by a multi-port analysis as opposed to transfers from one port to another?

66. Was the appropriate ship fleet and design vessel identified?

67. Discuss the extent to which need for land, easements, rights of way, relocations, borrow, disposal, and mitigation are clearly and adequately explained and costs justified.

68. Are the components of the final channel deepening plans sufficient for a comprehensive analysis?

69. Based on your area of expertise, are there any additional problems that should be considered when deepening this harbor that have not been identified for this project? If so, what and why?

70. Discuss advanced maintenance dredging and whether the detail described is sufficient to provide a thorough understanding of the higher efficiency noted.

71. Are the channel widths, including passing lanes and turns, adequate for the design vessel? If not, explain.

72. Comment on the adequacy of the assumptions, models, and methods used to calculate the slope stabilities.