DEPARTMENT OF THE ARMY
SOUTH ATLANTIC DIVISION, CORPS OF ENGINEERS
ROOM 10M15, 60 FORSYTH ST., S.W.
ATLANTA, GA 30303-8801

EN 6/17
EN-T
EN-T Matthews

REPLY TO
ATTENTION OF:

CESAD-RBT

11 June 2010

MEMORANDUM FOR COMMANDER, JACKSONVILLE DISTRICT (CESAJ-EN-T)

SUBJECT: Approval of the Design Phase Type II Independent External Peer Review Report for Site 1 Impound/Fran Reich Preserve, Palm Beach County, Florida

1. References:

a. Memorandum, CESAJ-EN-T, 25 May 2010, Subject: Approval of the Design Phase Type II Independent External Peer Review Report for Site 1 Impound/Fran Reich Preserve, Palm Beach County, Florida.

b. Review Plan for Site 1 Impound/ Fran Reich Preserve, Palm Beach County, Florida, 20 January 2010.

c. EC 1165-2-209, Civil Works Review Policy, 31 January 2010.

2. The purpose of this memorandum is to document the verbal approval provided on 27 May 2010 of the IEPR Reports submitted by reference 1.a. SAD has reviewed the 13 May 2010 Report documenting the IEPR of the design documents for Site 1 Impound/Fran Reich Preserve. All comments produced by the review were resolved with concurrence by the SAJ evaluator. We concur that these reports have been completed in accordance with references 1.b and 1.c. The reports are therefore approved.

3. The district should take steps to post the approved IEPR Reports to its website and provide a link to CESAD-RBT.

4. Reference 1.b requires Type II IEPRs of the construction phase. The reports from the construction phase IEPRs shall be submitted for MSC approval upon their completions.

5. The SAD point of contact is Mr. James Truelove, CESAD-RBT, 404-562-5203.

FOR THE DIRECTOR, REGIONAL BUSINESS:

CHRISTOPHER T. SMITH, P.E.
Chief, Business Technical Division

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

CESAJ-EN-T

25 May 2010

MEMORANDUM FOR Commander, South Atlantic Division (CESAD-RBT)

SUBJECT: Approval of the Design Phase Type II Independent External Peer Review Report for Site 1 Impoundment/Fran Reich Preserve, Palm Beach County, Florida

1. References.

a. EC 1165-2-209, Civil Works Review Policy, 31 January 2010

b. WRDA 2007 H. R. 1495 Public Law 110-114, 08 Nov 07

c. Review Plan for Site 1 Impoundment/Fran Reich Preserve, Palm Beach County, Florida, 20 January 2010

2. I hereby request approval of the enclosed Type II Independent External Peer Review (IEPR) Report and concurrence with the conclusion that the Design Phase Type II IEPR of this project has been completed in accordance with references above. The Type II IEPR process was used to review the design documents for risk and hazard. All comments were resolved with concurrence by the CESAJ evaluator.

3. The district will post the CESAD approved Type II IEPR Report onto its website and provide a link to the CESAD for its use.

FOR THE COMMANDER:

Encl

STEPHEN C. DUBA, P.E.
Chief, Engineering Division

June 3, 2010

U.S. Army Corps of Engineers
Jacksonville District
701 San Marco Blvd
Jacksonville, FL 32207

Contract No. W911NF-07-D-0001
TCN 10086
SUBMITTAL OF DELIVERABLE: Independent External Peer Review Report

Dear Mr. Matthews,

This letter accompanies the submission of the revised Final Independent External Peer Review Report for the Independent External Peer Review (IEPR) of the Assessment, Analysis, and Evaluation of Site 1 Impound, Palm Beach, Florida.

If you have any questions, please feel free to contact me at (410) 297-2147, or Mario Lopez, Project Manager at (703) 416-5878.

Sincerely,

Monica Malhotra
Deputy Project Manager
Battelle Memorial Institute

Enclosure

Independent External Peer Review Report

Assessment, Analysis, and Evaluation of Site 1 Impound, Palm Beach County, Florida

Prepared by
Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Jacksonville District

Contract No. W911NF-07-D-0001
Task Control No. 10086

June 3, 2010

ACKNOWLEDGEMENTS

This work was supported by the U.S. Army Corps of Engineers (Mr. Jimmy Matthews, Mr. Gerald Deloach) under the auspices of the U.S. Army Research Office Scientific Services Program administered by Battelle (Contract No. W911NF- 07-D-0001, TCN 10-086).

SHORT-TERM ANALYSIS SERVICE (STAS)

Independent External Peer Review Report

of the

Assessment, Analysis, and Evaluation of Site 1 Impound, Palm Beach County, Florida

by

Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

for

Department of the Army
U.S. Army Corps of Engineers
Jacksonville District
Mark Nelson

June 3, 2010

Contract No. W911NF-07-D-0001
TCN 10086
Scientific Services Program

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1.0 INTRODUCTION

1.1 Background of Program

The Site 1 Impoundment project was proposed as part of the Comprehensive Everglades Restoration Plan (CERP), which resulted from the Central and Southern Florida Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, dated April 1999. The CERP was authorized by the Water Resources Development Act of 2000 (WRDA 2000). The Site 1 Impoundment project was specifically authorized by Section 601(b)(2)(C)(iii) and (D) of WRDA 2000. Since the estimated total project cost has exceeded the 902 limit (Section 902 of WRDA 1986), the project underwent re-authorization as part of WRDA 2007.

The purpose of the Site 1 Impoundment is to capture and store the excess surface water runoff from the Hillsboro Watershed as well as releases made from Loxahatchee National Wildlife Refuge (LNWR) and Lake Okeechobee, which were historically discharged to tide via the Hillsboro Canal, for the purpose of maintaining water levels in the natural system and meeting water demands. This would benefit economic attributes and social well being by increasing the availability of fresh water. Water withdrawals currently taken from LNWR during dry season to meet water demands will be reduced, allowing more natural, desirable, and consistent water levels within the LNWR; in addition, benefits to the downstream estuaries are also expected as a result of the reduction in fresh water flows and pulsed releases. The Site 1 Impoundment would also reduce groundwater seepage from LNWR, which should improve habitat function and quality and improve native plant and animal species abundance and diversity.
This project will be constructed under two separate contract solicitations. Site 1 Impoundment Contract 1 for D-525N (L-40 Modification) and Miscellaneous Features will be constructed under the American Recovery and Reinvestment Act of 2009 (ARRA). Contract 1 activities and features include clearing and grubbing, dewatering activities, miscellaneous demolitions, establishing onsite borrow and disposal areas, and earthwork modification to approximately 15,000-LF of the existing L-40 levee that include placement of turf reinforcement mat and smooth plate soil cement. Once modified, the L-40 levee will become D-525N. The project also includes construction of a 6 acre wildlife wetland area and auxiliary spillway located in D-525N, S-530 spillway which is comprised of soil cement and articulating concrete block mat. Soil cement is used on the spillway crest and interior side slope. The block mat is used on the exterior side slope and toe.

Site 1 Impoundment Contract 2 will install D-525 40,000 LF remainder (impoundment east, south and west embankments) and associated features which include: a 600-cfs inflow pumping station; a 45 cfs seepage pump station; discharge and overflow spillways; seepage canal construction; and Hillsboro Canal deepening. Contract 2 related activities include clearing and grubbing, dewatering activities, miscellaneous demolitions, and establishing onsite borrow and disposal areas. The D-525 new embankment will include a turf reinforcement mat and soil cement smooth plate for slope protection.

In compliance with the Water Resources Development Act (WRDA) Section 2035 and *Water Resources Policies and Authorities, Civil Works Review Policy* (EC 1165-2-209) dated January

31, an Independent External Peer Review (IEPR) was conducted of the Site 1 Impound Design Documentation Report (DDR) and Plans & Specs (P&S) by the Hydraulics and Hydrology (H&H) Expert (Dr. Mark Houck), Geotechnical Expert (Dr. Greg Fischer), and Construction Management Expert (Dr. Ralph Ellis). Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

Battelle Memorial Institute (hereinafter Battelle), as a non-profit science and technology organization with experience in establishing and administering peer reviews, was engaged to coordinate the IEPR of the Site 1 Impound project. The IEPR followed the procedures described in the Department of the Army, EC 1165-2-209; *Engineering and Design, Quality Management* (ER 1110-1-12) dated July 21, 2006; and *Engineering and Design, DrChecks*^{SM} (ER 1110-1-8159) dated May 10, 2001.

This interim IEPR report provides a summary of the results of the IEPR teleconference and summarizes the IEPR comments on the DDR and P&S. All IEPR comments were detailed and documented in Design Review and Checking System (DrChecks^{SM}), the USACE's Web-based tool for facilitating the review of complex project documents.

1.2 Purpose of Independent External Peer Review

The purpose of an IEPR, in general, is to strengthen USACE's safety assurance as outlined in the Water Resources Development Act (WRDA) 2007, Section 2035 (Type II). Independent, objective external peer review is regarded as a critical element in ensuring the reliability of scientific and engineering analyses.

To help ensure that USACE design, engineering, and construction documents are supported by the best scientific and technical information, a peer review process has been implemented by USACE that utilizes an IEPR to complement the agency technical review, as described in the Water Resources Development Act (WRDA) Section 2035 and *Water Resources Policies and Authorities, Civil Works Review Policy* (EC 1165-2-209). In this case, the IEPR of the Site 1 Impound Project was conducted and managed using contract support from an independent 501(c)(3) organization, Battelle, to ensure independent objectivity, along with a high degree of flexibility and responsiveness, which was essential for USACE to meet deadlines.

1.3 Project and Documents Reviewed

The IEPR for the Site 1 Impound Project reviewed the *DDR and P&S*. This is the Design Phase of the review process, to be followed by the Construction Phase.

2.0 INDEPENDENT EXTERNAL PEER REVIEW PROCESS

2.1 Identification and Selection of Independent External Peer Reviewers

Battelle identified four peer review candidates who had requisite related areas of expertise for Site 1 Impound Project and also served on previous peer reviews for the Jacksonville District. The candidates were identified using referrals, internet searches, and personal contacts. Of the four potential candidates, all were contacted and screened for their technical expertise, potential conflicts of interest (COIs), previous performance on similar reviews, and availability to meet the project schedule. Of the four peer review candidates who were contacted, three were

available and selected to review the Site 1 Impound Project based on their expertise and availability.

The three external peer reviewers selected for the IEPR were professional disciplines from Ayres Associates and independent consultants from academia. The areas of technical expertise of the selected IEPR external peer reviewers were geotechnical, H&H, and construction management (respectively), which corresponded to the technical content of the Site 1 Impound review materials. Battelle evaluated the credentials of the external peer reviewers according to the overall scope of the Site 1 Impound Project, focusing on these key areas of expertise. Participation in previous USACE technical review committees and other technical review panel experience was also considered.

The peer reviewers were screened for the following *potential* exclusion criteria or COIs:

- Involvement in any part or work related to the Site 1 Impound Project.
- Involvement in any other Comprehensive Everglades Restoration Plan (CERP) projects
- Current USACE employee
- Involvement with paid or unpaid expert testimony related to the Site 1 Impoundment Project or other CERP Impoundments
- Financial or litigation association with USACE, the Non-Federal sponsor (South Florida Water Management District), Tribal Interests, Site 1 Impoundment design A/E or other CERP Impoundments, their engineering teams, subcontractors, or construction contractors
- Current or previous employment or affiliation, with members of the Site 1 Impoundment Project or other CERP Impoundments **and** currently working on Site 1 Impoundment-related projects (for pay or *pro bono*)
- Past, current or future interests or involvements (financial or otherwise) of the reviewer, their spouse or their children related to the Site 1 Impoundment or other CERP Impoundments
- Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE
- Current firm involvement with other USACE projects, *specifically* those projects/contracts that are with the Jacksonville District.
- Previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, *notably* if those projects/contracts are with the Jacksonville District
- Pending, current or future financial interests of the reviewer, spouse or children in the Site 1 Impoundment Project or other CERP Impoundments related contracts/awards from USACE
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the Comprehensive Everglades Restoration Plan (CERP) or the Site 1 Impoundment Project

- Participation in prior non-Federal studies relevant to this project and/or the Palm Beach County vicinity
- Is there any past, present or future activity, relationship or interest (financial or otherwise) that could make it appear that the reviewer would be unable to provide unbiased services on this project

In selecting final peer reviewers from the list of potential peer review candidates, Battelle pursued select experts who were not conflicted by the above COI and who met the criteria and experience factors described in Section 3 of this report. The selection of the final three peer reviewers was based on these considerations (see Section 3 for names and biographical information on the selected IEPR peer reviewers). Battelle established subcontracts with the peer reviewers who had indicated their willingness to participate and confirmed the absence of COIs (see Appendix A).

2.2 Biographical Information on External Peer Reviewers

Potential peer review candidates were identified based on their experience serving on previous panels for the Jacksonville District.

All IEPR peer reviewers met the following minimum requirements:

- Registered professional engineer (or equivalent in home country);
- 15 years of experience and responsible charge of engineering work.

Peer reviewers in each discipline also were required to have specific technical experience in the areas summarized in Table 2 below.

Table 2. Required Technical Experience for Armoring Manual Peer Reviewers

Discipline	Required Experience		
Geotechnical Engineer	Analyses and risk assessments for levees, dams, and impoundments	Flood risk management structures	Static and dynamic slope stability evaluations
Hydrology & Hydraulic Engineer	2D hydraulic modeling, 3D hydrologic and groundwater modeling, wind/wave analysis	Flood risk management projects	Performance of risk assessments
Construction Management	Construction management for dams, impoundment projects with pump stations and/or complex conveyance systems		

A draft list of potential reviewers that were screened for availability, technical background, and conflict of interest was prepared by Battelle and provided to the USACE. The final list of peer reviewers was determined by Battelle (Table 3) based on their specific experience in the areas of expertise specified in the scope of work (Table 4).

Table 3. Final List of Peer Reviewers

Discipline/Name	Affiliation	Location	Education	P.E.	Yrs of Experience
Geotechnical Engineer					
Gregory R. Fischer	Shannon & Wilson, Inc.	Denver, CO	BSCE, MSCE, PhDCE	x	24
Hydrology & Hydraulic Engineer					
Mark Houck	MHH Engineering, LLC	Ellicott City, MD	BSES, PhD Environmental Engineering	x	35
Construction Management					
Ralph D. Ellis, Jr.	University of Florida	Gainesville, FL	BSCE, MS Engineering, Ph.DCE, MBA	x	37

Table 4. Specific Experience of Peer Reviewers Requested in the Scope of Work

Expertise	Total	Mark Houck	Greg Fischer	Ralph Ellis
Hydrology & Hydraulics Engineer				
≥ 15 years experience in conducting and evaluating hydrologic and hydraulic analyses for flood risk management projects.	1	X		
Experience with 2D hydraulic modeling, 3D hydrologic and groundwater modeling, wind/wave analysis, and performance of risk assessments.	1	X		
Experience with the Dam Safety Program.	1	X		
Active participation in related professional societies.	1	X		
Geotechnical Engineer				
≥ 15 years experience in conducting & evaluating geotechnical & geological analysis, & Risk assessments for levees dams and impoundments.	1		X	
Experience performing static & dynamic slope stability evaluation of flood risk management structures such as levee embankments, floodwalls, closure structures etc.	1		X	
Experience evaluating seepage through earthen embankments & underseepage through foundations of flood risk management structures such as levee embankments, floodwalls, closure structures etc.	1		X	
Experience performing settlement evaluations on flood risk management structures.	1		X	
Experience in the design and /or evaluation of bridge scour protection.	1		X	
Experience with the Levee Safety program.	See Footnote		X[1]	
Construction Management				
≥ 15 years experience in performing construction management for dams, impoundment projects with pump stations and/or complex conveyance systems.	1			X
Familiar with projects similar to the Site 1 Impoundment across the United States.	1			X

Familiar with construction industry and practices used in Florida and/or the Southeastern United States.	1			X
Active participation in related professional societies.	1			X

[1] Dr. Fischer has completed levee inspections but, these are not associated with the recent federal program.

A summary of the credentials of the three reviewers selected for the IEPR panel and their related qualifications to the technical evaluation criteria is presented below. A resume including more detailed biographical information for each reviewer and his technical areas of expertise is presented in Appendix C.

Dr. Mark Houck has been a Professor of Civil, Environmental and Infrastructure Engineering at George Mason University since 1992. His research and teaching interests include water and environmental systems engineering. His most recent research work has been in the area of water and wastewater infrastructure security. Prior to coming to George Mason, Dr. Houck held faculty appointments in Civil Engineering at the University of Washington at Seattle (1976-78), and Purdue University (1978-91). He has also held visiting faculty appointments at The Johns Hopkins University (1989-90), and Heriot-Watt University in Scotland (2003). In the private sector, he has served as an officer of two engineering firms specializing in water resources engineering.
At George Mason, Dr. Houck is responsible for a group of undergraduate water courses; and graduate urban systems engineering, water resources, and environmental systems courses. He has taught courses on statistics and probability; engineering economics; systems analysis and engineering; mathematical modeling (optimization and simulation) of complex engineering systems; operations research; urban systems engineering; and all aspects of water management and engineering, including hydrology, hydraulics, and water resources. He was a Principal Lecturer on systems analysis, modeling, and decision support systems at a NATO scientific conference in Scotland.

Dr. Greg Fischer has over 24 years of geotechnical and civil engineering experience related to levees, dams, and other water resources projects, and is a Senior Vice President with Shannon & Wilson Inc.. Dr. Fischer received his Doctorate in Civil Engineering from the University of Washington in 1994, and is a registered Professional Engineer in 22 states within the USA.
Dr. Fischer has completed safety inspections of existing levees and dams, provided recommendations for levee and dam rehabilitation, as well as designing new dams. Within the past ten years he has completed two levee risk analyses for King County, Washington, using the USACE HEC-FDA program. He is experienced in performing earthquake engineering analysis/design, retaining wall design, slope stability evaluation, settlement studies, seepage analyses, and erosion protection design and evaluation. He has also designed both hard armor and soft armor systems along rivers. Dr. Fischer has been involved with levee and dam engineering projects in various geologic settings, including levees and dams founded on alluvial deposits. He has authored over 25 technical and peer reviewed papers including a 2008 paper entitled “Rapid Levee Assessment for Reliability and Risk Analysis”, which presented a review of levee failure causes and mechanisms and describes methods that can be used to quickly and effectively incorporate reliability and risk into levee maintenance or repair decision-making processes.

Dr. Ralph Ellis has over 37 years of construction engineering and management experience. Dr. Ellis worked in the construction industry for 15 years. Prior to joining the University of Florida, he was president of Hammer Corporation, a construction firm and Director of Projects for the FMI-Hammer Joint Venture. He was responsible for estimating and delivering all construction projects including many projects for the US Army Corps of Engineers. In his university position Dr. Ellis teaches a wide range of project management and construction engineering subjects. He has worked closely with the Florida Department of Transportation in both research and industry training initiatives. Dr. Ellis was selected to serve an industry advisor to the US State Department's Bureau of Overseas Building Operations. Currently he is an appointed member to the American Society of Civil Engineer's Committee on Critical Infrastructure. This is a Board of Direction level committee, providing input on national infrastructure renewal issues.
As a professor at the University of Florida, Dr. Ellis has been teaching graduate and undergraduate courses in engineering management, project delivery, construction engineering and legal aspects of construction. He has 20 years experience as a Professor of Engineering, teaching and performing national research in construction engineering and management. He has performed sponsored research at the national and state levels focusing on construction engineering management. He has performed over 48 research projects focusing on construction management and construction technical issues and authored over 55 publications transferring construction research results.

Dr. Ellis has 15 years experience as a Project Engineer and Construction Project Manager on heavy civil construction projects, many for the USACE with several projects involving significant earth structures. Many of these projects have involved significant drainage systems, pumping stations, and distribution piping. As the head of Hammer, Dr. Ellis worked on projects with scopes that typically included construction of the pump station structure, piping, pumps, controls, and power. Dewatering was often one of the project challenges in south Florida.

2.3 Schedule of Events

Table 1. Site 1 Impound Schedule

Task 4	Orientation Briefing (via telecon)	1-Apr-10
	Site Visit	19-Apr-10
Task 5	Documents Received from USACE	9-Mar-10
	Comments in DrChecks	8-Apr-10
	Comments Evaluated	19-Apr-10
	Comment Resolution Conference Call	26-Apr-10
	USACE resolution to open comments	29-Apr-10
	Review Complete in DR Checks	*29-Apr-10*

2.4 USACE Orientation Teleconference and Site Visit

On April 1, 2010 USACE conducted an Orientation briefing, attended by Battelle and the peer reviewers, via telecon. During the call, Battelle and the external peer reviewers were provided an overview of the reviewed project, as well as aerial pictures of the site. During the planning process for the Site 1 Impound IEPR, Battelle and USACE agreed to conduct the orientation via telecon to maintain the aggressive schedule necessary to complete the review with the understanding that a site visit would be necessary if the peer reviewers saw value added through a site visit. After the initial teleconference the peer reviewers requested a visit and USACE

planned a site tour which occurred on April 19, 2010. This enabled the external peer reviewers and the corresponding USACE personnel to interact and engage in technical conversations specific to the project. The following photographs were captured on the site visit.

	Site 1 Impound Interior area showing intial clearing of the area to begin construction.
	Site 1 Impound Storage area/wildlife refuge area, view from the access road.
	Site 1 Impound interior area, planned to be a restored wetland.

During the site visit, the Team discussed several water resources issues, including: (1) the quality of the water to be pumped into the impoundment from Hillsboro Canal, stored in the impoundment, and then released back into Hillsboro Canal; (2) the flow rate of water in Hillsboro Canal during the filling of the impoundment relative to the pumping rate, and the rate of release from the impoundment into the Canal relative to the flow rate in the Canal; and (3) possible water quality problems—in particular, erosion or scour in the Canal during the pumping into and release from the impoundment.

2.5 Conduct of the Peer Review

The review of the Site 1 Impound Project DDR and P&S was conducted according to the schedule shown in Table 1. Battelle provided the external peer reviewers with a Charge to guide the IEPR of the Site 1 Impound Project. The Charge to external peer reviewers is attached in Appendix B. Using the Charge to the external peer reviewers as the basis for their review; peer reviewers developed 38 individual comments on the two documents. These comments were collected and Battelle conducted a quality review of the comments to ensure they adhered to the charge provided. The peer reviewers entered these comments directly into DrChecks ^{SM}. The USACE Team evaluated and reviewed the IEPR comments in DrChecks^{SM} and provided evaluation responses back via DrChecks^{SM}. The peer reviewers were able to review the evaluations and close all comments for which they concurred.

2.6 IEPR Comment Review Teleconferences

Battelle facilitated an IEPR Comment Review Teleconference on the H&H Report comments, between the USACE Team and the H&H Expert Reviewer on April 26, 2010. The purpose of the IEPR comment review teleconference was to provide a forum for a discussion of specific comments that the IEPR external peer reviewers considered inadequately addressed regarding the Site 1 Impound Project DDR and P&S.

The discussion between the IEPR external peer reviewers and USACE Team during the IEPR Conference focused on two open H&H comments. Battelle facilitated and monitored the discussions while the USACE Team and external peer reviewers discussed the specifics of the open comments. The main concerns were related to the quality deterioration because of the impoundment and the calculations for overflow values. Upon completion of the IEPR Teleconference, all comments were considered adequately addressed, pending some actions to be taken by both the Expert Reviewer and the USACE Team.

3.0 CONCLUSIONS

3.1 Findings

The IEPR comment review and associated teleconference proved extremely successful and the initial briefing followed by the site visit provided the most valuable opportunity to examine the site conditions indicated in the contract documents. All comments were document and resolved in DrChecks^{SM} A summary of the overall evaluations/concerns/conclusions are:

Geotechnical

The geotechnical reviewer's comments focused on settlement of the embankments and hydraulic gradients through and beneath the embankments of the new construction. In particular, the Team commented on (1) information on the hydraulic conductivities resulting from differential water levels on either side of the embankment, (2) whether the gradients resulting from these differential water levels could result in excessive uplift pressures beneath the soil-cement facing, and (3) settlement parameters used in the analysis for secondary compression of peat layers beneath the embankments and the potential effect of such settlement on the soil-cement facing.

Hydrology and Hydraulics

The H&H peer reviewer's review comments focused on: (1) the selection of design events used to define the risk of failure; (2) the related estimated probabilities of failure of the impoundment under these design events during the hurricane and non-hurricane seasons; and (3) water quality issues at the source, during receiving and impoundment waters.

Construction Management

The construction management comments generally focused on constructability issues that could potentially affect construction of the project. More specifically, the comments addressed; (1) contactor management of environmental protection, (2) whether a minimum elevation for the temporary cofferdam could be provided, (3) disposition of the excavated materials during the work on D-525, (4) clarification of the requirements for the temporary dam indicated in Note 3 on plan sheet C-204, (5) clarification of the pricing of the work provided in Specification section 30 60 00 EMBANKMENT FOUNDATION PREPARATION and section 10 22 00, (6) design approach significantly optimizes construction efficiency by making maximum use of material indigenous to the project site, (7) coordination of the scope of work between contract 1 and contract 2, and (8) clarification of railing details.

3.2 Conclusions

The IEPR process was used to review the design documents for risk and hazard. All comments were resolved with concurrence by the USACE evaluator. Through the IEPR and the comment review process the reviewers expressed concern and upon resolution they concur that the assumptions made during the decision document phase for hazards remain valid through the completion of design and that the assumptions made for hazards are being addressed in the Design Documentation Report.

APPENDIX A – Charge to External Peer Reviewers

For a Type II – IEPR, the design and construction phases, the Safety Assurance Review should focus on unique features and changes from the assumptions made and conditions that formed the basis for the concept design. The peer reviewer(s) should address the following questions:

1. Do the assumptions made during the decision document phase for hazards remain valid through the completion of design as additional knowledge is gained and the state-of-the-art evolves? Note: The assumptions made for hazards are being addressed in the Design Documentation Report for Site 1 Impoundment.

2. Do the project features adequately address redundancy, robustness, and resiliency with an emphasis on interfaces between structures, materials, members, and project phases?

> (1) Redundancy. The use of multiple lines of defense that are linked to potential failure modes. The most vulnerable failure modes need the greatest redundancy.
>
> (2) Resilience. The use of enhancements to improve the ability of the system to sustain loads greater than the design load to achieve gradual failure modes over some duration rather than sudden failure modes.
>
> (3) Robustness. The use of more conservative assumptions to increase capacity to compensate for greater degrees of uncertainty and risk.

3. Do the assumptions made during design remain valid through construction?

4. For O&M manuals, do the requirements adequately maintain the conditions assumed during design and validated during construction; and will the project monitoring adequately reveal any deviations from assumptions made for performance? An IEPR peer reviewer will be determined near the mid-point of the construction period.

The Charge to the external peer reviewers also included instructions on acceptable and non-acceptable comments, comment teleconference protocol, contact information, and the overall project schedule.

APPENDIX B – Conflict of Interest Screening Form

Panel Candidates' Conflict of Interest Screening for Independent External Peer Review (IEPR) Safety Assurance Review (SAR) of the Site 1 Impoundment, Palm Beach County, Florida

Name: ,	
E-mail:	
Affiliation:	
Please indicate below (yes/no) whether any of the following potential conflict of interest (COI) statements apply to you, your firm, or any joint ventures in which your firm is involved. If you responded "yes" to any COI statement, please elaborate. (*Note:* Unless absolutely certain, please do not respond to the COI statements below based on your personal knowledge. Active inquiries within your company will likely be necessary to respond with the necessary accuracy.) Potential conflicts will be evaluated on a case-by-case basis.[1]	
1. Involvement by you or your firm[2] in any part of the Site 1 Impound Project.	
2. Involvement by you or your firm[2] in any work related to the Site 1 Impound.	
3. Involvement by you or your firm[2] in any other Site 1 Impound projects.	
4. Involvement by you or your firm[2] in any work on Phase 1, 2, or 3, of the Site 1 Impound Project.	
5. Involvement by you or your firm[2] in the conceptual or actual design, construction, or O&M of the Site 1 Impound Project or related projects.	
6. Current employment by the U.S. Army Corps of Engineers (USACE).	
7. Involvement with paid or unpaid expert testimony related to the Site 1 Impound Project.	
8. Financial or litigation association with USACE, Site 1 Impound design A/E, their engineering teams, subcontractors, or construction contractors, including CMA Architect & Engineers LLP, Puerto Rico Infrastructure Financing Authority (AFI) or Puerto Rico Department of Natural Resources (DNER).	
9. Current or previous employment or affiliation, with members of the Site 1 Impound Team, including CMA Architect & Engineers LLP, Puerto Rico Infrastructure Financing Authority (AFI) or Puerto Rico Department of Natural Resources (DNER) and currently working on Site 1 Impound-related projects (for pay or *pro bono*).	
10. Past, current or future interests or involvements (financial or otherwise) of you, your spouse or your children related to Site 1 Impound.	
11. 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, ERDC, etc.), and position/role. Please highlight and discuss in greater detail any projects that are *specifically* with the Jacksonville District.	
12. Current firm[2] involvement with other USACE projects, *specifically* those projects/contracts that are with the Jacksonville District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.	

13. Previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, *notably* if those projects/contracts are with the Jacksonville District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.	
14. Other USACE affiliation [*e.g.*, scientist employed by USACE (except as described in NAS criteria, see EC 1105-2-410 section 8d)].	
15. Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning dams and levees, stability analysis, flood control reservoirs, and mass concrete placements, and include the client/agency and duration of review (approximate dates).	
16. Pending, current or future financial interests of yourself, spouse or children in Site 1 Impound Project related contracts/awards from USACE.	
17. A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts.	
18. Any publicly documented statement (including, for example, advocating for or discouraging against) related to Site 1 Impound and/or the Site 1 Impound Project.	
19. Participation in relevant prior Federal studies relevant to this project: a. Site 1 Impound Review Plan. b. Site 1 Impound Project Quality Management Plan c. Other Site 1 Impound related reports or studies.	
20. Participation in prior non-Federal studies relevant to this project and/or Site 1 Impound and vicinity.	
21. 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:	

[1] Note: Battelle will be evaluating whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See the OMB memo 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."

[2] Note: Includes any joint ventures in which your firm is involved.

APPENDIX C – Peer Reviewer Resumes

Gregory R. Fischer, PhD, PE | Senior Vice President

GEOTECHNICAL ENGINEER

EDUCATION

PhD, Civil Engineering, University of Washington, 1994
MS, Civil Engineering, University of Illinois, 1986
BS, Civil Engineering, University of Illinois, 1984

REGISTRATIONS AND CERTIFICATIONS

Professional Engineer 22 states (AZ, CO, FL, IL, IA, KS, LA, MD, MN, MT, NE, NV, NM, NC, ND, OK, SD, TX, UT, WA, WI, WY)
Post-earthquake Structure Evaluation (ATC-20)

PROFESSIONAL SUMMARY

A Dr. Greg Fischer has over 23 years of geotechnical and civil engineering experience related to dams, levees, and other water resources projects. Greg also has significant experience in soil mechanics and retaining wall design. He has been responsible for estimating budgets and cost management, developing subsurface exploration and laboratory testing programs, managing field and laboratory work, completing analyses for design, managing staff engineers in the analyses and report preparation portions of projects, developing and/or reviewing plans and specifications, and managing construction monitoring activities. Greg has designed new dams, completed safety inspections of existing dams and levees, and provided recommendations for dam and levee rehabilitation. His experience includes earthquake engineering analysis/design, retaining wall design, slope stability evaluation, settlement studies, seepage analyses, and erosion protection design and evaluation. He also designed both hard armor and soft armor systems along rivers. Greg has been involved with dam and levee projects in various geologic settings, including dams and levees founded on alluvial deposits. Representative projects illustrating his experience are provided below.

RELEVANT EXPERIENCE

1 ***Green River Levee Raise Evaluation, King County, Washington.*** Greg is the lead investigator for an evaluation of methods to raise the levees along the Green River in anticipation of significant flow increases over the next five years. The work consisted of a comparison of the advantages and disadvantages of methods to raise the levees, followed by probabilistic and deterministic stability analyses to evaluate the stability of the slopes following a raise.

2 ***USACE, Independent Peer Review – Hurricane and Storm Damage Risk Reduction System, New Orleans, Louisiana.*** Greg served as an Independent Peer Reviewer (IPR) for the U.S. Army Corps of Engineers' (USACE) Backside Armoring Manual. The manual will provide guidance on backslope levee erosion for designers engaged in work for the USACE in the Greater New Orleans Area. Greg's role was to review the document, provide comments on the manual, and participate in a peer review conference. Following the conference, Greg co-authored a final report summarizing opinions and recommendations of the IPRs.

3 ***Confidential Water Storage Project, Western Slope, Colorado.*** Greg was the Principal-in-Charge for a water storage project on the Western Slope for a confidential client. The project involved looking at the feasibility of constructing one or more dams to retain up to 60,000 acre feet of water.

4 ***King County, Hidden Lake Restoration Project, King County, Washington.*** Project Manager for the Hidden Lake restoration project in King County, Washington. The project involved the design of an earth dam to restore a lake that had been drained by a dam failure in the 1970s. Because of low inflow into the lake during the drier months, project criteria required that the quantity of seepage be less than 0.5 cubic feet per second (cfs). A field investigation consisting of borings and in situ field permeability testing was completed revealing the presence of a thick, permeable alluvial deposit beneath the proposed embankment location. The presence of the alluvium indicated that seepage quantities would likely be higher than desired, that liquefaction of the alluvium was possible, and that piping was possible if the material was not properly filtered. Further explorations revealed the presence of landslide debris on the right abutment. After recognizing these deficiencies, additional explorations were completed at a downstream location, indicating the presence of a hard silt layer in the valley floor, and it was recommended to move the berm to this downstream location. Recommendations were provided for zoning of the earthen dam, foundation preparation, outlet pipes and control structures, spillway design, slope treatment, and reservoir rim stability.

5 ***Dam Design, Cowlitz County, Washington.*** Greg was the lead designer for the design of a 700-foot-long, 20-foot-high, zoned earth retention dam, in Cowlitz County, Washington. Foundation investigation revealed that the dam was constructed over 80 feet of soft, compressible soils with permeable horizontal layers of coarse sand and gravel. Analyses indicated that stability of the embankment would be inadequate immediately following construction, necessitating the recommendation for flat side slopes. The proximity of an existing housing development located just downstream of the dam made it necessary to minimize seepage through and beneath the structure. To achieve the level of seepage required for the project, a slurry trench cutoff wall was designed. Special considerations were necessary at the contact between the slurry trench and the overlying embankment to reduce the potential for cracking at this contact. Following design, Greg provided on-site engineering services for the County during construction.

6 ***Harbour Pointe Dam, Mukilteo, Washington.*** Greg was the Project Engineer responsible for the design review of a 35-foot-high zoned earth detention dam in Mukilteo, Washington. The fast-track nature of the project required a review of the plans and specifications approximately one week before being sent out to bid. Because no explorations had been completed, three borings were drilled and several test pits were excavated. These explorations revealed that foundation conditions consisted of permeable sand layers requiring detailed filter placement and an upstream impermeable zone. The numerous changes required in the plans and specifications based on the review meant that many could not be implemented in time for bidding. Supervised Shannon & Wilson, Inc. construction monitoring personnel during construction. This monitoring included a number of field modifications as conditions were exposed to successfully complete the project.

7 ***St. Joe Dam, Flat River, Missouri.*** Greg was the Project Engineer for the rehabilitation of a 4,000-foot-long, 130-foot-high tailings dam in Flat River, Missouri. The dam was built by hydraulic filling of loose sands/silts, and as a consequence had a low seismic stability factor of safety. A complete geotechnical, hydrologic, and hydraulic analysis was provided,

including detailed seismic analyses to evaluate the potential for liquefaction and lateral deformations during ground shaking. Recommendations were provided for improving the stability to pass major seismic events generated by the New Madrid fault zone. The recommendations included several remedial alternatives that provided varying levels of post-remediation factor of safety with relative degrees of risk and cost.

8 ***Tywappity Dam, Scott County, Missouri.*** Project Engineer responsible for a liquefaction analysis of the Tywappity Dam in Scott County, Missouri. The study indicated that liquefaction was possible under the design earthquake event and recommendations were provided to either decrease the probability of occurrence for liquefaction or increase the stability of the dam following a liquefaction event.

9 ***Safety Inspections, State of Alaska.*** Greg was the Project Engineer for Phase I periodic safety inspection of 22 earthfill, rockfill, timber, and sheetpile cutoff dams throughout the State of Alaska. Co-authored safety inspection reports as required by the Alaska Department of Natural Resources to evaluate stability and safety of existing dams.

10 ***Green River Levee Risk Analysis, King County, Washington.*** Project Manager for a risk assessment study for the Green River in King County, Washington. Greg led a risk-based analysis of potential flooding-related damage that could occur along the Green River. The study developed an estimate of the expected annual damage considering river discharge probabilities; the probability of failure of flood damage reduction structures (levees); and probable damage to land, structures, and other property and goods. The results of the study allowed King County to understand the risk and consequences of flooding in a highly urban area and consider taxing/assessment options to landowners who were provided protection by the levee system.

11 ***Green River Levee Stability and Seepage and Stability Study, King County, Washington.*** Greg was the Project Manager for the study of flood hazards along a 2,000-foot-long stretch of the Green River in King County, Washington. The purpose was to determine the rate of seepage through and beneath the levee to allow King County Surface Water Management Division (SWM) to design a collection and pumping system. In addition, an evaluation of the stability of the levee was required to assist SWM in designing remedial measures for the levee. The study included geotechnical explorations, in situ field permeability testing, and laboratory testing. Analyses were performed for underseepage and dike stability during various river stages and under rapid drawdown conditions. The results of the studies indicated the presence of confined horizontal clean sand layers. These layers had the potential to transmit the full head of the river to the landside toe of the levee. Finite element and flow net analyses indicated that high uplift pressures could exist beneath the toe of the levee. Under flood conditions, the analyses suggested factors of safety approaching 1.0. Stability analyses also suggested the potential for rapid drawdown failures on the riverward side of the levee. Recommendations were provided for rebuilding the riverward side of the levee to increase stability during rapid drawdown conditions and installing a berm and relief wells along the landside toe of the levee to relief and resist high uplift pressures. Before the recommendations could be implemented, 1995 floods resulted in the occurrence of sand boils behind the levee. As an emergency measure during flood fighting, on-site observations were made and recommendations were provided to SWM to strengthen the levee until the long-term recommendations could be implemented.

12 ***Raw Water Assessment Program, Colorado Springs Utilities, Colorado.*** Greg was the project manager for CSU's systematic evaluation and assessment of its raw water system.

This five-year project included an evaluation of the entire raw water system for CSU. Shannon & Wilson's role included assessing the condition of dams, tunnels and pipeline corridors associated with the Blue River, South Slope, Ruxton, North Slope, Northfield, Penrose, North and South Cheyenne, Manitou, Rosemont, Pikeview, and 33rd Street Systems. This included the assessment of approximately 32 dams and sedimentation ponds, nine tunnels, over 250 miles of pipeline, and eight pump stations.

13 ***USACE Flood Control Alternatives Evaluation Study, Grand Forks, North Dakota.*** Greg was the project manager for the review and alternatives evaluation of a USACE-proposed flood control system. To prevent future flooding in the City, the USACE proposed to build a much needed levee system. Because of the presence of deep deposits of weak soils, the levees were to be set back from the riverside by several hundred feet; requiring the abandonment of hundreds of residential homes and businesses. Shannon & Wilson was retained by the City to review the USACE methodologies and results and determine if there were alternatives to the setback levee system. Greg organized a one-day brainstorming session in Seattle with the USACE, City, and expert consultants from around the country. Following this meeting, Greg directed the efforts of Shannon & Wilson in preparing a Summary Report in just two weeks. This report indicated that potential alternatives existed. Following this report, Greg led Shannon & Wilson's effort in completing detailed slope stability analyses and finite difference modeling and determined that a deep secant pile wall system and soil mixing walls were economical alternatives to the taking of homes in the Grand Forks area.

14 ***Outfall Revetment, Seattle, Washington.*** Project Manager for the design of a revetment to prevent scour caused by a 72-inch-diameter outfall emptying into Puget Sound, Seattle, Washington. Design included the use of a fabric revetment filled with a highly fluid cement slurry and placed underwater.

15 ***Finite Difference Evaluation, Cleveland, Ohio.*** Project Engineer responsible for the finite difference evaluation of a deep excavation adjacent to a historic building in downtown Cleveland, Ohio. Hired as a consultant after movements to the historic building occurred during construction, and managed the finite difference studies to predict future movements and redesign the shoring system to stabilize the excavation.

16 ***Concrete Lock Walls, Buffalo, New York.*** Greg was the Project Engineer for the rehabilitation of 50-foot-high concrete lock walls. During the field investigation, solution cavities and gypsum partings were discovered in the rock foundation. Subsequent analyses concluded that the lock walls could slide along gypsum partings in the rock foundation. Several alternatives were analyzed with the recommended remediation consisting of the installation of low-level struts and tiedowns along with an extensive grouting program to increase the stability during sliding by providing intimate contact between the foundations of the lock walls and the underlying rock.

17 ***I-25 Highway and Light Rail Expansion Project, T-REX (CDOT/RTD), Denver, Colorado.*** Greg was the Principal-in-charge overseeing all geotechnical aspects of the TREX Segment 1.1 design-build project. TREX was a 19-mile expansion of I-25. Segment 1.1 consisted of 40 retaining and sound walls, many over 25 feet high, and ten bridges in slightly more than a mile of highway. Greg prepared geotechnical design recommendations for the bridges, retaining walls, two RTD stations, track subgrade, and pavement design. He also provided the geotechnical design and instrumentation monitoring for a 15-foot-diameter drainage tunnel to the S. Platte River.

18 ***Pan American Highway Slope Improvements, Peru.*** Greg designed remedial measures for unstable slopes at three sites located along the arid Peruvian coast. As project manager for this fast-track 4-month-long project (fast-track schedule required to provide sufficient construction time before the anticipated El Nino event), Greg led the team in developing practical and economical solutions for 25 km of unstable sand slopes and 53 km of unstable rock slopes. He completed geotechnical explorations and laboratory testing to characterize the types of failures and the engineering properties. He completed stability analyses and designed corrective solutions, including reinforced soil walls, new drainage measures, new procedures for maintaining the roadway, realignment, rock scaling, blasting, and rock anchors.

PROFESSIONAL ASSOCIATIONS

American Council of Engineering Companies
American Society of Civil Engineers
American Public Work Association
Structural Engineers Association of Colorado
ASTM International, Permeability and Filtration Subcommittee to Committee D35 (Geosynthetics)
International Geotextile Society
North American Geosynthetic Society
Society of American Military Engineers
American Society of Foundation Engineers
Association of State Dam Safety Officials

PUBLICATIONS

1 Author of a research report for the Waterways Experiment Station titled, "The Incorporation of Wall Movement and Vertical Wall Friction in the Analysis of Rigid Concrete Structures on Rock Foundations." The purpose of the study was to review the overturning stability method used by the U.S. Army Corps of Engineers, to find deficiencies in the method, and suggest new analytical techniques to analyze sliding stability of concrete structures. The results of the study recommended incorporating strain compatibility and wall friction into the methodology currently used by the Corps.

2 "Filter Criteria Based on Pore Size Distribution," by G.R. Fischer, B.R. Christopher, and R.D. Holtz, Proceedings, 4th International Conference on Geotextiles, Geomembranes and Related Products, The Hague, Netherlands, 1990, Vol. 1, p. 289-294.

3 "Geotextile Filtration Principles, Practices and Problems," by B.R. Christopher and G.R. Fischer, Geotextiles and Geomembranes, Vol. 11, No. 4-6, Elsevier Science Publishers, Ltd., 1991, p. 337-353.

4 "Comparative Studies of Different Parametry Determination Methods for Geotextiles," by G.R. Fischer and R.D. Holtz, Geotextiles and Geomembranes, Vol. 10, 1991, p. 379-381.

5 "A Critical Review of Geotextile Pore Size Measurement Methods," by G.R. Fischer, R.D. Holtz, and B.R. Christopher, Filters in Geotechnical and Hydraulic Engineering, J. Braun, M. Heibaum, and U. Schuler, eds., A.A. Balkema, 1993, p. 83-90.

6 "Research Needs in Geotextile Filter Design," by R.D. Holtz, B.R. Christopher, and G.R. Fischer, Filters in Geotechnical and Hydraulic Engineering, J. Braun, M. Heibaum, and U. Schuler, eds., A.A. Balkema, 1993, p. 18-26.

7 “Incorporation of Wall Movement and Vertical Wall Friction in the Analysis of Bridges Concrete Structures on Rock Foundations,” by G.R. Fischer, C.B. Groves, and J.R. Salley, *REMR-GT-21,* U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, 1993.

8 The Influence of Fabric Pore Structure on the Behavior of Geotextile Filters, by G.R. Fischer, Ph.D. dissertation, University of Washington, Seattle, Washington, 1994, 502 p.

9 “Filtration Behavior of Broadly Graded Cohesionless Tills,” by G.R. Fischer, R.D. Holtz, and B.R. Christopher, Proceedings, 5th International Conference on Geotextiles, Geomembranes and Related Products, Singapore, 1994, p. 659-662.

10 “Potrzeba Badan W Projektowaniu Filtrów Z Geotekstyliów,” by B.R. Christopher, R.D. Holtz, and G.R. Fischer, Proceedings, Geotechniczne Aspelity Skladowania Odfpadow, Ton 1, 1994, p. 245-252.

11 “Construction of Log Storage Facility Over Dredged Organic Soils,” by G.R. Fischer, M.G. Vitale, D.R. Johnston, and B.C. Dorwart, Proceedings, Geosynthetics '95, Nashville, 1995, p. 377-390.

12 “Design and Construction of a Log Storage Facility Over Dredged Organic Soils,” by G.R. Fischer, S. Puri, and D.R. Johnston, paper submitted to Geosynthetics Case Studies Book for North America, Draft 2.

13 “Evaluating Geotextile Pore Structure,” by G.R. Fischer, R.D. Holtz, and B.R. Christopher, Recent Developments in Geotextile Filters and Prefabricated Drainage Geocomposites, ASTM STP 1281, S.K. Bhatia and L.D. Suits, eds., American Society for Testing and Materials, 1996.

14 “Evaluating Geotextile Flow Reduction Potential Using Pore Site Distribution,” by G.R. Fischer, R.D. Holtz, and B.R. Christopher, Proceedings, Geofilters '96, p. 247-256.

15 “A Critical Review of Granular Soil Filter Retention Criteria,” by G.R. Fischer and R.D. Holtz, Proceedings, Geofilters '96, p. 409-419.

16 “Influence of Procedural Variables on the Gradient Ratio Test,” by G.R. Fischer, A.D. Mare, and R.D. Holtz, Geotechnical Testing Journal, Vol. 22, No. 1, March, 1999, p. 22-31.

17 “Analysis of Low Frequency Vibrations From an Underground Light Rail Transit System,” by H.L. Ellis, R.A. Mikhail, G.R. Fischer, and P.M. Godlewski, Proceedings, North American Tunneling 2000, Underground Construction: “The Revolution Continues,” A.A. Balkema, Rotterdam, 2000, p. 403-410.

18 “Models for Predicting Surface Settlements Due to Soft Ground Tunneling,” by Z.W. Wang, K.L. Sampaco, G.R. Fischer, M.S. Kucker, P.M. Godlewski, and R.A. Robinson, Proceedings, North American Tunneling 2000, Underground Construction: “The Revolution Continues,” A.A. Balkema, Rotterdam, 2000, p. 645-652.

19 “Earth Pressures on Deep Shafts,” by R.A. Mikhail, M.S. Kucker, G.R. Fischer, R.A. Robinson, and P.M. Godlewski, Proceedings, North American Tunneling 2000, Underground Construction: “The Revolution Continues,” A.A. Balkema, Rotterdam, 2000, p. 563-571.

20 “Database Management of a Large, Fast-Track Field Exploration Program,” by D.C. Ward, P.M. Godlewski, G.R. Fischer, and R.A. Robinson, Proceedings, 10th International Association for Computer Methods and Advances in Geomechanics, Tucson, Ariz., 2001.

21 “Design-Build of the New Mississippi Outfall Tunnel at I25 for TREX – Geotechnical Challenges,” by A. Stirbys, J. Kaneshiro, A. Foung, L. Piek, and G. Fischer, American Society of Civil Engineers (ASCE), Colorado Section Geotechnical Seminar, 2002.

22 “Deep Caisson Sinking in Soft Soils, Grand Forks, North Dakota,” by G.R. Fischer, F.J. Barchok, M.K. Yavarow, and W.L. Gerszewski, Proceedings of the International Conference on Case Histories in Geotechnical Engineering, New York, 2004.

23 “Directionally Drilled Raw Water Intakes, Grand Forks, North Dakota,” by B.C. Dorwart, G.R. Fischer, F.J. Barchok, M.K. Yavarow, and W.L. Gerszewski, Proceedings, International Conference on Case Histories in Geotechnical Engineering, New York, 2004.

24 “Earth Pressure Balance Tunnelling for Two Short Drives for the New Mississippi Outfall, Denver, Coloardo,” by J.Y. Kaneshiro, A.F. Stirbys, and G.R. Fischer, Proceedings, ITA, 2005.

25 “Risk-Based Design Procedures for Directionally Drilled Raw Water Intakes, Grand Forks, North Dakota,” by B. Dorwart, G. Fischer, W. Gerszewski, and M. Yavarow, Proceedings, North American Society for Trenchless Technology NO-DIG 2004.

26 “A Geotechnical Solution to Setback Flood Control Systems,” by G.R. Fischer and K.A. Kershaw, Geotechnical Practice Publication No. 2, H2GEO Geotechnical Engineering for Water Resources, Wiltshire, R.L., Goss, C.M., and Olsen, H.W. eds., Denver, 2004, p. 101-122.

27 “Rehabilitation of the St. John’s Tunnel,” by G.R. Fischer, M.E. Levin, and D.A. Garcia, Geotechnical Practice Publication No. 2, H2GEO Geotechnical Engineering for Water Resources, Denver, 2004, p. 123-135.

28 "Rapid Levee Assessment for Reliability and Risk Analysis," by Hollie Ellis, Christopher Groves, and Gregory Fisher, for Geocongress 2008.

Mark H. Houck

Positions

President
MHH Engineering, LLC
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Professor
Department of Civil, Environmental & Infrastructure Engineering
The Volgenau School of Information Technology and Engineering
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George Mason University
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Education

Doctor of Philosophy (PhD) in Environmental Engineering, The Johns Hopkins University, 1976.
Bachelor of Engineering Science (BES), with concentrations in Environmental Engineering and Operations Research, The Johns Hopkins University, 1972.

Licenses and Certifications

Professional Engineer, Indiana
Professional Engineer, Maryland
Professional Hydrologist, American Institute of Hydrology
Board Certified Environmental Engineer, American Academy of Environmental Engineers

Professional Experience

President, MHH Engineering, LLC. June 2008 to present
Professor, Civil, Environmental & Infrastructure Engineering Department, The Volgenau School of Information Technology and Engineering, George Mason University. January 1992 to present. Department Chairman: July 1998 to June 2002.

Co-Editor, *Civil Engineering and Environmental Systems*, 2004 to 2007.

Visiting Professor, School of the Built Environment, Heriot-Watt University, Edinburgh, Scotland, United Kingdom. January to August 2003.

Affiliate Faculty, Department of Systems Engineering and Operations Research, George Mason University. 1996 to present.

Affiliate Faculty, Department of Environmental Science and Policy, George Mason University. 1996 to present.

Professor, School of Civil Engineering, Purdue University. Professor: August 1987 to December 1991. Associate Professor: August 1982 to July 1987. Assistant Professor: December 1977 to July 1982.

Doctor of the University, The Johns Hopkins University. Visiting faculty member in the G.W.C.

Whiting School of Engineering. October 1989 to September 1990.

Vice President, Water Resources Management, Inc., Columbia, Maryland. September 1988 to September 1989.

President, Omtek Engineering, Inc., West Lafayette, Indiana. July 1983 to December 1991.

Acting County Drainage Engineer, Tippecanoe County, Indiana. May 1987 to August 1988.

Research Assistant Professor, Department of Civil and Environmental Engineering, University of Washington, Seattle, Washington. December 1975 to December 1977.

Awards, Honors and Listings

- Sigma Xi: The Scientific Research Society
- Omega Rho (International Operations Research Honorary Society)
- Chi Epsilon (Civil Engineering Honorary Society)
- Huber Research Prize, American Society of Civil Engineers, 1988.
- Fellow, American Society of Civil Engineers
- Diplomate, American Academy of Water Resources Engineers
- Outstanding Teacher Award, The Volgenau School of Information Technology and Engineering, George Mason University, 2005.
- Listed in various biographical references including: *Who's Who in America*, *Who's Who in Science and Engineering*, *Who's Who in the World*, and *Who's Who in Computational Sciences and Engineering*

Teaching

Professor Houck is actively involved in classroom and laboratory teaching. At George Mason, he is responsible for a group of undergraduate water courses; and graduate urban systems engineering, water resources, and environmental systems courses. He has taught courses on statistics and probability; engineering economics; systems analysis and engineering; mathematical modeling (optimization and simulation) of complex engineering systems; operations research; urban systems engineering; and all aspects of water management and engineering, including hydrology, hydraulics, and water resources. Professor Houck has also been active in teaching outside of the university in a variety of forums. For example, he has lectured on the legal and engineering implications of a new drainage control ordinance before a group of practicing engineers and government officials; he was an invited lecturer on expert systems at a bi-national conference organized by the Chinese Academy of Sciences and the U.S. National Science Foundation in the People's Republic of China; and he was a Principal Lecturer on systems analysis, modeling, and decision support systems at a NATO scientific conference in Scotland. Courses taught at George Mason include:
CEIE 100 Environmental Engineering Around the World
CEIE 230 Hydraulics
CEIE 301 Engineering and Economic Models in Civil Engineering
CEIE 340 Water Resources Engineering
CEIE 440 Water Supply and Distribution
CEIE 530 Water Resource Systems
CEIE 601 Infrastructure Modeling
CEIE 605 Infrastructure Systems Analysis
CEIE 632 Groundwater Systems Modeling
CEIE 683 Water and Wastewater Security
IT 892 Special Topics in Environmental and Water Resource Systems Engineering

Research Dr. Houck has conducted an active research effort focusing on the use of systems analysis and engineering in support of public sector decision making, with special emphasis on environmental and water resources problems. He has supervised twelve students who have completed their Ph.D. degrees

and a number of other Masters students. Research sponsors have included a wide range of federal, state, and local governmental agencies; and private organizations. Examples include the U.S. Army Corps of Engineers Waterways Experiment Station for development of expert systems to manage potentially hazardous dredged materials; U.S. Department of the Interior for drought management, expert systems for infrastructure rehabilitation, and design of optimal drainage control networks; the National Science Foundation for development of optimal reservoir system operating rules; and the U.S. Departments of Homeland Security and Justice for assessment of risk management in the water sector of the National Capital Region, and development of methods to enhance water security. Dr. Houck has published extensively in the scientific and engineering literature on environmental and water resources planning, management, and engineering.

Ralph D. Ellis Jr., P.E., Ph.D.

Professional Qualifications
Dr. Ellis has over 37 years of construction engineering and management experience. Dr. Ellis worked in the construction industry for 15 years. Prior to joining the University of Florida, he was president of Hammer Corporation, a construction firm and Director of Projects for the FMIHammer Joint Venture. He was responsible for estimating and delivering all construction projects including many projects for the US Army Corps of Engineers. In his university position Dr. Ellis teaches a wide range of project management and construction engineering subjects. He has worked closely with the Florida Department of transportation in both research and industry training initiatives. Dr. Ellis was selected to serve an industry advisor to the US State Department's Bureau of Overseas Building Operations. Currently he is an appointed member to the American Society of Civil Engineer's Committee on Critical Infrastructure. This is a Board of Direction level committee, providing input on national infrastructure renewal issues.

Education
1970 Bachelor of Civil Engineering, University of Florida
1971 Master of Engineering, University of Florida
1987 Master of Business Administration, Nova University
1989 Ph. D. Civil Engineering, University of Florida

Experience
Associate Professor in Department of Civil Engineering
1989 – present University of Florida Gainesville, Florida
• Teaching graduate and undergraduate courses in engineering management, project delivery, construction engineering and legal aspects of construction.
• Performing sponsored research at the national and state levels focusing on construction engineering management.

Ph.D. Graduate Student in Civil Engineering
1987 - 1989 University of Florida Gainesville, Florida

Director of Projects
1980 – 1989 The FMI-Hammer Joint Venture Miami, Florida and Panama City, Republic of Panama
• Managed all off-shore construction for the Joint Venture
• Principal customers included the U.S. Army Corps of Engineers, U.S. Department of the Navy, and the Panama Canal Commission

President
1974 -1980 Hammer Corporation Miami, Florida
• Founder of a family owned business
• Position involved executive management of a construction company
• Principal customers included Dade County School Board, U.S. Army Corps of Engineers and other federal government procurement agencies

Projects Manager
1973 – 1974 Fred McGilvray, Inc. Miami, Florida
• Position involved complete management responsibility for multiple construction projects in the South Florida area
• Additionally responsible for estimating and bidding new work

Combat Engineer Officer
1971 – 1972 U.S. Army
• Retired from US Army reserves at grade of Captain

Professional Activities and Honors
2009- present Member, Committee on Critical Infrastructure, American Society of Civil Engineers
2006- 2007 **Member**, Industry Advisory Panel, US Department of State, Bureau of Overseas Building Operations
2003 – 2007 **Member of Board,** Board of Directors, American Society of Civil Engineers, Construction Institute
2003 - 2007 **Director,** American Society of Civil Engineers, Construction Institute, Research and Education Directorate
1976 – present **Registered Professional Engineer,** State of Florida, PE 14982
1995 – present **Member,** CIB Working Commission W065 Construction Management
1998 –2000 **Secretary and Member,** American Society of Civil Engineers, Construction Division EXCOM
1998 – 1999 **President,** American Society of Civil Engineers, Construction Research Council
1995 – 2002 **Member,** National Transportation Research Board, Committee AF205 Construction Management
1995 – present **Member,** American Society of Civil Engineers, Construction Research Council
1995 – present **University of Florida Representative and Member of Board of Direction,** Florida Construction Users Roundtable
2005 – 2007 **Member, AASHTO Standing Committee on Quality, Subcommittee on Project Delivery**

Research
1989 – present University of Florida Gainesville, Florida
Principal Investigator
• Has been the lead investigator on 48 research projects focusing on construction issues
• Sponsors have included Florida Department of Transportation, U.S. Department of Transportation, and the Transportation Research Board, Federal Highway Administration, and The U.S. Department of Energy

Representative Projects:
Pedestrian Safety Engineering and Intelligent Transportation System-Based Countermeasures Program for Reduced Pedestrian Fatalities, Injuries, Conflicts and Other Surrogate Measures, Phase II., FHWA

Improving Pedestrian and Bicyclist Safety in Highway Construction Work Zones, FDOT

Developing Procedures for Night Operations of Transportation Construction Projects, US Department of Transportation

Illumination Guidelines for Nighttime Highway Work, Project 5-13, NCHRP, Transportation Research Board

Determination of Contract Time for Highway Construction Projects, Synthesis of Highway Practice, Transportation Research Board

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Evaluation of the FDOT Pilot Design – Build Program, Florida Department of Transportation

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Strategies for Integrating Utility Priorities in Highway Renewal Projects SHRP II R-15, Transportation Research Board

Developing a Model to Estimate Maintenance of Traffic Quantities and Cost, Florida Department of Transportation

Publications
• Has published over 55 publications transferring research results
• Publications include the Transportation Research Record, the ASCE Journal of Construction Engineering and Management, Construction Management and Economics and others

Representative Publications:
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