



US Army Corps
of Engineers
Waterways Experiment
Station

July 1994

AD-A284 649



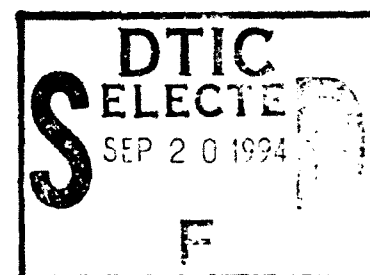
(1)

Proceedings of the 59th Meeting of the Coastal Engineering Research Board

16-18 November 1993

Point Clear, Alabama

Hosted by U.S. Army Engineer Division, South Atlantic



Approved For Public Release; Distribution Is Unlimited

94 9 19 905

94-30069



1180

DTIC QUALITY INSPECTED 3

**Best
Available
Copy**

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.



PRINTED ON RECYCLED PAPER

July 1994

Proceedings of the 59th Meeting of the Coastal Engineering Research Board

16-18 November 1993

Point Clear, Alabama

Hosted by U.S. Army Engineer Division, South Atlantic
Room 313, 77 Forsyth Street, S.W.
Atlanta, GA 30335-6801

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Final report

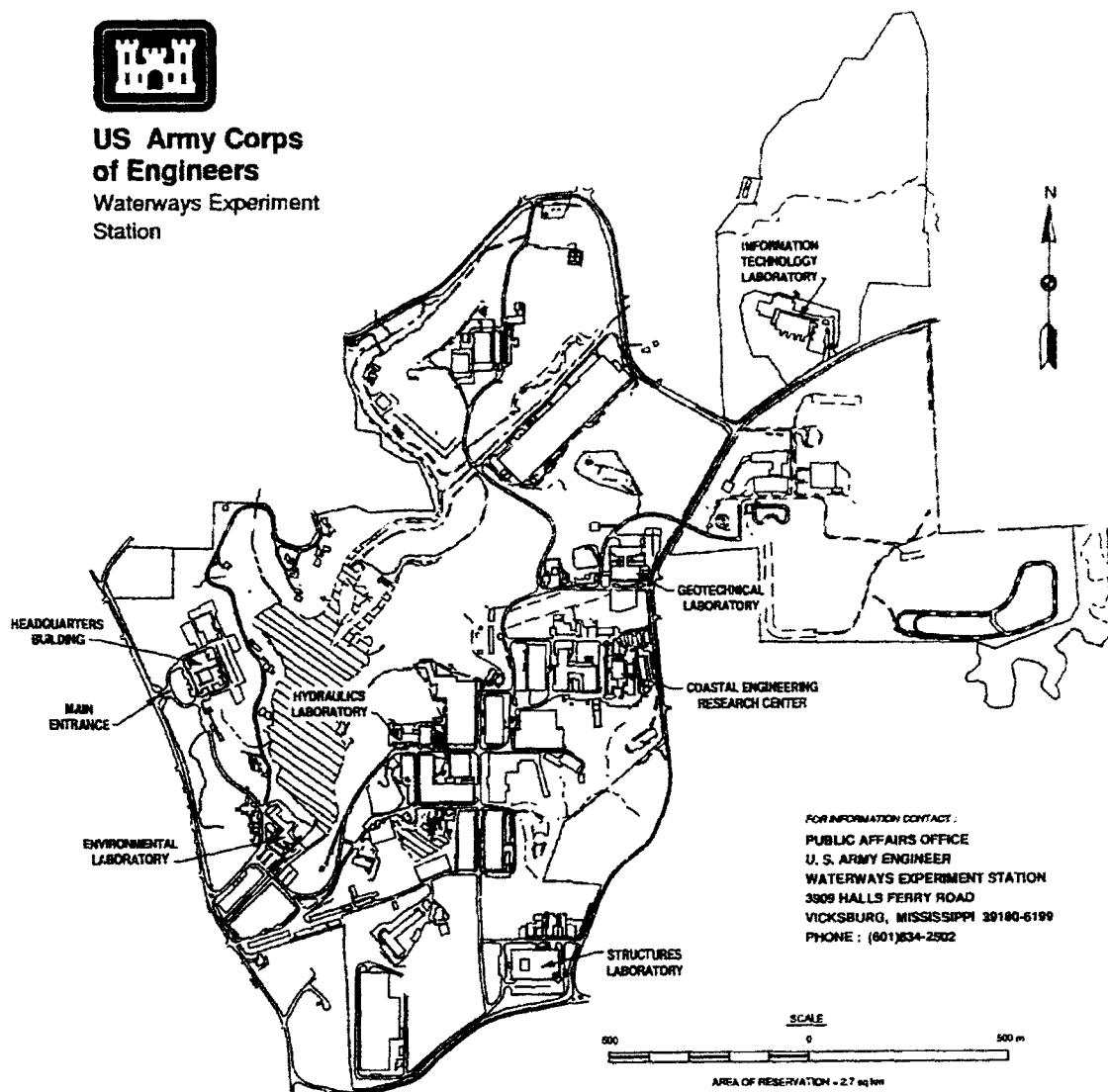
Approved for public release; distribution is unlimited

DTIC QUALITY INSPECTED 3

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000



**US Army Corps
of Engineers**
Waterways Experiment
Station



Waterways Experiment Station Cataloging-in-Publication Data

Coastal Engineering Research Board. Meeting (59th : 1993 : Point Clear, Alabama)

Proceedings of the 59th meeting of the Coastal Engineering Research Board : 16-18 November 1993, Point Clear, Alabama / hosted by U.S. Army Engineer Division, South Atlantic ; prepared for U.S. Army Corps of Engineers.

119 p. : ill. ; 28 cm.

1. Wetland conservation -- Congresses. 2. Wetlands -- Congresses. 3. Coastal engineering -- Congresses. 4. Shore protection -- Congresses. I. United States. Army. Corps of Engineers. South Atlantic Division. II. United States. Army. Corps of Engineers. III. U.S. Army Engineer Waterways Experiment Station. IV. Title. V. Title: Meeting of the Coastal Engineering Research Board.
TC205 C6 1993 Nov.

Contents

Preface	vi
Agenda	vii
Attendees	x
Introduction	1
The Coastal Engineering Research Board	2
16 November 1993	
Opening Remarks and Welcome	
BG Paul Y. Chinen	
COL Robert Griffin	3
Report of Chief's Charge	
Dr. C. H. Pennington	
COL Bruce K. Howard	4
Review of CERB Business	
COL Bruce K. Howard	
Dr. James R. Houston	13
Theme Introduction	
Dr. James R. Houston	17
Coastal Wetlands Issues and Problems: Panel Discussion	
General Overview	
Dr. William L. Klesch	19
Shoreline Erosion Losses	
Mr. David L. Ruple	24
Subsidence: Implications for Coastal Wetland Restoration in Louisiana	
Dr. Leonard M. Bahr	27
Development/Mitigation Required in Coastal Wetlands	
Ms. Patricia N. Bevel	30
Problems, Challenges, and Experiences in Coastal Restoration, Protection, and Creation	
Dr. Mary C. Landin	32

Wetlands Research Program: Panel Discussion

Overview of Program	
Dr. Russell F. Theriot	35
Wetlands Coastal Processes	
Mr. Jack E. Davis	37
Wetlands Engineering	
Dr. Michael R. Palermo	39
Bioengineering Practices in Coastal Wetlands	
Mr. Hollis H. Allen	42
Breakwaters for Wetland Restoration and Protection	
Mr. John W. McCormick	45
Numerical Modeling of Wetland Processes for Restoration and Protection	
Mr. Joseph V. Letter	46

Specific Wetlands Projects: Panel Discussion

Using Geotubes for Engineering and Environmental Projects	
Mr. Robert N. Blama	48
The Restoration of Batiquitos Lagoon	
Ms. Lisa W. Sales	50
Wetlands Creation/Atlantic Intracoastal Waterway - North Carolina	
Mr. G. Frank Yelverton	52
Coastal Wetlands Planning, Protection, and Restoration Act	
COL Michael Diffley	54
Needs and Opportunities for Future Wetlands Research	
Dr. Russell F. Theriot	57

17 November 1993

Field Trip Overview	
Dr. Susan I. Rees	60

18 November 1993

Gulf of Mexico Program	
Dr. Susan I. Rees	62
Coastal Inlets Research Program	
Mr. E. Clark McNair, Jr., Ms. Jane M. Smith, and Mr. W. Jeff Lillycrop	64
Optimized Concrete Armor Units: The CORE-LOC	
Mr. Jeffrey A. Melby and George F. Turk	68
WES Reconnaissance Report on Expedient Structures Used During the Flood of 1993	
Mr. George F. Turk	71
Public Comment	73
Study for Office of Management and Budget on Shore Protection	
Mr. Harry M. Shoudy	74
Recommendations by CERB	77

Closing Remarks	
BG Ralph V. Locurcio	80
Appendix A: Biographies of Speakers/Authors	
Appendix B: Status of Action Items	
Appendix C: Numerical Models Used by CERC	
Appendix D: Memorandum to Director of Civil Works	
Appendix E: Initiatives	
SF 298	

Preface

The Proceedings of the 59th Meeting of the Coastal Engineering Research Board (CERB) were prepared for the Office, Chief of Engineers, by the U.S. Army Engineer Waterways Experiment Station's (WES) Coastal Engineering Research Center (CERC). These proceedings provide a record of the papers presented, the questions and comments in response to them, and the interaction among program participants and the CERB.

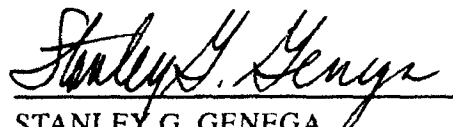
The meeting was hosted by the U.S. Army Engineer Division, South Atlantic (SAD), under the direction of BG Roger F. Yankoupe, Commander, and the U.S. Army Engineer District, Mobile (SAM), under the direction of COL Robert H. Griffin, Commander.

Acknowledgements are extended to the following from SAM: Mr. F. L. Currie, who assisted with the coordination of the meeting and field trip; Dr. Susan I. Rees for field trip coordination; Ms. Gloria Liggett for all transportation support; Mses. Catherine P. Reese, Liz Warren, and Pam Dolan, who assisted with registration and various administrative details for the meeting; Messrs. Adrien Lamarre and George Edwards Dung, photographers. Thanks are extended to guest participants Dr. Leonard M. Bahr, Governor's Office of Coastal Activities, Baton Rouge, LA; Mr. David L. Ruple, Mississippi Bureau of Marine Resources, Biloxi, MS; and Ms. Lisa W. Sales, Port of Los Angeles, San

Pedro, CA. Thanks are extended to Mrs. Sharon L. Hanks, WES, for coordinating and assisting in setting up the meeting and assembling information for this publication; Mr. Andre Z. Szuwalski for assisting in the preparation of the draft proceedings from the transcript; and Ms. Janean Shirley of the Information Technology Laboratory, WES, for editing these proceedings. Thanks are extended also to Ms. Susan C. Soderberg, Pro/Tech Reporting Services, for taking verbatim dictation of the meeting.

The proceedings were reviewed and edited for technical accuracy by Dr. James R. Houston, Director, CERC, and Mr. Charles C. Calhoun, Jr., Assistant Director, CERC. COL Bruce K. Howard, Executive Secretary of the Board and Commander and Deputy Director, WES, provided additional review.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.


STANLEY G. GENEGA
Major General, U.S. Army
President, Coastal Engineering
Research Board

Agenda

Theme: Coastal Wetlands

Monday, 15 November 1993

6:30 - 8:30 Registration and Cash Bar Icebreaker

Tuesday, 16 November 1993

7:00 - 8:00 Registration

8:00 - 8:05 Open and Welcome to Meeting
 BG Paul Y. Chinen

8:05 - 8:20 Welcome to South Atlantic Division and Mobile District
 COL Robert H. Griffin

8:20 - 9:30 Report of Chief's Charge
 Dr. C. H. Pennington, WES
 COL Bruce K. Howard

9:30 - 9:45 Review of CERB Business
 COL Bruce K. Howard
 Dr. James R. Houston, CERC/WES

9:45 - 10:00 Break

10:00 - 10:15 Theme Introduction
 Dr. James R. Houston, CERC/WES

10:15 - 12:00 **Panel: Coastal Wetlands Issues and Problems**

10:15 - 10:35 General Overview
 Dr. William L. Klesch, HQUSACE

10:35 - 10:50 Shoreline Erosion Losses
 Mr. David L. Ruple, Mississippi Bureau of Marine Resources

10:50 - 11:05 Subsidence: Implications for Coastal Wetland Restoration in Louisiana
 Dr. Leonard M. Bahr, State of Louisiana

11:05 - 11:20 Development/Mitigation Required in Coastal Wetlands
 Ms. Patricia N. Bevel, SAD

11:20 - 11:40	Problems, Challenges, and Experiences in Coastal Restoration, Protection, and Creation Dr. Mary C. Landin, EL/WES
11:40 - 12:00	Discussion
12:00 - 1:15	Lunch (Open)
1:15 - 3:30	Panel: Wetlands Research Program
1:15 - 1:35	Overview of Program Dr. Russell F. Theriot, EL/WES
1:35 - 1:55	Wetlands Coastal Processes Mr. Jack E. Davis, CERC/WES
1:55 - 2:15	Wetlands Engineering Dr. Michael R. Palermo, EL/WES
2:15 - 2:35	BioEngineering Practices in Coastal Wetlands Mr. Hollis H. Allen, EL/WES
2:35 - 2:55	Breakwaters for Wetland Restoration and Protection Mr. John W. McCormick, CERC/WES
2:55 - 3:15	Numerical Modeling of Wetland Processes for Restoration and Protection Mr. Joseph V. Letter, HL/WES
3:15 - 3:30	Break
3:30 - 4:35	Panel: Specific Wetlands Projects
3:30 - 3:35	Introduction Dr. Russell F. Theriot, EL/WES
3:35 - 3:55	Using Geotubes for Engineering and Environmental Projects Mr. Robert N. Blama, NAB
3:55 - 4:15	The Restoration of Batiquitos Lagoon Ms. Lisa W. Sales, Port of Los Angeles
4:15 - 4:35	Wetlands Creation/Atlantic Intracoastal Waterways - North Carolina Mr. G. Frank Yelverton, SAW
4:35 - 5:00	Coastal Wetlands Planning, Protection, and Restoration Act COL Michael Diffley, LMN
5:00 - 5:25	Wrapup/Needs and Opportunities for Future Wetlands Research Dr. Russell F. Theriot, EL/WES
5:25 - 5:30	Remarks BG Paul Y. Chinen
5:30	Recess for the Day
6:30 - 8:30	Social and Dinner

Wednesday, 17 November 1993

8:15 - 8:20	Reconvene Meeting BG Paul Y. Chinen
8:20 - 9:00	Field Trip Overview Dr. Susan I. Rees, SAM

9:15 - 2:15 Field Trip for Executive Committee
9:15 - 5:00 Bus Field Trip
3:00 - 5:00 Board in Executive Session

Thursday, 18 November 1993

8:00 - 8:15 Reconvene Meeting
 BG Paul Y. Chinen
8:15 - 8:40 Gulf of Mexico Program
 Dr. Susan I. Rees, SAM
8:40 - 9:20 Coastal Inlets Research Program
 Mr. E. Clark McNair, Jr., CERC/WES
 Ms. Jane M. Smith, CERC/WES
 Mr. W. Jeff Lillycrop, CERC/WES
9:20 - 9:35 Optimized Concrete Armor Units: The CORE-LOC
 Mr. Jeffrey A. Melby, CERC/WES
9:35 - 9:55 WES Reconnaissance Report on Expedient Structures Used During the
 Flood of 1993
 Mr. George F. Turk, CERC/WES
9:55 - 10:15 Break
10:15 - 10:45 Public Comment
10:45 - 11:00 Study for OMB on Shore Protection
 Mr. Harry M. Shoudy, HQUSACE
11:00 - 11:45 Recommendations by CERB
 CERB
11:45 - 12:00 Closing Remarks
 BG Paul Y. Chinen
12:00 Adjourn

Attendees

Board Members

BG Paul Y. Chinen
BG Ralph V. Locurcio
Dr. Paul D. Komar
Dr. Robert G. Dean

Headquarters, U.S. Army Corps of Engineers

Mr. Charles Chesnutt, CECW-PF
Mr. James E. Crews, CECW-O
Mr. Barry W. Holliday, CECW-OD
Mr. John G. Housley, CECW-PF
Dr. William L. Klesch, CECW-PO
Mr. John H. Lockhart, Jr., CECW-EH-D
Dr. Robert B. Oswald, CERD-ZA
Mr. Samuel B. Powell, CECW-EH-D
Dr. William E. Roper, CERD-C
Mr. Harry M. Shoudy, CECW-PA
Mr. Hugh Wright, CECW-P

Institute for Water Resources

Dr. Robert Brumbaugh, CEWRC-IWR-P

Lower Mississippi Valley Division

COL Michael Diffley, CELMN-DE
Mr. Adrian J. Combe, CELMN-ED-HC

New England Division

Mr. Thomas C. Bruha, CENED-OD-R

North Atlantic Division

Mr. Marshall G. Nelson, CENAD-PL-R
Mr. Andrew Petallides, CENAD-EN-HH
Mr. Robert N. Blama, CENAB-OP-N
Mr. Ronald A. Cucina, CENAB-OP
Mr. Wesley E. Coleman, CENAB-PL-PC
Mr. Jerry W. Swean, CENAO-EN-DG
Ms. Beth Brandreth, CENAP-PL-E

Mr. Douglas A. Gaffney, CENAP-PL-PC
Mr. Carmen G. Zapille, CENAP-PL-PC

North Pacific Division

Mr. Jim Goudzwaard, CENPP-PE-RR

Pacific Ocean Division

Mr. Stanley J. Boc, CEPOD-ED-PH

South Atlantic Division

Ms. Patricia N. Bevel, CESAD-CO-OR
Dr. Albert G. Holler, Jr., CESAD-EN-HH
Mr. Douglas S. Rosen, CESAJ-EN-GG
COL Robert H. Griffin, CESAM-DE
MAJ Dennis Heuer, CESAM-DD
Mr. F. L. Currie, CESAM-EX
Dr. Susan Ivester Rees, CESAM-PD-EC
Ms. Cheryl Ulrich, CESAM-PD-FP
Mr. G. Frank Yelverton, CESAW-PD-E

South Pacific Division

Mr. George W. Domurat, CESPD-ED-W
Ms. Pamela G. Castens, CESPL-PD-C
Mr. Arthur T. Shak, CESPL-ED-DC

Southwestern Division

Mr. T. Neil McLellan, CESWG-CO-M

Waterways Experiment Station

COL Bruce K. Howard, CEWES-ZB
Dr. James R. Houston, CEWES-CV-Z
Mr. Charles C. Calhoun, Jr., CEWES-CV-A
Mr. C. E. Chatham, CEWES-CW
Mr. D. D. Davidson, CEWES-CW-R
Mr. Jack E. Davis, CEWES-CD-SE
Ms. Sharon L. Hanks, CEWES-CV-AC
Mr. W. Jeff Lillycrop, CEWES-CD-SE
Mr. John W. McCormick, CEWES-CD-SE
Mr. E. Clark McNair, Jr., CEWES-CP-D

Mr. Jeffrey A. Melby, CEWES-CW-R
Mr. Thomas W. Richardson, CEWES-CD
Ms. Jane M. Smith, CEWES-CR-P
Mr. George F. Turk, CEWES-CW-R
Mr. Hollis H. Allen, CEWES-EN-S
Mr. Richard Coleman, CEWES-EP-W
Dr. Mary C. Landin, CEWES-ER-W
Dr. Michael R. Palermo, CEWES-EE-P
Mr. R. Glenn Rhett, CEWES-EP-W
Dr. Russell F. Theriot, CEWES-EP-W
Mr. Joseph V. Letter, CEWES-HE
Mr. David R. Richards, CEWES-HE-S
Dr. C. H. Pennington, CEWES-ZT-E

Guest Participants

Dr. Leonard M. Bahr, Governor's Office of
Coastal Activities, Baton Rouge, LA
Mr. David L. Ruple, Mississippi Bureau of
Marine Resources, Biloxi, MS
Ms. Lisa W. Sales, Port of Los Angeles, San
Pedro, CA

Guests

Ms. Terry C. Bassett, Brown and Root, Inc.,
Mobile, AL
Mr. Theodore Bisterfeld, U.S. Environmental
Protection Agency, Region 4, Atlanta, GA
Mr. John P. Carey, Alabama State Docks,
Mobile, AL
Mr. J. Michael Hemsley, National Buoy
Center, Stennis Space Center, MS

Ms. Carol B. Higbie, Office of Personnel
Management, Atlanta, GA
Dr. William Kruczynski, U.S. Environmental
Protection Agency Lab, Gulf Breeze, FL
Mr. Louis J. Martinez, Brown and Root, Inc.,
Mobile, AL
Ms. Karen P. McDonald, Brown and Root,
Inc., Mobile, AL
Mr. Heinz Mueller, U.S. Environmental
Protection Agency, Region 4, Atlanta, GA
LT Paul A. Mullins, Naval Station Mobile,
Mobile, AL
Mr. Jesse A. Pfeiffer, Jr., Pfeiffer and
Associates, Blanco, TX
Mr. John Porter, Mobile Audubon, Mobile, AL
LT Earl D. Ramsey, Naval Station Mobile,
Mobile, AL
Mr. R. Blake Roper, Alabama Department of
Environmental Management, Mobile, AL
Dr. Clifford L. Truitt, Mote Marine, Sarasota,
FL
Mr. Barney Vermillion, Office of Personnel
Management, Atlanta, GA

Court Reporter

Ms. Susan C. Soderberg, Pro/Tech Reporting
Service

Contractor

Mr. Andre Z. Szuwalski, Vicksburg, MS

Proceedings of the 59th Meeting of the Coastal Engineering Research Board

Introduction

The 59th Meeting of the Coastal Engineering Research Board (CERB) was held at the Marriott's Grand Hotel in Point Clear, AL, on 16-18 November 1993. It was hosted by the U.S. Army Engineer Division, South Atlantic, under the direction of BG Roger F. Yankoupe, Commander, and the U.S. Army Engineer District, Mobile, under the direction of COL Robert H. Griffin, Commander.

The Beach Erosion Board (BEB), forerunner of the CERB, was formed by the Corps in 1930 to study beach erosion problems. In 1963, Public Law 88-172 dissolved the BEB by establishing the CERB as an advisory board to the Corps and designating a new organization, the Coastal Engineering Research Center (CERC), as the research arm of the Corps. The CERB functions to review programs relating to coastal engineering research and development and to recommend areas for particular emphasis or suggest new topics for study. The Board's four military and three civilian members officially meet twice a year at a particular coastal Corps District or Division to do the following:

- a. Disseminate information of general interest to Corps coastal Districts or Divisions.
- b. Obtain reports on coastal engineering projects in the host (local) District or Division; receive requests for research needs.
- c. Provide an opportunity for state and private institutions and organizations to report on local coastal research needs, coastal studies, and new coastal engineering techniques.
- d. Provide a general forum for public inquiry.
- e. Provide recommendations for coastal engineering research and development.

Presentations during the 59th CERB meeting dealt with coastal wetlands. Documented in these proceedings are summaries of presentations made at the meeting, discussions following these presentations, and recommendations by the Board. A verbatim transcript is on file at the U.S. Army Engineer Waterways Experiment Station, CERC.

The Coastal Engineering Research Board



BG (P) Stanley G. Genega
Commander, U.S. Army Engineer
Division, South Atlantic
77 Forsyth Street, S.W.
Atlanta, GA 30335-6801



COL Bruce K. Howard
Executive Secretary
Commander and Deputy Director
U.S. Army Engineer Waterways
Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199



BG Roger F. Yankoupe
Commander, U.S. Army Engineer
Division, South Pacific
630 Sansome Street, Room 720
San Francisco, CA 94111-2206



BG Paul Y. Chinen
Commander
U.S. Army Engineer Division,
North Atlantic
90 Church Street
New York, NY 10007-2979



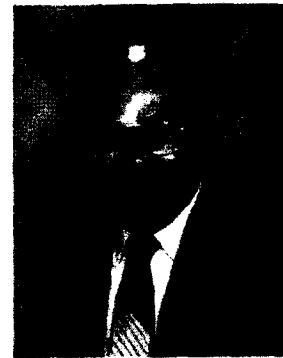
BG Ralph V. Locurcio
Commander, U.S. Army Engineer
Division, Pacific Ocean
Building 230
Fort Shafter, HI 96858-5440



Dr. Paul D. Komar
College of Oceanic and
Atmospheric Sciences
Oregon State University
Oceanography Administration
Building 104
Corvallis, OR 97331-5503



Dr. Robert G. Dean
Coastal and Oceanographic
Department
University of Florida
336 Weil Hall
Gainesville, FL 32611



Dr. Edward K. Noda
Edward K. Noda and Associates,
Inc.
615 Piikoi Street, Suite 1000
Honolulu, HI 96814

Opening Remarks and Welcome

BG Paul Y. Chinen opened the 59th meeting of the Coastal Engineering Research Board for MG Stanley G. Genega, who could not attend, and welcomed attendees to the meeting. He introduced Board members BG Ralph V. Locurcio, Commander, U.S. Army Engineer Division, Pacific Ocean; Dr. Paul D. Komar, Oregon State University; and Dr. Robert G. Dean, University of Florida. BG Roger F. Yankoupe, Commander, South Atlantic Division, and Dr. Edward K. Noda of Edward K. Noda and

Associates, Inc., were unable to attend the meeting. BG Chinen also introduced COL Bruce K. Howard, Commander and Deputy Director of the U.S. Army Engineer Waterways Experiment Station, who is Executive Secretary of the Board.

BG Chinen then turned the podium over to COL Robert H. Griffin, host Commander, U.S. Army Engineer District, Mobile. COL Griffin welcomed all attendees on behalf of BG Yankoupe.

Report of Chief's Charge

*Dr. C. H. Pennington
Director
WES Graduate Institute
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

In his opening remarks at the 57th meeting of the Coastal Engineering Research Board (CERB) in October of 1992, LTG Arthur E. Williams stated, "I ask that you look at innovative ways that will allow for more of our engineers and scientists to take advantage of advanced education and training programs."

LTG Williams was referring to the coastal engineering education program that was endorsed by the CERB and has been worked out between the U.S. Army Engineer Waterways Experiment Station (WES) and Texas A&M University. As a result of that directive from the Chief, a task group chaired by BG Roger F. Yankoupe was formed to discuss technology transfer and education and training issues. This task group, along with another task group headed by BG Ralph V. Locurcio, met in March of 1993 at Fort Belvoir, VA, and identified 18 initiatives, or tasks, to be studied with the purpose of generating recommendations for action to accomplish the tasks.

I will discuss 6 of the 18 initiatives dealing with technology transfer and training and education. Initiative Nos. 1, 2, 3, and 7 dealt with the issue of delivery of technology. How can we make training and education including postgraduate education available to Corps engineers and scientists in the Districts, Divisions, and Laboratories? Initiative No. 4 dealt with the issue of capturing and retaining the institutional knowledge of the Corps' coastal experts who are retiring or leaving the Corps of Engineers. Finally, we looked at outreach programs (Initiative No. 5). How does the Corps attract young people early on to look at engineering and science and the Corps of Engineers as a career?

At the June 1993 meeting of the Board, numerous recommendations were presented to the CERB that related to technology transfer and education and training issues. At that meeting, we were tasked to do an education and training needs survey. I will outline the process that was used to conduct that survey and present some of the highlights of the analysis of that survey.

The survey addressed three components. The organizational needs: What are the Corps' needs now and for the future? What is it that the occupation needs? What is it that the Districts and Divisions need for education and training to develop leaders for the future? The survey also addressed individual needs. In the process of conducting this survey, we requested the assistance of the Training and Development Division, Office of Personnel Management (OPM), Atlanta Region. They have developed a survey tool called Competence 2000 that we felt could be modified and used rather than trying to develop something on our own. One of the first things that we did to get this survey modified was to convene a panel of Corps coastal experts, in Atlanta, on 13 August 1993. We took the OPM survey tool and modified it considerably. The 13 pages of the survey consisted of about 7 major parts that covered planning, organizing, problem-solving skills, research skills, knowledge of organizational structure and procedures, communications skills (existing and needed), and required technical skills and knowledge as applied to coastal engineering. Another issue dealt with in the survey pertained to computer matters.

The survey was modified, and there were actually two surveys that resulted from this. One went to supervisors and one went to employees. The surveys (705) were mailed on 1 September 1993 to 9 Divisions, 19 Districts, 4 Laboratories, the Water Resources Support Center, and personnel in Headquarters. The return rate, to date, is 71 percent (502 surveys returned; 311 employees and 91 supervisors.)

Detailed results of the survey will be delivered to the President of the CERB on 15 January 1994. I will present some preliminary analysis as it addresses the five initiative areas of: delivery of technology, advanced degrees, short courses and continuing education, retention of knowledge and expertise, and outreach programs.

In order to address the delivery of technology issue, survey respondents were asked to identify their experiences with five types of training and delivery methods. For each type of delivery method they had experience with, respondents were also asked to rate each method as to its effectiveness. The preliminary analysis indicates that the vast majority of respondents' training experiences were limited to the traditional face-to-face training methods. There were 44 respondents who had some experience receiving education and training through computer-aided instruction, 32 percent by videotape instruction, 5 percent have had experience with teleconferencing, and about 4 percent with satellite instruction. The traditional face-to-face training had the highest degree of satisfaction with the use of the method. Only 16 percent of those that received training through videotape said that it was an excellent method. With video teleconferencing, none of those trained said it was an excellent method. Of the 4 percent that received satellite instruction, 33 percent said it was an excellent method.

Survey questions were developed that dealt with advanced degree and postgraduate education and short courses of continuing education. One set of questions explored the

perceptions of a need for advanced educational opportunities for individuals in coastal disciplines. The other questions examined preferences for the different types of advanced educational opportunities. In the first case, we asked if a need existed for a nonengineering, science-oriented, Corps-sponsored graduate program in coastal studies. In the sample analyzed, the largest percent of respondents answered this question, "Don't know." Yes responses were 26 percent of the sample, and no responses were 23 percent. Those responding "yes" to this question were also asked which scientific areas should be contained in this program. The responses were, in order of frequency: oceanography, ecology, economics, a multidisciplinary program including biology and physical engineering-type program, programs that dealt with regulatory issues in coastal engineering, planning, geology, and marine biology.

The second question provided an idea of the continuing education standards and asked respondents to identify whether their interest in these types was high, medium, or low. For several analysis purposes, four levels of experience were identified: prospect training, private sector short courses, university short courses, and long-term training. Prospect courses seemed to be an effective strategy, and were rated as a high preference by 71 percent of the respondents. There was a high degree of interest in university short courses and long-term training, which indicates an emphasis for future training classes. Other strategies identified and rated high by respondents were workshops and seminars; on-the-job developmental classes at their present location, not at a new location; and attendance at scientific conferences.

In the training needs survey, the respondents were asked if their office had a method to capture and retain institutional knowledge of coastal experts within the Corps. The analysis of the results indicates that if such programs do exist in the Corps, respondents were largely unaware of that. Most respondents did not know whether such

a program existed in their offices or in the Corps. Thirty-four percent indicated that such a program did not exist, while eight percent stated that a means of capturing this experience was currently in operation. While some respondents indicated that new hires in the office benefitted from mentoring of an experienced staff, others stated that many good employees leave the Corps without their knowledge being captured. Others stated that incentives for mentoring and an apprenticeship must be established in order for this type of program to be successful.

The survey asked if an outreach program existed in their offices and provided examples of the types of programs that existed. Almost half the respondents were aware of those programs in their office. Only 23 percent stated that such a program did not exist, 32 percent were not sure that the program did or did not exist. Comments indicated that most offices had some sort of program similar to other offices, but that each program was locality-based; that is, local school relationships determined the effectiveness of the outreach program. Examples of the most common types of program identified were presentations in schools, school partnerships, minority outreach programs, and annual programs such as Engineering Week seminars and cooperative education. Perhaps one of the most telling comments received on this was, "They tell me we have this program," which indicates that many of our professionals are not involved in outreach programs.

In the next item of interest on the survey, respondents were asked to indicate whether their offices were organized to use coastal expertise in the most effective manner. Only 10 percent of the respondents agreed that their offices were effectively organized to utilize this expertise. While 35 percent of the respondents answered this question "don't know," only 19 percent felt that their offices were not effectively organized. Where problems existed, communication and exchange of information were the most commonly cited reasons for difficulty. Other

barriers to effective organization identified by respondents were: there are too many project management responsibilities; our experts are spread too thinly; we do not have opportunities to utilize our expertise; we need more trained people; coastal engineering is not recognized as a distinct discipline in the Corps of Engineers; and there is a lack of supervisory expertise in the Corps of Engineers. That statement is not so unusual if you look at the length of time that supervisors have had in their position versus the length of time that the employees have been in their positions. Supervisors had been in their jobs an average of 4 years, and the employees have been in their positions for an average of 7 years. So again, a young management team supervised an older work force.

We were also able to group the needs identified by supervisors and employees into about 16 or 17 major categories. Both the supervisors who are rating the employee and the employees stated that technical skills and knowledge of coastal engineering were their number one priority. We need to develop short courses and educational programs to give Corps engineers in the Districts, Divisions, and Laboratories more technical skills in that particular area. In the grouping of the skills needs areas, there is a difference between what the supervisors perceived and what the employees perceived. The supervisors stated that employees need more management- and communication-type training so that they can become a better class of managers; whereas the employees stated that they needed more technical skills-type training.

Another thing that is interesting to note from the survey is where career development appears on the supervisors' list: 10th. It does not appear in the top 10 on the employees' list. This can indicate several things. One is that the employees are happy where they are. The other is that they may be complacent, "there's not much I can do," or that the Corps has a good, well-thought-out career development program.

It was also interesting to look at the different disciplines. The biologists, economists, and life scientists all felt career development was more important to them than the engineers who responded to this particular question.

One thing that can be done with this information is scan the types of programs and types of educational training courses that are available at OPM, within the Corps of Engineers and the Department of Defense and see what courses can be matched with the skill needs area. When there is a skill need identified and there's not a course or program developed, we can identify that quickly and say we need that course in response to the skill need identified by the survey.

Our recommendation today is that we go ahead and complete the analysis of the survey data. Then we would like to reconvene the resource group that we had together early on this year, those from the universities, Districts, and Divisions, and let them look at that survey result and re-analyze it, because we may change the recommendations that we made to the Board in June. Then we would like to distribute the survey results to all the training Divisions so that they can adjust their training to meet the needs of the coastal professionals.

In conclusion, I feel like the survey that we have conducted with the assistance of OPM will be very valuable information.

Discussion

BG Paul Y. Chinen asked if when survey results are distributed, will guidance be given to the Divisions and the Districts regarding the program? *Dr. C. H. Pennington* said that we can identify the types of courses required to eliminate the deficiencies that have been identified in that particular Division.

BG Ralph V. Locurcio asked if the Divisions are going to get a chance to comment on the survey results. *Dr. Pennington* said that was not planned.

BG Locurcio commented that we need to get communications training and those kinds of interpersonal skills incorporated into the technical training; that the two ought not to be separate. He said that if you just send somebody off to communications class and he is a technical person, he is not going to pay attention, but if it is an integral part of the technical training, he cannot escape it; then it is a means to an end of getting technical training, and then he might coalesce the two.

Dr. Robert G. Dean asked if the Corps has a commitment in terms of the amount of percentage of time that should be dedicated to education and training? *Dr. Pennington* responded saying he was not sure what percentage of the budget is spent on education and training, but that it is a tremendous amount of money each year. He said, hopefully from the results of this survey, we can help direct some of that education and training at least into the coastal engineering disciplines. *Dr. Pennington* said that WES spends about 2 percent of its annual budget on education and training. What it is for the entire Corps, he did not know. This year at WES alone there are 65 people off on long-term training, and that is about \$8,000 per individual.

Dr. Robert B. Oswald commented that it would be very appropriate, particularly at certain grade levels, that the Corps have a policy that an employee is expected to spend a certain amount of his time in training appropriate for career development. He said we are in an age where technology has overtaken us at a tremendous clip, and that we really need to make our employees much more effective by continually upgrading and refreshing their technical skills as well as their management skills. He feels that a policy that would dedicate a certain amount of time to education would be an important step to take.

Dr. Dean asked if the Corps has an active co-op program with universities in terms of bringing people in for one semester and then going back? *Dr. Pennington* said that the

Corps does have co-op programs, and also a contact youth program.

BG Locurcio asked if there is some type of an intern program where spaces are dedicated to interning new coastal engineers?

Dr. Pennington responded that if the co-op program functions properly, then there would be an intern-like program.

Continuation of Report of Chief's Charge

*COL Bruce K. Howard, Executive Secretary
Coastal Engineering Research Board
Commander and Deputy Director
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

I will continue discussing the remaining 12 initiatives of the Chief's Charge.

Initiative No. 6 deals with scientific exchange. This concern was brought up due to foreign visitors and partners in our universities who wanted to visit the U.S. Army Engineer Waterways Experiment Station (WES) or work through contracts at WES or other Corps facilities. Beginning in 1990, the authority for granting visits was changed from the Commander of WES to the Department of the Army. This appears to be a program that is no more than a rubber stamp at that level. The data supporting that is that we have requested since that time, 972 clearances for individuals and clearances on 100 separate contracts, and every one of them has been approved. The problem here is with the timeliness of doing it and some of the difficulties that foreign travelers and students working at the universities have in acquiring these clearances. MG Genega has asked for our data, which he will use to try to bring back to WES or at least to within the Corps, the authority for granting this approval on a much more timely and easier basis. This is not a complete initiative and we will keep working on it.

The Public Affairs Office at Headquarters, U.S. Army Corps of Engineers (HQUSACE) was asked to prepare a public relations plan (Initiative No. 8). That plan has been prepared and it has been presented to the Board. When the Board members have had an opportunity to review it and provide suggestions or improvements, that plan will be implemented.

Initiative No. 9 is the forming of strategic regional partnerships with other agencies and groups and will be discussed with Initiative No. 18.

Initiative No. 10 has to do with the area of the environment, to develop national dredging partnerships. Working with HQUSACE, through the Director of Civil Works and Assistant Secretary of the Army for Civil Works, WES and other Corps Divisions and Districts have indicated that they would like to initiate a meeting with the Departments of the Interior, Transportation and Commerce, and with the Environmental Protection Agency to coordinate actions in the dredging program. Several actions are occurring in other agencies that pertain to this issue within the Department of the Army.

Initiative No. 11 has to do with the Dredging Operations and Environmental Research (DOER) Program. The DOER Program is to be included in the FY95 budget. The specifics of the FY95 budget are still under way. I do not have anything new to present on this issue, other than the three action charges under this issue will be covered and will be reviewed as the 1995 budget is put together. At the last Board meeting, the 1994 budget had already been in front of the Congress, so 1995 is the first opportunity to include the specifics in the program.

Initiative No. 12 is to review the administrative budget to identify funding priorities and trends that related to coastal engineering research. WES has decided to roll this initiative also under Initiative No. 18.

Initiative No. 13 deals with seeking increased engineering funding from the National Science Foundation (NSF) for universities. This has been somewhat successful in that the NSF also agreed to this goal. In preliminary talks with them, they said they would like to see a new thrust with the development of a research plan that has wide consensus throughout the different universities we work with and other industries. We have worked with the Office of Naval Research (ONR), and they would like to join us in this initiative. We also have been talking to the U.S. Geological Survey (USGS), who is going to be one of the hosts for the program. We have talked to the National Oceanic and Atmospheric Administration and NSF, and they have indicated that they want to join us. We want to coordinate all this with the other strategic partners and include our civilian industry partners and other government agencies at the same time.

Initiative No. 14 has to do with developing funding authorities to monitor beach fills and other forms of shore protection. There are different types of funding within the Corps that we use to do our work. One that is not available, and would on the surface make more sense to use in this program, is Operation and Maintenance funding. That is not allowed by the way the law is currently written. So there are two other types of funds that we can use within the Corps of Engineers to do this work. The first is Construction General (CG) funds, which is a cost-share method with the user. This requires the user to come up with a portion of the funds in order to go ahead and do the program. The other is General Investigation (GI) funds, which is a line item in the budget each year and is used for research or other studies for various engineering activities. It is our recommendation that we use a combination of both CG funds and GI funds to do this work: CG funds to gather beach profile data, and GI funds to analyze these data.

Initiative No. 15 is to seek coastal engineering research partnerships to optimize use of funds. There are many agencies within and outside the Department of Defense that have an interest in coastal engineering. The ONR and the Navy have indicated an interest in coastal research and have visited WES on numerous occasions within the last few months to set up a data exchange and establish contracts with WES to do some of this research. Along with that, WES's Coastal Engineering Research Center (CERC) is working with the NSF to develop a coastal engineering process experiment later on in 1994.

WES is also looking at developing some exchanges with foreign laboratories. Spain right now is probably the leader in this field as far as being able to get an exchange program of at least data sharing with a foreign government. This is still in the exploratory phase, but we have representatives from Spain coming to WES to talk in more detail about this program. Finally, one of the questions under this initiative was: How can the coastal community contribute to oil spill research efforts as a subset of this overall subject title? CERC is a cofounder of a consortium of private sector companies and government agencies that are providing funding in this field. The Naval Oceanographic Command has named CERC as a researcher and principal investigator in this program, and it is well under way.

Initiative No. 16, funding of the *Coastal Engineering Manual* (CEM), has been very successful so far. The Coastal Engineering Research Board identified the need to develop and keep publishing this manual. The CEM is going to be funded under the Civil Works Guidance Update Program and the Coastal Research and Development (R&D) Program.

Initiative No. 17 was to evaluate national laboratory status for CERC. This essentially means the changing of the name to the National Coastal Engineering Research Center. There are pros and cons to this

initiative. From the legal point of view, the lawyers say it is just a notational-type adjective, and it really has no legal bearing as far as having to get legislation from Congress. It may formalize the de facto position CERC already holds in the community, and the name change would probably add prestige to the organization. One of the negatives that is associated with this name change is that it may be misleading, as CERC is a portion of the Corps of Engineers and not a separate agency. People may get the wrong idea that it would be not a subset of the Corps of Engineers, but an agency all by itself. During this period of reinventing government, we may get uninvited or unwarranted consequences from doing such a name change. Dr. Robert B. Oswald has tasked the R&D community to come up with a strategic plan for the future on what the R&D community is going to be doing now that the Department of Defense is downsizing. I would recommend that we do not take the name change and let Dr. Oswald and the various labs take this as part of their question and see if it is a good idea or not and then present it back to the Board in the spring.

Initiative No. 18 is probably the most involved and could bear the most fruit. The initiative is: Identify future coastal engineering research and program directions. This initiative is being coordinated with Initiative Nos. 9, 12, and 15. CERC has been working on the best way to do this, and has decided that to identify these future directions for coastal engineering, including funding and partners, a comprehensive workshop with various parties would be the best way to accomplish this task. The workshop will be conducted in the summer of 1994 in St. Petersburg, FL. The subjects will be varied, including waves, their generation and nearshore transformation, currents and water elevation, sediment transport, dredging, structures, and the environment and engineering. The goal of this workshop will be to discuss these subjects, funding, and the various partners that may be involved. The partners that will be discussed include the Navy, the USGS, NSF, private industry, and

various states. This program has a tremendous potential.

Discussion

BG Chinen commented that with respect to dredging, the Corps has had much positive movement into the resolution of dredging and dredging disposal. He said the Corps is having these national meetings with the American Association of Port Authorities and this is going to help the Corps to solve a lot of regional issues. He cautioned, however, that regional meetings by themselves will not resolve the big problem of dredging and dredging disposal. We still need to keep that at the top of our agenda, the need for the Chief of Engineers, the Secretary of the Army for Civil Works, the Environmental Protection Agency Director and others to get together and recognize that we have a national issue. He said unless we have a joint meeting and understanding of common policy, we are not going to get to the real heart and soul of this issue, which is dredging.

BG Locurcio commented that the public affairs plan was awfully generic. It had a lot of nice round terms with few verbs in it that pointed to actions. He was wondering if there is a supplement to it or if this is the final product. *Mr. Charles C. Calhoun, Jr.*, responded that the Public Affairs Office was asked to provide a general plan that could be looked at in the Executive Session in more detail. One of the keys in the plan was to develop a funding mechanism to conduct this plan, and it is one of the areas that will be looked at very closely in the Executive Session.

Dr. Paul D. Komar asked for more details about Initiative No. 18 and the meeting that is going to be held in St. Petersburg. *Dr. James R. Houston* said the meeting will take place later in the summer. He has been talking with a number of other Federal agencies that were mentioned to see if they would be cosponsors of the meeting. It would be a general meeting on coastal engineering and sciences with invited individuals from universities, Corps

Districts and Divisions, CERC, other Federal agencies, and foreign countries. *Dr. Houston* said that the USGS has agreed to host the meeting in St. Petersburg and to provide some of the funding support. In addition, the ONR has agreed tentatively to cosponsor the meeting and to provide some funding. The NSF has agreed tentatively to provide some funding to bring over some foreign researchers. The purpose of the meeting would be to look at the research needs into the future and put together a plan for the future. *Dr. Houston* thought this would be a great forum to go with, then later on bring the plan to the NSF.

Dr. Dean commented with respect to Initiative No. 15 that one of the driving forces for the research funding is the amount of money that is spent on coastal engineering projects and he would like to see, at a future meeting, the history of expenditures on coastal engineering projects in the United States. He thinks that the United States is clearly falling behind in this area. This is in part because the European and the Japanese communities, and others, are increasing their funding and activities on coastal engineering research. In the European area, this is in part because of the European Common Market. *Dr. Dean* is currently reviewing the abstracts for the next international coastal engineering conference and the research that is being done both in Europe and Japan is far greater in terms of expenditures than in the United States. He said it is important for us to note that we are clearly falling behind.

Dr. Dean also commented with respect to Initiative No. 14 that the monitoring of beach fills is extremely important. He thinks one of the difficulties there is that there has been no formalized program as to what is really needed. He would like to know what has been done in the Corps in terms of recommendations for appropriate monitoring programs for beach nourishment projects.

Dr. Dean said he has had discussions with the NSF, in particular *Dr. Grant Gross*, who is the head of the Ocean Sciences Division. He said that *Dr. Gross* told him that the way to get a research program implemented within the NSF was to have a National Research Council (NRC) committee carry out a study to develop recommendations for such a program. And he cited that recently there was such a study on water resources and the report that was developed by the NRC was entitled *Opportunities in Water Resources*. This did lead to a new program in water resources in the NSF.

Dr. William E. Roper commented with respect to Initiative No. 11, the DOER Program, that it is probably optimistic that the program will start in 1995. He said it is just more likely to be more seriously considered in 1996, with the changes in budget guidance that Headquarters has received over the last few weeks.

Mr. Barry Holliday commented on the dredging program and the problems there with the various agencies. On 28 October 1993, the first meeting of an interagency working group on the dredging process occurred at the Department of Transportation through the initiatives of several of the agencies. But the driving force is Secretary Pena's recent speeches and President Clinton's speech in Oakland indicating a need for resolving the impasse on getting dredging permits and dredging projects under way. The impetus of these meetings and the interagency working group is to try to establish, at the highest agency level, an understanding between the necessary environmental concerns and the need for economic development and maintenance of our ports, especially with the areas like the New York harbors and the San Francisco bays. *Mr. Holliday* said it is clear that all of the agencies recognize a need for this gathering and meetings are going on now.

Review of Coastal Engineering Research Board Business

*COL Bruce K. Howard, Executive Secretary
Coastal Engineering Research Board
Commander and Deputy Director
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

There were several action items resulting from the 58th Coastal Engineering Research Board (CERB) meeting in Atlantic City, NJ. The list at Appendix B covers the status of action items from the Atlantic City meeting and continuing action items from previous Board meetings. All other action items have been completed. We will continue to update the status of action items prior to each meeting, and provide a list to the Board as read-ahead material. At the 47th CERB meeting in Corpus Christi, TX, we were asked to formalize the action item list. A master list showing actions taken since the 47th meeting is maintained at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center (CERC).

Item 58-1. Provide Board members draft action items prior to finalizing list.

This has been done and will be done in the future.

Item 58-2. Provide status of action items at least 2 weeks prior to scheduled meeting via COASTNET.

This also has been done and will be done prior to future meetings.

Item 58-3. Review CERC numerical models with regard to currency, determine if deficiencies exist, establish impacts of any deficiencies, and recommend action to alleviate any deficiencies in priority order, and determine costs.

Discussions at the last Board meeting of the HARBD harbor oscillation model and its limitations prompted a status review of the major documented numerical models used by CERC

on Corps projects throughout the nation. The spreadsheet shown at Appendix C summarizes these models in matrix form by category, priority (high, medium, or low), use, deficiency, and CERC action. Priority ratings refer to the priorities of the actions proposed to address deficiencies.

You will note from the spreadsheet that improvement of existing models or development of new models in the Waves, Circulation, Beach Response and Dredging categories is being or will be supported through several research and development (R&D) programs and the Numerical Model Maintenance Program (NMMP). The NMMP provides funds for maintenance, documentation, consultation, and correction/update. Most major models used by CERC are supported in this program. The NMMP provides the sole source of support for models after the proponent work unit ends. NMMP funds are being requested for the last four programs shown on the spreadsheet. Because of its funding mechanism - bill-backs - the NMMP may be in jeopardy. If this program is terminated and similar support is not provided by another means, the quality of all models used by the Corps - not just coastal models - will significantly deteriorate. We ask the Board to strongly support continuing a model maintenance program regardless of the funding mechanism.

Important model deficiencies are not ignored but are continually addressed through use of NMMP funds or by submitting R&D proposals to the appropriate research program to compete with other important research. The Field Review Groups overseeing these programs are very aware of their modeling

needs and can be counted on to assign an appropriate priority to modeling research to reflect their needs. As can be seen at Appendix C, there are actions or plans for improvements to all major models.

Item 58-4. Review state of practice of nearshore hydrographic surveys, identify any deficiencies, and recommend action to alleviate any deficiencies.

CERC representatives met with Headquarters (HQ) representatives from the Survey and the Hydraulics and Hydrology Branches in Washington, D.C., and jointly defined a specific scope of action and developed an approach to addressing it. The scope will cover surveys on beaches, offshore borrow areas, ebb deltas, coastal structures, and nearshore dredged material placement. The approach will begin with an end-use-derived requirements analysis to quantify the characteristics, such as vertical accuracy, needed for specific survey types and purposes. These required characteristics will be compared with the known performance characteristics of typical survey systems and methods. This comparison will identify and quantify deficiencies, and conversely will show what degrees of end-use accuracy are reasonably achievable with existing systems and methods. Results can be incorporated as guidance into an engineer manual on hydrographic surveying and will form a basis for recommended actions. Work has begun on the requirements analysis, and draft results of the overall effort are anticipated in time for the spring CERB meeting.

Item 58-5. Transmit list (not prioritized) of eligible inlets that can benefit from mitigation through Section 933 or 111 to Division Commanders.

After the last CERB meeting, MG Genega tasked each coastal Division to provide HQ an up-to-date list of inlets in their Division area that were eligible for study under either Section 111 or Section 933.

A letter to each Division was then sent tasking them to inform the appropriate state agencies that these inlets are eligible for study under these authorities and that any further action would have to be initiated by them.

Item 58-6. Director of CERC will make a presentation at each CERB Board meeting to place the theme topic of the meeting in perspective with CERC/Corps programs, goals, and directions.

Dr. Houston will make a presentation of the theme topic for this meeting in a few moments and we will continue to do this at future Board meetings.

Item 58-7. Investigate feasibility of collecting coastal zone data (emphasis on long-term) needed for environmental analysis in concert with physical data collection efforts.

Efforts to date on this item have concentrated on identifying needs for such data and opportunities to pursue collaborative efforts.

In July, the CERC Field Wave Gauging Program Manager participated in an interagency workshop on environmental measurements sponsored by the National Data Buoy Center (NDBC). Proceedings of the workshop will be published shortly, but one recommendation already being investigated is to develop a standard interface that would allow CERC and NDBC instrument platforms to accept a wide range of sensors.

Through existing cooperative agreements on wave gauging, the states of Florida and Washington have expressed interest in pursuing long-term measurements of specific environmental parameters. These contacts have been coordinated with the Jacksonville and Seattle Districts. In Florida, a pilot installation for long-term turbidity measurement at a wave gauge site is being pursued. In the state of Washington, a joint

CERC/District/state workshop is planned for December 1993 to discuss the feasibility of coupling the state's existing program of stand-alone dissolved oxygen and water level measurements with the automated collection and reporting capabilities of the Field Wave Gauging Program.

Discussions at the Headquarters level have suggested the possibility of interacting with the proposed National Biological Survey on joint environmental/physical long-term data collection. A principal mission of the National Biological Survey will be to establish through monitoring and other means a baseline of data on the nation's biological resources. The National Biological Survey will be directed to "develop methods for the consistent and systematic collection and analysis of data on ecosystems and their components," as well as to perform such collection and analysis. Augmenting the existing Corps infrastructure for coastal physical data collection would be a cost-effective means for accomplishing progress toward such goals.

Item 58-8. Develop recommendation for funding beach-fill monitoring.

This item was discussed in detail as Initiative No. 14 of the Chief's charge. To summarize, Operations and Maintenance funds cannot be used for monitoring shoreline protection projects that are funded by Construction General (CG) funds. Legislation would be needed to change this situation. Consequently, it is recommended that appropriate data be collected using CG funds (even though this must be cost-shared with the local sponsor) and that additional General Investigations funds be programmed for CERC to properly analyze the data.

Item 58-9. Review opportunities for Pacific and Caribbean beach research needs and the development or modification of necessary engineering tools within the research program recommended by the Field Review Group and approved by Headquarters' Technical Monitors.

Dr. Houston forwarded a memorandum to the Director of Civil Works on 20 July 1993 specifically addressing this action item. You will find a copy of this memorandum in Appendix D. In summary, the memorandum said that without a change in Administration policy on recreational beaches and subsequent increases in Corps' projects involving Pacific and Caribbean beaches, study of these beaches will not be a high priority in the Corps. The Corps has a user-driven system that sets priorities for all Corps' research, and this system can provide for small and well-focused efforts that would satisfy the Pacific Ocean Division's (POD) needs. CERC has discussed with POD how this can be achieved. As stewards of public funding, the Corps must spend the funding to meet high-priority mission needs first. Dr. Houston will further discuss R&D efforts on the west coast and Pacific Islands.

Item 58-10. Meet at CERC for next regular spring (60th) meeting to review all CERC programs and observe facilities.

The Board will meet at CERC in Vicksburg for its regular spring meeting. Arrangements are being made.

Item 55-5. Report on the Wetlands Research Program, beneficial uses of dredged material, and the Environmental Protection Agency's Gulf of Mexico Program at the October 1993 meeting.

These items will be addressed later at this meeting.

Discussion

Dr. Roper commented with regard to Action Item 58-3, that the numerical modeling program is currently supported under the centralized bill-back program. Although the R&D community got a smaller amount of support there than asked for, it is still about a 2- to 3-percent growth over last year. He said the program continues to get support under a very constrained and critical review. It is very important that the type of

direct field support that is coming out of the numerical modeling program meet the criteria for continuing support with that type of funding.

Theme Introduction

*Dr. James R. Houston
Director
Coastal Engineering Research Center
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

LTC Arthur E. Williams stressed in his Charge to the Coastal Engineering Research Board (CERB) that a holistic approach must be used to solve the complex environmental problems and issues the Corps faces. He noted that environmental problems involve a chemical and/or biological component and a physical processes component, and a holistic approach requires consideration of both components. He said that "research to ensure that technology is available for such an approach (holistic)...for Corps' activities in the coastal zone falls within the missions of the Coastal Engineering Research Center (CERC) and our Environmental Laboratory (EL)." Through the theme of this meeting - Wetlands - I believe we will show the great progress that can be made through the holistic approach. You will see the results of the synergism that occurs through experts from EL, CERC, and other labs working in interdisciplinary teams to solve problems. You will also see that the role of CERC has expanded beyond traditional coastal engineering into broader applications of the principles of coastal zone engineering and science.

After my presentation, the next five speakers will give you an overview of wetlands issues and problems and the Corps' role in addressing these challenges. Those presentations will be followed by a review of the Corps' Wetlands Research Program managed by the U.S. Army Engineer Waterways Experiment Station's EL. When the theme for this meeting was established over 2 years ago, the meeting was to coincide with the wrap-up of that program. Since the theme was established, the program was extended because of funding constraints during 1 year and is now scheduled for

completion at the end of this fiscal year (FY). Therefore, some of the products originally scheduled will not be available until the end of the year, but we have a number of the principal investigators here to discuss the coastal-related aspects of the program. A researcher from CERC was the manager for one of the four technical subdivisions in the program - the Critical Processes Task Area.

As I noted, the current Wetlands Research Program will end this FY. The decision was made to establish a continuing General Investigations-funded research program for wetlands challenges beginning next FY. As with the current program, CERC will play an important part in the new program. Although planning is still in progress, present plans are for one of the major demonstration projects in the new program to address coastal problems. Dr. Russell Theriot will discuss this more later in his wrap-up. We will provide updates on this program at subsequent meetings.

We will finish the day with three presentations on the application of technology developed by the Corps and a presentation and discussion of the Breaux Bill.

On the last day, we will have presentations outside the theme. In response to an action item, a presentation will be made on the Gulf of Mexico Study. This is an Environmental Protection Agency study in which CERC and other elements of the Corps play a key role.

The CERB has been a major factor in the creation of the Coastal Inlets Research Program or CIRP. At a past meeting of the CERB, then Board President, LTC H. J. Hatch, was asked what the major coastal challenges were and would be. His answer

was "Inlets, inlets, inlets!" The Board strongly recommended research in that area and this was the genesis of CIRP. The program manager and the two principal technical managers will update you on that program.

Two of the CERC engineers have developed a new armor unit - CORELOC - that will be described to you. Finally, we will have a presentation on CERC's role in the flood on the upper Mississippi River. You may ask why CERC is involved with inland flooding. CERC has historically conducted

research on expedient flood-fighting structures. Our engineers were asked to assist in developing lessons learned in this technical area.

In summary, I believe you will find this meeting stimulating as you will see the role CERC plays in solving extremely complex multidisciplinary problems being faced by the Corps. More and more, CERC and other elements of the research and development community will be working together as LTG Williams' vision of problem solving through a holistic approach is fully implemented.

Overview of Coastal Wetland Issues and Problems

*Dr. William L. Klesch
Chief, Office of Environmental Policy
U.S. Army Corps of Engineers
Washington, D.C.*

Introduction

The Corps of Engineers is in a unique position to deal positively with our nation's wetlands by virtue of the growth of our civil works environmental program into a coherent program with a unified philosophy, i.e., the restoration and preservation of significant environmental resources consistent with the dual fiscal principles of economic efficiency and cost-sharing. Further, given the nature of our business, i.e., water resources development, we find ourselves nearly exclusively dealing with wetland habitat when conducting our activities, be they regulatory, planning, construction, and/or the operation and maintenance of existing projects. Thus, our wetland activities are carried out in a number of programs and activities. Finally, these programs and activities, in many ways, already conform to the goals of President Clinton's new wetlands policy.

New Federal Wetlands Policy

The Clinton Administration announced their new wetlands policy on 24 August 1993. The wetlands policy is based upon five principles:

- a. Support for the interim goal of no net loss of the nation's remaining wetlands and the long-term goal of increasing the quality and quantity of the nation's wetlands base.
 - b. Regulatory programs must be efficient, equitable, flexible and predictable, and administered in a manner that avoids unnecessary impacts upon private property.
 - c. Nonregulatory programs, such as advanced planning and wetlands restoration, are vital elements of meeting the wetlands goals.
 - d. The Federal government should expand partnerships with state, tribal, and local governments, and the private sector, and approach wetlands protection and restoration in an ecosystem/watershed context.
 - e. Federal wetlands policy should be based upon the best scientific information available.
- Principal features of the plan include the following initiatives:
- a. The Administration will issue an Executive Order embracing the interim goal of no net loss of the nation's remaining wetlands and the long-term goal of increasing the quality and quantity of the nation's wetlands base.
 - b. The Corps will establish an administrative appeals process so that landowners can seek speedy recourse if permits are denied without having to go to court.
 - c. A regulation has been jointly issued (25 August 1993) by the Corps and the Environmental Protection Agency (EPA) ensuring that approximately 53 million acres of prior converted cropland will no longer be subject to regulation.
 - d. The Soil Conservation Service will be the lead Federal agency responsible for identifying wetlands on agricultural

lands under both the Clean Water Act and the Food Security Act.

- f. A revised regulation has been issued (25 August 1993) by the Corps and EPA ensuring that essentially all excavation activities in wetlands will be regulated. This regulation closes the loophole in the regulatory framework of the Corps Regulatory Program under which certain excavation activities in wetlands were not historically regulated.
- g. The Corps and EPA issued guidance to their field elements indicating that flexibility exists within the regulatory program in order to apply less rigorous review to permits for small projects with minor environmental impacts.
- h. All agencies will use the 1987 wetlands delineation manual pending completion of the National Academy of Sciences study scheduled for September of 1994.
- i. The Administration will endorse the use of mitigation banks; encourage and support incentives for states and localities to engage in watershed planning; promote the restoration of damaged wetland areas through voluntary, nonregulatory programs; and support increased funding for the U.S. Department of Agriculture's Wetland Reserve Program.

Existing Programs

Presently the Corps engages in a number of programs that positively affect the wetland resources of the nation. Given the Administration's new wetlands policy outlined above, these programs and activities can now be used to further this policy. A brief description of these programs follows:

- a. *Coastal America.* The Corps cooperates closely with nine additional Federal departments and agencies and

numerous state and non-Federal organizations in the development and implementation of this initiative. The initiative provides for joint actions to address three major natural resource problems along the coasts of the United States; (1) the management of contaminated sediments, (2) the loss and/or degradation of coastal habitats, including wetlands, and (3) pollution from non-point sources. In FY93, the partnership agencies continued 24 joint projects, each examining one or more of the three natural resource problem areas as identified in various regions of the country. These projects were implemented under the existing program authorities of the participating agencies. The 24 projects are located within 15 states and are valued at nearly \$10 million, one half of which is supported by non-Federal project sponsors. Upon completion of these 24 projects, nearly 5,000 acres of wetland habitat will have been restored, over 200 miles of spawning streams will have been opened by removing man-made restrictions, 50 farms will have implemented non-point source controls, and critical habitat for over 10 endangered species will have been protected. These projects are small to moderate by Federal government standards. However, they represent the beginning of a new way of doing business—one in which the combined talents and assets of the Federal, state, and local governments, and private interest can effectively begin to solve both immediate and long-term environmental problems. The Corps of Engineers has the lead on 6 of the 24 projects, all of which address wetland restoration.

- b. *Section 1135 Program.* This program was authorized by the Water Resources Development Act of 1986 and provides for modifications to the operations and/or structures of existing Corps projects to improve the environment.

FY93 expenditures in this program totaled \$7.5 million. Since the program's initiation, 59 studies have been initiated, 6 of which are now under construction and 4 of which are awaiting the initiation of construction. Among those either under or approved for construction, several address wetland resources. One project, the "New Cut" closure at Savannah Harbor, Georgia, will help with the restoration of nearly 4,000 acres of coastal freshwater marsh. Another, Salt Bayou at McFaddin Ranch, Texas, will enable improved water regulation to preserve and restore nearly 60,000 acres of fresh to brackish wetlands. Additionally, on 28 September 1993, the Director of Civil Works distributed a memorandum to his commanders requesting that Section 1135 be used to examine potential environmental opportunities associated with levee rehabilitation efforts under way in the Upper Mississippi River and Missouri River Basins as a result of the flood of 1993.

- c. *North American Waterfowl Management Plan.* The Corps signed a Cooperative Agreement with the U.S. Fish and Wildlife Service in 1989 for the continued coordination and cooperation to conserve, develop, and manage habitat for waterfowl and associated wetland species on Army civil works projects. A recently completed survey conducted on Corps lands indicates that these lands and waters are extremely important to migrating waterfowl. Over 49 percent of wetlands managed by the Corps (1.7 million acres) are found within habitats of major concern. In addition to wetlands used by waterfowl, the Corps also manages 7 million acres of open water that potentially provide important resting areas for migrating waterfowl. Activities conducted to date on Corps land under the auspices of the North American Waterfowl

Management Plan include: the restoration of 25,000 acres of waterfowl habitat, maintenance of over 1,000 wood duck boxes, seasonal plantings of wildlife food crops, management of seasonal waterfowl impoundments, and proposals for nearly 160,000 acres of waterfowl habitat restoration.

- d. *Corps/National Oceanic and Atmospheric Administration Agreement on the Restoration of Fishery Habitat.* In 1986, the Corps and the National Marine Fisheries Service (NMFS) entered into a demonstration program to determine the feasibility of both agencies collaborating in restoring fisheries habitat, including wetlands. Six sites from around the country were selected, and over 2 years, the demonstration was evaluated. Based upon the successful completion of the demonstration program, the Corps and NMFS entered into a formal agreement in 1991 to initiate a national program of fish habitat restoration and creation through the Civil Works Program. In FY93, there are 18 approved projects being examined under this agreement, seven of which involve wetlands restoration and creation.
- e. *Coastal Wetlands Planning, Protection, and Restoration Act.* The purpose of this act is to plan, design, construct, maintain, and monitor coastal wetland restoration projects that provide for the long-term conservation of coastal wetlands and dependent fish and wildlife in coastal Louisiana. The Corps is the chair of an interagency task force established by the Act that is composed of representatives of the EPA; the Departments of Interior, Commerce, and Agriculture; and the Governor of Louisiana. In FY93, \$33 million was expended on the program, which to date has generated 28 individual

projects for nomination, with the Corps having the lead on 6 of them. Additionally, a comprehensive plan to restore Louisiana's coast wetlands is being developed for submittal in November 1993.

f. Project-Specific Wetland Activities.

The restoration of wetlands is also a significant part of the Corps water resources development program as more and more project authorizations direct us to examine the feasibility of restoring natural resources, including wetlands, associated with the more traditional activities of flood control and navigation. In FY93, the Corps expended nearly \$46 million on wetland activities, including mitigation, restoration, and protection activities associated with over 90 Federal projects. Some examples of the types of wetland activities in which we are engaged include (1) purchase and management of nearly 18,000 acres of wetlands and the construction of waterfowl impoundments for the Tennessee-Tombigbee Waterway, Alabama and Mississippi; (2) development of a comprehensive plan for the environmental restoration of the Kissimmee River, Florida (including nearly 29,000 acres of wetlands); (3) continuing cooperative efforts with the Departments of Interior and Commerce, and EPA, on the Everglades National Park to restore the hydrology of the natural system; and (4) a feasibility study, in partnership with the state of Maryland and the District of Columbia, to develop solutions to various environmental problem areas within the lower reaches of the Anacostia River Basin, Maryland, including water quality, habitat loss (wetlands and fisheries), sedimentation, and the reestablishment of anadromous fish runs.

g. Corps Regulatory Program. The Corps Regulatory Program continues to provide strong protection for the nation's wetlands. During FY93, the Corps expended nearly \$86 million, issuing 100,000 authorizations, including approximately 10,000 individual permits. This is consistent with the level of regulatory activity over the last several years. As in the past, the vast majority of the activities authorized are only permitted after the Corps requires reductions in impacts and mitigation to offset the unavoidable wetland impacts through wetland restoration, enhancement, or creation. The Corps estimates that in FY93 it authorized impacts to 10,780 acres of wetlands and required 14,500 acres of compensatory mitigation. On 25 August 1993, the Corps issued a revised regulation ensuring that essentially all excavation activities will be regulated. This regulation closes the loophole in the regulatory framework of the Corps Regulatory Program under which certain excavation activities in wetlands were not historically regulated. With this added protection, the Corps now regulates essentially all construction activity that physically destroys or degrades wetlands.

h. Wetlands Research Program. In 1991, the Corps initiated a 4-year Wetlands Research Program designed to support water resources activities, i.e., planning, design, operation and maintenance, and regulatory. The purpose of this program is to develop and field-verify more rapid, cost-effective techniques and criteria for the (1) identification of wetlands, (2) delineation of wetland boundaries, (3) evaluation of wetland functions and values, (4) restoration, establishment, and protection of wetland resources, and (5) stewardship of Corps-owned wetlands. Products from this program are intensively coordinated with other

agencies' wetland programs and activities and will greatly improve Corps capabilities in wetland management and restoration. In FY93, \$6.8 million was expended on this program in the five areas listed above.

Discussion

BG Locurcio commented that the Corps has continuous wetlands across District boundaries, for example, on the east coast, and this leads to differing calls based upon differing judgments and definitions of the truth among the different District boundaries. He asked if there is a component that looks at the consistency of Corps regulation across District boundaries. *Dr. Klesch* responded that he did not think there was but that the research work units that deal with the wetland delineation should bring us closer together in terms of what really is called a wetland and how we regulate it. He said that one of the problems that has plagued the wetlands regulatory program is the disparity between the nature of calls made by Districts around the country. There are a number of things that contribute to that, some of which the Corps may be able to control by a stronger and tightly developed delineation manual.

Dr. Klesch does not believe that the Corps will be able to get away from some variability. He hopes that the research products that come out of the delineation of wetlands research area will help the Corps do a better job.

Dr. Komar asked if, within this overall program, were there specific studies relating to wastewater management. *Dr. Klesch* responded that the Corps of Engineers did some work in terms of how wetlands could be used to treat effluents. He also said he knows from personal experience that the private sector uses wetland plants to treat effluent from various types of food processing. *Dr. Klesch* said that when he was with the Baltimore District, he had an opportunity to look at a food processing plant on the Eastern Shore where a great deal of vegetables are grown. They took the water that was processed in that operation, which is a highly concentrated brine, and used a number of species of wetland plants to remove the brine before it was discharged back into a local river. He said the technology is there and he thinks it is just a matter of taking that technology and applying it innovatively to projects that the Corps anticipates doing in the future.

Shoreline Erosion Losses

David L. Ruple
Mississippi Department of Wildlife, Fisheries and Parks
Bureau of Marine Resources
Biloxi, MS

Diverse and complex natural processes within the nation's coastal zone serve to continually change the physical, chemical, and biological features of our fragile coastlines. Regional and local shoreline characteristics control the differing interactions and relative consequences of these natural processes. Small vertical changes in water level can impact coastlines dramatically on gently sloping coasts such as those found along much of the eastern coast of the United States and the Gulf of Mexico, but cause only minor shifts on steep slopes as found along much of the Pacific coast and on the steep, rocky New England shoreline. Natural processes that influence shoreline changes nationwide include waves, tides, littoral currents, water depth, sea level rise, subsidence, severe storm events such as hurricanes, and sediment transport.

Human activities in the coastal zone add yet another dimension affecting changes to our coastlines. Activities which modify and disturb the natural processes in the coastal environment can directly and indirectly impact rates of shoreline erosion and wetland loss. Sediment starvation, sediment trapping, water level changes, ship-generated waves, channelization, pollution, dredging, and overall coastal development influence the rates of coastal erosion.

Coastal erosion and wetland loss are serious and widespread problems of national importance with long-term economic and social consequences. A 1985 U.S. Geological Survey (USGS) study reports that a majority of the nation's coastlines are undergoing moderate to severe rates of erosion. Rates of coastal land loss in Louisiana have increased from 10 km²/yr to more than 100 km²/yr over the past century. While erosional rates are

somewhat less in other states, loss of coastal wetlands is a serious problem.

Approximately half of the northern Gulf of Mexico shoreline is considered to be seriously eroding. Portions of Louisiana shorelines have been reported to recede at 20 m/yr or more, while erosion rates of 4.5 m/yr can be found in many areas of Gulf states. Average coastal erosion rates in Louisiana are 4.2 m/yr and 1.8 m/yr along the northern Gulf of Mexico shoreline.

In Alabama, shoreline erosion has been calculated at approximately 2 m/yr along the northern shoreline of the Mississippi Sound, western Mobile Bay and Bon Secour Bay, with slightly lesser rates in most other estuarine areas.

Problematic erosion rates are experienced along many of Florida's barrier islands, mainland shorelines, and associated estuarine systems. Many beach restoration projects have been undertaken in Florida, replenishing the sediment budget of various coastal barrier beach systems which serve to protect vegetated coastal wetland areas. In the late 1970's, \$64 million was spent to replenish Miami Beach with 13 million cu m of sand.

As previously noted, Louisiana is experiencing the highest rates of coastal erosion and wetland loss in the United States. Louisiana's barrier islands help to support and protect at least 40 percent of the nation's coastal wetlands. These barriers protect the marshes and bays from offshore conditions and saltwater intrusion. Unfortunately, these islands are eroding at a very rapid rate between 4 and 19 m/yr.

Large sections of the Mississippi mainland are armored by concrete seawalls. Sediment budgets are supplemented in these areas by periodic replenishment projects. Extensive areas of coastal wetlands located in western Hancock County and eastern Jackson County are experiencing extensive land losses due to erosion. Average rates of erosion in the Hancock County marshes have been 3.9 m/yr over the past 70 years. During this same period, the Grand Bature Islands, which served as a barrier to the Point aux Chenes/Grand Bay marshes in Jackson County, have been totally eroded to below sea level.

Of the 587 km of Texas Gulf shoreline, approximately 60 percent is eroding at rates between 0.3 and 15 m/yr, 33 percent is stable and 7 percent is accreting. Every year along the Texas beaches, bay margins, and within alluvial valleys, nearly 1,500 acres are lost to erosion and land submergence. Wetlands constitute about 75 percent of this loss. Diversion of the Brazos River has impounded sediments that would have historically been transported to Sargent Beach by longshore currents. Consequently, the Sargent Beach area is one of the fastest eroding barriers in the state. Continued erosion threatens a large wetland system and the integrity of the Gulf Intracoastal Waterway.

Shoreline erosion is one of the major factors threatening the nation's coastal environment. Highly developed shorelines, residential developments, recreational beaches, protective barrier islands, and productive coastal wetlands are eroding, in many instances, at alarming rates. While many wetland restoration projects are currently under way or planned for areas of the Gulf coast, the potential for great losses due to erosion persists. Projected sea level rises, coupled with current erosion rates and certain shoreline protection projects (i.e., levees, bulkheads), are likely to result in major wetland losses in the future, as the path of retreating wetlands will be blocked. Nationally, wetland losses in such developed

areas may range from 50 to 90 percent, with a 5-ft rise in sea level.

Discussion

Dr. Dean asked whether the data quality of shoreline change is adequate for assessment and design or decision-making purposes. *Mr. Ruple* responded that because of the complexities of the issue of shoreline erosion and all of the various causes that contribute to the forces of erosion, the question is difficult to answer.

Dr. Dean commented that the one USGS map *Mr. Ruple* showed, which he thought was by Bob Dolan and his group, was a pretty broad-brush map. He said you really need a long-term database in order to develop a good average erosion rate or shoreline change rate. *Mr. Ruple* agreed and said that additional information on erosion rates has to be acquired before we can adequately address the issue.

Dr. Leonard M. Bahr commented that the Louisiana Geological Survey and the USGS have collaborated on a regular program to assess shoreline changes in the barrier islands in Louisiana. He did not know how much profiling has been done of the subsurface beaches. He read recently that this is being considered a problem in some areas; that the subsurface profile may be eroding much more quickly than what has surface expression. *Dr. Bahr* said there is a regular monitoring program in the most rapidly eroding island in Louisiana and he thinks there are pretty good data there.

Dr. Oswald asked if satellites are being used to monitor the erosion rates, monitor the status and quality and health of the wetlands, and, if so, how adequate is this technology. *Dr. Landin* responded that satellite technology is being used by an interagency group composed of the New Orleans District, U.S. Fish and Wildlife Service, Louisiana Coastal Restoration Division, and the U.S. Army Engineer Waterways Experiment Station to keep track of the losses that are

going on down there. She said satellite monitoring is very adequate, but that does not mean there is not room for improvement.

Subsidence: Implications for Coastal Wetland Restoration in Louisiana

*Dr. Leonard M. Bahr
Executive Assistant
Louisiana Governor's Office of Coastal Activities
Baton Rouge, LA*

Subsidence in coastal Louisiana, a combination of tectonic effects plus sediment compaction, dewatering and oxidation, is at least ten times greater than global sea level rise, which is currently estimated at 0.12 m/century (not including potential global warming effects). Present rates of subsidence along the Louisiana coast are up to 5 cm/year in the eastern deltaic plain and up to 1 cm/year in the more stable western chenier plain.

Continual subsidence, in the absence of sufficient mineral nourishment to allow wetlands to keep pace with apparent sea level rise, creates a "sediment deficit." This deficit was recently estimated at about 80 million m³/yr. Long-term reversal of Louisiana's coastal land loss will, therefore, ultimately entail the annual distribution throughout the coast of sufficient sediment to overcome this deficit.

This sediment, to be maximally effective, would have to be distributed at a rate of at least 10,000 lb (dry weight)/acre for 20 years. Distribution of this sediment has been estimated to cost about \$1 billion and would theoretically solve a major part of the land loss problem.

Testing the feasibility of a sediment distribution scheme will necessitate the development of certain technical information, including:

- a. Identifying sediment requirements by specific location.
- b. Identifying adequate sources of mineral sediments.

- c. Developing appropriate hardware and techniques to convey and distribute the sediment.
- d. Developing a program for implementing cost-effective sediment nourishment.

The use of abandoned oil and gas pipelines as a long-term distribution network for pumped slurried sediments offers much promise for the sediment conveyance problem. Other techniques that need to be developed and tested include new sediment dispersion hardware and new ways to use existing hydraulic dredging equipment. Sediment distribution would supplement the large-scale Mississippi River diversions and outfall management techniques that are already under consideration.

In the absence of this kind of dramatic action, 50-year projections of the Louisiana coastal zone imply the loss of over \$100 billion in resources and infrastructure.

Discussion

BG Locurcio asked where the environmental community might be on some of these innovative approaches. *Dr. Bahr* said he is dealing with that on a regular basis. For example, Kaiser Aluminum is generating material called spent bauxite. It is soil from Jamaica that is brought into the country and stripped of alumina using caustics. The remaining material is an iron-rich soil with a high PH that can be neutralized with acid. He said if we can find a use for this in terms of building salt marshes—and the high iron levels may be very appropriate for building marshes, because it would tie up sulfides—

that could be a win/win situation. They can get rid of a waste material that they have and we could build marshes that are sorely needed. *Dr. Bahr* said the same thing goes for dredged material. There is a scientist at Tulane University in New Orleans who has done some experiments on dredged spoil disposal in San Francisco, where he has used municipal sludge to tie up the heavy metals in some of the dredged material. It may make a very good soil supplement. *Dr. Bahr* said we need to try everything that we can, and he is very optimistic that the public will be less concerned once they understand what is at stake.

Dr. Komar commented that the subsidence in Louisiana for the most part is a natural process and you would expect the marshes to disappear naturally as well. He said what is absent in this picture geologically is the shift of the Mississippi River itself. What you would expect to naturally happen eventually with the disappearance of the marsh is that the river would shift back there. *Dr. Komar* asked if there is an option for diverting at least a bit of the Mississippi River through that area. *Dr. Bahr* responded that is one of the things that he is urging an open-minded look at. He said the whole technical community in Louisiana is urging a hard look at changing the ratio of flow at the Old River structure between the Atchafalaya and the Mississippi. He said it would be naive to do a sediment water budget of that river system without at least considering that possibility. That Old River structure is the world's biggest water control structure, and it has the potential to be used not only for flood control but also for marsh building, if the studies show that is an effective way to do it. He said even in the absence of changing that ratio of 70/30, which is the present ratio, the land building is very dramatic in the Atchafalaya. The Corps is doing a study right now to look at the feasibility of separating the navigation channel in the lower Atchafalaya from the marsh-building capability of the river.

Dr. Dean asked if an assessment has been made of the percentage importance, in terms of contribution to this problem due to natural causes and cultural processes. *Dr. Bahr* responded that he has seen estimates that 16 percent of the losses have been due to oil and gas canals, and another percentage has been due to impoundments of the river, the flood control system on the lower river. He said we had 5,000 years of net growth of this very rich delta system. And even though one channel would be a delta, a subdelta would form and then be abandoned and then erode back, there was still a gradual net gain. He said that gain was reversed when human beings started messing with the system. *Dr. Bahr* feels that the contribution to this problem is all cultural and it is incumbent upon us to find a cultural way to reverse it.

Dr. Dean asked what quantities of sediment are being carried offshore through channelization of the Mississippi. *Dr. Bahr* responded that he didn't know but that the numbers are available. He said that it has been estimated very recently that if we used the river system to the maximum extent possible, that is, if we diverted every drop that the Army would allow, we could build 10 to 12 square miles of wetland a year. That is about half of the 25 square miles that we are losing. The Corps has said on occasion that maybe 100,000 cu ft/sec of the total flow of the river could be available for diversions for building marsh. *Dr. Bahr* would argue that maybe we ought to look at it the other way; that if we say what is the minimum amount of water required for all the commercial uses of the river, navigation and dredging, drinking water, then everything else ought to be put up for grabs. We ought to be able to use that, if it is technologically feasible, to build marshes. *Dr. Bahr* said that one of the main considerations of the plan that the state is sending up to Congress right now is the consideration to essentially turn the river loose south of New Orleans, either into the Breton Sound to the east or into the Barataria Basin to the west. It has been estimated we could build a number of marshes on a fairly stable platform that exists there and then not

have to worry about the rapidly subsiding modern delta. He said that there are going to be all kinds of objections but we need to think of how we can build a functional coastline

that will do everyone the most good. The socioeconomic dislocation that will come along with this will have to be built into the cost of the program.

Development/Mitigation Required in Coastal Wetlands

*Patricia N. Bevel
Regulatory Program Specialist
U.S. Army Engineer Division, South Atlantic
Atlanta, GA*

The major threat to coastal wetlands is pressure of population growth. (Population of coastal counties is five times greater than that of noncoastal counties nationwide - coastal counties along the Atlantic Ocean are ten times more densely populated than inland counties.) Coastal systems include both wetlands immediately along the ocean and those lining rivers and bays that drain into the coast.

Human activity has converted wetlands from one category to another (swamps to marshes or open water). Airports in Boston, New York, and New Orleans are all built on wetlands. In freshwater marshes and forested wetlands, drainage and clearing for agriculture and silviculture have been major causes of loss. Other losses are the result of phosphate mining, industrial development, and oil and gas exploration.

Increased urban development and groundwater withdrawals have resulted in saltwater contamination of public water supplies in many coastal communities. Upland development alters drainage patterns. Inland levees, dams, and reservoirs have reduced water and sediment supply to coastal marshes. Around the periphery of many estuaries, networks of small canals are dug to speed water off urban and agricultural land (as a result, vital nutrients and sediment bypass wetlands). Coastal wetland flooding patterns change and salt marshes migrate inland.

All of these alterations can have a dramatic impact on the wetlands and the fish and wildlife species they support.

Losses associated with shoreline instability and coastal flooding are caused in part by construction and excavation undertaken on coastal property which destroy or alter beaches, beachfront dunes, beachfront bluffs, and beachfront vegetation. These natural features are essential factors in promoting shoreline stability and protecting upland properties from erosion and flooding. Continued development in these areas could necessitate future construction of erosion-preventing structures or devices which may directly or indirectly impact public access and use of public beaches.

Construction of new roads and widening of existing roads result in an increase in private development pressure in areas opened up by these projects. Some cross major expanses of tidal wetlands as well as freshwater wetlands located adjacent to tidal systems.

For example, bulkheading single lots in the Florida Keys affects developing mangrove fringes or aquatic plant communities on shorelines. Although many times no mitigation is required for minor impacts, Department of the Army permits are denied because of major wetlands impacts. The Jacksonville District is discussing regional mitigation bank approaches for such projects with the local government in the Keys.

Most single-family residential fills involve minor access/parking fills to get to buildable uplands, and mitigation is generally not required beyond avoidance. However, mitigation for large shoreline stabilizations for highway improvements, residential subdivision shoreline protection or large, single-family lot protection generally involves enhancing existing onsite wetlands through hydrologic manipulation (berm

removal, culverts, scraping areas to lower elevations, etc.), but wetlands creation is diminishing because of ineffectiveness.

Marina developments require shoreline protection, minor dredging, and docks. We have seen some creation or replanting of wetland vegetation in suitable areas, but have found seagrass restoration or replanting to be much too costly and uncertain to accept in some areas.

The coastal area of Mississippi is undergoing an enormous change caused by legalized floating gaming casinos, resulting in considerable pressure on the coast's infrastructure. Because of the lack of available uplands in the coastal area, parking facilities for the casinos and condo development for gaming workers will impact a number of wetlands. Developers have visions of hotels with golf courses. There are individuals now pursuing a change in the Alabama state law to allow gaming in Alabama.

Golf courses are being developed at a fast pace. Some have been designed and then redesigned to avoid wetland impacts or the project abandoned when wetland impacts cannot be avoided.

Of the types of mitigation available, restoration and enhancement mitigation have had a lot of success because once the initial restorative measures are made (removal of fill material to original contours or restoration of the hydro period) the other factors necessary are already present for the reconversion to wetlands.

Preservation mitigation alone has not been as desirable in tidal wetlands. These areas already exist, and the bulk of these tidal areas are being claimed by the states. In coastal freshwater wetlands, other forms of mitigation are usually preferred. However, in conjunction with restoration and enhancement, preservation can be an acceptable form of mitigation which can protect the area from future development.

Mitigation on a single large tract is more desirable than a multitude of small unconnected sites because fragmentation of wetlands can result in units too small to serve many of the valuable functions of wetlands. Consequently, mitigation banking can be of tremendous benefit. Most of the mitigation banks around the country have been developed by state highway departments, port authorities, and other local governments for their own projects or by public, non-profit entities such as refuges.

The U.S. Fish and Wildlife Service is attempting to expand its Mississippi Sandhill Crane Refuge in coastal Mississippi. Individuals are purchasing and deeding adjacent land to the Refuge as mitigation.

Because of the limited experience with commercial banks and the cost and uncertainty involved, interest in them has been slow but is likely to increase.

Marshes are being built in the Everglades agricultural area to store water for irrigation and to remove agricultural pollutants.

Wetlands have been designed and created to act as wastewater treatment facilities. Various local government agencies have begun working with the Mobile District on a proposed 1,400-acre wetland creation that will be used for waste treatment in South Mobile County.

Some states and counties are establishing beach setback lines.

One of the biggest problems that remains with development in coastal areas is poor planning, which results in detrimental impacts to the coastal ecosystem, such as: water quality, loss of habitat, erosion and sedimentation, loss of flood storage, and increased runoff.

(There was no discussion.)

Problems, Challenges, and Experiences in Coastal Restoration, Protection, and Creation

*Dr. Mary C. Landin
Environmental Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

The U.S. Army Corps of Engineers has restored, created, and/or managed close to one million wetland acres since the early 1970's; approximately one fourth of these are coastal. For example, over 60,000 acres have been created or restored using dredged material beneficially; the majority of these projects are intertidal. The experience and expertise gained in the past 20 years have provided the Corps with the necessary credentials to partner with other Federal agencies, states, and private conservation groups on numerous ongoing and completed wetland restoration, protection, and creation (RPC) projects. We expect to continue partnering these projects.

The National Academy of Sciences (National Research Council) recently completed two aquatic RPC studies, one on interior wetlands that has already been published, and one on the role of technology and engineering on coastal (marine) habitat restoration and protection. I coordinated work with the interior committee and am a member of the coastal committee. The information in our Academy report was put together by a 10-member committee from academia and private business. Our work is completed and will be published within the next 3 months.

Problems. Although considerable RPC information exists and numerous projects have been completed and monitored, the information is poorly distributed, resulting in a misperception that RPC is not working and is still very much experimental. A major RPC technology transfer effort is needed to counteract this.

Constraints are often not technical. Numerous technically feasible RPC projects are stopped or severely limited due to socioeconomic or institutional factors beyond the control of scientists and engineers.

Technical constraints tend to also be driven by cost factors, in that expansion and continuation of research in promising wetlands engineering and science technology is extremely limited by lack of public and private funding.

Some identified RPC technical research areas include the need for:

- a. Decision-making, user-friendly RPC software and inexpensive wetland personal-computer-based models.
- b. Innovation with geotextiles as temporary and permanent breakwaters.
- c. Bioengineering (the coupling of traditional engineering technology with living plant materials and biological techniques).
- d. Better equipment for working in wetlands.
- e. Better ways to accomplish multidisciplinary work efforts and partnering.
- f. Expansion of technology on techniques and plant materials for wetlands RPC.

Challenges. Our primary challenge as a Federal agency with specific missions that involve the coastal zone is to find low-cost and cost-effective ways to provide coastal

wetlands RPC. This includes seeking and continuing to work with other agencies and the private sector. It must include continued engineering and scientific research, because wetlands RPC is a rapidly evolving, dynamic research field. As an illustration of the interest in wetlands RPC, the American Society of Civil Engineers (ASCE) has had a Wetlands Task Committee for 4 years; ASCE will conduct a wetlands specialty conference in Washington, D.C., in May 1994.

Other Federal agencies with ongoing coastal wetlands RPC efforts include the U.S. Department of Agriculture Soil Conservation Service, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Minerals Management Service, military branches, numerous state agencies, and several private conservation groups. The challenge is to find better and more ways to finance RPC construction and research. To date, the great majority of moneys have been Federal; ways to bring the private sector and states into full funding partners should be sought.

Opportunities. Given the present condition of coastal erosion, subsidence, development, population growth, and sea level rises, opportunities for coastal wetlands RPC are so numerous that priorities probably should be set on projects by immediate (urgent) versus long-term need, by available funding, and by availability of cost-sharing and work-sharing partners.

Wetlands RPC is at a threshold of recognition and technical opportunities that opens numerous windows of laboratory and field engineering and scientific research. The Corps began much of the early wetlands RPC research with the Dredged Material Research Program and subsequent programs such as the Wetlands Research Program. The wetlands RPC train has left the station; for the Corps to be more than just a passenger, we must find more ways and means to continue building and repairing coastal wetlands, be allowed to take advantage of the RPC opportunities in projects as they arise, and continue coastal wetlands research.

Discussion

BG Locurcio asked if there was a time when the Environmental Protection Agency (EPA) was trying to launch into environmental master planning, which definitely related significantly to wetlands and programming development, and if there is any money attached to it to make that happen. *Dr. Klesch* responded that EPA has been very active in watershed planning. The White House has established a watershed and ecosystem management task force. On that task force there are representatives from most of the major Federal natural resource agencies. What extent the Corps is going to play in that and some of the more development-oriented organizations is too early to say because the task force is just at the very beginning in terms of the kinds of things they want to do.

Dr. Klesch reminded the Board of the fact that the Coastal America Program he mentioned earlier was begun under the Bush Administration. It has been examined by the White House Office of Environmental Policy and has been embraced by that office as a model on which future Federal activities ought to be conducted. In that mode, not only do the other Federal agencies, but also state agencies, play a very significant role.

BG Locurcio asked if there is any evidence of incentives being applied to the private sector such that they will incorporate various types of mitigation or creation activities as they plan and develop, other than through the regulatory process. *Dr. Klesch* responded that private organizations have come forward and want to get engaged in just that sort of activity. He added that Coastal America is very interested in habitat restoration work and in wildlife enhancement activities. They have come to the Corps of Engineers to simply (a) understand our environmental program, and (b) find ways in which they can partner in Corps activities. *Dr. Klesch* strongly feels there is an emerging interest on the part of corporate America to get more involved in these kinds of activities.

Mr. Holliday offered to the Board a concept that has not been previously addressed with respect to the use of dredged material. That is the transport of material through natural processes (like crevasses in levees) by placing large volumes of material in suitably arranged structures that could then be transported by water when water levels are high. This concept would be an alternative to physically pumping the material long distances. *Mr. Holliday* offered another option to be considered. Instead of using dredged material to paste a new marsh against one that is in a highly erosive area to start with, maybe sacrificial anodes or mounds of dredged material could be developed, that could then support and supply sediment to some of these marshes, rather than actually using the material to build the marsh. He said this concept would require research on what might be the best sediment transport techniques to design those mounds and material. *Dr. Bahr* pointed out that recent data indicate that there is limited ability to build marshes with the water transportation technique, because open channel conveyance is relatively inefficient for moving sediments. It moves water fine, but sediments fall out fairly quickly. He said the advantage of using slurried sediments through either abandoned or newly laid pipelines, is that cost-effectiveness goes up quite steeply when the sediment density increases, up to about 50 percent. *Dr. Bahr* felt strongly that we

need to try a whole spectrum of ideas and not close our minds.

Dr. Landin commented that the National Academy committee looked at cutting a new pass for the lower Mississippi River. The Corps gave no advice on that, because it felt like in the short time frame it did not have enough information in hand to make a recommendation. She said 30 percent of the water and 50 percent of the sediment is going down the Old River control structure, through the Atchafalaya, to form that new basin. Some of the sediment is going through the Mississippi River Gulf Outlet, and in a few other places some little bit is going through the crevasses, but something less than 50 percent is going off the shelf. She said they were considering cutting a new pass in an appropriate place that would put the material back into the drift system, just dredge a new channel, cut off Southwest Pass so that the material would get into the drift system and nourish the marshes in Terrabonne Parish and other places, and help recover marshes. It would mean a major study to evaluate the environmental as well as the engineering aspects. Somehow the environmental part of it has to become an economic factor, or it will never sell. But it would keep 100 percent of the sediments in the river in the Louisiana system, where they would like for them to be.

Wetlands Research Program Overview

Dr. Russell F. Theriot
Director, Wetlands Research and Technology Center
Environmental Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS

The U.S. Army Corps of Engineers (USACE) is required to evaluate and minimize the environmental impacts of its water resources projects to sensitive areas such as wetlands. In addition, the following legislations mandate USACE involvement in minimizing the destruction, loss, or degradation of wetland functions and in preserving and enhancing the value of existing wetlands: **Clean Water Act - Sections 404 & 401; Water Resources Development Act of 1990 - Sections 306, 307 & 409; and the River and Harbors Act of 1899 - Section 10.**

In order to achieve these environmental protection mandates, USACE must incorporate knowledge gained through research conducted by the Corps and others into a sound, logical, and technically defensible approach. This approach must include improved/cost-effective methods and techniques to:

- a. Delineate wetland boundaries and evaluate their functions and value.
- b. Minimize wetlands impacts from Corps projects.
- c. Create and restore wetlands at Corps-managed-controlled lands.
- d. Determine cumulative impacts of wetland losses.

The Corps' current Wetlands Research Program (WRP) was established to respond to these needs and is in the final year of its 4-year authorization. Because of the short time allotted to this program and the complicated ecological issues to be resolved,

the focus of the WRP has been to demonstrate state-of-the-knowledge techniques and methods for characterizing, restoring, creating, and managing our nation's wetlands resources.

Key areas of research and development within the WRP include:

- a. Improved wetland delineation techniques.
- b. Improved quantitative knowledge of functions and values of wetlands.
- c. Wetland stewardship and management on Corps lands.
- d. Restoration and creation techniques.
- e. Quantitative understanding of the critical processes of wetlands. Coordination and cooperation with Federal, state and local agencies, as well as environmental, conservation, and academic groups, have been important aspects of this program. Included in the WRP are cooperative research, data acquisition, and field demonstrations throughout the nation.

Some of the major products, listed by Task Area, that will be produced at the conclusion of this program include:

- a. Delineation and Evaluation.
 1. Hydrogeomorphic Classification System for Wetlands Evaluation Techniques.

2. Field indicators for wetland delineations for special problem soils and hydrologic situations in SE/NE USA.
 3. Refined evaluation techniques for bottomland hardwoods.
- b. Restoration and Creation.
1. Handbook on techniques, equipment, and structures for restoration, creation, and protection of bottomland hardwood coastal wetlands.
 2. Guidelines manual for construction design of bottomland hardwood and coastal wetlands.
 3. Interagency guidelines for monitoring the success of wetlands restoration and creation.
- c. Stewardship and Management.
1. Wetlands management techniques handbook.
 2. Handbooks for selection of wetlands plant species/vendors.
 3. Guidance manual framework for cumulative impact analysis.
 4. Guidance manual for USACE resource inventory and decision support system.
 5. Remote sensing of temporal/spatial wetlands changes.
- d. Critical Processes.
1. Predictive techniques for surface/groundwater processes.
 2. Predictive techniques for sediment processes in bottomland hardwood (BLH) wetlands.
 3. Predictive techniques for water quality processes in BLH's.
 4. Predictive techniques for soils/vegetation processes in BLH's.
- e. Interagency Coordination and Technology Transfer.
1. Establish an interagency wetlands research advisory group at the Federal level.
 2. Develop summary documentation of ongoing wetlands research activities for Federal agencies.

The development of more cost-effective and environmentally acceptable techniques and methods for the preservation, restoration, and enhancement of our wetlands resources will be applied to existing and future Corps water resources project plans. These operational tools will provide rapid and broadly applicable benefits to the Corps and the nation in complying with environmental regulatory requirements and the conservation of our valuable wetlands natural resources.

(There was no discussion.)

Wetlands Coastal Processes

*Jack E. Davis
Coastal Structures and Evaluation Branch
Coastal Engineering Research Center
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

Traditional coastal wetland research and engineering have focused on wetlands as indicators of coastal system evolution, as elements in dredged material management projects, as shoreline erosion buffers, and as part of the coastal sediment transport system. In essence, the wetlands were often considered only as part of a larger physical process or system. The wetlands themselves were not usually the focus of an investigation. However, with the development of our national and Corps policies recognizing the value of wetlands, projects are being undertaken solely for the protection, enhancement, creation, or restoration of wetlands.

In traditional coastal engineering projects, such as shore protection or beach nourishment, understanding the physical processes of the problems is imperative. The better we understand the processes of the problem, the more successful we are at solving the problem. Conversely, without an understanding of the processes, our solutions are often reduced to either solutions based on experience, solutions by trial and error, or solutions by educated guess. Coastal wetland engineering is no different. We must understand the physical, chemical, and biological processes of coastal wetlands to successfully develop solutions to the problems at hand.

The Corps' Wetlands Research Program (WRP) has devoted significant resources to developing our understanding of wetland processes. Understanding is being developed through two significant mechanisms, direct research and research applications. Under direct research, specific coastal engineering processes are being studied. For example, the

hydrodynamic and sediment movement processes in small coastal wetland pools (e.g., 100 m in diameter) in southern Louisiana are being evaluated. We are learning how wind-waves grow and propagate over very short fetches, muddy bottoms and through wetland vegetation, as well as how sediment erodes or deposits based on local waves and currents. In Texas, along the Gulf Intracoastal Waterway (GIWW), studies are being conducted to determine the relative influence of wind-generated waves versus boat-generated waves along the waterway.

Through several of our coastal wetland research applications we are learning about more general process relationships. For example, wetlands and associated shoreline protection designs are being constructed in the Chesapeake Bay, and along the Texas GIWW. The designs for the projects are largely based on current knowledge of general physical, chemical, and biological processes (not necessarily wetland processes). The projects are being monitored and evaluated to determine whether that knowledge is thorough enough. The questions that are being answered include: Is the shore protection performing adequately? Is it influencing the health of the wetland in any way? Are water level ranges adequate for the vegetation? Is the system flushing properly (i.e., is the water quality adequate)? Is the wetland being colonized by desirable plants, invertebrates, fish and wildlife? Is the wetland developing the desired functions? What were the flaws in the design and what caused them? By answering these and many other questions we will come to understand more about coastal wetland processes.

Through these studies and others in the WRP, the Corps is tackling directly the difficult and lengthy task of learning about coastal wetland processes and all of their many interactions. As this research advances, so too will our ability to solve coastal engineering problems in, around, and for wetlands.

Discussion

BG Chinen commented that in the New York District area there was a breach at Westhampton. When the breach occurred, there was much controversy by the environmental people. After the inlet developed and the water started mixing with the back bay, it was found that the inlet helped the back bay. So the fishermen did not want the Corps to close the inlet. *BG*

Chinen said that he is not so sure that a breach by itself is hazardous, it might have a good effect.

Mr. Jesse A. Pfeiffer commented that the breach at the Aransas National Wildlife Refuge was probably undesirable. He said those happen to be freshwater ponds and the whooping cranes do not like salt water.

Mr. T. Neil McLellan commented that in instances found in the Galveston District, the Intracoastal Waterway is introducing salt water into freshwater marshes and degrading them. In this instance, you have increased the salt water and killed the plants. Also, when that system is exposed to bay waves and increased tidal flushing, the bay deepens and becomes less stable for shallow and wading birds and that kind of habitat.

Wetlands Engineering

*Dr. Michael R. Palermo
Research Civil Engineer
Environmental Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

Introduction

This presentation summarizes ongoing efforts by the U.S. Army Corps of Engineers (USACE) to develop technical guidance for wetlands engineering. A successful wetlands restoration project must be based on a thorough understanding of wetland functions and processes along with their related engineering design considerations. The USACE, as a part of its Wetlands Research Program (WRP), is developing technical guidance on the engineering aspects of wetlands restoration. This emerging field can be referred to as "wetlands engineering."

Design Considerations

The planning, design, and construction of wetland enhancement and restoration projects requires a strong interdisciplinary effort, bringing together various scientific and engineering disciplines and interests. Wetlands needs, site characteristics, and design criteria; fill or excavation equipment and techniques for wetlands soils; wetlands hydrology and flow control; erosion protection; and techniques and materials for establishing wetlands vegetation must be considered. The technical approach for engineering these projects is based on the concept that design activities associated with establishing and protecting wetland substrate soils and providing the proper hydrology and hydraulics should precede those associated with establishing wetland vegetation.

Wetlands Engineering Guidance

A series of technical notes, reports, handbooks, and computer software related to wetlands engineering will be available from

the WRP to support the requirements of wetlands restoration projects. Manuals or handbooks on design criteria and wetlands engineering will be the primary technical guidance documents oriented toward field use. These handbooks will incorporate field experience and the results of research and will build upon and supplement earlier guidance documents prepared by the USACE, Soil Conservation Service, Federal Highway Administration, and others. A series of Technical Notes and seminar papers pertaining to wetlands engineering have been published through the WRP covering a recommended design sequence, vegetation selection and establishment techniques, soils handling equipment and techniques, wetlands hydrology, and wetlands hydrodynamics. The manuals on design criteria and wetlands engineering will build on the documents now available and will provide comprehensive guidance.

A workshop on wetlands engineering was held in St. Louis, MO, in August 1993 to provide a forum for exchange of information on engineering techniques for wetlands restoration and enhancement projects. Over 225 participants representing Federal, state, and local governments, private consultants, and other agencies attended the workshop, and over 50 technical papers were presented. Working sessions provided a forum for input from the participants on the content of the design criteria and wetlands engineering handbooks to be developed under the WRP.

The design criteria handbook will contain separate criteria for a variety of wetlands functions and geomorphologic wetland types. These criteria will define parameters such as depth and duration of flooding, soil

characteristics, and vegetation requirements to support the desired functions. The wetlands engineering handbook will provide the design and construction guidance. In addition to these manuals, a computer software package entitled WETER is being developed to assist the designer. WETER is a knowledge-based system, which will include modules on planning and site selection, design implementation, monitoring, and management. A framework for this software package is complete and the initial version should be available along with the design criteria and wetlands engineering handbooks.

Conclusion

The design activities for wetlands restoration and establishment include consideration of wetlands needs, site characteristics, and design criteria; fill or excavation equipment and techniques for wetlands soils; water and erosion control structures for wetlands hydrology; and techniques and materials for establishing wetlands vegetation. The recommended sequence for design is based on the concept that activities associated with establishing wetland substrate soils and hydrology should precede those associated with establishing wetland vegetation. By following an efficient sequence of activities for design, duplicative and unnecessary evaluations can be avoided and a fully integrated design will result. Future research planned under the WRP will provide more detailed guidance on wetlands engineering.

Discussion

BG Locurcio said that as he understands it, there is an Operations and Maintenance cycle to a wetlands project. You don't just build it and forget it; there is a maintenance cycle that follows. He said whenever someone builds a wetlands project, they are going to have to stay with it for quite a while and do maintenance on it to make sure that the original objectives are achieved. *Dr. Palermo* concurred and said it is more so for some types of restoration projects. Some of the

functions are functions that require more monitoring than others to ensure that these restoration projects are successful. He said they are trying to develop some guidelines on just what makes a restoration project successful and that, of course, involves monitoring.

BG Locurcio asked how the environmental community feels about the concept of wetlands engineering. He remembered that about 4 or 5 years ago they were somewhat adamant about the fact that they did not feel that you could engineer a wetlands into creation. He asked if that attitude changed. *Dr. Palermo* responded that there are some naysayers that make the statements that a man-created wetland is inferior to the natural wetland. He said that there is probably not an easy way to refute that, other than to monitor the sites and ensure that they are providing the functions designed for. *Dr. Palermo* thinks a lot of this depends on setting achievable goals to begin with, goals that all the environmental community are satisfied with.

Dr. Komar asked about how much confidence there was in the manual in answering the complex questions on wetlands processes. *Dr. Palermo* responded that the objective in this particular manual is not to be all-inclusive in describing wetlands processes but to focus on engineering approaches. For example, what will be included in the manual is how to go about designing detached breakwaters; how to design fabric dike erosion control structures or bioengineered erosion control measures, and not particularly focusing as much on the processes.

Dr. Komar commented that in the Northwest, Oregon and Washington, forests with diverse trees are cut down and replaced with tree farms that have one type of tree with all the same age. He said he has heard this same thing said about marsh restoration, that basically one species is planted and then you have a marsh. He asked if this is a valid interpretation of what is done. *Dr. Palermo* responded that it goes back to objectives that

you set in the beginning and what functions you want to accomplish with the restoration project. If you need a variety of species to support the functions that you design for, then that has got to be part of your planning and design process. *Dr. Palermo* said that some of the projects where marshes have been restored in past years go through a successional stage. In other words, you start out with one plant but as the years go by, the vegetation succeeds and new plants come in.

Dr. Oswald asked if the manual will address restoration of existing wetlands that are in a period of deterioration. *Dr. Palermo* responded that it can. He said it goes back to that initial statement of how you set your objectives. If your objective is to enhance the functions of a particular wetland, maybe that

wetland needs to be nourished with more substrate to build up the elevation slightly to better fulfill its functions. Maybe you need to add more water or keep more water away from it. He said it gets back to that type of an objective that you would set in the beginning.

Dr. Oswald asked if there is a chapter in the manual on assessment. *Dr. Palermo* responded that there will be a chapter on how to set achievable and compatible goals. In many restoration projects, they are not trying to restore one wetland function but would like multiple functions. One of the main things *Dr. Palermo* hopes to achieve is to provide guidance on which functions to select, a primary function or maybe one or more secondary functions that are compatible and can be achieved with one engineering design.

Bioengineering Practices in Coastal Wetlands

Hollis H. Allen

Botanist

Environmental Laboratory

U.S. Army Engineer Waterways Experiment Station

Vicksburg, MS

Bioengineering, which is the use of vegetation in combination with various low-cost building materials, can often be established to develop wetlands for a combination of purposes, such as erosion control and habitat development. It is usually less costly than traditional methods of erosion control using traditional structures alone and offers a more diverse and more species-rich habitat. Some bioengineering methods were tested to create wetlands at a coastal dredged material disposal site on Bolivar Peninsula, Galveston Bay, Texas.

The Corps of Engineers dredging program involves maintenance work and improvement of 40,000 km of navigation channels and 400 ports. It involves the annual disposal of about 230 million m³ of dredged material.

Dredging and disposal are expensive, and it is important to keep that material from washing and eroding back into the navigation channels or bays to reduce dredging requirements. Also, eroding material can contribute to the degradation of water quality and wildlife and fisheries habitat, but this degradation can be offset when dredged material is beneficially utilized by planting it with salt marsh vegetation.

The sandy dredged material deposits that are placed periodically on the edge of Galveston Bay during maintenance of the Gulf Intracoastal Waterway along Bolivar Peninsula erode rapidly into the bay. Various bioengineering methods tested in the last 10 to 15+ years have ameliorated this erosion in demonstration areas.

Marsh grass planted shoreward of a large sandbag breakwater in 1976 and 1977 on a dredged material plume at Bolivar Peninsula,

Galveston Bay, Texas, demonstrated that marsh establishment, when combined with some bioengineering methods, such as a low-cost breakwater, is possible (Allen et al. 1978, Webb et al. 1978). A breakwater 300 m long and 1.5 m high was constructed from 0.5- by 1.4- by 2.9-m nylon bags. Sprigs of smooth cordgrass (*Spartina alterniflora*) were planted immediately landward of the breakwater. Before this project, no natural marsh existed on this side of Galveston Bay because of the high-energy conditions. The sandbag breakwater provided enough initial protection of the transplants to permit marsh establishment. Despite the eventual degradation of the breakwater structure, the marsh has continued for over 10 years (Landin 1986).

Floating tire breakwaters (FTB) and shoreward salt marsh plantings have been successfully used to stabilize shores of unconfined dredged material deposits at two sites on the gulf coast. In 1981, an FTB and smooth cordgrass sprigs stabilized part of the dredged material dike on Gaillard Island in Mobile Bay. Another FTB and a pole/tire breakwater with plantings behind them, and other plantings unprotected by breakwaters were tested in 1984 at Bolivar Peninsula, Texas. These methods were tested at a site 1 km west of the previously discussed 1975 high-energy site where large sandbags were used for a breakwater (Knutson, Allen, and Webb 1990).

Various treatments incorporating erosion control mats and plant wrappings have been tested to establish smooth cordgrass on bay shorelines (Allen, Webb, and Shirley 1984). Three of the most promising of these treatments plus two additional treatments

(one each of single-stemmed and multiple-stemmed plantings of marsh grass sprigs) were installed in four small replicated demonstration plots at Bolivar Peninsula in July 1984. In addition, two different configurations of tire breakwaters, a fixed-tire breakwater made from poles and tires and an FTB, were placed adjacent to the replicated treatment area for comparison of techniques.

The FTB with plantings behind it and erosion control mats with plants sprigged into them were the most successful of the bioengineering methods used. Plants established successfully behind the FTB, whereas the fixed tire breakwater was battered apart and plants were subsequently washed away. Three of the four replicated treatments using erosion control mats showed substantial spread and colonization after 5 years.

At this time, if the above bioengineering methods were being contemplated for further dredged material stabilization and wetlands development at Bolivar Peninsula, the safest course of action would be to select a combination of methods consisting of the FTB and the erosion control mat placed shoreward of the breakwater.

References

- Allen, H. H., et al. (1978). "Habitat development field investigations, Bolivar Peninsula, marsh and upland development site, Galveston, TX, summary report," Technical Report D-78-15, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Allen, H. H., Webb, J. W., and Shirley, S. O. (1984). "Wetlands development in moderate wave-energy climates." *Proceedings of Conference, Dredging '84*, Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Clearwater Beach, FL, 943-55.
- Knutson, P. L., Allen, H. H., and Webb, J. W. (1990). "Guidelines for vegetative erosion control on wave-impacted coastal dredged material sites," Technical Report D-90-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Landin, M. C. (1986). "Wetland beneficial use applications of dredged material disposal sites." *Proceedings: 13th Annual Conference on Wetlands Restoration and Creation*, Hillsborough Community College, Tampa, FL.
- Webb, J. W., et al. (1978). "Habitat development field investigations, Bolivar Peninsula, marsh and upland habitat development site, Galveston Bay, TX: Appendix D," Technical Report D-78-15, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Discussion

Dr. Dean commented that it was very clear that plant survival is limited by the wave activity. He asked if there is an upper limit of wave height that these plants can withstand while they are being established. *Mr. Allen* responded that more research needs to be done in this area, but generally speaking, if you get much more than a 2-ft wave height, you are talking about much more substantial-type engineering structures than these.

Dr. Dean commented that in the case of the tire breakwater, once the plants were established, they did not need the tire breakwater anymore. The tire breakwater's main function was just to get the plants established, and then they took off, even beyond its perimeter. *Mr. Allen* concurred and added that over on the sandbag breakwater, the sandbag breakwater subsided, but it got oysters established on it, which helped protect the front edge of that marsh for a while before the oysters were harvested. Once the oysters were harvested, the breakwater was no longer protected and the marsh started degrading. *Mr. Allen* said, however, that marsh has been in place for 18 years, so eventually this may lead to the opportunity of disposing dredged material

alongside it or in front of it for more wetland development.

Breakwaters for Wetland Restoration and Protection

*John W. McCormick
Coastal Structures and Evaluation Branch
Coastal Engineering Research Center
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

Significant loss of coastal wetlands due to wave-induced erosion has led to the need to restore or protect existing wetlands with structural means. Low-crested breakwaters used in combination with dredged fill and marsh grass plantings are increasingly being used to establish wetlands and control erosion along estuarine shorelines. Several sites are being monitored in the Chesapeake Bay and the Gulf of Mexico as part of the Wetlands Research Program to evaluate the structure's influence on resulting wetland habitat with the objective of improving existing wetland restoration and protection design guidance.

Coastal wetlands have been identified as being extremely valuable, mostly because of the wide variety of functions they provide such as aquatic and wildlife diversity and abundance, sediment stabilization and retention, recreation, and erosion and flood protection of upland habitat. Loss of such wetlands not only means loss of an aesthetically pleasing piece of our landscape, but loss of all associated functions, including loss of erosion and flood protection to upland habitat.

Erosion of the marshes primarily takes place at the seaward edge of the root mat. The marsh is very resistant during storms in which water levels are high and waves pass over or break on top of the marshes' strong root mat. Marsh erosion does occur as a result of offshore deepening and undermining of the root mat at the seaward edge during lower tide levels. Offshore breakwaters

provide the needed protection to establish new vegetation and prevent the existing vegetation from being undermined and eroded. Segmented detached rubble-mound breakwaters provide additional benefits of allowing uninterrupted nutrient and sediment supply to the wetlands as well as beneficial fish and shellfish habitat. Once the vegetation becomes established, the combination of breakwater and wetland can provide equivalent upland protection throughout a functional lifetime similar to frequently used hard structures such as bulkheads.

Past projects involving detached breakwaters to aid in wetland creation/stabilization have used design guidance similar to that used for beach stabilization projects for both structural and functional design. The increased tolerance of wave transmission for a vegetated shoreline and the wave attenuation characteristics of marsh grasses are not always directly incorporated into the overall design. Monitoring existing projects will improve our understanding of the relationship between the magnitude and frequency of transmitted wave energy and resulting wetland success. Improvements in existing wetland restoration and creation design guidance will concentrate on blending recent guidance for low-crested breakwaters with empirical methods of predicting wave attenuation by vegetation to result in cost-effective stable wetland habitat.

(There was no discussion.)

Numerical Modeling of Wetland Processes for Restoration and Protection

*Joseph V. Letter, Jr.
Estuarine Processes Branch
Estuarine Division
Hydraulics Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

Coastal Louisiana is experiencing extensive loss of wetlands associated with regional subsidence and erosion. The majority of Louisiana coastal wetlands were created by deltaic growth over a geologic time scale associated with the Mississippi River. The river has generated a series of deltaic lobes which experience a growth period followed by a decay cycle when subsidence causes the deltaic wetlands to revert back to open water. Subsidence has recently converted large areas to open water, increasing salinity intrusion into previously freshwater marsh. The changing salinity regime stresses the vegetation, making these areas vulnerable to erosion. This process accelerates the decay cycle for these wetlands.

A number of engineering efforts have been made in Louisiana to attempt to either create new wetlands or to restore or protect vulnerable areas. Research as part of the Wetlands Research Program is under way to demonstrate several of these engineering efforts. The purpose of the research is to illustrate the techniques used for the design and implementation of these efforts.

Four demonstration sites were selected. The first of these is the Tiger Pass dredged material placement effort, within the lower Mississippi River Delta. Alternative methods of placing the dredged material for potential wetland creation and restoration were attempted. These included placement in open water, within a diked disposal area, and within an area contained by hay bales. In addition, open-water placement in deeper water was attempted for possible creation of a bird island. The dredging activity in

November 1992 was the execution period for the effort. The initial experience with the hay bales was not successful, with the large rolled bales being displaced and containment ability diminished. The open-water placement for the bird island was dispersed and no discernable mounding was apparent.

The Mississippi River Delta splay cuts are an attempt to influence the natural deltaic activity within the delta. Cuts are made in the natural levees that flank the primary distributary channels within the delta at an angle consistent with the natural bifurcations occurring within the delta (approximately 60 deg). These splay cuts have been constructed by the Louisiana Department of Natural Resources in cooperation with the Louisiana Department of Wildlife and Fisheries and the U.S. Fish and Wildlife Service. The location of these splay cuts has been loosely coordinated with the U.S. Army Corps of Engineers to minimize the impact on the navigation channels; however, no clear design for overall influence on the delta has been performed. Process modeling is being performed to address the comprehensive delta response.

The Naomi Siphon is a structure that diverts fresh water and sediment from the Mississippi River into wetlands within the Barataria basin. The structure discharges 4,000 cfs into a receiving pond and local distribution channels. The receiving wetlands also have some bank stabilization and earthen dikes with weirs to control the movement of the diverted waters in an attempt to maximize local sediment retention. The diversion is being simulated with a process model of the

entire Barataria basin to estimate the overall effectiveness of the siphon.

Fina La Terre marsh management area is located within the Terrebonne marshes and is semi-enclosed by levees with control weirs. An earlier study performed by Louisiana State University (LSU) found that the managed site was performing worse than a nearby control site with regard to sediment deposition and freshwater retention. Apparently the levees were actually keeping the ambient sediments and nutrients from the system from effectively exchanging with the area. The monitoring of the site has been extended to include a period of revised management procedures for the weirs for effectiveness. This extended work is being performed by LSU under contract to the U.S. Army Engineer Waterways Experiment Station.

As a means to develop process models for each of the demonstration sites, a comprehensive bathymetric database (summarized below) has been developed for the coastal Louisiana wetlands from the Mississippi River Delta westward to Atchafalaya Bay.

Wetland Site Characterization				
Site	Natural Sediment Supply	Current Velocity	Wave Energy	Sediment Supply Potential
Delta (Splay cuts)	High	High	Medium	High
Naomi (Siphon)	Low	Low	Low	High
Tiger Pass (Placement)	High	Medium	High	High
Fina LaTerre (Management)	Low	Low	Low	Low

Discussion

Dr. Dean asked about the status of these different projects. *Mr. Letter* said that the delta splays have been constructed as an ongoing activity over the past 10 years, and a number of them have already been constructed. They tend to grow naturally, and then they experience their own little minute delta decay cycle. So they tend to grow, reach a maximum size, become hydraulically inefficient, and then actually die off. The splay cuts tend to choke off, then they will go and make another one. The Naomi Siphon was just completed last summer, and has been put into operation and is being monitored now. The dredged material placement at Tiger Pass was conducted in November of 1992 and the dredging cycle there is every 2 years. The Fina LaTerre site was originally monitored by LSU under contract to the Minerals Management Office in Louisiana. They looked at a control site outside the banking area, and then they monitored the site itself. They found out that the management strategies were starving the site from nutrients and sediment. So as part of this research program the Corps talked with LSU and the owner of the site, which is an oil company, and agreed to modify the weir operational strategy in an effort to try to increase the amount of retention. The weirs are operated in a way that would allow for an inflow of the ambient water into the site.

Using Geotubes for Engineering and Environmental Projects

Robert N. Blama
Project Manager/Ecologist
Operations Division
U.S. Army Engineer District, Baltimore
Baltimore, MD

The U.S. Army Engineer District, Baltimore (NAB), in conjunction with the National Marine Fisheries Service, conducted a series of demonstration projects using dredged material. One such beneficial use project was located at Twitch Cove, Smith Island.

Smith Island, Maryland and Virginia, is one of the few remaining inhabited islands in the Chesapeake Bay. It has historically been surrounded by a myriad of submerged aquatic vegetation (SAV). In recent years, SAV has declined throughout the bay and attempts have been made to reestablish the plants. In addition to the loss of plants, the island itself has experienced losses as a result of erosion.

During the period of June and July 1987, a Federal navigation channel at Smith Island was dredged and the materials, largely silts, were placed along the Eastern shore of the island at Twitch Cove. About 24,000 cu yd of dredged material was placed in order to shoal the bottom depth and provide suitable substrate for establishment of a seagrass bed. The bed would in turn provide a nursery habitat for juvenile fishes and a shedding area for blue crabs. The Twitch Cove site was selected because of its proximity to the navigation channel to be dredged and the absence of SAV. It was hypothesized that the absence of seagrass at the site was due to deeper than optimal water depths, which resulted in insufficient available light under prevailing turbid water conditions. By raising the bottom with dredged material, conditions were intended to be brought within appropriate light levels for seagrass establishment. The area was to be planted

with eelgrass (*Zostera marina*), a native plant found in the Smith Island area.

To help protect the plants from damaging wave energies and retain the dredged material from dispersing, three Longard tubes were placed along the site in a configuration of the letter "L." A Longard tube is a double-lined polyethylene impermeable inner liner and geotextile outer liner, about 110 cm in diameter and 100 m in length. Two holes about 0.5 m in diameter are cut into the fabric and a flange is attached. The tube is then stretched to its entire length and filled hydraulically with sand. The system used was an independent hopper with a 6-in. line. As the tube is filled, it settles to the bottom and once filled, the two holes are capped. The tube is sturdy enough to be walked upon and provides a surface for epibenthic organisms. The weight of the tube prevents it from rolling and also acts to dissipate wave energy to produce a quiescent environment behind the tube.

The dredged material was placed behind the tubes and allowed to settle for about a month, and a 3-acre site was planted. Planting was conducted in September 1987 using a transplant spacing of 2 ft on center. This spacing required the planting of 32,670 units of eelgrass. The plants were obtained from nearby native stands of vegetation.

The substrate elevations throughout the planting area ranged from -2.7 to -4.3 ft mean low water. The tidal range in the area is 2.0 ft and, therefore, covered the tubes with 1-2 ft of water at high tide, which may not have provided the wave dampening effect anticipated.

To obtain a quantitative measure of seagrass survival at the site, the National Marine Fisheries Service conducted surveys in July 1988 and June of 1989 and 1990. A grid of 150 points was laid across the planted area. In July 1988, the survey yielded 33 eelgrass contacts at the 150 grid points. Extrapolation of the 150-m² sampled area to the 12,541.5-m² total transplant plot gives an estimate of 2,822-m² (22-percent) site coverage after 1 year. This represents about 0.69 acre of seagrass habitat. The survey indicates that a substantial portion of the initial transplants had been lost within the first year, but also that the planting units in the central portion of the plot had undergone some detectible growth.

In June 1989, the site was resurveyed in a manner identical to that of the previous year. A total of 31 eelgrass contacts were obtained, and in 1990, 37 sea grass contacts were encountered.

Survival of eelgrass in the central portion of the plot for 2 years after transplanting indicates the success of the Longard tubes to prevent eradication of the plants by storm events or the transporting of dredged material away from the site. Over time, the dredged material can be expected to consolidate and further stabilize. The fact that survival was largely limited to the center of the plot may reflect a response of the planting units to adequate lift of the preexisting bottom only in that area. The volume of dredged material placed at the site may not have been sufficient to optimally raise the bottom. The distribution of surviving seagrass may also be indicative of the amount of protection provided by the Longard tubes. An additional benefit derived from the Twitch Cove project is from the natural recruitment of widgeon grass (*Ruppia maritima*), which is found in the area.

Another use of geotextile tubes (Nicolon) in the District was to serve as offshore segmented breakwaters for erosion control. The U.S. Fish and Wildlife Service constructed segmented rock breakwaters adjacent to their Eastern Neck Wildlife Refuge. The NAB extended the breakwater design by using two geotextile tubes the same length as the existing breakwaters (about 75 ft), placing dredged material behind the structures, and planting with cordgrass (*Spartina alterniflora* and *S. patens*).

One tube was placed parallel to the breakwaters but was at a depth that it is covered by mean high water (mhw). The other tube was placed closer to shore so it would extend above the surface at mhw. The tubes were filled directly from the dredge by using a 12-in. discharge line inserted into the tube. The use of a "Y" valve diverted some of the material as beach nourishment and also controlled the flow of material entering the tube. The tubes were semipermeable, which allowed the water to pass through but retained the material. Since the material was dredged from the channel, it contained all grain sizes along with shell and other material.

After placement of the material, the dynamics of the wave action redistributed the sand to form the expected tombolos. It appears that the geotubes are working in the same manner as the breakwaters since the depths behind the tubes are becoming shallower. The nearshore tube has captured enough sand that the beach has extended to the tube. The tubes are also acting as substrate for benthics and algae and many fish have been seined along the tubes.

Discussion

BG Locurcio asked if there were toxins in any of that fill. Mr. Blama responded that the fill was tested and there were no toxins. It was clean fine sand.

The Restoration of Batiquitos Lagoon

*Lisa W. Sales
Engineering Division
Los Angeles Harbor Department
WORLDPORT LA
Los Angeles, CA*

The Port of Los Angeles is restoring a degraded wetland located in Carlsbad, CA, as mitigation for its 2020 Program outer harbor landfills. Batiquitos Lagoon is currently shut off from tidal influence by a naturally occurring cobble berm at the inlet and is filling rapidly with organic and fine sediments. Consequently, predictions are the lagoon will become upland habitat in approximately 50 years if tidal influence is not restored.

The Batiquitos Lagoon Enhancement Project is comprised of the following elements:

- a. The physical reconfiguration of the lagoon and lagoon bottom through dredging and excavation as required to restore tidal inflows and aid in maintaining a permanently open lagoon inlet.
- b. The placement of approximately 3.0 million cu yd of sand for beach nourishment.
- c. Construction of 32 acres of California least tern (an endangered species) nesting sites.
- d. Construction of a nonnavigable tidal inlet structure.
- e. Modification or replacement of four bridges that cross the lagoon.
- f. Relocation of several utilities and the creation of subtidal and intertidal habitat suitable for the propagation of various wetland plant species.

Many challenges will be faced during design and construction of the lagoon restoration to accommodate the following project requirements:

- a. Creation of wetland habitat with 1V:300H slopes in some areas.
- b. Limiting construction activities during the least tern nesting season from 1 April through 1 October of each year.
- c. Protecting sensitive vegetation at the site by maintaining water levels within a defined range and restricting access of construction equipment.
- d. Moving dredges under low hanging bridges from one section of the lagoon to another.
- e. Restricting beach nourishment activities during certain seasons of the year.
- f. Performing all construction work to meet stringent air and water quality standards and noise restrictions.

The Batiquitos Lagoon Enhancement Project is the largest restoration project of its kind in the nation. The Project has been subject to research, review, and scrutiny for the past 8 years by various private parties, technical experts, and environmental interest groups. The Project will continue to be highly scrutinized throughout construction and the 10-year monitoring program to follow. It is imperative that this restoration project achieve success for future restoration efforts to be allowed.

The construction elements individually hold no particular challenge for a contractor. However, the coordination of the elements, the interesting dredge issues, and the sequence in which the elements must occur in order to comply with the permit conditions make the Project a challenging one for even the most experienced dredge contractor.

Discussion

Dr. Dean commented that the Port of Los Angeles's liability is limited to this \$8.5 million. He asked, if the jetties do not perform as designed (for example, if the lagoon entrance closes up), then will the \$8.5 million absolve any further responsibility of the Port. *Ms. Sales* responded that to date, that is the way the Port of Los Angeles would like to view that.

Wetlands Creation/Atlantic Intracoastal Waterway North Carolina

*G. Frank Yelverton
Environmental Resources Branch
U.S. Army Engineer District, Wilmington
Wilmington, NC*

The U.S. Army Engineer District, Wilmington (SAW), was one of four Districts that participated in the pilot study to determine the feasibility of establishing a nationwide program of fisheries habitat restoration and creation. This work was accomplished under the October 1985 agreement signed by the Administrator of the National Oceanic and Atmospheric Administration and the Assistant Secretary of the Army (Civil Works).

The SAW project proposal not only involved the creation of fisheries habitat by planting marsh (saltmarsh cordgrass and salt meadow hay) and sea grasses (eelgrass and shoalgrass), but also included erosion control and long-term monitoring of habitat value of the created sites compared to nearby natural sites. This was a cooperative effort between the National Marine Fisheries Service (NMFS), the U.S. Army Engineer Waterways Experiment Station (WES), North Carolina State University (NCSU), and SAW. NMFS designed the marsh and sea grass general replicate planting plan and planted the sea grass. In addition, NMFS monitored the long-term growth of the sea grass and long-term habitat value of the marsh and sea grass. WES provided advice on marsh plant spacing, type of plants to use, and special planting techniques (e.g., plant rolls). NCSU planted the marsh grass and monitored its long-term growth and productivity. SAW designed the slope profile needed for the marsh and sea grass planting, and monitored the long-term change in the graded slope profile at each site. SAW also provided funds for the grading work required at each site, planting of the marsh and monitoring, sea grass planting, and participation by WES.

Two sites are diked disposal islands located on the Atlantic Intracoastal Waterway (one near Sneads Ferry and the other near Swansboro), and the third site is a sandbag-diked disposal island located in Core Sound near Harkers Island. The Harkers Island site is adjacent to the channel from Back Sound to Cape Lookout Bight. Dredged material is placed on the upland portion of these areas about once every 3 years and disposal will continue at that frequency.

The grading activity was performed in the winter of 1986-87, the marsh was planted in the spring of 1987, and the sea grass was planted in the spring and summer of the same year. In addition, sand fence was installed and American beach grass was planted on the interior of each site in an attempt to stabilize the adjacent sands to prevent wind erosion of the sands onto the pilot sites.

The marshes completely covered their planted area within two growing seasons. Both above- and below-ground productivity were essentially equal to natural marsh within 3-4 years, which is the same as has been reported in the literature. Sea grass survival was poor at Sneads Ferry and Harkers Island, probably due to high turbidity. Survival was better at Swansboro, but coverage was not complete due to strong currents.

Habitat value of the sites is being measured primarily by faunal use. Two years of data are available for the marsh at all three sites and three years for the sea grass at Swansboro. After 2 years, crab and shrimp use of the planted marsh was not significantly different from the natural marsh, but fish use was still significantly different from natural marsh. After 3 years, shrimp use of the

planted sea grass was not significantly different from the natural sea grass, but fish and crab use was still significantly different from natural sea grass.

A comparison was made between planting marsh and sea grasses, and the costs of relatively inexpensive erosion control

structures such as sandbags. In most cases where extensive grading is not required, planting is more cost-effective. However, as with structures, planted sites may involve long-term maintenance issues.

(There was no discussion.)

Coastal Wetlands Planning, Protection, and Restoration Act

COL Michael Diffley
Commander
U.S. Army Engineer District, New Orleans
New Orleans, LA

Discussion Topics:

- a. Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA).
- b. Assessment of the Resource.
- c. Problems Impacting the Resource.
- d. The Restoration Plan.
- e. Issues.

CWPPRA...What the Act (Title III of Public Law 101-646, 29 November 90) Directs:

- a. Establish a Task Force consisting of the Secretary of the Army (as chairman); the Administrator of the Environmental Protection Agency (EPA); the Governor of the state of Louisiana; the Secretary of the Interior; the Secretary of Agriculture; and the Secretary of Commerce.
- b. The Act directs the Task Force to plan, design, construct, maintain, and monitor vegetated wetlands restoration projects to provide for the long-term conservation of wetlands and dependent fish and wildlife populations in the coastal wetlands of the state of Louisiana.
- c. Actions directed by the Act for accomplishment by the Task Force:
 - (1) Planning Budget (100 percent Federal) @ $\approx$ \$5 million per year to develop annual Priority Project

Lists (1991-2000) with construction to be Federal/state cost shared (75 percent/25 percent) @ $\approx$ \$40 million per year with all projects to be substantially completed within 5 years from selection for a priority list (thus, all completed by 2005).

- (2) Monitoring and reporting results of all completed wetlands restoration projects.
- (3) Comprehensive (coast-wide) Restoration Plan to be completed in Nov 93.
- (4) Conservation Plan to be developed by state under grant from EPA with oversight and review by Corps of Engineers and the U.S. Fish and Wildlife Service.

Accomplishments Since 11 January 91 (First meeting of Task Force):

- a. Established interagency Federal/state processes.
- b. Established committees for public and academic input.
- c. Conducted over 20 public meetings.
- d. Developed three priority project lists, 46 projects totaling approximately \$120 million.
- e. Established project monitoring procedures.

- f. Developed model cost-sharing agreements.
- g. Executed 11 cost-sharing agreements with the state.
- h. Initiated real estate actions on six projects.
- i. Completed and published draft Restoration Plan/EIS Jun 93.

Membership of the Citizen Participation Group:

Consists of 17 individual organizations representing environmental, conservation, commercial and sport fishing, landowner, shipping, farming, local government, and various other special interests. Currently chaired by Executive Director of the Coalition to Restore Coastal Louisiana.

Graphic of Louisiana's Coastal Wetlands:

Coastal Louisiana, comprising 40 percent of the continental United States' wetlands, is experiencing 80 percent of the nation's wetlands loss.

Assessment of the Resource:

- a. Coastal Louisiana's productivity.
- b. Coastal Louisiana's infrastructure.
- c. Coastal Louisiana's intangibles.
- d. Total capital investment over \$100 billion.

Graphic of Louisiana's Coastline in the Year 2040:

Between 1956 and 1978, about 550,000 acres of marsh were lost in coastal Louisiana, in addition to another 790,000 acres lost over the years to agricultural, industrial, and urban use conversions, totaling almost 1.4 million acres. By 2040, an estimated additional

1 million acres of marsh will disappear. This translates to the Gulf of Mexico advancing inland as far as 33 miles in some coastal areas.

Problems Impacting the Resource:

- a. Subsidence.
 - (1) Sediment deprivation.
- b. Flooding.
 - (1) Sea level rise.
 - (2) Highways.
 - (3) Spoil banks.
 - (4) Levees.
- c. Saltwater intrusion.
 - (1) Navigation channels.
 - (2) Oil and gas canals.
 - (3) Tidal flux.
 - (4) Reduced freshwater input.

Impacts:

- a. Fisheries reduced $\approx$ \$220 million per year.
- b. Infrastructure lost $\approx$ \$1.5 billion.
- c. Additional flood control costs $\approx$ \$800 million.
- d. People displaced as homes or jobs are lost $\approx$ 73,000.

The Comprehensive Restoration Strategy and Plan Features:

- a. Kinds of projects proposed include freshwater and sediment diversions, barrier island restoration, hydrologic restoration, marsh management, delta management, shoreline protection, beneficial use of dredged material and vegetative planting at an estimated cost $\approx$ \$1.2 billion.

- b. The area of coastal wetlands created, protected, or restored would be about 203,000 acres...70 percent of the projected "without project" losses.
- c. Provides an opportunity to strike a new balance to help sustain commercial fisheries and avoid infrastructure losses and escalating flood control losses.
- d. Bottom line: Attractive immediate return and an option on the future.

Considerations for Implementing the Restoration Plan:

- a. The CWPPRA Task Force concept works.
- b. Existing Trust Fund works for projects ≤ \$5 million.
- c. But...long-term success of the plan hinges on several kinds of large projects not fundable under the existing Trust Fund:
 - (1) Major river diversions.
 - (2) Large-scale navigation locks or gates.
 - (3) Barrier island restoration.
 - (4) Extensive shoreline protection.

Discussion

BG Chinen asked if this was a Mississippi River and Tributaries (MR&T) project and what is the cost-sharing formula for this project. *COL Diffley* said that this is not an MR&T project but rather a separate authority. He said that right now the funding they get is from the Coastal Wetlands Trust Fund. What Senator Breaux did was to convince Congress that some of the gasoline that we buy today never goes into automobiles or trucks but goes into snow blowers and lawn mowers, etc. So it should not go to the Highway Trust

Fund but someplace else. He convinced them to set up this Coastal Wetlands Trust Fund. It comes in at about \$30 million a year depending upon tax receipts. The state matches that 75/25.

Dr. Oswald asked if the cost of continual maintenance once the plan is completed will equal the \$40 million a year. *COL Diffley* said it would. He said what is being done now for each of these projects that are funded is that, the construction costs as well as the maintenance and monitoring costs, are included in the entire project cost and left in the trust fund. It was done that way at the urging of the state of Louisiana, and it made sense to fully fund these things up front. Then when the task force votes on them and approves them, the money is in the bank before any construction begins. No project is approved that does not have all the money tagged and money in the bank.

Dr. Klesch asked if the Corps is contributing to some of the goals and objectives of this restoration program by using dredged material beneficially. *COL Diffley* said yes, absolutely. The Corps has some projects that are earmarked for this, where they will use only one of these funds for beneficial-use type projects. However, he said, the greatest benefit is in the relationships that have been built between the Federal agencies and the state. He said that the Assistant Secretary of DNR in the state of Louisiana used to have a sign behind his desk that said, "I hate the Corps of Engineers, and given enough time, you will learn to hate them, too." Now, through having a positive way that we can roll up our sleeves and work together, the sign is down and he and *COL Diffley* work very well together, and that communication has gone on through the ranks. *COL Diffley* said that now when it comes to dealing with the issue of beneficial uses of dredged material on the spot, on the ground, then everyone down at the working level gets that done as a matter of routine in the New Orleans District.

Needs and Opportunities for Future Wetlands Research

*Dr. Russell F. Theriot
Director, Wetlands Research and Technology Center
Environmental Laboratory
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

The previous speakers have presented research elements of the Wetlands Research Program (WRP) that focus on engineering aspects for coastal processes and restoration/protection. Additional presentations have provided information on specific wetlands projects and represent the state-of-the-art technology in coastal engineering. We are presently in the final years of the WRP. However, that does not mean that the program has addressed all the wetlands research needs. The WRP was originally developed as a 7-year research effort. The program was subsequently funded for 3 years and pared down to emphasize demonstration projects in the restoration and management task areas with the more basic research efforts being conducted in the critical processes and wetlands delineation and evaluation task areas. After 1 year, the program was extended to 4 years and again the program was changed to accommodate the new timing and funding levels. I spoke previously on the particulars of that research program.

Since all of the needed research could not be accomplished in the 4-year time frame, it was decided to revisit the issue of research needs at a later date. On 22-25 June 1992, a workshop was conducted in San Antonio, TX, to identify future wetlands research needs. It consisted of Corps field elements, Headquarters personnel, and research scientists. The findings of this workshop were used to develop proposed work unit documentation for the new program in wetlands research scheduled to begin in FY95 immediately after the WRP is completed. It was decided that the new program should be structured essentially as the WRP was structured, with the same research task areas.

However, the priorities for research in each technical task area were changed based on current needs.

Work in the critical processes and characterization task areas identifies the characteristics of wetlands and determines how they function. These work areas provide a basic understanding of wetlands that are utilized by the restoration and management task areas. However, priorities of the wetland types to be studied are primarily determined by the needs of the regulatory program. Through past Corps of Engineers research programs and other research efforts conducted by other Federal agencies and universities, more has been learned about "coastal" systems than other major wetland types. Also, in the last 10 years, research in bottomland hardwood (flooded) systems has been accelerated and much more is now known on how these systems function. The next priority of the major hydrogeomorphic type of wetlands is depressional (prairie potholes, etc.) wetlands, and will be the initial wetland focus of these task areas in the new program.

The Stewardship and Management Task Area will provide technology primarily to Corps project managers on wetland resources associated with reservoir projects. These efforts were focused initially on wildlife and fisheries habitat needs, biodiversity, and pest management.

The research area I see coastal engineering having the greatest contribution in is the Wetlands Restoration/Establishment Task Area. Because much is understood about how coastal wetlands function and the social values they provide, the emphasis in the new program in this task area will focus on

developing and evaluating innovative engineering techniques to restore, create, and protect wetlands functions and values, with the initial emphasis being on coastal wetlands. As the WRP is winding down, we will be looking for opportunities to demonstrate what we have learned from these research efforts. Also, as the new program is being developed, we will be looking for additional opportunities in coastal engineering to study. I believe those opportunities to exist at Corps projects, as well as other programs such as the Gulf Coast initiative, Coastal America Program, etc. Efforts will be made to contact people associated with these various programs and Corps projects to identify specific projects where demonstrations or research efforts may be conducted.

Discussion

BG Locurcio was curious about interagency cooperation and coordination as the research is conducted. *Dr. Theriot* responded that they are working very closely with many agencies. The work in restoration already has half a dozen different partners from Federal and state agencies working on it. *Dr. Theriot* said there is presently an interagency committee of scientists that is developing standard monitoring and success criteria. In addition, there is an ad hoc committee that brings Washington-policy-level people and program management scientists together to look at each other's programs and see where we are on cumulative impacts, mitigation, mitigation banking, and the rest of those items that interface policy and science.

Dr. Komar asked about the succession of marsh communities and how fast they approach a natural condition. *Mr. Yelverton* responded that as far as the marsh creation, a lot of work has been done specifically by Dr. Steve Broom, North Carolina State University, up and down North Carolina. He found that in about 2 to 4 years the marsh will equal a natural marsh below ground in productivity, structure, and appearance. The

sea grasses are generally slower in spread. As far as critter use, *Mr. Yelverton* said he really is not an expert in that area, but from what he has seen in the North Carolina areas, if the marshes stay there, with time you are going to have equal use. He said it is just a matter of aging in the sediments, getting the right amount of organic content in the sediments, and having the structure there. With time, you would expect that the critters will use the created marshes.

Dr. Komar asked if there is a need for research on forested wetlands, specifically the mangroves. *Dr. Theriot* responded that right now in the Wetlands Research Program, there is no specific project that addresses mangrove restoration. He said because of the number of years that Florida has had to deal with wetlands and wetlands restoration and the regulatory issues surrounding that, there is a good body of information that deals with restoring mangroves.

Dr. Komar asked *Dr. Palermo* about the availability of the manual and software. *Dr. Palermo* responded that the manual is not available now but a draft copy will be ready at the end of this fiscal year. He said he would like to see that draft turned over to the Districts and Divisions for a field trial and he would like then to have the chance to revise, update, and add to the manual after the trial period. As far as the software is concerned, the framework is put together and some of the software is completed. He said there will be an initial version of that software by the end of this fiscal year. *Dr. Landin* added that they are developing a series of reports that address specific areas in restoration, protection, and creation. They are doing a manual of design criteria, another for mitigation, and one on engineering. She said there will be others that are how-to documents that are products of the program that will all be tied together.

Dr. Landin commented that there is statistical data on a number of the Corps' long-term monitoring sites. These have been published as Corps of Engineers reports. In addition, there are a number of journal

articles that are peer reviewed that have been published on these sites. In general, what has been found is that the man-made sites, properly designed and implemented, are equal to and in some cases better than the natural systems that in the same estuary may be degrading. Usually they find that while life use and vegetation productivity is greater, fish and benthos are at least equal to and occasionally greater. The kind of differences they find are that over a decade or longer of monitoring, they are still finding changes in the below-ground biomass of vegetation and the soil profile development. *Dr. Landin* said we do have a pretty good track record on hard data on these kinds of sites and these are accepted by the other agencies. In addition she said the last two Society of Wetlands Scientists annual conferences have had technical sessions on wetlands engineering and the American Society of Civil Engineers now has a task committee on wetlands that is bringing in biologists to be part of their work.

Dr. Komar asked *Mr. Davis* how severe a problem are ship wakes to the destruction of marshes. *Mr. Davis* responded that there is a study going on in Texas that is looking at that

problem but is not yet completed. What the study is doing is trying to compare the relative amounts of energy in wind waves and in boat wakes. He said if you just looked at it from an energy standpoint, the boat wakes, including the barge drawdown and the return velocities, had 20 to 1 the amount of energy as the wind waves, but that included barge drawdown and return velocities, which do not act like wind waves in an erosion process. The researchers have gone back, and are now considering just the boat wake energy and relating that to the wind waves.

Mr. Theodore Bisterfeld commented that in the agricultural and silvicultural realms, there is quite a bit of effort at hybridizing plants for growth vigor. He asked if there is any kind of similar effort in the wetlands research to select plants that will increase their survival potential. *Dr. Theriot* responded that they are working with the Soil Conservation Service and looking at various wetland plant species and cultivars that could be used for different purposes, whether erosion control, food production, waterfowl, or whatever.

Field Trip Overview

Dr. Susan Ivester Rees
Planning Division
U.S. Army Engineer District, Mobile
Mobile, AL

The field trip will highlight three constructed wetlands, as well as the natural wetland habitats of coastal Alabama. In addition, a shore protection project at Fort Gaines will be available for viewing.

The Grand Hotel is located on the eastern shore of Mobile Bay approximately halfway between Main Pass and the Mobile Delta. Moving northward from the hotel, you pass through the residential areas of Fairhope, Montrose, and Daphne. The trip then turns westward across the head of Mobile Bay. To the north is the extensive Mobile-Tensaw River Delta, which comprises approximately 115,103 acres of wetland habitats ranging from submersed "grass beds" to deep swamps. The delta extends from the confluence of the Tombigbee and Alabama Rivers, at its northern extreme, approximately 45 miles southward to the head of Mobile Bay. At its southern extreme, the delta drains through four rivers over an east-to-west expanse of approximately 8 miles. About 20,000 acres of the lands within the delta have been purchased by the Corps as part of the Tennessee-Tombigbee Mitigation Plan. The tour then moves south through the city of Mobile and down the western shore of Mobile Bay to Naval Station Mobile.

Naval Station Mobile, which was constructed in 1989 as part of the Gulf Coast Strategic Homeporting, caused the filling of approximately 15 acres of wetlands during site development. The Mobile District was tasked by the U.S. Navy to design and construct 25 acres of wetlands as replacement. The basic design was prepared by an interagency team to mimic a natural wetland south of the site with three tidal creeks. In addition, the wetland had to be compatible with the storm-water management

plan for the station. The wetland was constructed between July 1991 and September 1992 at a cost of \$1,227,392. Approximately 197,000 cu yd were excavated during construction and 130,000 nursery-grown *Spartina alterniflora* seedlings and 42,000 transplanted *Spartina patens* and *Juncus roemerianus* seedlings were hand-planted on the site. Problems at the site include approximately 10-15 percent plant loss over the first growing season and erosion of the buffer zone between Mobile Bay and the site. Steps are currently being taken to correct these problems.

Leaving Naval Station Mobile, we cross the Theodore Ship Channel, which was constructed in the late 1970's. Dredged material from this project was used to construct the Gaillard Island disposal area in Mobile Bay. This island, which unfortunately will not be viewed by our bus trip participants, provides not only for dredged material disposal, but also for shorebird nesting. Of particular note is the nesting success of the brown pelican on the island. In 1983, two pelican nests were found on the island, which represented the first recorded nesting in Alabama in 100 years. Last year over 1,700 pelican nests were counted on the island.

Our next stop will be the North America Gulf Terminals, Inc. (NAGTI) mitigation site. The construction of a coal and grain transloading facility on the Theodore Ship Channel required that the excavation of 23.5 acres of tidal marsh and other wetland impacts be mitigated by creation of a 40-acre brackish marsh near West Fowl River. The mitigation site was selected for its low elevation and access to tidal recharge via an existing canal network. The area was

excavated by dragline with the material placed in mounds to provide upland habitat in the midst of the new wetland. The site is fully flooded during high tide and flushes very quickly during ebb tides.

Leaving NAGTI, we pass through coastal wet pine savannahs, which are habitat for numerous insectivorous plants, and the coastal wetlands of Heron Bay on our way to Dauphin Island. The bridge to the island, which crosses Mississippi South and the Gulf Intracoastal Waterway, was destroyed by Hurricane Frederick in 1979 and was not rebuilt until 1983. Dauphin Island, the easternmost of the chain of islands that form the southern boundary of the Mississippi Sound, is 15 miles long and 1 mile wide at its widest point. The eastern portion of the island, through which we will pass, is well-developed, with extensive sand dunes on the gulf side, some of which reach 40 ft in elevation. In contrast, the western portion is flat with small dunes. Fort Gaines, a Civil War era fort which played a major role in the Battle of Mobile Bay, is located on the eastern tip of the island. In 1909, the Corps of Engineers constructed the shore protection features which you see today. We are preparing to rehabilitate these features, under the Section 14 authority, to the 1909 configuration.

The Dauphin Island Sea Lab, which is operated under the auspices of the Marine Environmental Sciences Consortium,

occupies a former U.S. Air Force Radar Base. In 1992, the Mobile District participated in the design of a small wetland here to be used for educational purposes. The project was an outgrowth of the Coastal America Partnership and was funded by the Gulf of Mexico Program. The site was formerly wetland, which had been filled and used for various purposes, including a trash dump and field lines for the septic system. Approximately 4,000 cu yd were excavated from the site and used to create the dune system which adjoins the wetland.

After visiting the Sea Lab wetland, the buses will board the Mobile Bay ferry for a trip across the mouth of Mobile Bay. During the ride, the participants will get a good view of the natural gas exploration and production facilities which are growing in Mobile Bay and offshore. Because the gas which is produced is "sour," it is piped to onshore "sweetening" plants where the sulphur is scrubbed from the gas before it is piped throughout the southeast. Fort Morgan occupies the eastern entrance to Mobile Bay and was the other significant participant in the Battle of Mobile Bay. From Fort Morgan, the tour route bisects the Fort Morgan Peninsula, which is characterized by a series of beach ridges and wetland swales. As we move northward toward the Grand Hotel, the tour route skirts the Bon Secour National Wildlife Refuge.

Gulf of Mexico Program (GMP)

*Thomas R. Campbell
Directorate of Planning
U.S. Army Engineer Division, Lower Mississippi Valley
Vicksburg, MS*

*Presented by
Dr. Susan I. Rees
Planning Division
U.S. Army Engineer District, Mobile
Mobile, AL*

Introduction

In August 1988, the Gulf of Mexico Program (GMP) was established by the Environmental Protection Agency as an intergovernmental program to resolve complex environmental problems appearing throughout the Gulf ecosystem. One of the major products of this effort will be a Framework for Action or Comprehensive Management Plan that will assure appropriate coordination of the activities of all Federal and state agencies in the Gulf of Mexico.

The program objective is to sustain the development of the Gulf's resources while protecting the environmental quality through an integrated and cooperative approach by establishing a long-term working relationship with all interests. This cooperative effort also includes maintaining working relations with other activities such as the National Estuary Program and the Coastal America Initiative.

Program Infrastructure

The GMP is guided by a Policy Review Board (PRB) with membership at the regional level for Federal representatives and at the department level for state representatives. The Management Committee provides advice to the PRB and directs the effort of the issue committees. There are eight issue committees responsible for characterizing problems and issues and preparing an "Action Agenda" for resolving the issue.

The Technical Advisory Committee provides peer review and assures scientific integrity of program efforts. The Citizens Advisory Committee, comprised of five Governor-appointed members from each of the five Gulf states, provides the user perspective and local support for program activities.

The Corps provides representation and participation in each of the committees and boards, as well as staff support to the Program Office.

Partnership for Action

On 10 December 1992, 11 Federal agencies and the Governors of the 5 Gulf states signed a "Partnership for Action" document which included a vision statement, a Program goal, and 5-year challenges, which were developed to use as measures of success in resolving Gulf problems.

The goal of the GMP is to protect, restore, and enhance the coastal and marine waters of the Gulf of Mexico and its coastal natural habitats, to sustain living resources, to protect human health and the food supply, and to ensure the recreational use of Gulf shores, beaches, and waters—in ways consistent with the economic well-being of the region.

Comprehensive Management Plan

The Comprehensive Management Plan will be developed over the next 2+ years and will include the "Action Agendas" of each of the issue committees. The Action Agendas will be developed in stages referred to as first, second, third, and fourth generations. The first generation will include issue identification and characterization, the second generation will develop a process to achieve the 5-year challenges, the third generation will include lead agency identification and setting of priorities, and the fourth generation will be the development of the Comprehensive Management Plan.

Accomplishments to Date

The Action Agendas are in varying stages of development, with all having the first generation at least in draft form.

In the absence of completed Action Agendas, specific projects of high visibility and Gulf-wide application have been or will be undertaken with funding provided by the Environmental Protection Agency for FY92, 93, and 94. In FY92, \$0.5 million was

provided and \$1 million in 1993. It is anticipated that \$1.5 million will be provided for FY94.

Gulf of Mexico symposiums were held in 1990 in New Orleans, LA; in 1992 in Tampa, FL; and the next symposium is scheduled for 28 March - 1 April 1995 in Corpus Christi, TX.

Legislative Activity

Four bills have been introduced to authorize the Gulf of Mexico Program, and one Congressional hearing was held in Washington in support of the program's authorization.

- a. H.R. 1899 (authors - Laughlin, D-TX, and Callahan, R-AL, with 50-plus co-sponsors).
- b. H.R. 1566 (author - De La Garza, D-TX).
- c. S. 83 (author - Graham, D-TX).
- d. S 686 (author - Kreuger, D-TX).

(There was no discussion.)

Coastal Inlets Research Program

*E. Clark McNair, Jr.
Program Manager*

*Jane Smith
Research Division*

*W. Jeff Lillycrop
Engineering Development Division*

*Coastal Engineering Research Center
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

Introduction

The Corps of Engineers will expend an estimated \$8 to 10 billion over the next 25 years at the 100+ tidal inlets where there are existing Federal navigation projects. Political, engineering, and demographic factors may increase these costs. The public perception, right or wrong, that Federal activities at inlets cause adverse response at adjacent beaches may require additional, expensive mitigation. Public sensitivity to current maintenance practices, where dredged material is placed in offshore disposal areas, may result in requirements for more expensive nearshore placements of maintenance materials to benefit adjacent beaches. Inlets are the primary conduit for the transport of environmental constituents from bays to the open ocean, and the Corps may be constrained from performing present activities unless accurate predictions of inlet response, and thus environmental response, to such activities are available.

To improve the cost-effectiveness and environmental soundness of Corps inlet projects, the Coastal Engineering Research Board, after hearing the numerous concerns of Headquarters, U.S. Army Corps of Engineers (HQUSACE) and field offices about tidal inlet problems, recommended to the Chief of Engineers that a research program addressing inlets be implemented. The Coastal Inlets Research Program (CIRP) was designed in response to Corps field office

needs for guidance in planning, engineering, operating, and maintaining tidal inlets.

Corps Needs

The Corps requires improved understanding of inlet processes and impacts of inlet activities on adjacent beaches.

- a. *Methods to Analyze Inlet Processes.*
Inlets are complex, and the physics and behavior of inlets are poorly understood. For instance, little is known about fundamental processes such as short- and long-term migration tendencies of an inlet, stability of the navigation channel, shoreline changes within and near an inlet, the response of inlet shoaling to varying wave and current conditions, and the distribution of sediment transport within the inlet proper. Design capabilities likewise suffer because so little is known about the effect of structures on inlet performance and on adjacent beaches. The ability to predict development of scour near structures and the stability of those structures is currently a hit-or-miss proposition even with sophisticated physical models. Inlets are important navigation links. Commercial and recreation vessels use inlet navigation channels daily, and maintaining the depth, width, and stability of these channels is an

expensive and continuous undertaking. In their natural, "unimproved" state, inlets migrate, close, open, shoal, deepen, and elongate in response to environmental, geological, climatological, and man-induced factors and to episodic events, such as storms. Recreation usage of tidal inlets adds materially to the economic base of coastal communities. Many inlets are "controlled" with coastal structures. These structures are expensive to maintain and repair. The Corps must have cost-effective methods to design, operate, and maintain inlet projects to provide safe navigation and minimize environmental impacts.

- b. *Methods to Evaluate Adjacent Shoreline Impact.* Inlets play a role in shoreline stability. Beaches are important elements in flood control of coastal zones, and any degradation or recession of beaches increases the danger of overwash and dune damage with resultant damage to resources near the shoreline. In addition, structures cause changes to local shorelines that are difficult to predict and may require expensive, long-term mitigation. Sand that might otherwise maintain a beach near an inlet collects behind structures, is diverted to deeper water, or is deposited on deltaic features of the inlet and lost temporarily or permanently to the system. Installation of structures to control inlet channel migration consistently affects the shoreline near the structure, sometimes for several miles along the beach. There are legislative mandates for mitigation of shoreline impacts caused by Federal activities at inlets. However, the impacts are difficult to predict, and confuse budgeting for planned inlet improvements. Methods for evaluating the impact of Corps inlet project activities on adjacent shorelines are required.

Design of the CIRP

The CIRP was designed interactively with personnel from HQUSACE and from several Major Subordinate Commands and District Commands. Workshops were held in February and November 1991 to lay the foundation of the program. Field problems, needs, and issues were discussed and factored into the program. The initial program formulation following the first workshop was for a 7-year program funded at \$43 million. The Assistant Secretary of the Army for Civil Works cited budgetary considerations and reduced the proposed CIRP to \$20 million with a 6-year life, with the possibility of a follow-on program. The reduced program was discussed at the second workshop. HQUSACE and field representatives attending the second CIRP workshop suggested that CIRP be approached in a Phase I/Phase II concept. Phase I CIRP will provide fundamental information and tools for Corps use, and Phase II will further develop the tools and provide advanced applications of the Phase I tools and technology and general design guidance.

Structure of CIRP

There are two technical areas in CIRP. Technical Area 1 is called "Inlet Sedimentation and Shoreline Change." This technical area addresses the short- and long-term behavior and evolution of tidal inlets and their response to waves, tides, and currents, given their basic geological makeup. Included in the technical area is the *Shoreline Change Adjacent to Inlets* task that will improve our ability to predict sediment transport rates and shoreline change adjacent to tidal inlets. Sediment budgets, natural bypassing, impacts on engineering activities, and effects of storm events will be included in the predictive methods. The task *Inlet Sedimentation* will improve our capability to predict inlet and navigation channel shoaling and interior shoreline changes. This requires improving our understanding of ebb and flood shoal dynamics, inlet sedimentation, and natural channel migration. An *Inlet Field*

Investigations task will develop techniques and strategies for measuring inlet processes and problems, provide field data and analysis for the remainder of the program, and will focus the other CIRP efforts by investigating and solving existing problems at several Corps inlets.

Technical Area 2 is called "Inlet Process Simulation." This technical area delves deeper into inlet hydrodynamics and short-term sediment transport associated with inlet behavior and will provide predictive tools for management of inlets. One task, transferred from the Coastal Research Program, investigates *Scour at Inlet Structures* and will increase our understanding of hydrodynamic conditions that cause scour near structures and processes that occur during scour hole development. This work will provide procedures for predicting the general configuration and major dimension of scour holes as well as laboratory procedures for modeling scour and impacts of scour on structural stability. Another task, the *Inlet Modeling System*, will produce an integrated method to numerically investigate the interaction of hydrodynamics and sediment transport at an inlet. A two-dimensional modeling system that links wave, current, and sediment transport modules will be developed. In addition, the ability to represent the local three-dimensional flow will be produced. The task *Modeling Waves at Inlets* will develop and validate a model that includes wave-current interaction, wave breaking in a flow environment, and wave-structure interaction. This task will improve our understanding of wave breaking in the presence of currents and wave/current/structure interaction. This model will be part of the Inlet Modeling System. The *Inlet Laboratory Investigations* task will improve physical modeling methodology for inlets and support other CIRP work through laboratory experiments.

The field and laboratory studies are central to the CIRP. As the program develops, these studies will focus on identified needs of all work tasks. The CIRP will work to solve

problems at inlets with an integrated effort including field measurements and physical, analytical, and numerical modeling.

CIRP Schedule

The CIRP is scheduled to begin in FY94 with a life of 6 years. Total expected funding is \$20 million over the life of the program. Planning for the program is progressing well. The Program Manager is Clark McNair, and the Technical Area Coordinators are Jeff Lillycrop and Jane Smith, all from the Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station. Principal Investigators are currently preparing detailed plans for their work tasks, briefly described above, including schedules for work completion and product development.

Discussion

BG Chinen asked if the field advisory group had experts from the private sector or from universities. *Mr. McNair* responded that there were experts from both the private sector and from universities.

Dr. Komar asked about the balance of investigations on natural inlets versus those with structures and how much flexibility will there be in modifying the program as it proceeds. *Mr. McNair* responded that the program is a finite-length, fixed-fund program, so everything has to be planned, organized, researched, reported on, and completed within the 6-year life and within the approved budget. However, opportunities do come along. He said they will reprioritize what they are doing within the program to take advantage of those opportunities as they arise. *Mr. McNair* said the program is funded through the Operations and Maintenance (O&M) side of the Corps and they will stress Federal inlets with O&M problems. Most of the inlets are structured and maintained and improved. He said, however, in order to fully understand the spectrum of inlet issues, they certainly need to look at unimproved and unmodified inlets. *Mr. McNair* did not know the exact balance right now, but it will

certainly include both unimproved inlets that occur naturally, as well as structured inlets that are fixed or hardened.

Dr. Dean commented that it is going to take a lot of creativity to understand where to cut off trying to understand the fundamentals and begin developing a tool that can be used in the field. Because of the complexity of inlets, he feels that some of the elements or objectives will have to be left unanswered. As an example, one might take bypassing on the ebb tidal shoal, where the ebb tidal shoal migrates around. *Dr. Dean* thinks no matter how much we study the fundamentals, we will never be able to completely understand that. So we may have to leave some of the boxes not understood, but perhaps understand

the effects and realize that those things will happen. He said it is certainly a challenging program and one that is very much needed by the Corps.

Dr. Dean assumed that there will not be any focused effort on studying the artificial transfer of sand at inlets such as mechanical or hydraulic bypassing. *Mr. McNair* said that assumption is correct.

Dr. Dean asked if the mixing, exchange, or renewal of waters inside bays is going to be studied. *Mr. McNair* responded that indirectly it will be. He said they will be looking at the tidal prism and at the flow and hydrodynamics at the inlet itself.

Optimized Concrete Armor Units: The CORE-LOC

Jeffrey A. Melby

and

George F. Turk

Wave Research Branch

Wave Dynamics Division

Coastal Engineering Research Center

U.S. Army Engineer Waterways Experiment Station

Vicksburg, MS

Introduction

The U.S. Army Engineer Waterways Experiment Station (WES), Coastal Engineering Research Center (CERC), has an ongoing research effort to develop optimal concrete armor unit shapes. These units are to be used for both new construction and repair of existing rubble structures. This research stems from the engineering need to protect navigation structures in high wave energy environments, such as on the U.S. west coast and the Hawaiian Islands. Because of the very difficult construction, in-service, and repair conditions in these environments, the basic development program is focussed on multilegged, randomly placed, non-interconnected concrete units. This development requires incorporation of all of the best engineering features from the various existing armor shapes into a single unit, while eliminating the major weaknesses. The optimal armor engineering characteristics are as follows:

- a. High hydraulic stability in single layer on relatively steep slope.
- b. Hydraulic stability, even if armor is broken.
- c. Hydraulic stability when used with dissimilar shapes.
- d. Low internal stresses.
- e. Constructable forms and armor layers.
- f. Minimal casting yard space.

- g. Use of conventional construction materials.

Existing slender unit shapes, such as dolos and tribar, have slender central sections and long legs, producing very high stresses in the central armor regions. This results in units that break into pieces having much less mass than the original unit. The broken units have little residual stability and contribute little to the stability of the structure. ACCROPODE® armor units, patented by the French, have high stability but require steep slopes to maintain stability because of the limited interlocking of the stout appendages. These steep slopes have a higher probability of exhibiting massive slope failure than more shallow slopes. Also, the ACCROPODE® armor layer is particularly sensitive to unit placement and, because the unit is patented, use of the unit requires paying substantial royalties.

A new series of concrete armor units called the CORE-LOC has been developed by CERC that incorporates all of the engineering performance features listed above, yet contains none of the major weaknesses of commonly used armor. A patent for the unit has been filed, with the unit referred to as the Melby-Turk unit, but the trademark application for the word CORE-LOC has been submitted. The CORE-LOC units were designed to be placed in a single layer on steep or shallow slopes. The unit shapes were designed to maximize hydraulic stability, unreinforced strength, and residual stability, but minimize material cost and casting yard space. The general shape is similar to the dolos shape, with octagonal appendages, but

the CORE-LOC unit has no slender central sections. The unit interlocks well on any slope and even interlocks well with dolosse, providing an effective repair unit for the many dolos slopes that are in need of rehabilitation.

Hydraulic Model Tests

A comprehensive suite of two-dimensional hydraulic stability flume tests were carried out on three CORE-LOC shapes during 1993 in order to quantify its stability characteristics. The tests were carried out using 210-g units, corresponding to a range of scales from 1:20 to 1:50. The CORE-LOC units were placed at a density of 1.40 units per square characteristic length of onslope area. This compares to dolosse, which require 2.86 units per square characteristic length.

The slopes were tested for a complete range of wave conditions up to the capacity of the flumes. Yet, through all of the testing, no measurable damage occurred to the armor layer. The armor units showed no instability other than, periodically, a single armor unit rolling down the slope. The armor layers always renested in the area of the single unit instability and continued to be stable for very violent wave conditions. For waves at flume capacity, the Hudson stability coefficient (the common measure of armor stability) was typically well over 200. The maximum stability coefficients were over 400. This stability can be compared to that of other commonly used armor units, with stability coefficients from 10 to 20. The wave height corresponding to a stability coefficient of 400 was over 7 times the CORE-LOC length. This compares with other commonly used concrete armor units, which typically can withstand maximum wave heights of less than three times the characteristic unit length.

Also, during the tests, other than a single unit that was sometimes unstable, no unit rocking was observed. This can be compared to dolos slopes, which have at least 1 percent of onslope units rocking for even small waves. These rocking units typically break in

the prototype, and thereafter contribute little to the structure stability.

Unlike many other concrete armor unit shapes, the CORE-LOC does not appear to be highly sensitive to placement. Because of the general difficulty in getting highly accurate prototype placement in black water, the model unit placement strategy was not over-specified. It was determined that the unit interlocking was increased if the units were 'slung' in a certain orientation, as they would be placed by crane in the prototype. Therefore, the placement specification was only that the units be slung a certain way and that they be placed per the specified density. Several different researchers and technicians placed the units in the model and the measurable stability did not vary.

Cost Savings

The CORE-LOC unit was recently evaluated for use in armoring the very small Kamalapau breakwater on the Hawaiian Island of Lanai. The CORE-LOC, on a relatively steep slope of 1V:1.5H, was compared to dolosse, on a shallower slope of 1V:2H. The design wave height was 7 m and the dolos design included 27-tonne and 14-tonne units on the head and trunk, respectively, with design stability coefficients of 8 and 15, respectively. A single size of 18-tonne CORE-LOCs with a stability coefficient of 16 was used for comparison. This CORE-LOC stability is very conservative and would result in a structure with extraordinary reserve stability.

The total amount of concrete required for the CORE-LOC slope was approximately half that of the dolos slope. The total number of CORE-LOC units was also approximately half the number of dolosse. The cost savings for initial armor layer construction would therefore be approximately half the estimated dolos cost of \$5,200,000. But with the steeper slope and single unit size, additional savings of approximately \$500,000 would be realized, due to reduced structure volume and reduced construction costs. The first cost

total savings would therefore be well over \$2,000,000 for this small structure. Finally, the added stability and structural stoutness of the unit would greatly reduce maintenance costs on the structure, compared to typical dolos structures, further improving the benefit-to-cost ratio.

Possible Revenue

The Corps plans to pursue foreign patenting and marketing of the CORE-LOC, if the U.S. patent is approved. Although the Corps is building fewer coastal structures than in the past, much of the world is still in the rapid development stage of port development. Therefore, the foreign market for the CORE-LOC looks very good. As the cost of the very small Kamalapau structure shows, typical armor layer costs are in the tens of millions of dollars, and CORE-LOC royalties could generate revenue of many millions of dollars for the Corps.

Conclusions

A new series of high-wave-energy concrete armor units called the CORE-LOC have been developed at WES, CERC. The units were designed to provide optimized hydraulic stability performance with relatively low internal stresses, when placed in a single layer. The units interlock well alone or when used as a repair unit with dolosse. Hydraulic stability tests show the unit to be exceptionally stable, with no damage for unusually high Hudson stability coefficients. Cost savings to the Corps should be substantial due to a reduction in required materials and due to reduced construction and maintenance costs. Finally, patent royalties from foreign marketing of the unit could result in substantial revenue to the Corps.

Discussion

Dr. Komar asked who would actually get the revenue from the patent; the Corps or does that have to be sent back to Washington,

D.C. *Mr. Melby* responded that as he understands it, the Corps would get the revenue and that the actual laboratory receives a majority of the revenue.

Dr. Dean commented that it looks like a dramatic improvement over what is available. He asked about internal stresses and the need for reinforcement of any kind. *Mr. Melby* said it was designed so that it has no slender central section, and therefore, the internal stresses will be much less. It is designed so that it will not require reinforcement, under the typical design condition.

Dr. Dean asked about the stability against overtopping on the back side. *Mr. Melby* said the back side stability seems to be tremendous. The unit has similar runup characteristics and reflection characteristics to other slender armor units like the dolos, so as far as runup and overtopping are concerned, it reacts similarly to the other slender-armor-unit shapes.

Dr. Oswald asked if all of this data is based upon lab simulation, or is there any field data yet. *Mr. Melby* responded that it is all lab simulations at the present time.

Mr. Lockhart congratulated Jeff and all the others that were involved with the Crescent City work and in developing the tools that permit the Corps to now optimize armor unit design. He said that it looks like we are going to pretty much get our money back on the first installation.

Mr. Samuel Powell commented that if you exceed the design wave on dolos, they will fly off the structure. He expects that maybe the same thing would happen with these units. *Mr. Melby* said that the way that they consider the design of these units is, they will be sized approximately the same as the existing units and they will have a tremendous amount of reserve stability. So even if the design conditions are exceeded, there is no movement and no instability of the units to be expected.

WES Reconnaissance Report on Expedient Structures Used During the Flood of 1993

*George F. Turk
Wave Research Branch
Wave Dynamics Division
Coastal Engineering Research Center
U.S. Army Engineer Waterways Experiment Station
Vicksburg, MS*

The Office, Chief of Engineers, tasked the U.S. Army Engineer Division, Lower Mississippi Valley (LMVD) with comprehensive collection of 1993 flood data from the Missouri River and North Central Divisions and its own St. Louis and Memphis Districts. Those data collection efforts are expected to require several months and are likely to be subject to some staleness because of the more urgent demands upon the involved Corps Districts. Consequently, Emergency Operations Management of LMVD (CELMV-CO-E) decided it desirable to seek a more expeditious means of collecting potentially perishable data specifically related to flood-fighting techniques or methods which were applied. This thinking was particularly shaped by the fact that the selection and installation of such structures or use of such techniques were actually more in the domain of local urban jurisdictions and levee districts or drainage districts rather than within the scope of the Corps role which, in general, was advisory and supportive.

The reconnaissance effort was specifically aimed at documenting flood-fighting structures used and their effectiveness. CELMV-CO-E was to request of the U.S. Army Engineer Waterways Experiment Station (WES) that it immediately field a two-man reconnaissance team to visit the Kansas City, Rock Island, and St. Louis Districts. These three Districts conducted significant flood-fight efforts. The request to WES was directed to the Wave Research Branch (CEWES-CW-R) of the Wave Dynamics Division of the Coastal Engineering Research Center. The

CEWES-CW-R had previously conducted a study of the effectiveness of expedient flood-fighting structures (Markle and Taylor 1988) under the Improvement of Operation and Maintenance Techniques Civil Works Research Program.

Concurrent with the request from CELMV-CO-E to CEWES-CW-R, WES was already in the process of responding to orders from Dr. Robert B. Oswald, Director, Research and Development (R&D), that R&D people should get out to the field and become familiar with the realities of flood fighting. Dr. Oswald's motivation was from higher command's desire that the Corps develop better ways to perform our flood-fighting mission. Since expedient flood-fighting structures are not only used to raise the levees but also to combat through-seepage and underseepage problems, the two-man team was composed of a hydraulic engineer from CEWES-CW-R and a geotechnical engineer from the WES Geotechnical Laboratory.

While the focus of the two-man team was to remain upon expedient methods actually employed in the 1993 flood fight, the broader questions relevant to future development of better methods were also addressed. It was considered important to ask questions as to "how to do it better" while the experiences were fresh. The two-man WES team conducted a threefold collection of perishable data. First and as a priority, information was gathered on the implementation of expedient flood-fighting structures. Data of interest included unique and innovative levee-raising and seepage control techniques. Methods used to raise floodwalls as well as temporary

urban flood-fighting techniques were also recorded. Second, information was collected on circumstances of levee failures as well as on the surrounding environs such as levee access and availability of materials that might prove useful in any expedient flood-fight methods. Third, lessons learned pertaining to the Corps' role in the emergency response were collected by extensive interviews of both Corps employees and local emergency response officials who directed the flood-fighting efforts in their communities or their levee or drainage districts.

The time constraints of the Coastal Engineering Research Board meeting will only allow the presentation to briefly focus on expedient structures. Findings of mission will be discussed, as well as recommendations for future research. Details from the mission will be available in the final report scheduled for completion in late November 1993.

Reference

Markle, Dennis G., and Taylor, Maury S. (1988). "Effectiveness of expedient levee-raising structures," Technical Report

CERC-88-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Discussion

BG Locurcio commented that it could be helpful to make a videotape of how to properly fill sandbags. *Mr. Turk* concurred, saying that a few individuals said that if they had a video it would help quite a bit.

BG Locurcio commented that on the field trip he saw an awful lot of use of long sandbags filled with a sand slurry rather than water. It seemed to him that those might be more stable. He said for linear dikes you could fill them with a concrete slurry mixture, and it might be faster than sandbagging them. *Mr. Turk* said that in that environment it may be difficult to quickly get the sand slurry mix put together in time to rapidly deploy something like this. He said these water-filled barriers really have a lot of potential, and he does not think that filling them with water is so much the problem as properly anchoring them quickly.

Public Comment

(There was no public comment.)

OMB Shore Protection Study

*Harry Shoudy
U.S. Army Corps of Engineers
Washington, D.C.*

The Corps of Engineers was asked by Office of Management and Budget (OMB), as part of the FY94 pass-back language, to analyze shore protection projects. The charge is to look at authorized and completed projects and compare anticipated versus actual costs, benefits, environmental impacts, and whether the projects have been responsible for inducing development in areas where the projects have been constructed.

Phase 1 of the study is concerned with comparing just the cost aspects of the historic projects. This has not been just a Headquarters effort but included a task force of shore protection experts across the country; people from the U.S. Army Engineer Waterways Experiment Station (WES), WES's Coastal Engineering Research Center, the Institute for Water Resources, and a number of District and Division personnel. The most recent meeting of the task force, on 4 and 5 November, included participants from the Federal Emergency Management Agency and from the Marine Board.

It is expected that a draft report will be given to the Acting Assistant Secretary of the Army by the end of November. Then a decision will be made as to when to brief OMB and when to provide them with a copy of it.

There are a total of 82 authorized, constructed projects, and 56 of them have been analyzed in detail. There are 26 that are considered smaller projects (constructed prior to 1962, prior to the Corps small project authority, Section 103 authority). They did meet the criteria of being authorized shore protection projects, so they are included in the total of 82.

Out of those 26 small ones, 21 of them are in the North Atlantic Division, and 5 of them are in the South Pacific Division. Of the 56 projects that were analyzed in detail, 9 are from New England Division; 11 from North Atlantic Division, with 6 in the New York District; 22 are from South Atlantic Division, with 16 of them in Jacksonville District; 1 is from the Lower Mississippi Valley Division, 2 from the Southwestern Division, 6 from the North Central Division, and 5 from the South Pacific Division.

Looking at the miles protected by these projects, the 56 projects protect 210 miles of shoreline and the 26 smaller projects account for 16 miles of protection. There are also 41 potential projects that have been authorized or that are in Preconstruction Engineering and Design (PED) studies. Of those 41 projects, 26 are authorized or in PED studies, and 15 are at feasibility level. The 26 authorized projects represent 151 miles and the 15 that are in the feasibility stage represent 186 miles. There are also six studies that are inactive, currently; and there are eight constructed or partially constructed projects that are now deauthorized.

The original cost of construction of the small projects was \$4.5 million, which represents 0.7 of 1 percent of the total cost of all of the constructed shore protection projects. This compares the actual expenditures, which have not been updated to current price levels. The total cost for initial beach restoration is \$302 million, of which the Federal cost was \$183.5 million, about 61 percent; periodic nourishment, \$234 million, with a Federal cost of \$146 million; structure improvements or structure protection measures, \$116 million, with \$60 million being the Federal cost share; and emergency

costs, \$3.4 million; for a total cost of \$655 million dollars.

After further study, for initial beach restoration projects, the actual-to-estimated ratio was determined to be 0.97. For periodic nourishment the actual-to-estimated ratio was 0.91. For structural improvements the actual-to-estimated ratio was 0.95. All of these ratios are slightly less than 1, which means we have slightly overestimated the cost to build these projects. This is probably a bit different than the perception that most people have that Corps estimates are less than what was actually spent.

Many times that occurred because when we got out there to construct the project, there was another dredge working there, and so you did not have to pay mobilization and demobilization costs or various other cost-saving items. For instance, a larger dredge was available, but they could not count on that larger dredge being available when they did the cost estimating, but they were able to take advantage during the construction of the project.

A better measure of how these projects compare is to look at the actual cubic yardage that was estimated versus what was actually placed. On the initial beach restoration projects; a total of 49 projects of that type, 39 of them were compared, and the estimated cubic yardage was 93 million versus 95 million actual. Periodic nourishment; out of 41 projects, 33 of them were compared, and the estimate was 65 million cu yd versus 73 million cu yd. So you can see that we slightly underestimated in our cubic yardage. The ratio for the initial beach restoration is 1.02, and for period nourishment it is 1.12.

There are a number of things that still need to be analyzed besides costs, and these will be done in Phase 2. The idea of Phase 1 was just to collect historical data, compare it and provide OMB the data quickly. Phase 2 will look at the benefits; comparing anticipated damages versus actual damages; are these projects causing induced development; what

are the environmental impacts of the projects; further analyzing the costs and looking at any policy implications as a result of these studies.

Discussion

BG Locurcio asked if the costs that were compared include change orders. *Mr. Shoudy* responded that the costs included everything, the entire history of the costs.

Dr. Dean commented that one of the pie charts *Mr. Shoudy* showed compared 226 miles of completed projects versus 20,500 miles of significantly eroding shoreline based on the National Shoreline Study. He feels that chart could be misinterpreted by OMB in terms that they would feel that the Corps has spent a lot of money but only addressed a very small part of the problem. He said speaking for the state of Florida, a lot of erosion problems have been addressed, and the projects are holding up. *Dr. Dean* said he was on the Board at the time of the National Shoreline Study, and it was a very broad-brush look at the shoreline erosion problem. He would caution against relying on that study too heavily, or at least putting in some caveats. *Mr. Shoudy* agreed that needs to be explained thoroughly in the report that will go to OMB.

Dr. Dean said that he and *Dr. Komar* are on a Marine Board beach nourishment and shoreline protection committee and are in the final stages of writing a report. He said some of the information that was presented here would be very valuable input to that committee. *Dr. Dean* was wondering when the information would be officially available. *Mr. Shoudy* responded that once the Corps gets a blessing from the Acting Assistant Secretary of the Army to provide it to OMB, then that information will be shared with the public and he expects that to occur in March.

Ms. Cheryl Ulrich asked about the methodology approach for Phase 2 of the study. *Mr. Shoudy* said that what they intend to do is to try to look at areas where the Corps has projects and then other similar areas,

either adjacent to or in the same general region, where there are the same development pressures, and see whether there is any difference between the development that has occurred after a project has been constructed by the Corps versus areas where there is no project right now, but development has gone on anyway. *Mr. Shoudy* said that the field is trying to come up with a number of examples of comparisons that they feel are pertinent to looking at this issue.

Mr. Holliday commented on the relationship between the estimated dredging or the placement costs versus the actual. He said the estimating procedure that the Corps normally uses is a fair and reasonable value. And when you solicit bids, you reasonably expect to get the lowest bids somewhere in a range of above and below that value. *Mr. Holliday* did not think that it would be appropriate to describe the relationship between those two numbers as an overestimation on the part of the Corps. *Mr. Shoudy* said that is probably a bad way to phrase it. But when you add up all of the numbers, and you compare them and you calculate an actual to an estimate ratio, then it is either going to come up as under or over. That does not imply that the Corps typically overestimates. *Dr. Oswald* commented that

factors of .95, .97, and 1.05 should be portrayed not as being over or under, but as very accurate estimates in terms of our estimating.

Dr. Oswald asked if instead of expressing the data singly, in terms of miles of shore, is it possible to represent it in terms of comparison of percent of value protected. *Mr. Shoudy* said that there is information in some Districts in terms of the value of shorefront development in areas where the Corps has projects. Those data have been asked for in the questionnaire that went out in Phase 1, with the intent of trying to analyze them in Phase 2.

Mr. Stanley J. Boc asked how many miles of shoreline protection have been contributed by the Continuing Authorities Program. *Mr. Shoudy* responded that there is a list of continuing authority projects that have been constructed since 1987, but he didn't have the entire history of the Continuing Authorities Program. He said the task force felt as if it would be a pretty monumental task to collect that information and that it would not be of great value, because that program had been, in dollar terms, such a small amount in relation to the total overall program.

Recommendations by CERB

BG Chinen emphasized the need for the Board to focus its energies on dredging and specifically on dredging disposal. It is a national problem, and it will affect national economy, unless the Corps can resolve this issue.

He also commented that there is a need for all of us to encourage the public to participate with us. It is nice for all of us in the Corps family to talk to each other, but it is also important to create partnerships, create an understanding with the public, so we can have the public support for the public issues that we are trying to address.

BG Locurcio commented that it is important to not only involve more of the public in future CERB meetings, but also other agencies. He said that from his own experiences as a District Engineer, he sensed the need to get those other agencies on board as early on in the process as possible. If they can be brought on board during a research stage, where they actually buy in to some of the processes that we ultimately advocate as tools out in the field, he thinks we will be going a long way towards smoothing the ultimate operations and applications that are performed by the Districts.

BG Locurcio's second comment was concerned with the presentations during the meeting on wetlands creation. He said given the element of the Chief's Charge, which strives for a holistic approach, it was great to have the theme of this meeting extend back into the wetland areas. He said it is a relatively new scientific and engineering area, not necessarily universally accepted by all of the other agencies; hence, it is important to get them involved as early as possible. The other facet that he noted throughout the presentations and the field trip was that these projects need a maintenance cycle as part of the construction process. The Corps or the customer is extremely concerned as to when the project is actually completed, when can

the project be turned over to either a municipality or back to nature, if it is a wetland or restoration project. In order to do that, the Corps has to satisfy the other agencies, which means that we have to come to closure on equilibrium criteria, standards of success, and things of that nature.

BG Locurcio said that is probably the least-agreed-upon aspect of a project, especially the wetlands creation process. He said the Corps' credibility as an agency depends upon whether or not we can convince the monitoring community, who is not an active participant in creation of these features, that we have succeeded and that we should proceed with this in the future. For those reasons, he stresses the need to include equilibrium criteria and standards and develop some interaction with the other agencies so that we can reach closure on that point.

Dr. Komar said that this has been a great meeting and he thanked the District for choosing this great facility to have the meeting. He particularly thanked the speakers on wetlands. He said those are really fascinating environments both from the biological side, and from the physical side, as well. He said it raised questions that left him with the feeling that not only do we need more studies of Pacific beaches and Caribbean beaches, but we need more studies of low-energy beaches and environments in lagoons.

Dr. Komar said he is in an awkward position now of feeling like a freshman at a university having taken Wetlands 101 and now going to advise the professor on what his research goals should be for the next 10 years. He said we heard questions about wave generation, travel and dissipation in these lagoons and bays, which are shallow-water, limited-fetch environments. That is very much stretching our knowledge of this since most of it is based on

measurements and theory of wave generation over the open ocean. He said a particularly interesting aspect of this is the wave dissipation itself, because ultimately that is what you want to do. You have to have wave dissipation to allow the persistence of these organisms in their development in a natural condition.

Dr. Komar said he came away with a feeling that not only do we need more knowledge about wave generation in this area and dissipation by the natural environment, but also, we need a better understanding of the erosion processes themselves. He said some very interesting problems were raised with respect to the actual erosion processes in this very complex type of environment where you have both grasses as well as cohesive sediments. He was pleased to see that in a few instances beaches are often an integral part of this restoration process. He said we really do need to look at beach processes in conditions under this unusual environment so that we can ultimately build better protecting beaches that will exist in a more natural harmony with the location so that we can avoid the continued use of hard structures. *Dr. Komar* said he can see where we may want to have a temporary hard structure, whatever it may be, to get the marsh to go, but we have to have in mind what its ultimate configuration will be so it can finally live on its own without the continued use of hard structures. He thanked the participants for providing him with some insight on this area of research and what programs are being conducted.

Dr. Dean added his expressions of appreciation to the hosts and to all of the presenters for a most interesting session. He made two recommendations related to the Coastal Engineering Research Center's (CERC) activities for their consideration. One was related to COL Diffley's presentation which was concerned with the wetlands restoration in the Mississippi River. He said we heard quite a bit about some of the techniques and some of the expectations and scope of that project but not too much

about the physical processes in which CERC should have a very measurable role, due to their capabilities and programs that they have carried out in the past. One of them is related to the restoration of the barrier islands which front the wetlands, and which are basically very vital to the survival of those wetlands once they are restored to their viability. He thinks that this is a problem area in which CERC should play a major role. He said it is not an easy problem, in part due to the subsidence and the fact that not only are the barrier islands disintegrating, but the bathymetry seaward of them is subsiding, so that the waves that reach the barrier islands are going to be larger than they were when the barrier islands were constructed by natural processes. He feels that this is a complex, challenging problem, and one in which CERC could contribute very substantially.

Dr. Dean said there is another sub-objective under this general topic in which CERC should play a major role, and that is a sand delivery system for the restoration of the wetlands. He said this is a challenging physical problem and one in which CERC could contribute very substantially.

Dr. Dean commented that in his experience every coastal engineering project or design that is carried out by the Corps is challenged by other entities. And this is of course proper, because we should be able to defend our designs and our actions. He recommended a focus on the improvement of the predictability in coastal engineering design and suggested two areas for evaluating the predictability of coastal design efforts. The two areas are beach nourishment and the effects of structures on coastal processes and coastal stability. Some of the elements that might be involved in such an effort would be to establish the state of our knowledge; that is, how good are our predictions; to identify the areas of weakness; and to develop a strategy to improve those areas of weakness. Also, *Dr. Dean* suggested establishing the limit of predictability. He said we are dealing

with complex systems, and perhaps we have to say we can only hope to carry out our predictions within 25 percent; the other 25 percent is really in a realm that even in the long term, maybe the next few decades, we cannot hope to be able to predict to that level. He said once we understand the limits of our

capabilities, we can develop means to improve those.

(NOTE: Each of the 18 initiatives from the Chief's Charge was discussed in the Executive Session. The status and recommended actions on the initiatives are shown in Appendix E.)

Closing Remarks

BG Locurcio reiterated BG Chinen's challenge that we make an effort for the next meeting to ensure that some members of the public sector or our sister agencies participate in the meeting.

He thanked all the folks who have worked so hard to produce this meeting. He said it was an absolutely outstanding meeting, as so many of them are. He asked COL Bob Griffin to stand up and take a bow and accept kudos for Mobile District. He said they have been a superb team. He thanked Dr. Susan Rees for the field trip and Les Currie who was the model for the personal floatation devices and provided a tremendous amount of support. He thanked Jim Jordan, Rich Degan, Lydie James, Cathy Reese, Major Dennis Heuer, Pam Doan, Liz Warren, Peggy Dees, and the host of other people who worked on the meeting. He said he has run several of these meetings, and it is a tremendous effort required on the part of the supporting District.

He thanked all of the presenters again and echoed BG Chinen's comments that this was a tremendously important meeting. He said the presentations on wetlands and the interaction directly point to one of the Chief's Charges.

He thanked COL Bruce Howard, Dr. Jim Houston, and Ms. Sharon Hanks for making this meeting happen and for taking care of all the details. He thanked team USACE (U.S. Army Corps of Engineers), for their participation, and especially for their wisdom, guidance, and most importantly for the funding that makes all this happen. He thanked Susan Soderberg, who has sat here and tried to capture every word. Finally, he thanked Andy Szuwalski, who was managing the little red light system.

The 59th Meeting of the Coastal Engineering Research Board was adjourned.

Appendix A

Biographies of Speakers/Authors

Hollis H. Allen

Mr. Allen is an ecologist with the Environmental Laboratory of the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. He has been at WES for 24 years, where he has conducted studies on man's impacts on the environment and how to correct negative impacts. Mr. Allen has spent a majority of those years using bioengineering techniques, a combination of vegetation and low-cost building materials and structures, on dredged material and reservoir shorelines, and stream and riverbanks for both shoreline erosion control and habitat development for wildlife and fisheries. Mr. Allen has attended Oklahoma State University, Oregon State University, and Colorado State University and holds a B.S. degree in forestry and an M.S. degree in forest ecology. He is a registered certified senior ecologist and is a member of the Ecological Society of America, the Society of Wetland Scientists, and the Society of Restoration Ecology. He is currently Acting Chief, Stewardship Branch, WES.

Dr. Leonard N. Bahr

Dr. Bahr has been the Executive Assistant, Louisiana Governor's Office of Coastal Activities, in Baton Rouge, LA, since 1992. From 1991 to 1992, he was the technical assistant for that same office. Prior to 1991, Dr. Bahr was with the Louisiana Department of Environmental Quality from 1989 to 1991; self-employed as a consultant and publisher from 1984-1988; assistant professor and associate professor in the Marine Science Department at Louisiana State University from 1975 to 1984; research associate, Louisiana State University, Center for Wetland Resources, from 1973 to 1974; and research assistant, University of Maryland, Chesapeake Biology Laboratory, from 1963

to 1966. Dr. Bahr received his B.S. degree in zoology from the University of Maryland in 1963, his M.S. degree in biology from the University of Richmond in 1968, and his Ph.D. degree in zoology/coastal ecology from the University of Georgia in 1974.

Patricia N. Bevel

Ms. Bevel has been employed as a regulatory program specialist with the U.S. Army Engineer Division, South Atlantic (SAD), since 1984. She provides technical advice and staff supervision and guidance to the five SAD Districts located in Alabama, Florida, Georgia, North Carolina, and South Carolina in accomplishing their responsibilities under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act.

Robert N. Blama

Mr. Blama has been with the U.S. Army Engineer District, Baltimore, since 1978. He was a biologist in the Planning Division for 11 years and has served as a project manager in the Navigation Branch for the past 4 years. His degree is in conservation and resource development. He currently serves on various research review boards and is the sediment specialist in the District. His primary responsibility is to develop beneficial uses of dredged material from maintenance dredging projects.

Thomas R. Campbell

Mr. Campbell is Chief of the Report Review and Flood Plain Management Services Division, Directorate of Planning,

U.S. Army Engineer Division, Lower Mississippi Valley (LMVD). He has a B.S. degree in civil engineering and is a graduate of the Corps' Planning Associates Program in Washington, D.C. He is a registered civil engineer. Mr. Campbell was responsible for development of recreation facilities in the U.S. Army Engineer District, Mobile, for 4 years. He has been in LMVD for 24 years and has been responsible for conducting and reviewing comprehensive and specific studies in the Lower Mississippi Valley and the Upper Mississippi Valley and is a special advisor to the President of the Mississippi River Commission. Currently, Mr. Campbell is the coordinator of Corps participation in the Gulf of Mexico Program and serves in a part-time status on the staff of the Gulf of Mexico Program located at the Stennis Space Center.

Jack E. Davis

Mr. Davis is a research hydraulic engineer in the Coastal Engineering Research Center at the U.S. Army Engineer Waterways Experiment Station in Vicksburg, MS. In 1983, he received his B.S. degree in civil engineering (hydraulics) from the University of Illinois at Urbana-Champaign. In 1990, he received his M.S. degree in civil engineering (hydraulics) from the University of Texas at Austin. He participated in the 1992-1993 long-term training program, where he studied coastal engineering topics at Texas A&M University. During his 13-year research career with the Corps of Engineers, Mr. Davis has worked in areas of particulate emissions control, design and testing of river and reservoir control structures, reservoir water quality, nearshore wind-wave modeling, and coastal shoreline protection. His current responsibilities include the development of shoreline protection (structural and natural) for reservoirs and the development of wetlands on dredged material in the Gulf of Mexico and Chesapeake Bay. Mr. Davis is the manager for the Critical Processes Task Area within the Corps' Wetlands Research

Program. The Critical Processes Task Area is conducting studies to improve our understanding of the physical, chemical, and biological processes of wetlands. The task area is involved in conducting field investigations of wetlands, as well as the development of numerical models for simulating wetland processes and supporting evaluations of wetland functions.

COL Michael Diffley

COL Diffley, Commander of the U.S. Army Engineer District, New Orleans, since June 1991, is responsible for water resources development in the 30,000 square miles under his jurisdiction, which include 2,800 miles of navigable waterways, over 950 miles of levees and floodwalls, 12 navigation locks, and 6 major flood control structures, as well as projects to protect and enhance wetland resources of Louisiana. A graduate of the United States Military Academy, Command and General Staff College, and National War College, COL Diffley holds masters' degrees in civil and nuclear engineering from Massachusetts Institute of Technology, and a master of business administration degree from Long Island University. His service includes tours in Germany, Korea, and Panama, as well as staff officer on the Army Staff in Washington, assistant professor of engineering at the United States Military Academy, and research engineer at Lawrence Livermore National Laboratory. He is a registered professional engineer in California and Virginia.

Dr. James R. Houston

Dr. Houston is Director of the Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station (WES). He has worked at WES since 1970 on numerous coastal engineering studies dealing with explosive waves, harbor resonance, tsunamis, sediment transport,

wave propagation, and numerical hydrodynamics. He is a recipient of the Department of the Army Research and Development Achievement Award. Dr. Houston received a B.S. degree in physics from the University of California at Berkeley, an M.S. degree in physics from the University of Chicago, and both an M.S. degree in coastal and oceanographic engineering and a Ph.D. in engineering mechanics from University of Florida.

Dr. William L. Klesch

Dr. Klesch received his B.S. degree from Ball State University in Muncie, IN, in 1965. After serving in the United States Navy, he entered the University of Texas, Marine Science Institute at Port Aransas, TX, and earned both an M.A. and Ph.D. in 1970 and 1972, respectively, in marine science. Following receipt of his Ph.D., Dr. Klesch received a post-doctoral fellowship from the University of Western Ontario, Canada, to further his doctoral studies in comparative endocrinology. Upon completion of his studies at the University of Western Ontario, he was hired by the Baltimore District, Corps of Engineers in 1974 as a member of the Environmental Resource Branch in the Planning Division. In that position, Dr. Klesch participated in development of environmental features associated with the formulation and operation and maintenance of flood control and navigation projects in the U.S. Army Engineer District, Baltimore (NAB), and the preparation of the required environmental documents. By 1980, he was a project manager for several ongoing investigations within NAB. In the fall of 1980, he moved to the Environmental Resource Branch, Planning Division, Directorate of Civil Works, in the Corps Headquarters in Washington, D.C. In that position, it was his responsibility to oversee the environmental aspects of Corps planning reports originating from several Corps Division offices when they were submitted for Washington level review. Dr. Klesch has

had several other positions subsequent to his arrival in Headquarters, including: in 1985, chairman of a Corps national investigation into the development of long-term management strategies for the placement of dredged material; in 1986, as an action officer with the Western Regional Branch, Planning Division; and in 1987, Special Assistant to the Chief of Engineers for Geographic Information Systems. In 1988, he was selected to his present position as Chief, Office of Environmental Policy, in which he oversees a staff of 10 environmental professionals responsible for the development and implementation of environmental policy within the Corps of Engineers and serves as the Corps principal spokesperson for the environment.

Joseph V. Letter, Jr.

Mr. Letter is a research hydraulic engineer in the Estuarine Processes Branch of the Estuaries Division of the Hydraulics Laboratory, U.S. Army Engineer Waterways Experiment Station. He has 20 years of experience in modeling estuarine processes. Mr. Letter received his bachelors degree in civil engineering from Georgia Institute of Technology, a masters of engineering degree in coastal and oceanographic engineering from University of Florida, and a year of graduate education in ocean engineering at the University of Miami. He has been a primary contributor to the development of the TABS-MD numerical modeling system and has extensive experience in estuarine hydrodynamics, salinity intrusion, and sediment transport. Mr. Letter is the principal investigator for the research area of the Wetlands Research Program on Demonstration Sites in Coastal Louisiana, and has modeled many of the coastal Louisiana wetlands.

W. Jeff Lillycrop

Mr. Lillycrop is a coastal engineer in the Coastal Structures and Evaluation Branch, Engineering Development Division, Coastal Engineering Research Center (CERC), U.S. Army Engineer Waterways Experiment Station. He received a B.S. degree in engineering sciences (1981) and an M.S. degree in coastal and oceanographic engineering (1983) from the University of Florida. Mr. Lillycrop worked 2 years in the Planning Branch of the U.S. Army Engineer District, Jacksonville, on a variety of erosion control and hurricane protection projects. Since joining CERC in 1986, he has worked on several District-sponsored studies on inlet stability and on a research effort on design criteria for shallow-draft coastal ports. He is the Program Manager of the SHOALS Program and is the Coastal Inlets Research Program Inlet Sedimentation and Shoreline Change Technical Area Coordinator.

John W. McCormick

Mr. McCormick is a hydraulic engineer in the Coastal Structures and Evaluation Branch, Engineering Development Division, Coastal Engineering Research Center (CERC), U.S. Army Engineer Waterways Experiment Station. He received his B.S. degree in civil engineering from Virginia Polytechnic Institute and State University and his M.E. degree from Old Dominion University. Since joining CERC in 1991, he has worked on a wide range of projects and research areas including the Wetlands Research Program (WRP), small boat harbors, and detached breakwaters. His current responsibilities with the WRP include the development of design guidance for coastal shoreline and channel protection (structural and natural) along coastal wetlands. He also has been involved in the design of several wetland demonstration sites involving the creation of wetlands through beneficial use of dredged material.

E. Clark McNair, Jr.

Mr. McNair is Program Manager of the Dredging Research Program (DRP), Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station (WES). The DRP is an integrated, multi-disciplinary research program that addresses the operational and managerial aspects of dredging. Several WES laboratories, as well as other Corps laboratories and Field Operating Activities, are actively involved in the DRP. New equipment and techniques will be identified, developed, or adapted for use by the Corps of Engineers for performing dredging operations more efficiently and economically. Mr. McNair earned a bachelor's degree in civil engineering from Mississippi State University and a master's degree in civil engineering from Texas A&M University. He is a member of the American Society of Civil Engineers, the Permanent International Association of Navigation Congresses, and the Western Dredging Association. He is a registered professional engineer in the state of Mississippi.

Jeffrey A. Melby

Mr. Melby is a research hydraulic engineer in the Wave Research Branch of the Wave Dynamics Division at the Coastal Engineering Research Center (CERC), U.S. Army Engineer Waterways Experiment Station. Mr. Melby joined CERC in 1987 after receiving an M.S. degree in ocean engineering at Oregon State University, and recently completed a year of study working toward his Ph.D. at the University of Delaware. Mr. Melby's work at CERC has concentrated on developing optimal armor and the associated design procedures. Mr. Melby is currently the principal investigator on two rubble-structure armor unit research work units.

Dr. Michael R. Palermo

Dr. Palermo is a research civil engineer with the Environmental Engineering Division, Environmental Laboratory, at the U.S. Army Engineer Waterways Experiment Station (WES), where he conducts research and applied studies concerning dredging and dredged material disposal and wetlands engineering. Dr. Palermo received his B.S. and M.S. degrees in civil engineering from Mississippi State University and his Ph.D. degree in environmental and water resources engineering from Vanderbilt University. While at WES, Dr. Palermo has authored numerous publications in the areas of dredging and dredged material disposal technology. He remains actively involved in studies concerning design, operation, and management of disposal sites, and beneficial uses of dredged material to include wetlands restoration. Prior to his position at WES, Dr. Palermo was a civil engineer with the U.S. Army Engineer District, Vicksburg, beginning his career with the Corps in 1967.

Dr. C. H. (Jim) Pennington

Dr. Pennington became the Director of the U.S. Army Engineer Waterways Experiment Station (WES) Graduate Institute when partnerships with several universities were formed in 1986. Prior to becoming the Institute Director, Dr. Pennington served as a research biologist in the WES Environmental Laboratory, where he conducted ecological studies on many U.S. rivers. He has also served on the faculty at Texas A&M University and Southeastern Louisiana University. He received his B.S. degree in zoology and his M.S. degree in biology from Southeastern Louisiana University. He received his Ph.D. in wildlife and fisheries sciences from Texas A&M University.

Dr. Susan Ivester Rees

Dr. Rees is a native of South Carolina. She received undergraduate training in the marine sciences at the College of Charleston and graduate training at the University of South Carolina. Since 1981, she has been affiliated with the U.S. Army Engineer District, Mobile, serving as oceanographer in the Environment and Resources Branch in the Planning and Environmental Division. Currently, she is Chief, Coastal Environment Section. Prior to 1981, Dr. Rees served on the faculty of the University of Alabama and was stationed at the Dauphin Island Sea Lab. Dr. Rees's duties included responsibility for the environmental aspects of civil works navigation and shore protection projects and military activities, ocean dredged material disposal coordinator, sediment specialist, and project manager of the Underwater Berm and Thin-Layer Disposal National Demonstration Programs. She also serves as the Corps of Engineers Project Manager for the U.S. Navy Gulf Coast Strategic Homeporting. Other activities include member, Advisory Council, University of South Alabama Coastal Research and Development Institute; associate editor, *Northeast Gulf Science*; member, Mississippi-Alabama Sea Grant Planning and Advisory Panel; reviewer, National Science Foundation; representative to the Environmental Protection Agency Gulf of Mexico Program; and Federal co-chair of the Freshwater Inflow Subcommittee. She has a number of publications and has received a number of honors including U.S. Army Corps of Engineers Planning Excellence Award, 1990; U.S. Army Corps of Engineers, South Atlantic Division, Planner of the Year, 1990; Department of the Army Achievement Medal for Civilian Service, 1988; Mobile District Federal Woman of the Year, 1984; Who's Who in the South, 1983; Society of Sigma Xi, 1979; Outstanding Young Women of America, 1976; and Slocum-Lunz Foundation Pre-doctoral Fellowship, 1975.

David L. Ruple

Mr. Ruple was born and raised in upstate New York. His undergraduate training was received from the State University of New York at Morrisville and North Carolina State University, with graduate training from the University of Southern Mississippi. He has served as a research biologist with North Carolina State University; research associate with Louisiana State University and the Gulf Coast Research Laboratory; museum director of the Scranton Museum in Pascagoula, MS; and is currently employed as a coastal ecologist with the Mississippi Department of Wildlife, Fisheries and Parks Bureau of Marine Resources, working with the state's Coastal Program. Coastal management issues of special interest include coastal preserves, marine fisheries, habitat degradation, and marine debris.

Harry M. Shoudy

Mr. Shoudy is a senior policy advisor in Headquarters, U.S. Army Corps of Engineers, Civil Works Directorate, Division of Policy and Planning. He has worked in the policy development area since January of 1993. Prior to that, he was a senior advisor at the Board of Engineers for Rivers and Harbors, Chief of Economics in the South Atlantic Division, and Chief of Economics in the U.S. Army Engineer District, Buffalo. He is the recipient of a Commander's Award. Mr. Shoudy received a B.A. degree in economics from Central University of Iowa and an M.S. degree in water resources planning from Colorado State University.

Lisa W. Sales

Ms. Sales is a civil engineering associate assigned to Biological Mitigation Projects in the Engineering Division of the Los Angeles Harbor Department at WORLDPORT LA. She is currently the Project Manager for the

Batiquitos Lagoon Enhancement Project. Ms. Sales' division is deeply involved with the expansion of the Harbor to meet the demands of Los Angeles' trade growth, which is expected to double by the year 2020. She received her B.S. degree in civil engineering at California Polytechnic University in Pomona. Before joining the Harbor Department in 1988, Ms. Sales was a civil engineer working in the area of Groundwater Hydrology for the Los Angeles Aqueduct Division. Prior to that, she worked in the area of Water Rights and Air Quality for the Los Angeles Department of Water and Power. Ms. Sales is a registered professional civil engineer in the state of California.

Jane McKee Smith

Ms. Smith is a research hydraulic engineer at the Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station, and works in the area of coastal hydrodynamics. She is the Technical Area 2 Coordinator for the Coastal Inlets Research Program. Her research interests include spectral wave transformation, wave breaking, and nearshore currents. Ms. Smith has been involved in hydrodynamic data collection at the DUCK 85, SUPERDUCK, Great Lakes '88, and DELILAH field experiments, as well as the SUPERTANK laboratory project. Ms. Smith earned a B.S. degree from South Dakota State University and an M.S. degree from Mississippi State University. She is a member of the American Society of Civil Engineers and the American Geophysical Union. She is a registered professional engineer in the state of Mississippi.

Dr. Russell F. Theriot

Dr. Theriot has worked in the environmental field for 20 years. In the last 10 years, he has worked specifically in the wetlands research area. He has a B.S. degree in wildlife management from Northwestern State

University in Louisiana, and both an M.S. degree in botany and a Ph.D. in aquatic and wetland ecology from the University of Florida. He is currently Director of the Wetlands Research and Technology Center and Manager of the Wetlands Research Program. He serves on many national-level committees associated with wetland delineation, hydric soils, and hydrophytic vegetation. He provides technical input related to wetlands issues to Congressional committees and the White House.

George F. Turk

Mr. Turk is a hydraulic engineer in the Wave Research Branch, Wave Dynamics Division at the Coastal Engineer Research Center (CERC), U.S. Army Engineer Waterways Experiment Station. He joined CERC in 1992. He has B.S. and M.S. degrees in civil engineering from Oregon State University. He is a registered professional engineer in the states of Mississippi and Oregon.

G. Frank Yelverton

Mr. Yelverton has worked for the U.S. Army Engineer District, Wilmington (SAW), since 1975. From 1975 to 1984, he worked in the Regulatory Branch as project manager for permit actions that required preparation of environmental impact statements (EIS). From 1984 to the present, he has worked with the Environmental Resources Branch and managed wetlands creation actions, regulatory EIS', and environmental aspects of General Investigations and Operation and Maintenance projects. Prior to working for SAW, Mr. Yelverton worked for the North Carolina Division of Marine Fisheries doing marine research on ocean scallops, American lobsters, and various anadromous fishes, and processed permits for activities that would alter wetlands. Mr. Yelverton received his B.S. degree in zoology in 1970 from the University of North Carolina at Chapel Hill, his M.S. degree in marine biology in 1984 from the University of North Carolina at Wilmington, and a Master of Public Health degree in biostatistics in December 1993 from the University of North Carolina at Chapel Hill.

Appendix B

Status of Action Items

Action Item	Place and Date of Action	Responsible Agent	Action and Status
58-1. Provide Board members draft action items prior to finalizing list.	Atlantic City, NJ 15-17 Jun 93	CERC	This has been done and will be done in the future.
58-2. Provide status of action items at least 2 weeks prior to scheduled meeting via COASTNET.	Atlantic City, NJ 15-17 Jun 93	CERC	This also has been done and will be done prior to future meetings.
58-3. Review CERC numerical models with regard to currency, determine if deficiencies exist, establish impacts of any deficiencies in priority order, and determine costs.	Atlantic City, NJ 15-17 Jun 93	CERC	A status review of the major documented numerical models used by CERC on Corps projects was performed. See Appendix C.
58-4. Review state of practice of nearshore hydrographic surveys, identify any deficiencies, and recommend action to alleviate any deficiencies.	Atlantic City, NJ 15-17 Jun 93	CECW-EP-S CERC	CERC and HQUSACE developed a specific scope of action which will cover surveys on beaches, offshore borrow areas, ebb deltas, coastal structures, and nearshore dredged material placement. Results to be incorporated into an EM on hydrographic surveying. Draft results will be reported at spring CERB.
58-5. Transmit list of eligible inlets that can benefit from mitigation through Section 933 or 11 to Division Commanders.	Atlantic City, NJ 15-17 Jun 93	CERC	MG Genega tasked each coastal Division to provide an up-to-date list of inlets. A letter was sent to each Division tasking them to inform appropriate state agencies of eligible inlets and further action would have to be initiated by them.
58-6. Director of CERC will make a presentation at each CERB Board meeting to place the theme topic of the meeting in perspective with CERC/Corps programs, goals, and directions.	Atlantic City, NJ 15-17 Jun 93	CERC	This is being done and will continue to be done at future CERB meetings.
58-7. Investigate feasibility of collecting coastal zone data (emphasis on long-term) needed for environmental analysis in concert with physical data collection efforts.	Atlantic City, NJ 15-17 Jun 93	CERC	Efforts have concentrated on identifying needs for such data and opportunities to pursue collaborative efforts.
58-8. Develop recommendation for funding beach-fill monitoring.	Atlantic City, NJ 15-17 Jun 93	CECW-O	Legislation would be needed in order for O&M funds to be used for monitoring shoreline protection. Recommend data be collected using Construction General funds and GI funds be programmed for CERC to analyze data.
58-9. Review opportunities for Pacific and Caribbean beach research needs and the development or modification of necessary engineering tools within the research program recommended by the Field Review Group and approved by Headquarter's Technical Monitors.	Atlantic City, NJ 15-17 Jun 93	CERC	Review indicated that without a change in Administration policy on recreational beaches and subsequent increases in Corps' projects involving Pacific and Caribbean beaches, study of these beaches will not be a high priority in the Corps. CERC is working with POD to satisfy some of their needs through the existing R&D system.

Action Item	Place and Date of Action	Responsible Agent	Action and Status
58-10. Meet at CERC for next spring regular meeting to review all CERC programs and observe facilities.	Atlantic City, NJ 15-17 Jun 93	CERC	This will be done.
55-5. Report on the Wetlands Research Program, beneficial uses of dredged material, and the Environmental Protection Agency's Gulf of Mexico Program at the October '93 meeting.	Mashpee, MA 30 Oct - 1 Nov 91	CERC/EL	These items will be addressed at this meeting.

Appendix C

Numerical Models Used by CERC

Category	Model	Priority	Use	Deficiency	Action
WAVES	RCPWAVE	M	Monochromatic wave refraction	No diffraction/island/structure/current	Use until replaced by REFDIF; NMMP-supported
	REFDIF	H	Monochromatic wave refraction and diffraction	Monochromatic; spectra by component superposition; no currents	To be addressed in CIRP
	STWAVE	H	Steady-state spectral wave model	No diffraction/currents/structures; needs further validation	To be addressed in CIRP; NMMP-supported
	WISWAVE	M	Directional spectral wave model (WIS hindcasts)	2nd-generation model	Use until replaced by 3GWAM; NMMP-supported
	3GWAM	H	Directional spectral wave model	Requires further validation, especially for shallow water	Supported by R&D work unit
CIRCULATION	WIFM	M	2-D circulation storm surge, etc; finite difference	2-D rectilinear grid; not robust for nonlinear terms	Use until replaced by CH3D-WES and/or ADCIRC; NMMP-supported
	CH3D-WES	M	2-/3-D circulation with salinity and temperature; finite difference; state of art	No flooding/drying; needs better turbulence closure; uses structured grid	Update via NMMP; may be replaced by ADCIRC
	ADCIRC	H	2-D circulation storm surge, etc; finite element; state of art	No flooding/drying, uses flexible unstructured grid; needs to handle 3-D and turbulence closure	Developed in DRP and improvements planned in CIRP
BEACH RESPONSE	GENESIS	M	Long-term shoreline response	Shoreline (one-line) change; inherent model assumptions; state of art	Supported by R&D & NMMP
	SBEACH	H	Beachfill response to storms	Inherent model assumptions; state of art	Supported by R&D & NMMP
DREDGING	STFATE	M	Open-water disposal; short-term fate	Inherent model assumptions; state of art	Supported by DRP & NMMP
	LTFATE	M	Open-water disposal; long-term fate	Inherent model assumptions; state of art	Supported by DRP & NMMP
HARBOR	HARBD	H	Harbor oscillations; design tool	No transmission, breaking, overtopping, wave/current interaction, monochromatic	Supported by NMMP; resubmit R&D proposal
	MSMAP	L	Moored ship motion analysis	Inherent model assumptions; state of art	NMMP support requested - \$20K/yr
OTHER	NMLONG	M	Nearshore wave transformation and longshore currents	1-D model assumptions; state of art	NMMP support requested - \$15K/yr
	DYNLET	M	User-friendly, field-oriented tide and current model	None; 1-D but pseudo 2-D	NMMP support requested - \$25K/yr
	IBREAK	M	Wave/structure interaction; runup and overtopping	Lacks treatment of compound and complex geometries	NMMP support requested - \$20K/yr

Appendix D

Memorandum to Director of Civil Works

CEWES-CV-Z

20 JUL 1993

MEMORANDUM FOR BG (P) Stanley G. Genega, Director of Civil Works,
U.S. Army Corps of Engineers, 20 Massachusetts
Avenue, N.W., Washington, D.C. 20314-1000

SUBJECT: Pacific and Caribbean Island Research

1. During the Executive Session of the CERB there was an extended discussion of Item 57-8, which is, "Undertake more basic studies of beach processes that would also be applicable to Pacific and Caribbean Islands." You said that you wanted to personally review the issue and asked me to provide information on CERC's R&D Programs. Enclosed is information relating to CERC expenditures by geographic region and the official documentation for each work effort in the Coastal Engineering Research Programs (CERP), Monitoring Completed Coastal Projects (MCCP) Program, and the Field Data Collection Program (FDCP). The information also sheds light on discussions at the last Board meeting that not enough funding is spent on data collection on the West Coast.

2. I think it useful that I briefly explain how priorities are set in coastal engineering R&D. Field Review Groups (FRG's) are functional for all Corps R&D programs including coastal engineering. The coastal engineering FRG's represent all coastal divisions and provide guidance on problems the R&D program should address to satisfy field needs. They meet at least once a year to provide a detailed review of the Programs (lasting 3 1/2 days). Civilian members of the CERB are full participants in these meetings. The FRG's and civilian members vote on priorities of all work efforts. They can recommend that new work be started, efforts be dropped or redirected, and funding be changed. Technical Monitors from your Policy and Planning; Engineering; and Operations, Construction, and Readiness Divisions; also attend the reviews, take into account what the FRG's have recommended, and recommend the work to be performed to the Civil Works R&D Review Committee. The Civil Works R&D Review Committee (consisting of the Chiefs of the Civil Works Divisions) make the final decisions on all spending in the General Investigations (GI) R&D Program.

3. I believe it very important that the process described in the previous paragraph not be short-circuited except under extraordinary circumstances. The current system is very powerfully a user-driven system, and its responsiveness as a result of user

CEWES-CV-Z

SUBJECT: Pacific and Caribbean Island Research

control provides the grass roots support for field responsive R&D programs to flourish. Participation of the civilian members of the CERB at the Program Review is an integral part of the process.

4. Item 57-8 is something that in my opinion we can only really address seriously if there is a change in Administration policy on recreation beaches. Professor Komar mentioned a couple of times that he had to do work on St. Lucia Island in the Caribbean, and he found a lack of information on coastal processes on Caribbean Islands. He thought that the Corps should remedy this situation through R&D. St. Lucia is a dependency of the United Kingdom, and I do not believe we could justify performing research on St. Lucia or similar Caribbean Islands. The Corps is responsible for Puerto Rico, and CERC has performed studies there (e.g., the coastal protection for El Morro Castle), but we have not had projects involving beach processes in Puerto Rico although there are some serious beach erosion concerns on the island. Probably, beach projects can only be justified in Puerto Rico on a recreational-benefits basis.

5. I have discussed the Executive Session meeting with Mr. Stan Boc, Pacific Ocean Division (POD), who was an attendee. Although he certainly would like studies of almost all processes unique to Pacific Islands, his acute need is for simple tools that can be used for Section 14 studies where he is limited to study expenditures of \$40K. I believe this is a reasonable request that can be worked through the current system. I have asked Mr. Boc to determine what simple tools he needs that he thinks can be developed at low cost, visit CERC so we can discuss with researchers, and we will propose a small work unit at the next Program Review in March 1994 to address his focused problem. My experience with our FRG and Technical Monitors is that they are enlightened and willing to support well-focused efforts. I do not believe they would be supportive of large-scale and vague efforts to study beach processes on "Pacific and Caribbean island beaches" when the Corps either has no mission to conduct the studies or Administration policy assigns the studies low priority. With funding of the CERP about 20 percent lower in FY 93 in actual dollars than it was a dozen years earlier, coastal engineering has many high priority studies that we have not been able to start because of budgetary constraints. Professor Komar himself strongly recommended funding for 5 new work units approved at the last Program Review. It is unlikely that we will be able to start more than 1-2 of these efforts (and maybe none) in FY 94 because of funding constraints.

CEWES-CV-Z

SUBJECT: Pacific and Caribbean Island Research

6. I believe the coastal engineering R&D programs have been responsive to POD and actually over-weighted efforts for POD. POD spends only about 0.3 percent of the funding spent by coastal divisions for civil works (encl 1) and virtually all of this is for navigation and flood control. POD had only \$9.5 million dollars in total civil works spending and \$919,000 in GI-fund spending in FY 91 (most recent data I have). Of course, as we discussed in Hawaii, the dollar value of many POD projects may be small, but the importance to local communities may be large. Even so, POD's civil works expenditures are put in perspective when one realizes that the recent Ocean City, Maryland, beach-fill project cost about 6 times the entire yearly civil works expenditures of POD or about 60 times POD's yearly GI expenditures. Approximately 6.8 percent of all of its CERP, MCCP, and FDCP funds (encl 2) that are specific to a particular coast (more than half the research is not specific to any coast) are expended on research relating directly to POD.

7. There was discussion during the Board meeting indicating that not enough data collection was occurring on the Pacific Coast relative to the Atlantic Coast. We actually spend more funds on data collection for the Pacific Coast than any other coast (I believe Professor Raichlen mentioned he was mistaken after seeing a slide during the Board meeting that showed gage locations). We have two programs that involve significant field-data collection. One is MCCP (encl 3). Note that the Pacific Coast has the largest block of funds and the Atlantic Coast the smallest. This would fluctuate from one year to another based on the particular projects monitored. The FRG's and Technical Monitors evaluate the projects on merit, concentrating on what can be learned and applicability of what is learned to other projects. Enclosure 4 shows spending of FDCP. Every coastal Division had input to the five-year plan for this program and the FRG's and Technical Monitors approved the plan. The Field Wave Gaging portion of FDCP started in the Pacific and has been expanding slowly as we have reduced costs and developed cost-sharing agreements with states. Clearly, the Gulf Coast and Great Lakes are under-represented. We recently signed our first cost-sharing agreement with a Gulf Coast state (Texas) and are negotiating with a Great Lakes state (Illinois). Relative expenditures will grow for these coasts in the future as we complete cost-sharing negotiations. Enclosure 5 presents details of all work units in CERP, MCCP, and FDCP.

CEWES-CV-Z

SUBJECT: Pacific and Caribbean Island Research

8. In summary, without a change in Administration policy on recreation beaches and subsequent increases in Corps' projects involving Pacific and Caribbean beaches, study of these beaches will not be a high priority in the Corps. We have a user-driven system that sets priorities for all Corps' research. I believe this system can provide for small and well-focused efforts that would satisfy POD's needs. I have discussed with POD how this can be achieved. I can appreciate Professor Komar's feelings that CERC should study coastal processes relating to all parts of the world, because CERC is indeed an international resource. Certainly, we would love to study Pacific and Caribbean Island beaches. But we are stewards of public funding, and we must spend the funding to meet high-priority mission needs first.

9. I will be pleased to meet with you if you need further elaboration on any aspect of this issue.

FOR THE DIRECTOR:

5 Encls

JAMES R. HOUSTON, PhD
Director
Coastal Engineering Research Center

CF (w/encls 1-4):
Mr. Jesse A. Pfeiffer, Jr.
CERD-C

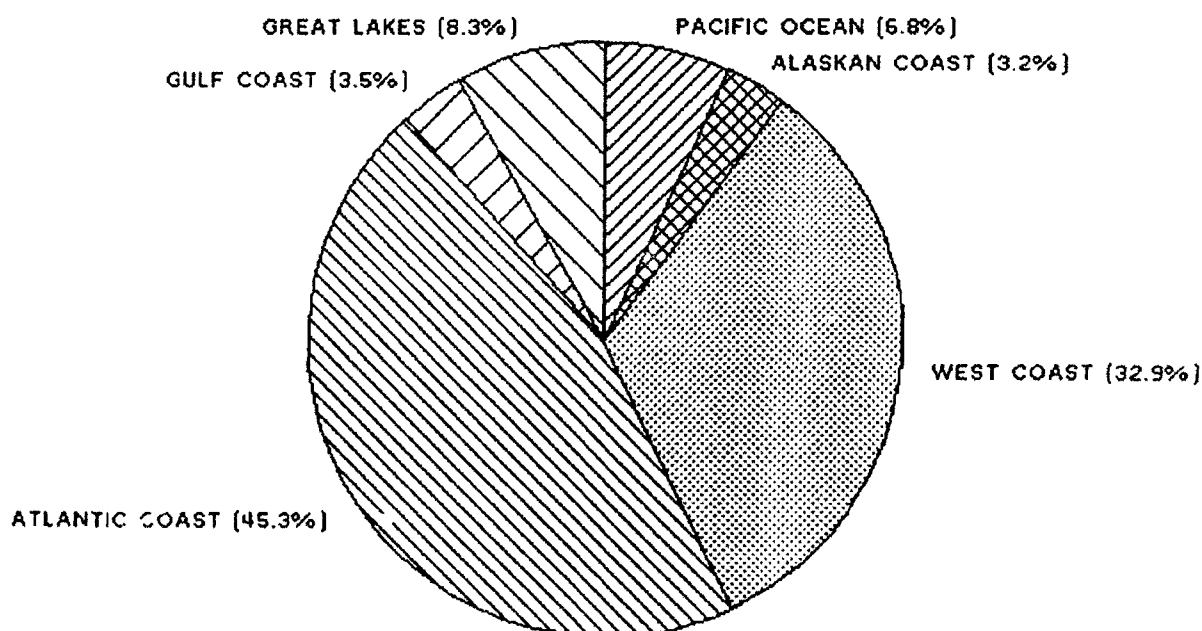
Inclosure 1

FY 1991 Civil Works Expenditures by Division (\$000)

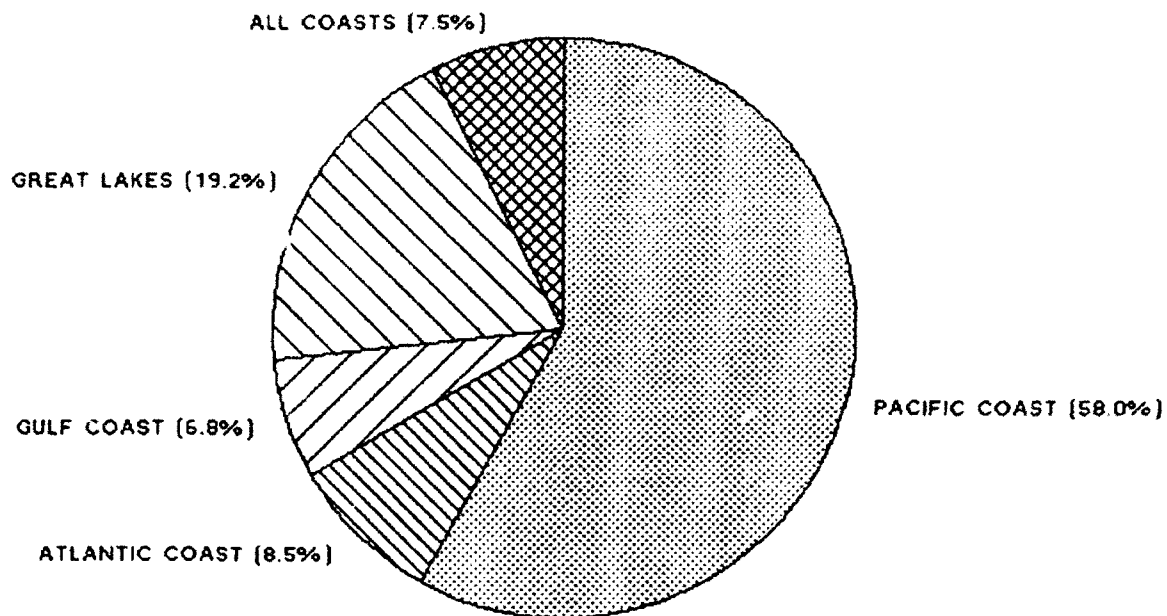
Division	General Investigations	Construction General	Operation and Maintenance General	Flood Control, Mississippi River and Tributaries	General Expenses	Flood Control and Coastal Emergencies	Regulatory Program	Permanent Appropriations	Rivers and Harbors Contributed Funds	Total
New England	3,838	5,317	23,664		773	252	4,041	0	2,452	40,337
North Atlantic	17,549	70,709	131,630		6,053	1,651	10,173	540	20,144	258,449
South Atlantic	14,267	163,351	225,019		6,601	5,438	12,346	1,408	21,826	450,256
Ohio River	11,783	213,327	17,370		8,623	1,548	5,427	1,671	1,583	416,032
North Central	10,457	105,865	183,720		9,131	2,516	9,500	360	18,036	339,585
Lower Mississippi Valley	9,236	254,477	168,590	349,552	9,396	3,894	5,679	767	8,852	810,653
Southwestern	13,525	122,561	230,778		7,787	5,702	6,073	1,236	16,907	404,569
Missouri River	3,270	19,285	81,491		4,869	1,749	4,622	0	1,775	117,061
North Pacific	5,452	162,673	159,629		6,253	8,533	9,248	1,080	4,889	357,757
South Pacific	16,819	156,799	65,696		8,179	2,017	6,101	625	22,138	278,333
Pacific Ocean	919	3,900	778		860	348	808	0	1,928	9,541
Headquarters Oversight and Centralized Support	29,891	18,719	25,179		67,677	573	669			142,708
Total	137,006	1,296,983	1,468,244	349,552	136,161	34,221	74,887	7,687	120,540	3,625,281

Inclosure 2

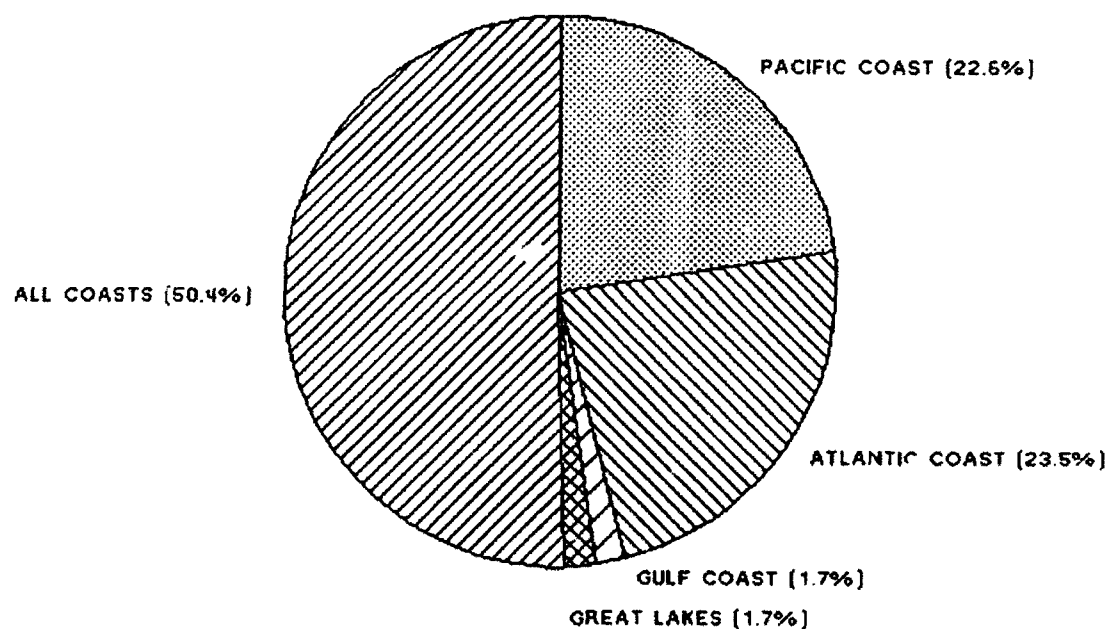
Combined FY 93 CERC Coastal Regional Funding for Research Specific to a Particular Coast



**Inclosure 3
FY 93 MCCP Regional Funding**



**Inclosure 4
FY 93 Coastal Field Data Collection Regional Funding**



**Inclosure 5
(Available Upon Request)**

Appendix E Initiatives

Initiative Number 1

Identify and develop more efficient and effective means and technology to deliver coastal engineering education and training.

Action By: Dr. Pennington
(CEWES-ZT-E)

Status of Recommended Action(s): At the previous meeting of the Coastal Engineering Research Board (CERB), further action on this initiative was put on hold pending results of Corpswide survey of coastal specialists. The survey was conducted by the Office of Personnel Management (OPM), and the data are at this time being analyzed by OPM. Results of the survey will be presented at the meeting in Point Clear.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Dr. Pennington presented preliminary results of the survey. Dr. Pennington and the other Action officers will make specific recommendations on the respective initiative at the next meeting.

Action By: Dr. Pennington
(CEWES-ZT-E), Mr. Lockhart
(CECW-EH-D), Mr. Housley (CECW-PH),
Dr. Camfield (CEWES-CW).

There were considerable discussions on the Corps' training policy. The Board broadened the Charge for Dr. Oswald to review the Corps' policy related to an individual's time allocated to training, and if appropriate to develop and recommend a new policy.

Action By: Dr. Oswald (CERD-Z)

Initiative Number 2

Develop more advanced degree/post-graduate education and training opportunities to Corps coastal engineers and scientists.

Action By: Dr. Pennington
(CEWES-ZT-E)

Status of Recommended Action(s): Same as Initiative Number 1.

Initiative Number 3

Short courses/continuing education.

Action By: Mr. Lockhart (CECW-EH-D)

Status of Recommended Action(s): Same as Initiative Number 1.

Initiative Number 4

Develop means to retain coastal knowledge and expertise as experts leave the Corps.

Action By: Mr. Housley (CECW-PF)

Status of Recommended Action(s): Same as Initiative Number 1.

Initiative Number 5

Education outreach in coastal engineering to junior high schools and high schools.

Action By: Dr. Pennington
(CEWES-ZT-E)

Status of Recommended Action(s): Same as Initiative Number 1.

Initiative Number 6

Scientific exchange.

Action By: CERD-C

Status of Recommended Action(s):
1. Review past dialogues on this topic.
Contact appropriate offices to recommend

changes to present policies, and possibilities to promote exchange. Report back to the CERB at the June 1993 meeting.

2. Propose conditions for foreign travel and security requirements for visiting foreigners.

MG Genega has tasked WES to provide data in order that an assessment can be made of the impact of current policies on foreign scientific exchange. Those data are being collected.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Data will be provided to MG Genega for his action.

Action By: MG Genega (CWCW-ZA), Mr. Housley (CECW-PF)

Initiative Number 7

Technology transfer from CERC to Districts/users.

Action By: Dr. Camfield (CEWES-CW)

Status of Recommended Action(s): Same as Initiative Number 1.

Initiative Number 8

Public relations/public education.

Action By: Director, HQ PAO

Status of Recommended Action(s): The Director, Public Affairs Office, HQUSACE, develop a preliminary plan of action for presentation at the June 1993 CERB meeting. CERB should provide feedback on the plan of action, and a final report should be prepared by HQUSACE PAO. Consider means internal and external to USACE.

See attached plan prepared by Public Affairs Office, HQ. Request approval to implement plan.

Discussion and/or Further Action (59th CERB in Point Clear, AL): The plan was deemed too general for thorough evaluation. WES representatives will meet with

representatives from Headquarters PAO to develop a detailed plan.

Action By: Chief, PAO (CEPA-ZA), Chief, PAO (CEWES-LV-Z)

Initiative Number 9

Form strategic regional partnerships (technical).

Action By: Mr. Housley (CECW-PF)

Status of Recommended Action(s):

1. Have regional conferences at Corps Division level with regional/national themes. Discussions have been held with SAD concerning hosting the first conference. This is also being coordinated with the workshop being developed in Initiative 18 - Identify future coastal engineering research and program direction.
2. Develop public involvement programs.
3. Explore new funding avenues.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Actions 1 and 2 are the responsibility of the Division Commanders. Recommend commanders begin organizing regional conferences and establishing appropriate public involvement programs.

Action By: Mr. Housley (CECW-PF)

Initiative Number 10

Develop national dredging partnerships.

Action By: CECW-OD

Status of Recommended Action(s):

1. Chief of Engineers to host national meeting of agency heads to highlight the importance of dredging to the integration of national economic and environmental goals.
2. Form working groups at Director of Civil Works level with equivalent agencies.

A recommendation has been coordinated through the Director of Civil Works to the Assistant Secretary of the Army for Civil

Works to initiate a summit meeting with the Department heads of the Departments of Interior, Transportation, and Commerce and the Secretaries of the Environmental Protection Agency and the Department of the Army. The goal of this summit would be to reach a consensus on the Administration's position on the construction and maintenance of the Federal navigation system.

Several actions are occurring in other agencies and within the Department of the Army that are directly related to both Recommended Actions that were initiated by a speech given by Secretary of Transportation Federico Pena. Because of the dynamic nature of this issue, and the multi-agency involvement, up-to-date information on this issue will be presented at the November 1993 CERB meeting.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Mr. Holliday (CECW-OD) provided a briefing on ongoing activities. The Board will be kept advised on progress.

Action By: Mr. Holliday (CECW-OD)

Initiative Number 11

Endorse the Dredging Operations and Environmental Research (DOER) Program.

Action By: Mr. Campbell (CECW-OD), Mr. McNair (CEWES-CP-D)

Status of Recommended Action(s):

1. Endorsement of the Dredging Operations and Environmental Research Program.

The Board endorsed the program at the Atlantic City meeting and that endorsement is contained in draft Proceedings of the meeting. DOER is scheduled to be initiated in FY95. Although it is not possible to know at this time what the situation will be in FY95, it is expected that due to decisions above the Corps, new starts may be in jeopardy. It is recommended that LTG Williams be advised in his update on the Charge of the CERB's strong support and that he take what action he

deems necessary to support the program. (CECW-OD)

2. Conduct technical workshops to determine focus of program.

Three Corpwide workshops have been conducted to focus the program (Feb 93, Apr 93, Nov 93). Details of the program will be presented at the meeting in Vicksburg. (CEWES-CP-D)

3. Involve independent outside technical people in the review process for developing the new research program.

Civilian CERB members are invited to all workshops and will review working documents. (CEWES-CP-D)

Discussion and/or Further Actions (59th CERB in Point Clear, AL): Dr. Roper stated that preliminary guidance from OMB indicates there is a high probability that DOER will not be funded until FY96. The Board agreed to go on record strongly supporting initiating DOER in FY95. If FY95 funding is not possible, the Board requests a commitment from Headquarters that the program will be recommended for funding in FY96.

Action By: Dr. Roper (CERD-C), Mr. Holliday (CECW-OD)

Initiative Number 12

Review the Administration budget to identify the funding priorities and trends that relate to coastal engineering research.

Action By: Mr. Housley (CECW-PF)

Status of Recommended Actions:

1. Develop report of findings and submit to the CERB at future meetings.

This report will be developed when the FY95 budget can be reviewed in detail.

2. Utilize initial analysis and develop plan of action.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Mr. Housley will develop a report of findings for review at next meeting.

Action By: Mr. Housley (CECW-PF)

Initiative Number 13

Seek increased coastal engineering funding from NSF for universities.

Action By: CERD-C

Status of Recommended Action(s):
Develop/execute strategy to approach NSF.

We have had discussions with the National Science Foundation (NSF) concerning how best to achieve our goal to have NSF increase funding in coastal engineering for universities. The NSF generally precedes a new thrust with the development of a research plan for the thrust that has wide consensus among practitioners of the discipline.

The key step in the strategy to approach NSF should be to hold the workshop addressed in Initiative 18. The goal of this workshop is to develop a plan for future coastal engineering/science research directions. All major people in the discipline of coastal engineering/sciences will be invited including those from academia, Corps' Districts and Divisions, CERC, the private sector, other government agencies, and international researchers. The workshop will develop a research plan that will have a wide consensus.

Another step in the strategy will be to have other agencies join the Corps in approaching NSF with the plan. The Office of Naval Research (ONR) has indicated a willingness to join us. The ONR, the U.S. Geological Survey, Sea Grant of the National Oceanic and Atmospheric Administration, and NSF itself have indicated an interest in joining the Corps in sponsoring the workshop. Therefore, the workshop will be sponsored by the major relevant agencies, and we can use it to get support for other agencies joining the Corps to approach NSF.

Discussion and/or Further Action (59th CERB in Point Clear, AL): The Board concurred with the approach outlined above. In addition, CERC will investigate the feasibility of a Marine Board study of the initiative.

Action By: Dr. Houston (CEWES-CV-Z)

Initiative Number 14

Develop funding authorities to monitor beach fills and other forms of shore protection to improve future designs.

Action By: Mr. Campbell (CECW-OD), CECW-OC

Status of Recommended Action(s):
Formulate new policy for beach fill and shore protection monitoring.

Any proposed policy has limitation.

By law, Operation and Maintenance funds cannot be used for monitoring shoreline protection projects that are funded by Construction General funds.

The use of Construction General funds for monitoring beach response following a renourishment event will require cost sharing with the local sponsor. The Corps can reprogram up to \$300,000 for additional data gathering and study of the project. The local sponsor share could be deferred until the next renourishment event, to allow a reasonable amount of time to obtain the funding. The perception that the local sponsor will be funding "research" for other than their own project may cause reluctance on the part of the local beach community to contribute to the monitoring costs.

General Investigation funds could be used to fund the beach profile monitoring under the R&D umbrella, similar to the justification used for the Coastal Field Data Collection Program. To obtain funding in FY95 would require additional coordination and unusual out-of-sequence input to OMB. Additionally, the justifications for this beach monitoring/research would appear to be redundant to

parts of the justifications for both the Coastal Field Data Collection Program and the Coastal Research Program. It would not be likely that monitoring of all beach projects could be funded under the GI program.

It is our opinion that data collected from the monitoring of beach projects are an integral part of the project. The cost of data collection is a reasonable cost to be funded by the Construction General appropriation with appropriate local sponsor cost sharing. The data collected will directly benefit the local sponsor's project by consistently monitoring the changes on their beach, and will indirectly benefit their project through enhanced beach design development.

It is our recommendation that the CERB recommend the use of Construction General funds to collect beach profile data at the required appropriate level and that additional GI funds be programmed for CERC to analyze these data under one of the existing research programs.

Discussion and/or Further Action (59th CERB in Point Clear, AL): CERC will develop "optimum" monitoring requirements for beach fills to establish funding requirements for projects. Mr. Holliday (CECW-OD) will document basis for not allowing O&M funds to be used to monitor beach fills. Further action will be based on Mr. Holliday's findings.

Action By: CERC, Mr. Holliday (CECW-OD)

Initiative Number 15

Seek coastal engineering research partnerships to optimize use of funds.

Action By: (CEWES-CP-C)

Status of Recommended Action(s):

1. Identify and prioritize coastal engineering research needs (i.e., beach erosion).

The workshop in Initiative 18 will satisfy this requirement.

2. Identify potential partners and develop strategies, and implement strategies.

Potential partners

The Corps of Engineers is by far the dominant government agency in coastal engineering in the United States. Coastal engineering is not a mission of any other government agency. However, there are interests in the coastal zone by other government agencies and there is common ground in some areas.

Potential partners in coastal engineering R&D from other agencies include parts of agencies such as the Navy, the National Oceanic and Atmospheric Administration (e.g., Sea Grant and the National Data Buoy Center), parts of the U.S. Geological Survey (USGS), and the National Science Foundation.

Develop and implement strategies

Since coastal engineering is not a mission of other agencies, agency-to-agency agreements do not seem to be a particularly fruitful path for developing partnerships. Instead, it is necessary to make contacts and develop relationships with laboratories or other subelements of agencies that have interests related to aspects of coastal engineering. For example, CERC has been successful in the past, particularly, in large scale experiments at its Field Research Facility in Duck, North Carolina, in developing partnerships in which each agency has goals that are complementary.

Under Initiative 18, we are attempting to put together a consortium of the major subelements of agencies with an interest in coastal engineering/sciences to cosponsor the workshop to develop a research plan for coastal engineering/sciences. The workshop will be a valuable vehicle to develop research partnerships.

One clear partner for the future is the Navy. The Navy is developing new thrusts into shallow water. We have explored closer relationships with the Navy since the Board's meeting on the initiatives. At the last Board meeting I reported the very positive news that Dr. Linwood Vincent, CERC ST Senior

Scientist, had become an official liaison between the U.S. Army Engineer Waterways Experiment Station and ONR. Dr. Vincent is involved in planning and execution of ONR coastal efforts as an ONR scientific officer. He now has an office at ONR, receives logistics support, and works about 1/4 time in this liaison role. We will be using this position to forge closer ties between the Navy and CERC. The ONR has considerable influence in the Navy, and the position will allow us not only to develop partnerships with ONR, but other Navy laboratories.

CERC is working with ONR in putting together a major ONR thrust for the remainder of the decade that will concentrate on two major experiments to be conducted in 1994 and 1996 at CERC's Field Research Facility (FRF). The U.S. Geological Survey (USGS) also will be a major partner in this set of experiments. ONR/USGS will invest about \$2 million per year in support of university participation and logistics. CERC/ONR/USGS have a joint committee directing the experiment, and this major partnership will highly leverage CERC funding and help draw researchers together from across the Nation and internationally.

In July 1993, Drs. Whalin, Houston, and Vincent attended a meeting at the Oceanographer of the Navy's Office concerning a joint DOD proposal to develop a common database of oceanographic and meteorological data. We have joined with the Navy and Air Force in a multimillion-dollar proposal to the Defense Modeling and Simulation Office to develop a common database. The proposal has received a high rank and promises to be a major new partnership.

The major partnership likely with state agencies is partnership in wave gaging in the Coastal Field Data Collection Program. We have been able to get California, Florida, Washington, Texas, and Virginia to join us in partnership in measuring waves on their coasts. This partnership saved us about three-quarters of a million dollars in FY93,

and is responsible for us being able to expand the system to coasts that have been without wave gages. We are negotiating further with Hawaii, South Carolina, Massachusetts, and Alaska.

CERC is working with the National Science Foundation (NSF) on the Coastal Ocean Process (COOP) experiment in 1994. This is an NSF multidisciplinary experiment and long-term R&D program. CERC has a member on the steering committee. COOP will be performing mainly environmental experiments off of CERC's Field Research Facility in 1994. CERC also has an NSF-funded joint research effort with Cornell University, the University of Washington, and the University of California.

Although there are significant restrictions that inhibit working with foreign laboratories, CERC is exploring partnership relations with them. Senor Jose Maria Grassa Garrido, Director del Centro de Estudios de Puertos y Costas, in Spain has contacted CERC concerning developing a research relationship with CERC. This organization is the analog of CERC in Spain. He is planning to visit CERC before the end of the year.

One of the questions appearing in the Task Force Fact Sheet for this initiative is, "How can the coastal community contribute to oil spill research?" CERC is a co-funder of a consortium of private sector companies and government agencies funding development of a Worldwide Oil Spill Model (WOSM). The Naval Oceanographic Command has named a CERC researcher as the Principal Investigator to integrate the Naval Oceanographic Data Distribution System with the WOSM. This effort should be a major advance in oil spill research.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Further action will be based on results of workshop described in Initiative Number 18.

Action By: CERC

Initiative Number 16

Funding for the Coastal Engineering Manual (CEM).

Action By: CERC

Status of Recommended Action(s):

1. CERB endorsement for the need for the CEM.

The CERB endorsed the need for the CEM at the Atlantic City meeting.

2. Report of endorsement in minutes of next CERB meeting.

Endorsement is in the Proceedings of the Atlantic City meeting.

3. Memo to Chief from CERB President of the endorsement of the CEM.

At the Atlantic City meeting, the decision was made to defer the letter to the Chief since it appeared a funding mechanism could be found and the Board could make a positive report. A funding mechanism was agreed upon. The CEM will be funded by the Civil Works Guidance Update Program and the Coastal R&D Programs.

Discussion and/or Further Action (59th CERB in Point Clear, AL): Complete.

Initiative Number 17

Evaluate National Laboratory status for CERC.

Action By: CERD-C

Status Of Recommended Action(s):
Develop a report outlining analysis and recommendations for CERB.

The Office of Counsel has determined that the addition of the word "National" is a designation that has no legal significance. In fact, the names of organizations such as the National Hurricane Center and the National Weather Service were administratively established by the agencies. Since CERC was established by Congress, it is Counsel's

opinion that legislation would be required for a name change. The legislative process would be rather routine. In essence, there is no legal reason precluding the "National" designation, and the name change would have no impact on CERC's operations or reporting hierarchy.

CERD-C and WES have made an initial determination of the advantages and disadvantages of the name change. There are a number of advantages. It is our opinion that the name change would formalize the defacto position CERC currently holds. The change would add prestige to the organization resulting in a number of positive impacts including potential recruiting benefits and enhancement of the Corps' effectiveness with organizations such as NSF. Disadvantages may include the designation being misleading to potential outside customers since CERC would still have support to the Corps as its primary mission. Pushing the "National" designation during this unstable period of "redefining how government should operate" may invite unwanted consequences.

The Corps' R&D community is undertaking a Strategic Planning Study, and since CERC is an integral part of the R&D system, the results of the study may produce changes in operations. We recommend a final decision on the issue be made after the study is completed to ensure the decision is based on benefits to the entire R&D system.

Discussion and/or Future Action (59th CERB in Point Clear, AL): CERD-C will make recommendation at next meeting.

Action By: CEPD-C

Initiative Number 18

Identify future coastal engineering research and program directions.

Action By: Dr. Houston (CEWES-CV-Z)

Status Of Recommended Action(s):

1. Formation of a workshop to evaluate tasks and develop alternatives.

CERB INITIATIVE WORKSHOP ON FUTURE COASTAL ENGINEERING/ SCIENCE R&D

GOAL: Identify future directions for coastal engineering R&D.

PARTICIPANTS: Engineers and scientists from Corps' Districts/Divisions/Headquarters, the Coastal Engineering Research Center, academia, the private sector, other agencies, and the international coastal engineering community.

FORMAT: Workshop with breakout groups similar to the Nearshore Processes Workshop hosted in 1989 by the U.S. Geological Survey (USGS) and funded by the National Science Foundation (NSF), CERC, Office of Naval Research (ONR), Sea Grant of the National Oceanic and Atmospheric Administration, and the USGS.

SPONSORS: We have had discussions with the USGS, ONR, Sea Grant and NSF, and there is an interest in these agencies to cosponsor the workshop including financial support. The USGS is considering a request from us to provide logistical support and host the conference at the site of the 1989 workshop in St. Petersburg, Florida.

LOCATION: Tentatively, St. Petersburg, Florida, at facilities provided by the USGS.

TIME: Summer, 1994. Considerable planning is necessary for a successful meeting and summer is most convenient for academicians.

TOPICS:

- **WAVES.** Generation, nearshore transformation, breaking, infragravity, wave/structure/current interaction, measurement, modeling, storms and global warming
- **CURRENTS, WATER ELEVATIONS.** Tidal, wind-driven, wave-induced, storm surge, measurement, modeling

- **SEDIMENT TRANSPORT.** Longshore, onshore/offshore, at inlets, wind-blown, shelf, geomorphology, measurement, modeling
- **DREDGING.** Fate of dredged material, efficiency of dredging processes, dredging and the environment
- **STRUCTURES.** Stability, effects on beaches, monitoring, modeling
- **ENVIRONMENT**
Hydrodynamics and water quality
Beach-fill effects on turtle nesting, reefs, etc.
- **ENGINEERING.** Functional and structural design, beach fills, computer-aided design and expert systems, innovative coastal technologies

2. Future Goal: Workshop and report.

Workshop to be scheduled for summer 1994 with report published on outcome.

3. Include linkages with other work group initiatives (e.g., "Review of administration's budget to identify funding priorities" and the initiative dealing with "Seeking coastal engineering partnerships to optimize use of funds").

Coordinating with John Housley, Initiative 12, on first. Potential partners identified on Initiative 15 will be among the invitees. The plan will be the key component of Initiative 9.

Discussion and/or Further Action (59th CERB in Point Clear, AL): The Board concurred with the approach. Progress will be reported at next meeting.

The results of the workshop will be presented at the next fall meeting. In addition, other agencies will be invited to the fall meeting to review their ongoing research and future research needs.

Action By: Dr. Houston (CEWES-CV-Z)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE July 1994	3. REPORT TYPE AND DATES COVERED Final report	
4. TITLE AND SUBTITLE Proceedings of the 59th Meeting of the Coastal Engineering Research Board, 16-18 November 1993, Point Clear, Alabama		5. FUNDING NUMBERS	
6. AUTHOR(S)			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Waterways Experiment Station 3909 Halls Ferry Road, Vicksburg, MS 39180-6199		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers Washington, DC 20314-1000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) These proceedings provide summaries of the papers presented at the semiannual meeting of the Coastal Engineering Research Board (CERB). Also included are discussions of CERB business, recommendations for research and development by CERB members, and public comment.			
14. SUBJECT TERMS Coastal engineering (LC) Research (LC)		15. NUMBER OF PAGES 119	16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT