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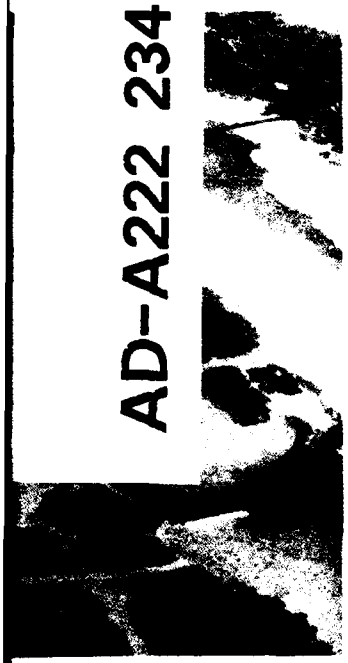


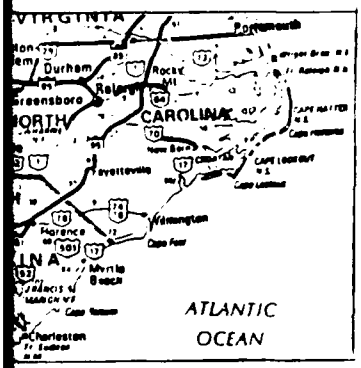
PROCEEDINGS OF THE 51ST MEETING OF THE COASTAL ENGINEERING RESEARCH BOARD

9-11 May 1989

WILMINGTON, NORTH CAROLINA

Hosted by

US Army Engineer Division, South Atlantic
and
US Army Engineer District, Wilmington



April 1990
Final Report

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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.

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PREFACE

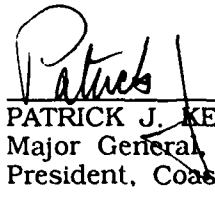
The Proceedings of the 51st meeting of the Coastal Engineering Research Board (CERB) were prepared for the Office, Chief of Engineers, by the Coastal Engineering Research Center (CERC), of the US Army Engineer Waterways Experiment Station (WES). These proceedings provide a record of the papers presented, the questions and comments in response to them, and the interaction among program participants and the CERB.

The meeting was hosted by the US Army Engineer Division, South Atlantic, under the direction of MG Robert M. Bunker, Commander, and the US Army Engineer District, Wilmington (SAW), under the direction of COL Paul W. Woodbury, Commander.

Acknowledgments are extended to the following: Mr. Gary L. Gamel, SAW, who assisted with the coordination of the meeting; Mr. James T. Jarrett, SAW, who coordinated the field trip; Mses. Susan B. Jahnke and Marilyn J. Knowlton, SAW, who assisted with various administrative details for the meeting; Mr. Bud Davis, SAW, photographer. Thanks are extended to guest participants Dr. Charles W. Finkl, Journal of Coastal Research; Mr. Kirby B. Green III, Florida Department of Natural Resources; Dr. Gary B. Griggs, University of California, at Santa Cruz; Dr. Robert A. Morton, University of Texas; Mr. Spencer M. Rogers, Jr., North Carolina Sea Grant Marine Advisory Service; Honorable Charlie Rose, Member, US House of Representatives; Mr. Richard E. Shaw, North Carolina Department of Natural Resources and Community Development; and Mr. Stan Tait, Florida Shore and Beach Preservation Association, Inc. Thanks are extended to Mrs. Sharon L. Hanks for coordinating and assisting in setting up the meeting and assembling information for this publication; Dr. Fred E. Camfield for preparing the draft proceedings from the transcript; the Information Technology Laboratory for editing these proceedings; Mrs. Karen R. Wood for typing, all of whom are at WES. Thanks are extended also to Ms. Dale N. Milford, Certi-Comp Court Reporters, Inc., for taking verbatim dictation of the meeting.

The proceedings were reviewed and edited for technical accuracy by Dr. James R. Houston, Chief, CERC, and Mr. Charles C. Calhoun, Jr., Assistant Chief, CERC. COL Larry B. Fulton, Executive Secretary of the Board and Commander and 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.



PATRICK J. KELLY
Major General, US Army
President, Coastal Engineering Research Board

CONTENTS

CONTENTS (Concluded)

INTRODUCTION

The 51st Meeting of the Coastal Engineering Research Board (CERB) was held at the Wilmington Hilton in Wilmington, North Carolina, on 9-11 May 1989. It was hosted by the US Army Engineer Division, South Atlantic (SAD), under the direction of MG Robert M. Bunker, Commander, and the US Army Engineer District, Wilmington (SAW), under the direction of COL Paul W. Woodbury, Commander.

The Beach Erosion Board (BEB), forerunner of the CERB, was formed by the US Army Corps of Engineers 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 and 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 51st CERB meeting dealt with shoreline erosion and restoration. Documented in these proceedings are summaries of presentations made at the meeting, discussions that followed these presentations, and recommendations by the Board. A verbatim transcript is on file at CERC, US Army Engineer Waterways Experiment Station (WES).

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51ST COASTAL ENGINEERING RESEARCH BOARD MEETING

Wilmington, North Carolina
9-11 May 1989

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51ST MEETING OF THE COASTAL ENGINEERING RESEARCH BOARD
9-11 May 1989
Wilmington, North Carolina

AGENDA

THEME: Shoreline Erosion and Restoration

1830 -	Registration (Lobby of Wilmington Hotel)	
TUESDAY, 9 May		
0800 - 0830	Registration (Outside Grand Ballroom)	
0830 - 0850	Opening Remarks and Welcome to South Atlantic Division	MG Robert M. Bunker
0850 - 0900	Welcome to Wilmington District	COL Paul W. Woodbury
0900 - 0945	Review of CERB Business	LTC Jack R. Stephens, WES
0945 - 1005	Break	
1005 - 1035	South Atlantic Division Research Needs	Dr. Albert G. Holler, Jr., SAD
1035 - 1100	Presentation by Local Congressman	Honorable Charlie Rose, Member, US House of Representatives
1100 - 1135	Management of North Carolina's Ocean Hazard Areas	Mr. Richard E. Shaw, North Carolina Department of Natural Resources and Community Development
1135 - 1200	Overview of Wilmington District Coastal Program and Field Trip	Mr. James T. Jarrett, Wilmington District
1200 - 1300	LUNCH	
1300 - 1700	Field Trip	Wilmington District
WEDNESDAY, 10 May		
0830 - 0845	Opening Remarks	MG Robert M. Bunker
0845 - 0900	Introduction to Theme of Shoreline Erosion and Restoration	Dr. James R. Houston, WES
0900 - 0930	Beach Preservation Technology '89	Mr. Stan Tait, Executive Director, Florida Shore and Beach Preservation Association
0930 - 1020	Numerical Modeling of Coastal Sediment Processes and Beach Change	Dr. Nicholas C. Kraus, WES

AGENDA (Continued)

1020 - 1040	Break	
1040 - 1100	Physical Modeling/Coastal Processes	Dr. Steven A. Hughes, WES
1100 - 1130	Coastal and Estuarine Physical Monitoring and Evaluation Program for the Kings Bay Naval Submarine Base	Ms. Joan Pope, WES
1130 - 1230	Lunch	
1230 - 1410	Shore Protection Structures: The Effects of Seawalls on the Beach - Special Edition of the Journal of Coastal Research	Moderator, Dr. Charles W. Finkl, Editor, Journal of Coastal Research
	--Literature Review of the Effects of Seawalls on the Beach	Dr. Nicholas C. Kraus, WES
	--Interactions of Storms, Seawalls, and Beaches of the Texas Coast	Dr. Robert A. Morton, University of Texas
	--The Effects of Coastal Protection Structures on Beaches Along Northern Monterey Bay, California	Dr. Gary B. Griggs, University of California, Santa Cruz
	--Shore Protection Using Offshore Breakwaters	Ms. Joan Pope, WES
1410 - 1430	Break	
1330 - 1600	Beach Fills	Moderator, Mr. Spencer M. Rogers, Jr., North Carolina Sea Grant
	--US Army Corps of Engineers Beach-Fill Projects: Past/Future	Mr. James E. Crews, HQUS ACE
	--State of Florida's Beach-Fill Program	Mr. Kirby Green, Director of Beaches and Shores, Florida Department of Natural Resources
	--Beach-Fill Design Procedures	Mr. James T. Jarrett, Wilmington District
	--Beach-Fill Research and Development at CERC	Dr. Donald K. Stauble, WES
1600 - 1615	Low Cost Shore Protection	Mr. John G. Housley, HQUSACE

AGENDA (Concluded)

1615 - 1630	Status Report: Economic Evaluation of Corps Shore Protection Projects	Mr. Robert M. Daniel, HQUSACE
1630 - 1645	Beach and Profile Nourishment Using Dredged Material/Section 933 Authority	Mr. Lim Vallianos, Institute for Water Resources
1830	DINNER	

THURSDAY, 11 May

0830 - 0845	Opening Remarks	MG Robert M. Bunker
0845 - 0945	Discussion of Themes	CERB
0945 - 1015	Public Comment	
1015 - 1030	Break	
1030 - 1130	Board Recommendations	CERB
1130 - 1145	Closing Business and Remarks	MG Robert M. Bunker
1145	ADJOURN	

OPENING REMARKS
AND
WELCOME TO SOUTH ATLANTIC DIVISION
AND WILMINGTON DISTRICT

MG Robert M. Bunker, Commander, South Atlantic Division (SAD), opened the 51st meeting of the Coastal Engineering Research Board (CERB), acting for BG Patrick J. Kelly, President of the Board. He introduced the other Board members present at the meeting and COL William J. Reynolds, who serves as a supernumerary to the Board and provides continuity. He noted that COL Reynolds is a permanent professor at the United States Military Academy at West Point and has his Ph.D. in coastal geomorphology from Rutgers University. He welcomed the participants and Congressman Charlie Rose, a participant in the morning session of the meeting, to SAD. He then turned the meeting over to COL Paul W. Woodbury, Commander, Wilmington District (SAW).

COL Woodbury welcomed the participants to SAW. He indicated that LTC Thomas C. Suermann, the incoming commander of SAW was also present. He said the afternoon field trip would provide an opportunity to visit "The Rocks," a project completed about 1884, which was the basis for the founding of SAW.

REVIEW OF COASTAL ENGINEERING RESEARCH BOARD BUSINESS

LTC Jack R. Stephens, Acting Executive Secretary
Coastal Engineering Research Board
Acting Commander and Director
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

There were several action items resulting from the last Board meeting in Virginia Beach. The list in Appendix B covers the status of action items from the Virginia Beach meeting and continuing action items from the Savannah Board meeting. 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, we were asked to formalize the action item list. A master list showing actions taken since the 47th meeting is being maintained at CERC.

Item one concerns the Monitoring of Completed Coastal Projects (MCCP) Program and project monitoring in general. Engineer Regulation (ER) 1110-2-8151, "Monitoring Coastal Projects," has been rewritten, and the draft is presently being reviewed by the Corps' Field Review Group. This ER spells out the requirements and opportunities of the MCCP Program and technology transfer (feedback) procedures. It also covers all other monitoring of coastal projects. Publication is expected this quarter. The draft of a new ER on local maintenance and operation requirements has been prepared and is being reviewed by the Office of Counsel at Headquarters (HQ) US Army Corps of Engineers (USACE). This new ER requires that all projects which include initial beach fill and continued beach nourishment have monitoring as part of the Local Cooperative Agreement. The costs will be borne by Construction General, and sufficient data will be collected and analyzed to ensure the project is functioning as expected.

Item two was concerned with a special CERB meeting to provide a status report on the Dredging Research Program (DRP), and that was accomplished in February. We have responded in writing to the Board's comments, and a copy of the response follows the status of action items.

Item three concerned the state of the art of coastal modeling. Models will be addressed at this and subsequent CERB meetings as a portion of the program. The models discussed will be appropriate to the theme of the meeting.

There has been considerable progress on the initiative to seek funds for universities to conduct basic research in coastal engineering (item four). Dr. Robert Oswald, Director of the Research and Development Directorate, HQUSACE, and Dr. James R. Houston, Chief, CERC, met in early February at the Army Research Office (ARO) with Dr. George Neece, Acting Technical Director, ARO. Dr. Oswald told

Dr. Neece the Corps sees strong need for basic research on fundamental physical processes that affect the Nation's coasts. ARO supported limited basic research in coastal engineering several years ago, but discontinued support in the 1970's because the research had low military priority. A follow-up meeting was held in April when Dr. Neece and ARO staff members came to WES. Although ARO has had severe funding cuts and imposed shifts in funding from its individual researcher's program to block grants, ARO agreed to work with the Corps in supporting basic research in coastal engineering.

An ARO representative subsequently attended a workshop on nearshore processes the last week in April sponsored by CERC, the Office of Naval Research (ONR), the National Science Foundation (NSF), Sea Grant, and the US Geological Survey. University researchers in coastal sciences and engineering throughout the United States attended the meeting. The purpose of the workshop was to define long-term goals of basic research in nearshore coastal processes. ONR is at least considering the possibility of funding research in this area. CERC became a sponsor and provided financial support to the workshop along with ONR in order to improve possibilities ONR would start supporting research in coastal processes once more. CERC will continue support of ONR's efforts and work with ARO to begin funding for coastal research.

Action item five was concerned with reviewing and modifying, if necessary, current design guidance on small storm surges. The current guidance has been reviewed in the Directorate of Engineering and Construction, and comments have been requested from the field. We have discussed COASTNET at previous Board meetings, and COASTNET has been a useful tool for obtaining discussions on this issue.

Action item six requested we review the feasibility of establishing an instrumentation information exchange network. The Permanent International Association of Navigation Congress (PIANC) has approved the proposal of the United States Section to establish a PIANC Working Group on Instrumentation. Mr. Thomas W. Richardson of CERC is a member of the Working Group and prepared the terms of reference which were forwarded by the United States Section to PIANC. This group will work with foreign agencies as well as US organizations and agencies, such as the National Bureau of Standards, on instrumentation issues such as the feasibility of an information exchange network.

We were requested by action item seven to recommend a procedure whereby the Corps can capture the performance experience and lessons learned from its more senior coastal engineers. The Office of History has recommended conducting oral history interviews with at least one senior coastal engineer in each of the 22 coastal Districts. That could be done by historians from the Office of History, Corps field historians, and oral history contractors. It is estimated that process would take 18 to 24 months.

An analysis of the Corps' involvement in coastal engineering could be prepared based on the interviews. In addition, the subject was presented to the Automated Coastal Engineering System (ACES) Pilot Committee in view of developing expert systems based on information gained. Experienced, senior-level engineers and scientists are able to draw conclusions based on their field observations. The purpose of an expert system is to allow a less experienced person who has training in making the necessary observations to obtain a set of probable conclusions based on the observations and the wealth of experience gained from the senior engineers and scientists. It would be necessary to obtain funding to develop the oral histories and/or the expert system.

Responsibility for accumulating historical cost information has been established (action item eight). The Cost Engineering Branch in HQ is establishing a cost data base for all civil works type projects similar to the one presently in use by the military. This will be a personal computer (PC)-based Computer Aided Cost Estimating System using local unit prices. Historical cost information can be broken down by items.

We were directed by action item nine to establish an ad hoc committee to evaluate the possible establishment of an NSF Engineering Research Center (ERC) or Science and Technology Center (STC) in coastal engineering. An ad hoc committee, consisting of Dr. Houston, Dr. Linwood Vincent, Messrs. Jesse Pfeiffer, John Housley, and John Lockhart, was established. The committee determined an ERC is not feasible since the emphasis of ERC's is funding by the private sector. Typically two-thirds of the funding of an ERC is provided by the private sector, and centers have 15 to 20 major private sector sponsors such as IBM, AT&T, or DuPont. There also are only a few new ERC's established per year, and they are in glamour fields such as fiber optics, bioengineering, and artificial intelligence.

The committee determined an STC for coastal engineering is feasible, although very few proposed STC's are funded. The primary objective of STC's is "...to exploit opportunities in science and technology where the complexity of the research problems require the advantages of scale, duration, and/or equipment and facilities that can only be provided by a campus-based research center." This may sound as if CERC would not have a role in an STC for coastal engineering, but actually STC's can be composed of several universities and joined by a government lab. However, a university must have the lead, and a single individual in a university must be the Center Director. That is, universities must drive the train. CERC can help in the formulation of an STC and be a member of the consortium, but leadership must come from a university.

It is clear the chance of success of establishing an STC in coastal engineering is critically dependent upon the university person who leads the effort. This person would have to be primarily concerned with the best interests of coastal engineering

rather than his own institution, be of unquestionable prominence in the field, and be willing to invest considerable time in developing and selling a well-focused program to NSF. The ad hoc committee decided Professor Bernard Le Méhauté is the person needed to lead such an effort, and he is considering the suggestion. We will report further developments at the next Board meeting. A letter of intent to submit a proposal is needed by November and a proposal by February 1990 to enter NSF's funding cycle.

Policy related to Section 933 of the Water Resources Development Act (WRDA) of 1986 has been reviewed by Planning Division, Directorate of Civil Works, in response to action item 10. For those of you not familiar with Section 933, it modified Section 145 of the WRDA of 1976 by authorizing 50-percent Federal cost sharing of the increased cost (over the least costly method of disposal) for placing on beaches the sand dredged from the construction and maintenance at Federal navigation projects. For the 50-percent Federal contribution:

a. The state must request the placement on the beach.

b. The added costs must be justified by the benefits associated with the beach protection.

c. The project must be justified on the basis of at least 50 percent of the benefits coming from hurricane and storm damage reduction benefits.

If the previous elements are not met, the non-Federal interests must pay 10 percent of the added costs.

A review of the policy on Section 933 projects finds that no changes are warranted at this time. Mr. Lim Vallianos will make a presentation on Section 933 Authority tomorrow afternoon.

Information on positive benefits of USACE involvement in the PIANC Working Group on rubble-mound structures was provided to the United States Section, PIANC (item 11). Dr. Robert W. Whalin, Technical Director of WES, is a member of this Working Group, which has already produced a report identifying important details of deepwater breakwaters and highlighting areas of uncertainty in the analysis, design, and construction of breakwaters in general. Further work in this area is the need for the designers of breakwaters to achieve a better understanding of the overall safety aspects in the design of rubble-mound structures and improve on the existing design tools. This is being done by identifying and listing the parameters to be considered in design, evaluating their relative importance, determining the quality of existing knowledge related to those parameters, and then evaluating the safety factors (risk of failure) applicable to such structures. All of this is important to Corps projects and extends our knowledge base without our having to redo the research. As an example, knowledge of the PIANC reported data on revetment blocks allowed Jacksonville District

and SAD to develop a value-engineering study for the Herbert Hoover Dike Improvement project that has a potential savings of approximately $24 million.

We discussed the potential for sharing execution of the Corps coastal research and development (R&D) responsibilities with the coastal states (item 12). For some years, the States of California and Florida have participated with the Corps' Coastal Field Data Collection Program in the collection of nearshore oceanographic data along their coastlines. In both cases, the states have independently funded the Corps' contractor. Because interest has been expressed by several other states, the use of cooperative agreements has been investigated. Legal authority for cooperation with the states in data collection exists through the Land Acquisitions Policy Act of 1960 and for cooperative agreements through the Federal Grant and Cooperative Agreement Act of 1977. The final draft of a cooperative agreement with the State of California for wave data collection is being completed by CERC and will be submitted for approval this fiscal year. Once approved, this agreement will serve immediately as the model for agreements with other states.

Action item 13 related to qualitative curves presented by Dr. Richard Weggel at our last Board meeting. Following our last meeting, we developed information on the Return on Investment (ROI) from our research program. Dr. Weggel's concepts express many of the ways in which research benefits can accrue. However, in their present form they are perhaps more complicated than can be readily absorbed during Congressional testimony. It would also be difficult to quantify the curves accurately to display the information for a project. We can summarize the concepts in three bullets that make the point succinctly:

- Research can make a known solution cheaper to build.
- Research can keep us from making a big mistake from ignorance or lack of information.
- Research can provide us with alternatives that may give us a better solution at a cheaper price.

We were directed (item 14) to examine the potential for facility recommendations proposed by Dr. Le Méhauté. Many of the facilities proposed by Dr. Le Méhauté are not feasible for CERC to construct using Plant Replacement and Improvement Program funds because CERC cannot afford the payback costs. Dr. Le Méhauté made it clear these facilities do not have a strictly economic return. He cited other facilities such as the proposed Supercollider where there is clearly no economic return, but the Nation supports construction because of the potential for advancement of knowledge. A possible mechanism to obtain national facilities is through the NSF, and this possibility will be pursued in the development of an STC.

Action item 15 concerns a proposal that we combine a CERB meeting with an American Society of Civil Engineers (ASCE) Specialty Conference for practicing engineers. A proposal was submitted to ASCE in March of this year to plan and conduct a specialty conference entitled, "Coastal Engineering Practice." This conference would be a 2- or 3-day conference focussing on practical aspects of solving coastal engineering problems, with emphasis on actual planned and constructed projects. The proposal was presented to the Executive Committee of ASCE's Waterway, Port, Coastal, and Ocean Engineering Division at their spring meeting last month. The proposal was well received, and the organizing committee, chaired by Dr. Steven Hughes of CERC, is presently awaiting official approval from ASCE to proceed with conference planning. Because of ASCE scheduling considerations and the requirement to avoid conflicts with other ASCE events, it appears the ASCE Conference may be in late January 1991. This would place the conference outside the normal spring date of CERB meetings. Coordination with a future CERB meeting would probably require adapting the CERB schedule to coincide with the conference venue.

Item 16 was a proposal to brief the Chief of Engineers on Logistics-Over-The-Shore R&D needs and develop an approach to acquire a deployable dredge and mobile breakwater support. The Chief will be briefed during his next visit to WES. Mobile breakwater research is currently scheduled in out years of the Corps' RDT&E Program. The 3rd Army has established a requirement for a deployable dredge, and Troop Support Command has issued a Request for Proposals (RFP). There have been three responses to the RFP, and those responses will be evaluated this summer. Dredging Division is tracking the deployable dredge activities.

Item 17, also from the Savannah meeting, was on consideration of sea level rise in planning and design of coastal structures. This was discussed at our meeting in Oconomowoc. An Engineer Circular (EC) has been prepared to furnish guidance. This EC is now being printed. The EC states that "potential relative sea level change should be considered in every feasibility study undertaken within the coastal zone ...." Procedures for considering changes in sea level are outlined in the EC (EC 1105-2-186, "Guidance on the Incorporation of Sea Level Rise Possibilities in Feasibility Studies").

Item 18, from the Savannah meeting, concerned re-evaluating Corps policy guidance on the potential for including downdrift beaches, outside project boundaries, in the benefit analysis for beach restoration projects. We reported on this at the Oconomowoc meeting. Mr. Robert Daniel from the Planning Division of the Directorate of Civil Works will include this item in his presentation tomorrow.

Item 19, from the Savannah meeting, was on the re-evaluation of current policy on least-cost dredging alternatives to see if a multi-use project consideration is possible for nearshore dredged-material disposal. We reported at the Oconomowoc meeting that

the lowest-cost dredging alternative policy is being reviewed at HQ. That action is continuing.

This concludes my report on the current action items. I want to update you on the 1-year coastal education program that had just been approved at our last meeting. The program will be initiated in the fall of 1990. As presently constructed, the students will spend the fall and spring semesters at Texas A&M. This will be followed by 3 to 4 weeks at the Field Research Facility. The students will complete the program with the summer session at WES. In addition to the benefits accrued by the government, the student will receive a Master of Engineering Degree from Texas A&M University upon successful completion of the program.

DISCUSSION

Dr. Chiang Chung Mei applauded CERC's effort in pushing forward and taking leadership in resuming the government's support, on a national level, of coastal engineering research. Dr. Dag Nummedal said there is an emphasis in the community at large of getting Federal agencies, such as the NSF, to play a more active role in funding coastal science. He thinks what we are doing in the Corps is to follow a trend which he can see developing within the earth sciences community at large.

In the case of establishing an STC, Dr. Mei questioned whether a leader should be designated prior to an open competitive process. Dr. Nummedal disagreed with Dr. Mei and pointed out that in the STC program someone has to start the ball rolling. The Corps has identified someone who is willing and capable of getting things started. An STC has to be housed at a university. We need an individual willing to spend half a year of his time putting together a major proposal. The last time NSF went through the proposal review procedure, they approved 11 STCs out of an initial submittal of 400 proposals. CERC has done well in identifying an individual who is willing to spend his time and is clearly very supportive of the cause. The competition will be there once his proposal is reviewed against many of the others.

Prof. Robert O. Reid agreed with Dr. Nummedal and said that if we have identified a leader for going forward with the proposal, he thought that is an extremely important step. It is very difficult to find a hero to do that. The coastal engineering community has to get its act together first and go forward with it; otherwise they do not stand a chance among all the many proposals for STCs that are submitted to NSF.

MG Bunker asked for clarification on the next step or alternative steps for an STC. Do we find a hero and leave it up to him, or do we support him in putting together a proposal; what evolves as the relationship between our abilities to focus interest, intent, and resources, and his willingness to take on the task and be the spear carrier for us? What do we do if the individual presently assuming this role decides he can't devote the time and energy necessary; do we then go to another individual, or where do we go? He noticed that we have to file Notice of Intent by November 1989 and a proposal by January 1990, which says that we ought to know where we are going before the next CERB meeting in the fall.

Dr. Houston said Dr. Nummedal did a good job expressing CERC's point of view. Any university can propose an STC, but odds are overwhelming against one. Of the 11 funded, almost all were in glamour fields like bioengineering and fiber optics, so the odds we would get one in coastal engineering are extremely small. As far as we know, no one has proposed such a center because of the small odds and the fact that it would take an individual at least 6 months to write up a good proposal. Our thoughts were to find someone willing to go forward with a proposal. We identified Dr. Le Méhauté as a good person to try to focus efforts and get the community

together. An STC is led by a single institution because of the way NSF has it constructed; but in fact it is usually a consortium of universities. Dr. Le Méhauté would work with some of the other institutions to see whether or not a group of institutions could put together a proposal that would be reasonable and have at least some chance of success. CERC would, of course, be willing to work with any institution in developing a plan; but no one has stepped forward.

Dr. Mei raised a question about the requirement for engineering registration for advancement to certain levels in the Corps. Many coastal specialists have backgrounds in areas such as oceanography and physical sciences. A registration requirement may be a hindrance to their career development. He suggested that item be considered and included in future CERB meetings. MG Bunker said they would do that. BG Theodore Vander Els said, in relation to that, the Corps has not formalized the educational requirements nor the position requirements with the Army for this kind of engineer. He proposed that the CERB President undertake a dialogue with the proponent for those concept activities, who is the Commandant of the Engineer School. We need to identify, formalize, and get approved Army Education Board Requirements positions. MG Bunker said he would commit the CERB President to do that. COL Reynolds said it is true that coastal engineers are blocked from promotion in some fields in the Corps Districts and Divisions, and something needs to be done about that. Perhaps we should go one step further and try to get coastal engineers registered. It is a distinct field, and maybe the time has come to try to get their own registration.

Dr. Nummedal said he was impressed by Dr. Weggel's presentation at the Virginia Beach CERB meeting. He said he thought it was incumbent upon all of us in research to take that challenge more seriously and try to explain to decision makers exactly how R&D does benefit the Corps and the national economy. He urged the Corps to reopen the discussion on how to evaluate return on investment in a more rigorous way than we have in the past.

Dr. Nummedal said interviews with senior coastal engineers and scientists should not be left entirely in the hands of the historians. He said it is important that interviews be conducted by technical personnel who have an interest in technical solutions. Mr. Housley said it was the intention of the Office of History to have coastal engineers along with them during the interview process.

SHORELINE EROSION FROM A CONGRESSIONAL PERSPECTIVE

The Honorable Charlie Rose
Member, United States House of Representatives
Seventh District of North Carolina

Congressman Rose said he was honored to be invited by his District Engineer, COL Woodbury, to speak at the Board meeting. He said he was extremely impressed with the Corps' study of erosion. He is one of its advocates and has been since he first set foot in Congress. Part of the problem in Congress right now is some Congressmen do not understand what erosion is all about or how much money it takes to research it, deal with it, or attempt to fix it. When Congressmen represent coastal counties, the people in those counties very quickly explain the needs of coastal people -- the need to solve and deal with erosion problems. The problem is that Congressmen from Kansas and Nebraska do not really understand the concept of beach renourishment.

According to Congressman Rose, the population on the coast is growing tremendously. People are attracted to places like New Hanover, Brunswick, and Pender Counties from all across the country. Resorts, tourism, and retirement homes are bringing more people into the area.

There has been great interest in beach and storm protection in North Carolina relative to commercial and recreational use of harbors and waterways. There is an extremely sensitive new awareness in Congress of environmental protection, water quality, and land-use planning. Although Congressmen complain frequently about wetlands and how they are administered, he said Congress, by and large, is behind the work that is being done in all these areas. The Corps of Engineers, providing professional experts on coastal engineering and providing a planning framework for all of this, is absolutely vital to our Nation.

Congressman Rose said Congress is besieged by individuals who are calling for more and more coastline protection. He said he hoped the science is established and Congress can provide the money needed to round out the research, as well as make sure that money is there for studies, construction, and maintenance. He said he hoped that the Appropriations Committee would find a way to do what has to be done to restore necessary funds in the budget for maintenance.

Congressman Rose went on to say some very intelligent people in his District have come forth with new ideas about ways to solve beach erosion. He is constantly visited by people with great ideas, and there may be some softer solutions to beach erosion than the ones that are being studied now. He encouraged creative thinking and the use of nontypical approaches, looking at as many things as possible. He said, "We, in Congress, are anxious to help you find some new answers. We are not

satisfied with the answer we get from the Research Triangle universities of North Carolina -- that there is nothing we can do about erosion, we should leave the beaches alone and let nature take its course."

Congressman Rose said he was proud that the Board was meeting in his District in Wilmington. He said it was a very distinguished group of people in fine company with some of his constituents, there to learn specific problems and specific needs. He noted that Mr. Howard Barker, the administrative assistant for Congressman Martin Lancaster, North Carolina Third District, was attending the meeting. He said the Corps of Engineers had lots of friends in Congress. Sometimes it is a matter of getting the Office of Management and Budget (OMB) to figure out where you sit in the priorities.

He said he hoped the meeting would go well, that participants would come up with some new ideas, and that they would challenge each other. Congress is counting on them to come up with some new solutions, and they are ready, to the best of their ability, to provide the funding.

SOUTH ATLANTIC DIVISION RESEARCH NEEDS

Dr. Albert G. Holler, Jr.
US Army Engineer Division, South Atlantic
Atlanta, Georgia

Introduction

The SAD's civil works boundaries include the second largest coastline within the Corps. Our District offices are responsible for projects along 14,600 miles of tidal shoreline and 3,600 miles of coastal beaches and at 29 major harbors and one "great lake," Lake Okeechobee, which has a significant wave climate. The research needs that we presented at the May 1986 and the November 1987 CERB meetings are being addressed.

Geotechnical Research Needs

We are interested in better methods of quantifying overfill in beach nourishment and in the durability and fate of shell fragments in beach sands. Another area of interest is the exploration and characterization of hard deposits in new work dredging. Exploration with conventional borings define discontinuous layers only if drilled on close centers, which greatly increases design costs.

Shelf-Surf Zone Coupling

Most wave-induced littoral drift analyses concentrate on the shore parallel components of sediment movement in the surf zone. Modeling capabilities should be expanded to address sediment movement in the cross shore-direction. Total sediment dynamics can be understood only if the larger range is considered, including the shoreface.

Ebb-Tidal Deltas

A very interesting project has recently been completed by a private engineering firm at Captain Sam's Inlet near Kiawah Island, South Carolina. The inlet was moved updrift to free sand trapped in the ebb-tidal delta. This sand is now nourishing the downdrift Seabrook Island beach, which was eroding. The inlet is migrating slowly to the original location; so additional work will eventually be needed. However, the cost per yard was reported to be one-tenth of the cost for trucking sand. Other methods of freeing sand from ebb-tidal delta areas for beach nourishment are needed. Dredging companies do not always have equipment to operate in shallow breaker zones where the ebb-tidal shoal is often located.

Sand Bypassing

Better sand management at inlets is a major need. Because of the importance of beaches for storm protection, recreation, and public economy, loss of sand is a major concern.

Shoreline Response to Coastal Projects

A reliable, accurate method of predicting the shoreline effects of navigation and nourishment projects is needed.

Estuarine Shoaling

Prediction of estuarine shoaling, both with and without channel modifications, is important. Estuaries are a large part of the District work load. Since dredged material disposal is becoming difficult at many sites, some nondredging remedies for shoaling problems would be very useful.

Shore Protection

A new application for a proven bank protection method is under study at CERC. The use of articulated concrete mattresses instead of riprap to protect the levees around Lake Okeechobee could save $25 million.

ACES

The capability of the modern personal computer presents a powerful tool to the coastal engineer. In the field of hydrologic engineering, we have sophisticated PC software and fully documented user manuals that allow us to quickly and conveniently make an unlimited number of complex computations. A similar capability in the coastal engineering field is a very important need.

Training

We are very interested in graduate degree programs for our people in coastal engineering. We would be particularly interested in a short, intense graduate program specifically tailored to the Corps.

DISCUSSION

Dr. Nummedal said he was pleased to hear the report on Captain Sam's Inlet and shared the opinion that it was a very successful project. He said that some of the ebb-tidal deltas in Georgia contain as much sand, if not more, than the adjacent barrier islands. He thinks this is the principal location in the country where we ought to emphasize studies on the sediment disbursement dynamics and ebb-tidal deltas, to really understand the process of exchange between the offshore bars and the adjacent

barrier islands. If CERC is going to move ahead with the Tidal Inlets Initiative, it would seem that some candidate inlet could easily be found within SAD to test many basic problems of inlet-barrier island sediment exchange.

MANAGEMENT OF NORTH CAROLINA'S OCEAN HAZARD AREAS

Richard E. Shaw
Division of Coastal Management
North Carolina Department of Natural Resources
and Community Development
Raleigh, North Carolina

Increasing development of North Carolina's 312-mile ocean shoreline led to the adoption of State regulations for development in ocean hazard areas. The Coastal Area Management Act of 1974 (CAMA) authorized the North Carolina Coastal Resources Commission to establish what is now considered a well-coordinated oceanfront management program that addresses several key areas, including the location of new development, shoreline erosion control, density of development near inlets, construction standards, and protection of public beach access.

The Ocean Hazard "Area of Environmental Concern" (AEC) includes the land along the oceanfront and inlets that are vulnerable to storms, flooding, and erosion. It consists of a High Hazard Flood AEC, an Ocean Erodible AEC, and the Inlet Hazard AEC. For all development proposed within the Ocean Hazard AEC, a CAMA development permit is required.

Before a permit can be granted, however, proposed development must meet the minimum oceanfront setback and a number of special construction standards. The "setback rule" encourages that all new development be located as far back from the ocean as possible. At a minimum, the structure must be built behind the "erosion setback line," the crest of the "primary dune," or the landward toe of the "frontal dune," whichever is farthest. The erosion setback line is located at a distance 30 times the long-term average annual erosion rate (60-foot minimum) as measured from the first line of stable natural vegetation. For large structures, the erosion setback line is 60 times the erosion rate (120-foot minimum). Certain exceptions to these setback rules are allowed, and all setbacks are determined on a case-by-case basis by a State or local permit officer.

The erosion rates for North Carolina are determined using historical aerial photographs of the coast. The changes in the shoreline over time are analyzed by computer and mapped. The rates can then be used to calculate a setback line. Although erosion rates do not predict future erosion, they can be used to determine relative risks of building in one area compared with another. The rates are updated every 5 or 6 years.

While setbacks reduce potential problems for new development, an increasing number of older cottages and motels are facing eventual collapse into the ocean. A survey conducted by the Division of Coastal Management in 1986 showed that over

750 oceanfront structures (insured at $50.6 million) could be lost to erosion in the next 10 years, and over 2,600 in the next 30 years. Traditional responses to this problem -- bulkheads, seawalls, groins, rock revetments -- are no longer allowed in North Carolina. Although those structures help protect threatened buildings, they tend to aggravate the loss of the public beach. Relocation of buildings to a safer site or replenishing the beach's sand supply is the preferred response. Recent amendments to the National Flood Insurance Program allow payments for the relocation or demolition of erosion-threatened buildings. Other "nonstructural" measures that are allowed include temporary sandbag bulkheads, beach bulldozing, and dune building and stabilization with vegetation.

Other nonregulatory tools used to manage oceanfront development in North Carolina include mandatory local government land use planning policies and strategies to address prestorm mitigation and poststorm reconstruction. Land acquisition for public beach access and natural area preservation are other key components of the program.

DISCUSSION

Dr. Nummedal thought the North Carolina shoreline policy was very progressive, and a guideline for what will happen in other states. He asked what the response was if a building could not be moved back because of other land use behind the building. He also asked if people could request variances. Mr. Shaw said they did not have a response if the owner was not capable of moving the building. He said that variance requests were taken before the Coastal Resources Commission. Mr. Preston Pate said the Commission has had about 40 variance requests to date and has not granted any of them. He said a condition of getting a variance is to show that the Commission could not have anticipated the effects of the setback requirement on an individual property owner. It is almost impossible to meet that requirement.

COL Reynolds asked if an existing structure not meeting setback requirements was destroyed by a storm, did they allow rebuilding. Mr. Shaw said that rebuilding would have to be behind the newly established setback line. MG Bunker asked if there was a mechanism within the laws to force the removal of derelicts once a house falls into the ocean. Mr. Shaw said that the local governments of North Carolina, particularly Nags Head, have developed policies for requiring the removal of structures that have fallen in.

BG Vander Els asked if the material lost due to erosion aggregates elsewhere along the coast. Mr. Shaw said he was unable to answer that question precisely, but there were barrier islands that lose sand to the next adjacent barrier island. Dr. Nummedal said that based on his understanding of the North Carolina coastline, just about the entire shoreline is retreating. Most of the sand from North Carolina beaches is going offshore and is lost, for practical purposes, on the Continental Shelf. Some of it goes directly offshore, and some of it is moving alongshore until it hits one of the three major Carolina capes, where it moves offshore onto the shoals and becomes located in an area where it is of no value to beach development. Mr. James T. Jarrett agreed that there is general erosion all the way from Cape Hatteras to the Virginia line. There are some areas of accretion, particularly on the downdrift side of the capes. At Cape Hatteras there has been quite a bit of accretion on the east-west shoreline orientation; but overall, the North Carolina coast is receding.

Mr. Lockhart said that homeowners are given very limited alternatives for protecting their property. Sandbags rip open and disappear. Mr. Shaw said they were also allowed to push sand up with bulldozers; and they were allowed to use vegetation to create dunes, but that is not always a possibility depending on the particular beach. He suspects they will be confronting a lot more discussion and tests of this policy in the next few years. Many larger structures, as well as beach cottages, are facing this dilemma.

Mr. Lockhart asked if they were proposing to move hotels. Mr. Shaw said it is technically possible, but more difficult; that is why the Commission established a double setback for larger structures. But that does not help those that are currently on the beachfront. Mr. Shaw said he realized that they had a hardline stance, and it is going to receive quite a bit of testing. Fortunately, the beaches in North Carolina were not as developed as some of the other coastal states.

Dr. Oswald asked about rebuilding houses that were destroyed and what property owners did with lot sizes that were too small. Mr. Shaw said they had a Beach Access Program in North Carolina where they try to work with local governments to purchase some of the unbuildable lots. Mr. Pate said there were no minimum lot sizes mandated by law, and most subdivisions were divided prior to enactment of the Coastal Area Management Act. They have tried unsuccessfully to enact legislation requiring disclosure at the time of sale. The issues of minimum lot sizes and density have been left up to the purview of local governments. Dr. Oswald said this is then buyer beware. Dr. Fred E. Camfield added that many areas on the west coast of the United States were subdivided in the last century, and the lots are too small by present standards. In such cases, unless structures already exist, present regulations prevent owners from using single lots; so it is very much buyer beware.

OVERVIEW OF THE WILMINGTON DISTRICT COASTAL PROGRAM

James T. Jarrett
Chief, Coastal Engineering Branch
US Army Engineer District, Wilmington
Wilmington, North Carolina

The Wilmington District is involved in a wide range of coastal projects in North Carolina from the Nags Head area all the way to the South Carolina border. The District has also been providing technical assistance to the Jacksonville, Charleston, and New York Districts.

In North Carolina, the Wilmington District is actively involved in plans to protect the Bonner Bridge, which spans Oregon Inlet. Severe northeast storms during February and March of this year caused considerable erosion on the north end of Pea Island which threatens the southern abutment of the bridge and North Carolina Highway 12 approaches to the bridge. The State of North Carolina has elected to construct a single terminal groin at the north end of Pea Island to halt the southward movement of the inlet. The Wilmington District is providing technical assistance to the state in the design of the terminal groin.

Other projects in the state include:

a. Navigation.
   (1) Deepening Morehead City Harbor from 40 to 45 feet.
   (2) Multiple improvements in Wilmington Harbor including widening several turns and bends, providing a passing lane, and modifying the turning basin opposite the North Carolina State Ports.
   (3) Improving the channel at New River Inlet.
   (4) Studying possible improvement to Bogue Inlet including a special study for the Coast Guard to examine shoaling in their access channel.
   (5) Development of a long-term dredged material disposal plan for the Atlantic Intercoastal Waterway.

b. Hurricane and shore protection projects.
   (1) New project (feasibility stage) for Topsail Beach.
   (2) Renourishment of Wrightsville Beach in 1990.
   (3) Renourishment of Carolina Beach in 1991.
   (4) Economic review of the area south of Carolina Beach and Long Beach and Yaupon Beach in Brunswick County.
   (5) Protection of the Fort Fisher historic site.
   (6) Several Section 103 and Section 933 studies.
   (7) Assisting the National Park Service in plans for protecting the Cape Hatteras Lighthouse.

The Wilmington District is assisting the Jacksonville District in the preparation of a General Design Memorandum for St. Johns County, Florida. The District has also

provided consultation to the Charleston District on Folly Beach and several other small beach erosion control projects. Recently, the Wilmington District contacted the New York District to explore the possibility of providing technical assistance on several of their hurricane and storm damage reduction projects. Thus far, the Wilmington District has advised the New York District on study plans for the Coney Island, New York, project.

FIELD TRIP

Mr. James T. Jarrett, Chief of the Coastal Engineering Branch of the Wilmington District, gave a briefing of the tour scheduled for Tuesday afternoon on 9 May. The first stop was at the north end of Carolina Beach. There is an existing rubble-mound seawall at the north end and a 14,000-foot-long beach fill beginning near the pier and extending southward. The beach fill was originally placed in 1965, and there has been a program of periodic nourishment. Erosion has been caused by an inlet opened by a local interest in 1952 just north of the area. The tour then proceeded along the coast to the Fort Fisher State Historic Site. There had been a ledge of rock that extended along the seaward side of the Fort. That material was taken out and used for road building, and that resulted in fast recession of the shoreline in front of the Fort. The tour proceeded from Fort Fisher to The Rocks. The Rocks were constructed in the 1870's as a barrier to close New Inlet. New Inlet was used as the entrance to Wilmington until the Civil War, but after the war the inlet was no longer needed. It was causing a lot of shoaling, so the Corps of Engineers constructed The Rocks as a swash defense dam to close the inlet. They are rubble-mound structures built on a foundation of willow mattresses. The sand spit south of The Rocks was created after their construction. The tour then stopped at the North Carolina Aquarium, where participants viewed a motion picture, "The Living Coast."

INTRODUCTION TO THEME OF SHORELINE EROSION AND RESTORATION

Dr. James R. Houston
Chief, Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

Shoreline erosion and restoration is an excellent theme for this Board meeting. The topic certainly generates considerable public interest. Recall the cover story of Time Magazine for August 1987 entitled, "Where's the Beach?" In March of this year, a northeaster storm with record duration pounded the east coast and inflicted severe damage here on North Carolina coasts in addition to other coasts. CERC's Field Research Facility measured elevated water levels over eight tidal cycle highs. Although wave heights were not as severe as for the infamous 1962 Ash Wednesday storm, the eight tidal cycles of elevated water level were longer than the five for the 1962 storm. One of the few good things to come out of this storm was measurement of beach-fill response to a major event. CERC began monitoring a new beach fill at Ocean City, Maryland, in 1988, and data collected for the unusual March northeaster will help us understand beach-fill dynamics.

Today's meeting will cover many aspects of shoreline erosion and restoration. Mr. Stan Tait, Executive Director, Florida Shore and Beach Preservation Association, will discuss a new yearly conference on beach preservation technology sponsored by the Corps and the American Shore and Beach Preservation Association. As mentioned yesterday, CERC will report current and emerging modeling technologies related to the theme at each Board meeting. Today Drs. Nicholas C. Kraus and Steven A. Hughes of CERC will discuss both mathematical and hydraulic models useful to shore protection and restoration.

Ms. Joan Pope, CERC, will describe a major new monitoring study the Corps is conducting for the Navy relating to the Navy navigation channel deepening at Kings Bay, Georgia. A major goal of the monitoring is to determine the effects, if any, of the deepening on adjacent shoreline erosion. The effect of inlets and navigation projects on shorelines is a major issue of recent years.

There will be two panel sessions after lunch. The first will be chaired by Dr. Charles Finkl, Editor, Journal of Coastal Research (JCR). The JCR is an excellent publication that melds coastal engineering, geology, and science. This session will focus on a special edition of the JCR edited by Dr. Kraus and Dr. Orrin Pilkey of Duke University that focussed on sea walls. Dr. Pilkey was not able to attend today's session because of a prior commitment, but Dr. Kraus will be a panel member along with two other contributors to the special issue - Dr. Robert A. Morton, University of

Texas, and Dr. Gary B. Griggs, University of California at Santa Cruz. Ms. Pope will complete the panel and discuss offshore breakwaters. Professor Morrough P. O'Brien, a Board member for 35 years, once said that offshore breakwaters were the wave of the future and indeed 2,500 have been constructed in Japan. Ms. Pope will discuss their use in the United States.

The second session will discuss what is sometimes called a soft beach restoration approach -- beach fills. Mr. Spencer M. Rogers, Jr., North Carolina Sea Grant, will chair a panel considering various aspects of beach fills. Mr. James E. Crews, HQUSACE, will discuss the Corps' involvement in beach fills in the past and what the future looks like through his crystal ball. Mr. Kirby B. Green III, Director of Beaches and Shores, Florida Department of Natural Resources, will discuss the State of Florida's plans for beach fills. Mr. James T. Jarrett, of the host Wilmington District, will discuss how the District currently designs beach fills and its experiences. Dr. Donald K. Stauble, CERC, will describe the current R&D efforts at CERC to improve beach-fill design.

After the panel sessions, Corps personnel will cover a few remaining topics. Mr. John G. Housley will consider low-cost shore protection. Mr. Robert M. Daniel will discuss work on Economic Evaluation of Corps Shore Protection Projects. Finally, Mr. Lim Vallianos will report on an action item from the last Board meeting on using dredged material for beach nourishment.

Today we will discuss hard, semi-hard, and soft structures. A seawall is often referred to as a hard structure, an offshore breakwater is perhaps semi-hard since it is not located on the beach itself, and beach fills are often referred to as soft structures. Another option to address beach erosion is to relocate back from the beach, often referred to as retreat. We are not addressing this option today because it is a State or local responsibility to exercise this option. If State or local governments want to retreat, they can. If they prefer beach protection or restoration, they can follow a path established by public law. The Corps becomes involved if this option is taken.

I look forward to a very interesting day.

BEACH PRESERVATION TECHNOLOGY '89

Stan Tait
Executive Director
Florida Shore and Beach Preservation Association
Tallahassee, Florida

Beach erosion is a serious and growing problem in many coastal areas. The economic and social impact of erosion is enormous, especially in resort communities and heavily developed coastal regions. Yet, all too often, decision-makers in State and local governments do not understand the alternatives available to them in erosion control. This lack of knowledge often results in making the wrong decisions. It is the responsibility of coastal engineers and other technical experts to educate government officials and the general public about workable beach preservation strategies.

One way to convey this information to public officials is through technical conferences such as the Beach Preservation Technology conferences co-sponsored annually by the Florida Shore and Beach Preservation Association (FSBPA), the University of Florida, and the US Army Corps of Engineers.

Such conferences, plus an aggressive program of public education, have led to the enactment of Florida's beach management program that anticipates a $1 billion investment in beach enhancement over the next decade. FSBPA representatives, including leading coastal engineers and scientists, testify regularly before the Florida Legislature, city and county commissions, and newspaper editorial boards.

DISCUSSION

Dr. Mei said he would expand on Mr. Tait's suggestion. He said that the coastal engineering profession should make the effort to convince the government of the importance of coastal engineering research. Mr. Tait replied that they were trying, in Florida, to find a dedicated funding source of about $50 million per year for beach management. That would include several million dollars for research and demonstration.

Dr. Nummedal said he thinks we are seeing a reaction to an attitude that has been prevalent in engineering for a long time, to fight nature at any cost. Now some people are saying the exact opposite, let's not fight it at any level at all. What we are now moving into is a situation where we start designing for nature and provide to the public a much broader spectrum of alternatives to coastal management. The choice is not necessarily to build a seawall or to nourish; retreat is a very logical option in many places. Beach nourishment that works in Dade County will not necessarily be economical at Cape Hatteras. The fact that major structures like the Cape Hatteras lighthouse can be moved is an additional management tool. The coastal engineering profession needs to diversify all its options. Mr. Tait replied that they are not trying to renourish all the beaches in Florida and are looking at other options. However, the silence of coastal engineers on the issue leaves a predominant message that retreat is the only option.

Dr. Kraus said that Dr. Nummedal's comments give the impression that the engineering community is stressing structures or perhaps destroying beaches. He said

that Matthews, in a 1913 British book on seawalls, pointed out that seawalls do not protect the beach. He warned that the function of seawalls was to protect the upland. Escoffier, who worked in the Corps' Mobile District, performed a study of seawalls in 1952. He said we must use nourishment in combination with seawalls if we want to preserve the beaches. J. V. Hall, Jr., in a 1963 engineering manual, clearly pointed out the function of seawalls and the use of beach fill. The BEB and CERC did the pioneering work on beach-fill performance and nourishment factors, including work by Hall, Eaton, Watts and others back in the '50s, and the Corps went on to lay the fundamental groundwork for all our knowledge of beach fill. In the case of Cape Hatteras, Dr. Kraus thinks putting in a few more groins in conjunction with beach fill would be a lot more economical. He thinks some research should be done on this. He also expressed an opinion that the Corps should be more proactive, rather than just being a benevolent, reactive agency.

Dr. Nummedal responded that in spite of successes, there is still a perception of engineers against nature at any cost. In relation to Cape Hatteras, he referred to the community of Buxton and noted that the eastern shoreline is retreating and the south basin shoreline is accreting. It would make sense to redesign the resort community to grow with the naturally evolving shoreline. He said the Park Service is doing that by retreating from the eastern shore and developing on the southern shore.

BG Vander Els asked how they looked at the instruments at the various hierarchial levels of governance to formulate policy that is coherent and that can guide engineers towards useful, acceptable solutions. Mr. Tait said it is not always easy because laymen get seduced by articulate people and sometimes make the wrong decision. They just have to do an effective job of communicating their solution. At Jupiter Island, the local people adopted a solution using heavier grain sand for renourishment, but they also adopted a building-block detached, submerged breakwater that has not had a very good record of success.

Mr. Housley said the Corps often furnishes information, like in a recent instance when they were contacted by the New York Times, but they are often misquoted or material is taken out of context. Therefore, efforts to communicate are totally thwarted by the media. Mr. Tait said there is always a risk and added he found it effective to initiate visits to newspaper editorial boards. Editorial boards set editorial policy and influence which subjects will be given more attention by that newspaper. The editors want to be right, particularly on technical subjects, and welcome information. We can inoculate against misinformation in advance. People within the Corps at the local level can also get out of the office and deal with people directly, troubleshooting potential problems.

Dr. Oswald said the key to coming up with the adequate engineering solutions is an adequate knowledge base of the fundamental processes controlling sediment transport. He said we could accelerate the learning process manyfold if we had an adequate R&D base, but that would require increased funding. Mr. Tait said they supported increased funding, and their board of directors was going to work to get those increases.

BG John F. Sobke asked about the charter, mandate, composition and purpose of the Association. Mr. Tait said the strength of the FSBPA is that it was organized by local governments and is, in effect, a league of cities and counties on coastal issues. The majority of members are nongovernmental individuals, but the by-laws mandate that local government will always control the board of directors. The Association then speaks for the local governments in presentations to higher level governments. That is lacking in the American Shore and Beach Preservation Association.

MG Bunker said Mr. Tait had reinforced the reality that coastal engineering, today, is right in the middle of public policy. There is a clear need to move carefully and aggressively forward in order to provide policy makers with the best scientific advice possible.

NUMERICAL MODELING OF COASTAL SEDIMENT PROCESSES AND BEACH CHANGE

Dr. Nicholas C. Kraus
Research Division
and
Mr. Mark B. Gravens
Coastal Processes Branch, Research Division
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

Beach change is an outcome of highly nonlinear and unsteady interactions between winds, waves, currents, sediment, offshore and nearshore topography, coastal structures, and boundary conditions such as inlets and headlands. Beach change and sediment movement can be studied on three general space and time scales as: (1) *microscale*, involving individual particle movement, turbulence, and other quantities on a spatial scale of millimeters and time scale of seconds or less; (2) *mesoscale*, typically involving time averages, such as radiation stresses, net sediment transport rates, and other calculations on a spatial scale of meters and time scale of wave periods to hours; and (3) *macroscale*, involving geomorphologic considerations and spatial scale of tens of meters to kilometers and time scale of months to years. Engineering numerical models of beach change typically operate from a mesoscale formulation, but research must be done on all scales to arrive at the most accurate and general transport rate formulas and models.

Beach change models can similarly be categorized by spatial and temporal scales. The temporal scale has as limits *short-term* duration, such as a single storm event occurring over the order of 12 hours, and *long-term* duration, such as shoreline change at a jetty, which proceeds over several years. The spatial scale of beach change models has as limits tens of meters, as in the case of dune erosion, and tens of kilometers, as in the case of shoreline change along a littoral cell. Beach change models calculate sediment transport rates and associated beach change, being driven by hydrodynamic submodels involving calculation of wave transformation and currents. The scales of all process and response calculations should be similar. This presentation focuses on beach change models.

The CERC presently operates two beach change models, one called GENESIS, which stands for GENEeralized Model to SImulate Shoreline Change, and the other called SBEACH, which stands for Storm-Induced BEACh CHange Model. These models were developed in cooperative research projects as doctoral dissertations for which the first author of this paper served as thesis advisor.

GENESIS

GENESIS calculates shoreline change on a grid as a function of wave input parameters and boundary conditions. The model is flexible, allowing representation of a wide range of phenomena which impact long-term shoreline change, including groins, jetties, detached breakwaters, seawalls, beach fills, and river discharges. Development of GENESIS began in 1985 and was funded by mission-support projects and the coastal research program. A technical reference manual for version 2.0 of GENESIS is in preparation for a workshop to be held at CERC in September 1989, for potential District and Division users. A PC version of the model is also under development. The model is sophisticated and requires considerable data and preliminary analysis, and its operation presupposes an advanced knowledge of coastal sediment processes. Much attention is being given to the user interface of GENESIS to allow efficient operation of the model.

GENESIS has been used on mission-support projects for the Alaska, Galveston, Los Angeles, and New York Districts, often involving multiple sites. Recognizing the great need for improvement of GENESIS and support to the field on use of this technology, a work unit was established in the coastal research program which will provide a "home" for the model. Although GENESIS has considerable power, much research is required to improve upon phenomenological representations of coastal sediment processes in the model, such as sand bypassing and permeability at groins, distribution of the longshore sand transport rate across the surf zone, wave transmission through detached breakwaters, multiple wave trains, and representation of boundary conditions. These and other topics will require field and laboratory work, in some cases combining micro-, meso-, and macroscale approaches.

SBEACH

The numerical model SBEACH was developed in FY88 as a generalization of wave-energy dissipation models based on equilibrium profile concepts. The model is at a research stage and has just entered use at CERC on mission-support projects. The model calculates beach erosion as a cross-shore sediment transport process controlled by the initial profile shape, grain size, wave conditions, and water level. It aimed at estimating short-term storm impacts and initial adjustment of beach fill to ordinary wave action.

SBEACH calculates the formation and movement of bars and berms, as well as overall change in shape of the profile. Reasonable results are obtained for erosional processes, but much work remains to better describe accretionary processes. An accurate description of accretionary processes (beach recovery) is necessary to extend model predictions from the short-term period of one storm to longer term simulations

of the impacts of multiple storms, as well as to describe the long-term adjustment of beach fill.

In FY89, a work unit was established to investigate cross-shore sediment processes and develop SBEACH. Initial testing and applications in mission-support projects have verified the model for use on both the east and west coasts of the United States; however, as can be expected, many research topics have been identified. We are highly encouraged by the successes of SBEACH. The model provides a framework for research on cross-shore sediment transport processes and has already led to many questions, such as the appropriate statistical representation of random waves for calculating cross-shore sediment transport, nature of wave energy dissipation, the influence of grain size on sediment transport, and accretionary processes in general. This progress, and a tool with which to focus our questions, could not have been foreseen just a few years ago.

DISCUSSION

Dr. Mei requested additional information on the validation procedure used in the model described by Dr. Kraus. Dr. Kraus said it is a sophisticated model, and it is necessary to provide instructions for the user. They are in the process of writing a user's manual, and they are going to have workshops. It does require coastal experience to run the model. There is some subjectivity that goes into it. There are other models like GENESIS, but to the best of his knowledge, he is the only one to verify some aspects of the wave component both in the field and laboratory. He plans to propose an R&D work unit to see if the wave transmission, diffraction, refraction, and shoaling algorithms are correct. Dr. Mei said it seems to be still undergoing development and revision. He noted that there are many issues involved in the model that are at the frontier of our knowledge, such as breaking waves. He wondered if there should be a little more extensive review and thought that it might be premature to prepare a manual for use by field engineers. Dr. Kraus said he would welcome advice or suggestions on how it could be opened up for review by the profession at large. He said a session was planned at Coastal Zone '89 to discuss this modeling.

Dr. Oswald asked what program we had to address the validation of the numerical program. What are the data input requirements and validation requirements? Dr. Kraus said they had used it on the top 10 projects in difficulty that he had seen, and it was calibrated on each project and verified if there were more data. The ideal data base would be to have concurrent wave data measurements and shoreline change measurements over several years so that the model can be made to reproduce measured shoreline change for a particular time interval, and then try to reproduce the shoreline change for another independent time interval; that is known as calibration and verification. Normally, for the United States, we rely on hindcast wave data from the Wave Information Study. For this specific case, we had measured shoreline change from a cooperative study between CERC and the Louisiana Geological Survey and wave data from an offshore oil platform with direction data from a wind gage.

Prof. Reid asked about specific model parameters. Dr. Kraus said the model has remarkably few parameters; one parameter governs the magnitude of the transport rate, and then there are boundary conditions. The model is relatively stable.

Mr. Michael J. Wutkowski pointed out the model is no more than a tool. An engineer would look at where it was to be applied, use common sense, history of the

shoreline, and similar projects in other locations to get an idea of what he would expect, and then he would run the model. He could see how the model would respond to different sets of input. The final result would be controlled by the engineer and what his analysis, common sense, and experience told him. A model like this would help the engineers right now as long as it's not misused. It really falls back on the engineer doing his job in analyzing the problem.

MG Bunker said he would like to follow up on that comment. He asked if the handoff was perceived as handing a cookbook to the field; or is it a spreading out of the model to other professionals, for a tool, but also for continued development. Dr. Kraus said he was opposed to a cookbook approach. He said the model could be a tool, but, ultimately, engineering and coastal judgment have to be applied. He said one thing they would do is Beta testing, which means giving it to people recognized as having knowledge and ability, letting them work with it, and incorporating their input into the manual and guidance. He said they were also going to have workshops. They hoped to work one on one with each Division's problems and have within the Corps small pockets of expertise with the model. MG Bunker said his perception was that we needed a fairly formalized feedback mechanism.

Mr. Charles N. Johnson referred to specific cases of profile response, including the movement of coarse-grained material onshore. He also asked about the relationship within GENESIS between longshore wave energy flux and longshore material movement. Dr. Kraus said he was quite optimistic that the model will do a reasonable job of simulating onshore movement and accretion. The longshore transport rate formula has two components. One is the classical CERC formula, moving sand by oblique wave incidence. The other term is one he added several years ago to model diffraction currents, which is very important at detached breakwaters and jetties. The alongshore gradient of wave height contributes to the alongshore current.

MG Bunker said the Board would undertake an action item to help bring some focus on complex models and how we transfer them from the laboratory to the field. He thinks the description of a Beta-test operation is right on the mark, but thinks that requires some overview by the Board over time.

PHYSICAL MODELING/COASTAL PROCESSES

Dr. Steven A. Hughes
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Vicksburg, Mississippi

Introduction to Physical Models

Physical models at reduced scale offer an alternative for examining coastal problems that are beyond our analytical skills. There are three distinct advantages to using physical models:

a. Properly scaled physical models include the appropriate physics without the simplifying assumptions that have to be made for analytical and numerical models.

b. The small size of the physical model permits easier data collection.

c. The environmental forcing in the physical model can be controlled with reasonable precision.

Of course there are well-known disadvantages to using physical models, most notably:

a. In models that are smaller than the prototype, scale effects occur when it is not possible to simulate all relevant variables in correct relationship to each other.

b. Laboratory effects, such as boundary conditions and wave generation capability, can influence the process being simulated to the extent that suitable approximation of the prototype is not possible.

c. Physical models are expensive relative to most numerical models.

Two types of physical models can be employed to study nearshore coastal processes: fixed-bed and movable-bed. Fixed-bed models are used to study wave, current, or similar hydrodynamic phenomena, and the scaling effects are reasonably well understood. Less well understood are the scaling effects inherent in movable-bed physical models intended for use in studying sedimentary problems.

Physical Modeling of Sediment Transport

Modeling sediment transport correctly in a physical model is an extremely difficult task because of scaling uncertainties. Sediment transport occurring in coastal processes can occur as bed load (bed shear stress-dominated process), as suspended load (turbulence-dominated process), or as a combination of the two. Attempts to determine a universally applicable set of scaling relationships for all situations have failed because the two modes of transport essentially require two different sets of scaling criteria. For this reason, coastal sediment processes that are viable candidates for study in a physical model need to be dominated by only one mode of sediment transport.

Other physical modeling considerations include dimensionality of the process, time scale of the process, and identification of what dynamic forcing appears to be controlling the phenomenon. Generally, it is more practical and cost effective to model short-duration events in two dimensions; therefore, it is wise to examine the field problem to see if it can be idealized in this manner before undertaking a three-dimensional modeling effort.

Modeling of Turbulence-Dominated (Storm Erosion) Events

Research has indicated that for turbulence-dominated situations reasonable movable-bed modeling success can be realized when using undistorted Froude scaling of hydrodynamics while maintaining similarity of the parameter H/wT between prototype and model (where H = wave height, T = wave period, w = fall speed of the median sediment size). In physical terms, this translates to the requirement that sediment fall trajectories should remain similar between prototype and model.

Recently, these scaling criteria were verified at CERC by scale model reproduction of prototype-scale profile evolution observed in a large German wave flume. The German tests were fairly unique because a sloping 1:4 impermeable revetment was exposed during the erosion processes; hence, the small-scale verification also validated the same scaling criteria for the case of turbulence-induced scour at the toes of structures.

Application to Field Problems

Verification of scaling criteria for turbulence-dominated events means that the following coastal sediment processes might be candidates for movable-bed modeling studies:

- o Beach and dune profile response to storms.
- o Initial beach-fill adjustment to large waves.
- o Beach-fill response to storm events.
- o Storm scour at structure toes.

Perhaps just as important, there are still many situations which fall outside the guidelines necessary for modeling of turbulence-dominated events. The following are examples[1] of sediment processes which may not be modeled in a movable-bed physical model using the scaling criteria developed for turbulence-dominated events:

- o Long-term shoreline change.
- o Longshore transport of sediment.
- o Current-dominated regimes.

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[1] Author's opinion

o Disposal mound evolution.

Different scaling criteria must be applied to model the above situations.

Hybrid Modeling

Recent advances made in numerical modeling of cross-shore sediment transport processes enable the possibility of combining the best features of both physical and numerical modeling technologies to provide enhanced capability at lower costs. For example, the design problem of providing engineering estimates of the storm protection afforded by particular beach-fill designs under different storm conditions would require extensive physical model tests to cover the multitude of cases. However, by conducting a small number of physical model tests, the movable-bed test results can be used to adjust empirical coefficients in a cross-shore sediment transport numerical model to reproduce the profile evolution observed in the physical model. The numerical model can then be used with greater confidence to examine the many possible storm wave and surge level combinations for each proposed beach-fill design. The final product is reliable estimates on which to base cost/benefit analyses and for project design.

DISCUSSION

Dr. Nummedal noted that Dr. Hughes was doing physical modeling and calibrating it against the prototype, while Dr. Kraus was doing numerical modeling and calibrating it against the prototype. He asked what guidelines people had in mind to interface between the two. Dr. Hughes said both technologies are emerging. At present they are proceeding separately, but there are contact and discussion between the two groups. Prof. Reid said that possibly the physical models might be used to supplement the prototype data for verification of the numerical models. Dr. Hughes said that he and Dr. Kraus have considered doing that.

Dr. Mei asked about the limitations of the physical model. Dr. Hughes said there is a growing international consensus that, for turbulence-dominated events, the modeling criteria he presented appears to work in various situations. Dr. Mei asked if he was able to give more specific guidance to users of the technology. Dr. Hughes said that Dr. Robert Dean had discussed these particular modeling criteria in a 1985 paper and went into the questions of Reynolds numbers, viscous stresses, and other forces. Intuitively, the parameter means something to us, and experience has shown we do a good job of modeling the gross features of the profile. At the moment, we do not completely understand the physics. There are certain guidelines in a Coastal Engineering Technical Note. It was agreed that use of the model required careful application.

Dr. Oswald asked about modeling in three dimensions. Dr. Hughes said CERC has facilities with that capability, but needs a good three-dimensional prototype data set before proceeding. They are looking for such a data set.

Mr. Johnson and Dr. Hughes discussed the equivalency between monochromatic and irregular waves. Dr. Hughes noted that there was a contradiction with the results of Dr. Kriebel in that, using Kriebel's guidelines, there was too much energy in the surf zone, and it moved the sediment farther offshore than the case for irregular waves.

There was some discussion about calling a particular parameter the D Number in honor of Dr. Dean's contributions. It was noted that various people had used the parameter, but it would be up to the international coastal community at large to decide on any particular name.

PANEL
SHORE PROTECTION STRUCTURES:
THE EFFECTS OF SEAWALLS ON THE BEACH -
SPECIAL EDITION OF THE JOURNAL OF COASTAL RESEARCH

Dr. Charles W. Finkl II, Moderator
Editor, Journal of Coastal Research

Dr. Nicholas C. Kraus
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station

Dr. Robert A. Morton
University of Texas

Dr. Gary B. Griggs
University of California, Santa Cruz

Ms. Joan Pope
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station

Dr. Finkl said among the many attempts to provide an adequate measure of shore protection, seawalls have historically been a method of choice. Although their construction and placement differs greatly from one location to another, the overall effectiveness of these structures remains controversial even today. The success or failure of such structures, i.e. their environmental impacts, is related to many factors, not the least of which include beach processes associated with seawalls. Seawall-beach interactions are the subject of Special Issue Number 4 of the Journal of Coastal Research (1988), edited by Dr. Kraus (WES) and Dr. Pilkey (Duke University). This issue contains technical papers that report various attempts to better understand the effects of seawalls on the beach. Each of the four coasts of the United States is represented. This special issue is noteworthy because it represents an initial effort to impartially evaluate seawall-beach interactions within the context of coastal (environmental) management. Research has not yet developed to the point where definitive statements can be posited as to where and when seawalls should or should not be constructed, but at least the proper questions are now being asked. New research similar to the examples cited in this issue will no doubt help define the complexity of interactions that occur when seawalls are constructed behind beaches. It is thus hoped that, in the future, not only the responses of beaches near seawalls may be predicted but that the conditions suitable for construction of seawalls may be adequately ascertained.

The complex effect of offshore breakwaters constructed in front of beaches is a closely related topic that also requires greater insight. The ability of coastal specialists

to more fully understand the interactions of beaches with seawalls and offshore breakwaters is of critical concern in many low-lying areas subject to erosion and flooding, especially in a time when sea level is rising.

Dr. Kraus said, as a background for this panel session on the effects of seawalls on the beach, that when he first arrived at the Coastal Engineering Research Center in late 1984, one of the coastal research program technical monitors from the Office, Chief of Engineers, stopped him in the hallway and asked what he knew about the effects of vertical walls on the beach. His reply was not very satisfactory, and a subsequent search for an authoritative and comprehensive source of information on this important topic proved unfruitful. As a result, in his capacity as Chairman of the Coastal Sediments '87 conference held under the auspices of the American Society of Civil Engineers, submission of papers on the subject of the effects of seawalls on the beach was promoted, and a panel session was convened at a plenary meeting of the 300 conference participants. Papers on the subject were also solicited and published in a special issue of the Journal of Coastal Research (Special Issue No. 4, 1988), entitled "The Effects of Seawalls on the Beach," edited by him and Dr. Pilkey of Duke University. He also contributed a literature review as one of the papers for the special issue. The review was researched and written intermittently in the evenings at home over a period of 1-1/2 years, during which time piles consisting of hundreds of papers and books migrated around the floor of his study as the project proceeded and the information was cross-referenced.

The review was eventually "narrowed" to approximately 100 publications covering field, laboratory, and conceptual studies judged to be most useful and definitive. In order to provide organization to such a great mass of information, eight questions were posed and answered on the basis of information available from the review. Many other interrelations between various subject matters in the papers were also analyzed. The presentation will summarize principal results, with the main conclusion being that "beach change near seawalls, both in magnitude and variation, is similar to that on beaches without seawalls, if a sediment supply exists."

Dr. Morton said field studies at three barrier island sites on a microtidal, storm-dominated coast document the effects of seawalls on:

a. Relatively stable beaches.
b. Slightly erosional beaches.
c. Moderately erosional beaches.

Analysis of beach dynamics using aerial photographs and beach profiles indicates that all seawalls reached by storm waves temporarily increase frontal beach erosion by concentrating scour at the seawall base. These deep scour troughs rapidly fill as beach and bar systems return to equilibrium positions. If an adequate sand supply is

available, complete poststorm beach recovery occurs in four interdependent stages: rapid forebeach accretion, slower backbeach aggradation, dune reconstruction, and vegetation recolonization. Even severely eroded beaches in front of seawalls can experience forebeach recovery, but seawalls may reduce or prevent the other three stages of recovery by impeding the onshore transport of sand that elevates the backbeach and builds the dunes.

All the field evidence of this study indicates that seawalls locally increase magnitudes and rates of long-term beach erosion with lateral erosion being greatest on the downdrift ends of those walls extending onto or seaward of the forebeach. These protruding structures alter the sediment budget by either intercepting sand transported by longshore currents or preventing sand from entering the littoral system. Beach profiles seaward of seawalls first respond to diminished sand volume by decreasing elevation while maintaining profile shape. As erosion proceeds, the profile above mean sea level becomes concave upward, and the radius of curvature decreases, causing a local steepening of the beach adjacent to the seawall base. With continued erosion, the entire profile becomes subaqueous. Longshore bars adapt to diminished sand volume and increased water depth by migrating landward and developing a curvature that, in plain view, is convex toward the seawall.

Dr. Griggs said that as a result of severe coastal storm damage experiences over the past decade along the California coast, a large number of coastal protection structures have either been built or proposed. As the number of structures and their coastal frontage has increased, concern with the effects of the structures on the adjacent beaches has arisen. A 2-year study along the central California coast has been carried out in an effort to resolve some of the critical questions regarding the impact of these structures on beaches. Based on precise bi-weekly wading-depth surveys in the vicinity of four different types of protective structures, a number of consistent beach changes were observed and documented:

a. With the arrival of winter waves, the summer berm in front of all seawalls monitored is eroded back sooner than the berm of the adjacent unstructured, unprotected, control beaches.

b. Where a sloping permeable revetment is adjacent to an impermeable vertical seawall, the berm in front of the vertical seawall may be eroded sooner.

c. Once the berm on the unprotected beach has retreated landward beyond the seawall, qualitative observations of the beach face in front and adjacent to the seawall are usually indistinguishable.

d. Surveyed profiles at this time, however, often indicate that sand levels are slightly higher and the slope of the beach face slightly steeper directly in front of the walls monitored, relative to adjacent unprotected beaches.

e. Increased scour at the ends of the seawalls studied, due to a combination of wave reflection and groin effects, may extend as far as 150 m downcoast.

f. Rebuilding of the nearshore beach profile occurs in a uniform manner with no obvious differences between seawall-backed beaches and adjacent control beaches.

g. A scour trough was never observed directly in front of the walls monitored.

h. Dean's hypothetical profile, based on the excess sand removal in front of a seawall required to balance the appetite for sand per linear meter of beach, did not occur.

Ms. Pope said shore protection breakwaters are a class of coastal structures which protect the beach by attenuating wave energy, thus promoting the deposition of drifting sediment in the lee of the structures. Breakwaters have been used in the United States and internationally for shore protection with different design philosophies and nomenclature. Breakwater alternatives range from uniquely shaped concrete units placed as a sill at or just seaward of the water's edge to large rubble-mound structures placed several hundreds of feet from shore.

Detached breakwaters, segmented breakwaters, reef breakwaters, artificial headlands, perched beaches, pocket beaches, and even floating breakwaters are variations on the breakwater concept. The construction material or block shape used and the placement configuration control the structure's durability and the beach response. Site-specific and project intent questions need to be resolved prior to the design and construction of any structure. The design conditions, the target beach planform, concern for adjacent shores, and the expected commitment to structure and beach maintenance are issues which need to be weighed.

DISCUSSION

Dr. Mei said it would be very important to do systematic and rather exhaustive experiments in the laboratory in order to get more quantitative information about the effect of regular versus irregular waves, and the effect of grain sizes, the wave conditions, and so forth. That would improve our understanding in light of the dispute about the value or the disvalue of seawalls.

Dr. Nummedal pointed out that the seawall at Timbalier Island was constructed by Gulf Oil Company to protect oil field installations in Timbalier Bay. What happened to the island was not a concern. He raised a question concerning seawalls used to protect against erosion and said we need to consider whether we want to keep the shoreline in a particular location, or whether we want to preserve the beach.

Dr. Morton said the controversy is over what the expectations are, and what we really expect in terms of any different kinds of structures. The Galveston seawall has obviously been a success; it was not designed to keep the beach there. It was pointed out that we need to use nourishment with some seawalls. He said the Galveston seawall has had an effect on the adjacent shoreline, increasing erosion. When we talk about successes and failures, it has to be with perspective.

Dr. Nummedal asked if it is the State's responsibility to look after the overall resource or to look after individual pieces of property. In the case of Galveston, is it a greater benefit to have a wide beach 20 miles long or to protect 8 miles of downtown Galveston. The answer to that kind of question lies beyond the engineering profession.

Dr. Morton mentioned that Texas has the Open Beaches Act, which is being used at this time to prevent building of structures on the beach, such as seawalls and bulkheads. The rationale is that they are protecting a public resource.

Mr. Lim Vallianos referred to the downdrift erosion following the extension of the Galveston seawall. He asked if the seawall had not been there, would the protected area have eroded to supply sand to the downdrift area. Dr. Morton said the seawall extension is not the total problem; the sediment supply is cut off to the northeast for other reasons, including the deep-draft channel and the jetties. That does not alter the fact that the extension accelerated erosion. Erosion rates are highest adjacent to the seawall.

There was some discussion concerning interpretation of historical photographs of the beach at Galveston. Dr. Morton said his conclusion was the photographs show that the beach eroded.

Dr. Griggs said the California Coastal Commission only seems to get permit requests in two categories: from people who claim they have never had erosion and should be allowed to build on the top of a cliff and from people who claim they have the highest rate of erosion in the state and should be allowed to build a seawall. The Coastal Commission looks at the overall statewide perspective. Their mandate was to develop coastal planning for the state's entire coastline, and ultimately they come back to the local municipalities to make up their own local coastal plans. Different communities have taken different attitudes, some prohibiting construction in zones that will require protection and some requiring coastal protection before construction. He said they are in a different physiographic setting; at least on the central coast, they do not see a long-term net loss associated with seawalls.

Prof. Reid observed that the questions fall into a number of areas: qualitative questions on success or failure, quantitative questions on changes in erosion rates and cyclic changes produced by seawalls, questions on storm-related changes, and, in the case of detached breakwaters, questions addressing quasi-permanent changes such as tombolo formation.

Mr. Johnson referred to a seawall in Berrien County, Michigan. He said he has been watching the seawall over the years. The updrift and downdrift beaches both lost sand, and in 1984 the northern part of the seawall collapsed and had to be replaced by a rubble structure. Subsequently, when water levels declined in 1987 and 1988, the subaerial beach developed on the updrift side of the seawall, and a supply of sand became available to the downdrift side. There are indications of a free passage of subaqueous beach past the seawall. There are not necessarily adverse effects on the downdrift shoreline due to reflection.

Mr. Tait asked if any research had been done on submerged, detached breakwaters. Ms. Pope said that perched beaches use such structures to hold the beach profile in place, but perched beaches have not been used much in the United States. We have research on the structural stability, but we need a better understanding of the onshore/offshore sediment transport. The Chicago Park District put in some perched beaches, and they have worked very well. The Soviet Union has used some in the Black Sea, and some experimental designs were used as part of the low-cost shore protection program. At the moment, we do not have much of a data base for design criteria. Dr. Camfield noted that the Washington State Park Service is putting in some detached submerged structures on the north side of Point Wilson in Fort Worden State Park. There are no data available at this time on those structures. BG Sobke said South Pacific Division had proposed submerged structures at Imperial Beach, California, but the project was stopped because of opposition from the surfers. He noted that similar opposition might develop at other locations.

Mr. Wutkowski referred to the data Dr. Morton had shown for North Padre Island, Texas. He asked about erosion outside the area affected by the seawall. Dr. Morton said the regional trend is considerably less than the 2 meters per year observed at the seawall. It is difficult to pin it down exactly.

Additional comments from Dr. David R. Basco, Director, Coastal Engineering Institute, Old Dominion University, are in Appendix C.

PANEL
BEACH FILLS

Mr. Spencer M. Rogers, Jr., Moderator
North Carolina Sea Grant
Marine Advisory Service
Raleigh, North Carolina

Mr. James E. Crews
Chief, Operations Branch
Operations and Readiness Division
Directorate of Civil Works
Headquarters, US Army Corps of Engineers

Mr. Kirby B. Green III
Director of the Division of Beaches and Shores
Florida Department of Natural Resources
Tallahassee, Florida

Mr. James T. Jarrett
Chief, Coastal Engineering Branch
US Army Engineer District, Wilmington
Wilmington, North Carolina

Dr. Donald K. Stauble
Coastal Engineering Research Center
US Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

Mr. Crews said the US Army Corps of Engineers has a long history in placing sand on beaches for beneficial purposes. Federal participation in periodic beach nourishment is justified when it is found to comprise a more suitable and economical remedial measure for shore protection than retaining structures such as groins. For placing beach-quality sand, which has been dredged in constructing and maintaining navigation inlets and channels, onto adjacent beaches or the nearshore environment, it is our policy to do so if: (1) such action is
requested by the State; (2) the Secretary deems such action to be in the public interest; and (3) payment is made of 50 percent of the increased cost thereof above the cost for the least costly method of disposing of such sand.

Mr. Kirby Green thanked the Board for the opportunity to speak concerning Florida's beach-fill program. He gave some historical perspective of Florida's program.

Florida began its beach-fill program in the years 1965 to 1970, with three projects: Mexico Beach Restoration, Pompano to Lauderdale By-The-Sea Restoration, and Virginia Key-Key Biscayne Restoration. These early projects totaled in cost $2,491,137 for 1,509,291 cubic yards of sand on 6.45 miles of beach.

From 1970 to 1988, approximately $170 million in Federal, State, and local funds has been expended for beach restoration, and approximately 88 miles of beach

(46,430,643 cubic yards of sand) have been restored. The Federal share of the total cost was $100 million.

Prior to 1985, the State's role in the beach-fill program was one of reacting to local governments' request for State sharing in the non-Federal share of the project cost. The local governments identified erosion problems and worked with the Corps of Engineers to get projects authorized for study, project design, and construction, and to obtain the appropriation of funds at the Federal level. Again, the State reacted to the end of the long authorization and appropriation process. The Department of Natural Resources acted as a pass-through receiving applications which were reviewed for eligibility compliance prior to going to the Legislature for funding decisions.

In 1982, the department began prioritizing the eligible requests prior to transmittal to the Legislature. In addition to those projects recommended by the department, other projects were approved by the State Legislature, which had not been subjected to the department's grant application process.

The State of Florida Erosion Control Trust Fund (now known as the Beach Management Trust Fund) was initially established as a funding source for protecting and enhancing Florida's beaches through participation in various beach erosion control projects. This fund, however, was not a stable funding base since it relied on year-to-year general revenue appropriations by the Legislature.

Only twice in the history of Florida's Beach Erosion Control Program has there been a comprehensive effort to resolve erosion problems, and that was in Dade and Broward counties. Eighty-six percent of all funds expended on beach-fill projects, through 1985, was spent in Dade, Broward, and Duval counties.

In 1985, the Florida Legislature approved the Growth Management Bill, which established a beach restoration management planning process. The Act was amended in 1986, making it a comprehensive beach management planning effort. The Legislature also funded the first studies in 1986.

Of the approximately 800 miles of sand beaches along Florida's coastline (Atlantic Ocean and Gulf of Mexico), approximately 330.8 miles or 43 percent are considered stable or accreting, approximately 303.8 miles or 39 percent are in a noncritical state of erosion, and approximately 140.3 miles or 18 percent are critically eroding. Most of the critically eroding beaches are concentrated in the more heavily developed areas of the state.

Agency studies indicated the need for a 10-year restoration project of the 140.3 miles. In 1986, the cost was estimated at $362,847,000. This estimate did not include equipment purchase but did include depreciation of the equipment. It was estimated that if a State work force was used for construction of the projects, the cost would be $320,569,000 and minimum equipment cost would be $114,000,000.

The studies also indicated that once restored, projects will need maintenance dredging, and a 10-year program was recommended. The estimated cost with a State work force was $55.4 million and with contractual services $60.7 million.

In 1988, the Governor and Cabinet, sitting as head of the Department of Natural Resources, approved the first beach restoration management plan. That plan identified projects in the south Florida area for Districts III, IV, and VI (Pinellas, Manatee through Collier, and Brevard through Dade Counties), which in the State's evaluation were in a critically eroded condition and needed restoration.

This plan initially identified 66 projects, 25 of which were authorized by the department, 23 were held in a pending status due to insufficient information, and 18 projects were in a not-authorized category for environmental and/or beach access reasons.

Mr. Jarrett said the design of beach-fills in the Wilmington District has evolved over time as a result of our continuing involvement with the Carolina Beach and Wrightsville Beach projects. Major steps in this design procedure include:

a. Sediment transport/budget analysis.

b. Evaluation of storm damage potential without the project.

c. Storm damage potential for various project alternatives.

d. Optimization of fill transition designs.

e. Beach-fill volumetric requirements.

f. Beach-fill construction techniques.

The procedures developed by the Wilmington District are applied to some degree by other Corps Districts; however, there still remains a diversity of application of some principles by various Corps elements. Some standardization of the design methods is needed in order to improve on a project's predictability and performance. The details of the Wilmington District practice were briefly discussed and recommendations were made on where we need to concentrate our research in order to improve project design.

Dr. Stauble said, at present, there is no state-of-the-art beach restoration technology for planning, designing, and evaluating (through monitoring) beach nourishment projects. Although this type of shore protection structure provides needed sediment and storm protection to eroding high-value coastal areas, critics of such projects have attacked the "success" of past projects. Unfortunately, little valuable postproject performance data are available to refute these critics or allow improvements in design strategies. Millions of Federal and State dollars are invested on a regular basis on beach nourishment projects, but little guidance is available to enhance planning and design of a successful project.

The objectives of beach-fill R&D are to:

a. Collect for the first time comprehensive field data on project response.

b. Improve and automate overfill computation.

c. Reduce fill losses by improved design criteria.

d. Automate improved fill design.

e. Develop monitoring procedure guidelines.

f. Assess downdrift benefits gained due to beach-fill projects.

By tracking the response of selected new projects through collection of unique field data sets, analyzing physical model tests, and examining the limited historic project performance data, the research will provide development of standardized monitoring techniques and an assessment of project response to physical forcing functions, which will provide improved empirical and conceptual design calculations. The R&D effort will coordinate with the ACES beach-fill module and provide data sets for verification of CERC numerical models.

A comprehensive study of all components of a project is required. The fill placement area sampling and analysis, project design requirements, borrow area sampling and analysis, coastal processes impacts, and project performance evaluation techniques will all be evaluated to understand the complex interactions of artificial fill placement and stability. This research has the potential to significantly advance beach-fill design technology and give the District engineer the tools necessary to construct successful projects.

DISCUSSION

Dr. Mei asked how much use was being made of physical models in beach-fill design. Dr. Stauble said the data he presented were new data which would be incorporated into the models.

Dr. Nummedal asked if there had been a statewide appraisal of borrow sites for the Florida beach nourishment program. Mr. Green said they did assess offshore sites, but they were running into a problem within the state because of the necessity of using a selective dredging technique to dredge small pockets of good quality material. They recently had a problem when 5 acres of coral reef were damaged. They would like to see some research to develop new techniques that might make selective dredging a little more applicable in beach-fill projects. Dr. Nummedal asked if there was any interfacing between the DRP and the needs the State of Florida has. MG Bunker said the issue seemed to be how one goes about dredging in a way that one can work relatively small pockets of high quality material in close proximity to sensitive coral reefs. Dr. Oswald said he did not believe the DRP was addressing that specific issue. MG Bunker said maybe we should take that on as an action item. Mr. Vallianos said there are techniques available in offshore mining; it is just a question of paying for that specialized type of equipment at a particular location.

Dr. Nummedal asked, in regard to the inventorying of beach fills in the United States, if any consideration had been given to looking at overseas experiences on beach fills. Dr. Stauble said they had not officially done that, but they had looked at some reports, and it would be a good idea.

BG Vander Els asked if we were far enough along in the collection and analysis of data to be able to correlate storm frequency with quantitative erosion rates after beach nourishment, leading towards the ability to project duration and economic benefit. Mr. Jarrett said they had a very limited data set on the impacts of storms on volumetric erosion and shoreline retreat. They are relying on numerical simulation. Dr. Kraus said that in support of New York District in a north New Jersey beach fill, they calculated recession versus stage curves statistically, both for northeasters and hurricanes. They followed that up on the Phase 2 study, Asbury Park to Manasquan, but it does require a good data base, either hindcast or measurements of storms.

Mr. A. J. Salem asked Mr. Green to summarize the setback law in Florida and the permitting process. Mr. Green said Florida has the Coastal Protection Act. It mandates establishment of a coastal construction control line, which is the predicted landward limits of a 100-year storm event. Any activity seaward of that line requires a permit from the Department of Natural Resources. In conjunction with that, they have a 30-year erosion projection line. No multifamily structures can be constructed seaward of the 30-year erosion projection. In certain instances, under very, very severe restrictions, a single-family dwelling may be placed seaward of the line. Once structures are sited properly, construction standards must be met based on the 100-year storm event. Any type of shoreline hardening goes to the governor and cabinet for their approval.

There was some discussion concerning the correlation between length of beach fill and the life of the project. There are only limited data available at the present time.

Mr. Arthur T. Shak asked about research to validate whether nearshore placement actually works. It was noted that there are some studies in the DRP and some physical modeling will be carried out in a CERC wave flume. It was also noted that mounds were placed offshore in Mobile and Galveston Districts and are being monitored.

STATUS REPORT: ECONOMIC EVALUATION OF CORPS SHORE PROTECTION PROJECTS

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Planning Division
Directorate of Civil Works
Headquarters, US Army Corps of Engineers
Washington, DC

Headquarters (HQ) is in the process of reevaluating the policies, procedures, and guidance on the evaluation of shore protection measures, based on concerns raised at recent CERB meetings. As a result of this reevaluation, HQ has issued some new guidance, held some workshops, and begun some research including work on a new National Economic Development (NED) manual involving Institute for Water Resources, the CERC, and some of the field offices.

New guidance, in the form of EC 1105-2-191, was provided to the field offices on 10 March 1989. It provides for the evaluation of downdrift shore protection benefits and costs using systems analysis. The EC recognizes that Corps shore protection projects can have significant impacts downdrift of the project area and that these effects must be evaluated when they occur to see how they affect the recommended plan.

The Corps has recently conducted two workshops on the economic evaluation of coastal projects. The first was held in Cape May, New Jersey, and was attended by a large number of Corps economists and coastal engineers and some consultants from the private sector. It was designed as a forum for the interchange of ideas about the evaluation of coastal projects. A second workshop was held at Jacksonville, Florida, in early February 1989. It was attended by a smaller group of about 16 Corps economists and coastal engineers who are directly involved in Corps shore protection efforts. The purpose of this workshop was to refine, develop, and organize the concepts and issues identified at Cape May so that they could be clearly addressed in an NED manual. Both workshops served to raise conceptual, analytical, and policy issues that need to be addressed.

Because of the difficulties related to the evaluation of shore protection projects and because it is considered an important project purpose for the Corps, HQ has revised priorities for the NED manual series to speed up completion of the storm damage reduction manual. The manual will begin with a discussion of the kinds of problems that exist along the coast, the types of projects that the Corps typically constructs, and the benefits that relate to those projects. The potential for downdrift impacts and the need for systems analysis will be discussed in the manual. The

manual will also discuss coastal models, estimation of benefits, and other special issues.

The other issues relate to three separate areas: economic analysis, coastal engineering, and policy. Economic evaluation concerns include the need for empirical data to validate assumptions about the causes of damages and individuals' reactions to coastal storm and erosion problems. The interface between the coastal engineer and the economist is also a major area of concern. The analytical models currently available are extremely complex and not well integrated to provide the economist with an accurate overall picture. Policy concerns include estimation of the value of land lost due to storms and erosion, including barrier islands and public lands, and policy concerns related to cost-sharing rules for downdrift areas that benefit from a project.

DISCUSSION

Dr. Mei asked if the NED manual was available to the public at large and what projects the manual was prepared for. Mr. Daniel said the manual would be available to anyone. It is a Corps-wide manual intended for use on all projects. It provides the analytic framework for doing the analysis.

Dr. Nummedal asked if there were other people preparing similar documents. Mr. Daniel said they see a lot of reports, and the consistency in shoreline evaluations is less than in any other area. The Corps manual emphasizes the Corps way of estimating the benefits, and it examines things from a national perspective. They do not, for example, count regional transfers. They are trying to particularize the general guidance they are given to shoreline problems. MG Bunker suggested that specifying the value of various components of the study would help justify more R&D dollars in order to develop those particular elements of the requirements.

Dr. Oswald brought up the loss of economic income to a community, as opposed to simply the loss of the capital investment. Mr. Daniel said they would not count that in determining the benefit-to-cost ratio, because it relates to a regional benefit. If recreation transfers to another location, then loss of recreation is a regional loss, but not a national loss. MG Bunker pointed out that the recreation may transfer out of the country. Dr. Oswald pointed out that people might not go at all, rather than go an additional distance.

Mr. Johnson pointed out observations of downdrift benefits at Grand Beach and Michiana on Lake Michigan. In 1981, the Corps placed beach nourishment at New Buffalo, Michigan, which is about 3-1/2 to 4-1/2 miles updrift. By 1987 and 1988, the material had propagated along the shore and produced a good quality beach at these communities. Downdrift incidental benefits could be very easily quantified.

COASTAL AND ESTUARINE PHYSICAL MONITORING AND EVALUATION PROGRAM FOR THE KINGS BAY NAVAL SUBMARINE BASE

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St. Marys Inlet, at the border between Florida and Georgia, is a Federally maintained entrance channel to the Intercoastal Waterway, ports at Fernandia, Florida, and St. Marys, Georgia, and the US Naval Submarine Base at Kings Bay. In the early 1980's, Kings Bay was selected as the Navy's home port for Trident-class submarines. In upgrading the Kings Bay base from the smaller Poseidon-class submarines, it was necessary to deepen and widen the interior channels in Cumberland Sound and deepen, widen, and lengthen the entrance channel through St. Marys Inlet.

During permit authorization, the State of Florida raised concerns about the potential for adverse impacts to coastal processes on Amelia Island to the south. As a result, the Navy signed a Memorandum of Understanding with the State of Florida agreeing to use construction and maintenance dredged sand for beach replenishment for a 5-year period and to potentially place all future maintenance dredged sand on Amelia Island based on the results of a monitoring and evaluation program. In addition, the Secretary for the Department of Interior (DOI) raised concerns to the Secretary of the Navy about potential impacts to the Cumberland Island National Seashore to the north of St. Marys Inlet. These concerns included the ocean coast of Cumberland Island and the bay shore and adjacent wetlands in the Cumberland Sound estuary. A second Memorandum of Understanding was signed by the Navy with DOI establishing a study to evaluate the physical and ecological impacts associated with the Trident fleet related channel modification.

A 5-year study (FY 1988-1992) was established to perform environmental monitoring in the area of Cumberland and Amelia Islands and Cumberland Sound. The ecological aspects of the monitoring program are the responsibility of the DOI with the National Parks Service as the implementing agency. The Department of the Navy is responsible for monitoring the physical aspects of the study area with the Naval Facilities Engineering Command (NAVFAC) as the implementing command. In March 1988, MG C. E. Edgar, Commander of SAD, agreed to perform, in effect, the entire physical monitoring program, through a negotiated Description of Services with NAVFAC. The entire annual monitoring program is subject to a $900,000 budget ceiling (of which $680,000 is for the physical monitoring studies). A Technical Review Committee composed of representatives from NAVFAC, the National Parks Service, the State of

Georgia, and academic consultants periodically reviews the study progress and provides recommendations to the Navy and DOI.

USACE support to the monitoring program involves the Jacksonville and Savannah Districts, who are responsible for conducting hydrographic and topographic surveys; CERC; and the Hydraulics Laboratory at WES. SAD is the lead USACE for coordination between the Corps elements and with the Navy.

The physical monitoring program includes both coastal and estuarine studies (Table 1). Tasks include long-term data collection, short-duration physical measurements, and numerical and physical model testing. The program has several components which are continuing throughout the 5-year period. There is also some planned annual variability and the option for further modification as experience is gained.

The coastal studies have, as their primary purpose, the identification and quantification of any cause-and-effect relationships between the entrance channel modification and the ocean shoreline. In order to address this problem, a tiered and internally structured study approach was adopted (Table 1). The threefold study plan includes a review of the historical setting and preproject data designed to document the long-term evolution of the project area, data collection during the 5-year program designed to identify any changes, and numerical modeling studies designed to extrapolate the measured process-response to scenarios beyond the measurement period or resolution.

The estuarine studies consist of six elements (Table 1) planned as independent activities. Extensive physical and numerical model studies were performed and field data collected in support of the Trident channel design program. In reviewing this body of work, the Navy and its consultants felt that there were several specific areas which needed to be addressed in order to better assess the potential for impacts on hydrodynamics, salinity, and sedimentation. The scope of the estuarine studies was influenced by this existing study base and the interrelationship of the physical processes with the ecological studies which DOI had planned in the same area.

The monitoring program has been in effect for slightly more than a year, and immediate products are not expected in a study of this type. However, several lessons from the first year of study have already resulted in changes in the monitoring plan, including the grouping of profile lines into generic shoreline zones and improvements in the instrumentation systems. Sedimentation patterns predicted in the Sediment Sources and Redistribution Task (Table 1, Estuarine, item C) have resulted in the addition of survey lines to document the critical shoaling areas. The historical study is effectively complete, and the study report will be forwarded to the sponsor shortly.

Table 1

ACTIVITIES FOR KINGS BAY COASTAL AND ESTUARINE ASSESSMENT PROPOSAL

SUBSTUDY/TASK	FISCAL YEAR 88	89	90	91	92
COASTAL					
1. HISTORY					
a. Collect & screen data	X X X				
b. Reduce & analyze data	X X	X X			
c. Draft technical report		X			
2. MONITORING					
a. Arrange for NDBC gage	X				
b. Operate NDBC gage	X X X	X X X X	X X X X	X X X X	X X
c. Begin nearshore station work		X X			
d. Operate short-term nearshore station		X X	X X		
e. Amelia & Cumberland Island profile surveys	X	X	X	X	X
f. Cumberland Sound profile surveys	X	X	X	X	X
g. Additional selected profile surveys			X	X	X
h. St. Marys ebb delta bathymetric survey	X				X
i. Aerial photography	X	X	X	X	X
j. Beach/channel sediment samples	X	X	X	X	X
k. Data analysis and draft interim misc. paper		X X X X	X X	X X	
3. SHORELINE EVOLUTION MODELING					
a. Develop bathymetry grid	X X				
b. Set up response model	X	X			
c. Initial calibration		X X			
d. Incorporate interim results		X	X X	X X	
e. Incorporate final results					X
f. Develop scenarios			X	X	X X
g. Assess scenario effects					X X
4. FINAL REPORT					X X X X
ESTUARINE					
a. Long-term field	X X X X	X X X X	X X X X	X X X X	X X X
Equipment	X	X	X	X	X
Reporting		X	X	X	X
b. Salinity impact				X X	
Reporting				X	
c. Sediment impact	X X				
d. Intensive field			X		
Reporting			X		
e. Fernandina tide				X X	
f. Bottom change.	X	X	X	X	X

DISCUSSION

MG Bunker noted that the depth and width of the channel that we are trying to maintain, given both the natural and the storm regime, is a very ambitious project; over a relatively short time, we have already started to experience and will probably continue to experience more dramatic events than one would normally expect to see in a Corps project. Ms. Pope noted that there are concerns about the maintenance of that channel simply because there is a large volume of sediment moving through that area. In answer to a question from Dr. Nummedal, Ms. Pope said that freshwater discharge is less than 10 percent and that it is dominantly a saltwater marsh environment.

LOW-COST SHORE PROTECTION

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At the request of the Chief of Engineers, the demonstration sites of the Section 54 Program were revisited to capture any "lessons learned." In the summers of 1986 and 1987, a team of five persons who had been critically involved in the program visited all of the sites, except Ninilchik, Alaska.

The philosophy of no maintenance and "successful failures" enabled us to observe what the aging process had done. When the monitoring phase of the program was completed, total control of the sites was assumed by the property owners. Some removed the devices, some maintained them, and the rest abandoned them.

The results of the revisit is a report now being reviewed in HQUSACE. Some of the major results are:

a. The program goal to "develop, demonstrate, and disseminate" information on low-cost shore protection was achieved; dissemination is continuing.

b. Low-cost shore protection is a design philosophy rather than a physical entity.

c. Devices that remained in place for the first few years tend to remain in place longer than 10 years.

d. Low cost is very site specific.

e. No panacea was found; no device solved all the problems all the time.

f. Foundation design, filtration, materials, and connectors are all critical.

g. With two exceptions, little vegetation survived.

h. Life cycle cost is more important than "low cost."

The most significant conclusion is that a universally applicable, innovative design that offers long life, low cost, and ease of construction probably does not exist. A structure designed in accordance with good established procedures, using "tried and true" materials is the only sure means of providing long-lasting shore protection.

DISCUSSION

Dr. Nummedal asked about the technology transfer. Mr. Housley said about 100,000 copies of the three guidebooks were mailed. Many universities and consulting firms have requested the full 830-page report, and those were sent.

Prof. Reid asked about the conclusions from the revisit and about availability of that information. Mr. Housley said the conclusions would be in a report, but availability would depend on having enough publication funding. Much of the technology transfer was in the original report. The revisit was just to add a little

more information. It was emphasized that distribution has been nationwide, including inland areas with reservoirs and lakes.

COL (Ret) Paul S. Denison noted that the published material is taken as gospel. He said the devices tested were designed to be used in low-energy environments; in some instances they work very well. He feels that continuing information transfer is essential because so many potential users have misunderstood what the program was intended to do, and they need to be advised of potential failures if devices are employed in areas where they are not intended to be used. It is difficult to explain to homeowners along the Atlantic Ocean that they cannot just put a bunch of scrap tires in front of their house and solve their problems. Mr. Housley said all of the reports specify a low-energy environment, but people do not always read the full report; they may just pull information from one or two pages.

BEACH AND PROFILE NOURISHMENT USING DREDGED MATERIAL SECTION 933 AUTHORITY

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US Army Corp of Engineers
Fort Belvoir, Virginia

In 1968, the Corps of Engineers established a general policy to productively use material dredged in the course of constructing and maintaining navigation projects. Over the years, this policy has been implemented across a broad horizon of uses, including the placement of dredged material on beaches and in nearshore zones as a means of preventing or ameliorating the adverse effects of shore erosion. The most common circumstance under which this particular use of dredged material is made is when beach or nearshore placement constitutes the least costly means of dredged material disposal. However, a number of legislated authorities can be applied for implementing beach/nearshore placement of dredged material when the cost of such placement exceeds the least costly disposal alternative. Most of these authorities require non-Federal cost sharing, including the latest which was enacted under Section 933, Water Resources Development Act of 1986. Section 933 provides for a 50/50 sharing of the added placement cost between Federal and non-Federal interests. There are currently 32 investigations being conducted under the Section 933 authority. Disposal actions resulting from these studies will add significantly to a growing trend of dredged material placement on beaches and in nearshore zones. In this regard, a comparative analysis has been made of the subject use of dredged material for two 3-year periods; viz, 1978-1980 and 1986-1988. In the first period, 211 navigation projects and project studies were examined. Of these, a total of 52 (25 percent) involved beach or nearshore material placement. In the latter period (1986-1988), a sample of 348 navigation projects and studies were examined. In this case, 152 (44 percent) of the projects and studies involved beach/nearshore placement of dredged material.

DISCUSSION

BG Robert C. Lee said that the emerging policy of the Environmental Protection Agency (EPA) would appear to prohibit the placement of dredged materials in any waters of the United States or offshore unless there is a beneficial use. Taking credit for beneficial use is very, very important. Mr. Pfeiffer asked if this means the Corps could not dispose of dredged material until beneficial uses had been considered. BG Lee said that was the direction that EPA was heading. Otherwise it would have to be placed upland or disposed of by some other method. He said a lot of material has beneficial uses, and he is encouraging its use for marsh creation or shoreline protection. We need to get our data base right and do the best we can.

BG Vander Els asked if there was a guide manual for dredging projects and a requirement to consider beneficial uses. Mr. Vallianos said the dredging regulations are very specific about that; that every opportunity should be taken. It is implicit in the planning guidance that all reasonable alternatives are to be considered. Only a small percentage of the Corps' dredged material can be used for beach fill. About 5 to 10 percent is contaminated. Much of the rest is either too fine or is too far from a beach. He estimated that only 4 to 5 percent of the total dredged material could be placed on beaches. Mr. Charles C. Calhoun, Jr., asked if there were any estimates as to how much material would be suitable for offshore berm construction. Mr. Vallianos said he suspected the quantity would be considerably larger. However, much of the material dredged from harbors is fine material that is unsuitable for use. Mr. Pfeiffer mentioned work in the DRP that is addressing the problem of stability.

MG Bunker noted the importance of coordinating with the State prior to the State budget cycle so that the State can come on-line at the same time as the Corps. Otherwise there is a mismatch in trying to respond to state desires on a project. It is also important to get out in front of a project, such as doing a sand inventory in appropriate places so that there is an understanding of where there is beach-quality sand that may become available.

Mr. Lawrence W. Saunders asked what the experience had been in doing benefit and cost analyses for dredged material placement on beaches, if that has slowed it down, and how long the whole process takes. Mr. Salem said it has slowed it down somewhat. Previously, in Florida, the State had contributed the added funds on two or three occasions to put the material on the beach when it was not the least-cost method of disposal. Under the present criteria, we have to do a little more rigid analysis; a complete least-cost alternative report to be signed by the Assistant Secretary of the Army for Civil Works. That process has been started on several harbors. That whole process takes at least a year. He said they have always had a very formal coordination process with the State of Florida on future dredging. He said what Mobile and Jacksonville Districts do now is give them a 5-year program. That information is distributed widely, to the State, to the counties, cities, and port authorities, and to the Congressional representatives. The problem has been the cost. At Kings Bay, for example, some of the dredging is 4 or 5 miles offshore. It is very costly to get the material back to the beach. What goes on the beach is normally the littoral drift material taken from between jetties. People criticize the Corps when they see a hopper dredge disposing of material offshore, but that material is unsuited for beach nourishment.

Mr. Mark R. Dettle asked about dredges pumping onshore. Mr. Vallianos said there are problems in the variation in dredges. He said the DRP would be looking at that type of technology.

PUBLIC COMMENT

Mr. Gilbert K. Nersesian addressed several issues. He noted that there had been controversial statements concerning Corps projects at Sea Bright, New Jersey, and Miami Beach, Florida. He provided the Board with copies of articles appearing in the Asbury Park Press (Appendix D). He also noted the need for a Corps of Engineers pamphlet on low-cost shore protection. This should be something that the general public can utilize and be able to assimilate with their own needs. He feels that there is sufficient information available to issue an Engineer Pamphlet (EP). In regard to models of groins, he noted that there is a large amount of information available on the Westhampton groins which could be used to verify the models. He also noted, in reference to professionals in the area of coastal engineering, that the latest update of the Corps' SKAP package does not list coastal engineering as one of the technical categories in planning or engineering. It is only shown for research. It needs to be included if we are going to give opportunities for people to advance. He thanked the Wilmington District for the fine meeting arrangements.

COL (Ret) Denison responded to a number of remarks and comments relative to the presentation by Mr. Shaw on the North Carolina Coastal Program. During his last year as District Engineer in Wilmington District, COL (Ret) Denison served on a panel that looked at the then impending national Coastal Zone Management Act. He later served on a committee that helped draft the State Act in North Carolina, and he has served as a technical advisor to the Coastal Resource Commission. He noted that the 15 members of the Commission are politically appointed and are lay people who, to a large degree, are making decisions on technical subjects beyond their expertise. He said that the North Carolina coast is unique in many ways. Its remoteness and physical setting resulted in a very slow development mode compared with adjoining states. The CAMA Program came along at an optimum time to influence that development. The state has also enjoyed a very low-density development as compared with the very high-density development that exists on many other coastal areas. All of those things influence what the Coastal Resource Commission pronounces as being policy and regulations.

COL (Ret) Denison said that the North Carolina policy is not one of retreat. The fundamental premise that drives the regulations is the basic concept that the coast and beaches are the property of the public and the public will have access and will be able to use those resources in perpetuity. Fundamental to that is the premise that we will not do things that interfere with that public access and public use. They know from experience that the hardening process causes beach erosion, and there is a tendency for the public beach to gradually disappear in front of the hardening. State

actions will be designed to protect that public interest at the expense of the private property owner who is suffering loss of his property through the erosion process. That gets to be a tough proposition for the local government officials to accept, so there have to be compromises. Temporary, soft protection is authorized in emergency situations, under certain criteria, specifically to allow time for the relocation of a structure.

COL (Ret) Denison said that the North Carolina program does specifically encourage and authorize renourishment as being the known solution today to the erosion process occurring along the state's 322 miles of coastline. That is a major economic question where the coast of North Carolina is concerned. It is costly because sand sources are remote and difficult to get to. Offshore retrieval is impractical at most locations at the present time, compared with what was done in Florida. It is not anticipated that there will be large-scale renourishment projects throughout the state. There are two early Federal projects at Wrightsville Beach and Carolina Beach. Beyond that, the Commission will entertain any innovative and imaginative proposal that can provide respite to the situation as long as it can be shown not to interfere with public access and use. He also referred to the proposed structures at Oregon Inlet and said that the Commission is receptive to arguments that can be shown not to interfere with the public interest.

Mr. Vallianos said that by categorically denying the use of structures such as groins and proper seawalls, we have removed the possibility of a professional investigation of a situation to come up with the most cost-efficient means of handling the problem of beach erosion or storm protection. He also noted that there is some implication of a dichotomy existing between science and engineering. He does not think that exists, that there is a very close linkage, and pointed out that a substantial number of the people at the meeting were not actually engineers, but were physicists, geologists, and so forth. He said most coastal engineers have some geological background. He noted that geologists are progressing from a descriptive to a quantitative state, and he said quantitative arguments have always been necessary to justify projects.

COL (Ret) Denison said the North Carolina policy leaves the door open for innovative projects that can be shown to be constructive. If a seawall is ultimately determined to be the most cost-effective and the most beneficial project or approach for coastal protection and it can be shown in the long term not to deny the public interest, then the Commission will entertain that recommendation from responsible engineers who can prove their point.

Mr. Donald L. Barnes said they are concerned that there are a lot of hurdles between the time a project is designed and the time that the project is implemented.

Good design makes the job a lot easier, and with that comes the need for good cost estimates. The sponsor has to know what he is signing up for, both in initial project costs and periodic nourishment costs. There will be a tougher job in the future because of study cost sharing. Modeling can be expensive, and the non-Corps sponsor has to pick up 50 percent of those costs. He may not be interested in advancing the state of the art. The Corps is trying to do more in the feasibility phase, and the sponsor pays 50 percent of those costs. During project implementation, the sponsor pays about 35 percent.

Mr. Barnes said Section 902 of the Water Resources Development Act of 1986 puts a cap on project cost estimates. We have to go back to Congress to get additional authority to exceed that, and that means delays and possibly missing a new start opportunity. He noted that there had recently been a House hearing in Washington on Ocean City, Maryland. The Corps came under attack because of cost estimating and our coastal expertise. At the meeting, the Corps' message carried, and people did a good job rebutting criticism, but the news media reported the opposing viewpoint. He said we need some success stories we can point to in rebutting the challenges that come to those projects. The Corps only had a limited time to speak at the hearing, and we had a difficult time getting things ready in advance.

Mr. Barnes also noted that budget deficits will continue for a while and recreation is going to remain a low priority. He mentioned Section 933 and said if the project is just for recreational beach purposes, it will not receive support in the budget. He mentioned benefit analysis and said the 1986 Act changed the way we perceive coastal projects. The focus is on storm damage reduction, rather than beach erosion control. A new EC on shore protection policy, EC 1165-2-130, will be coming out shortly.

BG Vander Els asked about the allusion to the unacceptability of recreation benefits as independently justifying. Mr. Barnes clarified that by saying that we can still use recreation benefits, but the focus is on storm damage reduction, and recreation benefits are incidental benefits. If the project is primarily recreation oriented, it will not receive support in the budget process. BG Vander Els asked what the economists were doing about formulating the economic realities of recreation. Mr. Barnes said the reality is that there are a lot of benefits associated with recreation, but it is viewed as a regional transfer.

MG Bunker said his perception is that more emphasis is being placed on recreational benefits and they are getting more visibility over time. In considering research and development aspects and the future, he would look beyond today's policy and start to be concerned about defining recreation benefits and bringing those into the scheme, rather than being stuck with 1989 policy, which may change. He noted

that recreation is industry and that in 1985, 26 percent of all tourists on Waikiki were spending Japanese yen. That is not a regional transfer. He questioned how we are handling that type of thing. It is happening and we need to deal with it.

Mr. Lockhart referred to discussion on determining benefits. He said if we want better estimates of costs and benefits, they have to be based on better design. We do not get better design by short cutting technical studies and doing studies without model assistance. We need to do a thorough analysis with the latest technology available. That is an application of R&D.

Mr. Jarrett said there are some sophisticated analyses being done by Corps Districts and specifically mentioned New York District. He thinks they have pretty well advanced the storm damage and benefit analyses for beach protection projects. He would like someone to coordinate an effort to look at ways the Districts are doing benefit analyses. Most of them depend on application of shoreline response models. He thinks the way New York District is doing their analyses should be adopted throughout the Corps. He emphasized that we really need to consider recreation in determining the value of a cubic yard of sand, particularly in the 933 Program. It is difficult on small projects to quantify the storm damage reduction. He noted that the sand is a very limited resource and that recreational value is a good measure of its economic worth.

Mr. Jarrett said he was pleased to hear that they could go to the North Carolina Coastal Resource Commission with variances. They have generally not received that indication locally when they deal with the staff of the Commission. In most instances, there are other ways of doing something besides beach fill. He said the north end of Carolina Beach is a good example, where a revetment protects the development behind it. He said the North Carolina State Department of Transportation plans to present its case to the Commission on the groin at Oregon Inlet. The Corps has not been invited as a participant.

Mr. Richardson referred to comments about ways to establish better linkages between design technology and the economic analysis process. There is a proposed effort in the FY90 Coastal R&D Program to begin looking at those linkages. The early part of the effort would be specifically directed toward beach-fill design. One of the things investigated would be sensitivity analysis, i.e., looking at what aspects of coastal design parameters the economic analysis is most sensitive to.

Mr. Pfeiffer noted that the arguments about benefits go all the way to the Assistant Secretary of the Army for Civil Works Office and OMB and are beyond the reach of the researchers. Besides the research and technical part, there also are policy considerations, and both have to go hand in hand because neither one alone will get things settled. He requested some help on the particular policy issue because

it touches all projects of this type with regard to allowable benefits. MG Bunker suggested that as an action item, and also an action item framed towards ensuring that coastal engineering R&D has the flexibility to reach beyond present policy.

MG Bunker said the present meeting seemed to be split into two areas, one area being public policy and the other being coastal engineering and technology. In the one there is a great deal of emotionalism, and in the other there's some reportage on dispassionate research. The public policy issue makes this field a huge challenge, but we need to take great care as a professional group to protect both the reality and the perception of our professional objectivity so that we can be respected and acceptable to all parties in the public discourse; to have our role being to develop our science to the point that we can confidently predict the resultant impact of proposed public actions; and to realize that there is as much professional expertise, research, and development work that needs to go into the decision of how to put sand on the beach so it will stay there, as there is to put in structures. He said he perceived a tendency to believe or not believe the technical pronouncements of individuals based upon where they happen to stand on the public policy issue, and he thinks that is very dangerous for us as a group of professionals.

BG Vander Els said there was great wisdom in that. He thought also, though, that there is a reality of synergism going on, and to the extent that policy either energizes or represses the collective energies and resources of the community, we must at least be aware and acknowledge those effects. He thinks there is concern with the amount of basic research that is funded as a very real problem, and there is a sense in which the whole domain of the economic significance of the recreation industry is prescribed from legitimate impact and as a legitimate ingredient; to that extent, there is perhaps an indirect influence on resources available for doing basic research.

Dr. Mei said that the possible confusion of public policy with regard to coastal protection and coastal engineering is perhaps in large part due to the confusion of the scientific status of coastal engineering itself. Because there are lots of controversies on some of the very common practices in coastal engineering, this defuses confidence of public policy makers in the coastal engineering profession. For this reason, he seconded BG Vander Els remark about the need for basic research.

MG Bunker said the difficulty is that we are working with an art and not a science, and that does make it difficult. He said we would get much better over time if we increased our R&D expenditures, but there will still be situations where our models and our best efforts will fail, and there will be occasional examples that allow those who believe it is not a firm science to reinforce their own thoughts.

Mr. Lockhart brought up the action item on small storm surge events. He said they were making good progress, but need to give more attention to how to input

storm duration and accretion into our models so that we can look at small events and their cumulative effect in determining benefits. We also need to look at joining our physical modeling and math modeling efforts to come up with a better tool. Dr. Mei suggested that storm surges would be included in the upcoming CERB meeting in New Orleans, which would be a natural place to discuss that.

Mr. Thomas C. Bruha brought up the question of the sand inventory program. He noted the sand inventory program of the 60's and 70's. He said New England Division receives many inquiries about the price of sand, and the price of upland sand is going out of sight. He recommended resurrecting the offshore inventory program because offshore sources of sand are going to be the thing of the future. With inlet problems and pollution, the sandy beaches will remain unsanded unless we come up with an offshore source. Consultants in New England are asking where sand is located and whether they can mine it. They are referred to the particular state having control, but Mr. Bruha thinks the Corps has to take the lead in locating some of those sources and analyzing the sand quality. He feels in the next 10 years that is going to be our primary source of beach nourishment.

Mr. Richardson said the inventory program referred to by Mr. Bruha was the Intercontinental Shelf Sediment Survey (ICONS). It was conducted entirely by CERC, and a lot of good information was obtained. Since the ICONS program ended, the Minerals Management Service of the Department of Interior has taken on a much broader mandate for exploration and regulation of a wide variety of minerals in the Exclusive Economic Zone, including sand and gravel resources. He suggested first possibly resurrecting what was already done under ICONS and improving the technology transfer of existing information and second exploring the possibility of some cooperative efforts with the Minerals Management Service

Dr. Nummedal supported Mr. Richardson's suggestion. He said the timing is very appropriate to go back and redo an inventory of offshore sand resources. He noted that the National Oceanic and Atmospheric Administration is now in charge of releasing newly acquired, very high resolution bathymetric maps that cover the entire US continental shelf. They were produced by SEABEAM technology and seafloor radar mapping techniques. He said he thinks the stage is right to do a nationwide inventory of where the resources are located. He said it makes sense to move sand from the shelf back to the beach because nature moves it in the opposite direction, and we are completing that loop.

COL Woodbury said there are a lot of individuals and small organizations spending a lot of money to protect their investments. He suggested looking a little harder at erosion, storm, and flood-control measures that take advantage of newer

technology in the areas of both sand transport and new materials that might provide a quicker, cheaper, and less permanent solution to today's needs.

Mr. John P. D'Aniello said he was impressed with tools that are being worked on such as GENESIS, which will assist the Districts in years to come in terms of doing good technical studies up front. His concern is that some of these tools appear to be very manpower intensive and data intensive. He thinks consideration should be given to looking at development of these tools in the arenas that the field will have to use them in the future, the cost-sharing arenas where the local sponsor will have to come up with 50 percent of the cost during the feasibility study when they do not know if they will even have a project approved. Tools are needed at different stages: formulation, preliminary design, and detail design. He thinks the Board and the community at large needs to take a look at that.

Dr. Kraus replied that this had been discussed, and a chapter in the GENESIS user's manual discusses two modes of operation of the model. One is the scoping mode, which tries to give guidance with a minimum of information; the other is the design mode, which uses all the information that can be obtained, and ingenuity, in applying the model. He said he plans to follow up on this and would contact Mr. D'Aniello and others to see how the model could be used in various phases of a project.

THEMES FOR FUTURE MEETINGS

MG Bunker said the next CERB meeting would be in October in Redondo Beach, California, and the theme would be Pacific Coastal and Navigation Challenges. The May 1990 meeting will be in Florida, and the theme is Coastal Inlets. The October 1990 meeting will be in New Orleans, and the tentative theme is Coastal Flood Protection.

Mr. Pfeiffer suggested that the May 1990 meeting should perhaps address coastal benefits in addition to coastal inlets. He noted that the meeting would be in Florida, and the issue is very hot in that state and would perhaps be a suitable second topic for the meeting.

Dr. Camfield suggested that coastal benefits are strongly tied to coastal inlets. It concerns the policy issues and economic issues: where the dredged material is placed, what justification is needed for placing it there, and so forth.

CPT James N. Marino disagreed with having two topics at the meeting because of the extent of material on tidal inlets alone. He did not feel that there would be sufficient time for an additional topic. Mr. Salem agreed that the inlet theme is very broad, and most of the appeal in Florida is going to be considering bypassing and sand transfer. Nevertheless, there is a very large desire from the people around the area to claim all of the possible benefits when they are bypassing sand. He thinks both topics are very important and very germane, but suggested leaving the theme as inlets only because the other topic is being fought in a much broader arena, on different grounds.

MG Bunker stated that the theme would be left as is, but directed the inclusion of at least one segment on coastal benefits simply to look at the tie between the two.

BOARD RECOMMENDATIONS

BG Vander Els suggested that the meetings could be more focused. He said there had been progress in that direction, and the listing of action items and the theme process are improvements over the last few years. He said perhaps we could be a little more focused and a little bit more aggressive. He was unsure exactly what the mechanism is to identify as more substantive those things that the Board feels are worthwhile putting a priority on as an adjunctive action to the program review that goes on at CERC. He said the first panel gave preliminary indications showing correlation between grain size and durability. That has very practical applications. It is a $10 million question for Presque Isle, as to what kind of beach material to use for nourishment. He asked if that could be pursued as an R&D item.

Prof. Reid said we should look into the ways and means of a follow-on transfer of information to the public with regard to the low-cost option that the public may have in protecting their shoreline property. In reference to modeling shoreline changes, we need to make sure that such modeling efforts receive peer review. That can be done through publication in refereed journals and through general symposia in which people from the entire field of coastal engineering are invited to participate and address and compare different model options.

BG Lee remarked on the progress that had been made during the 4 years he was off the Board. He suggested that the oral history program should be utilized with Drs. Nummedal and Mei, relating to their 4 years on the Board, as to what we have accomplished as a Board and as a research institute.

Dr. Mei commented on accomplishments during the 4 years he was on the Board. He mentioned the realization of the DRP, the WES Graduate Institute and the 1-year program in Coastal Engineering, the advances of DUCK and SUPERDUCK, and the wide acceptance of ACES as among the very outstanding progress made. He said he supported most of what CERC has been doing, but he thinks significant breakthroughs in the art of coastal engineering can come about only by emphasizing basic research. That is currently overshadowed by immediate needs and the more or less empirical approach to our problems. He used the example of seawalls, saying that even with this ancient problem, we still do not know why seawalls work better in California than on the east coast. He thinks that it is only through long-range research that we can make significant advances. He feels that the Corps has a responsibility to play a more assertive role in stimulating greater participation in coastal engineering, including pushing the National Science Foundation to create a Coastal Hazard Research Program and urging the Army Research Office to create the same.

Dr. Mei mentioned the Broad Agency Announcement, which is an existing mechanism for attracting proposals, and said he hoped the procedures could be made more effective in order to attract really good proposals. He mentioned the proposed Science and Technology Center and said he thought it was great that CERC was lending its weight to start the ball rolling. He thinks the movement towards the center will be significant to the future of coastal engineering, but he thinks CERC should give all universities the opportunity to compete for acceptance and approval.

Dr. Nummedal noted that the CERB is charged with providing long-term policy guidance for the coastal engineering research effort, and he thinks that the Board has been party to some of the major achievements. He agreed with what Dr. Mei had listed as major steps forward over the past 4 years. He said many components of the Corps are responsible, and he sees the principal role of the CERB as providing a forum for a friendly yet open-minded exchange of ideas, goals, policies, and research results, and where we should use our expertise and where we want to take the American shoreline in the future. He thinks the CERB serves the function of establishing a camaraderie and mutual respect among all members of the coastal community far better than any other meeting of any professional society, and he will certainly speak highly of the CERB as an organization.

Dr. Nummedal said he was pleased with the presentation by COL (Ret) Denison, and what he presented made it clear that North Carolina has implemented a truly enlightened policy of coastal development. It does sound as if North Carolina has excluded a variety of options by insisting on no hard structures. He feels the State has forced us to become a little more creative. He believes any large organization, by nature, is very conservative and will not become more creative unless forced into a position of having to diversify. North Carolina is telling us we can construct hard structures only if all other solutions have been evaluated and found to be unacceptable. He feels that is a meaningful requirement.

Dr. Nummedal referred to earlier comments during the meeting about a dichotomy between scientists and engineers. He said he did not think there is a major dichotomy between our approaches to coastal issues and did not feel he experienced any during his 4 years on the Board. He thinks both coastal scientists and engineers have been quantitative in their approach. The difference lies in the perspective. Engineers solve site-specific problems, while scientists are more concerned with regional issues and fundamental principles.

Dr. Nummedal said he clearly supports the efforts by HQUSACE to encourage greater involvement by ONR, ARO, and NSF in sponsorship of coastal research. He is very concerned that the most critical element is missing, and that is the Corps itself, which is the principal benefactor of increased coastal research, must find a way within

its own organization to support basic research in a meaningful way. He feels this will give the Corps more credibility when they discuss this issue with other agencies. He said most of his colleagues would not take a request seriously if they were serving on an NSF Board and looked at the low percentage of the Corps' budget being spent for that purpose. He does not feel the burden can be pushed onto other agencies.

Dr. Nummedal said he favors an STC in coastal engineering and made a presentation to that effect at the previous Board meeting. He thinks a more successful approach would be for the Corps to take the initiative to find the funding to start an STC and then go out to universities on a competitive basis. The Corps could then decide which proposal to accept.

Dr. Nummedal expressed his personal view that the Corps does not have an image in society at large of being a very creative agency. He suggested that the Corps, in places where natural beaches accrete, should take advantage of how the coastline is changing, designing with the flow rather than forcing stationary locations on the shoreline. Hatteras Island is an example of how we have the opportunity to look maybe 50 years down the road and design in a way that is consistent with how the island wants to evolve. He said we discuss using segmented breakwaters on Presque Isle to keep the beach in place, but never discuss why we need to keep the beach in place to begin with. The breakwaters really preserve the road, but the purpose of Presque Isle is not to have a road, but to have a state park. An alternative solution would be to forget the road and provide ferry service.

CLOSING REMARKS

MG Bunker expressed his appreciation to COL Woodbury for hosting the meeting. He thanked Mr. Gary Gamel for coordination, and George Birch, Tom Jones, Elvira Sandy, Sue Jahnke, Marilyn Knowlton, and Bud Davis. He also thanked Lynn Jack, and "our tour guide extraordinarie" Tom Jarrett, and expressed special gratitude to Sharon Hanks. He thanked Dr. Nummedal and Dr. Mei for their 4 years on the Board and for giving us an awfully good charge to keep us moving in the right direction over the next couple of years.

The 51st meeting of the CERB was adjourned.

APPENDIX A
BIOGRAPHIES OF SPEAKERS/AUTHORS

JAMES E. CREWS

Mr. Crews is the Chief, Operations Branch, Operations and Readiness Division, Directorate of Civil Works, Headquarters, US Army Corps of Engineers (HQUSACE). He is responsible for developing the national policy for the operations and maintenance (O&M) of all civil works projects involving flood control, navigation, and hydropower. He coordinates the Corps project design deficiencies program and major rehabilitation of existing projects and heads a major research and development (R&D) program for extending the physical life of the Corps' approximately 1,200 existing projects. Mr. Crews also develops and manages the Corps $1.5 billion O&M budget. Prior to this position, he directed the development of the national policy for managing water and water support resources during national security emergencies; he also directed the Corps' R&D program for water supply and water conservation activities. Other career assignments included planning and directing water resources studies at the District level -- most notable, the Metropolitan Washington, DC water supply study.

Mr. Crews graduated from Tennessee Technological University in 1965 with a BSCE degree; from Catholic University of America in 1970 with a MCE degree; and from the Corps Planning Associates Program in 1974. Mr. Crews is a registered professional engineer in the District of Columbia.

Mr. Crews has received numerous awards. Some of these include: Young Engineer of the Year Award from the Baltimore Post, Society of American Military Engineers in 1977; Baltimore District Engineer of the Year Award in 1978; North Atlantic Division-wide Engineer of the Year in 1978; and the Commander's Award for Civilian Service in 1978.

Mr. Crews is active in professional societies and serves on several committees in both the American Society of Civil Engineers and the American Water Resources Association. He is a Past President of the Baltimore Post, Society of American Military Engineers. He is a member of the American Geophysical Union and the International Water Resources Association.

ROBERT M. DANIEL

Mr. Daniel is Chief of the Economics and Social Analysis Branch in the Planning Division at the HQUSACE. In that capacity he develops and implements economic policy guidance for the Civil Works Program; provides technical economic support to the Field Operating Activities and other HQUSACE elements; reviews economic information

for consistency with procedural standards and policy; and acts as technical monitor for the planning methods research.

Mr. Daniel started his career with the Corps as an economist in the Kansas City District in 1966. In 1971 he moved to the Omaha District, and in 1979 he became Chief, Economics Section, St. Louis District.

Mr. Daniel received his B.A. degree in economics from Creighton University in 1966 and his M.A. degree in economics from the University of Missouri in 1971.

DR. CHARLES W. FINKL II

Dr. Finkl, a geologist, received his B.Sc. degree in 1964 and M.Sc. degree in 1966 from Oregon State University and his Ph.D. degree from the University of Western Australia in 1971. He was Staff Geochemist for Southeast Asia, International Nickel Australia Pty. Ltd., from 1970-74; Director and Program Professor, Institute of Coastal Studies, Nova University in Port Everglades, Florida, from 1979-83; Adjunct Professor, Department of Geology, Florida Atlantic University, Boca Raton, Florida, from 1983 to the present; Chief Editor, Encyclopedia of Earth Science Series and Consulting Editor of Earth Science (Van Nostrand Reinhold, NYC), 1974 to present; Series Editor, Van Nostrand Reinhold Soil Science Series from 1982-87; member of the Executive, International Geological Correlation Programme, Project 274: Theoretical and Applied Aspects of Coastal and Shelf Evolution, Past and Future, from 1988 to present; member, IGU Commission on River and Coastal Plains; member IGU Commission on Coastal Environments; Certified Professional Soil Scientist, American Registry of Certified Professionals in Agronomy, Crops, and Soils; Certified Professional Geological Scientist, American Institute of Professional Geologists; Volume Editor and Contributing Author to: Soil Classification (1982); The Encyclopedia of Soil Science: Physics, Chemistry, Biology, Fertility, and Technology (1979); The Encyclopedia of Applied Geology (1983); The Encyclopedia of Field and General Geology (1988). Dr. Finkl has been Executive Director and Vice President, Coastal Education and Research Foundation since 1983 and Editor-in-Chief of the Journal of Coastal Research since 1984. He is a member of numerous national and international organizations and contributing author to professional journals.

KIRBY B. GREEN III

Mr. Green is Director of the Division of Beaches and Shores, Florida Department of Natural Resources. Prior to his appointment to this position, he held positions as

Assistant Director of the Division of State Lands and as State Cadastral Surveyor for the State of Florida. In those positions, he was responsible for implementation of the State's tidal boundary mean high water determinations and management of state-owned submerged lands. Mr. Green has 10 years of private consultant experience in civil engineering, land planning, and surveying prior to joining the Department of Natural Resources. He was educated at the University of Florida Civil Engineering, with graduate level work in applied geodesy at George Washington University.

MARK B. GRAVENS

Mr. Gravens is a research hydraulic engineer at the Coastal Engineering Research Center (CERC), US Army Engineer Waterways Experiment Station (WES). He started working for CERC in 1986 and has conducted several civil research projects involving the numerical modeling of coastal processes. Mr. Gravens received a B.S. degree in ocean engineering from Florida Atlantic University and an M.E. degree in civil engineering from the University of Florida.

DR. GARY B. GRIGGS

Dr. Griggs received his B.A. degree in geology at the University of California at Santa Barbara in 1965 and a Ph.D degree in oceanography from Oregon State University in 1968. His research focus over the past 15 years has been the coastline of California including shoreline erosion, sediment budgets and littoral drift, and the effectiveness and impacts of coastal engineering structures. He is the co-author of "Geologic Hazards, Resources, and Environmental Planning," "Living with the California Coast," and "Coastal Protection Structures and Their Effectiveness."

DR. ALBERT G. HOLLER, JR.

Dr. Holler is Chief of the Hydraulic Design and Coastal Engineering Section, Engineering Division, South Atlantic Division (SAD), US Army Corps of Engineers, Atlanta, Georgia. He has worked in SAD since 1972. Prior to that he worked in the Ohio River Division in Cincinnati, Ohio. Dr. Holler received a B.S. degree in civil engineering from the University of Michigan and M.S. and Ph.D degrees from the University of Cincinnati. He is a registered professional engineer and a member of the American Society of Civil Engineers.

JOHN G. HOUSLEY

Mr. Housley is the senior coastal engineer in the Planning Division, Directorate of Civil Works, HQUSACE. He received a B.S. degree in Civil Engineering from Lehigh University and an S.M. degree in Civil Engineering from Massachusetts Institute of Technology. His entire professional career has been with the Corps of Engineers, first with WES, then the US Lake Survey, where he conducted hydraulic and coastal research. His present assignment is in the Flood Plain Management Services and Coastal Resources Branch, HQUSACE. Mr. Housley was the program manager for the Shoreline Erosion Control Demonstration Program.

DR. JAMES R. HOUSTON

Dr. Houston is Chief of CERC, WES. He has worked at WES since 1970 on numerous coastal engineering studies dealing with explosion 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, an M.S. degree in coastal and oceanographic engineering, and a Ph.D. in engineering mechanics from the University of Florida.

DR. STEVEN A. HUGHES

Dr. Hughes is a research hydraulic engineer in the Wave Dynamics Division, CERC, WES. He joined CERC in 1981 and has been involved in the Shore Protection Manual revision, numerical modeling of shallow-water waves, wave coherence, wave height distributions, remote sensing, image analysis, and instructing in workshops and the Coastal Engineering Short Course. Since stepping aside as Chief of the Coastal Processses Branch, his primary interests have been coastal scouring, movable-bed modeling, and wave phenomena. He received a B.S. degree in aerospace engineering (1972) from Iowa State University of Science and Technology, an M.S. degree in coastal and oceanographic engineering (1978), and a Ph.D. degree in civil engineering (1981) from the University of Florida. He is a registered professional engineer in the State of Mississippi.

JAMES T. JARRETT

Mr. Jarrett is Chief of the Coastal Engineering Branch of the US Army Engineer District, Wilmington, (SAW) since 1985, administering the coastal program within the District including coastal protection and navigation projects. He worked at SAW from 1966 to 1972, at WES from 1972 to 1974, and SAW from 1974 until the present. Mr. Jarrett received B.S. and M.S degrees in civil engineering from North Carolina State University. He is a registered professional engineer in the State of North Carolina, a member of Chi Epsilon, Civil Engineering Honorary Fraternity, and Tau Beta Pi, Engineering Honorary Fraternity.

DR. NICHOLAS C. KRAUS

Dr. Kraus is a senior research scientist in the Research Division, CERC, WES. He joined CERC in September 1984 and is presently involved with numerical modeling of beach evolution; fundamentals of sand transport, including windblown sand; and finite amplitude wave theory. Previously he was a senior research engineer at the Nearshore Environment Research Center in Tokyo, Japan. Dr. Kraus received a B.S. degree in physics from the State University of New York at Stony Brook and a Ph.D. degree in physics from the University of Minnesota. He is a member of the American Society of Civil Engineers, Japan Society of Civil Engineers, American Geophysical Union, and Society of Economic Paleontologists and Mineralogists.

DR. ROBERT A. MORTON

Dr. Morton is a senior research scientist and former Associate Director of the Bureau of Economic Geology. For the past 17 years, he has been responsible for studies of coastal processes and shoreline changes in Texas, as well as investigation of the structural and stratigraphic framework of the western Gulf Basin. Prior to joining the Bureau in 1972, he was employed by Chevron Oil Company in New Orleans as a petroleum geologist. Dr. Morton received his master's and doctoral degrees from West Virginia University. He is a member of numerous professional organizations including American Association of Petroleum Geologists, Society of Economic Petroligists and Mineralogists, and Geological Society of America.

JOAN POPE

Ms. Pope is Chief of the Coastal Structures and Evaluation Branch at CERC and is responsible for overseeing the work of the Engineering Applications and Coastal Geology Units. This Branch includes civil, ocean, and coastal engineers, geologists, and ocenaographers who are involved in evaluating and analyzing the application of research and development technology to coastal engineering problems. Ms. Pope holds a B.S. degree from the State University of New York at Oneonta and an M.S. degree in geology from the University of Rhode Island. She started work at CERC in 1984 after working for approximately 10 years on coastal projects for the Buffalo District. Her research interests include development of design criteria for segmented breakwater systems, coordination of the development of a helicopter-mounted laser bathymetry system, application of geologic and coastal processes to project design, and WES's Study Manager for the Kings Bay Monitoring Program. Ms. Pope is a registered professional geologist in the State of Indiana.

SPENCER M. ROGERS, JR.

Mr. Rogers received his B.S. degree in engineering science from the University of Virginia, Charlottesville, in 1973. He received his M.S. degree in coastal and oceanographic engineering from the University of Florida, Gainesville, in 1975. Since 1978, Mr. Rogers has been employed as a Coastal Engineer with North Carolina Sea Grant's Marine Advisory Service and the Department of Civil Engineering with North Carolina State University, specializing in shoreline processes, erosion, storm-resistant building construction, coastal management, and marine construction. Prior to 1978, Mr. Rogers was employed by Florida Division of Beach and Shores administering the state's coastal control line.

CONGRESSMAN CHARLIE ROSE

Congressman Rose was born in Fayetteville, North Carolina, and attended public schools there. He graduated from Davidson College and from the University of North Carolina Law School. Upon graduation from Law School, he entered the practice of law with former Governor Terry Stanford in Raleigh, North Carolina. He returned to Fayetteville to become the Chief District Court Prosecutor for the 12th Judicial District.

Congressman Rose ran for Congress and was first elected as a Member of the United States Congress, 7th District of North Carolina, in November 1972, and has

been re-elected to each succeeding Congress. He is Chairman of the Subcommittee on Tobacco and Peanuts of the House Committee on Agriculture, a Member of the Subcommittee on Livestock, Dairy, and Poultry, and the Subcommittee of Department Operations, Research and Foreign Agriculture. Congressman Rose is the founder of the Policy Group on Information and Computers of the Committee on House Administration and is Chairman of the Subcommittee on Office Systems. He also serves as Chairman of the Speaker's Advisory Committee on Broadcasting, which is responsible for the telecasting of the sessions of the House of Representatives. The Congressman is also Chairman of the House Recording Studio.

In addition, Congressman Rose is Vice-Chairman of the House Delegation to the North Atlantic Assembly. The Assembly is a Parliamentary Group of Representatives from North Atlantic Treaty Orgranization countries. Congressman Rose is the founder of the Congressional Clearinghouse on the Future and a co-founder of the Congressional Rural Caucus. He also serves as a Whip at large.

RICHARD E. SHAW

Mr. Shaw is a Coastal Program Analyst with the Division of Coastal Management, North Carolina Department of Natural Resources and Community Development, in Raleigh. He holds a bachelor's degree in management science from Duke University and a master's degree in environmental management from the Duke School of Forestry and Environmental Studies.

Mr. Shaw worked for 2 years with the State Division of Water Resources before joining the North Carolina Coastal Management Program in 1986. Since then he has worked on issues dealing with the North Carolina National Estuarine Research Reserve, maritime forest protection, natural area acquisition, and loss prevention in coastal high hazard areas.

DR. DONALD K. STAUBLE

Dr. Stauble is team leader of the Coastal Geology Unit of the Coastal Structures and Evaluations Branch of the Engineering Evaluations Division, CERC. The Coastal Geology Unit investigates geologic process and response changes to the coastlines of the United States. These studies encompass a broad range of research topics, including historic shoreline trends, beach nourishment technology, barrier island and other coastal sedimentation processes, coastal engineering Geographic Information System and

remote sensing image analysis, the effect of sea level rise, and general research into coastal geomorphic and geologic problems pertinent to the Corps of Engineers.

Dr. Stauble earned his bachelor's degree in geology from Temple University in 1969, his master's degree in oceanography from Florida State University in 1971, and a Ph.D. in marine/environmental science from the University of Virginia in 1979.

He came to CERC after teaching and conducting research for 9 years in the Department of Oceanography and Ocean Engineering at the Florida Institute of Technology. His research has been in the fields of beach nourishment technology; coastal processes; storm-induced beach changes; inlet, beach, shoal, and estuarine sediment transport and morphology; and coastal remote sensing.

Dr. Stauble is a member of the Society of Economic Paleontologist and Mineralogist, American Shore and Beach Preservation Association, Florida Shore and Beach Preservation Association, American Society of Photogrammetry and Remote Sensing, American Geophysical Union, and the Marine Resources Council of East Central Florida.

STAN TAIT

Mr. Tait has been Executive Director of the Florida Shore and Beach Preservation Association (FSBPA) since 1975. Since then, FSBPA has spearheaded the most ambitious program of beach preservation in the United States. In 1984-85, he chaired the Governor's "Restore Our Coast Task Force," whose recommendations led to the adoption of Florida's Beach Management Act of 1986. This law anticipates a $1 billion investment in Florida's beaches by the year 2000.

Mr. Tait began his career as a reporter for the Miami Herald and United Press International. He served 9 years as Assistant Secretary of State for Florida. In 1971, he founded Stan Tait and Associates, a Tallahassee-based public relations and association management company. He has won numerous state and national awards for public awareness and public relations campaigns.

LIM VALLIANOS

Mr. Vallianos received his B.S. degree in civil engineering from Polytechnic Institute of Brooklyn and a diploma in hydraulic engineering (coastal engineering and tidal hydraulics) from Delft, Netherlands. He is presently Senior Engineering Policy Analyst for the Institute for Water Resources in Fort Belvoir, Virginia. Prior to his

present position, Mr. Vallianos was Chief, Coastal Engineering Branch, Wilmington District, and Manager, Dredging Research Program, CERC, WES, Vicksburg, Mississippi.

APPENDIX B
STATUS OF ACTION ITEMS

ACTION ITEM	PLACE AND DATE OF ACTION	RESPONSIBLE AGENT	ACTION AND STATUS
51-1. President of CERB should have a dialogue with the commandant of Engineer School relating to training of military in coastal specialty (establish AERB requirement.)	Wilmington May 89	CECW-P	Action deferred pending establishment of Coastal Engineering Education Program.
51-2. Report on procedures for transferring complex numerical models from the laboratory to the field (e.g. beta sites).	Wilmington May 89	CERC	Complete. Numerical models will be transferred through a Coastal Modeling System.
51-3. Report on process used to integrate numerical and physical modeling.	Wilmington May 89	CERC	Complete. Physical models routinely used for data to evaluate and develop numerical models.
51-4. Establish a mechanism to ensure visibility/use of other nations' data/ experience, e.g., German breakwaters.	Wilmington May 89	CERD CERC	Various means used from personal contacts to formalized information exchanges. Problem with limits on foreign travel. See Items 52-1 and 52-2. Technical Director of WES handling PIANC breakwater working group.
51-5. Publish John Housley's results from the follow-up studies on low-cost shore protection.	Wilmington May 89	CECW-P	Funding available in FY90. Action proceeding.
51-6. Ensure that present coastal engineering R&D is flexible, to work beyond present policy snapshots.	Wilmington May 89	CERC	Complete. Field Review Group and Technical Monitors support research with benefits in intermediate to long term.
51-7. Determine whether NOAA or Minerals Management Service is mapping coastal sand resources. If not, should Corps establish a program to map the resources.	Wilmington May 89	CERC CERD	US Geological Survey performing offshore surveys. CERC will complete contacts and report findings.
51-8. Review establishment of STC.	Wilmington May 89	CERC	Complete. Universities have been contacted. CERC has joined one university consortium submitting a proposal.

51-9. Include a discussion on determining coastal project benefits at the Florida meeting in May 1990.	Wilmington May 89	CERC	Discussion will be included at Ft. Lauderdale meeting. Planning and IWR will be contacted.
51-10. Get coastal engineering added to SKAP categories other than R&D.	Wilmington May 89	CECW-P	Personnel Office, HQUSACE, has been opposed. Issue will be revisited and discussed with Career Planning Board.
50-5. Review and modify as required current design guidance on small storm surgers. Report progress at next CERB.	Virginia Beach Nov 88	CEEC	Complete. Areas requiring development have been identified. New guidance will be issued as it becomes available.
50-12. Explore potential for sharing with coastal states, Corps execution of its coastal R&D responsibilities.	Virginia Beach Nov 88	CERD	A draft cooperative agreement with the State of California for data collection has been forwarded to HQUSACE for approval. Model for other state agreements. Presently undergoing review in the Office of Counsel.
50-17. CERB should consider land use issues. Example, should Corps provide protection to condominium at mouth of Chesapeake bay. What are policies?	Virginia Beach Nov 88	CECW-P	Complete. Land use controls are a local government issue. Corps approaches problem through the NED test and NEPA criteria.
49-5. Explore possibilities and merits of establishing a Great Lakes Technical Information Center as a repository for Great Lakes coastal information.	Oconomowoc/May 88	CENCE	Complete. Computerized Geographic Information System being developed by Great Lakes States and Corps under International Joint Commission sponsorship.

APPENDIX C
ADDITIONAL COMMENTS
DR. DAVID R. BASCO, OLD DOMINION UNIVERSITY

OLD DOMINION UNIVERSITY

College of Engineering and Technology
Coastal Engineering Institute
Norfolk, Virginia 23508-8513
(804) 683-3763

May 16, 1989

LTC Jack R. Stephens, Acting Executive Secretary
Coastal Engineering Research Board
USAE Waterways Experiment Station
Vicksburg, MS 39181-0631

Subject: Seawalls and Beaches: Boundary Conditions and Shoreline Change

Dear Colonel Stephens:

I wish to add the following written comments to those presented at the recent 51st CERB meeting in Wilmington, NC, (10 May 89) on the subject of how seawalls affect beaches.

We need to consider *all* the boundary conditions when presenting field data relating long term shoreline erosion rates and the influence of seawalls on these rates. At the meeting, Dr. Bob Morton presented some data for Galveston Island that only considered the *landward* boundary condition; i.e., the seawall (hard) boundary condition versus the dune (soft) boundary condition and their respective influence on long term shoreline change rates. Dr. Morton in his presentation and also in his Journal Coastal Research article, Special Issue No. 4, August 1988, pp. 115-136 does not consider the *seaward* boundary condition in his analysis. The wave height variation along the shoreline *must* also be considered in any discussion of seawalls, dune/beach systems and shoreline change.

As an example, the attached figure is for the ocean section of Virginia Beach, VA (cite of the 50th CERB meeting). The documented shoreline change rates date back to 1859 and are from a NOAA/CERC sponsored effort by Craig Everts, et al, (1983), TR CERC-83-1, p 67. The bathymetry and resulting breaking wave height variation along the shoreline are from numerical simulations using the RCPWAVE numerical code in a Virginia Institute of Marine Science report (Wright, et al, 1987 (p. 8 and p. 71) for 55 representative wave characterizations (height, period, direction) as measured at Duck, NC, 60 miles south. A seawall/boardwalk has existed at the tourist beach section since the 1930's. If we *neglect* the seaward boundary condition and only relate the landward boundary condition, i.e., seawalled reach versus dune/beach reach, we can reach some very misleading results. For example, we could erroneously conclude that the long term shoreline erosion rate in front of the seawalls is about 4 times *less* than for the dune/beach systems. In our opinion, the offshore bathymetry and resulting offshore wave height variation are responsible for the resulting shoreline change rates. The *offshore boundary conditions* dominate in this example, and in many other cases where false conclusions may have been reached by neglecting the offshore conditions*.

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*For further details, see D.R. Basco (1989) "The Effects of Seawalls on Coastlines and Beaches", Proceedings, 2nd Annual National Beach Preservation Technology Conference, Tampa FL, February.

Research efforts by CERC to develop wave transformation numerical models such as RCPWAVE should continue and include bottom friction and wave-current interaction effects. Lower cost and relative routinely deployed, nearshore wave gages should also be developed at CERC to calibrate these models. Much more field research is needed to further understand seawalls and beach interactions.

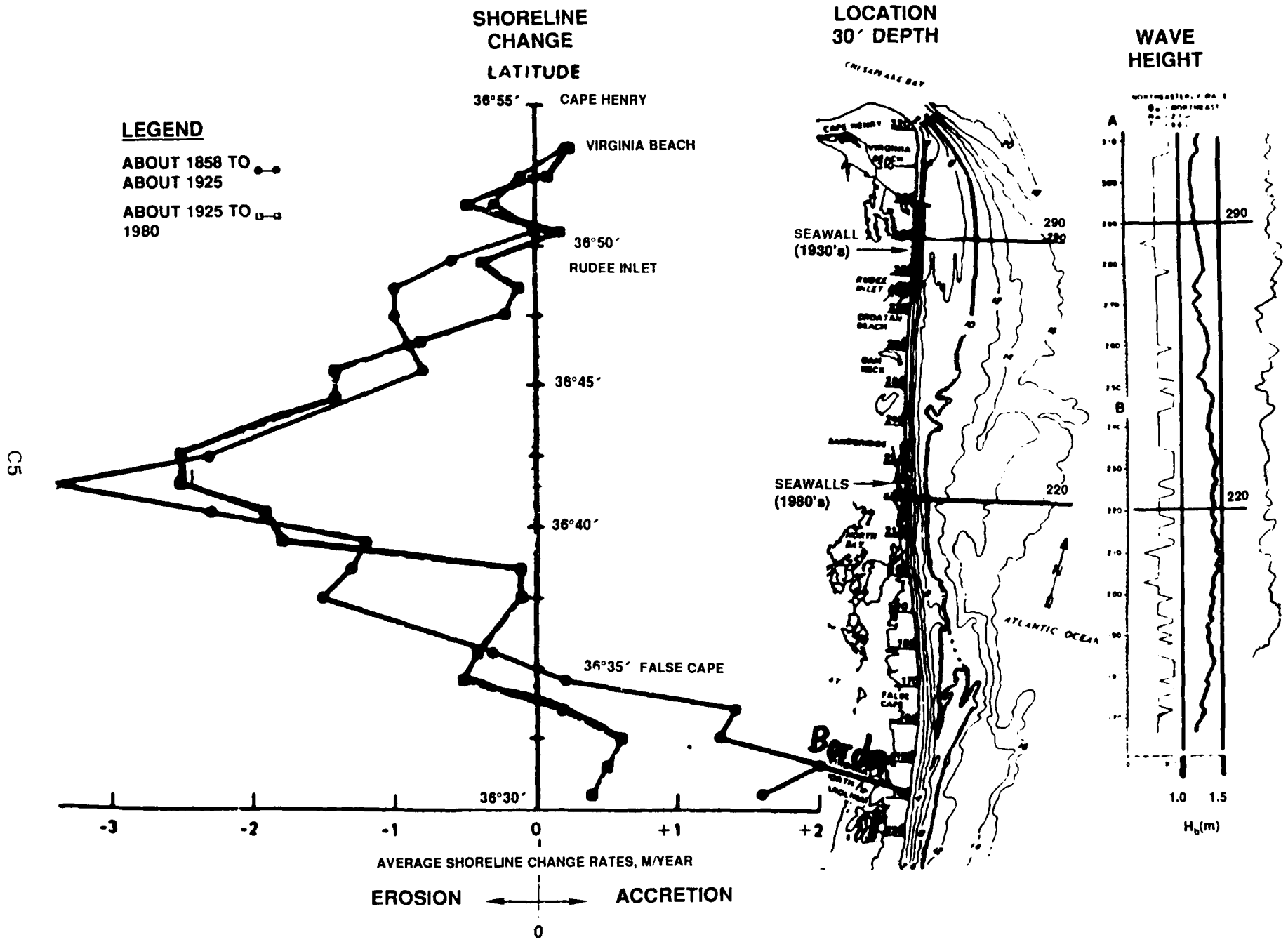
Sincerely yours,

David R. Basco

David R. Basco
Director, Coastal Engineering Institute
Professor, Civil Engineering Department

/cg

cc: CERB Board (Military and Civilian Members)
Panel Members (Finkl, Kraus, Morton, Griggs, Pope)
Other selected individuals at HQUSACE, IWR, CERC, Sea Grant, etc.
Mr. Stan Tait, FSBPA


SHORELINE CHANGE
LATITUDE
LEGEND
ABOUT 1858 TO ABOUT 1925
ABOUT 1925 TO 1980
36°55′
CAPE HENRY
VIRGINIA BEACH
36°50′
RUDEE INLET
36°45′
36°40′
36°35′ FALSE CAPE
36°30′
-3
-2
-1
0
+1
+2
AVERAGE SHORELINE CHANGE RATES, M/YEAR
EROSION
ACCRETION
0
LOCATION 30′ DEPTH
CHESAPEAKE BAY
SEAWALL (1930's)
SEAWALLS (1980's)
290
220
ATLANTIC OCEAN
WAVE HEIGHT
A
B
290
220
1.0
1.5
H_b(m)

APPENDIX D

ARTICLES APPEARING IN ASBURY PARK PRESS

SUBMITTED AS PART OF PUBLIC COMMENT

Geologist calls for retreat

By SHERRY FIGDORE
Press Staff Writer

NEW BRUNSWICK — Despite the enormous investment of private and public money in beachfront development, Orrin H. Pilkey Jr., a Duke University marine geologist, says it is time to plan a strategic retreat from the shoreline before nature forces the evacuation.

The only alternative, he said, will be "a very expensive program of armoring the coastline" that will probably fail anyway as the sea level rises.

Pilkey, speaking at a meeting of the Northeastern Section of the Geological Society of America at the Hyatt Regency Hotel, said there are three ways of dealing with an eroding shoreline: hard stabilization (sea walls, groins and jetties), which protects buildings for the short term at the expense of beaches; soft stabilization (beach replenishment), and relocation.

Admitting that relocation is "politically difficult," Pilkey said several states, including North Carolina, are already prohibiting any rebuilding in the same location of beach structures destroyed by storms.

Commenting on a photographic slide of a Texas apartment building teetering over an eroded sea wall, Pilkey said, "As a rule of thumb, you should not be able to fish from your condominium window."

Another slide showed the "$82 million worth of damage done to the sea wall in Sea Bright during the 1984 storm, to a town of less than a square mile and valued at $65 million."

"The town wasn't destroyed, but we've come to the point in Sea Bright where, if economics count, the town should be abandoned," Pilkey said.

Relocation was accepted historically, he said. The Brighton Hotel on Coney Island was moved 2,000 feet inland in the last century, and many beach houses in South Jersey were built on wooden runners.

In 1979, the state legislature introduced a Dune and Shore Protection Act that would have prohibited rebuilding any beachfront structure more than 50 percent destroyed in a storm, but the bill failed to provide for compensation for property owners, and died in the wake of opposition from coastal landowners.

Pilkey said the public has been misled about the success of restoring beaches with pumped-on sand.

"They're told that 'some sand will move offshore,'" he said, but when storm waves repeatedly attack the shoreline, replenished beaches do not recover as natural beaches do.

"We find we have to pump up the entire volume of the original beach" to maintain a restored beach, he said. "The public is getting less than a forthright version of what is happening."

The restoration of Miami Beach, completed in 1981, is probably the most successful replenished beach in the country, and optimistic geologists "say it looks as if it will last at least 10 years," Pilkey said.

But in Ocean City, N.J., much of a new $5.2 million beach disappeared in 2½ months, and in Ocean City, Md., more than half of a newly-replenished beach was gone in less than six months.

In one study of 90 replenished beaches, Pilkey said about half lasted from two to five years, but 40 percent had largely disappeared in less than two years.

"New Jersey has the worst luck of all," he said. "Few here last more than 2½ years."

Rapid beach loss is usually attributed to "unexpected" storms.

"You hear engineers say that this beach should last forever — if no major storms occur," he said. "We have accepted that storms are 'accidents,' and that allows engineers to walk away and say, 'Well, how were we to know a storm would hit?'"

"Shorelines retreat naturally and that is not a problem for the beach," Pilkey said. "There is no erosion problem until you build something too close to the beach. Geologists understand that, but the public doesn't."

Underlying all these problems is the sea level rise, Pilkey said. Accelerated by global warming from the greenhouse effect, the sea level, which rose one foot in the last century, is expected to rise three or four feet in the next century.

Geologist's New Jersey coastal data aren't accurate

In "Geologist calls for retreat" (Sunday, April 2), Professor Orrin H. Pilkey Jr. of Duke University restates his views on retreat from the shoreline, bolstered by allusions to local conditions, in a talk similar to that given by him in many other places throughout the country. I will refute Professor Pilkey's argument by correcting the information he presents.

Professor Pilkey indicates that there was "$82 million worth of damage done to the sea wall in Sea Bright during the 1984 storm, to a town of less than a square mile and valued at $65 million." This quotation would surely persuade people of the correctness of Professor Pilkey's views, if they accept the numbers he gives as facts. However, they are not.

Instead of being valued at $65 million, as stated by Professor Pilkey, the Borough of Sea Bright assesses its own real property at over $139 million, but this is only 64.4 percent of the true value, which Monmouth County assesses at $215,880,960 (County Tax Assessment, Table of Equalized Valuations, October 1988). The adjacent Borough of Monmouth Beach, where value is partly dependent on the Sea Bright shore protection, is valued at $350,437,236 by Monmouth County (Table of Equalized Valuations, October 1988).

As for the $82 million worth of damages to the sea wall for Sea Bright: A more realistic cost is contained in the Corps of Engineers' January 1989 General Design Memorandum. This document estimates that it will cost $12 million to provide needed repairs to both the Sea Bright and Monmouth Beach sea walls. Even if three-quarters of those repairs are allocated to Sea Bright, Professor Pilkey's damage estimate is about 9 times too high.

Thus, Professor Pilkey gives numbers that indicate $1.26 of sea wall damages resulted for every $1 of valuation, but the facts indicate that much less than 6 cents of damages exists for every $1 of valuation.

Professor Pilkey discusses the beach replenishment project at Miami Beach. He states that this project is probably the most successful in the country and that "optimistic geologists say it looks as if it will last at least 10 years." In the context of the article, the reader of that statement unacquainted with the project might understand that the replenished sand is already well-eroded. The facts are that the project, constructed between 1977 and 1981, has shown losses of only 0.3 percent per year (less than a third of 1 percent per year), and the beach is now in very good condition 12 years after the project started, to the considerable benefit of the local and regional economy.

Professor Pilkey is quoted as saying, "You hear engineers say that this beach should last forever — if no major storms occur." I have not heard such a statement from any coastal engineer, and I am personally acquainted with most of those who work on beach renourishment projects. Beach replenishment requires continuing attention. More sand will ultimately be needed. The time intervals between replenishment will vary with the locality. More frequent replenishment will be required where the length of replenished shorefront is small, or where the waves are high, or where the sand is fine. And vice versa.

Shore protection is a complex question involving policy, economics, and engineering. To arrive at reasonable solutions, it is necessary to start with a grasp of the facts. The reader should sift carefully for the facts before being persuaded by statements such as those in "Geologist calls for retreat."

CYRIL GALVIN,
Springfield, Va.

APPENDIX E
RECOMMENDATION LETTER

RALPH M. PARSONS LABORATORY
DEPARTMENT OF CIVIL ENGINEERING, BLDG. 48- 411
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CAMBRIDGE, MASSACHUSETTS 02139

June 12, 1989

Hydrodynamics and Coastal Engineering
Hydrology and Water Resource Systems
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Phone: (617) 253- 2994
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Major General Robert Bunker
President, CERB
Commander, South Atlantic Engineering Division
US Army Corps of Engineers
77 Forsyth Street, SW
Atlanta, GA 30335–6801

Dear General Bunker:

Allow me first to thank you for the honor of serving on CERB for the past four years. During this period I have learned a great deal about the immense contributions to Coastal Engineering by the Corps and have appreciated with admiration the dedication and professionalism of its staff. It has been exciting to see the realization of the of the Dredging Research Program at WES, the founding of the Graduate School at CERC, the many advances made at the Duck Field Station and the broadening uses of ACES for engineering design. All these initiatives are bold in concept and executed in the most thoughtful manner. One can be sure that they will bear fruits that will benefit all the US coastal projects in profound ways.

The economic importance of our coasts is rising, hence the need to protect and to preserve them is more pressing than ever. Due to the complexities of the natural processes involved, advances of our capabilities to handle coastal engineering problems have been slow. Although we now have much better knowledge of the sea waves: their propagation, their interaction with structures and coasts and the effects of nonlinearities, etc. our quantitative understanding of sediment transport is still primitive. Design and maintainence practices of the shore lines are still based on empirical rules that often fail.

As is always true, significant breakthroughs come only from scientific research of the underlying laws of nature. Given that the Corps has the largest responsibility for the nation's coast, it is logical that it should be the vanguard of scientific research, for improving our coastal design practices. I feel therefore that (A) the missions of CERC ought to be expanded in the direction of more basic research and (B) that the Corps should become the leader of fostering coastal research in the civilian sector, most importantly in the universities. The two objectives are vital because CERC's own involvement in basic research can only accelerate the convergence of coastal science and engineering. CERC will be able to decipher and to choose more quickly those scientific progresses already made and can stimulate further scientific inquiries. However, the resources at CERC can never be sufficient to handle the task alone. The expertise at universities, where doing basic research is naturally more emphasized, must not be left untapped. Toward both objectives

A and B, I suggest the following to the Corps:

(A) Urging NSF to create a Coastal Hazards Program to support both individuals PI's and large centers.

(B) Urging the Army Research Office to create a similar program. It has often been said that ARO is traditionally uninterested in civil works research. As long as civil works are a major responsibility of the Corps, this disinterest seems inconsistent and short-sighted.

(C) Making the Broad Agency Announcement a more effective vehicle for attracting good proposals. At present all proposals are welcome in principle, but there is no sure money set aside for supporting them. Ideas are selected from the proposals to prepare budgets or work units for the next year. At best this is a slow process, consequently few universities can afford to waste efforts to prepare good proposals. Recent CERC contracts with universities show that innovative contracts are far outnumbered by small tasks that CERC cannot handle owing to its limited manpower. To get innovative proposals, CERC must keep BAA open and avoid sole-contractor arrangements. (If there is only one expert for a given task, the task is probably not worthy.) More important, BAA should have a predetermined budget for each FY for which proposals are solicited. If BAA is well established, both the Corps and the universities are benefactors as well as beneficiaries; it is not a one way street.

I regard as one of the important long-range tasks for the Corps to promote and to institute a comprehensive research program in coastal engineering science, in and outside the Corps. It is simply a necessity for improving its functions, and cannot be argued as a luxury.

The above comments are certainly not original, for many previous CERB members have ennunciated them. I humbly submit them once more and thank you for this opportunity.

With best regards,

Sincerely yours,

Chiang C. Mei
Professor of Civil Engineering
Member, CERB 1985–1989

cc: Mrs. Sharon Hanks
CERB