

SCSGE-W-83-001C2

LOAN COPY ONLY

CIRCULATING COPY
Sea Grant Depository

SOUTH CAROLINA'S MIGRATING BEACHES

Proceedings of a Conference
Charleston, South Carolina
December 9, 1983

Editor
Henrietta S. Wilson

An activity of the South Carolina Sea Grant Consortium.
This work is sponsored by NOAA National Sea Grant College
Program Office, Department of Commerce. The U.S. government
is authorized to produce and distribute reprints for govern-
mental purposes notwithstanding copyright notation that may
appear hereon.

The South Carolina Sea Grant Consortium
221 Fort Johnson Road
Charleston, South Carolina 29412

SC-SG-PR-84-01

NATIONAL SEA GRANT DEPOSITORY
PELL LIBRARY BUILDING
URL NARRAGANSETT BAY CAMPUS
NARRAGANSETT, RI 02882

FOREWORD

South Carolina's beaches are moving. Communities built on the edge of those beaches are threatened by erosion. The South Carolina Sea Grant Consortium designed this conference on "South Carolina's Migrating Beaches" to address considerations that result from living with eroding and accreting beaches.

As the population on the South Carolina Coast has increased in recent years, beach migration has affected a greater number of people. Many of these coastal residents have little or no understanding of the coastal processes at work or of the options open to them as coastal property owners. The same is true of the millions of visitors who expect to have access to the state's beaches each year. To ensure the future of South Carolina's beaches, the public must begin to understand not only the natural coastal processes at work, but the complex legal and engineering issues that have evolved in recent years.

This conference was designed to increase public understanding of coastal processes and issues engendered by South Carolina's Migrating Beaches.

ACKNOWLEDGEMENTS

The South Carolina Sea Grant Consortium thanks the participants for their attention to this public education effort. Staff members of the Sea Grant Consortium who contributed to the production of this proceedings include: Pattie Christian, Martha Hogue, Steve Hoffius, and Anne Hill.

TABLE OF CONTENTS

	<u>Page</u>
OPENING REMARKS: Major General James A. Grimsley, Jr., USA, Retired Chairman of the Board of Trustees, South Carolina Sea Grant Consortium President, The Citadel	1
SESSION I: COASTAL PROCESSES AND PROSPECTS Dr. Timothy W. Kana Director, Coastal Dynamics Division Research Planning Institute, Inc. Columbia, S.C.	3
SESSION II: LEGAL CONSIDERATIONS OF A MOVING SHORE Mr. Benjamin H. Gregg, Jr. Attorney-at-Law St. Matthews, S.C.	14
SESSION III: REVIEW AND ECONOMIC ANALYSIS OF SHORE PROTECTION DEVICES	
Part 1	20
Dr. Billy L. Edge President and Senior Engineer Cubit Engineering, Ltd. Charleston, S.C.	
Part 2	28
Dr. James B. London Department of Business Administration/ Economics The College of Charleston Charleston, S.C.	
COASTAL CASE STUDIES	
Moderator:	
Dr. John E. Montgomery Associate Dean for Academic Affairs Law School University of South Carolina Columbia, S.C.	33
Dr. Robert G. Dean Department of Coastal Engineering University of Florida Gainesville, Fla.	

Dr. Miles O. Hayes
President
Research Planning Institute, Inc.
Columbia, S.C.

Mr. Carl A. (Tony) Niemeyer
Vice-President/Planning
Fairfield Communities, Inc.
Knoxville, Tenn.

Dr. Orrin H. Pilkey, Jr.
Department of Geology
Duke University
Durham, N.C.

A. HILTON HEAD ISLAND

The Honorable Benjamin M. Racusin 35
Mayor
Hilton Head Island, S.C.

PANEL DISCUSSION 41

B. MYRTLE BEACH

The Honorable Erick B. Ficken 53
Mayor
Myrtle Beach, S.C.

PANEL DISCUSSION 58

C. FOLLY BEACH

The Honorable Richard L. Beck 73
Mayor
Folly Beach, S.C.

PANEL DISCUSSION 78

SOUTH CAROLINA'S MIGRATING BEACHES

OPENING REMARKS

**MAJOR GENERAL JAMES A. GRIMSLEY, JR., USA, RETIRED
CHAIRMAN OF THE BOARD OF TRUSTEES
SOUTH CAROLINA SEA GRANT CONSORTIUM**

It is my pleasure, on behalf of the South Carolina Sea Grant Consortium, to welcome each of you here today. I am very proud of the Citadel's role in the Consortium. I speak for all of the institutions represented in the Sea Grant Consortium; we are all proud of our respective roles in that organization, which is responsible for this session today.

The Sea Grant Consortium has made a major contribution in a most important area in this state, that is, furthering the understanding of our coastal and marine resources. The subject of today's meeting, "South Carolina's Migrating Beaches," is a very important off-shoot of that contribution. This meeting highlights the important role that the Consortium is making and will continue to make to this great Lowcountry of ours and to the State of South Carolina. This meeting also highlights a role for academic institutions: working closely with other sectors to help promote the well-being of the people and the communities of our great State of South Carolina.

Margaret Davidson, the Executive Director of the Consortium, an able individual with a small, but very capable staff, has done a splendid job for the Consortium and we're fortunate to have her in that role. I think that today's program follows last year's program, of which the theme was South Carolina's Coastal Heritage: how we got here, where we are now, and where we are going. That meeting opened the stage for this year's program focusing on beach erosion, which has specific appeal for a lot of people.

I have been asked and I know others in the Consortium have been asked what we expect to come out of this meeting. I hope that from today's discussions will come concrete suggestions to those many citizens of this state that have a love and a yearning for the preservation and best use of our beach resources.

I welcome all of you here. I hope that you will have a profitable day. I predict that you will. I hope that those who have not had an opportunity to visit Fort Johnson and

the Sea Grant Consortium office will do so. Let them show you the many activities that, through the collective effort of the institutions which make up the Consortium, we are endeavoring to do for the good of the whole Lowcountry and the State of South Carolina.

SESSION I
COASTAL PROCESSES AND PROSPECTS

Dr. Timothy W. Kana

I will begin with a scenario that is not at all uncommon. In fact this scenario has occurred many times in the past, and it's probably going to occur again in the future, despite what we say here today. In fact, many of us in the coastal geological or coastal engineering profession have staked our careers on the fact that this is going to be a never-ending process. The scenario begins like this: Fripp Island, South Carolina, 1974. Some people thought that Fripp Island was a very nice place to develop and so they built some condos which are worth a lot of money today. Those condos were strategically located right at the end of the very northeastern corner of Fripp Island with an open view to the northeast and to the south. Unfortunately, about the time that the condominiums were built, the beach eroded to such an extent that seawalls had to be built. Unfortunately, with the seawalls, the beach continues to lower, waves get higher, with damaging action along the walls which in some cases destroys the walls. The beach, at that point, retreats to a more landward location. This is what we call the beach's erosion or the beach's migrating landward. This is a very common scenario. The last part of the scenario is public outcry, headlines, and the cost of some solution: with some cost-sharing, some federal money, and some community monies to be spent to somehow solve the erosion.

This scenario, which is happening now and will happen again in the future is what I call the "B-4" scenario: "Buy, Build, Bulkhead and Bail-out."

Obviously there's a lot of interest in development on the coastline. If there wasn't, the condominiums on Kiawah Island and Hilton Head wouldn't go for three hundred thousand to half a million dollars apiece. With that kind of economic pressure, it's no wonder that we have problems. I suspect most people in this room would like to own a condo right on the water's edge. I shouldn't say everybody in this room, because if we did take a poll, I suspect that about half of you would think that erosion is inevitable, there's nothing that man can do about it without spending a huge fortune and it's better to just leave the beaches to the birds. However, I also know a good many in the audience would like to gamble the family fortune on just a hundred feet of beachfront property. During the past five years at

Kiawah Island, property has appreciated by well over one hundred percent. At Myrtle Beach the cost of just one foot of oceanfront property goes for as much as seven thousand dollars today.

There are many causes of erosion and I've been asked to discuss some of these today. Obviously it's a much more comprehensive topic than I'll have time to discuss, but I do want to focus in on a couple of them. In particular, I want to illustrate the causes of erosion as they pertain to the South Carolina coast. We'll start off at Myrtle Beach and work our way down to some of the other areas that are going to be discussed this afternoon, such as Folly Beach and Hilton Head Island, stopping along the way at several sites on the South Carolina coast.

There are well over a dozen factors which control or alter erosion on the coast, ranging from sea level rise to storm waves, to effects of man-made structures. In our increasing understanding of the coast today, it is possible (and necessary) to narrow down the causes of erosion on a case-by-case basis. It makes problem solving much easier.

Many of the examples that I will illustrate were originally studied by the Coastal Research Division of the University of South Carolina. But there are many other people from Clemson, the College of Charleston, and The Citadel who have been actively involved in the studies of the coast in recent years. Some of this research was funded by the Sea Grant Consortium in the early 1970s, and is continuing today. One of the studies that more or less describes the coast of South Carolina in a geomorphic sense was funded by Sea Grant back in 1973 - 1974 under the direction of Dr. Miles Hayes at the University of South Carolina. From this, we gained a better understanding of the morphological development of the coast and the erosion variability of the shoreline throughout the state.

Myrtle Beach

At Myrtle Beach, the problem is relatively simple. This is a fairly straight section of the coastline, with no significant tidal inlets in the vicinity. The primary processes that affect Myrtle Beach are wave action, fluctuating water levels and long-term sea level rise. At the south end of Myrtle Beach, there has been intensive development in the last two decades. Hotels and swimming pools are built right up to the edge of the beach. People see parking lots falling onto the beach during storms and

they conclude that Myrtle Beach has one of the worst erosion rates in the state. That is not true. Recent studies by our group have shown that Myrtle Beach erodes at less than one foot per year (past 25 years). It is one of the worst from the perspective of a hotel owner who is losing his property there. Unfortunately, the response to erosion has been traditional: to build some kind of a bulkhead or wall, as much as ten feet above the existing beach. We have found, however, that when you build vertical structures in the active beach zone, the dynamics of the beach cycle change. So let me just back-track here a moment and explain briefly what the beach cycle is all about.

The beach exists as a buffer for the wave action that comes in from offshore. In general, waves break on a gentle slope and the beach absorbs that wave energy in an efficient manner. During storms when the waves and tide levels are higher than normal, there is often a focus of energy along the backbeach (dune area). Where loose sediments are present, some naturally erode and are deposited along the lower beach. The entire beach profile flattens itself out as a natural response to the erosion. It is the beach's way of absorbing wave energy in a more efficient manner. As the tide returns to normal, a bar is left deposited along the lower beach. Over time, much of that sand will move back up the beach by the natural process of accretion, rebuilding much of the profile. (Figure 1 illustrates the natural process.)

When seawalls are placed in the way of the movement of sand, they affect wave dynamics during high tide. Besides eliminating the dune reservoir of sand, seawalls cause waves to break at that vertical surface and produce a reflected wave that goes back offshore. This often leaves a trough along the upper beach. At this stage, there is no longer a beach-blanket zone at high tide. We only have an inter-tidal beach that is out of the water only at low tide.

This process is occurring in varying degrees throughout the Grand Strand. In 1981, we set up a network of 50 profile stations along Myrtle Beach and have monitored them as many as ten times each over the past three years. At each profile we computed the volume of sand and then we integrated all the measurements to determine the effect of seawalls on erosion. The results indicate that erosion is greater where the shoreline is armoured with seawalls and that recovery of the beach is slower. We concluded from this research that seawalls at Myrtle Beach have accelerated the erosion rate. This study was done primarily by Mike Svetlichny as a

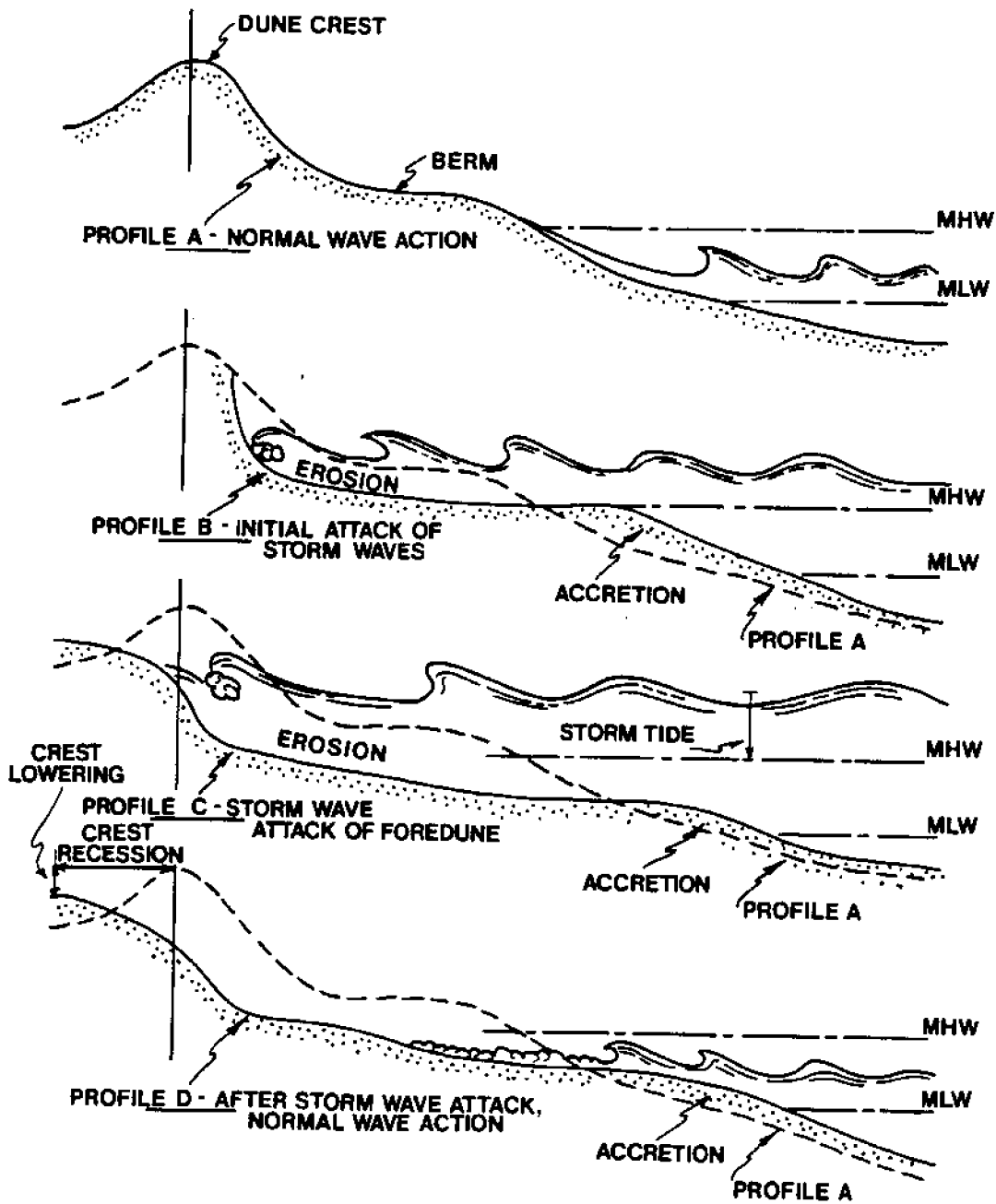


Figure 1: The natural cycle of beach profile adjustment to storm tide and wave action modified from U.S. Army Corps of Engineers, Shore Protection Manual, pp. 1-11.

Master's thesis at the University of South Carolina, and we think it has proved the hypothesis unequivocally, using about 350 data sets.

What can we do about it? Well, in Myrtle Beach as a short-term response, much like nature moves sand after a storm, they've been moving sand from the low-tide zone up along the erosional scarps. The sand is manicured by bulldozers at a cost of about a dollar or two dollars a linear foot; just a few yards of sand are moved for every foot of beach. This creates a wave-absorbing beach which, of course, is not a permanent solution to erosion. We have merely shifted sand from one part of the profile to another and provided some buffer to erosion. Ultimately the goal of Myrtle Beach is to preserve a recreational beach at high tide. Right now there is a very narrow beach throughout most of the city and, in some cases, no high-tide beach at all along the seawalls in the southern area. I, for one, don't want Myrtle Beach to be renamed "Myrtle Seawall."

One thing that we found with all these data is that erosion rates over the long-term in Myrtle Beach and the Grand Strand are quite low. In fact, during the last 50 years there's only been about 30 feet of retreat of the beach. Most of this can be accounted for by sea level rise. For Myrtle Beach, there is undoubtedly a solution for the problem that is commensurate with the value of the development. Myrtle Beach and the Grand Strand bring in over a billion dollars a year in tourist revenues. It's certainly worth the effort to preserve the beach and maintain the principal attraction because of the fact that it has a slow erosion rate.

Coastal Wildlife Preserves

South Carolina has an incredible legacy south of the Grand Strand. The coast between Georgetown and Charleston represents about 60 miles of shoreline held in trust, either as national, state, or private wildlife refuges. It extends from Winyah Bay, encompassing the Yawkey Plantation (a state wildlife preserve), to the Santee Delta, Cape Romain, Bulls Island, and Capers Island.

The Santee Delta illustrates another type of erosion that has affected our coast. It is one of the largest deltas on the East Coast. In 1940 or thereabouts, the flow of the Santee River was diverted into the Cooper River and Charleston Harbor. Most of you know that soon the Cooper River will be rediverted back to the Santee. This federal

project designed by the U.S. Army Corps of Engineers will put the river back where it used to be. The original diversion changed the hydrodynamics of the Santee Delta system, cutting off much of the sediment supply to the coast. As a result, this area is one of the most rapidly eroding shorelines on the coast. Erosion has proceeded at rates of over 25 feet per year (South Island) and land that was once marsh is now exposed in the surf zone. Large washover deposits have formed as sand is pushed over the land, burying wetlands as it shifts. The beach just rolls right over the marsh much like a tractor tread. This type of erosion occurs at a number of undeveloped barrier beaches in South Carolina including Edingsville Beach near Edisto Island.

South of the Santee Delta is Cape Romain, a classic cusped foreland. It's analogous to the foreland at Cape Hatteras and Cape Lookout (N.C.). There is little sand in the Cape Romain system and that sand moves under a different process causing erosion. There is a predominance of sand transport away from the headland, which forms spits in either direction. As waves roll in, sand is shifted away from the headland toward the ends of the spits; the entire system, shaped like an arrowhead, retreats in a landward direction. A lot of people say all the barriers are migrating landward, that is, eroding. Well, that is certainly true in some cases. But it isn't true on many of the other islands that we have in the state.

Central South Carolina Barrier Islands

Let's look now at the central South Carolina coast, where we have, in my mind, some "classic" barrier islands. When I first came to South Carolina about ten years ago, my idea of a classic barrier island was much different than those we have near Charleston, which tend to be short and "stubby." I come from eastern Long Island (N.Y.) where the idea of a classic barrier island is one like Westhampton Beach, which is long and skinny with barely enough room for two rows of houses on it.

But during one of my first field trips as a graduate student, Professor Miles Hayes (USC) brought us down to the beach and started sketching out the evolution of the South Carolina coast to us, right there in the sand. He showed us how most of the barrier islands in central South Carolina are shaped something like a chicken drumstick. They are fairly wide and bulbous at the north end, tend to be about five miles long, on average, and have a broad arcuate

shoreline along the central part of each island. At the south end they tend to have a big hook, which is called a "recurved spit." Over the past few years there have been many reports on these types of barrier islands published. They differ from many barrier islands such as Westhampton due to the higher tide range that we have in South Carolina in comparison to the Long Island shoreline. This basic model for South Carolina barrier islands is so characteristic on our coast and many other coasts of the world that it was coined as a model by Hayes, "the barrier island drumstick model." It is useful for interpreting the processes which control erosion and deposition on our coast.

Each barrier island is a system which includes tidal inlets at either end of the barriers. Our barrier islands are built up as a series of parallel ridges, each of which actually represents former shoreline positions. The central part of the barrier islands tends to be arcuate in shape with closely spaced ridges, whereas the ends of the islands tend to broaden substantially and include alternating bands of marsh and dune deposits. Sand transport tends to be southerly producing a characteristic curved spit which grows in a downdrift direction (to the southeast in this case). There are numerous examples of drumstick barriers on our coast including Bulls Island, Isle of Palms, Kiawah Island, and Fripp Island, to name a few. The inlets at either end of each barrier greatly influence the development and short-term stability of the shoreline. Because of various hydraulic factors, South Carolina inlets tend to be dominated by ebb flow. This means the outgoing tide transports more sand offshore building out very broad, shallow deltas. The size of the tidal deltas are a function of the amount of water flushing in and out of each inlet. Shoals associated with tidal deltas cause waves to bend or break before reaching the shoreline. This, in turn, creates sheltered areas along the beach (protected by offshore shoals) which can build up as sand is transported along shore. Conversely, if shoals move or disappear they can cause higher waves to reach the shoreline and produce erosion. Since this process is most pronounced near the inlets, the shoreline at either end of the barrier island tends to be unstable. Some of the time it may erode rapidly, whereas during other periods it will accrete.

Some tidal inlets get really complex, like Fripp Inlet where there are several channels off to the sides of the main channel. One thing to consider is that once the main channel exits between the barrier islands into the ocean, it becomes unstable and can shift back and forth like a dog

wagging its tail, in the words of Professor Hayes. This is a very important process and one that has many implications for the adjacent barrier beaches. In a simple tidal inlet, the channel goes straight out into the ocean; but with a predominance of sand transport arriving from the updrift barrier beach, the tidal delta overextends in a downdrift direction, forcing the channel toward the south. This route often becomes less efficient for handling the flow, especially during storm tides, and eventually a shorter channel will break through the shoals. This, in turn, frees up large sand shoals which then start moving onto the adjacent barrier. We've seen this happen many times before. At Kiawah Island in 1975, a large shoal was released from the tidal delta due to a minor shift of the southern channel. The horseshoe-shaped shoal migrated over two thousand feet during the next three years, finally wrapping around the east end of Kiawah Island. This is an important process because it adds sediment to the beach but at the same time produces dynamic shoreline changes adjacent to tidal inlets.

We have found that on many of the central South Carolina barrier islands, the bulbous updrift ends adjacent to tidal deltas experience wide fluctuations in shoreline position, whereby rapid erosion can occur adjacent to rapid accretion. These variations occur in response to the movement of offshore shoals. Different scales of this phenomenon occur. The most recent one which received a lot of publicity was at the Isle of Palms this past year. In 1982 we noted a big deposit of sand that was forming opposite the Beach and Racquet Club. That sand as it was released from the inlet was about a thousand feet offshore in October of 1982. By March of 1983, just a few months later, the shoal aquired a classic horseshoe shape and had moved on toward the shore. The shoreline in the lead of the shoal, which was sheltered from wave action, began to build out. In fact this was one of the most rapidly growing areas of shoreline in the state at the time. The beach was building out by a couple of hundred feet over that year's time. By September of this year the shoal had actually attached onto the beach. The shoal acts just like an offshore breakwater would. Waves break offshore, pushing the sand onto the beach. This provides a new source of sand for the northeast end of Isle of Palms and accounts for the bulbous build-up of the beaches on the north end toward the inlets.

Unfortunately in this particular case, and this is what received all the adverse publicity, there was a development

just adjacent to the shoal called Mariners Walk. I'm sure it's been in every paper and on every television station in South Carolina. Back in January of 1983, Mariners Walk was adjacent to the bulge and was eroding very rapidly. It was eroding because the sand had been trapped in the lee of the bulge and wasn't being provided to this general vicinity. It was a very localized problem but a severe problem which stemmed from some lack of regard for setbacks there. Now, however, the accretion wedge is coming in. Processes like these are providing sand to Isle of Palms and other beaches like them and have actually accounted for the net accretion that these islands have undergone over the last 1500 years. But, superimposed on this long-term trend of accretion are short-term trends of erosion adjacent to where these shoals are shifting around. Obviously, care needs to be applied in that sort of development.

Folly Beach

Let's go on to the situation at Folly Beach. Our data base is not as extensive on Folly Beach as it is on some of the other parts of the coast, but I think the processes that we understand from other areas can apply, to some extent, in this case. Much of Folly Beach's recent history is tied in with the development of the Charleston jetties. Before the jetties were built back in the late 1800s, there were extensive tidal shoals at the harbor entrance. Shipping required a safer channel so there was a need to stabilize the channel. Stabilized it was by a series of parallel jetties forming the main entrance into Charleston Harbor. While creating a stabler entrance, the jetties blocked the process of shoal bypassing, "the dog wagging its tail," or the natural shift of sand across the entrance. North of the Charleston jetties, on Sullivans Island, over the last fifty years, the island has grown considerably. There's been a tremendous amount of accretion on the north side of the jetties. Even at Isle of Palms there's been accretion which may or may not be due to the jetties; in any event, it is an accreting island on the southern end. There's probably 500-600 feet of new dunes between the ocean and the old houses at the Isle of Palms.

On the south side of Charleston Harbor, Morris Island and Folly Beach have eroded a comparable amount during the same time period. A classic scene illustrating the erosion is Morris Island Lighthouse which was located on the south end of Morris Island as recently as 1939. Today, it's almost a quarter of a mile offshore.

On Folly Beach, there have been a lot of makeshift attempts at shore protection to preserve the existing property. The fundamental cause of erosion is probably an inadequate sediment supply bypassing the Charleston Entrance. Some people may differ with that opinion. We can debate that later on, but I think that's basically the problem. Folly Beach is so narrow in places that the houses are just barely hanging on by a thread. Technology exists to restore the beach; but whether there's a cost-effective solution for this particular problem is uncertain. The value of this particular island development has to be balanced against the cost of a long-range solution. I am sure most residents of Folly Beach would feel that their homes are worth saving at any cost. This is probably the most complex problem to solve that we'll discuss today. The big question is whether we can get sand from offshore or whether there needs to be some kind of a structural alternative and just write off the beach. Folly Beach also is an example of the use of groins; groins have been given a bad name by many people in the past. I have got some prejudices against them for aesthetic reasons, but we do know that groins trap a tremendous amount of sand. It may be possible to find some sand in the general offshore area and bring it back up on the beach without great effort.

Hilton Head Island

Hilton Head Island at the southern end of our state is a little different from the central South Carolina barrier islands, but the processes controlling the coastline are much the same. Toward the Georgia-South Carolina border, the tidal inlets, such as Port Royal Sound, get huge. Tidal deltas sometimes extend as much as two to three miles offshore and force the adjacent islands to take on a more irregular shape. Hilton Head Island is about ten miles long and considerably wider than other South Carolina barrier islands. It has a central bulge similar to the bulge on Isle of Palms, Kiawah Island, and some others, caused by sand wrapping around the tidal delta and then depositing midway down the island. The south end of Hilton Head Island forms an accreting spit analogous to the recurved spit at Sullivan's Island. It's a little larger than the ones in the Charleston area, but nevertheless it's formed by the same kind of process. Sand generally moves in a southerly direction toward Calibogue Sound, wrapping around the island and actually building out the shoreline in this vicinity. In general, the south end of Hilton Head Island has been accreting. Houses in the Sea Pines community have reasonably good protection from erosion or storms due to the

surplus of sand being supplied to the south end. This sand supply also accounts for a large build-up of the shoals opposite Daufuskie Island at the very southern end of Hilton Head.

The central part of Hilton Head Island where a broad bulge is located seems to be where the main problem is at present. Data from a 1977 Sea Grant study indicate that the mid-portion of Hilton Head Island has experienced a 25-year erosion trend averaging between 3-10 feet a year. Remedial efforts have included construction of revetments and beach renourishment with sand from new marinas. It seems to be working for the present. There has also been a lot of sand-scraping of the lower beach in order to rebuild the dunes after storms. When you're trying to deal with erosion in this kind of fashion, it's better to keep a soft edge and it's better to find the cheapest source of sand even if it's only temporary, bring it up to the beach and then recycle the sand later.

We've looked at several causes of erosion, but not all by any means. Of the processes that cause erosion in the first place, the relationship of sediment supply to sea level rise and wave action are probably the most important. Generally, man-induced causes of erosion can be avoided. Past abuses include construction near migrating tidal inlets and inadequate set-backs in many cases.

A big question now is, "What is a reasonably good set-back for the life of the development?" Some people may feel that no development on a barrier island is safe. That may be true for a thousand-year time frame, but we measure our developments on barrier islands in terms of twenty-five or fifty year investments, often even less. At some point a balance must be sought between a reasonable density of development, life expectancy of the development, and sensitivity for the unique dynamics of coastal barriers. Coastal structures, in some cases, have adversely affected adjacent property, but not in all cases by any means. We should be open minded about that.

I would recommend several things to conclude. One is that we have to maintain very good surveys of the coast. We are dealing with inches and feet now rather than gross, qualitative shoreline changes. Developers are very concerned about every inch of erosion, just as much as environmentalists are, but we don't know how much the beach is eroding unless we have accurate quantitative surveys. There should be a statewide computerized data base for beach

surveys that is rigorously updated each year, especially in developed areas where comparisons are so important. This is the only way land disputes can be objectively settled after property is lost or gained at the shoreline.

There are short-term as well as long-term erosion/deposition trends. Some problems can be identified as short-term, with temporary solutions to the erosion. I think the recent Isle of Palms case is one of those short-term problems that has been solved. But we also have some long-term problems that need to be dealt with. The long-term problems tend to be harder to solve for many reasons. Causes of erosion need to be identified before any solutions can be promulgated. Unfortunately, many of the solutions to erosion have been implemented without really understanding the causes of erosion. In almost every case, there is a site-specific cause of erosion which cannot be determined by crude extrapolation from another source.

I'd like to think that soft solutions are going to be increasingly appealing, no matter where we're working on the coast, solutions that work with the natural dynamics of the area wherever possible. That's the tact that I plan to take for the next couple of decades, as long as I stay around in this state. Obviously we should ensure that any solution implemented does not adversely impact adjacent areas.

The recent project to relocate Captain Sam's Inlet between Seabrook and Kiawah Islands, south of Charleston, can serve as a soft engineering model for erosion control. The project has been designed after the natural process of inlet migration and is intended to promote a natural flow of sand toward an eroding beach. If the project is successful, it will demonstrate how minor manipulation of the shore by man can produce significant long-range benefits in an environmentally compatible fashion.

Thank you very much for your attention.

SESSION II
Legal Considerations of a Moving Shore

Mr. Benjamin H. Gregg, Jr.

I would like to give you a brief overview of some of the legal implications of beach erosion. I will talk on two general areas: 1) the governmental levels of jurisdiction when erosion is discussed; and 2) the status of the common law and the status of some of the case law in South Carolina. On the governmental level I will talk first about the federal and then the local and then the state. The points I want to make will be conveyed best that way.

On the federal regulatory level, the U.S. Army Corps of Engineers operates a program under the 1899 Navigational Act. That is basically a navigational concern when it comes to beach projects; as a result, the Corps really does not have a permitting requirement for private beach erosion control projects. The Corps of Engineers does get involved, of course, in public beach erosion projects. The most important thing in the federal area right now is the federal incentives that are available for construction on barrier islands and on other beaches: Federal Flood Insurance, disaster relief, highways and bridges funds, water and sewer project funds. These funds provide incentives for private landowners to build on beaches. With the passage of the Coastal Barrier Resources Act in 1982, that situation was changed in certain areas of South Carolina; areas that were designated as undeveloped barrier islands are now not eligible for those federal funds. Incentives remain available on beaches and islands that have been developed.

I look at beach erosion as primarily a local problem. I think in most situations it's more a local problem than a statewide or national problem. There have been a couple of local jurisdictions that have begun to grapple with it through setbacks. I know that Tim Kana mentioned the setback idea and I think that's what this state will come to over the next few years. I think more and more jurisdictions will begin to talk about a setback line. Beaufort County and Surfside Beach are, as far as I know, the first jurisdictions to have established a setback line in the state. When I was working with the Coastal Council, I found it very interesting that when talking to local officials, local elected officials and local staff officials along the eight coastal counties, a lot of times they declared confidentially that they were glad the Coastal Council was in existence. They realized there were problems

that were very difficult to deal with on the local level because of the vested local interests that are involved when you're dealing with private development. When the Coastal Council came into creation, there was no question but that it was a controversial act at the time and there was a lot of local opposition. I think a lot of the people who dealt with the local situation realized that the Coastal Council was needed.

The Coastal Council has set up state-wide standards for review of their four critical areas. There is direct permitting in these four critical areas. I think that the legislation creating the Coastal Council put the onus as far as erosion problems on the Council and did it in two primary ways. The first way was critical area direct permitting. The Coastal Council has direct permitting authority in four critical areas. The two most relevant when we talk about beach erosion are the beaches and the primary front-row sand dunes. The Council has no direct permitting authority outside of the critical areas; and therefore it has no authority on the beaches landward of the primary front-row sand dune. That is one aspect of the Council's concern for erosion devices. That is a piecemeal approach. Basically the applicant applies, standards are provided under the Coastal Council legislation and under the Coastal Council Management Plan. These standards are applied in particular cases. The Council is also required, under the Coastal Management Act of 1977, to come up with a comprehensive erosion management plan. To the best of my knowledge this has not been done and I think, quite frankly, it's very difficult to come up with a comprehensive erosion management plan when the Council has no authority landward of the primary front-row sand dune. If there is a primary front-row sand dune, it usually indicates that the beach is fairly stable and the erosion problem is not as severe. Ironically, in areas that have severe erosion problems, there is often not a front-row sand dune; as a result, the Council jurisdiction there only covers the beach and covers none of the dune field. Therefore, at times, the Coastal Council has further jurisdiction landward in more stable areas than they do in areas that have a larger problem.

The Coastal Council has other powers under its enabling legislation, including the ability to require that erosion control devices contrary to public interest be taken out. As far as I know, that (power) has not been used too much. It may have been used on one or two occasions. But, as you can see, coming up with a comprehensive erosion control plan is definitely very difficult. I think the Council can make

recommendations but as far as direct enforceability, there's very little the Council can do now, because the Act is specific as far as on beach and the sand dunes: their authority extends no further landward than the primary front-row sand dunes.

I will now talk about the status of the common law and case law. I'll cover property law aspects and then personal claims between the state and private landowners and between one private landowner and another private landowner. I will then talk briefly about beach access.

Tim mentioned the Isle of Palms case involving removal of some sand dunes there. I think that took place about six or seven years ago; that is about the most notorious controversy regarding the removal of sand. The crux of the issue was that the land out on the Isle of Palms was subdivided and the lots were described legally down to a certain point on the beach. As a result, there was a small strip of land between this specific boundary point on the beach and the mean high water line. The original landowner maintained ownership between the mean high water line and this property line. Originally, it was a very small strip, but after these lots were built on, the beach began to accrete. What was once a small strip of land between the mean high water line and these property lines became a large piece of property, in fact, it became a dune field. The original landowner went out and leveled this dune field with the intent, I suppose, of eventually subdividing additional lots. The South Carolina Attorney General came in and filed a lawsuit. Eventually the original landowners prevailed on a legal technicality and that technicality was that they maintained ownership between the point certain (boundary mark) and the mean high water line. If the property description had gone down to the mean high water line, then as the land accreted their property would have been extended out as the mean high water line receded. So it was basically a case that was decided on a legal technicality. Interestingly enough this scheme was obviously on the mind of some legislators when the Coastal Council Act was passed in 1977, because there is a provision that says no person or governmental agency may develop ocean-front property accreted by natural forces/or as the result of structures beyond the mean high water line as it existed at the time the ocean front property was initially developed and subdivided. And such property shall remain the property of the state, held in trust for the people of the state; so what this statute attempts to do is to change the holding in the Isle of Palms case. It would be interesting if this

provision were to be tested. If I was the private landowner and my land accreted and if the state claimed the accreted land, I would question that, because the state seems to be picking up something without any cost. There's no question that the state owns all property below the mean high water line, unless the ownership presumption can be overcome. But it's a new question regarding land above the mean high water line, which this statute covers by saying that the state owns that. I think there's a question there about who owns it: whether this statute would prevail or whether the common law theories of the private landowner owning that property would prevail. As far as I know this has not become an issue. When you talk about property law and erosion, of course, the state owns all property below the mean high water line and that's really the overriding consideration.

I would like to discuss another area of the law: torts. A tort is basically a personal injury and usually involves one person against another. One person, the plaintiff, is alleging injury against the defendant. Of course, the defendant may counterclaim an injury against the plaintiff. When you talk about torts in the erosion area, usually it is between two landowners. To my knowledge, there is no case law on this topic, at least not in our State Supreme Court. Maybe there have been some lower court decisions, but as far as I know there is no case law on controversies between two landowners. You've got landowner "A" that goes out and builds an erosion control device. Landowner "B" is adjacent or down the way a bit and he notices that once that erosion control device is put up, his property begins to erode; he puts two and two together and says, "Well, I think that landowner 'A's' erosion control device is causing my problem." As far as I know there's never been any contest on that sort of case. I suppose that can be attributed to several things. Number one, South Carolinians have a good neighbor policy. There is also a very high regard for protection of private property. If I see that my adjacent neighbor is losing his lot, then I have sympathy for him and I feel like, well, let him go out there and protect it as best he may; that's a tradition in South Carolina, protection of private property. The third and perhaps the most important idea is causation. It's going to be very difficult for a landowner to show that a certain erosion control device is causing his problem. There are many different causes of erosion, but one of the things you must do if you're initiating a suit is to shoulder the burden of proof.

These questions have come up in the Coastal Council appeals process, but as far as I know there has been no precedent set in court. Conflicts along our coast are increasing. I think we will eventually have some precedent in this area. Of course, it will be plaintiffs' experts against defendants' experts and really won't be as much of a legal contest as it will be a scientific contest over causation.

An interesting case involved Folly Beach several years ago. The City of Folly Beach filed a suit in Federal court against the Corps of Engineers. The contention in that lawsuit was that, number one, the erosion of Folly Beach is severe. I don't think there's any question about that. Number two, that the residents of Folly Beach, landowners on Folly Beach and the City of Folly Beach itself have been injured by this erosion. Probably no question about that. Of course the big question, once again, was causation. The City of Folly Beach was alleging that the jetties, the Charleston Harbor jetties, were the cause of their problem and therefore, the Corps of Engineers, since it was responsible for maintenance of those jetties, was the responsible agency and therefore the Corps should compensate the City of Folly Beach and its citizens. Many people that were siding with the Corps of Engineers and saying the jetties may be one contributing factor, or may not be a factor at all, but they're surely not the only factor. So that would have been an interesting lawsuit if it had been followed to the end. The case was eventually dropped by the City of Folly Beach upon certain concessions for doing studies (on the part of) the Corps of Engineers. I suppose we'll get an update later on in the day about exactly what is happening on Folly Beach. There has been a lot of work in the last several years in the scientific, engineering phase of erosion that is needed prior to talking about any future legal solutions.

As far as future solutions, I believe that the setback line is the way that we'll go, whether it be by local authority or by statewide authority. I think that the Coastal Council will see a setback line as a future solution. One suggestion I would have would be to go ahead, based on what research and information is available, and establish a setback line. It would not be mandatory, but it would give landowners and municipalities an idea, based on statewide knowledge and statewide information, of where the setback line should be. At the same time, the Council could make it very clear that if the setback line is violated, if structures are built seaward of that setback line, then in

the future if there are erosion control problems, their cases will get less sympathy than if the setback line had been followed. I think the Council would be able to extend its authority that far, I think that's one possibility.

I will close by talking about beach access and the associated legal implications. There are basically two types of beach access. You have lateral access along the beach, the ability to walk or travel or sit along the beach. With lateral access, there are problems with structures obstructing your ability to move along the beach, including groins and structures that actually come out onto the beach. In some cases, those structures are below the mean high water line. There is also vertical access, the ability to reach the beach from the uplands. Of course, with horizontal structures that is often a problem. The problem can be overcome quite often. At public access points where erosion control devices cross these public access points, there are mitigation devices that can be used to overcome the access problem. The most important thing to remember regarding beach access, is the public trust on all lands below the mean high water line. The state is presumed owner of those lands in the public trust.

That public trust is the legal responsibility of the Attorney General. When it comes to tidelands, the filling of tidelands, the Attorney General is very alert to what's going on in that area. I don't think the Attorney General's Office is as alert on the questions of beach access and how the public can be denied access to those lands in the public trust below the mean high water line. That probably goes back to the idea that people look on wetlands as being a statewide issue, whereas these erosion problems and beach access problems are seen as local problems. The Attorney General deals more with statewide issues but I still think there are questions of public trust that the Attorney General could get involved in regarding beach access and erosion. The Attorney General is charged with protecting those areas below the mean high water line.

I'm going to close on that. I really appreciate the opportunity to be here today. If there are any questions, I'll be glad to answer those at the break. Thank you very much.

SESSION III
Review and Economic Analysis of
Shore Protection Devices
Part I

Dr. Billy L. Edge

Everyone here is probably already aware that erosion really is in the eye of the beholder. I'd like to share with you some of the information that I have learned from other people over the years concerning shore protection devices, shore stabilization techniques, and some of the associated costs. I will indicate those that I have observed here in South Carolina that seem to be working and those that aren't working, and also draw from experiences around the world. When appropriate, I also will relate some of the specific costs of the particular devices where we've had an opportunity to actually see the costs of doing some of the construction.

Shore protection devices focus on many different aspects of the beach profile. Some only deal with the dunes, some deal with the berm, some deal with the toe of the berm and some deal with the offshore environment where waves are breaking. In the context of trying and inventing solutions to deal with shore erosion, people have focused on each of those different areas. The kinds of devices that are available are really not new. They have been known for many years; revetments, bulkheads, seawalls, groins, and other devices have probably all been tried in South Carolina at one point or another. Some of them have been successful here and some of them have not been successful.

It was recognized a long time ago that the brunt of shore protection costs has been borne by the government, whether it be federal government, state government or, in some cases, the local government. The federal government is precluded by law from solving erosion problems for private property. For property owners faced with erosion, there is no mechanism for those governments to take care of the private property. Therefore, the property owners are faced with doing it themselves. Because of a massive letter writing campaign and public interest, legislation was passed in 1975 to create a program that would address what the homeowner can do for his own property. The program looked at all the different low-cost solutions that were in existence, tried to develop new ones and then tried to disseminate that information to the public.

The legislation that was created is called the Shoreline Erosion Control Demonstration Program, a program wherein approximately five million dollars was spent to demonstrate solutions around the country for erosion control in various geographic locations. A lot of innovative work was done in that program. The results of that program are contained in a set of four documents that have been published by the Corps of Engineers. I would suggest the property owners' guide for those who are interested; there is some extremely good information inside. It is not the Rosetta Stone for solving erosion problems, but it does give some very good information. In addition, there is a special publication put out for engineers, another for the government people that are involved in regulating these activities, and one for contractors, as well.

The cost for shoreline protection when we were beginning that program was around \$400 a meter, that's around \$120 a foot. The cost hasn't changed much since then. Some of the recent projects we've been involved with are still costing about \$125 a foot as about the least expensive erosion control that you can do, unless you get into something like a vegetative type of activity. Associated with the program were projects constructed around the country. Each of those had a variety of different devices and types of protection at each of the sites so that people could go in and see how the devices did or did not work. I will discuss some of the more established and useful devices that we know work well. They probably cost somewhat more than some of the innovative devices that people are coming up with every day.

The bulkhead is one of the most common devices along the South Carolina coast. It presents a nice vertical wall that retains the property behind it. It is not designed to build up the beach or protect it. It is designed to retain the property located behind the bulkhead itself. A bulkhead built of concrete sheet piles can be put in place by a front-end loader or backhoe with a water jet that's using a pump. The sheets are just lowered down into the sand; once they are in place, a concrete cap is poured on the top to hold it all together. It is important that bulkheads be constructed in continuous alignment from one property to the next. With non-alignment there may be an aggravation of the problem that existed prior to the placement of the walls.

Folly Beach is one of those communities that, working with the S.C. Coastal Council, has undertaken a program to try to get away from having these bulkheads built at

different lines, so that all the lines are uniform and they are protecting the beach uniformly. A cinderblock wall or concrete construction block wall is a very poor design for the coast. It doesn't work well at all. Behind a bulkhead wall is a tie-back, rods going back to a dead-man or anchor. Filter cloth is also used in the construction and has a very specific function. It is designed to keep the sand from leaking between the concrete panels of the bulkhead. A continuous sheet should be used so that there is no opportunity for the cloth to become fouled during the construction process. If it is not designed properly, of course, it can hold the fill, hold the waves off and hold the property up, and yet if the wall is breached on the side, all the fill will leak out, just like punching a hole in the bag. If the material from behind the bulkhead is lost going through the cracks or lost going around the end of it, the waves will eventually knock the wall over.

Before I discuss revetments, I will indicate some recent costs that we've encountered for bulkheads. Concrete bulkheads are a little more expensive than wooden ones. Using a good contractor and getting hard-nosed about it, you can probably get the cost of wooden ones down to about \$125 per linear foot. Concrete sheet pile is on the order of \$175-\$250, depending on how good a job the contractor does. If he uses twelve foot long concrete sheets, it's probably \$250. If he skimps and puts in an eight foot long sheet, it's probably down to \$150. Some less reputable contractors might do it for a little bit less than that and might skimp on the filter cloth.

Revetments are seen all up and down the coast, at Folly Beach, at Fripp Island, practically everywhere. Some of them are designed, some of them are built and some of them just consist of trash that's just been thrown out on the beach with the hopes that it would hold against the waves. Those built from trash do not work for long. We will talk about a properly built revetment, something that is really useful. Rocks used in a revetment should be sized, small stones in a large storm may go through the windows of the houses behind or they can even be carried seaward and lost in the sand. Again, it is important to continue a line along the beach front. If there is not a continuous line along the beach front, the waves can focus right in between the revetments, and continue to erode back. In that case, the property owners will have to wrap their revetment right around their property and underneath their foundation or they'll have to pay to have their neighbor's property reveted, if given permission to do that. That brings up

some of the issues that Ben Gregg was talking about in terms of being able to deal with competing interests and desires of the people who live along the coast. People who live on the beach are trying to protect their property. On the other hand there are those who would like to use the beach for something other than homes and who would like to see no more development or protection of what exists.

Other types of revetments include a revetment made strictly from bags of mortar that are stacked up on a graded slope then wet down. Unless they get thoroughly wet, the bags will just develop a crust and not be an effective, solid wall. Sandbags filled with wet, mixed cement and then placed seem to work much more effectively. Both of these options are less than \$150 per foot for most installations. It's one of the few things that a homeowner/property owner could do him or herself. Bags filled only with sand are not very effective. We monitored a sand bag revetment on the coast. After the first storm, the bags were still there but the sand was gone.

Another type of revetment is made out of pre-cast blocks which are fitted together much like a puzzle. When it is put together correctly it is great; but when it begins to unravel, it unravels just like a sweater. The cost is relatively high. Unlike some of the rock revetments which a good negotiator could get for as low as \$250-\$280 or more for one or two lots, it might cost as much as \$400-\$450 a foot if you had properly sized stone. A fitted block is probably on the order of \$500 - \$800 per linear foot, if not more.

In the extreme cases where there are heavy waves and the property absolutely has to be protected at all costs, the property can be armoured using artificial armour units. The armour units are massive protection, and are generally used in an offshore breakwater. For large activities, large storms and large waves, there are devices that can protect the shoreline. It costs quite a bit for each one of those armour units. A finished structure could cost well in excess of one or two thousand dollars per foot of structure that has to be built.

For lower wave environments, there is a similar option. Filter cloth is laid out and onto it is glued a set of blocks. These blocks are sometimes called Gobie blocks, but several different kinds of blocks are available. They are laid on a filter mat, and are taken to the field by crane, where they are unrolled and laid on the shoreface for an

effective armour unit. There was a large strip of it on the Louisiana coast recently that failed and there has been some concern about its ultimate life and the strength of the glue. I assume that those are just technological problems that the industry can solve. The cost of this option is relatively expensive. It probably costs on the order of \$225-\$250 a foot. What has been done in some other locations is to prepare a slope with a standard variety filter cloth, and then hand place each of these blocks, rather than have a large crane come in and unroll them off a drum.

There is also the fortressing that takes place with some revetments. We've often heard about the shoreline in New Jersey. We've heard about trying to "New Jerseyize" the shoreline of South Carolina. I want to give you an idea of the revetments in New Jersey; they have worked very effectively. They occasionally require maintenance work. There is a revetment that runs for approximately twenty miles, covering the northern part of the State of New Jersey. There is usually not a sandy beach on the seaward side of the revetment, although its presence depends on the time of the year and the state of the storms. If that revetment failed, the whole spit of land that it protects would be broken into and the structures and all of those community resources there would be lost.

Groins are another erosion control device. In the State of New Jersey and some other states the groins are significantly longer than they are in South Carolina. In the early days when there was plenty of sand in New Jersey, those groins worked very effectively. Groins actually work to trap sand as it moves along the coast. They trap sand with a scalloping effect as one side of the groin catches the sand moving down the coast. If it is unchecked and if there is not a groin downstream of the one to which that scalloping effect is attached some severe erosion will probably take place. One principle involved in our groin research is that you can not build just one. If you build one you have to have another one downstream and then another one downstream from that and another one downstream from that until a natural terminus. Many good projects have failed because they did not continue the sequence. Therefore, groins have acquired a bad reputation. The second design criteria is that wherever a groin is built there has to be some longshore transport of sand or the groin will not work very effectively. If there is longshore transport of sand, the groin can catch it. If there is a series of groins built rather than just one, they'll work

effectively if they're designed correctly. Groins must be built long enough both landward and to sea. One of the problems with groins in South Carolina is that we have not maintained them over the years. Folly Beach went for a long period of time with groins that weren't working effectively because they didn't have any wood in them. The waves and sand went through them and they weren't very effective. A low cost one can be built out of Palmetto logs. Palmetto logs will probably never rot and most marine organisms don't infest them.

We recently completed a study of the groins down at Edisto Island. There was a question as to whether or not the groins were providing any protection and whether or not they should be pulled out. Basically, the problem boiled down to the fact that the groins worked very effectively when they were built, but over a period of years they deteriorated. With minimal effort to rebuild them or maintain them, they would again work very effectively and function. In fact, the S. C. Coastal Council has helped the town to do that very thing—rebuild those groins and put them back in order again.

Some devices protect the beach as well as the upland. An underwater sill can be built offshore with a structure that runs parallel to the beach. It is a submerged fence, so that in a storm the sand goes offshore, the fence will catch it so that it doesn't go out and get lost beyond where the wave activity can push it back up onto the shoreline. Various people have tried doing this with other devices. Sandbags have been placed parallel to the shoreline acting as a sill or a perched beach. The concept is great, but the jury is still out on the general applicability of this solution to more of our shoreline.

Vegetation is a device which is very inexpensive at fifty cents per square foot. It could be a little bit more than that, depending on the amount needed. If planted and left to its own accord it can provide a very significant buffer against wave activity from across the sounds and across the bays. It is effective in areas where there is not only wind wave but also boat activity that creates erosion on the bank.

I would be remiss if I did not add that the dunes are indeed our final means of erosion control, our last defense against the ocean. Whatever measures are taken to promote their growth and to maintain them is extremely important and probably one of the least costly efforts that can be done.

Beach nourishment is a subject of intense interest right now in the State of South Carolina and particularly vis-a-vis Myrtle Beach. A dredge picks up the sand and brings it onshore. Of course, it's not a permanent solution. It, too, requires maintenance over time. When the shoreline is eroded back it should be maintained by adding more sand to it. In Miami Beach, renourishment has been so successful that people complain about how far they have to walk to get to the water's edge. Nourishment is not a permanent solution and often requires additional applications. The cost would be approximately \$150 to \$300 per foot of beach.

Another kind of device entirely separate from those discussed so far is offshore breakwaters or offshore headlands. These create a large volume of sand offshore that allows waves to break offshore but not on the protected site. These concepts have been used in a number of fishing villages in Japan, in Singapore, and in Lake Erie. Artificial armour units are being used offshore of Japanese fishing villages as breakwaters. The costs for these are a bit more than other options I've mentioned, on the order of \$500 per foot. But they protect more than a foot of beach for every foot of structure, so there is a cost savings. Some of the more metropolitan areas, such as Tel Aviv, have an extensive series of these offshore breakwaters which are working very effectively. In a place near Rome there are a series of these which are used because of the tremendous population in spite of their excessive costs. They provide a very worthwhile recreational and beach stabilization scheme.

Sometimes we're faced with doing something that's a little different and innovative. Perhaps these devices will provide in the future not only successful but inexpensive solutions. Floating frisbees offshore have been designed to dampen wave energy. If tuned properly they have been shown to be very successful, but it is a difficult design task to develop a system that will work effectively. It is not a do-it-yourself project. Likewise, artificial seaweed we hope will be successful but it has not been proven yet. Another structure that has been out for some time and has been marketed extensively throughout the country is called a sand grabber. It is a patented device consisting of concrete blocks tied together with reinforcing rods and laid parallel to the shoreline. An installation does exist here in South Carolina. The jury is still out on this inexpensive innovative device.

Most of the solutions that I've mentioned do not address the maintenance of the beach or the recreational opportunities. I have addressed what the people in South Carolina who are on an exposed coastline really have as choices for protecting their property. Creating a beach is not something that an individual can do. Creating a beach is something that no less than a local unit of government can do. To build a beach, sand must be obtained from offshore, backbay, or inland sources. Although these are expensive options, to maintain our beaches in South Carolina, these solutions may need to be seriously considered.

Thank you.

SESSION III
Review and Economic Analysis of
Shore Protection Devices
Part 2

Dr. James B. London

The erosional trends that we've been talking about today are long-term geological trends. The property losses that we're experiencing now are a function of the increased utilization of beach areas in recent years. The use of the beach for recreational purposes in South Carolina is not new. In the eighteenth century, Edingsville, Pawley's, and Sullivans Island were used for recreation. However, much of the development along the South Carolina coast has happened since the turn of the century and particularly since the end of the Second World War. The Grand Strand has tripled visitation within the last decade. On Hilton Head, building permits have increased from \$12 million to \$90 million during the 1970s.

Several factors have contributed to increased beach use. There has been no significant hurricane along the Atlantic coast since 1960 which has caused a sense of easiness among individuals. Income levels have continued to increase in the post-war era bringing about the use of the beaches by the vast middle class as well as upper classes. At the same time, geographic accessibility, transportation improvements, and the fact that individuals have become accustomed to using the beaches for recreation have all increased recreational use of the beach. In terms of public inducements: infrastructural improvements for bridge work, wastewater treatment, HUD, and EPA programs; financial leverage which has allowed individuals easier access to building along barrier islands; and shore protection programs that have helped communities and individuals to maintain the beaches.

To lay a framework for developing appropriate erosion policy, we might view beach use in terms of benefits and costs that have accrued from increased levels of activity. Individuals are willing to pay significant amounts for beach access which serves as a first approximation for the benefits of beach use. Along the six oceanfront counties in South Carolina, expenditures are now running in excess of three billion dollars on an annual basis; that's better than two-thirds of the tourism-related spending throughout the state. To a great extent, land values incorporate the value of beach activities. Along Hilton Head in the late 1970's,

land appreciated by more than twenty-five percent per year despite a downturn in the overall real estate market, while in Myrtle Beach, properties on the oceanfront incorporate a fifty percent premium over similar property across the street. Market forces do then serve as a first proxy for benefits, although there are also some non-market factors which we need to consider. That is, while individuals use beaches they may receive surplus above and beyond what is paid for in terms of lodging, food, and other activities. There's also the option value of knowing that whether we use the beach or not, it continues to exist for the use of future generations. The costs of beach utilization have been fairly significant, ranging from the loss of human life by hurricanes to the expense of building along coastal areas, such as the cost of beach erosion abatement programs.

Now, what does government do along these lines; what are its appropriate responsibilities? First of all **providing information** is an appropriate responsibility for government. That includes: providing good data bases with which to work; public awareness, including forums such as this one; and particularly forums where we can address some of the issues before the damages have occurred, so that we can approach these issues from a somewhat more neutral perspective. **Technical assistance** is a government responsibility, providing local governments with the expertise necessary to properly evaluate current situations and alternative solutions. What is necessary from a long-term perspective is to anticipate erosion-related problems. Too often, decision-making on a piecemeal basis may produce inconsistent, stop-gap solutions.

In terms of state level activities, we've talked about information bases. Also there is the issue of addressing damages inflicted upon innocent third parties from the actions of individuals along the shoreline, what is referred to as "spillover effects." To address these points, building standards are a point that the Coastal Council in this state has considered to apply some consistency, to make sure that the structures are sound. Setbacks are an area that's been discussed off and on for some time and I know that setbacks have been mentioned today. That is not an area of state authority at this time. Localities have land-use authority in the State of South Carolina and, in most cases, are going to have to take the initiative, perhaps with the support and cooperation of the Coastal Council. Other state level responsibilities of increasing importance include: the evaluation of engineering solutions within the critical

areas and coordination with local governments to ensure that coastal areas are staying within their natural carrying capacities.

In terms of short-term solutions, Dr. Edge outlined many of the alternatives that are available to use. We can sit back and talk about long-run approaches, but even if institutional changes are enacted, individuals acting in good faith under previous guidelines cannot be penalized. As such, we're going to need some short-run contingency plans. Engineering solutions should be allowed only consistent with prescribed guidelines and where public benefit can be shown. Life expectancy on engineering solutions bears consideration and is something that we have not addressed sufficiently in the past. I have suggested before that if engineering solutions are to be used at all for short-term erosion control, their authorization should be tied to the depreciation schedule in place for the buildings to be protected. With rapid depreciation schedules being applied to the beachfront and, in many cases, frequent redevelopment, such a system would require that new activities be consistent with long-range plans. Where community resources exist for erosion control, relocation plans in unusual circumstances should be considered.

In terms of local governments, local governments will need to identify and evaluate the resources that they work with (as many have), examine existing statutes, delineate and identify potential uses that may involve establishing setback lines and consider policies before the fact, to lay out alternative uses.

In terms of funding, to the extent practical, funding ought to come from the users of public beaches where the predominant benefits accrue. To date, state funding in South Carolina has been based on a previous bond issue. New Jersey voters recently considered a \$50 million shore protection bond issue; South Carolinians may have to make similar decisions. Still, general revenue expenditures are unlikely at this time, with the possible exception of erosion bonds. The tying of state funding for erosion abatement programs to local initiatives is something that has been discussed and something that we will have to consider again with the scarcity of resources. Local governments are going to have to show some initiative and state funding may be tied to the fact that local governments have proceeded in responsible ways. The degree of public access afforded by particular beaches is another measure to which state funding might be tied. The relative share of

benefits accruing outside of local communities might serve as a basis for funding; that is, in a predominantly residential beach with limited public access, state funding might be somewhat less than in a predominantly public, open access beach. In terms of localities, if localities want to determine their own destinies, including the practice of land use authorities, they're going to have to be willing to share in the cost of beach protection. It may be necessary to have localities pay a significant share to ensure that there is fiscally sound planning and management of local programs.

In terms of federal government, the assistance will be somewhat limited and is very time consuming as the Myrtle Beach case will attest. As a result, creative funding arrangements will have to be considered. For residentially based beaches, local governments are going to have to look to such options as local property taxes where a graduated millage rate might be assessed based on the proximity to the oceanfront where greatest erosion control benefits will be realized. Special tax districts could be devised in the case of beach community or resident's management organization to support their beach protection programs. In terms of visitation beaches (beaches using or having significant day users): parking fees in central parking lots, and user fees to gain access to the beach so that users of the beach help to pay for beach preservation. In highly commercial beaches, an accommodations tax is something that has been discussed in the last couple of sessions of the Legislature and will probably be discussed further. Local sales taxes are another option. These fees essentially tap the surplus from beach visitors who rightfully should bear proportionate costs of erosion management programs.

If, in fact, significant moves are made toward the long run approach to beach preservation, there's going to be a period of transition and temporary solutions are going to have to be taken within this long-run perspective. With modest resource bases, communities may be able to put together erosion control programs to include both long-term policies and short-term contingency plans to aid in transition.

One thing that bears consideration is compensation; that is, how do we protect individuals from what seem to have been relatively sound decisions based upon old criteria, but have resulted in significant damages as we transform public policy? Windfall losses may accrue if individuals are denied the use of beachfront areas.

Compensation, if we have a source of revenue such as accommodations taxes or local option sales taxes, may allow localities and/or the state to compensate damaged parties who may be forced to relocate away from the beachfront.

Essentially in terms of the public sector we can look at its roles in terms of information; limiting, to some extent, damages inflicted upon other parties and setting up ground rules that allow individuals to make decisions in their own best interest, but also consistent with prescribed local and state policies. Thank you.

COASTAL CASE STUDIES

MODERATOR

Mr. John E. Montgomery

It's a pleasure to be here this afternoon. I hope we can put together some of the points that were elaborated this morning. Economists, engineers, geologists, lawyers each have unique perspectives about the problems of beach erosion in South Carolina and they all have a slightly different approach to the problem. Let me relate to you what would be my ideal approach from the standpoint of someone who likes the beaches and uses them. I love to come to Charleston about the middle of June, after Spoleto, on the weekends, on a Saturday because nobody's here; everybody's at Folly Beach, Sullivans Island, or the Isle of Palms. The restaurants are not crowded, I can have a very nice time walking around, I can find a place to park. Then on Sunday, I like to go out to the beach. I would like a four-lane highway, free parking when I get there, a shuttle bus to the beach, arcade games for my son, boutiques and shops for myself and my wife; I would like luxurious, chic but reasonably priced beach houses for rent, elegant but cheap hotels with no occupancy taxes on them. When I get on the beach I want to look up and down and I don't want to see another soul for five miles. When I take my run in the afternoon I don't want to have to jump over groins and around revetments and trip over huge boulders. And I'd like the mayors to be able to provide all this for me free of charge, of course, with no added cost to the taxpayers. Unfortunately, this does not exist. If it did, it would last about ten minutes, because all of us would go there immediately.

All of those extremes point up the diverse interests that have to be accommodated to allow all of us who like the beaches and even use the beaches to do what we like to do, within reason. We can't all have what we want.

Ultimately, despite the considerations of economics, engineering, and geology, it all boils down to a question of politics. There has to be consensus as to what to do: coming up with cost-effective solutions, which can withstand legal challenges and which can be done relatively promptly. The geologists talk in terms of the slow erosion rate at Myrtle Beach. I think they said fifty feet in fifty years.

If Myrtle Beach moves back ten feet in ten years there are going to be a lot of seagoing hotels and motels. I think we have a problem there that needs a short-term solution. The geologists say there will always be a beach, it's just a question of where it will be. Unfortunately in South Carolina, as elsewhere, there are situations in which we've got people, commercial interest, recreational interest, all that have to be reconciled.

So this afternoon, we will hear the perspectives of three major areas, Hilton Head, Folly Beach and Myrtle Beach and see what they think as far as beach erosion is concerned because they have to deal with this complex problem on a continuing basis. The mayors of those communities are each going to make a short presentation. We'll have a few comments from the panel members and then open it up for discussion. We'll first discuss Hilton Head, take a short break, come back and proceed on.

The panel members are: Dr. Orrin Pilkey, Professor of Geology at Duke University; Dr. Miles Hayes, President of Research Planning Institute, Inc., and a coastal geomorphologist; Tony Niemeier, Vice-President of Development for Fairfield Communities; and Dr. Robert Dean, Graduate Research Professor of Coastal and Oceanographic Engineering at the University of Florida. At this point in time I'd like to turn it over to Mayor Ben Racusin from Hilton Head who will talk about the erosion situation at Hilton Head Island.

Coastal Case Studies

Hilton Head Island

The Honorable Benjamin M. Racusin
Mayor, Hilton Head Island

Thank you, Mr. Montgomery, Ms. Davidson, gentlemen, ladies and gentlemen. First, I would like to take this opportunity to congratulate the Sea Grant Consortium and its staff for putting on this wonderful and educational program. Sitting here this morning, I have gained a great deal of understanding as to what our problems are and how we might cope with some of those problems. After listening to the speakers this morning and the thoughts that they've presented to us, I'm reminded of a story about Jekyll Island at the turn of the century when it was a resort for wealthy northern families. The Carnegies, Rockefellers, and the Mellons had homes there. One day Andrew Carnegie was walking on the beach and someone approached him and said, "Have you seen the beautiful new home of the Mellons?" He said, "Yes, it's a lovely little place and I admire it." "But have you seen their art collection, Mr. Carnegie?" (You know that the Mellons were great art collectors.) He said, "Yes, it is one of the most fantastic art collections, private or public, that I've ever seen, and I don't understand it, the Mellons aren't wealthy, you know." That story reminds me, as did the speakers this morning, everything is a matter of degree.

What we heard this morning certainly highlights the fact that erosion takes different forms in different places. I will tell you about what our problem is on Hilton Head. But first let me try to orient you to Hilton Head Island. The island is as described by Dr. Kana, large at the northern end and coming to a smaller rounded tip at the southern end, in the shape of a boot. If you think of the island as a boot, I think you'll better understand some of the comments that I will make later on. The Inland Waterway runs behind the island then enters Calibogue Sound. Broad Creek runs through, almost dividing the island in half.

I'm not an authority on the subject of erosion, but having observed the phenomenon as an interested individual in various parts of the world and more specifically on Hilton Head Island, there are some observations which I feel competent to make. As a relatively new mayor of a recently

incorporated community on a barrier island, I obviously have more than just a passing interest in this particular subject.

Mayor Beck of Folly Beach was kind enough to send me a copy of a letter from Florida engineer Eric Olson dated December 11th, 1980, addressing a Department of Interior report on barrier islands, "I am of the opinion that human needs must be considered along with environmental needs when addressing the issues of our vanishing coastlines....The human needs, in many instances, are people's concerns about environmental problems.... The very act of protection against environmental mishap or damage does in fact address human needs."

Hilton Head Island falls into the category of being a developed barrier island, some say overdeveloped. But the human equation is very much in evidence and is constantly on our official minds and in the minds of the island's residents. I say island because almost all of the island comprises the Town of Hilton Head Island. We're particularly concerned about hurricanes, their effects on the environment and more particularly in whether or not we can evacuate all of the people who are on the island at any given time. The possibility of doing this is drastically reduced when and if access to our new high bridges is cut off by a rush of water across unprotected low areas of the island. I do not believe that we must wait until someone's home has been washed out to sea before we take the necessary steps to protect against this happening to any structure, nor do I believe that the problems can be solved unilaterally. It should take a cooperative and collective effort from all of us, each learning from the other.

Monday of this week the Town of Hilton Head Island was four months old, South Carolina's newest municipality, hardly time for us to have given much thought to the erosion problem. That is not to say that others have not been addressing the problem for many years and we as a town shall inherit the fruits of their endeavors as we officially address the problem. We are a town of some 27,000 acres, of nearly 14,000 permanent residents and some 36 miles of coastline, not including each side of Broad Creek.

According to Dr. Pear Bruun, an island resident and internationally known coastal engineer, Hilton Head's erosion problem is relatively mild and can be solved through a proper study by experts with a thorough knowledge of the island and its surroundings to make appropriate

recommendations. Just such a study is presently in progress. Implementation obviously follows, but funding for such leaves this a very major question to be addressed. At this point in time we have no ready answers for the individuals whose property is being eaten away and who can ill afford the cost of nourishing a beach, rebuilding a dune or building a revetment or a seawall. Dr. Bruun, incidentally, considers these to be the three viable options for erosion control. Although the town assumes no responsibility for protection or restoration of buildings damaged as a result of natural erosion, we have adopted the rather strict controls that were set by Beaufort County. We have adapted them in our own development standards ordinance, requiring setbacks from primary dunes for construction, except for beach pavilions of less than four hundred square feet, beach boardwalks or other structures whose specific purpose is to protect or improve the beach and dune. I might add that our setbacks require a 40 foot setback from the top of the primary dune or 75 feet from mean high water, whichever is greatest. Our ordinance also includes this statement:

(I)n approving all new subdivisions of land or new construction permit applications within five hundred feet of Port Royal Sound, the Atlantic Ocean and Calibogue Sound, the Town Planning Commission shall give due consideration to the historic patterns of erosion or accretion to forestall subdivision of lots or parcels which face a substantial likelihood of being eroded away within fifty years. If patterns of erosion or accretion of the past fifty years (exist) then interject opposition to any development in this area.

We have other qualifying information in the ordinance to follow that.

Erosion control, as I said earlier, is not new on Hilton Head Island. It has been a major concern and subject of study at least since the mid-1950s. Much has been accomplished. So far as I know there is little if any immediate danger of a major structure on the island falling prey to the advancing tides, but unless appropriate action is taken, and by that I mean cooperative action as opposed to individual action, (that action then becomes counter-productive, we may encounter this threat in the future).

In North Forrest Beach, an area along the Atlantic Ocean near the center of the island's barrier beach, there is serious problem. Individual property owners have built stone revetments on the dunes at considerable expense, leaving some areas unprotected and subject to erosion which ultimately will undermine the stone revetments already in place. In only one area has a revetment been properly put in place.

In the area of Palmetto Dunes where that "big bump" occurs, the maximum outward curvature of the shoreline at that point creates maximum erosion. We heard that this morning. A scraping or panning process has been used there to maintain the beach.

Panning is also used elsewhere along that thirteen miles of beach along the Atlantic Ocean. A proposal is being considered whereby offshore sources of sand of the proper consistency, possibly from Gaskins Banks which is two to three miles offshore, will be barged in for nourishment, a very expensive operation indeed. Redirecting the Folly, a small tidal creek to the northeast of this Palmetto Dunes area, would drastically reduce erosion in the Palmetto Dunes area. In this area renourishment was essential to stabilize the eroded beach and with the addition of an artificial dune the result has been a wide and beautiful beach which, however, will require constant renourishment. Incidentally, plans are to use a special split hull barge, to bring this sand in from the Gaskins Banks, if in fact it is deemed practical. In the past "T" groins at each end of that thirteen mile stretch of beach have been used effectively and in their vicinity the beach tends to renourish itself. In fact, in one instance the beach area has expanded.

In the Sea Pines area on the southern part of the island, a dune breakdown caused by people has been a major problem; to the extent possible these dunes and all others must be rebuilt, repaired, and protected as they are what I believe to be our first line of defense. In a 1982 presentation to the Florida Shore and Beach Preservation Association Inc., Dr. Pear Bruun wrote, "the fate and the future of Hilton Head Island's beaches with particular reference to five to six miles of eroding shoreline lies in nourishment and protection of the dunes."

In addition to the ordinances previously mentioned, we have under consideration an ordinance which would prohibit the moving of a house across a dune such as recently happened on the island and which would possibly have broken

a major dune formation down. At the moment, our Council is working on such an ordinance and in a very short time we hope to have passed such an ordinance.

When rebuilt, dunes should be built to a height of sixteen or more feet and be strengthened by revetments along the dune face. At one area along this beach sprigging with sea oats has not been too successful, although sprigging with American beachgrass and (panicum) has also been successfully used. Along Fort Royal Sound, the process is less intense, although a five thousand foot revetment has been in place on High Bluff. This seems to be performing satisfactorily, although some renourishment has been necessary.

At the northernmost tip of the island, however, considerable erosion has taken place and dunes must be built up between Dolphin Head Point and Pine Island, which is just adjacent to that northern most point. Relatively few problems were noted along Skull Creek, that is, the Inland Waterway. At this point we have only lapping action, the water moves in rather slowly back and forth. There is a partial retaining wall and there are marinas along this area. Along Calibogue Sound, we find an escarpment cut by countless years of tidal action, along which at low tide a narrow beach can be observed. This area narrows into a peninsula called Bram's Point, bordered on one side by Calibogue Sound and on the other by Broad Creek. At the narrowest point of what is known as Spanish Moss Plantation, the scarp has eroded nearly to the very narrow road serving the residents of Bram's Point, and I might add that there has been some undercutting of that road at that point. Property owners have applied for permits for breakwaters or seawalls, but Coastal Council regulations will not permit bulkheads to be built far enough out to provide for adequate anchorage. Authorities believe that hurricane walls, from the low-tide mark inward, of boulders piled six feet high on filter sheets and properly sloped would provide adequate protection in this area, although some rip-rap has washed away.

In closing, let me say that we do have problems, albeit somewhat less than many. Beach problems are very real to those people most affected by them. To the degree that we can seek out and find solutions, we shall exert every effort to do so. At the moment, despite the many hours of research and study of Hilton Head's erosion problems, I would guess that it exceeds that of many communities, we are not yet satisfied that we have all of the answers that we want or

need. Perhaps we have some problems to which there is no permanent solution. So we shall continue to monitor our shoreline, examine all the new options and we hope to come up with some, if not all, of the solutions. Thank you very much.

HILTON HEAD ISLAND
PANEL DISCUSSION

MR. MONTGOMERY: To launch the discussion, I'll ask a question of Tony Niemeyer. Since you are active in planning and development corporations, had experience with and responsibility for corporations who are building in beach areas, and had experience with tidal systems, what should be the responsibility and the needs of private corporations who are building in beach areas?

MR. NIEMEYER: I think the best way to answer that is (that they need to) do homework up front. The best thing to do is study historical facts to know what the trends are on the island before you ever even get to the planning stages. Once you've collected all this data and put it together, then plan accordingly.

MR. MONTGOMERY: I suppose those (studies) cost money; who should pay for the work? Is it built into the cost of the development or (is there) something to help with that (cost)?

MR. NIEMEYER: Most of the developers will fund this themselves to protect themselves. (It is best to avoid fragmentation of this work, as could occur on Hilton Head Island where there are several development groups.) Each one could be doing individual studies and use them collectively.

MR. MONTGOMERY: Dr. Pilkey, from the standpoint of a person who is looking at this problem nationally, how different are the problems in South Carolina from other parts of the country? In general, in terms of what the communities are doing, is this best handled locally, does it have to be a local or state project?

DR. PILKEY: Well, I think the problems of Hilton Head Island are the problems... on all of the American barrier islands. Most of the American barrier islands are eroding on the front side. Basically, the response of this community is very similar to that of other communities. I think it's a response that in the long run will not resolve the problem. If the recreational beach is deemed to be an important aspect of Hilton Head, then I think Hilton Head is heading in the classic direction of New Jerseyization, even though...it's a long time away. My grandchildren will see a New Jerseyized Hilton Head unless something is done. I

think the community will never be able to afford replenishment (/renourishment) along the entire shoreline. The community, like all communities in South Carolina apparently seems to (approve and) construct seawalls for buildings that are in danger. Knowing how it works in other communities, and I've seen it in other states, we can expect those seawalls to grow in number, length, and abundance in the future unless something changes in terms of regulations. Ultimately on an eroding shoreline with an accelerating sea level rise, as per the recent U.S. Environmental Protection Agency report, we can expect the seawalls to destroy the beach. Whatever happens, ultimately the revetments and seawalls will end up with no beach in front of them.

The solution, I think, is to have setbacks, especially for condos, strong setbacks and there are very few states that can do that. A lot of states have setbacks, but not very many enforce them. I think you need to be willing to either move buildings or let them fall in when their times comes. The reason you want strong setbacks for condominiums is that politically it is very difficult to allow a ten-story building to fall into the sea. You also need a post-storm plan. When the next storm comes, it will destroy a lot of houses on Hilton Head, as it will everywhere. A good strong storm plan (is needed,) not allowing people to build back where things were built before.

Basically I see Hilton Head as being an island in serious trouble because it's doing what so many other islands have done in other areas of the country. I've yet to see an individual community along the American shoreline develop in anything but a vacuum. Everybody seems to have to learn the lesson for themselves.

Mr. MONTGOMERY: One quick follow-up question. To what extent is the federal government providing low cost flood insurance in the absence of setback restrictions (that) in effect help people to build close to the beach and then help them rebuild after their houses are (destroyed)?

DR. PILKEY: Well, the federal government's been guilty of some sad things for barrier island development in the past. I think the federal government has taken the first major step and I think we can see more steps in the future to get off the islands. I think communities like Hilton Head can expect less federal help in the future for replenishment or anything else. The island(ers) are basically going to be thrown out on their own, in my view.

As regards who minds the shore here, I think it has to come from a state level. Comparing North Carolina and South Carolina, South Carolina is light years away from North Carolina in terms of a viable coastal zone management policy for the beach. North Carolina, I think, leads the nation among all the barrier island states in having strong beach protection in the coastal zone management policy. Here's one quick example without going into detail, the State of North Carolina just ordered an individual who happened to be a Duke professor to remove a seawall from in front of his house. South Carolina is a long way from that.

MR. MONTGOMERY: Dr. Hayes and Dr. Dean you might comment just briefly. What seems to be, from the technical standpoint, the best thing to do as far as the erosion problem?

DR. HAYES: Let me comment on that a little bit. I can comment on what Dr. Pilkey had to say. First of all, to make the pronouncement that Hilton Head is in trouble sounds good to those that want to hear that sort of thing, but may not be correct. Most of these islands like Hilton Head in South Carolina go through cycles of erosion and deposition. It's conceivable that parts of Hilton Head Island will go into another cycle of accretion; so it's not necessarily "in trouble" in terms of prospects within the next few decades. Also the statement that he made about all islands being developed in a vacuum is wrong. I'm sure Tony (Niemeyer) wouldn't want to say that, because Tony planned Kiawah which is developed very nicely as far as beach erosion is concerned. They haven't as yet had any major problems with beach erosion, because they studied the historical trends of erosion on the island, or they paid for the study. They developed a setback line and consequently don't have any erosion problem.

Let me say something about Hilton Head. You might wonder about the theory about drumsticks that you heard the speakers talking about this morning, because Hilton Head doesn't really look like a drumstick, it looks like a runner's shoe or boot. The reason (is that the) two components of that island were formed at drastically different times. The upper part of the "boot" was formed at a higher stand of sea level, at least twenty thousand years ago. That part of Hilton Head was formed in a manner similar to the way Johns and James Islands were formed, it's what they call a "sea island." It's an old Pleistocene remnant that was formed when the sea level was higher. Then

there was a glacial period and the sea level dropped. The sea level later rose again and the rest of the island was formed. That's why it has a different shape. Now, the reason it has the part near the center, the bulge, as Tim (Kana) pointed out this morning, is because that's where the shoal from the big tidal delta offshore of Port Royal Sound meets the island. The bulge fluctuates back and forth as a new wedge of sand comes around the tidal delta and then another bulge comes around; it is not a rolling pin moving toward Columbia or anywhere else. It moves back and forth. Not to downgrade the problem that they're having right now, but we ought to keep the facts straight about barrier islands. These barrier islands in South Carolina are not like the barrier islands in North Carolina. Most of the barrier islands in North Carolina are what we call transgressive or eroding barriers. Some South Carolina islands are moving landward, that's true, but there are a lot of barrier islands in South Carolina that have accreted as much as a thousand feet since the Civil War. As far as Hilton Head's problems go, I guess I will agree with some of the things that Pear Bruun said in his memo and disagree with some of the others. (I would have to be asked specific questions.)

DR. DEAN: I think that there's a certain basic agreement here, at the panel table at any rate. I certainly agree with Tony (Niemeyer) that one of the first problems you should try to understand is the system: that involves the trends and fluctuations and history, response to storms, etc. Orrin Pilkey indicated that Hilton Head was on its way to New Jerseyization. Miles (Hayes) indicated that he wasn't so sure about that and I tend to agree.

I'm not so sure that an effective nourishment program costs any more than revetments. It is true that...the beaches do have to be renourished, if they are in an erosional trend, which seems to be a subject of some difference with regard to Hilton Head. Some of the nourishment projects that we're now having opportunities to monitor are very effective. They're also very expensive, at least initially, but I think they're lasting longer than people tended to think at the outset. It seems to me really that the jury is still out on whether beach nourishment would be effective in some locations like Hilton Head. I think one of the major problems is that nourishment requires a concerted action, whereas revetments can be carried out on a piecemeal basis. It seems to me that one of the operational problems is to try to aid or implement that

concerted action toward beach nourishment programs where they're needed and where they're warranted. Certainly beach erosion tends to occur on a spot basis. There could be erosion in one area that will threaten a dwelling and the landowner will be forced to build a revetment, thereby putting his investment in place. It seems to me one thing educational programs can do where it's warranted or needed, is to apprise the landowners of the need for concerted actions which will both retain the recreational characteristics of their beaches and also the storm protection characteristics of the beaches. I would say, looking at it from a pretty distant perspective, Hilton Head has an interesting avenue to these problems, but none of them are really critical. The future may not be so bad there, it seems to me.

MR. MONTGOMERY: Thank you. Let me open the floor for questions.

A SPECTATOR: I would like to ask Dr. Hayes a hypothetical question just for pure purpose of isolation. If the sea level rose a hundred feet or fell a hundred, would we still have beach erosion or land/water interface erosion?

DR. HAYES: The beach retreats or builds up in response to two principle factors. 1) The rate of the water level going up and down, 2) the amount of sand that comes into the system. That's the balance. That balance can change very quickly around a tidal inlet. At Seabrook, for example, when Captain Sams Inlet was cut, sand went on the beach quickly. There was a lot of sand coming on the beach in a place that had been eroding for about three years. It's now building out. That's because all of a sudden there's a slug of sand coming in. When you try to determine whether a beach will accrete or erode, you have to balance the two factors of sea level change and sediment supply.

If the sea level is rising very fast, there's almost no way that the beach can do anything but retreat. A good example of that is on the Mississippi Delta. I don't know if you're familiar with it or not, but the Mississippi River has switched channels many times over the past five thousand years. The river delta will build way out to the shelf and it gets so long that the river gets too flat and sluggish and a big flood will cut it off. The delta is left sticking out on the Continental Shelf and that sand pile is sitting

on mud, so it starts to sink, and I mean sink fast, like a foot or two a year, something like that, really fast. When it starts doing that the sea can move across it, erodes it right across the front. So some of the worst erosion in North America occurs on those abandoned lobes of the Mississippi Delta. If the sea level drops drastically, then you would expect the shoreline to build out. It's really the balance of the ratio of those two factors: sea level and sediment supply. A generalization can't be made about all the shoreline of the East Coast, because one place has a lot of sand coming in and in another place there isn't much sand. Presently, the sea level is rising slowly.

A SPECTATOR: Okay. Do the mechanics of erosion or accretion still exist at the new water level?

DR. HAYES: Yes. But look at it in the context of what makes the shoreline retreat over a period of, say, ten years. In Louisiana, for example, in one of those areas the shoreline might erode a half a mile in ten years. That's because the land is sinking and the sea is just going across it.

A SPECTATOR: So far everything mentioned has been concerned with the cyclic or gradualistic process but you have the catastrophic processes. For example, you can lose a half a mile in one night due to a hurricane. Now, we do not have any such instances that I know of along this coast. Nevertheless, what sort of planning is done for evacuation from these increasingly heavily populated barrier islands? The roads in and out are not adequate.

MAYOR RACUSIN: Perhaps I can address that because I've been involved in planning for hurricanes on Hilton Head Island for at least the past ten years. Prior to the appointment of an emergency planning officer for Beaufort County, we had a plan for Hilton Head Island that we thought might get everybody out. When our emergency planning officer came aboard, he took that and today we have an excellent plan, but the plan itself is dependent upon a number of things. One is the number of cars that we can move over one exit route in a given period of time. The other is that we do have the potential for the island being cut in two by a heavy surge of water. All of these things have been taken into consideration in a plan that has been developed for Beaufort County, a portion of which addresses Hilton Head Island. Fortunately we have two new high bridges which give us some means of security, ensuring that, all things being

equal, the bridges will be operable. We think that we're in reasonably good shape so far as hurricane planning and evacuation is concerned. Depending upon how the island builds up in the future, we may have to put a cap on growth in order to ensure adequate evacuation. That is something that we'll still have to address.

A SPECTATOR: I know this is the subject of a future conference, but my own information, how fast is the sea level rising now and is that expected to increase?

DR. PILKEY: I think there's pretty wide agreement that the sea-level is...(well, there's a lot of disagreement on it,) but probably the majority figure may be on the order of one foot per century and the recent EPA report suggested that by the year 2100 the sea level... the scenarios, all of which have a lot of uncertainties, lead to figure (of)...a two foot rise to a ten foot rise by the year 2100. Two feet being the minimum expected and ten feet being the maximum. I think in any case that it's prudent to expect the sea level rise to accelerate.

Not only can we expect the shoreline erosion rate on Hilton Head to increase because of this, but I think it's important to not forget the factor that has affected so many other states and that is, these islands tend to be interconnected in a long-range sense. Sand flows across inlets in one direction or another, especially during storms and that's all part of the sand supply system. South Carolina, like some of the other states, is building sea-walls, jetties, and groins, which is slowing up that sand supply considerably. In the State of Texas where they've actually looked at the impact of stabilization on the shoreline erosion rate, Robert Morton has estimated that it has had an "important impact on the rate of erosion on the entire coast of Texas." He said "important" without putting a number on it, but he did say that fifty percent of the sand supply of the entire coast has now been tied up by the jetties; so there is this additional factor of man that has an impact on the erosion rate.

A SPECTATOR: Addressing the panel on Hilton Head with all the knowledge that each individual person on the panel has, together with the Mayor of Hilton Head, with your knowledge, what would you do in the next ten years on trying to help the new city plan for the erosion as it occurs today?

MR. NIEMEYER: Let me speak to that. I think setback lines are something that are going to come and I think that you need to prepare for that and get the best available scientific help that you can in establishing those lines and go ahead and establish them. I like Ben's (Ben Gregg) statement earlier about not necessarily making them mandatory, but go ahead and have a line that you identify and let people understand and educate the public as to the problems they can have if they get in front of that line.

DR. PILKEY: I would monitor the beaches very carefully so that I'd know how much sand is being lost. Erosion is often a redistribution of sand from one place to another. Of course, if you're in an area that's losing sand, then you have beach erosion and if you're in an area that's gaining, then you don't. A lot of times the maintenance problems on an island such as Hilton Head can result in redistributing the sand along the beach. It's important to know the magnitude of the problem you're dealing with to find out fairly precisely how much sand is being lost from your system, because that's important. If you do a nourishment project, you've got to replenish that amount of the sand from offshore, which is a fairly expensive operation, but redistributing is a much less expensive operation.

MAYOR RACUSIN: If I may just comment. This is precisely our plan and goal, to continue to monitor, to set up study teams. As part of our planning commission, we had a beach erosion committee which will be coordinating this. I think that this is a must. The other thing that I think and perhaps this was what Mr. Niemeyer was approaching, is a coastal setback line for the entire state, rather than just locally established. Thank you.

A SPECTATOR: Yes. I'd like to ask two questions about the quality of the sand. I have heard that in order to renourish the beach you have to match that sand exactly. Is that true?

DR. DEAN: I certainly don't think you have to match the sand exactly, but by quality of sand as far as stability and performance is concerned, the sand that you place on the beach should be as coarse or coarser than the native materials. It's not essential. There's a beach in Florida that's been nourished a number of times with finer sand, but it just tends to be carried away more rapidly. First of all, if you place a certain number of cubic yards of sand on

the beach, a certain volume, then the finer sand has a milder profile so it tends to equilibrate to a farther distance offshore. You're left with less usable beach, even if it all stayed in front of the area of placement, but in fact it doesn't even do that. It tends to be carried down the beach more rapidly. The rule of thumb is that the sand should be as coarse. If you can find a little coarser sand, but still a good quality for beach bathing, then you're even farther ahead.

A SPECTATOR: I'd like to go back to the New Jerseyization of South Carolina for a minute. I don't know enough about it but was questioning Dr. Hayes on what he says is continuing accretion. That's fine, maybe it will accrete, but in the meantime to protect property people are putting rocks, etc., to stop the undermining of their property. The New Jerseyization of the South Carolina beaches has just begun. New Jersey started when I was a child. I saw it. I've heard your argument before, that it is all accreting. I live on Seabrook where indeed sand may be accreting now, but (as a result of past erosion) we have rocks there that are not removable according to Tim (Kana). They won't be removed. So we can't have a good beach again, can we?

DR. HAYES: I did not mean to imply, if you understood me to say all beaches in South Carolina are accreting. That is not what I said.

A SPECTATOR: Well, Hilton Head is...let's take Hilton Head.

DR. HAYES: I said sometimes it accretes and sometimes it erodes, but the general trend in a historical context is that it accretes. That's true of all these barrier islands, the big ones like Hilton Head and Kiawah and Seabrook. Otherwise you wouldn't see the parallel lines of trees. We have cored (many of these islands) we've dated them, we can draw lines showing when they built out. Now what I'm trying to say to you is that all the beaches in South Carolina are not retreating. We've tried to deal with the truth. The truth is that the beaches move back and forth. That's the truth.

A SPECTATOR: But the truth is also human response of putting...(rocks on the beach).

DR. HAYES: I agree with you. It's a bad idea in general to put rocks on the beach. I've never once in my life recommended putting rocks on the beach. But let's try to keep the facts straight, which are that in general on the barrier islands of South Carolina over the past three thousand years these islands have accreted. What that tells me is it's possible to intelligently deal with the problem. It also tells me that every beach in South Carolina will not necessarily look like New Jersey, not if we deal with it correctly.

DR. PILKEY: I'd like to respond. I think the important point, Miles, the thing that has happened on many North Carolina islands in the last three thousand years is they've been going seaward, but right now most of North Carolina and most of South Carolina is eroding, the beach is retreating at this moment, perhaps in response to the 1930s sea level right now. I know there are islands that are building up, perhaps with sand from Folly Beach and so forth. But basically we are eroding, the shorelines are eroding now.

DR. HAYES: Some shorelines are eroding and some are accreting. I don't know exactly what the percentage is but we determined that rate on every inch of South Carolina's coast. We have a publication out front there if you want to look at it, you can tell exactly how beaches have eroded and accreted in South Carolina in the historical context between 1939 and 1976. If you want to know go look in that book and you can tell exactly what the beach was doing between 1937 and 1976.

MR. MONTGOMERY: Any more specific questions about Hilton Head?

A SPECTATOR: I want Dr. Hayes and Dr. Dean to tell the Mayor of Hilton Head what they would suggest as the general thing to do at Hilton Head. He said it doesn't have to be New Jerseyization if you do it right. What is right?

DR. PILKEY: I think they ought to have strong setbacks, have a post-storm plan, they should be prepared to either let buildings fall in or move them and that's fundamentally my idea. I would like to see the time come when the government of South Carolina can say what the government of North Carolina has said with regard to a line of beach houses, which are in the surf right now, just north of Nags Head. The Governor of North Carolina said we're not

going to protect those buildings because in order to protect them we would probably destroy the beach, so we're letting them go. But meanwhile the community flourishes.

A SPECTATOR: In certain cases, the Hilton Head shoreline is gaining. The south part of the beach is building (out) a lot of the beach. North of Port Royal is building because of the jetties. In Palmetto Dunes, there is tremendous erosion. The question is: If you were Mayor and we had tremendous erosion there, with your knowledge, tell us or the City of Hilton Head what can we do in the next five years to keep that erosion at a minimum or maybe even build up.

DR. HAYES: Bob Dean looked into the possibility of nourishing the beach. That's what he was talking about when he said that nourishment projects, where you bring fairly large volumes of sand, require an analysis of cost and benefits. Somebody that studies it carefully can probably tell you how much it's going to cost to put it there, how long it's going to stay there and then you'll have to decide if it's worth it or not. It won't stay there forever, but it would certainly slow down the erosion for some time.

Now, if you want to keep it there longer, the way that many engineers are dealing with that now is to develop what is known as an offshore breakwater. You put a structure offshore and then the beach develops an equilibrium form in between these offshore structures. In fact, in Japan where they have very intense use of the shoreline, and it's very important to the people that live there, they've gone over to this technique and almost all the areas of severe erosion are being dealt with by this method. It's rather expensive. It would be cheaper probably just to dump the sand on there and let it wash away through time, but if you want a solution that is more permanent, you would probably go to the offshore breakwaters. It's been done in many places. We're not talking about magic. There are many examples of how erosion has been slowed down around the world. It just costs a lot of money and the question is do the people in Hilton Head want to spend the money to do it.

MAYOR RACUSIN: There is already in place a proposal which will be considered next week for doing precisely what you say, Dr. Hayes. That is, going offshore, using split hull barges, bringing that sand on the beach. It's going to be a continuing...obviously a continuing operation, but this proposal has resulted from many long hours and a lot of

people considering it. But as Mayor of Hilton Head Island, I would like to also say that we in no way wish to denigrate New Jersey. We think New Jersey is a great place to be from. Although I'm not from New Jersey, I did come from up north. We also think that Hilton Head is a great place to come from and to the degree that we can solve this problem we've been discussing here today, we are certainly going to move along the lines that we will find appropriate and we certainly thank you gentlemen for your advice.

COASTAL CASE STUDIES

MYRTLE BEACH

THE HONORABLE ERICK B. FICKEN MAYOR, MYRTLE BEACH

MAYOR FICKEN: Thank you very much. Thank you, John, distinguished panel, my friend Tony Niemeyer, and ladies and gentlemen. It's a pleasure to be with you on this occasion. It's been a great day, a very enlightening discussion and a very important topic for the State of South Carolina, "migrating beaches." I want to thank the Sea Grant Consortium for pulling this together, because I think it's very beneficial. Obviously by the interest and the attendance that we had today, a lot of you think so also. I also want to thank them for not seating me between Dr. Pilkey and Dr. Hayes over there. Maybe we ought to put Tony Niemeyer in between them. I don't know. I'm sure they'll get along all right as we move forward.

A lot has been said about the migrating beaches, at one point Dr. Pilkey mentioned that the State of South Carolina is light years behind our neighboring State of North Carolina and other areas, I think that may be the case. I would follow that by saying that we're light years ahead of where we were ten years ago in the State of South Carolina. Those of us who were involved seven or eight years ago recognize some significant changes in the state's ability to deal with the beaches and coastal areas, the wetlands of our state. I think we've made great progress. Indeed, there's a long way to go but this type of forum, the creation of the Sea Grant Consortium in its present condition, the Coastal Council as we know it today and the work that they're doing with the wetlands across our state, have helped us come a long way in dealing with some of the problems of our coastal regions. I think with that background and that history we'll be able to move forward in the next few years and maybe catch up that light year or pass it without too much delay.

I will speak to you briefly on what's been happening in Myrtle Beach for the past few years, some of the things we've seen, and some of the things we've done in an attempt to deal with the erosion that we've seen in the past three to six years.

Myrtle Beach is located on what's called Long Bay. You only need to remember the crescent shape of the moon and that is the shape of the Grand Strand. Certainly our problems are different than some of the barrier islands. We are separated by a man-made cut of the Intracoastal Waterway from the mainland, but we are basically a part of the mainland. There have been a lot of comparisons with New Jersey and other places, but my observation is that there's really no final answer or no (comprehensive) answer to deal with the problem at Myrtle Beach the same as you would deal with the problems in New Jersey (or on the) barrier islands of South Carolina. (Each place has) many contributing factors that cause the movement and migration of sand.

Historically, at Myrtle Beach, we've had a very stable beach. Up until 1971 or 1972 most folks didn't worry about erosion because it just didn't seem to happen. Things stayed in place and the beach stayed there and there wasn't a whole lot of concern about it. In 1972 and 1973 development increased substantially. If you looked at a chart of building permits, you would see them jump right off the top of the chart in those two years. If you looked on this year you'd see them doing the same thing, just like they did ten years ago. Now, I think development has led to some increase in our problems. In fact, some of you may have seen the study done out of Chicago that projected that Myrtle Beach and the Grand Strand area would be the second most rapidly growing area in the country during the next three years of cities less than 500,000 people, behind Ft. Myers, Florida. We're going to continue to see development and growth. What we've attempted to do in our area, in Myrtle Beach particularly, is to deal with that in a proper fashion so that we can have some control over it.

There is a syndrome on Hilton Head and indeed in some other places. I think I heard somebody talk about the peninsula of Charleston as I was coming in, and it's there in Myrtle Beach also. I call it the "Drawbridge Syndrome," that says "Eureka, I'm here, now, pull the bridge and don't let anybody else in." I think it's going to take some careful management to deal with that attitude in rapid growth areas. South Carolina will be one of the fastest growing states in the country during the next decade, and that's going to take some very careful management of growth, not necessarily controlling or limiting, but managing growth and development. That's where I think we need to be and

that's where we have attempted to be in the past few years.

(I will talk to you now about) some of the overall erosion that we've experienced in the last seven or eight years and what's happening now. If you've got a motel or a swimming pool that's about to fall into the ocean, you don't care that over the past three thousand years sand has been accreting on our beach. The problem brings political pressure on the elected officials to do something about it now, whether it's right or wrong; that's the kind of pressure that we in local government have to deal with.

(Seawalls are a measure which we have historically been against in Myrtle Beach, but which have been used to deal with the erosion problems.) We recently experienced a series of significant northeasters. Damage to existing vertical concrete seawalls was shored up with rip-rap, as the beach was scarped in front of the seawalls by waves hitting the seawalls. In some places, the drop in beach level was significant. (We also have a problem with these seawalls or revetments, they were built on an uneven line down the beachfront back in the 1970s.)

Outfall lines of corrugated pipe carry stormwater off of the streets and parking lots (directly onto the beach). That process was begun a long time ago, to deal with handling stormwater and the easiest thing to do was to let it run downhill, which happened to be on the beach. This has led to and created a worsening condition for our erosion process. Scarp lines cut into the dry sand beach area there (near the outfalls). (There is a wastewater sewer line (on the beach) that used to be below sea level, and is now exposed. If something is not done, it will pose a continuing problem for the City in its efforts to deal with the erosion of the beach. (We must have over 200 of these outfalls on the beach.)

We've been very pleased with the response from the South Carolina Coastal Council and financial assistance providing the dollars to build dune crossovers at many of our public access points. If you compare beaches, the City of Myrtle Beach has more public access points on its beach than any beach I know of. In an attempt to maintain the dunes that still exist, we've built numbers of crossovers at public access points. (They) have been very well accepted and have done a good job of helping maintain our dunes in those areas.

We began the sand scraping and panning process three years ago after we established bench marks on the beach in 1982. We began the process of removing the sand at low tide and on the berm that builds up at the lower edge of the water and re-depositing it up at the base of the primary dune and then shaping it with a bulldozer. This has been a very effective, temporary process of maintaining, if nothing more, the aesthetic quality of Myrtle Beach.

I said we've consistently been against seawalls. We have passed an ordinance that directed how and where seawalls could be built. We now do not allow any vertical seawalls in the city. We require them to be built on a 2:1 slope. In fact, if we could disallow them entirely, I think we would do that. As I think Dr. Pilkey mentioned, it's a continuing process, once you build one (you have to build more). We've attempted to minimize the detrimental effect of the vertical seawalls. We now have in place a Shoreline Management Committee working to study our problems and to establish some controls and development along that area. We're pleased with that effort, and I think we'll see some good results soon.

There is, I think, no final answer. Some of us are searching as if we could come up to a final answer and say, okay, this is the cure-all to the erosion process. Realistically that's not going to happen, even with the best of results we're not going to see a final answer, because things change. Certainly the dynamics of our beachfronts change on a regular basis.

I think it is important to point out from a municipality standpoint, that we have taken considerable steps in dealing with erosion and met those with some financial assistance from Coastal Council, but very little assistance from anywhere else. It is not realistic for the City of Myrtle Beach to maintain a recreational beach that attracts nine million people during the year to the State of South Carolina, that in fact produces two-thirds or better of the billion dollar tourism industry that the State of South Carolina enjoys. It is just not fair to ask those 18,000 people to foot the bill. We need state assistance. We need state assistance in the form of setback lines or the permission to have setback lines with the backup of the state government. We need revenue sources. The accommodations tax is vitally needed, not that it's going to be the cure-all to the erosion process, but it is a vital

revenue source that allows some of those nine million people who enjoy the State of South Carolina and the Grand Strand to contribute to solving some of the problems and the demands that are placed on our local communities. We need a General Assembly and a state government aware of the value of the beaches of the State of South Carolina, and willing to back us up. I think local governments across the state in our coastal communities are willing to take the tough stances that are needed, but they're going to have to have some support and back-up from the higher levels of government.

I thank you for your attention and giving me the opportunity to be before you today.

MYRTLE BEACH

PANEL DISCUSSION

MR. MONTGOMERY: Let me direct a general question to the panel. The problems of Myrtle Beach seem to me more akin to Miami Beach, for example, than they might be to Hilton Head. Could you address from each of your viewpoints what significance that might have and what suggestions you might have to approach the problems in Myrtle Beach?

DR. PILKEY: I agree with almost everything that the Mayor said. I think that in the case of Myrtle Beach, replenishment (renourishment) with federal, perhaps federal and state, aid is more than justified. I look at Myrtle Beach as being South Carolina's Coney Island where you have six hundred thousand to one million people in a single day enjoying the shoreline. When you have that many people enjoying the beach, then any amount of money that is required for replenishment can be more than justified. Myrtle Beach seems to me to be that type of situation. I don't think you have six hundred thousand to a million people a day on the beach, but this is quite different from Hilton Head where the major problem is that houses are going to fall in rather than that the recreational beach is disappearing. So, it's an entirely different justification and I think the chances of getting federal or state aid are greater in Myrtle Beach and they should be, in my opinion. We're talking about an answer to a lot of the problems in South Carolina that is too costly for the whole state. I think a good generalization for a (replenished) beach is a million dollars a mile and I don't think you can predict how long a replenished beach will stay on. A replenished beach that stays there for a decade is a good replenished beach. In North Carolina we haven't had one of our three beaches that have been replenished stay that long. Recently in Florida I talked to citizens and city managers of Pompano Beach and Hope Sound. Hope Sound was on its second replenishment in six years and Pompano Beach was on its second or third replenishment in about that length of time. They were quite surprised that the beach had disappeared that quickly. That's a major problem with replenishment. I think another problem with replenishment, as I've seen in Jacksonville Beach, Florida and in Carolina Beach, North Carolina is that replenishment tends to change development patterns. It might not happen in Myrtle Beach, but in Carolina Beach, North Carolina, the low-cost small beach

cottages are suddenly now being replaced by condominiums. It's a very rapidly eroding beach and I don't believe the replenished beach will last more than four or five years. When the shoreline is back to its former position, at a cost of four million dollars per mile, there will be an entirely different political situation, with high rises or large condominiums instead of small cheap beach cottages and the response therefore cannot be nearly as flexible.

DR. HAYES: You can't predict how fast the beach will erode without some kind of detailed analysis of the transport processes on the beach. The way to do that is to try to get a seasonal average of the wave conditions and by making the proper measurements of how big the waves are, what angle the waves approach the beach and other kinds of measurements, then a fairly accurate estimate of how long a given volume of sand will stay on that beach can be made. If you look at Myrtle Beach in an historical context, which we have, it's quite different from the other parts of South Carolina. In an historical context, not the last three thousand years, but the last thirty or forty years, it's been relatively stable. Now, the Coastal Council has sponsored a project to analyze the erosion at Myrtle Beach, which is being done by Tim Kana and two of his associates. Generally speaking, the mistakes that have been made in Myrtle Beach, and Tim can correct me if I'm wrong, have had to do with not having a decent setback line. A lot of those structures have been built right on top of the dune. In some cases, they have just flattened out the dune and built, not leaving any space for the beach to fluctuate. If you understand the beach in a given locality you can predict fairly well what that fluctuation distance is and then you can draw reasonable setback lines. Erosion at Myrtle Beach is a problem that was brought about by unwise construction practices over the last few decades and in my opinion doesn't have much of anything to do with rising sea level.

To deal with the erosion is going to cost some money. It's similar in some respects to Hilton Head in that it's probably to be solved by nourishment. The size of the project has to be determined. The sand could be added in small increments or in one large increment. It's not a bad place to do the offshore breakwater solution; but that's very expensive. I don't think offshore breakwaters would be necessary in this particular case.

MR. NISMEYER: I just wanted to ask a question (of Mayor Ficken), and I'm thinking a little bit into the

future. If you had a setback line established and you also had a zoning ordinance or some sort of building criteria that says you replace the older buildings with lower density and go toward higher density as you move farther away (from the beach), you have to start somewhere. Once you establish the (setback) line, then beyond that point when something goes in there you go the low density, closer to the ocean and then you back that up with higher density farther away and offer some way to transport the people to the beach.

MAYOR FICKEN: I like that concept and I guess the word "density" is how I got involved in this mess anyway. The city passed a "density ordinance" in 1974 that I didn't agree with. It said that we would make the density 1500 square feet of land area per unit, which equates to twenty-nine units per acre and it did not equate to hotel units at all, just to condominiums or apartments; so it really was no density ordinance at all. The concept of restricting density on the front and allowing the greater density as you move away is a concept that I agree with. Since I don't have but one or two of my constituents out there (in the audience) I think I can say here that I agree with that. It would not be received very well at home, I'll tell you that.

MR. NIEMEYER: Well, I was looking to the future; you could adopt or at least work toward the adoption of some of those types of programs in the future. If it accretes then you're okay; but if you have an erosional trend that continues, at least you'll have planned for it.

MAYOR FICKEN: I think that's vitally important and a very good suggestion.

DR. DEAN: I'd just like to agree with Orrin Pilkey in that it seems that your figures justify beach nourishment and replenishment programs, as the nourishment does tend to be eroded away. In a sense, Myrtle Beach is regarded as a state facility because it does draw many people and thereby free up some of the other beaches for more pristine use, if you will. The concept of setback lines is good and interesting but if you do have an erosional trend, all it buys you is time and it buys you nothing more than time. Although Miles has brought up another point that a setback line is the zone that you need for the natural fluctuation.

I don't like seawalls of any kind, but in your case seawalls may take in a little bit of an unwarranted "bum rap," because I think everybody on this panel will agree that seawalls do not remove sand from the system. They hold some sand out of the system, but if you put in a seawall, it's not going to take one cubic yard of sand away from Myrtle Beach, and so the same sand is there and you have to start (with), some basics like that.

I would like to say a little bit about replenishment duration that Orrin (Pilkey) has addressed. The cost has been brought up as a million dollars a mile, with questions about how long that will last and so on. One of my good late friends who was not trained in coastal engineering had a very interesting analogy: when one initially nourishes the beach then basically one is trying to set it back in time. If there's an erosional trend, and in many areas there is, you're trying to set it back in time maybe twenty or fifty years.

If there's an erosional trend of a foot per year and you spend a million dollars a mile, then you may be putting the shoreline seaward where it was fifty or one hundred years ago, so that's not really a fair maintenance cost to try to extrapolate. I think the cost per year per foot is more on the order of maybe ten dollars or so or with the beach erosion projects in Florida. It's difficult to give

you some of those figures, but they've lasted very well. The Miami Beach project is a case in point. One thing that we found is that the longer you make a beach nourishment project, the more successful it is. A beach nourishment project tends to unravel, the sand tends to be carried away from the ends. The way it works out is that, if a beach nourishment project one mile long loses half of the volume in a certain number of years then a two mile long project would take four times the length of time to lose the same percentage of materials (these are just theoretical examples.) In the case of Myrtle Beach where it is regarded as a state facility, it is useful to think of the beach like a building, a car, or a road: they all require maintenance.

On the lighter side, perhaps some of you wonder what the panel up here represents. I don't think we have any easy solutions because there probably are none to beach erosion. One of the characteristics of this panel is that we've seen a lot of things that don't work. You tend to get a bit jaded because of that, but one thing that I keep coming back to is I think a lot of beaches, like Myrtle Beach, really need sand. Anything you can do to put the sand in the system is going to provide a benefit. I think sand panning or scraping, is acknowledged as a short-term solution. A long-term remedy, if we're going to try to maintain a recreational beach is always going to require putting sand in the system if the background includes an erosional trend. There's no other way around it.

MAYOR FICKEN: I want to respond to a couple of things there, Dr. Dean. That's about all we have done is some beach maintenance and moving sand around. I think the seawalls, the vertical seawalls, may not cause a loss of sand but certainly lower the beach at the site. The point that you made about the length of a renourishment project is very important in the case of Myrtle Beach, because we're as a city we're just thirteen miles of a fifty mile strand, and I had great fears of the City of Myrtle Beach trying to do something on its own and my good friends from Surfside sitting there receiving all the benefit, just down south of Myrtle Beach. I think that speaks to the need for a higher level of government participating so that the Grand Strand area can be dealt with as one entity because there are no magical lines on the beach that deal with our problem.

MR. MONTGOMERY: Let's open it up for questions. Try to take immediate questions just pertaining to Myrtle Beach and the more general ones we'll take later on.

A SPECTATOR: I live in Garden City in the summer and Conway in the winter time. Let me thank the panel for accepting Myrtle Beach as a state beach. We appreciate that and we realize that some of you might work for the state. That's where the state gets most of the taxes.

Is it possible for a dredging machine, like they dredged the Inland Waterway, to sit off the coast just a few hundred feet, because I'm sure the sand that has washed off the Strand isn't far, and pump that sand back on the beach? If it can be done for thirty million dollars for thirty miles, that would be the best money ever spent. Is that possible?

DR. DEAN: Well, you said a few hundred feet offshore. I'd like to see that material be obtained from a much greater distance offshore. If you think about it in an annual cycle, then probably that several hundred feet would be closer to a thousand feet, at least out to the winter bar, if there is a winter bar in that area. I think that probably it doesn't matter too much whether you're pumping within a few hundred feet or even a mile offshore. The critical distance is about a mile; that is, if you pump for more than a mile you have to put in an extra booster pump. If there's good quality material within a mile offshore (that's a critical factor with regard to Hilton Head) then I think probably it's better to go farther offshore. Otherwise you get this "short-circuiting," where you put the sand up on the beach, high tide comes up and pulls it back. The farther you go offshore, the better, out of the active zone, maybe a thousand or two thousand feet, depending on the severity of the storms during that particular year.

A SPECTATOR: But you think that is possible?

DR. DEAN: I think it is possible. The million dollars a mile costs of dredging have gone up dramatically in the last decade. They've gone from maybe a dollar and a half to six dollars, maybe up to eight dollars, but at any rate I think probably two million dollars a mile or something like that is probably practical. I think that would last you much more than a decade. Early this week I was down on a small island in southwest Florida. Although the wave height is not the same (as in S.C.), they put in a beach nourishment project of only a mile or mile and a half in length, in 1981. It's losing ten percent of its volume per year, so it's a very short project. But it will last a decade. In a decade it will be back where it was two years ago.

MAYOR FICKEN: Dr. Tim Kana and his associates have completed, just this past year, an offshore sand survey. We studied the sand locations and deposits off the coast of the City of Myrtle Beach and know that the sand's out there and know that we can bring it on shore. The cost and paying for it is something else, but we can develop a means to do that. It's certainly one of the things that we're ready to begin exploring.

A SPECTATOR: You continue to talk about the initial placement of the projects. How do figures change when you come back with a second placement of the project? Is the second placement of the project more stable than the first placement if you're getting your sand from this resource?

DR. DEAN: That's a good question and I probably should preface everything by saying that I'm basing my remarks on the presumption, although it's probably not true, that sea level rise is going to continue about as it has in the past. Orrin Pilkey has mentioned the other side of that coin, but basically it depends on how long you wait before you renourish. My understanding of the problem is that if you were to advance the shoreline fifty feet seaward or something, it would behave the same way (as) the first time around. There is no real additional benefit that I see the second time around. I might mention that if one does place a short beach nourishment project or if it's on a barrier island where sand tends to be lost around the tips of that barrier island, we found that "retention structures" or "terminal structures," basically structures that keep the sand from bleeding off around the tips of the barrier islands or from the ends of projects, tend to be very effective.

A SPECTATOR: With as many pipes as you have (at Myrtle Beach), how do you cope with the pipes that are above ground level at low tide?

MAYOR FICKEN: Those have caused problems in some areas. With heavy storms, a lot of rain water, and at the same time, a high tide, those drain pipes have taken the water back inland and caused some severe flooding in some areas. Our present method of dealing with that is to have passed an ordinance that requires developers to try to maintain the majority of their stormwater on site, to handle their stormwater so that it doesn't increase the problem that's been created over the past couple of decades. We've also had a study done with the help of our regional planning

commission of a stormwater run-off solution. It's a \$30-40 million solution to collect that water and run pipes subsurface out into the ocean and let it disperse through perforated pipe or to collect it on the oceanfront and pump it to the Waterway, which is a pretty expensive ongoing process. So, the short-term solution has been to ask developers and to require developers to deal with the stormwater run-off on site by some means of containing it, and we hope to develop a long-term solution and be able to solve that problem.

A SPECTATOR: But the ones that you have now, what do you do about it, how do you cope with it?

MAYOR FICKEN: We just live with it and get a lot of phone calls.

A SPECTATOR: They just put jetties at Little River. Is there any provision made to transfer the sand from the north side of the jetty to the south side?

DR. DEAN: I think the Corps of Engineers recently constructed jetties both at Murrells Inlet and at Little River. My understanding is that they originally designed those jetties with weirs for handling the sand, and there's a low section in the jetty on both sides. They constructed the Murrells Inlet jetties first and found out that the transport up there was not as great as they had thought. When they built the Little River jetties, they didn't construct the weir part of the jetty, but they are actively monitoring. If they find that the sand does need transporting, there are provisions for that. That was in the original design and then they decided to adopt a "wait and see" attitude and decide whether to implement that feature in the design.

A SPECTATOR: Isn't there a special movement of sand from north to south along the coast?

DR. HAYES: We've never studied that particular question in detail as far north as Little River; but down in the middle part of the coast of South Carolina, the longshore transport rate is about 200,000 cubic yards of sand a year, moved past a single place. That's from north to south, but as Bob (Dean) pointed out there's a change as you go farther north. In fact, there's a big accumulation on the south jetty at Murrells Inlet. One of my students, Dennis Hubbard, said that years ago. I didn't really believe it, but it turns out that there is some kind of a reversal

right at the jetties. If you go to the jetties at Huntington Beach State Park, there is a big accretion on the south jetty.

DR. DEAN: It's (difficult to determine) that's not shoal material moving in.

DR. HAYES: Yes, it's kind of hard to say. The provision is in the Corps of Engineers design in case there is a problem with accretion on the north side and erosion of the south side of those particular jetties. The arcuate strand (the Grand Strand) has more or less adjusted to the dominant wave approach, so that the waves are coming in closer and closer to straight on through time. When the waves come straight on the shoreline, you don't get longshore transport. Farther south, that's not the case. The waves strike the shoreline at a bigger angle, so as you go farther south in South Carolina, generally speaking, the rate of longshore transport increases.

MR. NEIMEYER: Erick, I want to ask you one quick question. Has anyone done any studies on recycling of sand? For example, have a pit, if you will, that's located somewhere south of the city that has pumps and discharge lines built into it. You pump out of this region northward, (the waves) drift this sand southward and then it fills in the hole again and you recycle it. Has anything ever been done or have any studies been done in that area? You (could) actually find a place that is relatively stable to start with that you know will trap the sand when it comes back later.

MAYOR FICKEN: We really haven't done any studies in that area. Myrtle Beach is in the center of that crescent with jetties on each end. I don't know whether Garden City jetties are collecting any sand or not.

A SPECTATOR: There's a deposition basin there (near Garden City, the north Murrells Inlet jetty). Although I don't know how it's been filling in, the plan was that the sand that drifted past Garden City would go into the deposition basin. Periodically it's supposed to be pumped over the south jetty to renourish the beach at Huntington Beach. That's the plan. Now, whether funds for this will ever come forth is another question.

DR. HAYES: But right now it's not eroding south of the south jetty. As Bob pointed out, it may just be because the new jetties freed up some sand that was offshore. We

haven't really looked at that in detail. That's a possibility, but it wouldn't make sense to pump it right now because it's accreting.

DR. DEAN: There's no sand in the deposition. I think that's the other point.

MAYOR FICKEN: From a city standpoint what we have are different political entities. Unless we're talking about a comprehensive plan to deal with the Grand Strand, it would be very difficult for us to create a pit on the southern extremity of our little stretch and expect it to work. That's something that we haven't talked about anyway.

A SPECTATOR: I'd like to address this to Mayor Ficken. When you go out in the City of Myrtle Beach to scrape this sand, referring to the build-up out there, and carry it back to the scarp line, is this a continuing process in the City of Myrtle Beach now?

MAYOR FICKEN: It has been, Fred. (Fred Holland, Council member from Folly Beach with whom I had the pleasure of serving on council in Myrtle Beach.) We have been doing the panning process for three years, I believe. I think we did the best job this past winter and spring ever. We did that looking at the bench marks and knowing exactly where the sand had built up. We took given amounts of sand from the berms that were created and moved it into the areas that were selected. In areas where the berm hadn't built up we didn't move any sand. We did it with more knowledge and expertise than we've ever had before. The more information you have have about what you're doing when you do it, the better off you're going to be.

We've been pushed and urged, as I'm sure you have in Folly Beach, to do things immediately, i.e. "the storm came last night and the swimming pool's in danger, do something today," but we're trying to be very careful not to take action that would cause more harm than the ultimate benefit might be. Sometimes that's not easy to do, but I think this past year we had tremendous success.

A SPECTATOR: Is this being paid for totally by the City of Myrtle Beach?

MAYOR FICKEN: We've had a little help outside and we've had some help from the property owners on the oceanfront, some assistance from the county, but by and

large the city has footed that bill. It's part of the maintenance on the land that Dr. Dean was talking about.

A SPECTATOR: I don't mean to be antagonistic, but I'm doing this to express a point of difference. In the list of causes of erosion that was on the slide this morning, it appears to me that elements were missing. One of them is earth's (Coriolis effect?) and the other is coastline orientation on beach property. Of course, it's not been proven and it remains to be proven. On the Brunswick County beaches, just above the North Carolina line, we have practically no beachfront erosion on all beaches. As we go just a few miles to Carolina Beach which has a north-south orientation, we have severe beachfront erosion. However, in Brunswick County where inlets are north-south oriented, there is severe inlet erosion. The beach corners are cut off sharply. I believe that the earth's (Coriolis forces?) are primarily the cause of this, from the beach geometry. I also believe that the earth's (Coriolis effect?) gives you the condition where you have the highest tides on the beachfront when the wind is blowing parallel to the beach instead of onto the beach.

MR. MONTGOMERY: Any other particular questions?

DR. HAYES: I agree about the orientation comment, that's very true.

A SPECTATOR: I want Dr. Hayes to talk more about the offshore breakwaters in Japan, the materials they used and the cost? If you look at fifty years; (what is the) cost of continuing to replenish as opposed to the cost of putting in the breakwaters?

DR. HAYES: The reason I know a little bit about Japan, to give you a little background, is that I just finished writing a book for the National Park Service, entitled Beach Erosion. I did a case study on the Japan coastline. I'm not real interested in the details of the costs. Maybe Bob (Dean) can provide this.

The evolution of beach erosion in Japan is very interesting; you can trace it back to the impact of man. In fact, one thing that you'll find is that man has had a big influence on erosion in a lot of different places. In Japan, what they did was build dams on the rivers which were (providing) the sediments for the beaches. That's a special case because they're short steep rivers and the sand is dumped right on the beaches. They went through an evolution

in Japan in trying all kinds of different structures, everything. This seawall didn't work, that didn't work, etc. In the last ten years or so they've started using offshore breakwaters. Using the breakwaters has had a very happy side affect in that they've created beaches. They weren't really that interested in beaches, they wanted to save the fishing villages, but the breakwaters allowed sand to accrete behind them.

Now, as for the question about cost, what would you say, Bob?

DR. DEAN: It depends on what water depth you place them. In thirty feet of water, which is very deep, it's about ten thousand dollars a foot; it really depends a lot on the depth. In fact, if you were to put it in four feet of water and then double that depth, the cost goes up. Probably if you put them in six or eight feet of water, it's at least a one thousand dollars (per foot.)

A SPECTATOR: What are they made of?

DR. DEAN: Just rock, granite. I think one important side effect that Miles didn't mention is that if you make them long enough, they completely interrupt the regular flow of sediment. In the case of Myrtle Beach you'd starve all the downdrift shores.

DR. HAYES: Yes, you have to design them right. There's an example on Lake Erie where they designed them so that a certain volume of sand was allowed to pass through.

DR. DEAN: There are a fair number of examples in the United States, Lake Erie is one place. In California they have them in Channel Islands Harbor and in Venice. The Corps of Engineers has plans to put them down south at Imperial Beach, so there are some examples in the U.S., too, but they're quite expensive.

A SPECTATOR: I was wondering how the breakwaters and offshore dredging of sand affect the environment in terms of the fishing industry, were there studies done to say how we were saving the beaches/or are we destroying the areas offshore for fishing industries?

DR. DEAN: I'll try that. In Florida I think the answer is no. As a matter of fact any breakwaters that are put in provide an excellent habitat for fishing because they allow places where the small fish can seek refuge from their

predators. In Florida, every beach nourishment project has had a very extensive and intensive biological study associated with the borrow areas, or deepened area, and they found that by almost every measure, as I understand it, within two years the area was back to normal or better. In some cases better, I think, because you kind of stir up things and give a variety to the habitats.

DR. HAYES: It is true that the sand environment has the least species diversity, so if you're moving sand you're not as apt to do as much damage as in other environments.

(Questions inaudible.)

DR. DEAN: There are some smaller units, the Gobie blocks (that) are successful in armouring the beach, but there's a lot to that. For example, a lot of it depends on whether it's the beach face, the upper part of the beach that's eroding or whether you get deep seated erosion like you might around tidal inlets. Each of them has to be considered, I think, on a case-by-case basis. Of course, if you armour the beach like that then it's no longer a recreational facility unless you place sand on it and use the revetment or Gobie block, whatever it is, as a back-up protection.

MR. MONTGOMERY: Other questions specifically about Myrtle Beach?

A SPECTATOR: I was wondering if maybe the Mayor could address this, as to the suitability of material immediately off of Myrtle Beach. There has been some information that there has been some localized or maybe even more extensive area (rock bottoms) that run very low to the coastline in that area. How much is known about the extent of that type of area and how easily available sand is in the offshore area, let's say a thousand foot or two thousand foot levels from the beach.

MAYOR FICKEN: Maybe Dr. Kana can address that in more detail, but we studied the area off the beach for about a mile and a half. We found sufficient compatible quantities of sand in various spots and have that charted as to location. Now, expense was mentioned, I guess a good bit of sand was out there past the one mile mark. When you get past one mile it gets a bit more expensive. The other part of your question I'm not sure I know the answer to. Tim?

DR. KANA: Yes, there's extensive hard bottom throughout the offshore of Myrtle Beach. We had an hypothesis before we started this project, about a year and a half ago, we felt that a lot of sand that had been eroded from the city was working its way offshore and being redeposited on bars. We (did not find) defined, distinct bars as such. What we found were some broad zones that are measured in terms of a mile long, perhaps about a quarter of a mile wide that might have three to six feet of sand similar to that on the beach now. We also found tremendous areas that are flat hard bottom and is probably the old Pleistocene deposit, similar to some of the beach rock you have on the lower beach in Myrtle Beach. We know there's a lot of hard rock out there and we're still trying to pin down exactly the extent of the sand bodies before we can go to the next step of actually bringing it onshore.

A SPECTATOR: Did you notice whether these were productive areas in terms of recreation fisheries resources?

DOCTOR KANA: No, unfortunately we didn't have a chance to scuba on the site. We only had about five or six days and the emphasis was on coring and sidescan and sonar and looking at the shallow sizing. It was really a physical and geological study. We have recommended that (biological studies) be an integral part of any future plan to renourish the beach with offshore deposits. You really have to do that before you send a dredge out there. It would probably be required, I'm sure, prior to any permit application by the Coastal Council as well as the Corps of Engineers.

MAYOR FICKEN: Thank you, Tim. I have, over the years, received a thousand recommendations and cures (for beach erosion). One letter I got a few years ago said we ought to plant mangrove trees; I discarded that one because I felt like that would take away from the attractiveness of the beach. There is a local expert in town who is saying that if we're going to do breakwaters that we ought to use railroad cars, that railroad cars are available and that you can build breakwaters, surface breakwaters, by sinking railroad cars out there. I've been putting that one on the back shelf, but it keeps coming up on the front again. (While I have a panel of experts,) I'd like to ask whether anybody has done that, whether you think that's feasible or whether they'll rust out and we'll have contaminated refuse on the beach? Is there an answer?

DOCTOR PILKEY: I remember a study in Puerto Rico, I'm not an expert on that, but I remember a study in Puerto

Rico that found that they had a reef made by piling up automobiles and it ended up in five years as just a little layer of chrome.

MAYOR FICKEN: Thank you very much. We'll put that one to rest, too, I believe.

COASTAL CASE STUDIES

FOLLY BEACH, SC

THE HONORABLE RICHARD L. BECK
MAYOR, FOLLY BEACH

At Folly Beach, the problems of beach erosion have been apparent longer than in many other communities in the state, so we have more historical data. As far as I know we're the only community in the state that the Corps of Engineers has completed a mitigation study on and so we also have the results of that study. I will give you some background on Folly Beach and then tell you about what our community has done and what it plans to do.

The City of Folly Beach is located on one of Dr. Hayes' characteristic drumstick barrier islands. It was originally known as Coffin Island. You will remember from Dr. Kana's presentation this morning that the entrance to Charleston Harbor at the turn of the century was about where the Morris Island Lighthouse is now. Folly Beach (at that time) was on the left as you entered the Harbor. Ships used to disembark the dead and dying on Folly so that they could clear the health authorities in the City of Charleston. From that beginning Folly evolved into a summer residence island. The island enjoyed a period of growth in the 1940s and 1950s and was quite an entertainment center for the area. It has always had a history of being available and accessible to the public.

Today Folly is a mixture of summer and year-around residents, 1940s and 1950s architecture, low-density, low-crime, and is just a really lovely place to live. The present community represents a broad range of the socio-economic spectrum. The latest census reports that about forty-six percent of the 1500 year-around residents are classified as low income.

Folly supports an ever-increasing number of summer tourists, the majority of whom come from the tri-county area that fans out from metropolitan Charleston. On any given summer weekend as many as 30,000 people come to Folly Beach. The reason that so many people can come to an island that's only six miles long is that we have practically unlimited public access. We have unlimited public parking on the rights of way and we have fifty-two public access points in

six miles of beach. We are completely open to the visiting public. Folly is the only barrier island in the tri-county area that actively makes itself available to the public. To the north lie Isle of Palms and Sullivans Island, which have off-street parking and in some ways actively prohibit or actively discourage summer crowds. Not to say that they don't have terrific summer crowds, but of the three islands we are the one that's most accessible. To the south lie Kiawah and Seabrook which are essentially privately held and collectively have less than four hundred parking places. Folly has about five thousand parking places within a thousand feet of the beach.

In 1976 the Army Corps of Engineers undertook a study of the erosion problem at Folly; it was a mitigation study designed to determine the best thing to do about erosion at Folly. Their conclusion was that nourishment of Folly was worthy of public participation.

I thought we'd start out by looking at Morris Island. The Corps of Engineers says an abrupt change took place in the configuration and erosion rate on Morris Island with the construction of the Charleston Harbor jetties. Basically, before the jetties were constructed the southern end of the island was accreting and the northern end was eroding; after the jetties were completed this reversal took place quite rapidly. In 1920, the Morris Island Light was situated about 1600-2000 feet inland on a tidal creek. Now, it stands about a quarter of a mile offshore, so there's been a tremendous amount of erosion on Morris Island.

Now, I'd like to take you for a walk down Folly from east to west. If we divided the island into five reaches with the Coast Guard Loran as the first reach and the Charleston County Park as the fifth reach, you will see that those two reaches have been fairly stable over the last fifteen years. The middle three reaches have experienced more or less ongoing erosion with the middle reach from 7th Street East to 3rd Street West having experienced the greatest impact. As we can see, erosion hasn't been uniform from one place to another or over time. As a matter of fact it's true to say of Folly that the erosion in the last twenty-two years is equal to the erosion in the last 122 years. It's a tremendous problem for us.

Between 1946 and 1975, fifty-one rock and timber groins were built and have been sporadically maintained by the South Carolina Highway Department. A couple of years ago we repaired about fourteen of them. Basically, half of them

have had some repair and half of them are in complete disrepair. A revetment that the South Carolina Highway Department built in the wash-out area has performed very well, although these things don't last long unless you constantly maintain them.

The people that live on Folly have tried everything that doesn't work to retard erosion: broken concrete, concrete block walls, vertical timber seawalls, sand grabbers, vertical corrugated asbestos, Christmas trees (a low-cost alternative). Most successful is a vertical wall fronted by a well-designed sloping revetment or stone wall. It's a foregone conclusion in our community that the short-term approach to the erosion problem is going to be revetments. A problem is that we have a situation in which neighbors cannot agree on the thing to do and some of them don't want to do anything. There are seventy-five people on Folly still paying taxes on lots that are completely underwater. It's terribly complex to get people to cooperate adequately. That educational need is the importance of a conference like this.

In 1978, the State of South Carolina, recognizing the recreational value of Folly, appropriated \$440,000 for erosion abatement. Now, that's not a whole lot of money, but it's more than we'd ever gotten before. We were very happy to get it. At about the same time, through the help of Dr. John Manzi, we got a National Science Foundation grant to fund an erosion abatement workshop. We were very fortunate to attract a lot of talented people, some of whom are here today. We broke down the problem of erosion on Folly into three segments. A methodology section, a legalities and legal restraints section and an economics section. They basically looked at the problem as a whole; the purpose of this workshop was to tell us what direction to take.

Their primary recommendation was that the city should first ask the Army Corps of Engineers to do a Section III review on the relationship between erosion on Folly and the existence of the Charleston Harbor navigation project. The people at the workshop felt there was a very strong correlation between the problem on Folly, the existence of the Charleston Harbor jetties, and the dredging that's done in the entrance channel. So the primary recommendation was that we ask the Army Corps of Engineers to study and attempt to quantify that relationship. At the time we were in a lawsuit with them because we didn't know that there was a mechanism in place in federal law that would allow us to do

it without being antagonists. With the help of Colonel Stallman and now Colonel Smith, that Section III review is underway, expected to be completed in about three years.

Their second recommendation was that \$440,000 was not much money to do anything with, so we should just escrow the money until we had enough money to do something. Well, that fell on deaf ears right away. The next two years was spent in presenting things to the Coastal Council that we thought were reasonable to do. I can't tell you how happy it makes me to have a conference like this, because it may save someone else from wandering around in the dark for two years. We had nowhere to go. We finally involved the Florida Shore and Beach Preservation Association. They provided a tremendous amount of experience and expertise.

The money was finally spent to improve public access by the construction of twenty public walkovers and the planting of 65,000 American beachgrass seedlings. That project has been most helpful. Aside from that, the City Council of Folly Beach has worked with the S.C. Coastal Council to establish an erosion control line. It dictates the position of seawalls. It allows people who own property on the island who had not taken the opportunity to protect their property to protect it, and allows them to back-fill. It's an important step. I hope it's going to help straighten out the jagged seawall line on the east end, where neighbors have been in disagreement.

Aside from those short-term solutions, I agree with Dr. Dean, whom I heard speak not long ago at the Florida Shore and Beach Preservation Association. With an eroding shoreline you really have three choices. One of those is to abandon the shoreline, to ignore all the human factors of the equation, all the socioeconomic and all the personal loss that goes along with that decision. The second option that you have is to armor the shoreline. My position is that in the absence of a state posture that recognizes the importance of the beaches as a recreational resource, that is the option that local communities will be forced to take due to lack of help. The third option that we have is to renourish the shoreline. Of those three options, I personally favor renourishing the shoreline and hope that's what the Corps of Engineers will help us do. To echo what Dr. Dean has said, it's the only option that we have that returns both the usefulness of the shoreline and provides protection from the storms.

The beach has such an ability to entertain. As you look at the demand for ocean recreation in this state you'll see that it's going to increase and not decrease in the coming years.

Basically, in the short-term, we're depending on a combination of projects that deal with trying to level out our seawall line. We have no other choice, and we're already committed to that approach. The best we can do is build good revetments, maintain them, and understand that it's a short-term approach. If we get a bad storm, it's going to go through those seawalls like tissue paper.

Long-term, we're looking for help from a combination of monies from our survey report, which initially gave us a federal participation in our problem, about thirty-eight percent. Section III will provide another pool of resources.

Our biggest hope and the hope of Mayor Ficken and everybody else that has a community with an eroding beach is that the community-at-large would recognize the importance of ocean recreation and the value that the beach has to the economy of the state and give us some help along the way. Between that and local support we hope to be able to renourish the beach, restoring its former usefulness and protection.

FOLLY BEACH
PANEL DISCUSSION

MR. MONTGOMERY: If each of you would comment on the Mayor's remarks, specifically again how Folly Beach's problems differ from the other examples. I know the question has already been asked, it's going to come up again, about the affect of the Charleston Harbor jetties on the erosion problem at Folly Beach. You might address that in passing.

DR. DEAN: Well, I think that the case of Folly Beach is clearly a case in which again it is a state facility. A facility that's for more than the people of Folly Beach in the number of access points. If the State of South Carolina doesn't help (Folly) out, we'll see if the State of Florida will be glad to build (Folly) a beach. Right now, of course, building protective structures, revetment structures will have to be the approach. In the long term, what the beach really needs is more sand and maybe stabilization structures somewhere along the ends to keep the sand from flowing off. One of the differences between Folly Beach and the other beaches might be placed in the category of "who pays." I think that the responsibility of paying for maintaining the beach and nourishing the beach should go to those that benefit from the beach.

There are other people on this panel that are more qualified than I to address the question of the relationship of the Charleston jetties and Folly Beach, but I'm sure there's some relationship. Certainly the Charleston jetties are a contributing factor.

It's always interesting to me as a first step to try to find out where that sand went. I don't know whether the studies that Miles Hayes has carried out have identified where the eroded sand went, whether it went offshore or to the two ends of the island. If it went to the two ends remedial measures would indicate one approach; if it went offshore, perhaps another approach.

DR. HAYES: Those studies didn't say anything about the jetties. Well, it's been getting dull so I'll say what I think about the jetties. Yes, the jetties caused the erosion, no doubt about it. Actually, I arrived at this conclusion through a fairly winding route of reasoning which expands several years. The first time we worked on this probelm was in 1974 when we did the setback study for Kiawah

Island. Being a bright young man in those days, I just wrote in the report, from looking at the charts and so forth, that building the jetties had something to do with the erosion on Folly and Morris Island and the fact that Kiawah had taken off accreting like crazy. I think that a large part of the sand that was eroded off of Folly Island is heading for or has already made it to Kiawah, but there is kind of a reversal of transport somewhere around the north end of Folly Beach and a lot of that sand has moved back toward Charleston Harbor itself. The north end of Morris Island is actually accreting. The north end is called a recurved spit; so at least some of the sand off of Morris Island and off of the north end of Folly is accreting on the north end of Morris Island.

A SPECTATOR: That's inside the jetties?

DR. HAYES: Inside the jetties. The sand goes right down the beach, around the beach and builds this spit back in towards the harbor. A lot of that sand going down that spit will eventually end up in the channel, be carried back out the channel to be dredged and dumped somewhere else. So the sand is being lost in that way. Therefore, one potential source of sand would be that recurved spit on the north end of Morris Island.

I wrote in a paper or two about the jetties causing erosion, and I don't think the Corps of Engineers liked it too much. I was beginning to get a little nervous because it came to my attention that, actually, after the jetties were built, instead of eroding right away in a rapid fashion, Folly Island actually built out some. Ah hah!, the Corps said, the jetties did not cause the erosion because the beach built out after the jetties were built. I was a little nervous then because my statement on the jetties causing the erosion was already in the literature. Then in 1977, Billy Edge wrote a paper in which he concluded that the jetties caused the erosion, so I felt a little better. Anyway, to make a long story short, what I think actually happened was that when the jetties were built, they freed up a huge load of sand stored offshore, about the largest ebb-tidal delta in the whole state.

(If you look at the old charts from Revolutionary War days back when the British ships tried to come in here past Fort Moultrie, they had to go all the way down to the middle of Folly Island, then called Coffin Island, turn north and come back up the channel into the Harbor. They didn't have nice jetties to come zipping through; it was very difficult

to come up the channel and go around. In fact, one of them went aground out there where Fort Sumter is now during the battle of Fort Moultrie.)

When the jetties were put in, it freed up a huge volume of sand that was stored offshore. That sand had been kept offshore by the tremendous volume of water that flows out of the harbor every day. When (the tidal flow) was cut off, (the sand came) on the beach, that's why Folly Beach accreted. Once the jetties were there and the Corps of Engineers (began) dredging sand, there was no more coming through. Eventually, with no more sand coming through, the island was losing about 200,000 yards a year. Where was it going? Some of it was going back in the harbor to be dredged and be dumped offshore eight miles, and some of it was going on down to build up the north end of Kiawah. I was a bit shaky with that conclusion until a guy named Hodge did a thesis on the jetties at the mouth of the Winyah Bay. If you look at the jetties at the mouth of the Winyah Bay, they did the same thing, except the response time was slower. In fact, in the 1930s and 1940s the beach south of Winyah Bay built out like crazy, and now it's eroding. It's going through the same cycle. The cycle is always there, its timing depends on how big the harbor or estuary is. It's a cycle that has to do with the relation of the tidal prism carrying the sand out and the waves bringing it back in.

(To Mayor Beck:) I'm amazed that you're really serious about taking three more years to figure out whether the jetties caused the erosion or not.

A SPECTATOR: Dr. Hayes, I'd like to ask you a question to see if this is what caused it. I grew up in the waters around here. The erosion really didn't start until 1942 when the Santee Cooper came into effect. That break in the southern jetty: you used to be able to come through it in a rowboat, I'd hate to try it now. A greater flow of water through the breaks in the south jetty increased (after the Santee-Cooper project)... four to six knots per hour on the ebb tide. That's when Morris Island and Folly Island started to wash.

DR. HAYES: FitzGerald, one of my students, did a study on the jetty. He did view that as part of the problem. That new channel through the south jetty has a jet flow that goes out and carries some of the sand out as well. That's a possible (minor) cause, but the overall problem really is related to the abrupt cutoff of the sand that comes from the north. It built up early because that

abandoned sand came in, but then the normal processes of erosion finally carried it out. Now, I wasn't there the whole time and haven't painted every sand grain and can't tell you exactly where all the sand came from, but that's a deductive analysis of what I think happened.

A SPECTATOR: In a statement that I read by you in 1979, you said that offshore shoals have gradually disappeared and Morris Island and Folly Island (now have) a wave type that they never had experienced.

DR. HAYES: That's correct, because before that there was a huge shoal out there, a tremendous shoal bigger than the one at Edisto Inlet. The waves would break on those shoals and they tended to accrete sand on the downdrift side of Charleston Harbor. It was doing that until the supply of sand was cut off.

An argument that the Corps of Engineers took, another side to the story, is that South Carolina's beaches are eroding elsewhere, too, as at Huntington Island. It's eroding there, but there are no jetties. So it's tricky. But there's no question that the outer shoal disappeared. When that outer shoal disappeared, there's also no question that the waves had more exposure on the beach of Folly Island and that's why the middle part has eroded. If it had the shoals out there it would normally have without the jetties, it wouldn't erode.

DR. PILKEY: I'd like to comment on this. I first visited Folly Beach in 1960 and I've visited there every few years since. I found the Mayor's presentation to be amazingly forthright. I think this is a classic example, the beach was destroyed in order to save the houses of very few individuals. Destroyed, meaning degraded in terms of width, degraded in terms of fragments of seawalls, groins, revetments, and so forth strewn on the beach. It is a much different quality of beach than the one I saw in 1960.

I really disagree with Bob Dean's statement that we have three alternatives, at least in the way he has interpreted it. The idea that we only have three choices: putting in a new beach, putting in a seawall, or abandoning the shoreline, is quite extreme. In North Carolina, the coastal zone management program is oriented toward making sure that we don't have to put in new beaches and new seawalls, at least that's our hope, for the next hundred years. Whether we succeed politically is another question. We have beaches that look like your beaches, we do have

beaches where revetments have been built and scattered all over the beach, so we're not "lily-white" in this regard by any means. If you adopt the attitude that if you don't stabilize you must abandon the shoreline, you're basically writing off the natural beach. You're putting yourself into a system where a great deal of expenditure of money will be required to maintain either the wall or the beach, with this attitude that every single house along the shoreline must be saved. On the other hand, you don't have to take the attitude that every single dune should fall in either.

One can live flexibly with the shoreline, which is what North Carolina is trying to do and trying to step through the mine field of politics. To simply say that the alternative is abandonment is just not correct. What North Carolina, Maine, and Massachusettes are, for example, taking is the tact that we don't have to stabilize. Now, in terms of what could have been done at Folly, that's not for me to say. If we let all the houses fall in the beach we would still be in great shape, but there wouldn't be any houses there, which might distress the people on Folly Beach.

There are other alternatives that we haven't explored and that we do need to look at in this stage of the game in South Carolina, some creative approaches to shoreline management. How about doing what the federal government did in some parts of North Carolina? They moved the houses back near South Nags Head at federal expense. They spent tax money because it would have cost a lot more if the buildings had fallen in, through the Federal Flood Insurance Program. Another possibility is to buy the houses and then let them fall in or buy the houses and move them or require people to move them. Something other than just letting people build their own small-scale cheap revetment, because, as we can see, the quality of Folly Beach has degraded considerably over the last twenty years. I don't think the future speaks well either, because I don't know what the solution is now. I know what I would do, but I don't think I could ever be a politician or be elected as Mayor of Folly Beach.

THE MAYOR: The idea that you could just let the community fall in the ocean intrigues me. I wonder if you could give me an example of some place that's just done that. How does the beach look with houses, broken houses, all over the place?

DR. PILKEY: Well, basically before World War II that's what happened to all our beaches, we basically let things fall in: Hog Island, Va.; Edingsville Beach, S.C;

Tillman Spit, Oregon. Letting the houses fall in is basically a sarcastic way of putting it, a way of attracting attention, which it usually does. There are general ways of letting the houses fall in, such as the ones that I mentioned: moving the houses, buying the houses. Rhode Island and Virginia both have considered seriously the possibility of buying houses on the front beach with the idea being that if they didn't buy the houses, as soon as the shoreline gets up to them, people are going to build seawalls and revetments and that's the end of the beach. So, it has been considered by at least these two states, possibly others that I don't know about.

DR HAYES: Could I raise a question here? Has the beach really degraded in the last 20 years? I thought roads were lost on Folly after Hurricane Gracie in 1958.

MAYOR BECK: On the east end of the island we did lose a road.

DR. HAYES: The beach probably didn't look too good just after that hurricane. I guess the pictures taken then look just as bad as they do after a storm now.

MAYOR BECK: It really doesn't look that bad today and the beach seems fairly stable, once the revetments are put in. I don't know, it may be changing. Our community has shouldered the burden of entertaining these people all these many years, policing them, picking up their garbage, without any sort of assistance from the state. I just feel that it's reasonable, to take the entirety of ocean recreation, and work out the numbers. It's just senseless to (incur) the personal cost that is involved with moving houses, because I think it's unrealistic. I can't imagine this state or any other state that would just take the property away from the people or allow them to just suffer without help.

DR. PILKEY: I look at this on a national scale and I see that narrow beaches with rubble on them are not unusual. There are many of these in many of our coastal and barrier island states. In each community, of course, the mayors and the individuals look at it exactly as you (Mayor Beck) do. I fully understand that. I guess I would look at it exactly that way, too.

If we look at it from the standpoint of the Omaha, Nebraska citizen and millions of people who wish to use the beach, in order to save the property of a very few people

you have degraded the recreational asset for many millions of people. It's happening everywhere. On a federal level we have to start looking at this. In fact, the federal government is doing just this and asking some very fundamental questions as to where our recreational beaches are going.

MAYOR BECK: With Myrtle Beach, with multimillion dollars worth of real estate is where it's really going to be justified. I don't think the erosion is going to stop (Folly) from developing. It's a shame that we'll have to overdevelop in order to qualify for the same sort of consideration. There's not a willingness for a low-crime, single-family residential beach to qualify for a renourishment project based on its accessibility to a large population and the use that it gets.

There's a double standard, too, about the coast. It's always bothered me. When there's a problem on Folly Beach, people just stand back and say, those people are really idiots to build on the coast. In Louisiana when (residential areas along the Mississippi River flood, it's) "What are you going to do?" When something happens on the coast it's a curious double standard that we have such punitive measures that are offered for legal problems and then people on the Mississippi River get bailed out every year. It's just amazing to me.

DR. HAYES: I agree. That's a good point.

MAYOR BECK: (Certainly) they spend a lot more money on the Mississippi River than we've ever spent in Folly Beach, probably on the whole coast of South Carolina, North Carolina, and Georgia combined.

MR. MONTGOMERY: Dr. Dean, one comment and then we'll open it for questions.

DR. DEAN: Folly is a recreational beach; I'd like to follow up on Orrin Pilkey's scenario, and see how it progresses. It seems to me that if you let the beach go, you let the houses fall in, and you still want to consider it as a recreational beach, then you still need parking and restroom facilities, access, etc. If you let the beach move back, I think you're going to run into the same problem again.

I think your philosophy presumes that with regard to the wealth of our nation, stabilizing beaches is going to be

expensive. Sometimes it seems that originates from wanting things in their natural state. Sometimes I think of that like taking vitamins, you know, vitamins are not all that expensive. I don't think stabilizing the beaches is all that expensive, when a fighter plane costs \$20 million. It seems that we get things out of perspective.

A SPECTATOR: A while back one of the speakers mentioned that certain property (on the Isle of Palms) was accreting and that the homeowners who are now back from the ocean aways were worried that a developer might build something in front of them. Wouldn't that land either go to those property owners or else it would be the state's and no developer could build there?

DR. HAYES: As Ben Gregg discussed, there is some little fine flaw in the way that original deed was drawn up. There was an endpoint on the survey that wasn't exactly on the high tide line, so the developer has ingress over that property now because of that little flaw, if you want to call it a flaw. I guess the guy that owns the property doesn't think it's a flaw.

A SPECTATOR: Mayor Beck, what were some of the legal problems that you ran into establishing your setback lines? I know we had the legal discussion at some length this morning, but if you establish the line in Folly Beach where some people are allowed to backfill, I would assume that other people might lose a portion of their property back to this line. How did you handle that legal problem?

MAYOR BECK: It wasn't a legal problem. What we basically did was take aerial photographs and then view them with the City Council, have public hearings and try to establish as smooth a line as possible connecting all the jagged group of revetments. Existing revetments became the line. There really hasn't been a problem as far as I know. As yet, no one has applied for a permit to build a new seawall and backfill. (The setback line) can only help the situation. It's not a legal problem.

We need to establish a delineation between public and private property before we can have a renourishment project. The Coastal Council is considering this right now. The state law in Florida says that you can establish a line delineating the difference between public and private property on agreement of some majority of the property owners. This affects linear footage of the property that is affected, which essentially would be taking property from

someone who didn't agree. Apparently in Florida it's just not challenged, because it's a state law. It would take a lot of resources to challenge it and in the final analysis people can see good in it. It's not a problem even though in a strict sense of the word it probably is unconstitutional.

A SPECTATOR: (What about the Barrier Island Legislation?) Supposedly it didn't slow down the development of barrier islands and already insurance companies have picked up the slack in the development of (private flood insurance ?)

MAYOR BECK: There is the risk of catastrophic events on the barrier islands, of course. That risk is not any greater than living in any other high-hazard area, living on fault lines, living next to Mount St. Helens, next to a flood plain somewhere. The force is such at the time, the demand for ocean recreation is so great, I personally think it (Barrier Island Legislation?) wouldn't make a whole lot of difference.

A SPECTATOR: The only breakwater that I've ever seen was the Indian Ocean, but I noticed that the surf between the wall and the beach had, as I notice sometimes in pockets on Folly, sort of a certain slime to it. I've also stepped on all sorts of sea cucumbers or something. Would that happen if we had a breakwater off Folly Beach, would we have those kind of changes in the nature of the surf? It's beautiful sand now. Do you anticipate any difference in the surface?

DR. DEAN: That's a tough question. I've noticed that a lot of times these offshore breakwaters will cause little circulation cells in the water, which basically cause whatever is floating on the water to concentrate in one point and deposit out on the beach. I've noticed pieces of floating wood tend to concentrate at locations. If there is material floating on the water that's objectionable, I would expect that to concentrate in little areas, but I think that would not be a major problem.

DR. HAYES: Let me respond to that. There have been several examples in South Carolina of natural offshore breakwaters, sand shoals. One came in on the north end of Kiawah a few years ago. That was the same affect as having a man-made offshore breakwater. The beach is very nice there because there are no slimy substances or other foreign

objects floating around in the water, so there was nothing to accumulate there except the sand. The same thing has happened in front of Senator Hollings house on the Isle of Palms; I don't think you'll find too much slimy stuff on the beach there either. It's just that whatever is floating in the water will accumulate. Now, if we were down in Texas, I would worry about it, because the water is full of all kinds of things, tar balls, and all kinds of garbage.

A SPECTATOR: Somebody asked about railroad cars being put down as a breakwater. I've also heard that rubber tires make a great fishing ground and sort of a breakwater type thing. Does that go in the railroad car division?

DR. HAYES: It's very difficult to design one of those tire breakwaters in deep water that will survive. The problem with that kind of breakwater is that it's hard to design it so that storm waves won't break it up, resulting in tires all over the beach.

A SPECTATOR: I have several short questions. Mayor Beck, I'm given to understand that a flood plain insurance program does not fund preventative maintenance and so you've not been able to get any funding from the Flood Insurance Program to prevent damage?

MAYOR BECK: That's true. The Federal Flood Insurance really does not cover ongoing erosion.

A SPECTATOR: Dr. Pilkey, I understand that when you were discussing Nags Head, moving houses at Nags Head, the Flood Plain Insurance does not pay for that move, does it?

DR. PILKEY: It did in this particular case. In fact, one very famous dome house cost \$36,000 to move. It may have been a test program. This was back in the Carter Administration. It was a situation where there was a very, very steady six feet per year erosion rate and it was clear that about six houses were going to fall in. In fact, the dome house literally began to tilt over the edge of the bluff and they decided on a crash basis to move those houses. The houses were on lots that were bought in the 1950s when everybody knew there was an erosion problem there and they were 100 x 600 feet. Now in the same area the lots are 100 x 200 feet or something like that. This was an exceptional situation.

MR. MONTGOMERY: Any other questions?

A SPECTATOR: Could I check on one more point? This gentlemen over here mentioned that the big developer has been picking up the slack in flood plain insurance, has any private flood insurance been available?

DR. PILKEY: To be quite honest with you, I don't know of any, but I do know that there are companies out there that will pick that up.

A SPECTATOR: The Sea Grant Consortium is now doing a study on the effects of federal flood insurance changes with respect to private flood insurance and it appears that flood insurance is being provided. Approximately seven companies/agencies in the state will cover any structure, commercial or private, on barrier islands. They will provide more comprehensive coverage with relatively low deductibles and with a premium that's lower than the Federal Insurance Program premiums.

DR. PILKEY: They are intending to make their insurance actuary. That's why it's tripled in three years and it's going to continue to go up.

A SPECTATOR: The market is being taken by private insurance and that's what appears to be happening.

A SPECTATOR: Recognizing that rip-rapping of any beach usually occurs on a piecemeal basis and that renourishment has to occur, to be effective, on a concerted basis. What is the cost difference between the two if communities could act on a concerted basis? That would be over equivalent periods of time. In other words, can you buy 10-15 years of erosion insurance, what's the difference in cost between rip-rapping and renourishment?

DR. DEAN: They're comparable, the difference is that if you put in a quality revetment then you may not need a lot of maintenance, but you don't have a beach in 10-15 years either.

Beach nourishment generally requires maintenance, maybe every five years, maybe every ten years, but by putting in retention or terminal structures, that extends the longevity of the nourishment project. We heard some costs from Billy Edge this morning on the order of two hundred dollars per foot. I think one can usually put in a fairly good beach nourishment project (for that), but again one on the problems with beach nourishment is that usually there are areas of erosion stress. You may have most of the project

working just fine, but then you have a localized erosion problem and that has to be dealt with sort of separately, perhaps by transporting sand along the beach with large equipment.

A SPECTATOR: What do you think would happen to the problems at Folly Beach if the sand that's trapped behind the north jetty is transported over the south jetty and all the sand that has been accumulated there for the last hundred years goes where it should be? You certainly wouldn't have the problem with the accretion on the Isle of Palms and you wouldn't have the problem with accretion on Sullivan's Island, because that sand would be down there. What's happening at Folly Beach is that Folly Beach is subsidizing the Charleston Harbor, we're subsidizing the Navy Yard and all of their supports, so why can't we get that sand across? Would that make Folly Beach's problems disappear?

DR. HAYES: He's looking at you, Orrin. It would cost a lot. You're basically correct.

DR. PILKEY: I'm not an expert on this particular subject by any means, but from knowing how things have happened on other jetties, I suspect not only is a lot of sand piled up there but you have probably lost sand offshore too. So, yes, I think maybe your statement that you're subsidizing the jetties is a valid viewpoint.

DR. DEAN: The Corps of Engineers, in the Charleston navigational project, a seven mile entrance channel, takes out about a million cubic yards a year that is probably beach quality material. They dump it offshore because they're mandated by their present legislation to choose the cheapest way to do it unless someone picks up the difference in the cost. There's legislation, I understand, promoted by the State of Florida Legislature in the United States Congress. This legislation would mandate that the Corps return the sand to the beaches, which could certainly be good for Folly Beach and directly to the State of South Carolina, so that's also something that needs to be worked on.

A SPECTATOR: Well, I believe that Folly's problems were created by the jetties and by man, they're man-made problems and I take the position that the man-made problems be corrected by man.

DR. DEAN: I suppose that's why they created, in 1968, the Rivers and Harbors Act, Section III.

DR. HAYES: The sand that's accumulated on the south end of Sullivan's Island, a lot of it is actually welded to the beach and formed dune ridges and so on. You might have a problem digging those dunes back up. You also alluded to the problem on Isle of Palms, what did you mean by that?

A SPECTATOR: That sand should be at Folly Beach, it shouldn't be there.

DR. HAYES: I'm dubious about that because every barrier island has one of those recurved spits on the south (downdrift) end, that's part of the drumstick model. That (on Isle of Palms) doesn't necessarily have anything to do with the jetties.

A SPECTATOR: All the talk about looking to state and even federal subsidies for these renourishment plans sets quite well here in Charleston. I'd be curious to know to what extent or how close we are to any final legislation that would accomodate that plan and whether anyone has explored the depths of support or opposition for such a plan in, say, Greenville, Spartanburg, or Columba?

DR. DEAN: To my knowledge this is the first large-scale discussion on the problem as a statewide problem, so today is the beginning. I don't think there's any discussion. I think if you get over a hundred miles from the coast, they only think it exists when they go down there. I don't think they have much of a feeling for it. It's one of the shortcomings that, as Mayor Ficken said earlier, people don't understand the impact the coast has on the economy.

A SPECTATOR: I'd like to ask Mayor Beck a somewhat more pressing question. What would happen if hurricans came through and cut the island in half? On Folly Beach I think that prospect is there, I wonder if a hurricane could do it? The high tide is about five yards from the road and the road's not but twenty yards wide, what steps have been taken to try to alleviate that possibility?

MAYOR BECK: There's really nothing that can be done short of working with the South Carolina Highway Department. Actually that area in there is fairly stable. I don't think there's really anything you can do short-term. There are many places about 300 yards (wide) there that could be

breached in a major storm. I don't think there are any simple intermediate steps that can be taken. We keep thinking about doing a little revetment at that one place you're talking about, but it doesn't really erode. I don't think it would do any good, anyway.

MR. MONTGOMERY: Thank you Mayor Beck and members of the panel.

END CONFERENCE

NATIONAL SEA GRANT DEPOSITORY
PELL LIBRARY BUILDING
URI, NARRAGANSETT BAY CAMPUS
NARRAGANSETT, RI 02882

RECEIVED
NATIONAL SEA GRANT DEPOSITORY
DATE: AUG 21 1985