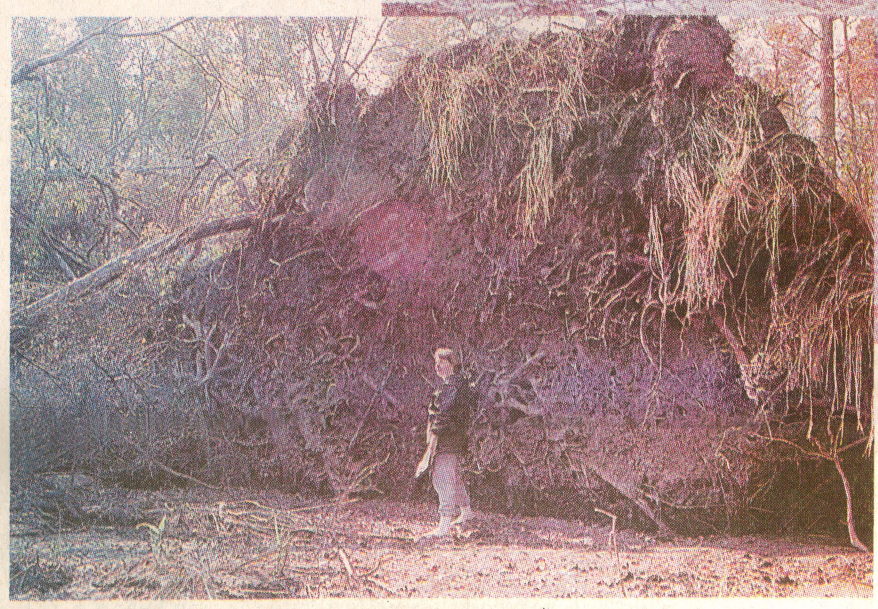
Erosion

Shoreline at Nevil Creek

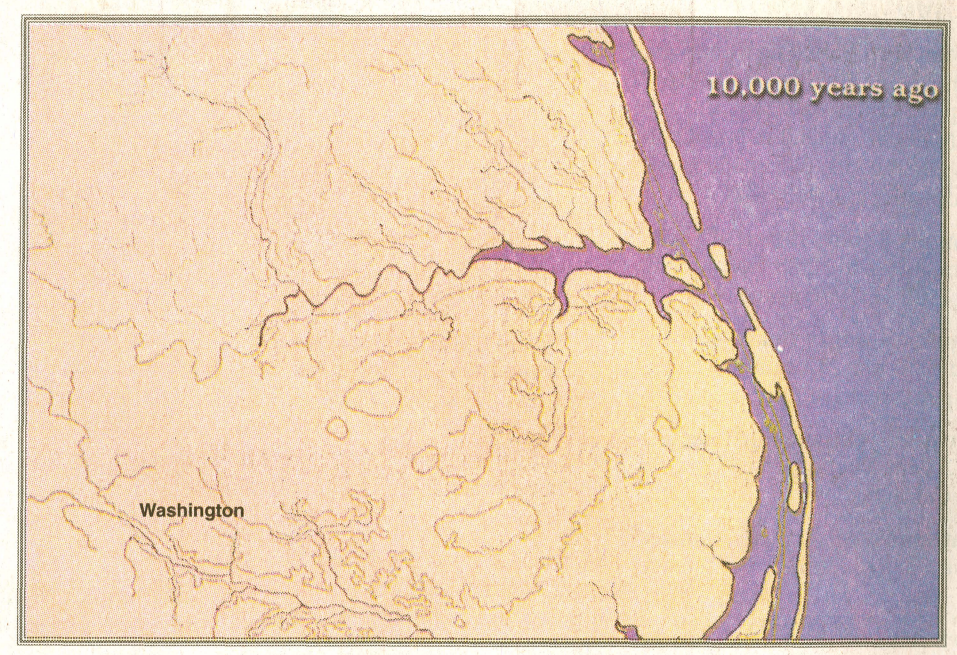
Severe erosion on bluff at Crystal Beach



Photos by Elmo Carawan and R. Walker

Sculpted banks at Bristol Moor development on the south side

Uprooted tree system in a swamp forest on the south side of the Tar River two miles east of Washington



Present shoreline outlined on both projected maps

By Rusty Walker and Alison Paul

"Lot for lot, we have seen some terrible sights," reports Terry Moore of the Division of Coastal Management in the N.C. Department of Environment and Natural Resources. "Some people can step out of their back door and almost step off a cliff where before there was a gradual slope to the water. Tons of soil went into the river," Moore says of his post-storm evaluations.

Pamlico, Moore's and Crystal beaches were some of the hardest hit as photos on this page document.

"We were lucky," says Stan Riggs, professor of geology at ECU. "As bad as it was, we were lucky."

Riggs and Moore both point to the supersaturated conditions of the shoreline soils created by rains before, during, between, and after Hurricanes Dennis and Floyd. According to Riggs, when Floyd hit with two feet of water in two days over Eastern Carolina, the flood stage on the Tar River was approaching 24 feet, the previous record level.

So how were we lucky?

Because Floyd was a south to north moving storm and the winds were well below hurricane force inland.

"The storms that dump the most water on us have been the ones that moved from east to west because the Tar River drainage basin is elongate in this direction. If Floyd had moved this way, we would have gotten much more water in the drainage basin. With the saturated soil conditions, root systems were weak. Hurricane force winds would have been devastating to both the vegetated and unvegetated shorelines," Riggs said.

That's how we were lucky, even if it doesn't feel that way.

A curious fact Riggs uncovered in the data is that the three storms of 1955 (Connie, Diane, and Ione) may have dumped as much rain on Eastern North Carolina as Dennis and Floyd. But there wasn't as much flooding. Part of the reason was that the storms were spaced further apart in time. But a contributing factor may also be the tremendous development in the area since the mid-50s. Impermeable areas like shopping malls and parking lots have increased orders of magnitude along with subdivisions and networks of ditches that rapidly direct storm runoff into streams nature designed to receive the runoff at a much slower pace.

"Planners and governments now have a taste of how bad things could be with the worst case combination of several back-to-back storms coming in from the east with high winds that slow down or stall over us," Riggs said.

Larry Crowder, a researcher at the Duke Marine Lab, pointed out to the Pamlico-Tar River Foundation advisory board Wednesday night that most climatologists now seem to believe "we are in another hurricane cycle" and can probably expect more years with multiple storm events. Riggs agrees.

Scientists, regulatory agencies, economic developers and others will continue their study of storm impacts on everything from water quality to fishing and motel occupancy. State and local governments can expect a whole series of recommendations and requests for funding for studies to restrict rebuilding and new building along shorelines and in the flood plains.

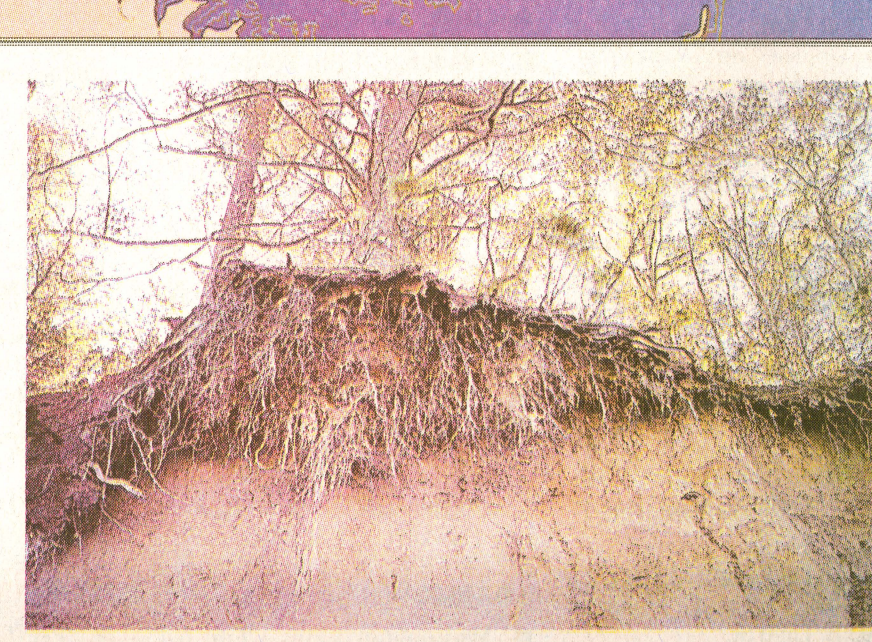
But right now, the DENR field people are still in the evaluation stage and concentrating on working with property owners that have been hurt.

Downed trees line the south shore across from Washington Harbour.

"A lot of the hardest hit properties in Floyd had weathered the other recent storms. They were feeling good before Floyd. Everybody seemed to agree that you want to buy and build on the highest waterfront property you can get. But the hardest hit shorelines this time were the ones on high banks and bluffs. It's left property owners exploring all kinds of shoreline stabilization techniques, not just bulk heading. They're looking at back fill with sloping to the water and even terracing. They want ways to reclaim the land they've lost," Moore said.

"We had virtually no erosion with Fran...but with Bonnie, we had significant erosion which was magnified by Dennis and Floyd...We lost about 50 feet of shoreline, and a lot of trees ," said Dr. Kelley Wallace of Down Shore Road

See EROSION Page 4C



Soon, nothing to hold on too

Erosion *From Page 1C*

in the Core Point community. "Right now we are in the middle of rebulkheading with granite...Some of my family that live on the Point about a quarter of a mile from here have lost several hundred feet of land in the last few storms."

DENR is trying to help expedite the permitting process to repair storm damage by waiving the permit fee and issuing storm permits to be valid until October 1, 2000. State regulations allow a property owner to apply for a CAMA major permit to reclaim land lost to erosion during the preceding twelve months.

An issue of keen interest for some property owners is bulkheading. Bulk heading does offer short term protection from erosion and many property owners are doing it. However, there are problems. Bulk heading will quickly eliminate the beaches and if adjacent property is not bulkheaded, storms will erode around the ends of bulkheads and do serious damage.

Dr. Wallace, for example, reported that family members living nearby bulkheaded their property and asked the adjacent property owners to do the same. The neighbors said no and the storms have created an island affect on the sides of the bulkheaded property.

"The erosion has been terrible over the last two or three years," said June Knaup of Hickory Point, east of PCS Phosphate. " I've lost a fourth of my land and have had 10 loads of dirt and two or three loads of reject brought in to fill the holes. I have been lucky with my house....It has been bad up and down the shore here ever since Bertha and Fran."

Ms. Knaup said recent storms have edged holes underneath the bulkhead that blockades her property.

"All of the storms have caused erosion since my father built the house in 1957," said Betty Alfred of Cary, who owns a home on Jarvis Landing near Aurora. "We use rock to block the property...We've lost a lot of rock over the years. It is definitely something that needs to be maintained regularly. Our cement boat slip breaks up because of battering from storms. The roots of a tree that sits near the pier are exposed. The land has eroded a few feet up to the tree. Since the house was built our property has eroded approximately 25 feet."

The majority of the erosion on the Alfred property has occurred over the past few years due to recent storms.

According to Moore, property owners he has talked to want to know if there is some legal recourse for those who spent money bulkheading when their neighbors did not and damage resulted. Moore said he was not aware of any such recourse.

These photo pages documents some of the more dramatic damage to the Pamlico and lower Tar river shorelines from the combined wallop delivered by Dennis and Floyd.

What follows is background information provided to help put storm erosion in its broader context. It is taken from material prepared by Stan Riggs and Vince Bellis of ECU and published in 1978 as a Sea Grant project.

The setting

North Carolina's coastal plain, including surface sediments, soils and topography, are the result of the Atlantic ocean moving inland and seaward between Raleigh and points well offshore. As the ocean "transgressed" and "regressed," it eroded soils from the mountains and Piedmont to produce the coastal plain. When the sea covered the coastal plain, minerals like calcite (calcium carbonate) precipitated out of ocean water and helped to build the land. The in and out cycling shaped and reshaped the coastal plain surface.

The cycling was in response to ice ages that alternated with warming trends many times during the Pleistocene Epoch, roughly two million to 10,000 years ago.

At the height of the last major ice age, approximately 18,000 years ago, the cold locked up so much of the oceans water in the form of mile-thick glacial ice, sea level was about 400 feet below its current level. The shoreline then was as far as 50 miles offshore, east of its present location.

Approximately 10,000 years ago, the present warming trend began. As the glaciers melted, the swelling ocean drowned the land. Estuaries like the Pamlico, began forming. With sea level rise, the ocean, its shoreline and the entire coastal system slowly migrated westward flooding the Tar and other river valleys and eroding the shorelines as it did so. The zone of separation between the inland Tar River and the Pamlico estuary (by convention the bridge between Washington and Chocowinity) was well out in present day Pamlico Sound. See map.

Shoreline (see chart).

There are five basic types of shorelines in the Pamlico and lower Tar river system. The abundance and erosion rates of each type are summarized on the accompanying table. A brief description follows.

The most inland shoreline type is that nebulous area where swamp forests end and the river begins. Bald cypress trees can survive in the rising tide and act as a temporary erosion shield.

Low banks are composed of sand and clay and have a relief of less than 1.5 m above mean water level. These make up 30 percent of the shoreline miles.

High banks are a result of erosion against high upland areas. Clay banks, which are more prevalent on the southside of the Pamlico, are hard and tight and erode slower than sandy banks. High banks have sandy beaches that extend into the Pamlico.

The Tar-Pamlico has eroded southward over time, leaving the low banks on the northside of the river. The high banks on the southside make up 5 percent of Pamlico shoreline and the low banks constitute 19 percent of the shore.

High bluff shorelines are composed of Pleistocene sands and clays that reach 30 feet above sea level. Bluffs are spectacular and in them can be seen the different sediment types and vegetation that formed over the past two million years. Examples of these type shorelines can been seen at Crystal Beach, Hills Point and Pamlico Beach. They are associated with the Suffolk scarp, the remains of an ancient barrier island chain which was a former outer banks that existed several hundred thousand years ago.

The last shoreline is the marsh, which is the most common at 62 percent. but least developed by people. Familiar sights such as great blue herons trekking through murky grass areas, feeding on smallfish life can be found in this area.

Erosion

Rising sea level.

Overall, the rate of erosion is controlled by the rate of sea level rise. At present this rate is between 5 and 10 inches every 100 years. Day-to-day, effects are hard to see but they are as inevitable as death and taxes.

Storms

The second major overall factor influencing erosion rate is storms from small, seasonal storms to northeasters and hurricanes like Dennis and Floyd. Day to day, a significant factor is fetch, the average distance of open water in front of the shoreline. Lots of fetch means even daily winds have enough space to whip up wave action against the shoreline.

Shoreline characteristics play a significant role in determining the effects of sea level rise and storms have on the shoreline in any given area.

These include offshore bottom geometry, bank height and type of soil, vegetation type and amount, shoreline shape, and orientation to winds and waves.

Human activity

A growing factor influencing erosion is the activity of people - everything from shoreline development such as clearing and bulkheading for housing to wake/wave action from boating. Bulkheading has localized effects. It reduces beaches and inhibits erosion in the immediate area and may enhance its effect on nearby property. No quantitative study has been made on the relative significance of these human activities on shoreline erosion. In the mid-term, bulkheading of ever increasing amounts of shoreline prevents the natural inland migration of valuable marshland with significant ecological consequences as sea level continues to rise. It is expected, however, that with the apparent return of major hurricane activity on the Atlantic coast, the need to better understand the human factor will grow.

In the long term -

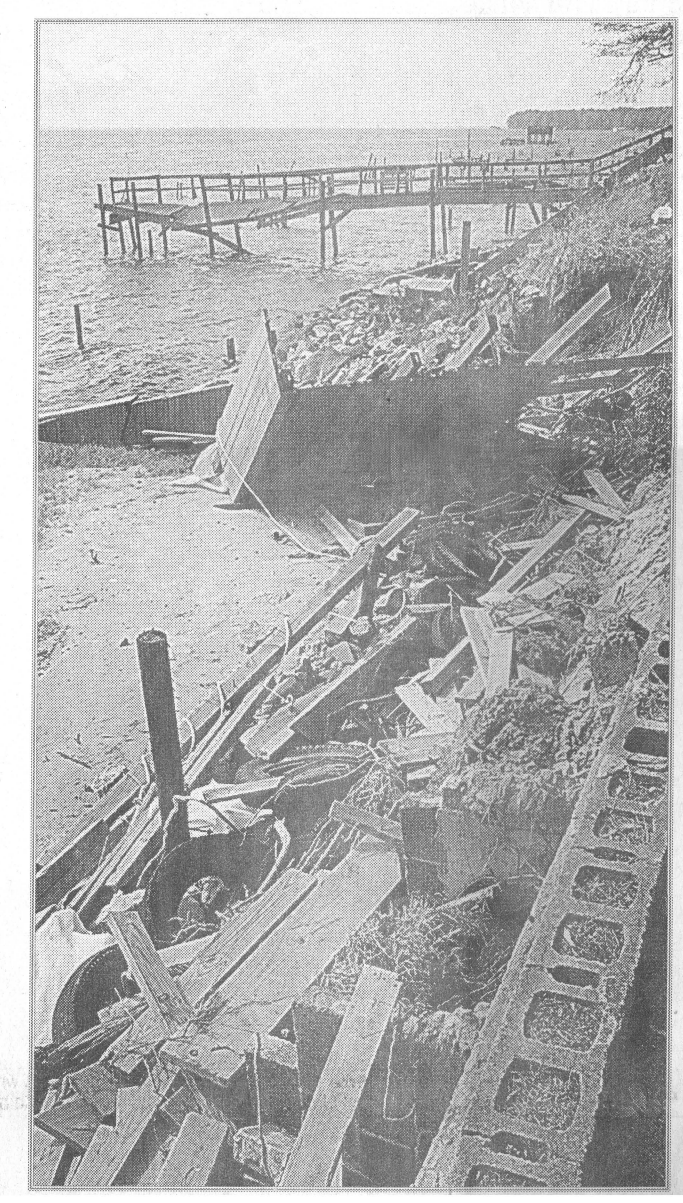
the next millennium, for example

No matter what we do, scientists and common sense tells us, the Atlantic is the semi - ultimate 500-lb gorilla. It will do what'er the ultimate gorilla, the climate, makes it do. The second map on Page 1C is the result of evaluation of all the factors discussed above including soil and other shoreline characteristics to predict where the Pamlico shoreline will be at the beginning of the next millennium. In 1978 when the map was first generated, Drs. Riggs and Bellis concluded it represented the shoreline in about a thousand years. Riggs has been working with the data since that time and has recently revised his projections so that the map, he now believes, could be representative of conditions throughout the system in 100 to 500 years.

"A single category 5 hurricane or several large ones could produce the conditions predicted for the outer banks on the map in much less time," Riggs explained.

He will soon be publishing a new series of maps and data on the coastal system based on his recent work.

Bulkheads at Pamlico Beach on the north shore suffered significant damage in Floyd.



Shoreline Systems of the Pamlico

Types	mi (%)	Averages Rates of Shoreline Erosion: (range of feet/year)
Low Bank:	112 (23)	2.6
High Bank:	19 (4)	1.9
Bluff:	5 (1)	2.1
Swamp Forest:	7 (2)	2.1
Marsh:	340 (70)	3.1

Special Natural Shoreline Features

Cypress Fringe:	5 (1)
Marsh Fringe:	27 (6)
Sand Apron (marsh):	17 (4)

Shoreline Status

Conspicuous Bank & Bluff Erosion:	47 (10)
Conspicuous Accretion:	2 (1)
Modification (bulkheads):	24 (5)