FLEEING FLOYD

by JIM REED

RIC FELD AP Photo

Thousands who tried to race to safety before Hurricane Floyd hit last year ended up going nowhere fast, stuck in traffic. Were such problems a fluke or a glimpse of the future?

Last September Hurricane Floyd became one of the largest tropical cyclones to form over the Atlantic Ocean. As it threatened to incapacitate several major cities along the southeastern coast of the U.S., the nation's civil defense system snapped into gear. Sirens howled, schools and courthouses closed, and navy ships headed to sea. Along barrier islands, soldiers darted among houses instructing residents to clear out, while the National Aeronautics and Space Administration battened down its shuttles.

As the 600-mile-wide storm bore down on Florida with winds of 155 miles per hour—just one mile per hour below the threshold of the fiercest, Category 5, storms—the specter of its potency chilled coastal residents and alarmed local emergency managers. "Floyd had the potential to be the worst hurricane to ever strike the East Coast," says James Lee Witt, director of the Federal Emergency Management Agency (FEMA) and a cabinet adviser to President Bill Clinton on natural disasters. "This is the first time we have ever had an evacuation that involved so many states at one time. It was my worst fear."

Dreading casualties, officials in more than 60 counties urged residents to move to higher ground. In response, an estimated 3.2 million Floridians, Georgians and North and South Carolinians rolled their vehicles onto the highways, yielding the largest single evacuation on U.S. soil.

Yet the question remains: Was the evacuation a success? Not surprisingly, the answer depends on one's perspective. Many emergency managers, the people who oversee such operations, consider it a qualified success—insofar as early warnings sounded, residents complied, and large numbers of imperiled people moved from

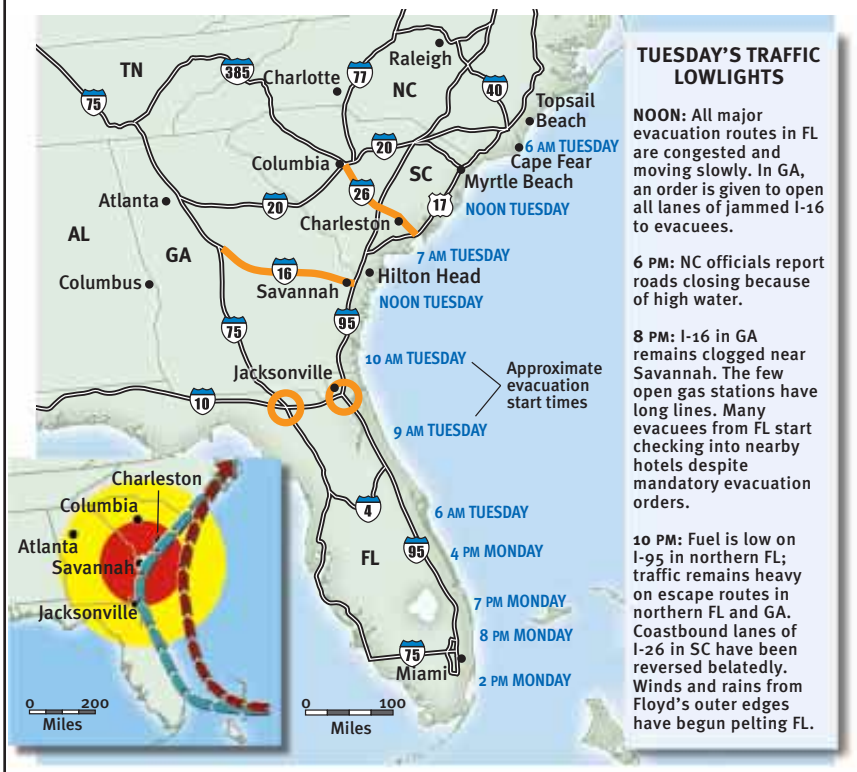
NATIONAL HURRICANE CENTER/AP PHOTO

HURRY UP AND WAIT: Even the opening of all lanes of Interstate 16 in Georgia to evacuees failed to free up traffic on Tuesday, September 14, 1999 (*above*). Meanwhile Floyd, shown on Monday evening (*left*), hovered menacingly off the coast.

Floyd's dangerous path with time to spare. But not all knowledgeable observers concur. Critics note that traffic gridlock kept many evacuees from reaching their designated shelters. Thousands of families were stranded in rest stops, strip malls and parking lots—even inside their cars on low-lying bridges. Mercifully for them, Floyd veered slightly east, sparing the most inhabited areas before its eye made landfall in southeastern North Carolina.

Both boosters and critics agree, however, that Floyd has lessons to teach for the future and that the need for smooth evacuations may be becoming increasingly critical. The number and intensity of hurricanes bombarding the U.S. Southeast have risen in the past couple of years. Moreover, the size of the at-risk population is climbing. According to FEMA, the

ESCAPE ROUTES?



TUESDAY'S TRAFFIC LOWLIGHTS

NOON: All major evacuation routes in FL are congested and moving slowly. In GA, an order is given to open all lanes of jammed I-16 to evacuees.

6 PM: NC officials report roads closing because of high water.

8 PM: I-16 in GA remains clogged near Savannah. The few open gas stations have long lines. Many evacuees from FL start checking into nearby hotels despite mandatory evacuation orders.

10 PM: Fuel is low on I-95 in northern FL; traffic remains heavy on escape routes in northern FL and GA. Coastbound lanes of I-26 in SC have been reversed belatedly. Winds and rains from Floyd's outer edges have begun pelting FL.

- GRIDLOCKED ROAD OR INTERSECTION
- TROPICAL STORM–FORCE WINDS; SUSTAINED SURFACE WINDS OF 39 TO 73 MPH
- HURRICANE-FORCE WINDS, 74 TO 155 MPH AND GREATER. WIND GUSTS COULD BE AS HIGH AS 190 MPH
- ACTUAL PATH
- WORST-CASE-SCENARIO PATH

Major evacuation routes in Florida, Georgia and South Carolina (*above*) became clogged after many regions issued mandatory or voluntary evacuation orders within a short time on Monday and Tuesday, Sept. 14 and 15. Floyd's eye stayed offshore until it reached the Cape Fear, N.C., vicinity at about 3 A.M. on Thursday. Had the storm sped up and veered significantly to the west (*inset*), its winds and rain could easily have harmed hundreds of evacuees who did not reach safe shelters by Tuesday night.

LAURIE GRACE

number of people living in hurricane-prone locations has reached nearly 50 million, with new families migrating daily to the coast. More people live in or near Miami today than lived in all 109 coastal counties from Texas to Virginia in 1930.

Best-Laid Plans

Although the traffic and other difficulties that bedeviled Floyd's refugees may seem to suggest a lack of forethought by officials, each state involved in the evacuation actually had—and put into effect—a detailed hurricane evacuation plan, which is part of a state's overall emergency plan.

"The state emergency manager has replaced the civil defense man, who used to drive around in an army car with a blue light," says Bill Massey, hurricane program manager at FEMA's Regional IV Office in Atlanta. "Only now, instead of worrying about the atom bomb, we're worried about bad weather."

Evacuation procedures can vary among states but are all quite specific. In Florida, for example, evacuations occur in four phases. In the initial (standby) stage, officials determine which regions are most likely to be affected. In the next stage, the decision to evacuate is rendered, and the governor declares a state of emergency. At that point, crisis telephone lines are set up, shelters prepare, and hundreds of support organizations get ready to help.

As the third stage—the evacuation itself—begins, emergency managers call on HURREVAC, a restricted-use U.S. government computer program used to help coordinate local evacuations. Launched in 1988, the program integrates lessons from previous evacuations and research by the federal government and the U.S. Army Corps of Engineers. The software tracks hurricanes on computer plot maps and assists in determining when to evacuate individual high-risk areas.

Two key factors influence the start times. One is clearance time—how long it will most likely take to get all cars to safe havens after the first evacuees enter an evacuation route. The other factor is the prelandfall time, or the lapse between the onset of tropical storm–force winds and the arrival of the storm's eye over land. Emergency managers aim to relocate all at-risk populations before high winds ensue, because people remaining on the roads during the prelandfall phase are vulnerable to injury from the winds, flooding and tornadoes. The final stage, the return home, begins when conditions are no longer hazardous.

The National Hurricane Center has identified three major hazards that most require evacuation: storm surges, high winds and heavy rain. Historically, storm surges—wind-pushed swellings of ocean water, sometimes measuring up to 20 feet high and 100 miles wide—have been the deadliest of all storm hazards, accounting for up to 90 percent of all hurricane-related fatalities. High winds can prove treacherous as well, especially to mobile homes and other lightweight dwellings or to structures with unprotected windows. When glass shatters, soaring shards become lethal projectiles. Rushing wind can blow a house apart. And torrential rain can cause fatal floods, depending on a hurricane's size, strength and path.

Consequently, residents of barrier islands, which have limited roads to the mainland, are among the first evacuees, followed by coastal inhabitants and mobile-home dwellers. Depending on the expected hazards, a county may totally or partially evacuate, first urging voluntary evacuation, then issuing an order to leave. Residents with special needs, such as those reliant on oxygen, dialysis or spe-

cialized medical care, usually relocate during the voluntary phase. Typically, officials guide evacuees to state-authorized shelters 20 to 50 miles inland.

Taking the Floyd Test

Last September Hurricane Floyd put the hurricane evacuation plans of the Southeast to a severe test. During the four-state evacuation millions competed for rapidly vanishing space on local roads. Floyd's wide range of possible landfall locations stymied evacuation timing. No one wants to order an evacuation unless it's absolutely necessary, and so orders cannot be given too early.

As it turned out, many areas began to evacuate within the same 24-hour period. Between 2 P.M. on Monday, September 13, and noon the next day, an estimated 47 at-risk counties sounded sirens, evacuating within hours. "Our infrastructure can't handle an evacuation with the kind of participation that took place during Floyd," says Massey in Atlanta. "There just weren't enough roads to hold everybody." Among the roads that clogged quickly were I-75, I-95 and I-10 in Florida, I-20 (spanning South Carolina and Georgia) and the most jammed of all: two main evacuation arteries heading away from the Atlantic Ocean, I-16 in Georgia and I-26 in South Carolina.

On Tuesday afternoon, with hundreds of thousands of Floridians caravaning into southern Georgia (many joining 350,000 Georgians heading west), Georgia's emergency managers reversed all normally coastbound lanes on I-16, hoping to ease traffic. But the effect was limited. As Floyd hovered offshore, local roads became clogged with vehicles.

In Savannah, Sheila Watson and her family, including a baby, discovered to their horror that they had driven from one evacuation region (in Florida) to another. Exhausted and ignoring the order to leave, the Watsons collapsed in a motel that required them to clean their own rooms, because maids had fled.

In South Carolina, where close to a million coastal residents were ordered to evacuate by Governor Jim Hodges, vehicles were also at a standstill. Hurricane castaways lounged in beach chairs beside cars and campers, shuffling cards in the drizzle as others cursed La Niña. But unlike Georgia officials, who initiated a lane reversal, disaster planners in South Carolina spent much of Tuesday arguing over whether or not to reverse coastbound lanes of I-26, the primary evacuation route for the citizens of Charleston and Hilton Head Island. By Tuesday night, I-26 was paralyzed with traffic at a time when the dangerous prelandfall period was fast approaching.

Meanwhile local DJs announced to evacuees stranded along I-16 and I-26 that the nearest available rooms were in Chattanooga—some 200 miles away. (Indeed, shelter options for evacuees had dwindled rapidly. By 8 A.M. Tuesday, even before evacuations became mandatory in Savannah, Hilton Head Island, Charleston and Myrtle Beach, hotels and shelters in Georgia and South Carolina were already packed.) Hearing the news reports, angry, exhausted motorists took the risk of pulling over to sleep, parking at highway rest stops. Some evacuees even began making U-turns and heading back toward the ocean.

"People were irate," remembers Lynn Willhite, a National Park Service real estate appraiser from Kennesaw, Ga., who spent the night in his car at a strip mall in South Carolina after moving only 87 miles in 10 hours. Emotions often reach a high pitch in an evacuation. During Hurricane Georges, the second deadliest cyclone of 1998, roughly 15 hours into the state of emergency some 14,000 evacuees sheltered in the Louisiana Superdome decided that they had had enough. When authorities said that conditions outside remained unsafe, armed National Guardsmen blocked exits—provoking frustrated evacuees to smash glass, rip up seats and destroy $50,000 in property.

Briefed on the developing Floyd mutiny, South Carolina's governor issued an emergency executive order compelling officials to open all lanes of I-26 to evacuees by 10 P.M. Tuesday. But time was running out. Gasoline supplies, too, ran short. Because of heat and humidity, motorists revved engines for hours to power air conditioners, overheating engines. Abandoned cars littered local roads.

Officials were sweating as well by the time the lane openings took place. Rain was falling in Florida and Georgia, storm winds were already whipping the Florida peninsula, and refugees in Georgia and

STEPHEN MORTON *AP Photo (top left)*; COREY LOWENSTEIN *The News and Observer (bottom left)*; CHUCK LIDDY *The News and Observer (right)*

SCENES FROM FLOYD: In addition to traffic, refugees endured lines for buses (*top left*) and crowded shelters (*bottom left*) to avoid being trapped and hurt by Floyd. After the storm hit North Carolina, a trucker had to be airlifted to safety because his vehicle had floated off I-95.

ANSWERS BLOWING IN THE WIND

While public officials squabbled over how to evacuate residents, scientists struggled to predict when and where the storm would make landfall. "The 72-hour forecasts were as good as we'd expect the 24-hour forecasts to be," says Hugh E. Willoughby, director of the National Oceanic and Atmospheric Administration's Hurricane Research Division, which provides forecasters with real-time wind analyses. Willoughby himself has flown into the eyes of hurricanes and typhoons more than 400 times.

As Floyd approached Cape Fear, N.C.—roughly where the eye eventually came ashore—three hurricane reconnaissance planes were aloft, assessing the speed, direction and behavior of the storm's threatening winds. Two NOAA WP-3D Orion turboprop planes traversed Floyd at altitudes between 1,500 and 10,000 feet, with airborne Doppler radar recording the wind's rapidity. Each plane also sports sophisticated instruments bolted to its underside to measure fluctuations in sea-surface movement; storm-blown waves are reliable indicators of wind velocity. Since 1997 a modified Gulfstream IV-SP jet has also soared over hurricanes at altitudes above 35,000 feet, releasing 16-inch-long instruments—dropsondes—that bear Global Positioning System receivers to relay wind velocity data every five seconds.

On the ground, through stream-flow gauging stations, the U.S. Geological Survey tracked rising waters, which closed 600 roads and 40 bridges in North Carolina during Floyd. Satellites relayed up-to-the-minute data on river levels to the National Weather Service, which issued warnings on storm surges and waves along the southeastern coast.

JIM REED

INTO THE BREACH: The Doppler on Wheels truck is able to measure wind speed and direction from within a hurricane.

Meanwhile in North Carolina, Joshua Wurman of the University of Oklahoma took to the road in Doppler on Wheels (DOW), a state-of-the-art mobile laboratory and radar that is designed to penetrate super-high-velocity winds and to relay wind measurements directly to the National Hurricane Center. During Floyd, Wurman and his crew parked the 12.5-ton mobile radar near the shore of Topsail Beach, N.C., north of Cape Fear, readying to scan the storm from within—using both the rotating radar and a 30-foot hydraulic pole bearing three anemometers (two high-speed, one regular) that measure wind speed.

"When a reconnaissance aircraft flies toward radar on the ground, you can cross the airborne Doppler with the ground-based beam and get a 3-D wind profile," Willoughby says. "The DOW cuts a sample of the boundary layer wind underneath the aircraft, which [airborne scientists] can't see because of the beam's geometry."

Beyond helping with storm tracking, information gathered by the DOW is expected to result in a better general understanding of hurricane behavior and in improved models for determining when, and if, a county should evacuate. *—J.R.*

South Carolina were still on the roads. If the hurricane had suddenly changed course, as Hurricane Andrew did in 1992, thousands of evacuees could have been exposed to two of the three most lethal hazards: high winds and flooding.

"If Floyd had made landfall in Savannah, it would have traveled right up parts of I-16 and I-26 and killed people sitting or sleeping in their cars," says Michael Phelps, a meteorologist at the Weather Channel, the Atlanta-based 24-hour cable channel. "I think we would have seen a death toll of at least 500."

Fearing for their lives, more than 500 stranded evacuees sought shelter at Georgia's brand-new, state-of-the-art visitor center along I-20, near the South Carolina state line. Officials transformed the center, which is typically closed after 5:30 P.M., into a makeshift storm shelter; it remained open for more than 33 hours straight. From early Wednesday morning through Thursday afternoon, evacuees watched hurricane highlights on a super-wide TV screen normally reserved for showing tourism videos on the joys of living in the Southeast.

Shortly after 3 A.M. on Thursday, many officials issued a collective sigh of relief as Floyd made landfall near Cape Fear, N.C., and weakened. The monster storm pummeled North Carolina, but the worst of it bypassed most of Florida, Georgia and South Carolina.

Pinpointing Causes of Problems

Ironically, the jamming of roads and shelters stemmed in part from disaster plans that worked only too well. "About 90 percent of the people in mandatory evacuation areas actually evacuated," says Robert S. Lay, director of the Office of Emergency Management in Brevard County, Florida. "I think people looked at the hurricane on TV and said, 'I'm leaving!' "

Reviewing poststorm reports, some disaster planners contend that certain residents also evacuated unnecessarily. How Americans view breaking news has changed since Hurricane Andrew. Real-time information beams into living rooms and offices around the clock. Massey believes TV coverage actually alarmed the wrong people—stirring up thousands who really didn't have to leave ("shadow" evacuees) and further snarling traffic. A survey after Floyd by David N. Sattler, a psychologist at the College of Charleston, suggests citizens trust local weather forecasters more than they do state officials.

This is not to say that officials want

people who should flee to stay. On the contrary, they worry a great deal about those who remain behind in mandatory evacuation areas. Commonly, it is the elderly or those of low income who insist on staying put, and indeed, during Floyd a number of nursing home residents refused to go. Too often those who stay live in areas prone to storm surges, and many pay a price for their resistance.

"During Floyd, there were some people on the Outer Banks who didn't evacuate," says FEMA director James Lee Witt. "Then all the roads got washed out, and they didn't have any power or phone service. The state then had to airlift food and water in to them."

Of course, not all the problems stemmed from high responsiveness. In South Carolina, Governor Hodges called the I-26 part of the evacuation "inexcusable," apologized to state residents and pledged to open all lanes in the future. So upset were residents over the botched I-26 Floyd evacuation that motorists slapped bright yellow bumper stickers on their vehicles exclaiming "Evacuate Hodges." Department of Transportation director Morgan Marton apologized for not properly advising the governor, and the state's top Highway Patrol officer, Wesley Luther, a 27-year veteran of the force, resigned under controversy. A "traffic czar" has now been appointed to ensure that evacuations run smoothly in future emergencies.

Yet even if all needed lanes were opened promptly and all shadow evacuees stayed home, the possibility exists that gridlock may be unavoidable during huge evacuations. Despite the American Society of Civil Engineers's 1994 statement that the interstate road system is one of the "seven wonders" of the U.S., impenetrable gridlock has plagued every hurricane evacuation since Camille in 1969, prompting traffic experts to question the feasibility of a multistate evacuation altogether.

Roger A. Pielke, Jr., a social scientist with the Environmental and Societal Impacts Group of the National Center for Atmospheric Research, warns that after decades of low hurricane frequencies, U.S. citizens live with a false sense of security, dwelling in hurricane-vulnerable regions without fully appreciating the risks. "The issue is, What level of risk are we willing to take?" he asks. "People look to Mother Nature as the cause for our problems, when the decisions we make every day actually underlie our vulnerabilities."

One thing people can do to improve their odds of survival is to strengthen their homes against storms. In 1997 FEMA launched Project Impact, a nationwide initiative to help homeowners shore up disaster protection. Arguing that homeowners can save two dollars in repairs for every dollar spent on prevention, FEMA urged residents of vulnerable regions to become more self-sufficient, trim trees, strengthen roofs and install a "safe room" able to withstand violent winds. Such measures cannot guarantee safety to those in the path of a storm surge, however.

The Outlook

Leading meteorologists say the question is not if but when a lethal storm will incapacitate a major U.S. city. "A Category 5 hurricane will make landfall in a heavily populated area," Pielke, Jr., warns. "It shouldn't surprise anyone." Witt agrees, emphasizing that scientists believe the U.S. has entered a busy hurricane period, reminiscent of the 1950s.

Between 1995 and 1999 an unprecedented 41 hurricanes formed in the Atlantic, 20 of them major. In fact, last year's Hurricane Lenny was the first Category 4 hurricane to occur in November since Greta in 1956. Ominously, with at least 9,000 hurricane-related fatalities, 1998 was the deadliest hurricane season in North and Central America since the Galveston, Tex., hurricane killed more than 8,000 in 1900. (In the Galveston episode, officials did not expect the hurricane to hit hard and so did not order an evacuation.) Moreover, the 1999 hurricane season was the first on record to spawn five major hurricanes with winds of at least 131 mph (1926 was the last year that four such hurricanes arose in one season). And Floyd was the first single hurricane to turn 10 states into major disaster areas (and that was after it weakened).

Researchers at the Benfield Greig Hazard Research Center in London predict that at least three tropical storms and one hurricane will directly strike the U.S. mainland between June 1 and November 30, 2000. Other regions are also at risk.

Disaster planners hate to think of what might have happened if the eye of Floyd had made landfall near Savannah or Charleston. Few people appreciate a tropical cyclone's capacity to kill and destroy property inland. In the case of Hurricane Andrew, the storm actually strengthened as it moved over Dade County, Florida. In September 1989 the remnants of Hurricane Hugo traveled 175 miles inland, pounding Charlotte, N.C., with 100-mph gusts, uprooting trees, shredding power lines and disrupting the city.

Although Floyd weakened, its torrential rains, flooding and winds still claimed 75 lives, making it the deadliest hurricane since Agnes in 1972. Thousands of unsheltered Floyd evacuees might have been injured had Floyd taken a more western track, Pielke, Jr., observes. Because of Floyd's enormity, its winds would have lashed evacuees even if the eye had remained offshore. Toppling trees might have crushed evacuees dozing in cars, downed power lines could have electrocuted pedestrians, and flash flooding might have swept others away, given that a packed I-26 rest stop stands next to a swamp and that I-16 intersects four rivers.

Gridlock may be unavoidable during huge evacuations. It has plagued every hurricane evacuation since Camille in 1969.

"If you go through an evacuation and the hurricane turns out to be weaker than forecast, just thank God and prepare for the next one," says the Weather Channel's Michael Phelps. Floyd, it seems, was a good trial run for the Big One.

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