Chapter 2
Hazards/Vulnerability Data

In FEMA/Corps comprehensive hurricane evacuation studies, the primary objective of the hazards analysis is to determine the probable worst-case effects from the various intensities of hurricanes that could strike an area. Specifically, a hazards analysis quantifies the expected hurricane-caused inundation and wind impacts that would require emergency evacuation of the population. The National Weather Services' SLOSH numerical storm surge prediction model was used as the basis of the hazards analysis for studies completed in North Carolina, South Carolina, and Georgia.

A vulnerability analysis performed for these studies takes the hazards analysis and identifies the population-at-risk from coastal flooding caused by the hurricane storm surge. Inundation maps are produced showing surge limits for various hurricane intensities with and without consideration of storm direction.

Hazards and vulnerability issues related to Hugo and discussed by the study team with local and state officials included the following:

What technical data/mapping was used to choose the areas to evacuate?

Did the technical data provide a good depiction of the hazard area?

Without question, the SLOSH model and inundation maps developed from the SLOSH model output were some of the most heavily utilized study products during Hugo. Although some local directors asked barrier islands and low lying areas to evacuate (rather than specific zones), most directors based their decision of who to evacuate primarily on the inundation maps. Evacuation zone maps which depict the inundation areas in a more generalized, "easier to describe" manner were used heavily in the Charleston and Beaufort County areas of South Carolina. Cable News Network (CNN) and the local newspaper in Charleston both showed the zone map to give viewers and readers an idea of the extent of evacuation that would be required just in the Charleston area. In the Beaufort County area, evacuation

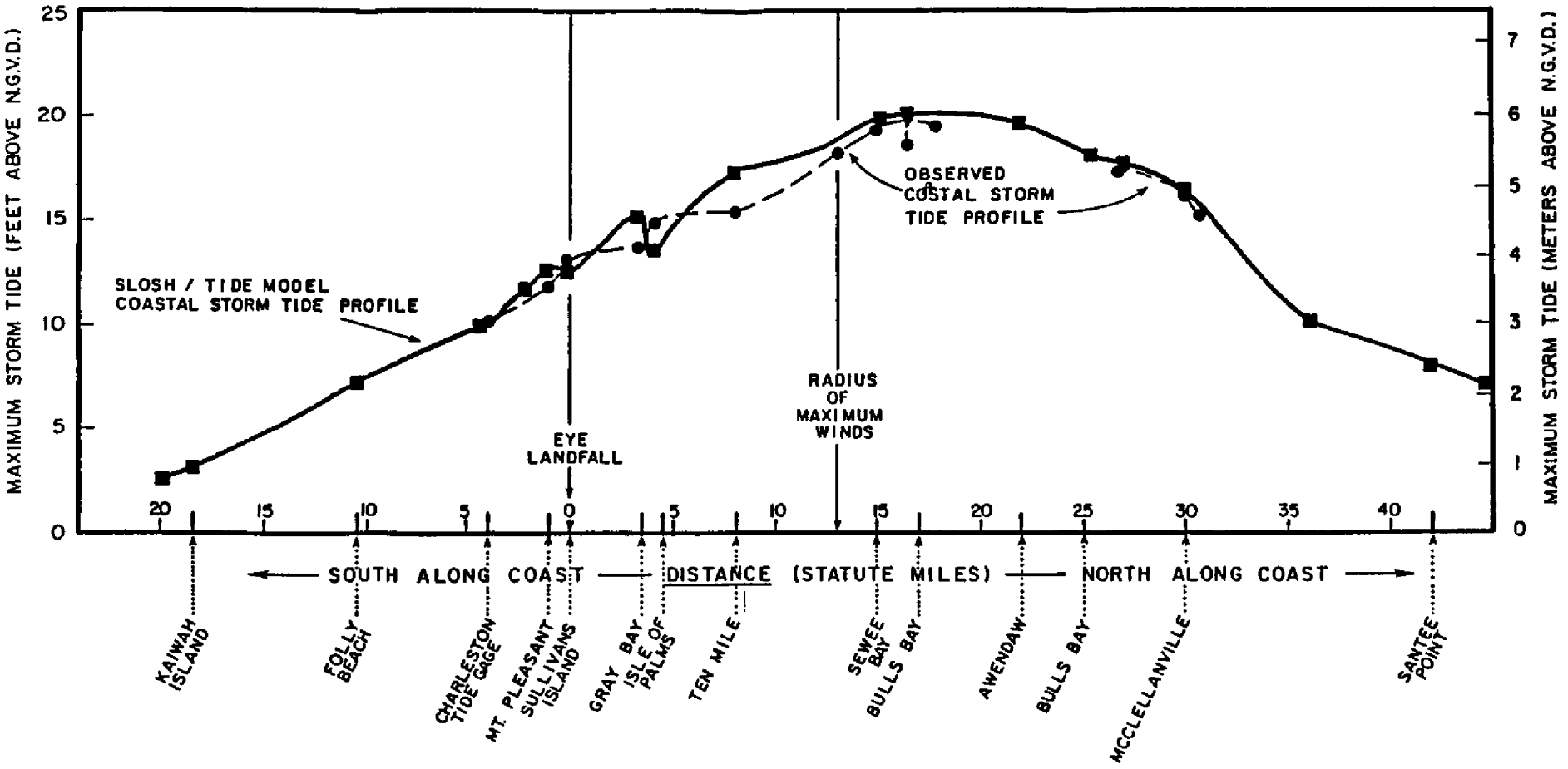
zones were used operationally by officers to warn specific areas of people of their need to evacuate.

In those areas that were directly affected by Hugo, officials had great confidence in the SLOSH model before the storm and even more importantly after the storm. In general, local and state officials felt that the hazards areas had been accurately depicted in the study data and products provided by FEMA and the Corps. The most exciting and important comparison of the SLOSH data and Hugo's effects occurs in the area where the eye of Hugo made landfall as well as those areas 30 to 40 miles north and south of landfall. Figure 1 graphically portrays a profile of SLOSH predicted stormtide values at key locations north and south of eye landfall. Observed high water marks from field reports are also plotted on the figure providing an amazing comparison of how well the SLOSH model worked in predicting maximum surge levels in Hurricane Hugo. Much of the success in minimizing loss of life during Hugo can be attributed to local directors taking the SLOSH values seriously and evacuating those areas that the SLOSH data and associated mapping said would need to be evacuated.

The most difficult issue regarding Hugo's hazards characteristics revolved around the storms' reported change from a Category 2 to a Category 4 hurricane in such a short period of time immediately before landfall. Fortunately many local directors took action for a Category 3 hurricane and had completed evacuation of the coastal barrier islands several hours before landfall. Miles Lawrence of the National Hurricane Center in his October 1989 preliminary forecast and warning critique of Hugo, noted that the highest sustained winds increased from 105 to 135 mph from 6:00 PM on the 20th of September to 6:00 PM on the 21st of September. During this same period, the wind forecast contained in all of the public advisories was "little significant change in strength is likely". (See Appendix B for a time table of selected storm and warning data provided by the National Hurricane Center.) This coupled with a slight right bias for two track forecasts just before landfall on September 21st accentuate the importance of all emergency officials recognizing the limitations in tropical cyclone intensity forecasting. Some officials indicated it may be prudent in some situations to take action for one category above that of the threatening hurricane. This proved wise on the part of local officials in Hugo.

Figure 1

SLOSH Tide Values/Hugo High Water Mark Comparison



NOTE: Data plotted above is preliminary NHC/USGS data regarding Hugo.

RECOMMENDATIONS

Some local officials needed the inundation mapping at a larger scale. This problem could be easily rectified in the future if SLOSH surge mapping is produced on CADD (Computer Aided Drafting and Design) systems. Products can then be output at whatever scale the user desires irregardless of the scale limitations of a printed atlas. The development of a SLOSH model for the Myrtle Beach area would greatly help in defining expected storm tide heights for the upper South Carolina coast and the southeast North Carolina coast in a Hugo event.

Chapter 3
Behavioral Analysis - Public Response in Hugo

Approximately three months following Hugo's landfall in South Carolina, telephone interviews were conducted with residents in Myrtle Beach, the Charleston area, and Beaufort. Survey results were compared with responses in previous behavioral studies in the area regarding hypothetical hurricane threats. Behavioral responses in Hurricane Diana were also compared with the post-Hugo survey results. In Myrtle Beach and Beaufort a total of 150 post-Hugo interviews were completed, and in Charleston, on the peninsula and west of the Ashley, 200 households were interviewed. In addition, a combined 100 interviews were completed in Mt. Pleasant, Sullivan's Island, and Isle of Palms. The great majority of respondents in all areas were in category 1, 2, or 3 surge zones. No post-Hugo surveys were outside category 4 zones.

Evacuation Rates

In none of the primary sample locations was evacuation complete. In Beaufort 72% left, in Charleston 62%, Mt. Pleasant/Sullivan's 81%, and Myrtle Beach, 79%. There were, however, variations within these areas. From Sullivan's Island and Isle of Palms 96% left, and there were probably comparable successes in other high-risk barrier islands. It would be inaccurate to say that everyone in the sample should have evacuated or that officials indicated that they should. A small minority in fact lived outside areas advised or ordered to leave. Taking just the category 1, 2, and 3 surge areas, it is unlikely that more than 75% to 80% evacuated from most areas other than barrier islands and beachfronts.

Most but not all respondents believed they had been told by officials to leave (71% in Beaufort, 64% in Charleston, 72% in Mt. Pleasant/Sullivan's, and 73% in Myrtle Beach). Very few respondents interpreted the evacuation notices as being mandatory. Of the total sample, 30% in Beaufort and Myrtle Beach and 15% to 20% in Charleston said they heard an order to evacuate. Overall 89% of those who said they heard an order evacuated, compared to 70% who said they heard a recommendation. Surprisingly, of those saying they heard neither, 61% evacuated.

This is relatively high for people not hearing official evacuation notices. Many did, however, hear from other sources that they should leave and were aware that neighbors were leaving.

Those saying they lived within a block of most types of water bodies were most likely to evacuate (84%). Of the respondents saying they lived more than a block but less than a mile from water, 73% left, compared to 65% who said they lived more than a mile from water. The exception to this trend were respondents living within a block of rivers, of whom 67% left. Respondents were asked whether they thought their homes would have flooded if Hugo had struck their location directly. If they believed their homes would have flooded, 83% left, compared to 65% of those who felt their homes would not have flooded.

Evacuation Timing

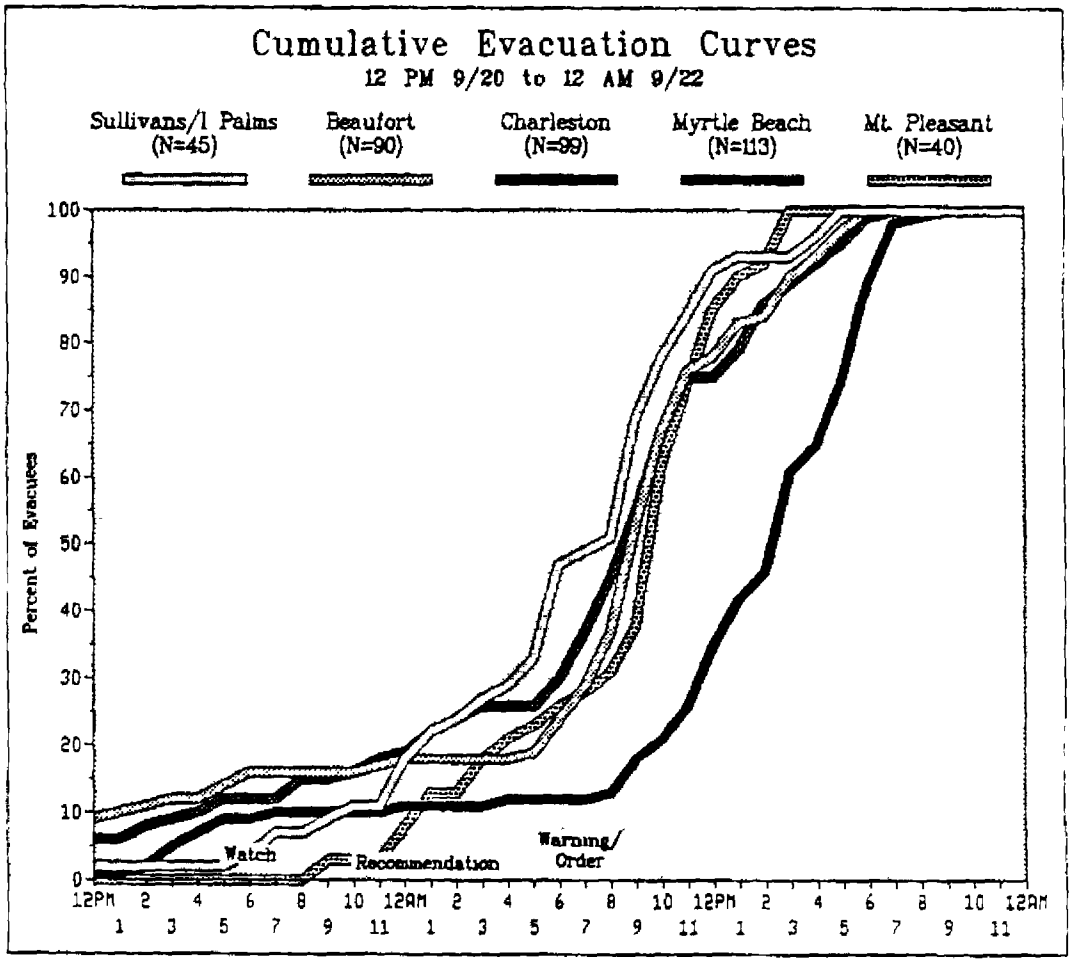
Figure 2 depicts the cumulative evacuation curves for five of the survey areas (with Mt. Pleasant and Sullivan's/Isle of Palms shown separately). When a watch was issued Wednesday at 6 PM, fewer than 10% of the eventual evacuees from most areas had left. The percentage was slightly higher in Beaufort (17%) where officials indicated they had suggested to residents earlier in the day that a visit to friends or relatives in safer locations might be prudent. By midnight, following the earlier voluntary evacuation notice in the Charleston area and statements by the Governor, additional evacuees had left, between 10% and 20% of the eventual totals.

When the warning was issued at 6 AM Thursday morning, and the governor ordered evacuation from the most vulnerable coastal areas, 50% of the evacuees from Sullivan's Island and the Isle of Palms said they had already left. In Charleston 30% of the evacuees said they had gone when the warning was issued, followed by 25% from Mt. Pleasant, 22% from Beaufort, and 10% from Myrtle Beach, farther to the north and away from the storm. These figures indicate that a significant number of people evacuated during the nighttime.

Throughout Thursday morning most evacuees departed, and by noon between 75% and 90% had left from all the survey areas except Myrtle Beach, from which only 35% had gone. By 4 PM almost everyone who left had already done so

Figure 2

Cumulative Evacuation Curves



except in Myrtle Beach where departures continued until 7 PM. Almost two-thirds of the Myrtle Beach evacuees said they left between noon and 7 PM.

Type of Refuge

Very few evacuees went to public shelters (9% in Beaufort, 7% in Charleston, 2% in Mt. Pleasant/Sullivan's, and 13% in Myrtle Beach). Across the four sites more people went to motels than shelters, ranging from 15% in Myrtle Beach to 26% in Mt. Pleasant/Sullivan's. More than half the evacuees from all areas (56% to 66%) went to the homes of friends or relatives.

Shelter use is usually associated with income, and such was the case in Hugo. In households reporting annual incomes below $10,000, 25% used public shelters. In no other income group did more than 8% go to shelters. Non-whites -- primarily blacks -- were much more likely to use public shelters than whites (31% vs. 5%). There was a difference even within most income groups 39% vs. 9% for incomes less than $10,000/year, 27% vs. 3% for incomes between $10,000 and $25,000/year, and 22% vs. 3% for incomes from $25,000 to $40,000/year.

Respondents living in mobile homes were slightly more likely to use public shelters than other residents (14% vs. 8%). Evacuees living within a mile of water bodies other than rivers were less likely than other groups to use public shelters. Of the evacuees staying in their own county 25% went to public shelters, compared to only 2% of those going out-of-county. However, breakdowns by county for in-county evacuees going to public shelters are unreliable due to the small sample sizes involved.

Evacuation Destinations

In all primary sample locations between 64% and 78% of the evacuees went to out-of-county destinations. Roughly a fifth of all evacuees reached their destinations in less than 30 minutes, indicating very short trips. Between 28% (Mt. Pleasant/Sullivan's) and 49% (Myrtle Beach) took an hour or less. Beaufort (16%), Charleston (20%), and Mt. Pleasant/Sullivan's (29%) all had substantially more evacuees requiring over five hours to reach their destinations than Myrtle Beach (3%).

Number of Vehicles

The number of evacuating vehicles per household ranged from 1.1 in Charleston to 1.4 in Beaufort and Mt. Pleasant/Sullivan's. This represented 59% of all available vehicles in Charleston to 71% in Beaufort.

Comparison to Behavioral Assumptions Derived Before Hugo

Evacuation Rates

In hypothetical response surveys conducted before Hugo very few people said they would refuse to evacuate even if ordered (1% to 4%). The behavioral analysis indicated that without disseminating evacuation orders door-to-door 35% would not leave in Beaufort, 35% in Charleston west of the Ashley River, 20% in the Charleston peninsula, 20% in moderate-risk areas in Myrtle Beach, and less than 10% in high-risk islands and beachfronts. Evacuation rates in Hugo were extremely close to those indicated in the behavioral analysis. Exact comparisons are not possible without further disaggregating the Charleston sample east and west of the Ashley and without more precise determination of respondents' evacuation zones.

Evacuation Timing

In responses to hypothetical hurricane scenarios, 40% to 50% of those interviewed before Hugo said they would evacuate when a watch was posted, before officials indicated they should leave. The behavioral analyses indicated that a variety of response curves were plausible, depending upon various warning scenarios, but suggested that not more than 10% to 15% of the evacuees were likely to leave before evacuation notices were issued by officials. In Hugo, officials in different locations said various things at certain times, but overall the behavioral analysis figures were very close to the mark. If anything there was slightly more early response in Hugo than behavioral analysis guidelines suggested.

Type of Refuge

In hypothetical response surveys 37% in Beaufort, 40% in Charleston west of the Ashley, 49% on the Charleston peninsula, and 35% in Myrtle Beach said they would go to public shelters if they evacuated. The behavioral analyses cautioned that hypothetical shelter use is normally twice actual. Shelter use assumptions in the behavioral analysis labelled "cautious" (i.e., attempting not to underestimate demand in normal circumstances) were 15% for Beaufort, 15% for Gharleston west of the Ashley, 30% for the Charleston peninsula, 20% for moderate-risk areas of Myrtle Beach, and 5% to 10% for high-risk barrier island and beaches. (The exception to the last case was St. Helena island, a socially close-knit, predominantly black community, where shelter use was projected at 40%, compared to 62% who said they would use shelters). Shelter use in Hugo was generally lower than the numbers cited in the behavioral analyses, particularly in moderate-risk to low-risk predominantly white areas. The behavioral analyses did, however, point out that in early evacuations for severe storms more evacuees would leave the local area, causing shelter use to be lower, and that if officials took actions to discourage shelter use, it would be lower. Both conditions appeared to pertain in most locations during Hugo, especially in Charleston and Beaufort where shelter use was lowest and deviated most from the norms cited in the behavioral analysis. In Myrtle Beach 18% of the post-Hugo survey respondents used public shelters, almost exactly the figure indicated by the study behavioral analysis.

South Carolina officials have estimated that 256,000 people evacuated in the state during the Hugo threat, and Red Cross records indicated that 94,000 were registered in public shelters, almost half in inland shelters. Those figures seem to imply that 37% of South Carolina's evacuees went to public shelters, which is almost certainly not the case. The figures also appear to conflict with the survey data indications that only 2% of the evacuees who went out-of-county went to public shelters. It is possible that there were substantially more than 256,000 evacuees, including many from low-risk areas not included in the statistics. It is also possible that those in shelters included inland county mobile home residents and people seeking refuge after the storm.

Destinations

The behavioral analyses indicated that 40% from Beaufort, 45% from Charleston west of Ashley, 35% from the Charleston peninsula, and 60% and 70% in Myrtle Beach (the latter for a severe storm with a timely evacuation) would leave the local area. The behavioral assumptions were very close in Myrtle Beach, but low for the other areas. Here too the analyses indicated that early evacuations would see more people going inland, but no numerical guidelines were given except for Myrtle Beach. The effect of actions by public officials, which was largely responsible for the large out-of-town evacuation in Hugo, was not addressed explicitly in the behavioral analyses as it was in the discussion of shelter demands.

Vehicle Use

Hypothetical response data indicated that about 65% of all available vehicles would be used in evacuating households, and the behavioral analyses recommended using that figure for Charleston and Beaufort and using 70% and 75% for Myrtle Beach. Actual use was within five percentage points.

Response Outside South Carolina

No behavioral surveys were conducted for Hugo in North Carolina or Georgia, therefore no firm conclusions are possible for public response in those states. The evacuation in some counties of North Carolina appears to have been partially implemented, making comparison between actual response and that projected in behavioral analyses for that area difficult.

Summary and Recommendations

Public response to the Hugo threat was extremely good and demonstrated once again the impact public officials can have on evacuation behavior. Over 90% of the respondents felt that officials had handled the evacuation well. Relatively few evacuees left prior to explicit recommendations or orders from public officials, but in some locations a substantial portion of the eventual evacuees had already left when the warning was posted Thursday morning. Public shelter use and local refuge demand were relieved considerably by officials' urging evacuees to seek other

alternatives. Behavioral analyses upon which evacuation studies were based for South Carolina were quite accurate for most locations and most behaviors but would have been more useful had they provided numerical guidelines for planning for a greater variety of scenarios.

Behavioral analyses should provide a numerical adjustment for special circumstances affecting shelter use rather than simply a directional adjustment, and more situational guidelines rather than place-specific estimates should be provided in the analyses. Those practices are in fact the norm in most contemporary behavioral analyses, the process having evolved since the South Carolina studies were completed. Behavioral analyses should also project demand for in-county and out-of-county public shelter separately. The bulk of public shelter demand was assumed in the behavioral analyses to be in-county, but a numerical distinction was not made in the report. The issue of non-white demand for shelters being greater than white demand across income groups is a factor that needs further consideration.

Chapter 4
Shelter Issues

The primary objectives of shelter analyses prepared for FEMA/Corps comprehensive hurricane evacuation studies are to list public shelter locations, assess their vulnerability relative to storm surge flooding, and to estimate the numbers of people who would seek local public shelter for a particular hurricane intensity or threat. Shelter location/capacity data are obtained from Red Cross, schoolboard or other local agencies. Comparisons are then made with SLOSH data to assess flooding potential. Public shelter capacity is usually compared to public shelter demand figures generated in the transportation analysis to determine potential deficits or surpluses in sheltering. The behavioral analysis is important to this process as assumptions for the transportation analysis (regarding the percent of evacuees going to public shelter) come from the behavioral analysis results or behavioral parameters recommended by the local directors.

Public shelter issues related to Hugo were discussed with local and state officials by the study team. Discussions focused on the following topics:

When were shelters opened and when did evacuees arrive/stop arriving?

How many shelters were opened and how many sheltered?

Were any flooding, wind, or loss of power problems encountered with shelters during the storm?

Tables 1, 2, and 3 summarize the responses to each of these topics gathered from discussions with shelter officials in each area. In Georgia, public shelters within the coastal counties were opened Thursday morning at 0800 and remained open for approximately 24 hours at which time it was clear that Georgia would be spared the brunt of Hurricane Hugo. Shelters in inland Georgia counties were opened throughout the day (Thursday September 21st) as evacuees began to arrive from the coastal areas. No flooding, wind, or loss of power problems were cited for public shelters in Georgia although one shelter in Savannah was closed because of a concern of too much glass exposure for evacuees. Evacuees were moved to

Table 1
Hurricane Hugo
Public Shelter Data - Georgia

Location	Number of Shelters Opened	Number of People Sheltered in County	Number of Shelters/ Expected Public Shelter Evacuees - Tech. Data Report*	Time Shelter Opened/ Shelter Duration	Flooding, Wind, or Loss of Power Problems
GEORGIA					
Camden Co.	1	150	6 shelters/2,355 people	Wednesday night 20th/ 24 hours	none
Glynn Co./ Brunswick	4	308	8 shelters/1,950 people	8 AM Thursday 21st/ 24 hours	none
McIntosh Co.	-	-	3 shelters/1,200 people	-	-
Liberty Co.	4	880	9 shelters/7,200 people	8 AM Thursday 21st/ 22 hours	none
Bryan Co.	1	100	8 shelters/1,990 people	8 AM Thursday 21st/ 24 hours	none
Chatham Co./ Savannah	6	1,850	11 shelters/10,900 people	8 AM Thursday 21st/ 24 hours	none, decided to close one shelter because of too much glass
inland counties	-	2,700	-	-	none

* In Georgia, coastal counties took action for a Category 2 hurricane - therefore, data for a Category 2 scenario (low tourist occupancy) from the Technical Data Report is presented here for comparison to Hugo data.

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Table 2
Hurricane Hugo
Public Shelter Data - South Carolina

Location	Number of Shelters Opened	Number of People Sheltered in County	Number of Shelters/ Expected Public Shelter Evacuees - Tech. Data Report*	Time Shelter Opened/ Shelter Duration	Flooding, Wind, or Loss of Power Problems
SOUTH CAROLINA					
Jasper Co.	3	600	9 shelters/1,600 people	9 AM Thursday 21st/ 26 hours	none
Beaufort Co./ Hilton Head	7	5,500	13 shelters/11,700 people	6 AM Thursday 21st/ 30 hours	loss of power at shelters
Colleton Co.	3	1,000	11 shelters/5,200 people	6 AM Thursday 21st/ 30 hours	none
Charleston Co.	52 plus auditorium in Tri-County area (including Berkeley and Dorchester)	35,000 in Tri-County area	16 - Berkeley/8,590 people 45 - Charleston/44,720 people 18 - Dorchester/4,300 people	11 PM Wednesday 20th/12 shelters open 1 week, 1 shelter 2½ weeks, others - ½ week	Lincoln High in McClellanville flooded, several shelters lost roof, loss of power in all shelters
Georgetown Co.	8	2,959	17 shelters/4,000 people	9 AM Thursday 21st/ most shelters 30 hrs., 1 shelter 1 month	3 shelters experienced wind damage, other shelters lost power except for a high school which had emergency power
Horry Co./Myrtle Bch.	19	9,000	38 shelters/40,000 people	4 PM Thursday 21st/ 24 hours	all shelters lost power, however 9 shelters have emergency power
inland counties		44,000		-	-

* In South Carolina, the level of evacuation carried out in Hugo was directly related to a Category 3 low tourist occupancy situation as presented in the Technical Data Report. The exception to this was in in Jasper and Horry Counties where evacuation level resembled the Category 2 low tourist occupancy scenario.

Table 3
Hurricane Hugo
Public Shelter Data - North Carolina

Location	Number of Shelters Opened	Number of People Sheltered in County	Number of Shelters/ Expected Public Shelter Evacuees - Tech. Data Report*	Time Shelter Opened/ Shelter Duration	Flooding, Wind, or Loss of Power Problems
NORTH CAROLINA					
Brunswick Co.	7	2,485	10 shelters/3,250 people	1 PM Thursday 21st/ 24 hours	none, loss of power only in Southport
New Hanover Co./ Wilmington	5	1,100	5 shelters/2,940 people	4 PM Thursday 21st/ 17 hours	none
Pender Co.	-	-	13 shelters/2,290 people	-	-
Onslow Co.	6 plus 8 military shelters	987 plus 408 in military shelters	18 shelters/9,360 people	6 PM Thursday 21st/ 12 hours	none
Carteret Co.	4	3,000	7 shelters/4,080 people	4 PM Thursday 21st/ 17 hours	none
Dare Co.	none	-	-	-	-

* In North Carolina, the level of evacuation carried out in Hugo was a scenario A type situation as presented in the Technical Data Report. This corresponds to a Category 1-3 Hurricane, low tourist occupancy.

tlt:HH/a

another shelter with adequate capacity and less glass exposure. As shelters opened in the coastal areas of Georgia, some evacuees were ready to go in. Evacuees arrived throughout the day until late afternoon/early evening.

In South Carolina, public shelters were generally opened early Thursday morning the 21st although officials in Charleston opened some shelters at midnight Wednesday the 20th due to their need to accommodate longer evacuation times. Shelters generally remained open 24 hours except in the heaviest hit areas of Charleston and Georgetown Counties. In Charleston County most shelters were open ½ week with 12 shelters open a week. To accommodate those residents devastated from the McClellanville area a shelter in Georgetown County was open for a month. Evacuees generally arrived as soon as shelters opened and continued until early Thursday evening. Inland shelters in South Carolina handled thousands of coastal residents as well as their own mobile home residents - these shelters opened throughout the day Thursday the 21st. Most shelters in coastal South Carolina experienced loss of power. In addition, several shelters in Charleston and Georgetown Counties suffered wind damage including loss of roofs. Lincoln High School in McClellanville experienced severe flooding. Officials reviewing this unfortunate situation determined that the elevation reported in the study produced Technical Data Report was based on an elevation shown on school board drawings and was roughly two times the actual land elevation.

Public shelters in coastal North Carolina were opened Thursday afternoon and remained open for approximately 12 to 17 hours. Evacuees arrived immediately upon shelters opening and most left by early Friday morning as it was obvious that the North Carolina coast would be missed by the direct fury of Hugo. No problems were encountered with public shelters except for the Southport area of Brunswick County, North Carolina where loss of power occurred.

As can be seen in Tables 1, 2, and 3 the number of public shelter evacuees in coastal county shelters during Hugo was significantly less than what was anticipated through statistics generated in study products. Local officials had a fairly good and reliable estimate of the number of people in public shelters. However, estimates of the total number of people evacuating dwelling units within each county are rough at best. Therefore it is hard to get an accurate handle on the exact percent of total evacuees that went to local public shelters. State officials

estimate that approximately 265,000 people evacuated dwelling units in coastal South Carolina. The Red Cross statistics imply that 50,000 of these were in public shelters in the coastal counties and another 44,000 evacuees went to public shelters in inland counties. In Georgia, of approximately 175,000 people evacuating only 6,000 went to public shelters throughout the state (see notes below). In North Carolina it is difficult to make comparisons between Hugo figures and study report figures due to the limited evacuations that were carried out (relative to scenarios in the Technical Data Report). The exception to this is Brunswick County where actual shelter demand was about 75% of study generated shelter demand.

There are several important reasons why anticipated in-county shelter demand was much lower than actual shelter demand:

1) In many cases, local officials discouraged evacuees from going to local shelter by pointing out the discomforts of such or by encouraging people to go to the home of a friend/or relative or an inland public shelter.

2) Many people went to or sought public shelter in inland counties as opposed to local coastal public shelters.

3) Many churches and union halls served people who would be expected to be in public shelters.

4) Due to the excellent publicity by the media, early evacuation action of local officials, and general fear of the storm, evacuees were able and certainly willing to leave the threatened counties and go inland.

5) Compared to the number of shelter locations identified in each county (in the Technical Data Reports) a limited number of shelters were opened.

6) In Georgia coastal evacuees were unable to find out the location and availability of inland shelters as evidenced by evacuees at tourist information centers along I-16.

RECOMMENDATIONS

Based on the Hugo experience, it is recommended that future Corps/FEMA hurricane studies incorporate the following:

1) Monies must be budgeted for the shelter analysis to include surveys of all public shelter first floor elevations and notes of general architectural features regarding wind vulnerability. Secondary sources must not be relied upon for elevation and flooding considerations.

2) Local officials should be encouraged to work with inland county or host county shelter officials regarding expected shelter demand and resource needs.

3) Public shelter destination percentages should be varied or additional scenarios considered in the transportation analysis reflecting a "Hugo event" where most public shelter evacuees go inland to a host county. Behavioral analyses and recommendations should also anticipate this type of response.

4) Study managers should confirm with shelter officials whether all identified shelters will be open for a particular scenario.