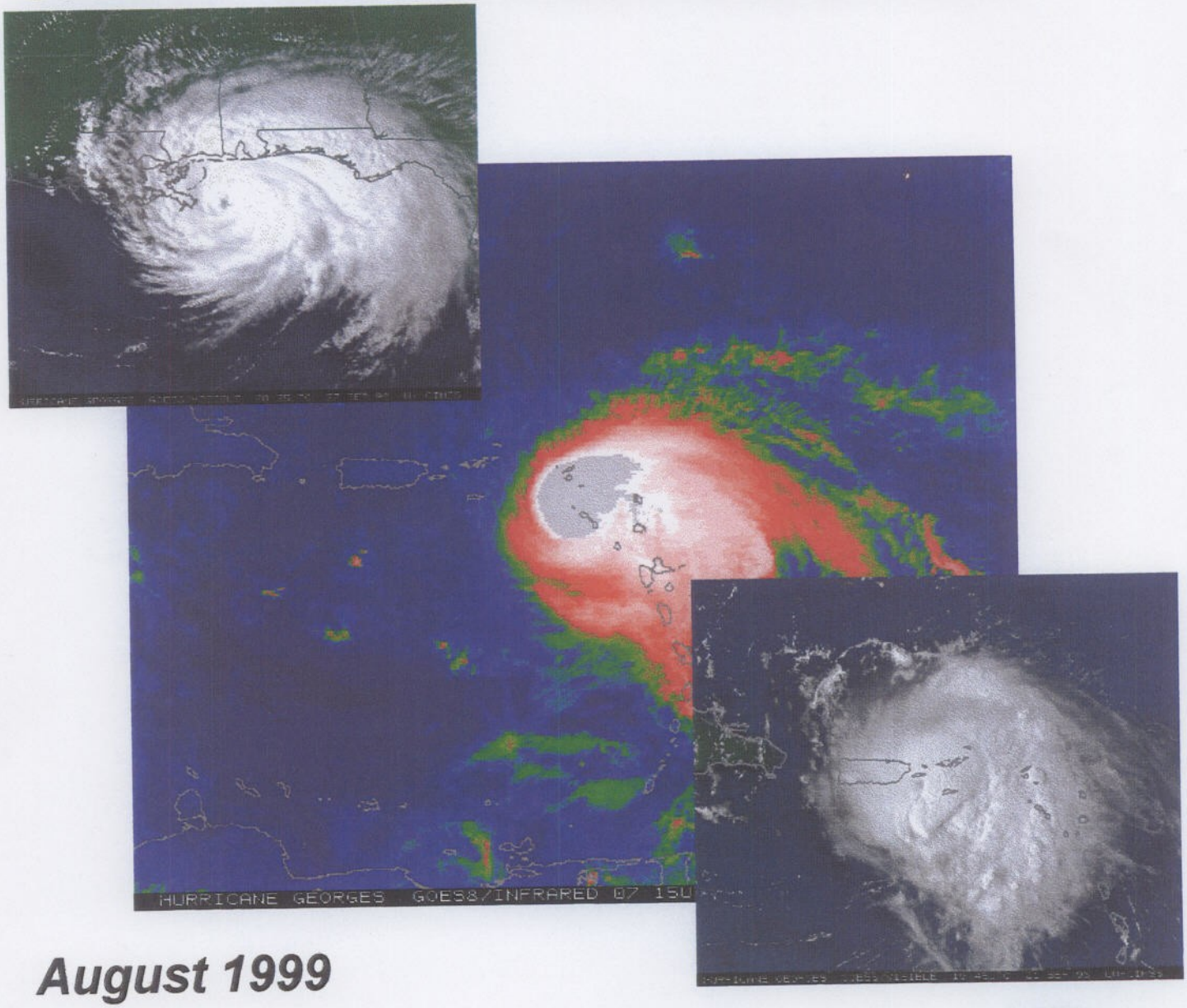
Hurricane Georges Assessment

Review of Hurricane Evacuation Studies Utilization and Information Dissemination



August 1999

US Army
Corps of Engineers

HURRICANE GEORGES ASSESSMENT
Review of Hurricane Evacuation Studies Utilization And Information Dissemination

Prepared for

U.S. Army Corps of Engineers
Mobile and Jacksonville Districts
And
Federal Emergency Management Agency
Region IV

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Executive Summary

On September 20, 1998, Hurricane Georges passed near the U.S. Virgin Islands making landfall over Puerto Rico. Georges made its way into the Florida Straits early on the 25th after making landfall over Hispaniola and Cuba. Georges made its next landfall near Key West before moving towards the Gulf Coast. On September 28th, Georges made landfall again near Biloxi, Mississippi. Georges caused 602 direct deaths and over 5 billion dollars of estimated damage.

Hurricane Georges provided an opportunity to answer several key questions regarding these major FEMA/Corps planning efforts:

> Did local and state officials use the products produced in these major studies?
>
> Were study data regarding storm hazards, behavioral characteristics of the threatened population, shelter information, evacuation times, and decision-making accurate and reliable?
>
> Which study products were most useful and which least useful - what improvements could be made to current methodologies and products?

To answer these questions, study teams comprised of representatives from FEMA, the U.S. Army Corps of Engineers, and Post, Buckley, Schuh & Jernigan, Inc. visited with local and state officials throughout the directly impacted areas of South and Northwest Florida, Alabama, Louisiana, Mississippi, Puerto Rico, and the U.S. Virgin Islands.

Interviews and analysis conducted during the post-Georges effort revealed modest evacuation participation rates on the part of permanent population and tourists throughout the study areas.

Major recommendations from this post-Georges effort include:

1. Complete new SLOSH modeling and associated mapping for the Florida Keys, Alabama, Mississippi, and Louisiana.

2. Produce a comprehensive atlas showing storm surge areas and 100 year floodplain for the entire island of Puerto Rico.

3. Address the unique rainfall vulnerability and mudslide potential for hurricane events in the Caribbean through activities of the FEMA/Corps/NWS Island Task Force.

4. Educate the emergency management community about the three fold effect of wave run up, wave set up and wind driven wave run up on SLOSH predicted values and measuring high water marks.

5. Provide Puerto Rico and the U.S. Virgin Islands with public shelter evaluation resources and monies for emergency power supplies/generators.

6. Address the unique wind vulnerability of island shelters due to mountain terrains/downslope accelerations.

7. On the Gulf Coast, make sure public shelter staff keep evacuees out of gymnasiums during the brunt of storms due to potential roof problems.

8. Build on the success of Escambia County, Florida, in working with the military to successfully staff public shelters.

9. Update Alabama, Mississippi, Louisiana and lower southeast Florida hurricane evacuation studies.

10. Run scenarios for St. Thomas under lower assumed participation rates.

11. Develop maintenance of traffic plans for Louisiana parishes that have road construction projects on major evacuation routes (specifically for the hurricane season).

12. Conduct a Louisiana-Mississippi regional hurricane evacuation analysis to better anticipate traffic flows into Mississippi and associated shelter demand.

13. Provide Gulf states and counties with an abbreviated version of the transportation model so that roadway construction impacts to clearance time can be calculated in real time.

14. Implement permanent traffic count stations along the Gulf Coast states so that evacuation traffic can be monitored and documented.

15. Update clearance time data and incorporate into the new HURREVAC model.

16. Conduct extensive training sessions with local EM's regarding the new HURREVAC model.

17. Deliver new SLOSH storm tide atlases to Mississippi Counties as soon as possible.

18. Provide detailed river and mudslide area maps such as USGS maps for Puerto Rico and the U.S. Virgin Islands.

19. Provide rain and wind gauges for the U.S. Virgin Islands.

20. Study update in Alabama including clearer/more definable evacuation zones.

21. Update Louisiana study including SLOSH forecasts.

22. Assist Puerto Rico municipios in obtaining necessary data during a storm.

Chapter 1
Introduction

As reported from the National Hurricane Center, Georges developed from a tropical wave in the far eastern Atlantic on September 15, 1998 and became a tropical storm a day later. Georges moved west to west-northwest for the next several days intensifying to a Category 4 hurricane. Georges' first landfall was over Antigua in the Leeward Islands late on the 20th. After moving near the U.S. Virgin Islands, Georges made landfall in Puerto Rico the evening of the September 21st with estimated maximum winds of 115 mph. Georges weakened very little while over Puerto Rico and was even stronger when it made landfall in the Dominican Republic on the afternoon of the 22nd. After crossing the mountainous terrain of Hispaniola, Georges made landfall over eastern Cuba on the afternoon of the 23rd. Georges continued along the northern coast of Cuba for the next day and moved into the Florida Straits early on the 25th. It then intensified, making landfall near Key West, Florida. Georges turned northwest and moved toward the Gulf Coast while it gradually slowed down. Georges made its final landfall near Biloxi, Mississippi early on September 28 with 105 mph winds. Georges weakened to a tropical storm later that day and was downgraded to a tropical depression by midmorning on the 29th.

Prior to Hurricane Georges, comprehensive hurricane evacuation studies (HES) had been conducted for many of the impacted areas. These studies and their associated work products are jointly funded by the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACOE) and the National Weather Service (NWS). The Jacksonville District of the U.S. Army Corps of Engineers had completed studies for St. Thomas and St. Croix in the early and mid 1990's and had developed HES products for portions of Puerto Rico. The district also had developed a study for lower southeast Florida (including the Florida Keys) which was about ten years old. The Mobile District had recently completed a restudy of the northwest Florida area and had initiated a restudy for Alabama and Mississippi. A ten year old study was also available for the southeast Louisiana area which had been developed by the New Orleans District of the Corps. It should also be noted that the Southwest Florida Regional Planning Council had recently produced a study update for southwest Florida which included several interviewed counties.

With these studies in hand and with some draft restudy products on the table, Georges provided an opportunity to answer several key questions regarding these major FEMA/Corps planning efforts:

Did local and state officials use the products produced in these major studies?

Were study data regarding storm hazards, behavioral characteristics of the threatened population, shelter information, evacuation times, and decision-making accurate and reliable?

Which study products were most useful and which least useful - what improvements could be made to current methodologies and products.

To answer these questions, study teams comprised of representatives from FEMA; the Corps of Engineers; and Post, Buckley, Schuh & Jernigan, Inc. visited with local and state officials throughout the directly responding or impacted areas of Northwest and South Florida, Alabama, Louisiana, Mississippi, Puerto Rico and the U.S. Virgin Islands. Post, Buckley, Schuh & Jernigan, Inc. was retained to accompany the study team and document all relevant findings. Many local and state officials provided their observations. Local emergency management directors, law enforcement officers, and shelter personnel were involved in meetings held in each area that responded to Hurricane Georges. Separate meetings were held to discuss study product usage with local media representatives. Appendix A lists those individuals who either attended meetings or provided input through telephone conversations.

Discussion with local emergency management officials focused on study products and their use relative to the evacuation decision process, evacuation and clearance time, sheltering, and public information. Discussions with state officials centered on the role the state played in the evacuation process, including the use of study products in communicating with local officials. Media representatives were asked to focus on study related materials that they possessed and that were broadcast to the general public. They also addressed the types of materials and public information they could have used that had not been developed or delivered to them to date.

In addition to the meetings held with state and local officials, Hazards Management Group conducted and analyzed a residential behavioral sample survey for selected communities in Northwest and South Florida, Alabama, Louisiana, and Mississippi. Telephone interviews were conducted to ascertain actual evacuation response in Georges and to predict evacuation response parameters for future comprehensive hurricane evacuation restudies. The behavioral analysis focused on the actual percent of the affected population that evacuated during Georges, when the evacuees left their residence, what sort of evacuation refuge was used, where the refuge was located, and the number of vehicles used by evacuating households.

This report documents the findings of the study team and is organized by general category of hurricane evacuation study product. Those general categories that are addressed include:

Hazards/Vulnerability Data
Behavioral Characteristics of Evacuees
Shelter Issues
Transportation/Clearance Time Data
Evacuation Decision-Making
Public Information

Each of the following chapters describes typical study components and products produced in comprehensive hurricane evacuation studies. The chapter then summarizes actual data related to Georges, and where relevant, compares it with study produced data for a relevant storm scenario. Recommendations are then given for future study efforts concerning that study topic.

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 storm surge effects for the various intensities of hurricanes that could strike an area. Specifically, a hazards analysis quantifies the expected hurricane-caused inundation that would require emergency evacuation of the population. Historically, the hazards analysis also has assumed that mobile homes outside the surge inundation area must be evacuated due to their vulnerability to winds. The National Weather Services' SLOSH (Sea, Lake, and Overland Surge from Hurricanes) numerical storm surge prediction model was used as the basis of the hazards analysis for studies that have been completed or studies that are ongoing in Florida, Alabama, Louisiana, Mississippi, Puerto Rico, and the U.S. Virgin Islands.

The vulnerability analysis uses the hazards analysis to identify the population potentially at risk to coastal flooding caused by the hurricane storm surge. Storm tide atlases are produced showing the inland extent of surge inundation for various hurricane intensities.

Hazards and vulnerability issues related to Georges that were discussed with local and state officials included the following:

> What technical data/mapping were used to choose the areas to evacuate?
> Did the technical data provide a good depiction of the hazards area?

The National Hurricane Center was able to compare SLOSH model predictions with actual high water marks for the Florida Keys and the Gulf Coast. High water mark data collected by the Mobile District of the U.S. Army Corps of Engineers for the Gulf Coast, and collected by the Jacksonville District for the Keys were transmitted to the National Hurricane Center for comparison with the SLOSH model. Figures 2-1, 2-2, 2-3 and 2-4 show these interesting comparisons. The radius of maximum winds is indicated on Figure 2-4 for the Gulf Coast landfall but not for the Florida Keys

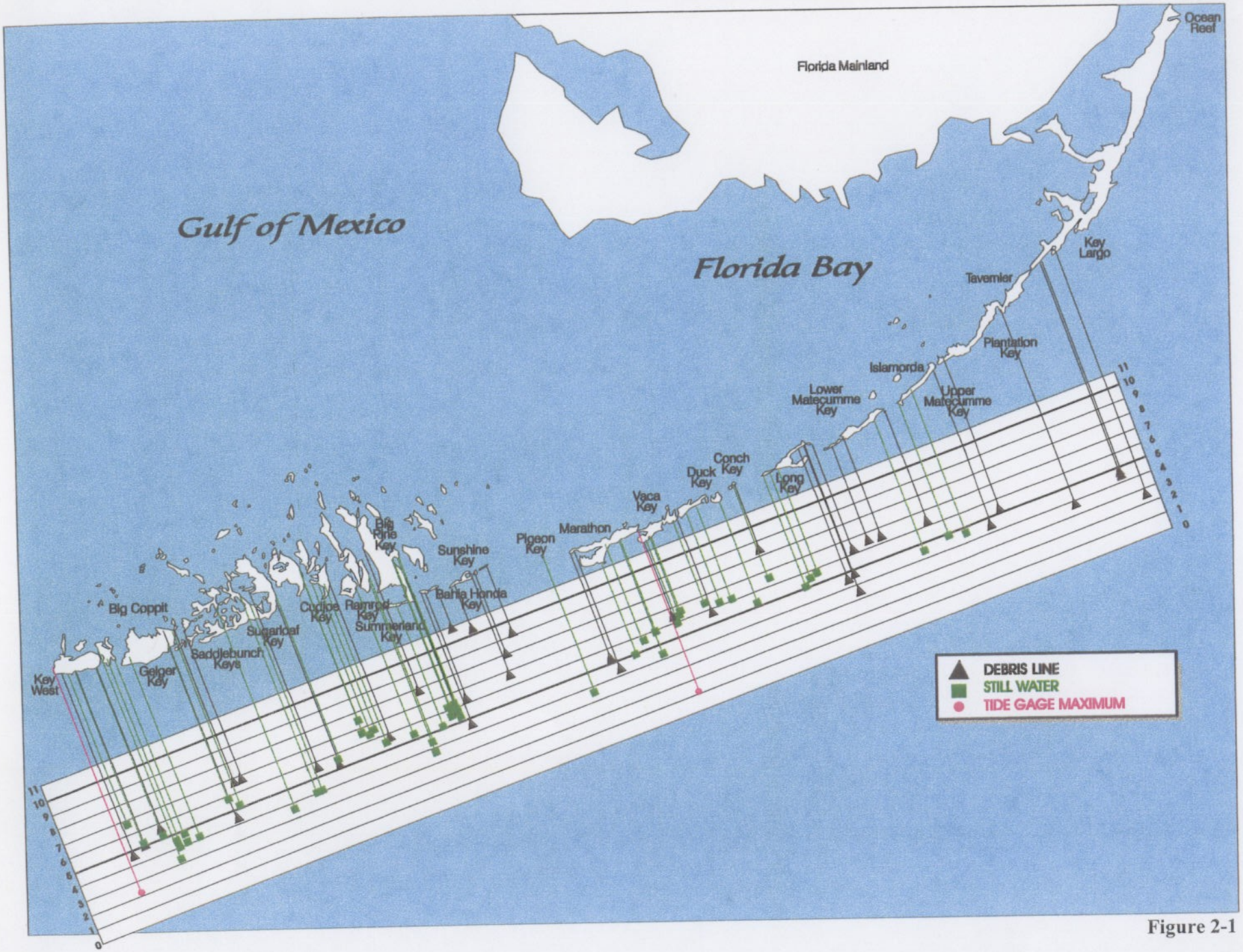
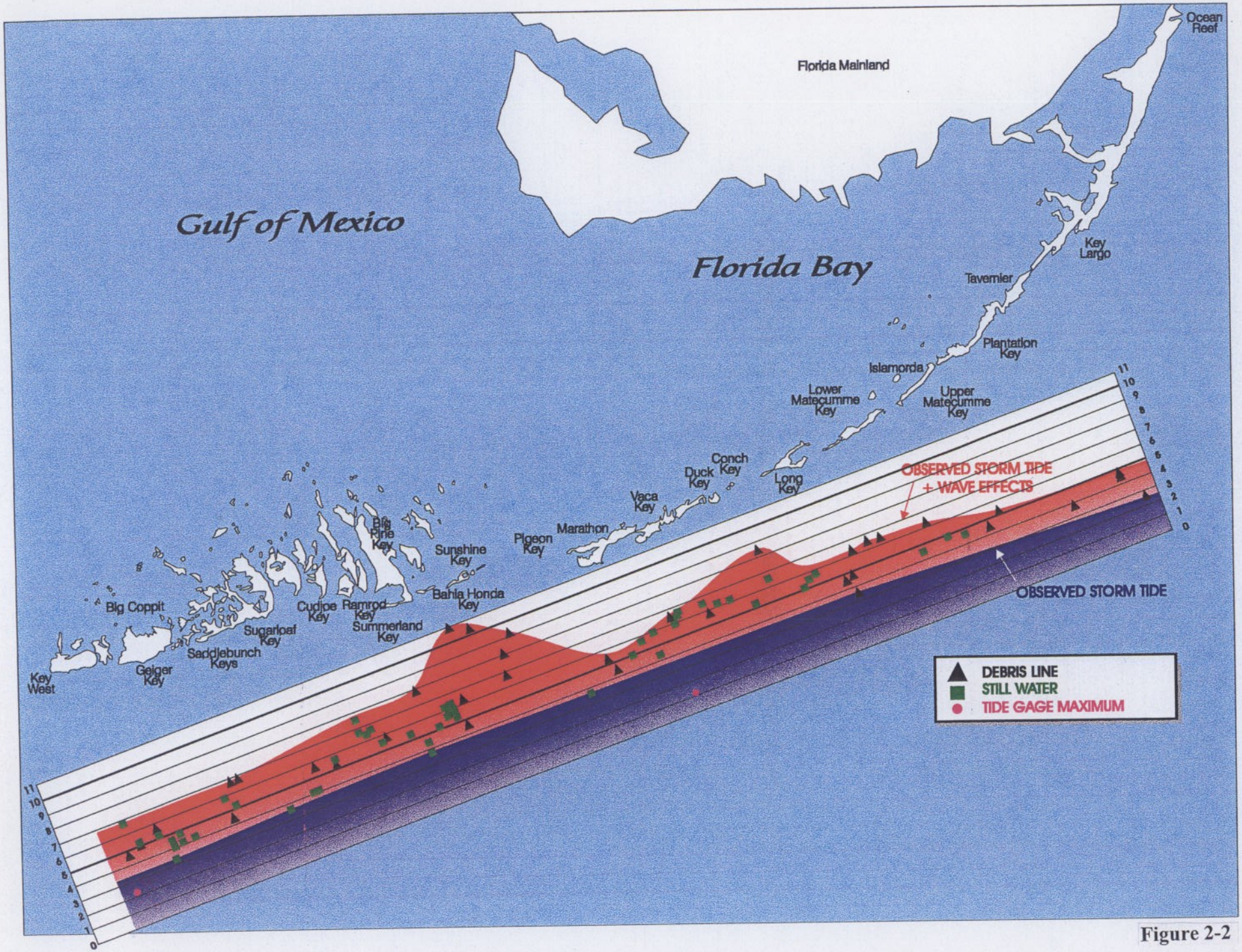

Gulf of Mexico
Florida Bay
Florida Mainland
Ocean Reef
Key Largo
Tavernier
Plantation Key
Islamorada
Upper Matecumbe Key
Lower Matecumbe Key
Long Key
Conch Key
Duck Key
Vaca Key
Marathon
Pigeon Key
Big Pine Key
Sunshine Key
Bahia Honda Key
Summerland Key
Ramrod Key
Cudjoe Key
Sugarloaf Key
Saddlebunch Keys
Geiger Key
Big Coppitt
Key West
DEBRIS LINE
STILL WATER
TIDE GAGE MAXIMUM

Figure 2-1


Gulf of Mexico
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Marathon
Pigeon Key
Big Pine Key
Sunshine Key
Bahia Honda Key
Summerland Key
Ramrod Key
Cudjoe Key
Sugarloaf Key
Saddlebunch Keys
Big Coppit
Geiger Key
Key West
OBSERVED STORM TIDE + WAVE EFFECTS
OBSERVED STORM TIDE
DEBRIS LINE
STILL WATER
TIDE GAGE MAXIMUM
0
1
2
3
4
5
6
7
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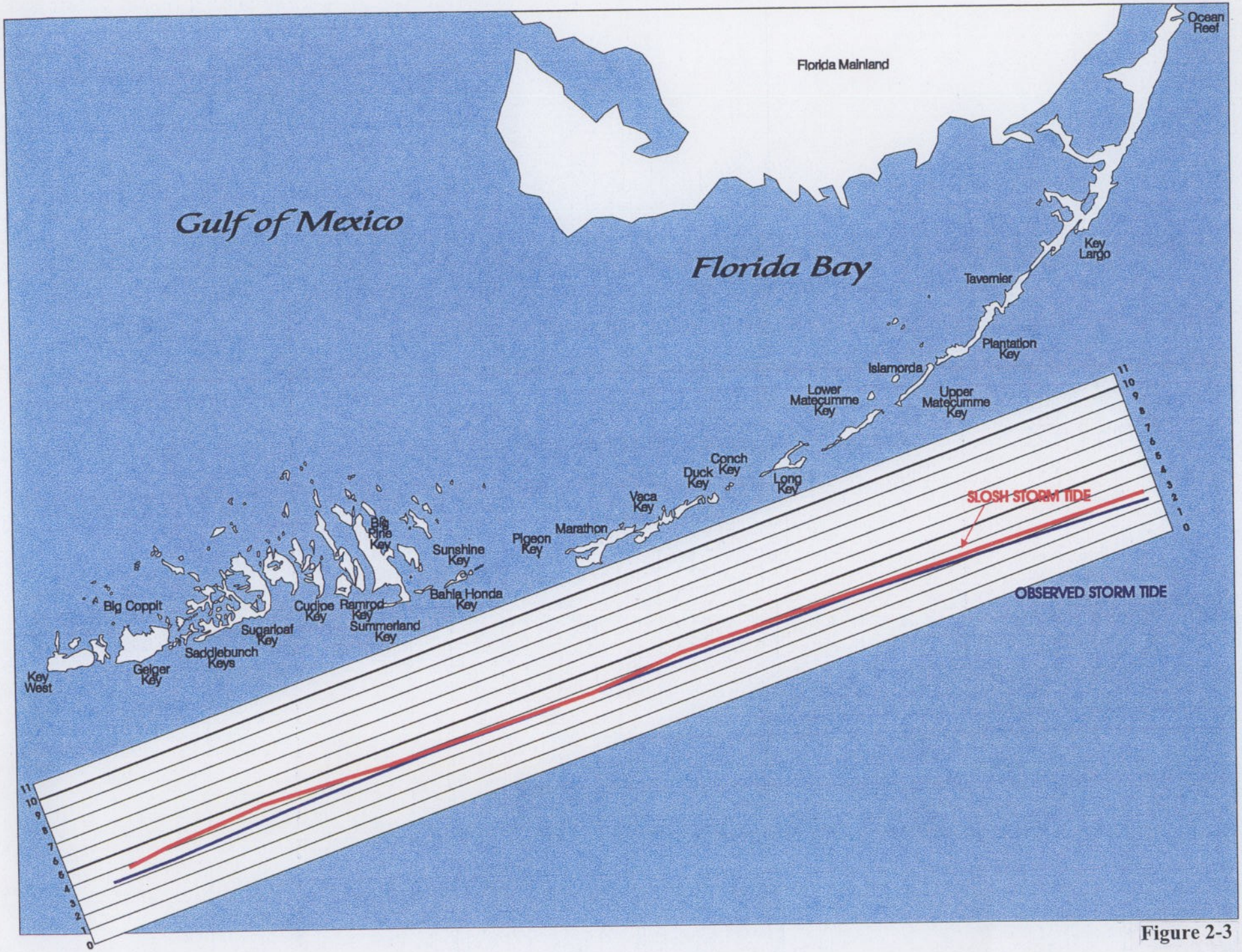
10
11

Figure 2-2


Florida Mainland
Gulf of Mexico
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Ocean Reef
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Conch Key
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Pigeon Key
Big Pine Key
Sunshine Key
Bahia Honda Key
Big Coppit
Cudjoe Key
Ramrod Key
Summerland Key
Sugarloaf Key
Saddlebunch Keys
Geiger Key
Key West
SLOSH STORM TIDE
OBSERVED STORM TIDE
0
1
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Figure 2-3

OBSERVED HIGH WATER MARKS VERSUS SLOSH MODEL CALCULATED STORM SURGE PROFILE FOR HURRICANE GEORGES (1998)

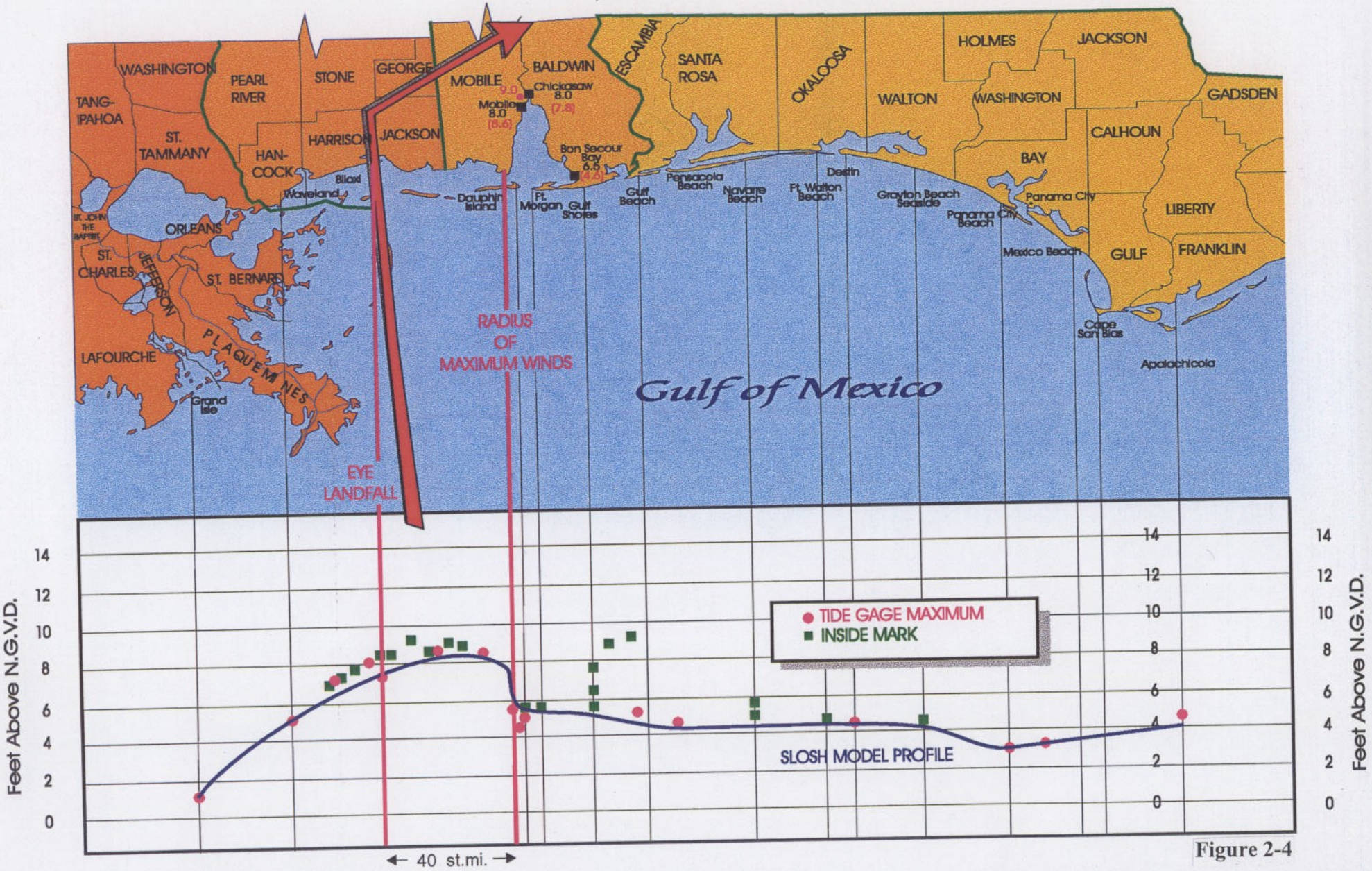


Figure 2-4

graphics. This is because Georges took a left-hand (westerly) turn as it made landfall at Key West which swept the radius of maximum winds across Marathon and the lower Keys. In addition, the storm had a broad area of maximum winds extending out some 60-70 miles from the center. A more typical storm would have maximum winds extending only 40 miles from the center.

The results of the SLOSH comparison are similar to previous hurricane storm surge comparisons and generally show that the SLOSH model calculates the storm surge within plus or minus 20 percent of the observed values. At first glance, differences in the Key's values appeared higher than 20 percent different, however when wave run up, wave set up and wind driven wave run up are factored out, the comparison is quite favorable. In the Gulf Coast area the comparison is also favorable except in the Gulf Shores, Alabama area where the water is quite deep immediately off shore (30 feet plus), causing a significant breaking wave effect during Georges. When this is factored out, the SLOSH comparison is within acceptable and anticipated margins of difference.

In addition to the SLOSH model comparison, the National Hurricane Center provided their preliminary forecast and warning critique for Hurricane Georges. Appendix B includes the "Best Track" positions for Hurricane Georges, including positions, barometric pressure, wind speed, and storm classification by date. The appendix also includes a table reporting selected surface observations at various localities throughout the impacted areas and a tropical cyclone watch and warning summary for Georges. An important rainfall graphic for Puerto Rico is also included.

Excerpts from the NHC report regarding forecast error are provided as follows:

> Overall, the track forecasts for Georges were generally good. The low average errors of CLIPER show that the hurricane followed a climatologically-favored path. The average official forecast errors are well below the most recent 10-year average. These values represent a 47% to 60% improvement over the 10-year official averages: 60% at 12 hours, 56% at 24 hours, 56% at 36 hours, 53% at 48 hours, and 47% at 72 hours. It should be noted that the slow motion of Georges over the north central Gulf of Mexico contributed to the low errors.
>
> Examination of the intensity forecast history of Georges shows several interesting trends. The first five official forecasts after the system attained tropical storm strength under-

forecast the intensity an average of 18 knots between 12 to 48 hours and 44 knots at 72 hours. While SHIPS' intensity errors were comparable to the official forecast, the GFDL faired worse with 29 knots between 12 and 48 hours and 55 knots at 72 hours. These forecasts represent the period when Georges went through its rapid intensification phase.

The intensity forecasts from 1800 UTC 19 September to 0600 UTC on 20th show a significant positive bias. This is when Georges went through a marked weakening trend. During this period, both the official NHC forecast and SHIPS over-forecast the intensity an average of about 21 knots between 12 and 48 hours; at 72 hours the errors were 43 knots and 36 knots, respectively. The GFDL showed lower errors for this period with a mostly negative bias. Several of the 12 hour forecasts under-forecast the intensity by 50 knots. These data highlight our limited skill level in forecasting rapid, abrupt changes in intensity.

Recommendations:

1. Complete new SLOSH modeling and associated mapping for the Florida Keys, Alabama, Mississippi, and Louisiana.

2. Produce a comprehensive atlas showing storm surge areas and 100 year floodplain for the entire island of Puerto Rico.

3. Address the unique rainfall vulnerability and mudslide potential for hurricane events in the Caribbean through activities of the FEMA/Corps/NWS Island Task Force.

4. Educate the emergency management community about the three fold effect of wave run up, wave set up and wind driven wave run up on SLOSH predicted values and measuring high water marks.

Chapter 3

Behavioral Analysis - Public Response in Georges

(Prepared by Hazards Management Group)

The narrative below is provided by Hazards Management Group (HMG) for the post Georges evacuation assessment and focuses on describing the evacuation behavior of permanent residents in Northwest and South Florida, Alabama, Mississippi, and Louisiana during the Georges event.

Method/Sample

Telephone interviews were conducted with approximately 800 residents ranging from Louisiana through the Florida Keys. The sample locations and sample sizes are given below.

Sample Sizes, by state

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
206	193	99	106	208

In Louisiana, interviews were conducted in Orleans and Jefferson Parishes. Residents were advised to evacuate from both parishes by local officials. In Mississippi, the interviews were distributed among Hancock, Harrison, and Jackson Counties, with half coming from Harrison. Households were selected from locations advised to evacuate by local officials. In Alabama, the respondents were equally divided among Mobile and Baldwin Counties, and in Northwest Florida they came from Escambia through Bay Counties. In both Alabama and Northwest Florida, most of the interviews were conducted in Category 1 storm surge areas, with the remainder selected from Category 2 and 3 surge zones. All were either advised or ordered to evacuate in Georges. In the Florida Keys, all interviews were conducted in the "Lower Keys" south of Big Pine Key. This area was smaller than the "Lower Keys" as defined in the Monroe County Evacuation Plan, which extends northward to Seven-Mile Bridge. Half the interviews were conducted in Key West. It is important to recognize that there can be different response patterns within these survey locations, from county to county.

Statistical Reliability

Figures reported in surveys cited in this report are based upon samples taken from larger populations. The sample values provide estimates of the values of the larger populations from which they were selected, but are usually not precisely the same as the true population values. In general, the larger the number of people in the sample, the closer the sample value will be to the true population value. A sample of 200 will provide estimates which one can be 90% "confident" are within 4 to 6 percentage points of the true population values. With a sample of 100, one can be 90% "confident of being within 5 to 8 percentage points of the actual population value. A sample of 50 is "accurate" only within 7 to 11 percentage points, and a sample of 25 is 90% "accurate" only within 10 to 17 percentage points. The sample size was too small in most cases to report separate findings for each risk zone by county, for example.

This is particularly noteworthy in drawing conclusions about whether two survey results are "different" from one another. Differences of a few percentage points in sample results of 100 or less do not necessarily mean the populations from which the samples were drawn are different. When the aggregate samples are broken down into subgroups, the reliability of estimates for the subgroups suffers.

Evacuation Participation

In all the survey locations, except Northwest Florida, more than half those interviewed said they left their homes to go someplace safer. However, the participation rates were only slightly more than 50%, ranging from 54% in Louisiana to 67% in Alabama. In Northwest Florida, only 22% evacuated their homes. These are not substantial participation rates, considering that all the interviewees lived in locations from which evacuation was at least recommended by authorities. The Louisiana figure is not significantly different in a statistical sense from the 48% found by Howell (1998). The Keys figure is higher than the 54% found in a survey by the Monroe County School Board (Lannon, 1998), among other things, the difference could stem from the school board questionnaire asking whether the household evacuated, rather than asking whether residents left their home to go someplace safer. To some people evacuation implies leaving the local area. The results are shown below.

Percent evacuating in Georges, by state

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
54%	60%	67%	22%	62%

Those who did not evacuate were asked whether they would have eventually left if they had been convinced that Georges was going to strike their location more directly. Roughly half said they would have left in that case. More than half (59% in Louisiana to75% in Northwest Florida) said they had made the necessary preparations to leave in case the situation worsened. The results are shown below.

Percent of stayers in Georges saying they would have left if storm had hit directly

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
55	48	39	59	48

Percent of stayers in Georges saying they were prepared to leave

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
59	61	61	75	65

When asked what convinced them to go someplace safer, the two most common groups of responses centered on the severity of the storm and advice or notices from others. Using the breakdowns in table below, concern about the severity of the storm was the most frequently mentioned factor in each location, with a high of 52% giving that response in Alabama. The percentage would be even higher if other response categories dealing with concern about flooding and wind were included. Advice or appeals from others were mentioned often in every survey location, but in some places (Northwest Florida, Mississippi, and the Keys) notices from officials were most prominent. In other places (Alabama and Louisiana) appeals from friends and relatives were cited more often. Finally, some people focused on being convinced that the storm would hit their location. A variety of other reasons were also given, reflected collectively under "other."

Reasons given for evacuating in Georges

	LA	MS	AL	NW FL	Keys
Officials said evacuate	3	20	15	35	22
NWS said evacuate	10	1	14	30	19
Police/Fire said evacuate	4	7	11	4	5
Media said evacuate	11	5	6	17	8
Friend/Relative said evacuate	14	12	23	9	19
Concern about severity of storm	33	35	52	44	44
Concern about increase in severity	12	8	11	9	9
Concern about flooding	23	18	14	22	6
Concern about wind	6	17	14	4	20
Concern about road flooding	4	10	8	0	4
Concern storm would strike	12	8	6	4	12
High strike probabilities	1	3	2	4	3
Other	24	16	8	22	25

As shown in the following table, most of those who did not evacuate said they did not think the storm was strong enough to pose a threat to their safety, given their home's construction and location. Those giving that sort of response ranged from 56% in the Florida Keys to 76% in Mississippi. No other response category was cited nearly so often. Most notably, fewer than 10% in every location mentioned a lack of transportation or a place to go as reasons for not evacuating, and the figure was below 5% every place except Louisiana, where it was 7% . No one in Alabama or Northwest Florida gave those reasons. Concerns about being able to prevent looting and damage from the storm were over 10% only in Alabama and the Keys. Traffic, in one form or another (traffic bad, tried and gave up, waited too long, too dangerous), was a fairly frequently mentioned factor except in Mississippi. Fewer than 10% mentioned jobs or lack of facilities for pets in public shelters.

Reasons given for not evacuating in Georges

	LA	MS	AL	NW FL	Keys
Storm not severe/house safe	50	76	67	68	56
Officials said stay	2	0	0	5	3
Media said stay	2	1	0	2	1
Friends/relatives said stay	5	12	6	0	3
Officials did not say to evacuate	0	1	6	2	4
Low probability of hit	9	5	9	11	13
Would miss	1	3	3	4	4
No transportation	7	3	0	0	4
No place to go	7	4	0	0	3
Protect against looters	1	3	12	1	8
Prevent damage	7	3	12	1	9
False alarms	1	4	6	6	10
Job	4	5	0	3	10
Waited too long	7	1	0	1	9
Traffic bad	11	1	9	12	17
Tried, gave up	0	0	0	3	8
Too Dangerous	4	4	0	4	8
No pets allowed in shelters	0	7	6	0	6
Other	28	20	9	5	9

Everyone in the survey was asked whether they heard, either directly or indirectly, from anyone in an official position that they should evacuate. Those who answered affirmatively were asked whether officials recommended that they evacuate or whether they said evacuation was mandatory. The results appear in the table below. Few people said they heard mandatory evacuation orders, the highest being 37% in the Florida Keys. In Northwest Florida only 6% gave that response. Slight majorities said they heard some sort of official notice in Louisiana and the Florida Keys. In the other three survey locations, most people (77% in Alabama) said they heard no evacuation notice from officials.

Type of evacuation notice heard in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Mandatory Order	12	21	29	6	37
Recommendation	42	20	19	17	24
None	46	60	52	77	39

Hearing notices from officials made a major difference in response in Georges in every survey location except the Keys. As shown in the table below, Louisiana, Mississippi, Alabama, and Northwest Florida, 79% (Louisiana) to 88% (Mississippi) residents left if they thought they heard mandatory evacuation orders, which were much higher rates than those for people who said they did not hear official notices at all. In Mississippi and Alabama, recommendations were more effective than in other locations. In Florida's Lower Keys, however, the response was essentially the same, regardless whether respondents heard orders, recommendations, or neither.

Percent evacuating in Georges, by type of official evacuation notice heard, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
If Heard Mandatory Order	79	88	86	83	61
If Heard Recommendation	49	70	71	44	61
If Hear None	49	47	56	9	67

Respondents were told that at one point Georges's winds were nearly 125 MPH. They were then asked whether Georges would have caused dangerous flooding of their home if Georges had struck near their location with winds that strong. The sample was designed to include households located in areas which would be inundated by at least some hurricanes of that strength, depending upon other characteristics of the storm such as its forward speed and angle of approach to the coast. Only in Louisiana did a clear majority (65%) say a 125 MPH Georges would have caused dangerous flooding of their home. In Mississippi and the Keys approximately half expected dangerous flooding, but in Alabama and Northwest Florida less than 40% gave that response. The table below describes the results.

Belief that home would experience dangerous flooding in 125 MPH hurricane, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Would Flood	65	50	33	39	53
Would Not Flood	27	40	61	44	42
Don't Know	8	10	7	17	4

People who believed their homes would be vulnerable to flooding in 125 MPH hurricane were more likely than others to evacuate in Georges. The table below shows that in every location, except Northwest Florida, a clear majority evacuated in Georges if they thought their homes were susceptible to dangerous flooding.

Percent evacuating in Georges, by belief home would flood in 125 MPH hurricane, by risk state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
If Said Would Flood	63	74	75	27	69
If Said Would Not Flood	38	44	60	16	53

Respondents were also asked whether they thought their homes would be safe, considering both wind and water, in a 125 MPH hurricane. Only in Alabama did as many as half (53%) say their homes would be safe. However, the highest percentage saying their homes would definitely not be safe was 65% (in Louisiana and Northwest Florida). In Alabama, only 41% said their homes would be unsafe in a 125 MPH hurricane. The results are shown below.

Belief that home would be safe in 125 MPH hurricane, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Would Be Safe	26	43	53	26	37
Would Not Be Safe	65	52	41	65	57
Don't Know	10	5	6	9	7

Those believing their homes would be unsafe in a 125 MPH hurricane were much more likely to evacuate in Georges than those who said their homes would be safe. The table below shows that of those believing their homes would be unsafe, at least two-thirds evacuated in Georges in every location except Northwest Florida. In the Keys (76%), Mississippi (79%), and Alabama (80%) even more left. Only in Northwest Florida did a majority not evacuate. But even in Northwest Florida those believing their homes would be unsafe in a 125 MPH hurricane were more than twice as likely as other to evacuate in Georges.

Percent evacuating in Georges, by belief home would be safe in 125 MPH hurricane, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
If Said Would Be Safe	35	39	57	13	40
If Said Would Not Be Safe	66	79	80	33	76

Those who did not evacuate in Georges were asked whether they had any concerns about trying to evacuate and having the storm arrive while they were caught on the road because of heavy traffic. This has often been mentioned as a concern in the Keys and the New Orleans area, and in Opal traffic congestion was a major problem in Alabama and Northwest Florida. Roughly half the stayers expressed concern about being caught trying to evacuate in every survey location except Mississippi, where only 24% expressed that worry. The results are shown below.

Percent of stayers in Georges saying they were concerned about being trapped on road in heavy traffic

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
53	24	42	57	47

Those who indicated they were concerned about the possibility of being caught on the road in heavy evacuation traffic were given another scenario. They were asked whether they would be more likely to evacuate if emergency management officials were able to monitor traffic on the roads so that they could reassure residents that if they left at a certain time they would still have enough time to reach their destination before the storm arrived. In every survey location except Alabama (44%), a strong majority (78% in Northwest Florida) said they would be more likely to evacuate in that case. It is

notable that Monroe County already has such a monitoring and notification scheme in place. The results are shown below.

Percent concerned (Table 13) saying they would be more likely to leave if officials could ensure safe passage

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
73	60	44	78	65

The tables below show that between 13% (Alabama) and 27% (Keys) said someone in their household had to work while the Georges evacuation was in effect. Most said the circumstance had no effect on their decision whether to evacuate in George, however, there was considerable variation among survey sites. In the Keys, 25% of those in households in which someone had to work during the evacuation said they delayed their departure, and 13% said they did not evacuate at all because of that.

Percent of households with someone required to work in during Georges, by state

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
21	20	13	18	27

How work affected evacuation in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
No Effect	67	69	77	79	54
Made All Stay	7	5	0	0	13
Made Some Stay	2	0	0	5	0
Delayed Some/All	14	21	8	11	25
Other	5	0	8	5	7
Don't Know	5	5	8	0	2

Some emergency management officials have expressed concerns that when businesses stay open in areas under evacuation notices, residents are deterred from leaving. In Georges, between 22% (Mississippi) and 40% (Louisiana) said businesses remained open in their neighborhoods during the Georges evacuation. In Louisiana, Alabama, and the Keys, most respondents said the businesses were located in areas being evacuated. The results are shown in the following two tables.

Percent saying businesses stayed open in neighborhood in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Yes	40	22	28	26	37
No	43	53	39	44	46
Don't Know	17	24	32	29	17

Percent saying open businesses were in evacuation zone in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Yes	59	30	61	36	83
No	28	47	29	57	12
Don't Know	13	23	11	7	5

As shown in the table below, very few said the open businesses affected their response in Georges. Only in Louisiana did as many as 13% say they stayed because the businesses were open. In other locations, fewer than 10% gave that response.

Percent saying open businesses affected response in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Stayed	13	0	4	7	4
No Effect	81	95	89	93	93
Other	4	2	0	0	0
Don't Know	2	3	7	0	3

Finally, all respondents were asked whether they would do anything differently, given the same situation in the future. In the Keys, 43% of those who did not evacuate in Georges said they would do so if faced with the same situation again. Twenty-three percent gave that response in Mississippi, but in Louisiana and Northwest Florida fewer said they would leave in the future. The Lower Keys and Mississippi were hit by Georges. The results are shown below.

Percent saying they would respond differently in future

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Stayers Who Say They Would Leave	14	23	12	5	43
Leavers Who Say They Would Stay	10	6	8	9	5

Sources of Information in Georges

People in the survey were given a list of sources of information and asked how much they relied on each for information about Georges. For each source they were asked whether they relied on that source none at all, a little, a fair amount, or a great deal. The table below indicates the percentage of respondents who said they relied a great deal on the various sources. Local television was indicated by a clear majority every place except in the Florida Keys, where 49% said local TV. In Louisiana and Northwest Florida, 80% and 82% respectively, said local TV. In most locations, The Weather Channel on cable and local radio were in virtual dead heats for second place. In the Keys, local radio was relied upon more than other sources. CNN on cable was a distant fourth, and other sources such as other cable stations, and the Internet got relatively little attention. Word of mouth was relied upon a great deal by up to 19% (in the Keys), but word of mouth was also said to be the most unreliable source of information.

Percent of respondents saying they relied a fair amount or a great deal on sources of information about Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Local Radio	35	47	49	38	57
Local TV	80	71	66	82	49
CNN	20	15	17	18	18
Weather Channel	38	45	46	56	50
Other Cable	5	3	5	5	6
Internet	3	8	6	1	9
On-line Services	2	4	4	1	4
Word of Mouth	15	11	7	4	19

Evacuation Timing

For the Florida Keys, a hurricane watch was issued for Georges at 5 AM on Wednesday, September 23, followed by a warning at 5 AM on Thursday the 24th. For the middle Gulf Coast, a watch was issued at 11 AM on Friday, September 25, followed by a warning at 10 AM on Saturday the 26th. Beyond the Keys, early forecasts pointed toward Northwest Florida. Later forecasts shifted Georges farther west, eventually to New Orleans, and then back east again to Mississippi. The times when evacuees left were generally consistent with those events. More evacuees than usual indicated that they left prior to the time warnings were issued. Timing of evacuation notices may have been earlier in some locations. Note too, that a substantial percentage of the population did not evacuate at all. If they had eventually decided to leave, they would have been late evacuees, reducing the percentage of total evacuees who left early. The results are shown below.

Date evacuated in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Tuesday	0	0	0	0	17
Wednesday	4	4	5	19	44
Thursday	8	4	8	6	30
Friday	24	18	22	38	6
Saturday	51	49	47	38	1
Sunday	12	26	17	12	0

Type of Refuge

As described in the table below, very few residents who evacuated (as a percentage of all evacuees) went to public shelters. The highest stated usage rate was 5% in Louisiana. A plurality in every survey location, and a majority in all but Louisiana went to the homes of friends and relatives. Between 16% (Mississippi) and 35% (Northwest Florida) went to hotels and motels. Others went to churches, workplaces, second homes, and a sundry of other places. Such low public shelter use is lower than usual but generally consistent with a trend observed in hurricane evacuations within the past decade. Low reliance upon public shelters is especially common when a substantial percentage of evacuees leave their local area and go significant distances inland.

Type of refuge in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Public Shelter	5	3	2	0	1
Friend/Relative	45	68	65	65	57
Hotel/Motel	30	16	24	35	29
Other	20	13	9	0	13

Evacuation Destinations

Few evacuees sought refuge in their own neighborhoods. In most locations only 12% to 18% did so, and in Northwest Florida only 4% did so. In Louisiana, 23% said they went someplace in their own neighborhood. However, a substantial number of respondents in Louisiana indicated they did not know whether their refuge was in their neighborhood or not, and in subsequent questions regarding whether the place they went was in their own parish or state, others said they did not know. The "don't know" responses were excluded from calculations. If the "don't know's" were included, 18% in Louisiana said they left their home but stayed in their neighborhood. The results are shown below.

Evacuation destinations in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
Own Neighborhood	23	18	12	4	13
Own County/Parish	16	27	31	38	12
Louisiana	24	8	2	0	0
Mississippi	9	36	2	0	0
Alabama	1	5	49	4	0
Florida	1	1	2	38	73
Georgia	4	1	2	4	1
Texas	13	2	0	0	0
Arkansas/Tennessee	6	2	2	4	0
Other	3	0	0	8	2

There was more variation among the sites with respect to whether evacuees who went out of their neighborhood stayed within their own county or parish. In Northwest Florida and Alabama, approximately a third of all evacuees said they stayed in-county (or in-parish). In Louisiana and the Florida Keys, however, fewer than 15% gave that response. The low figures for Louisiana and the Keys could result from the lack of availability of shelters within the south Louisiana parishes and Monroe County. Nevertheless, in both Louisiana and the Florida Keys, numerous "evacuees" stayed in county, either in their own neighborhoods or elsewhere in their parish or county. In Louisiana, 37% of the evacuees said they went out-of-state, with most of those going to Mississippi and Texas. Although the survey did not address reasons for going to the destinations they identified, other information suggests that many did so because of a shortage of accommodations closer by. Howell (1998) reported that more than half the evacuees from Orleans and Jefferson Parishes went out-of-state.

Transportation

It was indicated earlier that few respondents overall indicated they did not evacuate because of a lack of transportation (although that constraint almost certainly affected the destination to which some people evacuated). The table below shows that when evacuating households were asked whether they or anyone else in their household required assistance evacuating, the percent replying affirmatively ranged from zero in Northwest Florida (based on a small number of evacuees in the sample) to 6% in Louisiana. About half those requiring assistance need just transportation, with the remainder also needing special care due to a medical or physical condition. In almost all instances, the assistance was provided either from within the household itself or by friends or relatives. Non-evacuating households were asked whether anyone would require assistance in evacuating, and the results were comparable to those from evacuating households except in Northwest Florida. Four percent of the non-evacuating households there said someone in the residence would require assistance.

Percent of evacuating households in Georges with someone requiring assistance, by state

Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
6	3	3	0	5

Not all vehicles available to households are used in evacuations, as reflected in the table below. In Georges, the percentage of vehicles actually used in evacuating ranged from 68% in Alabama to 79% in Louisiana. The figures are consistent with those observed in other evacuations. The number of vehicles used per evacuating household varied from a low of 1.21 in the Florida Keys to 1.54 in Mississippi. Finally, evacuees were asked if they pull a trailer, camper, boat, or took a motorhome. In most locations, fewer than 10% of the evacuating households said they did so, with a slightly higher figure in Alabama.

Vehicle use in Georges, by state

	Louisiana	Mississippi	Alabama	NW Florida	Lower Keys
% of Available Vehicles Used	79	77	68	77	71
Vehicles per Household	1.28	1.54	1.31	1.25	1.21
% Who Pulled Trailer or Took Motorhome	5	6	14	8	7

References

Howell, S. E. (1998) "Evacuation Behavior in Orleans and Jefferson Parishes," University of New Orleans Survey Research Center, New Orleans, Louisiana.

Lannon, M. J. (1998) November 29, 1998 Correspondence to Billy Wagner, from Monroe County School Board, Key West, Florida.

Note:

In addition to the two Georges surveys cited above, at least two others were performed. One was conducted by Hazards Management Group, Inc. for the Tampa Bay Regional Planning Council. The other was done in Dade and Monroe counties by Florida International University.

Chapter 4

Shelter Issues

The primary objectives of shelter analyses prepared for FEMA/Corps of Engineers comprehensive hurricane evacuation studies are to list public shelter locations, assess their vulnerability relative to storm surge flooding, and to estimate the number of people who would seek local public shelter for a particular hurricane intensity or threat. Shelter location/capacity data are obtained from state and local emergency management staff working in conjunction with the American Red Cross, school board 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 or behavioral parameters recommended by the local directors.

Shelter issues related to Georges were discussed with local and state officials. 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 people were sheltered?
Were any flooding, wind, or loss of power problems encountered with shelters during the storm?

Table 4-1 summarizes the responses to each of these topics gathered for the areas interviewed in Florida, Alabama, Louisiana, Mississippi, Puerto Rico and the U.S. Virgin Island.

Northwest Florida Counties experienced low numbers of public shelter evacuees except Escambia County where a large number of military trainees were housed. The military provided tremendous help in staffing the local shelters. Low public shelter demand resulted from very low evacuation

Table 4-1
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Northwest Florida					
Escambia County	23	5200 of which 200 were from Santa Rosa County, 3250 from military, 61 special needs	Applicable due to low evacuation participation levels	9/25/98 6 PM	No problems; military students staffed shelters and did excellent job
Santa Rosa County	5	1,000	Applicable due to low evacuation participation levels	9/25/98 5 PM	None reported
Okaloosa County	2	325	Applicable due to low evacuation participation levels	9/25/98 6 PM	Staffing for special needs
Walton County	2 (1 of which was special needs)	Few	Applicable due to low evacuation participation levels	9/26/98	Need emergency generators at shelters
Bay County	2 shelters on standby	None	Applicable due to low evacuation participation levels	Not applicable	None reported

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
South Florida					
Lee County	11	3650 of which 150 were special needs	(No Corps/FEMA study)	9/23/98 Shelter open for special needs 9/24/98 1 PM other shelters opened	None reported
Collier County	12	3415 of which 281 were special needs and 250 homeless evacuees	(No Corps/FEMA study)	9/24/98 2 PM 2 Days	Dilemma with ARC 4496 rule
Broward County	12	4450 of which 450 were special needs	No scenarios run with this level of evacuation	9/23/98 Noon One day	One shelter lost power
Dade County	16 plus 15 Medical Management Facilities plus FIU for Monroe Co.	10,701 of which 1050 were special needs	No scenarios run with this level of evacuation	9/23/98 Variable durations	Shelter staffing at special needs shelters
Monroe County	FIU in Dade County	150	No scenarios run with this level of evacuation	9/23/98 8 AM	Difficulty in getting FIU's activated fully for Monroe Co. due to normal business

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Alabama					
Washington County	None	Not applicable	N/A Study 17 years old	Not reported	None reported
Mobile County	9	4,189	N/A Study 17 years old	Opened upon voluntary evacuation order; 4 days	Minimal power loss
Baldwin County	8	788	N/A Study 17 years old	8/26/98 8 AM	None reported
Louisiana					
Lafourche	6	1,200	3,600 people	9/26/98 9:00 AM	Shelters have no food or beds
Terrebonne	5	1,800	No study	Already open due to prior storms	None reported
Orleans	6	20,900	Local public shelters not recognized for this category of storm	9/26/98 9:00 AM	News media needs briefing; need inland shelters
St. James	Not available	Not available	850 people	9/26/98 8:00 AM	Red Cross policy should be re-evaluated
St. Charles	Not available	Not available	3,400 people	Not reported	No shelters in Parish for a category 3 storm
Jefferson	9	Not available	5,000 people	9/26/98 5:00 PM	None reported

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Puerto Rico Aguadilla Zone					
Añasco	1	118	Study not available	9/21/98 10:00 AM	Not enough bathrooms
Aguadilla	3	121	Study not available	9/21/98 4:00 PM	None reported
Quebradillas	Not available	Not available	Study not available	N/A	N/A
Isabela	1	89	Study not available	9/20/98 5:00 PM	Loss of power
Aguada	2	139	Study not available	9/20/98 6:00 PM	Loss of power; lack of water; not enough bathrooms (including showers)
Rincón	4	225	Study not available	9/20/98 8:00 AM	None reported

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Mississippi					
Harrison County	27	3,800	N/A Study 17 years old	9/26/98 4:00 PM	Need emergency power; need more shelters
Hancock County	5	1,000	N/A Study 17 years old	9/26/98 4:00 PM	Need emergency power; communication difficulties; security problems; language barriers with foreigners
Forrest County	10 + Camp Shelby	Not calculated	N/A Study 17 years old	Not reported	People sheltered were eventually moved to Camp Shelby
Jackson County	8	2,000	N/A Study 17 years old	9/26/98	Roof damage at 2 schools; shelters are announced but not published

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelter Opened	Number of People Sheltered	Technical data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Puerto Rico - Arecibo Zone					
Vega Baja	5	300 - 400	Study not available	9/21/98 9:00 AM	Lack of water; loss of power
Hatillo	5	113	Study not available	Not recorded	
Manatí	9	240	Study not available	9/21/98 1:00 PM	Broken windows due to wind; lack of water, flooding
Puerto Rico - Carolina Zone					
Loíza	3	3,000	Study not available	9/20/98 1:00 PM	Loss of power; lack of water
Río Grande	6	175	Study not available	9/20/98 6:00 PM	Shattered windows during storm
Carolina	8	218	Study not available	9/21/98 8:00 AM	Flooding; shattered windows

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Puerto Rico - Mayagüez Zone					
Lajas	7	785	Study not available	9/21/98 3:30 PM	Loss of power
Cabo Rojo	4	400-600	Study not available	9/21/98 2:00 PM	None reported
Mayagüez	3	1,500	Study not available	9/20/98 4:30 PM	Not enough of cots/sleeping bags
Puerto Rico - San Juan Zone					
Toa Baja	5	962	Study not available	9/20/98 9:00 AM	Loss of power; lack of water; need generators; need showers in bathrooms
Dorado	6	2,000	Study not available	3:00 PM	Need more bathrooms

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
[illegible]					
Ponce	Not available	Not available	Study not available	9/20/98 6:00 PM	Loss of power
Juana Diáz	8	2,000	Study not available	9/21/98 8:00 AM	Loss of power; lack of water
Guayanilla	4	1,100	Study not available	9/20/98 10:00 AM	Flooding; loss of power
Guánica/Yauco	11	591	Study not available	9/20/98 6:00 AM	Lack of water; loss of power

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Puerto Rico Fajardo Zone					
Fajardo	3	205	Study not available	9/20/98 6:00 PM	Loss of power; lack of water
Ceiba	1	175	Study not available	9/19/98 5:00 PM	Loss of power; lack of water
Vieques	1	80	Study not available	9/21/98 8:00 AM	Lack of communication with state
Puerto Rico Guayama Zone					
Guayama	7	1,500	Study not available	4:00 PM	Loss of power; need generators
Arroyo	3	230	Study not available	9/19/98 6:00 PM	Structural problems; loss of power; lack of water
Salinas	11	1,606	Study not available	9/21/98 2:00 PM	Loss of power; lack of water
Coamo	5	1,500 - 2,000	Study not available	9/21/98 8:00 AM	Loss of power; lack of water
Santa Isabel	3	1,800	Study not available	9/20/98 9:00 AM	Flooding & structural damage in some shelters
Patillas	4	500	Study not available	9/20/98 12:00 PM	Lack of food; loss of power; lack of water

Table 4-1 (Continued)
Public Shelter Data Summary
Hurricane Georges Evacuation Assessment

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelters/Expected Shelter Demand	Time Opened/Duration	Problems Encountered
Puerto Rico [illegible]					
Humacao	Not available	Not available	Study not available	Not recorded	None reported
Yabucoa	2	85	Study not available	9/20/98 5:00 PM	Lack of water; loss of power
Maunabo	4	90	Study not available	9/21/98	Loss of power; lack of water
US Virgin Islands					
St. Thomas/ St. Croix/ St. John	St. Thomas 6 St. Croix 3 St. John 3	St. Thomas 476 St. Croix 802 St. John 92	St. Thomas - 2,845 people	3 PM/2 days	Roofing problems; leakage; loss of power; wind problems due to weak structures

participation rates even in the Category 1 evacuation areas. Okaloosa County is concerned about staffing in the special needs shelters. Walton County identified the need for emergency generators at the shelters.

South Florida Counties had several sheltering issues. Collier County is wrestling with the American Red Cross 4496 Rule in regards to shelter selection. Broward County had loss of power at one shelter, and Dade County commented on the need for staffing at the special need shelters. Considering the modest levels of evacuation that took place in Dade and Broward Counties, public shelter demand was actually quite substantial. Monroe County experienced difficulty getting Florida International University fully activated for sheltering due to their normal academic business.

On the Gulf Coast, Washington and Baldwin Counties in Alabama reported no problems encountered while Mobile County reported minimal loss of power at shelters. Parishes in Louisiana encountered several problems with shelters including lack of food and beds. Red Cross shelters are north of I-10, requiring drive times of 4-6 hours for evacuees. St. Charles Parish does not have adequate facilities for a Category 3 storm. Counties in Mississippi experienced lack of power at shelters. Local officials in Mississippi experienced difficulties with evacuees not going to their designated shelters. Residents travel to Camp Shelby even if it is not their designated shelter causing traffic and shelter capacity problems. Significant roof damage occurred at two schools in Jackson County that were used as shelters. However, they were not in the primary impact area of Georges.

Puerto Rico and the U.S. Virgin Islands had similar difficulties in shelters including loss of power, lack of water, lack of bathrooms and beds, staffing needs, loss of communication, and structural damage. Currently, there are "refugees" in several municipios in Puerto Rico. Once the official shelters close, evacuees are moved to abandoned buildings that can serve as shelters managed under the Puerto Rico Department of Housing. Local officials commented on the need for permanent shelters throughout the Island to combat many of the problems that are encountered during a storm. Some of the shelters in Puerto Rico experienced flooding problems. It is understood that this was from freshwater flooding from rainfall.

Recommendations:

1. Provide Puerto Rico and the U.S. Virgin Islands with public shelter evaluation resources and monies for emergency power supplies/generators.

2. Address the unique wind vulnerability of island shelters due to mountain terrains/downslope accelerations.

3. On the Gulf Coast, make sure public shelter staff keep evacuees out of gymnasiums during the brunt of storms due to potential roof problems.

4. Build on the success of Escambia County, Florida in working with the military to successfully staff public shelters. This should be explored in communities with a high concentration of military.

Chapter 5

Transportation/Clearance Time Data

In FEMA/Corps of Engineers comprehensive hurricane evacuation studies, the primary objective of the transportation analysis is to determine the clearance times needed to conduct a safe and timely evacuation for a range of hurricane threats. Information from the vulnerability, shelter, and behavioral analyses are directly input as well as various sources of permanent and seasonal population data.

Except for Northwest Florida and Southwest Florida, clearance times available from existing FEMA/Corps of Engineers hurricane evacuation studies were either outdated or non-existent. Most of Puerto Rico has not been studied for evacuation clearance time issues. Times developed for Alabama and Mississippi are over 15 years old. Times for Louisiana were calculated almost ten years ago.

Transportation and clearance time issues related to Georges and discussed by the study teams with local and state officials included the following:

> Was the evacuation roadway network accurate - did evacuees use projected routes?
> Were any traffic control actions taken to speed up flow?
> When was the evacuation essentially completed - how long did the evacuation take?
> Were any major problems encountered in this evacuation?

Table 5-1 provides a summary of the interview responses regarding transportation and clearance time data. Northwest and South Florida traffic moved smoothly during the evacuation process indicating that local and state officials started the evacuations in a timely manner, that traffic control was appropriate and effective, and that evacuation participation rates were modest out of those areas that potentially could have been impacted. Figures 5-1 and 5-2 show the evacuation traffic versus normal daily traffic for US 1 south of CR 905 in Monroe County, Florida. The graphs depict traffic moving

Table 5-1
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Northwest Region					
Escambia County	Yes	Minimal	Not discernible due to lack of evacuation response	No scenario with low participation rates	I-10 closed due to flooding after the storm
Santa Rosa County	Yes	Minimal	Not discernible	No scenario with low participation rates	None; traffic was not heavy
Okaloosa County	Yes	Assets prepositioned but not necessary	Not discernible due to low compliance with evacuation order	No scenario with low participation rates	None reported
Walton County	Yes	Minimal	Minimal	No scenario with low participation rates	None reported
Bay County	Not applicable	None reported	Not discernible	No scenario with low participation rates	None reported

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
South Florida					
Lee County	Yes	Law enforcement monitored evacuation; people told to evacuate to local destinations	Not discernible	(No Corps/FEMA study)	Traffic was very light; SR 74 blocked in Glades County
Collier County	Yes	None reported	5½ hours; evacuation was complete by 8 PM	(No Corps/FEMA study)	None reported
Broward County	Yes	None reported	Mass transit completed by 6 PM; other traffic not discernible	No scenario run with this level of evacuation	None, no roads were blocked with evacuating traffic
Dade County	Yes	None reported	Not discernible	No scenario run with this level of evacuation	None reported; bridges locked down at 5 PM; mass transit played key role
Monroe County	Yes	9/22/98 7 PM Bridges locked down, tolls lifted 9/23/98 all southbound traffic stopped 9/24/98 5 PM all northbound traffic stopped in Middle Keys	Traffic spread out over several days; FDOT counts showed modest levels of evacuation taking place	No scenario run with this level of evacuation	None reported

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Alabama					
Washington County	Yes (Hwy 43 & 45)	None reported	Not Reported	Not included in old HES	Would like Hwy 45 4- laned to Mississippi; heavy traffic moved fine
Mobile County	Yes	Manned congestion points; worked well	People evacuated over a 24 hour period	Study data over 17 years old	Construction affected routes; complacency of people who were asked to leave
Baldwin County	Yes	Highway 59 three- laned northbound	Not discernable	Study data over 17 years old	None - people left early and orderly
Louisiana					
Lafourche	Yes	None reported	12 hours	11½ hours	Highway 90 East flooded from previous storms; I-10 backed up; need better coordination between parishes; signed evacuation routes did not work
Terrebonne	No	None reported	15 hours	Not calculated	US 90 flooded; previous storm flooding; EAS not working
Orleans	Not applicable	None reported	Not reported	15¼ hours	US 90 floods; I-10 construction slowed evacuation; do not have sufficient traffic capacity for evacuation

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Conditions Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
St. James	Yes	None reported	13 hours	12 hours	Not enough roadway capacity for evacuation; evacuation routes are closed off too early due to flooding; coastal erosion
St. Charles	Yes	None reported	10 hours	12 hours	No Hurricane protection levees; need more highway maintenance
Jefferson	Yes	None reported	Not reported	15¼ hours	Traffic congestion on I-10; traffic/information signs in plan not in place
Mississippi					
Harrison County	Yes	None reported	Not reported	Study out of date	Evacuation roadway network not adequate
Hancock County	Yes	None reported	Not reported	Study out of date	No comments provided
Forrest County	Yes	None reported	Not reported	Study out of date	Heavy congestion on Hwy 49; many vehicles parked on side of highway; flash flood problems of US 49; fallen trees along major roadways
Jackson County	Yes	None reported	Not reported	24 hours	None reported

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Action	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Puerto Rico Ponce Zone					
Ponce	Yes	None reported	7-8 hours	8 hours	Some flooding but alternate routes taken
Juana Diáz	Yes	None reported	6-8 hours	Not calculated	None reported
Guayanilla	Yes	None reported	4-5 hours	Not calculated	None reported
Guánica/Yauco	Yes	None reported	2 hours	Not calculated	None reported
Puerto Rico Arecibo Zone					
Vega Baja	Yes	None reported	2-3 hours	Not calculated	None reported
Hatillo	Partial	None reported	2-3 hours	Not calculated	None reported
Manatí	Yes	None reported	2-3 hours	Not calculated	None reported

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Puerto Rico - Carolina Zone					
Loíza	Yes	None reported	6 hours	8 hours	None reported
Río Grande	Yes	None reported	6-8 hours	Not calculated	None reported
Carolina	Yes	None reported	Not reported	8 hours	Not reported
Puerto Rico - Aguadilla Zone					
Añasco	Yes	None reported	10 hours	Not calculated	Fallen tree limbs
Aguadilla	Yes	None reported	3-4 hours	Not calculated	None reported
Quebradillas	Yes	None reported	Not reported	Not calculated	None reported
Isabela	Yes	None reported	2-3 hours	Not calculated	None reported
Aguada	Yes	None reported	4 hours	Not calculated	Last minute evacuations; timing
Rincón	Yes	None reported	4-5 hours	Not calculated	None reported

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Puerto Rico - Mayagüez Zone					
Lajas	Yes	None reported	3-4 hours	Not calculated	None reported
Cabo Rojo	Yes	None reported	5 hours	Not calculated	None reported
Mayagüez	Yes	None reported	3 hours	Not calculated	None reported
Puerto Rico - San Juan Zone					
Toa Baja	Yes	None reported	12-16 hours	Not calculated	None reported
Dorado	Yes	None reported	None recorded	Not calculated	None reported

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Puerto Rico [illegible] Fajardo Zone					
Fajardo	Yes	None reported	6 hours	Not calculated	None reported
Ceiba	Yes	None reported	6 hours	Not calculated	None reported
Vieques	Yes	None reported	None recorded	Not calculated	No comment provided
Puerto Rico [illegible] Guayama Zone					
Guayama	Yes	None reported	Not available	Not calculated	None reported
Arroyo	Yes	None reported	Not available	Not calculated	None reported
Salinas	Yes	None reported	5 hours	Not calculated	None reported
Coamo	Yes	None reported	6 - 8 hours	Not calculated	None reported
Santa Isabel	Yes	None reported	12 - 15 hours	Not calculated	None reported
Patillas	Yes	None reported	6 hours	Not calculated	No comment provided

Table 5-1 (Continued)
Transportation/Clearance Time Data Summary
Hurricane Georges Evacuation Assessment

Location	Evacuation Roadway Network Accurate	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time	Problems Encountered
Puerto Rico Municipal Zones					
Humacao	Not available	None reported	Not available	Not calculated	No comment provided
Yabucoa	Yes	None reported	4-5 hours	Not calculated	Flooding on some roadways
Maunabo	Yes	None reported	3 hours	Not calculated	Improve computer system
US Virgin Islands					
St. Thomas/ St. Croix/ St. John	Yes	None reported	Not discernable	3-8 hours	No traffic problems during evacuation; difficult to tell tourists what to do; air lines stop service at least 12 hours before event

Figure 5-1

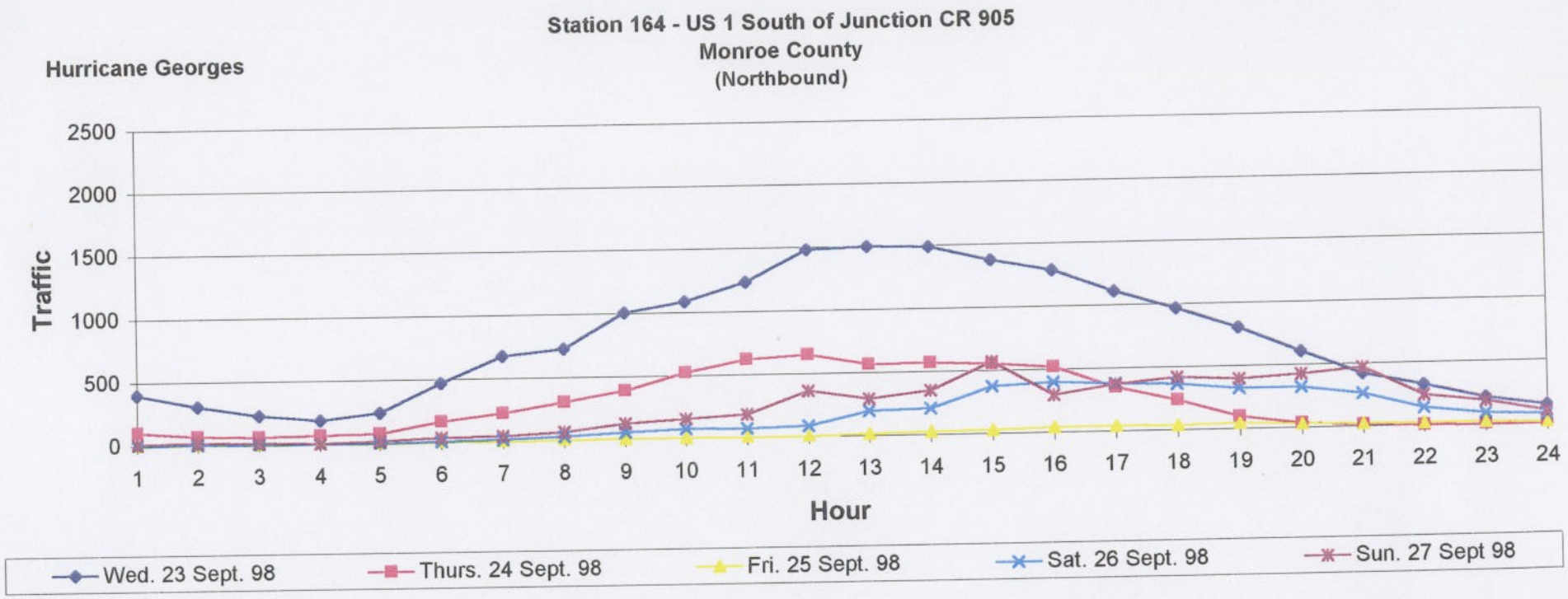
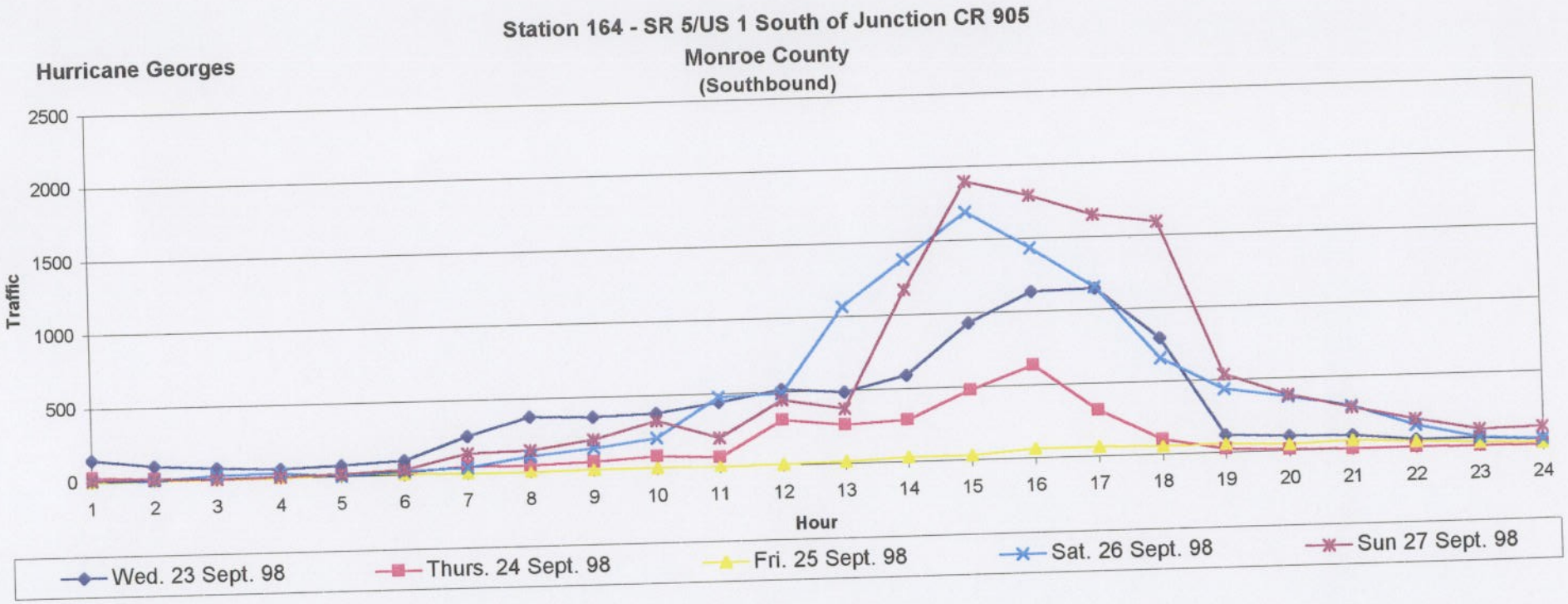

Station 164 - US 1 South of Junction CR 905
Monroe County
(Northbound)
Hurricane Georges
Traffic
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
Wed. 23 Sept. 98
Thurs. 24 Sept. 98
Fri. 25 Sept. 98
Sat. 26 Sept. 98
Sun. 27 Sept 98

Figure 5-2


Station 164 - SR 5/US 1 South of Junction CR 905
Monroe County
(Southbound)
Hurricane Georges
Traffic
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
Wed. 23 Sept. 98
Thurs. 24 Sept. 98
Fri. 25 Sept. 98
Sat. 26 Sept. 98
Sun 27 Sept. 98

northbound and southbound two days prior to the Georges landfall and two days after. The northbound traffic substantially increased on Wednesday September 23, peaking during the early afternoon with about 1,500 vehicles per hour moving through US 1. The only traffic problems reported were for vehicles re-entering the Keys after the Georges event. No traffic problems were reported for Northwest Florida which is a great improvement over the Opal experience.

Alabama, Louisiana, and Mississippi experienced similar issues with construction along evacuation routes causing delays. Washington County, Alabama, and several parishes in Louisiana commented on the lack of capacity along evacuation routes. The most significant traffic congestion appeared on I-10 westbound out of New Orleans where one westbound lane was closed due to construction. This congestion was alleviated by the State by clearing construction and opening both westbound lanes. Parishes in Louisiana also had flooded roadways due to the heavy rains of previous storms. Lafourche Parish mentioned the need for better traffic coordination between parishes. St. Charles Parish also noted the need for hurricane protection levees and associated highway maintenance. Harrison County, Mississippi commented on the need to reevaluate the roadway network for evacuation routing. Forrest County, Mississippi had heavy traffic congestion and flash flooding on a major evacuation route, US Hwy 49.

Four municipios in Puerto Rico encountered traffic problems due to flooding, fallen tree limbs and last minute evacuation by residents. The remaining municipios experienced little traffic problems during evacuation. The close proximity to shelters for residents and early evacuation due to local experience made the process smoother. The U.S. Virgin Islands also had no significant traffic problems. The only difficulty experienced was directing tourists during evacuation. Actual clearance times of three to ten hours matched up well with the few areas where hurricane clearance time analysis had been conducted.

Recommendations:

1. Update Alabama, Mississippi, Louisiana and lower southeast Florida hurricane evacuation studies.

2. Run scenarios for St. Thomas with lower participation rates assumed.

3. Develop maintenance of traffic plans for Louisiana parishes that have road construction projects on major evacuation routes (specifically for the hurricane season).

4. Conduct a Louisiana-Mississippi regional hurricane evacuation analysis to better anticipate traffic flows into Mississippi and associated shelter demand.

5. Provide Gulf states and counties with an abbreviated version of the transportation model so that roadway construction impacts to clearance time can be calculated in real time.

6. Implement permanent traffic count stations along the Gulf Coast states so that evacuation traffic can be monitored and documented.

Chapter 6
Decision Making

Some of the most important products developed as part of the FEMA/Corp of Engineers hurricane evacuation studies and delivered to local and state officials have been evacuation decision making tools. These tools are decision arc maps and tables as well as computer software such as HURREVAC. These products graphically tie real-time storm characteristics with HES produced hazards, shelter and clearance time data. Their purpose is to give emergency management directors a means of retrieving Technical Data Report information without having to dig through a report during an emergency. Evacuation decision tools provide guidance and assistance to decision makers as to when an evacuation should begin relative to a specific hurricane, its associated wind field, forward speed, probabilities, forecast track, and intensity.

Discussions initiated by the FEMA/Corps study teams with local and state officials regarding the evacuation decision process focused on the following questions:

> When was the Emergency Operating Center fully activated and what prompted this decision?
> What study products/decision aides were used to decide when to evacuate and who should evacuate? Was the new HURREVAC product used?
> When was the evacuation order or request made?

Table 6-1 provides a summary of the responses and information gathered from each county. Most areas interviewed used similar products: HURREVAC, decision arcs, zone maps and surge maps. Those that did not have HURREVAC used HURRTRAC or other commercial products. Northwest Florida counties agreed that the study products worked well. Several areas commented that a FEMA/Corps of Engineers study was not available for Lee and Collier Counties in South Florida. Those areas without studies used decision arcs, and/or HURREVAC. Several areas also mentioned the need for HURREVAC training. Mobile County, Alabama and St. Charles Parish,

Table 6-1
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aids Were Used in Decision Making	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Northwest Florida					
Escambia County	9/25/98 10 AM	HURREVAC, NHC information	HURREVAC, decision arcs	9/25/98 5 PM Reissued 9/26/98 6 PM	New study products worked great; used HES zones
Santa Rosa County	9/25/98 1 PM	HURREVAC not up and running at new EOC	Zone and route mapping; storm surge maps	9/25/98 1 PM 10,000 is population of evacuation area	New study is great; promoted zone map heavily
Okaloosa County	9/25/98	HURRTRAC	Zone maps, surge maps	9/25/98 11 AM 26,000 in area	HURREVAC won't work because of county's internet server "firewall"; other study products were excellent; flood forecasts were low
Walton County	9/25/98 10:30 AM	NHC information/clearance time requirements	HURREVAC (beta version), clearance times	9/25/98	New study products worked well
Bay County	9/23/98 Level 2 9/25/98 11 AM full activation	NHC HURREVAC decision arcs; HURRTRAC	HURREVAC (new)	No major areas of evacuation recommended or ordered	Worked well

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aids Were Used in Decision Making	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
South Florida					
Lee County	9/22/98	GDS, TDS, NHC information	(No Corps/FEMA study)	9/24/98 1 PM Voluntary 11 PM mandatory with warning issued	(No Corps/FEMA study)
Collier County	9/23/98 5 AM	GDS, Decision ARCs	(No Corps/FEMA study)	9/24/98 2:30 PM Marco Island - 8,000 left 25,000 left county wide	(No Corps/FEMA study)
Broward County	9/23/98 5 AM	Anticipation of hurricane watch issuance by the NHC	HURREVAC, decision arcs, GDS, HURRTRAC	9/23/98 mobile home/low lying area evacuation	Well
Dade County	9/21/98 initial 9/23/98 level II activation 9/24/98 level III activation	SALT, GDS, NWS forecast information; state conference calls	GDS	9/24/98 11:30 AM mobile home and electric dependent residents encouraged to evacuate	Need training on HURREVAC
Monroe County	9/21/98 8 AM partial 9/23/98 7 AM full 2 operation centers primary - Marathon secondary - Key West	NHC information	No comments provided	9/22/98 7 AM tourists 4 PM mobile homes mandatory 9/23/98 7 AM mandatory evacuation ordered for 7 Mile Bridge South 11 AM mandatory for Middle Key 4 PM mandatory for Upper Keys	No comments provided

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aides Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Puerto Rico - Mayagüez Zone					
Lajas	9/20/98	Internet information on Hurricane	Municipal operational plan	No comment provided	No comment provided
Cabo Rojo	9/20/98 9:00 AM	No comment provided	Operational plan, HURREVAC, Local maps	9/21/98 2:00 PM 400	Would like additional information on HURREVAC; information on HURREVAC from zone; no computer available
Mayagüez	9/20/98 8:00 AM	Experience with past hurricanes	Municipio operational plan, experience	10,000 -12,000	No comment provided

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aides Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Puerto Rico – San Juan Zone					
Toa Baja	No comment provided	Hurricane trajectory	Decision Arcs, National Weather Service, EIS System, new forecast office in San Juan, data obtained from University of Hawaii	3,000	No comment provided
Dorado	Once information was given from the State Civil Defense	Safety of local population	Maps	2% of population	No comment provided
Puerto Rico – Fajardo Zone					
Fajardo	9/18/98	Hurricane trajectory	Internet, maps, weather channel	205	No comment provided
Ceiba	9/19/98 10:00 AM	State Civil Defense; Internet; hurricane trajectory	Maps, information from State Civil Defense, risk analysis, Surge maps	9/19/98 175+	No comment provided
Vieques	9/19/98	Maps; information from National Meteorology Center	No comment provided	9/20/98	No comment provided

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aids Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
[illegible]					
Guayama	9/20/98	Experience	HURRTRAC, Surge maps and hurricane study	1,500	Data needs to portray number of evacuees better; not much data available
Arroyo	9/18/98	Hurricane trajectory	Maps	9/20/98 4% of population	No comments provided
Salinas	9/20/98	Hurricane trajectory	No comment provided	9/21/98 1,606	No comment provided
Caomo	9/21/98	Hurricane trajectory	Maps, hurricane updates	2,000	No comment provided
Santa Isabel	9/19/98	Hurricane trajectory	Information from State CD, National Meteorology Service, National Hurricane Center Updates	2,500	Worked very well
Patillas	9/19/98 10:30 AM	Experience	Information from State Civil Defense	9/20/98	No comment provided

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aids Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
[illegible]					
Humacao	9/19/98	Proximity of hurricane to the municipio	Operational plan	9/20/98	No comment provided
Yabucoa	No comment provided	Threat of hurricane to Puerto Rico	Maps, information from State Civil Defense, operational plan	175	No comment provided
Maunabo	No comment provided	Hurricane trajectory	Hurricane trajectory map	Not reported	No comment provided
[illegible]					
St. Thomas/ St. Croix/ St. John	9/20/98 11 AM	NHC information, NWS, Governor's actions	Old HURREVAC model, Decision Arcs	9/20/98 3 PM	HURREVAC was good; would like scenarios incorporated with less public shelter use assumed; need new HURREVAC and automated rain and wind gauges; mapping to be more detailed and show potential mudslide areas

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC was Activated	What Prompted Decision to Activate	What Study Products/Decision Aids Were Used in Decision Making	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Alabama					
Washington County	9/25/98 Alert 9/26/98 Full activation	Information from state emergency management; DTN information	No comments reported	9/26/98 100 ± homes in low lying areas	Don't have enough staff and computers to run Inland Winds programs
Mobile County	Partial activation during watch; full activation during warning 9/26/98 6 AM	Weather/rainfall/wind predictions; NHC forecast; continuous calls; HURRTRAC	HURREVAC, SLOSH Model	9/26/98 Asked people to evacuate locally and not to leave county	Need study updated; zones too hard to describe to public
Baldwin County	9/26/98 6 AM	NHC information, HURRTRAC	HURREVAC, beta version	9/26/98 6 PM Pleasure Island, Ono Island and mobile homes under mandatory order; 20,000 ±	Evacuation zone too difficult to classify to the public; need update of study
Louisiana					
Lafourche	9/25/98 Morning	Impending threat of hurricane	HURREVAC, decision arc's, National Weather Service	9/26/98 8:00 AM 30,000 ±	Would like exact elevation maps; information on structural integrity of shelters
Terrebonne	9/26/98	Not provided	National Weather Service (Slidell), DTN, Weather Channel, HURRWIN 95, surge maps, decision arcs's	9/26/98 102,000	Extremely well

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aides Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Orleans	9/25/98	Expected hurricane land-fall	HURREVAC, National Weather Service, State	9/26/98 2:00 PM	Need more HURREVAC training; SLOSH maps over predicts flooding; Roadway elevations/levees may have changed since study
St. James	9/25/98 5:00 AM	Storm intensity, location and forecast National Hurricane Center information	Contracted meteorologist, HURREVAC, National Weather Service	9/26/98 6:00 AM 4,000	Believe SLOSH maps over predict water levels; Need better tools to predict hazards such as including rainfall in model
St. Charles	Not reported	Not provided	Hurricane Evacuation Study, HURREVAC	9/26/98 6:00 AM 38,000 - 40,000	Study is outstanding; Need to update study; SLOSH model worked well
Jefferson	9/26/98 8:00 AM	Not provided	No comments reported	Not recorded	SLOSH model predicts realistic results; Clearance times are realistic; Need to update study (levee heights); erosion needs to be included in next study

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aides Were Used	Time of Evacuation Order/ Number Evacuated	How Well Study Products Worked
Mississippi					
Harrison County	Not reported	Not provided	Decision arc, HURREVAC	9/26/98 9:00 AM 10,000	Need an updated SLOSH model
Hancock County	9/26/98	Not provided	HURREVAC	9/26/98 7:00 PM 4,500	Need study to be updated
Forrest County	Not reported	Not provided	Hurricane Center bulletins off Internet	Not recorded	Forecast of hurricane landfall too far off
Biloxi County	8/26/98	Not provided	HURREVAC, old SLOSH software	Not recorded	Need SLOSH model for Mississippi; need new SLOSH maps; include traffic count data in next study
Jackson County	9/25/98 1:00 PM	Not provided	HURREVAC, National Hurricane Center information	9/26/98 2,500 - 3,000	Need new SLOSH model for Mississippi Would like better communications with Hurricane Center; more accurate elevation data needed

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aides Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Puerto Rico - Ponce Zone					
Ponce	9/19/98	None recorded	Maps in the operational plan, Weather bulletins	9/20/98 2,000	Not aware of HURREVAC
Juana Diáz	9/19/98	Experience	Local operational plan	9/20/98 Afternoon 1,500 - 1,800	Have computer but need HURREVAC
Guayanilla	9/19/98 Afternoon	NOAA information; State Civil Defence information	Surge Maps	9/20/98 Morning 6,000 - 7,000	Have Internet access; not aware of HURREVAC
Guánica/Yauco	9/19/98 8:30 AM	Weather Service information; Internet	Experience, Surge Maps, Local operational plan	9/20/98 1:00 PM 1,200	Not aware of HURREVAC; have computers

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aides Were Used	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Puerto Rico Arecibo Zone					
Vega Baja	9/19/98	Experience	Surge Maps, Communications with Manati & zone	300 - 400	Maps need to be improved; Not aware of HURREVAC
Hatillo	9/19/98	Advisories/warnings	Maps; news (media), Zone, Program - "storm"	125	No study available; need HURREVAC; have computer
Manatí	No comment provided	Hurricane trajectory	No comment provided	1:00 PM 240+	No comment provided
Puerto Rico Carolina Zone					
Loíza	9/19/98 Alert 9/20/98 Full activation	Weather service; experience; history of municipio during disaster; operational plan	Municipio operational plan	9/20/98 Approximately 3,500	Plan worked well. Primary source of information was experience
Río Grande	9/20/98	Weather information	Maps, weather channel bulletins	9/20/98 Approximately 175	No study available
Carolina	9/19/98 Morning	Public need to begin evacuation	Maps, Decision arcs	9/21/98 3::00 6,316	No comment provided

Table 6-1 (Continued)
Evacuation Decision Process Summary
Hurricane Georges Evacuation Assessment

Location	Time EOC Was Activated	What Prompted Decision to Activate	What Study Products/Decision Aids Were Used in Decision Making	Time of Evacuation Order/Number Evacuated	How Well Study Products Worked
Puerto Rico – Aguadilla Zone					
Añasco	9/19/98	Experience; size of hurricane	Decision arcs and maps	± 600	Not aware of HURREVAC
Aguadilla	9/19/98	Trajectory of hurricane	Computer program developed by municipio	9/21/98 Morning 120-130	Not aware of HURREVAC
Quebradillas	9/20/98 Morning	Hurricane Track, expected landfall	Surge Maps, experience	9/20/98 Morning	No comment provided
Isabela	9/20/98	Experience; good communications with zone	Used draft surge map	9/20/98 Approximately 225	No study available
Aguada	9/19/98 1:00 PM	Information from NOAA	Maps, program developed (tracking) by municipio	139	Not aware of HURREVAC
Rincón	No comment provided	Hurricane trajectory	Surge Maps, data from Corps of Engineers	9/20/98 225	No comment provided

Louisiana requested a study update. Counties in Mississippi commented that a new SLOSH model is needed.

The municipios without a study rely on local operational plans and surge maps produced by the Corps of Engineers. Many municipios were unaware of HURREVAC, and also lacked the computer hardware to use it. These areas relied on decision arcs, weather bulletins, and local experience. Also, many areas commented on the need for measuring river flooding and mapping areas prone to mud slides, the cause of most deaths and property destruction.

Local officials in the U.S. Virgin Islands use HURREVAC and decision arcs. Comments made included getting the upgraded HURREVAC, and automated rain and wind gauges.

Recommendations:

1. Update clearance time data and incorporate into the new HURREVAC model.
2. Conduct extensive training sessions with local EM's regarding the new HURREVAC model.
3. Deliver new SLOSH storm tide atlases to Mississippi Counties as soon as possible.
4. Provide detailed river and mudslide area maps such as USGS maps for Puerto Rico and the U.S. Virgin Islands.
5. Provide rain and wind gauges for the U.S. Virgin Islands.
6. Study update in Alabama including clearer/more definable evacuation zones.
7. Update Louisiana study including SLOSH forecasts.
8. Assist Puerto Rico municipios in obtaining necessary data during a storm.

Chapter 7
Public Information

Although not a major part of previous FEMA/Corps of Engineers hurricane evacuation study efforts, public information is recognized as an important final element that must be addressed. Study products and data must ultimately be tailored to a format that the media and general public can understand so that correct evacuation decisions and preparations can be made at the household level. Georges provided a glimpse of the current means of getting hurricane evacuation information into the hands of the general public. Georges also provided local and state officials with an opportunity to assess additional needs regarding public information.

Methods used and suggestions offered in the study areas to inform the public in Georges and future events included the following:

1. Public information brochures were developed and widely distributed early in the season showing vulnerable areas, evacuation levels, and tips on hurricane preparedness.
2. Press briefing with national and local media to insure that they (radio, TV, newspapers) disseminate consistent information to the public - Media were given packets of hurricane materials early in the season by some emergency officials.
3. Law enforcement officials drove through neighborhoods with sirens and P.A. systems to encourage people to evacuate - this technique was used in Puerto Rico extensively - some officials went door-to-door.
4. Some communities were able to provide evacuation information to the public through printed information in the local phone book.
5. An important means was through radio and television - some communities used cable TV overrides to alert the public of evacuation advisories and provide PSAs.
6. The Weather Channel was used extensively by local emergency management staff and citizens for public education and information.
7. Some emergency management officials faxed advisory and teleconference information to media every six hours.

8. Some counties used their web sites to display storm information and advisories.
9. Decision arc systems are good for public and school education as they are easy to understand.
10. County public information officers are important resources during the event to interface with the media and public.
11. There is a mixture of ideas from the media regarding "canned" HES media products. Many would rather develop their own graphics.
12. Some selected areas would like hurricane information in Spanish.
13. There is a need for better coordination between the media and EOC during a storm.
14. Improve evacuation zone maps distributed to the public by better delineating zones.

Appendix A

Meeting Attendees/Persons Providing Input In Affected Areas

HURRICANE GEORGES
MEETING PARTICIPANTS
1999

FLORIDA

NAME	ORGANIZATION
Robert Smith	FEMA
Rick Zyvoloski, Jr.	FDEM (Area 6)
John Wilson	Lee County OPS
Louetta Muller	Lee Co. EM
Don Lewis	PBS&J
Bob Collins	DEM
Dan Trescott	SWFRPC
Dave Saniter	Lee County EM
Bill Johnson	Miami-Dade OEM
David Fariss	Miami-Dade Police
Jack Schnettler	PBS&J
Iñabi A. Rezola	American Red Cross
Erle S. Peterson	Miami-Dade OEM
Frank J. Reddish	Miani-Dade OEM
Royce B. Tipton	Corps of Engineers
Cathie Perkins	Miami-Dade OEM
Nixsa Serrano	Miami-Dade OEM
Niel Batista	OEM
Chuck Lanza	OEM
Don Lewis	PBS&J
Tom Roche	SRC EM
Matthew Green	FDEM
N.H. Sanderson	FEMA
Bill Gilbert	Santa Rosa County PJO
George Gimino	PIO Volunteer
Jeff Mullendore	Escambia County EM
Janice Kilgore	Escambia County EM
Jon Dosh	Escambia County EM
Ron McNesby	Escambia County Sheriffs Department
Greg Strader	West Florida American Red Cross
Ken Pineau	Collier County EM
Jim Von Rinteln	Collier County EM
Tom Storrar	Collier County Sheriffs Office
Mike Price	Collier American Red Cross

FLORIDA (Continued)

NAME	ORGANIZATION
Dave Karsek	Okaloosa Co. EM
George Collins	WZEP Radio Defuniak Springs
Art Dees	WGTX
Ron Kelley	WCSO (Walton Co. Sherriffs Office)
Col. Bill Chapman	WCSO
Bill Bishop	WCSO
Capt. Earl Campbell	WCSO
Capt. Rick Sutton	Walton Co. Board of Comm.
Shirl Williams	WCSO EOC
Capt. Thomas L. Pagels	Bay Co EM
Jon Fillinger	Tyndall AFB
Brian Kelling	Fl. DEM
Michelle Pope	Fl DEM
Brandon Bolinski	PBS&J
Christy Palin	FEMA
Billy Wagner	

ALABAMA

NAME	ORGANIZATION
John Eringman	USCOE Mobile
Wiley Page	PBS&J
John H. Armstrong	Washington County Probate Judge
Hilton Robbins	Washington County Commission
Ruby Taylor	EMA
J.O. Pete McGough	AEMA
Robert A. Smith	FEMA
Floyd Williams	EMA Coordinator
Bruce McCrory	MCEMA
Toni Jennings	Mobile County EMA
Jimmy Jones	AEMA
Scott Adcock	AEMA
Steve Huffman	Mobile County EMA
Kim Lanier	Mobile Register
Gary A. Beeler	NWS
Thomas Duncan	MCPSS

ALABAMA (Continued)

NAME	ORGANIZATION
Steve Scarcuff	Mobile Police
Ken Poston	American Red Cross
Jack C. Castleberry	American Red Cross
David Roberts	MDB EMA
Jimmy Jones	AEMA
Sandra Kennedy-Owes	American Red Cross
John P. VanHook	MCEMA
Ronnie Adair	Mobile County EMA
John Wilson	Mobile County EMA
Walt Dickerson	Mobile County EMA
Ginger Simpson	Dauphin Island

LOUISIANA

NAME	ORGANIZATION
Gregory J. Sgrigny	Lafourche Parish Council
Elmo Broussard	Lafourche Parish School Board
Jerry Monier	CPSO
Brett Herr	Corps of Engineers
Kent Baxter	FEMA Region 6
Sean R. Fontenot	LOEP
Wiley Page	PBS&J
Windell A. Curole	Lafourche Parish OEP
Earl J. Ewes, Jr.	Terrebonne OEP
Mike Brown	LOEP
Robert Bott	LOEP
Jim Ballow	LOEP
Jim Wilks	LOEP
Hucky Purpera	LOEP
Gaston Vernon	Assistant Director-St. James

LOUISIANA (Continued)

NAME	ORGANIZATION
Tiffany Kliebert	Administrative Assistant
Eric Deroche	Communication/Emergency
Billy Zwerschke	EMC FEMA
Billy Wagner	EMC
Brant Mitchell	LOEP
Gerald J. Falgoust	Director - EDC
Frank Hijuelou	Director OEP
Charley Inland	Deputy Director OEP
Lou Reese	OEP - New Orleans
Brant Mitchell	LOEP
Eric Crooker	OEP, Shelter Coor.

MISSISSIPPI

NAME	ORGANIZATION
Lynette Carbon	EMC
Charlene Favre	CD
Ivy Lacy	Harrison Co. CD
Linda Rouse	Harrison Co. CD
Andy Crawford	MEMA
Raven James	Stowe Co EMA
Beth Johnson	Forrest Co.
Terry Steed	Forrest Co.
Wayne Cook	Stone Co. EMA
Eddie Ivy	Lauderdale EMA
John Eringman	COE Mobile
Hank Turk	EMA
Wiley Page	PBS&J
Heather Houston	PBS&J
Robert A. Smith	FEMA
Billy Wagner	FEMA

PUERTO RICO

NAME	ORGANIZATION
Bill Massey	FEMA
Allan McDuffie	USCOE
Don Lewis	PBS&J
Robert A. Smith	FEMA
Marie E. Gonzalez	FEMA/CD
Martin Gonzalez	USCOE
Isabel Suazo	USCOE
Jose Bralo	FEMA
Christine Palin	PBS&J
Bruce Swiren	FEMA II
Mariano Vargas	SCD-Mitigation
Rafael Mojica	NOAA - NWS
Jesus Poupart	PRCD
Matthew C. Larsen	USGS
Maria M. Irizarry	USGS
Daniel O. Melendez	DCE
Luis Almodovar	DCE
Pedro L. Diaz	USGS
Eloy Colon	NWS
Maria T. Navarro	PBS&J
Martín Concepción	Director D.C. Aguada
Pedro Bermúdez Mendez	Director D.C. Aguadilla
Alberto Feliciano Hernandez A.	Director D.C. Añasco
Adalberto González Medina	Director D.C. Isablea
Aníbal Delgado	Director D.C. Quebradillas
Ramóne Ventura	Director D.C. Rincón
Marsha Gomez	D.C. Isablea
Orlando Lizardi	D.C. Aguadilla
Maria Echevarria	D.C. Aguadilla
Carmen H. Geliga	D.C. Aguadilla
Bruce Swiren	FEMA Region II
Rene Aqueron	DCE
Hector Velez	DCE
Pedro Luis Aviles	D.C. Quebradilla
Luis Butler	D.C. Quebradilla
Awildo Sanchez Velez	DCE Zone III
Aida M. Ortiz	Civil Defense, Loiza
Juan O. Fuentes	Civil Defense, Loiza

PUERTO RICO (Continued)

NAME	ORGANIZATION
Ana C. Canales Lopez	Civil Defense
Daniel O. Rivera	DCE
Aquilino P. Osorio	DCE, Loiza
Eduardo S. Rivera	DCE
Jesus Poupart	DCE
Rubén Gómez	Rio Grande
Lourdes Quiñones	Rio Grande
Rene Aquenon	DCE
José R. Collazo	CE, Manati
Fermin Otero	DC, Vega Baja
Gilberto V. Román	DC, Hatillo
Edgar Jiminez	DCE
Joel Rivera	Zona 4
Jose E. Suvita	Director, Cabo Rojo
Freddy Cruz Negrón	Director, Lajas
Aníbal RománMorales	Director, Magaguez
Manuel R. Renta	DC, Juana Diaz
Norma A. Rodz	DC, Juana Diaz
Luis M. Maldando	DC, Guayanilla
José A. Green	DC, Ponce
Luis A. Torres Vidro	DC, Guanica
Domingo Mercado	DC, Guanica
Daniel O. Melendez Rivera	DCE
Bill O. Quende	DC, Dorado
Victor P. Rodrigy	DC, Dorado
Agustin Millex	DC Cataño
Nora E. Zamora	DC San Juan
Carlos Acevedo	DCE Zone I
Rodolfo Gonzaloz	DC Guaynabo
Carlos de Jesús	DC Guaynabo
Victor M..Vega	DC Toa Baja
Isabel Suazo	USA COE
Amalio Loíz	DC Humacao
Jerry Kirkland	Director DC Naguabo
José A. Millan	Director, DC, Yabucoa
Rafael Bulgalá	DC Arroyo
Fermin Hernandez	DC Patillas
Eddie A. Vázquez	DC Guayama

PUERTO RICO (Continued)

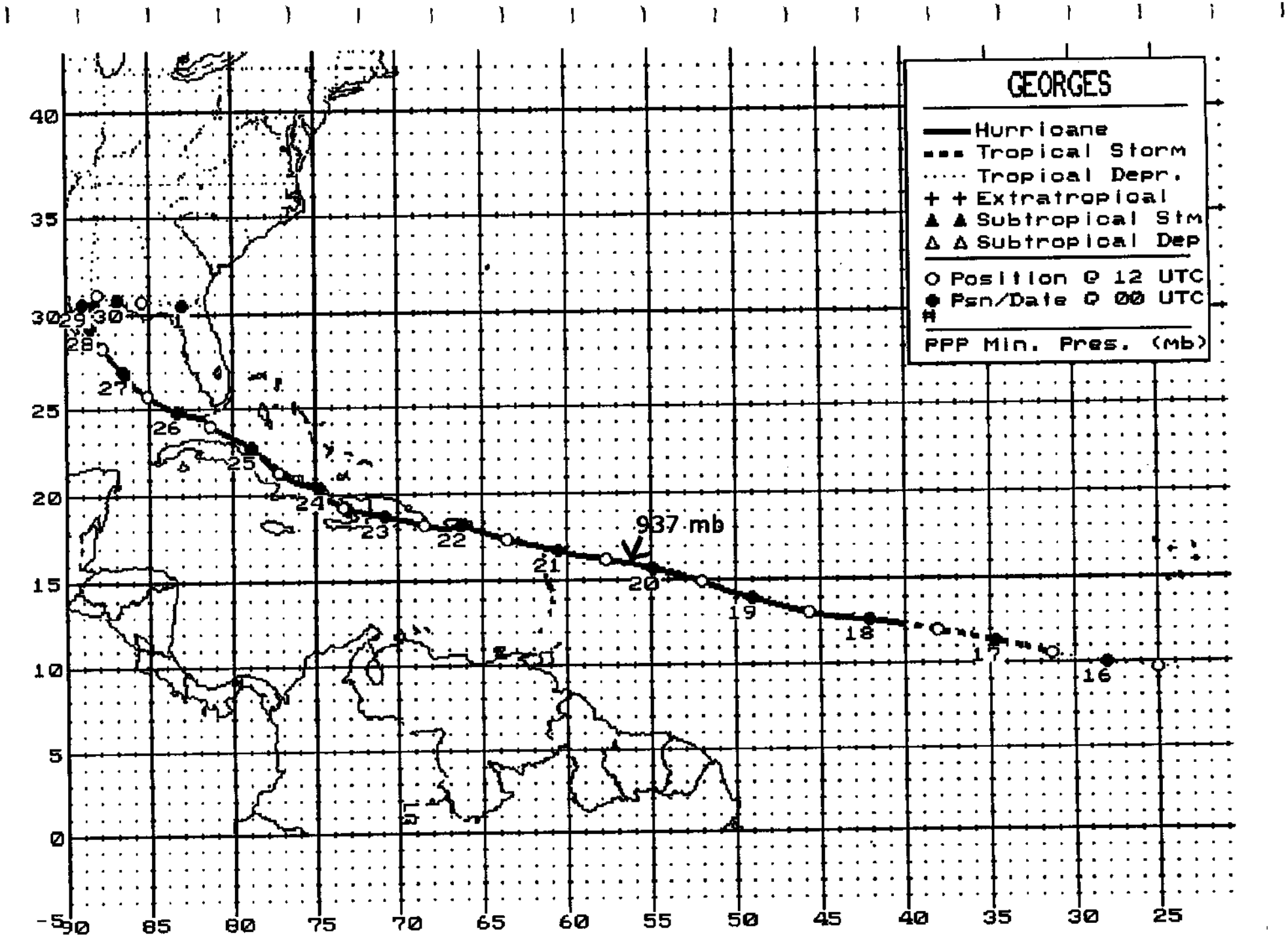
NAME	ORGANIZATION
Daniel O. Helendez	DCE
William J. Munez Coccazo	DE Coamo
Simon Padron	DC Culebra
Angel M. Camacho	DC Ceiba
Carlos Betancourt	DC Fajardo
Rafael Perez	DC Luquillo
Adolfo Losa	DC Vieques
Luis E. de Jesús	Director Regional Zone 11

VIRGIN ISLANDS

NAME	ORGANIZATION
Col. Gene Walker	VITEMA Director
Joe Elmore	American Red Cross
Don Lewis	PBS&J
Allan McDuffie	USCOE
Bill Massey	FEMA IV
Robert Smith	FEMA
Conrad E. Knowles	VITEMA
June A. Archibald	VIDOE
Clayton Sutton	VIFEMA
Carlos Farchiffe	DPNR
Louis Hill	Governor's Office
Marie E. Gonzalez	FEMA/CD

Appendix B

National Hurricane Center's Hurricane Georges Warning Summary/Timetable and Best Track Data



Best Track for Hurricane Georges, 15 September - 1 October, 1998.

Preliminary Best Track - Hurricane Georges, 15 September - 01 October 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
09/15/1200	9.7	25.1	1009	30	Tropical Depression
1800	9.8	26.5	1009	30	" "
16/0000	10.0	28.1	1009	30	" "
0600	10.3	29.7	1009	30	" "
1200	10.6	31.3	1005	35	Tropical Storm
1800	11.0	32.9	1003	35	" "
17/0000	11.3	34.6	1000	45	" "
0600	11.7	36.3	997	50	" "
1200	12.0	38.1	994	55	" "
1800	12.3	40.0	987	65	Hurricane
18/0000	12.5	42.0	984	70	" "
0600	12.8	43.9	977	80	" "
1200	13.1	45.7	973	85	" "
1800	13.5	47.4	970	90	" "
19/0000	13.9	49.0	970	90	" "
0600	14.4	50.6	965	95	" "
1200	14.9	52.0	954	110	" "
1800	15.4	53.5	949	125	" "
20/0000	15.7	54.9	939	130	" "
0600	16.0	56.3	937	135	" "
1200	16.2	57.7	939	130	" "
1800	16.4	59.2	956	115	" "
21/0000	16.7	60.6	963	100	" "
0600	17.1	62.1	966	100	" "
1200	17.4	63.6	966	95	" "
1800	17.8	65.0	972	90	" "
22/0000	18.2	66.3	970	90	" "
0600	18.0	67.4	972	95	" "
1200	18.2	68.5	964	105	" "

Preliminary Best Track - Hurricane Georges, 15 September - 01 October 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
22/1800	18.6	69.7	970	95	Hurricane
23/0000	18.8	70.8	980	70	" "
0600	19.0	72.1	990	65	" "
1200	19.3	73.3	996	65	" "
1800	19.8	74.3	994	65	" "
24/0000	20.5	74.9	992	65	" "
0600	20.8	76.0	991	65	" "
1200	21.3	77.2	990	70	" "
1800	21.9	78.0	989	75	" "
25/0000	22.7	79.0	987	80	" "
0600	23.4	80.2	986	85	" "
1200	23.9	81.3	982	90	" "
1800	24.6	82.4	975	90	" "
26/0000	24.8	83.3	974	90	" "
0600	25.2	84.2	975	90	" "
1200	25.7	85.1	974	90	" "
1800	26.2	85.9	975	90	" "
27/0000	27.0	86.5	969	95	" "
0600	27.6	87.2	970	95	" "
1200	28.2	87.8	962	95	" "
1800	28.8	88.3	962	95	" "
28/0000	29.3	88.5	961	95	" "
0600	29.8	88.7	964	90	" "
1200	30.4	88.9	965	90	" "
1800	30.6	88.9	984	65	" "
29/0000	30.6	89.0	986	50	Tropical Storm
0600	30.6	88.4	992	40	" "
1200	31.0	88.1	994	30	Tropical Depression
1800	30.9	87.5	996	30	" "

Preliminary Best Track - Hurricane Georges, 15 September - 01 October 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
30/0000	30.8	86.9	998	30	Tropical Depression
0600	30.7	86.3	1000	30	" "
1200	30.7	85.4	1002	25	" "
1800	30.6	84.2	1004	25	" "
10/01/0000	30.5	83.0	1006	25	" "
01/0600	30.5	81.8	1008	20	" "
01/1200					Dissipated
20/0600	16.0	56.3	937	135	***Minimum Pressure***
LANDFALLS					
21/0430	17.0	61.7	966	100	ANTIGUA 3 SM SE of Falmouth
21/0800	17.2	62.6	966	100	ST. KITTS 8 SM SE of Basseterre
21/2200	18.1	65.8	968	100	PUERTO RICO 20 SM SW of Fajardo
22/1230	18.2	68.7	962	105	DOMINICAN REPUBLIC 84 SM E of Santo Domingo
23/2130	20.1	74.5	993	65	CUBA 30 SM E of Guantanamo Bay
25/1530	24.5	81.8	981	90	Key West, Florida
28/1130	30.4	88.9	964	90	Biloxi, Mississippi

Watch and warning summary, Hurricane Georges September, 1998.

Date/Time (UTC)	Action	Location
23/0900	Hurricane Watch Issued	Western Cuba for the Provinces of Villa Clara, Cienfuegos and Matanzas/Northwest Bahamas.
23/1500	Tropical Storm Warning Issued	Jamaica
23/1500	Hurricane Warning discontinued	Dominican Republic
23/2100	Tropical Storm Warning Issued	Cayman Islands...Cayman Brac and Little Cayman.
24/0600	Hurricane Warning discontinued	The Southeast Bahamas, the Turks and Caicos Islands.
24/0900	Hurricane Warning Issued	Northwest Bahamas/ South Florida from Deerfield Beach southward on the east coast...and from south of Bonita Beach on the west coast including the Florida Keys.
24/0900	Hurricane Watch Issued	Florida east coast north of Deerfield Beach to Stuart...and the Florida west coast north of Bonita Beach to Longboat Key.
24/0900	Hurricane Warnings discontinued	Haiti
24/1500	Tropical Storm Warnings discontinued	Cayman Islands...Cayman Brac and Little Cayman.
24/2100	Tropical Storm Warning Issued	Florida east coast north of Deerfield Beach to Stuart.
25/0300	Hurricane Warning Issued	Florida west coast north of Bonita Beach to Longboat Key.
25/0300	Tropical Storm Warning Issued	Florida west coast north of Longboat Key to Bayport.
25/0300	Hurricane Warnings discontinued	Central Bahamas.
25/0500	Hurricane Watch discontinued	Florida east coast Deerfield Beach to Stuart.
25/0700	Hurricane Warnings discontinued	Cuba
25/0700	Hurricane Watch discontinued	For Cuba east of Matanzas to Pinar Del Rio.
25/1300	Hurricane Warning changed to a Tropical Storm Warning	Florida east coast from north of Florida City to Deerfield Beach.
25/1500	Hurricane Watch Issued	Gulf Coast from Morgan City Louisiana to St. Marks Florida.
25/1500	Hurricane Warnings discontinued	Northwest Bahamas.

Watch and warning summary, Hurricane Georges, September 1998.

Date/Time (UTC)	Action	Location
18/2100	Hurricane Watch Issued	St. Lucia to Anguilla including Saba and St. Maarten.
19/1500	Hurricane Watch Extended North/East	St. Lucia northward and then northwestward to the British/U.S. Virgin Islands
19/2100	Hurricane Warning Issued	Dominica northward to Anguilla except St. Barthelemy and the French portion of St. Martin.
19/2100	Hurricane Watch Issued	Puerto Rico
20/0300	Tropical Storm Warning	St. Lucia and Martinique
20/0900	Hurricane Warning extended westward	Dominica north and west to Puerto Rico
20/2100	Hurricane Watch Issued	Dominican Republic
21/0900	Hurricane Warning extended westward	Dominica north and west to the Dominican Republic
21/0900	Tropical Storm Warning and Hurricane Watch discontinued	Martinique to St. Lucia
21/1500	Hurricane Watch extended north and west	North coast of Haiti from St. Nicolas to the border of the Dominican Republic / Southeast Bahamas, the Turks and Caicos Islands.
21/1500	Hurricane Warning discontinued	all islands east of the Virgin Islands except Antigua, Barbuda, and the French Islands of St. Barthelemy and St. Martin.
21/1500	Hurricane Warning discontinued	Antigua, Barbuda, and the French Islands of St. Barthelemy and St. Martin.
21/1900	Hurricane Watch Issued	Eastern Cuba from the Province o f Las Tunas to Guantanamo
22/0300	Hurricane Warning extended westward	U.S. & British Islands, Puerto Rico, Dominican Republic, Haiti, the Southeast Bahamas, the Turks and Caicos Islands.
22/0900	Hurricane Warning discontinued	U.S. & British Virgin Islands
22/1500	Hurricane Warning Issued	Eastern Cuba from the Province of Las Tunas to Guantanamo, the Central Bahamas from Acklins to Cat Island
22/1500	Hurricane Watch Issued	Eastern Cuba for the Provinces of Camaguey to Sancti Spiritus
23/0900	Hurricane Watch Issued	South Florida from Deerfield Beach southward on the east coast...and fromsouth of Bonita Beach on the west coast including the Florida Keys.
23/0900	Hurricane Warning Issued	Eastern Cuba for the Provinces of Camaguey to Sancti Spiritus / Central Bahamas.

Watch and warning summary, Hurricane Georges, September 1998.

Date/Time (UTC)	Action	Location
25/2100	Tropical Storm Warnings discontinued	Florida east coast from north of Florida City to Deerfield Beach.
25/2100	Hurricane Warnings discontinued	Florida east coast south of Florida City to Key Largo.
26/0300	Hurricane Warning changed to a Tropical Storm Warning	Florida Keys south of Key Largo and Florida west coast south of Bayport.
26/0300	Hurricane Watch discontinued	For Cuba east of Matanzas to Pinar Del Rio.
26/0900	Tropical Storm Warnings discontinued	Florida west coast from Longboat Key to Bayport.
26/1200	Tropical Storm Warnings discontinued	Florida Keys south of Key Largo and the Florida west coast south of Longboat Key
26/1500	Hurricane Warning Issued	Morgan City, Louisiana to Panama City, Florida.
26/1500	Tropical Storm Warning and a Hurricane Watch	Panama City, Florida to St. Marks, Florida.
26/1500	Hurricane Watch	Morgan City, Louisiana to Intracoastal City, Louisiana.
27/2100	Hurricane Watch discontinued	Panama City, Florida to St. Marks, Florida.
28/0300	Hurricane Watch discontinued	Morgan City, Louisiana to Intracoastal City, Louisiana.
28/1500	Hurricane Warning discontinued	Destin, Florida to Panama City, Florida.
28/1500	Tropical storm Warning discontinued	Panama City, Florida to St. Marks, Florida.
28/1500	Hurricane Warning changed to a Tropical Storm Warning	Grand Isle, Louisiana to Morgan City, Louisiana.
28/2100	Hurricane Warning changed to a Tropical Storm Warning	Grand Isle, Louisiana to Destin, Florida
28/2100	Tropical Storm Warning discontinued	Grand Isle, Louisiana to Morgan City Louisiana.
29/0300	Tropical Storm Warning discontinued	Grand Isle, Louisiana to the Mouth of the Mississippi River, Louisiana.
29/0900	Tropical Storm Warning discontinued	Mouth of the Mississippi River to Pascagoula, Mississippi.
29/1500	Tropical Storm Warnings discontinued	Pascagoula, Mississippi to Destin, Florida.

Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kt)[a]	Peak Gust (kt)	Date/ Time (UTC)[b]	Storm Surge (ft)[c]	Storm Tide (ft)[d]	Total Rain (in)
U.S. Virgin Islands								
St. Croix								
Hamilton Airport	976.0	21/1702	64	79	21/1842			6.79
Vitema/Hermon Hill			71	81	21/1815			
Maria Hill*	972.2		78	98	21/1534			
Jolly Hill								7.41
Estate The Sight/CO-OP Observer								2.63
Annaly/CO-OP Observer								5.30
East Hill/CO-OPObserver								6.20
St. Thomas								
Cyril E. King Airport	991.0	21/1943	66	81	21/2031			4.99
Bonne Resolution Gut								6.02
National Park Service Guinea Gut								5.70
Wintberg/CO-OP Observer								2.26
St. John								3.41
USGS Rain Gage								3.41
Coral Bay/CO-OP Observer								2.40
Catherineburg/CO-OP Observer								7.56
Puerto Rico								
Luis Munoz Marin Intl. Airport (TJSJ)	979.7	21/2311	69	81	21/2318			5.26
Roosevelt Roads NS (TJNR)	971.4	21/2145	76	93	21/2250			4.57
Ponce (TJPS)			65	85	22/0330			
Quebradillas*	978.4	22/0300	78	85	22/0244			
Naranjito (Barrio Guadiana Alto)*				109	22/0040			
Rincon*	983.1	22/0430	87	113	22/0445			
Mayaguez Bo Guanajibo	976.9	22/0345						
Cupey Rio Piedras/CO-OP Observer	974.5	21/2245						9.39
Isabela KP4MYO*			89	143	22/0610			
Yabucoa* (Courtesy of Sun Oil Co.)			65	83	21/2140			
USGS Rain Gages								
Caguas								28.67
Lago El Guineo / Villalba								24.62
Rio Saliente at Coabey Ne Jayuya								24.30
Rio Portuguez at Tibes								18.46
Quebrada Salvatierra / San Lorenzo								16.93
Rio Grande de Arecibo / Utuado								16.87
Lago Garzas / Adjuntas								13.49
River Espiritu Santo / Rio Grande								13.04
NWS CO-OP Observer Rainfall								
Jayuya								28.36
Orocovis (Cacao)								23.62
Coamo								22.50
Mayaguez City								21.30
Cayey								20.97
Maricao								18.75
Juana Diaz (Guayabal)								17.35
Ponce								13.83
San Lorenz								12.99
Yauco								9.62
Trujillo Alto								8.33

USGS Storm Surge Estimate - Fajardo 10[#]

Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kts)[a]	Peak Gust (kts)	Date/ Time (UTC)[b]	Storm Surge (ft)[c]	Storm Tide (ft)[d]	Total Rain (in)
Cuba								
Punta Lucrecia			71					
Sagua La Grande				80				
Cayo Coco	988.0							
Guantanamo Bay			60		20/0245			8.98
Limonar								24.41
Bermeja								20.32
Santiago de Cuba								18.54
Nueva								12.44
Ciego de Avila								7.91

[a] Standard NWS ASOS and C-MAN averaging period is 2 min; buoys are 8 min.
[c] Storm surge is water height above normal astronomical tide level.
[e] Estimated.
[g] Gage failed at 27/1945UTC.
[i] Preliminary estimate.
[j] Unofficial observer data.

[b] Date/time is for sustained wind when both sustained and gust are listed.
[d] Storm tide is water height above NGVD.
[f] Power failed shortly after this observation; a higher value may have occurred.
[h] Maximum gusts recorded (time unknown) higher gusts may have occurred; anemometer height 30 feet AGL.

Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kts)[a]	Peak Gust (kts)	Date/ Time (UTC)[b]	Storm Surge (ft)[c]	Storm Tide (ft)[d]	Total Rain (in)
Florida								
Leesburg	1013.3	25/1953	19	31	25/2218			1.19
Sanford	1013.6	25/2055	20	30	25/1834			1.81
Patrick AFB (KCOF)	1013.5	25/1955	15	23	25/1943			
Titusville (KTIX)	1011.9	25/1550	20	40	25/1550			1.69
Miami Intl. Airport (KMIA)			33	44	25/1056			0.94
Tamiami Airport			33	57	24/2318			
NWSFO MIA/TPC								1.76
Homestead								3.50
Tavernier								8.41
Duck Key			70	84	25/XXXX			
Marathon Airport (KMTH)				58	25/1100			
Marathon/Monroe EOC				96	25/XXXX			
Vaca Key						4-5		
Grassy Key						4-5		
Cudjoe Key						5-6		
Ramrod Key						5-6		
Big Pine Key						5-6		
Summerland Key						5-6		
New Port Richey (RRF)	1011.4	25/1953	20	36	25/2153			1.71
St. Pete/Clearwater (KPIE)	1010.7	25/1953	24	34	25/2117			0.65
St Petersburg (KSPG)	1010.1	25/1953	23	35	25/2331			
Tampa Airport (KTPA)	1010.6	25/2056	20	30	25/2116			1.23
McDill AFB (KMCF)	1010.8	25/1955	20	37	25/2100			1.04
Old Port Tampa			11	33	25/2150			
Sunshine Skyway			29	33	25/2150			
Winter Haven (GIF)	1012.2	25/1953	19	31	25/2146			0.89
Sarasota/Brad Airport (KSRQ)	1009.0	25/1853	29	36	25/1926			2.14
Punta Gorda (PGD)	1009.5	25/2053	30	42	25/1816			0.42
Fort Myers (KFMY)	1008.2	25/1753	31	38	25/1732			0.70
Regional SW Airport (RWS)	1007.7	25/1653	24	37	25/1703			
Naples			31	48	25/1855			
Inverness (INVF1)								0.46
Ruskin (KTBW)								1.43
Arcadia/Horse CK (ARHF1)								3.02
Levy County							2-4[e]	
Citrus County							1-3[e]	
Hernando County							2-3[e]	
Pasco County							1[e]	
Pinellas County							2-3[e]	
Hillsborough County							2-3[e]	
Manatee County							3[e]	
Sarasota County							3-4[e]	
Charlotte County							4-5[e]	
Lee County							2-3[e]	
Tallahassee Airport (KTLH)	1003.3	30/0752	24	29	29/2224			6.42
FSU Weather Station				39	26/2129			

[a] Standard NWS ASOS and C-MAN averaging period is 2 min; buoys are 8 min.
[c] Storm surge is water height above normal astronomical tide level.
[e] Estimated.
[g] Gage failed at 27/1945UTC.
[j] Preliminary estimate.
[e] Unofficial observer data.

[b] Date/time is for sustained wind when both sustained and gust are listed.
[d] Storm tide is water height above NGVD.
[f] Power failed shortly after this observation; a higher value may have occurred.
[h] Maximum gusts recorded (time unknown) higher gusts may have occurred; anemometer height 30 feet AGL.

Hurricane Georges selected surface observations, September 1998.

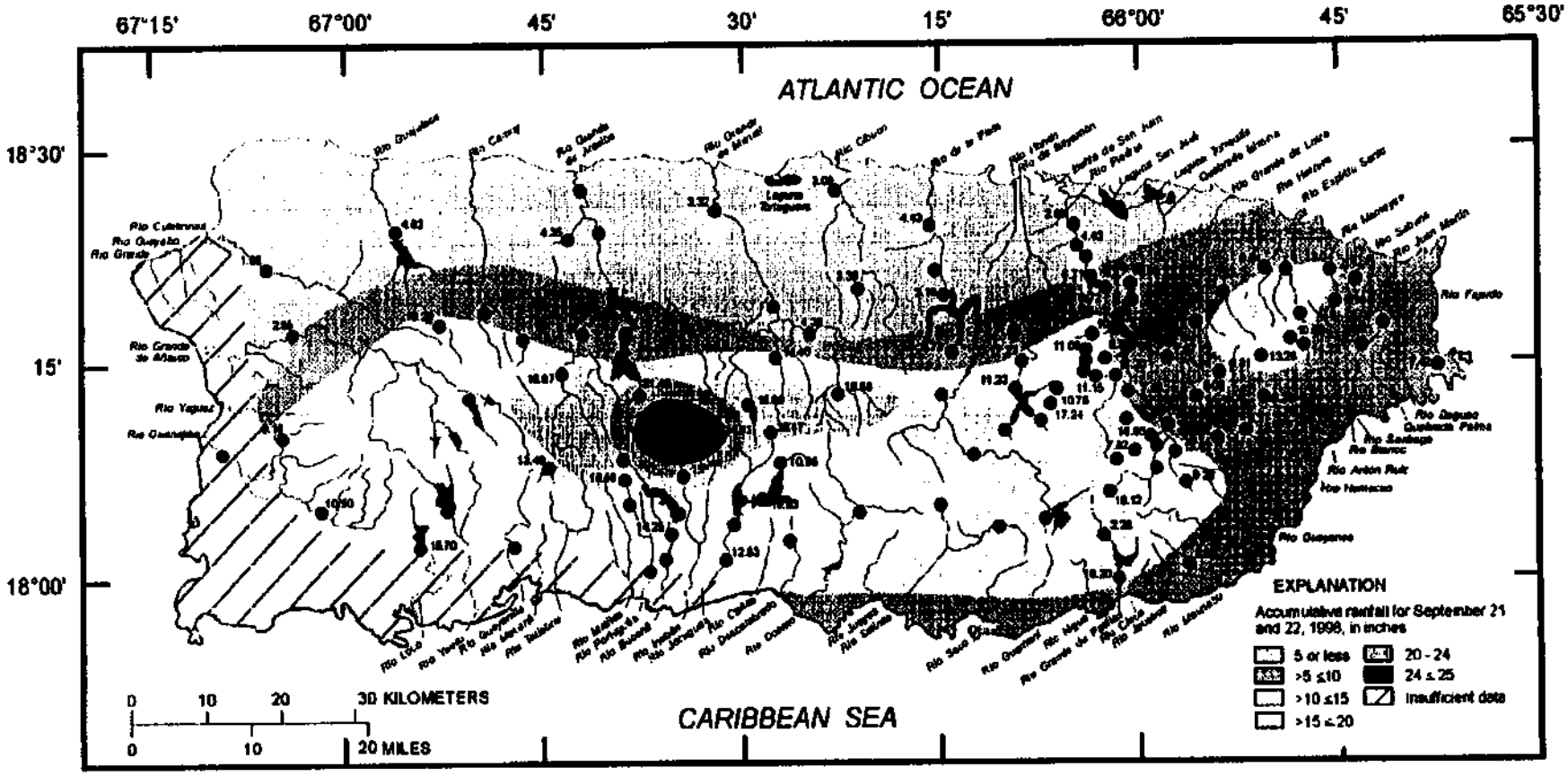
Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kts)[a]	Peak Gust (kts)	Date/ Time (UTC)[b]	Storm Surge (ft)[c]	Storm Tide (ft)[d]	Total Rain (in)
Florida (continued)								
Apalachicola (KAQQ)			28	33	29/1311			
Panama City Airport (KPAM)			24	37	29/0605			
Munson (NE of Milton)								38.46
Bay Minette								29.66
Andalusia								26.90
Milton (CO-OP)								25.06
Milton School								14.62
Milton/Whiting Field (NSE)	992.5	n/a	38	50	28/0240			18.41
Destin (DTS)	999.4	29/2353	33	49	28/0156			6.21
Hurlburt AFB (HRT)	1000.0	29/2200	44	69	29/0216			17.08
Crestview (KCEW)	999.6	29/2253	28	43	28/2005			19.98
Eglin AFB (KVPS)	994.0	29/2300	42	79	28/0642			24.24
Pensacola APT (KPNS)	998.7	29/0953	44	58	28/0321			15.78
Pensacola NAS (KNPA)	997.9	29/0956	40	61	27/2200			12.84
Pensacola EM Office				61	28/0235			
Pensacola (TV Station)								26.83
Shell Point Sailboard Club				39	29/2045			
St. Teresa Beach				49	29/2225			
Pensacola Beach						7.7		
Choctawhatchee Bay						5.2		
Destin Harbor						5.2		
Panama City Beach						5.2		
Alabama								
Mobile Regional Airport (KMOB)	989.9	28/0921	44	55	28/0924			15.02
Mobile Brookley Field (BFM)	989.9	28/0853	47	54	27/2240			
Evergreen (GZH)	999.6	29/2041	31*	39*	29/0353			7.67
Fairhope AG. Station				56	28/0709			14.57
Fairhope (CO-OP)								15.82
Grand Bay AG. Station				52	28/1811			
Semmes AG. Station				43	28/1836			17.84
Alabama Port								13.66
Atmore Nursery (CO-OP)								15.15
Bay Minette (CO-OP)								29.66
Brewton								14.80
Brewton AG Center								16.34
Brewton (CO-OP)								18.44
Leakesville (CO-OP)								11.44
Niceville								19.53
Alberta (CO-OP)								9.90
Georgiana (CO-OP)								19.15
Jackson (CO-OP)								12.76
Thomasville (CO-OP)								10.20
Whatley (CO-OP)								15.15
Mobile Downtown								13.13
Greenville (CO-OP)								18.15
Andalusia (TV Station)								26.90
Gulf Breeze								26.87
Jay								18.19
Spanish Port								19.86
Camden (CO-OP)								10.77
Gulf Shores						9.0*		
Bayou La Batre						8.8*		
Downtown Mobile						8.5*		
Fort Morgan - Gulf						8.5*		
Mobile Bay - Belle Fountaine						8.3*		

Hurricane Georges selected surface observations, September 1998.

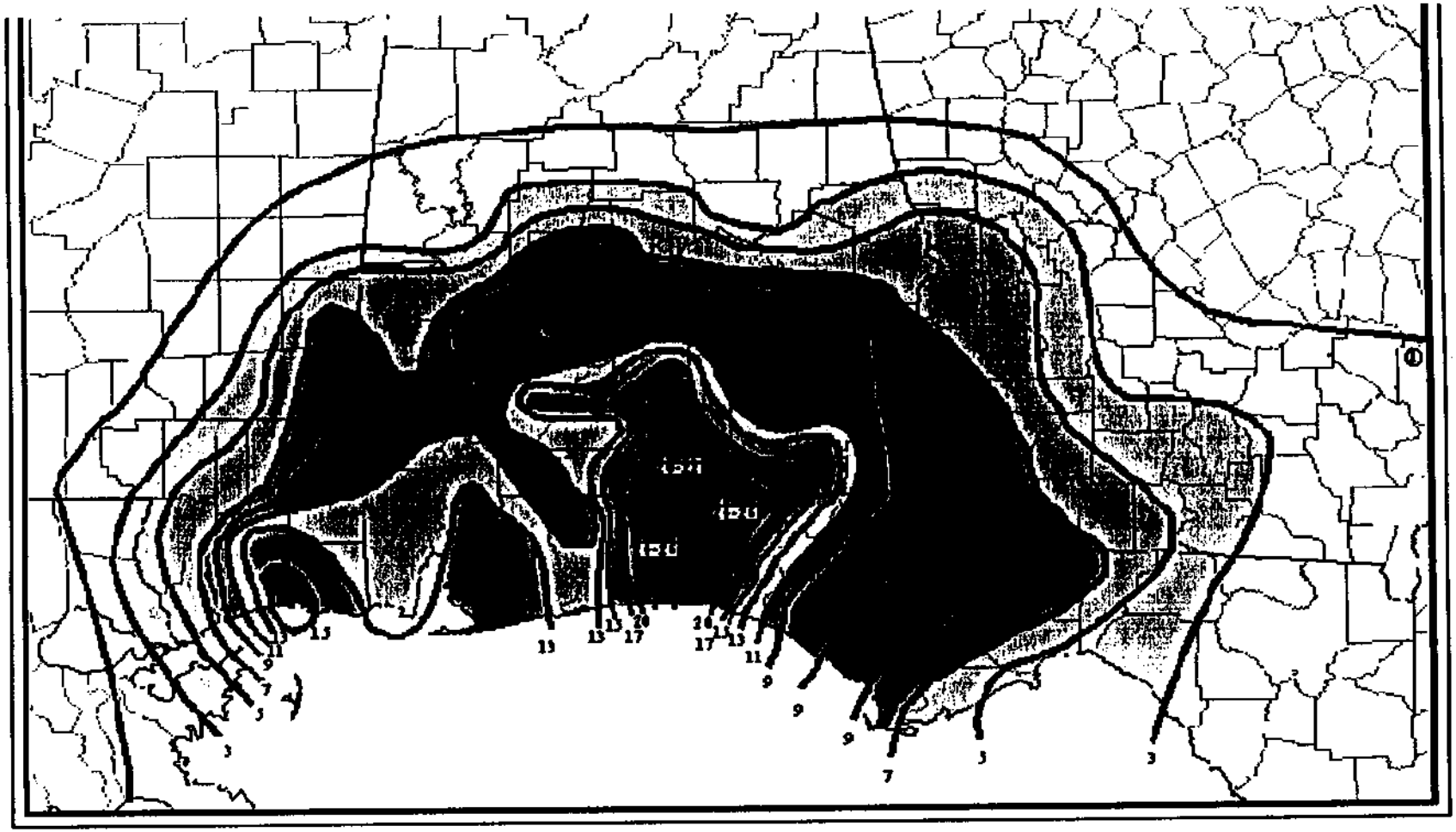
Location	Pres. (mb)	Date/ Tme (UTC)	Sust. Wind (kts)[a]	Peak Gust (kts)	Date/ Time (UTC)[b]	Storm Surge (ft)[c]	Storm Tide (ft)[d]	Total Rain (in)
Alabama (continued)								
Weeks Bay						6.5*		
Fort Morgan - Bay						5.8*		
Ono Island						5.4*		
Dauphin Island - Bay						5.3*		
Mississippi								
Gulfport Airport (KGPT)			42	63	28/0931[f]			
Keesler AFB (KBIX)	964.9	28/1055	65		28/0855			9.18
Pascagoula/Trent Lott Airport (KPQL)			36	47	27/2306[f]			
Gulfport Harbor - Harrison County CD			53	69	28/1015	8.1		
Gulfport - 1 MI North of Beach (Courtesy of MS Power and Light)				102[h]	n/a			
Gulfport - Harrison County CD	967.2	28/1015						
Pascagoula CO-OP Observer								16.68
Ocean Springs								15.68
Vancleave								14.81
Wiggins								13.25
Lyman								9.85
Pass Christian Harbor						6.2		8.79
Pascagoula - Bayou Chico						9.6*		
Biloxi - Black Bay						8.8*		
Gulfport						7.6*		
Pass Christian						6.4*		
Bay St. Louis						5.8*		
Louisiana								
New Orleans Intl. Airport (KMSY)	996.6	28/1052	35	46	28/1137[f]			
New Orleans Lakefront APT (KNEW)	994.5	28/0953	39	48	28/0911[f]			
Slidell (KSIL)			31	42	28/0401[f]			0.87
Lake Pontchartrain								
East Lake - Rigolets			37	54	28/0910	5.8		
Mid Lake - Pontchartrain Causeway			42	59*	28/1020	4.7		
West Lake - Frenier			33*	45	28/0110	4.7		
North Lake - Mandeville			21	42	28/0840			
New Orleans Audubon Park								0.88
Slidell CO-OP Observer								1.48
Covington CO-OP Observer								1.11
Bogalusa CO-OP Observer								2.98
West End Marina						5.3		
Industrial Canal						7.3		
North End Causeway						4.3		
Lake Borgne								
Bayou Bienvenu						7.4		
Bayou Dupre						6.4		
Plaquemines Parish - East Side								
NE Gardene Bay (13 MI ESE of Pointe A La Hache)						8.9[f]		

[a] Standard NWS ASOS and C-MAN averaging period is 2 min; buoys are 8 min.
[c] Storm surge is water height above normal astronomical tide level.
*** Estimated.**
[g] Gage failed at 27/1945UTC.
 # Preliminary estimate.
• Unofficial observer data.
*** - U.S. Army Corps of Engineers Data (Mobile District)**

[b] Date/time is for sustained wind when both sustained and gust are listed.
[d] Storm tide is water height above NGVD.
[f] Power failed shortly after this observation; a higher value may have occurred.
[h] Maximum gusts recorded (time unknown) higher gusts may have occurred; anemometer height 30 feet AGL.



Preliminary rainfall analysis for Puerto Rico for Hurricane Georges, 21-22 September 1998.
(Source: U.S. Geological Survey)



Preliminary rainfall analysis for the Gulf Coast for Hurricane Georges, 28-30 September 1998.
(Source: NOAA/NWS/Southeast River Forecast Center)

Appendix C

Hurricane Behavioral Georges Response Questionnaire

Hurricane Georges
Response Questionnaire
2-24-99

Hello, my name is _____ and I'm calling on behalf of the Army Corps of Engineers and your local emergency management office. I'm conducting a telephone survey of residents concerning experiences in hurricane Georges last summer, so that we can improve hurricane evacuation plans for the future. May I please speak with the **(ROTATE):**

1. Youngest male over 18
2. Oldest male
3. Youngest female over 18
4. Oldest female in your household?

My questions will only take a few minutes. Your responses are important to us so that we may have accurate information about hurricane preparedness. Before we begin, let me assure you everything you say will remain strictly confidential.

1. Do you live at this residence year-round?
   1 Yes **(GO TO Q3)**
   2 No **(GO TO Q2)**
   3 Other **(GO TO Q2)**

2. Do you live here at least part of the time during the summer or fall?
   1 Yes **(GO TO Q3)**
   2 No **(THANK & TERMINATE)**
   3 Other **(THANK & TERMINATE)**

   IF "NO," TERMINATE THE INTERVIEW BY RESPONDING "THANK YOU FOR YOUR TIME, BUT WE ARE LOOKING FOR PEOPLE WHO ARE IN THIS REGION DURING THAT TIME FRAME. THANK YOU AGAIN. GOODBYE."

3. Were you in the area, i.e., not out of town, when **HURRICANE GEORGES** began to threaten your area last September?
   1 Yes **(GO TO Q4)**
   2 No **(THANK AND TERMINATE)**
   3 Other **(THANK AND TERMINATE)**

   IF "NO," TERMINATE THE INTERVIEW BY RESPONDING "THANK YOU FOR YOUR TIME, BUT WE ARE LOOKING FOR PEOPLE WHO WERE IN THIS AREA AT THAT TIME. THANK YOU AGAIN. GOODBYE."

4. Did you leave your home to go someplace safer in response to the threat created by Hurricane Georges?

   1 Yes **(GO TO Q6)**
   2 No **(GO TO Q5)**
   3 Other, _____ **(GO TO Q19)**
   9 Don't know **(GO TO Q19)**

5. What made you decide *not* to go anyplace else? **(CATEGORIZE - PROBE UP TO 3) (THEN GO TO Q19)**

a. 0/1 Storm not severe/house adequate
b. 0/1 Officials said evacuation unnecessary
c. 0/1 Media said evacuation unnecessary
d. 0/1 Friend/relative said evacuation unnecessary
e. 0/1 Officials didn't say to evacuate
f. 0/1 Probabilities indicated low chance of a hit
g. 0/1 Other information indicated storm wouldn't hit
h. 0/1 Had no transportation
i. 0/1 Had no place to go
j. 0/1 Wanted to protect property from looters
k. 0/1 Wanted to protect property from storm
l. 0/1 Left unnecessarily in past storms
m. 0/1 Job required staying
n. 0/1 Waited too long to leave
o. 0/1 Traffic too bad
p. 0/1 Tried to leave, but returned home because of traffic
q. 0/1 Too dangerous to evacuate because might get caught on road in storm
r. 0/1 No place to take pets/Shelter would not accept pets
s. 0/1 Other, specify: _____
t. 0/1 Don't know

5a. **IF** Georges had looked to you like it was going to hit this area more directly, would you have left your home to go someplace safer?

1 Yes
2 No
3 Don't Know/Depends
4 Other (Specify)_____

5b. Were you ready, that is had you made the necessary preparations, to leave your home to go someplace safer in the event the situation had worsened?

1 Yes
2 No
3 Don't Know/Depends
4 Other (Specify)_____

5c. While you were deciding whether to leave, did you have any concerns that you might try to evacuate but have the storm arrive while you were caught on the road because of heavy traffic?

1 No **(SKIP TO Q 5E)**
2 Yes
3 Don't Know/Depends
4 Other (Specify)_____

5d. If emergency management officials were able to monitor traffic on the roads so that they could reassure you that if you left at a certain time you would still have enough time to reach your destination before the storm arrived, would that make you more likely to leave?

1 Yes
2 No
3 Don't Know/Depends
4 Other (Specify)_____

5e. If you had left your home to go someplace safer, would you have gone to a public shelter, a friend or relative's house, a hotel, or somewhere else? **(DO NOT READ)**

__1__ Public shelter (or Red Cross shelter)
__2__ Church
__3__ Friend/relative
__4__ Hotel
__5__ Workplace
__6__ Mobile home park clubhouse
__7__ Other, specify: _____
__8__ Don't know
__9__ Would not have evacuated

5f. Is that **(ANSWER FROM #5e)** located in your neighborhood or someplace else?

__1__ Neighborhood **(SKIP TO Q 5j)**
__2__ Somewhere else
__9__ Don't know

5g. In which city is that located?

_____

5h. Is that **(ANSWER FROM #5g)** located in your "county" **("PARISH" FOR LOUISIANA RESPONDENTS)**?

__1__ Yes **(SKIP TO Q 5j)**
__2__ No
__9__ Don't know

5i. In which state is that located?

__1__ Florida
__2__ Georgia
__3__ Alabama
__4__ Mississippi
__5__ Louisiana
__6__ Texas
__7__ Arkansas or Tennessee
__8__ Other, _____
__9__ Don't know

5j. Would you or anyone in your household require assistance in evacuating?

__1__ Yes
__2__ No **(SKIP TO Q 19)**
__3__ Not sure **(SKIP TO Q 19)**

5k. Would the person just need transportation, or do they have a disability or medical problem that would require special assistance?

__1__ Transportation only
__2__ Special need (disability or medical problem)
__3__ Both
__4__ Other, specify: _____
__5__ Don't know

5k. Would that assistance provided by someone within your household, or by an outside agency, or by a friend or relative outside your household?

__1__ Within household
__2__ Friend/relative (outside)
__3__ Outside agency
__4__ Other, _____
__9__ Don't know

(IF ANSWERING Q5k, SKIP TO Q 19)

6. Did you go to a public shelter, a friend or relative's house, a hotel, or somewhere else? **(DO NOT READ)**

__1__ Public shelter (Red Cross)
__2__ Church
__3__ Friend/relative
__4__ Hotel
__5__ Workplace
__6__ Mobile home park clubhouse
__7__ Other, specify: _____
__9__ Don't know

7. Is that **(ANSWER FROM #6)** located in your neighborhood or someplace else?

__1__ Neighborhood **(SKIP TO Q11)**
__2__ Somewhere else
__9__ Don't know

8. In which city is that located?

_____

9. Is that **(ANSWER FROM #8)** located in your county?

__1__ Yes **(SKIP TO Q11)**
__2__ No
__9__ Don't know

10. In which state is that located?

__1__ Florida
__2__ Georgia
__3__ Other, _____
__9__ Don't know

11. What convinced you to go someplace else? **(CATEGORIZE - PROBE UP TO 3)**

a. __0/1__ Advice or order by elected officials
b. __0/1__ Advice from Weather service
c. __0/1__ Advice/order from police officer or fire fighter
d. __0/1__ Advice from media
e. __0/1__ Advice from friend or relative
f. __0/1__ Concerned about severity of storm
g. __0/1__ Storm increased in strength
h. __0/1__ Concerned storm would cause home to flood
i. __0/1__ Concerned strong winds would make house unsafe
j. __0/1__ Concerned flooding would cut off roads
k. __0/1__ Concern that storm might hit
l. __0/1__ Heard probability (odds) of hit
m. __0/1__ Other, specify: _____
n. __0/1__ Don't know

12a. **FOR LOUISIANA, MISSISSIPPI, ALABAMA, NORTH FLORIDA:**
The National Hurricane Center issued a Hurricane Watch for this area at 11 AM on the morning of Friday, September 25. That was followed by a Hurricane Warning the following day at 10 AM on the morning of Saturday, September 26. On what day did you leave your home to go someplace safer?

FOR MONROE COUNTY, FLORIDA:
The National Hurricane Center issued a Hurricane Watch for this area at 5 AM on the morning of Wednesday, September 23. That was followed by a Hurricane Warning at 5 AM on the morning of Thursday, September 24. On what day did you leave your home to go someplace safer?

__1__ Monday, September 21st or earlier
__2__ Tuesday, September 22nd
__3__ Wednesday, September 23rd
__4__ Thursday, September 24th
__5__ Friday, September 25th
__6__ Saturday, September 26th
__7__ Sunday, September 27th
__8__ Other _____
__9__ Don't know

12b. About what time on the **(REPEAT DATE)** did you leave? **(USE 1 HOUR INCREMENTS) (TAKE MIDPOINT) (99=DK)**

_____ Hour **(IF 99, SKIP TO Q13)**

12c. Was that morning AM or PM? **(NOTE: 12 O□CLOCK NOON = 12 PM) (NOTE: 12 O□CLOCK MIDNIGHT = 12 AM ON THE A "NEW"DAY)**

__1__ AM (morning/or midnight until noon)
__2__ PM (afternoon/evening or noon until midnight)

13. Did you or anyone in your household require assistance in evacuating?

__1__ Yes
__2__ No **(SKIP TO Q15)**
__3__ Not sure **(SKIP TO Q15)**

13a. Did the person just need transportation, or did they have a disability or medical problem that required special assistance?

__1__ Transportation only
__2__ Special need (disability or medical problem)
__3__ Both
__4__ Other, specify: _____
__5__ Don't know

14. Was that assistance provided by someone within your household, or by an outside agency, or by a friend or relative outside your household?

__1__ Within household
__2__ Friend/relative (outside)
__3__ Outside agency
__4__ Other, _____
__9__ Don't know

14a. Were they dropped off at a shelter or taken someplace else?

__1__ Dropped off at shelter
__2__ Taken someplace else
__3__ Other,_____
__9__ Don't Know

15. How many vehicles were available in your household that you could have used to evacuate?

_____ Number of vehicles **(IF 0, GO TO Q16; OTHERWISE GO TO Q17) (9 = DK) (IF 1 OR MORE IN Q15, SKIP TO Q17) (8 =NA) (RECORD "0" IF NO VEHICLES ARE AVAILABLE)**

16. Did your household members leave in someone else's vehicle, did they use public transportation, or did you evacuate another way?

__1__ Other's vehicles **(GO TO Q19)**
__2__ Public transportation **(GO TO Q19)**
__3__ Other, specify: _____ **(GO TO Q19)**
__9__ Don't know **(GO TO Q19)**

17. How many vehicles did your household take in evacuating? **(9 = DK) (8 =NA) (RECORD "0" IF NO VEHICLES ARE AVAILABLE)**

_____ Number of vehicles

18. When you evacuated, did you take a motor home or pull a trailer, boat, or camper?

__1__ Yes
__2__ No
__3__ Other, specify: _____
__9__ Don't know

19. During the threat, did you hear either directly or indirectly anyone in an official position - such as emergency management, police, etc. - say that you **should** evacuate from your location to a safer place?

__1__ Yes **(GO TO Q20)**
__2__ No **(GO TO Q22)**
__9__ Don't know **(GO TO Q22)**

20. Did officials recommend that you **should** evacuate or did they say it was mandatory that you **must** evacuate?

__1__ Should
__2__ Must
__9__ Don't know

21. Did police or other authorities come into your neighborhood going door-to-door or with loudspeakers, telling people to evacuate?

__1__ Yes
__2__ No
__9__ Don't know

22. Would you do anything differently in the same situation again? **(CATEGORIZE) (PROBE UP TO 3)**

a __0/1__ Would evacuate
b __0/1__ Wouldn't evacuate
c __0/1__ Would leave earlier
d __0/1__ Would wait later to leave
e __0/1__ Would go further away

f 0/1 Wouldn't go as far away
g 0/1 Would go to public shelter
h 0/1 Wouldn't go to public shelter
i 0/1 Would use different route
j 0/1 No
k 0/1 Other, specify: _____
l 0/1 Don't know

23. We're interested in how you got most of your information about Georges - where the storm was; when it was going to hit; how severe it was. I'm going to list a number of different ways you might have gotten information, and I'd like you to tell me whether you relied upon that source none at all (0), a little (1), a fair amount (2), or a great deal (3). **(READ & ROTATE)**

	None	Little	Fair Amount	Great Deal	
a	0	1	2	3	Local radio stations
b	0	1	2	3	Local television stations
c	0	1	2	3	CNN on cable
d	0	1	2	3	The Weather Channel on cable
e	0	1	2	3	Other cable stations
f	0	1	2	3	The Internet ✱ **(DO YOU HAVE A COMPUTER WITH A MODEM)**
g	0	1	2	3	Services like American Online or Compuserve ✱ **(DO YOU HAVE A COMPUTER WITH A MODEM)**
h	0	1	2	3	Word of mouth

IF "0" TO ALL, SKIP TO Q 27a

24. Of those sources of information, did you find any one of them to have more accurate information than the others?
__1__ Yes
__2__ No **(SKIP TO Q26a)**
__3__ Don't Know/Not Sure **(SKIP TO Q26a)**

25. Which one was that?
__1__ Local radio stations **(SPECIFY:_____)**
__2__ Local television stations **(SPECIFY:_____)**
__3__ CNN on cable
__4__ The Weather Channel on cable
__5__ Other cable channel **(SPECIFY:_____)**
__6__ The Internet, if you have a computer
__7__ Computer services like American Online or CompuServe, if you have a computer
__8__ All equally accurate
__9__ Don't know

26a. Of those sources of information, did you find any one of them to have **less** accurate information than the others?
__1__ Yes
__2__ No **(SKIP TO Q27a)**
__9__ Don't Know/Not Sure **(SKIP TO Q27a)**

26b. Which one was that?
__1__ Local radio stations **(SPECIFY:_____)**
__2__ Local television stations **(SPECIFY:_____)**
__4__ CNN on cable
__5__ The Weather Channel on cable

__3__ Other cable channel (**SPECIFY:**_____)
__6__ The Internet, if you have a computer
__7__ Computer services like American Online or CompuServe, if you have a computer
__8__ All equally inaccurate
__9__ Don't know

27a. Did you receive any information from local government officials about whether Georges was going to be a danger to your safety or how to protect your home and property?
__1__ Yes
__2__ No **(SKIP TO Q28a)**
__9__ Don't Know/Not Sure **(SKIP TO Q28a)**

27b. How would you rate the information you received from **local government officials**? Would you say it was generally accurate or generally not accurate?
__1__ Generally accurate
__2__ Generally not accurate
__3__ Some accurate, some not
__9__ Don't Know/No Opinion

27c. Would you say it was generally useful or generally not useful?
__1__ Generally useful
__2__ Generally not useful
__3__ Some useful, some not
__9__ Don't Know/No Opinion

28. What information did you need that you were unable to find any place as Georges approached? **(RECORD VERBATIM)**
_____
_____
_____

29. Did you or anyone in your household have to go to work while the Georges evacuation was going on?
__1__ Yes **(GO TO Q. 29A)**
__2__ No **(SKIP TO Q. 3O)**
__9__ Don't Know **(SKIP TO Q. 30)**

29a. How did that affect the way your household responded during the evacuation?
__1__ Not at all
__2__ Kept household from evacuating
__3__ Kept part of household from evacuating
__4__ Delayed household from evacuating
__5__ Delayed part of household from evacuating
__6__ Other,_____
__9__ Don't Know

30. Did any businesses or offices in your neighborhood stay open during the time the evacuation was going on?
__1__ Yes **(GO TO Q. 30A)**
__2__ No **(SKIP TO Q. 32)**
__9__ Don't Know **(SKIP TO Q. 32)**

30a. Was that business or office located in a location from which people had been told to evacuate?

1 Yes
2 No
9 Don't Know

31. Did the fact that the business or office stayed open affect the way you responded during the evacuation?

1 Yes, made us decide to not evacuate
2 No
3 Other (Specify)_____
9 Don't Know

32. At one point Georges's maximum sustained winds were almost 125 MPH. If Georges had made landfall near your location with winds of 125 MPH, do you believe your home would have been at risk to dangerous flooding from storm surge or waves?

1 Yes
2 No
9 Don't Know/Depends

33. Considering both wind and water, do you think it would have been safe for you to have stayed in your home if Georges had hit near your location with winds of 125 MPH?

1 Yes
2 No
9 Don't Know/Depends

34. In Georges, what kinds of steps, if any, did you take before the storm arrived to protect your property? **(CATEGORIZE) (PROBE UP TO 3)**

a 0/1 Apply window protection
b 0/1 Apply door/garage door protection
c 0/1 Secure or remove loose objects from yard
d 0/1 Move boat, camper, etc.
e 0/1 Prepare pool
f 0/1 Elevate furniture, appliance, rugs, etc.
g 0/1 Protect documents, photos, etc.
h 0/1 Sandbag property
i 0/1 Purchase items for repair after/during storm (plastic film, plywood)
j 0/1 Buy/rent generator
k 0/1 Secure plants
l 0/1 Cut limbs
m 0/1 Other (Specify)_____
n 0/1 None
o 0/1 Don't Know/Not Sure

35. Have you identified the safest location in your home to ride out a strong hurricane if you had to?

1 Yes
2 No
9 Don't Know/Not Sure

36. Do you have any kind of window protection such as storm shutters, security film, or plywood sheets designed to protect the windows during a strong hurricane?

1 Yes **(GO TO Q36B)**
2 No **(SKIP TO Q37)**
9 Don't Know/Not Sure **(SKIP TO Q38)**

36b. What kind of protection is it?

1 Permanent roll-down metal panels
2 Removable metal panels
3 Plywood sheets
4 Security Film
5 Impact-resistant glass
6 Other
9 Don't Know/Not Sure **(SKIP TO Q38)**

IF ANSWERING Q36B, SKIP TO Q38

37. If not, why not? **(CATEGORIZE)**
   1 Don't need it
   2 Too expensive
   3 Don't think it works
   4 Don't have enough time to do it
   5 Other (specify) _____
   9 Don't know

38. About how much do you think window protection such as storm shutters would cost per window? **(PAUSE - READ IF NECESSARY)**
   1 Under $10
   2 $10 to $50
   3 $50 to $100
   4 $100 to $200
   5 $200 to $500
   6 Over $500
   9 Don't Know/Not Sure

39. Do you believe window protection like that would mainly just prevent the windows from breaking and reduc the danger of flying glass, or do you believe they would also significantly reduce the total damage your hous would suffer in other ways?
   1 Mainly Windows
   2 Total Damage Also
   9 Don't Know/Not Sure

40. Other than window protection, what permanent improvements, if any, have you made to your home to reduc the damage to your property in a hurricane? **(CATEGORIZE) (PROBE UP TO 2)**
   a 0/1 Roof/truss Strengthening
   b 0/1 Door/Garage Door Protection
   c 0/1 Flood proofing
   d 0/1 Other (Specify)_____
   e 0/1 None
   f 0/1 Don't Know/Not Sure

41. Is your home or building elevated on pilings or fill material to raise it above flood water?
   1 Yes
   2 No
   9 Don't Know/Not Sure

42. How much money do you plan to spend **this year** on changes to your home to make it stronger or safer fro hurricanes? **(999=DK)**
   $_____

43. If your homeowners insurance company offered to reduce the price of your insurance premium by 15% if yo were to make your home stronger by installing permanent window protection such as storm shutters, would yo be willing to it?
   (IF NO, PROBE WHY NOT)

   1 Yes
   2 No, already have window protection
   3 No, would cost more than it saved
   4 No, would look unattractive
   5 No, don't need them in this area
   6 No, don't own home
   7 No, other
   8 Depends on Cost/Savings
   9 Don't Know

43a. What was the most damage, in dollars, you've ever experienced to your property as the result of a hurricane?

1 None
2 Less than $1,000
3 $1,000 to $4,999
4 $5,000 to $9,999
5 $10,000 to $24,999
6 $25,000 to $49,999
7 $50,000 or more
8 Don't Know/Refused

NOW WE HAVE JUST A FEW MORE QUESTIONS FOR BACKGROUND PURPOSES ONLY.

44. Which of the following types of structures do you live in? Do you live in a: **(READ)**

1 Detached single family home?
2 Duplex, triplex, quadruple home?
3 Multi-family building -- 4 stories or less? (Apartment/condo)
4 Multi-family building -- more than 4 stories (Apartment/condo)
5 Mobile home
6 Some other type of structure
9 Don't Know
10 Refused

45. How old were you on your last birthday?

___ Number of years **(99 = DK)** (88=REFUSED)

46. How long have you lived in your present home? **(ROUND UP) (99 = DK)** (88=REFUSED)

___ Number of years

47. How long have you lived in the Tampa Bay Region? **(ROUND UP) (99 = DK)**(88=REFUSED)

___ Number of years

48. How many people live in your household, including yourself? **(99 = DK)** (88=REFUSED)

___ Number of people **(IF 1, SKIP TO Q60)**

49. How many of these are children, 17 or younger? **(99 = DK)** (88=REFUSED)

___ Number of children

50. Do you own your home or rent?

1 Own
2 Rent
3 Other

51. Do you have any pets?

1 Yes
2 No
9 Refused

52. Which race or ethnic background best describes you? **(READ)**

1 African American or Black
2 Asian
3 Caucasian or White
4 Hispanic

5 American Indian
6 Other _____
9 Refused

53. Which of the following ranges best describes your total household income for 1996? **(READ)**
1 Less than $12,000
2 $12,000 to $24,999
3 $25,000 to $39,999
4 $40,000 to $79,999
5 Over $80,000
9 Refused

54. Which category best describes your education level?
1 Some high school
2 High school graduate
3 Some college
4 College graduate
5 Post graduate
9 Refused

Thank you so much. Sometimes my supervisor will call people to check on my work. May I get your first name in case she wants to check?

54. _____

RECORD INTERVIEW INFORMATION ON RESPONDENT DISPOSITION SHEET

55. Sex of respondent 1 Male 2 Female
56. Interviewer ID _____
57. Date of survey _____
58. Phone number _____
59. Risk Zone _____ 1 = High Risk, 2= Moderate Risk, 3=Low Risk
60. State 1 = Florida
2 = Alabama
3 = Mississippi
4 = Louisiana

61. County or Parish (Louisiana)

1 = Monroe, Florida
2 = Bay, Florida
3 = Okaloosa, Florida
4 = Escambia, Florida
5 = Baldwin, Alabama
6 = Mobile, Alabama
7 = Jackson, Mississippi
8 = Harrison, Mississippi
9 = Hancock, Mississippi
10 = Jefferson, Louisiana
11 = Orleans, Louisisana