Hurricane Lili Post Storm Assessment

With effects from Tropical Storm Isidore

Review of Hurricane Evacuation Studies
Utilization and Information Dissemination

December 2003

US ARMY
CORPS OF ENGINEERS

NOAA

U.S. DEPARTMENT OF HOMELAND SECURITY

FEMA

Assistance Provided By

PBS&J

HURRICANE LILI
POST–STORM
ASSESSMENT
With Effects from Tropical Storm Isidore

Review of Hurricane Evacuation Studies Utilization And Information Dissemination

Prepared for

U.S. Army Corps of Engineers
New Orleans District
And
Federal Emergency Management Agency
Region IV and VI

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List of Acronyms and Abbreviations*

ARC	American Red Cross
DEM	Department of Emergency Management
DHS	Department of Homeland Security
DNR	Department of Natural Resources
DOT	Department of Transportation
ELT	Evacuation Liaison Team
EOC	Emergency Operations Center
ESF	Emergency Support Function
ETIS	Evacuation Traffic Information System
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
GPS	Global Positioning System
HES	Hurricane Evacuation Study
HLT	Hurricane Liaison Team
HURREVAC	HURRicane EVACuation program used via computers
ICCOH	Interagency Coordination Committee on Hurricanes
ITS	Intelligent Transportation Systems
LIDAR	Light Identification and Detection and Ranging
LUMCON	Louisiana Universities Marine Consortium
MEOWs	Maximum Envelope of Water (aka Maximum Envelope of Winds)
MOMs	Maximums of Maximums
NAD	North American Datum
NAVD	North American Vertical Datum
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PBS&J	Post, Buckley, Schuh and Jernigan, Inc.
ROC	Regional Operations Center
SLOSH	Sea, Lake and Overland Surge from Hurricanes
TPC	Tropical Prediction Center
USACE	United States Army Corps of Engineers

*This is a partial listing and contains only the most commonly used

Executive Summary

On Thursday, the 26th of September 2002, Tropical Storm Isidore came ashore at Grand Isle, Louisiana. One week later Hurricane Lili came ashore in Vermilion Parish, Louisiana. Although Lili was just a category 1 hurricane at landfall, it had been a powerful category 4 hurricane just 13 hours earlier. Lili was the first hurricane to make landfall in the United States since 1999. Combined insured property damage from both storms was estimated in excess of $1 billion.

In the United States, there were 4 direct fatalities from Tropical Storm Isidore and none from Hurricane Lili. Mexico recorded two indirect deaths from Tropical Storm Isidore. Hurricane Lili caused major damage and significant casualties (at least 13 direct fatalities) throughout the Windward Islands, Jamaica, Haiti, the Cayman Islands and Cuba. Both storms had a history and characteristics that could have changed direction and intensity with little notice thus causing more havoc than they did.

For Tropical Storm Isidore, rainfall amounts were as high as 9 inches in Florida and 7 inches in Louisiana. Isidore's highest storm surge reported along the U. S. coast was 8.3 feet and occurred at Rigoletes, Louisiana and Gulfport, Mississippi. Maximum sustained winds associated with Isidore were recorded as 58 mph at Belle Chase Naval Air Station in Louisiana. Hurricane Lili's highest recorded rainfall amount was over 8 inches in some parts of Louisiana. The highest storm surge for Hurricane Lili was over 11 feet recorded in St. Mary Parish, Louisiana.

According to the American Red Cross, there were 347 residences destroyed from Hurricane Lili in Louisiana, over two thirds were mobile homes. In addition, 2,495 residences suffered major damage and 7,037 had minor damage.

Federal and state emergency management officials estimated that 500,000 people were under some kind of evacuation directive along the Gulf of Mexico coast for Hurricane Lili. Interviews with local government officials and an evacuation behavioral response survey indicates that approximately 40-56% of the residents in various evacuation zones left their homes to go someplace safer. Less than 10% of the evacuees went to evacuation shelters

For Tropical Storm Isidore, approximately 3,500 people went to 32 hurricane evacuation shelters along the Gulf coast and over 18,000 going to 83 shelters before Lili made landfall. (These figures do not include special needs shelters). The Red Cross provided over a million meals and snacks while the Salvation Army and other volunteer organizations provided an additional 500,000-700,000 meals and snacks.

Prior to Tropical Storm Isidore and Hurricane Lili, U. S. Army Corps of Engineers (USACE) comprehensive hurricane evacuation studies had been done for Louisiana and Mississippi. No USACE study had been developed for Texas, however the Texas Division of Emergency Management conducted Hurricane Evacuation Studies with Texas A&M. In 2003, the State converted to the USACE Evacuation Study Program. With earlier completed studies in hand, Tropical Storm Isidore and Hurricane Lili provided an opportunity to answer several key questions regarding these major Federal Emergency Management Agency (FEMA)/USACE planning efforts:

- Did federal, state and local officials use the products from these 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?

Study teams comprised of representatives from FEMA, USACE, and the contractor Post, Buckley, Schuh & Jernigan, Inc (PBS&J). visited with local and state officials throughout the directly threatened areas of Louisiana, Alabama, Florida, Mississippi, and Texas.

Interviews and analysis conducted during the post storm assessment revealed the following:

- Modest evacuation participation rates on the part of the permanent population
- Few traffic problems were reported
- Lack of significant traffic problems indicates that local and state officials started the evacuation in a timely manner

- Traffic control actions were appropriate and effective
- Participation rates were much less than the 100% rates used in calculations
- Shelter usage was low throughout the risk and host areas (although high occupancy for some shelters in east Texas that accommodated both Texas and Louisiana)

State and local officials are anxious for remaining study products to be finalized and delivered. Most were very pleased with the HURREVAC program. Many parishes and counties felt the inland wind speeds were underestimated in the HURREVAC program. Some people interviewed requested that surge maps reflect coastal erosion that has taken place in some areas. Attention needs to be given to evacuation zone delineations.

Note: The National Hurricane Center, Tropical Prediction Center, maintains a web page devoted to hurricane names. On this web page is a notation stating that the name Lili was retired after the 2002 season. The authority for retiring and replacing a name rests with the World Meteorological Organization's Regional Association-IV. It did not retire Lili at last year's annual meeting (because the replacement name preferred was found then to have been used previously), but is expected to do so during their Spring 2004 meeting.

The following are the major recommendations from this post-Tropical Storm Isidore and post-Hurricane Lili effort. ***Note: The recommendations are addressed directly and indirectly in one or several of the chapters of this report.***

1. Issue: Risk Communication/Public Information

   State and local officials are concerned that many people are still not taking appropriate protective actions, including evacuation in a timely manner, despite a relatively high level of hurricane vulnerability and hurricane history.

Emergency management agencies and other organizations in the coastal areas should update and expand public education campaigns with materials (e.g., color-coded risk maps, evacuation zones) and include descriptions of the "catastrophic" consequences of a major land-falling hurricane.

2. Issue: Map development and standardization

Risk maps tend to vary in format and quality state to state depending on the latest technology and preferred methodology used at the time of the product development.

ICCOH (Interagency Coordinating Committee on Hurricanes) should form a task group to develop a document for guidance on recommended formats and the best methods of securing and updating data for hurricane risk maps from sources such as LIDAR, various GIS programs and FEMA's Map Modernization program.

3. Issue: Update Plans

Hurricane study products, exercises and actual events provide valuable information for revision of evacuation and shelter plans.

Emergency managers and other planners should update response plans as needed based on recent hurricane evacuations, latest census data, analyses (behavioral, transportation, etc.) and other sources such as post-storm reports.

4. Issue: Evacuation Route Changes

East-West evacuation routes (such as along I-10) can serve as viable options in some areas to support North-South evacuation routes.

Designated evacuation agencies (state and local emergency management, transportation and law enforcement) should consider East-West routing to compliment North-South routing where appropriate.

5. Issue: Evacuation Zone Maps

State and local authorities in some areas would benefit from guidance for designating evacuation zones and developing evacuation zone maps.

ICCOH should form a task group to provide specific guidance for development of evacuation zones including the process of engaging the proper agencies and providing sample products.

6. Issue: Traffic data during evacuations

State and local authorities cannot effectively manage evacuations in many coastal areas because of severe limitations to monitor traffic flow.

State emergency management and transportation agencies should continue to increase installation of permanent, protected real-time traffic counters and expand use of other Intelligent Transportation Systems (ITS) for traffic management programs such as ETIS (Evacuation Traffic Information System).

7. Issue: Transportation and evacuation data in Texas.

   Texas has existing data and methodologies from its former hurricane study manager and new data and methodologies from its new hurricane study manager (US Army Corps of Engineers-Galveston District).

USACE with Texas DEM (Division of Emergency Management) and Texas DOT conduct a comparative analysis of past, present and new data and methodologies for updating evacuation clearance times and plans.

8. Issue: HURREVAC Update

   The HURREVAC software program is dependent on updated information after completion of a new study or adjustments from the result of an actual event.

Hurricane Study Managers should coordinate with state emergency management agencies to provide the HURREVAC contractor with any changes such as clearance times.

9. Issue: Software training

   More training is needed at the state and local levels on HURREVAC, SLOSH Display and ETIS.

FEMA and the NWS, with the USACE and state agencies, should conduct workshops with the new training packages for HURREVAC, SLOSH Display and ETIS.

10. Issue: Strategic location of hurricane evacuation shelters

    Hurricane evacuation shelters are not always in the most accessible sites along evacuation routes.

State emergency management agencies should revise plans to strategically identify available lodging (hotels, motels) and designate most of the hurricane evacuation shelters along

evacuation routes beginning in the a) most highly impacted traffic areas to b) contiguous areas of thru traffic as well as c) inland "host" areas.

11. Issue: Hurricane Evacuation Shelter Information

    More facilities might be available as safe hurricane evacuation shelters in all areas following inspections and concurrence by the appropriate parties.

Emergency Support Function 6 (Mass Care) agencies at the state and local levels should coordinate with local emergency management agencies to inspect more public buildings as evacuation shelters by use of the ARC 4496 (American Red Cross "Standards for Hurricane Evacuation Shelter Selection) in all areas and seek "exception" approval. State and local ESF 6 organizations and the American Red Cross should add such facilities to the evacuation shelter database including the HURREVAC shelter profile list.

12. Issue: Increased hurricane mitigation of critical facilities

    Some local officials noted that various critical facilities (including some schools as potential shelters) could be disabled from the effects of a major hurricane.

State and local government agencies should apply for federal, state and local building and mitigation (structural and/or non-structural) funds from sources such as the Hazard Mitigation Grant Program (HMPG), Pre-Disaster Mitigation Plans (PDM) and Community Block Grants (CBG) so critical buildings are elevated for floods or retrofitted for wind resistance.

Chapter 1
Introduction

On September 9th, 2002 a tropical wave moved off the coast of Africa. As the wave approached Trinidad and the northern coast of Venezuela the system became reclassified as a tropical depression. This depression then interacted with land and was downgraded to a tropical wave. When the wave encountered the warm waters of the Caribbean Sea it redeveloped and was again reclassified to tropical depression status on September 17th, 2002. Tropical Storm Isidore was named on September 18. Isidore very slowly meandered west-northwest across the Cayman Islands and developed into Hurricane Isidore on September 19. Slow moving Isidore would then pound western Cuba for more than 12 hours. Isidore then moved west and southwest toward the Yucatan Peninsula. Here, Isidore reached its maximum intensity with winds of 125 miles per hour, a category 3 hurricane. For the next 24 to 36 hours Isidore would track over northern Yucatan and weaken into a minimal tropical storm. Isidore moved once again over the water. As it spun over the Gulf of Mexico, circulation expanded once again. This time Isidore would not regain its intensity and made landfall at Grand Isle, Louisiana on September 26th with winds of 63 miles per hour. Isidore produced torrential rainfall amounts over the southeastern United States before moving north where it was absorbed into a frontal zone. Isidore would be responsible for 4 direct deaths in the United States. Overall cost estimates of the damage done in the United States were $330 million. Hardest impacted was Louisiana. Unfortunately the hurricane season was not over for this area.

While Isidore was spinning its path, another tropical wave was moving over the Atlantic Ocean off the coast of Africa on September 16th. On September 21st the wave qualified for tropical depression status. As the system continued and crossed the Windward Islands on September 23rd, it was developing into tropical storm status. The storm then encountered vertical wind shear in the east-central Caribbean and weakened into an open tropical wave. September 27th the system re-acquired a low-level circulation and began slowing moving north around the north coast of Jamaica. The storm would inflict heavy rains on Jamaica for the next three days. Hurricane Lili developed on September 30th as the storm moved west-northwest over Cayman Brac and Little Cayman Islands. The hurricane moved over Cuba on October 1st with wind speeds as high as

104 miles per hour. While Hurricane Lili was centered in the north-central Gulf of Mexico, the storm intensified. Wind speeds would be estimated to be between 100 and 144 miles per hour, with gusts reaching over 155 miles per hour. Hurricane Lili was an extremely dangerous category 4 hurricane as it made it's way northwest towards the Gulf coast of the United States. Then inexplicably during the final 13 hours before landfall in Louisiana, Lili weakened. Landfall occurred October 3rd in Vermilion Parish, Louisiana as a category 1 storm. Lili was the first hurricane to make landfall in the United States since Irene hit Florida in 1999. While Isidore was directly responsible for four deaths, Lili had no direct deaths. The estimate of the damage costs for Hurricane Lili was $860 million. This made the combined dollar damage from the storms in excess of $1 billion. Most of the damage occurred in Louisiana, and prompted President Bush to declare Louisiana eligible for federal assistance (FEMA 1437-DR-LA).

Tropical Storm Isidore and Hurricane Lili caused mass evacuations in Louisiana parishes both coastal and inland. Additional limited evacuations occurred in Texas, Alabama, and Mississippi. The Federal Emergency Management Agency (FEMA) and the U. S. Corps of Engineers (USACE) New Orleans District initiated a post-storm assessment for these two storms. The purpose of the assessment is to analyze the effectiveness of the products provided in hurricane evacuations studies; which products were most useful and which were least useful; and what improvements could be made to current methodologies and products to assist during the next evacuation event. FEMA, the USACE and the National Weather Service jointly fund these studies and their associated work products. The assessment is used to determine if the data and products are useful and accurate.

Data was collected for each of the following technical areas:

- Hazards – High water mark data versus SLOSH model data; actual storm surge versus predicted; data concerning inland flooding, tornadoes, rainfall amounts
- Evacuation Decision Making – Evaluate usefulness of FEMA/USACE products in the decision-making process; determine when EOCs were activated and how long they were active; determine when and how evacuation orders were issued
- Transportation – Compare actual traffic accounts (when available) to study predictions; evaluate usefulness of the Evacuation Traffic Information System (ETIS) and the Evacuation Liaison Team (ELT)

in this event; assess effect of railroad traffic on evacuating vehicular traffic

- Sheltering – Data on shelter space actually available during Isidore and Lili compared to shelter estimates from FEMA/USACE studies
- Public Information – To what extent was public information released and was the message disseminated clearly and understood by the public

A behavioral component of the post storm assessment process is located in Appendix C. This data is collected via telephone surveys to randomly selected local residents to determine if and why they evacuated or did not evacuate, and then uses this data to compare to predicted behavioral parameters.

To answer these questions, study teams comprised of representatives from FEMA; the USACE and the contractor PBS&J visited with local and state officials throughout the directly impacted areas of Louisiana, Mississippi, Alabama, Florida, and Texas. PBS&J 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 Red Cross personnel were involved in meetings held in each area that responded to both Tropical Storm Isidore and Hurricane Lili. 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 Louisiana and Texas. Telephone interviews were conducted to ascertain actual evacuation

response in Isidore and Lili and to predict evacuation response parameters for the comprehensive hurricane evacuation restudy. The behavioral analysis focused on the actual percent of the affected population that evacuated during Isidore and Lili, when the evacuees left their residence, what sort of refuge evacuees 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 each category of hurricane evacuation study product. The report is chaptered to include each of the following:

(2) Hazards/Vulnerability
(3) Evacuation Decision Making Process
(4) Transportation/Clearance Times
(5) Public Shelter Issues
(6) Public Information

Each chapter describes typical study components and products produced in comprehensive hurricane evacuation studies. The chapter then summarizes actual data related to Tropical Storm Isidore and Hurricane Lili 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.

Finally, the FEMA Hurricane Liaison Team (HLT), with the National Weather Service again successfully coordinated video and audio conference calls with FEMA Headquarters, the FEMA Regional Operation Centers (ROCs) and the state emergency management agencies. In cooperation with the National Hurricane Center, FEMA arranged conference calls to discuss the latest advisories.

The NWS Southern Region supported deployment of NWS staff to the ROCs and state Emergency Operations Centers (EOCs). The Louisiana Office of Emergency Preparedness, Texas Division of Emergency Management, Mississippi Emergency Management Agency, Alabama Emergency Management and Florida Division of Emergency Management participated in those calls. The states in turn conducted their own conference calls with state and local government agencies to discuss the forecasts and consider appropriate response actions. Many

local government representatives interviewed for this report commended FEMA, NWS and state emergency management for the improved conference call systems that took place. The states also took advantage of our resources from universities including LSU at the EOC in Baton Rouge and the University of Texas at the state EOC in Austin.

The program utilized most frequently by local and state emergency managers for hurricane tracking and decision-making is HURREVAC. The figures1-1 and 1-2 are screen captures taken from the HURREVAC program for Tropical Storm Isidore and Hurricane Lili.

Figure 1-1 - HURREVAC - Tropical Storm Isidore

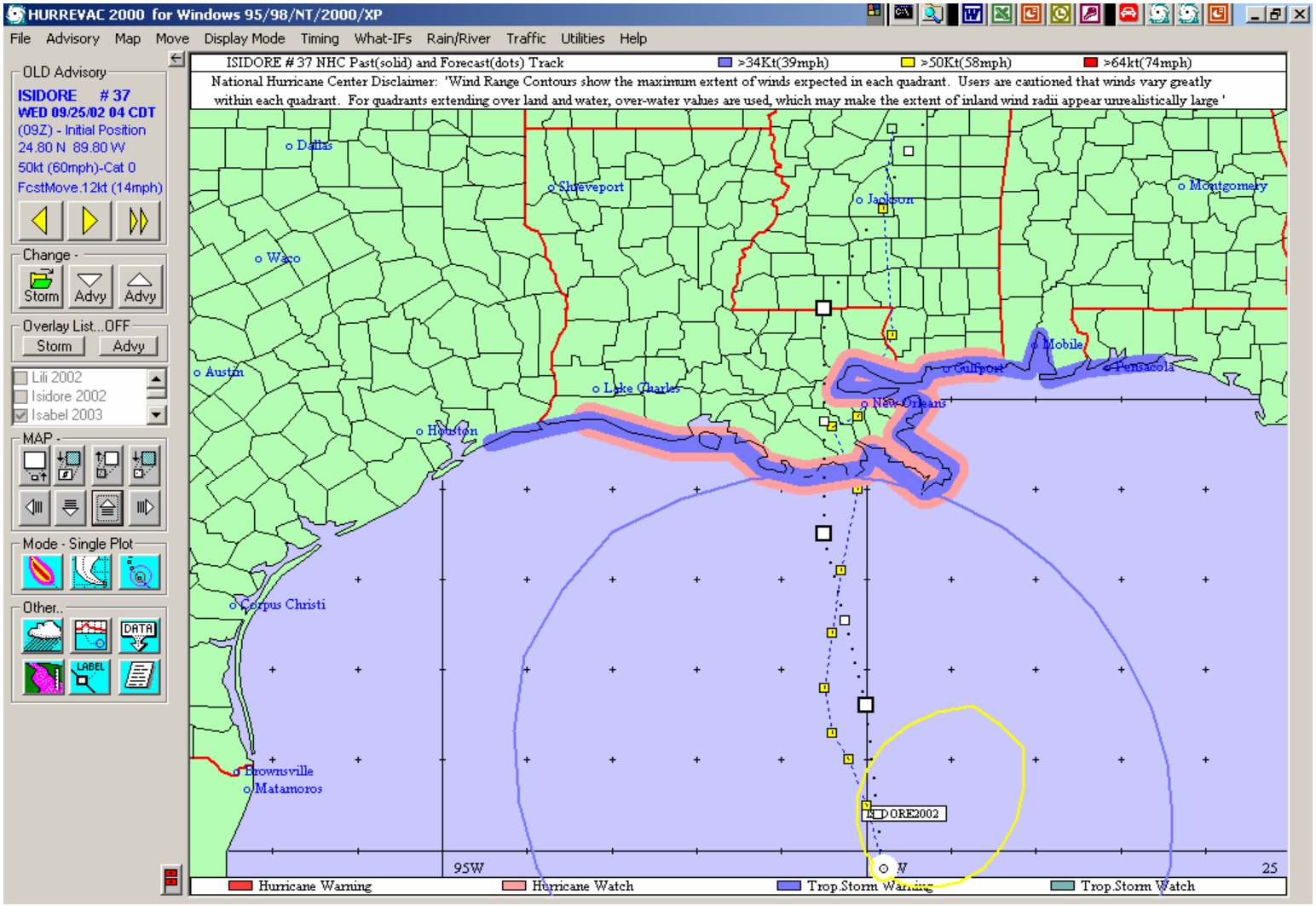
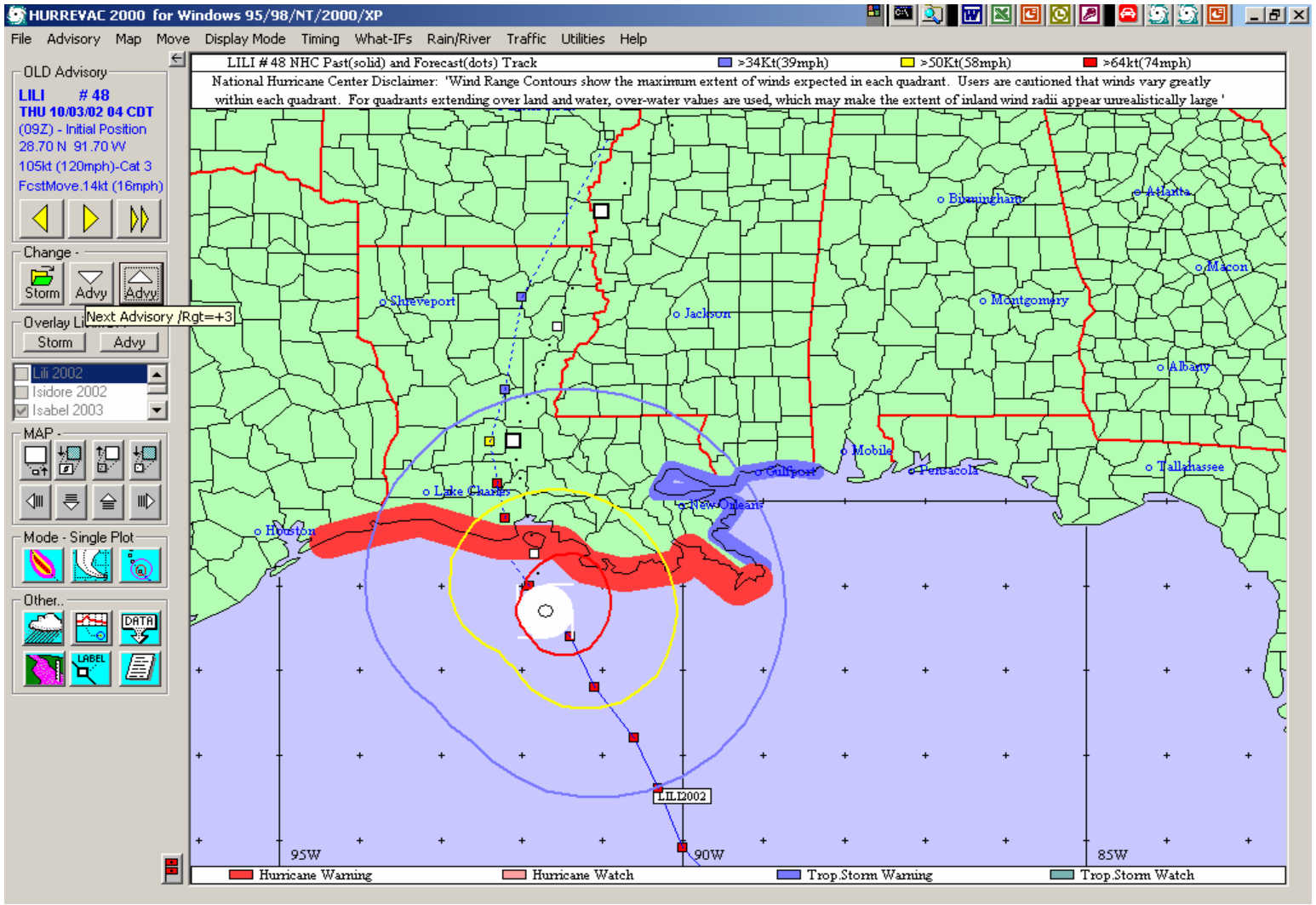


Figure 1-2 - HURREVAC – Hurricane Lili



Alabama Meeting - State Emergency Management

Louisiana State Emergency Management Office

Hancock County Mississippi

Texas – Galveston Emergency Management Office

Chapter 2
Hazards/Vulnerability

In FEMA/USACE comprehensive hurricane evacuation studies, the primary objective of the hazards analysis is to determine the probable worst-case effects for the various intensities of hurricanes that could strike an area. Recent studies completed include the following:

- Southeast Louisiana HES
- Southwest Louisiana HES
- Texas HES (Sabine and Valley Study Areas)
- Mississippi HES
- Bi-State (Louisiana and Mississippi) HES (being completed)

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 Service's 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 restudies that are ongoing in many coastal states. An example of a storm surge map can be seen in Figure 2-7, on page 2-10.

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 Isidore and Lili that were discussed with local and state officials included the following:

- What technical data/mapping was used to choose the areas to evacuate?
- Did the technical data provide a good depiction of the hazard area?

A high water mark survey for Hurricane Lili was conducted by Taylor Engineering, Inc. under contract to the FEMA Region VI, along with the surveying company, T. Baker Smith and Sons,

Inc. These firms gathered and prepared the data and then transmitted it to the National Hurricane Center for comparison with the SLOSH model. The survey was conducted from just west of Pecan Island, Louisiana to Burns Point, Louisiana. It included high water marks not only along the coastline but inland as well, where the storm tide penetrated. The highest recorded storm surge for Lili was over 11 feet at a location in St. Mary Parish, Louisiana. The following narrative and figures, provided by the National Hurricane Center, show a comparison between the observed storm tide high water marks and the SLOSH model calculated storm tide profile along the Louisiana coastline for Hurricane Lili.

Comparisons of observed and SLOSH model storm tide elevations for Hurricane Lili (Oct. 2002) provided courtesy of the Tropical Prediction Center, National Hurricane Center

The Storm Surge Group
TPC/NHC

Hurricane Lili made landfall on the Central Louisiana coastline on 3 October 2002, as a category 1 hurricane on the Saffir/Simpson scale. Lili caused storm tide flooding of two feet or greater from Pecan Island, Louisiana eastward to near Pensacola, Florida. A description of the complete history of hurricane Lili is given in a preliminary report available on the Tropical Prediction Center/National Hurricane Center web site (www.nhc.noaa.gov) under the title Hurricane History, sub title TPC Archives.

Figure 2-1 shows the landfall location and direction of hurricane Lili along the Louisiana coast.

A high water mark survey was conducted by Taylor Engineering, Inc., under contract to the FEMA. The survey was conducted from just west of Pecan Island, LA to Burns Point, LA. The survey not only included high water marks near the shoreline but inland as well, where the storm tide penetrated. In addition, numerous tide gauge maximums were collected from various agencies. These include the U.S. Army Corps of Engineers, U.S. Geological Survey, National Ocean Service, levee boards and the Louisiana Universities Marine Consortium. The surveyed high water marks and tide gauges all have various reference data. All of them were converted, if necessary, to the National Geodetic Vertical Datum of 1929 so that a direct comparison could be made to the storm tide values from the SLOSH model.

Figure 2-2 is a coastal profile, drawn from the plotted observed high water mark values and tide gauge maximums, from Pecan Island to Grand Isle LA (labeled west of the Mississippi River) and then from the Industrial Canal in New Orleans to Dauphin Island, Alabama (labeled east of the Mississippi River). Lili's track is highlighted in this figure as well as the two wind maximums. Note that the coastal profile plot does not include the inland inundation values...just those values that were near the coast. Also, the values given for

Cypremort Point and Burns Point represent an average of several observations. The profile shows that the maximum values west of the Mississippi River occurred from about Cypermort Point to Atchafalaya Bay. Also, because of the secondary wind maximum the wind field east of the Mississippi River was strong enough to generate significant surges along the Louisiana and Mississippi coastlines.

Figure 2-3 shows a comparison of the observed and SLOSH model storm tide derived coastal profiles. Reasonable agreement is seen west of the Mississippi River and excellent agreement occurs east of the River. The differences between the observed and SLOSH model values are typical and are similar to comparisons made in other storms in other locations along the U. S. coastlines.

Figures 2-4, 2-5 and 2-6 represent comparisons between observed tide gauge hydrographs at selected locations and the SLOSH model calculated hydrograph for that same location. The LUMCON Marine Center and Golden Meadow South hydrograph maximums are shown in figure 2-2. However, the Morgan City hydrograph is inland from the coast and its maximum was not plotted in figure 2-2. Over all the results are reasonable with some discrepancies in the phasing of the SLOSH hydrographs.

In summary, comparisons between observed high water marks, tide gauge maximums and selected tide gauge hydrographs and SLOSH model calculated maximums and hydrographs are reasonable and within the normal error range.

Appendix B is the data from the Tropical Cyclone Report prepared by the National Hurricane Center. This includes the "Best Track" positions for Hurricane Lili, including positions, barometric pressure, wind speed, and storm classification by date. Also included is the "Best Track" position for Tropical Storm Isidore. 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 Lili.

Figure 2-1

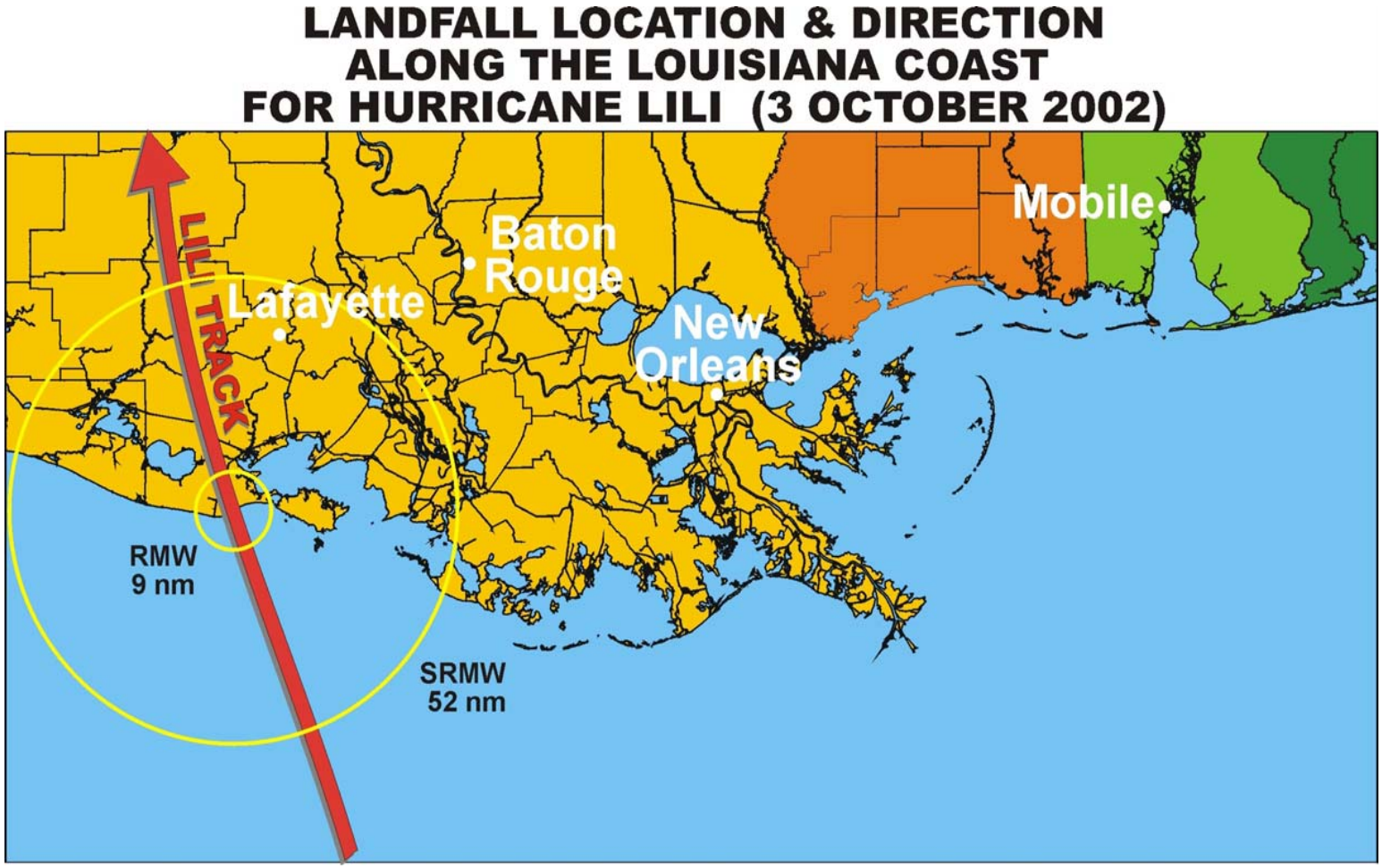


Figure provided courtesy of Tropical Prediction Center/National Hurricane Center and NOAA

Figure 2-2

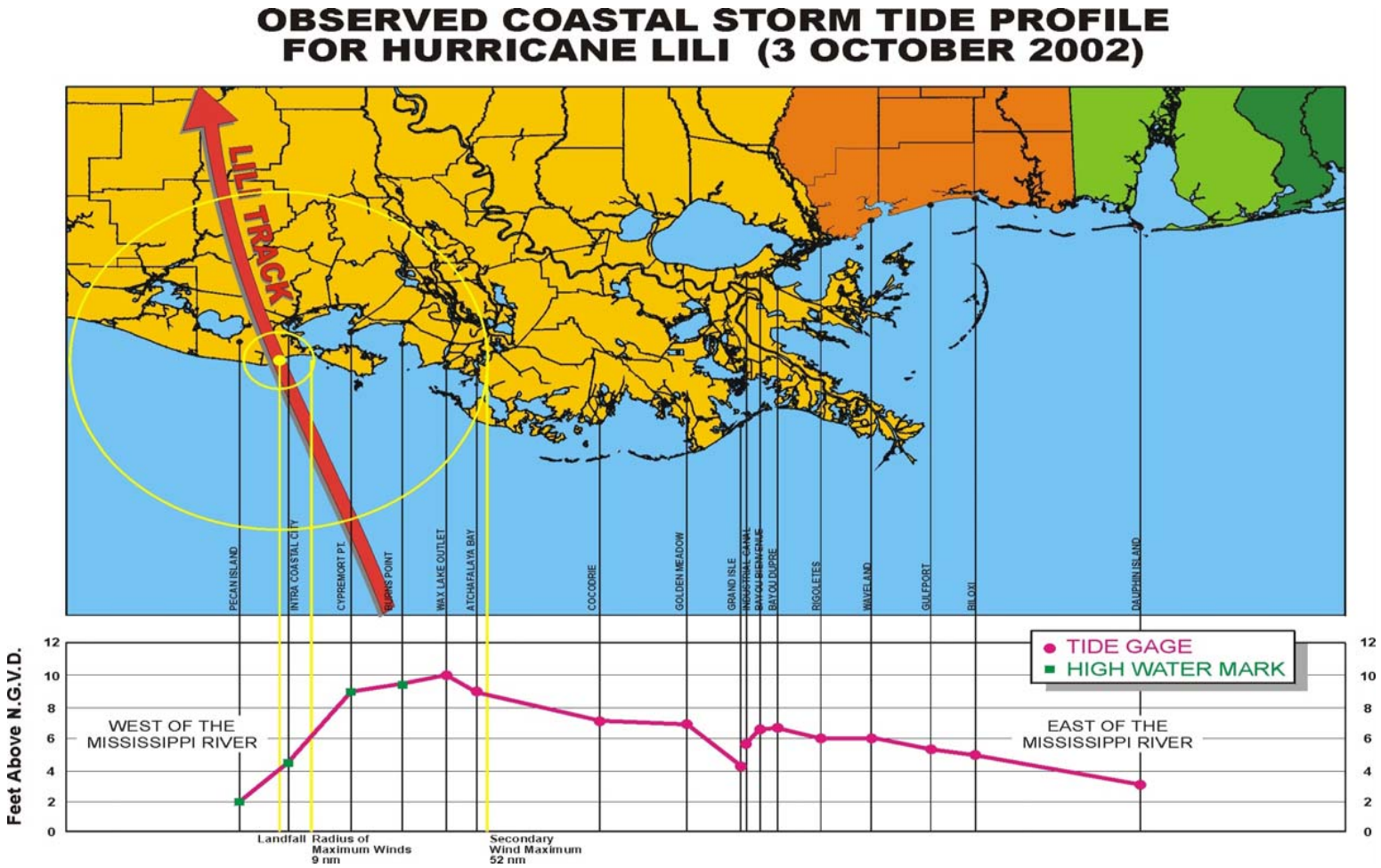


Figure provided courtesy of Tropical Prediction Center/National Hurricane Center and NOAA

Figure 2-3

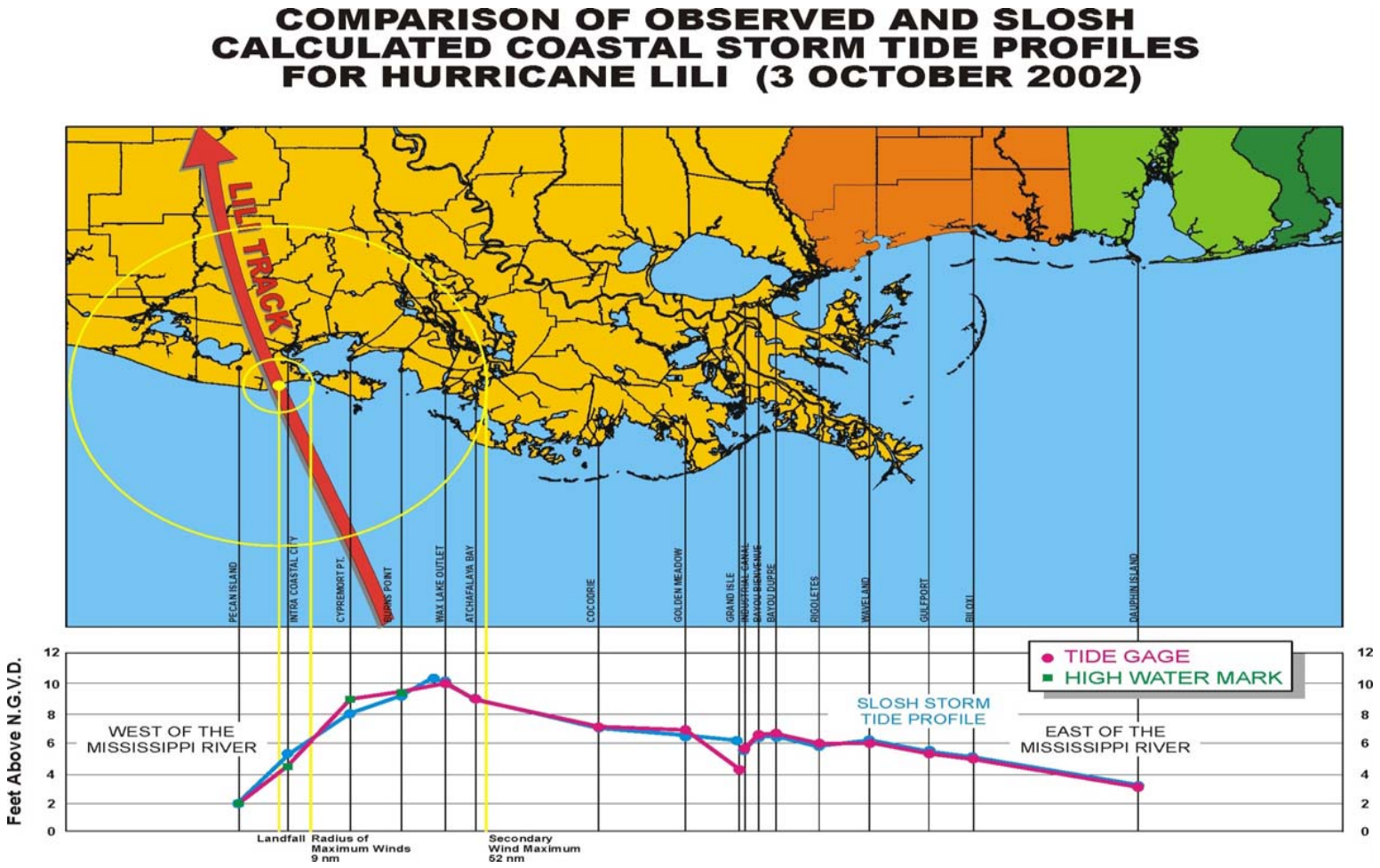


Figure provided courtesy of Tropical Prediction Center/National Hurricane Center and NOAA

Figure 2-4

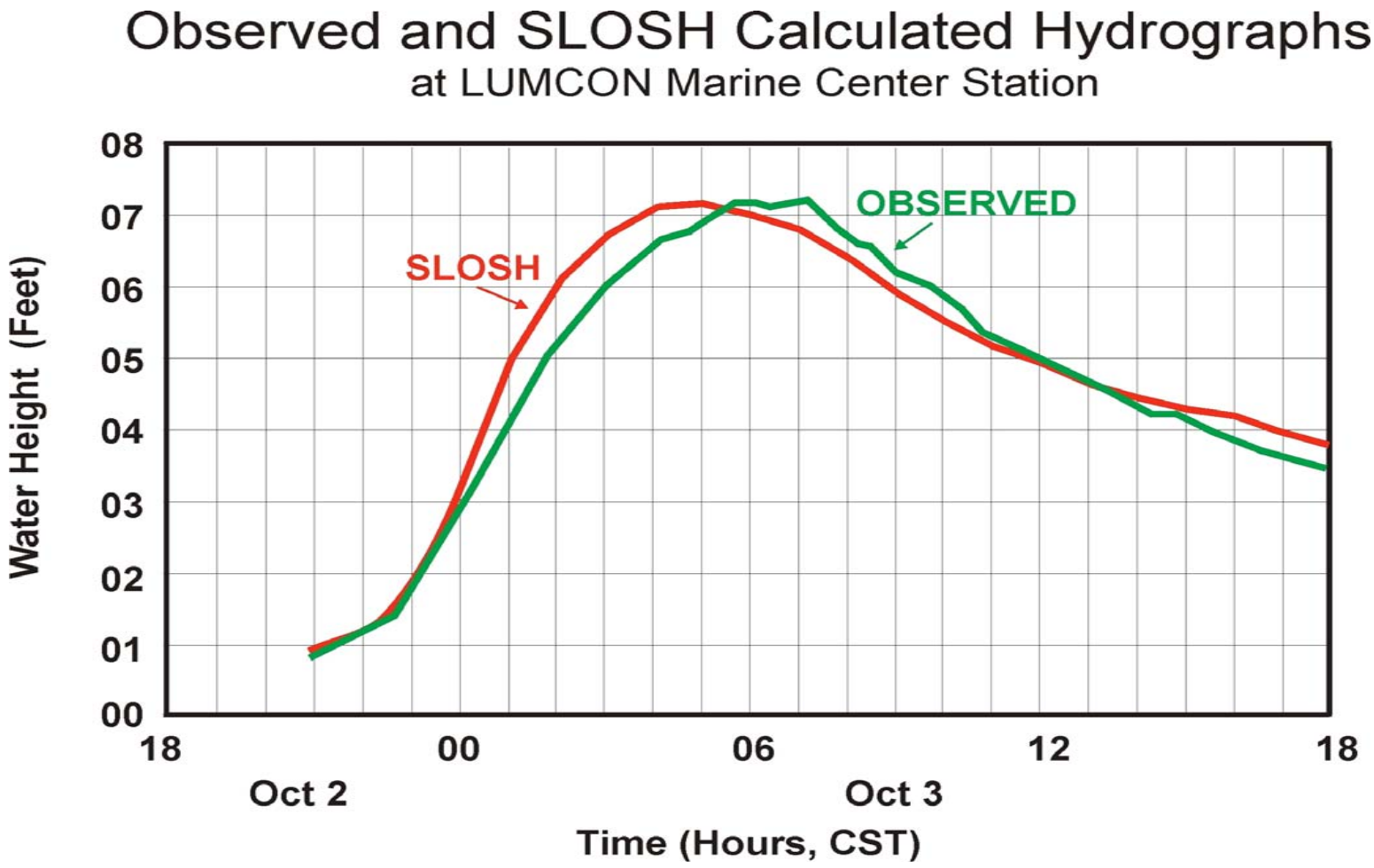


Figure provided courtesy of Tropical Prediction Center/National Hurricane Center and NOAA

Figure 2-5

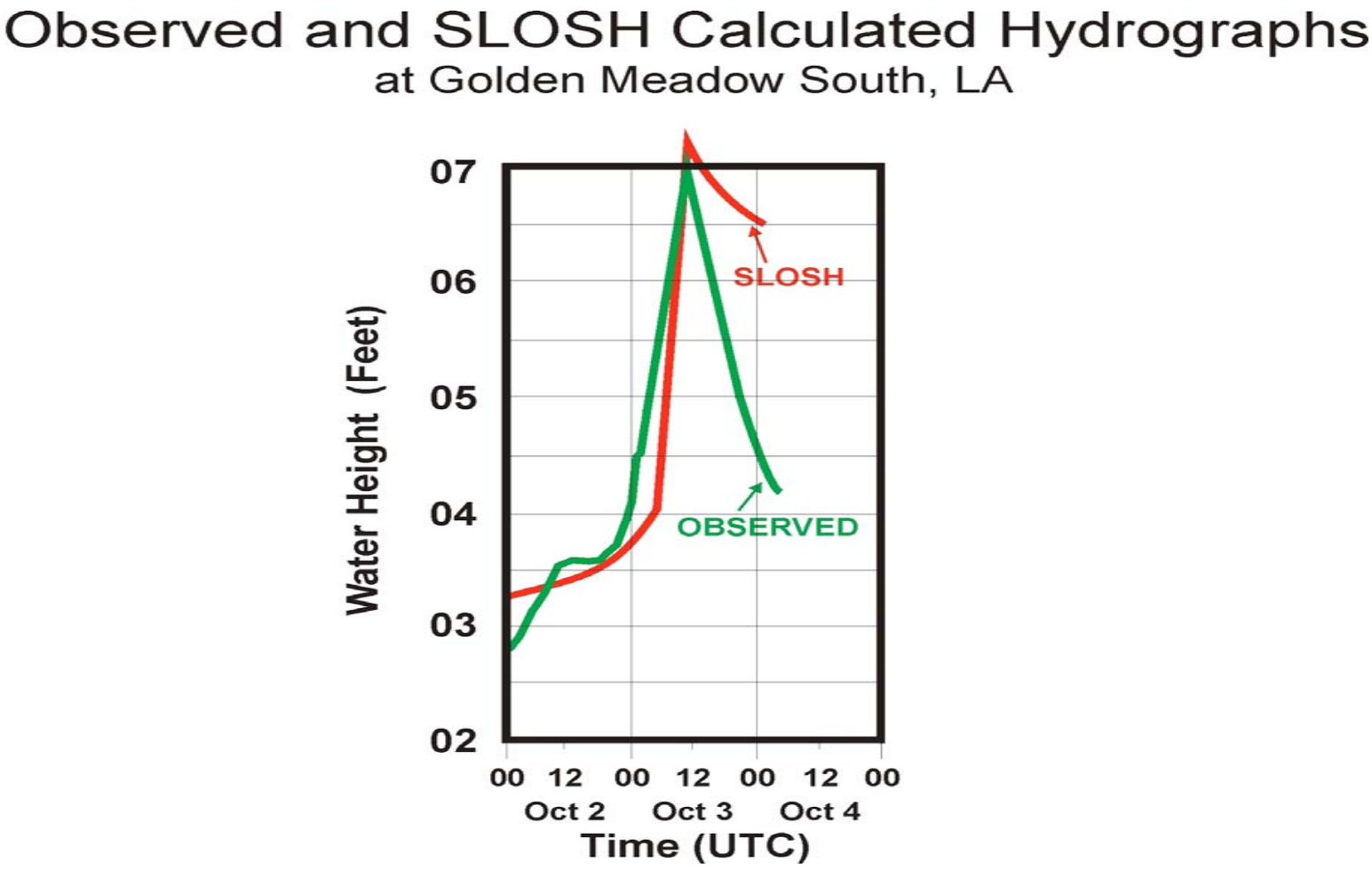


Figure provided courtesy of Tropical Prediction Center/National Hurricane Center and NOAA

Figure 2-6

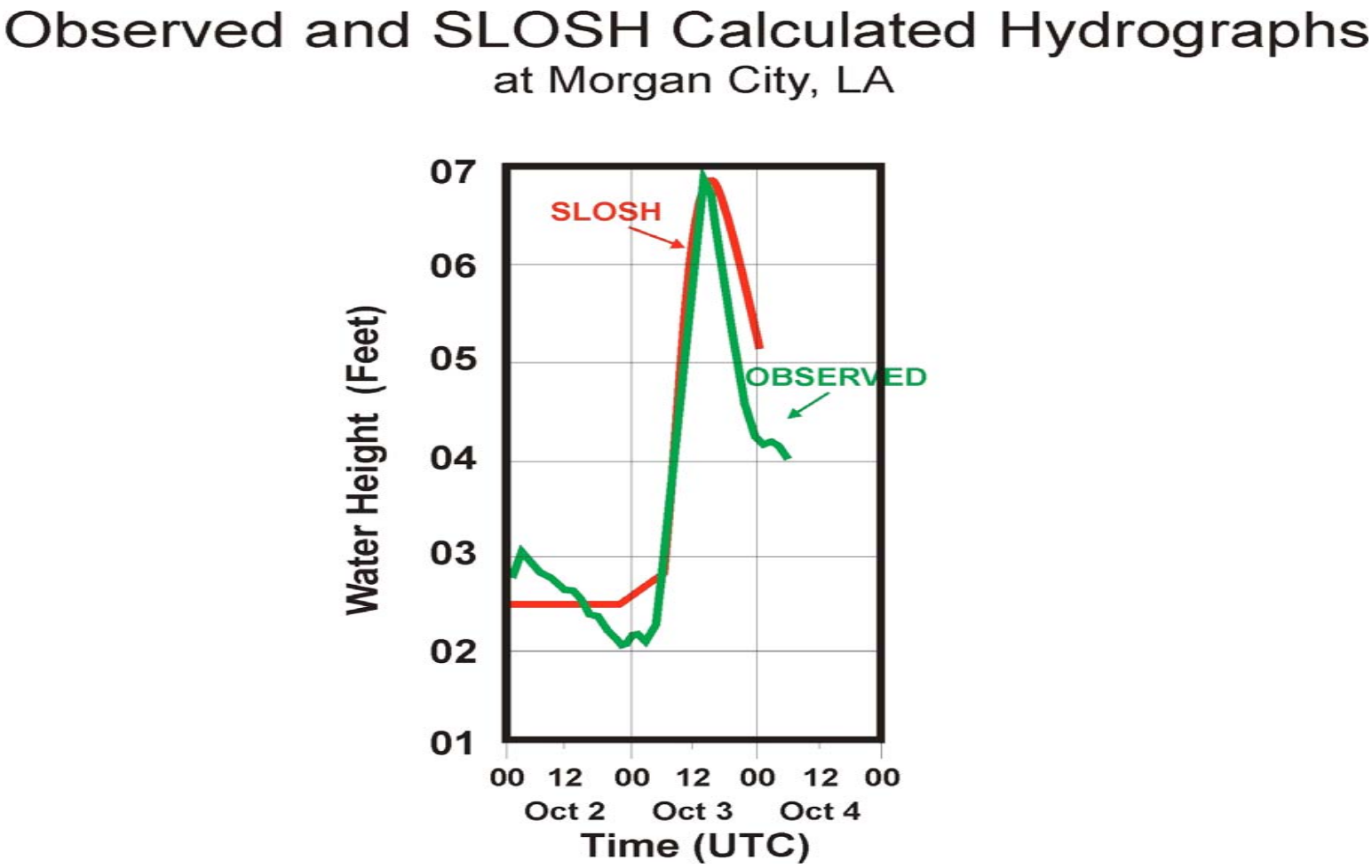
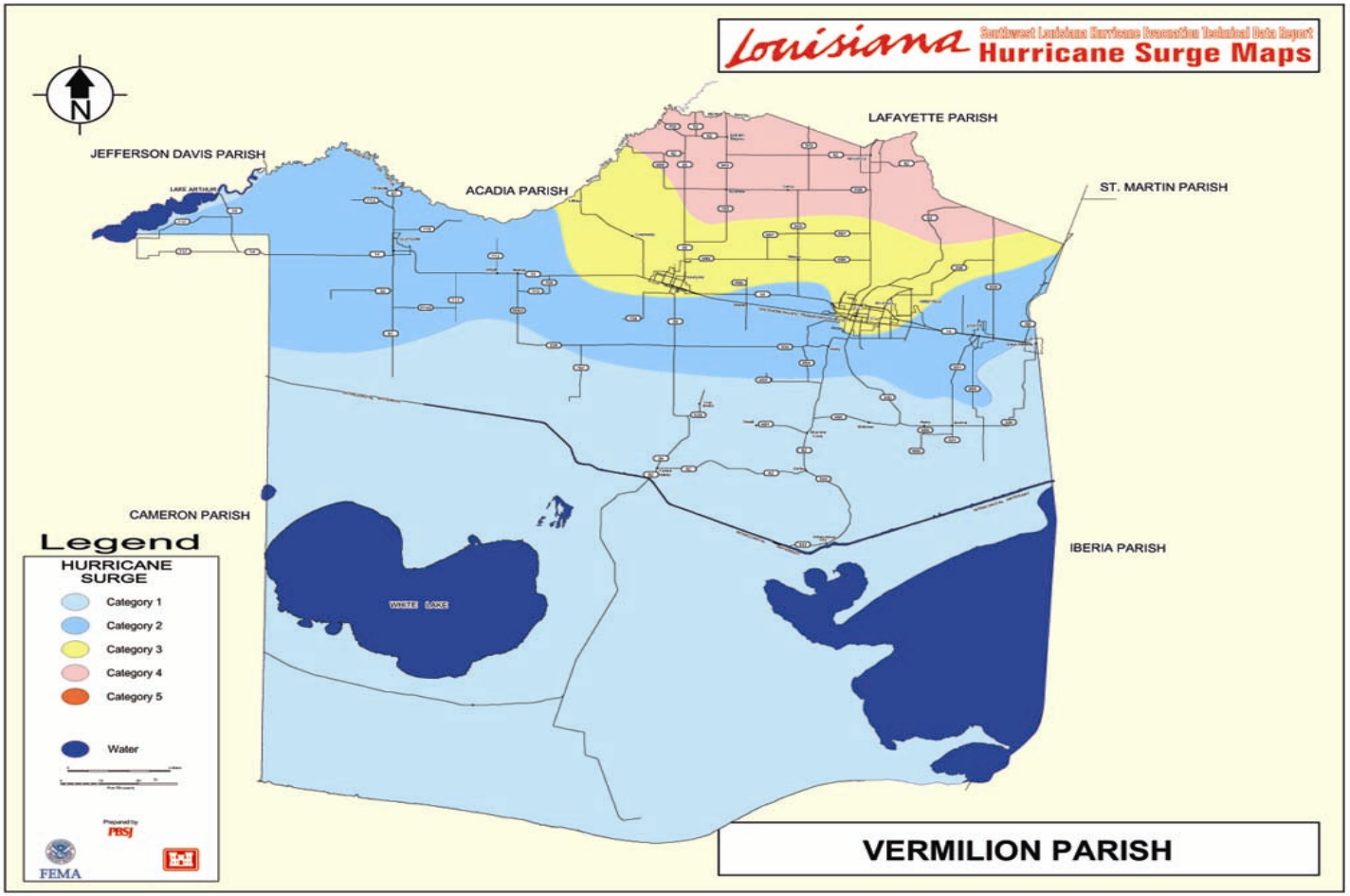


Figure provided courtesy of Tropical Prediction Center/National Hurricane Center and NOAA

Figure 2-7

Sample Surge Mapping

(NOTE: Colors should be standardized)



NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) maintains a network of tide gauges along the Gulf Coast from Brownsville, Texas to Key West, Florida. During hurricane season, CO-OPS maintain and monitor these gauges providing information regarding water levels along the coastline during storm events. Table 2-1 summarizes peak observed, predicted and storm surge water levels for five of these gauges. The data was calculated from six-minute acoustic data referenced to Mean Lower Low Water (MLLW).

Table 2-1 - Tide Gauge Data

Tide Gauge Location	Date/Time (GMT)	Elevation above MLLW (ft)		Storm Surge (ft)	Latitude	Longitude
		Observed	Predicted			
Mobile Channel, AL	10/03/02 17:30	4.19	1.79	2.40	30° 42.5' N	88° 2.6' W
Pilot Station SW Pass, LA	10/03/02 12:06	4.34	1.70	2.64	28° 55.6' N	89° 25.1' W
Grand Isle, LA	10/03/02 12:48	4.48	1.45	3.03	29° 15.8' N	89° 57.4' W
Lake Charles, LA	10/04/02 23:24	2.69	1.21	1.48	30° 13.5' N	93° 20.6' W
East Jetty Calcasieu Pass, LA	10/03/02 17:18	3.51	1.79	1.72	29° 45.9' N	93° 20.6' W

*Data taken from Taylor Engineering, Inc. Hurricane Lili Coastal High Water Mark Collection Report

The United States Geological Survey (USGS) provided the real-time water surface elevation information. Mobile Channel and Grand Isle gauges are referenced to NAVD88 heights based on benchmark data. The others have no benchmark data to establish NAVD referenced heights.

As part of the survey of high water marks, 40 points were surveyed in Iberia, St. Mary and Vermilion Parishes. Table 2-2 presents this data showing three points in Iberia Parish, four points in Vermilion Parish and six points in St. Mary Parish.

The following procedure established the horizontal locations and vertical elevations:

1) Transfer High Water Marks, transferred with a convention level, to an offset point, to an easily accessible location
2) Record the elevation of the High Water Mark above general land surface
3) Record the latitude and longitude of the offset point location
4) Use the recently update Department of Natural Resources (DNR) Louisiana Coastal Zone Primary Global Positioning System (GPS) Network for benchmark control. Note: The DNR established this network to overcome problems in elevation datum due to subsidence. This network is the best available benchmark system and provides a consistent benchmark network for the parishes surveyed.
   (a) Horizontal Datum: North American Datum of 1983 (NAD83)[1] State Plane Louisiana South Zone Coordinates
   (b) Vertical Datum: NAVD 88 (The North American Vertical Datum of 1988)[2] (GEOID 99)
5) Survey the elevation with a 4700/5700 GPS Total Station

[1] North American Datum of 1983 (NAD83) is an earth-centered datum based on the Geodetic Reference System of 1980. The size and shape of the earth was determined through measurements made by satellites and other sophisticated electronic equipment; the measurements accurately represent the earth to within two meters.

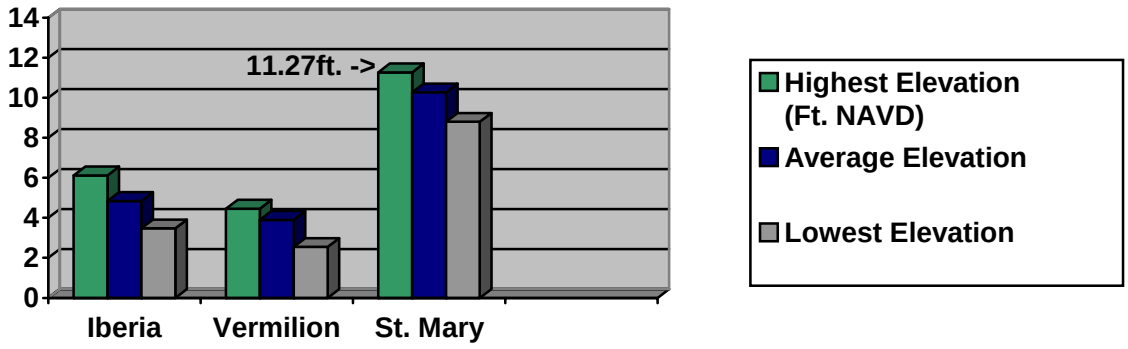
[2] NAVD 88 (The North American Vertical Datum of 1988) is a vertical geodetic datum created in 1991 from measurements in Mexico, the US, and Canada

Table 2-2 – High Water Mark Data

Latitude (NAD 83)	Longitude (NAD 83)	High Water Mark Elevation (FT NAVD)	Natural Grade Elevation (FT NAVD)
Iberia Parish			
29° 56' 30.25"	91° 50' 26.82"	6.12	3.38
29° 56' 14.36"	91° 54' 34.7"	3.47	2.70
29° 54' 17.44"	91° 49' 02.58"	4.93	3.02
Vermilion Parish			
29° 48' 14.60"	92° 08' 17.58"	4.11	1.84
29° 47' 00.27"	92° 09' 44.35"	4.5	1.28
29° 47' 41.96"	92° 08' 32.83"	4.46	2.34
29° 39' 28.11"	92° 31' 13.29"	2.55	0.99
St. Mary Parish			
29° 37' 40.02"	91° 32' 13.82"	10.02	5.50
29° 36' 36.97"	91° 32' 22.41"	11.27	4.70
29° 44' 15.05"	91° 49' 47.38"	8.80	3.21
29° 43' 55.59"	91° 50' 21.09"	10.33	4.22
29° 36' 15.83"	91° 32' 04.51"	10.55	4.86
29° 33' 33.34"	91° 31' 32.69"	10.65	3.46

*Data taken from Taylor Engineering, Inc. Hurricane Lili Coastal High Water Mark Collection Report

High Water Mark Data Graph



Recommendations:

Storm Surge: Many of the areas interviewed for Isidore and Lili are waiting for updated surge mapping. Most should have received it through the recently completed SW Louisiana HES. There is still a wide variety of technology being used to produce the mapping around the country and within the interviewed areas. The various agencies of ICCOH should continue to review past and present methodologies and technologies on a regular basis to determine the most cost-effective and user-friendly formats that state and local agencies should consider. FEMA and other federal and state agencies, including NOAA and the USACE, are securing and incorporating new data from LIDAR (Light Identification and Detection and Ranging) systems to increase as well as improve quality of maps. FEMA's multi-million dollar Map Modernization program should benefit not only floodplain mapping efforts but also storm surge maps. **Storm surge maps are based on SLOSH Models. Maps vary from one study to another based on existing map technology at the time that the Hazards and Vulnerability Analyses were conducted. Maps also vary based on the preference of the customers.** Figure 2-8 shows the predicted maximum envelope of water (MEOW) for Hurricane Lili using the SLOSH Model.

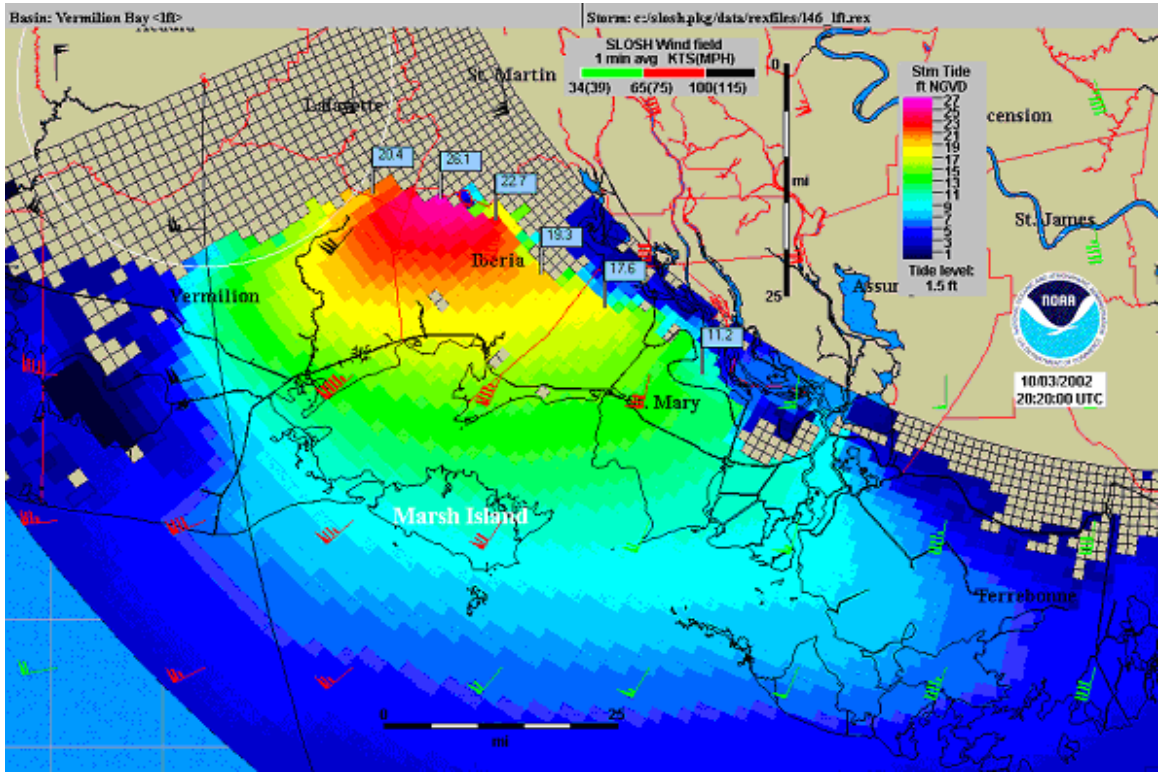
Wind: Additionally, researchers from Clemson University, Louisiana State University, Texas Tech University, University of Florida, University of Oklahoma and the Hurricane Research Division of NOAA collaborated to collect meteorological data from Lili at landfall about maximum sustained winds. Clemson and Florida also collected data for Isidore. These organizations collected data from a variety of surfaces including deployment of mobile teams and instruments. The research revealed that Tropical Storm Isidore made landfall with winds of 63 mph just west of Grand Isle in Jefferson Parish, Louisiana on September 26. Hurricane Lili made landfall farther west near Marsh Island in Iberia Parish on October 3 with maximum sustained winds of 92 miles per hour.

Rain: As usual, hurricanes bring rain but Lili moved very rapidly upon landfall and the highest rainfall was about 9 inches. For more detailed information about wind data from Isidore or Lili, see the following web site. http://www.ce.ufl.edu/~fcmp/pubs/pubs.htm

Figure 2-8

SLOSH MEOW (Maximum Envelope of Water) Run Hurricane Lili

Predicted run based on NHC 72 Hour Forecast Track



Courtesy of: FEMA-Hurricane Liaison Team-National Hurricane Center-Status Report 48

Storm Damage Photos

Oil platform Eugene Island, Louisiana

Flooded road, St. Bernard Parish, Louisiana

Up-rooted exit sign, Acadia Parish, Louisiana

Downed tree, Lafayette Parish, Louisiana

Tree and power pole vs. truck, Louisiana

Overturned mobile home, Vermilion Parish

Chapter 3
Evacuation Decision Making Process

Some of the most important products developed as a part of the FEMA/USACE hurricane evacuation studies and delivered to local and state officials have been evacuation decision-making tools. These tools are (decision arc[1]) maps and tables as well as computer software such as HURREVAC. These products graphically tie together 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/USACE 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?
- What prompted the decision to activate?
- What study products/decision aides were used to decide when to evacuate?
- What study products/decision aides were used to decide who should evacuate?
- Was HURREVAC used?
- When was the evacuation directive issued?

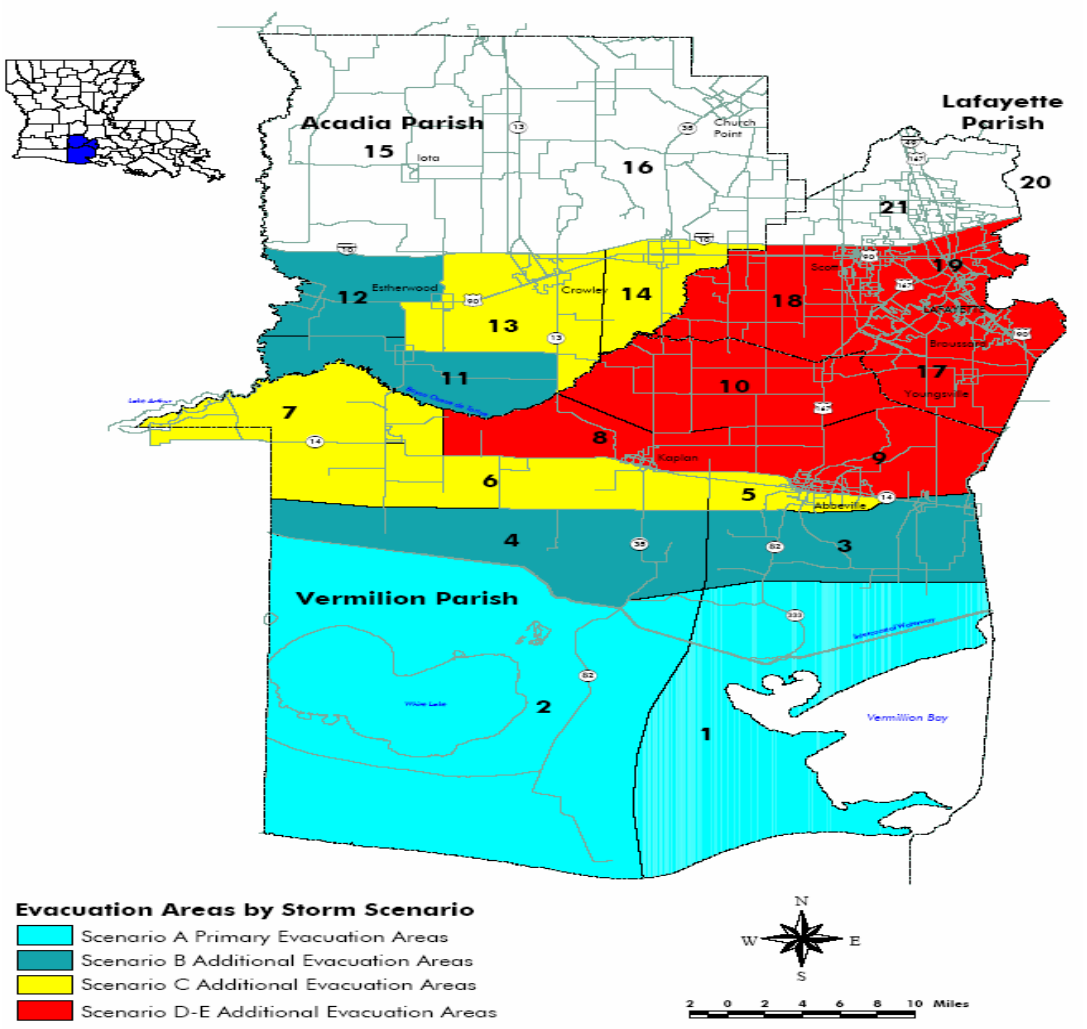
Table 3-1, located at the end of this chapter, provides a summary of the responses and information gathered from each parish and county. In general, most jurisdictions use and are satisfied with the HURREVAC program. Many parishes and counties stated that the HURREVAC program was very reliable but that the inland winds predicted were inaccurate to the actual force of the winds inland. Many parishes and counties also use other commercial tracking programs. Some parishes and counties still use the decision arc systems developed in

[1] A decision arc is an arc drawn a certain distance from the center of a county that shows when an approaching storm reaches an extent to where evacuation should commence for that county.

the old HES studies. Many areas use the evacuation zones developed in the older studies. Most local jurisdictions desire evacuation zone systems that can be easily described over radio and TV to convey to their residents. Additionally SLOSH models and surge maps were consulted in some jurisdictions. Many parishes and counties were still geared up when Lili began to threaten the Unites States because the storm occurred so quickly behind Isidore. Unfortunately this also may have contributed to the lack of response by residents.

Figure 3-1 shows an example of an evacuation zone map.

Figure 3-1



Recommendations:

1. Update clearance time data and incorporate into the HURREVAC program.
2. Conduct extensive training and refresher sessions with emergency managers on the HURREVAC and SLOSH Model Display program.
3. Review evacuation zones for parishes and counties and update if needed.
4. Work with state and locals to refine evacuation zone concepts.

A decision-making meeting in Vermilion Parish, Louisiana.

NOTE: *When Hurricane Lili threatened the US coastline in the Gulf of Mexico it was a category 2 hurricane except for brief interim period in the last few hours of approach when it unexpectedly experienced a dramatic increase of intensification to a category 4 hurricane. Therefore, most of the evacuation decision-making by the various local agencies was based on a less intense storm. At the same time, state and local agencies were considering the forecasted track of the storm, respectful of the possibility that a more eastward track would require a much more complex evacuation scenario because it would have involved the New Orleans area. State officials were coordinating with local governments to assure that evacuees in the "lower" or coastal area parishes had time and a clear roadway to travel out of harm's way.*

As it turned out, Lili experienced a sudden decrease of intensification alleviating the dilemma. In other words, the storm's unexpected peak and valley occurred at a time when it would have been too late to manage a huge evacuation effort of the New Orleans area. State and local officials had enough confidence in the forecast that the track of the storm (and its most severe winds and surge) would continue its track west of the New Orleans area. Evacuation planners must consider the unique circumstances as described above to evaluate Clearance Times and shelter demand.

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
Louisiana					
Acadia	10/1/02 – noon	Weather channel; internet; history	HURREVAC; decision arcs; SLOSH Models	10/1/02 – 4pm voluntary 10/2/02 – 11 am mandatory and recommended – less than 10 % left	Good, but additional training always helpful
Ascension	Yes, time not known	Storm's position	HURREVAC	10/2/02 – noon voluntary, less than 10 % evacuated	Excellent
Assumption	Yes, time not known	Storm	HURREVAC	Not provided	Good; could use additional training on SLOSH Models
Calcasieau	9/31/02 – 9 am	National Weather Service, internet	HURREVAC; SLOSH Models	10/2/02 - 9 am 30% of parish left	SLOSH Models could be more user friendly

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
Iberia	10/2/02 – 9 am	Knowledge of events, NWS	HURREVAC; Decision Arcs; SLOSH; TIDES	10/3/02 – 8 am 60% of population evacuated	SLOSH Models need to address shoreline erosion; inland winds on HURREVAC
Jefferson	Isidore- 9/24/02 8:30 Lili – 10/2/02 - 10 pm	History of storms	HURREVAC; SLOSH	10/2/02 – 9 am	SLOSH Models do not take into account heavy coastline erosion from all the storms in recent years
Jefferson Davis	Yes, time unknown	HURREVAC	HURREVAC; Decision Arcs	10/2/02 – noon Less than 10 % evacuated	Always need for additional training
Lafayette	10/1/02 – 7:30 am	HURRTRAK; HURREVAC	HURREVAC; Decision Arcs; SLOSH; HURRTRAK	10/2/02 – 8 am- voluntary evacuation	Good, SLOSH Models need to be reviewed for coastline issues
Lafourche	Yes, time unknown	Internet, NWS		Mandatory orders given to Golden Meadows	Excellent

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
Orleans	Isidore – 9/24/02 – 8 am Lili – 10/1/02 – 8 am	Recent storm history		No orders given	
Plaquemines	Yes, time unknown		HURREVAC	10/1/02 - 5 pm Voluntary order 10/2/02 – 10 am Mandatory order 3825 people evacuated	Good
St. Bernard	Yes		HURREVAC; SLOSH Models	10/2/02 9 pm voluntary orders	Need additional training on SLOSH models
St. Charles				No evacuation orders given	

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
St. James	Yes		HURREVAC; SLOSH Models	No evacuation orders given	Good
St. John the Baptist	10/1/02 – 8 am	History	HURREVAC; SLOSH Models; TIDES; HURRTRAK; Decision Arcs	60% of parish evacuated	Need additional staff and training for them
St. Martin	10/2/02	Storm position	HURREVAC; SLOSH Models	10/2/02 – 9 am 10% of parish evacuated	Inland wind speed on HURREVAC not accurate
St. Mary	10/2/02 – 9 am	Storm knowledge	HURREVAC	10/3/02 – 8 am 60% of parish	Inland winds in HURREVAC are not accurate; SLOSH Models need re-evaluation

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
Tammany	Not Applicable				
Tangipahoa	Not Applicable				
Terrebonne	8 am	History of storms	HURREVAC	8 am – mandatory orders issued for both events	Need additional training on SLOSH models use
Vermilion	10/1/02 – 6 am	National Weather Service Advisory	HURRTRAK RM/Pro 2002; LSU Climatologic website; HURREVAC; SLOSH Models	10/1/02 - 85% of parish residents	Well
Alabama					
Statewide	Autuaga: 9/25/02 -9 am Montgomery: 9/25/02 – 6pm Dale: 9/26/02 – 7 am Jefferson: 9/26/02 partial	Calls to National Hurricane Center			

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
Baldwin	9/24/02 – 6am partial 9/25/02 – 6 am full	National Weather Service; National Hurricane Center	HURREVAC; HURRTRAK; Surge Maps	Not available; population of county very low, so # of evacuees is hard to determine	Good, could always use additional training
Mobile	9/24/02 2 pm Lili – 10/2/02 – 1 pm, partial activation	National Weather Service; National Hurricane Center	HURREVAC; HURRTRAK	9/25/02 - 10 am 85% Dauphin Island 10/2/02 – 11 am 30% Dauphin Island	Good, could always use additional training
Florida: Additional/on-going training with hurricane evacuation decision-making tools is always helpful; they become “out -of –sight”, “out -of –practice”					
Mississippi					
Statewide	Yes	HURREVAC, conference calls	HURREVAC		Good
Hancock	Yes, time unavailable	National Weather Service, internet, local weather, knowledge of evacuation zones	HURREVAC	Unavailable	Well

Table 3-1 Executive Decision Process Summary

Location	Time EOC was Activated	What Prompted Decision to Activate	Study Products/Aids used in Decision Making	Time of Evacuation/# of Evacuees	Did Study Products Work Well
Harrison	Isidore- 9/24/02 – 8 am Lili – 10/2/02 – 8 am	National Weather Service	HURREVAC, Decision Arcs, SLOSH Models, TIDES	Isidore – 9/25/02 – 6 am Lili – 10/2/02 – 4:30 pm	Need on-going training
Jackson	Yes, both events, time and dates not provided		HURREVAC	Unavailable	HURREVAC needs to display intermediate advisories
Texas					
Statewide	9/23/02 – 8 am		HURREVAC; HURRTRAK; SLOSH Models		Excellent
Chambers	9/30/02 – 8 am	Storm position	HURREVAC; SLOSH Models; Decision Arcs	Not provided	Excellent
Galveston	Yes, time and date not provided	National Weather Service, history of storms	HURRTRAK; HURREVAC; Decision Arcs	5000	Good
Jefferson	County – yes; City of Beaumont – no	Storm history	Decision Arcs, TIDES	40-60% of population	Need additional training
Orange	9/30/02 – 8 am	National Weather Service	HURREVAC	55,250	Good

Florida meeting, Escambia County Emergency Management Office

Louisiana meeting, Jefferson Parish, Emergency Management Office

Louisiana meeting, St. Bernard Parish

Chapter 4
Transportation/Clearance Times

In FEMA/USACE comprehensive hurricane evacuation studies, the primary objective of the transportation analysis is to determine the clearance times[1] needed to conduct a safe and timely evacuation for a range of hurricane threats. The Transportation Analysis includes input from the Vulnerability Analysis, Shelter Analysis and Behavioral Analysis as well as demographic sources on permanent and seasonal populations. Federal, state and local government officials confirm results from an evacuation behavioral response survey that approximately 40-56% of people in evacuation zones under evacuation directives left their homes to go someplace safer.

For southwest Louisiana, clearance times had been updated for Acadia, Assumption, Calcasieu, Cameron, Iberia, Jefferson Davis, Lafayette, St. Martin, St. Mary, Terrebonne, and Vermilion Parishes in the Transportation Analysis done for the FEMA/USACE of Engineers New Orleans District by Post Buckley Schuh and Jernigan in May 2000. Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, and St. Tammany had clearance times prepared for them in the Hurricane Preparedness Study dated 1994. Only Ascension and Tangipahoa Parishes have not had studies done to calculate their clearance times. For Alabama clearance times had been calculated for Baldwin and Mobile counties in the study done August 1999. Mississippi had a transportation analysis done for Hancock, Harrison, and Jackson Counties in February 2001. Texas clearance times were updated in 2002 by a transportation analysis performed by Texas A&M University. Each of these studies provided clearance times for a range of scenarios reflecting differing storm intensities, seasonal occupancy levels, and differing mobilization rates. Tropical Storm Isidore and Hurricane Lili provided a limited opportunity to analyze the validity of these study products due to the low evacuation participation rates for both events.

Transportation and clearance time issues related to both Isidore and Lili, and discussed by the study teams with local and state officials included the following:

[1] When the first evacuating vehicle enters the road network, ends when the last vehicle reaches an assumed point of safety - includes travel time and waiting in traffic congestion (does not relate to any one particular vehicle)

- Was the evacuation roadway capacity sufficient to meet traffic demand?
- Were any traffic control actions taken to speed up traffic flow?
- When was the evacuation essentially completed?
- How long did the evacuation take?
- Were any major problems encountered in this evacuation?

Table 4-1, located at the end of this chapter, provides a summary of the responses received regarding transportation and clearance time data.

Regrettably, very few parishes and counties were able to state definitively how long the evacuations actually took. In areas that had been recently deluged with rain from Isidore, flooded roads were common and caused traffic problems. Heavy congestion resulting from many jurisdictions sharing the same roads was a common issue in many places. Halting construction on roads should be mandatory during hurricane evacuations. One incident was reported of railroad traffic causing a delay that forced evacuees to halt as the train crossed the evacuation route. Bottlenecks occurred in areas that forced reduction of four lanes of traffic into two lanes. The work that is slated for the I-49 by-pass in Lafayette Parish cannot come soon enough for the Parishes that share this route. Misunderstandings and lack of information exists in regards to the sharing of roads between parishes, counties and states. Receiving parishes and counties can be overwhelmed by the influx of evacuees traveling east and west in an evacuation, as opposed to going north to avoid the storm.

Alarmingly the events also showed the general lack of response by the population to evacuate even when faced with the possibility of a major hurricane event-making landfall. This continues to be an on-going frustration of local emergency management officials, especially as their population continues to grow in numbers. New residents to areas, which have never experienced a powerful storm, need to be aware of the danger and effects hurricanes cause. Emergency management officials continue to caution residents that each storm is unique and cannot be predicted. While most parishes and counties felt the roadway network was adequate and could handle the volumes experienced in both events, all agreed that should a mass evacuation occur serious congestion and traffic problems would occur.

A key issue in the evacuation process is the flow of traffic and the means by which traffic is kept moving through the evacuating areas. In the Texas Sabine Study Area an extensive Traffic Control Plan was developed after Hurricane Andrew. This plan is updated annually. Under the Traffic Control Plan traffic is "routed" away from coastal areas and non-evacuation traffic is kept from hindering the flow of evacuating vehicles. Texas reported this Plan was implemented during the Lili evacuation and worked well.

Traffic counters are located along many roads in the affected area. Unfortunately only traffic counters located in Mississippi recorded traffic during the Hurricane Lili evacuation. Figures 4-1 through 4-4 show the evacuation traffic versus normal daily traffic for I-55 and I-59. The data is reported for a 20-hour time span and reflects both Northbound and Southbound traffic. 1999 data was gathered on Wednesday, September 27th and Thursday, September 28th. 2001 was gathered Wednesday, September 26th and Thursday, September 27th. The 2002 data was recorded Wednesday, October 2nd and Thursday, October 3rd and reflects the actual traffic occurring during the Hurricane Lili evacuation. The 2002 data shows an increase in the traffic northbound out of the area on both roads occurring on Wednesday. From the interviews conducted, many jurisdictions indicated that some residents did in fact leave prior to evacuation orders being issued, and the traffic counts recorded in Mississippi support this observation.

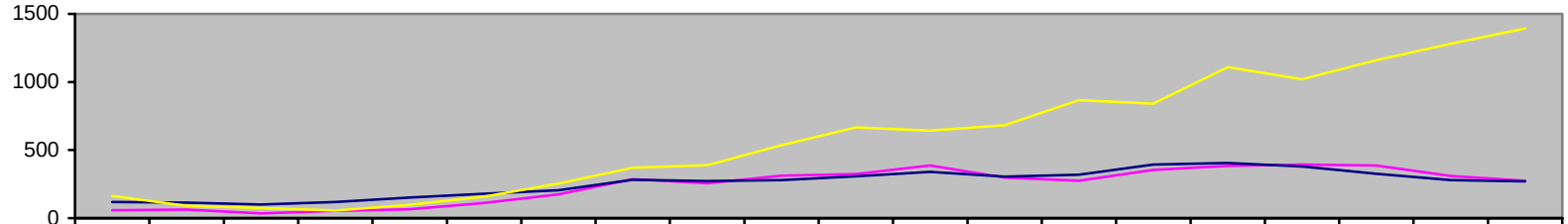
With close to 500,000 people advised to leave coastal and low-lying areas in Texas and Louisiana during the approach of Hurricane Lili, the U.S. Department of Transportation (USDOT) deployed its Evacuation Traffic Information System (ETIS) for the first time. ETIS is designed to more accurately predict specific levels and direction of evacuation traffic. Developed in direct response to significant traffic logjams occurring in southeastern states with Hurricane Floyd's 1999 near-landfall, ETIS operates on a sophisticated model that combines behavioral studies, data from past occurrences, and real-time data from ongoing incidents, including weather information, evacuation percentages and tourist occupancy rates in affected areas. FEMA requested that the USDOT develop the program with recognition that more sophisticated technology would be helpful for major evacuations, especially when neighboring states are sharing major road networks. Displayed as a series of tables and roadway-network graphics, ETIS provides emergency managers with crucial information to help with decisions

regarding highway lane usage and the provision of emergency services. The ETIS program, used in conjunction with a USDOT/FEMA organized Evacuation Liaison Team (ELT), is designed to be especially useful in helping state and local managers anticipate state-to-state traffic. PBS&J built the ETIS model using specially designed algorithms that allow data to be displayed in easily read graphics, illustrating congestion levels, for example, by altering the color and the size of map lines for highways. Figures 4-5 and 4-6 represent screen captures taken from ETIS. Prior to Hurricane Lili making landfall, contractors were deployed to FEMA Regions 4 (Atlanta, Georgia) and 6 (Denton, Texas) as well as the state Emergency Operations Centers (EOCs) in Louisiana to use the ETIS program for the first time. FEMA and USDOT as well as state emergency management and transportation agencies discussed their experiences. The following is a brief listing of some of the lessons learned from this experience.

- State EOC ELT support staff (DOT and Emergency Management staff) need additional training as to their roles in the ELT process and the use of ETIS. Communications between members of the ELT must be more organized and cohesive.
- Office space and equipment needs to be addressed. Additionally the connectivity at the National Hurricane Center (NHC) needs to be checked to ensure ETIS functions as needed.
- Revised guidelines for activation need to be addressed. Also staffing issues as to who goes where and when need to be resolved.

Figure 4-1 - Traffic Counts

I-55 Northbound: Wednesday - Evacuation Traffic vs Non-evacuation Traffic



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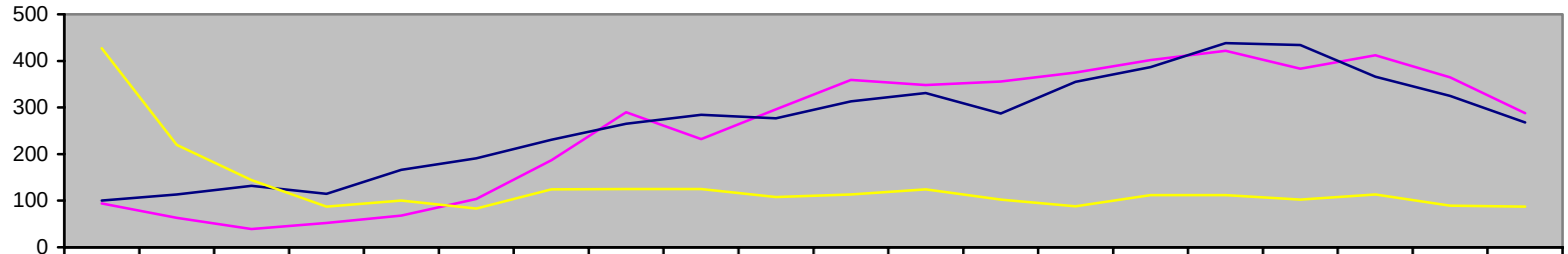
1999	59	64	35	53	66	111	175	286	257	312	324	386	297	276	354	384	393	387	309	274
2001	119	113	101	119	151	179	204	281	272	279	308	341	304	319	394	405	380	326	279	271
2002	164	92	74	55	97	159	254	371	389	536	666	644	683	866	841	1108	1020	1160	1282	1392

I-55 Northbound: Thursday - Evacuation Traffic vs Non-evacuation Traffic



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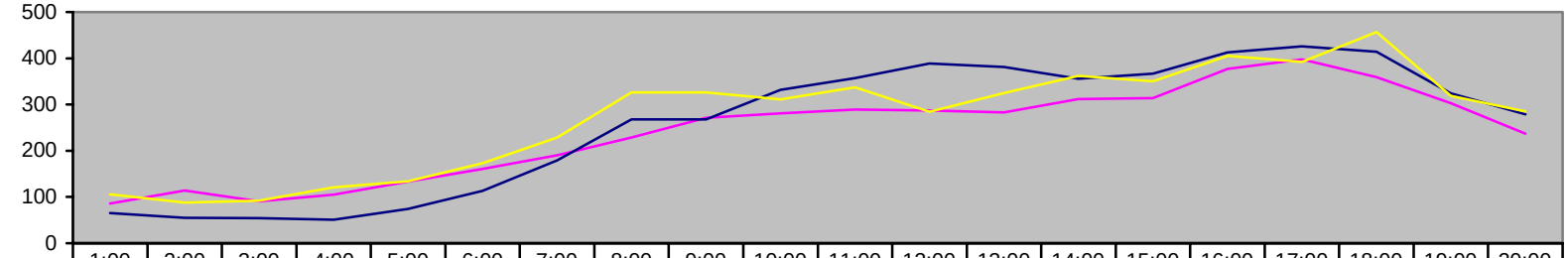
1999	94	63	39	52	68	104	187	290	232	296	359	348	356	375	402	422	383	412	365	288
2001	100	113	132	115	166	191	231	265	284	277	313	331	287	355	387	438	434	366	325	268
2002	427	220	144	87	100	83	124	125	125	108	113	124	102	88	112	112	102	113	89	87

Figure 4-2 - Traffic Counts

I-55 Southbound: Wednesday - Evacuation Traffic vs Non-evacuation Traffic



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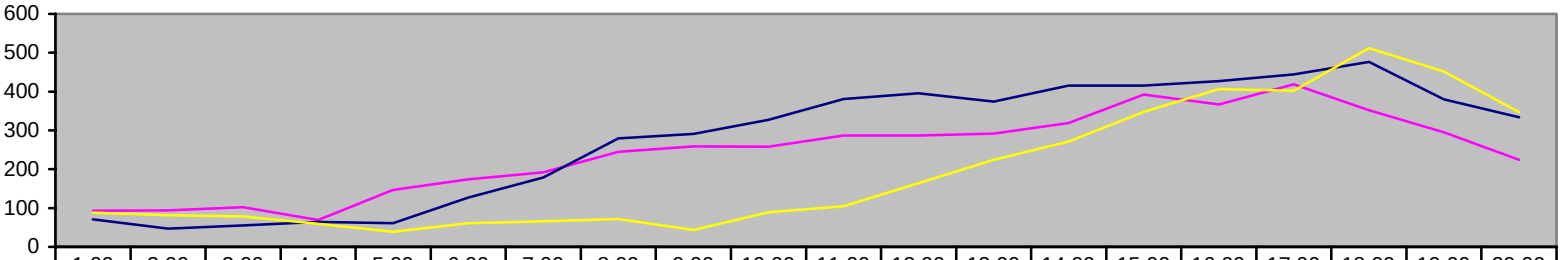
1999	86	114	91	105	133	161	190	229	271	281	289	287	283	312	314	377	398	359	303	237
2001	65	55	54	51	74	113	179	268	268	332	357	389	381	356	367	413	426	414	324	279
2002	106	88	92	121	134	173	229	326	326	311	337	284	325	362	350	405	392	457	319	285

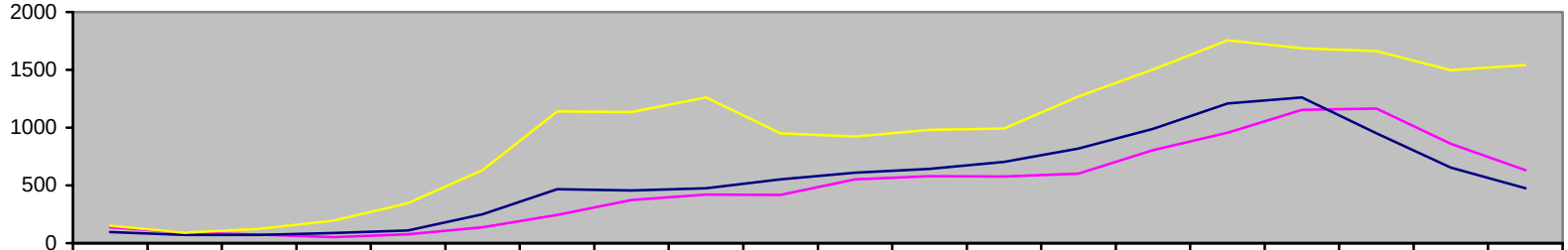
I-55 Southbound: Thursday - Evacuation Traffic vs Non-evacuation Traffic



	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
1999	93	94	102	69	147	174	192	245	259	258	287	287	292	319	392	367	419	352	295	224
2001	71	47	55	64	61	127	179	279	291	327	381	396	374	415	415	427	444	476	380	334
2002	88	82	78	59	39	61	66	72	44	89	105	164	224	271	348	406	402	512	452	347

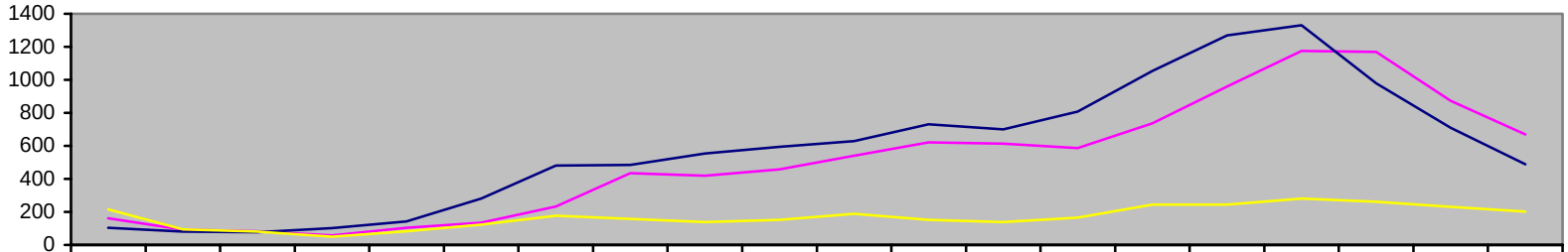
Figure 4-3 - Traffic Counts

I-59 Northbound: Wednesday - Evacuation Traffic vs Non-evacuation Traffic



	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
1999	136	90	74	53	78	137	245	375	420	418	553	581	578	601	804	955	1153	1166	861	633
2001	97	72	71	89	110	251	467	457	476	553	610	643	703	819	990	1210	1260	950	654	475
2002	150	90	124	196	346	632	1140	1134	1260	950	924	982	991	1270	1502	1755	1686	1662	1498	1541

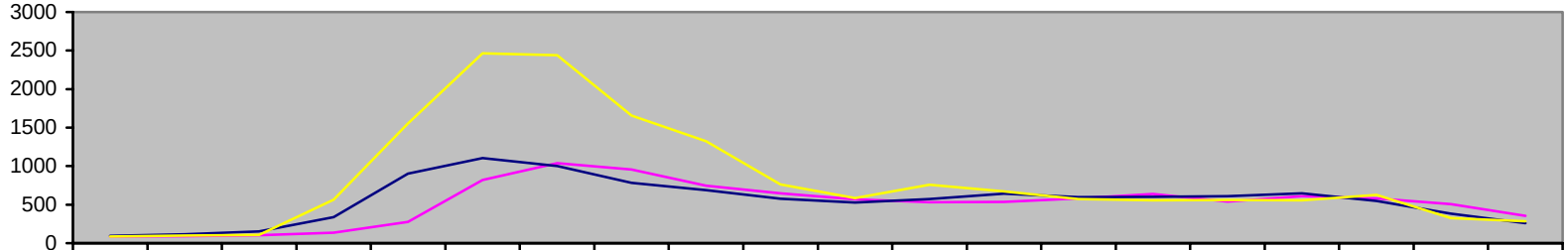
I-59 Northbound: Thursday - Evacuation Traffic vs Non-evacuation Traffic



	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
1999	161	93	83	58	103	135	232	434	419	457	541	621	614	586	736	960	1175	1169	873	670
2001	104	81	76	101	143	281	481	485	553	595	628	730	700	808	1054	1270	1330	979	709	488
2002	215	95	81	50	82	124	176	157	139	151	188	152	138	166	244	244	280	262	231	201

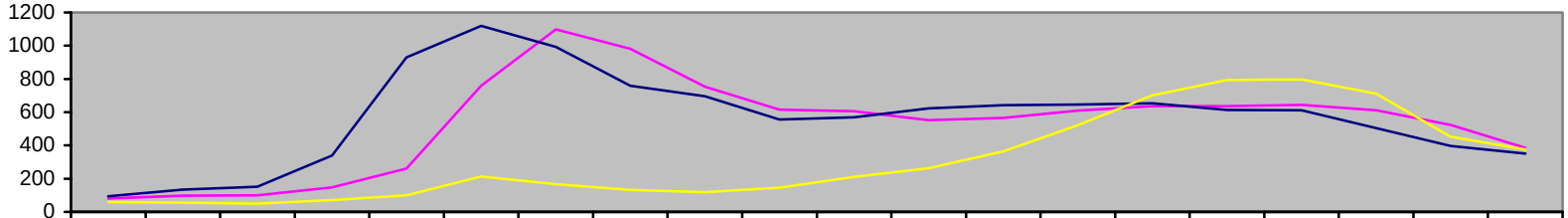
Figure 4-4 - Traffic Counts

I-59 Southbound: Wednesday - Evacuation Traffic vs Non-evacuation Traffic



	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
1999	88	91	102	136	275	818	1039	957	745	648	569	530	537	581	638	538	608	580	507	353
2001	95	116	154	336	902	1103	1002	782	689	578	527	573	642	599	601	611	646	548	382	258
2002	86	97	108	566	1552	2464	2438	1658	1324	761	586	757	671	573	558	561	558	628	327	283

I-59 Southbound: Thursday - Evacuation Traffic vs Non-evacuation Traffic



	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
1999	81	97	99	148	260	760	1098	981	753	615	605	553	566	610	637	636	645	612	523	386
2001	94	134	151	339	929	1120	993	760	695	555	569	623	643	646	654	613	612	505	396	351
2002	60	56	50	70	100	212	166	133	118	146	211	263	365	521	701	793	798	712	453	376

Figure 4-5 ETIS

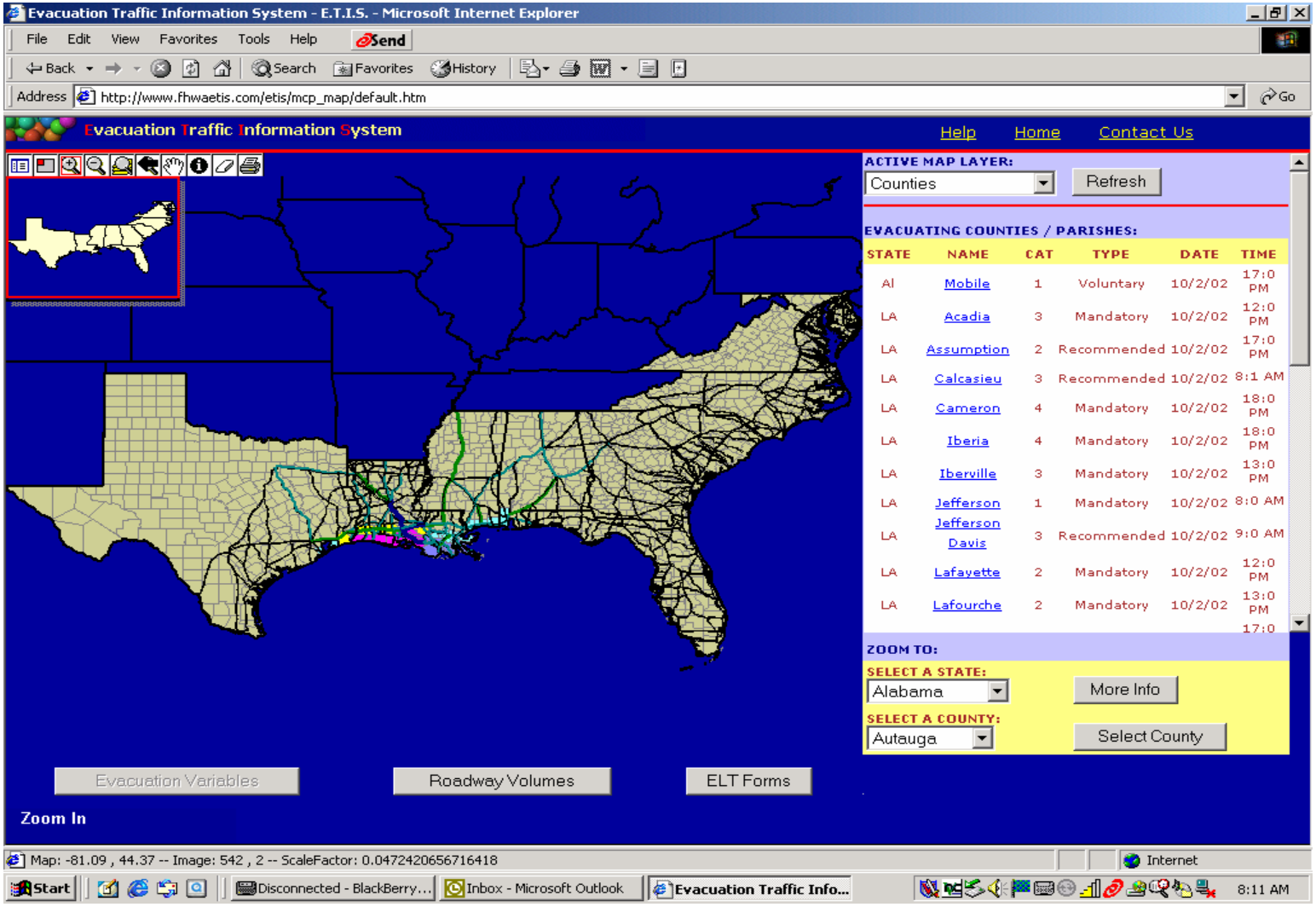
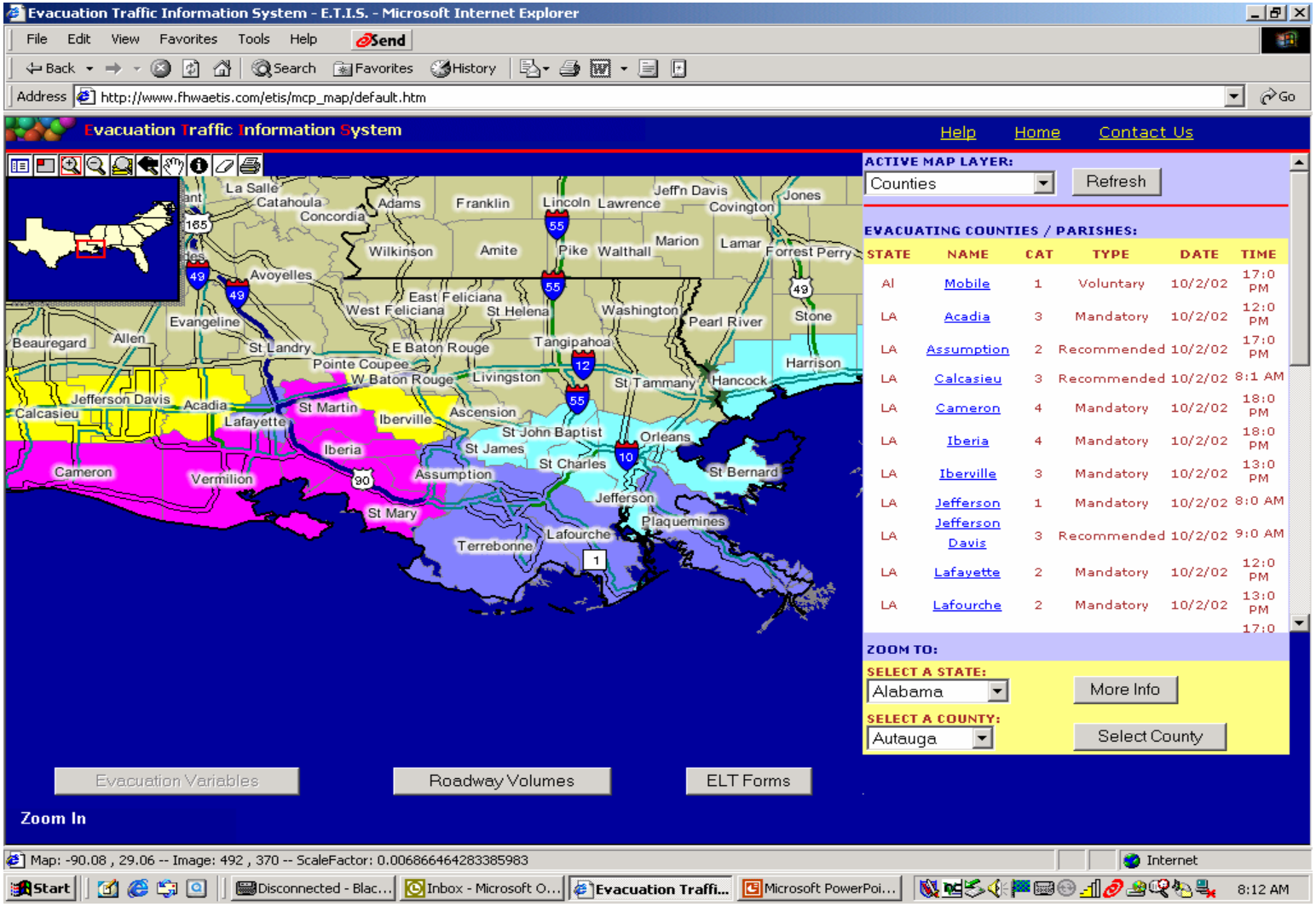


Figure 4-6 ETIS



Recommendations:

1. Update hurricane evacuation studies and provide a transportation analysis tool that will allow local jurisdictions the ability to update clearance times as housing unit growth/road construction dictates.
2. Update road networks to reflect traffic issues for evacuees traveling east and west.
3. Appoint an ICCOH subcommittee to develop a template for evacuation zone delineations. The template should provide guidance to FEMA and state hurricane program managers and USACE study managers about the process of examining risk maps, evacuation routes and road networks and include sample zone maps. It should also describe how to involve local agencies, DOT and law enforcement.
4. Texas has had hurricane evacuation studies through Texas A&M University in the past, including transportation analysis. Starting in 2003 the State of Texas is having the USACE perform hurricane evacuation studies. A USACE study should be done that will include the development of a transportation analysis tool for coastal counties and inland counties impacted by evacuees.
5. Federal and state agencies will need to install more "real time" traffic counters at strategic locations along major evacuation routes so traffic information programs like ETIS can be effective evacuation tools.
6. Encourage communication among neighboring states, counties, and parishes during and after hurricane evacuation events that would better allow for the handling of evacuees that do not always go where they are expected to go.

NOTE Discussion on Page 3-2 applies to the following table and data contained within.

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
Louisiana					
Acadia	Yes	Traffic control points	Unavailable	7 ¾ hours	Apathy to leave; construction hindering traffic; traffic from surrounding parishes increases congestion
Ascension	Yes	Traffic control points	4 hours	No study done in this area	None reported – no major evacuation
Assumption	Yes	None reported	Unavailable	7 hours	Heavy traffic
Calcasieau	No, evacuation roads should be four-lane only	Traffic control points; barricades; coordinated traffic lights	Unavailable	7 ¼ hours	Very heavy congestion; 4 lanes of traffic bottlenecked to two; other parishes using same roads
Iberia	Yes	Traffic control points; coordinated traffic lights	10 hours	6 ¼ hours	Traffic flowing until reaching other parishes; need by pass on 49

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
Jefferson	Yes	None reported	Unavailable	10 hours	Flooded roads; congestion
Jefferson Davis	Yes	Traffic control points	Unavailable	7 ¼ hours	None reported but found general apathy to leave in parish
Lafayette	Yes	Barricades; traffic control points; redirected traffic; am radio messages	Unavailable	7 ¾ hours	Congestion
Lafourche	Yes	None reported	Unavailable	9 ¼ hours	Minor road flooding
Orleans	Yes	None reported	8 hours	10 hours	Flooded roads

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
Plaquemines	Yes	None taken	Not applicable	10 hours	None
St. Bernard	Yes	Barricades; traffic control points	Unavailable	10 hours	None
St. Charles	Yes	None reported	Unavailable	9 ½ hours	Congestion; US Hwy 90 at I 310 backed up 10 miles
St. James	Yes	None reported	Unavailable	9 ½ hours	None
St. John the Baptist	Yes	None taken	Unavailable	9 ½ hours	Flooded roads; inadequate signage of evacuation routes

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
St. Martin	Yes	None taken	Unavailable	6 ¼ hours	None reported
St. Mary	No, too many evacuees sharing two-lane roads	None reported	7 hours	7 hours	Uncoordinated traffic lights; heavy congestion; four lanes reduced to two
St. Tammany	Yes	None	2 – 3 hours	10 hours	None experienced except I-55 which had heavy traffic and flooding
Tangipahoa	Yes	None taken	Unavailable	No study done for this area	None except I-55
Terrebonne	Yes	None taken	Unavailable	7 hours	None

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
Vermilion	Yes	Police stationed at critical points	Hard to determine	7 ¾ hours	None
Alabama					
Baldwin	Yes	None taken	Unavailable	9 ½ hours	Flooded roads; heavy congestion; county needs additional roads constructed
Mobile	Yes, but a larger event could be a problem	Barricades; control points; coordinated lights; message signs	Unavailable	9 ½ hours	East west travel very heavy; flooded roads; construction on roads an issue
Florida: I-10 very heavily congested but did not close; rest areas were extremely full; traffic counters to gauge traffic coming from the west would be very helpful; variable message boards to alert evacuees to keep going or advise them where to go would be helpful					

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
Mississippi: I –55 flooding an issue; the implementation of contra flow needs to be re-evaluated (issue resolved June, 2003)					
Hancock	Yes	Roads closed; barricades	Unsure	12 hours	None; congestion from sightseers an issue
Harrison	Yes	Barricades; traffic control points; lock down drawbridges; am radio messages	Unknown	12 hours	Flooded roads; US49 construction upstream from Harrison
Jackson	Yes	Barricades	Not available	12 hours	Additional barricades needed; no real issues since general apathy towards storms

Table 4-1 Transportation /Clearance Time Data Summary

Location	Evacuation Roadway Network Equal to Traffic Demand	Traffic Control Actions	Clearance Time Experienced	Study Calculated Time Category 1 –2	Problems Encountered
Texas (study-calculated times for Texas were done by Texas A&M)					
Chambers	No, not enough roads for evacuation	Barricades; traffic control points; coordinated lights	Unavailable	Category 1: 10 hours Category 2: 13 hours	Heavy congestion from Louisiana evacuees; construction on roads needs to be stopped during event
Galveston	Yes	None	Unavailable	Category 1: 14 hours Category 2: 20 hours	Need additional roads built
Jefferson	Yes	None	9 hours	Category 1: 14 hours Category 2: 20 hours	Construction on roads; trains need to be stopped from passing and cutting off evacuation routes
Orange	Yes	Barricades; traffic control points; vehicle assistance	Hard to determine, reported times vary from 30 minutes to 10 hours.	Category 1: 14 hours Category 2: 20 hours	Accidents; congestion; Louisiana evacuees

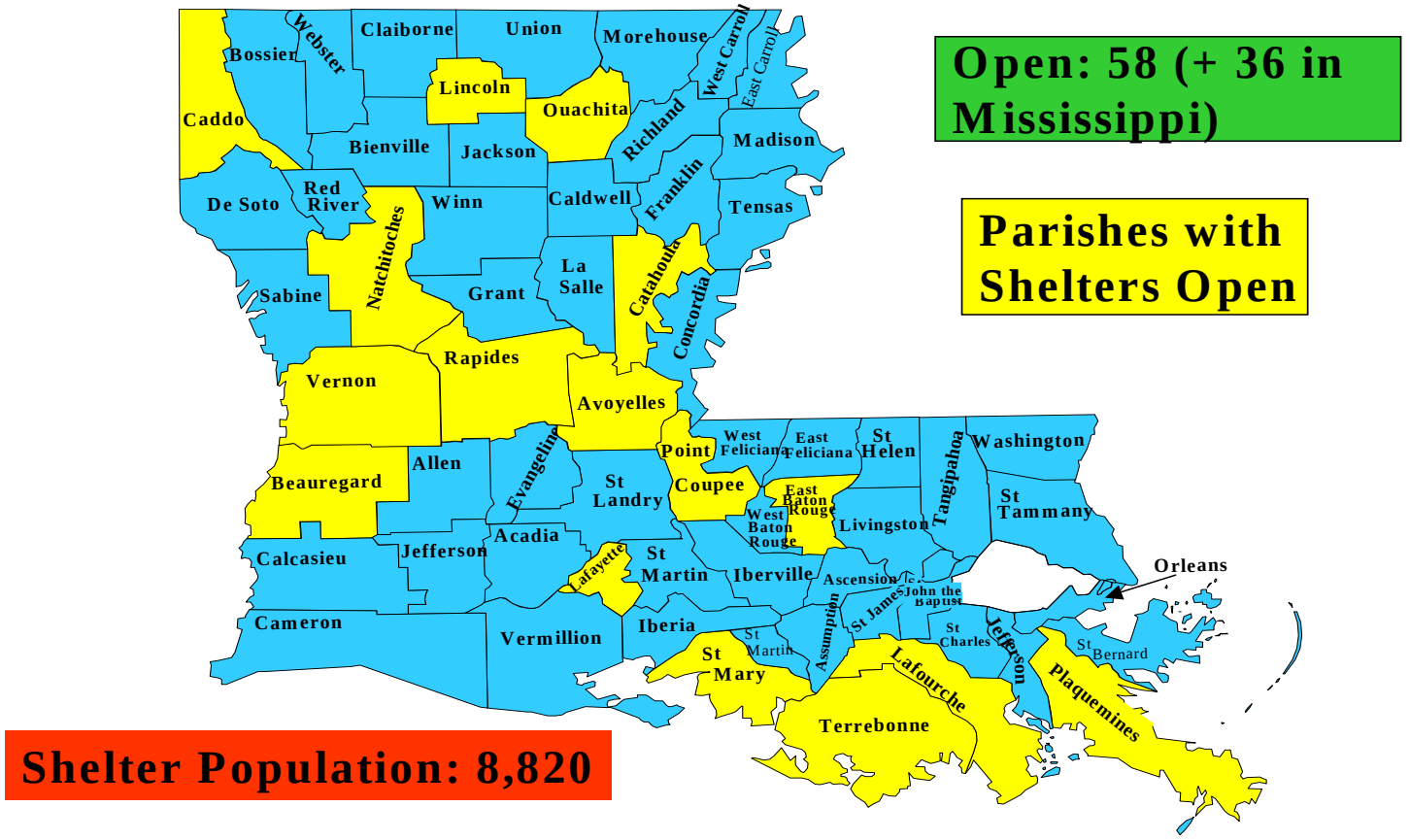
Chapter 5
Public Shelter Issues

The primary objectives of shelter analyses prepared for FEMA/USACE comprehensive hurricane evacuation studies are to list public shelter facilities, 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. An interagency group comprised of FEMA, the USACE, the Environmental Protection Agency, the American Red Cross, and Clemson University, has developed hurricane evacuation shelter selection standards[1]. These standards reflect the application of technical data compiled in hurricane evacuation studies, other hazard information, and research findings related to wind loads and structural problems. These standards are supplemental to information contained in ARC 3041, *Mass Care: Preparedness and Operations* concerning shelter selection. 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. The standards include a process so Red Cross can authorize "exception" approval for facilities as hurricane evacuation shelters if the facilities meet selected criteria. State emergency management agencies, with FEMA funding, have developed shelter selection programs to inspect and designate facilities as shelters based on the ARC 4496. 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. According to the American Red Cross and state emergency management agencies approximately 3,500 people went to 32 evacuation shelters for the threat of Isidore and over 18,000 evacuees went to 83 shelters when Lili threatened the Gulf Coast. This report's behavioral analysis estimates less than 10% of the evacuees went to public shelters (similar estimates from past hurricane evacuations). Figure 5-1 shows the shelter locations opened in Louisiana during Lili.

[1] Standards for Hurricane Evacuation Shelter Selection, ARC 4496, revised January 2002

Figure 5-1

SHELTERS



Shelter issues related to Tropical Storm Isidore and Hurricane Lili were discussed with local and state officials. Discussions focused on the following topics:

- When were shelters opened?
- When did evacuees arrive and stop arriving?
- How many shelters were opened?
- How many people were sheltered?
- Were any flooding, wind, or loss of power problems encountered with shelters during the storm?

Table 5-1, located at the end of this chapter, summarizes the responses to each of these topics gathered for the parishes and counties interviewed in Louisiana, Alabama, Florida, Mississippi, and Texas. **All data is reflective of Hurricane Lili unless specifically differentiated.**

In general, the number of evacuees going to public shelters was less than what was anticipated even in the hurricane evacuation studies for each area. Since evacuation participation rates of permanent residents from potential storm surge areas were much less than 100%, lower actual public shelter demand figures are to be expected.

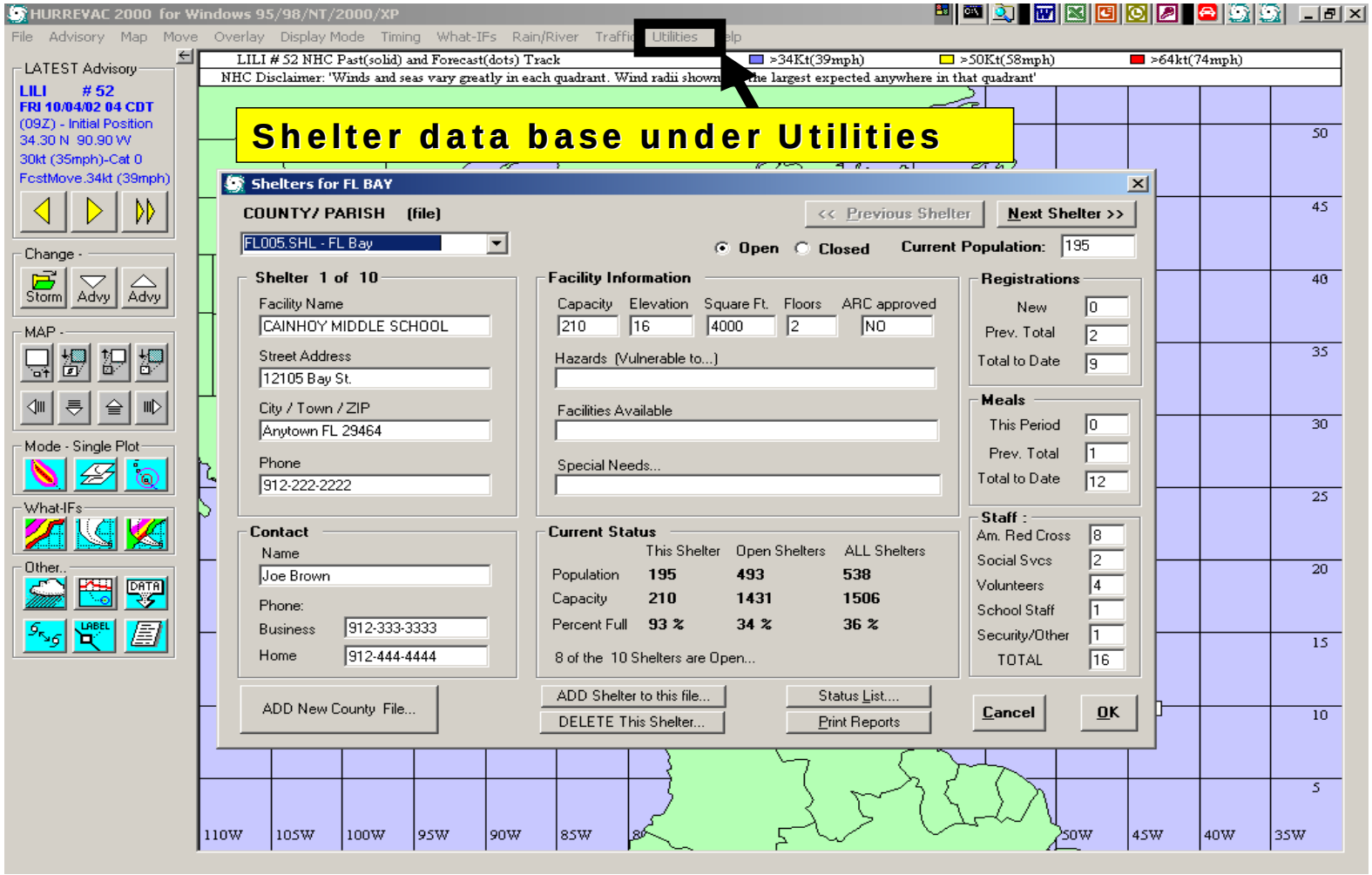
For most jurisdictions the evacuees were mainly local residents seeking shelter. The exception to this was in Texas where residents from Louisiana were sheltered, and after the storm made landfall, were unable to return home. Alabama opened no shelters statewide for either storm event. Mississippi had available 43,000 spaces statewide for Hurricane Lili, but reported only 300 used. Florida did open one host shelter but reported most evacuees coming into the state were utilizing the hotels and motels located in the panhandle counties. Some local emergency managers of inland communities in Louisiana, Texas, and Mississippi expressed concern about coastal evacuees seeking hotel and motel lodging as well as shelters in their locales. They had the perception that an influx of out-of-towners would create a negative reduction of available spaces for local residents. Past experiences indicate however, that shelter demand has been low for most events and very few inland residents go to local lodging or public shelters, even when local shelters were open to them and had not reached their capacity levels. Shelter information in future studies should document historical data to address this issue.

Some shelter locations experienced a lack of supplies and staff. Another common issue mentioned was incoming evacuees came without provisions for themselves. Minor power outages, wind damage, and flooding were also mentioned during the interviews. Again the low use of public shelters made it very difficult to gauge if public shelter capacity meets the needs of the evacuees seeking refuge in them.

The Figure 5-2 is provided to show the shelter information that the HURREVAC program can display.

Sean Fontenot from Louisiana's State Office of Emergency Preparedness provides the following narrative in regards to special needs shelters. "Special needs' sheltering is becoming a critical issue as the age of our population increases. Too often people with special needs are unable to travel great distances and require very special care and attention when they do leave their homes. This segment of the population must be given special care and cannot function in a general shelter environment. Louisiana Office of Emergency Preparedness has worked very diligently over the past several years, in coordination with their sister state agencies of Department of Health and Hospitals and Department of Social Services, to set up a regional special needs shelter concept. These Nine Regional State Special Needs Shelters are the only shelters in Louisiana that are run completely by a state agency and not by the American Red Cross or a particular Parish. Tropical Storm Isidore and Hurricane Lili were the first storms that could test Louisiana's new special needs shelter concept. For Tropical Storm Isidore, Louisiana opened two of its nine regional shelters and sheltered 27 people with special needs. This turned out to be what many in Louisiana called a good dry run in preparation for Hurricane Lili. Hurricane Lili the very next week gave Louisiana the opportunity to further test this new Special Needs Shelter plan, opening five of its Special Needs Shelters and providing care for 260 special needs persons. Many in Louisiana have considered this new Special Needs sheltering plan a success, however, many lessons were learned from this experience and a foundation was laid for a great special needs program."

Figure 5-2: Provided to show the shelter information that the HURREVAC program can display.



Recommendations

1. Emergency Support Function (ESF) 6 MASS CARE agencies should enhance annual preparations for proper inventory of shelters equipment and staffing levels.
2. ESF 6 agencies with local emergency management agencies (and support from the state) should annually review the structural integrity and location of current hurricane evacuation facilities and determine availability for new ones. This process should apply the ARC 4496 standards and determine if more facilities could be approved through "exception" applications.
3. State emergency management agencies should develop maps to display shelter locations relative to evacuation routes.
4. ESF 6 agencies end emergency management should use HURREVAC and other programs to monitor (and map) shelter operations for planning purposes and in operations for state and local Emergency Operation Centers (EOCs)
5. ESF 6 agencies should assure shelter supplies are replenished after each shelter activation
6. ESF 6 agencies, with state and local emergency management agencies, should increase public education about hurricane evacuation shelter locations and what personal (comfort and hygiene) supplies an evacuee should bring.
7. Inter-state coordination among state emergency management agencies should include information about availability and location of hurricane evacuation shelters.
8. Encourage local and state agencies to apply for federal and state mitigation funds to retrofit critical facilities (including public buildings as shelters) for elevation and wind resistance of hurricane hazards.

NOTE Discussion on Page 3-2 applies to the following table and data contained within.

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
Louisiana					
Acadia	5 – shelters of last resort	1,500	7,060 people	10/2/02 8pm	Wind damage Loss of utilities
Ascension	3	399	No study available	10/2/02 9pm	Shortage of staff, food and security
Assumption	Isidore – 1 Lili – 2	Isidore – 10 Lili – 250	1,200 people	Not provided	Not available
Calcasieau	2	None	2,350 people	Not provided	Not available
Iberia	None	N/A	N/A	N/A	N/A

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
Jefferson	Isidore – 2 Lili – 1	Isidore – 30 Lili – 78	15,187 people	Lili – 10/2/02 – 4 pm	Not provided
Jefferson Davis	1 shelter of last resort	25 – 30	2,375 people	10/3/02 – 4 am	Unruly guests, lack of security
Lafayette	1 special needs	134	5,183 people	10/2/02 – 1 pm	Wind damage, public unaware shelter was special needs, loss of utilities
Lafourche	Isidore – 1 Lili – 3	Isidore – 200 Lili – 1,700 +/- (36 in special needs shelter)	5,100 people	Not provided	Not available
Orleans	3	25	25,100 people	10/2/02 – noon	None

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
Plaquemines	Isidore – 1 Lili – 4	Isidore – 875 Lili – 1175	2,725 people	Lili – 10/2/02 – 8 am	None
St. Bernard	Isidore and Lili – 1 special needs each	Isidore – 300 Lili – 400	5,676 people	Lili – 10/1/02	None
St. Charles	Isidore – 2 Lili – 2	Isidore – 80 Lili – 200	1,700 people	Not provided	Not available
St. James	Isidore – 2 Lili – 2	Isidore – less than 600 Lili – 600	4,050 people	Not provided	None
St. John the Baptist	2 – shelters of last resort	200	4,075 people	6 am, closed the next morning	None

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
St. Martin	5	1009	1,872 people	10/2/02 – 4 pm, open 25 hours	None
St. Mary	2 – shelters of last resort	190	6,200 people	Not provided	Not available
St. Tammany	6 – one was special needs shelter	600 regular, 20/30 special needs	23,100 people	10/3/02	None
Tangipahoa	3	196	No study available	10/3/02	None
Terrebonne	Isidore - 1 Lili – 1	Isidore – 150 Lili – 1400	3,500 people	Not provided	Not available

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
Vermilion	5 – one shelter of last resort	280 regular, 35 in shelter of last resort	4,105 people	10/4/02 – 6 pm	Loss of power
Alabama					
Baldwin	Isidore – 3, one was special needs Lili – 1	Isidore – 87 Lili – none	8,000 people	Isidore – opened 2 days Lili – 1 day	No real problems, but security always an issue
Mobile	Isidore – 4 Lili – 1	Isidore – 356 Lili – none	24,350 people	Isidore – 30 hours Lili – 8 hours	No real problems but special needs must be addressed
Florida					
Escambia, Santa Rosa, Okaloosa	Lili – 1 host shelter	35		2 days	Did not realize impact from Louisiana and Alabama evacuees would have on hotel/motel space

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
Mississippi					
Hancock	Isidore – 2 Lili – 1	Isidore – 227, 25 were special needs Lili – 79, 22 were special needs	1,750 people	Isidore – 6 am, open 2 days Lili – 6 pm, open 1 day	None
Harrison	Isidore – 10, one was special needs Lili – 2	Isidore – 459, no special needs Lili – very few	10,590 people	Isidore – 9/25/02 1 pm Lili – 10/2/02 – 8 pm	None
Jackson	Isidore – 4 Lili – 2	Isidore – 200 Lili – 30	3,050 people	Not provided	Need for generators, ventilation issues
Texas (see note below table on next page)					
Angelina - (City of Lufkin) Nacogdoches (City of Nacogdoches)	26	5,000 – 8,000	No USACE studies done for Texas yet	Not available	Lack of supplies, staff; too many people coming at one time via buses; prisoners in shelters; security; people coming w/o medicines; out of state evacuees

Table 5-1 Public Shelter Data Summary

Location	Number of Shelters Opened	Number of People Sheltered	Technical Data Report Shelter Capacity	Time Opened/Duration	Problems Encountered
Chambers	2	231	No USACE studies done for Texas yet.	1 day	None
Galveston		4,165	No USACE studies done for Texas yet		
Jefferson	1 – Salvation Army shelter	3,094 80% were from homeless population	No USACE studies done for Texas yet		County is in risk area, public unaware shelter was for last resort only
Orange		1,188	No USACE studies done for Texas yet		

Note: Texas evacuating counties (Chambers, Jefferson, Orange and Galveston) do not shelter evacuees within their boundaries. Evacuees are instructed to move inland away from the coast, to safer locations before stopping at shelters or hotels. Angelina and Nacogdoches Counties are primary shelter locations for the Sabine Study Area (Jefferson, Orange and Chambers Counties).

Storm photos - Vermilion Parish, Louisiana

Chapter 6
Public Information

Although not a major part of previous FEMA/USACE 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 protective actions including evacuation and in-place sheltering can be made for each household. Tropical Storm Isidore and Hurricane Lili were good opportunities to evaluate how effective the messages were delivered to local and state officials and if the hurricane evacuation information is getting into the hands of the general public. It was also an opportunity to assess additional needs regarding public information both in terms of pre-season hurricane education as well as immediate information during a threat or response to a hurricane.

Methods used and suggestions offered in the study areas to inform the public in Tropical Storm Isidore and Hurricane Lili and for future events included the following:

1. Public information brochures are developed and widely distributed early in the season showing vulnerable areas, evacuation routes and levels, and tips on hurricane preparedness.
2. Press briefings are done with national and local media to insure that they (radio, TV, newspapers) disseminate consistent information to the public. Emergency management officials provided packets of hurricane information early in the season to media outlets.
3. Law enforcement officials drive through neighborhoods with sirens and P.A. systems to encourage people to evacuate – this technique is used in some beach communities – some officials even go door-to-door.
4. Some communities provide evacuation information to the public through printed information in the local phone book.
5. An important means is through radio and television – some communities use cable TV overrides to alert the public of evacuation advisories and provide public service announcements.

6. Local emergency management staff and citizens for public education and information use the Weather Channel extensively. The National Weather Service is also consulted for guidance and advice.
7. Some emergency management officials fax advisory and teleconference information to media.
8. Some agencies use their web sites to display storm information and advisories.
9. State produced hurricane brochures are popular in many areas.
10. Louisiana State University provides assistance with mapping of surge areas, evacuation routes, and shelter locations, and provides students to assist working in EOC's.
11. Local public information officers are important resources during the event to interface with the media and public.
12. NWS and emergency management agencies provide information about potential storm surge heights.
13. Some selected areas provided hurricane information in French, Vietnamese, and Spanish.
14. Vermilion Parish gave school children public information packages including hurricane-tracking charts. These were given out well in advance of the hurricane season and were well received by residents of the Parish.
15. Government agencies and other organizations at all levels should annually review and update and expand hurricane awareness public information materials. Such materials should have user-friendly graphics and describe the consequences of a major land-falling hurricane. Such materials could include risk maps and evacuation zones.
16. State and local organizations should develop public education materials and outreach campaigns for residents of mobile homes.
17. Local governments should continue to collaborate with news media outlets to clearly communicate evacuation orders or directives including the time frames and zones for phased evacuation, evacuation routes and estimated travel times to various destinations.

18. State and local emergency management agencies should develop a special public awareness campaign about the catastrophic scenarios of a major hurricane strike in the News Orleans area and include special protective action guidance.

Appendix A

Meeting Attendees/Persons Providing Input in Affected Areas*

*Note: Several persons attended multiple meetings, but have only been listed once.

Meeting Participants

Name – Affiliation - Contact Information (when provided)

Federal Emergency Management Agency – (FEMA)

Charles "Chuck" Gregg - Region VI - chuck.gregg@dhs.gov - (912) 898-5136

Lisa Hoover - Region VI - agent_lynne@hotmail.com - (225) 567-9292

Brock Long – Region IV - brock.long@dhs.gov - (770) 220-5668

William "Bill" Massey - Region IV – william.massey@dhs.gov - (770) 220-5430

Disaster Assistance Employees

Joe Candelario – jcandelario@satx.rr.com - (210) 363-7743

William Winn

Billy Zwerschke – billyz@cableone.net - (361) 552-7788

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Appendix B

National Hurricane Center:

- **Six-Hour Best Track Positions and Intensities**
- **Selected Surface Observations**
- **Official and Selected Model Forecast Errors**
- **Watch/Warning Summary**

Six-Hour Best Track Positions and Intensities for Hurricane Lili
September 21 – October 4, 2002
Positions and pressures during the tropical wave stage are representative of the low-level vorticity center.

Date/Time (UTC)	Position		Pressure (mb)	Wind speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
21 / 1800	10.2	44.6	1009	25	Tropical depression
22 / 0000	10.3	46.5	1007	30	"
22 / 0600	10.8	48.5	1006	30	"
22 / 1200	11.2	50.4	1006	30	"
22 / 1800	11.8	52.2	1005	30	"
23 / 0000	12.1	54.6	1005	35	Tropical storm
23 / 0600	12.2	56.8	1005	40	"
23 / 1200	12.4	58.7	1004	45	"
23 / 1800	12.5	60.4	1005	50	"
24 / 0000	12.7	62.1	1006	50	"
24 / 0600	12.8	63.7	1006	50	"
24 / 1200	13.0	64.9	1004	60	"
24 / 1800	13.2	66.0	1007	50	"
25 / 0000	13.5	66.9	1008	35	"
25 / 0600	13.7	67.5	1008	35	"
25 / 1200	14.0	68.2	1008	40	Tropical wave
25 / 1800	14.2	68.9	1007	40	"
26 / 0000	14.5	69.8	1007	35	"
26 / 0600	14.9	71.0	1007	35	"
26 / 1200	15.3	72.2	1007	30	"
26 / 1800	15.6	73.0	1006	30	"
27 / 0000	15.7	73.5	1006	30	Tropical depression
27 / 0600	15.9	74.0	1006	30	"
27 / 1200	16.1	74.6	1003	35	Tropical storm
27 / 1800	16.7	75.0	1004	40	"
28 / 0000	17.4	75.1	999	45	"
28 / 0600	17.5	75.6	999	45	"
28 / 1200	18.1	75.4	1002	45	"
28 / 1800	18.5	75.7	1003	45	"
29 / 0000	18.8	76.1	1001	45	Tropical storm
29 / 0600	18.8	76.8	999	40	"
29 / 1200	18.7	77.2	994	45	"
29 / 1800	18.7	77.6	994	50	"
30 / 0000	19.0	78.1	993	55	"
30 / 0600	19.1	78.7	990	60	"
30 / 1200	19.6	79.6	986	65	Hurricane
30 / 1800	20.0	80.3	984	65	"
01 / 0000	20.5	81.1	978	70	"
01 / 0600	21.0	82.2	970	75	"
01 / 1200	21.6	83.2	971	90	"
01 / 1800	22.4	84.4	971	90	"
02 / 0000	23.0	85.7	967	90	"
02 / 0600	23.6	87.2	954	100	"
02 / 1200	24.4	88.3	954	110	"
02 / 1800	25.4	89.5	941	120	"

Six-Hour Best Track Positions and Intensities for Hurricane Lili (continued)
September 21 – October 4, 2002
Positions and pressures during the tropical wave stage are representative of the low-level vorticity center

Date/Time (UTC)	Position		Pressure (mb)	Wind speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
03 / 0000	26.7	90.3	940	125	"
03 / 0600	28.1	91.4	957	105	"
03 / 1200	29.2	92.1	962	80	"
03 / 1800	30.5	92.4	976	60	Tropical storm
04 / 0000	31.9	92.1	985	40	"
04 / 0600	33.5	91.4	994	30	Tropical depression
04 / 1200	35.8	90.0	997	25	"
04 / 1800					Absorbed by extra tropical low
02 / 2013	25.9	89.9	938	125	**Minimum pressure**
30 / 1400	19.7	79.8	986	65	Landfall-Little Cayman and Cayman Brac
01 / 1100	21.3	83.0	971	90	Landfall-Isle of Youth, Cuba
01 / 1400	22.1	84.0	971	90	Landfall-Pinar del Rio Province, Cuba
03 / 1300	29.5	92.2	963	80	Landfall-near Intracoastal City, LA

Selected Surface Observations from Land Stations and Data Buoys
Hurricane Lili
September 21- October 4, 2002

	Minimum Sea-level Pressure		Maximum Surface Wind Speed (kt)					
Location	Date/ Time (UTC)	Press. (mb)	Date/ Time[1] (UTC)	Sust. Wind[2] (kts)	Peak Gusts (kts)	Storm Surge[3] (ft)	Storm Tide[4] (ft)	Rain (storm total) (in)
Louisiana								
Alexandria int. airport	03/2141	980.4	02/2054	33	52			4.14
Baton Rouge	03/2353	997.0	03/1717		41			
Belle Chase			03/0855		44			
Boothville	03/0957	1005.4	03/1732	34	43			7.19
Burns Point/Salt Point							10-12	
Buras								8.40
Cajun field, Lafayette			03/1636	41	66			
Castille Pass nr Morgan City							10.6	
Cocodrie, Terrebonne Parish							9.94	
Cote Blanch Is. (Tex. Tech.)			03/1406	52	79			
Crewboat Ch. Nr Calumet							12.3	
CSI-03 (29.44N 92.06W)				63				
Cypremort Point					88			
Dean Lee(Alexandria)			03/1810	43	58			
Delcambre, Route 14	03/1514	977.7	03/1508	54	84		2	
Frenier causeway			03/0910	34	46			
Grand Isle							4.46	
Iberia (Jeanerertte)			03/1416	46	59			
Intracoastal City					104		6	
Jennings					77			3.91
Kaplan (Tex. Tech tower)	03/1524	965.7	03/1438	64	86			
Lafayette reg. airport	03/1623	983.1	03/1559	47	63			4.54
L. Bourne Bayou Dupre							6.58	
Lake Charles reg. airport	03/1641	993.9	03/1604	31	41			2.47

[1] Date/time is for wind gust when both sustained and gusts are listed
[2] Except as noted, sustained wind-averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy-averaging periods are 8 min.
[3] Except as noted, sustained wind-averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy-averaging periods are 8 min.
[4] Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level)

Selected Surface Observations from Land Stations and Data Buoys (continued)
Hurricane Lili
September 21- October 4, 2002

	Minimum Sea-level Pressure		Maximum Surface Wind Speed (kt)					
Location	Date/ Time (UTC)	Press. (mb)	Date/ Time[1] (UTC)	Sust. Wind[2] (kts)	Peak Gusts (Kts)	Storm Surge[3] (ft)	Storm Tide[4] (ft)	Rain (storm total) (in)
L. Pontchartrain LUMCON	03/2012	1001.9	03/1034	51	60			
L. Pontchartrain mid cswy.			03/1020	50	60			
L. Pontchartrain RIGL1							6.04	
LUMCON consortium hq.	03/1024	997.7	03/1231	43	54			
Mandeville causeway			03/1640	36	48			
New Iberia (29.91N 91.76W)			03/1542	54	72			
N. Orl. int. airport	03/1159	1004.1	03/1617	34	44			
N. Orl. Lakefront airport	03/0943	1003.4	03/1002	39	47			
Perry								8.57
Rice (Crowly)	03/1543	963.9	03/1528	47	61			
Terrebone Bay LUMCON	03/1029	995.8	03/0553	50	59			
Vermilion bay/B. Fearman							11.7	
Other States								
Beaumont, TX reg. airport	03/1911	1001.4	03/1548	27	32		5.40	
Burkeville, Texas								0.94
Point Cadet, Mississippi								
Picayune, Mississippi								4.14
Connerly Bayou, Arkansas								4.34
Chicago-Midway, Illinois								1.04
Bloomington, Indiana								0.85
Padukah/Barkley, Kentucky								0.91
Cincinnati-Luken, Ohio								0.59
Pensacola, Florida								1.04
Fairhope, Alabama								1.20

[1] Date/time is for wind gust when both sustained and gusts are listed
[2] Except as noted, sustained wind-averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy-averaging periods are 8 min.
[3] Storm surge is water height above normal astronomical tide level
[4] Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level)

Selected Surface Observations from Land Stations and Data Buoys (continued)
Hurricane Lili
September 21- October 4, 2002

	Minimum Sea-level Pressure		Maximum Surface Wind Speed (kt)					
Location	Date/ Time (UTC)	Press. (mb)	Date/ Time[1] (UTC)	Sust. Wind[2] (kts)	Peak Gusts (Kts)	Storm Surge[3] (ft)	Storm Tide[4] (ft)	Rain (storm total) (in)
NOAA buoy and Cman								
42001			02/2010	98	130			
42003	02/0800	1009.0	02/0720	36	49			
42007			03/1140	36	47			
42041	03/0300	984.0	03/0220	56	70			
BURL1			03/1020	52	70			
DRYF1	01/0810	1010.8	01/1714		46			
DPIA1	03/1559	1010.5	03/1559	31	35			
GDIL1			03/0640	36	69			
Jamaica								
Cedar Valley in St. Thomas								23.11
Craighead in Manchester								20.26
Knock Patrick in Manchester								21.66
Shewsbury in Westmoreland								23.82
Sunny Hill in St. Thomas								22.06
Cuba								
Francia	01/1100	991.2	01/1120	87	98			
Isabel Rubio	01/1550	971.4	01/1625	43	63			
Matias, Santiago de Cuba								6.22
Pilon, Granma								6.20
Pinar del Rio	01/1500	990.0	01/1450	59	76			
Punta del Esta	01/0905	989.7	01/1030	77	93			
San Juan y Martinez	01/1550	981.4		72	88			
Other Islands								
Morne des Cadets, Martinique			24/0300	47	68			
Pt. Salines, Grenada	24/0700	1006	24/0800	40				
Grantley Adams, Barbados			23/1700	41	65			
Hewanorra, St. Lucia			23/2100	35	47			

[1]Date/time is for wind gust when both sustained and gusts are listed
[2] Except as noted, sustained wind-averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy-averaging periods are 8 min.
[3]Storm surge is water height above normal astronomical tide level
[4]Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level)

Official and Selected Model Forecast Errors
Hurricane Lili
September 21 – October 4, 2002

(Errors are for tropical storm and hurricane stages and are followed by the number of forecast cases in parentheses. Errors smaller than official forecast errors are shown in boldface type)

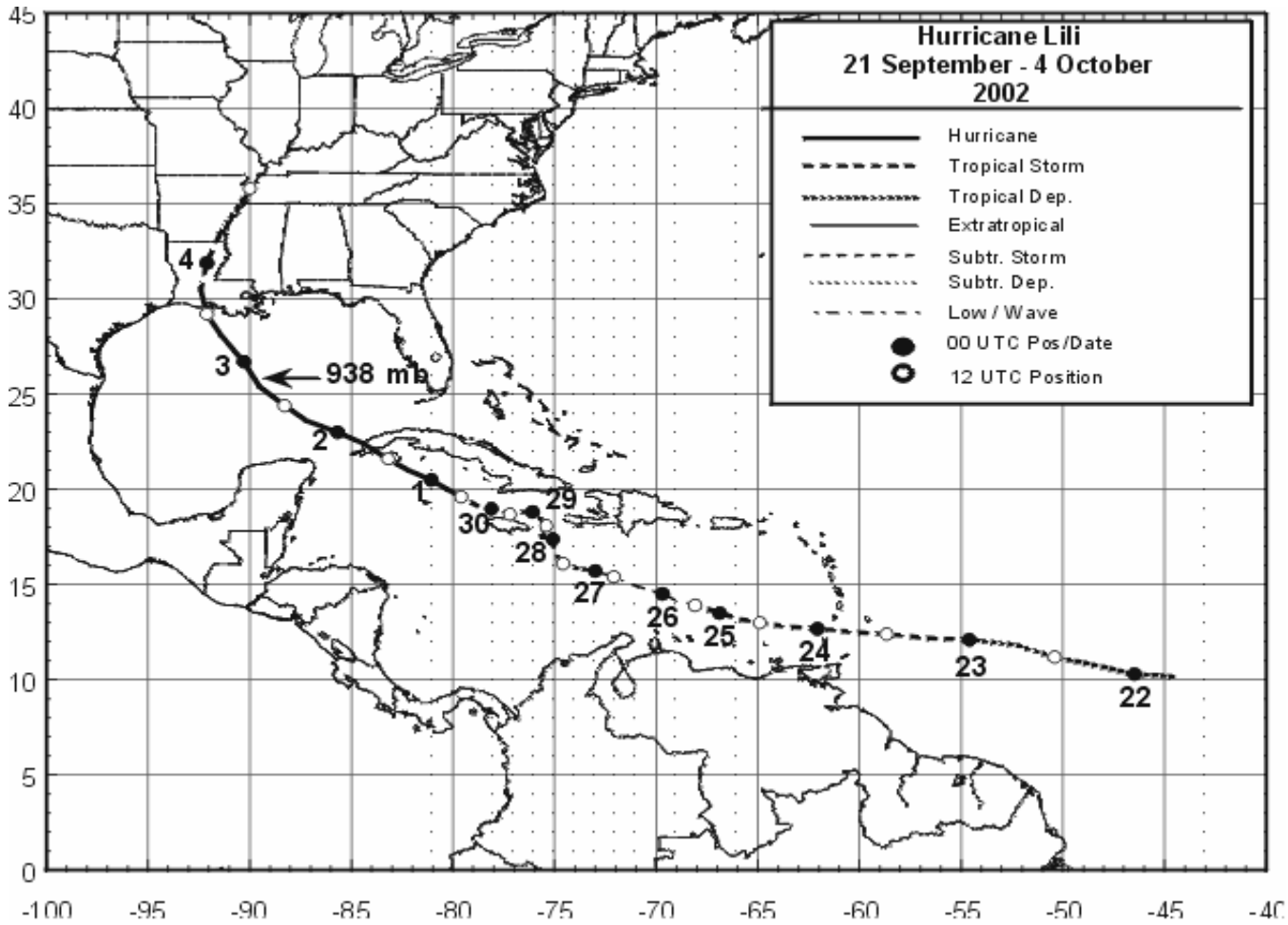
Forecast Technique	Period (hours)				
	12	24	36	48	72
CLP5	38 (33)	87 (29)	142 (25)	213 (21)	341 (19)
GFDI	30 (33)	51 (29)	72 (25)	89 (21)	178 (19)
LBAR	33 (33)	58 (29)	76 (25)	84 (21)	124 (19)
AVNI	36 (33)	66 (29)	90 (25)	99 (21)	141 (19)
AEMI	45 (26)	77 (23)	99 (20)	104 (16)	162 (15)
BAMD	40 (33)	67 (29)	87 (25)	96 (21)	151 (19)
BAMM	35 (33)	57 (29)	70 (25)	**71 (21)**	132 (19)
BAMS	43 (33)	72 (29)	89 (25)	90 (21)	120 (19)
NGPI	37 (33)	**53 (29)**	80 (25)	89 (21)	147 (18)
UKMI	38 (32)	70 (29)	91 (25)	102 (21)	135 (18)
GUNS	30 (32)	**49 (29)**	**65 (25)**	**67 (21)**	**95 (17)**
GUNA	**27 (32)**	**49 (29)**	**65 (25)**	**68 (21)**	**93 (17)**
OFCL	30 (33)	54 (29)	73 (25)	84 (21)	115 (19)
Official mean (1992-2001)	43 (2199)	81 (1965)	115 (1759)	148 (1580)	222 (1272)
Intensity errors (kt)					
SHF5	13 (33)	17 (29)	19 (25)	21 (21)	27 (19)
SHIP	13 (33)	16 (29)	16 (25)	19 (21)	24 (19)
GFDI	14 (33)	18 (29)	20 (25)	20 (21)	26 (19)
AVNI	13 (33)	19 (29)	21 (25)	25 (21)	30 (19)
UKMI	15 (27)	20 (24)	20 (20)	21 (16)	25 (12)
OFCL	9 (33)	13 (29)	13 (25)	14 (21)	21 (19)
Official mean (1992-2001)	7 (2198)	11 (1963)	14 (1760)	16 (1576)	19 (1272)

*Output from these models was unavailable at time of forecast issuance.

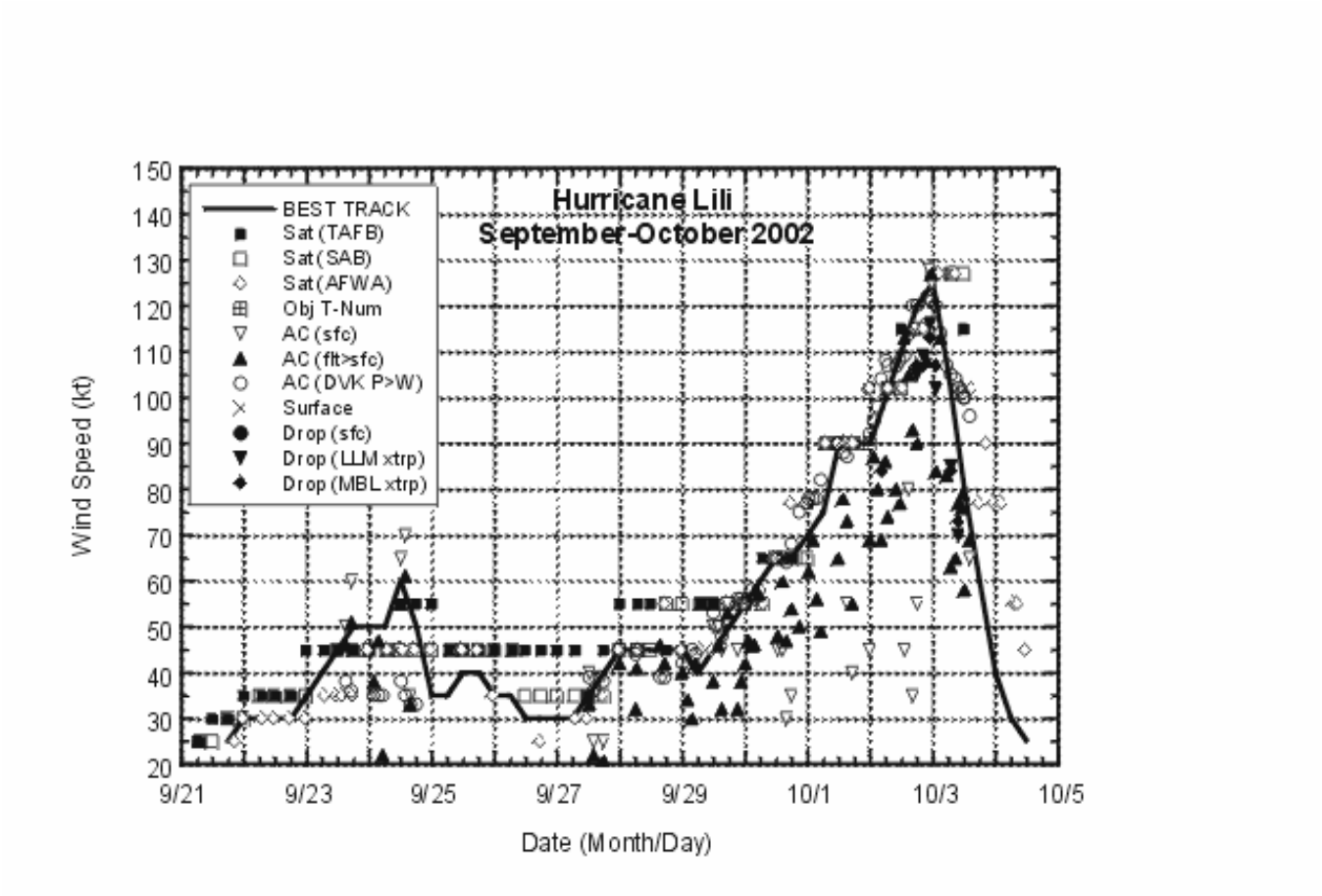
Watch and Warning Summary
Hurricane Lili
September 21 – October 4, 2002

Date/Time	Action	Location
22/2100	Tropical storm watch	Guadeloupe to Grenadines including Barbados
23/1800	Tropical storm warning	St Lucia to Grenadines including Barbados
24/0300	All watches and warnings discontinued	Lesser Antilles
24/1500	Tropical storm watch	S. Coast of Dominican Republic from Punta Galente to Haiti border
24/1800	Tropical storm watch	S. Coast of Haiti
25/2100	Tropical storm watch	Jamaica
26/1500	All watches discontinued	Hispaniola and Jamaica
27/0900	Tropical storm warning	Jamaica
27/2100	Tropical storm warning	Haiti
27/2100	Tropical storm watch	Cuba provinces of Camaguey, Las Tunas, Granma, Santiago de Cuba
28/0300	Tropical storm warning	Cuba: Granma, Santiago de Cuba, Guantanemo, Holguin
28/0300	Tropical storm watch	All of Cayman Islands
28/0600	Tropical storm watch discontinued	Cayman Island, still in effect for Little Cayman and Cayman Brac
29/0300	Tropical storm warning	Cuba: Camaguay, Las Tunas
29/0300	Tropical storm watch	Cuba: Matanzas, Cienfuegos, Villa Clara, Sancti Spiritus, Ciego de Avila
29/1500	Tropical storm warning	Little Cayman and Cayman Brac
29/1500	Tropical storm watch	Grand Cayman
29/1800	Tropical storm warning	Grand Cayman
29/2100	Hurricane watch	Cuba: Matanzas, Ciudad de la Habana, La Habana, Pinar del Rio, Isle of Youth
30/0000	Hurricane warning	All of Cayman Islands
30/0300	Tropical storm warning	All of Cuba
30/1500	Hurricane warning	Cuba: Matanzas, Ciudad de la Habana, La Habana, Pinar del Rio, Isle of Youth
30/1800	Tropical storm warning discontinued	Jamaica
30/2100	Tropical storm watch	Mexico: Cozumel to Progreso
30/2100	Tropical storm watch	Mexico: Cozumel to Progreso
01/0900	Tropical storm warning discontinued	Cienfuegos, Villa Clara, Sancti Spritus, Ciego de Avila, Granma, Santiago de Cuba, Guantanemo, Holguin, Camaguay, Las Tunas
01/1200	Hurricane warning discontinued	Cayman Islands
01/2100	Hurricane watch	San Louis Pass, Texas to mouth of Mississippi River, Louisiana
01/2100	Tropical storm watch	East of mouth of Mississippi River to Pascagoula, Mississippi including New Orleans and Lake Ponchartrain
02/0000	Hurricane warning discontinued	Cuba: Matanzas, Ciudad de la Habana, La Habana, Pinar del Rio, Isle of Youth
02/0900	Hurricane warning	East of High Island, Texas to mouth of Mississippi River
02/0900	Tropical storm warning	Freeport to High Island, Texas and east of mouth of Mississippi River to Alabama/Florida border including New Orleans and Lake Pontchartrain
02/0900	Tropical storm watch discontinued	Mexico: Cozumel to Progreso
03/0900	Tropical storm warning discontinued	Freeport to High Island, Texas
03/1900	All warnings discontinued	U.S. Gulf of Mexico coast

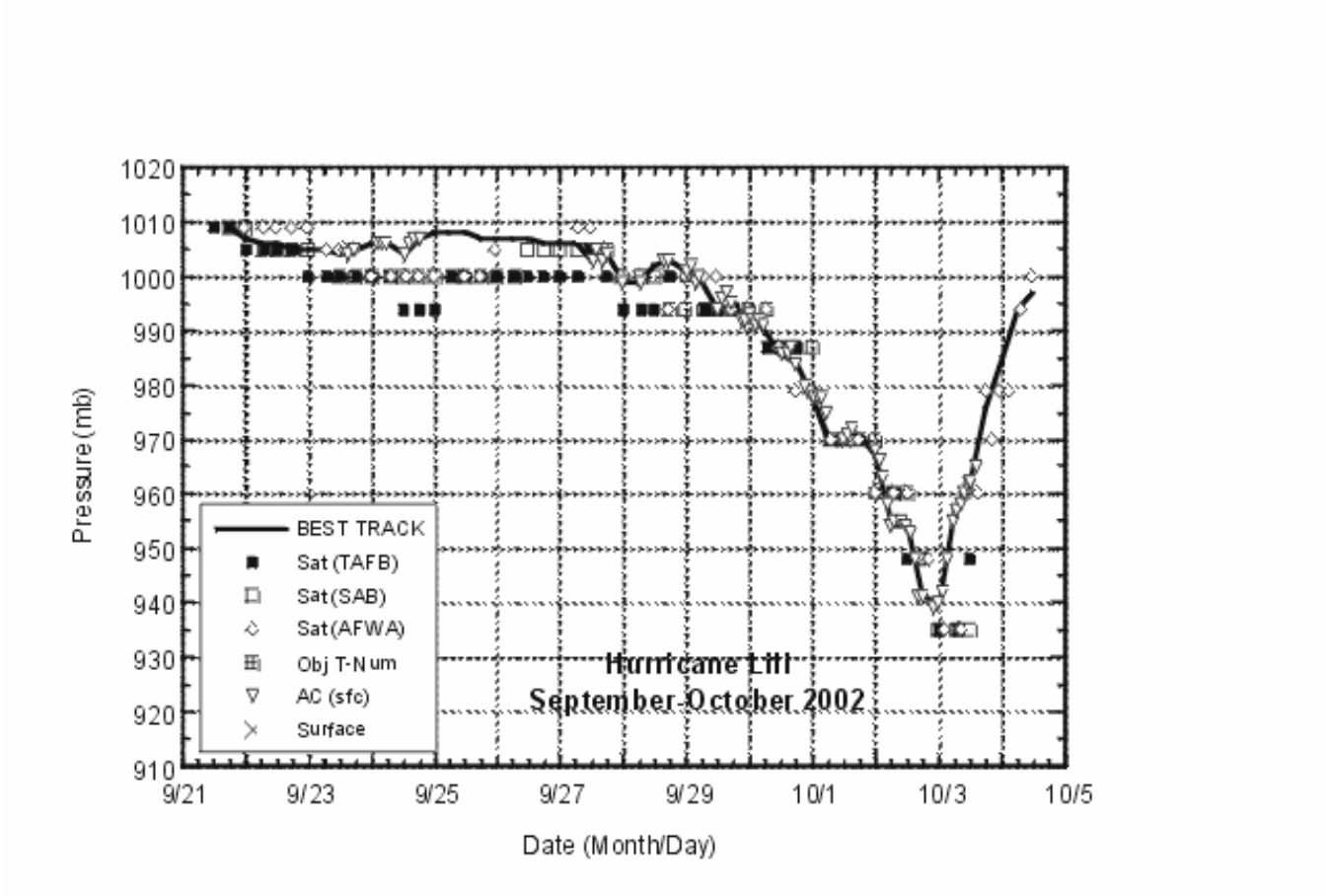
Best track positions for Hurricane Lili, 21 September - 4 October 2002.



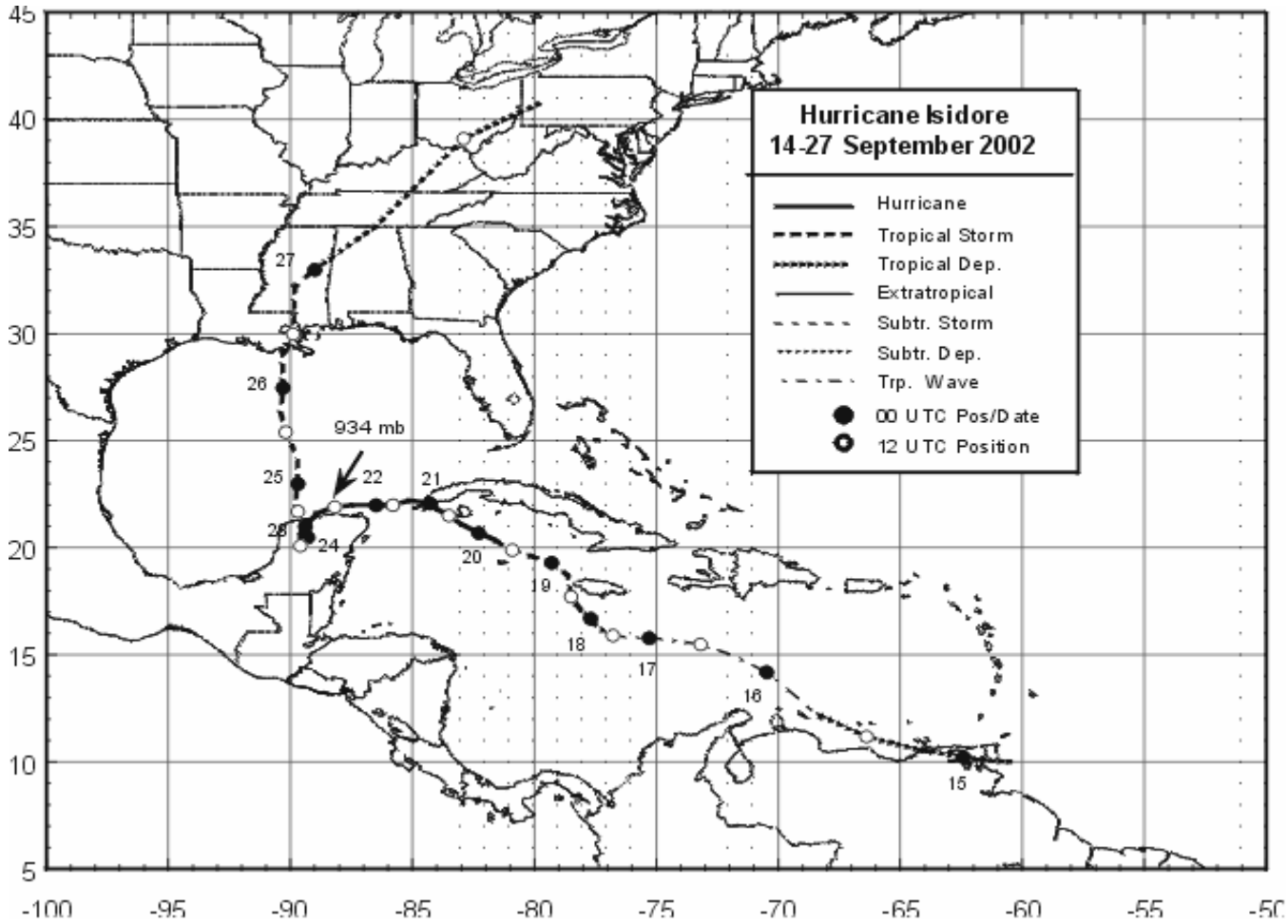
Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Lili, 21 September - 4 October 2002. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM) and from the sounding boundary layer mean (MBL).



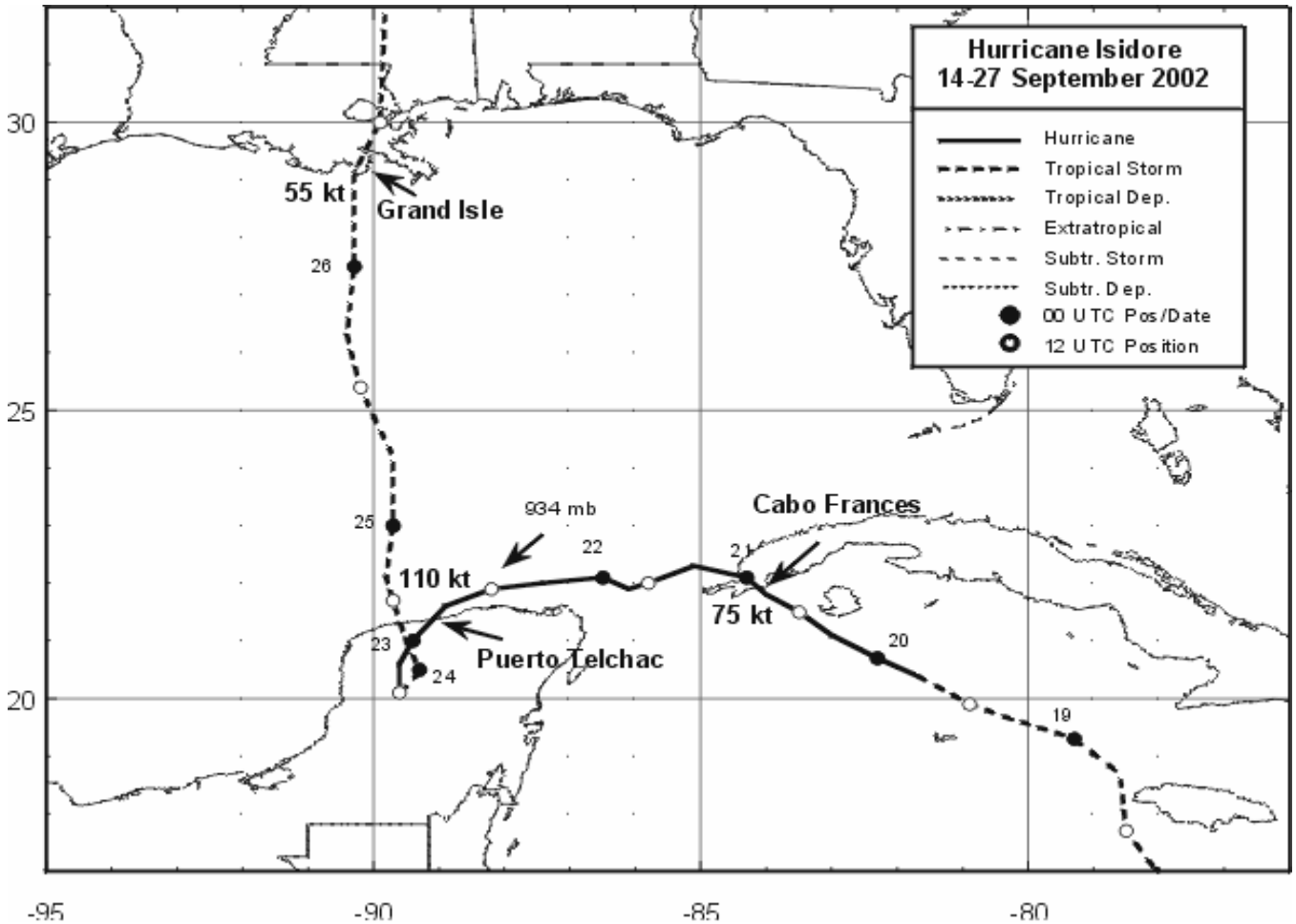
Selected pressure observations and best track minimum central pressure curve for Hurricane Lili, 21 September - 4 October 2002



Best track positions for Isidore, 14- 27 September 2002.
Track after 0000 UTC 27 September, based on analyses from NOAA Hydrometeorological Prediction Center.



Best track positions for Isidore, 14- 27 September 2002 denoting the landfall points.


Hurricane Isidore
14-27 September 2002
Hurricane
Tropical Storm
Tropical Dep.
Extratropical
Subtr. Storm
Subtr. Dep.
00 UTC Pos/Date
12 UTC Position
55 kt
Grand Isle
26
25
25
934 mb
22
110 kt
23
24
Puerto Telchac
21
Cabo Frances
75 kt
20
19
30
25
20
-95
-90
-85
-80

Appendix C

Permanent Resident Response to Hurricane Lili

And

Hurricane Lili Behavioral Questionnaire

Followed by

Statistical Reliability of Survey Results Statement

Prepared by

Dr. Jay Baker, Hazards Management Group

Permanent Resident Public Response To Hurricane Lili

(Prepared by Hazards Management Group)

Hazards Management Group provides the narrative below for the post Hurricane Lili evacuation assessment and focuses on describing the evacuation behavior of permanent residents in Texas and Louisiana during the Hurricane Lili event. A graphical representation has been included to show the locations of the behavioral surveys.

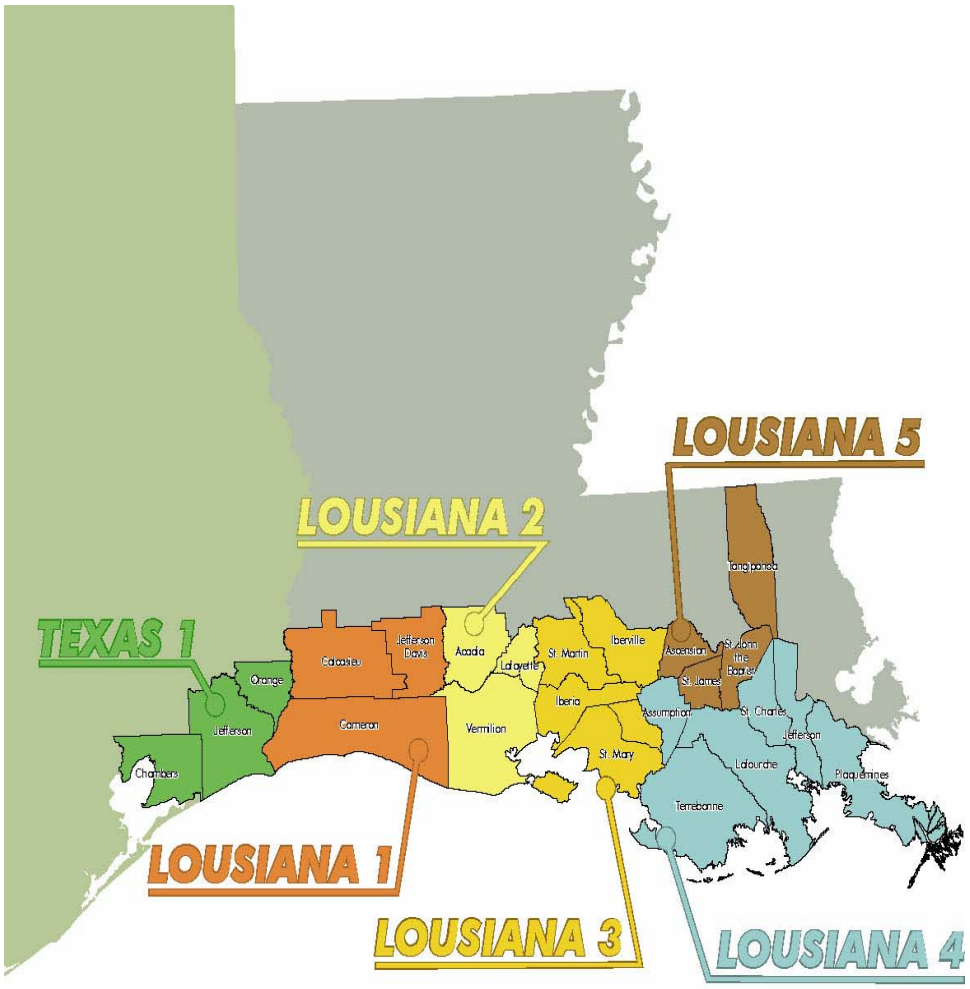
Introduction

In May and June of 2003 telephone interviews were conducted with residents in Louisiana and Texas to document their response in Hurricane Lili in October of 2002. Questions dealt with evacuation behavior in Lili and with factors that might help explain variations in evacuation behavior. The complete questionnaire is attached as Appendix C to this report.

A total of 1,802 interviews were completed, with approximately 300 interviews in each of six clusters of counties and parishes. The clusters were defined as follows:

- Texas Jefferson, Orange, and part of Chambers Counties
- Louisiana 1 Cameron, Calcasieu, and Jefferson Davis Parishes
- Louisiana 2 Vermilion, Acadia, and Lafayette Parishes
- Louisiana 3 Iberia, St. Mary, St. Martin, Iberville Parishes
- Louisiana 4 Terrebonne, Assumption, Lafourche, St. Charles, southern Jefferson, and southern Plaquemines Parishes
- Louisiana 5 Ascension, St. James, St. John, and southern Tangipahoa Parishes

Responses to most questions in the survey are reported in tables with data shown for each of the six clusters of parishes and counties. For brevity, the numbers used in the above list labels Louisiana clusters in the tables. The numbers and clusters increase from west to east. **In all the data tables, figures refer to percent of respondents answering the question posed, unless otherwise indicated, N refers to the number of interviews completed.**



TEXAS 1	Jefferson, Orange, Chambers Counties
LOUSIANA 1	Cameron, Calcasieu, Jefferson Davis Parishes
LOUSIANA 2	Vermilion, Acadia, Lafayette Parishes
LOUSIANA 3	Iberia, St. Mary, St. Martin, Iberville Parishes
LOUSIANA 4	Terrebonne, Assumption, Lafourche, St. Charles, Jefferson, Plaquemines Parishes
LOUSIANA 5	Ascension, St. James, St. John the Baptist Parishes

Evacuation Behavior in Lili

Evacuation Participation Rate

In most of interview locations between 40% and 56% the respondents said they left their homes to go someplace safer in Lili. Landfall occurred near Intracoastal City, Louisiana, located in the "LA 2" cluster, where response was highest. The easternmost area (LA 5) included parishes in which officials did not recommend widespread evacuation and which were outside the National Hurricane Center's warning area for Lili. All other survey locations were within the warning area, except for most of Chambers County in Texas.

Evacuation in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Evacuation in Lili	40	49	56	54	40	24

In Texas evacuation was recommended for all of the two largest counties in the survey (Jefferson and Orange), but in Louisiana the recommended evacuation areas varied among and within survey clusters. In some cases recommendations applied to entire parishes, and in others to just portions of the parishes. To help break down the Louisiana sample with respect to evacuation recommendation areas and risk, the sample was divided using three indicators: I-10, U.S. 90, and whether the parish fronted the Gulf of Mexico. Respondents were then asked whether they lived north or south of the highways to determine placement of their response into the six clusters. .

Evacuation averaged about 10 percentage points higher south of I-10 than north of I-10, with the difference being greater in the western parishes than in the eastern parishes. Differences north and south of U.S. 90 were smaller, averaging just 5 percentage points. U. S. 90 is south of I-10 throughout most of the Louisiana study area, but there was little difference in response south of U.S. 90 and south of I-10. The greatest distinction was between parishes directly on the Gulf of Mexico versus those inland. Parishes on the Gulf had evacuation participation rates averaging 30 percentage points higher than parishes to their north.

Evacuation in Lili by interview location in Louisiana north and south of I-10

	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
North of I-10	37	44	47	35	21
South of I-10	55	59	55	40	26

Evacuation in Lili by interview location in Louisiana north and south of US 90

	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
North of US 90	42	58	55	37	29
South of US 90	58	59	56	41	23

Evacuation in Lili by interview location in Louisiana by Gulf and non-Gulf parishes

	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Non-Gulf	46	45	38	57	24
Gulf	91	72	62	35	N/A

Preparations to Leave

People who said they did not evacuate were asked whether they would have left if it had looked like Lili was going to hit their location directly. More than half in all locations said they would have evacuated in that case. Respondents who did not evacuate in Lili were also asked whether they had made preparations to go someplace safer in case the threat had worsened. Slightly more than half said they had done so.

Would have evacuated in Lili if track were more direct, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=180)	(N=155)	(N=133)	(N=138)	(N=183)	(N=224)
Yes	59	57	50	55	60	55
No	33	38	43	41	32	34
Don’t Know	8	5	7	4	9	11

Made preparations to evacuate in Lili by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=180)	(N=155)	(N=133)	(N=138)	(N=183)	(N=224)
Yes	61	56	50	58	57	55
No	39	42	49	42	42	43
Don't Know	1	2	1	0	1	2

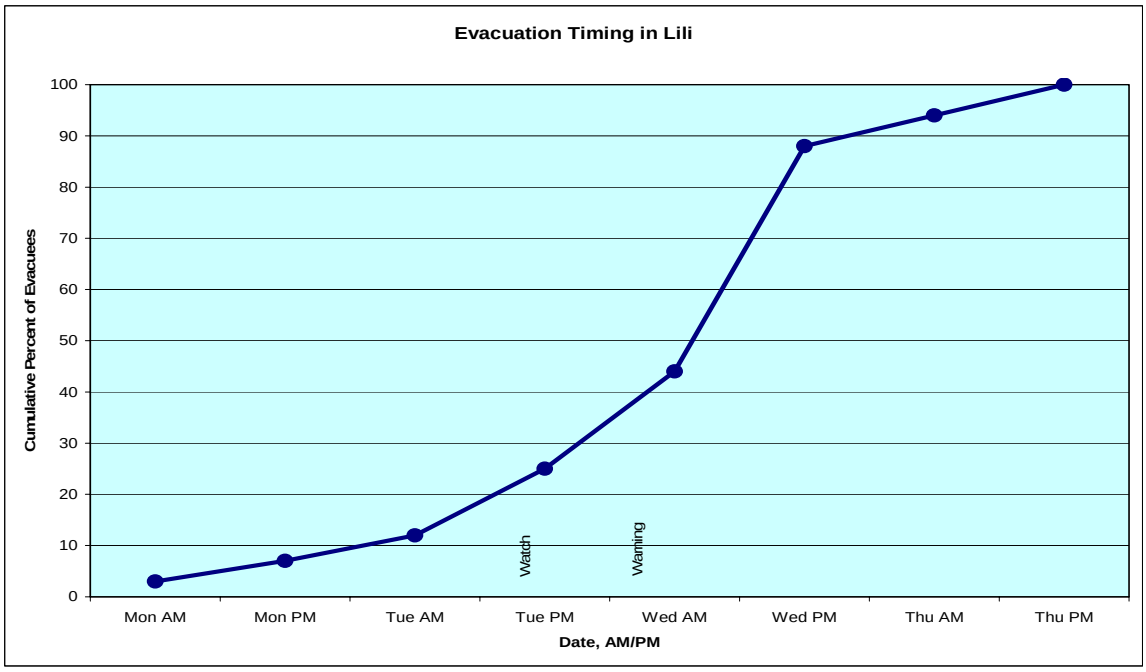
Evacuation Timing

A hurricane watch was issued by the National Hurricane Center at 4 PM on Tuesday, October 1, 2002 and included the entire coastal portion of the study area except for the easternmost cluster of parishes in Louisiana. The following morning at 4 AM a hurricane warning was issued for most of the same area, excluding most of Chambers County, Texas. Landfall occurred at 8 AM on Thursday. Timing of evacuation advisories varied among parishes and counties. Respondents who said they evacuated in Lili were reminded of the dates and times when the watch and warning were issued and when landfall occurred, and then asked when they left their homes. About 12% of the evacuees said they couldn't recall the day they left. Departure dates of those who did give a response are shown in the following table. A graph depicting cumulative evacuation for the entire study area is shown also on the following page.

Evacuation timing in Lili by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=99)	(N=136)	(N=151)	(N=146)	(N=98)	(N=61)
Mon Sep 30 or before	12	2	7	3	12	13
Tues Oct 1	21	16	12	23	22	18
Wed Oct 2	60	71	70	63	50	44
Thurs Oct 3	7	10	11	11	15	25

Cumulative evacuation response in Lili



If recollections are correct there was substantial evacuation prior to when the warning was issued. However, it was substantial in locations where the eventual evacuation participation rate was highest. That suggests that evacuation probably commenced in all locations around the same time, but continued longer, with more of the population evacuating, in the areas that eventually proved at greatest risk of landfall. According to respondents some evacuation continued on Thursday, even following landfall.

Travel Times

The time required to reach evacuation destinations is shown in the following table. In all locations most evacuees took 3 hours or less to reach their destinations, with times being longer in Texas than Louisiana. Evacuees were also asked how long they expected the trip to take and how long it normally takes. Actual travel times were longer than anticipated and normal times, but not greatly.

Travel times in Lili, by interview location (excluding "don't know" responses)

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=119)	(N=146)	(N=163)	(N=152)	(N=116)	(N=69)
.5 hr	3	9	31	14	22	29
1 hr	9	33	31	26	27	55
1.5 to 3 hrs	37	21	18	26	22	7
3.5 to 6 hrs	35	23	14	22	18	6
Over 6 hrs	16	14	7	13	10	3

Anticipated travel times in Lili, by interview location (excluding "don't know" responses)

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=103)	(N=141)	(N=157)	(N=144)	(N=112)	(N=68)
.5 hr	6	11	38	16	25	41
1 hr	9	33	24	27	29	41
1.5 to 3 hrs	47	29	20	31	27	10
3.5 to 6 hrs	31	21	15	21	14	2
Over 6 hrs	8	6	3	6	5	6

Normal travel times in Lili, by interview location (excluding "don't know" responses)

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=108)	(N=139)	(N=157)	(N=142)	(N=112)	(N=67)
.5 hr	7	14	41	20	28	43
1 hr	15	32	26	28	29	42
1.5 to 3 hrs	49	34	19	32	26	9
3.5 to 6 hrs	25	17	12	15	15	5
Over 6 hrs	5	3	3	4	3	2

Type of Refuge

Most evacuees went to the homes of friends and relatives. Except in the easternmost cluster of parishes in Louisiana, where the threat was lowest and the fewest evacuated, public shelter use

was below 10%. The "other" category included people going to churches, second homes, and places of work.

Type of refuge used in Lili by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=117)	(N=149)	(N=166)	(N=159)	(N=121)	(N=72)
Public Shelter	9	2	5	7	3	17
Friend/Relative	56	67	69	58	65	67
Hotel/Motel	27	23	15	29	27	8
Other	15	19	21	20	15	9

Location of Refuge

Except in the eastern, non-coastal parishes of Louisiana, the majority of evacuees left their own parishes or counties. In Texas 86% of the evacuees left their own counties. Of those who left their counties in Texas, almost all went to destinations in Texas. In Louisiana state destinations varied by location in Louisiana. In the southwestern parishes 41% of the out-of-parish evacuees went into Texas.

Location of refuge in Lili by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=118)	(N=148)	(N=167)	(N=160)	(N=121)	(N=72)
Own Neighborhood	5	10	24	17	20	51
Own Parish/County	9	18	17	11	17	15
Out of Parish/County	86	73	59	73	63	33

State where refuge was located, among Lili evacuees leaving their own parish or county, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=102)	(N=109)	(N=99)	(N=116)	(N=76)	(N=24)
Louisiana	1	53	76	66	54	63
Texas	96	41	17	14	5	4
Arkansas	1	3	5	2	1	8
Mississippi	0	2	2	9	22	13
Other	2	1	0	10	17	13

Vehicle Use

In the following table three aspects of vehicle use are shown. Overall, approximately 70% of the vehicles available to evacuating households were used in the evacuation. The actual number of vehicles used per household ranged from 1.14 to 1.53, depending on location. Texas evacuees were more likely than those in Louisiana to pull a trailer or take a motor home.

Vehicle use in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=119)	(N=149)	(N=168)	(N=160)	(N=121)	(N=72)
Percent of Available Vehicles Used	70	78	67	66	68	68
Vehicles per Evacuating Household	1.18	1.53	1.36	1.31	1.29	1.14
Pulled Trailer or Took Motor home	11	7	4	5	7	5

In most instances in which no vehicles were available to evacuating households, evacuees left with a friend or relative. Relatively few households required assistance from an agency in order to evacuate or receive special care in a shelter.

Assistance from agency required in Lili evacuation, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=117)	(N=148)	(N=160)	(N=155)	(N=119)	(N=64)
Assistance Required	2	3	4	6	4	5

Information Sources

Interviewees were provided a list of sources of information and asked how much they relied on each for information about Lili. The next table indicates the percentage of respondents saying they relied a "great deal" on the sources. Local television was the most relied-upon source in all locations. The Weather Channel on cable television was the second-most popular source of information except for one of the Louisiana locations were local radio was relied upon more. Fewer than 10% of the respondents in all locations said they relied a great deal on the Internet for storm information. About 20% said they relied on the Internet at least a little.

Information sources relied upon a "great deal" in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Local Radio	25	42	50	42	35	43
Local TV	70	74	75	77	77	76
CNN	14	15	15	15	21	20
Weather Channel	44	52	44	47	59	49
Other Cable TV	15	19	19	16	28	21
Internet	8	7	7	8	5	7
AOL	2	4	3	3	4	4
Word of Mouth	11	23	20	19	18	13

People who relied a great deal on local television were more likely than others to evacuate in Lili (45% vs. 37%). Word of mouth was a stronger predictor. Of those who said they relied upon word of mouth a great deal, 52% evacuated in Lili, compared to 39% of others. Reliance on other types of information sources was not related to whether respondents evacuated in Lili.

Fewer than half the respondents felt that any one of the categories of media information sources provided more accurate information than others. Of those who did believe one was more accurate than others, most named local television, followed by The Weather Channel.

One media information source more accurate than others in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Yes	44	33	42	39	46	38
No	53	65	56	57	48	59
Don't Know	4	2	2	3	6	3

Most accurate media information source in Lili, among respondents saying one source was more accurate than others, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=130)	(N=100)	(N=126)	(N=117)	(N=139)	(N=111)
Local Radio	4	8	14	6	4	5
Local TV	47	53	46	53	48	60
CNN	5	3	2	0	1	1
Weather Channel	25	27	29	25	34	17
Other Cable TV	9	2	3	8	5	5
Internet	8	5	2	3	4	5
AOL	1	0	0	0	0	0
Don't Know	2	2	3	6	4	6

Even fewer of the respondents indicated that one of the media information sources provided less accurate information than the others. There was no clear-cut "loser".

One information source less accurate than others in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Yes	10	12	12	10	12	6
No	83	85	83	83	82	90
Don't Know	7	3	5	7	6	3

Least accurate media information source in Lili, among respondents saying one source was less accurate than others, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=30)	(N=37)	(N=35)	(N=30)	(N=37)	(N=19)
Local Radio	27	3	14	13	5	21
Local TV	13	14	14	10	51	21
CNN	17	8	9	23	8	0
Weather Channel	20	19	17	7	16	26
Other Cable TV	17	5	9	3	5	5
Internet	3	14	0	3	3	0
AOL	0	5	0	3	0	0
Don't Know	3	33	37	37	11	26

A large majority said the information provided by the media about Lili was generally helpful. A comparable percentage said the media information was consistent.

Information provided by media was generally helpful in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Generally Helpful	90	92	93	93	89	96
Generally Not Helpful	4	5	4	2	6	3
Mixed	4	2	3	4	4	1
Don't Know	2	1	0	1	1	0

Information provided by media was generally consistent in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Generally Consistent	85	89	88	84	83	91
Mainly Consistent	10	6	8	11	9	6
Not Consistent	2	3	3	3	6	2
Don't Know	3	2	1	2	2	1

Explaining Variations in Response

Reasons Given for Staying or Leaving

People who did not evacuate in Lili were asked an open-ended question about what made them decide not to leave their home to go someplace safer. The responses for the aggregate sample are given in the following table. Most respondents said they stayed because the storm wasn't strong enough to pose a threat to their safety, given the location and construction of their home. The second most frequent explanation was that the storm was forecast to strike elsewhere. Few respondents offered constraints such as jobs and lack of transportation, although 10% indicated they had no place to go if they evacuated.

Reasons offered for not evacuating in Lili (percent of non-evacuees; multiple responses given by some respondents)

Home Safe, Given Strength of the Storm	54
Forecast to Hit Other Location	39
Officials Didn't Say to Evacuate	19
Traffic Heavy/Waited Too Late to Leave	12
No Place to Go	10
Job Required Staying	6
Advice of Friend/Relative	5
Wanted to Protect Property from Storm	3
No Place to Take Pets	3
Wanted to Protect Property from Looters	2

A similar question was asked of those who did evacuate. They were asked what convinced them to go someplace safer, and responses for the aggregate sample are given in the following table. Concerns about the strength of the storm and its effects were mentioned by slightly more than half the sample, but half also cited recommendations made by public officials, which included elected officials, law enforcement, and the National Weather Service.

Reasons offered for evacuating in Lili (percent of evacuees; multiple responses given by some respondents)

Concern about Strength of Storm, Severity of Effects	54
Advice from Officials	50
Anticipated Track	22
Advice from Friends/Relatives	23
Advice from Media	14
Experience in Previous Storms	11
National Hurricane Center Watch/Warnings	3

All respondents were given a list of factors and asked which was most influential in their decision to go or stay. A plurality of people wouldn't name a single factor as being most important, and instead attributed their decision to a combination of influences. Interviewees were about equally divided between the forecast track and severity being the most important factors in their decisions. Among those who evacuated, severity of the storm was mentioned more frequently. Among those who did not evacuate, track was mentioned more often.

Most important factor in decision whether to evacuate in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Forecast Track	24	16	14	20	19	25
Forecast Severity	18	25	24	17	20	23
Official Statements	8	10	5	8	5	6
Media Statements	13	7	10	17	15	14
Combination	29	37	41	31	35	28
Don't Know	4	2	2	4	3	2

Notices from Public Officials

All respondents were asked whether they heard public officials say they should evacuate. Specifically, they were asked whether during the threat they heard, either directly or indirectly,

anyone in an official position – such as elected officials, emergency management officials, and law enforcement – say that the respondent and people in the respondent's location should evacuate to a safer place. To avoid any misinterpretation, the question was rephrased, and respondents were asked whether state or parish officials issued any kind of evacuation notice that applied to the respondent, that the respondent was aware of at the time it was issued. Interviewees who said they did hear such a notice were asked whether officials recommended that people should evacuate or whether officials said it was mandatory that people must evacuate. Results are shown in the next table.

Evacuation notice heard from officials in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Mandatory Order	6	9	16	28	15	3
Recommendation	47	39	26	30	29	20
Neither	47	53	58	43	56	77

In most locations fewer than half the respondents said they heard any sort of evacuation notice from officials at all, and few in any location said they heard mandatory orders to evacuate. In Louisiana respondents in parishes on the Gulf were more likely than others to hear evacuation notices (57% vs. 36%), and people living south of I-10 were more likely than those north of I-10 to hear them (46% vs. 32%). There were no differences north and south of U.S. 90.

The importance of hearing, or believing that one heard, evacuation notices from public officials is suggested by the data in next table. ***Overall, if residents believed they heard mandatory evacuation notices from officials, 77% evacuated, compared to 53% who evacuated if they heard recommendations, and 30% who evacuated if they heard neither.*** The pattern was found in all six-survey locations, although it was more pronounced in some places than others.

Evacuation participation rate in Lili, by notice heard from officials, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	Percent Evacuated in Lili					
If Heard Mandatory Order	(N=19) 74	(N=26) 77	(N=48) 83	(N=83) 80	(N=46) 70	(N=10) 80
If Heard Recommendation	(N=140) 50	(N=117) 63	(N=79) 65	(N=88) 49	(N=88) 42	(N=59) 44
If Heard Neither	(N=140) 25	(N=161) 34	(N=174) 44	(N=127) 40	(N=170) 31	(N=227) 17

A substantial majority of respondents in all locations said the information provided by their local officials was helpful in deciding whether to evacuate. Smaller majorities said their local officials seemed very certain in their messages about whether it was necessary to evacuate in Lili. In most locations more than half the respondents said they had a great deal of confidence in the ability of their local officials to decide whether evacuation was necessary in hurricane threats. When asked whether their officials tended to call for evacuation too often, not often enough, or about the right amount of time, most people said their officials called for evacuation about the right amount of time. Respondents were more likely to evacuate in Lili if they said information provided by officials was helpful, if officials were definite in their messages in Lili, and if they had confidence in their officials.

Helpfulness of information provided by local officials in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Generally Helpful	78	84	73	77	73	65
Generally Not Helpful	8	10	14	13	16	20
Mixed	3	3	4	3	5	6
Don’t Know	11	4	9	6	7	9

Definiteness of evacuation information provided by local officials in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Very Certain	51	65	58	61	53	42
Fairly Certain	23	19	19	18	22	20
Generally Not Certain	9	7	9	10	11	16
Depends on Official	3	1	<1	2	1	1
Sometimes Certain	2	2	2	3	2	1
Don't Know	11	6	12	6	11	18

Confidence in ability of local officials to make evacuation decisions, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
Amount of Confidence	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Great Deal	49	63	62	57	57	41
Fair Amount	35	26	23	26	24	35
Little	11	7	12	11	11	17
None	2	2	1	4	3	2
Don't Know	3	2	2	2	5	5

Perceived bias by local officials in calling for evacuation, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Too Often	10	10	10	12	9	14
Not Often Enough	4	8	9	11	7	10
About Right	78	77	71	70	78	64
Don't Know	8	5	9	6	6	11

Perceived Vulnerability

Respondents were asked two questions about the safety of their residences in three different intensities of hurricanes. The two questions asked 1) whether one's home would flood

dangerously and 2) if it would be safe to stay in one's home, considering both wind and water. The three intensities of storm were related to the intensity of Lili at various times: a 145 MPH category 4 at its peak, a 125 MPH category 3 later, and a 95 MPH category 2 at landfall. In each case the storm was described in terms normally used such as "dangerous" or "major" and it was explained that the Saffir-Simpson scale has a maximum category of 5. Interviewees were asked whether their homes would have been safe if Lili had passed directly over their location with winds of each of the three intensities. Results appear in the next six tables.

Believed home would flood dangerously in 145 MPH hurricane, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Would Flood	57	58	57	59	55	44
Would Not Flood	32	37	40	37	38	52
Don't Know	11	5	3	4	7	5

Believe home would be a safe place in 145 MPH hurricane, considering wind and water, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Would be Safe	29	32	25	29	33	35
Would Not Be Safe	63	62	70	66	62	58
Don't Know	9	6	4	5	6	7

Believed home would flood dangerously in 125 MPH hurricane, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Would Flood	48	49	42	47	42	38
Would Not Flood	40	44	54	45	49	57
Don't Know	13	7	4	8	9	5

Believe home would be a safe place in 125 MPH hurricane, considering wind and water, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Would be Safe	34	42	38	39	46	46
Would Not Be Safe	51	51	58	56	45	49
Don't Know	14	7	4	5	9	6

Believed home would flood dangerously in 95 MPH hurricane, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Would Flood	32	33	28	30	30	27
Would Not Flood	55	61	70	64	63	69
Don't Know	14	7	2	6	8	4

Believe home would be a safe place in 95 MPH hurricane, considering wind and water, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Would be Safe	50	58	56	56	57	56
Would Not Be Safe	38	34	41	40	36	37
Don't Know	12	8	4	3	7	7

In category 4 hurricanes slightly more than half the respondents said their homes would flood dangerously, and slightly larger majorities (ranging from 58% to 70%) said their homes would not be safe, considering both wind and water. In Louisiana there was little difference (about 5 percentage points) between respondents living in parishes on the Gulf and inland or in parishes north or south of I-10. In strong category 3 hurricanes fewer than half the interviewees said their

homes would flood dangerously, and 45% to 58% said their homes would be unsafe. In a 95 MPH storm most people said their homes would be safe and would not flood dangerously.

All respondents in the survey were asked how they came to believe their homes would be safe or unsafe in hurricanes, and answers for the aggregate sample are presented in the next table. Most people (67%) attributed their beliefs to personal experience with past storms in their current home. A large number (39%) cited knowledge about how their home was constructed.

Reasons given for belief about vulnerability of home (percent of evacuees; multiple responses given by some respondents)

Past Storm Experience in Current Home in LA/TX	67
Knowledge about Construction of Current Home	39
Knowledge about Location of Current Home	22
Past Storm Experience in Other Home in LA/TX	10
Elevation of Home Site	9
Observation of Experience of Others in LA/TX	5
Past Storm Experience in Other Locations	4
Information from Media	4
Information from Builder	4
Information from Officials	4
Observation of Experience of Others in Other Locations	2
Information from Neighbors	2
Don’t Know	7

People who believe their homes would be unsafe were more likely to evacuate in Lili by about 20 percentage points (e.g., 51% vs. 32% for category 4 storms). The differential varied from place to place, but the pattern was present in all survey locations.

Evacuation participation rate in Lili, by perceived safety, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
Perceived Safety	*Percent Evacuated in Lili*					
Flood in Cat 4	44	54	69	62	49	29
Won't Flood in Cat 4	27	44	37	41	25	20
Safe in Cat 4	34	40	42	36	27	13
Not Safe in Cat 4	45	55	63	62	49	32
Flood in Cat 3	49	56	73	65	52	30
Won't Flood in Cat 3	28	44	45	44	28	21
Safe in Cat 3	30	38	45	36	26	13
Not Safe in Cat 3	48	60	65	67	57	33
Flood in Cat 2	50	50	72	64	56	31
Won't Flood in Cat 2	34	50	50	49	31	21
Safe in Cat 2	34	44	49	45	27	17
Not Safe in Cat 2	46	60	66	68	59	35

Taken together, perceived vulnerability and receiving evacuation orders were strong predictors of evacuation in Lili. ***In Louisiana Gulf parishes, for example, 90% of the respondents evacuated in Lili if they said they heard mandatory evacuation orders AND they believed their homes would not be safe in a 125 MPH hurricane. Among people living in Louisiana Gulf parishes that said they did not hear evacuation notices from officials AND said their homes would be safe in a 125 MPH hurricane, only 23% evacuated in Lili.*** The difference was almost the same in parishes not on the Gulf (84% vs. 24%).

Perceived Accuracy of Forecasts

Everyone in the sample was asked a series of questions about the accuracy of National Hurricane Center forecasts. Many respondents said they didn't evacuate because Lili was forecast to strike

a location other than their own, although a large majority of the respondents lived within the warning area posted by the National Hurricane Center.

The average error made by the National Hurricane Center when forecasting landfall location 24 hours in advance is roughly 100 miles. About a third of the respondents said the error was just 10 miles and another third said it was 50 miles. Between 11% and 17% wouldn't guess. Most people in the sample appear to have more confidence in the track forecast than is justified.

Perceived accuracy of National Hurricane Center 24-hr landfall location forecast, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
10 Miles	24	41	41	32	29	30
50 Miles	34	32	37	41	38	32
100 Miles	19	11	8	11	16	17
200 Miles	3	2	1	2	3	5
Greater Than 200 Mi.	2	1	2	1	<1	2
Don't Know	17	12	11	12	14	14

There is about as much error in forecasting the forward speed of a hurricane as there is in forecasting its direction, thereby affecting forecasts of when landfall will occur. The National Hurricane Center doesn't maintain statistics on the accuracy of arrival time forecasts, but the "along track" forecast, indicating how far along its track the storm will be after a certain number of hours, is approximately the same as the "cross track" forecast error of 100 miles for 24 hours. For a storm moving at 15 MPH (as Lili was when the watch was issued, and not uncommon for storms at that latitude in the Gulf of Mexico), the average 24-hour landfall timing error would be nearly 7 hours.

Approximately 25% of the respondents who ventured an opinion said the average 24-hour landfall error is only 30 minutes. Another 21% said it was one hour, and 24% said it was 3 hours. Thus, 70% of those interviewed and who were willing to offer an opinion said the error is smaller than the actual error, although the practical implications for response (i.e., 3 hours vs. 6 hrs) are not completely clear. Most people offering a judgment said that storms are equally likely to arrive earlier as later than forecast. Of those who thought there was a forecast bias, more thought storms are more likely to arrive later than forecast rather than earlier.

Perceived accuracy of National Hurricane Center 24-hr arrival time forecast, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
30 Minutes	14	34	30	28	19	22
1 Hour	21	17	27	20	19	19
3 Hours	25	18	22	25	25	27
6 Hours	10	13	5	12	9	13
12 Hours	9	5	4	4	7	5
18 Hours	2	2	1	2	2	2
Greater Than 18 Hrs	2	1	2	1	3	1
Don't Know	17	10	9	9	16	10

Perceived bias in National Hurricane Center 24-hr arrival time forecast, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Sooner Than Forecast	12	21	18	17	15	15
Later Than Forecast	26	22	29	28	26	29
Neither	48	49	46	49	50	48
Don't Know	14	9	7	6	9	8

The next questions inquired about the accuracy of intensity forecasts: "If they're predicting that in 24 hours the storm will have winds of 115 MPH, for example, on average, how far off do you think they are on their forecasts?" Then respondents were read a list of wind velocities from which to choose. The average error at 24 hours is around 10 MPH. (The Hurricane Center points out that average error can be misleading because in unusual circumstances a storm can intensify much more than predicted, and those are the instances that pose the greatest hazard to safety.) This is why the National Hurricane Center generally recommends that communities prepare for a storm one category stronger than what is forecast.

In this case about a third of the interviewees said the error is smaller than actual, a fourth said it is larger, about 20% wouldn't guess, and about 20% got it right. When asked whether the National Hurricane Center is more likely to overstate or understate the strength of storms when forecasting intensity, about half the respondents said they didn't think there was a bias one way or the other. More people said that storms are more likely to be weaker than forecast rather than stronger.

Perceived accuracy of National Hurricane Center 24-hr intensity forecast, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
2 MPH	10	20	18	14	12	16
5 MPH	16	19	24	23	20	21
10 MPH	21	21	17	20	23	21
20 MPH	22	13	16	17	17	17
50 MPH	6	6	8	8	7	6
Greater Than 50 MPH	2	3	2	4	3	2
Don't Know	22	17	16	13	17	18

Perceived bias in National Hurricane Center 24-hr intensity forecast, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Stronger Than F'cast	13	16	16	19	19	18
Weaker Than Forecast	24	26	30	25	29	27
Neither	48	48	45	49	43	46
Don't Know	14	10	9	8	10	10

When asked how well the National Hurricane Center does in forecasting hurricanes, compared to their favorite television weathercaster, most people said both do equally well. Of those who said one does better than the other, most favored the National Hurricane Center, by a better than 4 to 1 margin.

Perceived accuracy of National Hurricane Center forecast vs. forecasts of favorite television weathercaster, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
NHC Better	30	41	31	35	32	35
NHC Worse	8	4	9	7	6	8
Both the Same	55	52	57	54	61	54
Don't Know	7	2	4	5	2	3

In 1992 Andrew weakened significantly just before moving inland over south Louisiana, and interviewees were asked whether Andrew's unanticipated decrease in intensity had any bearing on their expectation of how strong Lili would turn out to be. In the "middle parishes" of Louisiana 44% in one cluster and 52% in another replied affirmatively. In other locations the figure was closer to 25%.

Effect of Andrew's decrease in strength before landfall on expectation of Lili's intensity, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Affected by Andrew	19	24	44	52	29	27
Unaffected by Andrew	65	60	43	38	58	55
Affected a Little	7	8	7	6	8	11
Don't Know	9	8	7	4	5	6

The implications of misconceptions about forecast error are not clear. People who believe the landfall location error is less than 200 miles were more likely to evacuate in Lili than people who believe it is 200 miles or more (45% vs. 30%). Beliefs about the magnitude of timing error were unrelated to evacuation in Lili, but people who think storms are more likely to arrive sooner than forecast rather than later were more likely to evacuate (52% vs. 42%). Belief about the magnitude of intensity forecast error were also unrelated to evacuation in Lili, but people who believe that storms are more likely to be stronger than forecast rather than weaker were more likely to evacuate in Lili (52% vs. 37%). There was no difference in evacuation in Lili with respect to confidence in National Hurricane Center versus confidence in a favorite television weather forecaster.

Having to Work

Between 25% and 33% of the surveyed households said that someone in the home had to work during the Lili evacuation. Between 10% and 23% of those households (3% to 8% of all households) said that the household did not evacuate because of someone being required to work. In an additional 2% to 7% of homes, part of the household did not leave. Between 9% and 18% said their evacuation was delayed because of work. Of the households in which someone had to work, 40% evacuated, compared to 45% of the households in which no one had to work.

Someone in household required to be working during Lili evacuation, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Yes	33	28	25	29	32	28
No	67	71	75	71	67	72
Don't Know	<1	1	<1	0	1	1

Effect of work on evacuation in Lili, among households in which someone had to work, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=99)	(N=85)	(N=74)	(N=86)	(N=96)	(N=82)
No Effect	70	60	57	62	58	76
Household Stayed	11	17	23	20	13	10
Some Stayed	5	6	3	5	7	2
Delayed Evacuation	13	18	16	13	15	9
Don't Know	1	0	1	1	7	4

Concern about Traffic

Survey participants were asked if, while deciding whether to leave, they had any concerns about attempting to evacuate and being caught on the road in traffic as the storm arrived. Between 36% and 49% percent indicated that they did have that concern. However, people expressing that concern were more likely to evacuate than those without that concern (49% vs. 37%).

Concerned about being trapped on the road in traffic during evacuation, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Yes	47	45	37	43	49	36
No	52	53	62	56	50	62
Don't Know	2	1	1	1	1	2

When asked the number of hours that would be required to completely evacuate their parish or county in a major hurricane in which all of south Louisiana and east Texas was evacuating, responses varied greatly within survey locations but were similar from one location to another. About 15% of those interviewed wouldn't venture an opinion as to times required to evacuate, and roughly a third said a complete evacuation would take 12 hours or less. Whether respondents evacuated in Lili was not related to their beliefs about the time required for an evacuation.

Time believed required to evacuate parish/county, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
6 Hrs	12	19	14	15	15	16
12 Hours	20	14	16	21	17	16
18 Hours	9	8	13	12	8	15
24 Hours	21	16	13	14	16	16
30 Hours	2	6	5	4	5	3
36 Hours	7	11	8	7	7	9
More than 36 Hours	10	11	15	13	15	12
Don't Know	19	16	17	13	18	14

Concern about Re-entry Following Evacuation

Respondents were asked if they had concerns about being able to get back into their community if they evacuated, and in most locations a majority said they did not. Few said they had personally experienced that sort of difficulty in the past.

Concerned about being able to re-enter home following evacuation, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
No	68	60	49	51	49	68
Yes	30	39	50	47	47	30
Don't Know	2	1	1	2	4	2

Personally experienced re-entry difficulties following past evacuations, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
No	89	91	82	76	73	92
Yes	11	9	17	24	26	8
Don't Know	1	<1	1	<1	1	<1

People who said they were concerned about re-entry were slightly more likely than others to evacuate in Lili (48% vs 42%). Respondents who said they had personally experienced re-entry difficulties after previous evacuations were also more likely than others to evacuate in Lili (55% vs. 42%).

Window Protection

In most survey locations roughly half the respondents said they had window protection such as storm shutters or plywood panels. In the Louisiana cluster of parishes including Terrebonne, Assumption, Lafourche, St. Charles, southern Jefferson, and southern Plaquemines, 72% said they had window protection. In all the survey locations the most prevalent form of window protection was the use of plywood sheets. In Lili, people without window protection were slightly more likely to evacuate than people with protection (48% vs. 40%).

Home has window protection, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Yes	42	48	51	56	72	54
No	58	51	49	44	27	45
Don't Know	<1	1	<1	<1	<1	<1

Type of window protection, among those with protection, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=126)	(N=147)	(N=154)	(N=166)	(N=220)	(N=161)
Plywood Sheets	76	79	79	78	71	76
Roll Down	6	5	4	4	6	7
Metal Panels	4	8	4	5	2	4
Impact Resistant Film	2	1	3	1	1	1
Impact Resistant Glass	8	1	4	6	2	5
Other	5	7	7	6	20	6

Past Hurricane Experience

Most people in the survey have never experienced major financial losses in past hurricanes. The "middle parishes" in Louisiana reported greater losses than other locations. Among people who have never experienced property damage in the past, 40% evacuated in Lili, compared to 43% who had experienced up to $1,000 in damage, and 52% among those who had suffered more than $1,000 in damage.

Worst property damage experienced in past hurricanes, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
None	70	75	35	31	50	53
Less than $1,000	13	11	19	18	16	25
$1,000 to $5,000	6	7	22	25	18	13
More than $5,000	5	5	20	21	11	6
Don't Know	6	2	4	5	5	3

Almost all the participants in the survey were living at their current residence when Isidore threatened the area just a month before Lili, but far fewer were living in their current home when Georges (1998) and Andrew (1992) occurred.

Was living at current address in past hurricanes, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Isidore	89	91	93	93	96	96
Georges	66	66	66	76	75	78
Andrew	56	53	49	60	57	61

Of those present for Isidore, Georges, and Andrew, the evacuation participation rates are shown in the following table. Evacuation in Lili was greater than that in any of the other storms among respondents to this survey. People who did evacuate in the previous storms were much more likely to evacuate in Lili than people who did not leave in the other storms.

Evacuation participation rate in past hurricanes, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=267)	(N=278)	(N=280)	(N=276)	(N=293)	(N=285)
Isidore	9	11	13	15	24	13
	(N=197)	(N=199)	(N=200)	(N=225)	(N=229)	(N=230)
Georges	14	8	11	15	29	17
	(N=167)	(N=161)	(N=148)	(N=178)	(N=173)	(N=181)
Andrew	33	26	36	49	39	19

Evacuation participation rate in Lili, by response in previous storms

	If Evacuated in Previous Storm	If Stayed in Previous Storm
Isidore	83	35
Georges	69	34
Andrew	70	24

Other Predictors of Evacuation in Lili

Several demographic variables were tested to see if they were associated with whether people evacuated in Lili:

- People who had lived in their current home fewer than 5 years were more likely to evacuate in Lili than people who had lived in their homes more than 20 years (51% vs 38%)
- People who had lived in the region fewer than 10 years were more likely to evacuate in Lili than people who had lived in the region more than 10 years (51% vs. 43%).
- People living alone were slightly more likely than others to evacuate in Lili (48% vs. 43%).
- Households with children were more likely than others to evacuate in Lili (49% vs. 38%).
- Households with lower incomes were more likely to evacuate than others (58% in households with earning less than $12,000/year vs. 36% in households making more than $80,000 per year).
- Age was related to evacuation but not simply. The most likely people to evacuate were under 40, of whom 51% evacuated. The least likely to evacuate were people between 50 and 60, of whom 34% evacuated. Of those between 40 and 50 and those over 60, 42% evacuated.
- People living in mobile homes were more likely to evacuate than people living in single-family site-built homes (78% vs. 39%).

Evacuation was *not* related to pet ownership, home ownership, or race.

Intended Responses

Both those who evacuated in Lili and those who did not were asked if they would do anything differently in the future, given the same circumstances as they existed in Lili. Most people said they would do the same thing again. Of those who evacuated in Lili, between 7% and 11% said they would stay if they had it to do over again. Of those who stayed, between 4% and 17% said they would evacuate next time.

Intended future response, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
Left in Lili; Would Stay Next Time	11	7	8	10	7	10
Stayed in Lili; Would Leave Next Time	13	4	4	14	7	17

People who did not evacuate in Lili were asked where they would have gone if they had evacuated. Some resisted the hypothetical and said they would not have left. Of those who did respond, the homes of friends and relatives were mentioned most often, followed by hotels and motels. The percent saying they would go to public shelters was small, but larger than the percent that actually went to public shelters in Lili.

Anticipated refuge of respondents who did not evacuate in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=180)	(N=155)	(N=133)	(N=138)	(N=183)	(N=224)
Public Shelter	11	7	10	12	14	16
Church	0	7	5	1	1	2
Friend/Relative	42	45	38	36	35	31
Hotel/Motel	23	22	26	23	26	21
Other	11	3	6	5	7	6
Don’t Know	7	4	5	6	6	6
Would Not Have Left	7	14	11	17	12	17

Those who didn't evacuate in Lili were also asked what they would have done if Lili had turned toward their location and it appeared that it was too late to evacuate out of their own parish or county. A large majority said they would have stayed home and ridden out the storm. Among those who would not stay home, a substantial burden could be placed on public shelters.

Anticipated last-resort refuge among respondents who did not evacuate in Lili, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=180)	(N=155)	(N=133)	(N=138)	(N=183)	(N=224)
Stayed Home	72	79	84	78	77	81
Gone Nearby	12	14	14	12	13	12
Gone within Parish/Co	4	2	2	4	2	2
Gone Out of Parish/Co	4	3	2	7	5	2
Don't Know	7	1	0	1	3	3

Anticipated last-resort refuge of respondents who would not stay home, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=50)	(N=32)	(N=22)	(N=31)	(N=42)	(N=43)
Public Shelter	36	28	64	32	41	40
Church	2	13	9	3	0	5
Friend/Relative	26	28	9	39	36	23
Hotel/Motel	12	16	9	13	7	7
Other	10	9	9	3	2	9
Don't Know	14	6	0	10	14	16

Among both evacuees and non-evacuees, most people by far in the survey said they had identified the safest place in their home to ride out a hurricane if they had to. Those who had not identified the safest place were more likely than others to evacuate in Lili (64% vs. 39%).

Identified safest place in home to ride out a hurricane, by interview location

	Texas	LA 1	LA 2	LA 3	LA 4	LA 5
	(N=299)	(N=304)	(N=301)	(N=298)	(N=304)	(N=296)
Yes	78	84	77	81	78	84
No	20	15	21	17	21	15
Don't Know	2	1	2	2	1	1

Hurricane Lili
Response Questionnaire

Hello, my name is _____ and I'm calling on behalf of the Army Corps of Engineers and the **Louisiana Office of Emergency Preparedness/Texas Department of Public Safety**. I'm conducting a telephone survey of residents concerning experiences in hurricane Lili last year, 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.

To refresh your memory, Lili was the hurricane that made landfall around Intracoastal City, Louisiana in early October of last year. At one time Lili was a very strong storm, but weakened shortly before crossing the coast. Just to be clear, I'm **not** asking about Isidore which also hit last year. Isidore came in from off the coast of Texas and hit around Grand Isle in September. For now, I'm just going to be asking about hurricane Lili.

1. Were you at home, that is, not out of town, when **HURRICANE LILI** began to threaten this area last year?
   1 Yes **(GO TO Q2)**
   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."

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

1 Yes **(GO TO Q13)**
2 No **(GO TO Q3)**
3 Don't know **(THANK AND TERMINATE)**

3. What made you decide *not* to go anyplace else?

(CATEGORIZE - PROBE UP TO 3) (THEN GO TO Q4)

1. __ Forecast said storm would hit a different location
2. __ Officials seemed unsure whether evacuation was necessary
3. __ Heard conflicting messages from officials whether evacuation necessary
4. __ Storm wasn't severe enough to pose a severe danger even if it hit
5. __ Location was on the weak (left) side of the storm
6. __ House is well built (strong enough to be safe in storm)
7. __ Home is elevated above the level of storm surge
8. __ Officials said evacuation was not necessary
9. __ Officials didn't say to evacuate
10. __ Media said evacuation wasn't necessary
11. __ Friend/relative said evacuation wasn't necessary
12. __ Probabilities indicated low chance of a hit
13. __ Other information indicated storm wouldn't hit
14. __ Had no place to go
15. __ Wanted to protect property from looters
16. __ Wanted to protect property from storm
17. __ Left unnecessarily in past storms
18. __ Job required staying
19. __ Waited too long to leave
20. __ Evacuation notice from officials came too late
21. __ Traffic too bad
22. __ Tried to leave, but returned home because of traffic
23. __ Too dangerous to evacuate because might get caught on road in storm
24. __ No place to take pets/Shelter would not accept pets
25. __ Concerned about being able to re-enter community after evacuating
26. __ Unable to re-enter area after evacuating in past storms (e.g., Andrew)
27. __ Had no transportation
28. __ Other, specify: _____
29. __ Don't know
30. No second or third option.

4. **IF** Lili had looked to you like it was going to hit your location directly, would you have left your home to go someplace safer?

__1__ Yes
__2__ No
__3__ Don't Know/Depends
__4__ Other (Specify)_____

5. Were you ready, that is had you made the necessary preparations, to leave your home to go someplace safer if the threat had gotten worse?

__1__ Yes
__2__ No
__3__ Don't Know/Depends
__4__ Other (Specify)_____

6. If you had left your home in Lili 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 OTHER OPTIONS)**

__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 **(SKIP to v11)**

7. Is that **(ANSWER FROM Q6)** located in your neighborhood or someplace else?

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

8. Is that **(ANSWER FROM Q6)** located in your **parish/county**?

__1__ Yes **(SKIP TO Q10)**
__2__ No
__9__ Don't know

9. Is that **(ANSWER FROM Q6)** located in **Louisiana/Texas** or out-of-state (specify state)?

__1__ Louisiana
__2__ Texas
__3__ Arkansas
__4__ Oklahoma
__5__ Mississippi
__6__ Other_____
__9__ Don't know

10. What city or town would that be (specify)?

_____ __9__ Don't know

11. What would you have done if Lili had turned toward your location and it looked like it was too late for you to evacuate out of your **parish/county**? Would you have ridden the storm out in your own home, gone someplace nearby, gone to another town in your **parish/county**, or would you have tried to evacuate out of your **parish/county** anyhow?

__1__ Would have ridden the storm out at home **(SKIP TO Q26)**
__2__ Would have gone someplace nearby
__3__ Would have gone to another town in own **parish/county**
__4__ Would have tried to get out of **parish/county**
__5__ Don't Know/Depends
__6__ Other (Specify)_____

12. Would you have gone to a friend or relatives, a public shelter, a hotel or motel, or someplace else?

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

(IF ANSWERING Q12, SKIP TO Q26)

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

1 Public shelter (or Red Cross shelter)
2 Church
3 Friend/relative
4 Hotel
5 Workplace
6 Other, specify: _____
9 Don't know

14. Is that **(ANSWER FROM Q13)** located in your neighborhood or someplace else?

1 Neighborhood **(SKIP TO Q18)**
2 Somewhere else
9 Don't know

15. Is that **(ANSWER FROM Q13)** located in your **parish/county**?

1 Yes **(SKIP TO Q17)**
2 No
9 Don't know

16. Is that **(ANSWER FROM Q13)** located in **Louisiana/Texas** or out-of-state (specify state)?

1 Louisiana
2 Texas
3 Arkansas
4 Oklahoma
5 Mississippi
6 Other_____
9 Don't know

17. What city or town was that (specify)?

_____ 9 Don't know

18. What convinced you to leave your home to go someplace safer? **(CATEGORIZE - PROBE UP TO 3)**

1. __ Advice or order by elected officials
2. __ Advice or order by public safety officials
3. __ Advice from National Weather Service
4. __ Advice/order from police officer or fire fighter
5. __ Advice from the media
6. __ Advice from friend or relative
7. __ Information about the severity of the storm
8. __ Concerned storm would cause home to flood
9. __ Concerned strong winds would make house unsafe
10. __ Concerned flooding would cut off roads
11. __ Had no transportation
12. __ Concerned that storm might hit
13. __ Forecast indicated storm would hit
14. __ Forecast indicated storm could hit
15. __ Probability (odds) were high that the storm could hit
16. __ National Weather Service issued Hurricane Watch
17. __ National Weather Service issued Hurricane Warning
18. __ Experience in Andrew
19. __ Experience in other storms
20. __ Other, specify:_____
21. __ Don't know
22. No Second or third option.

19a. I'm going to ask about when you left your home to go someplace safer, but to refresh your memory I'm going to remind you when certain events took place. First, the National Hurricane Center issued a hurricane watch for Lili for this area on the afternoon of Tuesday, October 1st, at 4 PM. Then very early the next morning, Wednesday, October 2nd, at 4 AM, the Hurricane Center changed the watch to a hurricane warning. And then the following morning, around 8 AM on Thursday, October 3rd, Lili made landfall on the Louisiana coast.

On what day did you leave your home to go someplace safer?

__1__ Monday, September 30th or earlier
__2__ Tuesday, October 1st
__3__ Wednesday, October 2nd
__4__ Thursday, October 3rd
__5__ Other _____
__9__ Don't know

19b. About what time on the **(REPEAT DATE)** did you leave? **(USE 1 HOUR INCREMENTS) (TAKE MIDPOINT) (99=DK)**

_____ Hour **(IF 99, SKIP TO Q20a)**

19c. Was that morning AM or PM? (**NOTE: 12 O'CLOCK NOON = 12 PM) (NOTE: 12 O'CLOCK MIDNIGHT = 12 AM ON THE "NEW" DAY)**

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

20a. How long did it take you to get to where you were going? **(WAS IT MORE OR LESS THAN 2 HOURS?) (USE 1 HOUR INCREMENTS) (TAKE MIDPOINT) (88.8=NEVER GOT THERE) (99.9=DK) (ROUND TO NEAREST ½ HOUR)**
_____ Hours

20b. How long did you EXPECT it take you to get to where you were going? **(WAS IT MORE OR LESS THAN 2 HOURS?) (USE 1 HOUR INCREMENTS) (TAKE MIDPOINT) (99.9=DK) (ROUND TO NEAREST ½ HOUR)**
_____ Hours

20c. How long does it normally take you to make that trip? **(WOULD IT BE MORE OR LESS THAN 2 HOURS?) (USE 1 HOUR INCREMENTS) (TAKE MIDPOINT) (99.9=DK) (ROUND TO NEAREST ½ HOUR)**
_____ Hours

21. How many vehicles were available in your household that you could have used to evacuate?
_____ Number of vehicles **(IF 0, GO TO Q22; OTHERWISE GO TO Q23) (9 = DK) (IF 1 OR MORE IN Q21, SKIP TO Q23) (8 =NA) (RECORD "0" IF NO VEHICLES ARE AVAILABLE)**

22. 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 Q26)**
2 Public transportation **(GO TO Q26)**
3 Other, specify: _____ **(GO TO Q26)**
9 Don't know **(GO TO Q26)**

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

24. 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

25a. Did anyone in your household need assistance from an agency in order to evacuate or require any sort of special care in a shelter?
1 Yes
2 No **(Skip to v26)**
3 Other, specify:_____
9 Don't know

25b. Did they receive transportation assistance from an agency, special care in a shelter, or both?

__1__ Transportation
__2__ Shelter care
__3__ Both
__4__ Other, specify:_____
__9__ Don't know

26. During the threat, did you hear either directly or indirectly anyone in an official position - such as elected officials, emergency management officials, police, etc. - say that you and people in your location should evacuate to a safer place? That is, did state or parish officials issue any kind of evacuation notice that applied to you that you were aware of at the time it was issued?

__1__ Yes **(GO TO Q27)**
__2__ No **(GO TO Q29)**
__9__ Don't know **(GO TO Q29)**

27. Did officials recommend that you **<u>should</u>** evacuate or did they say it was mandatory that you **<u>must</u>** evacuate?

__1__ Should
__2__ Must
__9__ Don't know

28. 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

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

1. __ Would evacuate
2. __ Wouldn't evacuate
3. __ Would leave earlier
4. __ Would wait later to leave
5. __ Would go further away
6. __ Wouldn't go as far away
7. __ Would go to public shelter
8. __ Wouldn't go to public shelter
9. __ Would use different route
10. __ No
11. __ Other, specify:_____
12. __ Don't know
13. No second or third option.

30. We're interested in how you got most of your information about Lili - 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
g	0	1	2	3	Services like America Online
h	0	1	2	3	Word of mouth

IF "0" TO ALL, SKIP TO Q37

31. Of those sources of information, did you find any one of them to have more accurate information about Lili than the others?
   1 Yes
   2 No **(SKIP TO Q33**)
   9 Don't Know/Not Sure **(SKIP TO Q33**)

32. 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
   7 Computer services like America Online
   8 All equally accurate
   9 Don't know

33. Of those sources of information, did you find any one of them to have **less** accurate information about Lili than the others?
   1 Yes
   2 No **(SKIP TO Q35)**
   9 Don't Know/Not Sure **(SKIP TO Q35**)

34. 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
__7__ Computer services like America Online
__8__ All equally inaccurate
__9__ Don't know

35. In general would you say the media -- that is, radio, television, and newspapers – gave you the kind of information about Lili that was helpful in deciding whether to evacuate or would you say it was generally not helpful?

__1__ Generally helpful
__2__ Generally not helpful
__3__ Mixed; some of both
__4__ Don't Know; Don't Recall
__5__ Other

(specify)_____

36. In general would you say the information you got from the media about Lili was consistent – that is, you were hearing pretty much the same thing about what the storm was going to do and whether you needed to evacuate, regardless of which station or newspaper you got your information from? Or did the sources give conflicting information that you think led to confusion?

__1__ Yes, generally consistent
__2__ Mainly consistent, but sometimes not
__3__ No, not consistent
__4__ Don't Know; Don't Recall
__5__ Other

(specify)_____

37. In general would you say that public officials in your **parish/county** gave you the kind of information about Lili that was helpful in deciding whether to evacuate or would you say it was generally not helpful?

__1__ Generally helpful
__2__ Generally not helpful
__3__ Mixed; some of both
__4__ Don't Know; Don't Recall
__5__ Other

(specify)_____

38. Would you say that public officials in your **parish/county** were definite in their messages about whether you should evacuate in Lili? That is, did they appear to be certain about whether you needed to evacuate or did they seem uncertain?

__1__ Very certain
__2__ Fairly certain
__3__ Generally not certain
__4__ Depends on which official
__5__ Sometimes certain, sometimes not
__6__ Don't Know; Don't Recall
__7__ Other

(specify)_____

39. In general, not just in Lili, but in hurricanes generally, how much confidence do you have in the ability of public officials in your **parish/county** to decide whether you really need to evacuate or not when they issue evacuation orders? Do you have a great deal of confidence, a fair amount of confidence, not much confidence, or no confidence in their ability to decide whether you need to evacuate?

__1__ Great deal of confidence
__2__ Fair amount of confidence
__3__ Not much confidence
__4__ No confidence
__5__ Don't Know/Depends
__6__ Other

(specify)_____

40. Do you think that public officials in your **parish/county** tend to call for evacuation more often than they should, less often than they should, or about as often as they should?

__1__ More often
__2__ Less often
__3__ About as often as they should
__4__ Don't Know/Depends
__5__ Other

(specify)_____

41. Did you or anyone in your household have to go to work while the Lili evacuation was going on?

__1__ Yes (**GO TO Q42)**
__2__ No (**SKIP TO Q43)**
__9__ Don't Know (**SKIP TO Q43)**

42. 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 at least part of household from evacuating
5 Other,_____
_____
9 Don't Know

43. At one point Lili's maximum sustained winds were 145 MPH. That made it a category 4 hurricane on the Saffir-Simpson scale —what meteorologists would call a **very** dangerous hurricane. A category 1 on the scale is the weakest hurricane and a category 5 is the strongest possible. If Lili had made landfall near your location with sustained winds of 145 MPH and then passed directly over your home, do you believe that your home would have been flooded by storm surge or wave action severe enough to pose a threat to your safety if you stayed in your home?

1 Yes
2 No
3 Don't Know/Depends

44. Considering both wind and water, do you think it would have been safe for you to have stayed in your home if Lili had hit near your location with winds of 145 MPH and then passed directly over your home?

1 Yes
2 No
3 Don't Know/Depends

44a. Later Lili lost some strength and had winds of 125 MPH. That made it a category 3 hurricane on the Saffir-Simpson scale, still what meteorologists call a major hurricane. Eventually Lili got weaker than this, but if Lili had made landfall near your location with sustained winds of 125 MPH and then passed directly over your home, do you believe that your home would have been subject to flooding or wave action severe enough to pose a threat to your safety if you stayed in your home?

1 Yes
2 No
3 Don't Know/Depends

44b. Considering both wind and water, do you think it would have been safe for you to have stayed in your home if Lili had hit near your location with sustained winds of 125 MPH and then passed directly over your home?

1 Yes
2 No
3 Don't Know/Depends

45. Just before landfall Lili lost more strength and had winds of 95 MPH when it crossed the coastline. That made it a category 2 hurricane on the Saffir-Simpson scale. If Lili had made landfall near your location with sustained winds of 95 MPH and then passed directly over your home, do you believe that your home would have been subject to flooding or wave action severe enough to pose a threat to your safety if you stayed in your home?

1 Yes
2 No
3 Don't Know/Depends

46. Considering both wind and water, do you think it would have been safe for you to have stayed in your home if Lili had hit near your location with sustained winds of 95 MPH and then passed directly over your home?

1 Yes
2 No
3 Don't Know/Depends
4 Other

47. How did you come to believe that your home would be safe or unsafe in hurricanes? **(CATEGORIZE) (PROBE UP TO 3)**

1. _ Personal experience with this structure in past storms (e.g., Audrey, Andrew, Georges)
2. _ Personal experience in other structures in past storms in **Louisiana/Texas**
3. _ Personal experience in other storms in other locations
4. _ Observations of effects of storms on other structures in **Louisiana/Texas**
5. _ Observations of effects of storms on other structures in other locations
6. _ Knowledge of how well this structure is built
7. _ Knowledge about safety of location of this structure
8. _ Height of location in the building
9. _ Information provided by the media about storm effects and construction
10. _ Information provided by the builder
11. _ Information provided by neighbors or long-time residents
12. _ Information provided by public officials
13. _ Don't Know/Depends
14. _ Other (Specify)_____
15. No second or third option.

48. 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
2 Yes
3 Don't Know/Depends
4 Other (Specify)_____

49. About how many hours do you think it would take to evacuate your **parish/county** if all of **south Louisiana and east Texas** were ordered to evacuate at the same time for a major hurricane? **(READ)**

1 6 hours
2 12 hours
3 18 hours
4 24 hours
5 30 hours
6 36 hours
7 More than 36 hours
8 Don't Know/Depends

50. While you were deciding whether to leave, did you have any concerns about being able to get back into your community and to your home when you wanted to return after the evacuation?

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

51. Have you ever personally had difficulty being allowed to get back to your home after evacuating in past storms?

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

52. Which of the following would you say was the single most important factor in your decision to evacuate or not in Lili? (**READ THE FIRST FOUR)**

1 The forecast track
2 The forecast strength of the storm
3 Statements issued by officials
4 Statements issued by media
5 Other factors (Specify)_____
6 Combination of factors (don't list as a response option, but record if stated)
9 Don't Know

53. We're interested in how much confidence you have in the accuracy of hurricane forecasts made by the National Hurricane Center. The way we're going to do this is by describing three different aspects of a forecast and ask you how close you believe the Hurricane Center comes, on average, to getting each of them right, when the forecast is made 24 hours in advance. Obviously they do better with some storms than others, but we're interested in how well they do on average when you take their forecasts for all storms into account.

First of all, how well do you think the Hurricane Center does in forecasting how CLOSE the hurricane is going to come to a predicted location – that is, forecasting the track the storm will take. When the Hurricane Center is forecasting how close the storm will come to a certain location 24 hours from now, how far off do you think they are, on average? Would you say the average error is

1 10 miles
2 50 miles
3 100 miles
4 200 miles
5 more than 200 miles
6 Don't Know/Depends

54. Now we're interested in how well you believe the Hurricane Center does in forecasting WHEN the storm will arrive at the location they're predicting it will be in 24 hours. If they're predicting the storm will arrive at a certain location in 24 hours, on average how far off do you think they are with their forecasts? Would you say the average error is

1 half-an-hour
2 1 hour
3 3 hours
4 6 hours
5 12 hours
6 18 hours
7 more than 18 hours
8 Don't Know/Depends

55. Do you think the storm is more likely to arrive sooner than predicted, later than predicted, or neither – that is, it's just as likely to arrive sooner as later.

1 Sooner
2 Later
3 Neither
4 Don't Know/Depends

56. Finally, we're interested in how well you believe the Hurricane Center does in forecasting how STRONG the storm will be 24 hours from the time they make the prediction. If they're predicting that in 24 hours the storm will have winds of 115 MPH, for example, on average, how far off do you think they are with their forecasts? Would you say the average error is

1 2 MPH
2 5 MPH
3 10 MPH
4 20 MPH
5 50 MPH
6 more than 50 MPH
7 Don't Know/Depends

57. Do you think the storm is more likely to be stronger than predicted, weaker than predicted, or neither – that is, it's just as likely to be stronger as weaker.

1 Stronger
2 Weaker
3 Neither
4 Don't Know/Depends

58. How well do you think the National Hurricane Center does in forecasting hurricanes, compared to your favorite weather forecaster you watch on television? Would you say the Hurricane Center usually does better than the television forecaster, usually not as well, or usually about the same?

1 Better
2 Worse
3 Same
4 Don't Know/Depends

59. In 1992 hurricane Andrew was predicted by the National Hurricane Center to hit south Louisiana as a strong category 4 hurricane but weakened before making landfall. Did Andrew have any effect on how strong you expected Lili to be?

1 Yes
2 No
3 A little
4 Don't Know/Depends

60. 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

61. 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 Q62)**
2 No **(SKIP TO Q63)**
9 Don't Know/Not Sure **(SKIP TO Q63)**

62. 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

63. Do you believe window protection like that would mainly just prevent the windows from breaking and reduce the danger of flying glass, or do you believe they would also significantly reduce the total damage your house would suffer in other ways?
__1__ Mainly Windows
__2__ Total Damage Also
__9__ Don't Know/Not Sure

64. Other than window protection, what permanent improvements, if any, have you made to your home to reduce the damage to your property in a hurricane? **(CATEGORIZE) (PROBE UP TO 2)**
1. __Roof/truss Strengthening
2. __Door/Garage Door Protection
3. __Flood proofing
4. __Other (Specify)_____
5. __ None
6. __Don't Know/Not Sure
7. No second option.

65. How much money do you plan to spend **this year** on changes to your home to make it stronger or safer from hurricanes? **(9999=DK)**
$_____

66. 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

67. 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.

68. 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 Manufactured home
   7 Some other type of structure
   8 Don't Know
   9 Refused

IF ANSWER IS <u>NOT</u> MOBILE HOME OR MANUFACTURED HOUSE, GO TO Q89

69. In what year did you buy your Mobile Home or Manufactured House? **(2222=Don't Know)**

   _____

70. Was it new when you bought it?
   1 Yes
   2 No
   3 Don't Know

71. How old were you on your last birthday?
   ___ Number of years **(99 = DK)** (88=REFUSED)

72. How long have you lived in your present home? **(ROUND UP) (99 = DK)** (88=REFUSED)
   ___ Number of years

73. How long have you lived **in south Louisiana /on the Texas Coast**?
   (ROUND UP) (99 = DK)(88=REFUSED)
   ___ Number of years

74. How many people live in your household, including yourself? **(99 = DK)** (88=REFUSED)
   ___ Number of people **(IF 1, SKIP TO Q76)**

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

76. Do you own your home or rent?
1 Own
2 Rent
3 Other

77. Do you have any pets?
1 Yes
2 No
9 Refused

78. Which race or ethnic background best describes you? **(READ)**
1 African American or Black
2 White or Caucasian
3 Hispanic
4 Asian
5 American Indian
6 Other
9 Refused

79. Which of the following ranges best describes your total household income for 2002? **(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

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

81. Were you living at your current address when Hurricane Isidore threatened in September of last year?
1 Yes
2 No **(SKIP TO Q83)**
9 Don't Know/Don't Remember **(SKIP TO Q83)**

82. Did you leave your home to go someplace safer in Isidore?
1 Yes
2 No
9 Don't Know/Don't Remember/Not Applicable

83. Were you living at your current address when Hurricane Georges threatened in 1998?
1 Yes
2 No **(SKIP TO Q85)**
9 Don't Know/Don't Remember **(SKIP TO Q85)**

84. Did you leave your home to go someplace safer in Georges?
1 Yes
2 No
9 Don't Know/Don't Remember/Not Applicable

85. Were you living at your current address when Hurricane Andrew threatened in 1992?
1 Yes
2 No **(SKIP TO Q87)**
9 Don't Know/Don't Remember **(SKIP TO Q87)**

86. Did you leave your home to go someplace safer in Andrew?
1 Yes
2 No
9 Don't Know/Don't Remember/Not Applicable

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?

rname.

RECORD INTERVIEW INFORMATION ON RESPONDENT DISPOSITION SHEET

vgender. Sex of respondent 1 Male 2 Female
iname. Interviewer ID
vdate. Date of survey
vtele. Phone number
cluster. 1= County 1 thru 3 (Texas)
2= Parish 4 thru 6 (LA)
3=Parish 7 thru9 (LA)
4=Parish 10 thru 13 (LA)
5=Parish 14 thru 19 (LA)
6=Parish 20 thru 23 (LA)

vcounty.
1 Chambers County
2 Jefferson County
3 Orange County
4 Cameron
5 Calcasieu
6 Jefferson-davis
7 Vermillion
8 Acadia
9 Lafayette
10 Iberia
11 St. Mary
12 St. Martin

13 Iberville
14 Terrebonne
15 Assumption
16 Lafourche
17 St. Charles
18 Jefferson
19 Plaquemines
20 Ascension
21 St. James
22 St. John
23 Tangipahoa
24 Other county (Terminate)

The following questions were used in the Louisiana portion of the survey. They were used to determine the respondents location for quota purposes.

vla1

Do you live south of I-10
1 Yes (Skip to vla2)
2 No (Skip to v1)

vla2

Do you live south of Highway U.S. 90?

1 Yes
2 No

Statistical Reliability of Survey Results

The sample was designed so that statistically reliable statements could be made about each of the 6 clusters of parishes (Louisiana) or counties (Texas). Within the clusters sampling was allocated among parishes or counties to reflect the population at risk to category 4 hurricanes.

Figures reported in the survey 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 100 will provide estimates which one can be 90% "confident" are within 5 to 8 percentage points of the true population values. With a sample of 50, one can be 90% "confident" of being within 7 to 11 percentage points of the actual population value. A sample of 25 is 90% "accurate" only within 10 to 17 percentage points.

The ranges (e.g., "10 to 17") stem from the fact that the reliability of an estimate depends not only on the size of the sample but also upon how much agreement there is among the responses. Having 90% of the respondents give a particular answer means almost everyone agreed. By the same reasoning, if only 10% gave a particular response, almost everyone agreed (i.e., 90% disagreed with the 10% but agreed with one another). The maximum disagreement is for the responses to be split 50-50. Thus, if 90% (or 10%) of a sample of 100 give a particular response, that estimate will be within 5 percentage points of the true population value 90% of the time. If 75% (or 25%) of a sample of 100 give a particular response, that estimate will be within 7 percentage points 90% of the time. If 50% of a sample of 100 give a particular response, that estimate will be within 8 percentage points 90% of the time. Table 2 summarizes the reliability values for samples of various sizes and response distributions. For example, suppose we

interviewed 200 people in south of I-10 in one group of parishes and 50% of those 200 people said they believed their home would flood in a hurricane. We can be 90% "confident" that between 44% (50% - 6%) and 56% (50% + 6%) of *all* the people who live south of I-10 in that group of parishes believe their homes would flood. In order to increase confidence to 95% or 99% the confidence intervals would increase in width.

Table I. Approximate sample reliabilities for 90% confidence intervals, as a function of sample size and distribution of responses (i.e., variance)

Sample Size	**Percent Giving Response**		
	50%	***25% or 75%***	***10% or 90%***
25	± 17%	± 15%	± 10%
50	± 12%	± 10%	± 7%
75	± 10%	± 8%	± 6%
100	± 8%	± 7%	± 5%
200	± 6%	± 5%	± 4%
300	± 5%	± 4%	± 3%
800	± 3%	± 3%	± 2%
1800	± 2%	± 2%	± 1%

Assessing Differences

Differences of a few percentage points in sample results do not necessarily mean the populations from which the samples were drawn are different. An approximation for comparing results is to add and subtract values in Table I to and from of the two values being compared and seeing whether the ranges overlap. If there is overlap in the ranges created by adding and subtracting from the sample estimates, one should be reluctant to conclude that the population values differ. For example, suppose two samples of 100 yielded values of 50% and 40%. From Table 2 we see that the 50% value for the population might actually be as low as 42%, and the 40% value might actually be as high as 48%. The 42% to 50% and 40% to 48% ranges overlap.

A better method of assessing whether sample differences are large enough to imply population differences involves "tests of statistical significance." Where the text of the report makes statements about one group of respondents being more likely to evacuate in Lili than another, the conclusion was derived after performing such statistical tests.

In general the following guidelines can be used. For samples of 50 in each group, the sample differences must be at least 20% (20 percentage points); samples of 100 must differ by at least 15%; samples of 200 must differ by at least 10%; samples of 350 must differ by at least 7%; and samples of 500 each must differ by at least 5%. Those rules-of-thumb apply in cases in which both sample estimates are near 50% (55% vs. 45%, for example). In cases where the estimates are much higher or lower (90% vs. 80% or 10% vs. 20%) slightly smaller sample differences are required to conclude that population differences also exist.

Aggregation of Interview Locations

The sample was stratified to ensure inclusion of specified numbers of respondents in each of the six clusters of parishes or counties. Therefore the total sample over-represents some locations and under-represents others intentionally. This is not a problem when analyzing each cluster but can lead to erroneous impressions when the clusters are lumped together if an over-represented cluster differs in its responses significantly from other clusters. A weighting scheme would need to be employed in order to describe the general population accurately with the sample generated for this analysis.

Appendix-D

PowerPoint Presentation Slides

Prepared by Dr. Jay Baker, Hazards Management Group

Slide 1

Public Response in Hurricane Lili

Prepared by
Jay Baker
Hazards Management Group

For
FEMA and USACE

Sample

- 6 clusters of 300 interviews
- 1 cluster in Texas
- 5 clusters in Louisiana
- 1800 telephone interviews total

Sample

Cluster	Counties/Parishes
Texas	Chambers, Jefferson, Orange
Louisiana 1	Cameron, Calcasieu, Jefferson Davis
Louisiana 2	Vermillion, Acadia, Lafayette
Louisiana 3	Iberia, St. Mary, St. Martin, Iberville
Louisiana 4	Terrebonne, Assumption, Lafourche, St. Charles, Jefferson (lower), Plaquemines (lower)
Louisiana 5	Ascension, St. James, St. John, Tangipahoa (part)

Evacuation Rates

• Texas	40%
• Louisiana 1	49%
• Louisiana 2	56%
• Louisiana 3	54%
• Louisiana 4	40%
• Louisiana 5	24%

Evacuation Rates In Louisiana

• North of I-10	36%
• South of I-10	47%
• Parishes on not on the Gulf	41%
• Parishes on the Gulf Coast	54%

Reasons Offered for Not Evacuating

(multiple responses from some respondents)

• Home Safe, Given Strength of Storm	54%
• Forecast to Miss Location	39%
• Officials Didn't Say Evacuate	19%
• Traffic/Too Late to Leave	12%
• No Place to Go	10%
• Job Required Staying	6%
• Friend/Relative Advice	5%
• Protect Property from Storm	3%
• Pets	3%
• Protect Property from Looters	2%

Reasons Offered for Evacuating

(multiple responses from some respondents)

• Concern about Strength, Effects of Storm	54%
• Advice from Officials	50%
• Anticipated Track	22%
• Advice from Friends/Relatives	23%
• Advice from Media	14%
• Experience in Previous Storms	11%
• NHC Watch/Warning	3%

Slide 8

Heard Evacuation Notices from Officials

	Texas	Louisiana
Heard Must	6%	13%
Heard Should	47%	32%
Heard Neither	47%	55%

Evacuation Rate by Type of Notice "Heard"

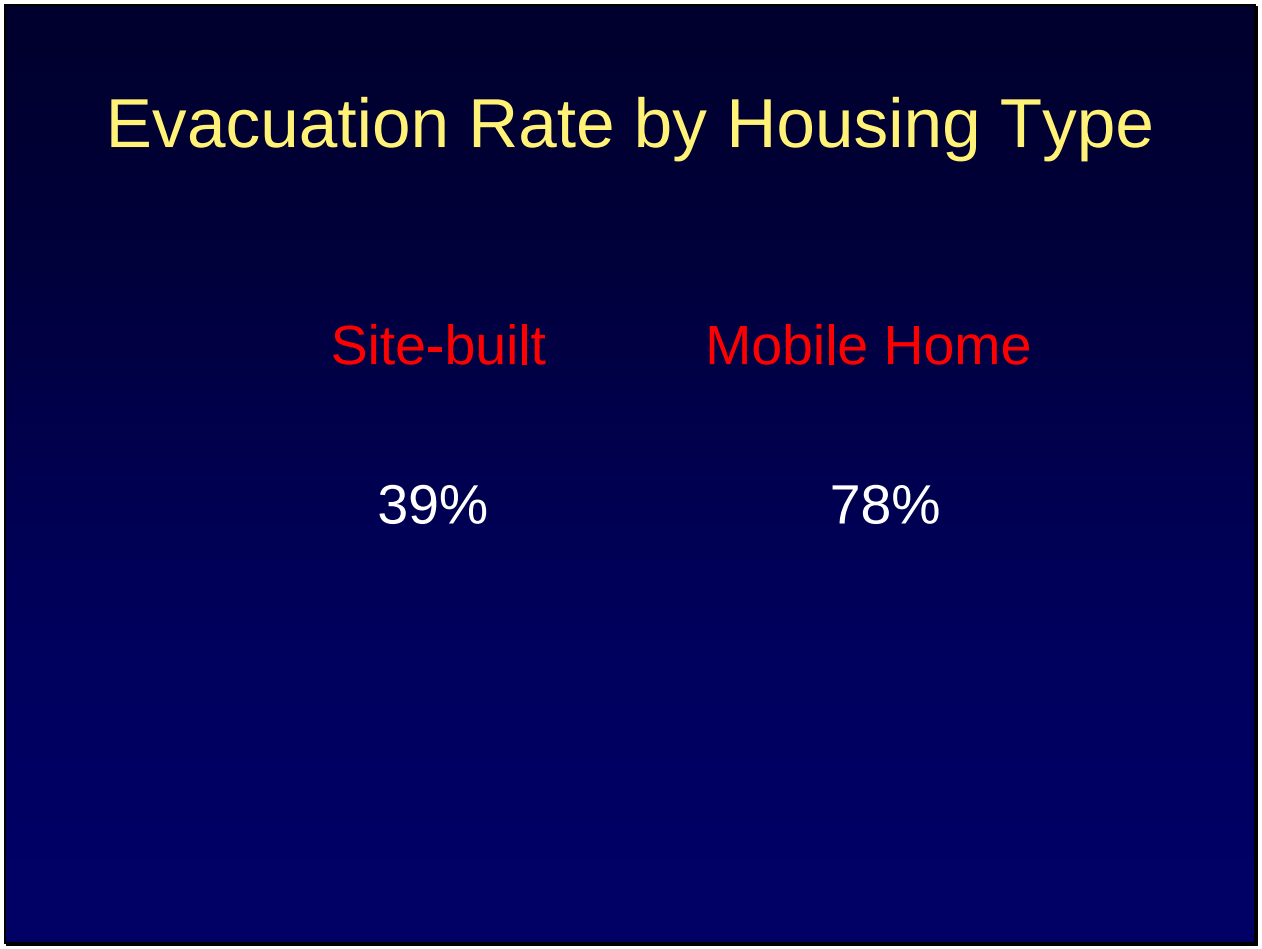
	Evacuation Rate in Texas	Evacuation Rate in Louisiana
If Heard Must	74%	78%
If Heard Should	50%	54%
If Heard Neither	25%	32%

Believe Home Would Be Safe Place in 145 MPH Hurricane

	Texas	Louisiana
Safe	29%	31%
Not Safe	63%	64%
Don't Know	9%	6%

Evacuation Rate by Belief Home Would be Safe Place in 145 MPH Hurricane

	Evacuation Rate in Texas	Evacuation Rate in Louisiana
If Believed Safe	34%	31%
If Believed Not Safe	45%	53%
If Don't Know	23%	24%


Evacuation Rate by Housing Type
Site-built
Mobile Home
39%
78%

Evacuation Rate in Lili by Response in Previous Storms

	If Evacuated in Previous Storm	If Stayed in Previous Storm
Isidore	83% left in Lili	35% left in Lili
Georges	69% left in Lili	34% left in Lili
Andrew	70% left in Lili	24% left in Lili

(e.g., 83% of people who evacuated in Isidore also evacuated in Lili; 35% of people who stayed home in Isidore evacuated in Lili)

Type of Refuge Used by Evacuees

	Texas	Louisiana
Public Shelter	8%	6%
Friend/Relative	55%	65%
Hotel/Motel	26%	22%
Other	11%	8%

Households with Someone Requiring Evacuation or Sheltering Assistance from Agency

Texas	Louisiana
2%	4%

Type of Assistance Required

- Transportation 27%
- Special Shelter Care 37%
- Both 10%
- Other 13%
- Don’t Know 13%

Location of Refuge of Evacuees Leaving Their Own County/Parish

	from: Texas	Louisiana
to:		
Own Neighborhood	5%	21%
Own Count/Parish	11%	16%
Louisiana	1%	40%
Texas	98%	12%
Arkansas	1%	2%
Oklahoma	1%	<1%
Mississippi	0%	5%
Other	1%	4%

Percent Relying a Great Deal on Various Information Sources

	Texas	Louisiana
Local TV	70%	76%
The Weather Channel	44%	50%
Local Radio	25%	42%
Other Cable	15%	21%
Word of Mouth	11%	19%
CNN	14%	18%
Internet	8%	7%
AOL	2%	4%

Would Respond Differently Next Time

- 9% who left in Lili would stay next time
- 11% who stayed in Lili would leave next time

Appendix E

One Year Later

- **FEMA Press Release**
- **Baton Rouge Advocate Newspaper Article**

U. S. DEPARTMENT OF HOMELAND SECURITY

FEMA

FOR IMMEDIATE RELEASE **October 3, 2003**
Contact: David Passey NR: R6-03-129
(940) 898-5287

LESSONS LEARNED ON HURRICANE LILI ANNIVERSARY

One-year ago today, residents of some South Louisiana communities were recovering from Tropical Storm Isidore. Many others evacuated their communities because Hurricane Lili, at one point a Category 4 hurricane with wind gusts over 155 mph, was making landfall.

Today, we know that Isidore and Lili caused more than $1 billion damage to insured properties and led to FEMA/State disaster assistance of more than $235 million. Flood insurance losses for these storms totaled nearly $118 million. The American Red Cross, Salvation Army and other volunteer organizations served more than 1.5 million meals and snacks in the aftermath of the storms.

Lili was the first hurricane to make landfall in the United States in three years. Between Hurricane Irene in 1999 and 2002, FEMA, the U.S. Army Corps of Engineers, the National Weather Service and state and local emergency management officials conducted evacuation studies, developed an evacuation information system, updated storm surge models and refined emergency plans.

In the past year, FEMA, the U.S. Army Corps of Engineers, the National Weather Service and state and local emergency officials have collaborated to conduct a post-storm analysis of Hurricane Lili and Tropical Storm Isidore. The study looks at evacuation, emergency sheltering, actual storm surge heights and the effectiveness of public information efforts. The assessment is based on data analysis, interviews with state and local officials and a behavioral survey of more than 1,800 randomly selected residents in Texas counties and Louisiana parishes.

More than 500,000 residents of Louisiana and Texas were advised to evacuate threatened areas in advance of Hurricane Lili's landfall. The assessment's behavioral surveys indicate that 40-56 percent of advised residents heeded evacuation recommendations. While 83 evacuation shelters were opened, housing 18,000 people, the assessment found that more than 90 percent of the evacuating population found safety by staying with family, friends or in hotels.

In the middle of an active hurricane season, the preliminary assessment offers several important recommendations or lessons learned.

- Improved hurricane forecasting and new technologies, combined with increased news media coverage has improved notification and increased knowledge of individual storm threats. However, emergency officials express concern that with increased information, residents

may discount local evacuation recommendations. Officials' fear that some coastal residents may wait too long to safely evacuate approaching storms.

- Government, volunteer organizations and the news media need to expand public awareness information materials. Materials should target vulnerable segments of the population such as residents who live in manufactured housing. Manufactured homes comprised two-thirds of structures destroyed by Hurricane Lili.

- Federal and state agencies continue to evaluate evacuation routes. More "real time" traffic counters that feed data to traffic information systems are recommended. Such systems aid transportation and law enforcement officials to manage evacuation traffic flow.

- Many coastal buildings are highly vulnerable to storm surge and flooding. The assessment recommends that government and insurance companies promote mitigation methods that increase safety and reduce property damage.

As atmospheric scientists and hurricane researchers forecast increased hurricane activity in the United States for the next few decades, residents of Louisiana and Texas remember Hurricane Lili. The preliminary post-storm assessment offers preparedness, planning and response recommendations to coastal states and communities throughout the United States.

On March 1, 2003, FEMA became part of the Department of Homeland Security. FEMA's mission within DHS is to lead the effort to prepare the nation for all hazards and to effectively manage the federal response and recovery efforts for any national incident. To help meet this mission, FEMA oversees the National Flood Insurance Program, the U.S. Fire Administration and Citizen Corps.

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HURRICANE LILI RECOVERY:

Hurricane Lili Damage Still Plagues Acadiana (Baton Rouge Advocate – LA)

Baton Rouge Advocate (LA)
By Angela Simoneaux
October 3, 2003

LAFAYETTE -- One year ago today, Acadiana suffered the intrusion of an unwanted guest when Hurricane Lili plowed onshore.

Although most of the debris is gone and much of the damage is repaired, there are people with tarps over their roofs and tree carcasses in their yards.

Dana Brignac of the United Way of Acadiana estimated she has about 100 open cases related to Hurricane Lili. The Unmet Needs committee, a group of nonprofit and social service agencies that formed shortly after the storm, still is meeting, she said.

"We're still reviewing cases for people who do not have repairs to their homes completed," Brignac said. "We continue to find senior citizens, disabled folks, people with special needs and a lot of single working mothers who are just trying to do the best that they can, who have no money in the budget; if they can afford to buy materials, (they) can't hire labor."

Acadiana looks deceptively recovered, Brignac said.

"You can ride by the front of a house, and it may look OK. The debris, the trees are gone. But if you ride around the back, you will see a lot of dismal situations that are going on," she said. "Black mold continues to be an issue. We are really still out there getting people back on their feet."

Volunteers still are coming to Louisiana, and more are needed, said Sarah Schoeffler of United Methodist Disaster Recovery. Nearly 1,000 volunteers have worked more than 30,000 hours to assist in the recovery, Schoeffler said.

More teams are coming in January, but volunteers are needed now to help people who have holes in their roofs, she said. No special skills are needed, but those who know how to do roofing, sheet-rocking, ceiling tiles, flooring and painting are welcome.

Work days are scheduled for Oct. 11, Nov. 15, Dec. 6, Jan. 24, Feb. 21, March 20, April 24 and May 8. To volunteer, call Schoeffler at 337-234-1177 or e-mail larecovery@bellsouth.net.

Schoeffler estimated that people from about 15 states have come to Louisiana to help out. When asked why people would travel across the country to help someone they do not know, she laughed.

"It's the church. What are we called to be other than servants?" she said. "These people are out on the mission, and it's a blessing to them as much as it is to the people who get their homes fixed."

The Federal Emergency Management Agency estimates that Lili and Tropical Storm Isidore, which hit Louisiana just a week prior to Lili's arrival, inflicted more than $1 billion in damage to insured properties, said FEMA spokesman David Passey.

The agency paid local governments and residents more than $235 million in disaster assistance. More than $118 million in flood insurance claims were paid, said Passey, who works in FEMA's regional office in Denton, Texas.

The Small Business Administration, which provides low-interest loans to individuals and businesses to repair damages, approved more than 4,200 loans for a total of more than $51 million, said Michael Lampton, public affairs officer for the agency.

The Red Cross opened 55 shelters in five states for Isidore, which 2,300 evacuees used, said Larry Rockwell of the American Red Cross's Washington D.C. disaster public affairs office. For Lili, 17,000 evacuees were sheltered in 85 locations in Louisiana, Texas and Mississippi.

More than 1.3 million meals and snacks were served during the recovery, he said. Red Cross mental health workers made more than 10,000 contacts.

In all, 6,342 Red Cross relief workers were mobilized, and more than $14 million was spent in the agency's response, Rockwell said.

After the storm hit on a Thursday morning, 49 parishes declared a state of emergency. More than 900,000 people lived in the areas where evacuations were called; nearly 17,000 fled to shelters.

Within hours of landfall, nearly 450,000 people were without power; by the time the storm passed, that number had hit more than 500,000.

It could have been worse.

While Lili approached the Gulf Coast on Oct. 2, 2002, it was a Category 4 storm, with winds of 140 mph and more. Hurricane Andrew was a Category 3 in 1992.

At that strength the storm surge could reach 10 feet to 20 feet and spread inland as far as 25 miles across low-lying coastal Louisiana.

But overnight, Lili hit cooler waters -- compliments of Isidore -- and although it still was a Category 4 just hours before landfall, by the time Lili barreled on shore Oct. 3, 2002, it had diminished to a powerful Category 2 storm.

That was good news, but FEMA officials worry that every time residents dodge a bullet such as that, they become more complacent.

FEMA is working on its post-storm assessment, which attempts to record the lessons that should be learned from Lili, Passey said.

FEMA's estimates are that 40 to 55 percent of the people told to evacuate actually left, Passey said.

"We're concerned about that. We went through a spell of hurricanes not making landfall, and we've had several -- Lili, Claudette, Isabel -- die out at the last minute," Passey said. "If people think, 'Oh, it will die out,' then those who should have heeded the evacuation notice won't evacuate. Our primary message is this: If you want to save your life, you need to heed the advice of local officials. If they recommend you evacuate, then do it. It's nothing more complicated than that."

Passey said many residents keep track of storms via the Internet and television weather programs, and that is good. But people must realize that local officials have many more resources at their disposal when they make the decision to order an evacuation.

"They have all those resources of the Internet and the Weather Channel, plus all the resources of the Hurricane Center, the National Weather Service, all the tools that we've put together as a team," Passey said. "Their decision on evacuation is not just an educated guess, it's a very well-informed decision."