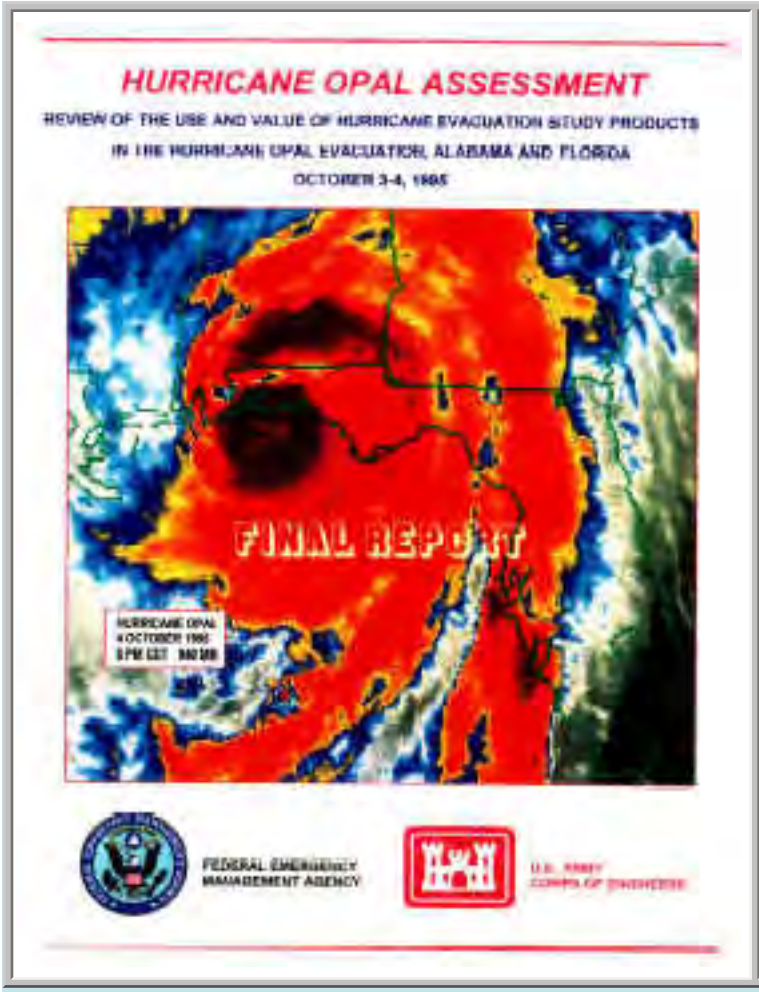


HURRICANE OPAL ASSESSMENT

Review of the Use and Value of
Hurricane Evacuation Studies
in the Hurricane Opal Evacuation,
Alabama and Florida

October 34, 1995

Prepared for
U.S. Army Corps of Engineers
Mobile District and
Federal Emergency
Management Agency
Region IV

Prepared by
U.S. Army Corps of Engineers
Philadelphia District
September 1996

CHAPTER 1

INTRODUCTION

Hurricane Opal crossed the western Florida coastline late in the afternoon of Wednesday, October 4, 1995. Earlier Wednesday Opal had intensified to a strong Category 4 hurricane with tropical storm force winds extending more than 200 miles away from the center. The storm then weakened somewhat, coming ashore between Pensacola Beach in Escambia County and Navarre Beach in Santa Rosa County as a marginal Category 3 hurricane at about five p.m., Wednesday. At landfall the storm had a forward speed of 23 mph and was on a north-northeastward track. Maximum storm tide heights were just over eight feet. Combined storm surge and wave effects reached a maximum near 24 feet in the Fort Walton Beach area and caused extensive property damage along approximately 120 miles of the Florida Coast from Pensacola Beach to Mexico Beach (eastern end of Bay County). Wind damages occurred well inland. With damage estimates near $3 billion, Opal was one of the top ten costliest hurricanes of the twentieth century. Given the severity of the storm, however, human casualties were minimal. A tornado spawned by Opal caused one death in the Florida Panhandle (at Crestview in Okaloosa County); several wind related deaths occurred in Alabama, Georgia and North Carolina. No deaths were caused by storm surge flooding.

Recent major hurricanes such as Hugo (1989) or Andrew (1992) which produced enormous property damages, did not cause many deaths or injuries. Evacuations of storm surge areas and mobile homes were completed before the arrival of pre-landfall surge or high winds, and evacuees had reached safe destinations. Following these storms Federal Emergency Management Agency (FEMA)/Corps of Engineers post-hurricane assessment teams concluded that hurricane evacuation study products had played a useful role in the evacuation plans that had been successfully implemented by state and local emergency management officials.

An estimated 100,0001 people evacuated for Hurricane Opal. While the successful evacuation of storm surge areas can be credited with preventing storm surge deaths during Opal, only fortune or providence can be credited for the lack of human casualties caused by wind. As Opal moved across the Florida panhandle, thousands of evacuees found themselves in wind vulnerable locations -- on highway evacuation routes, parked in service station plazas, or in whatever refuge of last resort could be found. Had Opal not weakened shortly before landfall it is probable that winds in the core of the hurricane would have killed or injured many people.

To attempt to learn from the experience, FEMA requested the Corps of Engineers to analyze the Hurricane Opal evacuation and to make recommendations for improvements to hurricane evacuation studies and also to recommend measures, both short and long term, which might help jurisdictions in and out of the Opal impact area avoid the chaos that marked this evacuation. A team composed of representatives from the Corps, FEMA, Florida and Alabama Emergency Management and the firm of Post, Buckley, Schuh & Jernigan visited and conferred with state and county emergency management officials and support agencies and interviewed media representatives, commercial proprietors and private citizens.

Discussions with local emergency management officials were centered on if, and how, products produced by hurricane evacuation studies were used and whether study data were accurate and in usable formats. Suggestions for improvements to the products themselves or to the way they are used were solicited. Meetings were held with representatives of ten coastal counties, from Mobile County in Alabama to Wakulla County in Florida, and a total of nine Florida and Alabama inland counties during the week of December 11 to 15 and on December 18 and 19, 1995. The counties visited are shown in Figure 1-1.

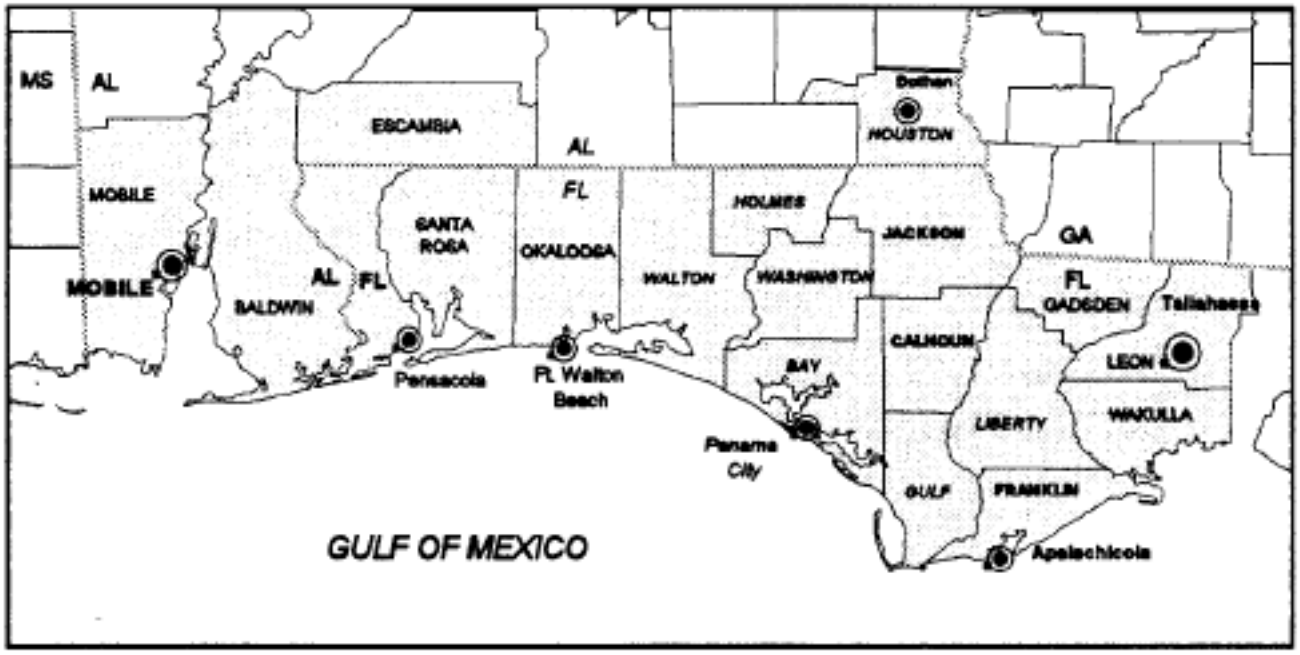


FIGURE 1-1
POST-HURRICANE OPAL ASSESSMENT COUNTIES

1995 HURRICANE SEASON

Hurricane Opal was the 14th named tropical cyclone of the extremely busy 1995 Atlantic hurricane season and it was the third 1995 hurricane to hit the Florida Panhandle (see Figure 1-2,). Hurricane Allison was a minimal hurricane on a somewhat erratic track when it came ashore on June 5 in the Apalachee Bay Region south of Tallahassee. Total estimated damages from Allison were less than one million dollars. On August 2 Hurricane Erin swept across Central Florida from the Atlantic Ocean, exited the Florida Peninsula and headed in the direction of Louisiana. On August 3 Erin turned to the northwest, striking Pensacola, Florida. During its passage through two Florida regions Erin caused 11 deaths and $700 million in damages. The experience of these two earlier storms may have had some effects, not necessarily consistent, on evacuation decision making and on public response during Opal. There was some post storm second guessing of one county's decision to order evacuations and to close schools for Hurricane Allison. The relative weakness of these storms may have prompted the public to take a "wait and see" attitude regarding Opal. On the other hand, there were widespread and lengthy power outages during Erin. The inconvenience and discomfort caused by the loss of power in Erin may have served to make some of those threatened by Opal more ready to evacuate.

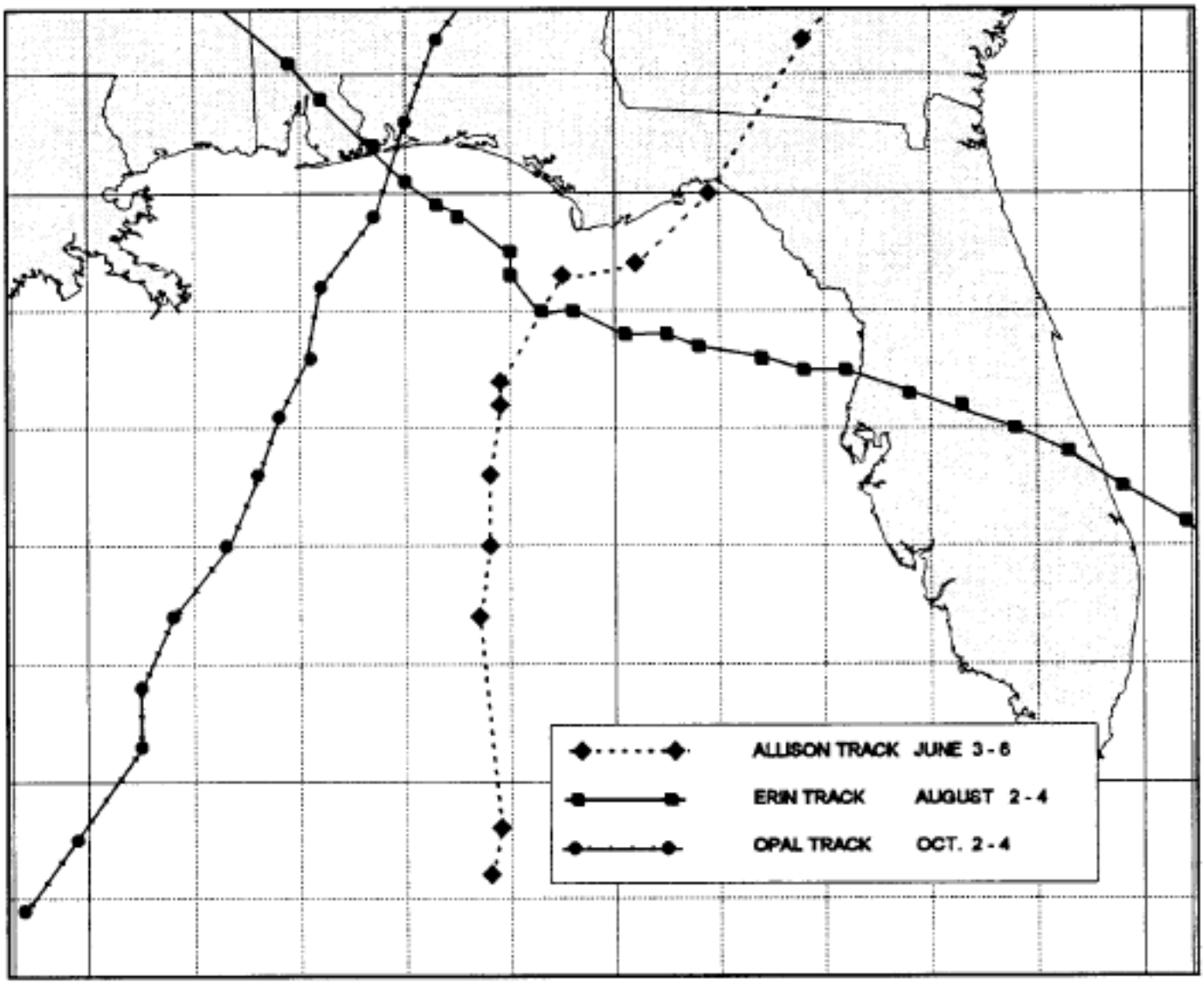


FIGURE 1-2
NORTHWEST FLORIDA
1995 HURRICANE TRACKS

HISTORY OF HURRICANE OPAL

The tropical depression which produced Opal did not develop until September 27. After forming the depression wandered slowly over the Yucatan peninsula for several days, becoming a tropical storm midday Saturday, September 30. Opal gradually strengthened and moved slowly westward over the Gulf of Mexico. It finally became a hurricane early on October 2, only two and a half days before its eventual landfall in Northwest Florida. At 4 a.m. on October 3 the National Hurricane Center posted the first hurricane watch for the United States Gulf Coast; it extended from Morgan City, Louisiana to just west of Pensacola, Florida. Later on the 3rd and early on the 4th Opal turned northeast and rapidly intensified. At 10 AM CDT on Tuesday, October 3 the hurricane watch was extended further east to the Suwannee River, Florida. At this time Opal was still a Category 1 hurricane but was forecast to strengthen to a strong Category 2 storm before landfall. The 10 a.m. CDT advisory (Advisory 24) the forecast track showed Opal coming ashore in the Pensacola Beach - Navarre Beach vicinity.

The intermediate advisory (24A) issued by the Hurricane Center at 1 p.m. CDT on Tuesday, October 3, warned of an expected increase in forward speed and a further strengthening during the next 24 hours. The advisory also noted that tropical storm force winds extended outward up to 230 miles.

Advisory 25 issued at 4 PM CDT on Tuesday, October 3, reported sustained wind speeds of 85 knots and predicted further strengthening to 95 knots -- a strong Category 2 hurricane on the Saffir- Simpson -- and some increase in forward speed. The advisory mentioned the likelihood of a hurricane warning being posted later that evening. The projected track had shifted very slightly to the east; highest strike probabilities were centered on the Florida coast between Pensacola and Panama City. Intermediate advisory 25A included a tropical storm warning for the Gulf coast from Morgan City, Louisiana to the Suwannee River, Florida and again noted that a hurricane warning for the same area could be expected shortly.

By the time advisory 26 was issued by the Hurricane Center at 10 p.m. CDT Tuesday Opal had become a Category 3 hurricane. A hurricane warning was posted from Mobile, Alabama to Anclote Key, Florida. The projected track had the center of the storm hitting the coast on Wednesday afternoon. Tropical storm force winds extended outward over 200 miles from the center and were predicted to reach the Northwest Florida coast by four or 5 a.m. CDT. The Hurricane Center in this advisory urged that all preparations be rushed to completion. Probabilities of Opal passing within 65 miles by 7 p.m. Wednesday were as follows: Appalachicola - 33%, Panama City - 35%, Pensacola - 26%. These numbers are at the upper end of the range of probabilities that the Hurricane Center will issue 24 hours before predicted landfall.

Throughout Tuesday night Opal continued to strengthen, eventually peaking Wednesday morning as a full Category 4 hurricane. From midmorning and through the rest of Wednesday, the storm weakened somewhat, making landfall at 5 p.m. CDT as a marginal Category 3 hurricane with maximum sustained winds of 100 knots. As it moved inland across the Florida Panhandle, into Alabama and further north, it continued to weaken, reaching tropical storm, tropical depression and extra-tropical storm status fairly rapidly. Although no land areas were subject to the core winds of a Category 3 hurricane, wind damages were experienced over wide portions of the Southeastern United States. Figure 1-4, shows Opal's positions for several days before landfall.

OPAL EVACUATION CHRONOLOGY

Table 1-1 provides an overview of the timing of County evacuation orders and evacuating traffic movements shown in relation to significant changes in the behavior of Hurricane Opal and information and advisories provided by the National Hurricane Center. The 2 PM Wednesday, October 4 entry shows a 79 mph wind gust at Pensacola and a fatal tornado in Okaloosa County. Meanwhile, the chart of duration of major evacuating traffic flow shows that the evacuation actually continued for at least another six hours after two p.m. within Northwest Florida. Obviously, the goal of completion of the evacuation before the arrival of tropical storm force winds was not met.

HURRICANE EVACUATION STUDY PRODUCTS

This assessment considers data from two hurricane evacuation studies, the 1986 Tri-State HES and the Draft Apalachee Bay Region HES. The Tri-State study encompassed the three Mississippi and the two Alabama coastal counties and the five westernmost coastal counties of Florida. The Draft Apalachee Bay Region LHES that covered four coastal and five inland counties was distributed in early 1995. A restudy of the Florida portion of the Tri-State HES was begun in 1994. Figure 1-3, shows the locations of the three study areas.

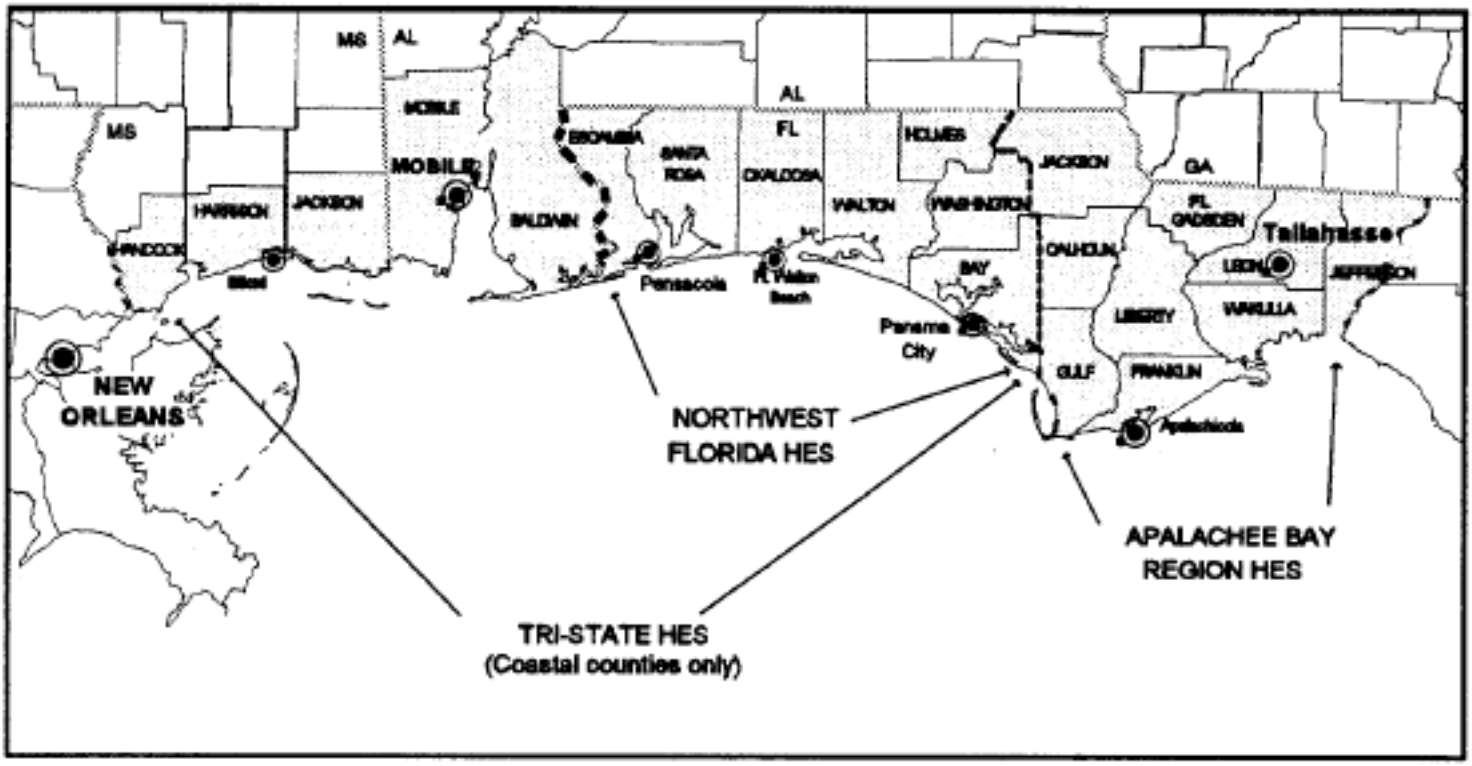


FIGURE 1-3
HURRICANE EVACUATION STUDY AREAS

Results of all hurricane evacuation studies are presented in Technical Data Reports. A standard sequence of analyses usually employed in hurricane evacuation studies was used in the Tri-State and the Apalachee Bay Region studies and is beingused in the Northwest Florida Study. The results of the Apalachee Bay Region HES were also incorporated into HURREVAC an evacuation decision assistance software package. HURREVAC allows quick access to critical study data and prompts the user to utilize this data and National Hurricane Center advisories in the evacuation decision-making process.

This assessment is organized similarly to an HES Technical Data Report. Separate chapters address the following five analyses of an HES:

- Hazards Analysis
- Vulnerability Analysis
- Shelter Analysis
- Behavioral Analysis (Public Response)

- Transportation Analysis

Additional chapters also address evacuation decision-making and public information. Short and long term recommendations for improvements to HES products and their use are summarized at the end of each chapter.

CHAPTER 2

HAZARDS AND VULNERABILITY DATA

The main objective of a Hurricane Evacuation Study hazards analysis is a determination of the effects of storm tide flooding from hurricanes of varying intensities that have some probability of striking the study area. The hazards analysis quantifies the expected hurricane generated storm tide flooding that would inundate an area. The National Weather Service's SLOSH (Sea, Lake, and Overland Surge from Hurricanes) numerical storm surge prediction model was used as the basis for the storm surge analysis performed for the Tri-State HES and the Apalachee Bay Region HES. Updated SLOSH modeling was performed in 1994 for the Northwest Florida portion of the Tri-State Study (Pensacola Basin and Panama City Basin). The Apalachee Bay Region was modeled in 1991 (Apalachicola Basin).

A general reference is usually made to possible riverine flooding caused by rainfall associated with a hurricane. However, because of the great variability both in the amount of precipitation caused by hurricanes and in the antecedent conditions that may contribute to or mitigate the flooding effects of rainfall, no distinct attempt is made to quantify possible riverine flooding. National Flood Insurance Studies and Flood Insurance Rate Maps and/or areas that have historically flooded are usually referenced as a reasonable starting point for evacuation planning efforts for non tidal flood areas.

Historically, hurricane evacuation studies have addressed the wind effects of hurricanes (other than the generation of tidal surge) in a very general manner. The Saffir-Simpson Scale, which classifies the intensity of hurricanes, is included in each HES Technical Data Report (TDR). Reference to the Saffir-Simpson scale provides jurisdictions with some idea of the maximum wind velocities that a threatening hurricane may produce. A recently developed tool that is currently being tested in several study areas, including the Apalachee Bay Region LIES, is a wind decay model developed by the Hurricane Research Division/Atlantic Oceanographic and Meteorological Laboratory (AOML). This model provides information that can be included in the Tropical Cyclone Forecast and Hurricane Local Statements that will help inland communities prepare for threatening high wind conditions. FEMA has developed software that enables state and local emergency managers to display anticipated wind intensities in the path of a hurricane. The program is designed to be used only in the last hours before storm landfall, when the NHC wind field forecast errors are relatively low.

The next step is the development of vulnerability data. Using the results of the hazards analysis, storm tide maps are produced showing the inland extent of surge inundation for various hurricane intensities. Analyzing these maps together with census maps, the population vulnerable to surge inundation is identified. Also identified are the locations and numbers of people living in mobile homes or other structures at increased risk to high winds. At-risk areas are mapped and included in "evacuation zones" which are used in traffic modeling. These zones are operational tools, used in communicating to the public what areas should evacuate under various hurricane threats.

This Hurricane Opal Assessment addresses the accuracy and usefulness of the hazards and vulnerability data provided by the Tri-State HES and the Apalachee Bay Region FES. The following subjects are addressed in the following paragraphs:

- - Were the technical data and storm tide maps provided accurate in depicting potential and actual hazards?
- - Were demographic data accurate and presented within the hurricane evacuation study so as to enhance the usefulness of the study as an evacuation planning resource?
- - Was the data contained in the Study appropriately used for this evacuation?

SLOSH MODEL PERFORMANCE

Usually, the peak surge from a hurricane occurs to the right of the storm path and within a few miles of where the radius of maximum winds is found. This is largely due to the counterclockwise rotation of the windfield surrounding the eye of the hurricane (in the northern hemisphere). To the right of the landfall point the winds blow toward the shoreline; to the left of the landfall point the winds blow away from the shoreline. It is important to note, however, that the least accurately predictable parameter of a hurricane is the point of landfall. The average error in the National Hurricane Center landfall forecast at twenty-four hours is approximately 100 nautical miles; the average error in the 12-hour landfall forecast is about 50 nautical miles.

Because of the inability to predict exactly where a hurricane will make landfall, and because it may be necessary to begin evacuations of areas susceptible to hurricane surges as much as 24 hours before landfall, it is necessary to predict potential surge elevations for a given hurricane over a range of potential landfall points. To meet this need, the SLOSH model is used to develop a map termed a "MEOW", which is the Maximum Envelope Of Water from a number of individual hurricane simulations that differ only in point of landfall of the storm center. In this manner, the maximum water surface elevations for a segment of coastline are calculated for different hurricanes, defined by direction, forward speed, and intensity, independent of where the storm actually crosses the coastline. This data is then compressed into a MOM (Maximum Of Maximums) which shows the maximum expected level of surge inundation irrespective of direction and forward speed, with category of hurricane being the only defining factor. This MOM data is incorporated into the Storm Tide Atlases upon which the Vulnerability Analysis is based.

The preceding information on how the SLOSH Model is used in hurricane evacuation studies is necessary for an understanding of how the Model is evaluated for its performance for a given storm. The model can only be evaluated on how its storm surge calculations compared to the surge produced by a particular storm having its own unique track, forward speed and intensity at or near landfall. The calculated surge heights that are compared with actual surge heights are those that the SLOSH Model produces for the storm parameters in evidence at landfall, not on the parameters that may have been predicted 6, 12 or 24 hours before landfall.

As it has throughout its history, the SLOSH Model performed well for Hurricane Opal. Figure 2-1 provides a comparison of the maximum surge heights experienced at a number of locations during Opal with the surge heights calculated by the SLOSH Model for a hurricane with Opal's track, intensity and forward speed. Observed surge heights are based mainly on maximum tide gage readings and on high water marks taken from inside buildings where the effects of waves can be eliminated.

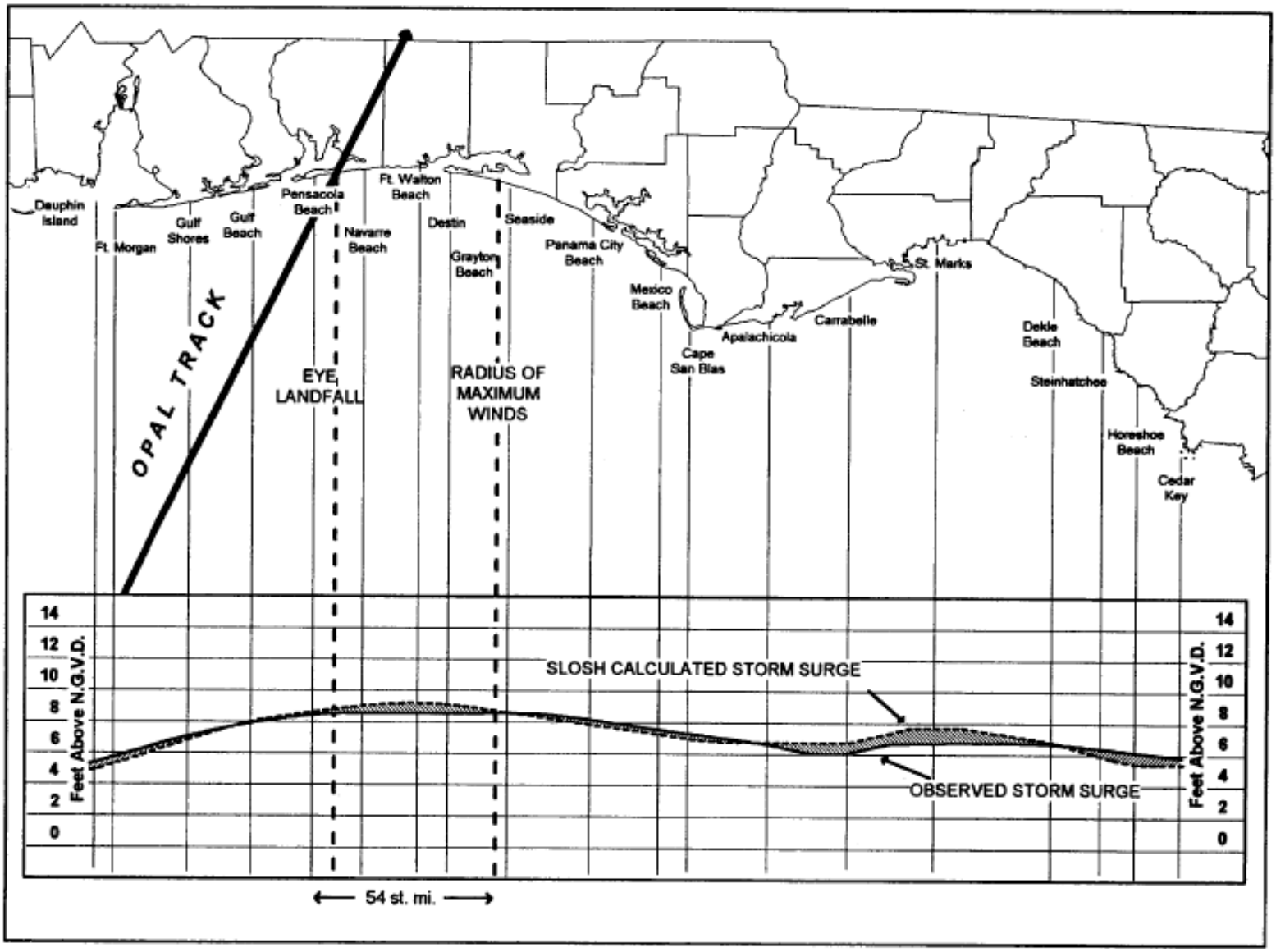


FIGURE 2-1
OBSERVED VERSUS SLOSH CALCULATED STORM SURGE
FOR HURRICANE OPAL, OCTOBER 1995

Figure adapted from original provided by National Hurricane Center Storm Surge Group.

The SLOSH Model calculates potential stillwater surge heights. Some very large breaking waves accompanied Opal's storm surge (Figure 2-2,). While the additional height of breaking waves was a significant factor in the property damage sustained during Opal, the wave heights are not very significant in an evaluation of SLOSH's utility in hurricane evacuation planning. Wave height damages are generally limited to areas and structures immediately along the open shoreline. These areas will be included in any hurricane evacuation. The severity of wave action should not be a factor in the number of evacuees and evacuating vehicles, or in evacuation clearance times.

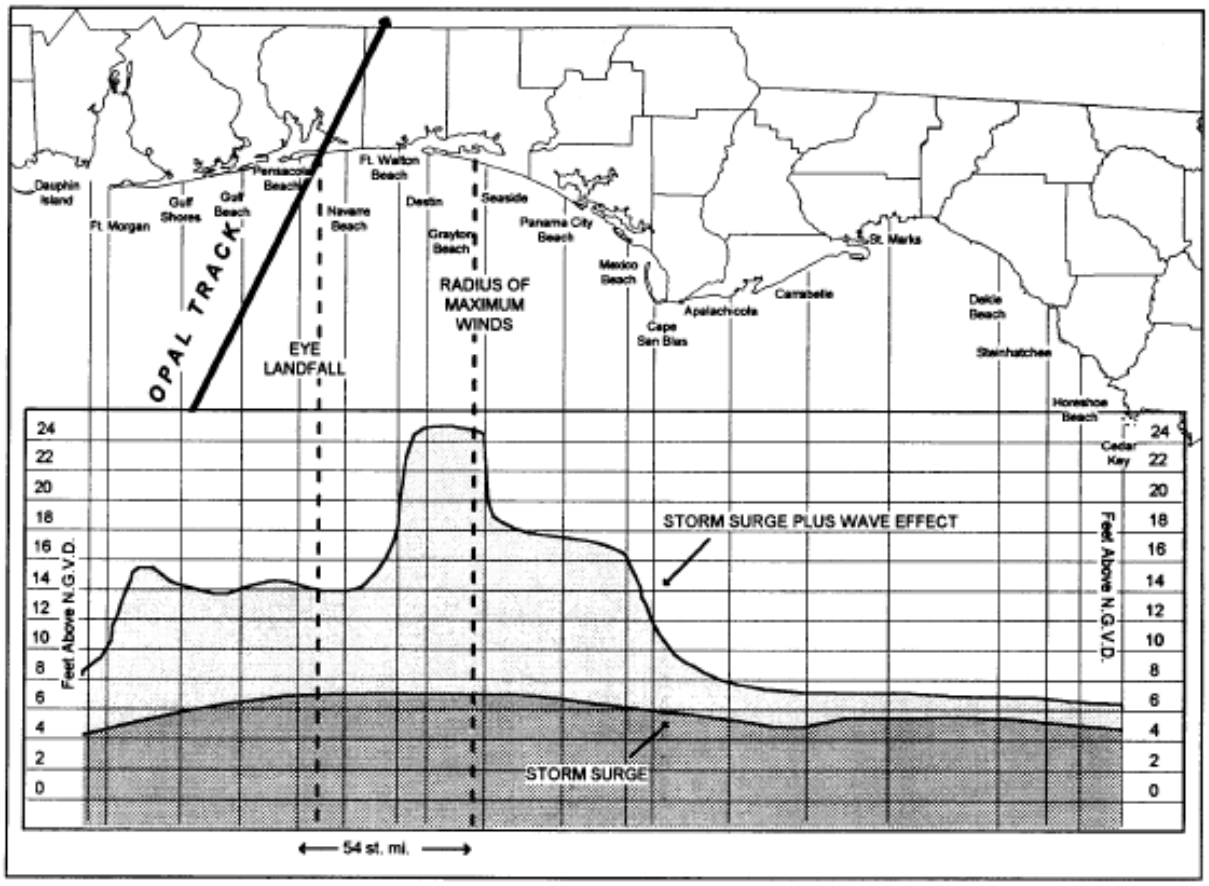


FIGURE 2-2
OBSERVED SHORELINE SURGE AND WAVE EFFECT PROFILES
FOR HURRICANE OPAL, OCTOBER 1995

Figure adapted from original provided by National Hurricane Center Storm Surge Group.

TRI-STATE HES COUNTIES USE OF INUNDATION MAPPING/EVACUATION ZONES

In general, the coastal counties in the Tri-State HES made use of inundation mapping and, to varying degrees, evacuation zone maps provided by the Tri-State HES, and considered them reasonably accurate.

Mobile County recommended evacuation of Dauphin Island, trailers and low-lying areas. These areas were included based on a combination of Tri-State inundation and zone maps and the experience of local officials. Following this recommendation, the Governor issued a mandatory evacuation order for Dauphin Island, which is completely

inundated by a worst case Category 3 hurricane. Baldwin County addressed its evacuation order to residents of Orange Beach and Gulf Shores and "anyone within a mile of water." Both Alabama Counties believe the Tri-State maps are fairly accurate and that appropriate areas were evacuated for Opal. Both, however, desire to have an updated SLOSH model and maps.

Escambia, the westernmost Florida county, ordered evacuation of Category 1-3 areas as well as all mobile homes. There are significant non-surge areas south of US 98 that are included in evacuation areas (Zones 20 and 21) because they would be isolated by tidal flooding. This situation will warrant careful examination during the vulnerability analysis of the Northwest Florida HES. Inclusion of these areas in evacuations can be expected to have significant ramifications on calculations of evacuating vehicles, shelter demand and clearance times. Santa Rosa, Oakloosa and Walton Counties also indicated they used Tri-State evacuation zones as the general basis for their evacuations.

Bay County used Category 1-3 zones as the basis of the area it evacuated. The Emergency Management Director regards the written zone descriptions provided by the Tri-State HES as not very useful for instructing the public. In 1994 the county "translated" the boundaries into "plain English."

APLACHEE BAY REGION HES COUNTIES USE OF INUNDATION MAPPING/EVACUATION ZONES

The Draft Apalachee Bay Region HES was distributed early in 1995. There was variety among study area counties both in the use of the Study produced maps and the attitude toward them.

The Gulf County Emergency Management Director indicated that the county makes use of the Maximum Envelope of Water (MEOW) data presented by the HES in conjunction with advisory data from the National Hurricane Center and the Florida Division of Emergency Management, rather than relying on the absolute worst case surge height generated by a particular hurricane category (MOM - maximum of maximums). This approach takes storm track direction into account and thus does not "overstate the risk so dramatically." County emergency management feels that there is a "cry wolf' syndrome in effect and that the MEOW approach may help to mitigate it.

Franklin County based all its evacuation decisions on conference calls with the National Hurricane Center. With the exception of storm surge maps, no products from the Apalachee HES were used. The County's evacuation order was mandatory for low lying areas and barrier islands only. Storm surge maps were used for information purposes only in talking to other agencies. They are not used to establish evacuation zones. The County has established two zones: mainland and islands.

Wakulla County indicated that it did not perceive the Apalachee Bay Region. FIES to be complete and thus had questions regarding its usefulness.

The inland counties of Holmes, Washington, Jackson, Calhoun, Liberty, Gadsden and Leon generally were aware of the vulnerability of mobile homes and ordered evacuation of these at some point.

TRI-STATE HES POPULATION AND HOUSING DATA

Base population, housing unit and vehicle ownership data used in the Tri-State HES was initially developed using 1980 census counts. These data were then supplemented and updated with traffic analysis zone data obtained from planning organizations and urban transportation studies. Tourist population and dwelling unit data was developed through state, regional and local planning agencies, travel bureaus, trade associations and chambers of commerce. When aggregated by evacuation zone and combined with tourist occupancy rates and various public behavioral assumptions, this demographic data is crucial to calculation of evacuating vehicles, shelter demand and clearance times. Table 2-1 reflects the enormous increases in population and housing units in the two Alabama and five Florida counties since the Tri-State data was developed. These increases constitute one of the primary reasons for initiation of the Northwest Florida HES and lends credence to the argument for an update of the Alabama portion of the Tri-State Study.

While Table 2-1 does not detail population or housing unit increases in surge vs. non-surge vulnerable areas, it is reasonable to assume those increases in surge areas are at least as large as county-wide increases. Emergency managers interviewed indicated that growth has occurred primarily in the southern, or coastal, end of these counties.

COUNTY	POPULATION 1986 TDR	1990 Census	Percent Change	TOTAL HOUSING UNITS 1986 TDR	1990 Census	Percent Change
Mobile, AL	364,980	378,643	4%	134,917	151,220	12%
Baldwin, AL	78,556	98,280	→ 25%	31,734	50,933	→ 60%
Escambia, FL	233,794	262,798	12%	88,724	112,230	→ 26%
Santa Rosa, FL	55,988	81,608	→ 46%	21,238	32,831	→ 55%
Okaloosa, FL	109,920	143,776	→ 31%	46,493	62,569	→ 35%
Walton, FL	21,300	27,760	→ 30%	11,462	18,728	→ 63%
Bay, FL	97,740	126,994	→ 30%	43,763	65,999	→ 51%

TABLE 2-1: TRI-STATE STUDY AREA POPULATION GROWTH

Along with the significant growth of population and housing units throughout most of these counties there has also been enormous growth in mobile home units in some of the counties. In addition, it should be noted that a high percentage of housing units in Holmes and Washington Counties are mobile homes. These inland counties were not included in the Tri-State HES. Assuming fill evacuation of these units to nearby shelters, additional volumes of background traffic should be factored into the region's clearance times in the ongoing Northwest Florida HES.

COUNTY	MOBILE HOME UNITS 1986 TDR	1990 Census	Percent Change
Mobile, AL	6,852	22,376	→ 227%
Baldwin, AL	3,818	8,821	→ 131%
Escambia, FL	6,435	10,576	→ 64%
Santa Rosa, FL	2,492	6,467	→ 160%
Okaloosa, FL	5,225	6,050	16%
Walton, FL	1,507	2,164	→ 44%
Bay, FL	6,070	11,084	→ 83%
Holmes, Fl		6,785	
Washington, FL		7,703	

TABLE 2-2: TRI-STATE STUDY AREA MOBILE HOME UNIT GROWTH

APALACHEE BAY REGION HES POPULATION AND HOUSING DATA

The population and housing data base for the Apalachee Bay Region HES was developed using 1990 census data and can, therefore, be considered reasonably up-to-date. The four coastal counties (Gulf, Franklin, Wakulla and Jefferson) are lightly populated with a total population under 50,000. However, a high percentage of housing units are either in surge areas or are mobile homes. In addition, the inland counties in the HES study area (Jackson, Calhoun, Liberty, Gadsden and Leon), which are more heavily populated, have high percentages and high absolute numbers of mobile homes, thus making a large contribution to the total number of vehicles on the evacuation network. Because of the small populations of the four coastal counties and the high percentages of those populations living in surge areas or mobile homes, any increases in housing units can be expected to produce large percentage increases in the vulnerable population, shelter demand, and highway clearance times. Frequent updating of the Apalachee Bay Region

HES housing and population figures would be prudent.

CONCLUSIONS AND RECOMMENDATIONS

Northwest Florida Hurricane Evacuation Study

- - Significant non-surge areas of Escambia County south of US 98 are currently included in evacuation areas because of the potential for isolation by flooding. Evacuation zones for the Northwest Florida HES should be drawn in close consultation with county emergency management directors and with close attention to issues such as isolation. Given the large population growth in the southern portions of the study area and the expected resultant increases in clearance times, it may be necessary for some counties to attempt to strongly discourage non-surge area residents from evacuating while taking into account the hazards associated with being cut off from other non-surge areas.
- - Attention should be paid to the clarity of the descriptions of evacuation zone boundaries as these zones may be used in public information products.
- - Several county emergency directors in the Apalachee Bay Region HES study area indicated that they were not familiar with, or ignored, data produced by the draft study. It would seem advisable that a renewed effort be made to acquaint these directors with the study and its potential usefulness.
- - Given the huge increases in housing units in Baldwin County, Alabama, a high priority should be given to a restudy of the Alabama counties included in the Tri-State HES. Alternately, consideration should be give to the addition of Mobile and Baldwin Counties to the NW Florida HES.
- - Mobile housing units and population in Holmes and Washington Counties were not included in the Tri-State HES. Given the large numbers of these units and their potential impact on evacuation traffic, they should be addressed in the vulnerability and shelters analyses of the Northwest Florida HES.
- - Housing unit increases for 1980-1990 in the eight Apalachee Bay Region HES study area counties (four coastal counties and five inland counties: Leon, Liberty, Gadsden, Calhoun and Jackson) ranged from twenty-six to forty-one percent. Assuming that this growth is likely to continue, vulnerability data for this region should be frequently updated.
- - It is likely that a significant percentage of Opal evacuees were non-surge residents who either were not aware of their non-surge status, or who were prompted to leave by the Wednesday morning Category 4 status of Opal. The fact that five people were killed by Opal related winds in the Atlanta area while one person was killed by winds in Florida (a tornado in Crestview, Okaloosa County) points out the need for explicit public policies regarding who should evacuate under what circumstances; a clear communication of these policies; and public education regarding these policies and the justifications for them.

CHAPTER 3

PUBLIC RESPONSE

The Hurricane Evacuation Studies Behavioral Analysis establishes assumptions regarding how the public in the study area will respond to a variety of hurricane threats and evacuation orders. These assumptions are used in the HES transportation analyses and for guidance in emergency decision-making and public awareness efforts. The specific objectives of the behavioral analysis are to develop reliable estimates of the following:

- The percentages of people in various risk areas that will evacuate.

- When the evacuating population will leave.

- Numbers of vehicles used by evacuating households; numbers of other vehicles utilized or towed such as boats and trailers.

- Probable destinations of evacuating households (e.g., public shelter, home of friend or relative, hotel/ motel, in-county/out-of-county, etc.).

- Evacuation responses of tourists.

- Differences in response behavior based on forecasts of hurricane intensity and probability.

Data sources for behavioral analyses typically include sample surveys regarding response to any hurricanes that may have impacted the study area in recent years and intended responses in hypothetical evacuations. Survey responses are compared to a "general response model," i.e. patterns observed in many of evacuations documented over several decades in a variety of locations. Data collected in the aftermath of a hurricane contributes to the continued development of the general response model. As part of the Northwest Florida HES a post-Opal survey of public response was funded by the Corps of Engineers. The survey was conducted by Dr. Jay Baker of the Florida State University, Department of Geography. A copy of the Preliminary Findings of this surveyed is included as Appendix I of this report. A final report will be prepared by Dr. Baker that will include guidance on establishment of public response assumptions to be used in the Northwest Florida Study.

Some interesting conclusions related to the public response in Opal can be derived from Dr. Bakers's preliminary report and also from information provided by emergency officials and members of the public who were interviewed during the post-Opal HES assessment. Several of these conclusions may be important for emergency officials in attempting to guide the public in future evacuations.

EVACUATION PARTICIPATION RATES

(The percentages of people that will evacuate)

The Post-Opal Public Response Survey grouped participation rate data across five areas from west to east: Mobile County, AL; Baldwin County, AL; Escambia and Santa Rosa Counties, FL; Okaloosa and Walton Counties, FL; and Bay County, FL. Participation rates of beach residents varied from 78 to 90 percent (Appendix 1, Fig. 1, page 4). Thirty-three to 66 percent of mainland surge residents evacuated with fairly high differences between the Alabama and Florida areas. Nonsurge residents in Alabama evacuated at rates of fourteen to fifteen percent, while the five Northwest Florida counties saw non-surge rates of 34% to 37%. By the time the bulk of evacuees started moving Opal was taking aim at the western end of the Florida Panhandle. Observed and forecast radii of hurricane, 50 knot and tropical storm force winds were all significantly wider on the eastern side of the hurricane. This may partially explain the higher participation rates in the Florida counties.

The participation rates shown by the Opal survey are in reasonable accord with the assumptions established by both the 1986 Tri-State HES and the 1995 Apalachee Bay Region HES. However, as in other post hurricane assessments, variations in terminology handicap attempts to make comparisons. The terms "inland" and/or "low-risk" have been used with a variety of meanings by hurricane evacuation study technical data reports and by post storm public response surveys to refer to areas outside tidal storm areas or away from immediate coastal areas. In light of the massive traffic congestion experienced in the Opal evacuation it would appear that careful attention should be paid to the definitions of "inland" and/or "low-risk" areas. It should be clear how these terms relate to surge areas. These distinctions are important both in terms of their ramifications for evacuation zone development and traffic modeling and for the strategies that emergency managers may wish to employ in influencing non-surge residents to not evacuate.

EVACUEE RESPONSE RATES

(When the evacuating population will leave)

"Behavioral Response Curves" are presented in the Tri-State HES Technical Data Report and the Apalachicola Bay Region BES Draft Technical Data Report. These curves depict slow, medium and rapid responses by the public to an evacuation order. Typically, a small percentage of households will start evacuating before an order is issued. Upon receiving the evacuation order, some percentage of households will leave within an hour, some within two hours, some within three, etc. A curve can be drawn to show the cumulative percentage of households that has entered the evacuation network over a number of hours. A rapid loading of the network produces a quickly rising curve; a medium loading produces a flatter curve, etc. Figure 3-1 shows samples of rapid, medium and slow responses.

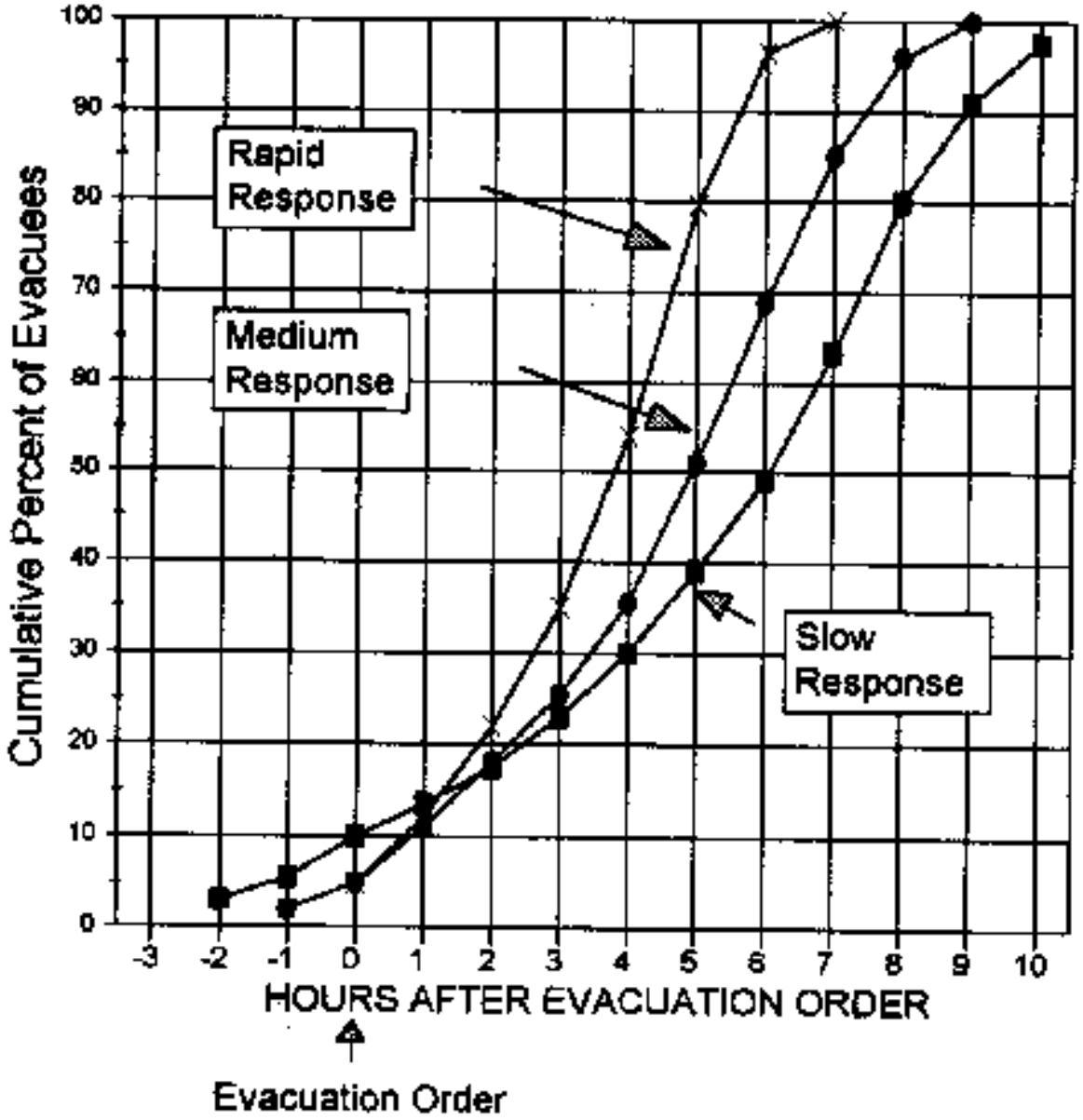


FIGURE 3-1
SAMPLE BEHAVIORAL RESPONSE CURVES

Examination of Florida Department of Transportation traffic counts on a number of evacuation routes suggested that Hurricane Opal behavioral response curves may have been elongated, at least in those counties that issued evacuation orders Tuesday night, October 3. Some of these curves would have had a very long, flat slope for eight to 10 hours after the evacuation order, followed by a very steep slope as large percentages of the evacuating vehicles entered, or attempted to enter, the evacuation network within a very short period. Traffic count summaries are available for Tuesday and Wednesday, October 3 and four. These summaries indicate that, despite the issuance of evacuation orders by a number of counties on Tuesday evening, there were only very small increases in traffic as compared to normal through about 5 am on Wednesday. At many of these sites on major evacuation routes the really substantial volume of evacuation traffic was not in evidence until mid-morning.

The overall behavioral response curve for the seven counties from Mobile County in Alabama through Bay County in Florida derived from responses to the Post-Opal Public Response Survey does, in fact, have a long very gradual slope until early Wednesday morning and then a rather steep slope from approximately 6 AM to 11 AM.

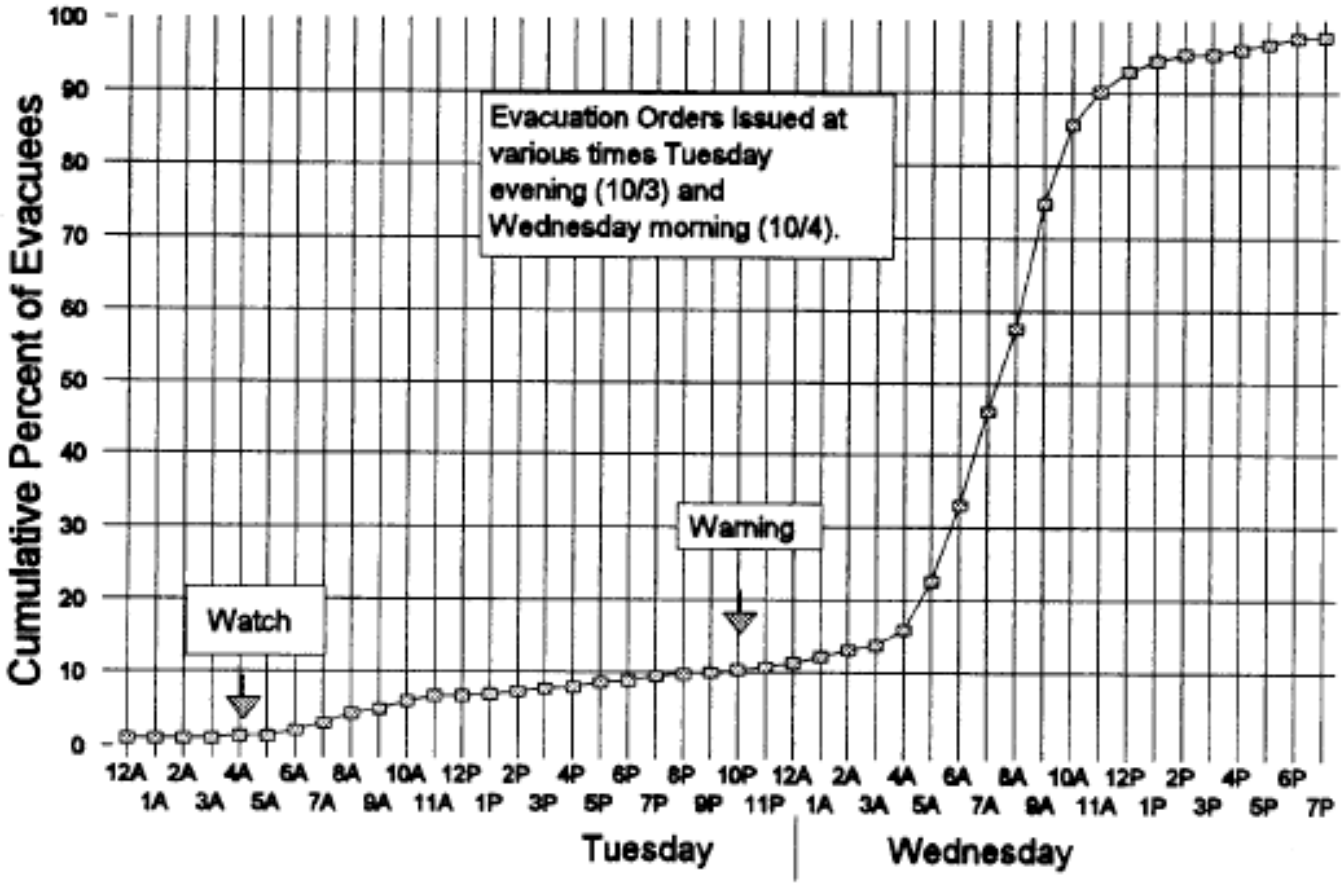


FIGURE 3-2
CUMULATIVE EVACUATION IN OPAL, OCTOBER 3-4

DESTINATIONS OF EVACUATING HOUSEHOLDS

Type of Refuge The Post-Opal Survey found the following breakdown of types of refuge for all seven counties:

TYPE OF REFUGE

	Public Shelter	Friend/Relative	Hotel/Motel	Other
Percentage	5%	58%	22%	15%

The overall percentage of 5% of evacuees going to public shelter (see page 4-1 of this report), included a low of 2% in the Mobile/Baldwin County area to a high of 7% in the Okaloosa/Walton County area. These

percentages were lower than the overall average of 15% assumed by the 1986 Tri- State HES. However, it was noted in the Technical Data Report that wide variations in destination percentages could be expected depending on hurricane intensity, available warning time and the information provided to the public by local officials.

Place of Refuge

The Tri-State HES assumed that an average of 55% of evacuees from the ten counties in the Study area would go to destinations outside their own county. This estimate was remarkably accurate for Hurricane Opal (see below).

LOCATIONS OF REFUGE OF EVACUEES

DESTINATION	AREA EVACUATED			
	Mobile/ Baldwin	Escambia/ Santa Rosa	Okaloosa/ Walton	Bay
Neighborhood	5%	7%	15%	6%
Own County	40%	38%	39%	29%
Out-of-County	55%	55%	46%	65%

The Apalachee Bay Region Draft HES assumes even larger percentages of evacuees will leave their coastal counties (up to 82 percent). The Technical Data Report explains this high percentage as follows:

> It is relatively uncommon for more than half the evacuees to leave their own county, but in the Apalachee region it is probably in recognition of the fact that a large portion of the developed areas of the counties would be affected by storm surge in strong hurricanes. Thus, residents do not believe there would be public shelters, motels, or even many friends and relatives whose homes would be safe in the coastal counties.

To a large extent, these same factors are causes for the large percentage of out-of-county evacuees in the Tri-State HES counties.

The Tri-State HES did not address in much detail the question of where, specifically, out-ofcounty evacuees would go. However, information collected by the Post-Opal response survey (below) may help provide guidance on breakdowns of specific destinations to be used in the Northwest Florida transportation analysis.

OUT-OF-COUNTY DESTINATIONS

DESTINATION	AREA EVACUATED Mobile/ Baldwin	Escambia/ Santa Rosa	Okaloosa/ Walton	Bay
Florida	6%	39%	34%	47%
Alabama	57%	37%	44%	34%
Georgia	0%	6%	5%	18%
Mississippi	30%	10%	9%	0%
Other	8%	8%	7%	0%

CONCLUSIONS AND RECOMMENDATIONS

The Post-Opal Public Response Survey results will form the basis for the Northwest Florida behavioral analysis that will be conducted in the near future. The survey will also contribute to the ever growing behavioral data that underpins the hurricane evacuation "general response model." Meanwhile, however, there are several important conclusions that should perhaps be given immediate attention. These conclusions are tied to public education and information issues and are included in the Recommendation and Conclusions section at the end of Chapter 7.

The 1986 Tri-State Hurricane Evacuation Study and most, if not all, studies published since then, have emphasized the importance of advice from local officials in determining what the public will do in response to a threatening hurricane. Operationally, two aspects of evacuation timing are very important: 1) people will not begin to leave in significant numbers until someone in a position of authority tells them to, and 2) Actions by public officials are extremely important in influencing evacuation timing. In issuing evacuation orders late Tuesday afternoon and evening, several counties set, and publicized, target times for completion of the evacuation. For example, Escambia County told the public that the evacuation should be completed by noon on Wednesday. Including this information in evacuation orders may be counter productive. Evacuees hearing an evacuation order Tuesday evening and planning to travel to destinations that can normally be reached in an hour or two may have considered it quite reasonable to wait until Wednesday morning to leave. Combinations of public education and care in the wording of public information during a hurricane event should help to produce more desirable (i.e., prompt) public responses.

One of the questions included in the post-Opal Public Response survey was addressed to evacuees who said their evacuation trip took longer than they had expected (over 50 percent). When asked their opinion as to why their evacuation trip took longer than they had expected 94% of the respondents blamed the heavy traffic, while only 16% mentioned said that too many people left simultaneously and only 3% said that too many people waited too long to leave (respondents could offer more than one reason). While it is certainly true that heavy traffic was the immediate cause of delays in evacuees reaching their destinations, the answers to this question support the belief that the public was largely uneducated regarding the concept of clearance times and that clearance times in the Northwest Florida region were as high as 24 hours. It is recommended that counties in the Opal impact area, in preparing for the 1996

hurricane season, make a concerted effort to impart to the public an education in clearance times and related concepts.

It is also recommended that extreme care be given to the wording of evacuation orders.

CHAPTER 4

PUBLIC SHELTER ISSUES

Hurricane evacuation study public shelter analyses list public shelter locations, assess their vulnerability to flooding and estimate the number of evacuees who would seek public shelter for various types of hurricane scenarios. Shelter location and capacity data are obtained from local emergency management and from shelter management agencies such as the American Red Cross (ARC). Public shelter capacity is compared to public shelter demand figures generated from the vulnerability and behavioral analyses to determine potential capacity deficits or surpluses.

In previous post hurricane assessments, the following subjects relating to public shelter were addressed:

- - The number of shelters opened and the number of people sheltered.
- - The timing of shelter openings, evacuee arrivals and duration of sheltering.
- - Problems encountered.

As was true of other aspects of the Opal evacuation, public sheltering was subject to much confusion; retrievable information relating to sheltering was sketchy. Many county emergency managers did not have complete information about how many evacuees their county sheltered, or how many of their county residents went to public shelter locally, out-of-county or out-of-state. The post-Opal survey conducted by Hazards Management Group for the Tri-State HES counties found that approximately one-quarter of the evacuees did not reach the destinations to which they had set out, whether those be public shelter, home of friend or relative, hotel or motel, in state or out of state.

The post-Opal survey found that fairly low percentages of evacuees went to public shelter.

PERCENTAGE OF EVACUEES GOING TO PUBLIC SHELTER

	COUNTIES EVACUATED			
BY REGION	Mobile/ Baldwin	Escambia/ Santa Rosa	Okaloosa/ Walton	Bay
Percentage	2%	5%	7%	6%

BY TYPE OF AREA	Beaches	Mainland Surge	Mainland Dry
Percentage	4%	8%	3%

The public shelter usage rate used for various hurricane scenarios in the Tri-State HES averaged 15%.

However, it was noted in the Technical Data Report that wide variations in destination percentages could be expected depending on hurricane intensity, available warning time and the information provided to the public by local officials.

Table 4-1 summarizes the shelter related information gathered during the Opal post storm assessment. A few shelters were opened Tuesday evening; the majority were opened Wednesday morning, and a relative few Wednesday afternoon. It appears that most shelters were operational in time to receive evacuees. Most counties reported that evacuees began to arrive immediately or soon after shelters were opened. Due to the concentration of damages along the immediate coastline, most shelters were able to close by Friday, October 6, approximately 48 hours after Opal's landfall. A phenomenon noted by Okaloosa County involved the fact that some evacuees checked out of shelters soon after the storm had moved out of the region, only to return when they found their houses uninhabitable because of damages or power outages. Others who had evacuated to non public shelters destinations had to go to public shelter after they returned to find their homes uninhabitable.

From the limited data available, shelter usage in the Tri-State HES counties generally was well below that assumed in the 1986 Technical Data Report. The Tri-State Study assumed that five to fifteen percent of evacuees would seek refuge in public shelters depending on a list of variables including proximity to water and types of housing being evacuated. Keeping in mind that the shelter analysis, along with much of the Tri-State data, is in need of updating, there are several explanations for the relatively low numbers of evacuees using public shelter.

- - Given the apparent thousands of last minute decisions to evacuate, there may not have been time for evacuees to obtain or retrieve information on shelter locations and availability.
- - Also, given the widespread and severe traffic jams that prevailed, many evacuees were probably not able to reach shelters for which they set out. Okaloosa and Escambia (FL) Counties reported that special needs evacuees were not able to reach special needs shelters; the same was true for many attempting to reach regular shelters.
- - The number of shelters available in some counties was significantly smaller than the number listed in the 1986 study.
- - Lack of shelter management staffing capability, due in part to changes in American Red Cross shelter selection policies, is one of the reasons for the reduced number of available shelters.

Shelter capacities listed for coastal counties in the Apalachee Bay Region HES are very limited, particularly for a major hurricane. Gulf County was unable to open either of the two shelters listed because of the unavailability of Red Cross staffing. Gulf, Franklin and Wakulla Counties combined have enough room for less than 900 people in refuges of last resort. The total Category 3-5 inland county public shelter demand listed by the Apalachee Bay Region HES is approximately 19,000 with approximately 5,000 being generated by out-of-county (coastal) counties. Jackson County estimates that it sheltered 8,000 people, Gadsden and Leon Counties combined sheltered about 2,000 people. Calhoun and Liberty Counties sheltered several hundred evacuees each.

Many evacuees were provided with public shelter or other refuge in Holmes and Washington Counties in Florida and Escambia, Houston and other counties in Alabama which are not included in the Tri-State or any other study.

Most counties providing public shelter experienced loss of power in many shelters for some period as Opal moved through. This was more of an inconvenience than a threat to life or safety. Some shelters are equipped with emergency lights or generators and a number of counties are making attempts to obtain emergency power equipment. The Okaloosa Director of Emergency Services pointed out power related issues identified several years ago. The county has established two special needs shelters in schools that

have emergency power sources. However, the emergency power supply of at least one school is tied in to overhead lighting, but not to power outlets. Without working electric outlets, equipment needed to operate oxygen tanks, administer intravenous medication, and perform other medical support functions cannot be operated. The County has been trying to identify funding sources and engineering strategies to correct the problem.

Okaloosa County also pointed out some ramifications of changes in the health care industry for hurricane evacuations. Persons who formerly might have been patients in hospitals are now at home supported by home health care agencies and a variety of medical equipment. And while these arrangements may usually be acceptable, there are often not adequate provisions for continuity of care of these persons in an evacuation. Although the special needs shelter in Okaloosa County has oxygen and cots, the HRS nurses who staff the shelter are not trained to care for the types of needs that these people have. Home health care professionals are needed to staff these shelters. The County is working with a temporary nursing services company to provide nurses in special needs shelters as well as regular shelters.

The Santa Rosa Hospital, which is located in northern Santa Rosa County near Milltown, evacuated patients to a nursing home in Andulasia, in Covington County, Alabama. The Alabama nursing home suffered major wind damage from Opal, while the Sanata Rosa facility was unscathed.

RECOMMENDATIONS

The following shelter related concerns surfaced during the Hurricane Opal evacuation:

- - The need for outside assistance in identifying suitable structures for use as public shelters.
- - The need for public sheltering to be recognized by the counties and the states as a regionalized function.
- - Reluctance of some local school boards to be partners in public shelter planning and implementation.
- - Reluctance of state colleges to allow the use of college buildings as public shelters.
- - The need for clarification of compensation and liability issues for non governmental shelter management agencies and host jurisdictions.
- - The need to educate the public in non-surge areas regarding the nature of hurricane hazards in order to limit unnecessary evacuations.
- - Evacuation and care of hospital and nursing home residents and other special needs citizens.
- - Personnel support and other resources to accompany out-of-county evacuees, especially special needs evacuees.
- - Registration of shelter occupants

None of these issues are new. Each is addressed by the 1993 Lewis Report published by the Governor's Disaster Planning and Response Review Committee following Hurricane Andrew. The Report provides detailed recommendations regarding shelter issues. These recommendations are currently being carried out by the Florida Division of Emergency Management through several initiatives, including the Statewide Emergency Sheltering Plan and the Model Shelter Selection Procedure.

In addition to issues related to public shelter capacity, the issue of in place sheltering is of direct importance to the Northwest Florida Hurricane Evacuation Study. The percentages of people evacuating non-surge vulnerable areas has an obvious impact on shelter demand and ultimately on clearance times.

The issue of shelter occupant registration is based on the need for out-of-town residents to ascertain the whereabouts of relatives --"disaster welfare inquiries." In addition, data on the home addresses of shelter occupants is also very valuable to the continuous development of public response assumptions used in hurricane evacuation studies.

CHAPTER 5

TRANSPORTATION/CLEARANCE TIME DATA

The primary objective of an HES transportation analysis is a determination of the clearance times needed to conduct a safe and timely evacuation for a range of hurricane threats. Clearance time estimates are built on information from the vulnerability, shelter and behavioral analyses and an analysis of the available evacuation highway network. Attention is focused on intersections and road segments that produce traffic bottlenecks--and thus lengthy clearance times--and recommendations are made for traffic control measures that will reduce clearance times.

Transportation and clearance time issues related to the Opal evacuation and discussed with local and state officials included the following:

- - Was the evacuation network accurate
- - did evacuees use the routes projected by the hurricane evacuation study?
- - Were any traffic control actions taken to speed up flow?
- - When was the evacuation essentially completed - how long did the evacuation take
- - what were the actual clearance times?
- - What problems were encountered in this evacuation?

NORTHWEST FLORIDA HES

As discussed in the introduction to this assessment, it has been recognized that much of the data, particular housing and population data, upon which the Tri-State HES transportation analysis is built are obsolete. Without significant road improvements, or other factors that might reduce clearance times, it can be expected that major increases in vulnerable population would result in increased clearance times. It has also been recognized that the Tri-State Study, as the earliest in a group of Gulf and Atlantic Coast studies, did not have the benefit of lessons learned during subsequent studies and during actual evacuations that have occurred since publication of the Tri- State in 1986. As an example, the Tri-State Study did not explicitly examine inland county clearance times that, in a multi county evacuation, may be just as important as coastal clearance times in planning for a safe and timely evacuation.

Though it is acknowledged that the Tri-State HES is in critical need of updating, a comparison of Opal evacuation data with Tri-State HES data may be useful to the Northwest Florida HES (a restudy of the Florida portion of the 1986 Tri-State HES), to future evacuation studies, and to the evacuation decision-making knowledge base of all hurricane vulnerable jurisdictions.

CALCULATING CLEARANCE TIMES

To accurately determine the clearance times experienced during a particular evacuation it is necessary to first ascertain when evacuees started traveling and when evacuating vehicles cleared the evacuation highway network. A discussion of "Behavioral Response Curves" can be found in Chapter 3 of this report. Figure 3-1 shows generalized slow, medium and rapid responses by the public to an evacuation order. Figure 3-2 shows the overall response curve for Hurricane Opal as derived from information gathered in the Post-Opal Public Response Survey and supported by traffic count data collected by the Florida Department of Transportation.

Figure 5-1 places the Opal response curve in the same period relative to the issue of an evacuation order as the Hurricane Andrew response curve for Dade County. Although there may be no such thing as a "typical" response curve, the Dade County curve shows a response to an evacuation order that is not unusual. The Opal evacuation order time used in this figure is 10 p.m. Although evacuation times varied widely across the Opal impact area, there were several county evacuation orders clustered around 10 p.m. Tuesday [(Okaloosa: 6 p.m.; Santa Rosa: 8 p.m.; Escambia: 10 p.m. (5:30 order effective at 10 p.m.); Walton: 11 p.m.; Bay: 10 p.m. (optional)]. The Dade County evacuation order for Hurricane Andrew was issued at 8 a.m. on Sunday, August 23, 1992.

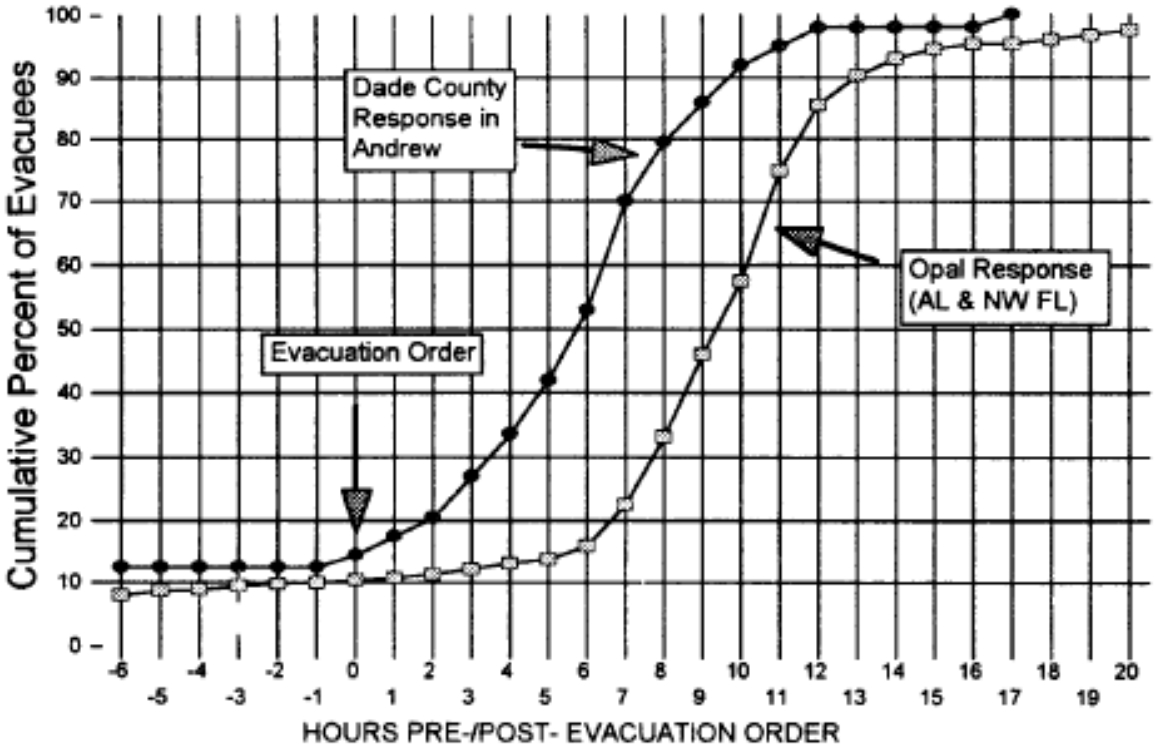


FIGURE 5-1
HURRICANE ANDREW/HURRICANE OPAL
BEHAVIORAL RESPONSE CURVES

Figure 5-1 shows that approximately 10 percent of evacuees placed their departure before 10 p.m. Wednesday night. One would normally expect to see a steep rise soon after ten o'clock (0 hours) in the cumulative percentage of people who have started their evacuation. However, this increase does not begin in earnest until approximately 5 a.m. Wednesday morning, seven hours after the 10 p.m. evacuation order.

Another parameter necessary for a calculation of an actual clearance time is the time that the evacuation ended. Traditionally, this determination is based on evidence that the evacuation network within a jurisdiction has cleared. The implicit assumption is that evacuating vehicles have either arrived at a safe destination or have left the jurisdiction. By 11 a.m. Wednesday, Escambia, Santa Rosa and Okaloosa Counties had all "canceled" their evacuations. Those who had not yet left home were advised to stay put, while evacuees still on county roads were advised to seek whatever refuge might be near nearby. Some traffic returned home unable to make progress in evacuation travel. However, traffic count summaries provided by the Florida Department of Transportation Table 5-1 show that evacuation traffic persisted for three to four hours after evacuation orders were canceled. Given the conditions under which the Opal evacuation ended, care must be

taken in assigning ending times from which clearance times are to be derived, particularly if they are to be evaluated for accuracy. Evacuation durations did not allow even for the volume of traffic calculated by the 1986 Tri-State HES.

Table 5-1 presents traffic data obtained from Florida Department of Transportation traffic count stations during the Opal evacuation. The table also shows the vehicle capacity assumed by HES traffic modeling for this type of road. The differences between these volumes (Opal Maximum Hourly Volume vs. Level of Service D Directional Service Volume) reflect both the effects of construction on Interstate 10 and the underutilization of some available evacuation routes.

CLEARANCE TIMES/TRAFFIC PROBLEMS

Traffic congestion, of enormous proportions in some places, was experienced throughout the Opal evacuation area. Several factors combined to produce this congestion including the "rapid response" loading of the majority of evacuating vehicles within a short duration of time. Although there were wide variations in the timing of evacuation recommendations and orders, there was very little movement of evacuees before dawn Wednesday, October 4. However, as the public took notice Wednesday morning that a dangerous hurricane was bearing down on the Florida panhandle, the region's evacuation network was very quickly loaded and overwhelmed.

Construction on Interstate 10 in Florida, on Interstate 65 in Alabama, and consequent major delays on both roads had ripple effects on other evacuation routes. Northbound traffic on Florida highways was delayed at many interchanges by the backup of traffic attempting to enter the eastbound lanes of 1-10. Road construction on several other major evacuation routes, most notably US 231 in Bay County, also contributed to the regional gridlock as did isolated road flooding caused by precipitation not related to Opal. Due, at least in part, to roadway construction, traffic flow at most monitored sites was well below the levels of assumed flow for hurricane events used in HES traffic analyses. Volumes of traffic headed eastbound were much higher than expected compared to westbound and northbound volumes. Secondary routes were not used to the extent they could have been.

Figure 5-2 graphs traffic counts on Interstate 10 east of US 231 in Jackson County, Florida during the Opal evacuation [This FLDOT traffic count station is shown as Location "4" on Figure 5-3, page 5-8]. The 1 p.m. dip in the hourly traffic count at this station may reflect the effects of 1-10 bridge construction further east in Jackson County at State Route 69 and at State Route 12 in Gadsden County. As congestion became worse, the number of vehicles able to traverse this segment of the highway significantly decreased. A similarly abrupt dip in the hourly traffic count occurred at the I-10 traffic count station at County Route 273 in Washington County (Location "3"); a less severe reduction was seen at County Route 280A in Walton County (Location "2"). Decreases of varying sizes occurred on other portions of the evacuation network in response to backups from 1-10 and to other obstacles not directly related to problems on I-10.

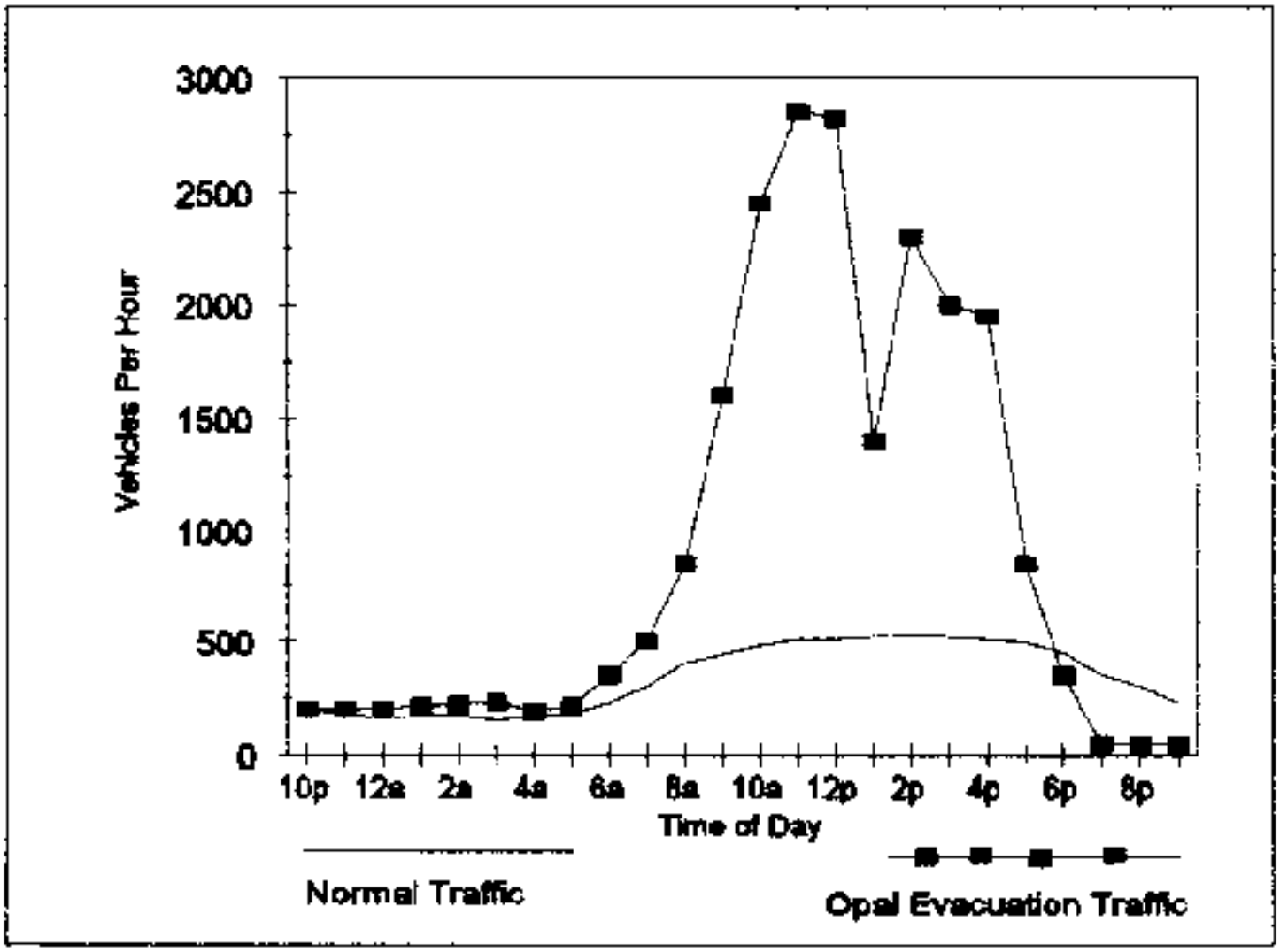


FIGURE 5-2

INTERSTATE 10 EASTBOUND TRAFFIC COUNTS

East of US 231, October 3-4, 1995

Table 5-2, summarizes clearance time data for each county in the assessment area and provides some of the more significant non quantitative information gathered. The numbers listed in the "HES CALCULATED CLEARANCE TIME" column were excerpted from Table VI-6 of the Tri-State HES and from Table 6-6 of the Draft Apalachee Bay Region HES. Times in the "TIME EVACUATION ORDER EFFECTIVE" column are based on information provided by County Emergency Management agencies. In counties where an "optional" evacuation advisory was issued before the evacuation "order" the times of both are listed. The "DURATION OF SUBSTANTIAL EVACUATING TRAFFIC" times are based on traffic count graphs obtained from the Florida Department of Transportation permanent count stations. Because these stations were somewhat scattered, some interpolations and estimates were necessary for construction of this table.

Figure 5-3 shows the locations of traffic count stations along with the times marking the end of substantial evacuation traffic flow. This "big picture" graphically illustrates the flow of the evacuation northward and eastward across northwest Florida. It also shows the locations of construction sites on major evacuation routes.

Following are additional details on the evacuation traffic information obtained for each county.

MOBILE AND BALDWIN COUNTIES

The two Alabama Counties, Mobile and Baldwin, reported that traffic flowed fairly smoothly through their in-county evacuation networks. They also reported that county residents eventually met significant congestion and long delays north on Interstate 65 in Escambia County and beyond. Evacuees used the evacuation network outlined in the Tri-State HES. However, road construction in the northern end of Baldwin County on approaches to 1-65 can be expected to result in changes in the evacuation network. Local law enforcement performed necessary traffic control as needed.

ESCAMBIA (FL) COUNTY

Escambia County traffic encountered a variety of obstacles to a smooth evacuation including late departures and local road repairs. Earlier in the summer many major arteries were under construction. And although much of the construction was complete by early October, there were still some projects that interfered with the Opal evacuation. The most significant problems occurred on Interstate 10 where several bridges were under construction. Backups on I-10 in turn caused major problems on highways feeding I- 10. As Opal approached, Florida DOT advised Escambia County that it had cleared as much construction as possible. US 29 experienced minor flooding in two places both in Hurricane Erin and during Opal. Traffic was not completely stopped, but was disrupted. Northbound Escambia County traffic eventually encountered the same congestion that stymied Mobile and Baldwin County evacuees on Interstate 65 in Alabama.

Escambia has not pursued reverse lane strategies on its evacuation routes because the resources that would be necessary to control access at intersections are not available. County officials also are skeptical of the potential benefits of reverse laning or other in-county road improvements because of the "ultimate" problems encountered by evacuating traffic on Interstate 10 or on the Alabama roads that carry northbound traffic. The county does believe that some improved traffic controls would facilitate future evacuations. It was noted that no traffic was moving out of Escambia County during the 2 to 3 am period Wednesday morning. The first significant traffic started at about 5 a.m. The evacuation never really cleared and many evacuees were forced to abandon their vehicles and seek refuge wherever it could be found.

SANTA ROSA COUNTY

The evacuation out of Santa Rosa County was described by county officials as a "nightmare." Within the exception of several beach areas, county residents went to bed Tuesday night, planning to evacuate Wednesday morning, if still necessary. The general evacuation was underway at approximately 8A.m.. Roads feeding Interstate 10 backed up as construction on the Interstate slowed traffic. Santa Rosa northbound traffic also encountered problems as it reached access roads to Interstate 65 in Alabama. Several in-county back roads were flooded due to heavy rainfall that occurred during the week preceding Opal. Thousands of evacuees pulled off roads at rest stops and service plazas.

OKALOOSA COUNTY

Given the age of the Tri-State HES and based on population growth, Okaloosa County used a "guesstimate" of 18 to 24 hours for clearance time (the Tri-State TDR listed a 151/2 hour clearance) and ordered an evacuation Tuesday evening. There is no evidence of a widespread public response to this order until Wednesday morning when tens of thousands of households attempted to evacuate with chaotic results. The evacuation network in the southern end of the county was so congested that many would-be evacuees were not able to get out of their subdivisions or immediate neighborhoods. Gridlock was encountered on Interstate 10 and evacuees eventually able to get into Alabama reported lengthy delays on 1-65 all the way to Montgomery.

Okaloosa County discouraged use of US 331 or State Hwy 87 because of conflict with traffic leaving Walton and Santa Rosa Counties. Route 85 (a four lane artery) was successfully three laned from Niceville north to Crestview. The county plans to make this a standard procedure for future evacuations.

The evacuation was "canceled" at 10 a.m., i.e., those who had not yet left home were advised to stay home and those on the road were advised to find refuge. County roads were reported cleared by 3 p.m.

BAY COUNTY

Bay County emergency management issued an order Tuesday night at approximately 10 p.m. for an evacuation to begin Wednesday morning at 6 a.m. Northbound traffic counts on US 231, the major evacuation route out of the County, were higher than normal from 11 p.m. on; but volume was low --less than 250 vehicles per hour. Significant evacuation flow did not begin until approximately 6 a.m. By midmorning the Countys three evacuation routes, US 231 and state routes 77 and 79 were bumper to bumper. Besides the problems caused by construction on Interstate 10, the Bay County evacuation was also hampered by bridge construction on US 231 near Fountain. The Bay County emergency manager was not aware of construction on I-10 in time to make adjustments in traffic control or in the timing of the county's evacuation.

At 11 a.m. Wednesday, as gridlock prevailed, Bay County decided to reverse the two northbound lanes on US 231. This was implemented by the Sheriffs Department and was coordinated with the Jackson County Sheriffs Department. The Florida Highway Patrol was present in the Bay County EOC when the decision was made. No plan was in place prior to the reverse laning, the county "just did it." But the uninterrupted mass of northbound traffic made southbound access virtually impossible and thus reduced the potential for collisions. Most major intersections were manned. The reverse laning extended to the vicinity of Round Lake in Jackson County, short of the intersection with Interstate 10, but beyond the intersection with State Route 20.

Bay County assumed an 81/2 hour clearance time based on Tri-State HES time calculated for a rapid response, low tourist occupancy scenario with four laning of US 231. (The TDR's 81/2 hour reverse lane time assumes implementation at the beginning of the evacuation. The calculated clearance time without reverse laning of US 231 is over 24 hours.)

Some evacuees reported travel times of ten to twelve hours to Tallahasse on Route 20, a less than 75 mile trip. Traffic slackened off late Wednesday afternoon, just before dark. There were unconfirmed reports of evacuees two-laning Route 77 on their own. Despite the severe congestion, Bay County is confident that all surge areas were evacuated by 1 p.m. Traffic within the County was cleared by late afternoon.

GULF COUNTY

The primary evacuation route used by Gulf County evacuees was State Highway 71. US 98 was open but relatively unused as many people believed it to be flooded. The lack of local media outlets contributed to this problem. By late afternoon Wednesday roads were gridlocked.

County officials expressed some skepticism about the seven to nine hours clearance times published in the Draft Apalachee Bay Region HES TDR. The TDR notes the need for consideration of the time needed for Bay and Gulf County traffic to clear the intersection of SR 73 and US 231 in Jackson County. Gulf County also noted the need for coordination with Bay County regarding traffic exiting Bay County via SR 22 that must merge with Gulf County traffic on SR 71.

Gulf County does not believe it has the resources necessary to implement one way traffic out of the county.

FRANKLIN COUNTY

The Franklin County emergency director did not use clearance times calculated by the Apalachee Bay Region HES. All evacuation decisions were based on the conference call with the National Hurricane Center. Traffic counts on highways leaving Franklin suggest that County roads were cleared approximately eight hours after the evacuation started at about 8 a.m. Wednesday. Normal season clearance times calculated by the Apalachee Bay Region HES range from 43/4 to 93/4 hours, depending on the rapidity with which evacuating vehicles enter the evacuation network. SR 65, SR 67, US 319 and US 98 are the four routes exiting the Count. Among the problems experienced during the evacuation was a limited availability of officers to help with traffic control. The sheriff said his wife helped him in directing traffic.

WAKULLA COUNTY

Wakulla County suggested a voluntary evacuation at 9:00 p.m. Tuesday evening with a mandatory evacuation beginning at dawn on the fourth. Traffic counts on US 319 show that the Wednesday evacuation of the County dragged on for approximately 10 hours, from 9 a.m. to 7 p.m. Normal season clearance times calculated by the Apalachee Bay Region HES range from 71/4 to 9/4 hours depending on the speed of the public response to evacuation orders.

HOLMES AND WASHINGTON COUNTIES

Although not included in any hurricane evacuation study published to date, the inland Florida counties of Holmes and Washington were very much involved with hurricane evacuation problems. As Opal was threatening 15 to 20 thousand people were camped in Holmes County as a major rodeo was about to begin. An orderly evacuation was conducted by the County. Mobile homes throughout both counties were also evacuated. Evacuation routes suggested by the Tri-State HES were, in fact, used by coastal evacuees passing through Washington and Holmes Counties. Traffic counts on Interstate 10 indicate that major delays were experienced in this area due to construction and the volume of traffic.

Traffic from Interstate 10 was routed through Chipley Wednesday afternoon in attempt to relieve construction bottlenecks. Traffic control requirements proved to be beyond the capacity of local law enforcement to handle. It was reported that the local National Guard unit did not receive authorization to assist with traffic control. Local law enforcement did best job they could until winds forced them to seek shelter.

JACKSON, CALHOUN, LIBERTY, GADSDEN AND LEON COUNTIES

Jackson County clearance times are included in the Apalachee Bay Region HES Draft TDR for use in traffic control planning purposes by the County and for consideration by coastal county emergency managers in their decision making procedures. As some portion of Northwest Florida HES area evacuating traffic passes through Jackson County these clearance times will be updated as the Northwest Florida HES is completed. Interstate 10 traffic counts indicate that Jackson County clearance times for Opal were consistent with those calculated by the Apalachee Bay Study.

Calhoun County experienced some major traffic problems with county roads being overwhelmed. The county school board, despite emergency management advice, opened schools Wednesday morning. By the time schools were closed at noon, traffic problems were severe, making it difficult for the school buses to get the students home. In addition, the school buses now contributed to the total traffic problem.

Gulf County northbound traffic on Route 71 caused severe traffic problems at Blountstown. In response to these problems at approximately 9 a.m. Wednesday the Calhoun County Sheriffs Department rerouted traffic around Blountstown via Route 73 through Clarksville. The re-routed Route 73 traffic encountered Route 20 eastbound traffic at Clarksville. Route 20 traffic was also diverted north onto Route 73. The combined Route

71-Route 20 traffic encountered major delays in its northward progress .

Sparsely populated Liberty County is not explicitly mentioned in the Apalachee Bay Region HES although several evacuation routes pass through it. Traffic counts on SR 12 east out of the town of Bristol show significant evacuation traffic from approximately 8 a.m. to 7 p.m. Wednesday.

GADSDEN AND LEON COUNTIES
Eastbound traffic counts on I-10 nearing Tallahassee indicate that evacuation traffic did not completely abate until 11 p.m. Wednesday evening. This is consistent with information that public shelters in the Tallahassee area were still receiving evacuees until 1 a.m. Thursday, the 5th of October.

INLAND ALABAMA COUNTIES
Escambia County in Alabama found it necessary to find and open refuges of last resort for coastal evacuees. As Opal neared the coast, some evacuees who were stuck in a 12-mile traffic jam on Interstate 65 abandoned their vehicles and sought refuge in nearby houses. Because of the late evacuation out of Florida, traffic controllers had to stay out beyond a point that they considered safe. Some reported poor visibility and not being able to stand up because of high winds.

Similar conditions were experienced in Houston County as evacuees from the Florida coast passed through. State Troopers handled traffic from the Florida-Alabama state line to Dothan. There Houston County took over with assistance from State Troopers. State Troopers have authority to reverse lane traffic flow but did not do so during Opal.

Escambia and Houston County officials observed that a major reason for the traffic tie-ups experienced during Opal was the construction on 1-65.

CONCLUSIONS AND RECOMMENDATIONS

Several factors appear to have contributed to the frightening traffic conditions that marked the Opal evacuation:

- - the delayed start to the full-fledged movement of traffic until Wednesday morning, October 4, followed by a rapid loading of the evacuation network;
- - the construction on Interstate 65 and several other major evacuation routes. However, even if clear and coordinated evacuation orders had resulted in a prompt public response Tuesday evening, and even if all evacuation routes were able to handle their design traffic capacities, it is not at all certain that a fast moving and quickly intensifying storm such as Opal would not have produced results similar to what did occur. To ensure that all efforts are being taken to reduce the probability of another evacuation ordeal, with perhaps more unfortunate results, the following is necessary:
- - clearance times based on current demographic, housing and highway data should be developed;
- - regional as well as local clearance times should be available;
- - any viable regional or local traffic control measures should be considered and planned for;
- - the public should be educated in the basic concepts of hurricane evacuation;
- - efforts should be made to reduce the number of people who evacuate unnecessarily;
- - careful thought should be given to the wording and delivery of evacuation orders. Accordingly, the following recommendations related to HES transportation analyses are offered (other related recommendations are addressed at the end of appropriate chapters of this report):
- - The Northwest Florida HES transportation analysis should be expedited.

- - The Alabama and Mississippi portions of the 1986 Tri-State HES should be updated.
- - The Tri-State Study did not explicitly treat inland county clearance times. The traffic congestion experienced in inland counties in Florida and Alabama affirms the necessity of the regional approaches taken in more recent studies. The Northwest Florida HES should include regional traffic modeling. Regional clearance times may be just as important as coastal clearance times in planning for a safe and timely evacuation.
- - Northwest Florida HES evacuation traffic should be examined for its impacts for the Apalachee Bay Region HES and vice versa. [Note: the ongoing Florida Statewide Hurricane Transportation Analysis will obviously be of relevance to this and the preceding recommendation].
- - A macro-level evacuation traffic analysis of Florida/Alabama northbound roads and connections to Interstate 65 and other major evacuation routes should be conducted to test the effects on regional clearance times of road widening, reverse laning or new roads.
- - Traffic counters have proven very useful in recent evacuations in testing public response and traffic flow assumptions. It is recommended that Florida DOT consider the need for hurricane evacuation traffic data in its placement of counters. Real time data from traffic count stations could be immensely useful to state and county emergency management in monitoring the progress of evacuations. It is recommended that Florida DOT and Florida DEM consider the feasibility of making this data available. It is recommended that all hurricane vulnerable states investigate the feasibility of using traffic counters in hurricane evacuations
- - State Departments of Transportation should consider hurricane evacuation concerns in highway construction scheduling and should work with emergency management and traffic control personnel (instate and out-of-state) to mitigate the impedance of hurricane evacuation traffic.
- Coordination of state and county evacuation plans: See Recommendation # 10 of the Lewis Report that addresses, among other topics, provision of adequate fueling along evacuation routes, contingency plans for sheltering people caught on evacuation routes, control of access to transportation corridors, and coordination of traffic control measures.

CHAPTER 6

EVACUATION DECISION MAKING

Each hurricane evacuation study includes information on how the data developed can be used effectively with National Weather Service/National Hurricane Center forecast products for evacuation decision-making. The primary questions regarding evacuation decision making that this assessment seeks to address are:

- Were decision making data and tools provided by hurricane evacuation studies used in this hurricane?

- Were data and tools understood and used correctly?

- To the extent these tools were used, were they valuable? How can they be improved?

Chapter Seven of the Tri-State HES Technical Data Report, entitled "Evacuation Times" presents a step by step approach to the calculation of available evacuation times by analyzing storm intensity, track and forward speed forecast data along with HES calculated traffic clearance times. Maps with concentric circles around each county, "Evacuation Time Arcs," are used to convert distances of approaching pre-landfall hazards into times that can be compared to clearance times. The Tri-State Study's evacuation time arcs eventually evolved into the "decision arcs" included in subsequent studies, including the Draft Apalachee Bay Region HES, and incorporated into various software programs used as decision making aids. The primary usefulness of time arcs, decision arcs and most of the related computer software is in calculating when an evacuation must begin if it is to be completed before dangerous conditions begin to affect a jurisdiction. These tools are not capable of making a decision if an evacuation should be ordered, but they help to frame the issues involved in that decision, especially timing issues, and thus can be of help in the decision making process.

A version of a decision making tool computer program, HURREVAC, was developed and funded by FEMA and the Corps of Engineers Program for the Apalachee Bay Region HES study area. The program was distributed and training provided to county emergency personnel early in 1995.

During the afternoon of Tuesday, October 3 the National Hurricane Center advisories cautioned that Opal, which was just edging into Category 2 status and was projected to landfall early Thursday, could intensify and speed up before landfall.

> OPAL IS MOVING TOWARD THE NORTHEAST NEAR 12 MPH AND SOME FURTHER INCREASE IN FORWARD SPEED IS EXPECTED DURING THE NEXT 24 HOURS. IF THIS OCCURS... TROPICAL STORM FORCE WINDS ASSOCIATED WITH HURRICANE OPAL COULD REACH THE COAST INTO THE WARNING AREA ON WEDNESDAY.

> MAXIMUM SUSTAINED WINDS ARE NEAR 100 MPH ... AND SOME FURTHER INCREASE IN STRENGTH COULD OCCUR DURING THE NEXT 24 HOURS. - OPAL ADVISORY NUMBER 25, 4 PM CDT TUE OCT03 1995

In response to this information, several counties issued evacuation orders, evacuation recommendations, or "pre-evacuation" notices late Tuesday afternoon or early Tuesday evening. The forecast track had Opal crossing the Gulf Coast in the vicinity of Okaloosa and Walton Counties. If, as seemed likely, an evacuation were to be necessary, the time available for an evacuation would include 12 non daylight hours.

At 10 p.m. CDT a Hurricane Center intermediate advisory said that Opal had indeed intensified -- to a Category 3, had increased its forward speed and was likely to further intensify and speed up before landfall, which was now forecast for late Wednesday afternoon. Tropical storm force winds were now predicted to reach the coast by 5 a.m.. The Hurricane Center declared that "all preparations should be rushed to completion."

As of the 10 p.m. Tuesday advisory (# 26) tropical storm force winds were forecast to arrive on the Northwest Florida coast by 6 a.m. Wednesday. Counties in the Tri-State HES portion of the assessment area had ten years old published clearance times ranging from 6/2 to 22 hours. Use of the Tri-State HES decision arcs or use of computer software derived from or used with Tri-State HES data would have suggested that, to complete an evacuation before the arrival of tropical storm force winds, an evacuation should begin immediately. Apalachee Bay Region coastal counties, with rapid response clearance times of from 43/4 to 71/4 hours, had some, but not much time to consider their options.

It has been noted elsewhere that the 10 p.m. Tuesday day advisory effectively cut 12 hours from the previously available (4 p.m. advisory) evacuation time, the implication being that Opal exhibited very unusual behavior in its acceleration. However, the 4 p.m. (#25) advisory had noted the possibility of intensification, an increase in forward speed, and the earlier arrival of tropical storm force and hurricane force winds. The intermediate advisory (#25A) again mentioned the possibility of intensification and the likelihood of an increase in forward speed.

In response to the 10 p.m. Tuesday advisory the Florida Division of Emergency Management (DEM) set up a conference call with the panhandle counties. During this call DEM urged that evacuations begin soon. The state called the Associated Press early enough to deliver information about changes in the storm and the need for evacuations in time for the 11 o'clock (EDT) news. At around the time of the 10 p.m. conference call the four westernmost Florida counties (Escambia, Santa Rosa, Okaloosa and Walton) issued or reissued evacuation orders. Three coastal Florida counties (Bay, Gulf and Wakulla) issued "voluntary" Tuesday night orders, with Bay County announcing a mandatory 6 a.m. Wednesday morning evacuation. Franklin County, Florida, and Mobile and Baldwin Counties in Alabama remained on standby, not yet issuing any orders or recommendations.

In the counties that ordered evacuations Tuesday night, the public, except residents of several barrier islands, did not begin to move in any significant volume. Most evacuees waited until Wednesday morning to leave; by that time Opal had become an extremely dangerous Category 4 hurricane. With most of the Florida evacuees leaving at practically the same time early Wednesday morning, harrowing

traffic jams developed.

It would appear that there were several reasons, some overlapping, that the public did not begin to leave in any appreciable numbers until Wednesday morning. Coming late in the day, it is quite likely that many people did not hear the evacuation order. As mentioned in Chapter 1, the O.J. verdict was announced early Tuesday afternoon and dominated the national and local news across the nation. Yom Kippur had begun at sundown, presumably lessening some Jewish residents' attention to the media. Perhaps linked to coverage of the Simpson verdict, and perhaps also linked to the busyness of the 1995 hurricane season, the electronic media were not well represented at the National Hurricane Center. Opal went from a tropical storm to a major hurricane within approximately 48 hours, not affording the media much time to focus on the storm before its becoming an imminent serious threat.

Panama City in Bay County is one of the two media markets that serve Northwest Florida (the other is Pensacola). Bay County did not issue an evacuation order for Tuesday night. It is possible that portions of the population in the middle of the two media markets (Walton, Okaloosa Counties) may have been tuned in to Panama City TV and radio stations and thus did not receive their counties' evacuation orders. Walton County, AL for instance, has only one low-power AM radio station that reaches the south end of the county. TV reception is from Panama City and Dothan, Alabama. According to Walton County Emergency Management only Dothan stations carried full hurricane warning information.

Those evacuation orders that were issued Tuesday evening may not have been received with a sense of urgency by the public. Okaloosa County emergency management noted that there was a lack of support on the part of other county government offices. Law enforcement did not back the Tuesday night evacuation order by notifying surge area business to close, and court administrators complained about cancellations. There had been complaints of over-reacting to Hurricane Erin by Okaloosa and other counties. This overall lack of a unified posture by county government may have been one of the origins of the slow response by the public to the evacuation orders.

Escambia and Santa Rosa Counties used their "Community Alert Network" (CAN), an automated telephone system, to notify residents in surge areas to evacuate (38,000 households). However, the system was not initiated until 4 a.m. in Escambia County in response to Opal's further strengthening. Santa Rosa County initiated its CAN earlier, but it took many hours to complete. While Bay County explicitly cited a "no nighttime evacuation" policy in its decision to wait until Wednesday morning to initiate its evacuation, other counties also seemed to have apprehension about nighttime evacuation.

USE OF HES PRODUCTS

Tables 6-1 and Table 6-2 provide a combination of information yielded by GDS (Graphic Decision System for Hurricanes - Hazards Management Group, Tallahasse, FL) and applicable clearance times extracted from the Tri-State HES and the Draft Apalachee Bay Region HES. GDS was used to process forecast data from Opal advisories 25 and 26 and to interpret the forecast and possible times by which the ten coastal counties in the Opal assessment area would be affected. These tables will serve as a frame of reference for the discussion of the use of HES products that follows.

The last column under CURRENT FORECAST in Tables 6-1 and 6-2 shows the number of hours between the time of the advisory and the forecast time of arrival of tropical storm force winds at each of the ten coastal counties in the post-Opal assessment area. The adjacent column shows the clearance time for each county calculated by either the Tri-State Hurricane Evacuation Study or the Draft Apalachee Bay Region Study. The generally accepted goal among hurricane vulnerable jurisdictions is to complete evacuations before the onset of pre-landfall hazards such as tropical storm force (TSF) winds. This goal is recognized by the two hurricane evacuation studies and is assumed in the decision making tools provided by the studies. The pre-landfall hazards concept is also built into the HURREVAC model distributed to the Apalachee Bay Region counties early in 1995. A comparison of the two columns (CURRENT FORECAST TSF WINDS HOURS AWAY and CAT. 3 CLEARANCE TIMES) in Tables 6-1 and 6-2 provides a comparison of the time needed vs. the time available to complete an evacuation.

As of Opal Advisory 25 (Table 6-1) the time available to the counties ranged from over 20 hours for Franklin and Wakulla Counties to two hours for Bay County. Use of this information would have suggested varying responses by the counties, ranging from a standby mode for those with greater time available to consideration of at least partial evacuation by those counties with little time available.

As of Opal Advisory 26 (10 p.m. Tuesday, Table 6-2) the time available to the counties ranged from about four hours for Franklin and Wakulla Counties to a negative nine hours for Bay County. The two Alabama counties and four of the five westernmost Florida counties were already behind schedule in beginning an evacuation that could be completed before hazardous conditions prevailed. The remaining counties would have had to begin evacuations within a few hours to meet the goal of completing them before the onset of pre-landfall hazards.

Bay County was directly in the forecast path of Opal as of the 10 p.m. Tuesday advisory. Application of decision arc tools provided by the Tri-State HES would have shown that tropical storm force winds could be expected to arrive in the Panama City area in 9 hours (7 a.m. Wednesday), and the center of the storm in 20 hours (6 p.m. Wednesday). The applicable clearance time calculated by the Tri-State HES was 22 hours. The County, carrying out a policy of no night time evacuations, announced an evacuation order effective at 6 a.m. Wednesday.

The 10 p.m. advisory put the three easternmost counties in the assessment area, Gulf, Franklin and Wakulla, on the right side of Opal where the highest storm surges could be expected. This relative position should have served to heighten the vigilance of these counties and to prompt them to work through the"what ifs" suggested by their clearance times, projected and possible arrival of tropical storm force winds, possible night time evacuations, etc. The intermediate advisory issued at I a.m. noted Opal's further intensification and increase in forward speed. Meanwhile the three counties sat tight (Franklin did not activate its EOC until 5 am). Fortunately, Opal veered slightly to the west, eventually making landfall between Pensacola Beach and Navarre Beach. Gulf, Franklin and Wakulla Counties were east of Opal's radius of maximum winds and its maximum storm surges. Apparently, these counties made only limited use HES data or HURREVAC. It was noted by Gulf County that the Apalachee Bay counties have had difficulty in accessing National Hurricane Center advisories.

While the Bay County Emergency Management Director did refer to the County's use of HES data, the data was not used as it was designed to be. The Director noted that he was assuming an 8¼2 hour

clearance time, based on the Tri-State HES published clearance time calculated for a reverse laning for US 231. An 8/2 hour evacuation begun at 6 a.m. Wednesday would have been completed before Opal's forecast arrival near 6 p.m., but plainly not before the arrival of tropical storm force winds. Even allowing that the relatively long pre-landfall hazards times associated with Opal might have allowed some "cheating," (i.e. road clearance completion under deteriorating, but not yet horrendous conditions), the two crucial parameters of clearance times and pre-landfall hazards were apparently not considered together. In fact, Bay County did not decide to attempt reverse laning until 11 AM Wednesday, in response to the traffic gridlock prevailing at that time. The Tri-State TDR 81/2 hour clearance time calculated for Bay County with a reverse laning of US 231 assumes that the reverse laning is implemented in a timely manner.

CONCLUSIONS AND RECOMMENDATIONS

There has been enormous development in coastal portions of Alabama and Northwest Florida. since the Tri-State Hurricane Evacuation Study was published in 1986. Presumably, the clearance times calculated by the Study have been out of date for some time. There were, however, a number of factors that contributed to the traffic chaos that prevailed during the Opal evacuation.

- - Opal's rapid development within two days from a tropical storm to a major hurricane, and within just hours from a well behaved Category 1 storm into a quickly moving dangerous Category 4.
- - The adverse timing of changes in Opal's approach resulting in much of the available evacuation time being at night.
- - Highway construction and consequent congestion on several major evacuation routes.
- - The effects of two previous 1995 hurricanes that threatened Northwest Florida but had not inflicted significant casualties.
- - Competition for media attention with the verdict of the "Trial of the Century." The afternoon and evening of Tuesday, October 3 constituted a crucial period for alerting the public to Hurricane Opal. During this period the national broadcast media was providing saturation coverage of the OJ Simpson verdict. It is quite probable that dissemination of public information about Opal was hindered.

Indeed, Hurricane Opal was a forecaster's and an emergency manager's nightmare. An exercise scenario based on Opal's behavior would likely have been faulted as farfetched. And, certainly, it is much easier to conclude after the fact that evacuations should have been vigorously implemented late Tuesday, October 3. However, it is possible that the Opal evacuation could have gone relatively smoothly if the evacuation decision making tools available had been fully utilized. Perhaps the Opal experience will serve to reinforce the frequently heard cautions about the capricious nature of hurricanes. Perhaps, also, Opal will serve as a counterweight to the economic and other pressures felt by emergency managers not to evacuate.

It is recommended that the following be implemented to address the problems identified by this assessment:

- - Work on the Northwest Florida Hurricane Evacuation Study should proceed with dispatch.

Much of the Tri-State data is obviously out of date. It is essential that emergency management officials have accurate data on which to base their evacuation decisions.

- - The Alabama portion of the Tri-State HES should be updated for the same reasons offered in support of the Northwest Florida HES.
- - Immediate table top exercises with instruction or review of hurricane evacuation study information and evacuation decision making tools should be scheduled for county emergency management officials. There has been an almost complete turnover in Tri-State HES county emergency directors in Alabama and Florida since the Study was completed. Refresher exercises should be held frequently. Opal advisory data would provide excellent material for a table top exercise.
- - All coastal counties should be provided with full access to National Hurricane Center advisories.
- - FEMA regions and Corps of Engineers Districts, in cooperation with state emergency management agencies, should offer instruction in the use of HES data for new County emergency managers and refresher sessions for veteran managers periodically (i.e., at least every two years). Corps of Engineers Districts that do not have a study or restudy in progress should be funded to stay involved in HES related activities such as local training, review of data, etc.
- - Obviously the understanding and cooperation of many elements of local government, including elected officials, are essential for successful hurricane evacuation decision making and implementation. While many emergency management agencies (EMA's) have been able to build and maintain the needed supportive relationships with their elected officials and other agencies and offices, it is apparent that many EMA's could use assistance. Briefings, seminars, workshops or other vehicles for the education of elected officials and support agencies should be made available to jurisdictions as new hurricane evacuation studies are concluded, revisions completed, or as otherwise needed (recent elections, agency turnovers, length of time since last workshop, etc.) This type of activity should be included in budgeting for hurricane evacuation studies and for ongoing Corps of Engineers District involvement.
- Coordinated decision-making among jurisdictions is a significant factor in the success or failure of any regional evacuation. During Opal various emergency managers altered evacuation plans yet failed to communicate these changes to other jurisdictions that would experience impacts from those changes. Also, some emergency managers had difficulty coordinating with decision makers within their own counties. Procedures for decision-making must be established across jurisdictions, thereby minimizing the chances of conflicts and redundancies.

CHAPTER 7

PUBLIC INFORMATION

Many, if not most, of the public information issues discovered by this assessment were addressed by the 1993 Lewis Report published by the Governor's Disaster Planning and Response Review Committee following Hurricane Andrew. The report recommended a comprehensive public information program on emergency preparedness issues, enhancements of pre-disaster communications with the public, cooperation with telephone companies in providing emergency information and instructions, and an assessment of the Florida Emergency Broadcast System (EBS) and identification of methods of rapid dissemination of emergency warnings to the widest audience.

Comments provided by the Florida Division of Emergency Management and by most of the counties affected by Opal reinforce the Lewis Report recommendations. Positive and negative experiences with the print and broadcast media, including national weather sources such as the Weather Channel and CNN, served to highlight the vital services these media can provide in hurricane education and evacuations and the need to promote their involvement.

Several unusual factors increased the difficulties involved in influencing the public to evacuate for Hurricane Opal in a timely manner. As noted above, the 1995 Atlantic hurricane season was very busy and the western Florida area had endured two earlier hurricanes. The OJ Simpson verdict was announced early in the afternoon of Tuesday, October 3 and press coverage of the verdict and reactions to it dominated the national news the rest of the day and evening. It was during these hours that Opal's intensity and forward speed increased sharply and that the public needed to be paying careful attention to the storm and emergency management information. In part because of the Simpson verdict and also because Opal had been a fairly weak hurricane as late as Monday, there was very little media presence at the National Hurricane Center Tuesday. Finally, the Jewish holiday, Yom Kippur, began at sundown Tuesday, thus presumably further decreasing the attention paid to the media by some of the public.

In issuing evacuation orders late Tuesday afternoon and evening, several counties set target times for completion of the evacuation. For example, Escambia County told the public that the evacuation should be completed by noon Wednesday. Including this information in evacuation orders may be counter productive. Evacuees hearing an evacuation order Tuesday evening and planning to travel to destinations that can normally be reached in an hour or two may have considered it quite reasonable to wait until Wednesday morning to leave. Combinations of public education and care in the wording of public information during a hurricane event should help to produce more desirable public responses.

This assessment discovered a wide range of methods used to provide hurricane education and preparedness information to the public in the months before Opal and to communicate evacuation advisories and orders Tuesday and Wednesday, October 3 and 4. Table 7-1 provides a county-by-county listing of these methods and a listing of successes, problems encountered and planned improvements.

CONCLUSIONS AND RECOMMENDATIONS -

There is a continuing need for up-to-date printed materials such as brochures and pamphlets that remind the public and tourists that an area is subject to hurricane hazards and provides general evacuation information. These materials should be available at tourist welcome and information locations, hotel/motel lobbies and rooms, etc. Evacuation zones, evacuation routes, shelter locations and at least rudimentary evacuation concepts should be covered.

- The public needs to be educated regarding evacuation clearance times. An understanding of this concept should help to decrease the number of people waiting until the last minute to evacuate. In addition, emergency management agencies should exercise care in the wording of evacuation orders so as to avoid inadvertent encouragement of late and "everyone at once" departures.

- Several counties believe that the public's dependence on the Weather Channel, whose information on local conditions or anticipated conditions may lag behind local information, may have hindered timely reception of, and response to, evacuation orders. It is recommended that the Weather Channel and Florida Division of Emergency Management continue to seek ways to impress on the public the importance of attention to local emergency management.

- Several counties not close to media centers such as Pensacola or Panama City had difficulty disseminating information unique to their situations.

- The Community Alert Network (CAN) automated telephone emergency warning system was used by Escambia and Santa Rosa Counties to contact thousands of surge area residents. The system was subscribed for the counties by Pensacola area chemical companies for use in hazardous materials accidents, etc. but can be used for any emergency. Cost to the counties is $1 per call. Approximately 25,000 messages were delivered during Opal. This system, or systems similar to it, may be worthwhile for other counties.

- Cellular phones were extensively used by evacuees during Opal to report traffic conditions to local radio stations, which were able to pass on this information to other evacuees attempting to find less congested routes and to avoid construction, road flooding, etc. However, in some instances, inaccurate information was circulated or advice contrary to that provided by local government was given. Local emergency management agencies and radio station managers may wish to consider how the effectiveness of cellular phone use can be enhanced, especially in coastal areas that do not have everyday media traffic information resources.

- Several counties maintain unlisted phone numbers to be used by local media to call emergency managers for information to be relayed to the public.

- Automated fax systems to provide information to broadcast media were used in Opal by Florida DEM and by several county emergency management agencies with apparent success. It was also suggested that state and county highway patrol agencies compile a list of media and fax numbers to provide TV and radio stations with traffic and shelter information.

- Gulf County, which is one of the counties lacking in TV/radio service, noted a potentially critical problem with the telephone company facilities in Port St. Joe. The building housing the phone lines is within a mile from the coast in a surge vulnerable location. Steps to mitigate this problem should be considered so as to avoid loss of long distance communication and resultant isolation.

- Law enforcement and fire personnel were effectively used in Opal for neighborhood alerting. In at least one county there was a lack of cooperation by sheriffs department probably rooted in a lack of conviction that an evacuation was necessary. This may have contributed to the slow start of the evacuation and affirms the value of this type of notification.

- Several counties expressed the need for additional signs for evacuation routes.

Fig 5-3 Hurricane Opal Traffic Go Back

This map shows the location of traffic count stations that were in operation during the Hurricane Opal Evacuation.
Other roads, that did not have operating traffic count stations, also carried evacuation traffic.

FIGURE 5-2
HURRICANE OPAL TRAFFIC

Go Back

Go Back

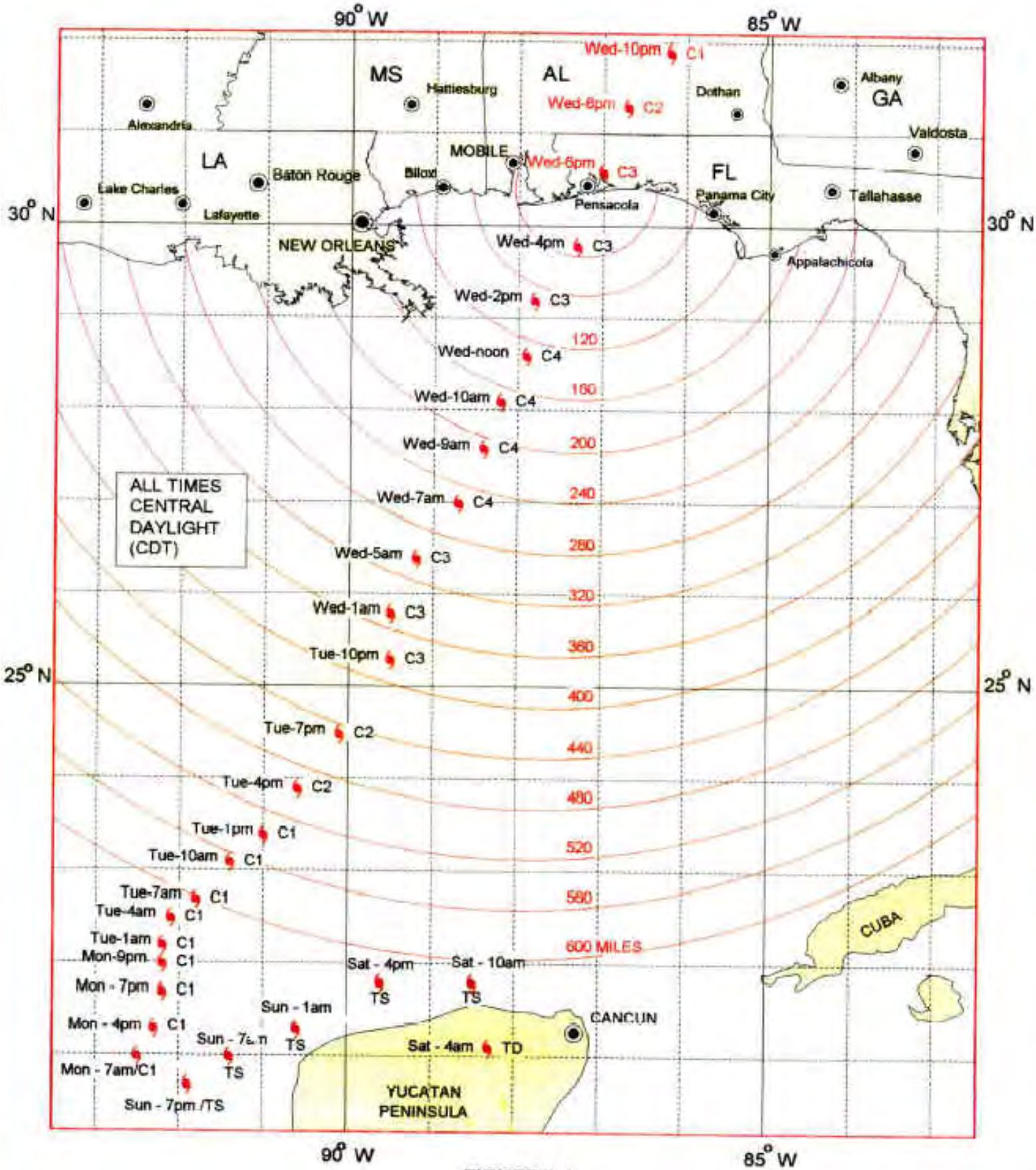


FIGURE 1-4

HURRICANE OPAL POSITIONS/INTENSITIES

FIGURE 14

HURRICANE OPAL POSITIONS/INTENSITIES

Information obtained from National Hurricane Center Hurricane Opal advisories 11 through 30, Saturday, September 30 through Wednesday, October 4, 1995.

Go Back

TABLE 1-1: HURRICANE OPAL EVACUATION CHRONOLGY*

June 3-6		Hurricane Allison threatens Florida Panhandle, comes ashore as a Category 1 hurricane via the Apalachee Bay . Damage minimal.
Aug. 2-3		Hurricane Erin exits the Florida Peninsula on a track headed to Louisiana. Turns to the southwest, striking Pensacola as a minimal Category 2 storm; disaster declared for NW Florida counties; prolonged power outages in Pensacola area.
Sept. 30 (Saturday)		Tropical depression becomes Tropical Storm Opal and slowly moves westward into Bay of Campeche.
Oct. 2 (Monday)		Opal becomes a hurricane at 0700. Florida and Alabama and some NW Florida and coastal Alabama county emergency management agencies are on low level alert.
Oct. 3	7 AM	ϕ **Opal a Category 1 hurricane; forecast to become Category 2 by landfall. Hurricane watch posted by NHC from Morgan City, LA to Pensacola, FL.**
	8 AM	
T		
	9 AM	
U		
	10 AM	ϕ **Watch extended further east to Suwannee River, FL; Forecast track crosses Pensacola.**
E		
	11 AM	
S		
	NOON	
D		
	1 PM	ϕ **NHC Advisory warns of expected increase in forward speed and possible strengthening; tropical storm force winds extend outward to 230 miles.**
A		
	2 PM	Santa Rosa issues limited vointary evacuation recommendation.
Y		
	3 PM	
	4 PM	ϕ **Track shift slightly to east; forecast of strong Category 2 by landfall. Tropical storm force winds forecast to reach Panama City by Wed., 3 PM. Santa Rosa County issues evacuation order.**
	5 PM	Escambia "pre-evacuation" notice
	6 PM	Okaloosa evacuation order for Cat. 1-3 broadcast on local TV news.
	7 PM	
	8 PM	Gulf Co. recommends evacuation of mobile homes, low-lying and coastal areas
	9 PM	ϕ **Opal now a Category 3 hurricane. Forecast to strike coast on Wednesday afternoon. Tropical storm force winds predicted to reach Panama City area by 5 AM.**
	10 PM	**NHC: "All preparations should be rushed to completion."** Escambia Evacaution order for Cat. 1 & 2 Santa Rosa evacuation order for beaches.
	11 PM	Wakulla voluntary evacuation recommendation. Access to Peridido Key (Escambia/Baldwin Cos.) stopped. Bay Co. announces Cat. 1-3 evac. order effective 6 am Wed.
Oct. 4	MIDNIGHT	(Approximate time) Escambia/Santa Rosa Cos. activate Community Alert Network
	1 AM	ϕ **Opal central pressure drops and winds strengthen through nighttime hours.**

OJ Simpson verdict announced; dominates TV & radio news.

Yom Kippur begins at sundown.

DURATION OF MAJOR EVACUATION FLOW

The times below were estimated from traffic counts provided by the Florida Department of Transportation and from information provided by local officials and private citizens. Evacuations of portions of counties were completed significantly earlier.

Mobile Co.

Baldwin Co.

Escambia Co.

Santa Rosa Co.

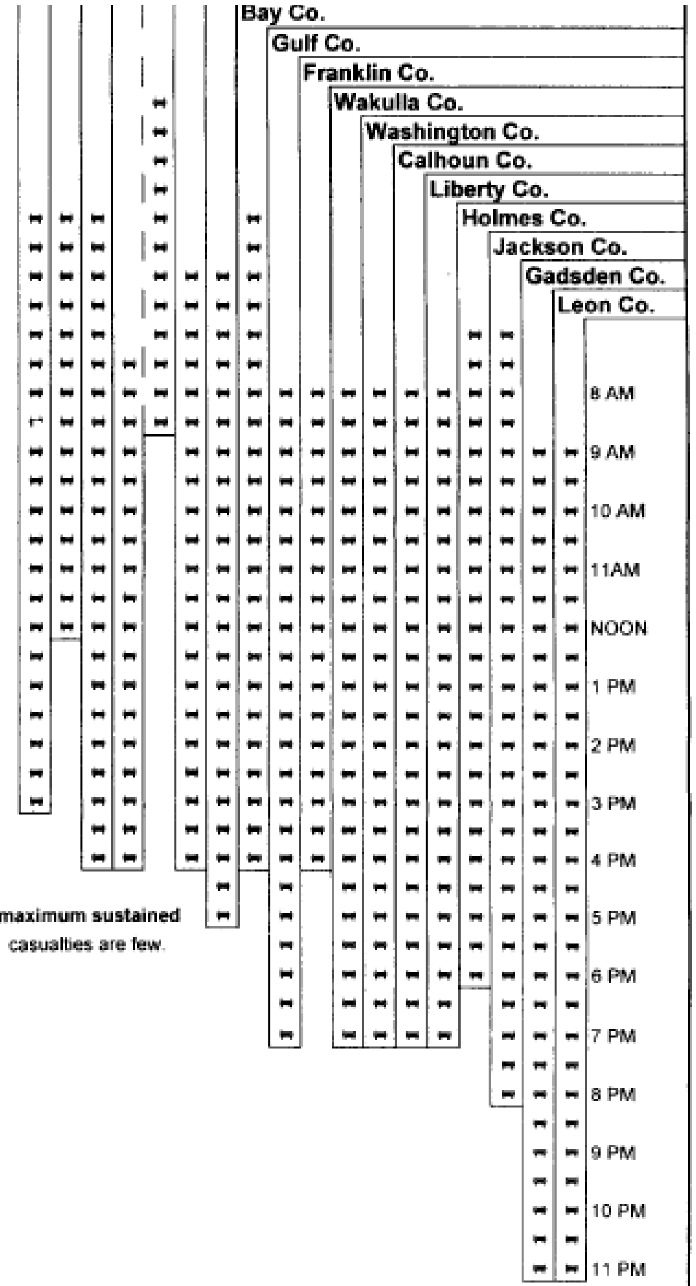
Navarre Beach

Okaloosa Co.

Walton Co.

WEDNESDAY

Time		Event
2 AM		
3 AM		Escambia and Santa Rosa expand evacuations to Cat. 3+.
4 AM		
5 AM		Mobile Co. evaculation recommendation; Baldwin Co. evacuation order
6 AM	ϟ	**Opal a Category 4 hurricane; expected to landfall later Wednesday.**
		Mobile Co. mandatory order by governor. Bay Co. evacuation order effective.
7 AM		Gulf Co. mandatory evacuation orderf or all coastal and low-lying areas. Wakulla Co. mandatory evacuation beginning at dawn. Franklin Co. evacuation order.
8 AM	ϟ	**"Explosive strenghtening" Maximum sustained winds = 150 MPH, strong Category 4.**
		Evacuation routes throughout NW Florida and So. Alabama becoming jammed.
9 AM		Gulf Co. evacuation order for the North part of the county and all mobile homes
		Calhoun & Leon Co. evacuation order for mobile homes. Okaloosa evacuation expanded to Cat. 4-5.
10 AM	ϟ	**Hurricane force winds overspreading extreme SE Louisiana, extending up to 145 mi. from center of Opal.**
		Escambia/Okaloosa County evacuations cancelled. "Seek refuge."
11 AM		1100 Santa Rosa: public told to stay put if not yet started to evacuate.
		Bay County reverses southbound lanes of US 231. Escambia Co. estimates tens of thousands still on road.
NOON	ϟ	**Hurricane intensity diminishes somewhat throughout afternoon.**
		Calhoun Co. school board closes schools; buses caught in evacuating traffic.
1 PM		Baldwin Co. evacuation essentially complete at noon according to Sheriff.
		Bay County surge areas evacuated by 1 pm.
2 PM		
	ϟ	**Tornado causes one death in Crestview, Okaloosa Co. 79 mph wind gust at Pensacola.**
3 PM		Mobile Co. evacuation complete according to sherrif.
4 PM		
5 PM	ϟ	**Opal landfalls between Pensacola Beach and Navarre Beach at 5 PM, as a marginal Category 3 hurricane with maximum sustained** winds of 115 MPH. Many evacuees have been unable to reach safe destinations before onset of gale force winds, but casualties are few.
6 PM	ϟ	**Sustained hurricane force winds at Eglin AFB.**
7 PM		
8 PM		
9 PM		
10 PM		
11 PM		
MIDNIGHT		



* Hurri Hurricane Opal history and advisory information was derived from the Hurricane Opal Preliminary Report prepared by Max Mayfield of the National Hurricane Center, dated 2 November 1995.

Infor Information on evacuation decisions, orders and traffic was obtained from state and local emergency management agencies in the Post-Opal Assessment area.

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TABLE 4-1 : HURRICANE OPAL PUBLIC SHELTER DATA[1]

COUNTY	HURRICANE OPAL SHELTERS OPENED	HURRICANE OPAL EVACUEES SHELTERED	HES TECHNICAL DATA REPORT SHELTERS AVAILABLE	HES TECHNICAL DATA REPORT EXPECTED EVACUEES	TIME OPENED	DURATION	NOTES/PROBLEMS, ETC.
TRI-STATE HES COUNTIES							
Mobile, AL	13	7,000	31	28,600	6 am Wed.	26 hours	Loss of power at many shelters. Will work with school board to obtain generators.
Baldwin, AL	8	3,000	21	6,400	9 pm Tues. (1) 4 am Wed. (7)	28-30 hours	2 courthouses serve as special shelters. Future plans to designate special needs shelters.
Escambia, FL	5	9,000	33	19,000			All shelters exceeded capacity. Current county est. capacity: 6,000; limited by ARC capabilities. Problems with school board cooperation. Many evacuees from Santa Rosa.. Co. State colleges will not shelter people. Many people wound up in wrong shelters, e.g special needs people in regular shelters. About 10 refuges, including some along S.R. 97 were opened. No concrete figures for the number of people in refuges.
Santa Rosa, FL	2	1,800	16	4,300			Most shelter managers evacuated county. Churches used as unofficial shelters; Buildings forced open to serve as refuges; overflow of special needs evacuees directed to Escambia Co.
Okaloosa, FL	8	6,480 [10/4] 8,000 [10/5-6]	9	10,000		Some for several days	Widespread lack of power extended shelter duration. Congestion prevented planned use of special needs facilities. Tornado missed special needs facility by 150 yards.
Walton, FL	4	600	9	2,400			
Bay, FL	5	3,000	17	11,300		Until Friday, Oct. 6	Large Deficit; Shelters opened in Dothan, AL for use by Bay Co. evacuees. No + Category 3 shelters in county.
APLACHEE BAY REGION HES COUNTIES							
Gulf, FL			2	200			No ARC staffing available. County policy is to use former shelters as refuges of last report -- locations not advertised. Special needs persons transported by bus to a state hospital 105 miles inland.
Franklin, FL	0		0	150 refugees			No shelters in county; 3 refuges of last resort were opened but were not needed. Continuing problem with nursing homes and evacuation of other elderly residents.
Wakulla, FL	0			470 refugees			Evacuees sheltered out-of-county (Gadsden & Leon Counties).
Calhoun, FL	6	359		990 from In-Co. 190 from Out-of-Co.	2 pm Wed.	Until Friday, Oct. 6	Host county for Franklin & Gulf evacuees; managed by Calhoun officials with cost to Calhoun. Red Cross not able to provide manpower for staffing. Because schools were not closed County was forced to use churches.
Liberty, FL	2	247		810 from In-Co. 105 from Out-of-Co.			
Gadsden, FL	5	132 from Co. 700 from out Co.		3,420 from In-Co. 140 from Out-of-Co.	Mid-day Wed.	Began closing early Friday, Oct. 6	Only 311 from Tallahasse area. Rest from out-of-county.
Leon, FL	6	1,158 all from out-of-Co.		6,000 from In-Co 4,100 from Out-of-Co.			
Jackson, FL		8,000 ARC: 1,162		3090 from In-co 440 from Out-of-co.			Mostly out-of-county evacuees.
INLAND COUNTIES							
Holmes, FL	6	400				Until Thurs, Oct. 5	Loss of power; no cots in special needs shelter; food problems in all shelters.
Washington, FL	5	500			Early Wed.		Loss of power; American Red Cross chapter currently forming; extensive shelter training program planned.
Escambia, AL	6	300			Early Wed.		70 % of shelterees from Florida; 30 % from in-county mobile homes.
Houston, FL		43,338			Early Wed.		A special needs shelter acommodated 34 patients brought in from Bay Co. All necessary nurses, equipment, records and transportation were supplied by the heath care providers or from Bay Co. assets. Some Florida residents returned to shelters in Dothan the day after the hurricane passed because of re-entry and other problems associated with the post-storm response phase in Bay Co.

[1] Data obtained from Florida and Alabama county emergency management officials and from Florida Division of Emergency Management.

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TABLE 5-1: HURRICANE OPAL TRAFFIC COUNT SUMMARIES

FLORIDA DOT TRAFFIC COUNT STATIONS			OPAL EVACUATION TRAFFIC						
MAP* ID	ROUTE	LOCATION	DIRECTION	DURATION OF FLOW	PEAK FLOW	END	MAXIMUM HOURLY DIRECTIONAL VOLUME	Los D DIRECTIONAL SERVICE VOLUME**	OPAL VOLUME PERCENT OF Los D VOLUME
1	I-10	West end of Esc. Co.	W	5 am - 2 pm	9:30	2 pm	2800	3330	84%
2	I -10	At CR 280A in Walton Co.	E	6 am - 5 pm	11:30	5 pm	2800	3330	84%
3	I-10	Wash. Co. at CR 273	E	7 am - 6 pm	10 - 4	6 pm	2950	3330	89%
4	I-10	Jackson Co. East of US 231	E	7 am - 6 pm	noon - 4pm	6 pm	2850	3330	86%
5	I-10	Gadsden Co. east of CR 268	E	9 am - 11 pm	10-6	11 pm	1650	3330	50%
6	SR 12	SR 12 at Bristol in Liberty Co.	N	8am - 7 pm	11 - 5	7 pm	270	800	34%
7	SR 267	in Gadsden Co. at state line	N	9 am - 8 pm	1 - 4	8 pm	95	800	12%
8	SR 83	North of DeFuniak Sprgs.	N	6 am - 5 pm	noon	5 pm	340	800	43%
9	SR20	West of US 231 in Bay Co.	E	7 am - 4 pm	10 am - 2pm	4 pm	335	700	48%
10	US 231	Florida-Alabama border	N	5 am - 5 pm	8am - 1pm	5 pm	1350	2170	62%
11	US 231	South of SR 20 in Bay Co.	N	5 am - 3 pm	8am - 1pm	3 pm	2100	2170	97%
12	US 29	North of US 90 in Escambia	N	5 am - 2 pm	7-noon	2 pm	1750	1640	107%
13	US 319	Crawfordville in Wakulla Co.	N	9 am - 7 pm	11 - 2	7 pm	550	700	79%
14	US 90	Perdido River Bridge	W	7 am - 1 pm	8 to noon	1 pm	320	1230	26%
15	US 90	West of SR 85 in Oakaloosa	E	6am - 4pm	10- 2	4 pm	1100	1530	72%
16	US 98	Pensacola Bay Bridge	W	midnite - 1pm	7am	1 pm	2350	3110	76%
17	US 98	Okaloosa-Walton Line	E & W	6 am - 1 pm	10:30 (E)	1 pm	700 WB 575 WB	1530	46% 38%
18	US 98	South of US 319 in Wakulla	E	8 am - 4 pm	1pm	4 pm	620	700	89%

* Map ID refers to Figure 5-1, page 5-7.

** "Los [Level of Service] D DIRECTIONAL SERVICE VOLUME" is the road capacity usually assumed in hurricane evacuation study traffic modeling. This level of service assumes unobstructed traffic flow; it is typically 75 to 90 percent of the theoretical maximum capacity of a road segment.

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TABLE 5- 2 : TRAFFIC/CLEARANCE TIME DATA

COUNTY	HES CALCULATED CLEARANCE TIME[1]	TIME EVACUATION ORDER EFFECTIVE	DURATION OF SUBSTANTIAL EVACUATING TRAFFIC[2]	NOTES: PROBLEMS/ CONGESTION/ TRAFFIC CONTROL ACTIONS/SUGGESTIONS
TRI-STATE HES COUNTIES				
Mobile	14½	6 am. Wed.	5 am - 3 pm 10 hrs.	Traffic backup on I-65 out of Mobile and Baldwin Counties.
Baldwin	14½	6 am. Wed.	5 am - noon 7 hrs.	Two new routes will be complete in 1996. See I-65 report.
Escambia (Florida)	15¼	Noon Tues. Campgrounds 10pm Tues. (Issued: 5:30pm)	5 am - 2 pm 9 hrs. Notes →	8-10 hour delays on I-65 reported. Roadway flooding on Route 29 at two places. Construction on I-65 in Alabama. Roads never really cleared; some evacuees abandoned vehicles to seek refuge.
Santa Rosa	7¾	10 pm Tues.	8 am - 4 pm 8 hrs. Notes →	Navarre Beach was evacuated by 8:30 am on Wednesday. At least several roads were flooded from earlier heavy rainfall, e.g. Rte. 85 north of Whiting NAS & Rte. 191 near Munson. I-65 in Alabama backed up down to Andalusia. At 11 am residents were advised to stay put if they had not begun evacuation; those on road were advised to find refuge immediately.
Okaloosa	14¼	6 pm Tue.	6 am - 4 pm 10hrs. Notes →	Tues. evening evacuation order was essentially ignored until Wed. am. Route 85 was "3-laned" north to _____. Gridlock on I-65 all the way to Birmingham, AL. Evacuation order was cancelled at 10 am Wednesday.
Walton	8	11 pm Tue.	6 am - 5 pm 11 hrs.	Severity of traffic gridlock: Service plaza managers on I-10 near US 331 had to call for assistance from Sheriff's Dept. and De Funiak Springs City Police for crowd control.
Bay, FL	US 2312 Lane 25¾ hrs. US 231 4 Lane 8½ hrs. See Notes →	10 pm. Tue. (opt.) 6 am. Wed.	5 am - 4 pm 11 hrs. Notes →	26¾ hr. clearance time: US 231 - 2 lanes north; 10¼ hrs - 4 lanes north. US 231 was 4 laned Wednesday morning in response to severe congestion; no detailed implementation plan in place. All routes were congested. Two bridges on US 231 were down to one lane because of construction; congestion further caused by backup from I-10. Unconfirmed reports that evacuees "2 laned" Route 77 on their own. Some evacuees in traffic 10-12 hours on Route 20 toward Tallahasse. Everyone out of surge areas by 1 pm Wednesday. Traffic slackened late afternoon, just before dark.
APLACHEE BAY REGION HES COUNTIES				
Gulf	7	11 pm.Tues. (opt.) 6 am Wed.	8 am - 7 pm 11 hrs.	Roads gridlocked by late afternoon on Wednesday. HES clearance times considered too optimistic.
Franklin	4¾ to 9¾	7:30 am. Wed.	8 am - 4 pm	Shortage of traffic control resources along US 98 eastbound.

			8 hrs.	County EM not familiar with HES clearance times.
Wakulla	7¼ to 9¼	9 pm.Tues. (opt.) 6 am Wed.	8 am - 7 pm 11 hrs.	Flooded roads in other jurisdictions; massive congestion on I-10 because of construction.
Calhoun	NA	N.A.	8 am - 7 pm 11 hrs.	County highways overwhelmed with Bay & Gulf County evacuating traffic. School buses taking students home became part of gridlock. Major problem locations: Rte. 71 at Blountstown. Traffic rerouted to Rte. 73 through Clarksville where it met Bay County traffic coming east from US 231 via Rte. 20. Eastbound Rte. 20 evacuation traffic also diverted north on Rte. 73.
Gadsden/ Leon	10¾	N.A.	9 am - 11 pm 14 hrs.	Evacuees arrived at shelters up until 1 am on Thursday, Oct. 5. Massive congestion on I-10 at Apalachicola River Bridge - and at I-10 overpass at SR 270 where construction reduced east-bound traffic to one lane, just west of Quincy.
Jackson	10 to 10½	N.A.	7 am - 8 pm 13 hrs.	US 231 4 laned as far north as Round Lake (approx. 7 miles into Jackson Co.). - no major traffic problems were noted with this procedure. I-10 exit 21 North of Blountstown -Heavy traffic all day long from daybreak until dark. Many evacuees started parking during late afternoon hours. Service station lot and road was solid with parked cars. Many people spent the entire night in their vehicles in parking lots and the roadside on SR 71 south of I-10.

INLAND COUNTY TRAFFIC INFORMATION	
Holmes, FL	Major rodeo (15,000 - 20,000 people) was about to begin. All evacuated with prompting by local authorities. Service plaza managers reported loss of power beginning at 5pm; closed operations. Parking area was jammed with vehicles at dark; local radio had very little guidance for evacuees. Repair work was being done at both sides of the bridge over Chotctawhatchee River. At MM 102, programmable signs were located for notification of reduction to one lane. These were said not to be operating during the evacuation process, nor were they removed. I-10 MM 96 Rest Area rest areas overloaded with vehicles parked to get out of the traffic and in search for refreshments and rest rooms.
Washington, FL	Eastbound I-10 at CR 273 had major evacuation flow from 7 AM to 6 PM. Traffic counts indicate stoppages near 2 PM. Traffic from I-10 was routed through Chipley as a last resort to prevent huge backup of traffic. This traffic was beyond the capability of local law enforcement resources. A request for assistance was made to the Local National Guard unit which apparently never received authorization to help. An I-10 service station employee reported a 5½ hour, 75 mile trip to Tallahasse. Noted major bottle necks were at the bridge repairs along I-10. Owner reported that the station was a "madhouse" with cars parking everywhere at nightfall. No FHP or other state traffic control observed in the area.
Escambia, AL	People abandoned cars when they were stuck in a 12 mile traffic jam and sought shelter with strangers in nearby residences. Escambia County had to find and open refuges of last resort. Because of late evacuation out of Florida, traffic controllers had to stay out beyond a point which they considered safe. Some couldn't stand up, visibility was zero but they still tried to direct traffic. Construction on I-65 caused a major portion of the traffic backlog. Similar comments to those in Florida relating to I-10. Local law enforcement was overwhelmed with traffic control duties.
Houston, AL	County expected 30,000 cars and 200,000 people to evacuate through county from Florida (only about 25% of the evacuees are expected to stay in the county.) This information comes from the Police Dept. and is based on southbound tourist traffic counts. Do not rely on traffic data provided in the HES because the data is too old. Evacuees from Florida called and reserved rooms in hotels in Alabama a week in advance. State Troopers handle traffic from state line to Dothan. Then Houston County takes over with assistance from State Troopers. State Troopers have authority to reverse lane traffic flow. Police Department was notified that Hwy 231 traffic was traveling one-way. Dothan Police and Houston Sheriff's Departments were prepared for traffic due to past experience of normal "beach" traffic.

[1] Clearance times listed in this table are for Category 4 hurricanes, low tourist occupancies and rapid loading of the evacuation network. Unless otherwise noted the longest times are listed for counties having different clearance times for different evacuation corridors.

[2] Duration of substantial evacuating traffic was estimated from Florida DOT traffic counts and from information provided by interviewees. Estimates were made for counties where traffic count data was not available.

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TABLE 6-1
OPAL ADVISORY 25 DECISION-MAKING DATA

HURRICANE OPAL ADVISORY#25, Tuesday, October 3, 1995 - 4 pm

	CURRENT DISTANCE		CURRENT FORECAST						WITH AVERAGE ERROR[4]			
COUNTY	STORM CENTER	TSF WINDS[1]	CPA[2]	ARRIVAL OF STORM CENTER	HOURS AWAY	ARRIVAL OF TSF WINDS	HOURS AWAY	CAT. 3 CLEARANCE TIMES[3]	ARRIVAL OF STORM CENTER	HOURS AWAY	ARRIVAL OF TSF WINDS	HOURS AWAY
Mobile	477 m.	247 m.	89 m.	Thur. 2 am	34	Wed. Noon	20	14½	Wed. 9 pm	29	Wed. 6 am	14
Baldwin	484 m.	254 m.	59 m.	Thur. 3 am	35	Wed. 1 pm	21	14½	Wed. 8 pm	28	Wed. 7 am	15
Escambia	506 m.	276 m.	39 m.	Thur. 4 am	36	Wed. 2 pm	22	13	Wed. 9 pm	29	Wed. 8 am	16
Santa Rosa	507 m.	277 m.	32 m.	Thur. 4 am	36	Wed. 2 pm	22	6½	Wed. 9 pm	29	Wed. 8 am	16
Okaloosa	518 m.	288 m.	18 m.	Thur. 5 am.	37	Wed. 3 pm	23	12¼	Wed. 9 pm	29	Wed. 8 am	16
Walton	527 m.	297 m.	15 m.	Thur. 5 am	37	Wed. 3 pm	23	6¼	Wed. 10 pm	30	Wed. 9 am	17
Bay	534 m.	304 m.	53 m.	Thur. 5 am	37	Wed. 4 pm	24	22	Wed. 10 pm	30	Wed. 9 am	17
Gulf	522 m.	292 m.	79 m.	Thur. 4 am	36	Wed. 3 pm	23	6	Wed. 10 pm	30	Wed. 9 am	17
Franklin	555 m.	325 m.	111 m.	Thur. 5 am	37	Wed. 6 pm	26	4¾	Wed. midnite	32	Wed. 11 am	19
Wakulla	583 m.	353 m.	125 m.	Thur. 7 am	39	Wed. 8 pm	28	7¼	Thur. 2 am	34	Wed. 1 pm	21

30 HOUR PROBABILITIES[5]

Mobile, AL	16	
Pensacola, FL	20	
Panama City, FL	22	← Highest % of any listed location
Apalachicola, FL	20	

NOTES

[1] Tropical Storm Force Winds (39 mph).

[2] Closest Point of Approach along the forecast track (in statute miles).

[3] Clearance Times excerpted from Tri-State HES and Draft Apalachee Bay Region HES. Times are for low tourist occupancy and rapid public response.

[4] With average forecast errors for direction and forward speed, storm could arrive sooner than current forecast indicates.

[5] Chances of center of the hurricane passing within 65 miles through next 48 hours. Probabilities listed are very high for a 30 hour forecast.

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TABLE 6-2
OPAL ADVISORY 26 DECISION-MAKING DATA

HURRICANE OPAL ADVISORY#26, Tuesday, October 3, 1995 - 10 pm

	CURRENT DISTANCE		CURRENT FORECAST						WITH AVERAGE ERROR[4]			
COUNTY	STORM CENTER	TSF WINDS[1]	CPA[2]	ARRIVAL OF STORM CENTER	HOURS AWAY	ARRIVAL OF TSF WINDS	HOURS AWAY	CAT. 3 CLEARANCE TIMES[3]	ARRIVAL OF STORM CENTER	HOURS AWAY	ARRIVAL OF TSF WINDS	HOURS AWAY
Mobile	364 m.	134 m.	131 m.	Wed. 2 pm	16	Wed. 5 am	7	14	Wed. 5 pm	19	Wed. 3 am	5
Baldwin	373 m.	143 m.	104 m.	Wed. 3 pm	17	Wed. 5 am	7	14½	Wed. 3 pm	17	Wed. 3 am	5
Escambia	389 m.	159 m.	88 m.	Wed. 4 pm	18	Wed. 6 am	8	13	Wed. 2 pm	16	Wed. 4 am	6
Santa Rosa	394 m.	164 m.	77 m.	Wed. 5 pm	19	Wed. 6 am	8	6½	Wed. 2 pm	16	Wed. 4 am	6
Okaloosa	405 m.	175 m.	56 m.	Wed. 5 pm	19	Wed. 6 am	8	12¼	Wed. 2 pm	16	Wed. 4 am	6
Walton	411 m.	181 m.	34 m.	Wed. 6 pm	20	Wed. 6 am	8	6¼	Wed. 2 pm	16	Wed. 4 am	6
Bay	416 m.	186 m.	1 m.	Wed. 6 pm	20	Wed. 7 am	9	22	Wed. 2 pm	16	Wed. 5 am	7
Gulf	404 m.	174 m.	32 m.	Wed. 5 pm	19	Wed. 6 am	8	6	Wed. 1 pm	15	Wed. 4 am	6
Franklin	435 m.	205 m.	54 m.	Wed. 7 pm	21	Wed. 7 am	9	4¾	Wed. 3 pm	17	Wed. 5 am	7
Wakulla	478 m.	248 m.	59 m.	Wed. 9 pm	23	Wed. 10 am	12	7¼	Wed. 5 pm	19	Wed. 7 am	9

24 HOUR PROBABILITIES[5]

Mobile, AL	14
Pensacola, FL	26
Panama City, FL	35 ← Highest % of any listed location
Apalachicola, FL	33

NOTES

[1] Tropical Storm Force Winds (39 mph).

[2] Closest point of approach along the forecast track (in statute miles).

[3] Clearance Times excerpted from Tri-State HES and Draft Apalachee Bay Region HES. Times are for low tourist occupancy and rapid public response.

[4] With average forecast errors for direction and forward speed, storm could arrive sooner than current forecast suggests.

[5] Chances of center of the hurricane passing within 65 miles through 7 p.m. Wednesday. Probabilities listed are very high for a 24 hour forecast.

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TABLE 7-1: PUBLIC INFORMATION

JURISDICTION	PUBLIC INFORMATION AND EDUCATION TOOLS	PROBLEMS/COMMENTS/FUTURE PLANS
Florida DEM	Full range of media, including autofax messages to 200 to 300 TV/radio stations. Live EBS message broadcast Tuesday night following National Hurricane Center update.	DEM believes Tuesday night evacuation messages were not effective enough. State might have helped delivery with full activation of public information contacts again after 10 p.m. National Hurricane Center update. Also recognizes need to reach out to smaller stations as well as the larger ones usually contacted.
Mobile Co.	Central media area in Mobile: TV, radio, cable. Tuesday County prepared handout showing evacuation times from Tri-state HES. Many pre-hurricane season & public presentations/ public information programs.	Will try to educate public to stay home in future(where appropriate). Would like to have new Tri-State maps & good canned public service announcements.
Baldwin Co.	TV, Radio, Some Cable. Automated fax system to AM radio, TV stations all 911 cities. Cable override for Pleasure Island. Maps with evacuation zones and routes published in newspapers.	Could have used brochures/pamphlets for distribution at tourist centers. In future will try to get non-surge area residents to stay home.
Escambia Co.	TV, Radio, Cable override CAN (Community Alert Network) 13,000 calls. Pre-recorded message to tune in to media. Police & fire personnel with PA systems. Public education meetings in surge areas	Tuesday evening evacuation orders mentioned goal of completion by noon Wednesday; this may have led public, unfamiliar with concept of clearance times, to delay leaving until Wednesday morning. Community Alert System (CAN) system initiated at about 4 a.m. Wednesday. At 9 a.m. instructed public not to evacuate if not already on the road. At noon public instructed to get out of cars and off highways. County noted that many households rely on the Weather channel; information can be two or three hours behind local information. Law enforcement did not attempt to encourage people to leave Tuesday evening. Public needs to be educated that everyone cannot evacuate simultaneously
Santa Rosa Co.	CAN (Community Alert Network), 25,000 calls beginning at 7:50 p.m. Tuesday, Oct. 3. Cable TV override. News releases to TV, radio stations; newspapers. Phone calls to mobile home parks and special needs residents.	Faxes from Santa Rosa County Emergency Management did not get into the right hands at the media offices. The Public Information Office is currently working on its relationships with all media outlets and on procedures for confirming receipt of emergency information.
Okaloosa Co.	TV, Radio, three unlisted telephone lines for media call in. Blue pages of CENTEL phone book. Newspaper maps of evacuation routes. Pre-season public education sessions.	Evacuation order issued 5 p.m. Tuesday. Confusion in dissemination of County commission's approval of mandatory evacuation order probably reduced compliance. Some businesses would not release people from work. Public was told "If leaving area, leave tonight; if staying locally, you can go tomorrow." Very few people left Tuesday night. Evacuation canceled at 10 a.m. Wednesday due to gridlock and advance of storm. Public told to clear roads. Many non-surge residents evacuated because of fear of Category 5 winds. One municipal police department told non-surge residents to evacuate. Confusion between local instructions & nation media Need better communication with Weather channel. Public information sessions were very poorly attended; little evidence of family preparedness. Work is underway on newspaper supplements; brochures; media public education system Need better direction by local officials to available evacuation routes and public shelters.
Walton Co.	One low power AM radio station. Faxes information to media. Sheriff deputies door to door Tuesday night on beaches and shore of Choctwachee Bay.	TV is from Dothan and Panama City; does not serve Walton Co.
Bay Co.	Room at EOC set aside for regular EM briefing for local TV & radio weather staff (every two hours). Police & fire PA used in some surge locations Wednesday morning; some door to door notification of special needs population. A newspaper article came out just before Erin showing evacuation zones, routes, etc. Information is usually included in telephone books. Electronic media also provided this information every year.	Announcement put out in time for Tuesday night 10 o'clock news that there would be a mandatory evacuation at 6 a.m.; suggested that people could leave when ready. No Wednesday morning upgrade to a Cat 4-5 evacuation was made because of the imminence of the storm and inability to handle. At 1-2 PM the public was told not to leave due to roadway congestion and arrival of hazards. All 4 TV and 16 of 17 radio stations went down during storm.
Gulf Co.	Must rely on Panama City (Bay Co.) radio/ TV stations that frequently give both Gulf and Franklin counties very poor coverage. Tuesday night disseminated optional evacuation notice via 2 Panama City TV stations. Wed AM order was disseminated via Sheriff and Fire Dept's. Notice to home health agencies via phone.	Lacked media coverage on when people could re-enter. County tried press releases but had difficulty having them announced. Need link to a powerful radio station to get information out to public about what is going on in Gulf County. Need a toll free number in state for people to call to get information. County believes it needs closer relationship with NHC and NWS. Needs more information and capability to use it and help with interpreting information from these agencies. Telephone company facilities in Port St. Joe (Gulf County) are within a mile from the coast. Equipment subject to flooding. Once this phone company closes down there can be no long distance calls made into or out of Franklin, Gulf or Tyndall AFB. Loss of long distance communication coupled with the lack of radio/TV service will act to isolate these areas during and after a major event.

TABLE 7-1: PUBLIC INFORMATION (CONTINUED)

JURISDICTION	PUBLIC INFORMATION AND EDUCATION TOOLS	PROBLEMS/COMMENTS/FUTURE PLANS
Franklin Co.	Apalachicola has a local radio station which serves county well. EM provided station a generator for use during emergencies. Police and fire personnel notified island population; realtors used to contact rental properties.	Media coverage from Panama City and Tallahassee is weak, especially if something is going on in those areas.
Wakulla Co. **Leon Co.** **Gadsden Co.**	Wakulla gave a "whisper notification" Tuesday night; final notification to evacuate was given on radio, television and door-to-door by law enforcement and fire department personnel. Faxes to media, Red Cross releases. Leon Co. notified by Wakulla via radio on the fourth. Pre-season information provided to the public in the evacuation areas via tabloid format.	Counties plan to promote more involvement from media in the future. Will also provide additional information to hotel/motel plus other high traffic businesses for evacuees. Public information needs to be greatly improved for people coming into the area. Additional signs needed for evacuees. There are also plans to use PBS for information. Concern was expressed about the abundance of hurricane information available to the public from many sources that was not always consistent with emergency management information.
Holmes Co.	Public notified by TV, radio & local law enforcement and fire departments; evacuation order for mobile homes made Wednesday morning to midday.	More public education planned.
Washington Co.	Radio, TV. Local radio station is low power AM station. Most Public Information was provided through Panama City radio and television. Return information provided through Dothan radio and word of mouth. Weather Channel was monitored, State EMA provided information via conference calls and FAX.	Much planning is being discussed.
Calhoun Co.	TV & radio; local stations in county.	
Houston Co.	Local radio WOLF stayed on air the entire time. Generators had been provided by FEMA and local EMA. Most of the information for the radio station came via AP wire. Radio station dispensed with usual format and advertising; had live interviews with agencies and callers. County EMA provides strip maps, hotel information and directions at the Alabama Welcome Center. Signs were also posted directing public to tune to WOLF for severe weather information.	Radio station had no trouble contacting county EMA but could not contact highway patrol; County believes Florida troopers should compile a list of media and fax numbers and provide information on traffic situation and evacuation routes to Alabama radio stations. Media did not get information on re-entry to give to public. As a result, Dothan County had to re-open shelters because people came back when they could not get home. Opened two shelters and housed about 800 people from Florida. Opened Farm Center for campers. Better cooperation with the local media is essential to a timely and effective Public Outreach operation. Need more evacuation signs on major evacuation routes.

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