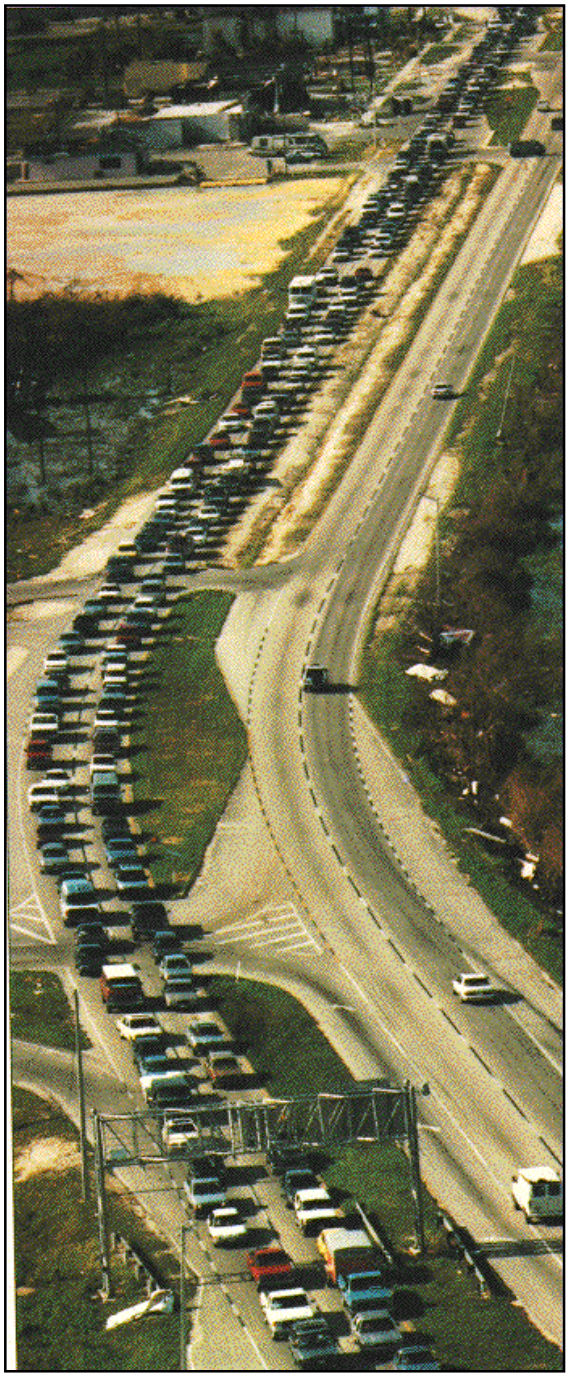
MISSISSIPPI HURRICANE EVACUATION STUDY

TRANSPORTATION ANALYSIS

(Taken from Chapter 6 of the Technical Data Report)

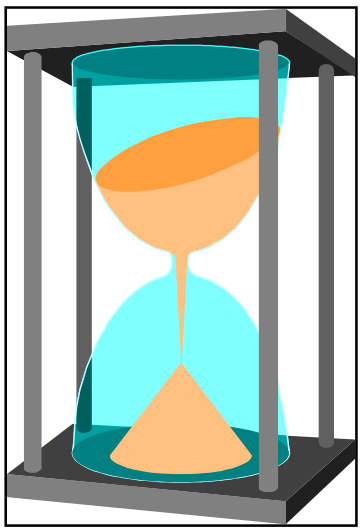
INTRODUCTION



During a hurricane evacuation in Mississippi significant number of vehicles have to be moved on the road network in a relatively short period of time. With limited sheltering available for a major hurricane in the coastal counties, most evacuees will go to inland counties and beyond to seek shelter. This often creates traffic backups and long travel times.

The magnitude of evacuating vehicles will vary depending upon; the intensity of the hurricane, publicity and warnings given about the storm, and certain behavioral response characteristics of the population. During a typical evacuation, vehicles enter the road network at different times depending on the evacuee's response relative to an evacuation order or storm advisory. Conversely, vehicles leave the road network depending on both the planned destinations of evacuees and the availability of acceptable destinations such as public shelters, hotel/motel units and friend's or relative's in non-surge prone areas. Vehicles move across the road network from trip origin to destination at a speed dependent on the rate of traffic flowing on various roadway segments and the ability of the segments to handle a certain volume of vehicles each hour. Estimates of evacuation clearance times for the study area include the effects of evacuation traffic generated by neighboring counties that will use Hancock, Harrison and Jackson Counties' roadways.

ANALYSIS OBJECTIVES



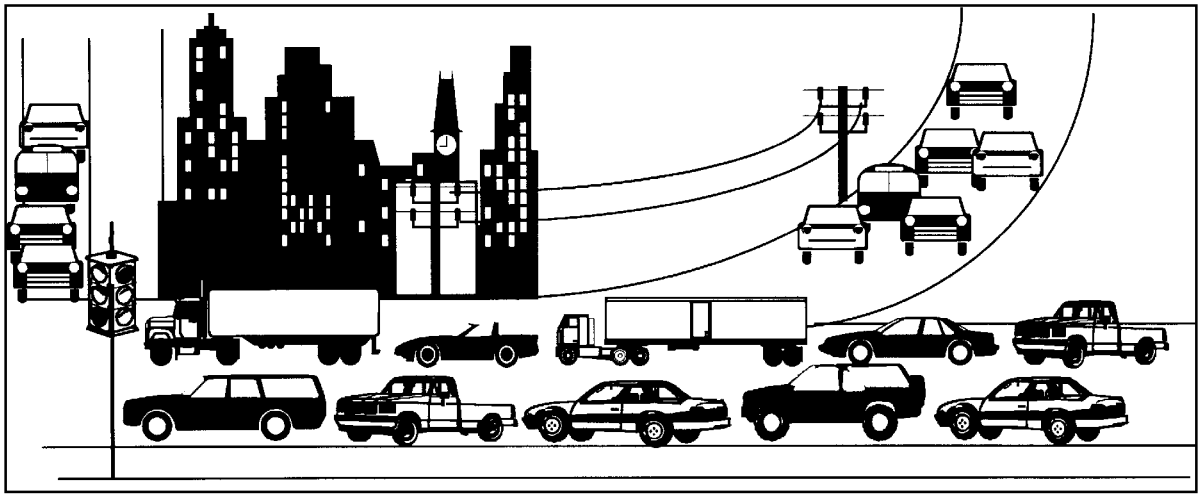
The main objective of the transportation analysis is to estimate evacuation clearance times, (the time it takes to clear a county's roadway of all evacuating vehicles). To estimate clearance times the evacuation road network had to be defined and general traffic control issues had to be examined. Clearance time is a value resulting from transportation engineering analysis performed under a specific set of assumptions. It must be coupled with pre-landfall hazards data to determine when an evacuation advisory must be issued to allow all evacuees time to reach safe shelter. Pre-landfall hazards are sustained gale force winds and/or roadway flooding prior to landfall of the eye of the hurricane. Factors that influence clearance time must be studied intensively to determine which factors have the strongest influence. Therefore, a sensitivity analysis was performed and a range of clearance times calculated for each county by varying key input parameters.

The transportation analysis task initially identified traffic movements associated with a hurricane evacuation. Basic assumptions for the transportation analysis were related to storm scenarios, population-at-risk, behavioral and socioeconomic characteristics, and the roadway system and traffic control. A separate transportation model and an evacuation roadway system were developed for each county to facilitate model application and development of clearance times. General information and data related to the transportation analysis are presented in summary form in this report. A separate Transportation Analysis Update Report and Transportation Model Support Document were printed in February 2001. These documents include detailed transportation modeling statistics and zone-by-zone data listings for each county.

STATE AND COUNTY ASSISTANCE

A critical element in performing the study tasks was the coordination with each county and the State of Mississippi. Meetings were held with the county emergency management offices to coordinate the various technical inputs and to review graphics and evacuation statistics developed in the study. Counties were provided with draft data throughout the process so that final results would be more credible and usable. The counties and the Gulf Regional Planning Council assisted in the development of the dwelling unit database.

EVACUATION TRAVEL PATTERNS



The movements associated with hurricane evacuation have been identified for the purposes of this analysis by five general patterns as follows:

a. In-County Origins to In-County Destinations. Trips made from the storm surge vulnerable areas and mobile home units in an individual county to destinations within the same county, such as public shelters, hotel and motel units, churches, and friends or relatives outside the storm surge vulnerable areas.

b. In-County Origins to Out-Of-County Destinations. Trips made from the individual coastal county to destinations in other counties of the study area or outside the study area entirely. This is a significant category for the Mississippi Region as many coastal evacuees seek safe destinations in Alabama and inland counties in Mississippi.

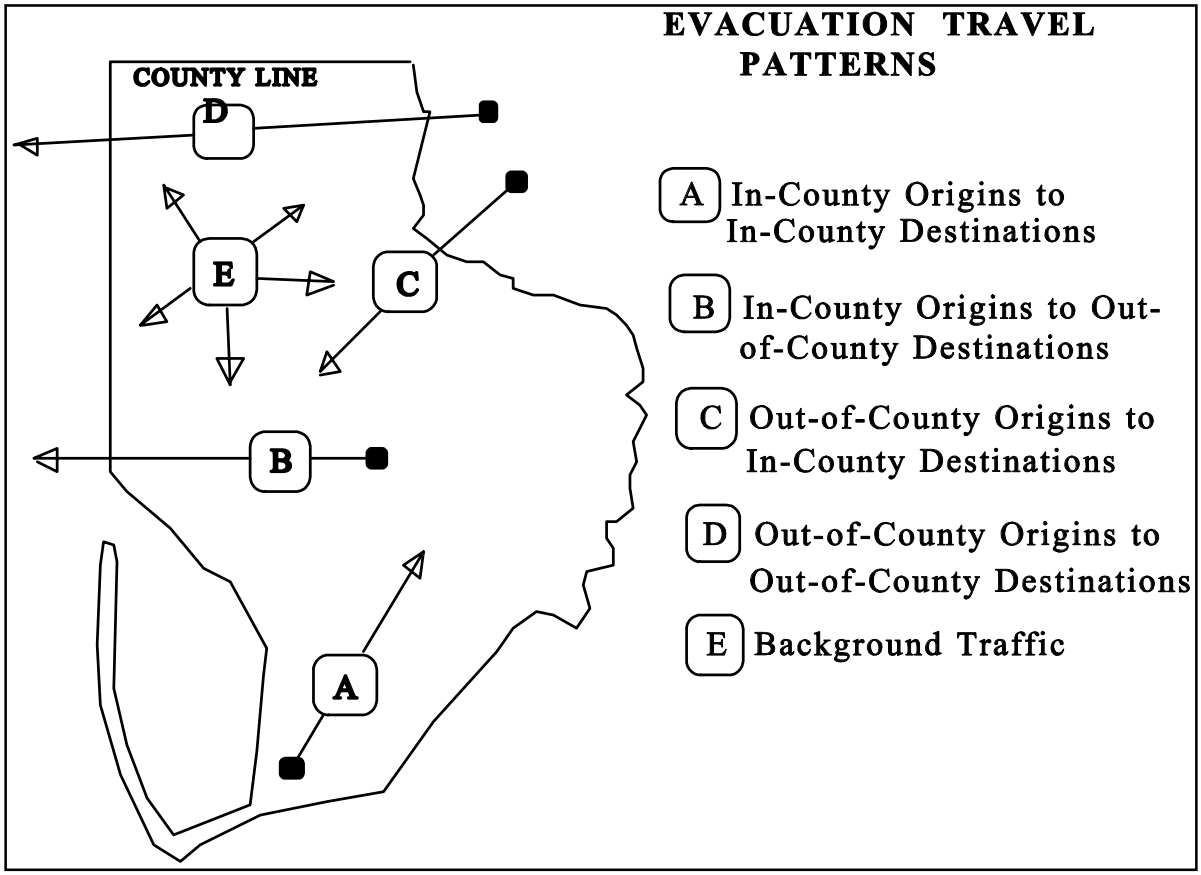
c. Out-Of-County Origins to In-County Destinations. Trips made from adjoining counties that enter coastal counties to reach their shelter destinations.

d. Out-of-County Origins to Out-of-County Destinations. Trips passing through coastal counties trying to reach their shelter destinations in other counties in the study area or outside the study area entirely.

e. Background Traffic. Trips made by persons preparing for the arrival of hurricane conditions; which are primarily shopping trips to gather supplies or secure property. Along the Mississippi coast, trips from work to home to assist the family in evacuation could impact evacuation of coastal evacuees. Background traffic can also include transit vehicles (vans/buses) used to pick up evacuees without personal transportation.

Figure 6-1 graphically depicts these traffic movement patterns associated with hurricane evacuation situations in the region. It is important to recognize that three of the five defined patterns involve traffic movement patterns outside the county's boundaries. It is evident that, depending on the track of the storm these inter-county movements can and do result in a number of regional traffic impacts. During the transportation analysis, these movements were quantified to estimate the traffic demand on roadway segments and resulting clearance times required to get all evacuating vehicles to safety.

FIGURE 6-1 EVACUATION TRAVEL PATTERNS



TRANSPORTATION ANALYSIS INPUT ASSUMPTIONS

Since all hurricanes differ from one another, it becomes necessary to set clear assumptions about storm characteristics and evacuees' expected response before transportation modeling can begin. Not only does a storm vary in its track, intensity and size, but also in the way residents in potentially vulnerable areas perceive it. These factors cause a wide variance in the behavior of the vulnerable population.

Even the time of day that a storm makes landfall influences the time parameters of an evacuation.
The transportation analysis computes clearance times based on a set of assumed conditions and behavioral responses. It is likely that an actual storm will differ from a simulated storm for which clearance times are calculated in this report. Therefore, a sensitivity analysis was performed. Those variables having the greatest influence on clearance time were identified and then varied to establish the logical range within which the actual input assumption values might fall.

Key information guiding the transportation analysis is grouped into five areas.

1. Storm Surge Areas and Evacuation Zones
2. Traffic Analysis Zones
3. Housing and Population Data
4. Behavioral Characteristics of the Evacuating Population
5. Roadway Network and Traffic Control Assumptions

These five areas and their assumed parameters are described in the following paragraphs.

a. Surge Areas and Evacuation Zones

The first building block of the transportation model was the development of evacuation zones. As discussed in Chapter 3, the new surge inundation maps were used to determine the evacuation zone boundaries. Each of the three coastal counties adopted three evacuation scenarios, which were shown on Figure 3-1 through 3-3. The evacuation zone boundaries follow roadways to make it easier for residents to determine what zone they live in.

b. Traffic Analysis Zones

Each evacuation zone is made up of smaller areas called traffic analysis zones, which are used by the transportation model to determine how many vehicles will use each roadway. The traffic analysis zones for each coastal county are shown on Figures 6-2 through 6-4. The traffic model uses dwelling unit data for each traffic analysis zone to estimate the number of vehicles that will be used during an evacuation. The traffic analysis zones used for each county vary in shape and size but conform to the evacuation zones.

c. Dwelling Unit and Population Data

Dwelling units and population were estimated for each traffic analysis zone for the year 2000. Data from the 1990 Census was supplemented with information from the Gulf Regional Planning Council to develop these estimates. Tables 6-1 through 6-3 give a breakdown of dwelling unit and population data by traffic zone and evacuation for each county.

FIGURE 6-2 HANCOCK COUNTY TRAFFIC ANALYSIS ZONES

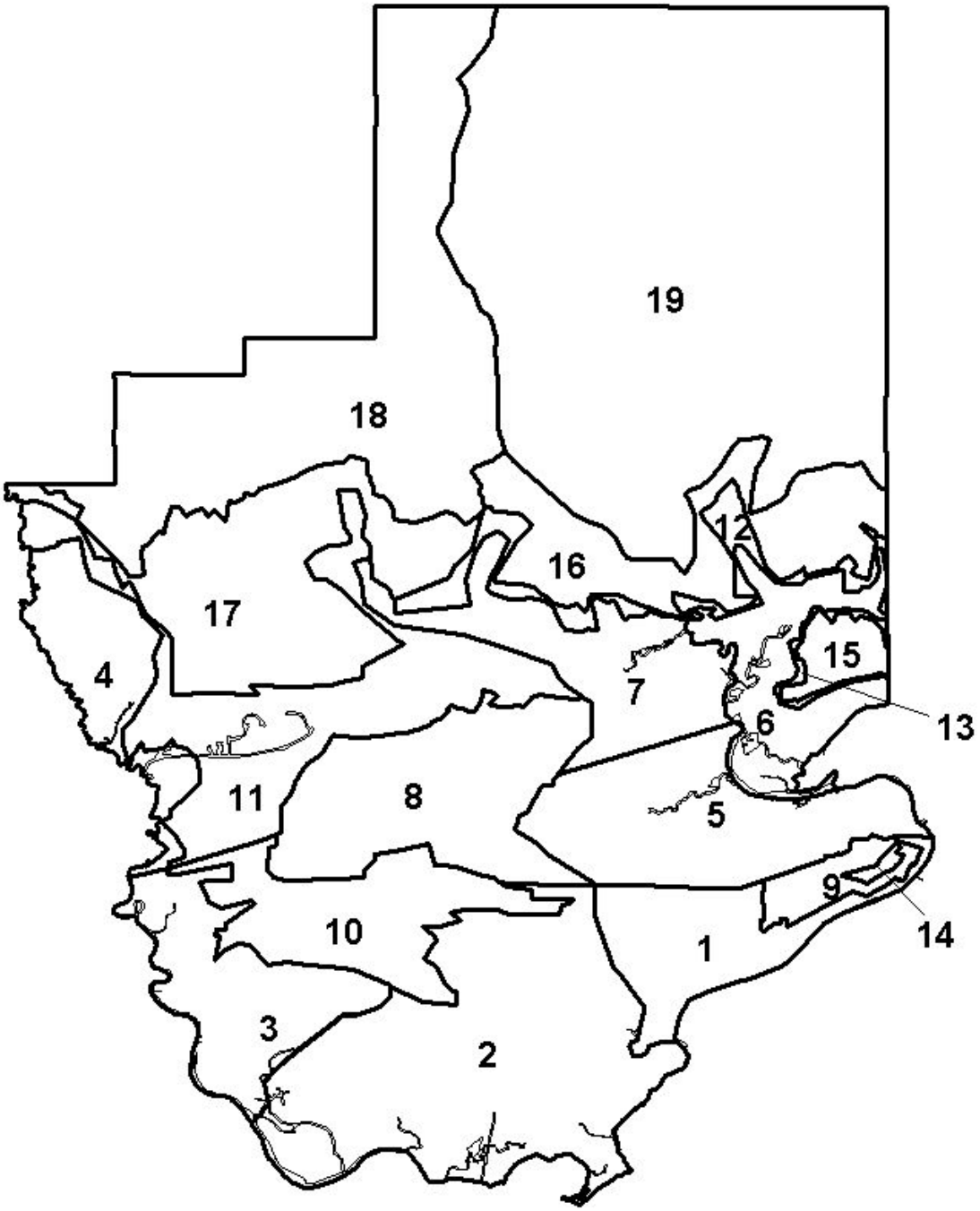


FIGURE 6-3 HARRISON COUNTY TRAFFIC ANALYSIS ZONES

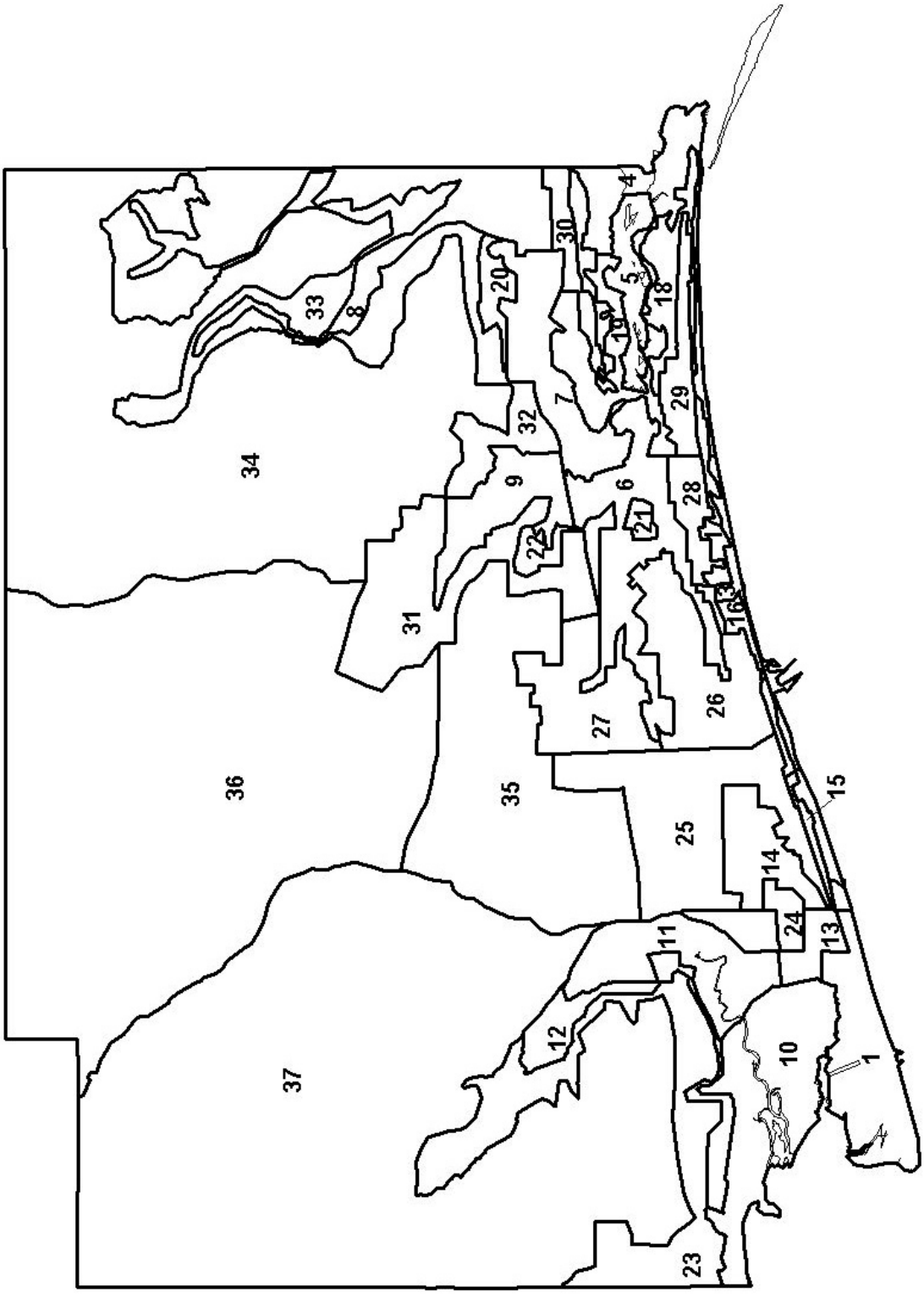


FIGURE 6-4 JACKSON COUNTY TRAFFIC ANALYSIS ZONES

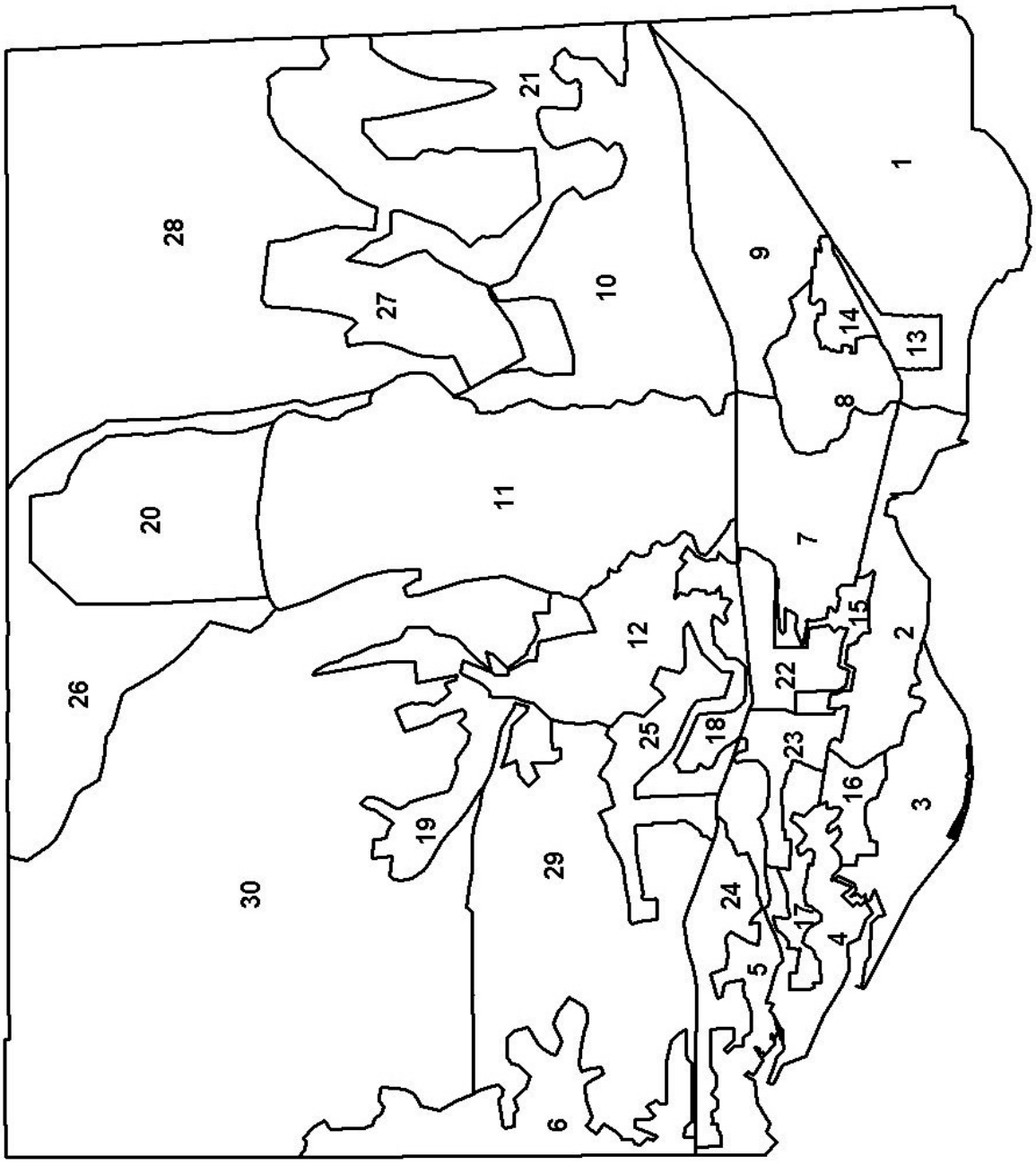


TABLE 6-1 HANCOCK COUNTY TRAFFIC ANALYSIS ZONE DATA FOR THE BASE YEAR 2000

	Dwelling Units			Population		
	Permanent	Mobile	Seasonal	Permanent	Mobile	Seasonal
Traffic	Occupied	Home	Tourist		Home	
Zone(TZ)	Units	Units	Units			
1	3,111	483	1,505	9,333	1,449	4,515
2	320	8	269	960	24	807
3	8	8	0	24	24	0
4	76	49	10	228	147	30
5	2,711	274	2,270	8,133	822	6,810
6	569	59	253	1,707	177	759
7	196	98	112	588	294	336
8	52	52	9	156	156	27
9	2,290	248	633	6,870	744	1,899
10	28	6	2	84	18	6
11	123	98	18	369	294	54
12	144	49	35	432	147	105
13	279	3	143	837	9	429
14	349	3	56	1,047	9	168
15	1,279	18	746	3,837	54	2,238
16	386	98	116	1,158	294	348
17	229	98	31	687	294	93
18	1,102	147	145	3,306	441	435
19	1,321	245	189	3,963	735	567
Total	14,573	2,044	6,542	43,719	6,132	19,626
Evac Zone						
A - TZ 1-8	7,043	1,031	4,428	21,129	3,093	13,284
B - TZ 1-13	9,907	1,435	5,259	29,721	4,305	15,777
C - TZ 1-17	12,150	1,652	6,208	36,450	4,956	18,624

Note: All evacuation zones includes the recommended evacuation of all mobile homes throughout the County in all traffic zones. Also the permanent dwelling units and the permanent population include the mobile home units and mobile home population.

TABLE 6-2 HARRISON COUNTY TRAFFIC ANALYSIS ZONE DATA FOR THE BASE YEAR 2000

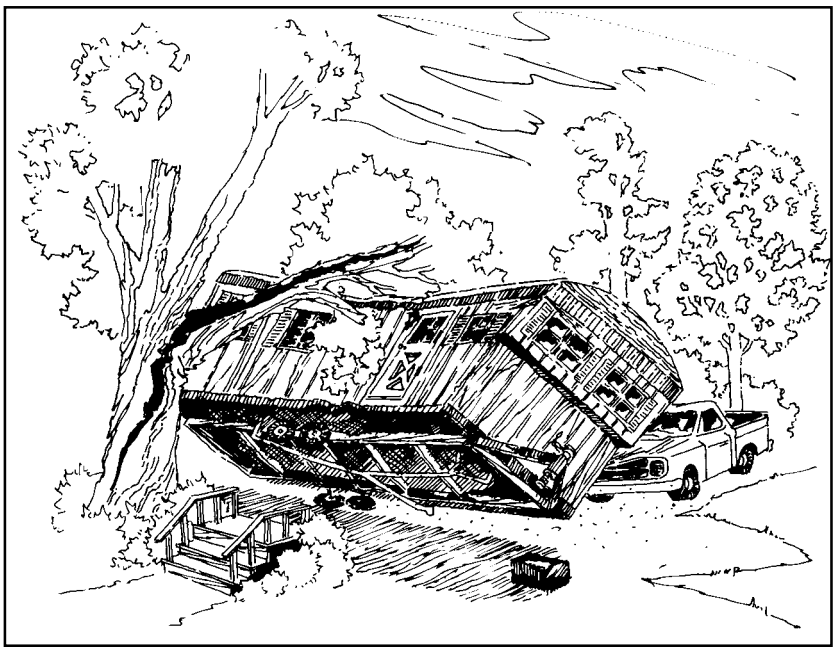
	Dwelling Units			Population		
	Permanent	Mobile	Seasonal	Permanent	Mobile	Seasonal
Evac	Occupied	Home	Tourist		Home	
Zone	Units	Units	Units			
1	2,453	130	1,152	6,427	342	3,456
2	1,529	42	394	4,007	109	1,182
3	1,669	100	626	4,372	261	1,878
4	6,771	428	3,147	17,741	1,121	9,441
5	2,914	338	214	7,636	885	642
6	3,560	473	631	9,327	1,240	1,893
7	826	183	79	2,165	481	237
8	622	215	224	1,630	563	672
9	802	54	82	2,102	141	246
10	683	58	133	1,789	151	399
11	440	153	52	1,154	402	156
12	360	111	25	943	290	75
13	458	58	36	1,199	151	108
14	1,401	10	90	3,670	26	270
15	541	15	191	1,416	40	573
16	2,283	114	743	5,982	297	2,229
17	1,523	123	1,089	3,990	322	3,267
18	4,322	213	1,862	11,325	558	5,586
19	759	177	62	1,989	463	186
20	253	54	12	663	141	36
21	409	78	31	1,073	203	93
22	391	67	34	1,025	177	102
23	770	221	53	2,018	580	159
24	687	14	40	1,801	38	120
25	4,155	274	563	10,886	719	1,689
26	6,230	389	813	16,324	1,019	2,439
27	2,408	192	1,107	6,310	504	3,321
28	2,667	59	273	6,988	153	819
29	3,755	178	583	9,839	467	1,749
30	1,006	252	96	2,636	660	288
31	1,531	310	135	4,011	811	405
32	493	107	29	1,292	281	87
33	408	107	34	1,070	281	102
34	2,198	215	164	5,758	563	492
35	5,064	497	472	13,267	1,303	1,416
36	2,617	435	209	6,858	1,139	627
37	2,448	654	180	6,415	1,715	540
Total	71,411	7,098	15,660	187,098	18,596	46,980
Evac Zone						
A - TZ 1-11	22,270	2,174	6,734	58,349	5,695	20,202
B - TZ 1-22	34,971	3,192	10,909	91,624	8,363	32,727
C - TZ 1-33	59,084	5,297	14,635	154,800	13,877	43,905

Note: All evacuation zones include the recommended evacuation of all mobile homes throughout the County in all traffic zones. Also the permanent dwelling units and the permanent population include the mobile home units and mobile home population.

TABLE 6-3 JACKSON COUNTY TRAFFIC ANALYSIS ZONE DATA FOR THE BASE YEAR 2000

	Dwelling Units			Population		
	Permanent	Mobile	Seasonal	Permanent	Mobile	Seasonal
Evac	Occupied	Home	Tourist		Home	
Zone	Units	Units	Units			
1	6,858	287	803	19,340	809	2,409
2	2,796	236	417	7,885	666	1,251
3	2,075	196	310	5,852	553	930
4	4,828	143	585	13,615	402	1,755
5	3,292	65	449	9,283	183	1,347
6	1,083	101	214	3,054	283	642
7	1,546	52	337	4,360	147	1,011
8	3,267	55	422	9,213	154	1,266
9	1,225	295	667	3,455	832	2,001
10	2,941	697	487	8,294	1,966	1,461
11	237	50	37	668	142	111
12	733	101	208	2,067	283	624
13	3,159	7	1,136	8,908	19	3,408
14	2,562	144	241	7,225	405	723
15	476	67	156	1,342	188	468
16	332	84	78	936	237	234
17	1,902	126	152	5,364	355	456
18	673	64	166	1,898	180	498
19	374	151	46	1,055	425	138
20	146	39	26	412	110	78
21	942	201	152	2,656	565	456
22	560	379	69	1,579	1,069	207
23	527	124	76	1,486	350	228
24	1,892	30	313	5,335	83	939
25	192	132	37	541	373	111
26	615	89	97	1,734	252	291
27	657	117	116	1,853	331	348
28	1,314	313	232	3,705	882	696
29	985	201	251	2,778	567	753
30	1,345	302	166	3,793	850	498
Total	49,534	4,845	8,446	139,686	13,664	25,338
Evac Zone						
A - TZ 1-12	30,881	2,277	4,936	87,084	6,421	14,808
B - TZ 1-21	41,447	3,158	7,089	116,881	8,906	21,267
C - TZ 1-27	45,890	4,030	7,797	129,410	11,364	23,391

Note: All evacuation zones include the recommended evacuation of all mobile homes throughout the County in all traffic zones. Also the permanent dwelling units and the permanent population include the mobile home units and mobile home population.



Past experience shows that mobile homes can be severely damaged and totally destroyed by hurricane force winds. Intense fast moving hurricanes can also cause severe wind damage in inland counties more than a hundred miles from the coast. Mobile home evacuations in non-surge areas and inland counties can substantially increase the number of vehicles that will be on the roadways during an evacuation. The transportation analysis focuses on dwelling units within the potential storm surge flooded areas of a county and inland mobile homes which would be vulnerable to hurricane force winds.

d. Behavioral Assumptions

Any hurricane evacuation of the Mississippi Coast involves the coordinated action of thousands of individuals. Information from the behavioral analysis described in Chapter 4 was used to derive the assumptions for the transportation analysis. The following behavioral variables were used in the transportation analysis:

- Participation rates - what percent of the population in different areas will evacuate their dwelling units for hurricane threats?
- Response rates (rapidity of response) - how quickly will evacuees respond to what local officials are telling them to do?
- Destination percentages - what percent of the population by county sub-area will evacuate to local public shelters, local hotel/motels, local friends' and relatives' homes, or out of the county entirely?
- Vehicle usage - of the vehicles available to the households, what percent of those vehicles will be used in an evacuation?

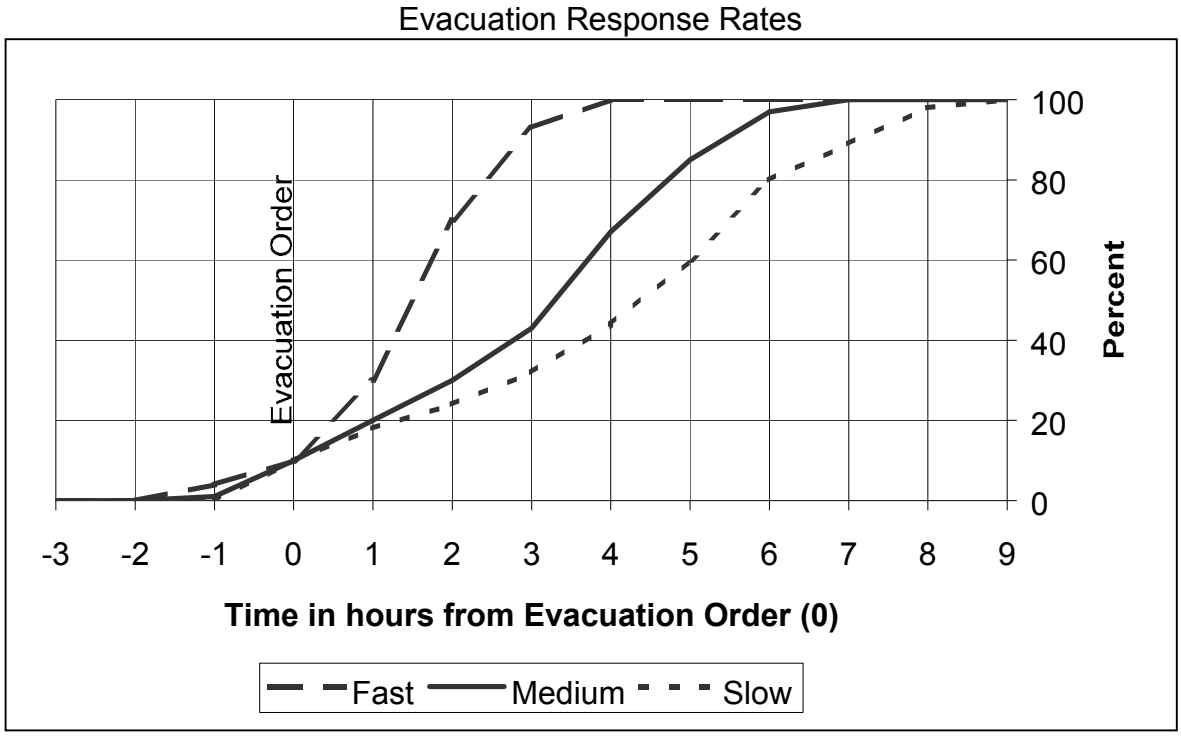
(1) Participation Rates

The behavioral analysis in Chapter 4 discusses many of the variables that a person considers to make a decision on whether to evacuate or not. For this analysis we assumed that there would be 100 percent participation rate in all storm surge zones ordered to evacuate. It was assumed that all mobile homes (100 percent) in inland zones would evacuate. A portion of the non-surge population was also assumed to evacuate. This percentage will be higher for more intense hurricanes (1 percent - 15 percent). The 100 percent participation rates were used as a matter of public safety to allow those who are vulnerable to storm surge the opportunity to evacuate whether they choose to or not. Actual participation rates are usually less than 100 percent.

(2) Response Rates

Another critical behavioral aspect of the transportation analysis is the response rate of the evacuating population. Behavioral data shows that actual departures of the evacuating population occur over a period of many hours or sometimes a very brief time. In the Hurricane Opal evacuation, evacuees loaded the road network in a very short period of time since most evacuees waited until the morning of the storm to leave. For this study, clearance times were tested for three evacuation response rates (slow, medium and fast) represented by different behavioral response curves as shown in Figure 6-5.

FIGURE 6-5 - EVACUATION RESPONSE CURVES



(3) Destination Types

The percentage of evacuees assumed to go to one of four general destination types was another important behavioral input to the transportation analysis. The destination types were discussed with emergency management staff and include local public shelters, hotel/motel units, the home of a friend or relative in-county, or out-of-county. Out-of-county evacuees would also use friends/relatives, public shelters and hotels/motels. When in-county shelter space was insufficient it was assumed that these evacuees would have to leave the county to find shelter. It should be noted that a larger percentage of evacuees would leave the county as the storm intensity increases. Table 6-4 displays evacuee destinations used in the study.

TABLE 6-4 ASSUMED EVACUEE SHELTER DESTINATIONS BY PERCENT

SHELTER TYPE	HANCOCK COUNTY		HARRISON COUNTY		JACKSON COUNTY	
	Permanent People (%)	Tourists (%)	Permanent People (%)	Tourists (%)	Permanent People (%)	Tourists (%)
Shelter	5-20	0-1	5-20	0-1	5-20	0-1
Hotel/Motel	0-5	0	0-5	0	0-5	0
Friend/Relative	25-50	0	25-50	0	25-50	0
Out-of-county	25-60	99-100	25-60	99-100	25-60	99-100

(4) Vehicle Usage

Vehicle usage percentages refer to the percentage of vehicles available at the home origin that would be used in the evacuation. Vehicle usage percentages were approximately 65 percent to 75 percent (depending on distance from the coastline). The percent of households expected to pull a boat, trailer or RV was approximately 5 percent in the immediately coastal area zones.

e. Roadway Network and Traffic Control Assumptions

A final group of assumptions used for input to the transportation analysis is related to the roadway system chosen for the evacuation network and traffic control measures considered for traffic movement. Although the assumptions developed for the transportation analysis are general, the efforts at county and municipal levels regarding traffic control and roadway selection must be quite detailed. In heavily urbanized areas most intersections will be controlled by existing traffic signals. However, as resources permit, traffic control officers will be stationed at bottlenecks identified in this study as well as other local locations of concern. Detailed law enforcement assignments to major bottlenecks involves extensive coordination among local and state officials. This study does not presume to replace those efforts, but seeks to quantify the time elements within which such personnel would operate.

In choosing roadways to be used for the evacuation network, an effort was made to include street facilities with sufficient elevations, little or no adjacent tree coverage, substantial shoulder width and surface, and roadways already contained in existing hurricane evacuation plans.

In order to determine the routing of evacuation, a representation of the roadway system was developed. A "link-node" system was developed to identify roadway sections. Nodes are used to identify the intersection of two roadways or changes in roadway characteristics. Links are the roadway segments. Each link is identified by a letter designation. Figures 6-6 through 6-8 show the evacuation network with link names and zone connections to the links shown by open circles and dashed lines.

Once the links and nodes were established for the evacuation routes, directional traffic service volumes at Level of Service D were established for each link for the Year 2000. This was accomplished by ascertaining number of lanes, facility type, and area type information from available mapping and field inspections. Tables were then used to specify a directional, level of service D service volume based on link characteristics.

FIGURE 6-6 HANCOCK COUNTY EVACUATION ROUTE MAP

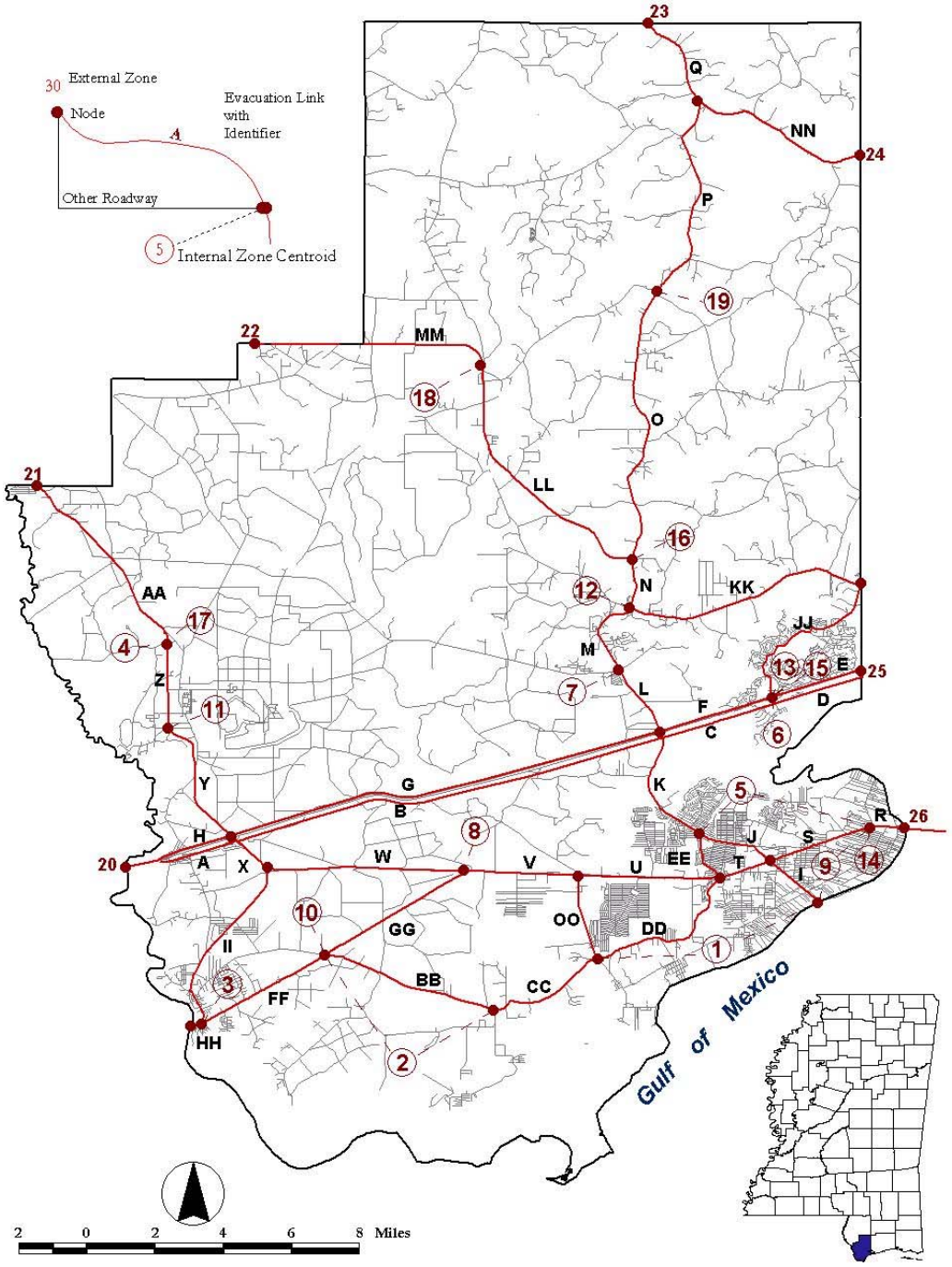


FIGURE 6-7 HARRISON COUNTY EVACUATION ROUTE MAP

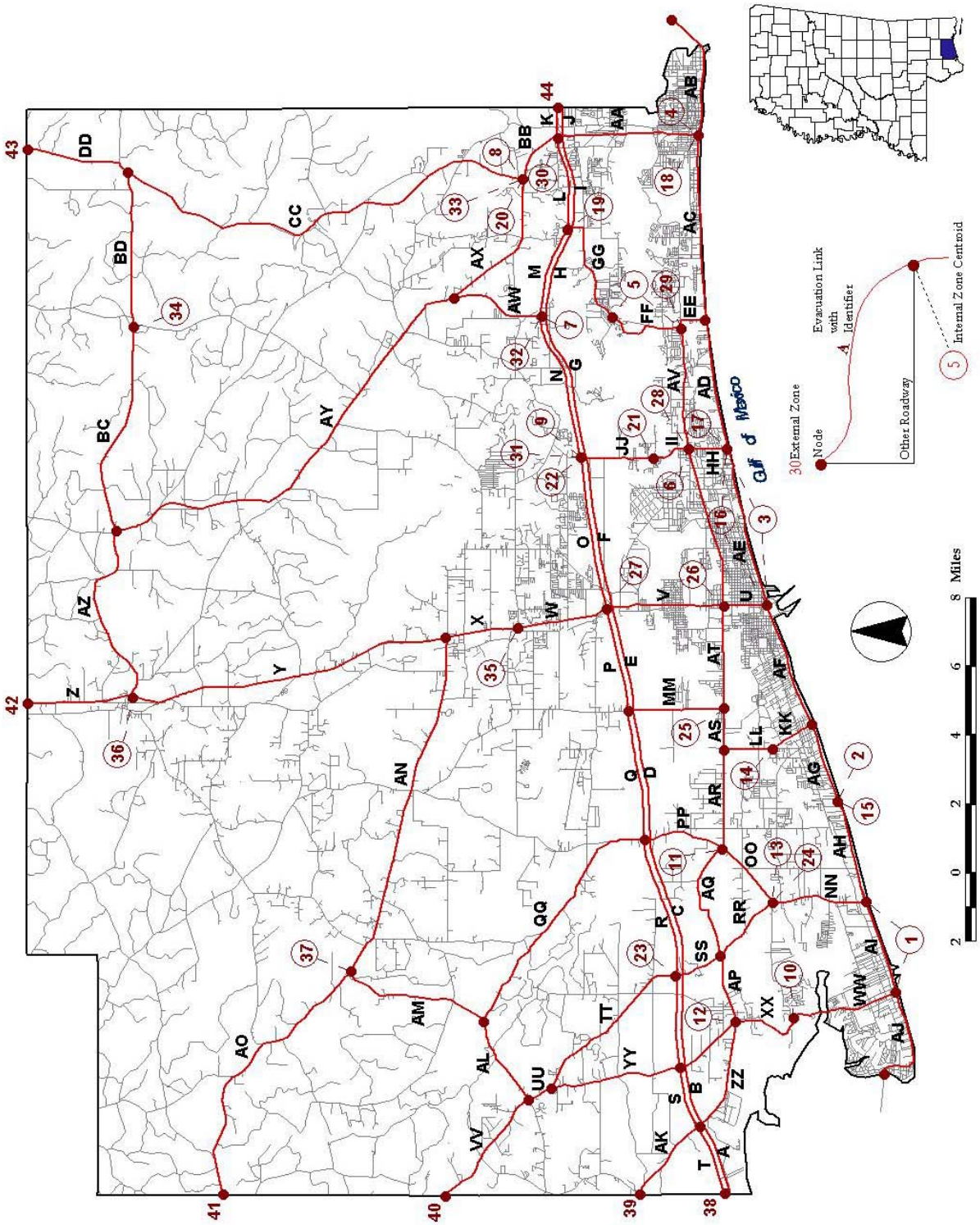
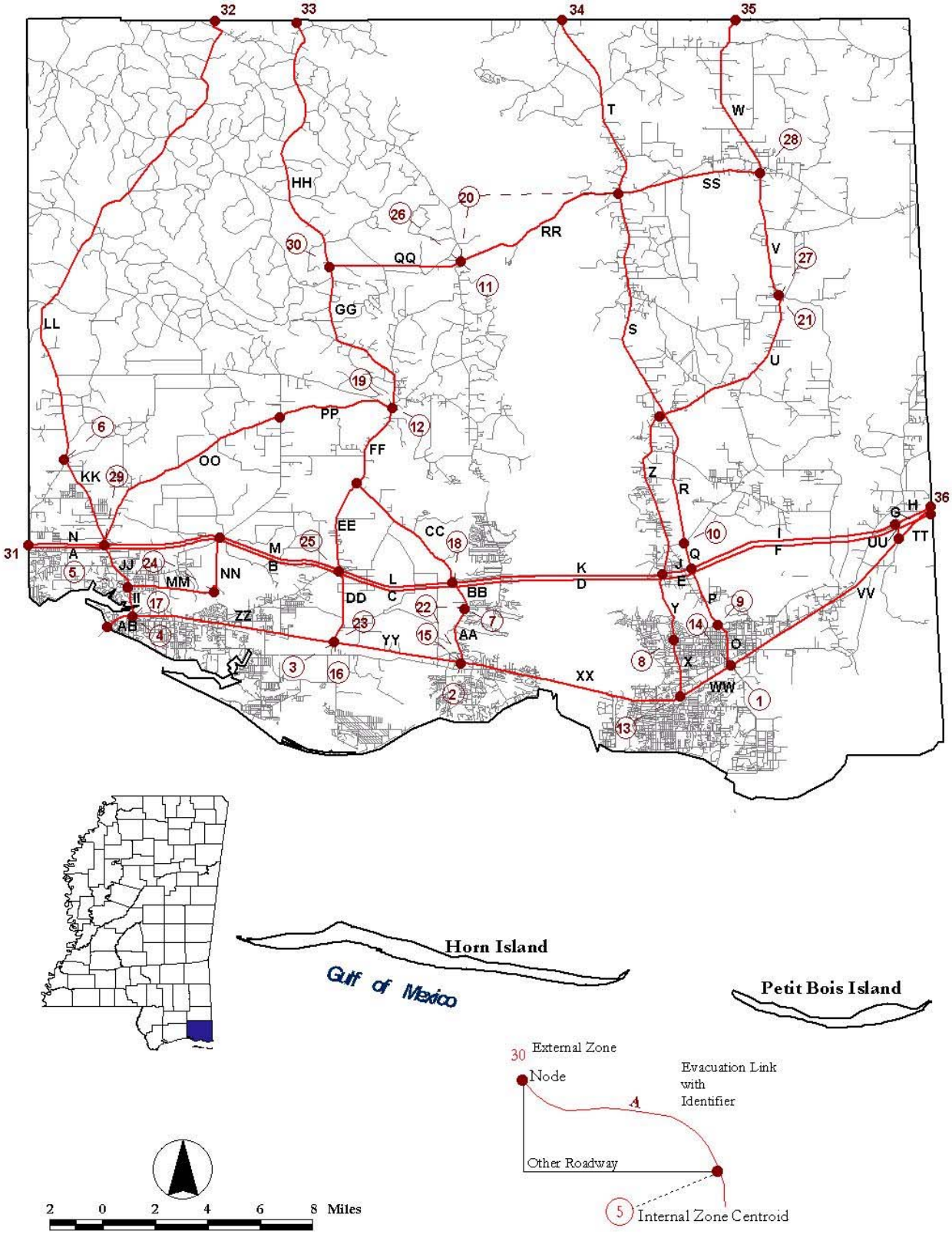


FIGURE 6-8 JACKSON COUNTY EVACUATION ROUTE MAP



Important analysis assumptions concerning the evacuation road network are:

- The evacuation of all vehicles should occur prior to the arrival of sustained tropical storm winds (39 mph) and storm inundation of evacuation routes.

- Provisions will be made for the removal of vehicles in distress on the network through aggressive incident management and agreements worked out with tow truck operators.

- Signal timings will be "actuated" to provide the most green light time for northbound movements away from the coast.

- The U.S. Coast Guard will be contacted to "lock down" draw bridges once evacuation orders or advisories are issued.

In summary, data inputs to the transportation analysis can be classified into one of four categories as shown in Table 6-5.

TABLE 6-5 TRANSPORTATION ANALYSIS DATA INPUTS

Hazards Data	**Socioeconomic Data**
Areas Flooded for each Hurricane Category	Housing Unit Data
Shelter Usability by Hurricane Category	People Per Housing Unit
Time of Arrival of Tropical Storm Winds	Vehicles Per Housing Unit
Roadway Inundation	Occupancy Assumptions
	Presence of Tourists/Visitors
Behavioral Data	**Roadway Network**
Rapidity of Response	Number of Lanes by Link
Participation Rates	Facility types by Link
Vehicle Usage	Elevation - "Low Spots"
Percent Pulling Trailer/Boat	Critical Links / Capacity Data
Destination Percentages	Traffic Count Data

f. Toll Bridge/Road Operations During Evacuations

Tollbooth operations during an evacuation are critical to the timing of the evacuation. A clear understanding must be made between the Tollbooth operators and the State and County prior to the evacuation to prevent traffic congestion and delays. The toll booth operations should be suspended when an evacuation order is made.

TRANSPORTATION MODELING METHODOLOGY

The transportation modeling methodology developed for this study involved a number of manual and computer techniques. The methodology, while very technical, was designed to be consistent with the accuracy level of the modeling inputs and assumptions. The methodology is unique in that it is sensitive to behavior of evacuees.

A summary of the six major steps of the transportation analysis are briefly described below:

SIX MAJOR STEPS OF THE TRANSPORTATION ANALYSIS

1. Evacuation Zone Data Development - Data gathered by census tract and block-groups were stratified by traffic/evacuation zone. Numbers of permanent residential dwelling units, mobile homes, and seasonal units were compiled by zone for the base year 2000.

2. Evacuation Road Network Preparation - This step identifies which roadways will be used for evacuation and includes the assignment of reasonable vehicle carrying capacities during an evacuation. This includes number of lanes and roadway type.

3. Trip Generation - Calculates the total evacuating people and vehicles originating from each evacuation zone.

4. Trip Destination - Determines where evacuees will go. (Shelter, hotel/motel, friends/relatives, out-of-county, etc.)

5. Trip Assignment - Determines what route(s) evacuees will take to get from their origin to their destination.

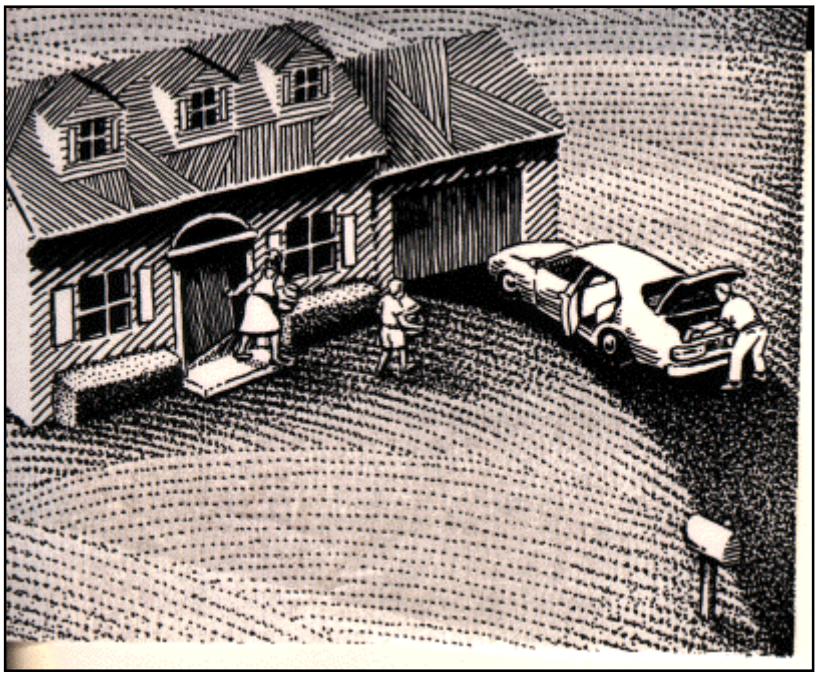
6. Calculation of Clearance Times - Determines how much time it will take for all evacuees to clear the evacuation network. The end product of this major step is a set of clearance times for all storm scenarios.

TRANSPORTATION MODEL RESULTS

The transportation modeling was set up for the Year 2000 base year. The items listed below are the most critical outputs for planning for shelter needs, anticipating bottlenecks, and defining the timing requirements of an evacuation.

- Evacuating people and vehicles.
- Destinations and shelter demand.
- Traffic volumes and critical roadway segments.
- Estimated clearance times.

a. Evacuating People and Vehicles



The evacuating vehicles and people produced by each evacuation scenario were split up by destination type. The four general destination types are in-county public shelter, in-county hotel/motels, in-county home of a friend or relative, and out-of-county. This was accomplished for each evacuation scenario and for high and low tourist occupancy. Table 6-6 shows the numbers of vehicles expected to evacuate by county and evacuation scenario. Numbers of vehicles involved in an actual evacuation will most likely be less than these figures because 100 percent participation of units in storm surge areas and all mobile homes were assumed for most scenarios. Even with door-to-door evacuation notification, it will be difficult to convince all to leave that should leave.

TABLE 6-6 EVACUATING VEHICLES BY DESTINATION AND EVACUATION SCENARIO HANCOCK, HARRISON AND JACKSON COUNTIES

	Total Evacuating Vehicles	Vehicles Going to Shelters	Vehicles Going to friends	Vehicles Going to Motel	Vehicles Going out of County
HANCOCK COUNTY					
Low Tourist Occupancy					
Category 1-2	12,832	914	5,195	499	6,224
Category 3	17,162	1,528	5,911	499	9,224
Category 4-5	22,111	2,366	6,142	499	13,104
High Tourist Occupancy					
Category 1-2	16,285	949	5,195	499	9,642
Category 3	21,204	1,567	5,911	499	13,227
Category 4-5	26,233	2,366	6,142	499	17,226
HARRISON COUNTY					
Low Tourist Occupancy					
Category 1-2	39,503	2,956	17,189	1,576	17,782
Category 3	58,963	5,725	21,743	1,576	29,919
Category 4-5	98,177	12,172	30,072	1,576	54,357
High Tourist Occupancy					
Category 1-2	46,554	3,025	17,189	1,576	24,764
Category 3	68528	5820	21,743	1,576	39,389
Category 4-5	108038	12172	30,072	1,576	64,218
JACKSON COUNTY					
Low Tourist Occupancy					
Category 1-2	48194	3320	22189	2187	20,498
Category 3	62078	5343	23593	2187	30,955
Category 4-5	66784	6029	19320	2187	39,248
High Tourist Occupancy					
Category 1-2	52408	3361	22189	2187	24,671
Category 3	67313	5396	23593	2187	36,137
Category 4-5	72107	6029	19320	2187	44,571

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b. Destinations and Shelter Demand

The potential public shelters shown in Chapter 5 include shelter locations and capacities. Local churches and other civic groups may help with public sheltering needs. Mobile home residents typically have a higher propensity to use local public shelter space than other residents do. Table 5-1 in Chapter 5 provides the calculated public shelter demand and available capacity by storm scenario for all coastal counties. Each county provided shelter locations and capacities.

Estimates of destinations for vehicles leaving the county were also made from behavioral data. Table 6-7 lists destination percentages by state for evacuees leaving coastal counties, and Table 6-8 breaks down the percentage of evacuees staying within Mississippi by cities.

TABLE 6-7 DESTINATION PERCENTAGES BY STATE*
MISSISSIPPI TRANSPORTATION ANALYSIS

Florida	Georgia	Alabama	Mississippi	Louisiana	Texas	Arkansas
1.6%	1.6%	9.5%	66.7%	14.3%	3.2%	3.2%

Source: Data obtained from behavioral analysis conducted by Hazards Management Group (HMG) for this study.

TABLE 6-8 DESTINATION PERCENTAGES WITHIN MISSISSIPPI*
MISSISSIPPI TRANSPORTATION ANALYSIS

Destinations Within Mississippi	Percent
Jackson	11.1%
Gulf Port	6.4%
Meridian	6.3%
Hattiesburg	4.8%
Wiggins	3.2%
Diamond Head	3.2%
Other Cities within Mississippi	31.7%

Source: Data obtained from behavioral analysis conducted by Hazards Management Group (HMG) for this study.

c. Traffic Volumes And Critical Roadway Segments

The Transportation Model estimates the number of evacuating vehicle on each roadway segment for each storm scenario by county. The model then compares the number of evacuating vehicles to the service volume of each roadway segment. Those segments with the highest ratio of evacuation vehicles to service volume were considered to be critical links for evacuation. These congested areas control the flow of evacuation traffic during a hurricane evacuation and are key areas for traffic control and monitoring. Table 6-9 lists the critical roadway segments in each county that will control the flow of evacuation traffic. Critical roadways are listed in order of severity. Some of the regions most congested roadway segments are well inland. Table 6-10 provides estimated numbers of evacuating vehicles that will exit the coastal Counties at key roadways.

TABLE 6-9 CRITICAL ROADWAY LOCATIONS

Hancock County
SR 43 from I-10 to SR 603

Harrison County
US 49 northbound (SR 53 intersection)
SR 15 northbound from I-110 to out of county
Lorraine Road from Pass Road to I-10
Old Pass Road and US 49 intersection
I-110 and US 90 interchange
US 90 (East Beach Blvd) and US 49 intersection

Jackson County
SR 63/SR 613 intersection at Lucedale in George County
SR 57 North of Ramsay Road
SR 609 from US 90 to I-10
Tucker Road from I-10 to Daisy Vestry Road
SR 63 bridge (high level bridge subject to early winds)

Inland Counties
US 49 interchanges with US 98 and I-59
US 49 intersection with US 11 in Hattiesburg
SR 63 and SR 613 intersection at Lucedale
SR 607 interchange with I-59 (northbound on ramp)
SR 53 interchange with I-59 (northbound on ramp)

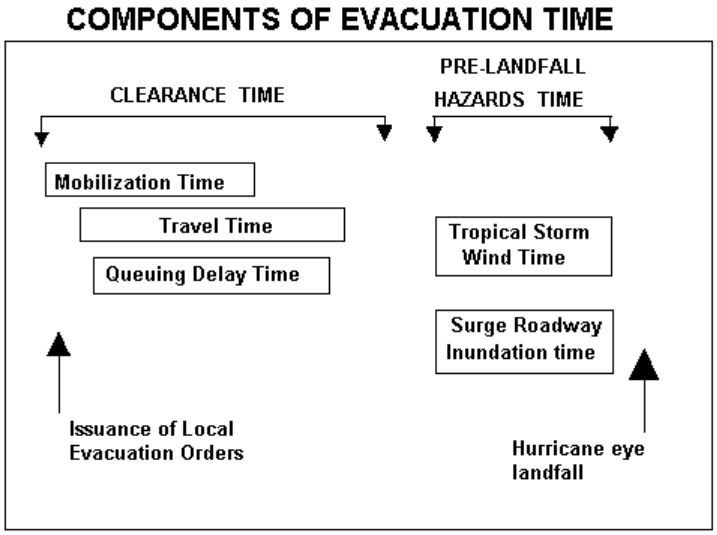
TABLE 6-10 OUT-OF-COUNTY TRAFFIC VOLUMES BY ROADWAY SEGMENT

Road Description	Roadway Volume Low Tourist Occupancy			Roadway Volume High Tourist Occupancy		
	Cat. 1-2	Cat. 3	Cat. 4-5	Cat. 1-2	Cat. 3	Cat. 4-5
Hancock						
SR 607 from Santa Rosa to County Line	1,256	2,109	4,462	1,762	2,772	5,035
SR 43 from Lee Town Road to County Line	2,076	3,272	4,574	3,108	4,493	5,826
SR 53 from SR 603 to County Line	2,595	4,224	6,731	3,838	5,747	8,439
SR 53 from SR 603 Eastbound to County Line	100	207	572	167	311	640
I-10 from SR 607 to County Line	862	1,424	2,194	1,273	1,922	2,729
Harrison						
SR 15 North from Bethel Road	9,130	14,841	23,290	12,511	19,109	27,659
US 49 North of SR 67	7,808	14,169	30,463	10,403	18,003	34,488
SR 53 from Northrup-Cuevas Road to County Line	1,204	2,357	6,861	1,682	3,089	7,649
Kiln-Delisle Road from I-10 to County Line	845	1,183	1,784	1,142	1,495	2,101
Vadalia Road from JP Lander Road to County Line	845	1,183	1,784	1,142	1,495	2,101
I-10 Eastbound from I-110 to County Line	2,588	4,323	7,821	3,628	5,658	9,218
US 90 from I-110 to County Road	1,706	2,922	5,814	2,335	377/	6,703
US 90 from County Line to Henderson Avenue	1,249	1,916	2,441	1,831	2,568	3,185
I-10 Westbound from Kiln-Deslisle Road to County Line	2,127	3,614	6,944	2,864	4,612	7,979
Jackson						
Daisy Vestry Road from Tucker Road	5,185	7,845	10,176	5,925	8,692	11,040
SR 57 North of Wade Vancleave Road	5,370	8,197	11,523	6,560	9,664	13,030
SR 63 North of SR 614	5,162	8,671	10,899	6,300	10,077	12,326
SR 613 North of SR 614	4,546	8,142	9,932	5,489	9,354	11,153
I-10 Eastbound from Exit 75 to County Line	2,675	4,259	5,292	3,221	4,923	5,970
US 90 Exit 75 to County Line	2,312	3,665	4,827	2,703	4,183	5,305

d. Estimated Evacuation Clearance Times

The most important product of the transportation analysis is the clearance times developed by storm scenario and by behavioral characteristics for each county. Clearance time is one of two major considerations involved in issuing an evacuation or storm advisory. Clearance time must be weighed with respect to the arrival of sustained tropical storm winds to make a prudent evacuation decision. Figure 6-9 illustrates these two timing issues of evacuation and their relation.

Figure 6-9 Components of Evacuation Time



Clearance time is the time required to clear the roadway of all vehicles evacuating in response to a hurricane situation. Clearance time begins when the first evacuating vehicle enters the road network (as defined by a hurricane evacuation behavioral response curve) and ends when the last evacuating vehicle reaches an assumed point of safety. Clearance time includes the time required by evacuees to secure their homes and prepare to leave (referred to as mobilization time). Clearance time also includes the time spent by evacuees traveling along the road network (referred to as travel time), and the time spent by evacuees waiting along the road network due to traffic congestion (referred to as queuing delay time). Clearance time does not relate to the time any one vehicle spends traveling on the road network and does not include time needed for local officials to assemble and make a decision to evacuate.

Table 6-11 presents the hurricane evacuation clearance times developed for each county for the Year 2000 storm scenarios. Clearance times generally fall between 8-31 hours. Clearance times shown in Table 6-11 reflect the effects of adjacent county traffic impacts and in that regard assume that consistent evacuation decisions will be made and coordinated between adjacent jurisdictions and the State of Mississippi. The worst individual commute times range from 4-26 hours.

TABLE 6-11 CLEARANCE TIMES (IN HOURS) YEAR 2000

Scenario	Hancock	Harrison	Jackson
Cat. 1-2	8-12 hours	6-12 hours	13-17 hours
Worst individual commute time	6	4 ½	10 ¾
Cat. 3	12-17 hours	11-17 hours	22-26 hours
Worst individual commute time	11	9 ¼	20 ½
Cat. 4-5	20-25 hours	23-30 hours	27-31 hours
Worst individual commute time	19	22	25 ¾

TRAFFIC CONTROL MEASURES

Some general recommendations concerning traffic control are as follows:

1. Where the state and local counties have sufficient personnel resources, officers should be stationed at critical intersections to facilitate traffic flow. Where intersections will continue to have signalized control, signal patterns providing the most "green time" for the northbound evacuation travel should be activated.

2. If possible, arrangements should be made with tow truck operators so that they are pre-positioned along key travel corridors and critical roadway facilities such as bridges.

3. All draw/swing bridges needed for evacuation should be locked in the "down" position during a hurricane warning, if possible. Boat owners must be made aware of flotilla plans and time requirements for securing vessels.

4. The state and counties should jointly work on a statewide evacuation and shelter monitoring system which would monitor travel flow at key locations, report traffic tie-ups and shelter and hotel availability to the general public as they evacuate.

5. Coordination with the State of Louisiana regarding traffic flow and sheltering requirements will be critical. As this report is being published both states DOTs have undertaken a joint study effort to address these critical concerns.

6. High level bridges must be monitored for early wind vulnerability as sustained tropical storm winds will arrive earlier on these structures than at ground level. Trucks, RV’s and other high profile vehicles will be especially vulnerable to these conditions.