TREASURE COAST
TRANSPORTATION ANALYSIS
HURRICANE EVACUATION STUDY
UPDATE 2003

DRAFT REPORT

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1.0 INTRODUCTION

1.1 OVERVIEW

With each new hurricane season, the counties of the Treasure Coast region in Florida remain extremely vulnerable to the threat of an intense hurricane strike. Recently, the region has sustained brushes with storms such as Hurricane Floyd 1999, and Tropical Storm Irene 1999. In response to this vulnerability, the counties of the Treasure Coast region continue to work diligently on every aspect of the hurricane preparedness process.

The study area faces distinct challenges due to the variety of vulnerable populations that must be considered in the evacuation process. For example, coastal areas in the region face significant storm surge inundation potential, and many residents are located in low-lying inland areas that are vulnerable to freshwater flooding. Every county in the region has a significant mobile home population, with homes that are highly susceptible to hurricane force winds. Major areas of urban population centers such as Port St. Lucie and West Palm Beach are vulnerable to both flooding and severe hurricane force winds well before a system decays following landfall.

The Treasure Coast region must be prepared to evacuate highly vulnerable populations on critical routes, often concurrently with northbound and westbound evacuees from southeast Florida. In this particular region, evacuees will find evacuation difficult due to the impact of evacuees from Monroe, Miami-Dade, and Broward Counties. Even though there is local public shelter capacity and inland hotel/motels available, there are limited route choices to leave the region.

During a hurricane evacuation, a significant number of vehicles will have to be moved across the local and regional road network. The quantity of evacuating vehicles will vary depending upon the magnitude of the hurricane, publicity and warnings provided about the storm, and particular behavioral response characteristics of the vulnerable population. In the event of an evacuation, the entry of vehicles onto the road network typically depends on the response of evacuees to an evacuation order or storm advisory.

Conversely, vehicles exit the roadway network depending on both the planned destinations of evacuees and the availability of acceptable destinations such as public shelters, hotel/motel units and the homes of friends or relatives in non-surge prone areas.

The speed at which vehicles on the road network can travel from origin to destination is dependent on the rate of traffic loadings on specific roadway segments and the ability of those segments to handle a particular volume of vehicles each hour. In order to produce accurate clearance times, the analysis of the study area must account for the impacts of evacuation traffic generated by neighboring counties using roadways within the study area.

This report documents the inputs and findings of the study analysis. A separately bound appendix entitled Transportation Model Support Document provides modeling information and data files too extensive for this report.

1.2 ANALYSIS OBJECTIVES AND SCOPE

Recognizing the importance of accurate clearance times, the U.S. Army Corps of Engineers, Jacksonville District (USCOE) hired Post, Buckley, Schuh and Jernigan, Inc. (PBS&J) to perform the tasks necessary to update the area=s hurricane evacuation clearance times. The major objectives of the study were as follows:

(1) Use evacuation zones and scenarios developed for each county in the region for transportation modeling and clearance time calculations.

(2) Quantify the potential evacuation population for each scenario using socioeconomic and behavioral data developed by PBS&J in conjunction with each county.

(3) Identify the existing evacuation roadway network, recognizing recent improvements that have been constructed.

(4) Develop hurricane evacuation clearance times for each county and storm scenario for an existing base year and Year 2008 forecast year.

(5) Determine regional evacuation traffic that is expected to cross county lines in order to increase the accuracy of operational planning.

(6) Identify local and regional bottlenecks/critical roadway segments and where applicable, recommend general traffic control strategies.

(7) Develop zone and road network graphics in an Arc Info and Arc View usable format.

(8) Using the evacuation zone graphic for each county, develop GIS graphics displaying:

Permanent occupied dwelling units by evacuation zone

Mobile home units by evacuation zone

Seasonal dwelling units by evacuation zone

Evacuating people by evacuation zone by scenario

Public shelter demand by evacuation zone by scenario

(9) Using the evacuation road network graphic for each county, develop GIS graphics displaying:

Directional service volume per roadway segment

Evacuation traffic congestion by roadway segment by scenario

(10) Use evacuation zones and scenarios developed by the counties for transportation modeling and clearance time calculations for each county. Develop a simplistic abbreviated model in a spreadsheet format that can be used by the counties to modify clearance times based on land use and system changes.

1.3 COORDINATION AND REVIEW ACTIVITIES

This study came to fruition through extensive cooperation by the USCOE with local emergency management (EM) staff, the State of Florida, and PBS&J. The effort included the collection of essential socioeconomic and behavioral data and the development of hurricane evacuation zones, as well as coordination of the various technical inputs. Zones, input assumptions and evacuation statistics used to form the foundation of the analysis were established through a study organization and kickoff meeting held in the summer of 2002 and subsequent phone coordination and field reviews

2.0 TRANSPORTATION ANALYSIS AND INPUT ASSUMPTIONS

The hurricane evacuation transportation modeling performed for the study area required a number of important data inputs and assumptions regarding anticipated evacuation behavior. All hurricanes differ from one another in some respect. Therefore, it became necessary to set forth clear assumptions about storm characteristics and an evacuee=s expected response before this type of transportation modeling could 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 can cause a wide variance in the behavior of the vulnerable population. Even the time of day at which a storm makes landfall influences the parameters of an evacuation response.

The hurricane evacuation transportation analysis results in 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 during the transportation modeling. 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 input assumptions guiding the transportation analysis include the following:

1. Traffic Evacuation Zones
2. Housing and Population Data
3. Behavioral Characteristics of the Evacuating Population
4. Roadway Network Assumptions

2.1 TRAFFIC EVACUATION ZONES

The foundation of the analysis is a system of evacuation zones displayed in public information brochures developed by each county. The counties, in conjunction with the Corps and PBS&J, developed the boundaries of each zone in relation to well-known man-made or natural features, census boundaries, roadways and SLOSH storm surge areas. Palm Beach County boundaries were

developed using newly available LIDAR data. Indian River, St. Lucie and Martin Counties zones were solely based on surge mapping done by the US Army Corps of Engineers, Jacksonville District. The primary purpose of the evacuation zones is to target areas that will be asked to evacuate by local emergency management for storm categories 1-5. The traffic evacuation zones are illustrated in Figures 2-1 through 2-4. In addition, Table 2-1 contains a breakdown for each county showing the number of evacuation zones and general vulnerability.

Table 2-1

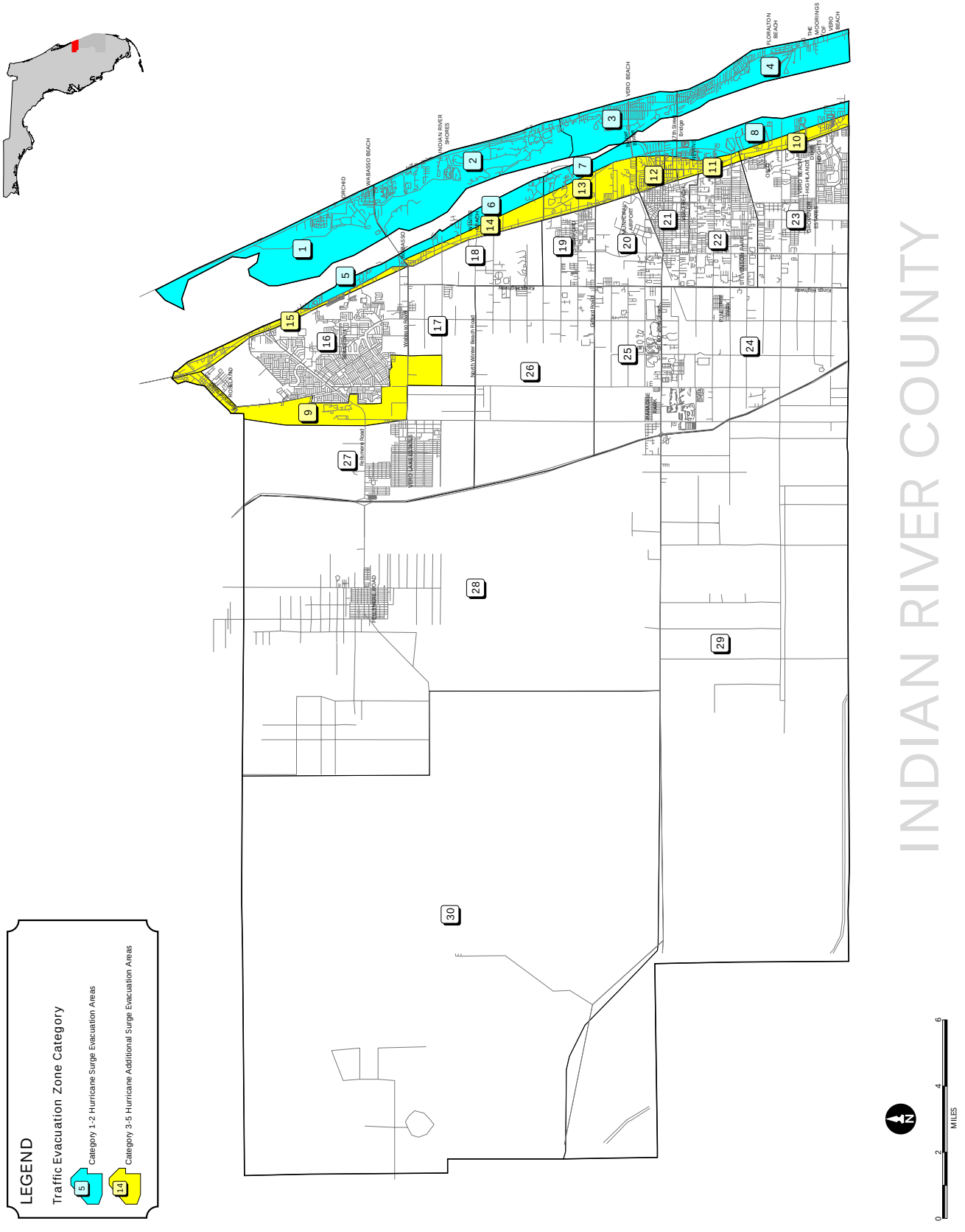
TRAFFIC EVACUATION ZONES

Assumed Vulnerability by Storm Scenario by County

Treasure Coast Hurricane Evacuation Study - 2003

County	Number of Traffic Evacuation Zones	General Zone Vulnerability
Indian River	30	1-8 predominantly Category 1-2 storm
		9-15 additional Category 3-5 storm areas
		16-30 predominantly inland areas/mobile homes
St. Lucie	31	1-10 predominantly Category 1-2 storm
		11-13 additional Category 3-5 storm areas
		14-31 predominantly inland areas/mobile homes
Martin	36	1-6 and 8-12 predominantly Category 1 storm
		7 additional Category 2-3 storm areas
		13-20 and 26 additional Category 4-5 storm areas
		21-25 and 27-36 predominantly inland areas/mobile homes
Palm Beach	59	1-13 and 22, 23 predominantly Category 1-2 storm
		14-21 and 24- 30 additional Category 3-5 storm areas
		31-59 predominantly inland areas/mobile homes

Traffic Evacuation Zones



2.2 HOUSING AND POPULATION DATA

Socioeconomic parameters for each traffic evacuation zone, such as dwelling unit totals and persons per dwelling unit were developed using 2000 information from the U.S. Bureau of the Census as a starting point. This data was supplemented and factored upward by current year mobile home unit, hotel/motel and population data provided by the counties. The key socioeconomic data for each county is summarized in Table 2-2, and this data is provided by traffic evacuation zone in the Transportation Model Support Document.

The use of GIS technology (ArcInfo, ArcView) facilitated the production of color graphics, and is used for quality control and display of study inputs. Existing permanent dwelling units by traffic evacuation zone and county are illustrated in Figures 2-5 through 2-8. Existing mobile home units by traffic evacuation zone and county are shown in Figures 2-9 through 2-12. Figures 2-13 through 2-16 display seasonal units by traffic evacuation zone by county.

Table 2-2

KEY POPULATION/DWELLING UNIT SUMMARY
By County
Treasure Coast Hurricane Evacuation Study - 2003

Indian River County
Existing Permanent Population - 112,947 people
Permanent occupied dwelling units - 49,137 units
Mobile homes - 6,785 units
Tourist/seasonal units - 6,137 units
People per permanent unit - 2.25
Vehicles per permanent unit - 1.29

St. Lucie County
Existing Permanent Population - 192, 695 people
Permanent occupied dwelling units - 76,933 units
Mobile homes - 11,576 units
Tourist/seasonal units - 10,180 units
People per permanent unit - 2.39
Vehicles per permanent unit - 1.30

Martin County
Existing Permanent Population - 126, 731 people
Permanent occupied dwelling units - 55,288 units
Mobile homes - 7,627 units
Tourist/seasonal units - 7,870 units
People per permanent unit - 2.34
Vehicles per permanent unit - 1.32

Palm Beach County
Existing Permanent Population - 1,131,184 people
Permanent occupied dwelling units - 474,178 units
Mobile homes - 20,043 units
Tourist/seasonal units - 69,269 units
People per permanent unit - 2.34
Vehicles per permanent unit - 1.50

2.3 BEHAVIORAL ASSUMPTIONS

A future evacuation in the Treasure Coast region will involve evacuation decision-making by thousands of individuals and households. In order to develop meaningful behavioral assumptions that account for the variations in decision-making, PBS&J reviewed the 1999 Post Floyd Behavioral Analysis conducted by Hazards Management Group (HMG). The PBS&J team used this data source and other relevant nationwide experience to focus the transportation analysis on the following behavioral aspects:

- Participation rates - What percent of the population in different areas will evacuate their dwelling units for future hurricane threats?
- Evacuation rapidity of response rates - 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?

PBS&J relied on the following sources of input to develop behavioral assumptions by evacuation zone:

- Discussions concerning expected behavioral response with emergency management staff in each county
- National hurricane behavioral trends ascertained by PBS&J and Hazards Management Group in recent studies

A great deal of judgment was needed in order to develop the necessary parameters on a zone-by-zone basis. PBS&J has accumulated a wealth of experience both in Florida and around the country developing and applying behavioral parameters for evacuation analysis. This experience aided significantly in the process of generating assumptions.

Early in the modeling process, the primary assumptions made by zone were developed and were then used in the regional model. These assumptions are provided in the evacuating people and vehicle/trip generation portion of summary sheets located in the Transportation Model Support Document. In addition, the assumed participation rates developed by evacuation zones in each county and for each scenario are provided in the model document as well. The primary participation assumptions are as follows:

- Zones that will be evacuated for storm surge were assumed to have a 100% participation rate; even though in actuality these rates will be lower, as a matter of public safety the clearance times calculated in this study should allow those who are vulnerable to storm surge the opportunity to evacuate whether they choose to or not. (ANNEX C of the Transportation Model Support Document provides data related to these scenarios.)
- All mobile homes in inland zones are assumed to evacuate, although in the category 1 and 2 hurricane scenarios slightly less than 100% were assumed to evacuate to make the analysis more realistic
- A portion of the theoretically non-vulnerable population (shadow evacuees) was also assumed to evacuate in the modeling; in an actual evacuation, the percentages could be higher than the figures used for modeling purposes (1% - 20%), particularly for more intense hurricanes; however, this difference will balance out with less than 100% of surge residents participating in an actual event

An abbreviated version of the transportation model produced in this study effort allows the user to charge behavioral parameters to see the impacts on evacuation, public shelter demand, and clearance time statistics.

One set of critical behavioral assumptions included in the transportation analysis involves the rapidity of evacuation response of the evacuating population, or how quickly the vulnerable population responds to an evacuation order or advisory. Behavioral data from past hurricane evacuation research demonstrates that mobilization and actual departures of the evacuating population can occur over a very brief time or over a period of many hours. To account for this variation, clearance times were tested for three evacuation response rates represented by different

behavioral response curves. The three response curves, shown in Figure 2-17, illustrate rapid response, medium response and long response and were designed to include a range of possible mobilization times that may be experienced in a future hurricane evacuation. For sensitivity analysis, the mobilization/traffic loading time was varied between five hours and twelve hours.

A second essential input into the transportation analysis involved the percentage of evacuees assumed to travel to one of four general destination types by scenario. These assumptions include the expected percent of evacuees from each zone and county traveling to local public shelters, hotel/motel units, the home of a friend or relative, or out of the region entirely. Destination percentages were varied for each traffic evacuation zone in the county depending on the category of risk (distance from the coastline) or special characteristics of a zone such as a high number of mobile home units. Assumptions were also varied for permanent residents versus tourists.

It should be noted that destination percentages refer to destination desires. In cases where the local hotel/motel demand outweighed the in-county capacities, the transportation analysis assumed that these evacuees would need to go out-of-county to find acceptable refuge. One important behavioral aspect built into the rates is that of a larger percentage of evacuees going out of county for each successive step in storm intensity scenario. Also, in the lower intensity scenarios, in the non-surge area, most of the evacuees are mobile home residents who have a higher propensity to use public shelters and this was reflected in the assumptions as well.

The final set of behavioral assumptions concerns vehicle usage rates during an evacuation. Vehicle usage rates pertain to the percentage of vehicles available at the home origin, assumed to be used in the evacuation. Vehicle usage percentages were 70% to 80% (depending on distance from the coastline) for this transportation analysis.

The key behavioral concepts and assumptions used for the study are summarized in Table 2-3. The precise parameters used for each county and zone for all scenarios are included in Annex C of the Transportation Model Support Document.

Table 2-3
SUMMARY OF BEHAVIORAL ASSUMPTIONS

TREASURE COAST HURRICANE EVACUATION STUDY UPDATE - 2003

TRANSPORTATION ANALYSIS

Participation Rates

Even in a scenario involving an intense, Category 4-5 hurricane, it is unlikely that the evacuation participation rate will be as high as 100%. However, conservative assumptions had to be made regarding the percentage of the population that would evacuate with the threat of a storm in each Category 1 through 5. In general, the following was assumed for each scenario:

A participation rate of 100% for people in storm surge evacuation areas, all mobile home residents and also a small portion of the theoretically non-vulnerable population. The exception to this is in Category 1-2 situation where only 70% of the inland mobile homes were assumed to participate.

Under this assumption, clearance times calculated in this transportation analysis will provide residents located in vulnerable areas the opportunity to evacuate, whether or not they choose to evacuate.

Destination Percentages

Destination percentages include estimates of the percentage of evacuees traveling to each destination. These estimates include the number of evacuees traveling to in-county shelters, in county homes of friends/relatives (including churches), in-county hotels/motels, or out of the county destinations. Evacuation zones containing similar characteristics, such as ocean front or inland areas were grouped together by assumptions. These assumptions were developed using data gathered from past observations of Florida and other coastal areas around the country.

Of those evacuating:

Percent to Local Public Shelter:

10% of high-risk areas (ocean front)
15% of moderate risk areas (Categories 2 – 5 zones)
20% of low risk areas (dry for all categories) depending upon income

Percent to Out-of-County:

30-60% in a strong storm depending upon risk area and income
20-40% in a weak storm depending upon risk area and income

Of those going out-of-county, 10% were assumed to go west, 10% east and 80% north; this may vary by direction of oncoming storm

In-County Friends and Relatives Homes:

25-50%in strong storm depending upon risk area and income
35-60% in a weak storm depending upon risk area and income

Vehicle Utilization

Depending on the risk area, evacuees will use 70-80% of the vehicles available at the household level. This is generally a constant from one evacuation to another.

2.4 ROADWAY NETWORK CHARACTERISTICS

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 like Palm Beach 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. A detailed law enforcement assignment 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.

Draft evacuation network maps were reviewed by the counties and roadways added to the analysis where appropriate. 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 an area such as south Florida, where there are urban and rural low lying streets that flood in heavy rainfall events, these criteria can be difficult to meet.

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 as defined by the nodes when connected. Each link is identified by a letter designation. Figures 2-18 through 2-21 illustrate the coded 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 (appropriate for evacuating) were established for each link for the existing base year. This was accomplished by ascertaining number of lanes, facility type, and area type information from highway maps available from the counties, and with “field check” updating accomplished by PBS&J. Tables were then used to specify a directional evacuation service volume based on link

characteristics. Figures 2-22 through 2-25 show the base year directional service volumes and number of lanes for the evacuation clearance time analysis. The number of lanes determines the service volume of a roadway because each lane has an established maximum capacity.

Important assumptions concerning the evacuation road network for the analysis that must be mentioned are:

- The evacuation of all vehicles will 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 time” for northbound movements away from the coast
- The U.S. Coast Guard will be contacted to "lock down" drawbridges at least 12 hours before the arrival of hazardous conditions

3.0 EVACUATION CLEARANCE TIME MODEL APPLICATION/SYSTEM FORECASTS

Application of PBS&J's transportation modeling methodology for hurricane evacuations, using inputs and assumptions discussed in Chapter 2, produced several key data items and forecasts for hurricane evacuation planning and preparedness. Completion of the transportation modeling process for the existing base year produced the following:

- Evacuating people and vehicle statistics by evacuation zone by storm scenario
- Shelter demand and capacity considerations by scenario
- Traffic volumes and critical roadway segments by scenario
- Estimated clearance times by scenario (developed for year 2008 scenario also)

Although an extensive amount of data is generated through the transportation analysis (as provided in the Transportation Model Support Document), the items listed above constitute the most critical outputs for planning for shelter needs, anticipating bottlenecks and defining the timing constraints of an evacuation.

3.1 CLEARANCE TIME MODEL DESCRIPTION

The general philosophy supporting all of PBS&J's hurricane evacuation clearance time work around the country is that the analysis must be technically sophisticated enough to produce reliable estimates of hurricane evacuation clearance times, yet clear enough for the emergency management community to be able to review key modeling assumptions and products. A brief overview of the steps in the modeling process and a description of the computer program framework used in the modeling steps are discussed in this section.

The key modeling steps used in the analysis are as follows:

~ Development of Evacuation Zones and Data - Identifies who is vulnerable and who is evacuating

~ Trip Generation - Calculates how many evacuees will move by county sub- area for a

particular scenario

- ~ Trip Distribution - Determines where evacuees will go
- ~ Development of Evacuation Road Network - Addresses the questions which roads can be used for evacuation and what is the carrying capacity of each road
- ~ Trip Assignment - Determines what route(s) evacuees will take to get from their point of origin to their destination
- ~ Calculation of Clearance Time - Determines how much time it will take for all evacuees to clear the evacuation network

The major inputs and outputs of the overall process are illustrated in Figure 3-1. PBS&J developed an in-house set of computer programs to facilitate the transportation modeling steps described above. Programs are in a Lotus for Windows environment and were originally developed in late 1993/early 1994 by PBS&J for use in the entire firm's ongoing hurricane work. The model was updated dramatically in 2000 and the Treasure Coast Study is a beneficiary of that update. At the conclusion of the study, PBS&J will provide the USCOE with a spreadsheet that will allow state and county officials to make changes when large developments come on line or when road construction restricts normal flow. This abbreviated model was developed in order to facilitate the ability of the Corps and each county in the study to update their clearance times by accounting for new development and roadway changes.

The Transportation Model Support Document Appendix to this report provides details about components of the model, file nomenclature and management and model application. One important aspect of operating in the Lotus environment for this study was the ability to import data files directly into the initial programs. In addition, the outputs of other programs were easily captured and exported to ArcView GIS for displays and mapping. Overall, the use of GIS by PBS&J significantly enhanced the process of technical data development and documentation in the study.

3.2 EVACUATING PEOPLE AND VEHICLES BY SCENARIO

Using the trip generation module of PBS&J=s battery of hurricane programs, total evacuating people and vehicles produced by each evacuation zone were calculated and split by general destination type (trip purpose). The four general destination types are in county public shelter, in-county hotel/motels, and in county home of a friend or relative, and out-of-county. This was accomplished for the Year 2000 base year, for each storm intensity and for two levels of assumed tourist occupancy. Low tourist occupancy was assumed to be 35% and high tourist occupancy was assumed to be 95%. Categories 4/5 were combined to form one scenario for modeling purposes. The zone-by-zone figures resulting from this process can be found in the Transportation Model Support Document in Annex C.

Table 3-1 shows the number of residents and tourists estimated to leave dwelling units for each county and scenario. **The number of people involved in an actual evacuation could total less than these figures** due to the assumed 100 percent participation rate of people from units in storm surge vulnerable areas and mobile homes assumed for each scenario. Even with door-to-door evacuation notification, it will be difficult to convince all to leave who should leave even for the most intense storm threats. Participation rates in tropical storm/weak Category 1 hurricanes can be quite low even in potential surge areas. Conversely, for Category 4 and 5 hurricanes, media hype and continual coverage on The Weather Channel tend to produce high participation rates from residents that local officials would rather have stay in county and in place.

Table 3-1
EVACUATING PEOPLE STATISTICS
Treasure coast Hurricane Evacuation Study - 2003

County/Scenario	Year 2000 Permanent Population*	People/Vehicles Evacuating	Public Shelter Demand	Local Public Shelter Capacity
Indian River	112,947 People			
Low Tourist Occupancy				
Category 1-2		36,782/15,872	2,594 People	22,330 People
Category 3-5		55,541/23,334	4,843 People	22,330 People
High Tourist Occupancy				
Category 1-2		45,190/18,814	2,680 People	22,330 People
Category 3-5		66,216/27,069	4,950 People	22,330 People
	Includes 15,266 mobile home residents countywide	Includes up to 18,411 Seasonal people countywide		
St.. Lucie	192,695 People			
Low Tourist Occupancy				
Category 1-2		42,384/17,069	3,604 People	6,666 People
Category 3-5		59,827/23,654	6,301 People	6,666 People
High Tourist Occupancy				
Category 1-2		56,663/22,067	3,746 People	6,666 People
Category 3-5		77,377/29,792	6,479 People	6,666 People
	Includes 27,667 mobile home residents countywide	Includes up to 30,540 Seasonal people countywide		

*All socioeconomic data developed by PBS&J using year 2000 Census data for input into the transportation analysis effort

Table 3-1 (continued)
EVACUATING PEOPLE STATISTICS
Treasure Coast Hurricane Evacuation Study - 2003

County/Scenario	Year 2000 Permanent Population*	People/Vehicles Evacuating	Public Shelter Demand	Local Public Shelter Capacity
Martin	126,731 People			
Low Tourist Occupancy				
Category 1		37,040/15,213	2,723 People	8,600 People
Category 2-3		50,376/20,394	4,476 People	6,900 People
Category 4-5		85,007/34,060	7,919 People	6,900 People
High Tourist Occupancy				
Category 1		47,210/18,774	2,830 People	8,600 People
Category 2-3		63,774/25,086	4,612 People	6,900 People
Category 4-5		98,759/38,877	8,060 People	6,900 People
	Includes 17,847 mobile home residents countywide	Includes up to 23,610 Seasonal people countywide		
Palm Beach	1,131,184 People			
Low Tourist Occupancy				
Category 1-2		194,962/87,250	25,256 People	28,465 People
Category 3-5		309,551/136,681	39,591 People	28,465 People
High Tourist Occupancy				
Category 1-2		276,577/115,814	26,078 People	28,465 People
Category 3-5		425,617/177,310	40,751 People	28,465 People
	Includes 46,900 mobile home residents countywide	Includes up to 207,807 Seasonal people countywide		

*All socioeconomic data developed by PBS&J using year 2000 Census data for input into the transportation analysis effort

The range of evacuating population is represented by a Category 1/2 storm with low tourist occupancy (lowest evacuating population) and Category 4/5 with high tourist occupancy (highest evacuating population) representing the two extremes of the range. Figures 3-2 through 3-9 graphically show ranges of evacuating population by county and by evacuation zone for the storm and tourist occupancy scenarios.

3.3 PUBLIC SHELTER DEMAND/CAPACITY CONSIDERATIONS

One crucial aspect of hurricane evacuation planning involves the coordination of shelter location and capacity to meet the shelter demand of evacuees in any given storm scenario. In terms of public shelter demand, counties generally exceed their theoretical capacities for the higher categories of hurricanes. However, this may be remedied in most cases by reducing the square footage per person required, if necessary. In the Treasure Coast Region, Indian River, St. Lucie, and Palm Beach Counties do not exceed theoretical shelter capacities for any storm scenario. Martin County exceeds shelter capacities for Category 2-5 storms. It should also be noted that in the event that shelter demand slightly exceeds theoretical capacities, local churches and other civic groups might assist with public sheltering needs.

One of the aspects of evacuations that PBS&J and HMG have observed nationally over the last five to ten years, is the relatively low public shelter demand that communities are experiencing relative to expected demand calculated in the study processes. In that regard, shelter demand numbers shown in Table 3-1 could be considered high estimates of people seeking shelters. However, in a storm situation where there is little time available to evacuate, there will be more pressure on local sheltering facilities.

As seen in Table 3-1, public shelter demand generally increases slightly within a county from low to high tourist occupancy for Category 1 and 2 storms. This demand between low and high tourist occupancy usually remains the same for Categories 3-5 storms. The tourist population generally seeks public shelters in lower scenario storms. There is a tendency for tourists to leave an area during a scenario Category 3-5 storm and return home.

Figures 3-10 through 3-17 illustrate the range of existing base 2000 public shelter demand by evacuation zone for each storm scenario. Since mobile home residents typically have a higher propensity to use local public shelter space than other residents, the future additions of significant mobile home population in each of the counties may increase the shelter demand. Growth in special needs and elderly populations could also add to the increased demand in this region. **It should be noted that not all shelters would be opened and available for use during all storms.**

3.4 EVACUATION TRAFFIC VOLUMES AND CRITICAL ROADWAY SEGMENTS

The assigned evacuating vehicle figures by roadway segment for each base year storm scenario by county can be found in the Transportation Model Support Document Appendix. In addition, the Appendix contains the evacuating vehicles to service volume ratio calculated for each roadway segment by scenario. Segments with the highest evacuation vehicles to service volume ratio are considered critical links under a particular scenario. These congested areas control the flow of evacuation traffic during a hurricane evacuation and are key areas for traffic control and monitoring. Many of these same roadways will be supporting not only the evacuating public but also the non-evacuating public attempting to gather supplies and fuel for homes and vehicles. In some cases, depending on the time of the evacuation, residents may also have to travel from work to home before beginning their evacuation movement.

In the urban areas of Martin and Palm Beach Counties, many locations could be listed, as congestion will be widespread. Table 3-2 lists the most critical roadway segments in each county that will control the flow of evacuation traffic. Figures 3-18 through 3-25 illustrate potential evacuation traffic congestion by roadway segment by storm scenario and county.

Table 3-2
CRITICAL ROADWAY LOCATIONS/SEGMENTS
Treasure Coast Hurricane Evacuation Study-2003

Indian River County	**Palm Beach County**
Fellsmere Road at I-95	Indian Road at I-95
Wabasso Road at US 1	PGA Boulevard at US 1
Barber Bridge/SR 60 at US 1	PGA Boulevard at I-95
17th Street Bridge from A1A to US 1	Blue Heron Boulevard at US1
SR 60 at I-95	Blue Heron Boulevard at I-95
St. Lucie County	Okeechobee Boulevard at US 1
Okeechobee Road from US 1 to Hawley Road	Okeechobee Boulevard at I-95
North Beach Causeway at US 1	Southern Boulevard at US 1
Seaway Drive at US 1	Southern Boulevard at I-95
US 1 from South Bridge/Seaway Drive to Orange Avenue	Southern Boulevard from Turnpike to Folsom Road
Orange Avenue at I-95	Lake Worth Road at US 1
Martin County	Lake Worth Road at I-95
Martin Highway at Florida Turnpike	Ocean Avenue (near Boynton Beach) at US 1
Causeway Boulevard west to Indian River Boulevard	Boynton Beach Road at I-95
A1A from Stuart Beach west to Sewalls Point	Atlantic Avenue at US 1
Bridge Road (near Hobe Sound) at I-95	Atlantic Avenue at I-95
High Meadows Road at I-95	Linton Boulevard at US 1
Palm City Bridge/Monterey Road – Mapp Road intersection	Spanish River Boulevard at US 1
Cove Road at I-95	Palmetto Park Road at US 1
	Glades Road at I-95

3.5 EXITING EVACUATION TRAFFIC BY ROUTE AND SCENARIO

Since the evacuation traffic from Dade and each Treasure Coast County is so intermeshed with all southeast Florida counties in an evacuation, it is important to recognize the levels of potential evacuation traffic that each county is contributing. PBSJ constructed the following table that shows for each storm scenario the levels of traffic that each county will potentially place on specific exiting routes. This becomes particularly significant for roadways that will be heavily impacted such as I-95, the Florida Turnpike, I-75, and even US 27. This information is presented in Table 3-3.

3.6 ESTIMATED EVACUATION CLEARANCE TIMES

An important product of the transportation analysis is the clearance times developed by storm scenario and by behavioral characteristic for each county. Clearance time is one of two major considerations involved in issuing an evacuation order or advisory. The other time aspect that must be weighed is the arrival of sustained tropical storm winds. Figure 3-26 illustrates these two timing issues of evacuation and their relation.

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 enter the road network (referred to as mobilization time), the time spent by evacuees traveling along the road network (travel time) and stoppage due to traffic congestion (referred to as queuing delay time). Clearance time <u>does not</u> 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.

Tables 3-4 through 3-14 present the hurricane evacuation clearance times developed for each county for the base year existing storm scenarios and forecasted clearance times for Year 2008. Clearance time runs were accomplished based on differing intensity of hurricanes, levels of background traffic, rapidity of evacuees= response, and differing tourist seasons. Clearance times fell between 3 ¼ and 16 2 hours for all of the Year 2003 evacuation movement scenarios. Clearance times reflect the

effects of adjacent county traffic impacts, and in that regard assumes that consistent evacuation decisions will be made and coordinated between adjacent jurisdictions and the State of Florida EOC. Clearance times were also developed to show the impact of adjacent regional traffic from southeast Florida on the Treasure Coast region.

The high times for the Category 4/5 scenarios reflect most of the study area=s population responding to evacuation and storm information and the funneling of multi-county traffic to only a few available northbound escape routes. Category 4/5 hurricanes will also push a lot of southeast Florida traffic into some of the same destination areas.

Table 3-3

EXITING EVACUTION TRAFFIC BY ROUTE BY COUNTY AND BY STORM SCENARIO

Treasure Coast Hurricane Evacuation Study Update 2003

EXITING EVACUATION TRAFFIC BY ROUTE BY COUNTY BY STORM SCENARIO
Miami-Dade County and Treasure Coast Hurricane Evacuation Studies 2003

Originating County	Storm Scenario	Exit Route Vehicles by Route									
		US 1	US 27	I-75	Fla Turnpike	I-95	SR 710	US 98	SR 70	CR 68	SR 60
MONROE	Cat 1-2 low occ	8,000									
	Cat 1-2 high occ	10,000									
	Cat 3-5 low occ	16,000									
	Cat 3-5 high occ	20,000									
MIAMI-DADE	Evac Plan A low occ	2,057	2,594	7,246	15,116	13,059					
	Evac Plan A high occ	2,682	3,434	9,550	19,775	17,094					
	Evac Plan B low occ	4,214	6,929	18,071	33,117	28,903					
	Evac Plan B high occ	4,986	8,090	21,166	39,043	34,056					
	Evac Plan C low occ	4,214	8,700	21,614	35,479	31,265					
	Evac Plan C high occ	4,986	9,864	24,714	41,408	36,422					
BROWARD	Cat 1-2 low occ		3,600	7,200	12,600	10,800					
	Cat 1-2 high occ		5,650	11,300	19,750	16,900					
	Cat 3-5 low occ		9,400	18,800	32,900	28,250					
	Cat 3-5 high occ		12,650	25,300	44,250	37,900					
PALM BEACH	Cat 1-2 low occ		4,738		16,533	14,529	2,776	1,502			
	Cat 1-2 high occ		8,402		28,060	24,643	4,549	2,699			
	Cat 3-5 low occ		9,240		32,633	28,693	5,413	2,831			
	Cat 3-5 high occ		14,594		48,989	43,037	7,834	4,574			
MARTIN	Cat 1 low occ	304			3,051	2,670	714				
	Cat 1 high occ	459			4,635	4,039	1,087				
	Cat 2-3 low occ	491			5,165	4,527	1,231				
	Cat 2-3 high occ	685			7,254	6,338	1,733				
	Cat 4-5 low occ	732			7,338	6,415	1,714				
	Cat 4-5 high occ	932			9,482	8,273	2,228				
ST. LUCIE	Cat 1-2 low occ	400			3,533	3,140			393	393	
	Cat 1-2 high occ	650			5,760	5,120			640	640	
	Cat 3-5 low occ	700			5,939	5,279			660	660	
	Cat 3-5 high occ	1,000			8,676	7,712			964	964	
INDIAN RIVER	Cat 1-2 low occ	1,386			2,772	7,623					2,079
	Cat 1-2 high occ	1,968			3,937	10,826					2,953
	Cat 3-5 low occ	2,640			5,280	14,519					3,960
	Cat 3-5 high occ	3,380			6,760	18,589					5,070

Table 3-4

YEAR 2003 CURRENT CLEARANCE TIMES (in hours)

Indian River – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Immediate	3 ¼	4
Rapid Response	5 ½	5 ½
Medium Response	8 ½	8 ½
Long Response	11 ½	11 ½

Worst individual household commute time – 1 hour

Category 3 5 Hurricane		
Immediate	9 ¾	10 ¾
Rapid Response	11	12
Medium Response	11	12
Long Response	11 ½	12 ½

Worst individual household commute time – 7 ¼ hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-5

YEAR 2003 CURRENT CLEARANCE TIMES (in hours)

St. Lucie – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Immediate	6	7 ¾
Rapid Response	6 ¾	8 ¾
Medium Response	9	9 ¼
Long Response	12	12

Worst individual household commute time – 3 ½ hours

Category 3 5 Hurricane		
Immediate	6 ¼	8
Rapid Response	7	9
Medium Response	7 ½	9 ½
Long Response	8 ¼	12

Worst individual household commute time – 3 ¾ hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-6

YEAR 2003 CURRENT CLEARANCE TIMES (in hours)

Martin – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 Hurricane		
Immediate	5 ¼	6 ¾
Rapid Response	6	7 ½
Medium Response	9	9
Long Response	10 ¾	10 ¾
Worst individual household commute time – 2 ¼ hours		
Category 2 – 3 Hurricane		
Immediate	8	9 ½
Rapid Response	9	10 ¾
Medium Response	9 ½	11 ½
Long Response	10 ¾	12 ¼
Worst individual household commute time – 6 ¾ hours		
Category 4 - 5 Hurricane*		
Immediate	8 ¾	10 ½
Rapid Response	9 ¾	11 ½
Medium Response	10 ¼	12 ¼
Long Response	11 ¼	13
Worst individual household commute time – 7 ½ hours		

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

*When looking at the Category 4-5, regional clearance times should be looked at because of the number of evacuees that move out of the county. These times mostly reflect in-county sheltering.

Table 3-7

YEAR 2003 CURRENT CLEARANCE TIMES (in hours)

Palm Beach – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Immediate	7 ½	8 ¼
Rapid Response	8 ½	9 ¼
Medium Response	9 ¼	10
Long Response	10	11

Worst individual household commute time – 5 hours

Category 3 5 Hurricane		
Immediate	9 ½	14
Rapid Response	10 ½	15 ½
Medium Response	11 ½	15 ¾
Long Response	12 ¼	16 ¾

Worst individual household commute time – 10 hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-8

YEAR 2003 CURRENT CLEARANCE TIMES (in hours)

Regional Movements for Treasure Coast Traffic Only

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Immediate	9 ¼	14 ½
Rapid Response	9 ¾	15
Medium Response	10	15 ¼
Long Response	12	15 ¾

Worst individual household commute time – 9 ½ hours

Category 3 5 Hurricane		
Immediate	17 ¾	25 ¼
Rapid Response	18 ½	26 ¼
Medium Response	18 ½	26 ¼
Long Response	18 ¾	26 ¾

Worst individual household commute time – 20 ½ hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-9

YEAR 2003 CURRENT CLEARANCE TIMES (in hours)

Regional Movements including South Florida Traffic

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Immediate	21 ¾	29 ½
Rapid Response	22 ½	30 ½
Medium Response	22 ½	30 ½
Long Response	23	30 ¾

Worst individual household commute time – 24 ½ hours

Category 3 5 Hurricane		
Immediate	46	61
Rapid Response	48	63
Medium Response	47	62
Long Response	47	62

Worst individual household commute time – 64 hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-10

YEAR 2008 CLEARANCE TIMES (in hours)

Indian River – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Rapid Response	5 ½	6 ¾
Medium Response	8 ½	8 ½
Long Response	11 ½	11 ½

Worst individual household commute time – 2 hours

Category 3 5 Hurricane		
Rapid Response	16 ¾	18 ¾
Medium Response	16 ½	18 ¼
Long Response	17	19

Worst individual household commute time – 14 hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-11

YEAR 2008 CLEARANCE TIMES (in hours)

St. Lucie – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Rapid Response	9 ½	12 ¾
Medium Response	10	13
Long Response	12	14

Worst individual household commute time – 7 ½ hours

Category 3 5 Hurricane		
Rapid Response	10	13 ¼
Medium Response	10 ½	13 ½
Long Response	11 ¼	14 ¼

Worst individual household commute time –8 hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-12

YEAR 2008 CLEARANCE TIMES (in hours)

Martin – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 Hurricane		
Rapid Response	8 ¼	10 ½
Medium Response	9	11
Long Response	11	11 ¼
Worst individual household commute time – 5 ¼ hours		
Category 2 – 3 Hurricane		
Rapid Response	14 ¾	17
Medium Response	15 ½	17 ¼
Long Response	15 ¾	18
Worst individual household commute time – 12 ¾ hours		
Category 4 - 5 Hurricane*		
Rapid Response	15 ¾	18
Medium Response	16	18 ½
Long Response	16 ½	19
Worst individual household commute time – 14 hours		

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

*When looking at the Category 4-5, regional clearance times should be looked at because of the number of evacuees that move out of the county. These times mostly reflect in-county sheltering.

Table 3-13

YEAR 2008 CLEARANCE TIMES (in hours)

Palm Beach – In-County Movements

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Rapid Response	9 ½	12 ¾
Medium Response	10	13
Long Response	12	14

Worst individual household commute time – 9 ¾ hours

Category 3 5 Hurricane		
Rapid Response	15 ¼	19
Medium Response	15 ½	19 ½
Long Response	16 ¼	20

Worst individual household commute time – 17 ¾ hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

Table 3-14

YEAR 2008 CLEARANCE TIMES (in hours)

Regional Movements for Treasure Coast Traffic Only

Treasure Coast Hurricane Evacuation Study Update 2003

	Low Seasonal Occupancy	High Seasonal Occupancy
Category 1 – 2 Hurricane		
Rapid Response	10 ¼	17
Medium Response	12 ¾	17 ½
Long Response	14	18

Worst individual household commute time – 17 ½ hours

Category 3 5 Hurricane		
Rapid Response	20 ½	29
Medium Response	21	29 ½
Long Response	22	30

Worst individual household commute time – 35 hours

Note: Commute time refers to how long one vehicle may be stuck in traffic making their evacuation movement

3.7 IMPACT OF REGIONAL ROUTE CONTRAFLOW

As a part of extensive work for FDOT, PBS&J modeled the I-75 and the Florida Turnpike to determine the number of additional vehicles and people that can get through the planned contraflow segments assuming there is enough time for the vehicles to arrive at the operation. Since the Florida Turnpike controls the overall clearance times for out of region traffic, this is the segment that will be highlighted in this report. The analysis was accomplished by calculating clearance times required to process the worst-case evacuation travel demand on the Turnpike for a Category 4-5 hurricane scenario with and without the one-way operation. In addition, worst individual household commute times through the route were estimated with and without the one-way operation. For scenarios where the one-way operation is in place, it was assumed that the reverse laning would be operational for no more than 12 to 24 hours. Scenarios were also differentiated for South Florida only and South Florida and Treasure coast concurrent evacuations.

As can be seen in the tables 3-15 and 3-16, regarding clearance times and worst household commute times, the one-way operation on the Turnpike could save 15 to 20 hours of corridor evacuation clearance time and 20 to 25 hours of corridor individual household commute time. Translating the increased vehicular movement (an additional 2,000 vehicles per hour) to people, an additional 5,000 people per hour are able to evacuate through the Turnpike due to the one-way operation. Looking over the length of an entire evacuation for a worst case Category 4-5 hurricane, this means some people will be able to make their evacuation movement that otherwise might not have been able to. Since the operation does not solve the Turnpike bottleneck in Palm Beach County, the greatest benefit will be for Martin, St. Lucie and Indian River evacuees who may not have been able to even enter the Turnpike without the contra-flow operation.

Table 3-15

TURNPIKE CORRIDOR EVACUATION CLEARANCE TIMES (IN HOURS)

Florida Turnpike from SR70 to MP235 north of Osceola Parkway

Analysis of Florida's One Way Operations for Hurricane Evacuation

	Normal Lane Usage		With One-Way Operations	
Category 4 / 5 Hurricane	South Florida Evacuation Only	South Florida and Treasure Coast	South Florida Evacuation Only	South Florida and Treasure Coast
Medium Response/Loading	37 ½ hours	53 hours	25 hours	35 hours

Please note: Times were revised using evacuation travel demand data compiled in the 2003 Transportation Analyses for Miami-Dade County and Treasure Coast study reports which was based upon hurricane evacuation study data available for Miami-Dade and Treasure Coast regions of Florida. The figures also include Broward and Monroe.

Table 3-16

CORRIDOR WORST HOUSEHOLD COMMUTE TIMES (IN HOURS)

Florida Turnpike from SR70 to MP235 north of Osceola Parkway

Analysis of Florida's One-Way Operations for Hurricane Evacuation

	Normal Lane Usage		With One-Way Operations	
Category 4 / 5 Hurricane	South Florida Evacuation Only	South Florida and Treasure Coast	South Florida Evacuation Only	South Florida and Treasure Coast
Medium Response/Loading	37 ½ hours	53 hours	25 hours	35 hours

Please note: Times were revised using evacuation travel demand data compiled in the 2003 Transportation Analyses for Miami-Dade County and Treasure Coast study reports which was based upon hurricane evacuation study data available for Miami-Dade and Treasure Coast regions of Florida. The figures also include Broward and Monroe.

3.8 EVACUEE NOTIFICATION/EVACUATION SHUT-DOWN TIME FRAMES

As Orlando is a potential destination for significant numbers of both Miami-Dade County and Treasure Coast evacuees, it will be important to implement evacuation shut down procedures so that evacuees are not stranded on the Turnpike and I-95 as a storm arrives. This could be a particularly dangerous situation if sustained tropical storm winds or hurricane winds begin to affect the roadway and evacuees are still on the facility. Late in an evacuation, it will be important to make a coordinated decision about when to tell evacuees to stop entering the Turnpike and I-95.

Since the region and state's population will respond differently for various storm events, the time at which evacuees should be advised to stop entering the Turnpike and I-95 should be based on actual traffic conditions and not modeled predictions such as clearance times calculated in this study (which indicates when an evacuation should begin). There are FDOT permanent traffic count stations located along the facilities that should be used for travel speed monitoring (sites 970410, 970413, 930198, 979931 and 940260). Traffic conditions can be further monitored through Civil Air Patrol support and/or highway patrolmen stationed on the ground at strategic locations. Traffic can also be monitored using CCTV cameras within Palm Beach and Metro-Orlando areas. Hourly snapshots of traffic volumes and average travel speeds at these locations, coupled with storm information regarding the radius of tropical storm winds and forward speed, will be critical to making prudent shutdown decisions. As average travel speeds are monitored hour-to-hour and the information fed back to the state and county Emergency Management Operation Centers (EOCs), data must be interpreted and public notified of evacuation shut down.

The best indicator of evacuation traffic congestion and progression is average travel speed. Identifying the most congested sites in the appropriate direction, PBS&J would propose that the state and counties notify the public to stop entering the Turnpike and I-95 in the hourly time frames shown. This should greatly help prevent people from being stuck on the roadway system as hazardous conditions arrive. Table 3-17 presents this information.

Table 3-17

EVACUATION CLOSURE/EVACUEE NOTIFICATION TIMEFRAMES

(Expressed in Hours Before Expected Sustained Tropical Storm Winds to Discourage New Evacuees from entering the Florida Turnpike and I-95)

Average Travel of Evacuation Traffic at Most Congested Sites	Most Congested Sites					
		Florida Turnpike Sites			I-95 Sites	
	Broward	Palm Beach	Ft. Pierce	Wildwood	Palm Beach	Ft. Pierce
5 mph	20	17	10	1	17	10
15 mph	7	5 ½	3 ½	1	5 ½	3 ½
25 mph	4	3 ½	2		3 ½	2
35 mph	3	2 ½	1 ½		2 ½	1 ½
45 mph	2 ¼	2	1 ¼		2	1 ¼
55 mph	2	1 ½	1		1 ½	1
65 mph	1 ½	1 ¼	1		1 ¼	1

Please note: These notification timeframes should not be confused with the time required to shut down the one-way operation.

3.9 TIME CONSTRAINED EVACUATIONS

Evacuation clearance times calculated for the Miami-Dade County and Treasure Coast studies can approach 2 to 3 days of heavy evacuation traffic movement for a worst-case storm if all those who wish to leave the area are to be accommodated. Obviously the meteorological characteristics of hurricanes rarely allow that amount of time for evacuation movements to take place. In that regard, PBSJ was asked by the State of Florida to look at the number of evacuees who would be unable to leave the southeast Florida area, if only 12, 24, or 36 hours of time was available for evacuation. These additional people could ultimately place more strain on public shelters or other in-area sheltering options. The table 3-18 shows the number of people for the timeframes mentioned above and shows this data for all southeast and Treasure Coast, Florida counties.

Table 3-18
Time Constrained Evacuations
Treasure Coast Hurricane Evacuation Study Update 2003

Evacuting People Statistics for Category 4/5 - High Occupancy Scenario
Time Constrained Evacuations - 12, 24, and 36 Hours
Miami-Dade and Treasure Coast Hurricane Evacuation Studies 2003

County	Maximum I-95/Turnpike Unconstrained Category 4/5 Evacuating Population	I-95/Turnpike 12 Hour Constrained Category 4/5 Evacuating Population	Evacuees Unable To Leave Area	I-95/Turnpike 24 Hour Constrained Category 4/5 Evacuating Population	Evacuees Unable To Leave Area	I-95/Turnpike 36 Hour Constrained Category 4/5 Evacuating Population	Evacuees Unable To Leave Area
Monroe	24,000	5,640	18,360	11,304	12,696	16,944	7,056
Miami-Dade	221,900	52,147	169,754	104,515	117,385	156,661	65,239
Broward	170,900	40,162	130,739	80,494	90,406	120,655	50,245
Palm Beach	216,000	50,760	165,240	101,736	114,264	152,496	63,504
Martin	53,900	12,667	41,234	25,387	28,513	38,053	15,847
St. Lucie	43,400	10,199	33,201	20,441	22,959	30,640	12,760
Indian River	39,300	9,236	30,065	18,510	20,790	27,746	11,554
Total	769,400	180,809	588,591	362,387	407,013	543,196	226,204

3.10 TRAFFIC CONTROL MEASURES

Some general recommendations concerning traffic control are as follows:

- 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 predominant evacuation travel direction should be activated.

- 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.

- 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.

- 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.

- Inter-county coordination between counties in and outside the study area is critical for successful evacuations in the south Florida region. Communication will facilitate improved traffic management and help solve sheltering issues.