Florida Statewide Regional Evacuation Study Program

Evacuation Transportation Analysis

Volume 4-9

Florida Division of Emergency Management

Southwest Florida Regional Planning Council

Southwest Florida Region

Includes Hurricane Evacuation Study

Statewide Regional Evacuation Study Program

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EVACUATION TRANSPORTATION ANALYSIS

VOLUME 4-9

SOUTHWEST FLORIDA REGION

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Southwest Florida Regional Planning Council
Florida Division of Emergency Management

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BCC Engineering, Inc.

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EXECUTIVE SUMMARY

The evacuation transportation analysis discussed in this volume documents the methodology, analysis, and results of the transportation component of the Statewide Regional Evacuation Study Program (SRESP). Among the many analyses required for the SRESP study, transportation analysis is probably one of the most important components in the process. By bringing together storm intensity, transportation network, shelters, and evacuation population, transportation analysis explicitly links people's behavioral responses to the regional evacuation infrastructure and helps formulate effective and responsive evacuation policy options. Due to the complex calculations involved and numerous evacuation scenarios that need to be evaluated, the best way to conduct the transportation analysis is through the use of computerized transportation simulation programs, or transportation models.

A. Background and Purpose

Over the years, different planning agencies have used different modeling approaches with varying degrees of complexity and mixed success. Some have used full-blown conventional transportation models such as the standard Florida model FSUTMS; others have used a combination of a simplified conventional model and a spreadsheet program, such as the Abbreviated Transportation Model (ATM). These models have different data requirements, use different behavioral assumptions, employ different traffic assignment algorithms, and produce traffic analysis results with different levels of detail and accuracy. These differences make it difficult for planning agencies to share information and data with each other. They also may produce undesirable conditions for staff training and knowledge sharing.

One of the objectives of the SRESP is to create consistent and integrated regional evacuation data and mapping, and by doing so, to facilitate knowledge sharing between state, regional, county, and local partners. To achieve this objective, it is important for all Regional Planning Councils to adopt the same data format and to use the same modeling methodologies for their transportation analyses. The primary purpose of the transportation component of the SRESP is to develop a unified evacuation transportation modeling framework that can be implemented with the data collected by the Regional Planning Councils.

B. Study Area

The study area for this analysis includes the six county Southwest Florida Regional Planning Council area. The transportation modeling methodology includes some processes that are performed at the statewide level, in order to determine the impacts of evacuations from other regions impacting the evacuation clearance times in the Southwest Florida region. While the impact of other regions is included in the Southwest Florida analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the six counties included in the Southwest Florida RPC. Transportation analysis results for other regions and counties are reported in the corresponding Volume 4 report for those regions.

C. Input and Coordination

The development of the transportation methodology and framework required coordination and input from all eleven regional planning councils in Florida, along with the Division of Emergency Management, Department of Transportation, Department of Community Affairs, and local county emergency management teams. At the statewide level, the transportation consultant, Wilbur Smith Associates, participated in SRESP Work Group Meetings which were typically held on a monthly basis to discuss the development of the transportation methodology and receive feedback and input from the State agencies and RPCs.

At the local and regional level, Wilbur Smith Associates conducted a series of four regional meetings to coordinate with and receive input from local county emergency management, the regional planning council, local transportation planning agencies and groups, as well as other interested agencies.

D. Evacuation Modeling Methodology and Framework

The evacuation modeling methodology and framework was developed during 2008 and 2009 in coordination with all eleven Regional Planning Councils and the Division of Emergency Management. The methodology used in the Southwest Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and includes the following components:

- **Behavioral Assumptions** – In 2008, the Statewide Regional Evacuation Study Program (SRESP) commissioned a survey of Florida residents. The purpose of this survey was to develop an understanding of the behavior of individuals when faced with the prospect of an impending evacuation. These data were used to develop a set of "planning assumptions" that describe the way people respond to an order to evacuate and are an important input to the SRESP Evacuation Model. The behavioral data provides insights into how people respond to the changing conditions leading up to and during an evacuation. The primary application of the survey data was to help anticipate how people would respond with respect to five behaviors:

    - How many people would evacuate?
    - When they would leave?
    - What type of refuge they would seek?
    - Where they would travel for refuge?
    - How many vehicles would they use?

    These evacuation behaviors are distinguished based on several descriptive variables as listed below:

    - Type of dwelling unit (site-built home versus mobile home);
    - The evacuation zone in which the evacuee reside; and,
    - The intensity of the evacuation that has been ordered.

- **Zone System and Highway Network** - The SRESP evacuation model relies upon data that covers the entire State of Florida as well as areas covering the States of Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee. While the primary

focus of the model is with evacuation behavior within Florida, areas outside of the state had to be considered in order to allow a more precise routing of evacuation traffic. This allows the model to measure the flow of traffic across the state line if needed.

The data included in this system contain the demographic information crucial to modeling evacuation traffic. The demographic information is labeled as "small area data". These data provide population and dwelling unit information that will identify where the individuals in the region reside. The planning assumptions developed from the behavioral analysis conducted for this study were applied to these demographic data. The result is a set of evacuation trips generated by the evacuation model. The number of these trips will vary depending on the hazard conditions that prompt the evacuation. Small area data geographies were aggregated into larger units known as Traffic Evacuation Zones (TEZ). These TEZ form the basic unit of analysis in the evacuation model. The final TEZ system for the State of Florida has 17,328 zones. This number provides sufficient detail to accurately accommodate the assignment of evacuation trips onto an evacuation network.

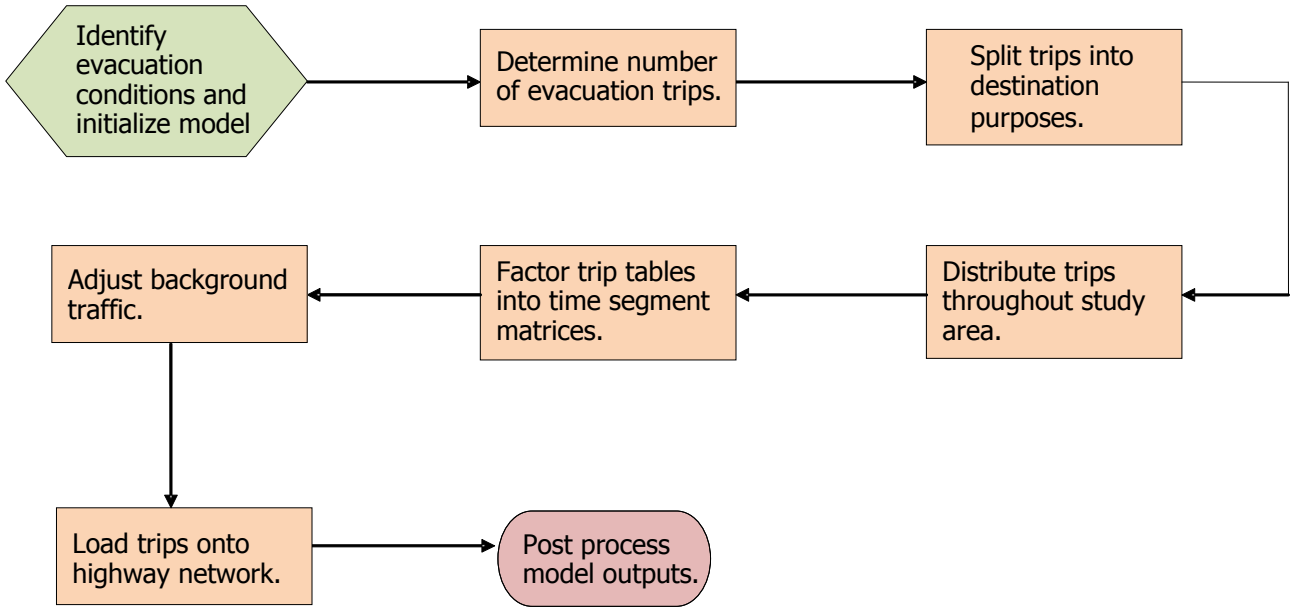
- **Background Traffic** - The traffic that consumes the roadway capacity of a transportation system during an evacuation can be divided into two groups. The first group is the evacuation traffic itself. Once the evacuation demand is determined, this information is converted into a number of vehicles evacuating over time. These evacuation trips are then placed on a representation of the highway network by a model. The model determines the speed at which these trips can move and proceeds to move the evacuation trips accordingly. The result is a set of clearance times.

  The second group of traffic is known as background traffic. Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis and is accounted for primarily to impede the movement of evacuation trips through the network. These trips represent individuals going about their daily business mostly unconcerned with the evacuation event. For the most part, background traffic represents trips that are relatively insensitive to an order to evacuate and are thus said to be occurring in the "background." Even though background traffic is relatively insensitive to evacuation orders, it is important to account for background traffic since it can have a dramatic impact on available roadway capacity. This in turn can severely affect evacuation clearance times.

- **Evacuation Traffic** - The model flow for the evacuation model is divided into a total of eight modeling steps. The following eight steps are represented graphically in the flowchart in Figure ES-1:

  1. Identify evacuation conditions and initialize model;
  2. Determine number of evacuation trips;
  3. Split trips into destination purposes;
  4. Distribute trips throughout study area;
  5. Factor trip tables into time segment matrices;
  6. Adjust background traffic;
  7. Load trips onto highway network; and,
  8. Post process model outputs.

Figure ES-1 - General Model Flow



- **Dynamic Traffic Assignment** - Dynamic traffic assignment (DTA) was utilized in the evacuation methodology because it is sensitive to individual time increments. DTA works by assigning a certain number of vehicles to the highway network in a given interval of time. The model then tracks the progress of these trips through the network over the interval. Another set of vehicles is assigned during the following time interval. The model then tracks the progress of these trips through the network along with the progress of the trips loaded in the previous time interval. As vehicles begin to arrive at the same segments of roadway, they interact with one another to create congestion. When vehicles that were loaded to the network in subsequent intervals of time arrive at the congested links, they contribute to the congestion as well. This results in a slowing down of the traffic and eventually spill-backs and queuing delays. It is this time dependent feature of DTA that makes it well suited to evacuation modeling. By dynamically adjusting the travel times and speeds of the vehicles moving through the network as they respond to congestion the model is able to do the following:

    - The evacuation model is able to estimate the critical clearance time statistics needed for this study;
    - The model takes into account the impact of compounded congestion from multiple congestion points;
    - The model is able to adjust the routing of traffic throughout the network as a function of congestion as it occurs throughout the evacuation; and,
    - The model is capable of adjusting its capacities from time segment to time segment, making it possible to represent such phenomena as reverse lane operations and background traffic.

- **Prototype Model Development** - Wilbur Smith Associates developed a prototype model to test the modeling methodology used to calculate evacuation clearance times. The prototype model demonstrated the viability of the methodology developed for this study. This included the use of dynamic traffic assignment, background traffic curves, regional sub-area trip balancing, the use of survey rates, the use of 100% participation rates, response curves, and county-by-county phasing of evacuations. The prototype model served as the backbone for all regional evacuation models that have been developed for this study. The models implemented for each RPC use a structure similar to the prototype with identical methodology.

E. Regional Model Implementation

The regional model developed for the Southwest Florida Region used a series of input data provided by the RPC, including the following:

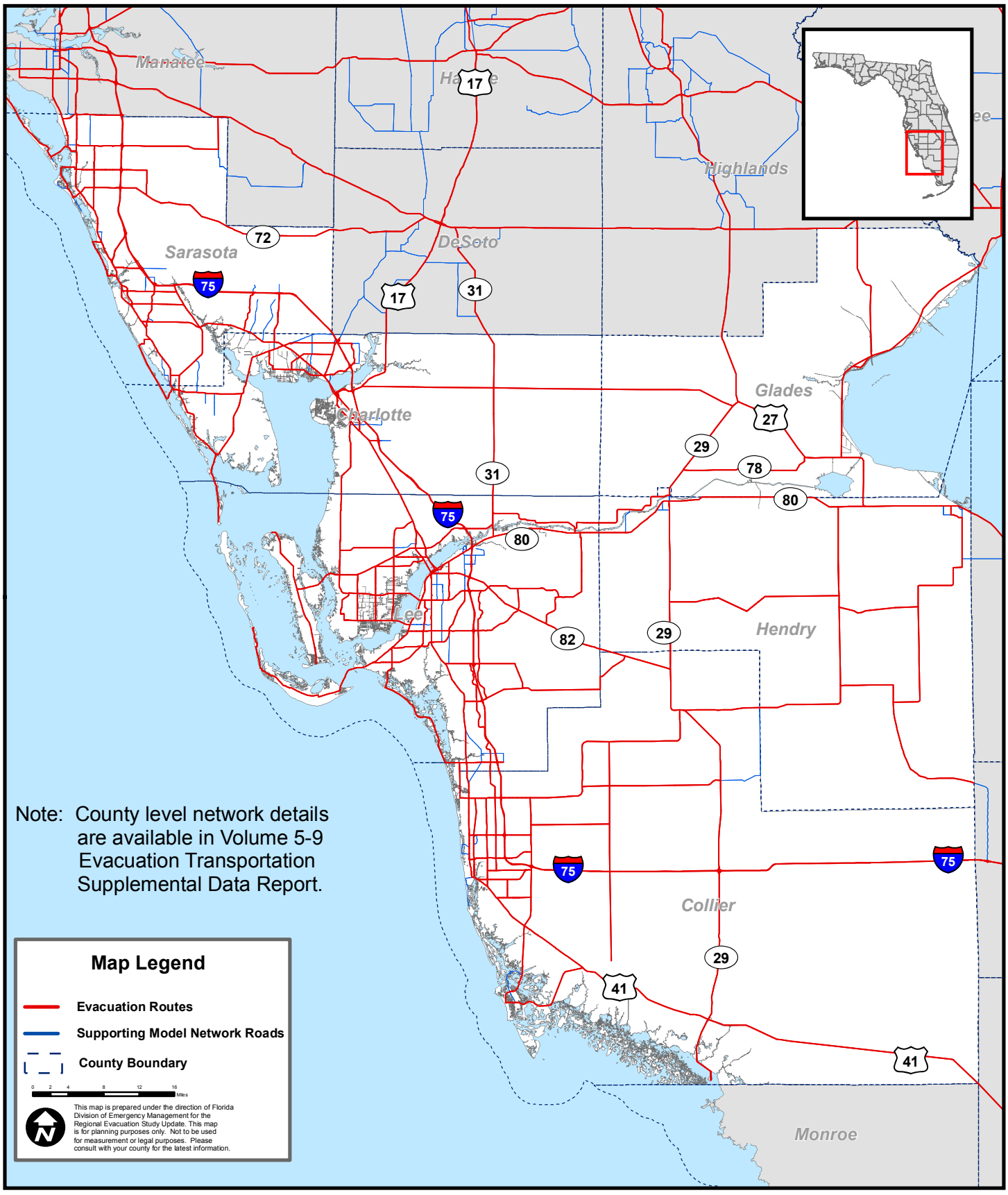
- **Regional Model Network** - The regional model network consists of the RPC designated evacuation routes as well as a supporting roadway network that facilitates movement of evacuation traffic. The 2005 Florida Department of Transportation (FDOT) Statewide Model Network was used as a basis for developing the regional model network, while the evacuation routes were obtained from the Southwest Florida RPC. The RPC relied on the emergency managers of its constituent counties to provide it with information on which roads were to be included as evacuation routes. The resulting model network was updated to 2006 conditions and is referred to as the base model network. **Figure ES-2** identifies the model network and evacuation routes for the SWFRPC. County level details of the regional model network are provided in the Volume 5-9 report. The regional model network for the Southwest Florida region includes key roadways within the six county region, including I-75, US 41, US 27, US 17, SR 29, SR 78, SR 72, SR 45, SR 31, SR 82, and SR 80.

- **Regional Zone System** - The regional zone system is based on Traffic Evacuation Zones (TEZ) and contains the regional demographic information, which includes housing and population data that is essential to modeling evacuation traffic. There are 972 zones located within the six county Southwest Florida region, as illustrated in **Figure ES-3**. In the Southwest Florida region, Lee County has the largest number of TEZs with 337, and Sarasota County follows with 275 TEZs. Charlotte County contains 175 TEZs; Collier County, 156 TEZs. Hendry and Glades Counties have the lowest number of TEZs in the RPC with 21 and 8 zones, respectively. The larger number of TEZs generally reflects counties with denser urban structure and/or higher population densities.

- **Regional Demographic Characteristics** - Demographic data were developed for the following years: 2006, 2010, and 2015. A snapshot of the key demographic data for each county in the Southwest Florida RPC for 2006, 2010 and 2015 is summarized in **Table ES-1**. The tables list the number of occupied dwelling units for site built homes, the permanent population in site-built homes, as well as the number of occupied dwelling units for mobile homes and the permanent population in mobile homes. The mobile home category includes RVs and boats and the permanent population in those housing options. The demographic characteristics summary also includes hotels and motels because many of these units are in or near vulnerable areas, and the proportion of seasonal units and hotel/motel units that are occupied at any point in time will have an important impact on the total population that may participate in an evacuation.

Figure ES-2

Southwest Florida Regional Model Network



Note: County level network details are available in Volume 5-9 Evacuation Transportation Supplemental Data Report.

Map Legend

- Evacuation Routes
- Supporting Model Network Roads
- County Boundary

0 2 4 8 12 16 Miles

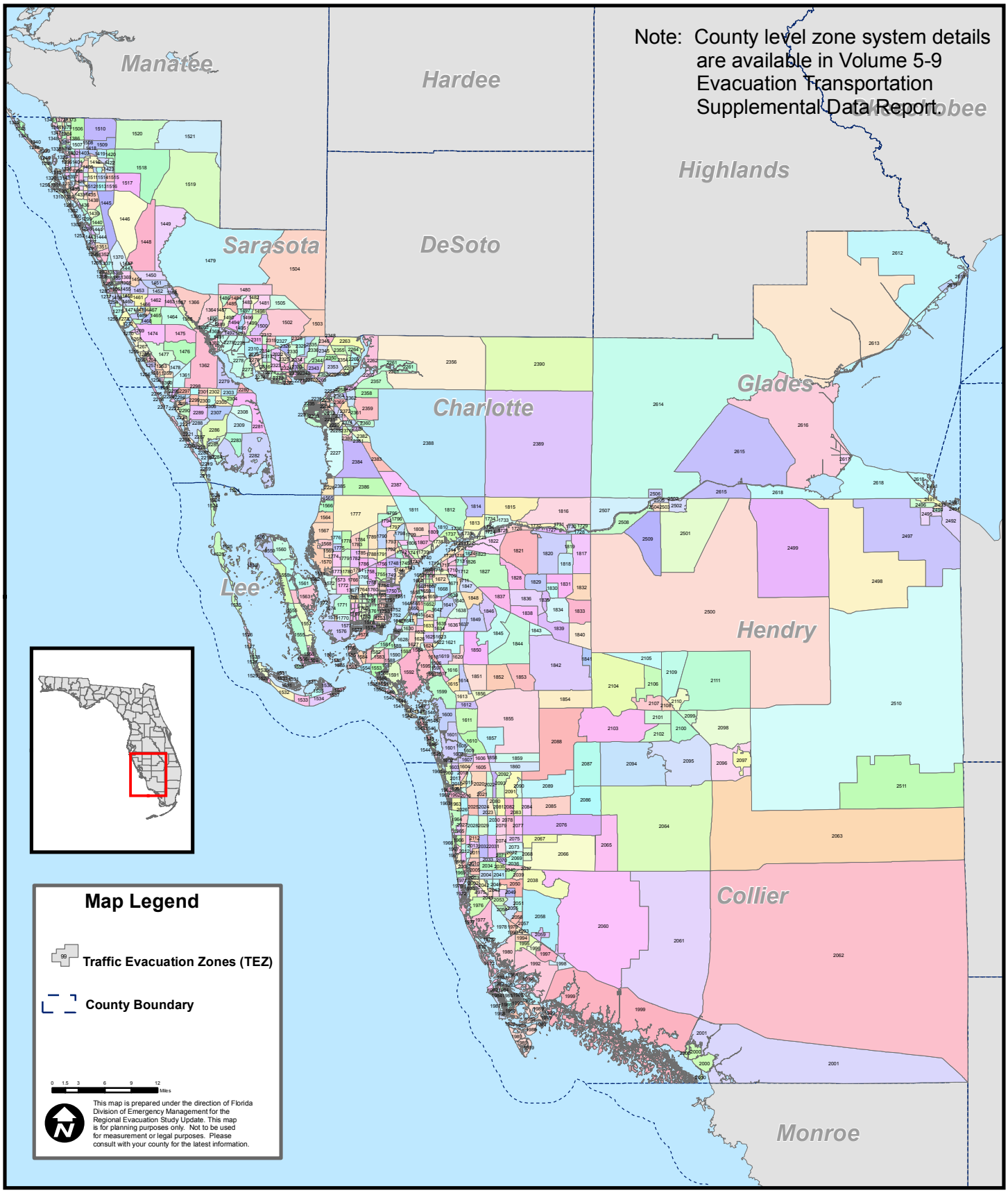
This map is prepared under the direction of Florida Division of Emergency Management for the Regional Evacuation Study Update. This map is for planning purposes only. Not to be used for measurement or legal purposes. Please consult with your county for the latest information.

Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: November, 2010

Figure ES- 3

Southwest Regional Model Transportation Evacuation Zone (TEZ) System



Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Lee County has the largest population in the region during all three time periods. The county is expected to reach over 670,000 people by 2015. Sarasota County has the second largest population in the region and is forecasted to have more that 440,000 people by 2015. Glades County has the smallest population in the region; the county is expected to have just more than 11,000 people by 2015.

Table ES-1 – Southwest Florida Demographic Characteristic Summary

County	Characteristic	Year		
		2006	2010	2015
Charlotte	Occupied site-built homes	67,738	75,962	87,992
	Population in site-built homes	151,896	166,676	182,451
	Occupied mobile homes	6,134	5,991	6,223
	Population in mobile home	10,450	10,162	10,476
	Hotel/motel units	2,805	3,132	3,893
Collier	Occupied site-built homes	115,997	123,529	107,795
	Population in site-built homes	279,001	307,337	338,168
	Occupied mobile homes	6,099	5,671	5,558
	Population in mobile home	15,056	13,838	13,625
	Hotel/motel units	10,834	11,029	11,269
Glades	Occupied site-built homes	1,697	1,898	2,140
	Population in site-built homes	4,220	4,677	5,056
	Occupied mobile homes	2,160	2,252	2,394
	Population in mobile home	5,419	5,704	6,134
	Hotel/motel units	244	244	244
Hendry	Occupied site-built homes	6,802	7,383	7,777
	Population in site-built homes	20,023	21,834	23,061
	Occupied mobile homes	4,999	5,343	6,017
	Population in mobile home	16,438	17,528	19,512
	Hotel/motel units	726	726	726
Lee	Occupied site-built homes	214,412	225,915	216,990
	Population in site-built homes	517,285	563,420	598,350
	Occupied mobile homes	25,672	30,648	47,650
	Population in mobile home	46,224	54,076	78,846
	Hotel/motel units	15,208	16,766	19,319
Sarasota	Occupied site-built homes	152,151	165,633	178,988
	Population in site-built homes	342,336	374,391	405,919
	Occupied mobile homes	15,542	17,064	20,901
	Population in mobile home	25,740	28,281	34,847
	Hotel/motel units	12,991	13,152	13,257

Source: Southwest Florida Regional Planning Council

- **Planned Roadway Improvements** - To correspond to the three different sets of demographic data, three model networks were ultimately developed. The base 2006 network and two future year networks to correspond to the 2010 demographic data and the 2015 demographic data. The 2006 base model network was updated to reflect roadway capacity improvement projects completed between 2006 and 2010 to create the 2010 network. The 2010 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2011 and 2015 to create the 2015 network.

  The planned roadway improvements that were added to the network generally include only capacity improvement projects such as additional through lanes. **Table ES-2** identifies capacity improvement projects completed between 2006 and 2010 that were included in the 2010 network. Likewise, **Table ES-3** identifies capacity improvement projects planned for implementation between 2011 and 2015. The tables identify each roadway that will be improved as well as the extent of the improvement. For example, by the end of 2015 in Charlotte County, Toledo Blade Blvd from US 41 to Hillsborough Blvd will be widened to 4 lanes.

  It is important to note that Tables ES-2 and ES-3 are not intended to be all inclusive of every transportation improvement project completed within the region. The tables only identify key capacity improvement projects that impact the evacuation model network and are anticipated to have an impact on evacuation clearance times.

- **Behavioral Assumptions** - For the Southwest Florida Region, all six counties within the region have evacuation zones corresponding to different categories of storm surge. Evacuation rates for site-built homes and mobile/manufactured homes are provided by county and summarized in **Figure ES-4** through **Figure ES-15**. Other rates, such as out of county trip rates, vehicle use rates, public shelter use rates, friend/relative refuge use rates, hotel/motel refuge use rates, and other refuge use rates, are detailed by county, storm threat, and evacuation zone in Volume 5-9.

  Please note that the original behavioral response rates provided by SRESP in Volume 2-9 were modified to fit the evacuation zones created for Glades and Hendry Counties. The original rates for Glades and Hendry were based on the assumption that those counties were inland areas with no evacuation zones; however, for the purpose of the transportation analysis, both counties utilize five zones.

- **Shelters** - In order for the transportation model to accurately assign public shelter trips to the correct location, a complete list of available public shelters needs to be available. In the six county region there are a total of 175 shelters, including 18 in Charlotte County, 56 in Collier County, 12 in Glades County, 17 in Hendry County, 50 in Lee County, and 22 in Sarasota County. The total number of shelters for Southwest Florida includes other shelters as well as those shelters compliant with ARC standards/risk shelters. All together, the 175 shelters located within the six county region can host more than 100,000 persons during an evacuation event. Detailed lists of the primary and other shelters used in the transportation analysis are included in Volume 5-9. It is important to note that the shelter list used in the transportation analysis was developed early in the study process and may not match the latest available list of primary and other shelters from each county.

Table ES-2 – Southwest Florida Roadway Improvements, 2006 – 2010

County	Roadway	From	To	Number of Lanes
Charlotte	Kings Highway	I-75	Desoto County line	4
	Veterans Blvd	Toledo Blade Rd	Kings Highway	4
Collier	CR 951 (Collier Blvd)	Green Blvd	Golden Gate Blvd	4
	CR 858 (Oil Well Rd)	CR 846 (Immokalee Rd)	Everglades Blvd	4
	Golden Gate Pkwy	Livingston Rd	Santa Barbara Blvd	6
	Immokalee Rd	US 41	Oil Well Rd	6
	SR 84 (Davis Blvd)	Santa Barbara Blvd	Radio Rd	6
Collier/Lee	I-75	Golden Gate Pkwy	Colonial Blvd (SR 884)	6
Hendry	SR 80 (Palm Beach Blvd)	Clark Street	Birchwood Pkwy	4
Lee	I-75	S of Colonial Blvd	S of SR 82	6
	SR 78	Chiquita Blvd	Del Prado Blvd	4
	SR 739 (Metro Pkwy)	Six Mile Cypress Pkwy	Daniels Pkwy	6
	SR 739 (Metro Parkway)	US 41	Six Mile Cypress Pkwy	6
	SR 739	Six Mile Cypress Pkwy	Daniels Pkwy	6
	SR 82 (MLK Blvd)	Ortiz Ave	Lee Blvd	6
	US 41	Bonita Beach Rd	Old US 41	6
Sarasota	US 301	Wood St	University Pkwy	6
	US 301	29th St	Northgate Blvd	6
	I-75	River Rd	SR 681	6
	US 41	US 41 Business	Laurel Rd	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Southwest Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects completed between 2006 and 2010 on roadways that are included in the regional transportation model network. Only projects which added roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project completed within the region. A list of historical projects completed during the last five years was included in this report because the base regional network developed for the study, along with the base demographic data, is for the year 2006.

Table ES-3 - Southwest Florida Planned Roadway Improvements, 2011–2015

County	Roadway	From	To	Number of Lanes
Charlotte	Toledo Blade Blvd	US 41	Hillsborough Blvd	4
	US 41	Enterprise Dr	Flamingo Blvd	4
	Burntstore Rd	Notre Dame Rd	US 41	4
Lee	Ortiz Ave	SR 884	SR 82	4
	I-75	S of SR 82	S of Luckett Rd	6
	US 41	Corkscrew Rd	San Carlos Blvd	6
	Del Prado Pkwy	NE 7th St	S of Diplomat Pkwy	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Southwest Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects planned for completion between 2011 and 2015 on roadways that are included in the regional transportation model network. Only projects which are planned to add roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project planned for completion within the region.

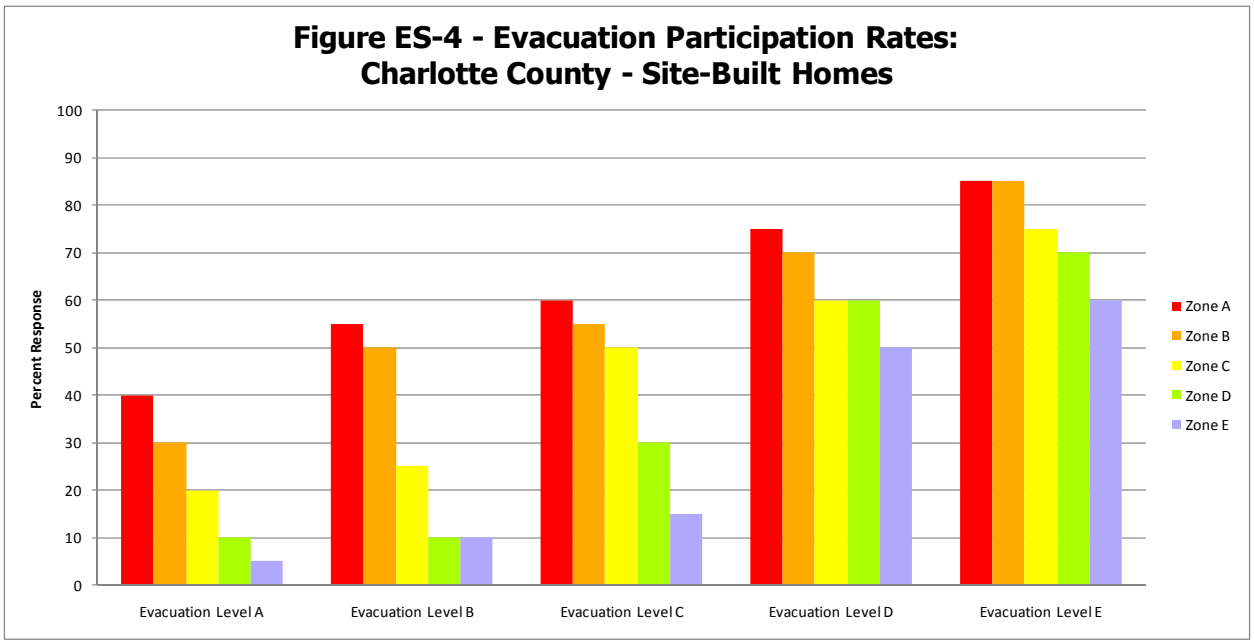


Figure ES-4 - Evacuation Participation Rates:
Charlotte County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

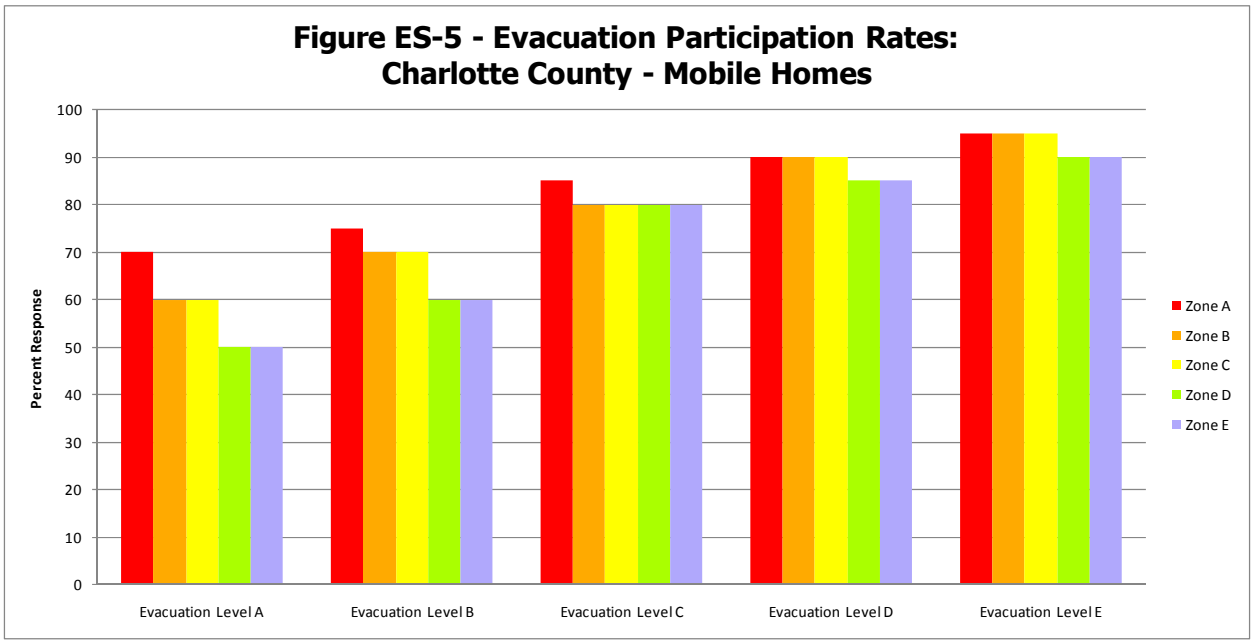


Figure ES-5 - Evacuation Participation Rates:
Charlotte County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

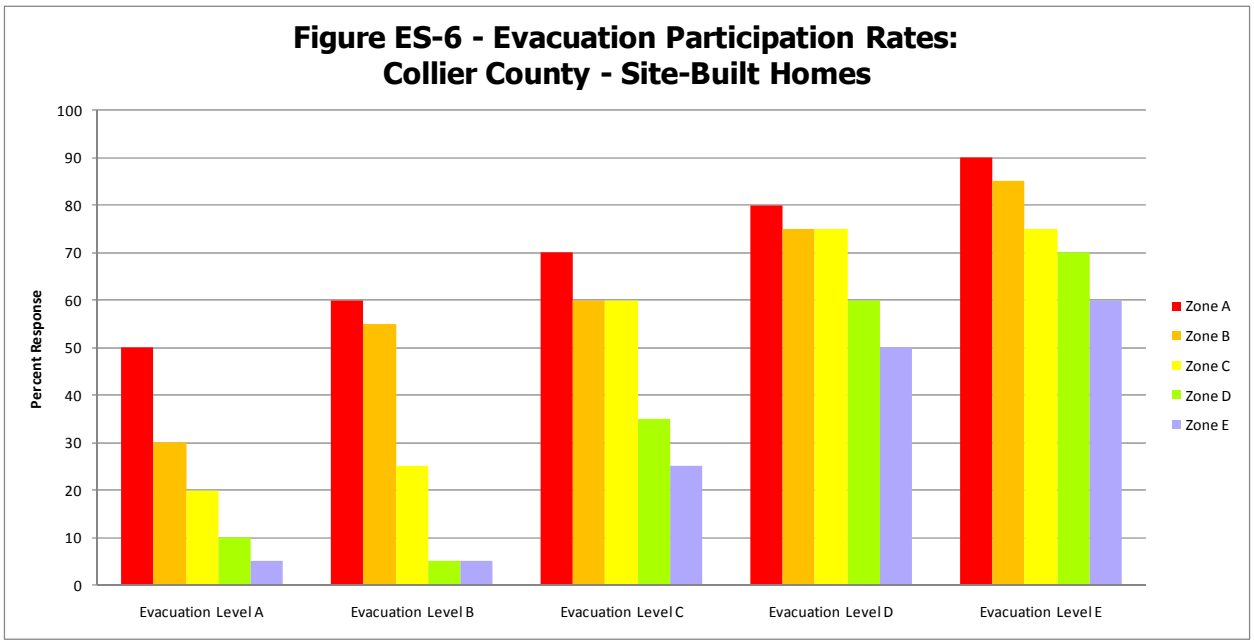


Figure ES-6 - Evacuation Participation Rates:
Collier County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

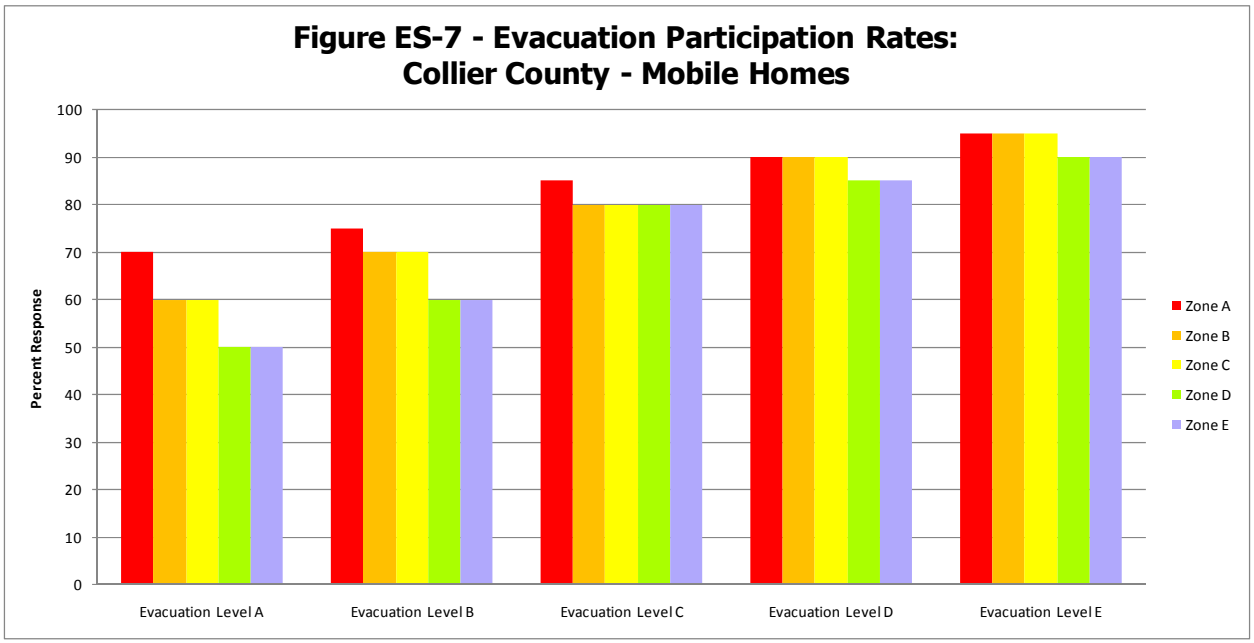


Figure ES-7 - Evacuation Participation Rates:
Collier County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

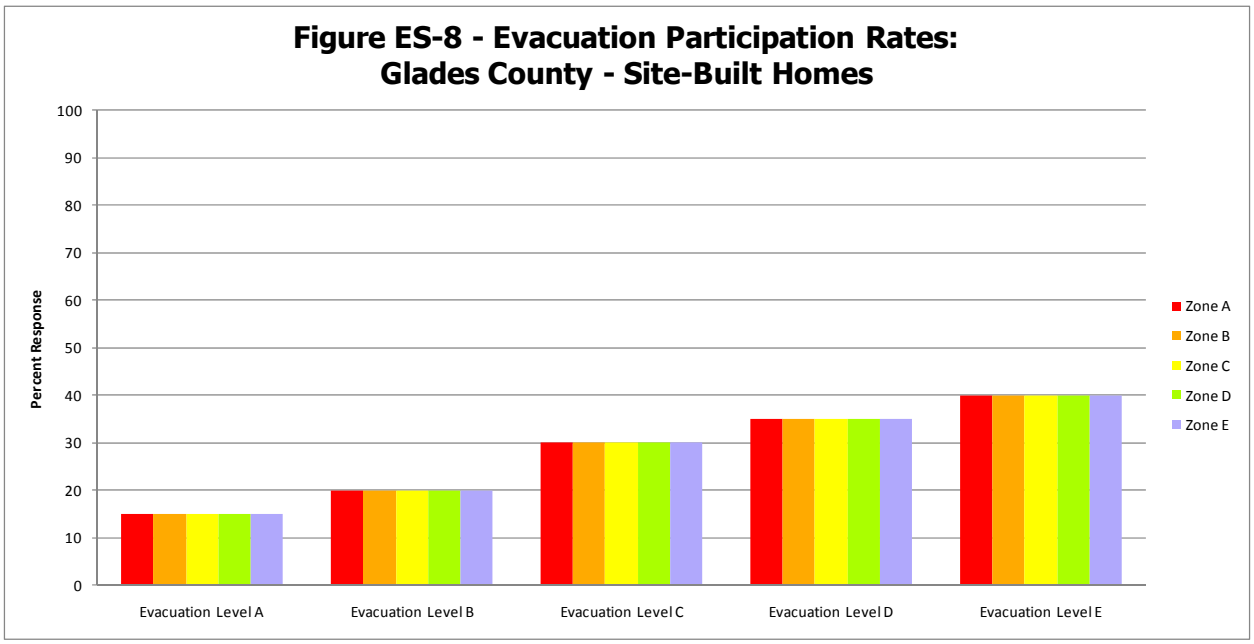


Figure ES-8 - Evacuation Participation Rates:
Glades County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

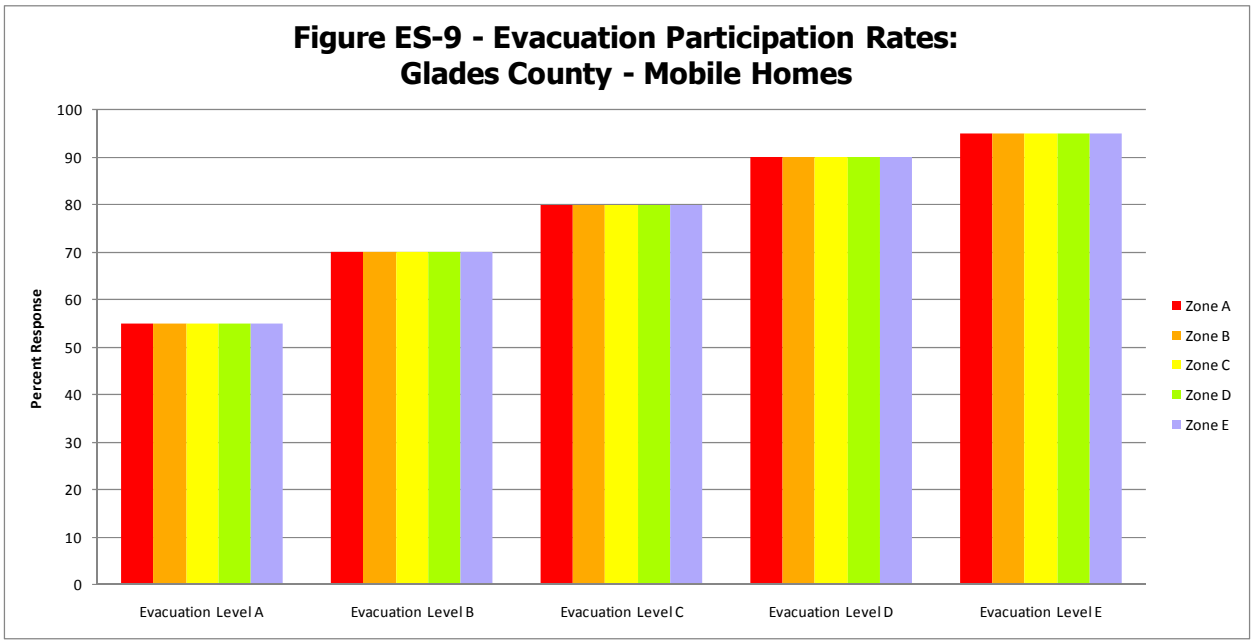


Figure ES-9 - Evacuation Participation Rates:
Glades County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

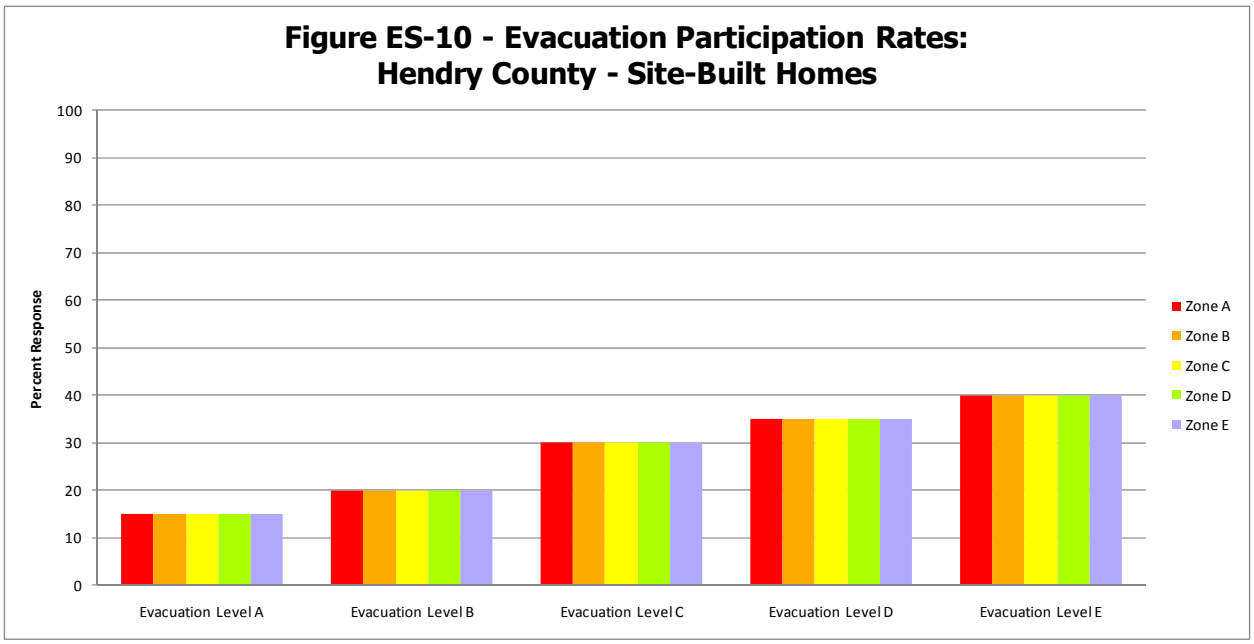


Figure ES-10 - Evacuation Participation Rates:
Hendry County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

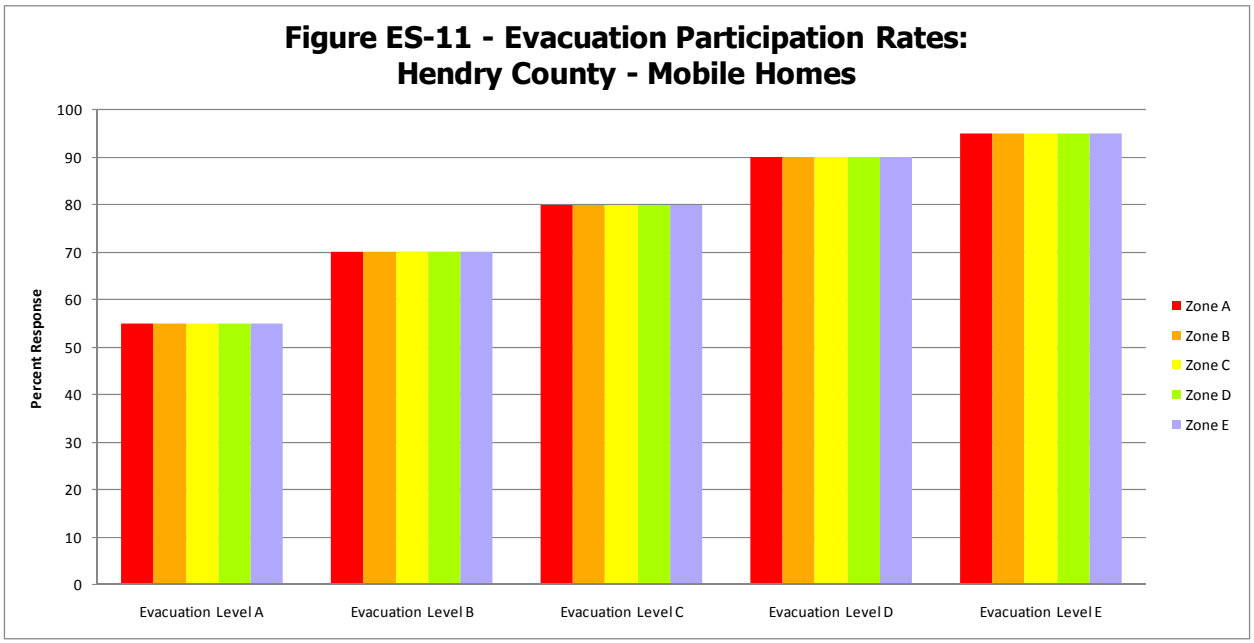


Figure ES-11 - Evacuation Participation Rates:
Hendry County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

Figure ES-12 - Evacuation Participation Rates: Lee County - Site-Built Homes

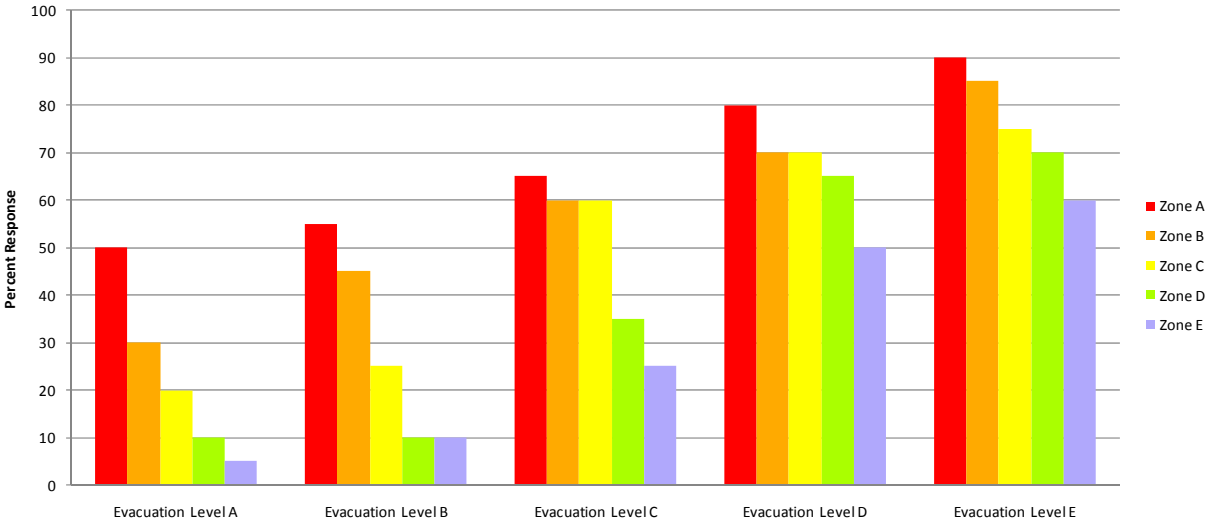


Figure ES-13 - Evacuation Participation Rates: Lee County - Mobile Homes

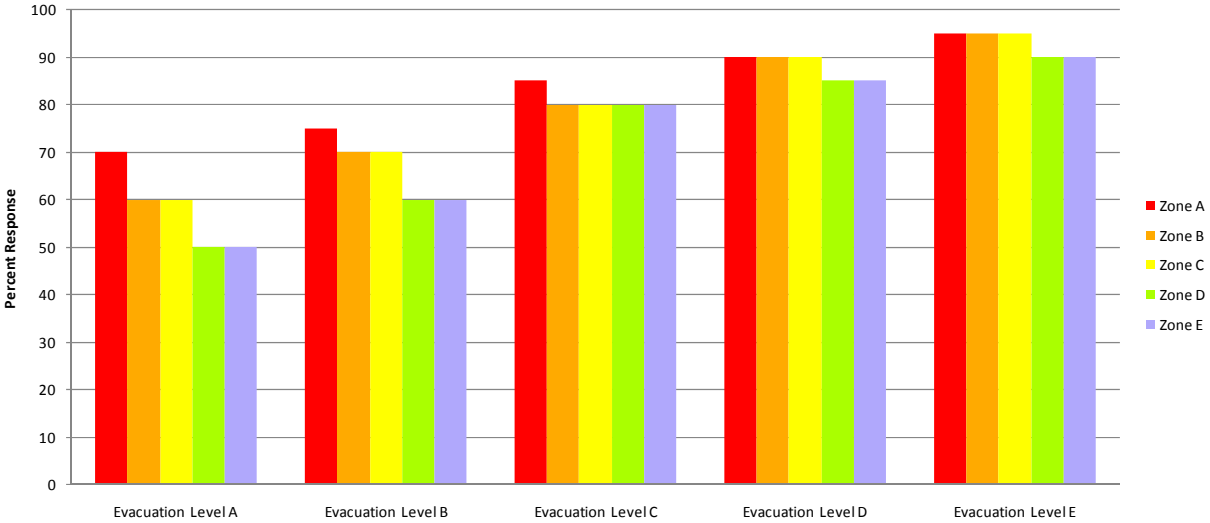


Figure ES-14 - Evacuation Participation Rates: Sarasota County - Site-Built Homes

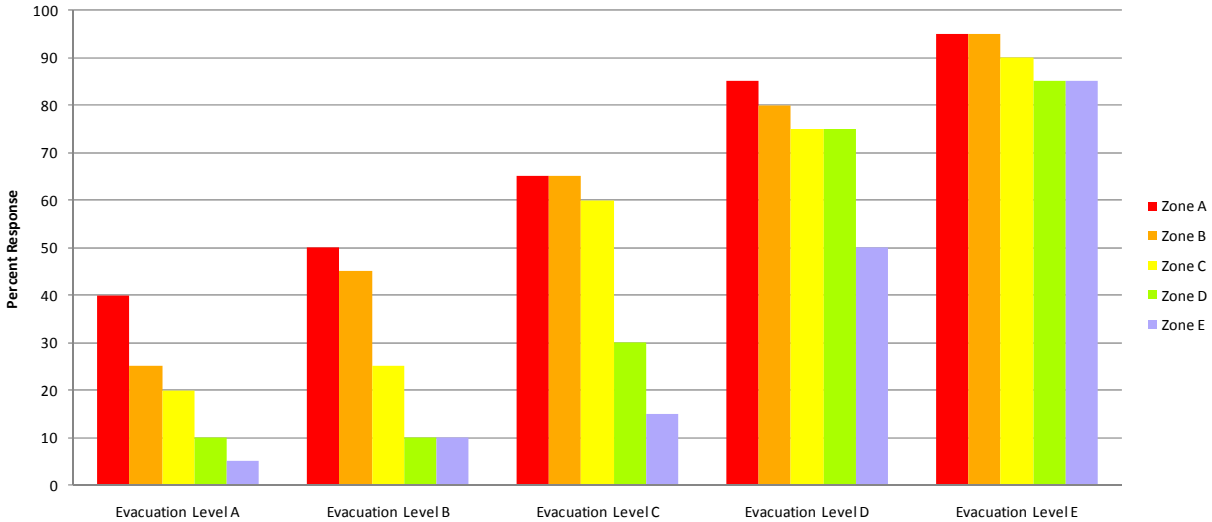
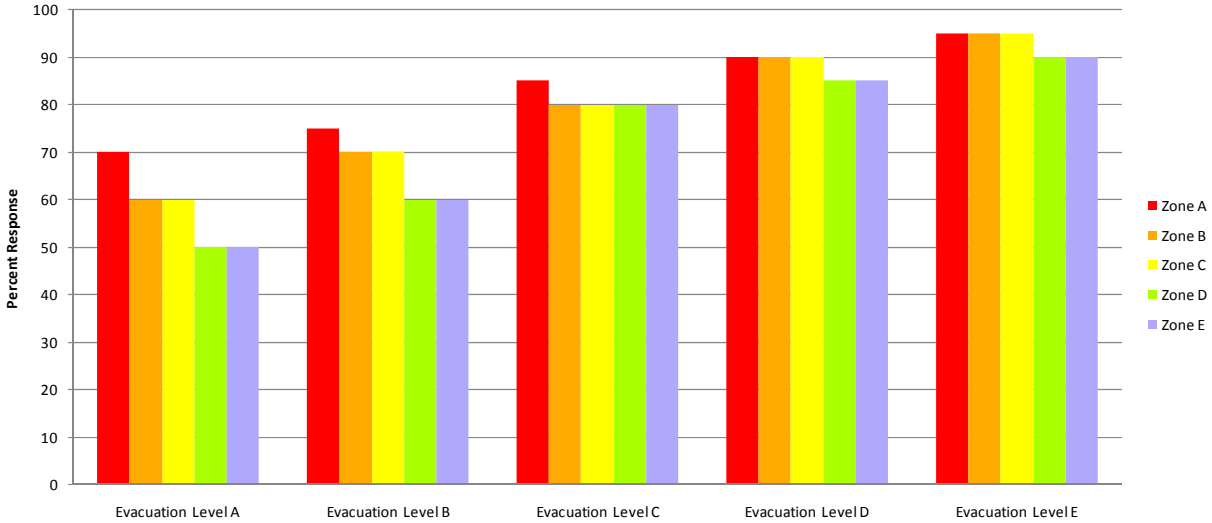


Figure ES-15 - Evacuation Participation Rates: Sarasota County - Mobile Homes



- **Evacuation Zones** - The final input variable that is needed to complete the transportation evacuation model is the delineation of evacuation zones for all coastal counties. Local county emergency managers have the responsibility of identifying and defining evacuation zones for their county. Within the Southwest Florida region, Charlotte, Collier, Glades, Hendry, Lee and Sarasota Counties have updated and established their evacuation zones based on the results of the new data and information collected as part of the SRESP. County level evacuation zones are included in Volume 5-9.

F. TIME User Interface

Wilbur Smith Associates developed the Transportation Interface for Modeling Evacuations (TIME) to make it easier for RPC staff and transportation planners to use the model and implement the evacuation methodology. The TIME interface is based on an ArcGIS platform and is essentially a condensed transportation model, which provides a user friendly means of modifying input variables that would change the clearance times for various evacuation scenarios.

The evacuation model variables include a set of distinguishing characteristics that could apply to evacuation scenarios as selection criteria. These following variables may be selected using the TIME interface and allow the user to retrieve the best results from various evacuation alternatives:

- Analysis time period;
- Highway network;
- Behavioral response;
- One-way evacuation operations;
- University population;
- Tourist occupancy rates;
- Shelters;
- Counties evacuating;
- Evacuation level;
- Response curve hours; and,
- Evacuation Phasing.

G. Vulnerable Population

Using a combination of the demographic data, behavioral assumptions, and evacuation zones, the vulnerable population in each county could be determined by evacuation level. For the purposes of the transportation analysis, the vulnerable population, or population-at-risk, is defined as the total population living within the county designated evacuation zones for each evacuation level. This population is living in an area that is at risk for severe flooding during a storm event. The vulnerable population for the Southwest Florida Region for 2010 is identified in **Table ES-4**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2015 is summarized in **Table ES-5**.

Table ES-4 – Vulnerable Population in the Southwest Florida Region for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
Site-built Homes	45,862	88,357	28,011	3,326	230
Mobile/Manuf. Homes	2,460	4,637	1,107	1,869	19
TOTAL	48,322	92,994	29,118	5,195	249
Collier County					
Site-built Homes	85,217	127,260	75,144	8,786	2,552
Mobile/Manuf. Homes	4,537	3,664	1,056	369	1,322
TOTAL	89,754	130,924	76,200	9,155	3,874
Glades County					
Site-built Homes	336	287	296	525	193
Mobile/Manuf. Homes	268	356	378	660	215
TOTAL	604	643	674	1,185	408
Hendry County					
Site-built Homes	739	137	229	60	0
Mobile/Manuf. Homes	1,529	170	45	10	0
TOTAL	2,268	307	274	70	0
Lee County					
Site-built Homes	95,163	245,594	118,236	40,296	47,096
Mobile/Manuf. Homes	17,500	16,638	19,304	411	0
TOTAL	112,663	262,232	137,540	40,707	47,096
Sarasota County					
Site-built Homes	26,182	48,068	107,295	66,128	37,745
Mobile/Manuf. Homes	3,501	7,172	7,423	2,659	1,506
TOTAL	29,683	55,240	114,718	68,787	39,251

Note: Vulnerable population determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table ES-5 – Vulnerable Population in the Southwest Florida Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
Site-built Homes	75,303	81,803	22,207	2,319	151
Mobile/Manuf. Homes	2,201	4,799	1,123	2,241	28
TOTAL	77,504	86,602	23,330	4,560	179
Collier County					
Site-built Homes	145,306	99,170	72,740	12,586	1,908
Mobile/Manuf. Homes	4,171	3,491	1,059	411	1,436
TOTAL	149,477	102,661	73,799	12,997	3,344
Glades County					
Site-built Homes	507	286	357	474	165
Mobile/Manuf. Homes	270	378	391	668	215
TOTAL	777	664	748	1,142	380
Hendry County					
Site-built Homes	767	140	191	56	0
Mobile/Manuf. Homes	1,550	172	46	10	0
TOTAL	2,317	312	237	66	0
Lee County					
Site-built Homes	72,531	202,454	156,318	70,136	77,885
Mobile/Manuf. Homes	32,351	21,691	24,037	492	0
TOTAL	104,882	224,145	180,355	70,628	77,885
Sarasota County					
Site-built Homes	17,781	44,214	133,880	94,657	29,181
Mobile/Manuf. Homes	4,995	9,114	9,152	3,613	1,816
TOTAL	22,776	53,328	143,032	98,270	30,997

Note: Vulnerable population determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

In addition, based again on the demographic data, behavioral assumptions, and evacuation zones, the planned destinations of vulnerable population in each county could be determined by evacuation level. Destinations include friends and family, hotel/motel, public shelter, and other locations. Vulnerable population destinations for the Southwest Florida Region are identified in **Table ES-6** for 2010 and in **Table ES-7** for 2015.

The vulnerable shadow population is provided in **Table ES-8** for both 2010 and 2015. The vulnerable shadow population was determined using the behavioral assumptions for evacuating shadow population and is based on evacuation level (storm category), not evacuation zone.

Table ES-6 – Vulnerable Population by Destination for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
To Friends and Family	26,823	51,610	16,125	3,045	139
To Hotel/ Motel	11,957	23,017	7,224	1,206	61
To Public Shelter	3,792	7,300	2,352	586	31
To Other Destination	5,749	11,067	3,417	360	19
Collier County					
To Friends and Family	53,625	78,371	45,614	5,456	2,192
To Hotel/ Motel	22,665	32,914	19,103	2,307	969
To Public Shelter	7,044	12,909	7,620	1,091	505
To Other Destination	8,975	9,275	5,366	476	260
Glades County					
To Friends and Family	349	368	386	678	234
To Hotel/ Motel	74	82	86	151	52
To Public Shelter	91	96	101	178	61
To Other Destination	91	96	101	178	61
Hendry County					
To Friends and Family	1,513	202	169	43	0
To Hotel/ Motel	150	22	25	6	0
To Public Shelter	454	62	55	14	0
To Other Destination	150	22	25	6	0
Lee County					
To Friends and Family	66,723	156,508	80,594	24,383	28,258
To Hotel/ Motel	28,166	65,558	34,385	8,162	9,419
To Public Shelter	5,633	13,112	7,842	4,877	5,652
To Other Destination	12,141	27,055	14,719	3,285	3,768
Sarasota County					
To Friends and Family	18,769	32,427	68,088	41,006	23,400
To Hotel/ Motel	7,246	11,048	22,944	13,757	7,850
To Public Shelter	1,834	5,280	10,068	8,467	4,831
To Other Destination	1,834	6,485	13,618	5,556	3,170

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table ES-7 – Vulnerable Population by Destination for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
To Friends and Family	42,848	48,111	12,944	2,732	101
To Hotel/ Motel	19,266	21,411	5,777	1,028	42
To Public Shelter	6,134	6,784	1,889	502	22
To Other Destination	9,257	10,296	2,721	298	14
Collier County					
To Friends and Family	89,478	61,422	44,173	7,757	1,863
To Hotel/ Motel	37,578	25,840	18,503	3,270	836
To Public Shelter	11,833	10,092	7,380	1,551	444
To Other Destination	14,948	7,291	5,198	670	239
Glades County					
To Friends and Family	453	380	429	652	217
To Hotel/ Motel	91	85	94	148	49
To Public Shelter	117	100	112	171	57
To Other Destination	117	100	112	171	57
Hendry County					
To Friends and Family	1,545	205	147	41	0
To Hotel/ Motel	154	23	21	6	0
To Public Shelter	463	63	47	13	0
To Other Destination	154	23	21	6	0
Lee County					
To Friends and Family	61,311	133,402	105,809	42,328	46,731
To Hotel/ Motel	26,220	56,036	45,089	14,150	15,577
To Public Shelter	5,244	11,207	10,220	8,466	9,346
To Other Destination	12,106	23,499	19,237	5,685	6,231
Sarasota County					
To Friends and Family	14,055	31,085	84,904	58,601	18,417
To Hotel/ Motel	5,444	10,666	28,606	19,654	6,200
To Public Shelter	1,638	5,360	12,541	12,082	3,865
To Other Destination	1,638	6,217	16,981	7,934	2,516

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table ES-8 – Vulnerable Shadow Evacuation Population

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
Charlotte County	41,409	13,877	7,170	4,486	4,397
Collier County	70,131	39,209	24,137	22,172	19,572
Glades County	6,064	5,867	5,844	5,229	5,130
Hendry County	19,261	20,177	22,159	23,164	24,197
Lee County	154,098	76,609	49,073	47,813	25,840
Sarasota County	78,833	69,455	62,663	54,971	41,846
2015					
Charlotte County	38,874	13,165	8,186	5,392	5,322
Collier County	62,127	39,586	26,502	22,815	20,424
Glades County	6,533	6,326	6,294	5,697	5,619
Hendry County	21,398	22,369	24,478	25,545	26,638
Lee County	166,187	100,455	70,751	66,733	29,398
Sarasota County	90,633	81,248	71,007	50,749	41,475

Note: Vulnerable shadow population determined using SRESP behavioral data and county provided evacuation zones.

H. Evacuation Model Scenarios

There are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. For the purposes of this analysis, two distinct sets of analyses were conducted using the SRESP evacuation transportation model, including one set of analysis for growth management purposes and one set of analysis for emergency management purposes. The two sets of analysis include the following:

- **Base Scenarios** – The base scenarios were developed to estimate a series of worst case scenarios and are identical for all eleven RPCs across the State. These scenarios assume 100 percent of the vulnerable population evacuates and includes impacts from counties outside of the RPC area. These scenarios are generally designed for growth management purposes, in order to ensure that all residents that choose to evacuate during an event are able to do so. The base scenarios for the Southwest Florida region are identified in **Table ES-9**; and,

- **Operational Scenarios** – The operational scenarios were developed by the RPCs in coordination with local county emergency managers and are designed to provide important information to emergency management personnel to plan for different storm events. These scenarios are different from region to region and vary for each evacuation level. The operational scenarios for the Southwest Florida region are identified in **Table ES-10**.

Because of the numerous possible combinations of variables that can be applied in the model, the evacuation transportation model is available for use through the Southwest Florida RPC to continue testing combinations of options and provide additional information to emergency managers.

I. Clearance Time Results

Each of the ten base scenarios and ten operational scenarios were modeled for the Southwest Florida Region using the regional evacuation model. Results were derived from the model to summarize the evacuating population, evacuating vehicles, clearance times, and critical congested roadways. Detailed results are discussed in Chapter IV. Clearance times are presented in this executive summary since the determination of clearance time is one of the most important outcomes from the evacuation transportation analysis.

Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. This calculation can include the population-at-risk, shadow evacuees, as well as evacuees from other counties anticipated to pass through the county. Clearance time is developed to include the time required for evacuees to secure their homes and prepare to leave, the time spent by all vehicles traveling along the evacuation route network, and the additional time spent on the road caused by traffic and road congestion. Clearance time does not relate to the time any one vehicle spends traveling along the evacuation route network, nor does it guarantee vehicles will safely reach their destination once outside the County. The four clearance times that are calculated as part of the evacuation transportation analysis include the following:

Table ES-9 – Base Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)

ML – includes mainland portion of Monroe County only.

Table ES-10 – Operational Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	12-hour	18-hour	18-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Collier Lee Monroe (ML) Hendry Glades Okeechobee Highlands	Sarasota Charlotte Lee DeSoto Glades (A) Hendry (A) Collier (A) Highlands (A)	Collier Lee Charlotte Sarasota (B) Monroe (ML-B) Glades (B) Hendry (B) Highlands (B) DeSoto (B)	Collier Lee Charlotte Sarasota (C) Monroe (ML-C) Glades (C) Hendry (C) Highlands (C) DeSoto (C) Okeechobee (B)	Collier Lee Charlotte Sarasota Monroe Manatee (D) Glades (D) Hendry (D) Highlands (C) DeSoto (C) Okeechobee (C) Hardee (C) Polk (C)
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	12-hour	18-hour	18-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Sarasota Lee Charlotte Manatee DeSoto Highlands Glades	Collier Charlotte Lee DeSoto Glades (A) Hendry (A) Sarasota (A) Highlands (A)	Sarasota Lee Charlotte Collier (B) Manatee (B) Glades (B) Hardee (B) Highlands (B) DeSoto (B) Hendry (B)	Sarasota Lee Charlotte Collier (C) Manatee (C) Glades (C) Hendry (C) Highlands (C) DeSoto (C) Hardee (C)	Broward Palm Beach Martin Highlands (D) Glades (D) Hendry (D) Okeechobee (D) Lee (C) Sarasota (C) Charlotte (C) DeSoto (C) Hardee (C) Collier (B)

(ML) – includes the mainland portion of Monroe County only.

- **Clearance Time to Shelter** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point in time when the evacuation order is given to the point in time when the last vehicle reaches a point of safety within the county. Key points to remember for clearance time to shelter include:
  - All in-county trips reach their destination within the county; and,
  - This definition does not include any out of county trips.

- **In-County Clearance Time** - The time required from the point an evacuation order is given until the last evacuee can either leave the evacuation zone or arrive at safe shelter within the county. This does not include those evacuees leaving the county on their own. Key points to remember for in-county clearance time include:
  - All in-county trips reach their destination within the county;
  - All out of county trips exit the evacuation zone, but may still be located in the county; and,
  - This definition does not include out-of-county pass-through trips from adjacent counties, unless they evacuate through an evacuation zone.

- **Out of County Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point an evacuation order is given to the point in time when the last vehicle assigned an external destination exits the county. Key points to remember for out of county clearance time include:
  - The roadway network within the county is clear;
  - All out of county trips exit the county, including out of county pass-through trips from adjacent counties; and,
  - All in-county trips reach their destination.

- **Regional Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the (RPC) region based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from last vehicle assigned an external destination exits the region. Key points to remember for regional clearance time include:
  - The roadway network within the RPC is clear;
  - All out of county trips exit the RPC, including out of county pass-through trips from adjacent counties;
  - All in-county trips reach their destination; and,
  - Regional clearance time is equal to the largest out of county clearance time for a given scenario for any of the counties within the RPC, since the out of county clearance time includes out of county pass through trips from adjacent counties.

Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. Clearance times for each of the base scenarios are summarized in **Table ES-11** and **ES-12**, while clearance times for each of the operational scenarios are summarized in **Table ES-13** and **Table ES-14.** Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongs, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

Base Scenarios

In-county clearance times for the base scenarios range from 13 hours for the evacuation level A scenarios to 70.5 hours for Charlotte County for evacuation level E scenario in 2010. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 11.5 hours for the evacuation level A scenarios to 66.5 hours for Collier County for evacuation level E scenario in 2010.

In 2015, in-county clearance times for the base scenarios increase slightly to between 13 hours for the evacuation level A scenarios and 78 hours for Sarasota County for the evacuation level E scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 11.5 hours for the evacuation level A scenarios to 74.5 hours for Lee County for evacuation level E scenario in 2015.

Out of county clearance times for the base scenarios range from 14 hours for the base evacuation level A scenario to 89.5 hours in Glades County for the evacuation level E scenario. Out of county clearance times remain relatively constant in 2015, with Glades County at 89 hours for evacuation level E.

Regional clearance time for the six county SWFRPC region ranges from 15.5 hours to 89.5 hours in 2010 and from 15.5 to 89 hours in 2015.

Operational Scenarios

In-county clearance times for the 2010 operational scenarios range from 0 hours to 51 hours depending upon the scenario. Counties that were not included in the evacuation scenario will have an in-county clearance time of 0 since no one within the county is evacuating. Clearance Time to Shelter shows a similar pattern, with clearance times for the operational scenarios ranging from 0 hours to 35.5 hours depending upon the county and the scenario.

In 2015, in-county clearance times for the operational scenarios vary from 0 hours to 34.5 hours for the level D evacuation in Sarasota County. The 2015 level E evacuation includes vehicle trips evacuating from the Treasure Coast region, which is why clearance times within the Southwest region are lower for the operational level E scenario than the operational level D scenario. Clearance Time to Shelter shows a similar pattern to the 2010 scenarios, with clearance times for the base scenarios ranging from 0 hours to 32 hours depending upon the scenario.

Out of county clearance times for the 2010 operational scenarios range from 10.5 hours to 51.5 hours for the evacuation level E scenario. Out of county clearance times for all counties in 2015 range from 10.5 to 35 hours depending upon the scenario. Regional clearance time for the six county SWFRPC region ranges from 13 hours to 51.5 hours in 2010 and between 12 and 35 hours in 2015.

Table ES-11 – 2010 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
Charlotte County	13.5	18.5	25.5	50.0	62.0
Collier County	13.0	19.0	38.5	45.5	66.5
Glades County	11.5	11.5	11.5	11.5	12.0
Hendry County	13.5	16.0	31.5	39.5	55.5
Lee County	13.0	19.0	42.0	48.0	63.0
Sarasota County	13.0	19.5	30.5	40.5	65.5
In-County Clearance Time					
Charlotte County	15.0	26.5	45.0	52.0	70.5
Collier County	14.0	19.0	39.0	46.0	68.5
Glades County	13.0	13.0	13.0	13.0	13.5
Hendry County	14.0	16.5	43.5	52.0	66.0
Lee County	13.5	23.0	43.5	52.5	66.0
Sarasota County	15.5	27.0	45.0	52.5	69.5
Out of County Clearance Time					
Charlotte County	15.0	26.5	45.0	52.0	70.5
Collier County	14.5	19.5	44.5	46.0	69.0
Glades County	15.5	24.0	45.0	62.5	89.5
Hendry County	14.5	24.0	44.5	53.5	71.0
Lee County	14.0	23.0	43.5	52.5	66.0
Sarasota County	15.5	27.0	45.0	52.5	69.5
Regional Clearance Time					
Southwest	15.5	27.0	45.0	62.5	89.5

Table ES-12 – 2015 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
Charlotte County	13.5	17.0	28.5	39.5	52.5
Collier County	13.0	18.0	37.0	45.5	55.0
Glades County	11.5	11.5	11.5	11.5	11.5
Hendry County	13.0	13.5	36.5	45.5	47.5
Lee County	13.0	17.0	36.5	45.5	74.5
Sarasota County	13.0	18.0	35.0	49.5	60.0
In-County Clearance Time					
Charlotte County	14.5	19.0	41.0	49.0	77.5
Collier County	14.0	18.0	37.0	46.5	68.0
Glades County	13.0	13.0	13.0	13.0	13.0
Hendry County	13.5	14.0	40.0	45.5	77.0
Lee County	14.0	18.5	40.5	49.5	77.0
Sarasota County	15.0	20.0	43.5	50.0	78.0
Out of County Clearance Time					
Charlotte County	15.0	19.5	41.0	49.0	77.5
Collier County	14.5	20.0	40.5	47.0	70.0
Glades County	15.0	23.5	41.5	62.5	89.0
Hendry County	14.5	21.5	41.0	53.0	77.5
Lee County	14.5	18.5	40.5	49.5	77.0
Sarasota County	15.5	20.5	43.5	50.5	79.0
Regional Clearance Time					
Southwest	15.5	23.5	43.5	62.5	89.0

Table ES-13 – 2010 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
Charlotte County	0.0	13.5	19.0	19.5	27.0
Collier County	10.0	13.0	17.0	28.5	35.5
Glades County	7.0	9.0	10.5	14.0	15.0
Hendry County	10.5	12.0	17.0	19.5	35.0
Lee County	10.0	13.0	19.5	27.5	35.5
Sarasota County	0.0	13.0	14.5	19.0	30.0
In-County Clearance Time					
Charlotte County	0.0	14.0	25.0	33.0	51.0
Collier County	10.0	14.0	17.5	28.5	37.0
Glades County	9.0	12.5	12.5	16.5	17.0
Hendry County	11.0	13.5	17.5	29.5	37.5
Lee County	10.5	14.0	20.0	32.5	40.5
Sarasota County	0.0	14.5	25.5	33.5	51.0
Out of County Clearance Time					
Charlotte County	12.5	14.5	25.0	33.0	51.0
Collier County	10.5	14.0	19.0	31.5	38.0
Glades County	12.5	16.0	27.0	33.0	42.5
Hendry County	11.5	14.5	23.0	32.5	42.5
Lee County	10.5	14.0	20.0	32.5	40.5
Sarasota County	12.5	15.0	26.0	34.0	51.5
Regional Clearance Time					
Southwest	13.0	16.0	27.0	34.0	51.5

Table ES-14 – 2015 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
Charlotte County	10.0	13.0	20.0	30.0	20.0
Collier County	0.0	13.0	14.5	23.5	19.0
Glades County	8.0	10.5	11.0	15.5	14.5
Hendry County	0.0	13.5	14.0	24.0	20.5
Lee County	10.0	13.0	20.5	24.0	20.0
Sarasota County	10.0	13.0	19.0	32.0	20.5
In-County Clearance Time					
Charlotte County	10.5	14.0	25.5	34.0	23.5
Collier County	0.0	14.0	17.0	24.5	20.5
Glades County	9.5	12.5	12.5	17.0	17.0
Hendry County	0.0	14.5	14.5	24.5	21.5
Lee County	10.5	13.5	20.5	31.5	22.5
Sarasota County	11.0	15.0	26.0	34.5	31.0
Out of County Clearance Time					
Charlotte County	10.5	14.0	25.5	34.0	23.5
Collier County	11.0	14.5	17.0	27.0	20.5
Glades County	12.0	16.5	22.0	31.0	23.0
Hendry County	11.5	15.5	21.5	31.0	22.5
Lee County	10.5	13.5	20.5	31.5	22.5
Sarasota County	11.0	15.0	26.0	35.0	31.5
Regional Clearance Time					
Southwest	12.0	16.5	26.0	35.0	31.5

J. Maximum Evacuating Population Clearances

From an emergency management standpoint, it is important to get an understanding of the maximum proportion of the evacuating population that can be expected to evacuate at various time intervals during an evacuation. Should storm conditions change during an evacuation, emergency managers will need to be able to estimate what portion of the evacuating population is estimated to still remain within the county trying to evacuate.

Using the base scenarios, which assume 100% of the vulnerable population is evacuating, along with shadow evacuations and evacuations from adjacent counties, an estimate was made of the evacuating population actually able to evacuate out of each county by the time intervals of 12, 18, 24, and 36 hours. The estimated maximum evacuating population by time interval for 2010 is identified in **Table ES-15** and for 2015 in **Table ES-16**.

It is important to note that these estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary slightly between evacuation level and either increase or decrease from one evacuation level to the next.

K. Sensitivity Analysis

As discussed previously, there are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. As part of the analysis process, a sensitivity analysis was conducted using the prototype model to evaluate the effect of different response curves on the calculated evacuation clearance times. Calculated clearance times will never be lower than the designated response time, since some evacuating residents will wait to evacuate until near the end of the response time window. For example, using a 12-hour response curve in the analysis means that all residents will begin their evacuation process within 12-hours, and some residents will choose to wait and begin evacuating more than 11.5 hours from when the evacuation was ordered. This will generate a clearance time of more than 12 hours.

The sensitivity analysis identified that clearance times will vary by scenario and by any of the numerous parameters that can be chosen in a particular scenario model run (demographics, student population, tourist population, different counties that are evacuating, response curve, phasing, shadow evacuations, etc.). A few general rules of thumb did emerge from the sensitivity analysis that can provide some guidance to the region regarding the sensitivity of the response curve to the calculated clearance times:

- For low evacuation levels A and B, clearance time will vary by as much as 40 percent depending on the response curve. Low evacuation levels A and B have fewer evacuating vehicles that can be accommodated more easily on the transportation network. In most cases, clearance times typically exceed the response curve by one to two hours. Thus, a 12 hour response curve may yield a clearance time of 13 or 14 hours while an 18 hour response curve may yield a clearance time of 19 or 20 hours. This leads to a higher level of variability than larger evacuations;

Table ES-15 – Maximum Evacuating Population by Time Interval for 2010

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Charlotte County					
12-Hour	71,785	70,276	47,361	41,565	30,685
18-Hour	89,731	105,414	71,042	62,348	46,028
24-Hour		140,552	94,722	83,130	61,370
36-Hour		155,193	142,083	124,695	92,055
Estimated Evacuating Population Clearing Collier County					
12-Hour	132,319	159,930	86,566	85,619	57,301
18-Hour	159,885	239,896	129,849	128,428	85,951
24-Hour		259,887	173,132	171,237	114,601
36-Hour			259,698	256,856	171,902
Estimated Evacuating Population Clearing Glades County					
12-Hour	5,162	3,557	2,071	1,600	1,159
18-Hour	6,668	5,336	3,106	2,400	1,738
24-Hour		7,114	4,141	3,201	2,318
36-Hour			6,212	4,801	3,477
Estimated Evacuating Population Clearing Hendry County					
12-Hour	17,817	11,376	6,744	5,850	4,583
18-Hour	21,529	17,064	10,116	8,776	6,874
24-Hour		22,752	13,487	11,701	9,166
36-Hour			20,231	17,551	13,749
Estimated Evacuating Population Clearing Lee County					
12-Hour	228,652	235,567	154,899	137,361	113,832
18-Hour	266,761	353,351	232,348	206,042	170,749
24-Hour		451,504	309,798	274,722	227,665
36-Hour			464,696	412,083	341,497
Estimated Evacuating Population Clearing Sarasota County					
12-Hour	84,012	68,612	69,948	73,920	60,350
18-Hour	108,516	102,919	104,922	110,880	90,524
24-Hour		137,225	139,895	147,840	120,699
36-Hour		154,378	209,843	221,759	181,049

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

Table ES-16 – Maximum Evacuating Population by Time Interval for 2015

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Charlotte County					
12-Hour	93,102	109,090	57,255	48,340	30,580
18-Hour	116,378	163,635	85,883	72,510	45,870
24-Hour		177,271	114,510	96,680	61,160
36-Hour			171,766	145,020	91,741
Estimated Evacuating Population Clearing Collier County					
12-Hour	175,121	175,034	104,426	92,361	62,177
18-Hour	211,604	262,552	156,640	138,542	93,266
24-Hour		291,724	208,853	184,723	124,355
36-Hour			313,279	277,084	186,532
Estimated Evacuating Population Clearing Glades County					
12-Hour	5,848	3,966	2,453	1,733	1,258
18-Hour	7,310	5,949	3,679	2,600	1,887
24-Hour		7,767	4,906	3,467	2,516
36-Hour			7,359	5,200	3,774
Estimated Evacuating Population Clearing Hendry County					
12-Hour	19,626	13,952	8,003	6,448	4,579
18-Hour	23,715	20,929	12,005	9,671	6,868
24-Hour		24,998	16,006	12,895	9,157
36-Hour			24,009	19,343	13,736
Estimated Evacuating Population Clearing Lee County					
12-Hour	224,333	278,583	171,891	156,786	107,111
18-Hour	271,069	417,874	257,837	235,179	160,666
24-Hour		429,482	343,783	313,572	214,221
36-Hour			515,674	470,359	321,332
Estimated Evacuating Population Clearing Sarasota County					
12-Hour	87,801	92,108	80,039	87,482	59,222
18-Hour	113,409	138,163	120,059	131,224	88,833
24-Hour		157,352	160,079	174,965	118,444
36-Hour			240,118	262,447	177,666

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

- For mid-level evacuations such as C and sometimes D, clearance time varied by as much as 25 percent during the sensitivity analysis. The number of evacuating vehicles is considerably higher than for levels A and B, and lower response curves tend to load the transportation network faster than longer response curves. The variability in clearance times is less in these cases than for low evacuation levels; and,

- For high-level evacuations such as some level D evacuations and all E evacuations, clearance time variability is reduced to about 10 to 15 percent. Large evacuations involve large numbers of evacuating vehicles, and the sensitivity test identified that clearance times are not as dependent on the response curve as lower level evacuations since it takes a significant amount of time to evacuate a large number of vehicles.

The counties within the Southwest Florida Region are encouraged to test additional scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in determining when to order an evacuation. Due to advancements in computer technology and the nature of the developed transportation evacuation methodology, this study includes a more detailed and time consuming analysis process than used in previous years studies. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different response curves.

L. Summary and Conclusions

Through a review of the results of the 20 different scenarios (10 base and 10 operational), several conclusions could be reached regarding the transportation analysis, including the following:

- Critical transportation facilities within the SWFRPC region include I-75, US 41, US 27, SR 82, SR 80, SR 29, SR 78, SR 31, and US 17. For large storm events, such as level D and E evacuations, other State facilities also play an important role in evacuations;

- During the level A and B evacuation scenarios, the roadway segments with the highest vehicle queues are primarily concentrated along the major Interstate and State Highway system. During these levels of evacuation, State and County officials should coordinate personnel resources to provide sufficient traffic control at interchanges and major intersections along these routes;

- In contrast, for the higher level C, D, and E evacuation scenarios, many other roadway facilities, both within and outside of the region, will require personnel resources for sufficient traffic control at interchanges and major intersections;

- The SWFRPC counties, in coordination with the State, should continue public information campaigns to clearly define those that are vulnerable and should evacuate verses those who choose to evacuate on their own. Shadow evacuations in inland areas of the counties impact the ability of the vulnerable population to evacuate;

- The Florida Department of Transportation should continue to work with local counties on implementing intelligent transportation system (ITS) technology, which will provide enhanced monitoring and notification systems to provide evacuating traffic with up to date information regarding expected travel times and alternate routes;

- The State can use the data and information provided in this report (specifically the evacuating vehicle maps in Volume 5-9) to estimate fuel and supply requirements along major evacuation routes to aid motorists during the evacuation process;

- For major evacuation routes that have signalized traffic control at major intersections, traffic signal timing patterns should be adjusted during the evacuation process to provide maximum green time for evacuating vehicles in the predominate north and east directions; and,

- The counties within the Southwest Florida Region are encouraged to test additional transportation scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in planning for an evacuation. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different evacuation conditions, such as different evacuation levels, different behavioral response assumptions, and different response curves.

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CHAPTER I
INTRODUCTION

The evacuation transportation analysis discussed in this volume documents the methodology, analysis, and results of the transportation component of the Statewide Regional Evacuation Study Program (SRESP). Among the many analyses required for the SRESP study, transportation analysis is probably one of the most important components in the process. By bringing together storm intensity, transportation network, shelters, and evacuation population, transportation analysis explicitly links people's behavioral responses to the regional evacuation infrastructure and helps formulate effective and responsive evacuation policy options. Due to the complex calculations involved and numerous evacuation scenarios that need to be evaluated, the best way to conduct the transportation analysis is through the use of computerized transportation simulation programs, or transportation models.

A. Background and Purpose

Over the years, different planning agencies have used different modeling approaches with varying degrees of complexity and mixed success. Some have used full-blown conventional transportation models such as the standard Florida model FSUTMS; others have used a combination of a simplified conventional model and a spreadsheet program, such as the Abbreviated Transportation Model (ATM). These models have different data requirements, use different behavioral assumptions, employ different traffic assignment algorithms, and produce traffic analysis results with different levels of detail and accuracy. These differences make it difficult for planning agencies to share information and data with each other. They also may produce undesirable conditions for staff training and knowledge sharing.

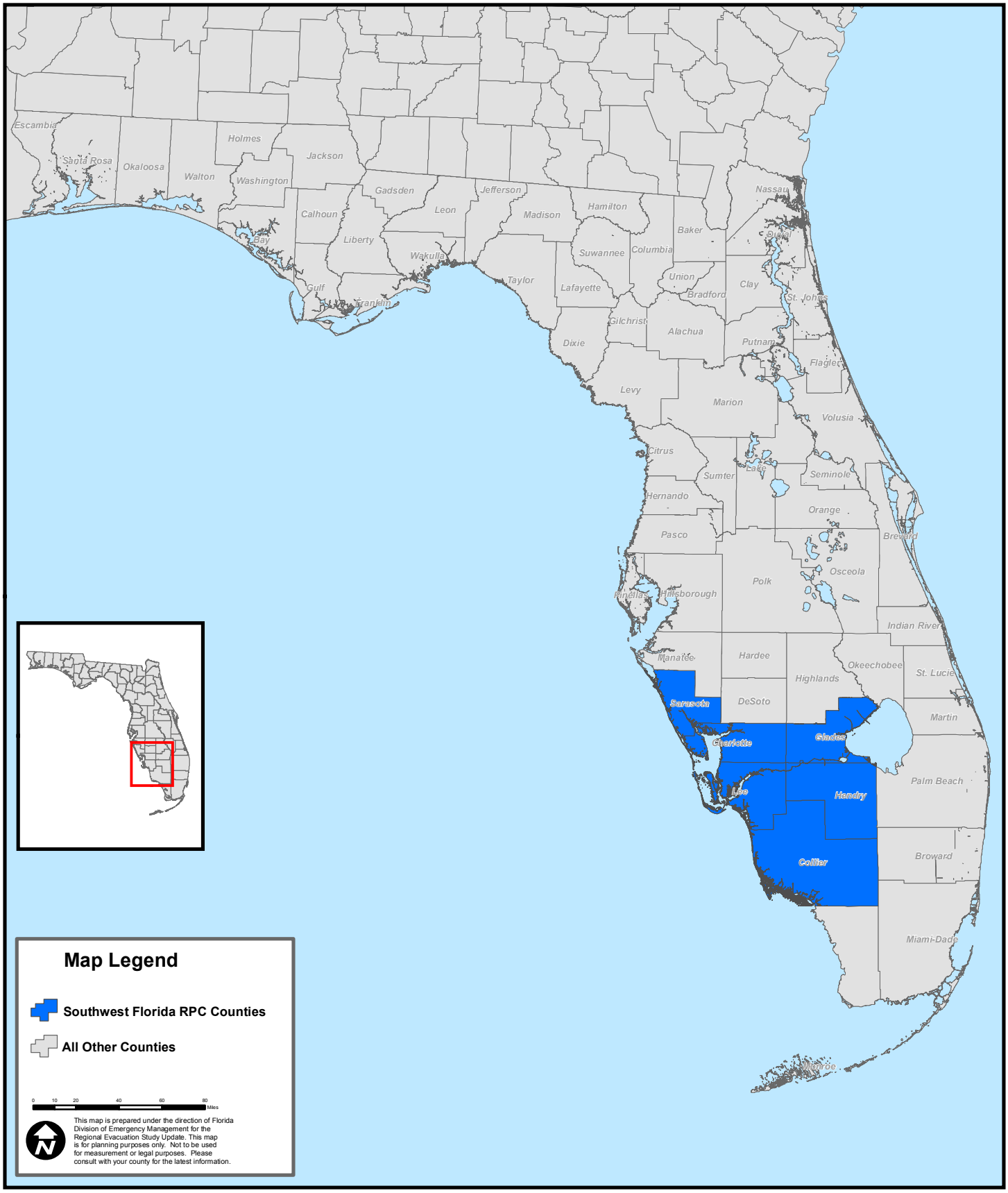
One of the objectives of the SRESP is to create consistent and integrated regional evacuation data and mapping, and by doing so, to facilitate knowledge sharing between state, regional, county, and local partners. To achieve this objective, it is important for all Regional Planning Councils to adopt the same data format and to use the same modeling methodologies for their transportation analyses. The primary purpose of the transportation component of the SRESP is to develop a unified evacuation transportation modeling framework that can be implemented with the data collected by the Regional Planning Councils.

B. Study Area

The study area for this analysis includes the six county Southwest Florida Regional Planning Council area, as illustrated in **Figure I-1**. The transportation modeling methodology includes some processes that are performed at the statewide level, in order to determine the impacts of evacuations from other regions impacting the evacuation clearance times in the Southwest Florida region. While the impact of other regions is included in the Southwest Florida analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the six counties included in the Southwest Florida RPC. Transportation analysis results for other regions and counties are reported in the corresponding Volume 4 report for those regions.

Figure I-1

Southwest Florida Regional Planning Council



Map Legend

- Southwest Florida RPC Counties
- All Other Counties

0 10 20 40 60 80 Miles

This map is prepared under the direction of Florida Division of Emergency Management for the Regional Evacuation Study Update. This map is for planning purposes only. Not to be used for measurement or legal purposes. Please consult with your county for the latest information.

Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: July, 2010

C. Input and Coordination

The development of the transportation methodology and framework required coordination and input from all eleven regional planning councils in Florida, along with the Division of Emergency Management, Department of Transportation, Department of Community Affairs, and local county emergency management teams. At the statewide level, the transportation consultant, Wilbur Smith Associates, participated in SRESP Work Group Meetings which were typically held on a monthly basis to discuss the development of the transportation methodology and receive feedback and input from the State agencies and RPCs.

At the local and regional level, Wilbur Smith Associates conducted a series of four regional meetings to coordinate with and receive input from local county emergency management, the regional planning council, local transportation planning agencies and groups, as well as other interested agencies. The four meetings held in the Southwest Florida region included the following:

Regional Meeting No. 1 – Model Development Meeting
The first regional meeting for the Southwest Florida region was held on October 10, 2008 at 1:00 PM. The purpose of the model development meeting was to introduce the transportation model development process. Feedback received through this process was used and incorporated into the development of the evacuation transportation methodology and framework.

Regional Meeting No. 2 – Model Implementation Meeting
The second regional meeting for the Southwest Florida region was held on March 30, 2009 at 1:30 PM. The purpose of the model implementation meeting was to discuss the evacuation modeling methodology, present the evacuation networks and small area data summaries, and obtain input from local county emergency management staff regarding county level traffic management plans, model input assumptions, and the geographic extents of the regional model. Feedback received through this process was used and incorporated into the development of the Southwest Florida regional model.

Regional Meeting No. 3 – Scenario Development Meeting
The third regional meeting for the Southwest Florida region was held on October 13, 2009 at 2:00 PM. The purpose of the scenario development meeting was to discuss the final evacuation methodology and framework, review the Southwest Florida regional model network, discuss the base scenarios for the region for growth management purposes, and discuss and receive input on the operational scenarios to be evaluated for emergency management purposes.

Regional Meeting No. 4 – Transportation Analysis Meeting
The fourth and final regional meeting for the Southwest Florida region was held on November 3, 2010 at 10:00 AM. The purpose of the transportation analysis meeting was to review the draft results of the transportation analysis and receive feedback on the draft final report.

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CHAPTER II
EVACUATION MODELING METHODOLOGY AND FRAMEWORK

The evacuation modeling methodology and framework was developed during 2008 and 2009 in coordination with all eleven Regional Planning Councils and the Division of Emergency Management. The methodology used in the Southwest Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and is summarized in the following sections.

A. Behavioral Assumptions

In 2008, the Statewide Regional Evacuation Study Program (SRESP) commissioned a survey of Florida residents. The purpose of this survey was to develop an understanding of the behavior of individuals when faced with the prospect of an impending evacuation. These data were used to develop a set of "planning assumptions" that describe the way people respond to an order to evacuate and are an important input to the SRESP Evacuation Model. The behavioral data provides insights into how people respond to the changing conditions leading up to and during an evacuation.

The primary application of the survey data was to help anticipate how people would respond with respect to five behaviors:

- How many people would evacuate?
- When they would leave?
- What type of refuge they would seek?
- Where they would travel for refuge?
- How many vehicles would they use?

These evacuation behaviors are distinguished based on several descriptive variables as listed below:

- Type of dwelling unit (site-built home versus mobile home);
- The evacuation zone in which the evacuee reside; and,
- The intensity of the evacuation that has been ordered.

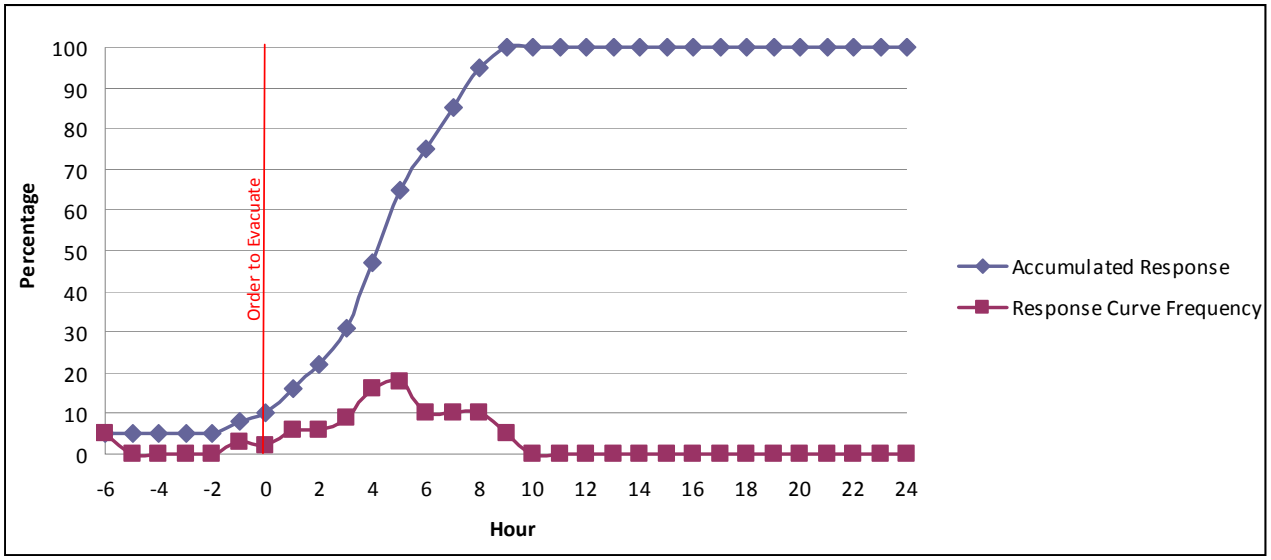
How many people?
The evacuation rate indicates the percent of residents who will leave their homes to go some place safer in each storm threat scenario. The evacuation rates are based on the following assumptions: that the storm track passes very close to the area being evacuated; and officials order evacuation for surge evacuation zones corresponding to storm category. Under the 100 percent response scenario, this rate will default to 100 percent.

When will they leave?
Consistent with behavior observed in past evacuations, evacuees do not begin their journey toward safety all at the same time. Rather, evacuees each begin their trips at different times

based on their unique characteristics and constraints. Some individuals will prefer to evacuate soon after an order is given. Others may need to spend time securing personal property or seeing to the welfare of their relatives before they feel comfortable evacuating. Yet others will underestimate the threat posed to them by an oncoming storm and may not evacuate until very late. A set of evacuation response curves show the proportion of evacuation by increment of time for evacuation orders that were issued.

Each curve represents a different assumption on the amount of time it will take for an evacuating population to fully mobilize. The curves reflect the sense of urgency with which the population perceives the impending evacuation. Faster curves represent more urgent circumstances and slower curves represent less urgent circumstances. These curves are used by the model to divide the total number of evacuating trips into segments representing each hour that evacuating trips begin their journey. For example, a nine hour curve will place a certain number of evacuating trips in the first segment. These trips will represent those evacuees leaving in the first hour of an evacuation. The curve will then place another number of trips in the second segment representing the number of people leaving in the second hour of an evacuation. This process continues until all evacuees have begun their journey, which in a nine hour curve occurs during the ninth segment. All of the curves developed for the SRESP assume that some portion of the evacuating population leave before an order to evacuate is given. Typically, this is ten percent of the evacuating population. The nine hour response curve used in the model is depicted in **Figure II-1**. Response curves are available in the model to evaluate six, nine, twelve, eighteen, twenty-four, and thirty-six hour responses.

Figure II-1 – Nine Hour Response Curve



What type of refuge would be sought?
The survey data identified four types of refuge sought by evacuees. Specific rates were developed that identified the number of evacuees seeking shelter at each of these following different types of refuge:

- Friends and family;
- Hotel or motel;
- Public shelter; and,
- Other types of refuge not covered elsewhere in the list including, but not limited to, office space, churches, civic organization halls, and club houses.

Where will they travel?
The behavior survey distinguishes between trips that leave the county where an evacuation journey begins and trips that stay within the county. The out-of-county trip rate indicates the percent of evacuees who will seek refuge outside their county of residence. The in-county trip rate will determine how many of the evacuating trips are destined to remain within the county.

How many vehicles are used?
The vehicle use rate indicates the percentage of vehicles available to the evacuating household(s) that will be used in evacuation in each storm threat scenario. This rate ultimately determines the number of vehicles on the highways during an evacuation.

B. Zone System and Highway Network

The SRESP evacuation model relies upon data that covers the entire State of Florida as well as areas covering the States of Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee. While the primary focus of the model is with evacuation behavior within Florida, areas outside of the state had to be considered in order to allow a more precise routing of evacuation traffic. This allows the model to measure the flow of traffic across the state line if needed.

Zone System
The data included in this system contain the demographic information crucial to modeling evacuation traffic. The demographic information is labeled as "small area data". These data provide population and dwelling unit information that will identify where the individuals in the region reside. The planning assumptions developed from the behavioral analysis conducted for this study were applied to these demographic data. The result is a set of evacuation trips generated by the evacuation model. The number of these trips will vary depending on the hazard conditions that prompt the evacuation.

The RPC developed their small area data by consulting either MPO or FDOT model Traffic Analysis Zone (TAZ) data or Census 2000 geography. In some cases, demographic data were developed at the parcel level. Data were developed for the following years: 2006, 2010, and 2015.

Traffic Evacuation Zones (TEZ)
Small area data geographies were aggregated into larger units known as Traffic Evacuation Zones (TEZ). These TEZ form the basic unit of analysis in the evacuation model similar to how traffic analysis zones form the basic unit of analysis in a standard travel demand model. The

TEZ system was developed so that the small area geographies will nest completely within one TEZ or another. This eliminates any potential for split data and will ensure that data in the TEZ system can always be updated with relative ease.

The final TEZ system for the State of Florida has 17,328 zones. This number provides sufficient detail to accurately accommodate the assignment of evacuation trips onto an evacuation network. Furthermore, additional roadway segments have been included in the model's highway network to facilitate the movement of evacuation trips onto and off of the evacuation network. Each TEZ has a unique identification number that will be used by the model to connect evacuation trip generation to the evacuation highway network.

Highway Network

A highway network is used to represent the roads that evacuees travel along as they journey toward safety. Various datasets were used to develop the highway network database as follows:

- Florida Statewide Model Network – The 2005 base year statewide model was used as a basis for developing the evacuation model. The statewide model was obtained from the Florida Department of Transportation (FDOT) Systems Planning Office;

- Evacuation Routes – Evacuation routes in each Regional Planning Council (RPC) area were obtained from the RPCs themselves. The RPCs relied on their constituent counties to provide them with information on which roads were to be included as evacuation routes;

- Florida Highway Data Software (FHD) – The 2006 Florida Highway Data software was obtained from FDOT. This software was used to view and query data extracted from the Roadway Characteristics Inventory (RCI) which includes number of lanes, facility types, speed limits, etc.;

- FDOT Quality/Level of Service Handbook – The 2002 FDOT Quality/Level of Service Handbook (QLOS) and the 2007 LOS Issue Papers (2002 FDOT QLOS addendum) were obtained from the FDOT Systems Planning Office website. The QLOS handbook and the LOS tables were used to establish roadway capacities for evacuation purposes; and,

- Microsoft and Google aerials and maps – These aerial maps were used to identify and clarify roadway alignments. Whenever questions concerning the existence of particular facilities, their characteristics, or their alignments arose, aerials were referenced.

Changes to the Florida Statewide Model Network

Some modifications to the Florida Statewide Model network were necessary in order to make the data usable for evacuation modeling purposes:

- The original database, which was coded for a 2005 base year, was updated to 2006 conditions to correspond to the SRESP base year;
- Additional facilities had to be added to the network to accommodate evacuation traffic behavior;
- Many attributes from the original data set were removed and new ones were added

specifically tailored for trip activity for evacuation modeling purposes;
- Based on RPC input, any missing facilities instrumental for evacuations were coded into the highway network database;
- The highway network database was extensively reviewed for the correct coding of one-way links;
- The 2006 FHD software was used to verify the highway network database number of lanes for the state roads, US highways, and major county roads. For other roads Microsoft and Google aerial maps were used;
- The area type and facility type attributes for each roadway segment were verified for their consistency with existing conditions; and,
- The network attributes were modified to the specific needs of evacuation modeling and reporting purposes. The evacuation routes designated by the RPC were flagged for reporting purposes. The County name attribute and the RPC number attributes were checked and modified accordingly.

Capacities

Network capacities for the evacuation model are based on facility type and area type. The network facility type classification and the area type classification were retained from the existing Florida Statewide Model highway network database.

FDOT's 2002 Quality/Level of Service (QLOS) generalized level of service volume tables were used for estimating the link capacity for each combination of functional class and area type. The generalized level of service volume tables were generated from conceptual planning software which is based on the 2000 edition of the Highway Capacity Manual (HCM). Using statewide default values for each of these roadway characteristics, the generalized LOS volume tables were developed from the conceptual planning software.

The peak hour volume represents the most critical period for traffic operations and has the highest capacity requirements. Many urban routes are filled to capacity during each peak hour, and variation is therefore severely constrained. The peak hour directional volumes at LOS E, closely represent the maximum volume (capacity) that can be accommodated through a given roadway. In some cases the Peak Hour Two-Way LOS tables do not show the maximum services volumes at the LOS E. For example, the four-lane Class I arterial service volumes are only shown from LOS A to LOS D, This indicates that the maximum volume thresholds (capacity) are reached at LOS D and these volumes represent the capacity of the roadway.

A lookup table was created with facility type, area type, number of lanes, and capacities by comparing model network characteristics to the roadway characteristics in the QLOS manual. The lookup table is shown in **the Transportation Supplemental Data Report**. The capacity attribute in the network was automatically assigned for any given link with a specific facility type, area type and number of lanes during the network preparation process.

Speeds

The existing highway network database link speeds were verified for their reasonableness and their suitability for evacuation modeling purpose. The speed values of the existing statewide model database were reasonable and therefore retained in for evacuation modeling.

Roadway Attributes
The roadway attributes contain the highway characteristics for each link in the highway network. Some of the attributes like DISTANCE, FTYPE, ATYPE, etc., were retained from the highway network database and other attributes like DENSITY and EVAC_RTE are specific to the evacuation modeling and were included in the network.

Reverse Lane Operations
Additional changes were also made in order to accommodate reverse lane operations in an evacuation scenario. Most of the facilities that would be subject to a reverse lane operations scenario were coded as a pair of one-way links. Additional attributes were added to the network in order to allow for the correct calculation of capacity in the reverse lane direction. The configurations of reverse lane facilities reflect the reverse lane operations plans established by the State.

C. Background Traffic

The traffic that consumes the roadway capacity of a transportation system during an evacuation can be divided into two groups. The first group is the evacuation traffic itself. Once the evacuation demand is determined, this information is converted into a number of vehicles evacuating over time. These evacuation trips are then placed on a representation of the highway network by a model. The model determines the speed at which these trips can move and proceeds to move the evacuation trips accordingly. The result is a set of clearance times.

The second group of traffic is known as background traffic. Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis and is accounted for primarily to impede the movement of evacuation trips through the network. These trips represent individuals going about their daily business mostly unconcerned with the evacuation event. For the most part, background traffic represents trips that are relatively insensitive to an order to evacuate and are thus said to be occurring in the "background." Even though background traffic is relatively insensitive to evacuation orders, it is important to account for background traffic since it can have a dramatic impact on available roadway capacity. This in turn can severely affect evacuation clearance times.

Methodology used to Account for Background Traffic
There are two dynamics at work when evacuation traffic and background traffic interact with one another. The first is the effect of background traffic displacing evacuation traffic as background traffic attempts to use the same roads as the evacuation traffic. The second is the effect of evacuation traffic displacing background traffic. As vehicles move along the network and try to get onto certain roads they leave less room for other vehicles to use those same roads. As background traffic builds up there is less room for evacuation traffic to move, and vice versa. While the effect that evacuation traffic has on background traffic may be of some interest to those who are concerned with disruptions in daily trip making behavior during an evacuation event, for the purposes of this study we are much more interested in the effect that background traffic has on evacuation clearance times.

The effect that background traffic has on evacuation traffic can be stated in terms of available capacity. The more background traffic there is on a segment of road, the less capacity is available for evacuation traffic to use. Following this logic, it becomes apparent that by causing the available capacity to fluctuate throughout the evacuation event, one is able to sufficiently

account for the impact of background traffic. FDOT's Florida Traffic Information DVD was used to develop average peaking characteristics for various functional classes of roadways throughout the state. These characteristics were analyzed to determine how much capacity is available throughout a given day during an evacuation.

Two sets of curves were developed, one for coastal evacuating counties that represent lower background traffic and one for all other counties representing greater background traffic. The model then adjusts capacities up and down consistent with these curves as it simulates the evacuation.

Figure II-2 illustrates the set of curves showing the percentage of available capacity throughout a 24 hour period for a coastal evacuating county after the model accounts for background traffic. **Figure II-3** illustrates the set of curves showing the percentage of available capacity throughout a 24 hour period for all other counties after the model accounts for background traffic.

Figure II-2 – Percent of Available Capacity for Coastal Counties

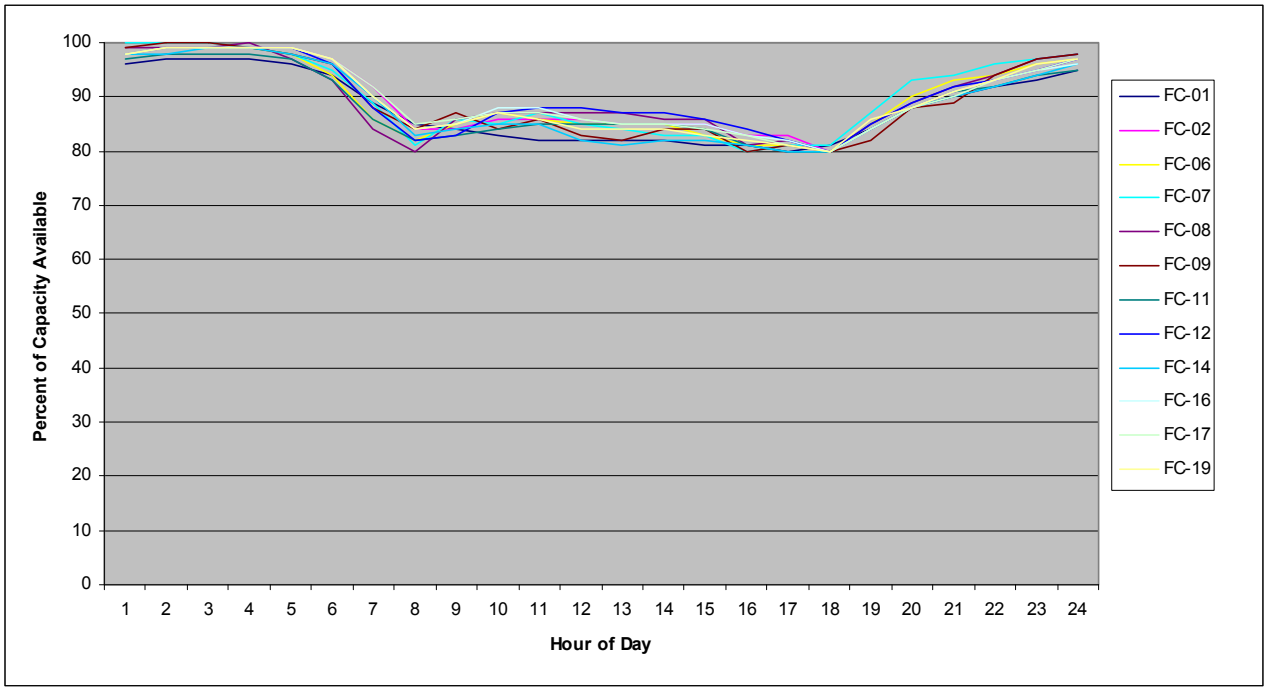
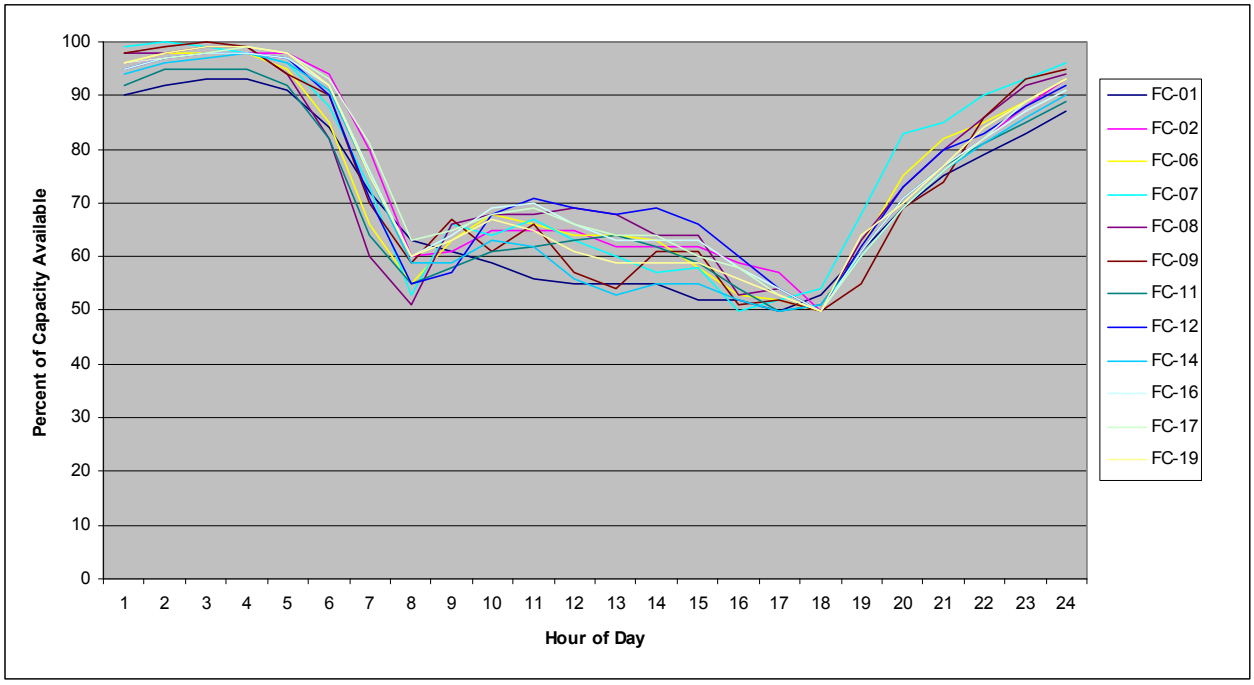


Figure II-3 – Percent of Available Capacity for Other Counties

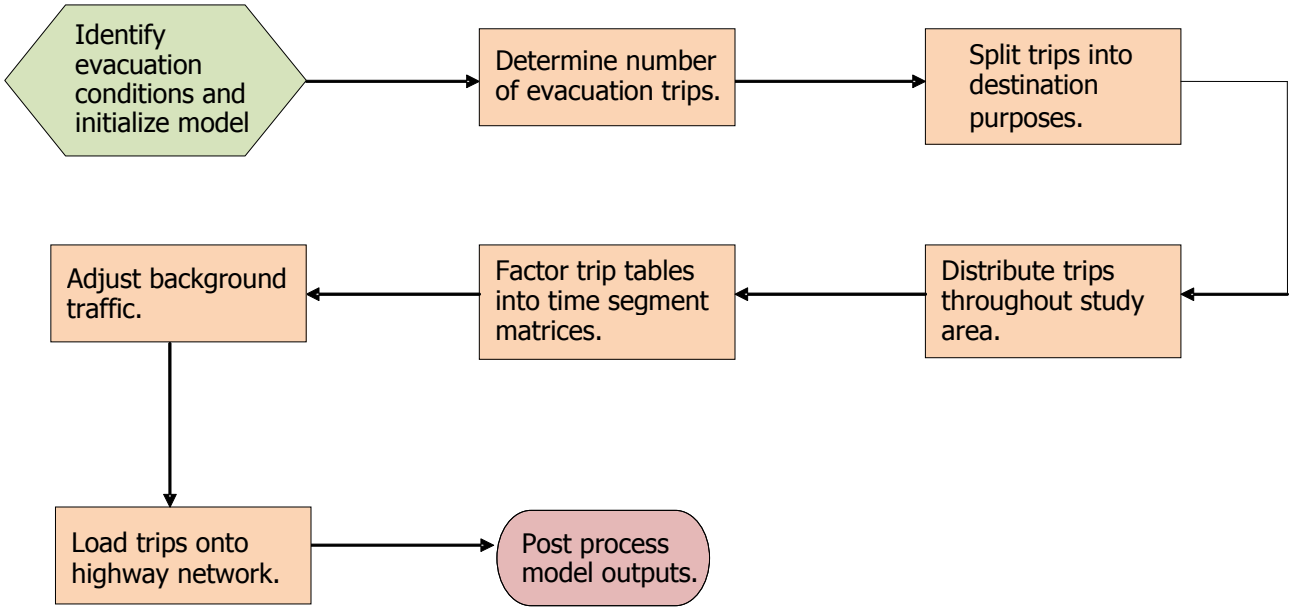


D. Evacuation Traffic

The model flow for the evacuation model is divided into a total of eight modeling steps. The following eight steps are represented graphically in the flowchart in **Figure II-4**:

1. Identify evacuation conditions and initialize model;
2. Determine number of evacuation trips;
3. Split trips into destination purposes;
4. Distribute trips throughout study area;
5. Factor trip tables into time segment matrices;
6. Adjust background traffic;
7. Load trips onto highway network; and,
8. Post process model outputs.

Figure II-4 - General Model Flow



Initializing the Model

At the beginning of the model flow, the model will need to determine the hazard conditions representing the particular scenario that will be analyzed. This will allow the model to accurately identify the areas that will be subject to evacuation and to determine the intensity of the evacuation event. This process will then establish the appropriate rates that will be used to determine the number of evacuation trips that will be generated.

Number of Evacuating Trips

After the model has finished initializing it will begin to calculate the number of evacuation trips that are generated. Estimating an appropriate number of trips is essential to ensuring that the behavior expressed on the highway network during trip assignment is reflective of likely conditions during a real world evacuation event.

The planning assumptions developed by the behavioral analysis were translated into a master rates file that can be referenced by the model in order to determine the number of evacuation trips that a particular scenario can be expected to generate.

Production Ends

Every trip has two ends. One end represents where a trip begins its journey and is typically referred to as the production end. The other end represents where a trip finishes its journey and is typically referred to as the attraction end. The calculation of the production end of each evacuation trip in the model is driven by the master rates file mentioned above.

Attraction Ends

The other end of an evacuation trip, the attraction end, is calculated using a much more simplified methodology. Public shelters have clearly defined capacities. For hotels and motels,

each room will be designated as an attraction. Trips destined to shelter with friends and family or in other unspecified destinations will have an attraction generated at each non-evacuating household in the model. This will ensure that these trips are evenly distributed around the area with some clumping occurring in highly residential areas.

Splitting Trips into Destination Purposes

Once the number of evacuation trips has been determined it will be necessary to divide the trips into various trip purposes. These purposes are based on the type of destination that an evacuee is headed to and the relative location of that destination. There are four types of destinations and two relative locations for a total of eight trip purposes, as identified below:

- Friends & Family – In County;
- Public Shelter – In County;
- Hotel/Motel – In County;
- Other – In County;
- Friends & Family – Out of County;
- Public Shelter – Out of County;
- Hotel/Motel – Out of County; and,
- Other – Out of County.

The same behavioral analysis that establishes the evacuation and vehicle use rates used to determine the number of evacuation trips that are being generated by the model is also a source of data for determining the various destinations where these evacuation trips are heading.

Trip End Balancing

Once the model has finished splitting the trip ends into their respective purposes, it will commence the process of balancing trip ends. The balancing of trip ends is critical so that the trip distribution process which is to follow this step will be able to tie every trip production to every trip attraction. A surplus or deficit of one trip end or the other may cause complications in the evacuation model that can lead to overestimating the model, underestimating the model, or aborting the model process.

In County Balancing - The trip balancing procedure begins by considering each purpose individually. If the trip purpose under consideration is an In County purpose the model compares the number of productions to the number of attractions. If the number of attractions is greater than the number of productions, the model will simply apply a universal adjustment of all attraction trip ends in the county down to the number of productions. The end result should be an equal number of In County productions and attractions.

If, on the other hand, the productions should exceed attractions the excess productions are shifted over to the corresponding Out of County purposes. For example, if the model estimates using the behavioral planning assumptions that there will be 3,000 evacuees destined In County to Hotel/Motel destinations, but there are only 2,500 Hotel/Motel attraction ends available in the county, the excess 500 trips will become Out of County Hotel/Motel trips.

Out of County Balancing - If the purpose under consideration is an Out of County purpose the model will balance the attractions regionally. Using data derived from the behavioral study, a

certain percentage of each out of county trip will be destined to a particular region. If a particular region is prohibited by the model from receiving evacuation trips, the model will reallocate the portion of evacuation trips originally destined for that regional equally among all other regions. **Table II-1** identifies the percentages of out of county trips destined from each region and to each region. When the model has finished balancing the evacuation productions and attractions, the model will then proceed with trip distribution.

Table II-1 – Out of County Trip Destinations by Region

From \ To	Apalachee	Central	East Central	North Central	Northeast	South	Southwest	Tampa Bay	Treasure Coast	West	Withla-coochie	Out-of-State
Apalachee	31.2%	0.1%	1.1%	2.3%	2.1%	0.0%	0.1%	0.7%	0.3%	3.5%	0.8%	57.8%
Central	5.9%	9.8%	13.0%	4.4%	4.7%	0.0%	4.2%	5.9%	5.4%	0.7%	1.7%	44.2%
East Central	2.5%	1.7%	27.1%	5.4%	5.9%	1.5%	2.6%	6.7%	0.8%	1.4%	3.1%	41.2%
North Central	5.2%	0.7%	3.6%	15.2%	6.3%	0.3%	0.3%	3.1%	0.2%	1.3%	2.0%	61.8%
Northeast	3.7%	0.7%	4.2%	6.6%	10.3%	0.6%	0.6%	1.8%	0.2%	1.9%	2.0%	67.4%
South	2.0%	3.4%	20.9%	2.1%	3.4%	24.5%	5.7%	2.1%	9.0%	0.5%	3.1%	23.4%
Southwest	1.4%	5.2%	15.9%	3.9%	3.3%	4.6%	11.0%	8.4%	3.2%	0.8%	5.4%	37.0%
Tampa Bay	3.2%	3.7%	14.1%	2.8%	4.5%	2.2%	1.3%	15.7%	2.0%	0.5%	7.3%	42.6%
Treasure Coast	2.8%	1.5%	22.8%	3.0%	4.4%	4.5%	4.0%	9.4%	11.5%	0.2%	2.0%	34.0%
West	6.3%	0.2%	2.1%	0.9%	3.5%	0.4%	0.1%	0.3%	0.3%	8.7%	0.8%	76.4%
Withla-coochee	2.4%	1.7%	12.4%	7.4%	3.3%	1.0%	0.7%	6.5%	0.5%	1.2%	15.0%	48.0%

Source: Derived from SRESP Behavioral Data and Planning Assumptions

Trip Distribution

After the model has determined how many evacuation trips there will be in a given scenario, split those trips into purposes, and balanced the trip ends for those purposes, it will be necessary for the model to perform a trip distribution. The trip distribution step in the model connects each production end to a unique attraction end. The end result is a trip table containing origins and destinations for each trip in the model. Typically, origin zones are referred to by the letter I and destination zones are referred to by the letter J. An Origin-Destination matrix, also known as an OD matrix, is one of the principal inputs into trip assignment. This matrix tells the model where each trip is coming from and where it is going to.

The trip distribution process begins by looping through each trip purpose and determining whether the purpose is In County or Out of County. In County trips are restricted to destination TEZs within the same county as the trip origin. Out of County trips are restricted to TEZs not in the same county as the trip origin. The trip distribution is conducted using a gravity model that relies on distances as the chief measure of impedance.

Time Segmentation
The final step of the model prior to initiating the trip assignment sequence is to segment the trip table into discreet time periods. This segmentation determines at what point in time each trip begins its evacuation. The model is set up to process a set of evacuation response curves with a period resolution of one-half hour. The model uses a set of factors developed from the behavioral response curves to divide the evacuation trip tables into the different segments.

The model makes the following assumptions. Due to limitations in the model, these assumptions cannot be adjusted. The analyst should keep these assumptions in mind when using results developed by the model:

- All evacuations begin when an order to evacuate has been issued;
- All evacuations begin during the first hour of daylight, approximately 7:00 AM;
- All evacuations begin during an average weekday;
- Some portion of evacuation trips, typically ten percent, leaves prior to the beginning of an evacuation; and,
- Those evacuation trips that leave prior to the beginning of an evacuation leave no later than the previous evening and have already cleared the network by the time an evacuation order is given.

E. Dynamic Traffic Assignment

Dynamic traffic assignment (DTA) was utilized because it is sensitive to individual time increments. DTA works by assigning a certain number of vehicles to the highway network in a given interval of time. The model then tracks the progress of these trips through the network over the interval. Another set of vehicles is assigned during the following time interval. The model then tracks the progress of these trips through the network along with the progress of the trips loaded in the previous time interval. As vehicles begin to arrive at the same segments of roadway, they interact with one another to create congestion. When vehicles that were loaded to the network in subsequent intervals of time arrive at the congested links, they contribute to the congestion as well. This results in a slowing down of the traffic and eventually spill-backs and queuing delays.

It is this time dependent feature of DTA that makes it well suited to evacuation modeling. By dynamically adjusting the travel times and speeds of the vehicles moving through the network as they respond to congestion the model is able to do the following:

- The evacuation model is able to estimate the critical clearance time statistics needed for this study;
- The model takes into account the impact of compounded congestion from multiple congestion points;
- The model is able to adjust the routing of traffic throughout the network as a function of congestion as it occurs throughout the evacuation; and,
- The model is capable of adjusting its capacities from time segment to time segment, making it possible to represent such phenomena as reverse lane operations and background traffic.

Parameters of the Evacuation Assignment
The DTA for the evacuation model makes use of certain parameters which dictate how the assignment will function. The parameters that were established are:

- **Capacity -** The SRESP evacuation model uses hourly lane capacities derived from the Florida Department of Transportation Quality/Level-of-Service Handbook. These capacities are initially set to represent Level-of-Service E conditions. These capacities are then further increased by an additional 20 percent for freeway links and 10 percent for non-freeway links. These increases in capacity are meant to reflect high volume usage typically found during an evacuation, optimal green timing of traffic signals and traffic control typically controlled during an evacuation by law enforcement personnel, and the use of shoulder and emergency lanes;

- **Storage -** Storage determines how many vehicles can remain standing on a length of roadway at any moment in time. The evacuation model assumes that storage is set to 250 vehicles per lane per mile. This assumes approximately 21 feet of space are "occupied" by any given vehicle. Given the mix of vehicles on a roadway network (including compacts, SUVs, trailers, and trucks) this spacing appears to be reasonable for stand-still traffic;

- **Time Intervals -** In order to properly implement a DTA model, the assignment process needs to be segmented according to a set of time intervals. Half-hour intervals provide sufficient detail to satisfy the planning needs of both emergency management and growth management concerns. The model calculates vehicle assignments over 192 such intervals for a 96 hour model period. This is sufficient to capture all evacuation activity during an event and allows sufficient time for the evacuation traffic to clear at both the county and regional level; and,

- **One-Way Evacuation Operation -** The State of Florida has recently published a series of one-way evacuation operation plans for major corridors throughout the state. The intention of these plans is to fully maximize the available capacity on a freeway by using all lanes to move evacuees away from danger. The model will emulate one-way operations by simultaneously increasing the capacity of links headed away from the threatened area and eliminating the capacity of links headed toward the threatened area. The capacity of links headed away from the threatened area will increase by 66 percent, which is consistent with capacity increases used by Florida's Turnpike Enterprise. Past experience of reverse lane operations have shown that capacities do not double, as is commonly assumed, but increase by a lower percentage of about two thirds.

F. Prototype Model Development

Wilbur Smith Associates developed the prototype model to test the modeling methodology used to calculate evacuation clearance times. The prototype model demonstrated the viability of the methodology developed for this study. This included the use of dynamic traffic assignment, background traffic curves, regional sub-area trip balancing, the use of survey rates, the use of 100% participation rates, response curves, and county-by-county phasing of evacuations.

The prototype model served as the backbone for all regional evacuation models that have been developed for this study. The models implemented for each RPC use a structure similar to the prototype with identical methodology.

The SRESP evacuation model relies upon data that covers the entire State of Florida as well as areas covering the States of Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee. While the primary focus of the model is with evacuation behavior within Florida, areas outside of the state had to be considered in order to allow a more precise routing of evacuation traffic. This allows the model to measure the flow of traffic across the state line if needed.

CHAPTER III
REGIONAL MODEL IMPLEMENTATION

The evacuation transportation model discussed in Chapter II includes several components that are completed using a statewide dataset (determine number of evacuation trips, split trips into destination purposes, and distribute trips throughout state) and several components that can only be completed at the regional level (factor trip tables into time segment matrices, adjust background traffic, and load trips onto the highway network) due to computer run time limitations with the model software. Thus, for the regional level steps, each RPC throughout the State needed to decide on a regional model network to complete the analysis in their region. For the Southwest Florida Region, the regional model network includes the six counties within the RPC plus fifteen other counties surrounding the region, as illustrated in **Figure III-1**.

This chapter discusses the input data used in evaluating evacuation transportation conditions for the Southwest Florida Region. It is important to note that the input data discussed in this chapter is included only for the counties within the Southwest Florida RPC, as these are the counties that the Southwest Florida RPC has direct responsibility for the data. Data for the adjacent counties included in the Southwest Florida Regional model were provided by the corresponding RPC in which the counties belong. The model data for these counties is discussed in the corresponding Volume 4 report for those respective RPCs.

A. Regional Model Network

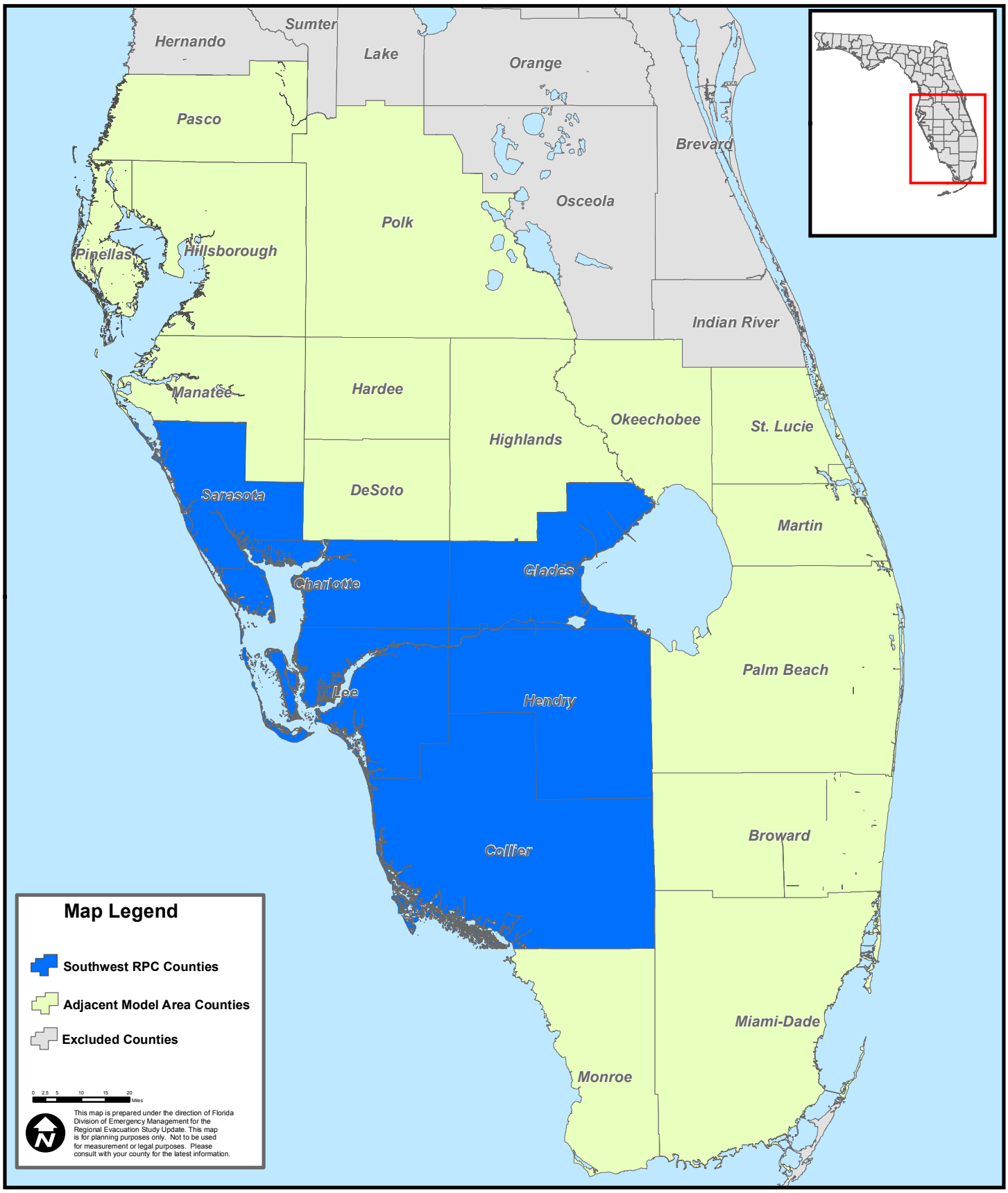
The road network is a key component of the evacuation model. The roadway variables in the network include area type, functional class, number of through lanes, capacity, speed, and several others. The regional model network consists of the RPC designated evacuation routes as well as a supporting roadway network that facilitates movement of evacuation traffic. The 2005 Florida Department of Transportation (FDOT) Statewide Model Network was used as a basis for developing the regional model network, while the evacuation routes were obtained from the Southwest Florida RPC. The RPC relied on the emergency managers of its constituent counties to provide it with information on which roads were to be included as evacuation routes. The resulting model network was updated to 2006 conditions and is referred to as the base model network. **Figure III-2** identifies the model network and evacuation routes for the SWFRPC. County level details of the regional model network are provided in the Volume 5 report. The regional model network for the Southwest Florida region includes key roadways within the six county region, including I-75, US 41, US 27, US 17, SR 29, SR 78, SR 72, SR 45, SR 31, SR 82, and SR 80.

B. Regional Zone System

The regional zone system is based on Traffic Evacuation Zones (TEZ) and contains the regional demographic information, which includes housing and population data that is essential to modeling evacuation traffic, as discussed in Chapter II. The regional demographic characteristics identify where the individuals in the region reside, as well as where the vulnerable populations are located. The TEZs are aggregations of the smaller small area data geographies provided by the RPC. Each traffic evacuation zone has a unique identification

Figure III-1

Southwest Florida Regional Model Area

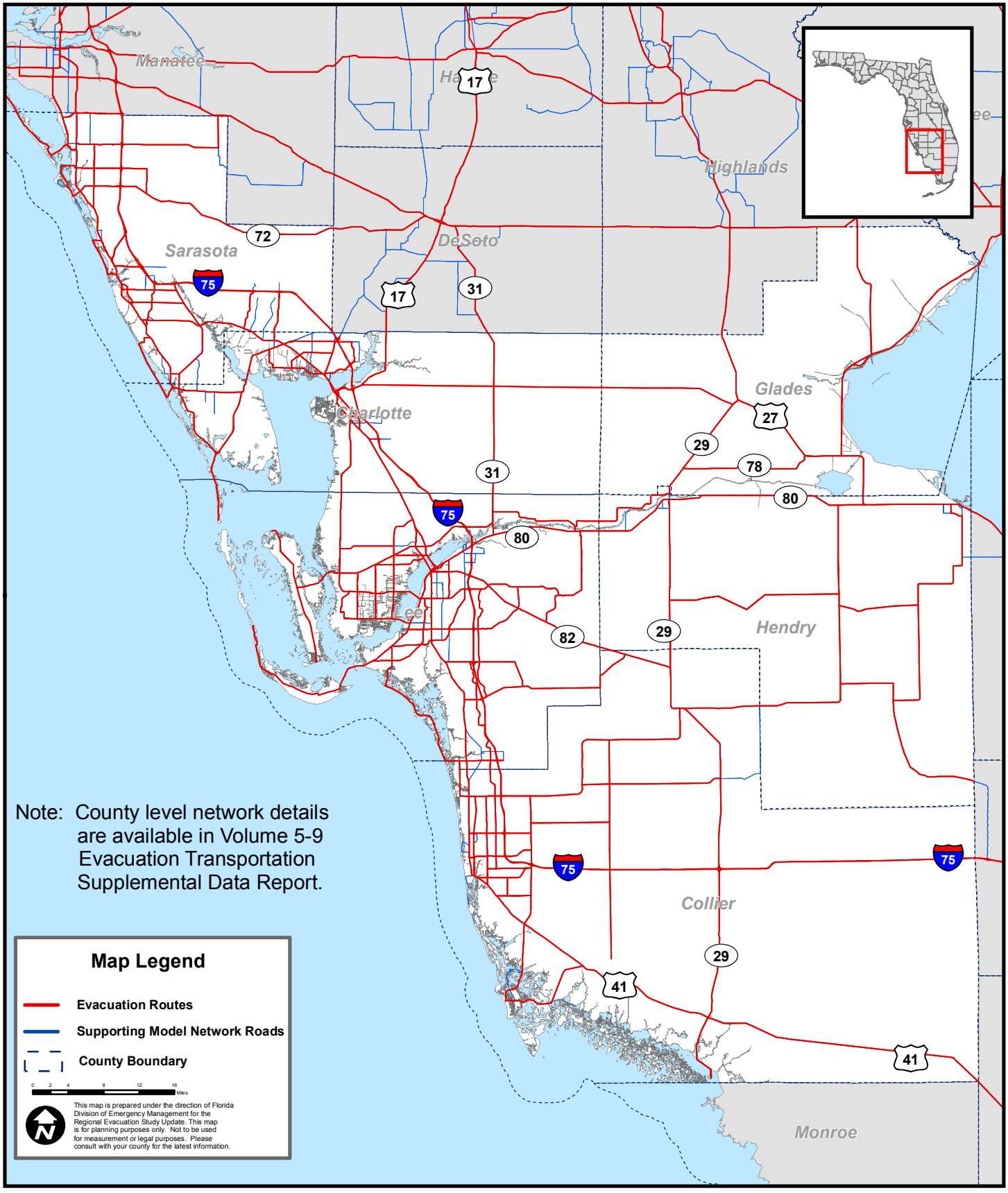


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: May, 2010

Figure III-2

Southwest Florida Regional Model Network



Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: November, 2010

number that is used by the model to connect evacuation trip generation to the evacuation highway network. There is a buffer in zone numbering between counties to allow for future growth in each county.

The final TEZ system for the State of Florida has 17,328 zones. Of the total number of zones in Florida, 972 of the zones are located within the six county Southwest Florida region, as illustrated in **Figure III-3**. In the Southwest Florida region, Lee County has the largest number of TEZs with 337, and Sarasota County follows with 275 TEZs. Charlotte County contains 175 TEZs; Collier County, 156 TEZs. Hendry and Glades Counties have the lowest number of TEZs in the RPC with 21 and 8 zones, respectively. The larger number of TEZs generally reflects counties with denser urban structure and/or higher population densities.

C. Regional Demographic Characteristics

As discussed in Chapter II, the evacuation model uses the demographic information as input for generating a set of evacuation trips. The demographic data were developed for the following years: 2006, 2010, and 2015.

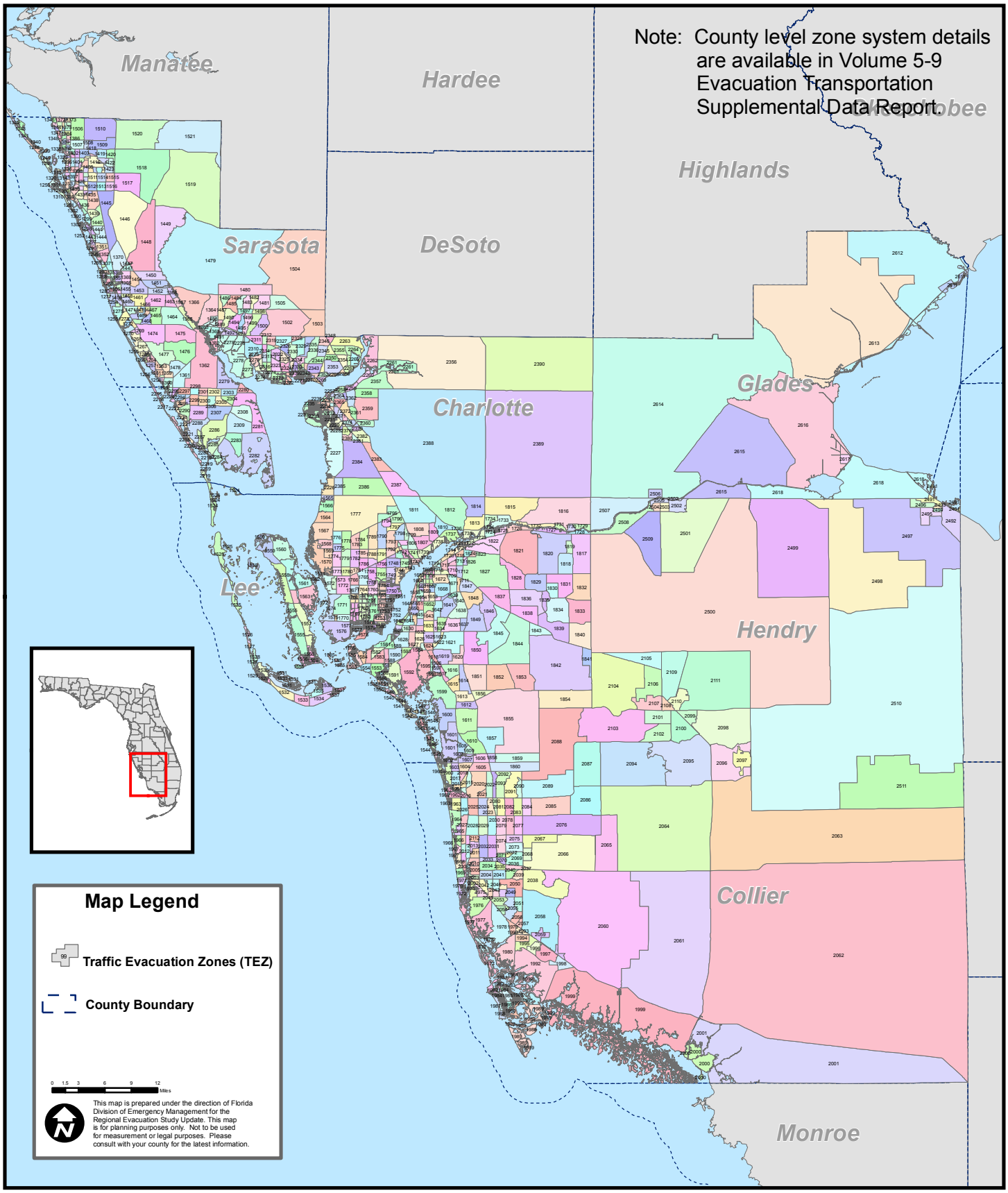
A snapshot of the key demographic data for each county in the Southwest Florida RPC for 2006, 2010 and 2015 is summarized in **Table III-1**. The tables list the number of occupied dwelling units for site built homes, the permanent population in site-built homes, as well as the number of occupied dwelling units for mobile homes and the permanent population in mobile homes. The mobile home category includes RVs and boats and the permanent population in those housing options. The demographic characteristics summary also includes hotels and motels because many of these units are in vulnerable areas, and the proportion of seasonal units and hotel/motel units that are occupied at any point in time will have an important impact on the total population that may participate in an evacuation. Detailed demographic data for each individual TEZ within the region is included in Volume 5.

Lee County has the largest population in the region during all three time periods. The county is expected to reach over 670,000 people by 2015. Sarasota County has the second largest population in the region and is forecasted to have more that 440,000 people by 2015. Glades County has the smallest population in the region; the county is expected to have just more than 11,000 people by 2015.

Within the Southwest Florida region, the number of mobile homes comprise between 10 and 13 percent of all occupied homes between 2006 and 2015. Lee County has the highest number of mobile homes followed by Sarasota. Glades County has the lowest number of mobile homes; however, in each time period the number of mobile homes in Glades is greater than the number of site-built homes.

Figure III- 3

Southwest Regional Model Transportation Evacuation Zone (TEZ) System



Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Table III-1 - Southwest Florida Demographic Characteristic Summary

County	Characteristic	Year		
		2006	2010	2015
Charlotte	Occupied site-built homes	67,738	75,962	87,992
	Population in site-built homes	151,896	166,676	182,451
	Occupied mobile homes	6,134	5,991	6,223
	Population in mobile home	10,450	10,162	10,476
	Hotel/motel units	2,805	3,132	3,893
Collier	Occupied site-built homes	115,997	123,529	107,795
	Population in site-built homes	279,001	307,337	338,168
	Occupied mobile homes	6,099	5,671	5,558
	Population in mobile home	15,056	13,838	13,625
	Hotel/motel units	10,834	11,029	11,269
Glades	Occupied site-built homes	1,697	1,898	2,140
	Population in site-built homes	4,220	4,677	5,056
	Occupied mobile homes	2,160	2,252	2,394
	Population in mobile home	5,419	5,704	6,134
	Hotel/motel units	244	244	244
Hendry	Occupied site-built homes	6,802	7,383	7,777
	Population in site-built homes	20,023	21,834	23,061
	Occupied mobile homes	4,999	5,343	6,017
	Population in mobile home	16,438	17,528	19,512
	Hotel/motel units	726	726	726
Lee	Occupied site-built homes	214,412	225,915	216,990
	Population in site-built homes	517,285	563,420	598,350
	Occupied mobile homes	25,672	30,648	47,650
	Population in mobile home	46,224	54,076	78,846
	Hotel/motel units	15,208	16,766	19,319
Sarasota	Occupied site-built homes	152,151	165,633	178,988
	Population in site-built homes	342,336	374,391	405,919
	Occupied mobile homes	15,542	17,064	20,901
	Population in mobile home	25,740	28,281	34,847
	Hotel/motel units	12,991	13,152	13,257

Source: Southwest Florida Regional Planning Council

D. Planned Roadway Improvements

To correspond to the three different sets of demographic data, three model networks were ultimately developed. The base 2006 network, discussed in section A, and two future year networks to correspond to the 2010 demographic data and the 2015 demographic data. The 2006 base model network was updated to reflect roadway capacity improvement projects completed between 2006 and 2010 to create the 2010 network. The 2010 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2011 and 2015 to create the 2015 network.

The planned roadway improvements that were added to the network generally include only capacity improvement projects such as additional through lanes. **Table III-2** identifies capacity improvement projects completed between 2006 and 2010 that were included in the 2010 network. Likewise, **Table III-3** identifies capacity improvement projects planned for implementation between 2011 and 2015. The tables identify each roadway that will be improved as well as the extent of the improvement. For example, by the end of 2015 in Charlotte County, Toledo Blade Blvd from US 41 to Hillsborough Blvd will be widened to 4 lanes.

It is important to note that Tables III-2 and III-3 are not intended to be all inclusive of every transportation improvement project completed within the region. The tables only identify key capacity improvement projects that impact the evacuation model network and are anticipated to have an impact on evacuation clearance times.

Table III-2 - Southwest Florida Region Roadway Improvements, 2006 – 2010

County	Roadway	From	To	Number of Lanes
Charlotte	Kings Highway	I-75	Desoto County line	4
	Veterans Blvd	Toledo Blade Rd	Kings Highway	4
Collier	CR 951 (Collier Blvd)	Green Blvd	Golden Gate Blvd	4
	CR 858 (Oil Well Rd)	CR 846 (Immokalee Rd)	Everglades Blvd	4
	Golden Gate Pkwy	Livingston Rd	Santa Barbara Blvd	6
	Immokalee Rd	US 41	Oil Well Rd	6
	SR 84 (Davis Blvd)	Santa Barbara Blvd	Radio Rd	6
Collier/Lee	I-75	Golden Gate Pkwy	Colonial Blvd (SR 884)	6
Hendry	SR 80 (Palm Beach Blvd)	Clark Street	Birchwood Pkwy	4
Lee	I-75	S of Colonial Blvd	S of SR 82	6
	SR 78	Chiquita Blvd	Del Prado Blvd	4
	SR 739 (Metro Pkwy)	Six Mile Cypress Pkwy	Daniels Pkwy	6
	SR 739 (Metro Parkway)	US 41	Six Mile Cypress Pkwy	6
	SR 739	Six Mile Cypress Pkwy	Daniels Pkwy	6
	SR 82 (MLK Blvd)	Ortiz Ave	Lee Blvd	6
	US 41	Bonita Beach Rd	Old US 41	6
Sarasota	US 301	Wood St	University Pkwy	6
	US 301	29th St	Northgate Blvd	6
	I-75	River Rd	SR 681	6
	US 41	US 41 Business	Laurel Rd	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Southwest Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects completed between 2006 and 2010 on roadways that are included in the regional transportation model network. Only projects which added roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project completed within the region. A list of historical projects completed during the last five years was included in this report because the base regional network developed for the study, along with the base demographic data, is for the year 2006.

Table III-3 - Southwest Florida Planned Roadway Improvements, 2011–2015

County	Roadway	From	To	Number of Lanes
Charlotte	Toledo Blade Blvd	US 41	Hillsborough Blvd	4
	US 41	Enterprise Dr	Flamingo Blvd	4
	Burntstore Rd	Notre Dame Rd	US 41	4
Lee	Ortiz Ave	SR 884	SR 82	4
	I-75	S of SR 82	S of Luckett Rd	6
	US 41	Corkscrew Rd	San Carlos Blvd	6
	Del Prado Pkwy	NE 7th St	S of Diplomat Pkwy	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Southwest Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects planned for completion between 2011 and 2015 on roadways that are included in the regional transportation model network. Only projects which are planned to add roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project planned for completion within the region.

E. Behavioral Assumptions

The behavioral assumptions provide important information on the way people respond to an evacuation order and are an important input to the SRESP transportation evacuation model. For the Southwest Florida Region, all six counties within the region have evacuation zones corresponding to different categories of storm surge. Evacuation rates for site-built homes and mobile/manufactured homes are provided by county and summarized in **Figure III-4** through **Figure III-15**. Other rates, such as out of county trip rates, vehicle use rates, public shelter use rates, friend/relative refuge use rates, hotel/motel refuge use rates, and other refuge use rates, are detailed by county, storm threat, and evacuation zone in Volume 5-9.

A review of the evacuation rates for the Southwest Florida region illustrates that evacuation participation rates increase as the evacuation level increases, and participation rates for persons living in mobile/manufactured homes are generally higher than for persons living in site-built homes. It should be noted that a certain percentage of the population evacuates, even when they are not living in an area that is ordered to evacuate. These people are commonly referred to as shadow evacuees. Shadow evacuation rates are also included in Figure III-4 through Figure III-15.

For example, if an evacuation order was issued for Charlotte County for persons living in evacuation zone A, the county could expect a 50 percent participation rate from persons living in site-built homes in evacuation zone A (Figure III-4) and a 75 percent participation rate from persons living in mobile/manufactured homes in evacuation zone A (Figure III-5). In addition, Charlotte County can expect shadow evacuations to occur for persons living in site-built homes at a rate of 30 percent from evacuation zone B, 10 percent from evacuation zone C, and 10 percent for evacuation zone D, which also includes zone E (Figure III-4). Likewise, for persons living in mobile/manufactured homes, Charlotte County can expect shadow evacuations to occur at a rate of 75 percent from evacuation zone B, and 65 percent each from evacuation zones C and D (Figure III-5).

Please note that the original behavioral response rates provided by SRESP in Volume 2-9 were modified to fit the evacuation zones created for Glades and Hendry Counties. The original rates for Glades and Hendry were based on the assumption that those counties were inland areas with no evacuation zones; however, for the purpose of the transportation analysis, both counties utilize five zones.

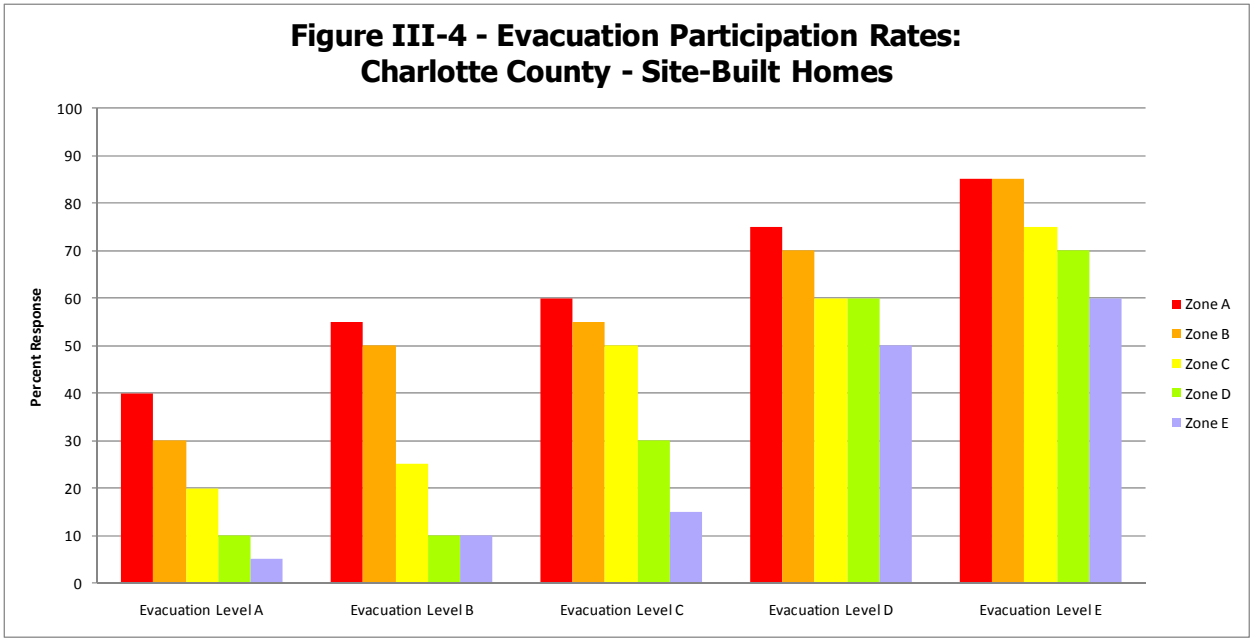


Figure III-4 - Evacuation Participation Rates:
Charlotte County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

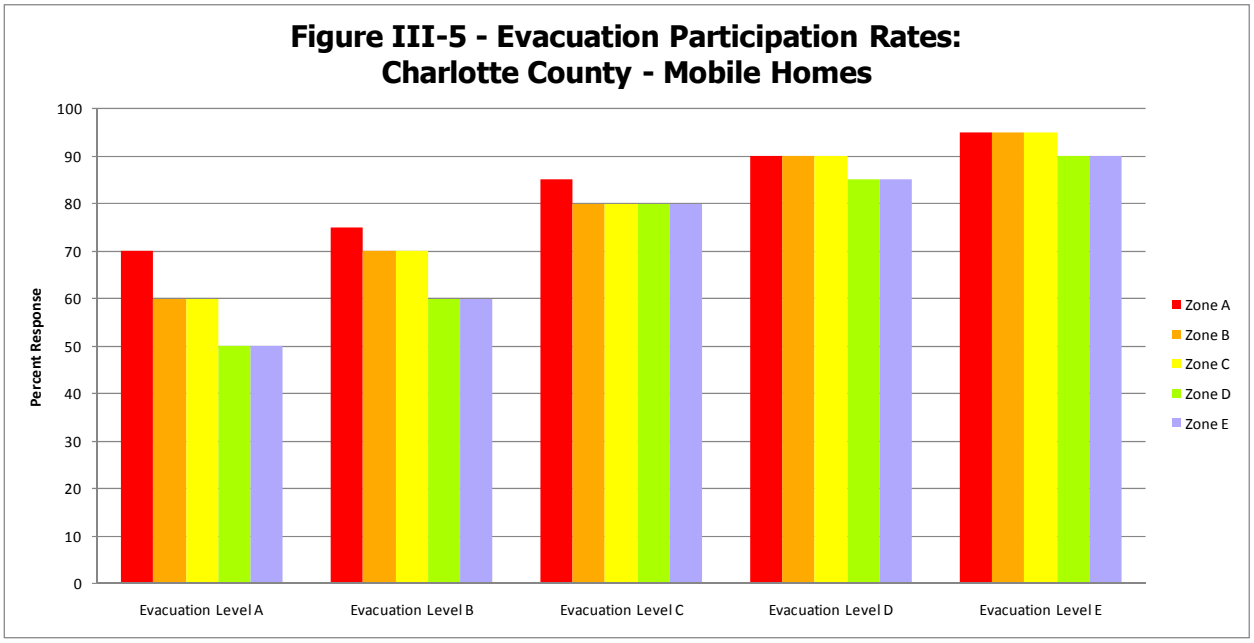


Figure III-5 - Evacuation Participation Rates:
Charlotte County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

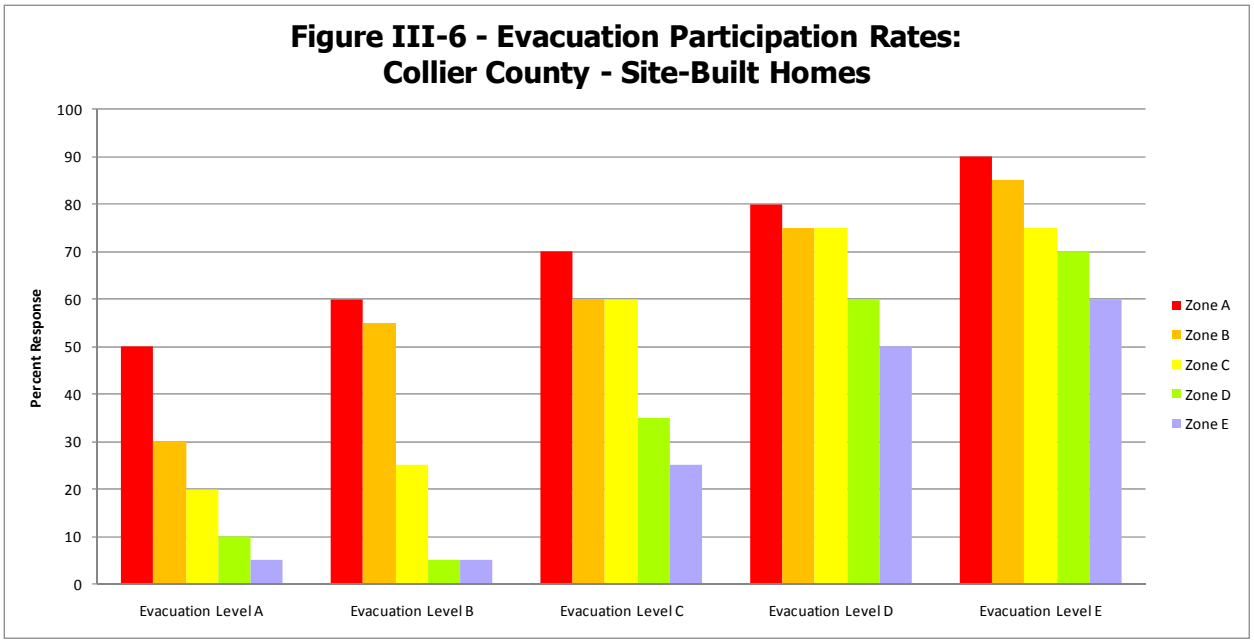


Figure III-6 - Evacuation Participation Rates:
Collier County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

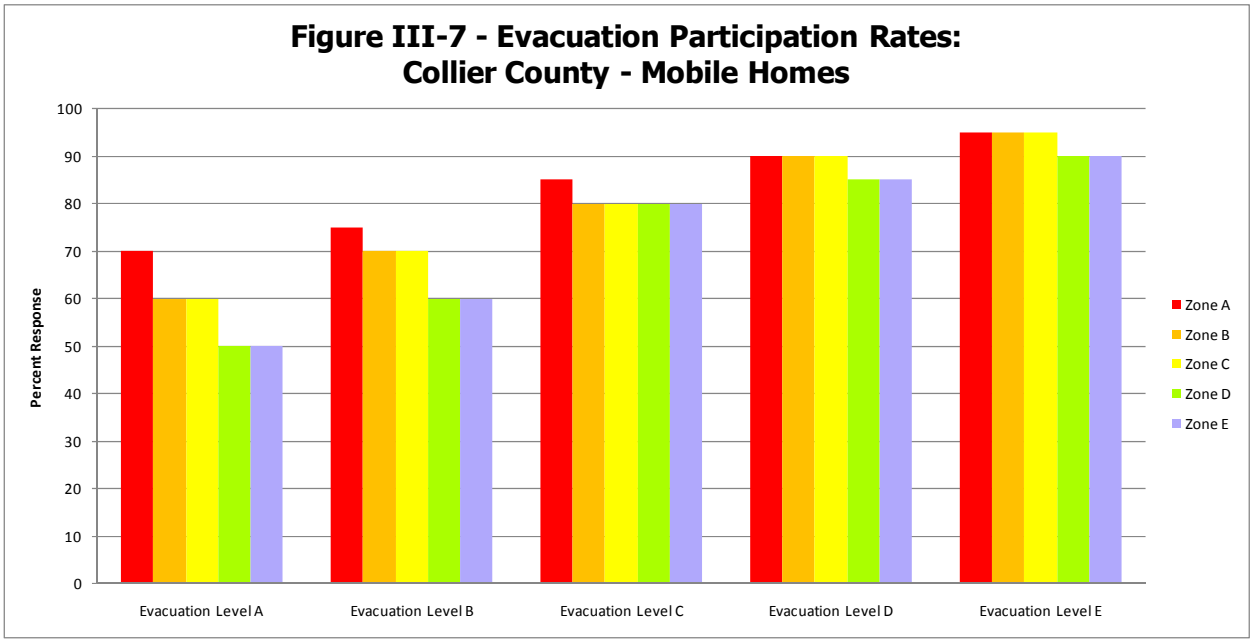


Figure III-7 - Evacuation Participation Rates:
Collier County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

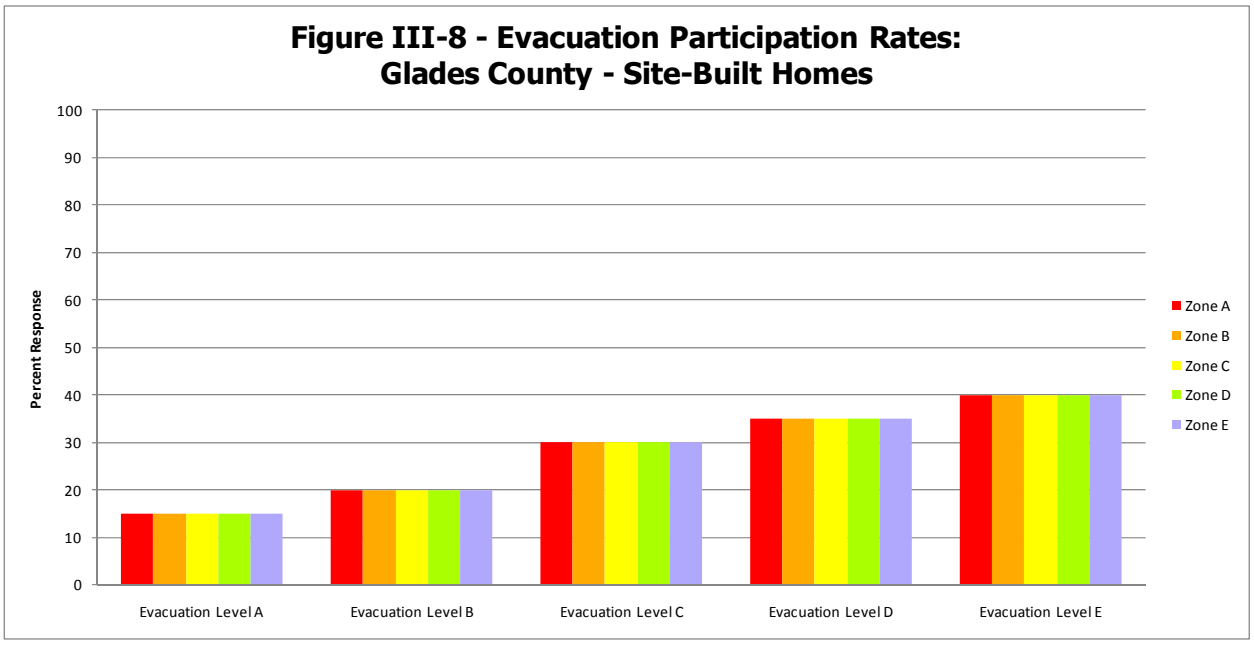


Figure III-8 - Evacuation Participation Rates:
Glades County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

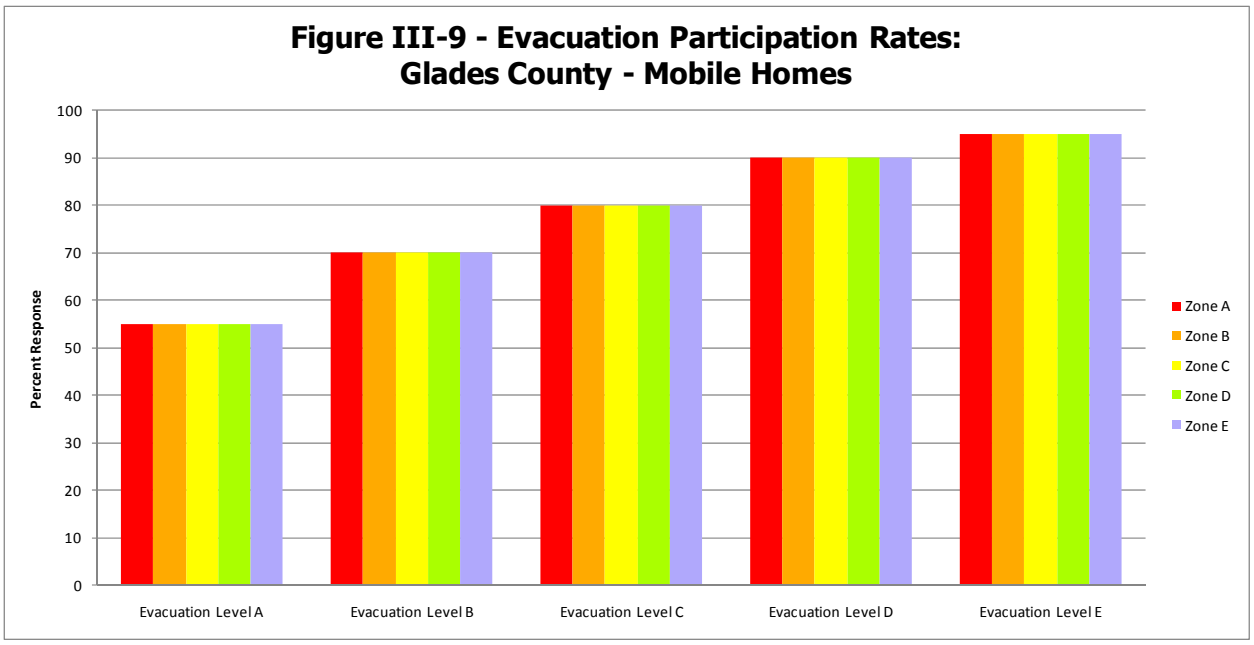


Figure III-9 - Evacuation Participation Rates:
Glades County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

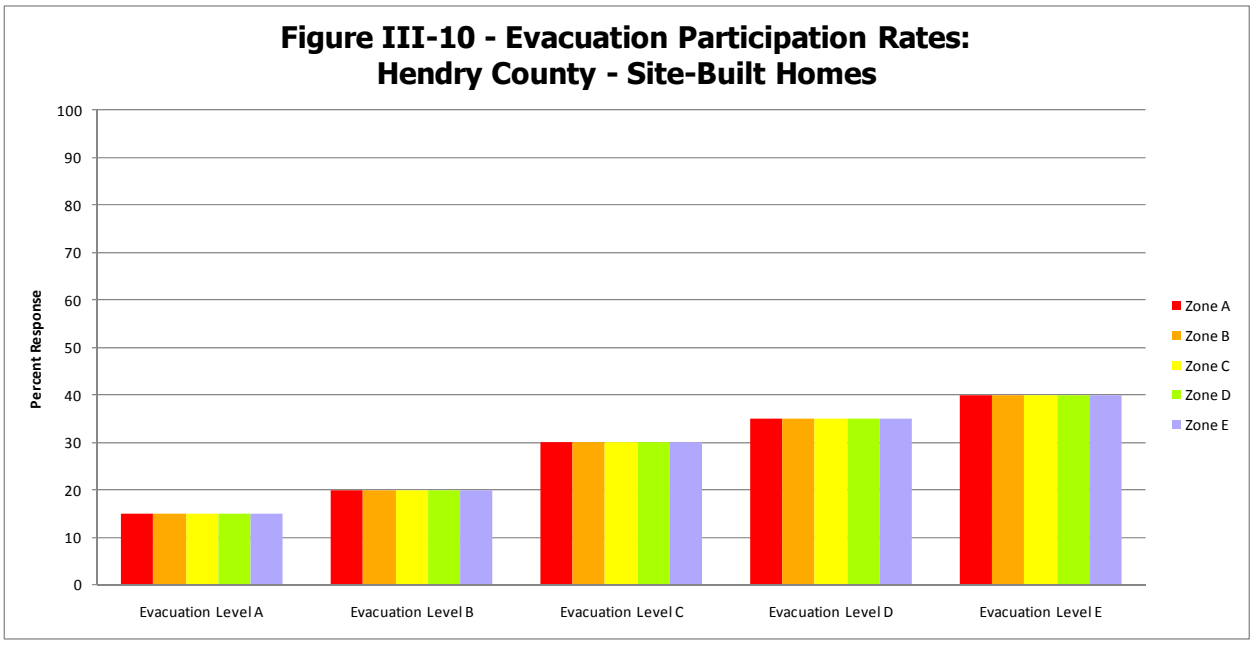


Figure III-10 - Evacuation Participation Rates:
Hendry County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

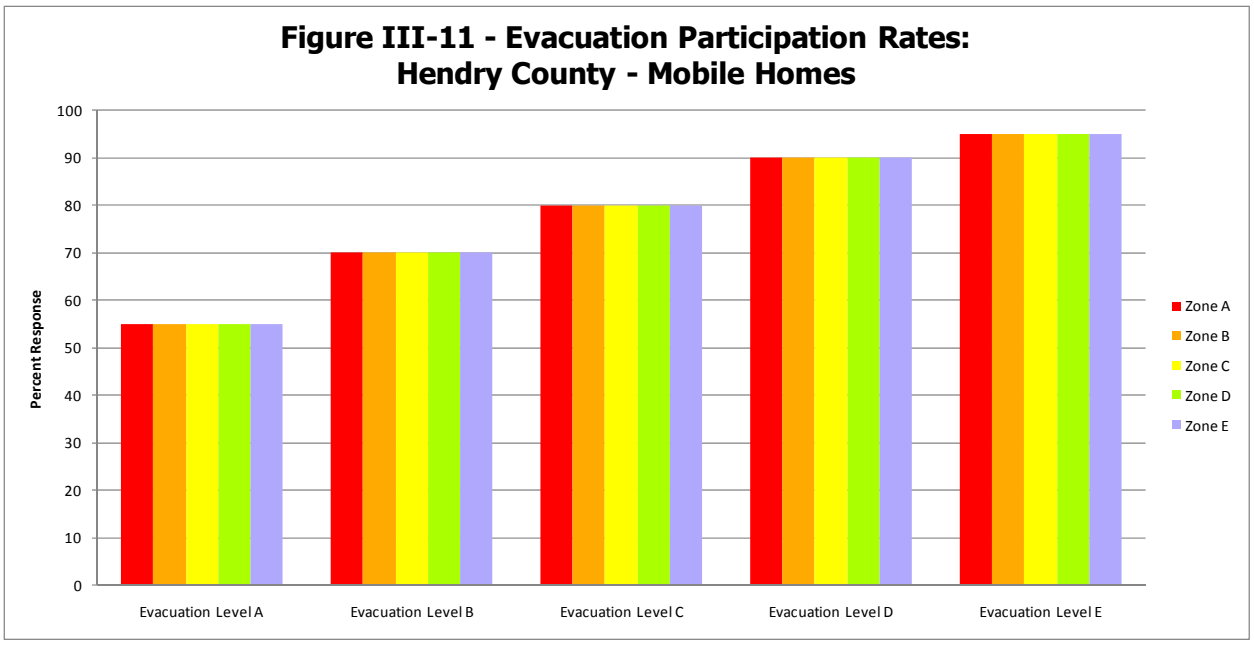


Figure III-11 - Evacuation Participation Rates:
Hendry County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

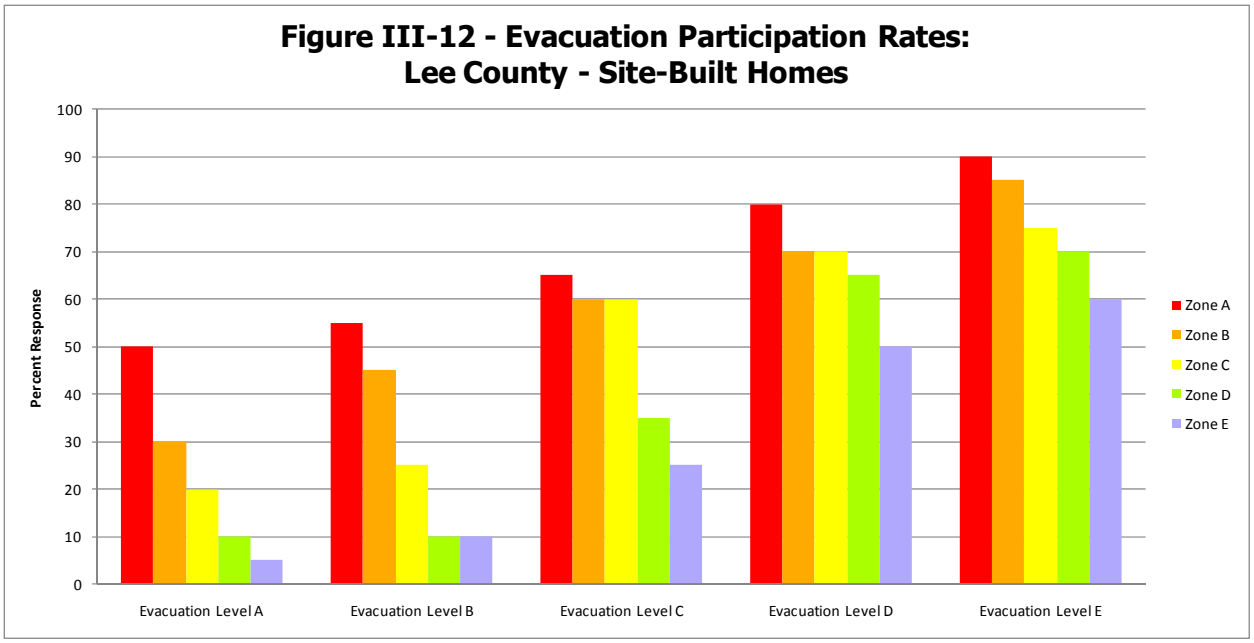


Figure III-12 - Evacuation Participation Rates:
Lee County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

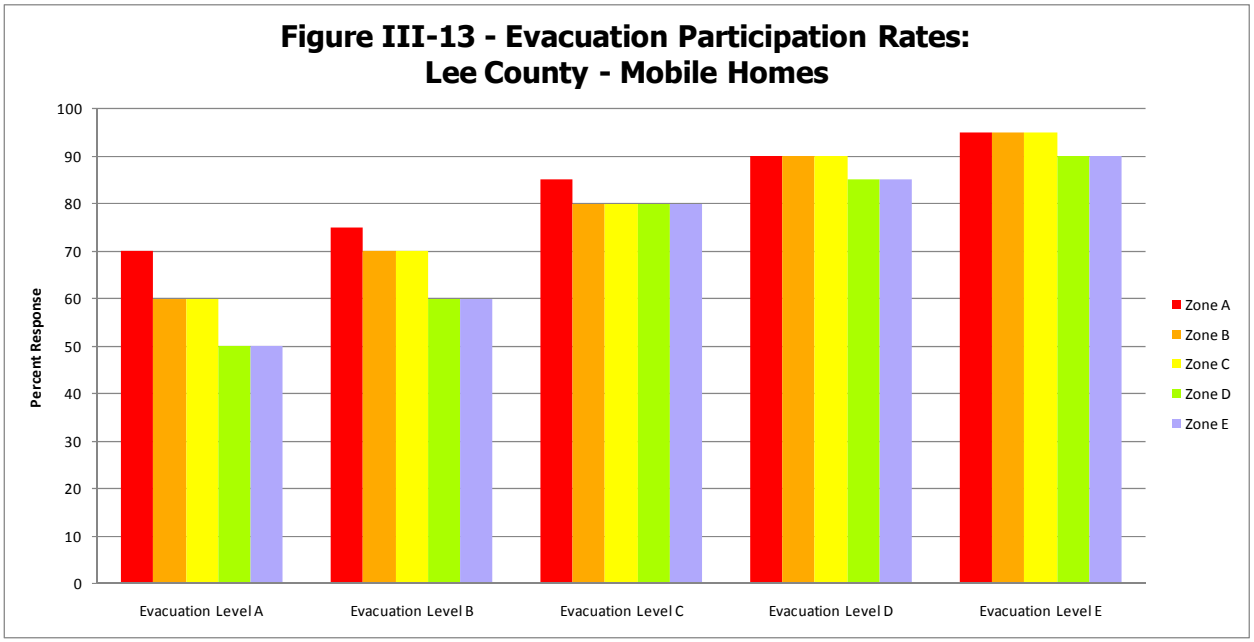


Figure III-13 - Evacuation Participation Rates:
Lee County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

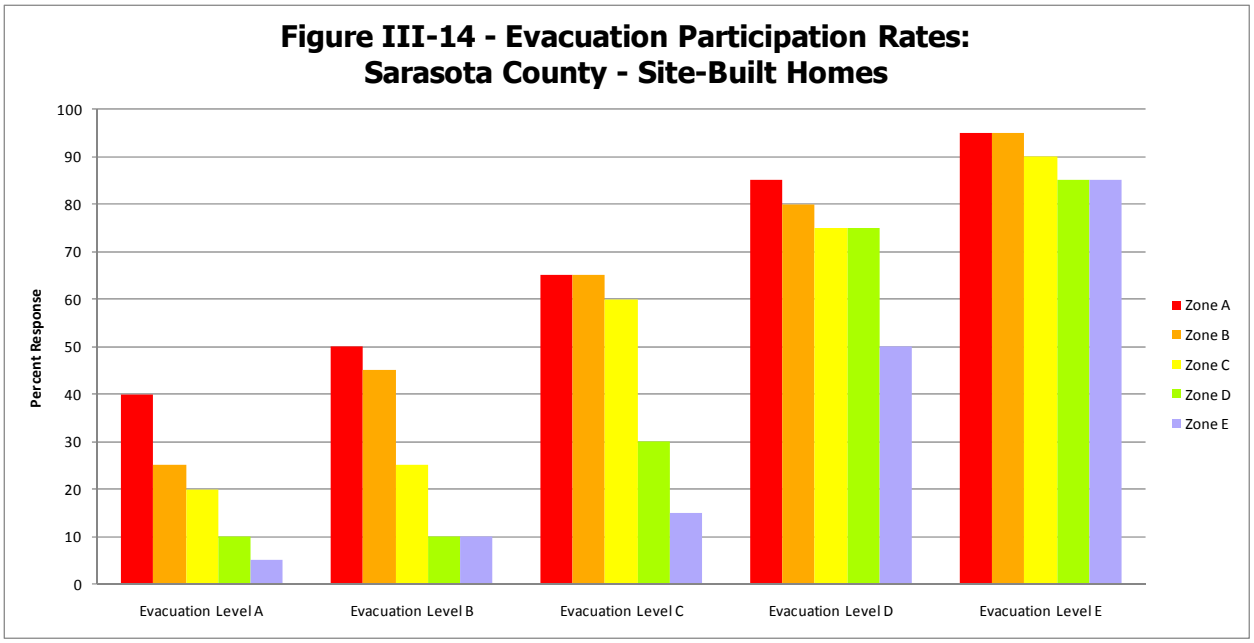


Figure III-14 - Evacuation Participation Rates:
Sarasota County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

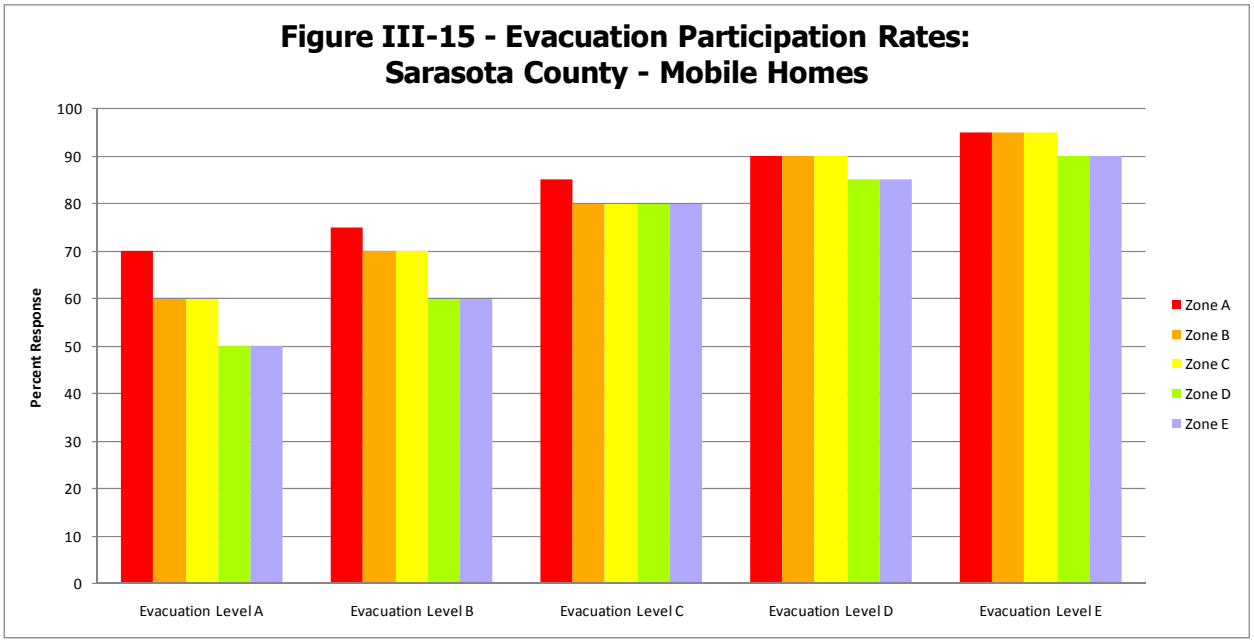


Figure III-15 - Evacuation Participation Rates:
Sarasota County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

F. Shelters

In order for the transportation model to accurately assign public shelter trips to the correct location, a complete list of available public shelters needs to be available. The Southwest Florida RPC compiled the list of available public shelters using information provided by the local county emergency managers. The shelters were categorized as either primary or other, with primary indicating that the shelter is compliant with American Red Cross standards for a shelter and other indicating all other shelters.

In the six county region there are a total of 175 shelters, including 18 in Charlotte County, 56 in Collier County, 12 in Glades County, 17 in Hendry County, 50 in Lee County, and 22 in Sarasota County. The total number of shelters includes other shelters as well as those shelters compliant with ARC standards/risk shelters. All together, the 175 shelters located within the six county region can host more than 100,000 persons during an evacuation event. Detailed lists of the primary and other shelters used in the transportation analysis are included in Volume 5-9. It is important to note that the shelter list used in the transportation analysis was developed early in the study process and may not match the latest available list of primary and other shelters from each county.

G. Evacuation Zones

The final input variable that is needed to complete the transportation evacuation model is the delineation of evacuation zones for all coastal counties. Local county emergency managers have the responsibility of identifying and defining evacuation zones for their county. All six counties within the Southwest Florida region have updated and established their evacuation zones based on the results of the new data and information collected as part of the SRESP. Evacuation zones for the Southwest Florida Region are illustrated in **Figure III-16**. County level evacuation zones are included in Volume 5-9.

H. TIME User Interface

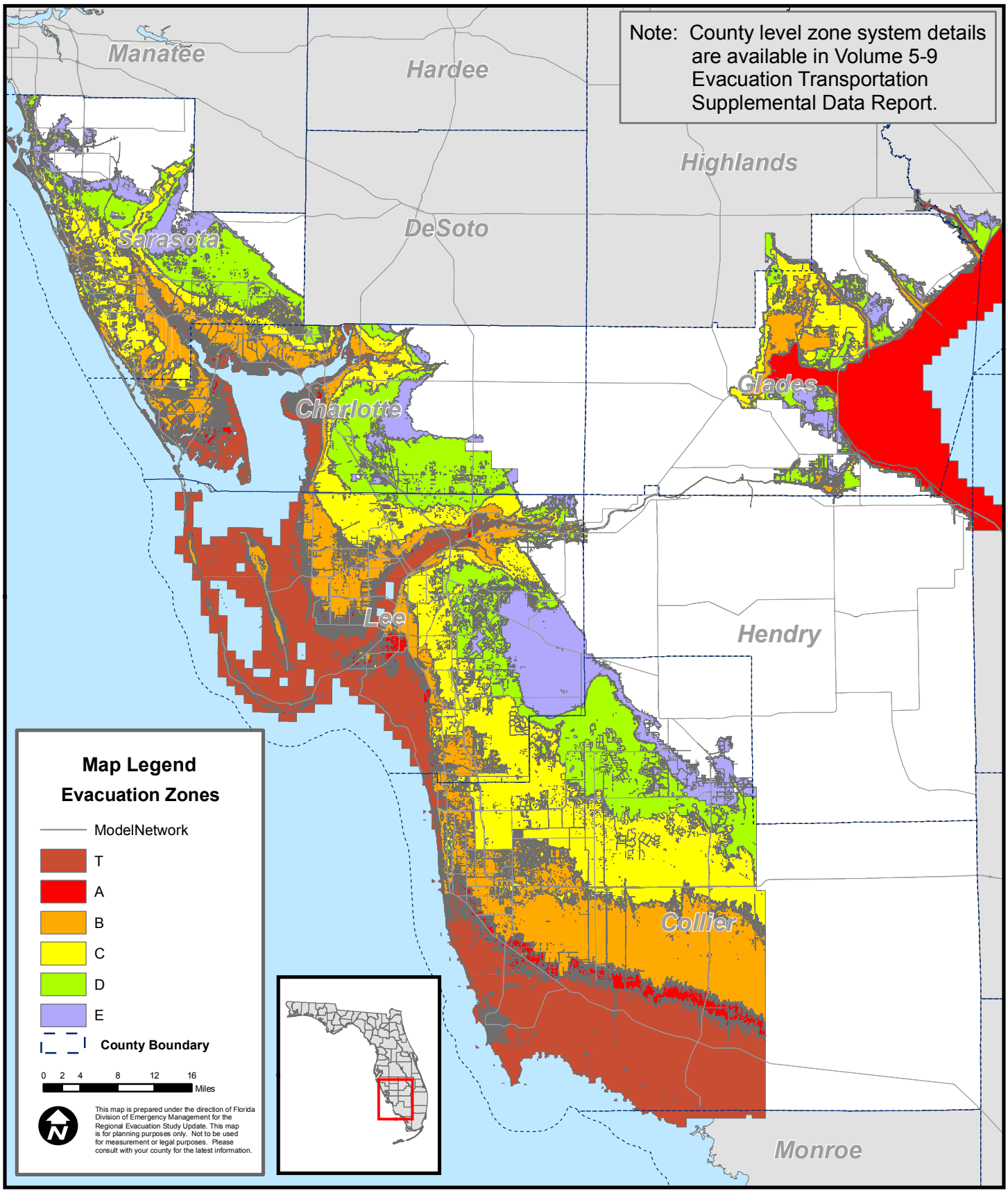
Wilbur Smith Associates developed the Transportation Interface for Modeling Evacuations (TIME) to make it easier for RPC staff and transportation planners to use the model and implement the evacuation methodology. The TIME interface is based on an ArcGIS platform and is essentially a condensed transportation model, which provides a user friendly means of modifying input variables that would change the clearance times for various evacuation scenarios.

The evacuation model variables include a set of distinguishing characteristics that could apply to evacuation scenarios as selection criteria. These following variables may be selected using the TIME interface and allow the user to retrieve the best results from various evacuation alternatives:

- **Analysis time period -** The first input variable is the evacuation analysis time period. The time period selections include 2006, 2010 and 2015. The time period determines which set of demographic data and which version of the model network will be used.

Figure III-16

Southwest Florida Regional Evacuation Zones



Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: November, 2010

- **Highway network -** Once the time period is selected, the user must pick either the default highway network or a modified network. The default includes the network corresponding to the selected time period and also incorporates planned highway improvement projects from the Florida Department of Transportation Work Program. In the case that there are any new projects or changes need to be taken into account, the modified network would be chosen. These changes could include possible road or bridge closures because of storm conditions or any managed traffic diversions or traffic control measures.

- **Behavioral response -** The next variable is behavioral response, which is a set of "planning assumptions" that describe the way people respond to an order to evacuate and are an important input to the SRESP Evacuation Model. A user may choose 100% or the survey response. The 100% response indicates that 100% of people in evacuation zones will evacuate, while the survey response uses the percentage of people from the behavioral planning assumptions corresponding to the evacuation level for each county.

- **One-way evacuation operations -** Another variable for consideration is whether to allow one-way evacuation operations or not. One-way evacuation operations allow take into account the FDOT one-way evacuation operations plans for major facilities, including I-75, I-4, and Florida's Turnpike.

- **University population -** The model permits the user to incorporate the population in university housing since this data is not included in the regular population numbers. The default assumption is that the region's universities are at the maximum housing capacity housing during the Fall/Spring semester. The other options available are the summer university population, which is generally much less than the fall or spring, and an option for no school in session.

- **Tourist occupancy rates -** The RPC has the option to choose the default rates or to modify those rates based on any special circumstance they may have for tourist rates since there are different tourist seasons, sectors and special events. If modified rates are desired, then the user may select no tourist occupancy or modify the rates on a county by county basis.

- **Shelters -** When choosing which shelters are open to the public during an evacuation event, the user may select either primary shelters or other shelters, both primary and other shelters, and/or modified. In many situations, the shelters category may need to be modified because of availability or capacity changes.

- **Counties evacuating -** The evacuating counties are the counties within the geographic extent of Southwest Florida's model network and include both coastal and inland counties. The coastal counties include Indian River, St. Lucie, Martin, Palm Beach, Hernando, Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, and Collier Counties. The inland counties are Polk, Hardee, DeSoto, Highlands, Okeechobee, Glades, Hendry, Sumter, Lake, Orange, and Osceola Counties. The user has the opportunity to pick which of the counties in the network actually evacuate.

- **Evacuation level -** Once the evacuating counties are chosen, the evacuation level is designated. The evacuation levels range from A to E and represent the evacuation zones that are ordered to evacuate. The user may also select "none", which assumes that no evacuations are made within the selected county; only regular background traffic will occur.

- **Response curve hours –** The user must define which evacuation response curve will be applied to each evacuating county in the area. The evacuation response curves show the proportion of evacuation by increment of time for evacuation orders that were issued. There are six different curves to from which to choose: a 6-hour curve, 9-hour curve, 12-hour curve, 18-hour curve, 24-hour curve, and a 36-hour curve. The faster curves represent more urgent circumstances and slower curves represent less urgent circumstances.

- **Evacuation Phasing –** The phase selection indicates when an evacuation would begin in a given county. There are ten different options beginning in hour 1 and extending to hour 27. After hour 3, the other phasing options follow in 3 hour increments.

CHAPTER IV
TRANSPORTATION ANALYSIS

The transportation analysis brings together key factors such as evacuation level, transportation network, shelters, and evacuation population, and explicitly links people's behavioral responses to the regional evacuation infrastructure. The results of this analysis help to formulate effective and responsive evacuation policy options. Two distinct sets of analyses were conducted using the SRESP evacuation transportation model, including one set of analysis for growth management purposes and one set of analysis for emergency management purposes. The results of this analysis are discussed in this chapter.

A. Vulnerable Population

Using a combination of the demographic data, behavioral assumptions, and evacuation zones, the vulnerable population in each county could be determined by evacuation level. For the purposes of the transportation analysis, the vulnerable population, or population-at-risk, is defined as the total population living within the county designated evacuation zones for each evacuation level. This population is living in an area that is at risk for severe flooding during a storm event. The vulnerable population for the Southwest Florida Region for 2010 is identified in **Table IV-1**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2015 is summarized in **Table IV-2**.

The vulnerable population in the Southwest Florida Region includes population from all six counties in the region and varies by evacuation zone. Charlotte County, for example, has nearly 93,000 vulnerable residents in evacuation zone B and only slightly more than 29,000 vulnerable residents in evacuation zone C in 2010. The vulnerable population living in site-built homes far exceeds the vulnerable population living in mobile/manufactured homes in all regional counties except for Glades and Hendry where they vary by evacuation zone.

In addition, based again on the demographic data, behavioral assumptions, and evacuation zones, the planned destinations of vulnerable population in each county could be determined by evacuation level. Destinations include friends and family, hotel/motel, public shelter, and other locations. Vulnerable population destinations for the Southwest Florida Region are identified in **Table IV-3** for 2010 and in **Table IV-4** for 2015.

In all cases in the Southwest Florida Region, the vulnerable population is far more likely to stay with friends and family during an evacuation. This is followed by hotel/motel and other locations, except for Glades and Hendry Counties where public shelter destinations are more likely. In the other four counties, public shelter destinations are identified as the least likely destination of the vulnerable population during an evacuation event.

The vulnerable shadow population is provided in **Table IV-5** for both 2010 and 2015. The vulnerable shadow population was determined using the behavioral assumptions for evacuating shadow population and is based on evacuation level (storm category), not evacuation zone. Vulnerable shadow population for the six county region ranges from 121,000 to nearly 370,000 persons for 2010, depending upon the evacuation level. For 2015, the range increases to between 128,000 and 386,000 persons.

Table IV-1 – Vulnerable Population in the Southwest Florida Region for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
Site-built Homes	45,862	88,357	28,011	3,326	230
Mobile/Manuf. Homes	2,460	4,637	1,107	1,869	19
TOTAL	48,322	92,994	29,118	5,195	249
Collier County					
Site-built Homes	85,217	127,260	75,144	8,786	2,552
Mobile/Manuf. Homes	4,537	3,664	1,056	369	1,322
TOTAL	89,754	130,924	76,200	9,155	3,874
Glades County					
Site-built Homes	336	287	296	525	193
Mobile/Manuf. Homes	268	356	378	660	215
TOTAL	604	643	674	1,185	408
Hendry County					
Site-built Homes	739	137	229	60	0
Mobile/Manuf. Homes	1,529	170	45	10	0
TOTAL	2,268	307	274	70	0
Lee County					
Site-built Homes	95,163	245,594	118,236	40,296	47,096
Mobile/Manuf. Homes	17,500	16,638	19,304	411	0
TOTAL	112,663	262,232	137,540	40,707	47,096
Sarasota County					
Site-built Homes	26,182	48,068	107,295	66,128	37,745
Mobile/Manuf. Homes	3,501	7,172	7,423	2,659	1,506
TOTAL	29,683	55,240	114,718	68,787	39,251

Note: Vulnerable population determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-2 – Vulnerable Population in the Southwest Florida Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
Site-built Homes	75,303	81,803	22,207	2,319	151
Mobile/Manuf. Homes	2,201	4,799	1,123	2,241	28
TOTAL	77,504	86,602	23,330	4,560	179
Collier County					
Site-built Homes	145,306	99,170	72,740	12,586	1,908
Mobile/Manuf. Homes	4,171	3,491	1,059	411	1,436
TOTAL	149,477	102,661	73,799	12,997	3,344
Glades County					
Site-built Homes	507	286	357	474	165
Mobile/Manuf. Homes	270	378	391	668	215
TOTAL	777	664	748	1,142	380
Hendry County					
Site-built Homes	767	140	191	56	0
Mobile/Manuf. Homes	1,550	172	46	10	0
TOTAL	2,317	312	237	66	0
Lee County					
Site-built Homes	72,531	202,454	156,318	70,136	77,885
Mobile/Manuf. Homes	32,351	21,691	24,037	492	0
TOTAL	104,882	224,145	180,355	70,628	77,885
Sarasota County					
Site-built Homes	17,781	44,214	133,880	94,657	29,181
Mobile/Manuf. Homes	4,995	9,114	9,152	3,613	1,816
TOTAL	22,776	53,328	143,032	98,270	30,997

Note: Vulnerable population determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-3 – Vulnerable Population by Destination for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
To Friends and Family	26,823	51,610	16,125	3,045	139
To Hotel/ Motel	11,957	23,017	7,224	1,206	61
To Public Shelter	3,792	7,300	2,352	586	31
To Other Destination	5,749	11,067	3,417	360	19
Collier County					
To Friends and Family	53,625	78,371	45,614	5,456	2,192
To Hotel/ Motel	22,665	32,914	19,103	2,307	969
To Public Shelter	7,044	12,909	7,620	1,091	505
To Other Destination	8,975	9,275	5,366	476	260
Glades County					
To Friends and Family	349	368	386	678	234
To Hotel/ Motel	74	82	86	151	52
To Public Shelter	91	96	101	178	61
To Other Destination	91	96	101	178	61
Hendry County					
To Friends and Family	1,513	202	169	43	0
To Hotel/ Motel	150	22	25	6	0
To Public Shelter	454	62	55	14	0
To Other Destination	150	22	25	6	0
Lee County					
To Friends and Family	66,723	156,508	80,594	24,383	28,258
To Hotel/ Motel	28,166	65,558	34,385	8,162	9,419
To Public Shelter	5,633	13,112	7,842	4,877	5,652
To Other Destination	12,141	27,055	14,719	3,285	3,768
Sarasota County					
To Friends and Family	18,769	32,427	68,088	41,006	23,400
To Hotel/ Motel	7,246	11,048	22,944	13,757	7,850
To Public Shelter	1,834	5,280	10,068	8,467	4,831
To Other Destination	1,834	6,485	13,618	5,556	3,170

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-4 – Vulnerable Population by Destination for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
To Friends and Family	42,848	48,111	12,944	2,732	101
To Hotel/ Motel	19,266	21,411	5,777	1,028	42
To Public Shelter	6,134	6,784	1,889	502	22
To Other Destination	9,257	10,296	2,721	298	14
Collier County					
To Friends and Family	89,478	61,422	44,173	7,757	1,863
To Hotel/ Motel	37,578	25,840	18,503	3,270	836
To Public Shelter	11,833	10,092	7,380	1,551	444
To Other Destination	14,948	7,291	5,198	670	239
Glades County					
To Friends and Family	453	380	429	652	217
To Hotel/ Motel	91	85	94	148	49
To Public Shelter	117	100	112	171	57
To Other Destination	117	100	112	171	57
Hendry County					
To Friends and Family	1,545	205	147	41	0
To Hotel/ Motel	154	23	21	6	0
To Public Shelter	463	63	47	13	0
To Other Destination	154	23	21	6	0
Lee County					
To Friends and Family	61,311	133,402	105,809	42,328	46,731
To Hotel/ Motel	26,220	56,036	45,089	14,150	15,577
To Public Shelter	5,244	11,207	10,220	8,466	9,346
To Other Destination	12,106	23,499	19,237	5,685	6,231
Sarasota County					
To Friends and Family	14,055	31,085	84,904	58,601	18,417
To Hotel/ Motel	5,444	10,666	28,606	19,654	6,200
To Public Shelter	1,638	5,360	12,541	12,082	3,865
To Other Destination	1,638	6,217	16,981	7,934	2,516

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-5 – Vulnerable Shadow Evacuation Population

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
Charlotte County	41,409	13,877	7,170	4,486	4,397
Collier County	70,131	39,209	24,137	22,172	19,572
Glades County	6,064	5,867	5,844	5,229	5,130
Hendry County	19,261	20,177	22,159	23,164	24,197
Lee County	154,098	76,609	49,073	47,813	25,840
Sarasota County	78,833	69,455	62,663	54,971	41,846
2015					
Charlotte County	38,874	13,165	8,186	5,392	5,322
Collier County	62,127	39,586	26,502	22,815	20,424
Glades County	6,533	6,326	6,294	5,697	5,619
Hendry County	21,398	22,369	24,478	25,545	26,638
Lee County	166,187	100,455	70,751	66,733	29,398
Sarasota County	90,633	81,248	71,007	50,749	41,475

Note: Vulnerable shadow population determined using SRESP behavioral data and county provided evacuation zones.

B. Clearance Time Definitions

The determination of clearance time is one of the most important outcomes from the evacuation transportation analysis. Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. This calculation can include the population-at-risk, shadow evacuees, as well as evacuees from other counties anticipated to pass through the county. Clearance time is developed to include the time required for evacuees to secure their homes and prepare to leave, the time spent by all vehicles traveling along the evacuation route network, and the additional time spent on the road caused by traffic and road congestion. Clearance time does not relate to the time any one vehicle spends traveling along the evacuation route network, nor does it guarantee vehicles will safely reach their destination once outside the County. The four clearance times that are calculated as part of the evacuation transportation analysis include the following:

- **Clearance Time to Shelter** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point in time when the evacuation order is given to the point in time when the last vehicle reaches a point of safety within the county. Key points to remember for clearance time to shelter include:
  - All in-county trips reach their destination within the county; and,
  - This definition does not include any out of county trips.

- **In-County Clearance Time** - The time required from the point an evacuation order is given until the last evacuee can either leave the evacuation zone or arrive at safe shelter within the county. This does not include those evacuees leaving the county on their own. Key points to remember for in-county clearance time include:
  - All in-county trips reach their destination within the county;
  - All out of county trips exit the evacuation zone, but may still be located in the county; and,
  - This definition does not include out-of-county pass-through trips from adjacent counties, unless they evacuate through an evacuation zone.

- **Out of County Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point an evacuation order is given to the point in time when the last vehicle assigned an external destination exits the county. Key points to remember for out of county clearance time include:
  - The roadway network within the county is clear;
  - All out of county trips exit the county, including out of county pass-through trips from adjacent counties; and,
  - All in-county trips reach their destination.

- **Regional Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the (RPC) region based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from last vehicle assigned an external destination exits the region. Key points to remember for regional clearance time include:

- The roadway network within the RPC is clear;
- All out of county trips exit the RPC, including out of county pass-through trips from adjacent counties;
- All in-county trips reach their destination; and,
- Regional clearance time is equal to the largest out of county clearance time for a given scenario for any of the counties within the RPC, since the out of county clearance time includes out of county pass through trips from adjacent counties.

C. Evacuation Model Scenarios

There are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. For the purposes of this analysis, two distinct sets of analyses were conducted using the SRESP evacuation transportation model, including one set of analysis for growth management purposes and one set of analysis for emergency management purposes. The two sets of analysis include the following:

- **Base Scenarios** – The base scenarios were developed to estimate a series of worst case scenarios and are identical for all eleven RPCs across the State. These scenarios assume 100 percent of the vulnerable population evacuates and includes impacts from counties outside of the RPC area. These scenarios are generally designed for growth management purposes, in order to ensure that all residents that choose to evacuate during an event are able to do so; and,

- **Operational Scenarios** – The operational scenarios were developed by the RPCs in coordination with local county emergency managers and are designed to provide important information to emergency management personnel to plan for different storm events. These scenarios are different from region to region and vary for each evacuation level.

Because of the numerous possible combinations of variables that can be applied in the model, the evacuation transportation model is available for use through the Southwest Florida RPC to continue testing combinations of options and provide additional information to emergency managers.

D. Base Scenarios

A total of ten base scenarios were developed through discussions with the SRESP Statewide Work Group and are identical for all eleven RPCs. The SRESP requires a consistent set of base scenarios that will be used by all regions across the State to provide a consistent background between regions. The base scenarios also allow the results to be used consistently from region to region for other purposes, such as growth management. The ten base scenarios were developed to include the following assumptions:

- **Analysis Time Period** – Five scenarios for the 2010 time period and five scenarios for the 2015 time period. The five scenarios for each time period include one for each of the five evacuation levels, A, B, C, D, and E;

- **Highway Network** – The five 2010 scenarios use the 2010 network and the five 2015 scenarios use the 2015 network, which includes planned roadway capacity improvement

projects expected to be implemented by 2015;

- **One-Way Evacuation Operations** – The base scenarios do not include implementation of any one-way evacuation operations;

- **University Population** – The base scenarios use the fall/spring semester data to estimate evacuation trips by the student population. This data was provided by each RPC as part of the demographic small area data;

- **Tourist Occupancy Rates** – The base scenarios use the default hotel/motel occupancy rates to estimate tourist evacuation trips. This data was provided by each RPC as part of the demographic small area data;

- **Shelters** – The base scenarios assume all designated primary shelters within each county in the model network are open. The base scenarios do not include shelters that are designated as other shelters, only primary shelters;

- **Response Curve** – The 12-hour response curve is used for all ten base scenarios;

- **Evacuation Phasing** - All counties that are evacuating begin at same time, within 1 hour of the evacuation order being given;

- **Behavioral Response** - For all five evacuation levels (A, B, C, D, or E) in both the 2010 and 2015 time periods, the behavioral response for the base scenarios includes the following:
  - 100% response in evacuation zones for both mobile homes and site built homes for the counties in the RPC, plus one coastal county on either side of the region (includes Charlotte, Collier, Glades, Hendry, Lee, Sarasota, Manatee, and mainland Monroe Counties);
  - 100% response for mobile homes in inland areas for the counties in the RPC, plus one coastal county on either side of the region (includes Charlotte, Collier, Glades, Hendry, Lee, Sarasota, Manatee, and mainland Monroe Counties);
  - Planning Assumption response (shadow evacuation) for site built homes in inland areas for the counties in the RPC plus one coastal county on either side of the region (includes Charlotte, Collier, Glades, Hendry, Lee, Sarasota, Manatee, and mainland Monroe Counties); and,
  - For the remaining counties in the Southwest Florida model network, no evacuations are assumed, including shadow evacuations.

The ten base scenarios are summarized in **Table IV-6**.

Table IV-6 – Base Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)

ML – includes mainland portion of Monroe County only.

E. Base Scenario Results

Each of the ten base scenarios were modeled for the Southwest Florida Region using the regional evacuation model. Results were derived from the model to summarize the evacuating population, evacuating vehicles, clearance times, and critical congested roadways. Each of these results are discussed in the following sections.

Evacuating Population

It is important to determine the evacuating population for each of the base scenarios in order to understand the magnitude of the evacuation effort, including estimated population that is evacuating and the county level shelter demand. Evacuating population for the base scenarios is summarized by county for 2010 in **Table IV-7** and for 2015 in **Table IV-8**.

Within the six county region, total evacuating population ranges from more than 653,000 persons for a base scenario level A evacuation to more than 1.5 million persons for a base scenario level E evacuation in 2010. By 2015, this range increases within the six counties to more than 743,400 persons for a base scenario level A evacuation and nearly 1.7 million persons for a base scenario level E evacuation.

Evacuating Vehicles

From a transportation standpoint, the number of evacuating vehicles is more important than the evacuating population. Evacuating vehicles for the base scenarios is summarized by county for 2010 in **Table IV-9** and for 2015 in **Table IV-10**.

The total number of evacuating vehicles within the six county region for the base scenarios also varies by evacuation level. A total of nearly 319,000 vehicles evacuate from the six county RPC for a base scenario level A evacuation in 2010, and this number increases to more than 735,000 evacuating vehicles from the six county region for a base scenario level E evacuation in 2010. By 2015, the number of evacuating vehicles is expected to increase to nearly 325,000 vehicles for a base scenario level A evacuation and more than 773,000 evacuating vehicles for a base scenario level E evacuation.

Shelter Demand

Shelter demand is another critical piece of the evacuating population, and shelter demand estimates by county are summarized for each of the base scenarios in **Table IV-11**. Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Public shelter demand in the six county region ranges from nearly 47,000 persons for the base scenario level A evacuation in 2010 to more than 111,000 persons for the base scenario level E evacuation. By 2015, the public shelter demand is expected to increase to nearly 50,000 persons for the level A evacuation and nearly 122,400 persons for the level E evacuation.

Table IV-7 – Evacuating Population by Base Scenario for 2010

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
Site-built Homes	78,333	141,603	163,330	165,786	165,946
Mobile/Manuf. Homes	10,165	10,165	10,165	10,165	10,165
Tourists	1,233	3,425	4,109	4,164	4,164
TOTAL	89,731	155,193	177,604	180,115	180,275
Collier County					
Site-built Homes	139,892	232,304	292,268	299,458	300,732
Mobile/Manuf. Homes	13,805	13,805	13,805	13,805	13,805
Tourists	6,188	13,778	14,942	14,942	14,942
TOTAL	159,885	259,887	321,015	328,205	329,479
Glades County					
Site-built Homes	988	1,434	2,046	2,575	2,852
Mobile/Manuf. Homes	5,680	5,680	5,680	5,680	5,680
Tourists	0	0	39	80	112
TOTAL	6,668	7,114	7,765	8,335	8,644
Hendry County					
Site-built Homes	3,905	5,070	7,326	8,401	9,434
Mobile/Manuf. Homes	17,544	17,544	17,544	17,544	17,544
Tourists	80	138	138	138	138
TOTAL	21,529	22,752	25,008	26,083	27,116
Lee County					
Site-built Homes	199,764	379,905	486,803	525,665	550,117
Mobile/Manuf. Homes	53,995	53,995	53,995	53,995	53,995
Tourists	13,002	17,604	20,710	21,295	21,966
TOTAL	266,761	451,504	561,508	600,955	626,078
Sarasota County					
Site-built Homes	72,571	115,860	220,311	279,851	303,192
Mobile/Manuf. Homes	28,284	28,284	28,284	28,284	28,284
Tourists	7,661	10,234	13,709	15,264	18,049
TOTAL	108,516	154,378	262,304	323,399	349,525

Table IV-8 – Evacuating Population by Base Scenario for 2015

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
Site-built Homes	104,466	162,843	180,016	181,727	181,836
Mobile/Manuf. Homes	10,483	10,483	10,483	10,483	10,483
Tourists	1,429	3,945	5,123	5,178	5,178
TOTAL	116,378	177,271	195,622	197,388	197,497
Collier County					
Site-built Homes	191,830	264,360	323,568	332,878	333,831
Mobile/Manuf. Homes	13,583	13,583	13,583	13,583	13,583
Tourists	6,191	13,781	15,288	15,288	15,288
TOTAL	211,604	291,724	352,439	361,749	362,702
Glades County					
Site-built Homes	1,192	1,649	2,326	2,830	3,100
Mobile/Manuf. Homes	6,118	6,118	6,118	6,118	6,118
Tourists	0	0	39	80	112
TOTAL	7,310	7,767	8,483	9,028	9,330
Hendry County					
Site-built Homes	4,104	5,329	7,675	8,808	9,901
Mobile/Manuf. Homes	19,531	19,531	19,531	19,531	19,531
Tourists	80	138	138	138	138
TOTAL	23,715	24,998	27,344	28,477	29,570
Lee County					
Site-built Homes	176,334	329,735	477,279	543,305	583,183
Mobile/Manuf. Homes	78,768	78,768	78,768	78,768	78,768
Tourists	15,967	20,979	24,086	24,670	25,342
TOTAL	271,069	429,482	580,133	646,743	687,293
Sarasota County					
Site-built Homes	70,811	112,134	241,446	317,886	336,825
Mobile/Manuf. Homes	34,851	34,851	34,851	34,851	34,851
Tourists	7,747	10,367	13,846	15,418	18,202
TOTAL	113,409	157,352	290,143	368,155	389,878

Table IV-9 – Evacuating Vehicles by Base Scenario for 2010

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
Site-built Homes	37,339	68,064	78,498	79,653	79,692
Mobile/Manuf. Homes	6,113	6,113	6,113	6,113	6,113
Tourists	536	1,489	1,787	1,810	1,810
TOTAL	43,988	75,666	86,398	87,576	87,615
Collier County					
Site-built Homes	67,512	114,019	144,218	147,518	147,948
Mobile/Manuf. Homes	4,545	4,545	4,545	4,545	4,545
Tourists	2,691	5,990	6,496	6,496	6,496
TOTAL	74,748	124,554	155,259	158,559	158,989
Glades County					
Site-built Homes	574	814	1,171	1,463	1,611
Mobile/Manuf. Homes	3,441	3,441	3,441	3,441	3,441
Tourists	0	0	19	40	56
TOTAL	4,015	4,255	4,631	4,944	5,108
Hendry County					
Site-built Homes	1,715	2,217	3,177	3,634	4,072
Mobile/Manuf. Homes	6,575	6,575	6,575	6,575	6,575
Tourists	40	69	69	69	69
TOTAL	8,330	8,861	9,821	10,278	10,716
Lee County					
Site-built Homes	99,923	188,185	235,771	255,027	267,220
Mobile/Manuf. Homes	27,621	27,621	27,621	27,621	27,621
Tourists	4,483	6,070	7,141	7,343	7,575
TOTAL	132,027	221,876	270,533	289,991	302,416
Sarasota County					
Site-built Homes	37,406	58,445	109,506	137,091	148,471
Mobile/Manuf. Homes	15,541	15,541	15,541	15,541	15,541
Tourists	2,891	3,862	5,173	5,760	6,811
TOTAL	55,838	77,848	130,220	158,392	170,823

Table IV-10 – Evacuating Vehicles by Base Scenario for 2015

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
Site-built Homes	44,268	72,978	81,239	82,046	82,071
Mobile/Manuf. Homes	6,412	6,412	6,412	6,412	6,412
Tourists	621	1,715	2,227	2,251	2,251
TOTAL	51,301	81,105	89,878	90,709	90,734
Collier County					
Site-built Homes	64,665	98,030	126,587	131,059	131,432
Mobile/Manuf. Homes	4,344	4,344	4,344	4,344	4,344
Tourists	2,692	5,992	6,647	6,647	6,647
TOTAL	71,701	108,366	137,578	142,050	142,423
Glades County					
Site-built Homes	756	1,014	1,433	1,722	1,870
Mobile/Manuf. Homes	3,679	3,679	3,679	3,679	3,679
Tourists	0	0	19	40	56
TOTAL	4,435	4,693	5,131	5,441	5,605
Hendry County					
Site-built Homes	1,819	2,347	3,339	3,819	4,280
Mobile/Manuf. Homes	7,439	7,439	7,439	7,439	7,439
Tourists	40	69	69	69	69
TOTAL	9,298	9,855	10,847	11,327	11,788
Lee County					
Site-built Homes	84,358	156,888	222,127	260,141	282,742
Mobile/Manuf. Homes	39,576	39,576	39,576	39,576	39,576
Tourists	5,506	7,234	8,305	8,507	8,739
TOTAL	129,440	203,698	270,008	308,224	331,057
Sarasota County					
Site-built Homes	35,887	55,770	120,000	155,460	164,671
Mobile/Manuf. Homes	19,961	19,961	19,961	19,961	19,961
Tourists	2,923	3,912	5,225	5,818	6,869
TOTAL	58,771	79,643	145,186	181,239	191,501

Table IV-11 – Shelter Demand by Base Scenario

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
Charlotte County	6,327	10,967	12,563	12,819	12,826
Collier County	11,955	20,874	26,562	27,284	27,380
Glades County	1,114	1,180	1,282	1,365	1,408
Hendry County	3,071	3,260	3,615	3,783	3,946
Lee County	13,603	22,074	27,682	31,922	34,595
Sarasota County	10,917	14,193	22,557	28,738	31,285
2015					
Charlotte County	7,417	11,772	13,061	13,240	13,246
Collier County	11,315	17,799	23,219	24,198	24,281
Glades County	1,230	1,302	1,419	1,504	1,547
Hendry County	3,430	3,628	3,996	4,172	4,342
Lee County	14,014	21,177	29,491	37,884	42,857
Sarasota County	12,589	15,679	26,174	34,103	36,169

Note: Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Congested Roadways

Another important component of the transportation analysis is the identification of critical roadway segments for evacuation traffic. This analysis includes a review of vehicle flows during the evacuation period, along with excessive vehicle queues. A summary of the total number of evacuating vehicles for each of the base scenarios is presented in **Table IV-12**. It is important to note that the total number of evacuating vehicles in the table below includes vehicles evacuating from the two coastal counties on either side of the RPC, in addition to the six counties within the RPC, for a total of eight evacuating counties.

Table IV-12 – Total Evacuating Vehicles for Base Scenarios

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
2010	368,827	575,864	737,689	819,628	865,879
2015	373,412	547,731	736,023	843,632	896,777

The identification of critical roadways in the evacuation network is also important to assist emergency managers with identifying roadways that have the greatest impact on clearance times. Critical roadways were identified by reviewing roadways in the model network that have the highest vehicle queues for extended periods of time during an evacuation. Due to the nature of a major evacuation in general, nearly all roadway facilities will have extended vehicle queues at some point during the evacuation process. The point of this analysis is to identify those roadway facilities that have vehicle queues for the longest time periods during each of the evacuation scenarios. Critical roadway segments for the Southwest Florida Region are identified in **Figures IV-1** through **IV-10** for each of the base scenarios for 2010 and 2015.

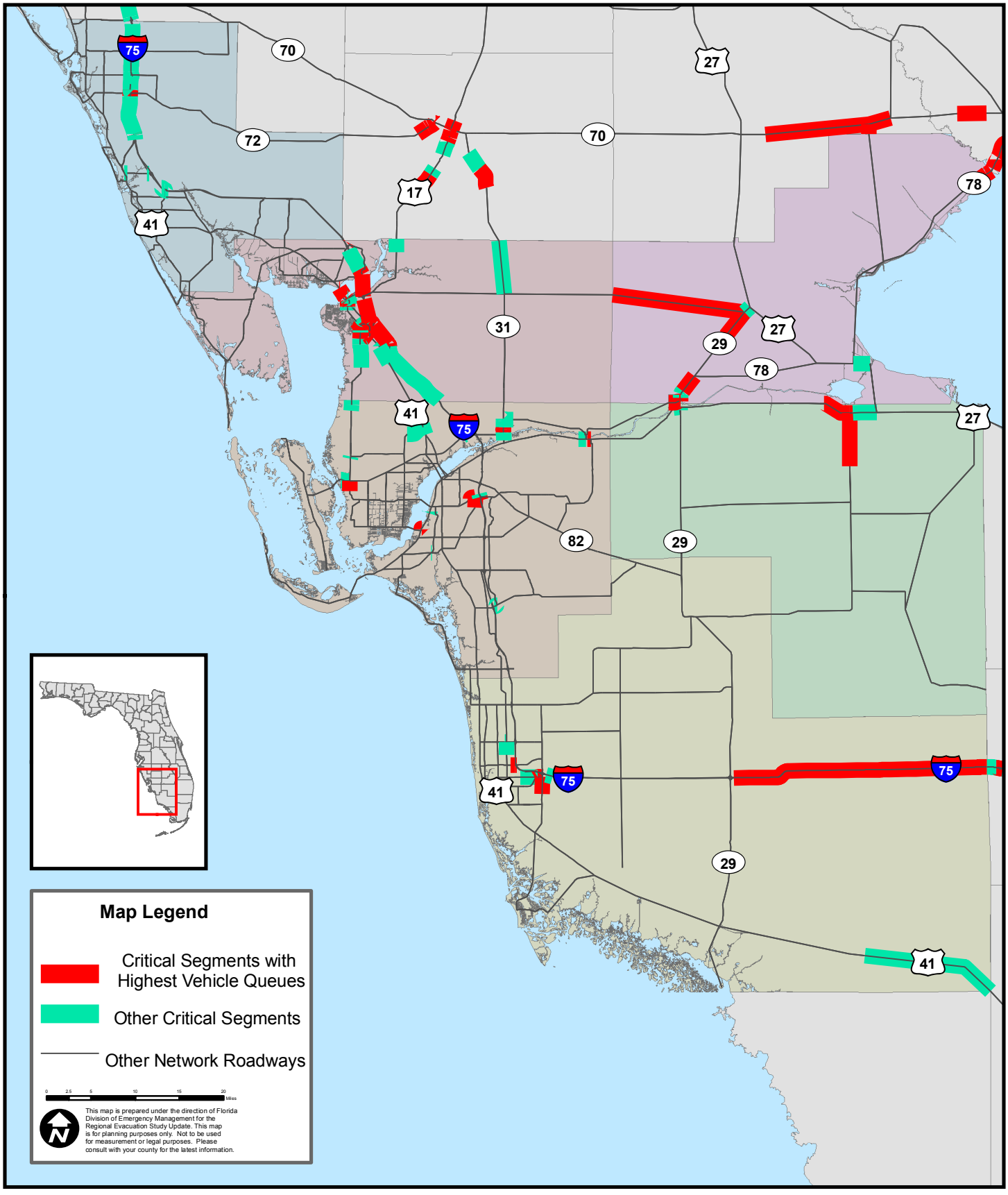
Through a review of the critical roadway segment figures, it is clear that I-75, US 41, US 27, SR 82, SR 80, SR 29, SR 78, SR 31, and US 17 are critical facilities for all evacuation scenarios. During the level A evacuation scenarios, the roadway segments with the highest vehicle queues are primarily concentrated along the major Interstate and State Highway system. In contrast, for the level E evacuation scenarios, the roadway segments with the highest vehicle queues include other roadways within the region.

In addition to the identification of critical roadway segments, the total number of evacuating vehicles entering and exiting each county by evacuation scenario was also determined. Evacuating vehicles exiting each county by major evacuation route are identified in **Table IV-13** for 2010 and **Table IV-14** for 2015. In addition, evacuating vehicles entering each county by major evacuation route are identified in **Table IV-15** for 2010 and **Table IV-16** for 2015. Detailed volume figures for all evacuation routes in the Southwest Florida Region for each base scenario are included in Volume 5-9.

The number of vehicles entering and exiting each county during an evacuation varies widely depending upon the scenario, roadway, and county. As expected, major interstates and state highways generally carry larger volumes of evacuating traffic. The vehicle flows into and out of each county also generally follow the same pattern as the critical segment figures, as locations with higher queues and congestion generally have higher traffic volumes.

Figure IV-1

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level A

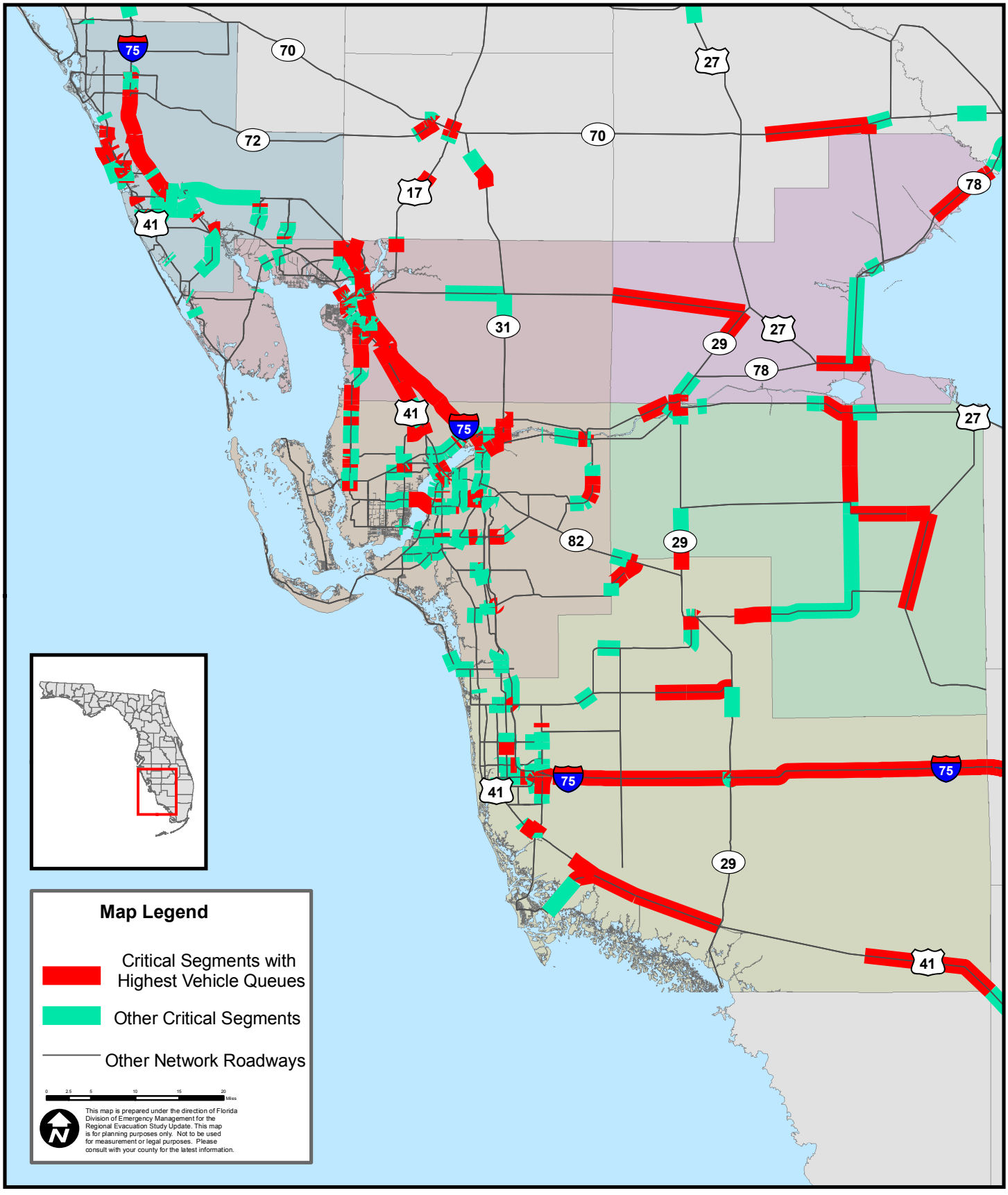


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August , 2010

Figure IV-2

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level B

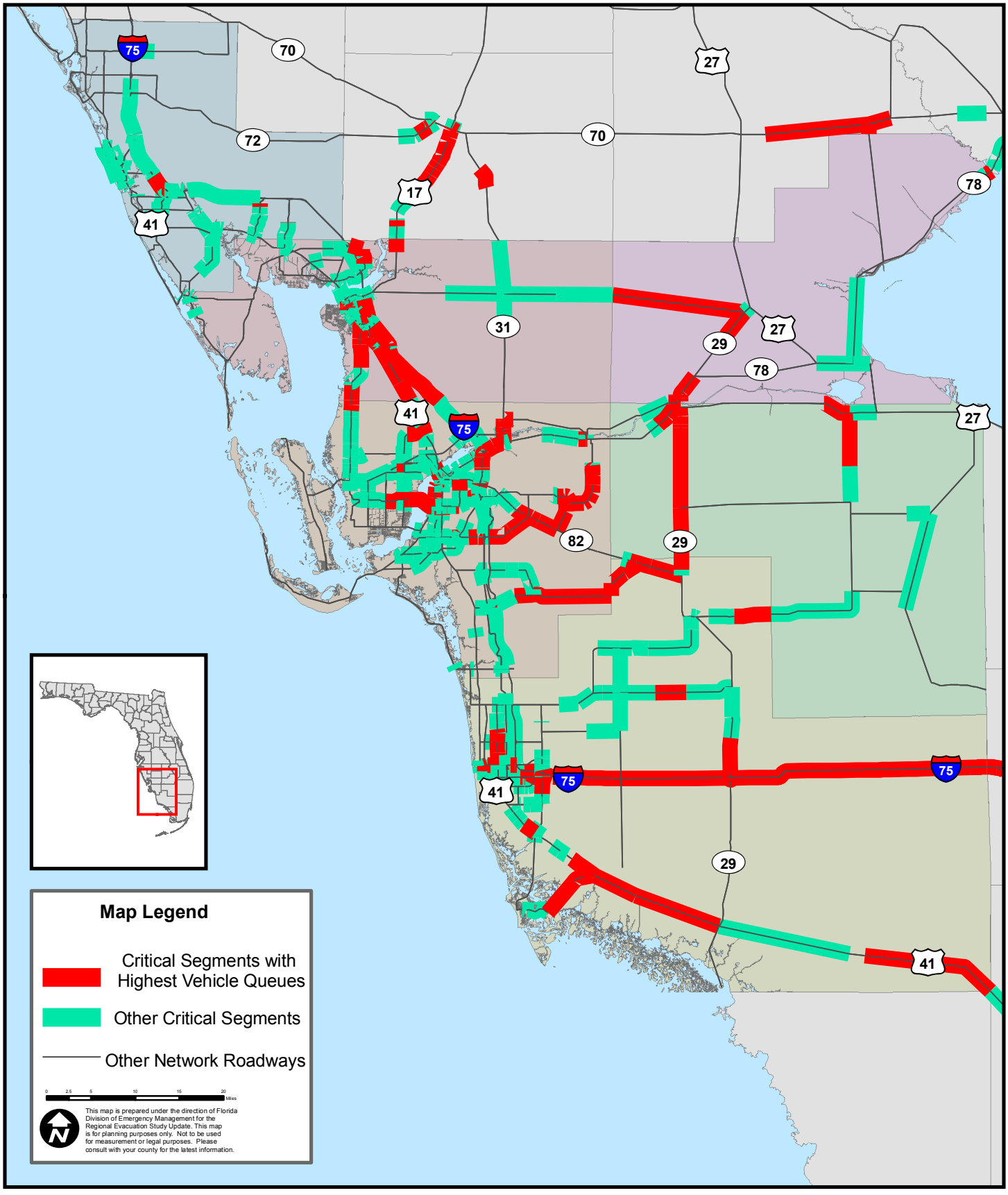


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August , 2010

Figure IV-3

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level C

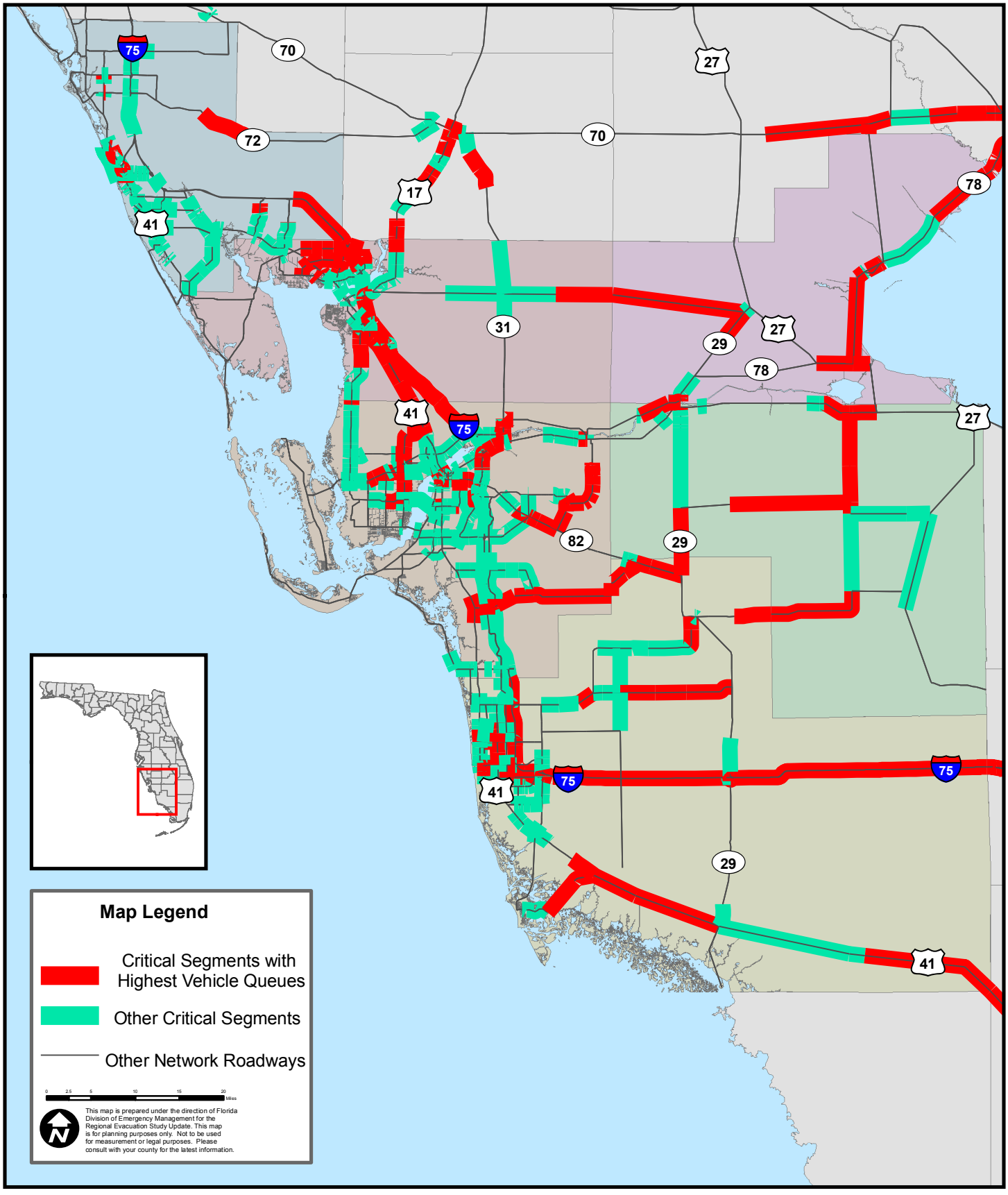


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August , 2010

Figure IV-4

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level D

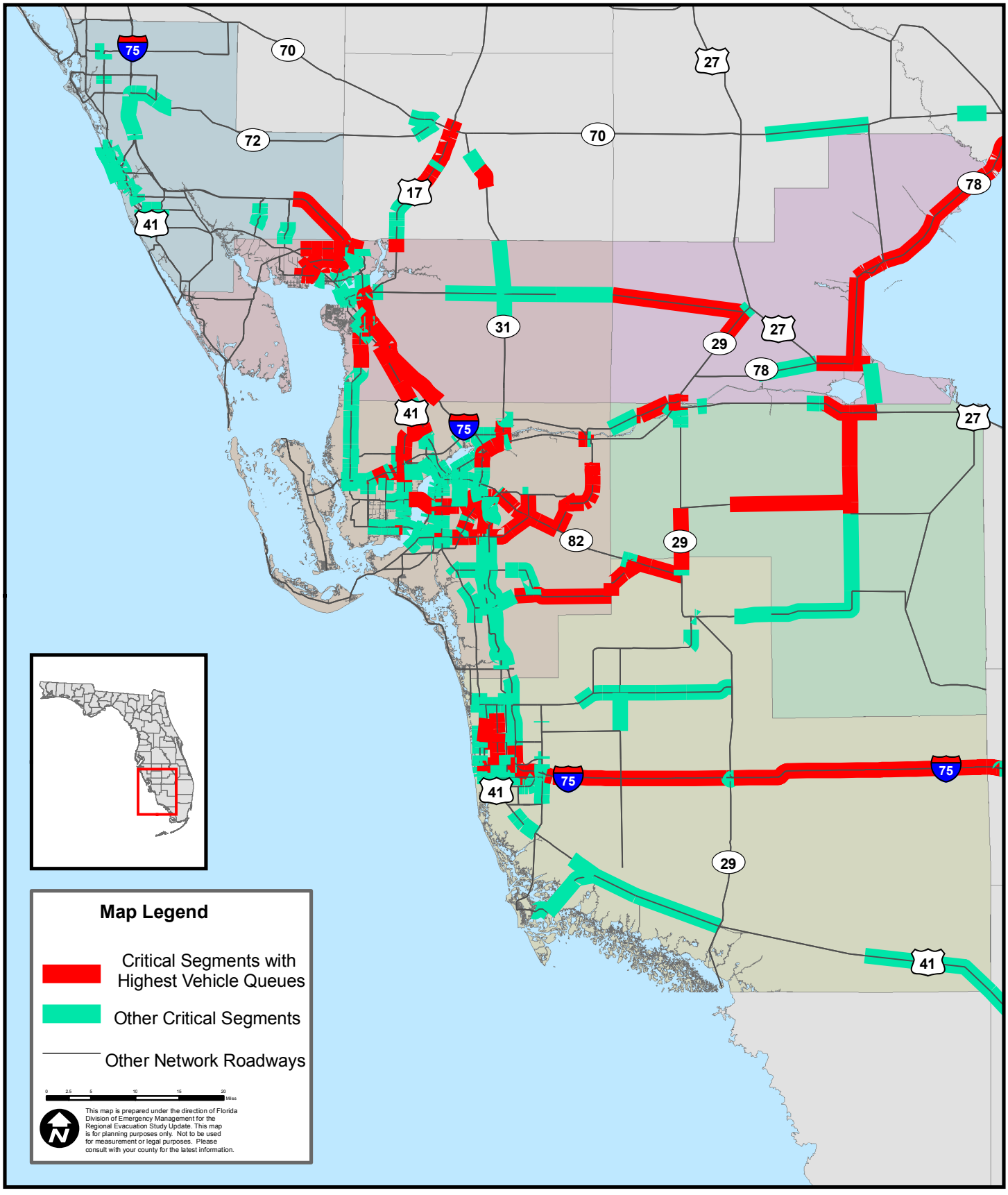


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August , 2010

Figure IV-5

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level E

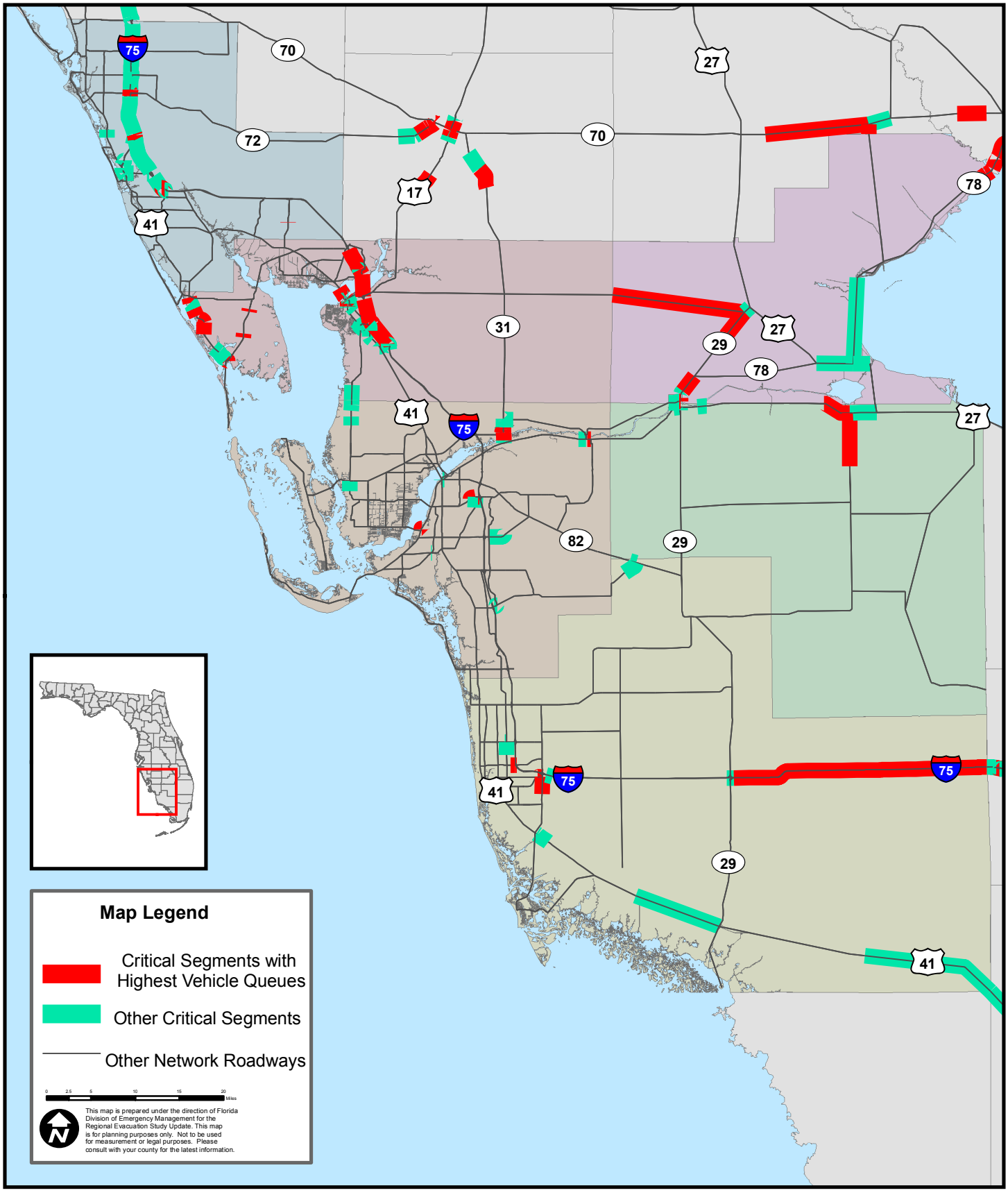


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August , 2010

Figure IV-6

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level A

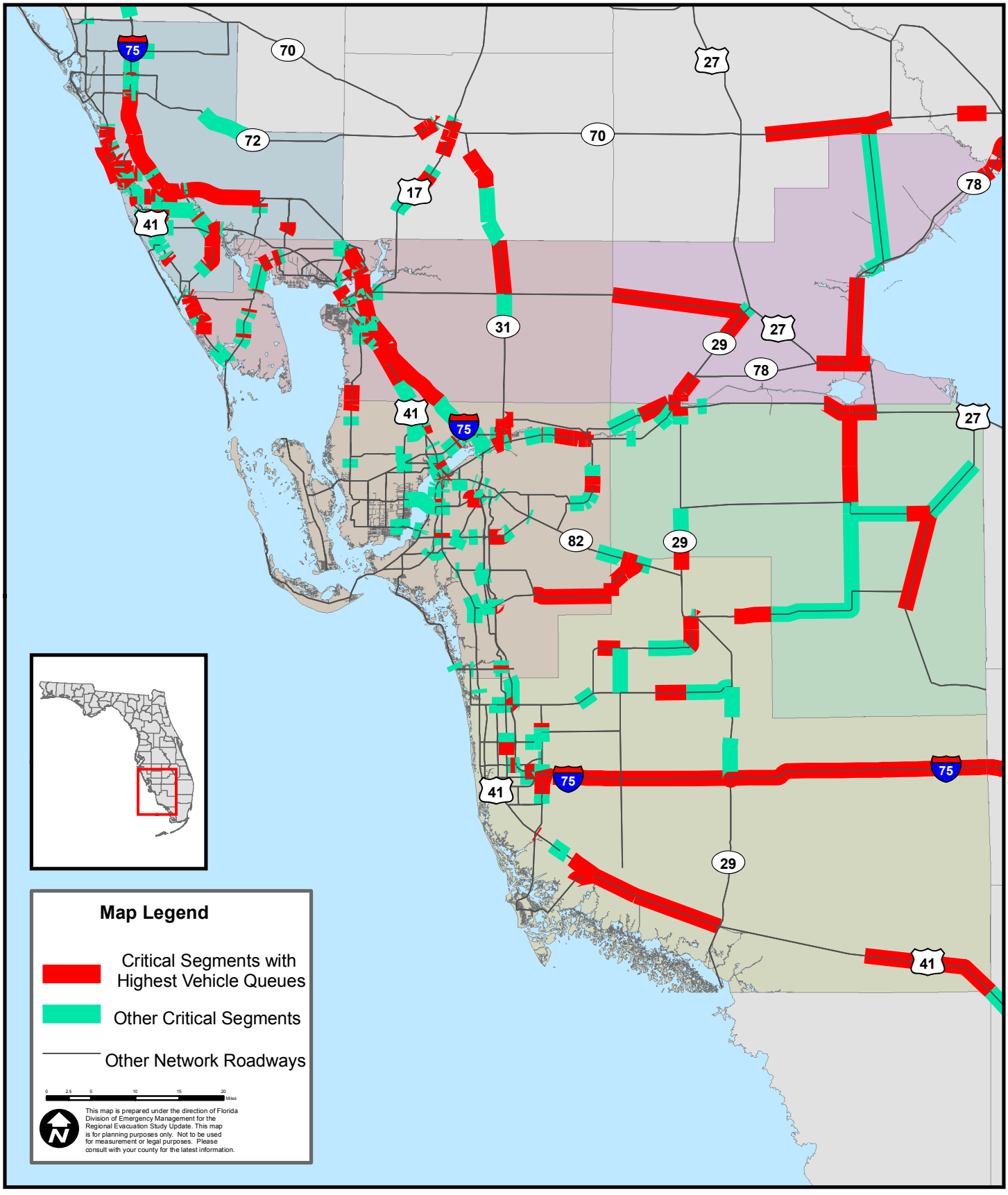


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-7

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level B

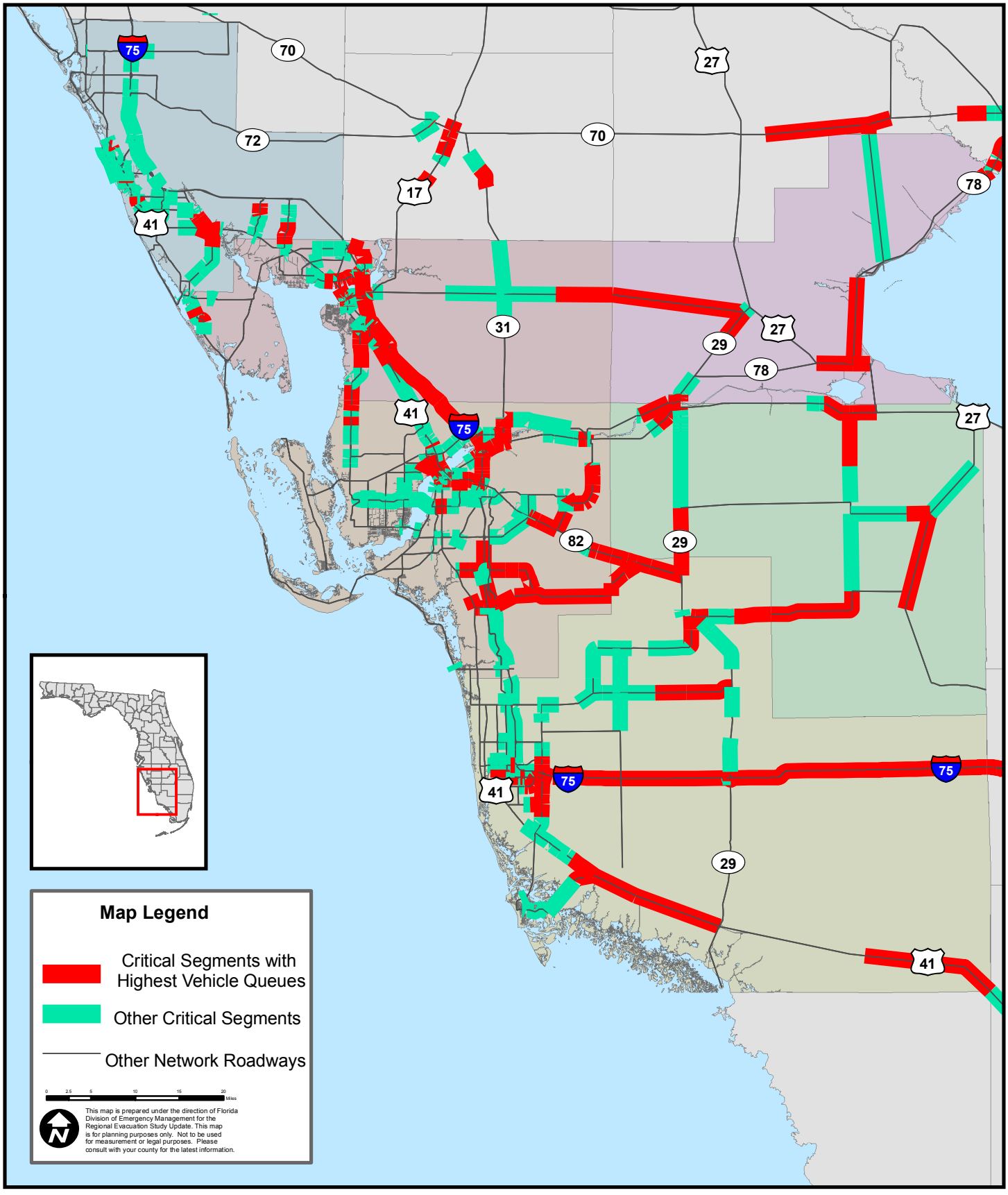


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-8

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level C

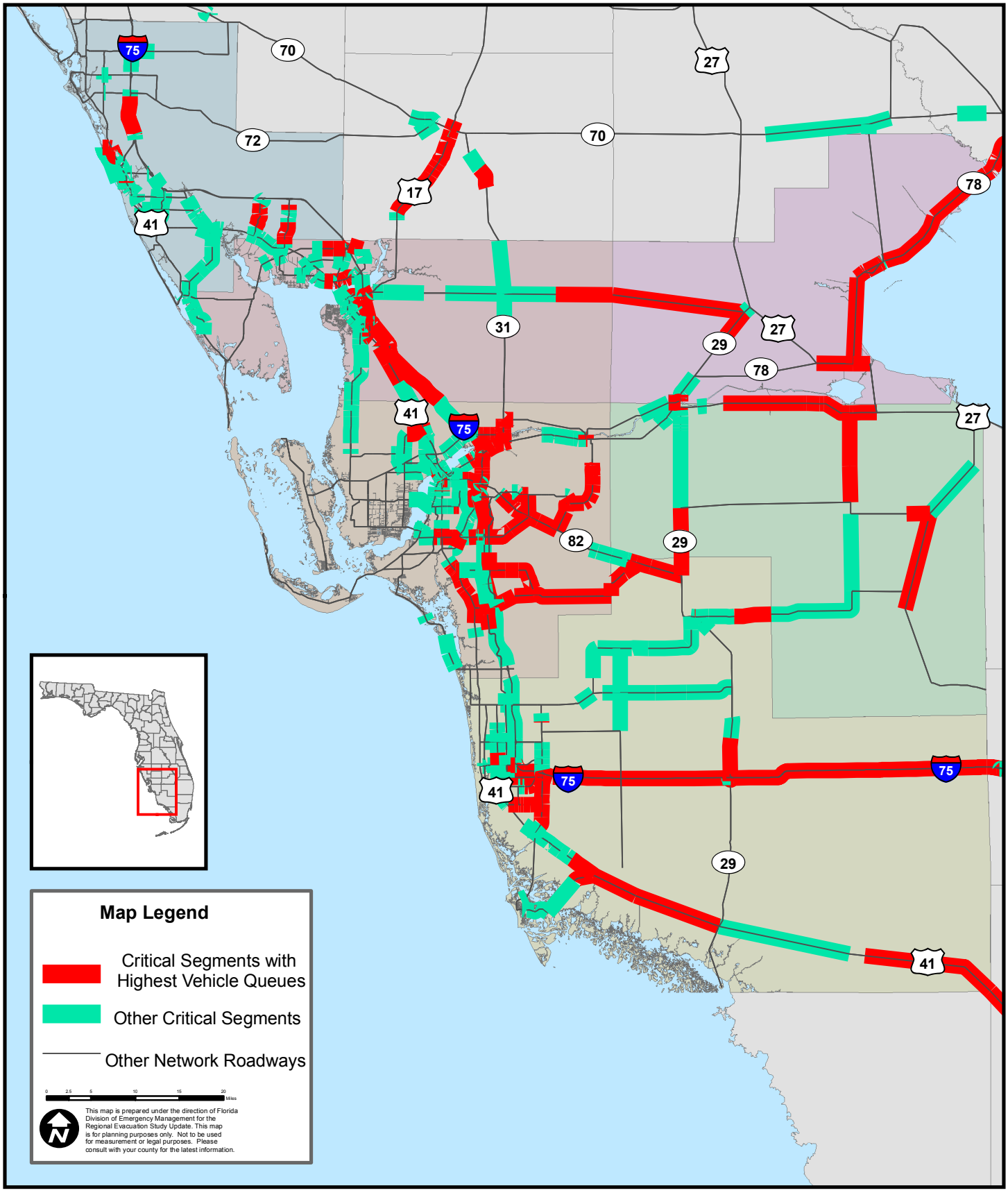


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-9

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level D

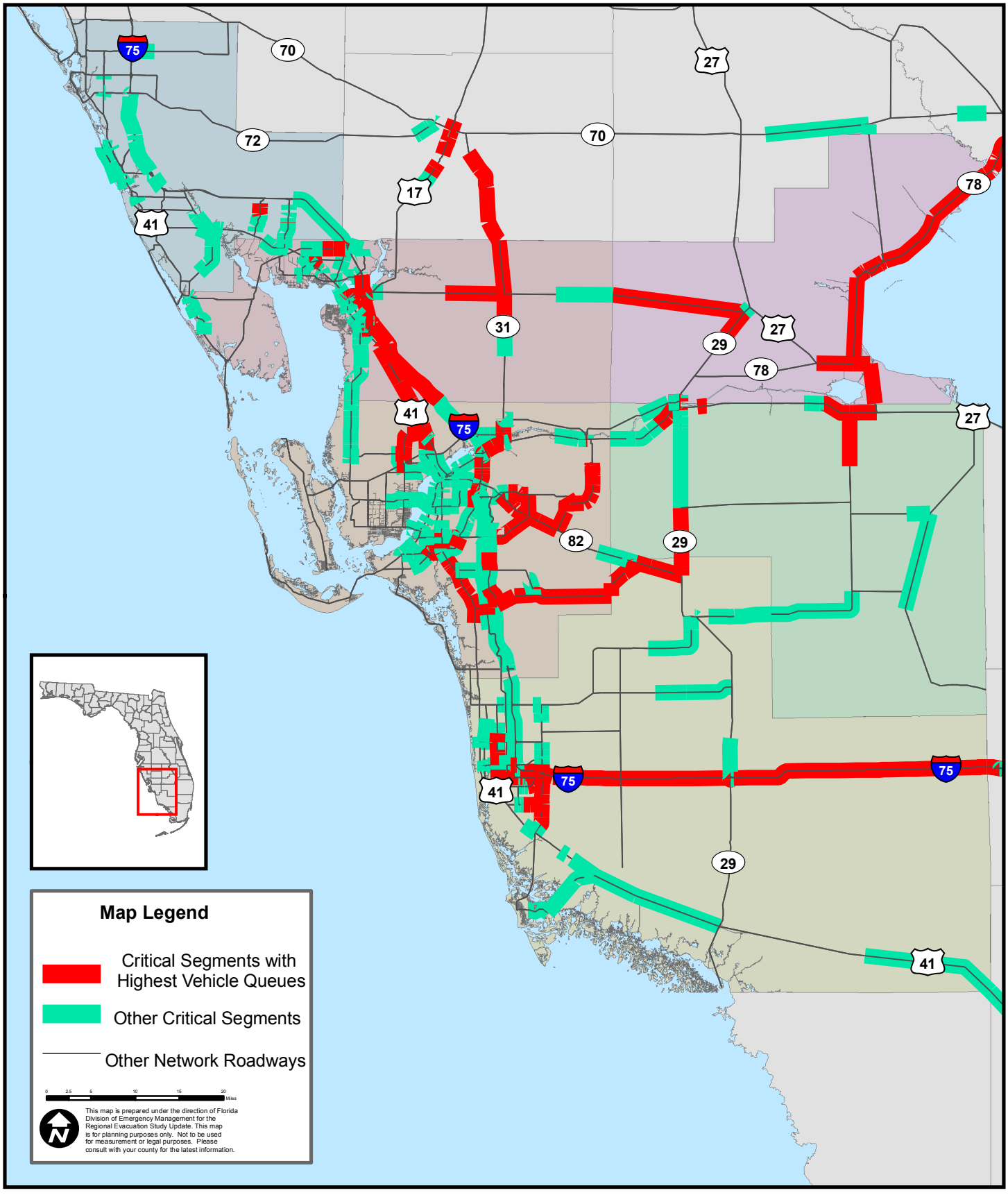


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-10

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level E



Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Table IV-13 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2010 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
SR 776 Northbound	3,800	7,400	14,100	8,600	12,200
US 41 Northbound	800	13,400	6,000	7,000	4,900
I-75 Northbound	45,600	68,300	89,400	55,400	29,600
US 17 Northbound	5,200	10,500	20,900	25,700	20,500
SR 31 Northbound	4,900	8,400	18,200	17,400	24,800
SR 31 Southbound	0	1,700	3,400	2,200	5,400
I-75 Southbound	5,500	6,300	3,100	4,700	6,300
US 41 Southbound	500	300	0	100	200
Collier County					
US 41 Northbound	300	5,300	3,500	2,100	1,500
I-75 Northbound	12,800	9,000	10,000	7,000	3,800
SR 82 Northbound	200	300	800	800	200
SR 29 Northbound	4,000	12,300	30,400	38,300	42,800
I-75 Southbound	24,000	48,300	94,100	115,400	130,600
US 41 Southbound	3,200	11,300	22,200	28,800	29,500
Glades County					
SR 78 Northbound	6,100	10,300	17,000	26,800	44,100
US 27 Southbound	1,200	4,000	9,700	17,200	21,900
SR 29 Southbound	300	600	2,000	4,300	9,000
Hendry County					
SR 29 Northbound	10,100	16,500	3,700	41,200	52,700
US 27 Northbound	5,400	14,500	32,000	47,600	53,900
US 27 Southbound	3,500	6,400	13,000	18,200	19,500
SR 29 Southbound	100	100	0	0	0
SR 80 Westbound	500	700	2,200	900	1,200
Lee County					
SR 80 Eastbound	9,900	15,100	32,100	39,500	50,900
SR 82 Southbound	1,800	4,900	8,700	9,500	11,100
I-75 Southbound	10,000	19,500	29,100	41,100	52,100
US 41 Southbound	100	500	3,800	6,700	9,500
US 41 Northbound	14,100	22,600	29,500	27,900	27,100
I-75 Northbound	26,000	44,600	40,600	31,600	14,400
SR 31 Northbound	7,000	10,700	28,800	29,700	35,600
Sarasota County					
SR 776 Southbound	0	200	700	700	600
US 41 Southbound	1,000	2,500	3,000	3,100	3,300
I-75 Southbound	3,300	4,100	2,300	6,700	11,900
SR 78 Eastbound	0	300	3,600	5,900	6,800
I-75 Northbound	59,400	94,000	123,200	106,900	132,300
US 41 Northbound	2,200	4,400	9,700	23,600	7,000

Table IV-14 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2015 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
SR 776 Northbound	7,000	11,500	13,000	12,300	14,300
US 41 Northbound	1,500	11,500	4,400	1,800	2,900
I-75 Northbound	41,700	58,100	74,700	83,800	56,900
US 17 Northbound	5,100	6,400	12,700	9,300	10,300
SR 31 Northbound	5,400	8,300	17,800	19,500	32,800
SR 31 Southbound	0	700	2,600	3,700	6,800
I-75 Southbound	6,100	8,500	3,600	4,900	5,800
US 41 Southbound	500	400	0	100	200
Collier County					
US 41 Northbound	200	3,200	1,300	600	700
I-75 Northbound	12,400	8,200	10,500	6,000	3,600
SR 82 Northbound	500	600	1,900	1,200	400
SR 29 Northbound	4,500	13,300	35,500	41,500	50,500
I-75 Southbound	23,700	44,900	90,600	120,100	136,600
US 41 Southbound	3,400	8,600	20,000	26,900	27,200
Glades County					
SR 78 Northbound	5,500	1,100	15,700	29,400	42,700
US 27 Southbound	1,400	4,400	12,000	19,200	26,700
SR 29 Southbound	300	600	1,900	4,700	8,100
Hendry County					
SR 29 Northbound	9,600	18,200	28,300	30,300	52,700
US 27 Northbound	5,200	14,400	34,300	50,900	50,200
US 27 Southbound	4,100	7,700	12,900	19,100	20,900
SR 29 Southbound	100	100	0	100	200
SR 80 Westbound	600	1,300	2,100	1,200	2,100
Lee County					
SR 80 Eastbound	9,100	17,900	23,700	35,300	56,500
SR 82 Southbound	1,000	21,500	32,800	45,100	59,800
I-75 Southbound	10,000	21,500	32,800	45,100	95,800
US 41 Southbound	100	300	6,100	9,600	9,500
US 41 Northbound	13,900	19,700	19,000	27,700	29,000
I-75 Northbound	22,200	35,600	27,200	22,200	20,100
SR 31 Northbound	7,900	13,300	29,400	37,900	39,400
Sarasota County					
SR 776 Southbound	0	200	900	900	800
US 41 Southbound	1,400	4,400	4,200	5,200	4,600
I-75 Southbound	3,000	3,000	4,600	8,600	12,900
SR 78 Eastbound	0	400	2,400	7,900	8,700
I-75 Northbound	596,600	86,500	105,200	120,200	136,000
US 41 Northbound	2,000	4,800	14,200	26,200	10,000

Table IV-15 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2010 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
US 41 Northbound	14,100	22,600	29,500	27,900	27,100
I-75 Northbound	26,000	44,600	40,600	31,600	14,400
SR 31 Northbound	7,000	10,700	28,800	29,700	35,600
SR 776 Southbound	0	200	700	700	600
US 41 Southbound	1,000	2,500	3,000	3,100	3,300
I-75 Southbound	3,300	4,100	2,300	6,700	11,900
Collier County					
SR 29 Southbound	100	100	0	0	0
SR 82 Southbound	1,800	4,900	8,700	9,500	11,100
I-75 Southbound	10,000	19,500	29,100	41,100	52,100
US 41 Southbound	100	500	3,800	6,700	9,500
Glades County					
SR 29 Northbound	10,100	16,500	3,700	41,200	52,700
US 27 Northbound	5,400	14,500	32,000	47,600	53,900
Hendry County					
SR 29 Northbound	4,000	12,300	30,400	38,300	42,800
US 27 Southbound	1,200	4,000	9,700	17,200	21,900
SR 29 Southbound	300	600	2,000	4,300	9,000
SR 80 Eastbound	9,900	15,100	32,100	39,500	50,900
Lee County					
SR 31 Southbound	0	1,700	3,400	2,200	5,400
I-75 Southbound	5,500	6,300	3,100	4,700	6,300
US 41 Southbound	500	300	0	100	200
US 41 Northbound	300	5,300	3,500	2,100	1,500
I-75 Northbound	12,800	9,000	10,000	7,000	3,800
SR 82 Northbound	200	300	800	800	200
SR 80 Westbound	500	700	2,200	900	1,200
Sarasota County					
SR 776 Northbound	3,800	7,400	14,100	8,600	12,200
US 41 Northbound	800	13,400	6,000	7,000	4,900
I-75 Northbound	45,600	68,300	89,400	55,400	29,600

Table IV-16 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2015 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Charlotte County					
US 41 Northbound	13,900	19,700	19,000	27,700	29,000
I-75 Northbound	22,200	35,600	27,200	22,200	20,100
SR 31 Northbound	7,900	13,300	29,400	37,900	39,400
SR 776 Southbound	0	200	900	900	800
US 41 Southbound	1,400	4,400	4,200	5,200	4,600
I-75 Southbound	3,000	3,000	4,600	8,600	12,900
Collier County					
SR 29 Southbound	100	100	0	100	200
SR 82 Southbound	1,000	21,500	32,800	45,100	59,800
I-75 Southbound	10,000	21,500	32,800	45,100	95,800
US 41 Southbound	100	300	6,100	9,600	9,500
Glades County					
SR 29 Northbound	9,600	18,200	28,300	30,300	52,700
US 27 Northbound	5,200	14,400	34,300	50,900	50,200
Hendry County					
SR 29 Northbound	4,500	13,300	35,500	41,500	50,500
US 27 Southbound	1,400	4,400	12,000	19,200	26,700
SR 29 Southbound	300	600	1,900	4,700	8,100
SR 80 Eastbound	9,100	17,900	23,700	35,300	56,500
Lee County					
SR 31 Southbound	0	700	2,600	3,700	6,800
I-75 Southbound	6,100	8,500	3,600	4,900	5,800
US 41 Southbound	500	400	0	100	200
US 41 Northbound	200	3,200	1,300	600	700
I-75 Northbound	12,400	8,200	10,500	6,000	3,600
SR 82 Northbound	500	600	1,900	1,200	400
SR 80 Westbound	600	1,300	2,100	1,200	2,100
Sarasota County					
SR 776 Northbound	7,000	11,500	13,000	12,300	14,300
US 41 Northbound	1,500	11,500	4,400	1,800	2,900
I-75 Northbound	41,700	58,100	74,700	83,800	56,900

Clearance Times

Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. Clearance times for each of the base scenarios are summarized in **Table IV-17** and **IV-18**, as well as **Figures IV-11, IV-12,** and **IV-13**. Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongs, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

In-county clearance times for the base scenarios range from 13 hours for the evacuation level A scenarios to 70.5 hours for Charlotte County for evacuation level E scenario in 2010. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 11.5 hours for the evacuation level A scenarios to 66.5 hours for Collier County for evacuation level E scenario in 2010.

In 2015, in-county clearance times for the base scenarios increase slightly to between 13 hours for the evacuation level A scenarios and 78 hours for Sarasota County for the evacuation level E scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 11.5 hours for the evacuation level A scenarios to 74.5 hours for Lee County for evacuation level E scenario in 2015.

Out of county clearance times for the base scenarios range from 14 hours for the base evacuation level A scenario to 89.5 hours in Glades County for the evacuation level E scenario. Out of county clearance times remain relatively constant in 2015, with Glades County at 89 hours for evacuation level E.

Regional clearance time for the six county SWFRPC region ranges from 15.5 hours to 89.5 hours in 2010 and from 15.5 to 89 hours in 2015.

Table IV-17 – 2010 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
Charlotte County	13.5	18.5	25.5	50.0	62.0
Collier County	13.0	19.0	38.5	45.5	66.5
Glades County	11.5	11.5	11.5	11.5	12.0
Hendry County	13.5	16.0	31.5	39.5	55.5
Lee County	13.0	19.0	42.0	48.0	63.0
Sarasota County	13.0	19.5	30.5	40.5	65.5
In-County Clearance Time					
Charlotte County	15.0	26.5	45.0	52.0	70.5
Collier County	14.0	19.0	39.0	46.0	68.5
Glades County	13.0	13.0	13.0	13.0	13.5
Hendry County	14.0	16.5	43.5	52.0	66.0
Lee County	13.5	23.0	43.5	52.5	66.0
Sarasota County	15.5	27.0	45.0	52.5	69.5
Out of County Clearance Time					
Charlotte County	15.0	26.5	45.0	52.0	70.5
Collier County	14.5	19.5	44.5	46.0	69.0
Glades County	15.5	24.0	45.0	62.5	89.5
Hendry County	14.5	24.0	44.5	53.5	71.0
Lee County	14.0	23.0	43.5	52.5	66.0
Sarasota County	15.5	27.0	45.0	52.5	69.5
Regional Clearance Time					
Southwest	15.5	27.0	45.0	62.5	89.5

Table IV-18 – 2015 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
Charlotte County	13.5	17.0	28.5	39.5	52.5
Collier County	13.0	18.0	37.0	45.5	55.0
Glades County	11.5	11.5	11.5	11.5	11.5
Hendry County	13.0	13.5	36.5	45.5	47.5
Lee County	13.0	17.0	36.5	45.5	74.5
Sarasota County	13.0	18.0	35.0	49.5	60.0
In-County Clearance Time					
Charlotte County	14.5	19.0	41.0	49.0	77.5
Collier County	14.0	18.0	37.0	46.5	68.0
Glades County	13.0	13.0	13.0	13.0	13.0
Hendry County	13.5	14.0	40.0	45.5	77.0
Lee County	14.0	18.5	40.5	49.5	77.0
Sarasota County	15.0	20.0	43.5	50.0	78.0
Out of County Clearance Time					
Charlotte County	15.0	19.5	41.0	49.0	77.5
Collier County	14.5	20.0	40.5	47.0	70.0
Glades County	15.0	23.5	41.5	62.5	89.0
Hendry County	14.5	21.5	41.0	53.0	77.5
Lee County	14.5	18.5	40.5	49.5	77.0
Sarasota County	15.5	20.5	43.5	50.5	79.0
Regional Clearance Time					
Southwest	15.5	23.5	43.5	62.5	89.0

Figure IV-11 - Clearance Time to Shelter Base Scenarios

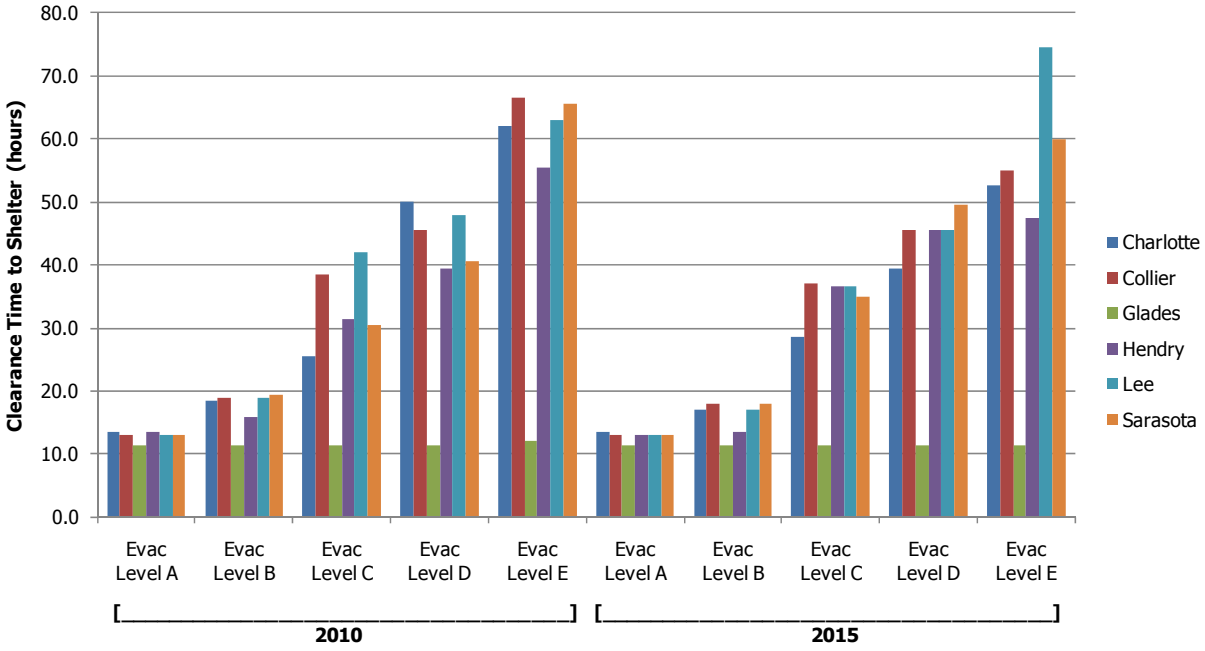


Figure IV-12 - In-County Clearance Times Base Scenarios

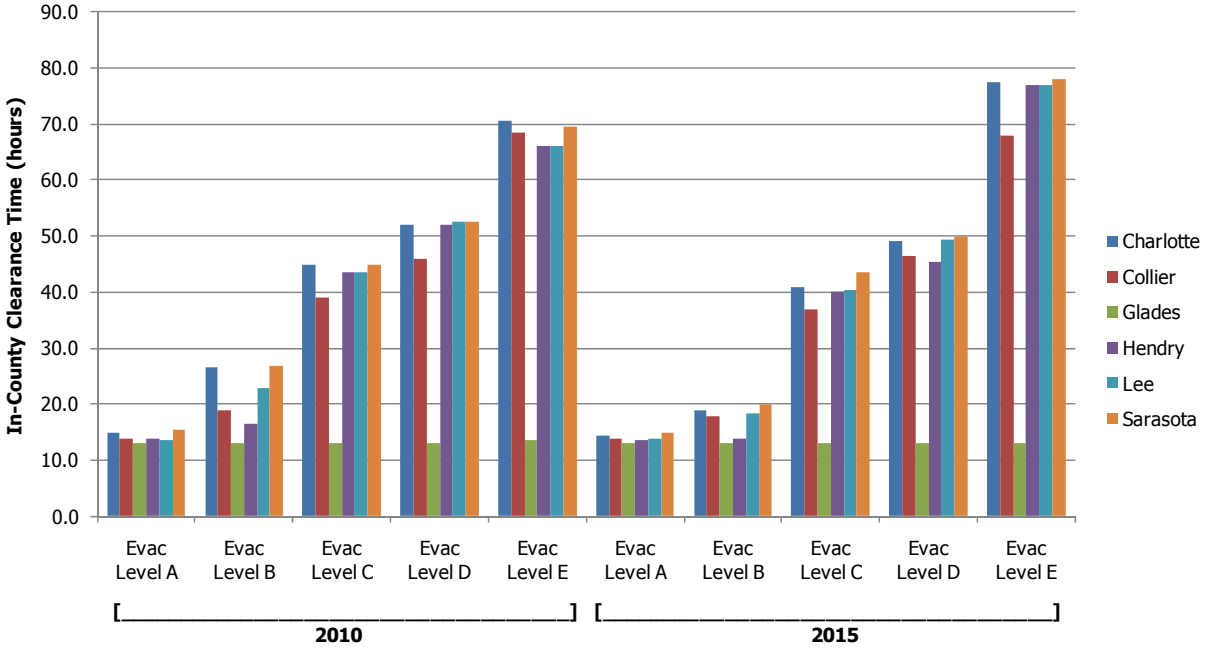
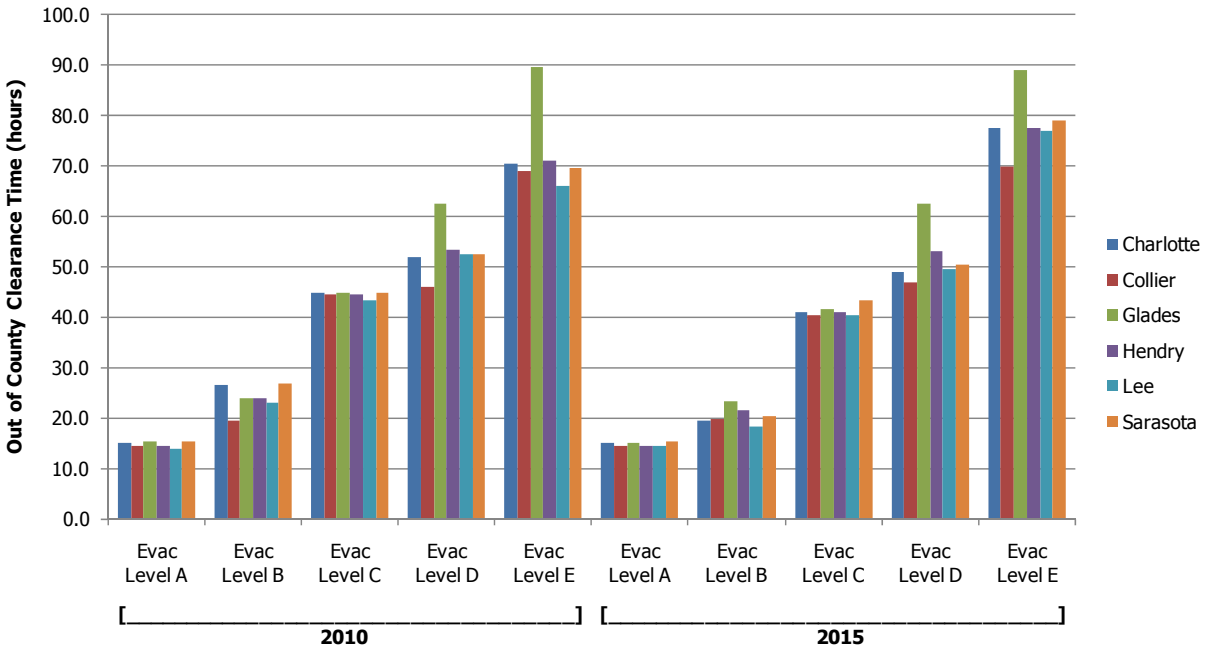


Figure IV-13 - Out of County Clearance Times
Base Scenarios



F. Operational Scenarios

The transportation analysis also included ten region wide operational scenarios selected by the county emergency managers and RPC staff for the Southwest Florida Region. While the base scenarios required that the basic assumptions were consistent between scenarios except for the year and the evacuation level, this is not the case for the operational scenarios. The only requirement for each region is that two operational scenarios are developed for each evacuation level (two for Level A, two for Level B, etc.). Otherwise, the assumptions and characteristics between the ten operational scenarios can be different for each scenario.

The ten operational scenarios selected for analysis in the Southwest Florida Region are illustrated in **Table IV-19**. All ten operational scenarios used the default tourist and university population rates, along with the planning assumption behavioral response rates. The Southwest Florida region's largest issues in terms of evacuation response typically come from direct impact storms from the Gulf of Mexico. The ten operational scenarios were developed to estimate response and evacuation conditions for a variety of Gulf of Mexico storms and include the following:

- 2010 Level A – Mild Gulf direct hit to south part of SWFRPC region;
- 2010 Level B – Moderate Gulf direct hit to north part of SWFRPC region;
- 2010 Level C – Moderate Gulf direct hit to south part of SWFRPC region;
- 2010 Level D – Severe Gulf direct hit to south part of SWFRPC region;
- 2010 Level E – Severe Gulf direct hit to entire SWFRPC region;
- 2015 Level A – Mild Gulf direct hit to north part of SWFRPC region;
- 2015 Level B – Moderate Gulf direct hit to south part of SWFRPC region;
- 2015 Level C – Moderate Gulf direct hit to north part of SWFRPC region;
- 2015 Level D – Severe Gulf direct hit to north part of SWFRPC region; and,
- 2015 Level E – Severe East Coast direct hit to Palm Beach crossing storm.

All operational scenarios did not use phased evacuations, but did include a mixture of fast and slow response conditions. In addition, only primary shelters were open in all scenarios.

Table IV-19 – Operational Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	12-hour	18-hour	18-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Collier Lee Monroe (ML) Hendry Glades Okeechobee Highlands	Sarasota Charlotte Lee DeSoto Glades (A) Hendry (A) Collier (A) Highlands (A)	Collier Lee Charlotte Sarasota (B) Monroe (ML-B) Glades (B) Hendry (B) Highlands (B) DeSoto (B)	Collier Lee Charlotte Sarasota (C) Monroe (ML-C) Glades (C) Hendry (C) Highlands (C) DeSoto (C) Okeechobee (B)	Collier Lee Charlotte Sarasota Monroe Manatee (D) Glades (D) Hendry (D) Highlands (C) DeSoto (C) Okeechobee (C) Hardee (C) Polk (C)
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	12-hour	18-hour	18-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Sarasota Lee Charlotte Manatee DeSoto Highlands Glades	Collier Charlotte Lee DeSoto Glades (A) Hendry (A) Sarasota (A) Highlands (A)	Sarasota Lee Charlotte Collier (B) Manatee (B) Glades (B) Hardee (B) Highlands (B) DeSoto (B) Hendry (B)	Sarasota Lee Charlotte Collier (C) Manatee (C) Glades (C) Hendry (C) Highlands (C) DeSoto (C) Hardee (C)	Broward Palm Beach Martin Highlands (D) Glades (D) Hendry (D) Okeechobee (D) Lee (C) Sarasota (C) Charlotte (C) DeSoto (C) Hardee (C) Collier (B)

(ML) – includes the mainland portion of Monroe County only.

G. Operational Scenario Results

Each of the ten operational scenarios were modeled for the Southwest Florida Region using the regional evacuation model. Results were derived from the model to summarize the evacuating population, evacuating vehicles, clearance times, and critical congested roadways. The results are discussed in the following sections.

Evacuating Population

Similar to the base scenarios, the evacuating population was estimated for the six county region. Evacuating population for the operational scenarios is summarized by county for 2010 in **Table IV-20** and for 2015 in **Table IV-21**.

Within the six county region, total evacuating population ranges from 327,800 persons for the operational scenario level A evacuation to nearly 1.3 million persons for the operational scenario level E evacuation in 2010. By 2015, this range increases within the six counties to more than 365,000 persons for the operational scenario level A evacuation and more than 1.2 million persons for the operational scenario level D evacuation. The 2015 level E evacuation includes fewer evacuating population from the six county region since it tests the effect of a Treasure Coast evacuation on the SWFRPC.

Evacuating Vehicles

From a transportation standpoint, the number of evacuating vehicles is more important than the evacuating population. Evacuating vehicles for the operational scenarios are summarized by county for 2010 in **Table IV-22** and for 2015 in **Table IV-23**.

The total number of evacuating vehicles within the six county region for the operational scenarios also varies by evacuation level. A total of more than 157,200 vehicles evacuate from the six county RPC for the operational scenario level A evacuation in 2010, and this number increases to nearly 625,800 evacuating vehicles from the six county region for the operational scenario level E evacuation in 2010. By 2015, the number of evacuating vehicles is expected to increase to slightly more than 175,000 vehicles for the operational scenario level A evacuation and more than 550,200 evacuating vehicles for the operational scenario level D evacuation.

Shelter Demand

Shelter demand estimates by county are summarized for each of the operational scenarios in **Table IV-24**. Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Public shelter demand in the six county region ranges from only 21,100 persons for the operational scenario level A evacuation in 2010 to nearly 94,000 persons for the operational scenario level E evacuation. By 2015, the public shelter demand is expected to increase to more than 24,700 persons for the level A evacuation and more than 85,700 persons for the level D evacuation.

Table IV-20 – Evacuating Population by Operational Scenario for 2010

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
Site-built Homes	0	76,794	91,228	115,283	137,723
Mobile/Manuf. Homes	0	7,039	8,248	9,047	9,555
Tourists	0	3,425	4,109	4,164	4,164
TOTAL	0	87,258	103,585	128,494	151,442
Collier County					
Site-built Homes	97,269	97,269	185,706	228,273	250,659
Mobile/Manuf. Homes	8,279	8,279	10,982	12,052	12,743
Tourists	6,188	6,188	14,942	14,942	14,942
TOTAL	111,736	111,736	211,630	255,267	278,344
Glades County					
Site-built Homes	702	702	936	1,403	1,637
Mobile/Manuf. Homes	3,124	3,124	3,976	4,544	5,112
Tourists	0	0	0	39	80
TOTAL	3,826	3,826	4,912	5,986	6,829
Hendry County					
Site-built Homes	3,274	3,274	4,366	6,549	7,640
Mobile/Manuf. Homes	9,649	9,649	12,280	14,035	15,789
Tourists	80	80	138	138	138
TOTAL	13,003	13,003	16,784	20,722	23,567
Lee County					
Site-built Homes	152,182	202,052	307,887	383,313	443,169
Mobile/Manuf. Homes	34,090	38,605	44,057	48,562	51,263
Tourists	13,002	17,604	20,710	21,295	21,966
TOTAL	199,274	258,261	372,654	453,170	516,398
Sarasota County					
Site-built Homes	0	76,360	76,360	151,449	273,186
Mobile/Manuf. Homes	0	18,657	18,657	22,203	26,062
Tourists	0	10,234	10,234	13,709	18,049
TOTAL	0	105,251	105,251	187,361	317,297

Table IV-21 – Evacuating Population by Operational Scenario for 2015

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
Site-built Homes	59,341	88,100	102,011	128,567	102,011
Mobile/Manuf. Homes	6,274	7,208	8,488	9,313	8,488
Tourists	1,429	3,945	5,123	5,178	5,123
TOTAL	67,044	99,253	115,622	143,058	115,622
Collier County					
Site-built Homes	0	161,367	161,367	210,930	161,367
Mobile/Manuf. Homes	0	9,079	9,079	10,774	9,079
Tourists	0	13,781	13,781	15,288	13,781
TOTAL	0	184,227	184,227	236,992	184,227
Glades County					
Site-built Homes	759	759	1,012	1,518	1,771
Mobile/Manuf. Homes	3,365	3,365	4,283	4,895	5,506
Tourists	0	0	0	39	80
TOTAL	4,124	4,124	5,295	6,452	7,357
Hendry County					
Site-built Homes	0	3,454	4,605	6,907	8,058
Mobile/Manuf. Homes	0	10,742	13,672	15,625	17,578
Tourists	0	80	138	138	138
TOTAL	0	14,276	18,415	22,670	25,774
Lee County					
Site-built Homes	140,108	185,809	308,361	396,585	308,361
Mobile/Manuf. Homes	50,463	56,714	64,660	70,901	64,660
Tourists	15,967	20,979	24,086	24,670	24,086
TOTAL	206,538	263,502	397,107	492,156	397,107
Sarasota County					
Site-built Homes	60,148	60,148	166,246	249,292	166,246
Mobile/Manuf. Homes	20,254	20,254	27,516	30,480	27,516
Tourists	7,747	7,747	13,846	15,418	13,846
TOTAL	88,149	88,149	207,608	295,190	207,608

Table IV-22 – Evacuating Vehicles by Operational Scenario for 2010

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
Site-built Homes	0	36,885	43,815	55,352	66,151
Mobile/Manuf. Homes	0	4,234	4,964	5,439	5,745
Tourists	0	1,489	1,787	1,810	1,810
TOTAL	0	42,608	50,566	62,601	73,706
Collier County					
Site-built Homes	47,482	47,482	91,343	112,258	123,180
Mobile/Manuf. Homes	2,782	2,782	3,648	3,980	4,207
Tourists	2,691	2,691	6,496	6,496	6,496
TOTAL	52,955	52,955	101,487	122,734	133,883
Glades County					
Site-built Homes	390	390	520	781	911
Mobile/Manuf. Homes	1,892	1,892	2,408	2,753	3,097
Tourists	0	0	0	19	40
TOTAL	2,282	2,282	2,928	3,553	4,048
Hendry County					
Site-built Homes	1,399	1,399	1,866	2,798	3,265
Mobile/Manuf. Homes	3,616	3,616	4,602	5,260	5,917
Tourists	40	40	69	69	69
TOTAL	5,055	5,055	6,537	8,127	9,251
Lee County					
Site-built Homes	75,023	99,375	149,438	186,420	215,865
Mobile/Manuf. Homes	17,438	19,751	22,533	24,844	26,225
Tourists	4,483	6,070	7,141	7,343	7,575
TOTAL	96,944	125,196	179,112	218,607	249,665
Sarasota County					
Site-built Homes	0	38,205	38,205	74,993	133,992
Mobile/Manuf. Homes	0	10,423	10,423	12,331	14,430
Tourists	0	3,862	3,862	5,173	6,811
TOTAL	0	52,490	52,490	92,497	155,233

Table IV-23 – Evacuating Vehicles by Operational Scenario for 2015

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
Site-built Homes	26,311	39,386	45,806	57,761	45,806
Mobile/Manuf. Homes	3,835	4,404	5,194	5,693	5,194
Tourists	621	1,715	2,227	2,251	2,227
TOTAL	30,767	45,505	53,227	65,705	53,227
Collier County					
Site-built Homes	0	60,265	60,265	81,325	60,265
Mobile/Manuf. Homes	0	2,940	2,940	3,475	2,940
Tourists	0	5,992	5,992	6,647	5,992
TOTAL	0	69,197	69,197	91,447	69,197
Glades County					
Site-built Homes	444	444	593	889	1,037
Mobile/Manuf. Homes	2,023	2,023	2,575	2,943	3,311
Tourists	0	0	0	19	40
TOTAL	2,467	2,467	3,168	3,851	4,388
Hendry County					
Site-built Homes	0	1,472	1,962	2,943	3,434
Mobile/Manuf. Homes	0	4,091	5,207	5,951	6,695
Tourists	0	40	69	69	69
TOTAL	0	5,603	7,238	8,963	10,198
Lee County					
Site-built Homes	66,350	87,939	145,605	190,755	145,605
Mobile/Manuf. Homes	25,312	28,474	32,457	35,617	32,457
Tourists	5,506	7,234	8,305	8,507	8,305
TOTAL	97,168	123,647	186,367	234,879	186,367
Sarasota County					
Site-built Homes	29,937	29,937	82,247	122,034	82,247
Mobile/Manuf. Homes	11,748	11,748	15,911	17,580	15,911
Tourists	2,923	2,923	5,225	5,818	5,225
TOTAL	44,608	44,608	103,383	145,432	103,383

Table IV-24 – Shelter Demand by Operational Scenario

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
Charlotte County	0	6,114	7,289	9,089	10,736
Collier County	8,704	8,704	17,077	20,898	22,823
Glades County	633	633	812	982	1,116
Hendry County	1,859	1,859	2,401	2,990	3,404
Lee County	9,972	12,841	19,033	24,316	27,672
Sarasota County	0	9,766	9,766	16,578	28,244
2015					
Charlotte County	4,425	6,538	7,663	9,518	7,663
Collier County	0	11,209	11,209	15,174	11,209
Glades County	686	686	879	1,066	1,212
Hendry County	0	2,063	2,658	3,299	3,754
Lee County	10,545	13,407	21,514	29,132	21,514
Sarasota County	9,089	9,089	19,325	27,580	19,325

Note: Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Congested Roadways

A summary of the total number of evacuating vehicles for each of the operational scenarios is presented in **Table IV-25**. It is important to note that the total number of evacuating vehicles in the table below includes vehicles evacuating from all of the counties included in the operational scenario, as identified in Table IV-19. The number of counties varies by scenario, with the 2015 Level E scenario including 13 counties stretching from Monroe County to Manatee County.

Table IV-25 – Total Evacuating Vehicles for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
2010	167,179	289,932	405,213	529,309	849,682
2015	215,981	301,156	479,923	630,869	997,183

Similar to the base scenarios, critical roadways were identified by reviewing roadways in the model network that have the highest vehicle queues for extended periods of time during an evacuation. Due to the nature of a major evacuation in general, nearly all roadway facilities will have extended vehicle queues at some point during the evacuation process. The point of this analysis is to identify those roadway facilities that have vehicle queues for the longest time periods during each of the evacuation scenarios. Critical roadway segments for the Southwest Florida region are identified in **Figures IV-14** through **IV-23** for each of the operational scenarios for 2010 and 2015.

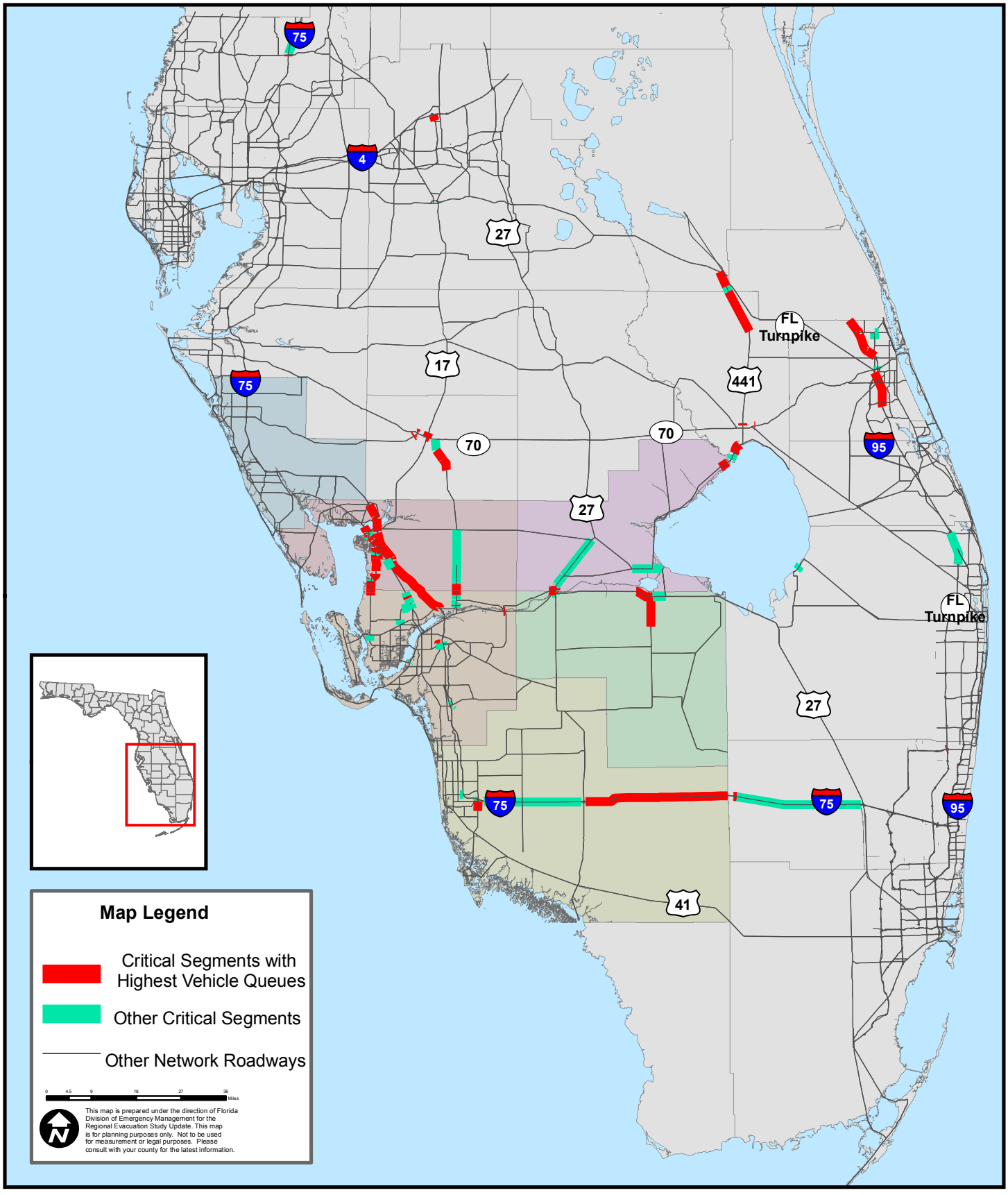
I-75, US 41, US 27, SR 80, SR 82, SR 29, SR 78, SR 31, and US 17 are critical facilities for the operational scenarios as well. Critical segments do vary by scenario, however, as the location of the evacuation event determines which portions of the region experience congestion and queuing. For example, for the level E operational scenario for 2015 where the Treasure Coast region is evacuating, I-95 and US 441 along Florida's east coast experience higher queuing than elsewhere within the Southwest region.

In addition to the identification of critical roadway segments, the total number of evacuating vehicles entering and exiting each county by evacuation scenario was also determined. Evacuating vehicles exiting each county by major evacuation route are identified in **Table IV-26** for 2010 and **Table IV-27** for 2015. In addition, evacuating vehicles entering each county by major evacuation route are identified in **Table IV-28** for 2010 and **Table IV-29** for 2015. Detailed volume figures for all evacuation routes in the Southwest Florida Region for each operational scenario are included in Volume 5-9.

The number of vehicles entering and exiting each county during an evacuation varies widely depending upon the scenario, roadway, and county. As expected, major interstates and state highways generally carry larger volumes of evacuating traffic. The vehicle flows into and out of each county also generally follow the same pattern as the critical segment figures, as locations with higher queues and congestion generally have higher traffic volumes.

Figure IV-14

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level A

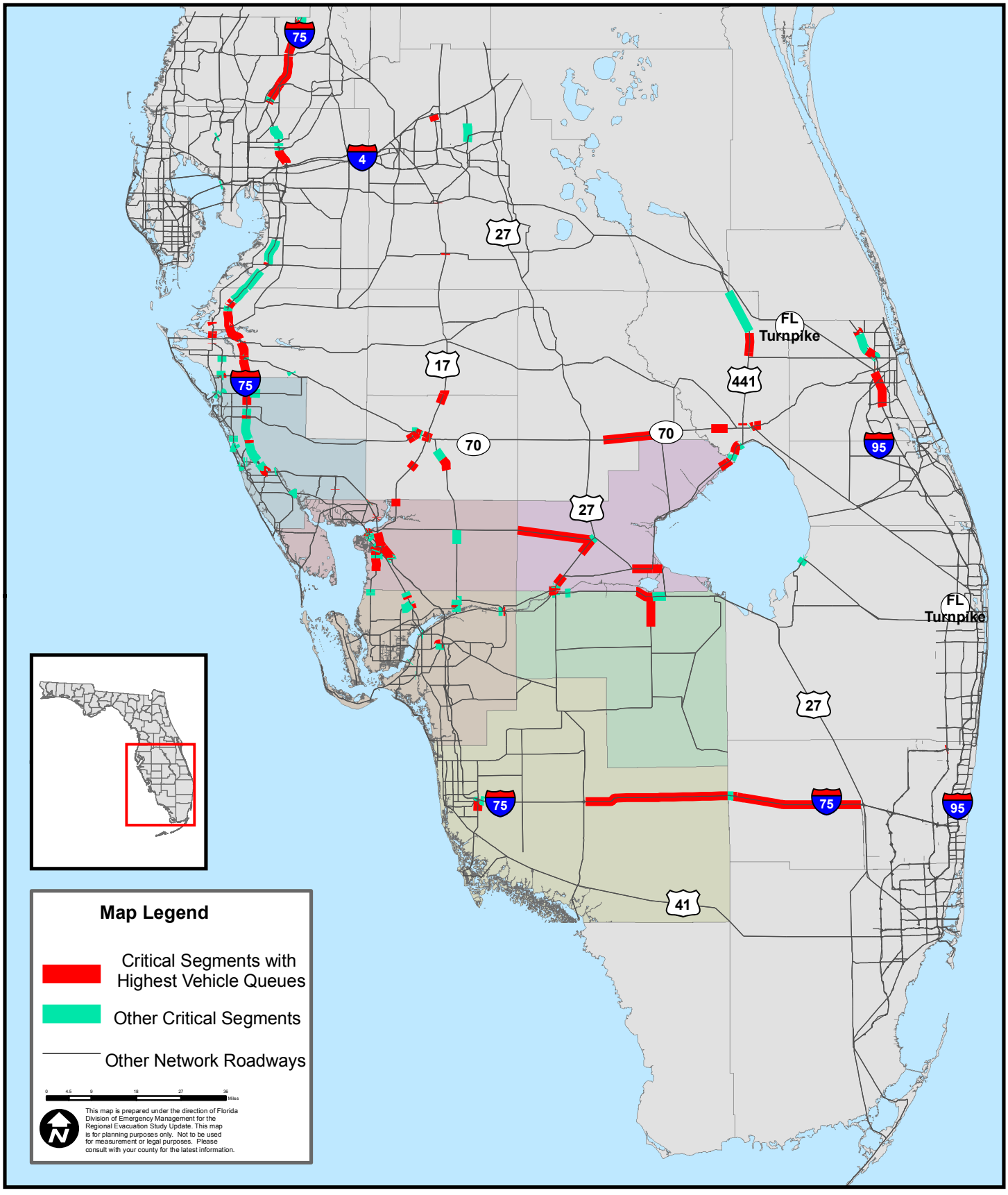


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-15

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level B

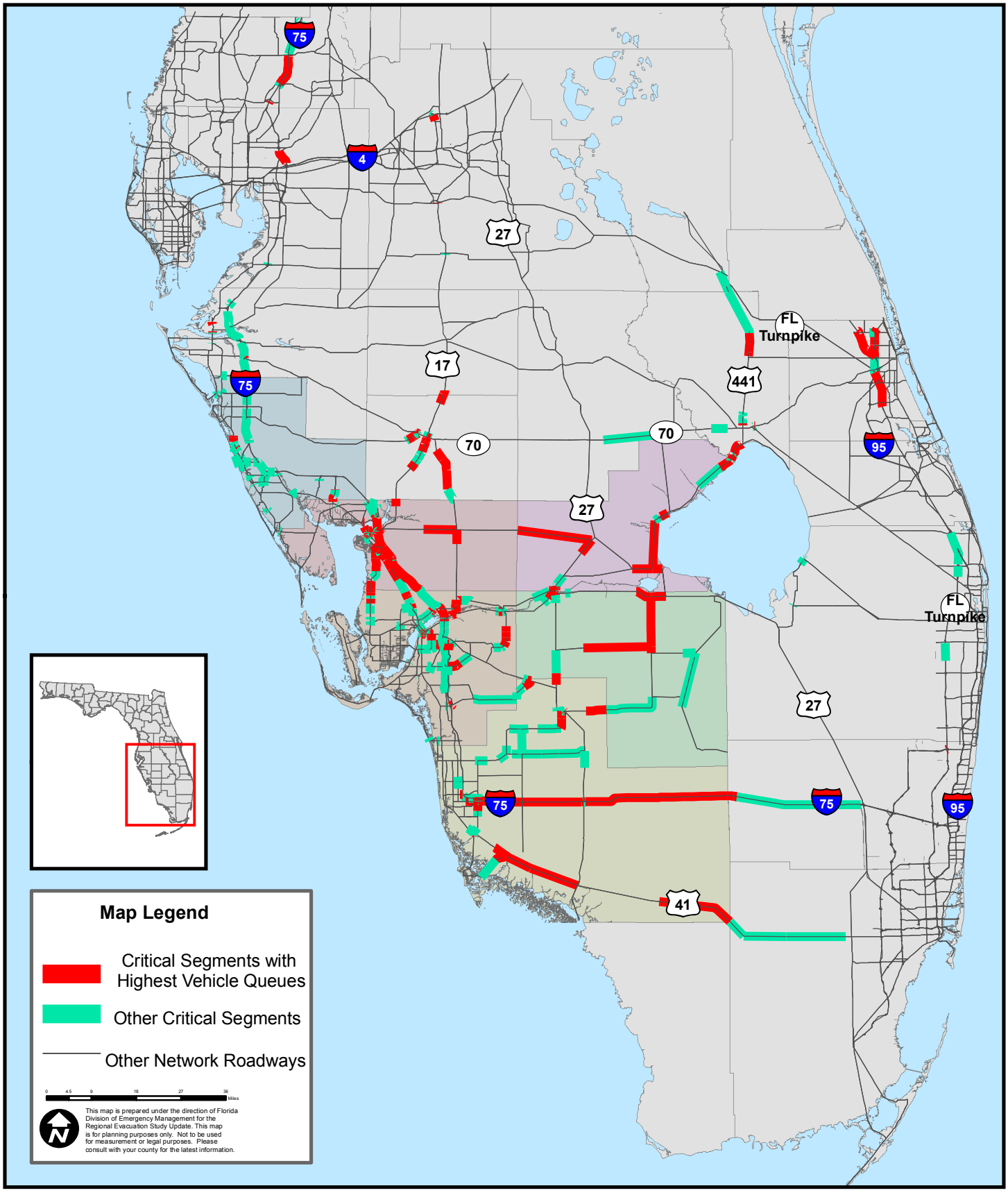


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-16

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level C

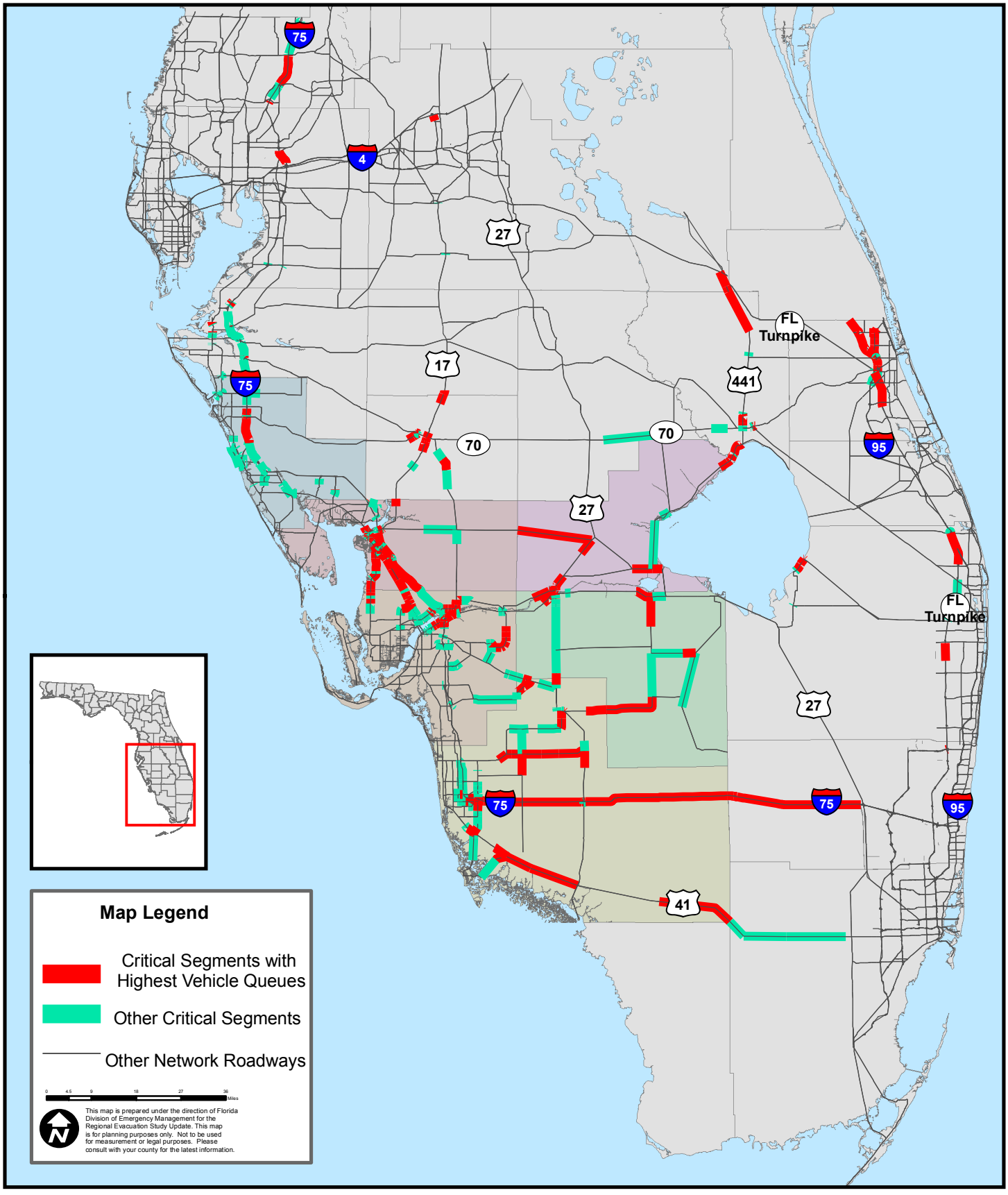


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-17

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level D

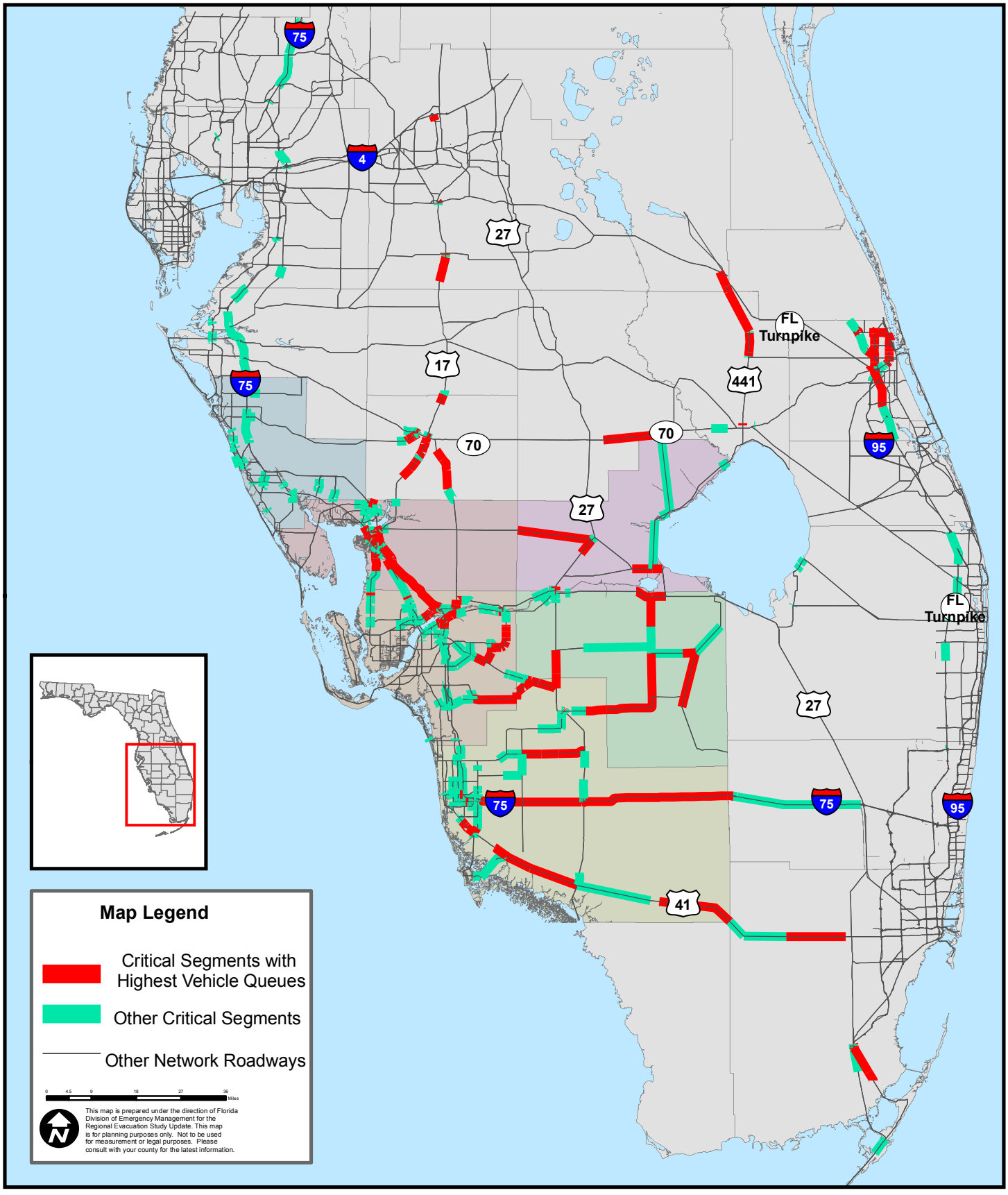


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-18

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level E

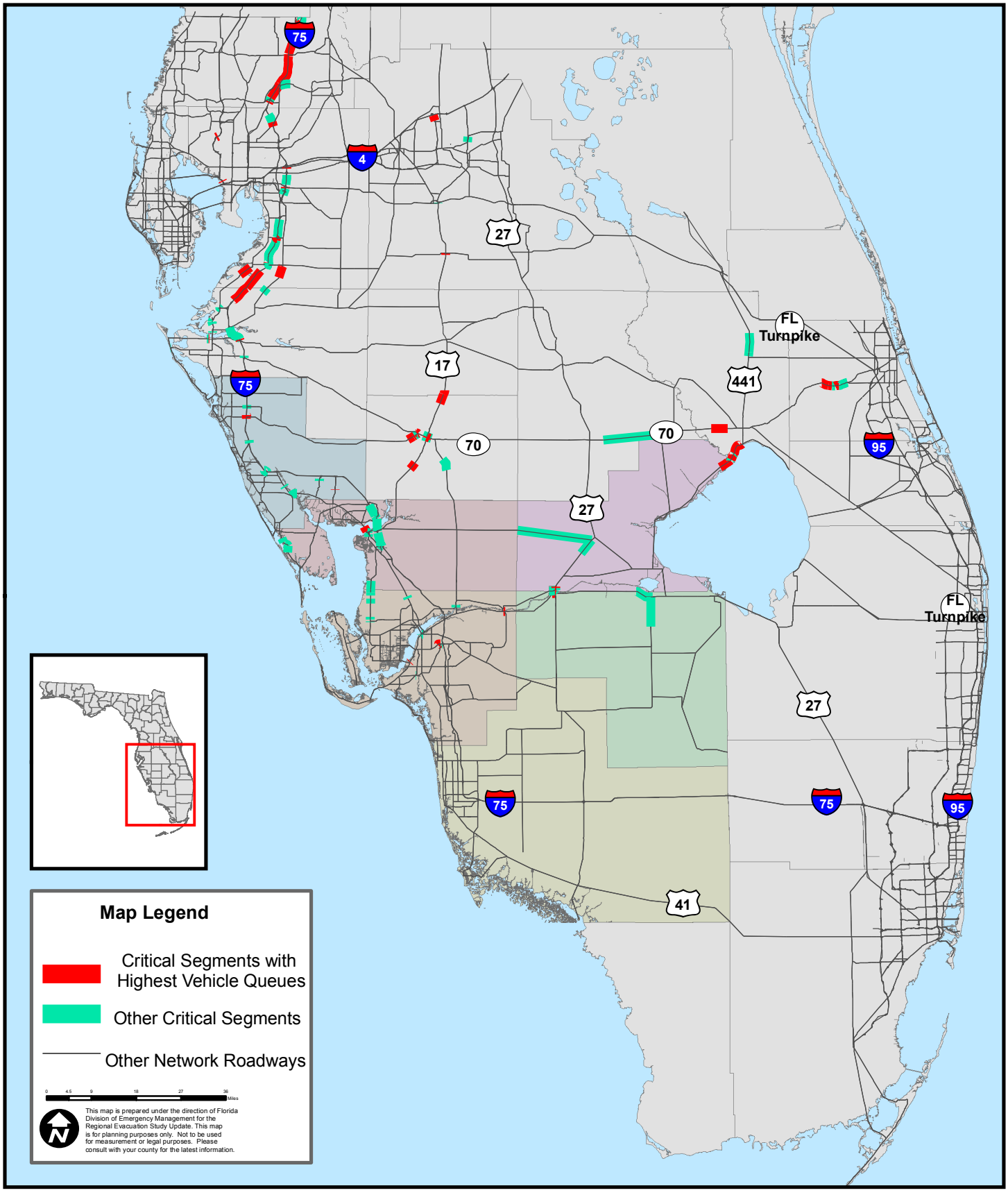


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Figure IV-19

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level A

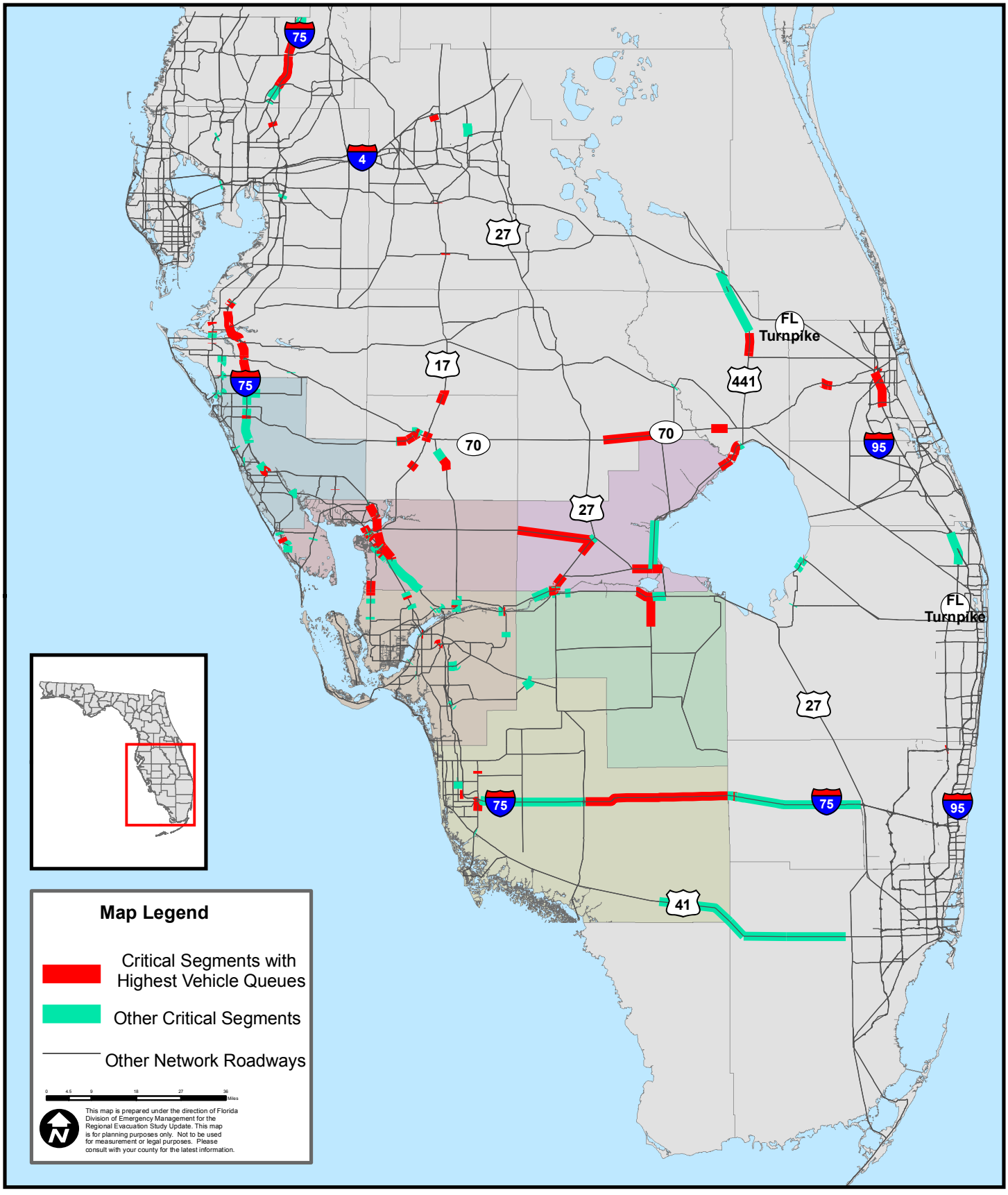


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August ,2010

Figure IV-20

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level B

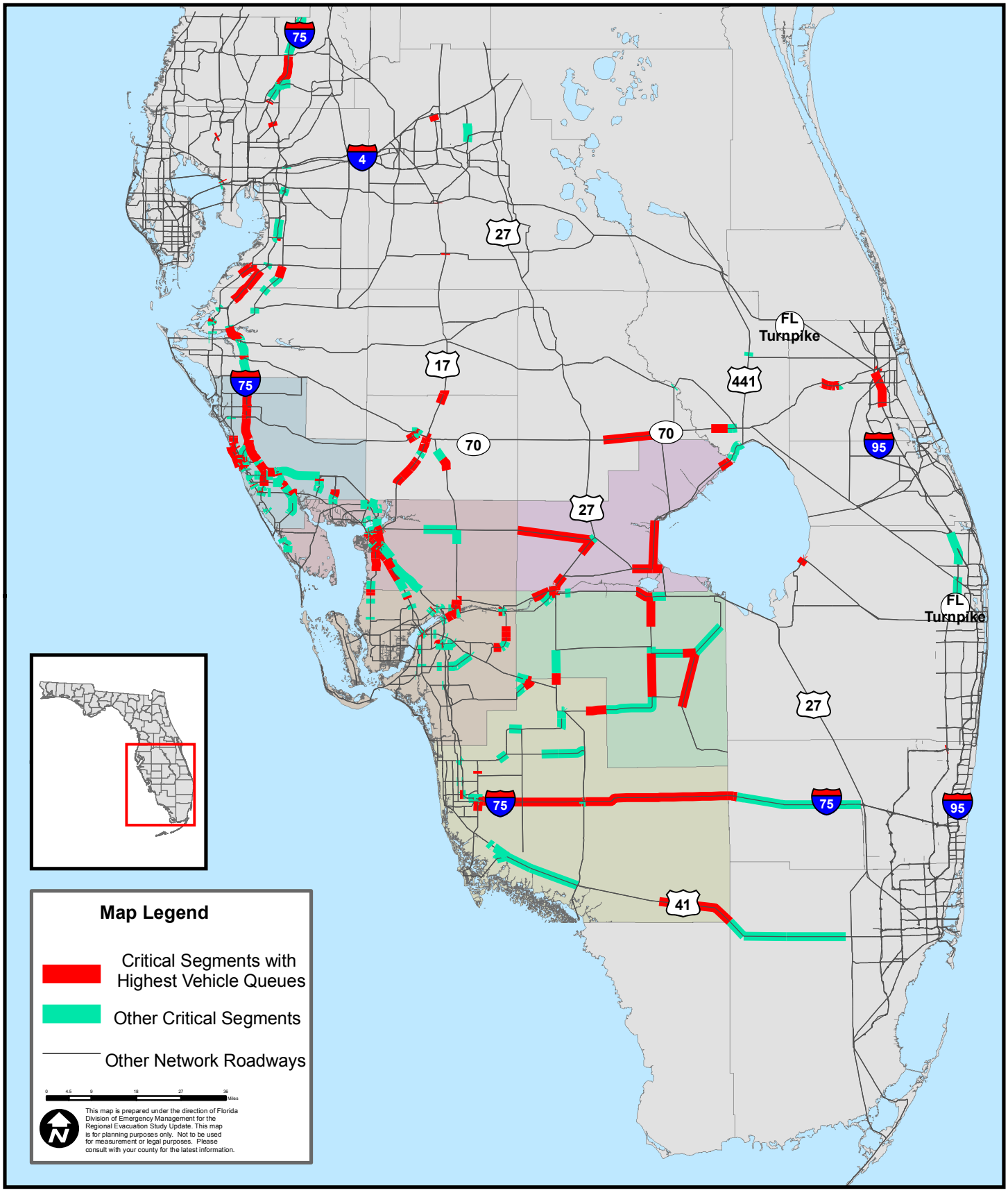


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August ,2010

Figure IV-21

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level C

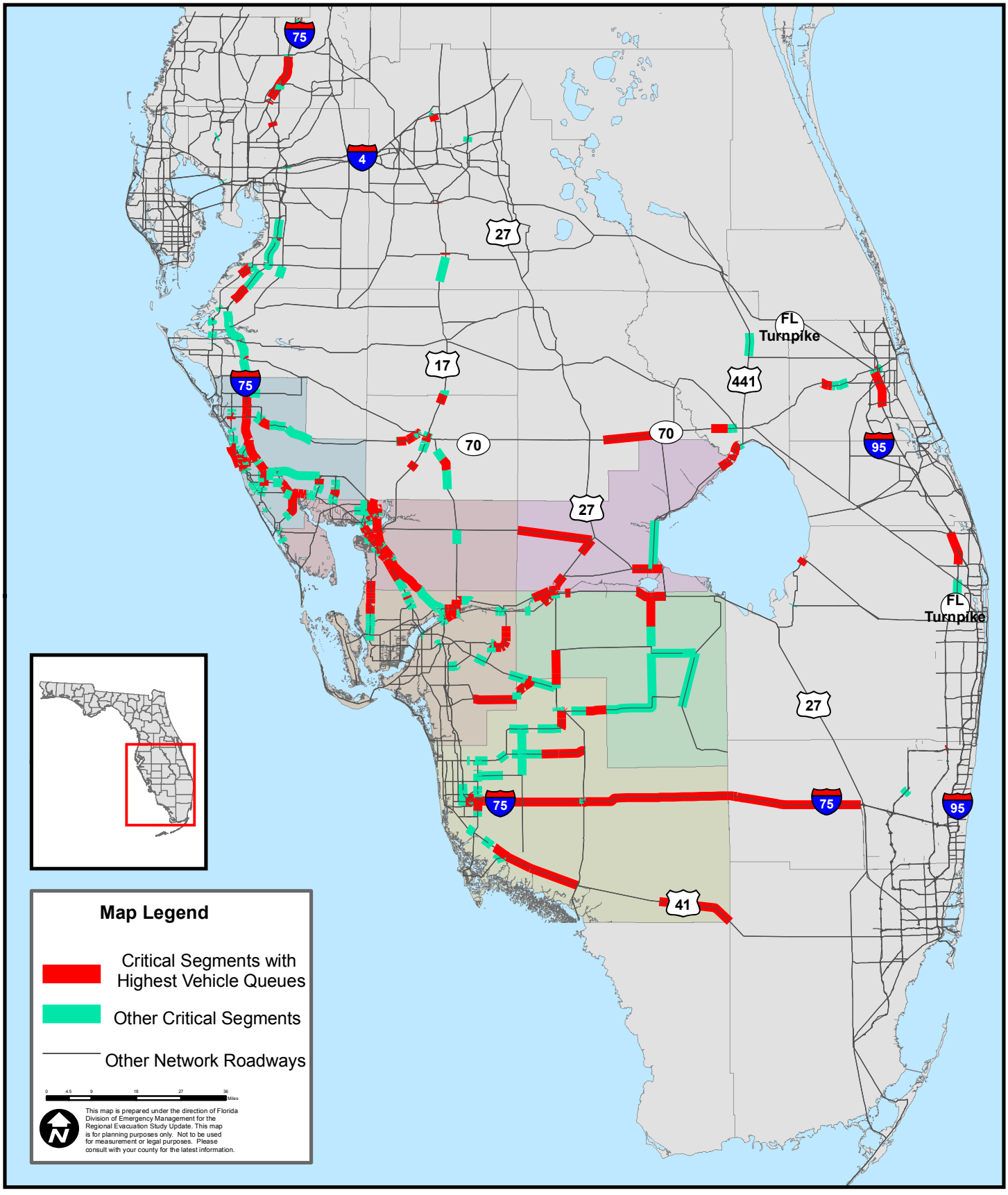


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August ,2010

Figure IV-22

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level D

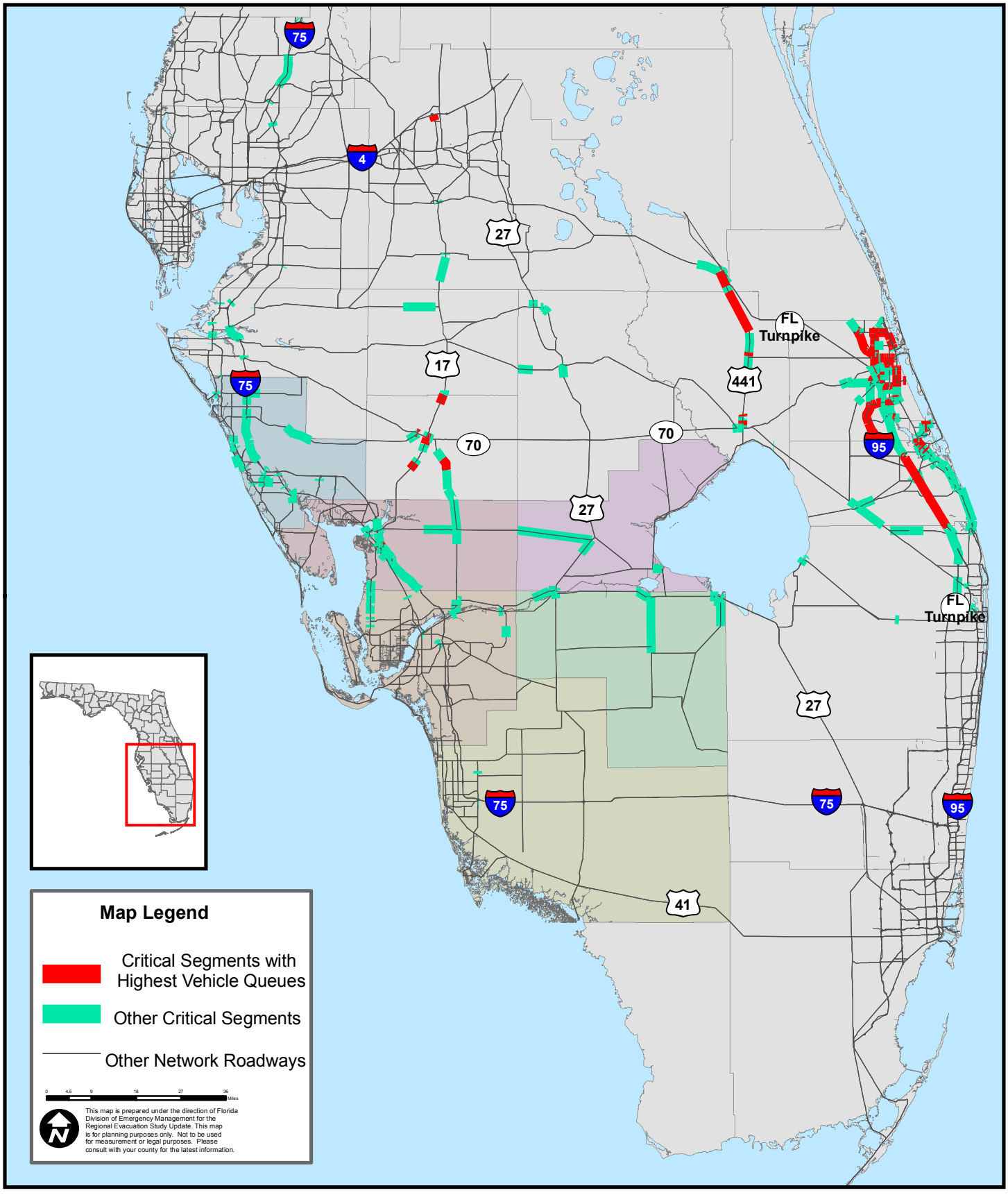


Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August ,2010

Figure IV-23

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level E



Sources: Southwest Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August ,2010

Table IV-26 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2010 Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
SR 776 Northbound	200	5,400	1,700	13,000	19,400
US 41 Northbound	300	1,500	13,400	15,100	11,400
I-75 Northbound	27,900	39,000	53,100	74,000	42,000
US 17 Northbound	2,700	7,900	13,600	18,400	24,200
SR 31 Northbound	4,300	5,900	15,400	20,500	20,700
SR 31 Southbound	0	100	500	2,000	2,900
I-75 Southbound	100	6,200	1,800	2,900	4,000
US 41 Southbound	0	200	0	200	400
Collier County					
US 41 Northbound	200	0	2,700	1,700	1,300
I-75 Northbound	9,700	8,300	18,200	20,500	9,300
SR 82 Northbound	200	300	800	600	200
SR 29 Northbound	2,600	3,900	14,200	19,600	33,100
I-75 Southbound	15,500	21,500	42,200	68,800	98,000
US 41 Southbound	800	2,000	9,500	15,900	25,300
Glades County					
SR 78 Northbound	5,800	6,100	12,600	18,700	16,500
US 27 Southbound	200	1,000	2,500	4,700	13,000
SR 29 Southbound	200	200	300	1,300	5,700
Hendry County					
SR 29 Northbound	7,400	9,600	16,700	25,500	38,800
US 27 Northbound	5,100	4,900	20,000	22,200	36,400
US 27 Southbound	1,500	2,700	6,400	8,900	12,000
SR 29 Southbound	100	100	0	0	100
SR 80 Westbound	400	300	500	400	900
Lee County					
SR 80 Eastbound	6,900	9,700	17,600	25,700	30,900
SR 82 Southbound	500	2,100	5,400	7,300	11,800
I-75 Southbound	4,400	13,100	11,900	31,900	32,000
US 41 Southbound	100	300	500	2,000	10,700
US 41 Northbound	11,100	15,600	20,100	28,400	25,200
I-75 Northbound	16,700	23,100	49,600	46,800	37,000
SR 31 Northbound	5,400	7,100	14,200	24,200	27,300
Sarasota County					
SR 776 Southbound	0	0	0	300	2,400
US 41 Southbound	0	1,000	700	1,400	2,600
I-75 Southbound	0	2,900	1,000	2,700	6,200
SR 78 Eastbound	0	100	200	1,400	7,600
I-75 Northbound	25,200	42,400	56,300	95,300	122,000
US 41 Northbound	0	8,800	15,900	16,500	12,800

Table IV-27 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2015 Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
SR 776 Northbound	3,800	7,700	8,700	17,200	12,500
US 41 Northbound	900	2,200	7,000	3,000	11,700
I-75 Northbound	22,100	44,300	51,300	72,500	66,000
US 17 Northbound	3,400	6,700	9,000	10,500	14,600
SR 31 Northbound	2,500	5,500	11,700	16,800	14,700
SR 31 Southbound	0	0	1,900	2,700	900
I-75 Southbound	3,900	4,100	8,400	5,700	10,700
US 41 Southbound	400	200	300	1,100	300
Collier County					
US 41 Northbound	0	100	200	700	300
I-75 Northbound	0	13,600	5,800	12,900	25,500
SR 82 Northbound	400	700	1,000	900	3,200
SR 29 Northbound	1,600	54,500	11,300	20,600	10,300
I-75 Southbound	5,600	24,700	38,000	64,000	23,800
US 41 Southbound	0	3,400	6,800	12,700	600
Glades County					
SR 78 Northbound	4,100	6,700	7,300	13,700	6,900
US 27 Southbound	600	1,100	3,800	8,500	2,900
SR 29 Southbound	100	200	600	1,600	1,400
Hendry County					
SR 29 Northbound	5,900	9,600	13,800	24,500	17,400
US 27 Northbound	1,800	6,800	9,600	18,600	30,400
US 27 Southbound	1,300	3,500	6,200	11,300	2,000
SR 29 Southbound	0	100	200	100	300
SR 80 Westbound	100	300	400	800	900
Lee County					
SR 80 Eastbound	6,700	9,700	16,500	28,100	16,200
SR 82 Southbound	400	2,200	4,800	6,400	4,300
I-75 Southbound	7,200	7,500	21,100	33,000	19,300
US 41 Southbound	0	0	1,600	3,200	100
US 41 Northbound	9,500	15,700	17,400	27,700	24,800
I-75 Northbound	11,400	27,300	30,500	34,300	43,900
SR 31 Northbound	3,500	7,700	13,600	19,800	16,200
Sarasota County					
SR 776 Southbound	0	0	600	700	200
US 41 Southbound	1,100	1,200	3,700	5,600	2,800
I-75 Southbound	2,400	1,400	3,800	4,700	4,600
SR 78 Eastbound	0	100	400	1,300	400
I-75 Northbound	37,600	43,300	85,200	112,700	85,900
US 41 Northbound	1,000	8,300	5,500	7,100	18,200

Table IV-28 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2010 Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
US 41 Northbound	11,100	15,600	20,100	28,400	25,200
I-75 Northbound	16,700	23,100	49,600	46,800	37,000
SR 31 Northbound	5,400	7,100	14,200	24,200	27,300
SR 776 Southbound	0	0	0	300	2,400
US 41 Southbound	0	1,000	700	1,400	2,600
I-75 Southbound	0	2,900	1,000	2,700	6,200
Collier County					
SR 29 Southbound	100	100	0	0	100
SR 82 Southbound	500	2,100	5,400	7,300	11,800
I-75 Southbound	4,400	13,100	11,900	31,900	32,000
US 41 Southbound	100	300	500	2,000	10,700
Glades County					
SR 29 Northbound	7,400	9,600	16,700	25,500	38,800
US 27 Northbound	5,100	4,900	20,000	22,200	36,400
Hendry County					
SR 29 Northbound	2,600	3,900	14,200	19,600	33,100
US 27 Southbound	200	1,000	2,500	4,700	13,000
SR 29 Southbound	200	200	300	1,300	5,700
SR 80 Eastbound	6,900	9,700	17,600	25,700	30,900
Lee County					
SR 31 Southbound	0	100	500	2,000	2,900
I-75 Southbound	100	6,200	1,800	2,900	4,000
US 41 Southbound	0	200	0	200	400
US 41 Northbound	200	0	2,700	1,700	1,300
I-75 Northbound	9,700	8,300	18,200	20,500	9,300
SR 82 Northbound	200	300	800	600	200
SR 80 Westbound	400	300	500	400	900
Sarasota County					
SR 776 Northbound	200	5,400	1,700	13,000	19,400
US 41 Northbound	300	1,500	13,400	15,100	11,400
I-75 Northbound	27,900	39,000	53,100	74,000	42,000

Table IV-29 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2015 Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Charlotte County					
US 41 Northbound	9,500	15,700	17,400	27,700	24,800
I-75 Northbound	11,400	27,300	30,500	34,300	43,900
SR 31 Northbound	3,500	7,700	13,600	19,800	16,200
SR 776 Southbound	0	0	600	700	200
US 41 Southbound	1,100	1,200	3,700	5,600	2,800
I-75 Southbound	2,400	1,400	3,800	4,700	4,600
Collier County					
SR 29 Southbound	0	100	200	100	300
SR 82 Southbound	400	2,200	4,800	6,400	4,300
I-75 Southbound	7,200	7,500	21,100	33,000	19,300
US 41 Southbound	0	0	1,600	3,200	100
Glades County					
SR 29 Northbound	5,900	9,600	13,800	24,500	17,400
US 27 Northbound	1,800	6,800	9,600	18,600	30,400
Hendry County					
SR 29 Northbound	1,600	54,500	11,300	20,600	10,300
US 27 Southbound	600	1,100	3,800	8,500	2,900
SR 29 Southbound	100	200	600	1,600	1,400
SR 80 Eastbound	6,700	9,700	16,500	28,100	16,200
Lee County					
SR 31 Southbound	0	0	1,900	2,700	900
I-75 Southbound	3,900	4,100	8,400	5,700	10,700
US 41 Southbound	400	200	300	1,100	300
US 41 Northbound	0	100	200	700	300
I-75 Northbound	0	13,600	5,800	12,900	25,500
SR 82 Northbound	400	700	1,000	900	3,200
SR 80 Westbound	100	300	400	800	900
Sarasota County					
SR 776 Northbound	3,800	7,700	8,700	17,200	12,500
US 41 Northbound	900	2,200	7,000	3,000	11,700
I-75 Northbound	22,100	44,300	51,300	72,500	66,000

Clearance Times

Clearance times for each of the operational scenarios are summarized in **Table IV-30** and **IV-31**, as well as **Figures IV-24, IV-25,** and **IV-26**. Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongs, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

In-county clearance times for the 2010 operational scenarios range from 0 hours to 51 hours depending upon the scenario. Counties that were not included in the evacuation scenario will have an in-county clearance time of 0 since no one within the county is evacuating. Clearance Time to Shelter shows a similar pattern, with clearance times for the operational scenarios ranging from 0 hours to 35.5 hours depending upon the county and the scenario.

In 2015, in-county clearance times for the operational scenarios vary from 0 hours to 34.5 hours for the level D evacuation in Sarasota County. The 2015 level E evacuation includes vehicle trips evacuating from the Treasure Coast region, which is why clearance times within the Southwest region are lower for the operational level E scenario than the operational level D scenario. Clearance Time to Shelter shows a similar pattern to the 2010 scenarios, with clearance times for the base scenarios ranging from 0 hours to 32 hours depending upon the scenario.

Out of county clearance times for the 2010 operational scenarios range from 10.5 hours to 51.5 hours for the evacuation level E scenario. Out of county clearance times for all counties in 2015 range from 10.5 to 35 hours depending upon the scenario. Regional clearance time for the six county SWFRPC region ranges from 13 hours to 51.5 hours in 2010 and between 12 and 35 hours in 2015.

Table IV-30 – 2010 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
Charlotte County	0.0	13.5	19.0	19.5	27.0
Collier County	10.0	13.0	17.0	28.5	35.5
Glades County	7.0	9.0	10.5	14.0	15.0
Hendry County	10.5	12.0	17.0	19.5	35.0
Lee County	10.0	13.0	19.5	27.5	35.5
Sarasota County	0.0	13.0	14.5	19.0	30.0
In-County Clearance Time					
Charlotte County	0.0	14.0	25.0	33.0	51.0
Collier County	10.0	14.0	17.5	28.5	37.0
Glades County	9.0	12.5	12.5	16.5	17.0
Hendry County	11.0	13.5	17.5	29.5	37.5
Lee County	10.5	14.0	20.0	32.5	40.5
Sarasota County	0.0	14.5	25.5	33.5	51.0
Out of County Clearance Time					
Charlotte County	12.5	14.5	25.0	33.0	51.0
Collier County	10.5	14.0	19.0	31.5	38.0
Glades County	12.5	16.0	27.0	33.0	42.5
Hendry County	11.5	14.5	23.0	32.5	42.5
Lee County	10.5	14.0	20.0	32.5	40.5
Sarasota County	12.5	15.0	26.0	34.0	51.5
Regional Clearance Time					
Southwest	13.0	16.0	27.0	34.0	51.5

Table IV-31 – 2015 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
Charlotte County	10.0	13.0	20.0	30.0	20.0
Collier County	0.0	13.0	14.5	23.5	19.0
Glades County	8.0	10.5	11.0	15.5	14.5
Hendry County	0.0	13.5	14.0	24.0	20.5
Lee County	10.0	13.0	20.5	24.0	20.0
Sarasota County	10.0	13.0	19.0	32.0	20.5
In-County Clearance Time					
Charlotte County	10.5	14.0	25.5	34.0	23.5
Collier County	0.0	14.0	17.0	24.5	20.5
Glades County	9.5	12.5	12.5	17.0	17.0
Hendry County	0.0	14.5	14.5	24.5	21.5
Lee County	10.5	13.5	20.5	31.5	22.5
Sarasota County	11.0	15.0	26.0	34.5	31.0
Out of County Clearance Time					
Charlotte County	10.5	14.0	25.5	34.0	23.5
Collier County	11.0	14.5	17.0	27.0	20.5
Glades County	12.0	16.5	22.0	31.0	23.0
Hendry County	11.5	15.5	21.5	31.0	22.5
Lee County	10.5	13.5	20.5	31.5	22.5
Sarasota County	11.0	15.0	26.0	35.0	31.5
Regional Clearance Time					
Southwest	12.0	16.5	26.0	35.0	31.5

Figure IV-24 - Clearance Time to Shelter Operational Scenarios

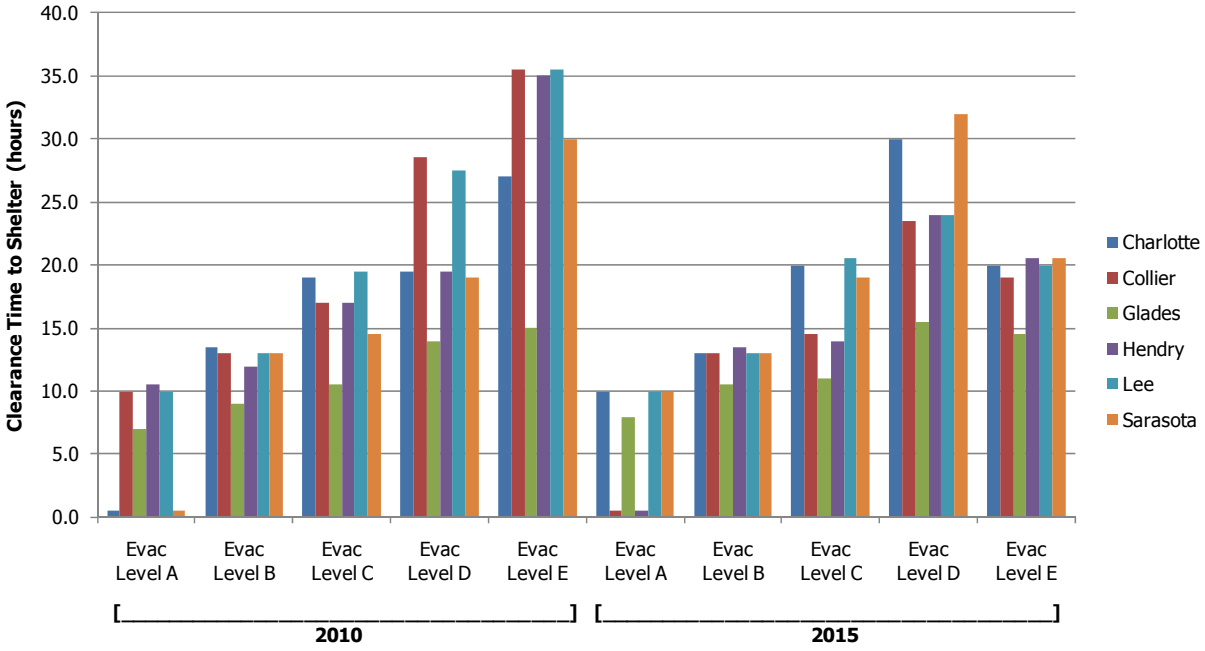


Figure IV-25 - In-County Clearance Times Operational Scenarios

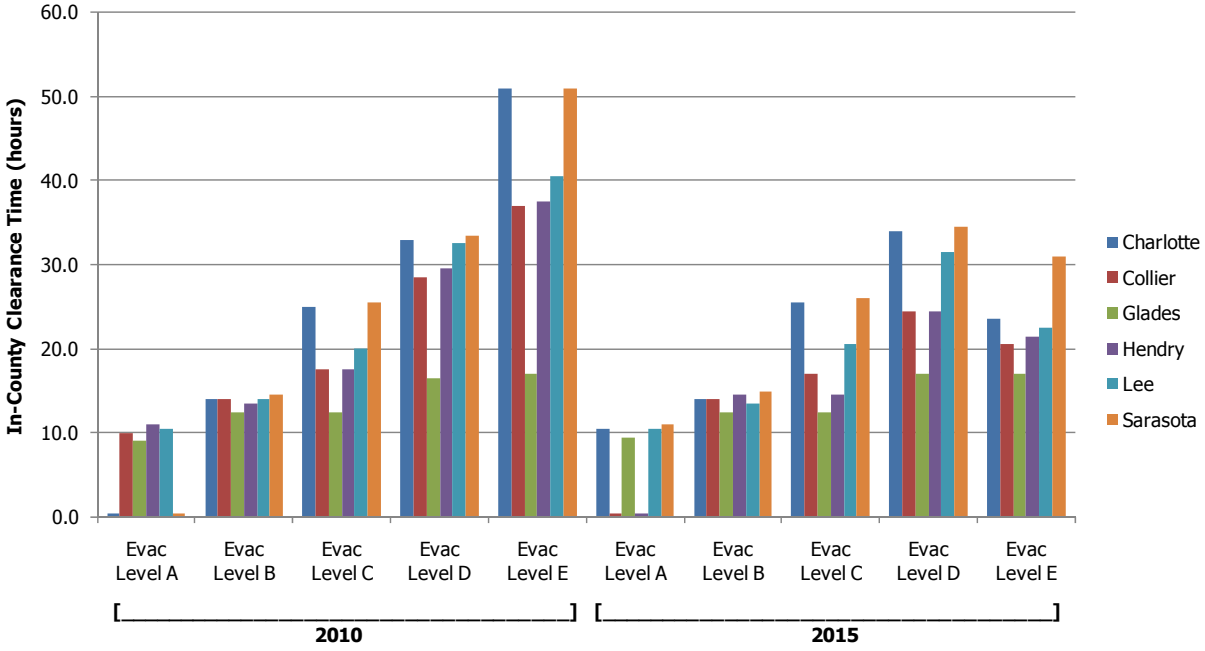
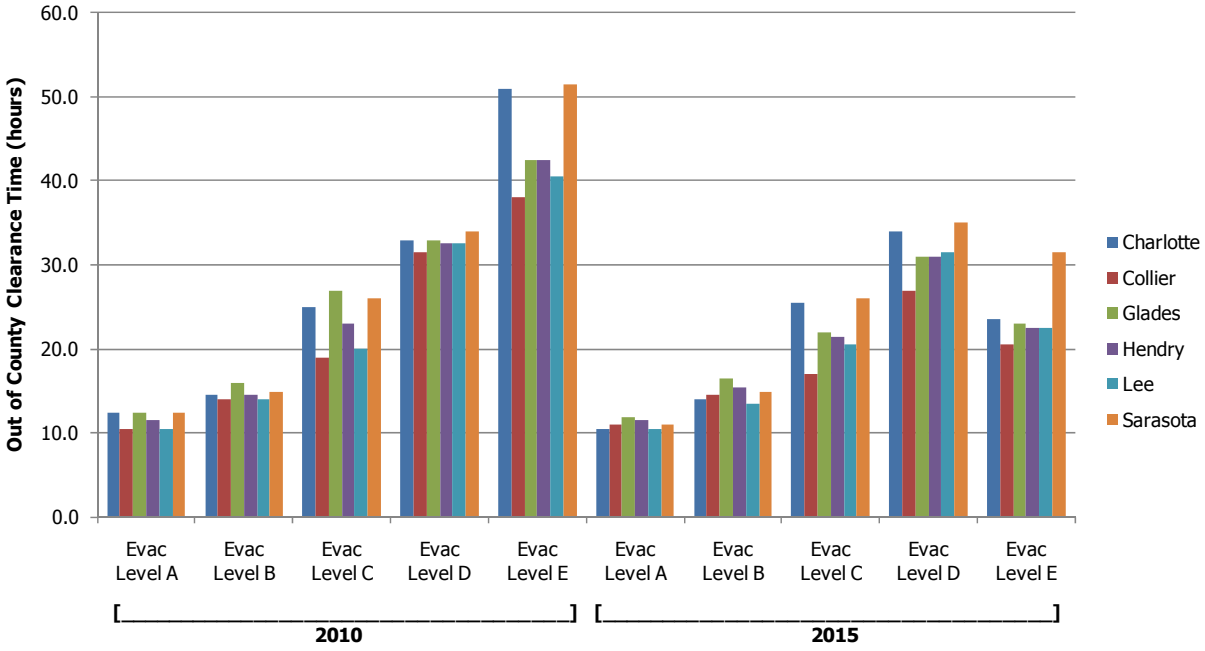


Figure IV-26 - Out of County Clearance Times Operational Scenarios



H. Maximum Evacuating Population Clearances

From an emergency management standpoint, it is important to get an understanding of the maximum proportion of the evacuating population that can be expected to evacuate at various time intervals during an evacuation. Should storm conditions change during an evacuation, emergency managers will need to be able to estimate what portion of the evacuating population is estimated to still remain within the county trying to evacuate.

Using the base scenarios, which assume 100% of the vulnerable population is evacuating, along with shadow evacuations and evacuations from adjacent counties, an estimate was made of the evacuating population actually able to evacuate out of each county by the time intervals of 12, 18, 24, and 36 hours. The estimated maximum evacuating population by time interval for 2010 is identified in **Table IV-32** and for 2015 in **Table IV-33**.

It is important to note that these estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary slightly between evacuation level and either increase or decrease from one evacuation level to the next.

I. Sensitivity Analysis

As discussed previously, there are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. As part of the analysis process, a sensitivity analysis was conducted using the prototype model to evaluate the effect of different response curves on the calculated evacuation clearance times. Calculated clearance times will never be lower than the designated response time, since some evacuating residents will wait to evacuate until near the end of the response time window. For example, using a 12-hour response curve in the analysis means that all residents will begin their evacuation process within 12-hours, and some residents will choose to wait and begin evacuating more than 11.5 hours from when the evacuation was ordered. This will generate a clearance time of more than 12 hours.

The sensitivity analysis identified that clearance times will vary by scenario and by any of the numerous parameters that can be chosen in a particular scenario model run (demographics, student population, tourist population, different counties that are evacuating, response curve, phasing, shadow evacuations, etc.). A few general rules of thumb did emerge from the sensitivity analysis that can provide some guidance to the region regarding the sensitivity of the response curve to the calculated clearance times:

- For low evacuation levels A and B, clearance time will vary by as much as 40 percent depending on the response curve. Low evacuation levels A and B have fewer evacuating vehicles that can be accommodated more easily on the transportation network. In most cases, clearance times typically exceed the response curve by one to two hours. Thus, a 12 hour response curve may yield a clearance time of 13 or 14 hours while an 18 hour response curve may yield a clearance time of 19 or 20 hours. This leads to a higher level of variability than larger evacuations;

Table IV-32 – Maximum Evacuating Population by Time Interval for 2010

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Charlotte County					
12-Hour	71,785	70,276	47,361	41,565	30,685
18-Hour	89,731	105,414	71,042	62,348	46,028
24-Hour		140,552	94,722	83,130	61,370
36-Hour		155,193	142,083	124,695	92,055
Estimated Evacuating Population Clearing Collier County					
12-Hour	132,319	159,930	86,566	85,619	57,301
18-Hour	159,885	239,896	129,849	128,428	85,951
24-Hour		259,887	173,132	171,237	114,601
36-Hour			259,698	256,856	171,902
Estimated Evacuating Population Clearing Glades County					
12-Hour	5,162	3,557	2,071	1,600	1,159
18-Hour	6,668	5,336	3,106	2,400	1,738
24-Hour		7,114	4,141	3,201	2,318
36-Hour			6,212	4,801	3,477
Estimated Evacuating Population Clearing Hendry County					
12-Hour	17,817	11,376	6,744	5,850	4,583
18-Hour	21,529	17,064	10,116	8,776	6,874
24-Hour		22,752	13,487	11,701	9,166
36-Hour			20,231	17,551	13,749
Estimated Evacuating Population Clearing Lee County					
12-Hour	228,652	235,567	154,899	137,361	113,832
18-Hour	266,761	353,351	232,348	206,042	170,749
24-Hour		451,504	309,798	274,722	227,665
36-Hour			464,696	412,083	341,497
Estimated Evacuating Population Clearing Sarasota County					
12-Hour	84,012	68,612	69,948	73,920	60,350
18-Hour	108,516	102,919	104,922	110,880	90,524
24-Hour		137,225	139,895	147,840	120,699
36-Hour		154,378	209,843	221,759	181,049

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

Table IV-33 – Maximum Evacuating Population by Time Interval for 2015

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Charlotte County					
12-Hour	93,102	109,090	57,255	48,340	30,580
18-Hour	116,378	163,635	85,883	72,510	45,870
24-Hour		177,271	114,510	96,680	61,160
36-Hour			171,766	145,020	91,741
Estimated Evacuating Population Clearing Collier County					
12-Hour	175,121	175,034	104,426	92,361	62,177
18-Hour	211,604	262,552	156,640	138,542	93,266
24-Hour		291,724	208,853	184,723	124,355
36-Hour			313,279	277,084	186,532
Estimated Evacuating Population Clearing Glades County					
12-Hour	5,848	3,966	2,453	1,733	1,258
18-Hour	7,310	5,949	3,679	2,600	1,887
24-Hour		7,767	4,906	3,467	2,516
36-Hour			7,359	5,200	3,774
Estimated Evacuating Population Clearing Hendry County					
12-Hour	19,626	13,952	8,003	6,448	4,579
18-Hour	23,715	20,929	12,005	9,671	6,868
24-Hour		24,998	16,006	12,895	9,157
36-Hour			24,009	19,343	13,736
Estimated Evacuating Population Clearing Lee County					
12-Hour	224,333	278,583	171,891	156,786	107,111
18-Hour	271,069	417,874	257,837	235,179	160,666
24-Hour		429,482	343,783	313,572	214,221
36-Hour			515,674	470,359	321,332
Estimated Evacuating Population Clearing Sarasota County					
12-Hour	87,801	92,108	80,039	87,482	59,222
18-Hour	113,409	138,163	120,059	131,224	88,833
24-Hour		157,352	160,079	174,965	118,444
36-Hour			240,118	262,447	177,666

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

- For mid-level evacuations such as C and sometimes D, clearance time varied by as much as 25 percent during the sensitivity analysis. The number of evacuating vehicles is considerably higher than for levels A and B, and lower response curves tend to load the transportation network faster than longer response curves. The variability in clearance times is less in these cases than for low evacuation levels; and,

- For high-level evacuations such as some level D evacuations and all E evacuations, clearance time variability is reduced to about 10 to 15 percent. Large evacuations involve large numbers of evacuating vehicles, and the sensitivity test identified that clearance times are not as dependent on the response curve as lower level evacuations since it takes a significant amount of time to evacuate a large number of vehicles.

The counties within the Southwest Florida Region are encouraged to test additional scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in determining when to order an evacuation. Due to advancements in computer technology and the nature of the developed transportation evacuation methodology, this study includes a more detailed and time consuming analysis process than used in previous years studies. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different response curves.

J. Summary and Conclusions

Through a review of the results of the 20 different scenarios (10 base and 10 operational), several conclusions could be reached regarding the transportation analysis, including the following:

- Critical transportation facilities within the SWFRPC region include I-75, US 41, US 27, SR 82, SR 80, SR 29, SR 78, SR 31, and US 17. For large storm events, such as level D and E evacuations, other State facilities also play an important role in evacuations;

- During the level A and B evacuation scenarios, the roadway segments with the highest vehicle queues are primarily concentrated along the major Interstate and State Highway system. During these levels of evacuation, State and County officials should coordinate personnel resources to provide sufficient traffic control at interchanges and major intersections along these routes;

- In contrast, for the higher level C, D, and E evacuation scenarios, many other roadway facilities, both within and outside of the region, will require personnel resources for sufficient traffic control at interchanges and major intersections;

- The SWFRPC counties, in coordination with the State, should continue public information campaigns to clearly define those that are vulnerable and should evacuate verses those who choose to evacuate on their own. Shadow evacuations in inland areas of the counties impact the ability of the vulnerable population to evacuate;

- The Florida Department of Transportation should continue to work with local counties on implementing intelligent transportation system (ITS) technology, which will provide enhanced monitoring and notification systems to provide evacuating traffic with up to

date information regarding expected travel times and alternate routes;

- The State can use the data and information provided in this report (specifically the evacuating vehicle maps in Volume 5-9) to estimate fuel and supply requirements along major evacuation routes to aid motorists during the evacuation process;

- For major evacuation routes that have signalized traffic control at major intersections, traffic signal timing patterns should be adjusted during the evacuation process to provide maximum green time for evacuating vehicles in the predominate north and east directions; and,

- The counties within the Southwest Florida Region are encouraged to test additional transportation scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in planning for an evacuation. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different evacuation conditions, such as different evacuation levels, different behavioral response assumptions, and different response curves.

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