Florida Statewide Regional Evacuation Study Program

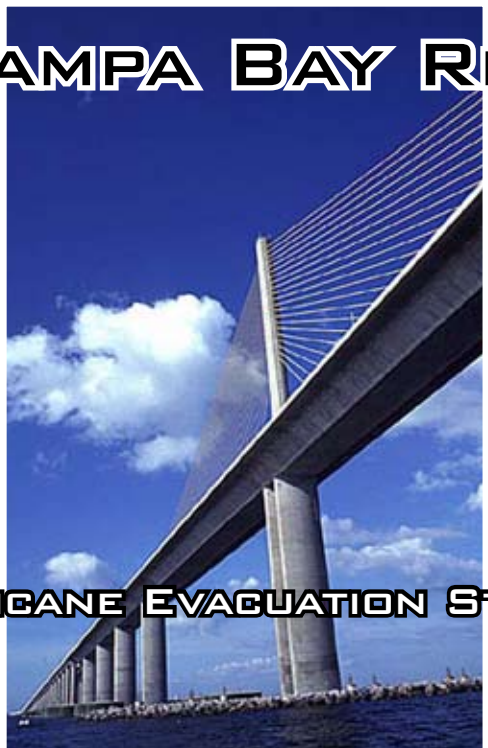
Evacuation Transportation Analysis

Volume 4-8

Florida Division of Emergency Management

Tampa Bay Planning Regional Council

Tampa Bay Region



2015

Includes Hurricane Evacuation Study

Statewide Regional Evacuation Study Program

CREDITS & ACKNOWLEDGEMENTS

Funding was provided by the Florida Legislature with funds provided by the Federal Emergency Management Agency (FEMA) through the Florida Division of Emergency Management, 2555 Shumard Oak Blvd., Tallahassee, 32399. Web site: www.floridadisaster.org. Local match was provided by the Tampa Bay Regional Planning Council and the counties of Hillsborough, Manatee, Pasco and Pinellas counties.

The Council acknowledges and extends its appreciation to the following agencies and people for their cooperation and assistance in the development of this Atlas:

National Oceanic and Atmospheric Administration (NOAA/TPC-NHC) for the SLOSH numerical storm surge model developed by the late Chester L. Jelesnianski, the development of the 2009 Tampa Bay Basin under the management of Jaime Rhome, and for the storm surge computation and interpretation provided by the NOAA Storm Surge Modeling team.

Florida Division of Emergency Management
Andrew Sussman, Hurricane Planning Manager
Richard Butgereit, GIS Manager

Northeast Florida Regional Council
Elizabeth Payne, SRES Project Manager

Florida Emergency Preparedness Association
For their support in this statewide effort

County Emergency Management Agencies
Preston Cook, Director of Hillsborough County Emergency Management
Sally Bishop, Director of Pinellas County Emergency Management
Annette Doying, Director of Pasco County Emergency Management
Don Hermey, Director of Manatee County Emergency Management

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Tampa Bay Region

EVACUATION TRANSPORTATION ANALYSIS

Executive Summary

(UPDATED 2015)

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CHAPTER VI EVACUATION TRANSPORTATION ANALYSIS

The evacuation transportation analysis discussed in this chapter 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) as in the 2006 Tampa Bay Study Update. 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 four county Tampa Bay 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 Tampa Bay region. While the impact of other regions is included in the Tampa Bay analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the four counties

included in the Tampa Bay 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. Transportation Study Comparisons

It is important to note that this study contains significant updates and revisions in comparison to the 2010 SRESP study for the Tampa Bay Region. These revisions include updated population projections, modifications to the roadway network due to recently completed and planned construction projects, and changes to the location and size of available shelters. These revisions have significant impacts on evacuating vehicle behavior for the region and caused changes to the calculated clearance times in each county. These updates and revisions make comparisons to the previous 2010 study difficult.

First, the population and demographic data that is used in this 2015 update are much more up-to-date than the data used in the 2010 Study. This updated population data more accurately represents the actual population distribution and demographic characteristics across the Tampa Bay region. Because work on the 2010 Study began as early as 2006, population/demographic projections used for that Study did not account for the severe economic downturn (aka the “Great Recession”), which slowed population growth in the Tampa Bay region and throughout Florida beginning in 2007 and continuing well into the next decade. As the economy recovered and population growth rates increased, the actual geographic distribution of the population in 2015 may not match the geographic distribution of the population as forecast in the 2010 Study. The population/demographic data used for this 2015 update to the Study is based on the 2010 Census, and are validated to 2014 Florida Department of Transportation (FDOT) and area Metropolitan Planning Organization (MPO) projections. Therefore, the population/demographic data used in the 2015 Study more accurately represent the actual population/demographic characteristics of a given geographic area. This provides a more accurate representation of traffic loading at specific locations on the regional roadway network, which may differ significantly from the 2010 Study and cause changes in evacuation clearance times.

Second, the 2015 Update includes updated modifications to the regional and statewide roadway networks. In part because of the “Great Recession” and lingering economic downturn that followed, some planned road construction projects that were represented in the transportation

model for the 2010 Study were not completed, and other projects were accelerated because of increased Federal stimulus funding. The transportation modelling for the 2015 Update accounts for these changes, and provides a more accurate representation of the current and planned roadway network.

Third, shelter locations change over time for various reasons. These shelter location changes, along with potential changes in shelter space availability can affect the evacuation clearance times as calculated by the transportation model. The number, size, and location of shelters in the Tampa Bay region have remained fairly constant since the 2010 Study, so changes in evacuation clearance times from the 2010 Study to the 2015 Update are more likely attributed to more up-to-date population/demographic data and updated roadway network information.

Finally, some changes were made in the evacuation transportation model for the 2015 Update to better represent traffic loading and vehicle movement along the regional evacuation roadway network. These model improvements for the 2015 Update did not alter the overall model framework as described in the following section, but may contribute to differences in evacuation clearance times compared with the 2010 Study.

E. 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 Tampa Bay 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 8,829 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.

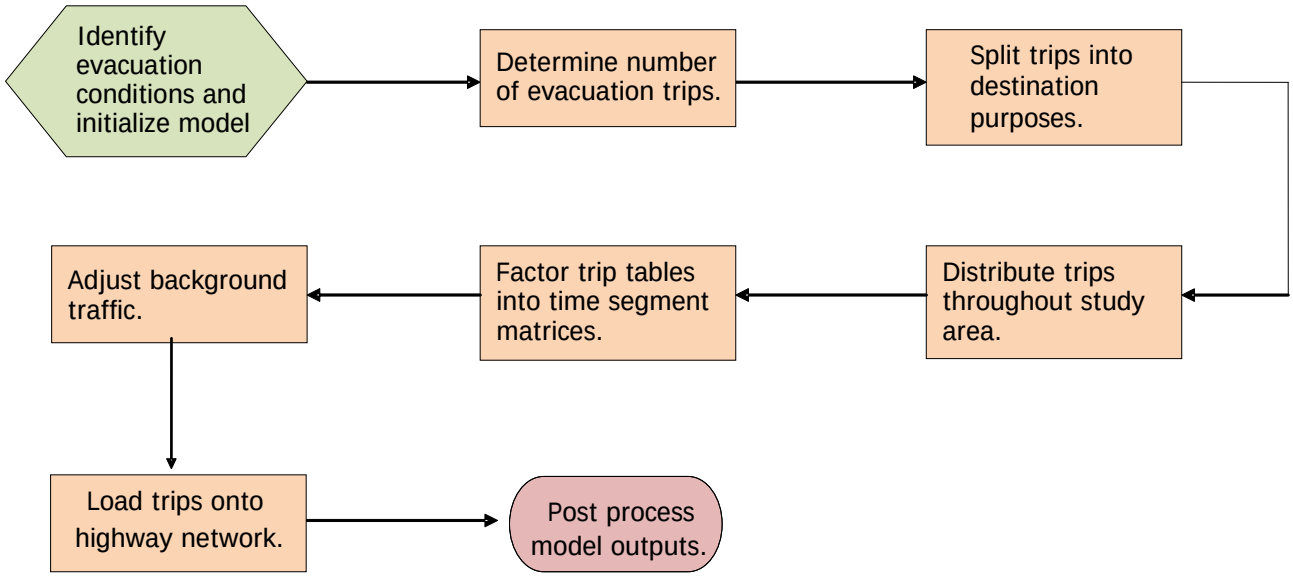
The second group of traffic is known as background traffic. Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis and is accounted for primarily to impede the movement of evacuation trips through the network. These trips represent individuals going 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 VI-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 IV-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 (now CDM-Smith) 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.

F. Regional Model Implementation

The regional model developed for the Tampa Bay 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 Tampa Bay 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 model timeframe conditions and is referred to as the base model network. **Figure VI-2** identifies the model network and evacuation routes for the TBRPC. County level details of the regional model network are provided in the Volume 5-8 report. The regional model network for the Tampa Bay region includes key roadways within the four county region, including I-4, I-75, I-275, US 301, US 19, SR 39, SR 64, SR 70, SR 52, and SR 54.

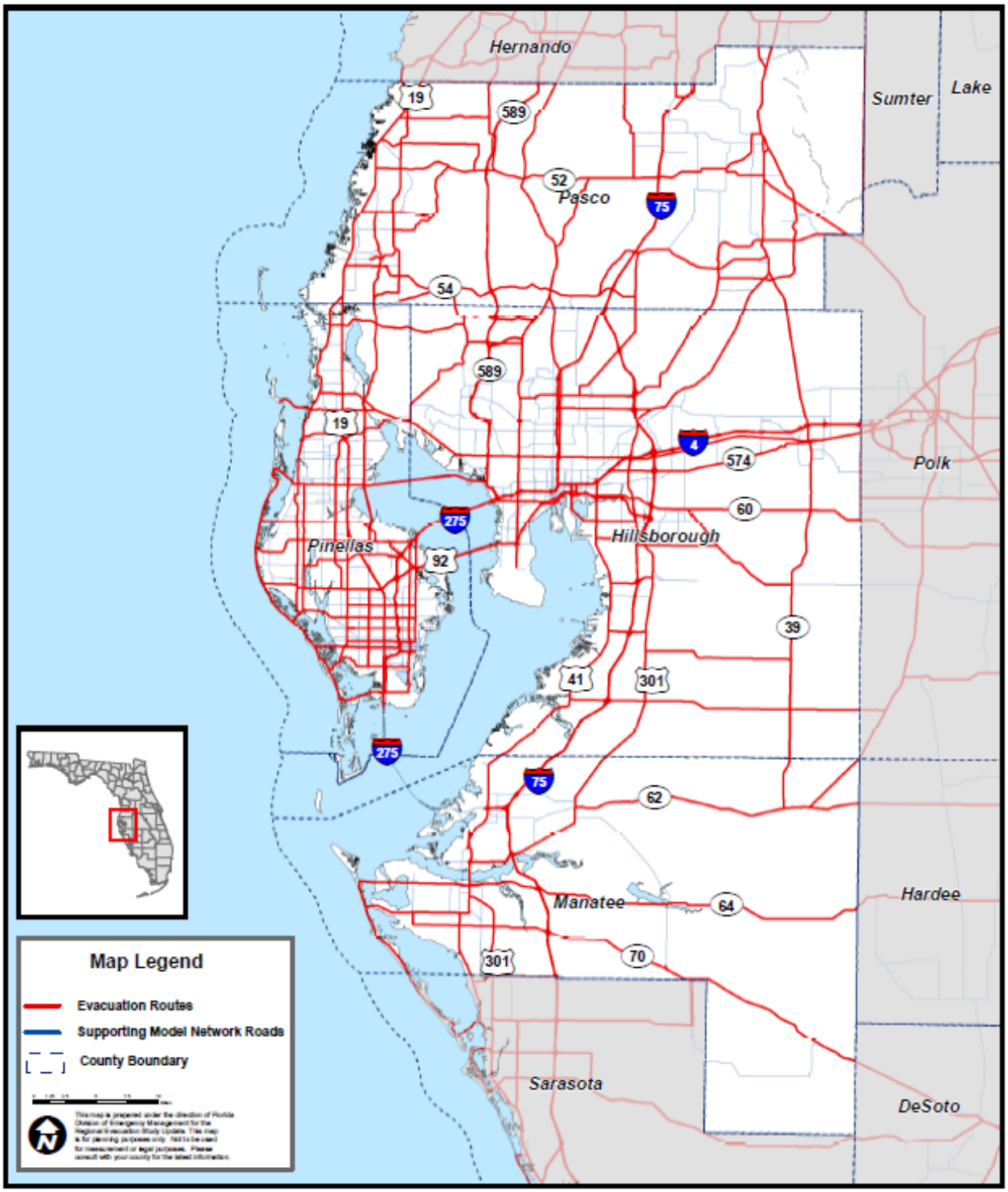
Regional Zone System - The regional zone system is based on Traffic Evacuation Zones (TEZ) and contains the regional demographic information, which includes housing and population data that is essential to modeling evacuation traffic. There are 1,673 TEZs located within the four county Tampa Bay region, as illustrated in **Figure VI-3**. In the Tampa Bay region, Pinellas County has the largest number of TEZs with 631, with Hillsborough following 505 TEZs. Manatee and Pasco Counties have the lowest number of TEZs within the RPC 332 and 205 zones, respectively. The larger numbers of TEZs generally reflect counties with dense urban structure and higher population densities.

Regional Demographic Characteristics - Demographic data was updated for the following years: 2015, and 2020. A snapshot of the key demographic data for each county in the Tampa Bay RPC for 2015 and 2020 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 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

Tampa Bay Regional Model Network

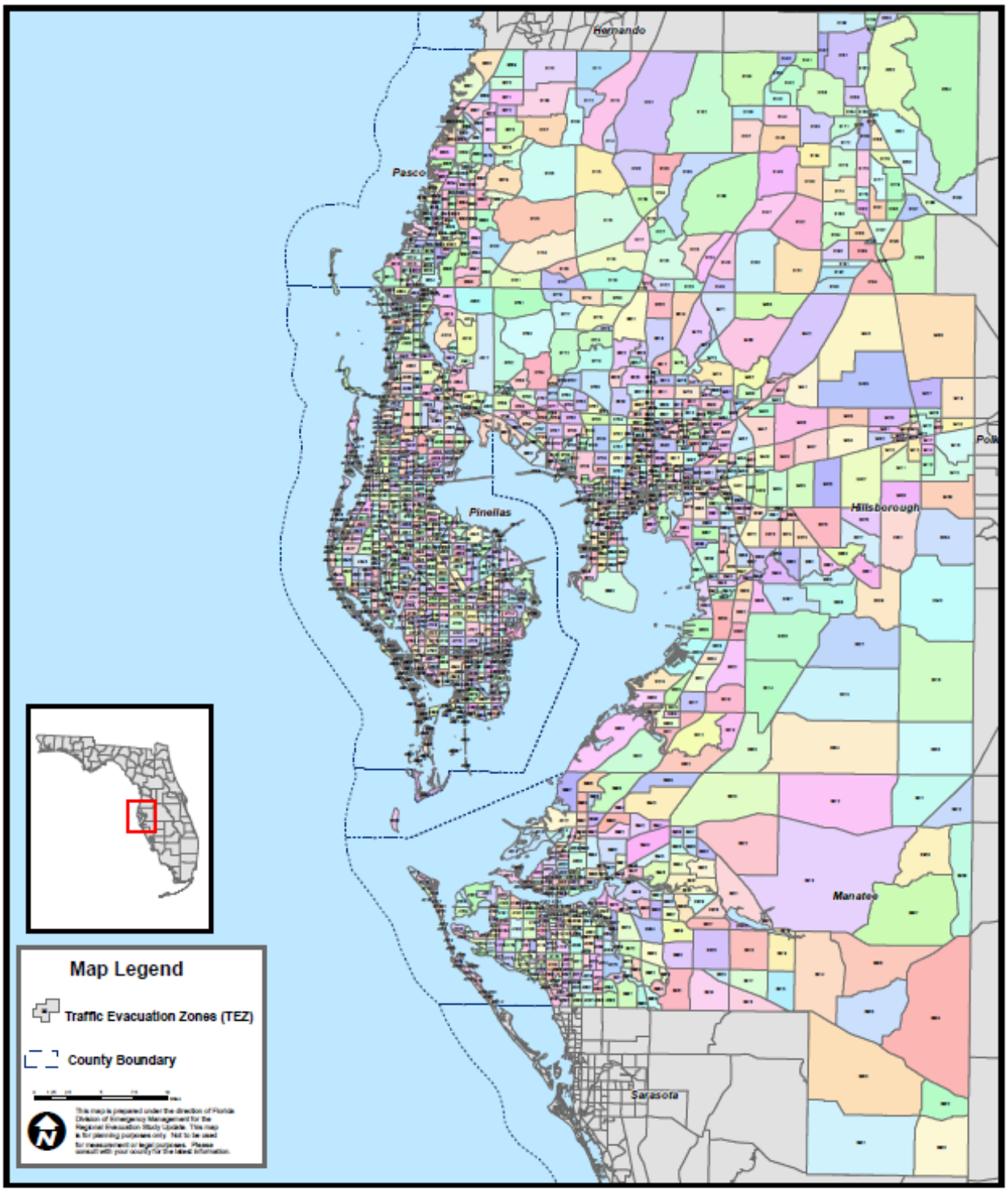


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure ES-3

Tampa Bay Regional Model Transportation Evacuation Zone System (TEZ)



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Hillsborough County has the largest population in the region during both periods. The county is expected to reach over 1.4 million people by 2020. Pinellas County has the second largest population in the region, and this county is far more densely populated than the other counties, including Hillsborough. This is very significant in the behavior of the evacuation transportation model because most of the population in Pinellas lives close to a coastline and in an evacuation zone.

Table ES-1 - Tampa Bay Demographic Characteristic Summary

County	Characteristic	Year	
		2015	2020
Hillsborough	Occupied site-built homes	477,120	515,727
	Population in site-built homes	1,219,576	1,320,729
	Occupied mobile homes	35,083	35,205
	Population in mobile homes	95,704	96,011
	Hotel/motel units	16,769	20,576
Manatee	Occupied site-built homes	120,987	126,729
	Population in site-built homes	284,827	300,548
	Occupied mobile homes	23,349	22,947
	Population in mobile homes	46,698	45,959
	Hotel/motel units	13,535	14,117
Pasco	Occupied site-built homes	195,253	225,087
	Population in site-built homes	467,959	531,523
	Occupied mobile homes	24,789	24,788
	Population in mobile homes	57,818	57,813
	Hotel/motel units	1,834	2,712
Pinellas	Occupied site-built homes	400,874	421,621
	Population in site-built homes	875,362	918,307
	Occupied mobile homes	35,909	36,451
	Population in mobile homes	51,271	52,047
	Hotel/motel units	13,603	16,037

Source: Tampa Bay Regional Planning Council, FDOT, MPOs

Planned Roadway Improvements - To correspond to the different sets of demographic data, two model networks were updated from previous 2010 Study. The two networks to correspond to the 2015 demographic data and the 2020 demographic data. The 2010 base model network was updated to reflect roadway capacity improvement projects completed between 2011 and 2015 to create the 2015 network. The 2010 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2016 and 2020 to create the 2020 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 2010 and 2015 that were included in the 2015 network. Likewise, **Table ES-3** identifies capacity improvement projects planned for implementation between 2016 and 2020. 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 Hillsborough County, US 301 from Balm Road to SR 674 will be widened to 8 lanes.

It is important to note that Tables IV-2 and IV-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 Tampa Bay Region, all four counties within the region have evacuation zones corresponding to five categories of storm surge. Evacuation rates for site-built homes and mobile/manufactured homes are provided by county and summarized in **Figure VI-4** through **Figure VI-11**. 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 5-8.

A review of the evacuation rates for the Tampa Bay 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 VI-4 through Figure VI-11.

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 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 four county region there are a total of 135 shelters, including 47 in Hillsborough County, 25 in Manatee County, 29 in Pasco County, and 34 in Pinellas County, all of which are classified as primary shelters. All together, the 135 shelters located within the four county region can host more than 185,000 persons during an evacuation event.

Table ES-2 - Tampa Bay Region Roadway Improvements, 2011-15

County	Roadway	From	To	Number of Lanes
Hillsborough	Lutz Lake Fern Rd	Suncoast Parkway	TPC Blvd	4
	Lutz Lake Fern Rd	TPC Blvd	Dale Mabry Highway	2
	SR 574	W of Highview	E of Parsons Ave	4
	I-4/Selmon Expressway	S of Selmon Expresswy	7th Ave	4
	I-4/Selmon Expressway	7th Ave	I-4	4
	I-275	Tampa CBD Interchange	ML King Blvd	8
	I-275	MLK	Fowler	6
	N 21st St/N 22nd St	SR 60	I-4	4
	US 301	Balm Rd	SR 674	2
Manatee	I-75	Fruitville Rd	N of University Prkwy	8
Pasco	Clinton Ave.	Ft. King Hwy	U.S.301	4
	Denton Ave	US 19	Shady Hills	2
	CR 587 (Mass Ave)	Congress St	Little Rd (CR 1)	4
	CR 587 (Mass Ave)	Little Rd (CR 1)	SR 52	2
	CR 518 (Trouble Creek Rd)	US 19	Rowan Rd	2
	Mitchell Blvd	CR 77	CR 1	4
	Trinity Blvd	Little Rd (CR 1)	SR 54	2
	I-75	I-275/Pasco County Line	SR 56	10*
	I-75	SR 56	SR 54	6
	I-75	SR 54	Hernando County Line	4
Pinellas	Keystone Rd	US 19	East Lake Rd	4
	Bryan Dairy Rd	Starkey Rd	72nd St	6
	US 19 (SR 55)	N of Whitney Rd	S of Seville Rd	10*
	US 19 (SR 55)	S of Seville Blvd	N of SR 60	10*
	SR 688 (Ulmerton Rd)	W of 38th ST	W of I-275	6
	SR 688 (Ulmerton Rd)	E of 119th ST	W of Seminole Bypass	6
	SR 688 (Ulmerton Rd)	E of Wild Acres Road	El Centro / Ranchero Blvd	6
	SR 688 (Ulmerton Rd)	El Centro Ranchero	W of US 19	6
	Starkey Rd (Park Street)	84th Lane	Tyrone Blvd	4
	Gandy Blvd	4th Street North	28th St (Ext)	4
	Pinellas Bywy/54th Ave S	Gulf Blvd	Bahia Del Mar	4
	Trinity Blvd	East Lake Rd	Little Rd (CR 1)	4

Sources: FDOT,MPOs,Tampa Bay Regional Planning Council
Note: 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.
** 10 lanes includes 6 partially controlled lanes w/ 4-lane service roads*

Table ES-3 - Tampa Bay Planned Roadway Improvements, 2016-20

County	Roadway	From	To	Number of Lanes
Hillsborough	US 301	Balm Rd	SR 674	6
	Bruce B. Downs Blvd	Pebble Creek Dr	Pasco County	8
	I-275 (SR 93)	Himes Ave	Hillsborough River	8
	I-275 (SR 93)	SR 60 (Memorial Hwy)	Himes Ave	8
	I-275 (SR 93)	Howard Frankland	Himes Ave	8
	I-75	S of Fowler Ave	N of CR-581	8
	I-75	N of Fowler Ave	Bruce B Downs	8
	I-275	SR 60/Memorial Interchange	Tampa CBD Interchange	8
	I-75	Bruce B Downs	I-275/Pasco County Line	6
	SR 589 (Veteran's Expy)	S of Gunn Hwy	Sugarwood Mainline Plaza	6
	SR 589 (Veteran's Expy)	Sugarwood Mainline Plaza	Van Dyke Rd	8
	SR 589 (Veteran's Expy)	Memorial Hwy	Barry Rd	6
	SR 589 (Veteran's Expy)	Barry Rd	S of Gunn Hwy	8
	SR 60 (Adamo Dr)	E of US 301	W of FlakenBurg Rd	6
Manatee	I-75	N SR 64	N of 301 Interchange	8
Pasco	SR 52 (Schrader Hwy)	E of Old Pasco Rd	McKendree Rd	4
Pinellas	Starkey Rd	84th Lane	Flamevine Rd	6
	US 19 (SR 55)	N of SR 580 (Main St)	Northside Dr	6
	I-275 (SR 93)	S of 118th Ave	S of 4th St N	8
	Gateway Expy	SR 690 at US 19/ SR 686 Ext at CR 611	W of I-275	4
	SR 688 (Ulmerton Rd)	E of 49th St	W of 38th St N	6

Sources: FDOT,MPOs,Tampa Bay Regional Planning Council
Note: 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.

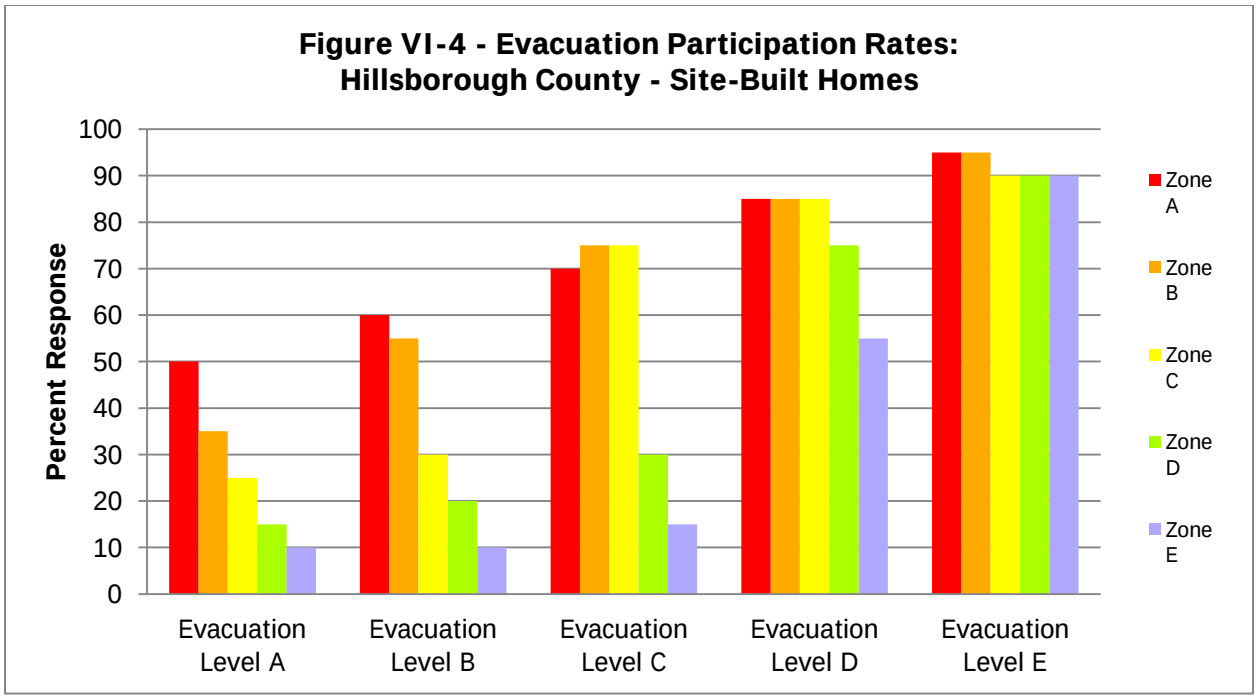


Figure VI-4 - Evacuation Participation Rates:
Hillsborough County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

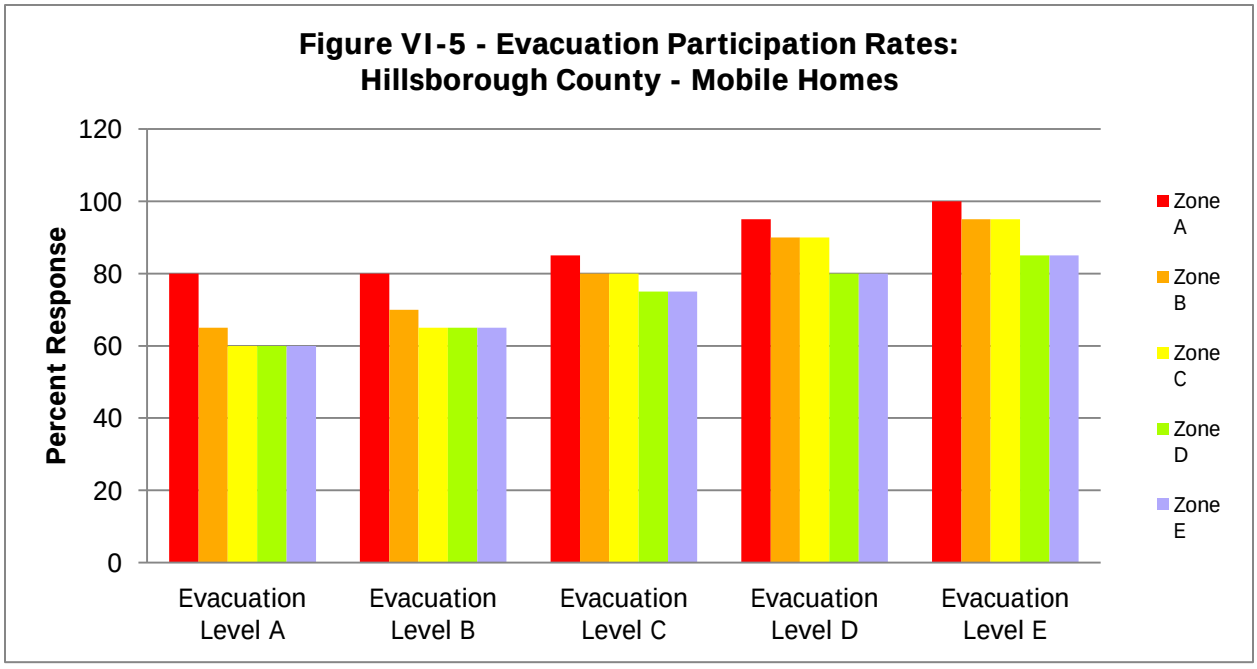


Figure VI-5 - Evacuation Participation Rates:
Hillsborough County - Mobile Homes
Percent Response
120
100
80
60
40
20
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

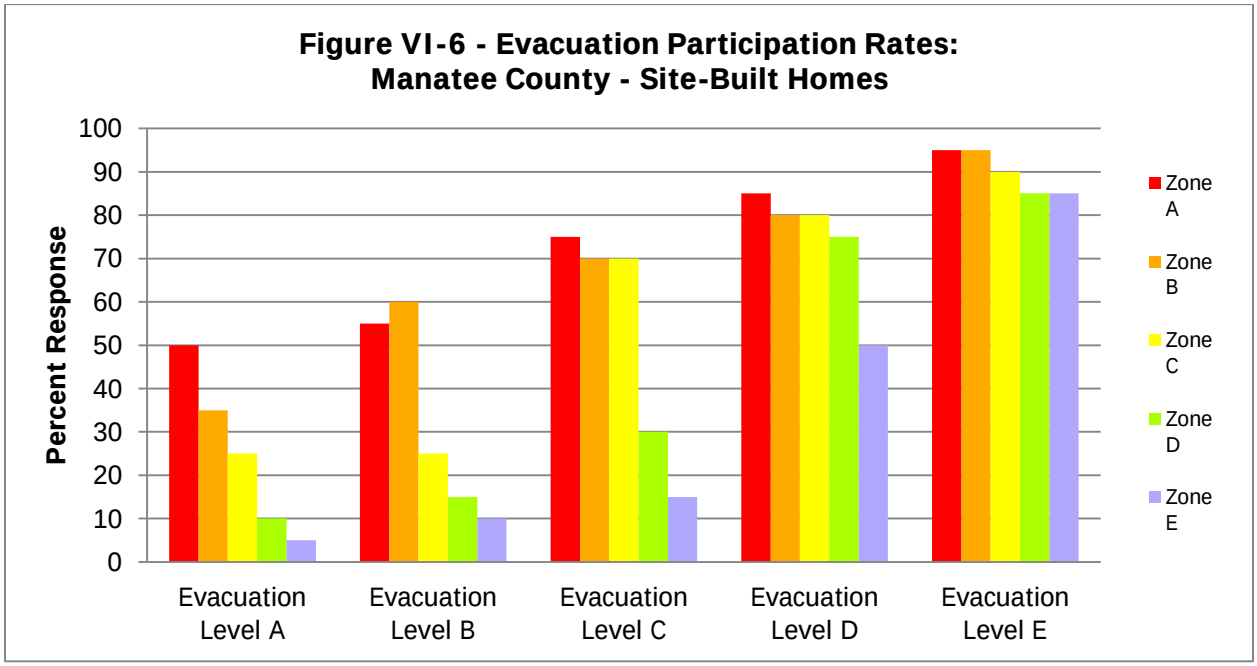


Figure VI-6 - Evacuation Participation Rates:
Manatee County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

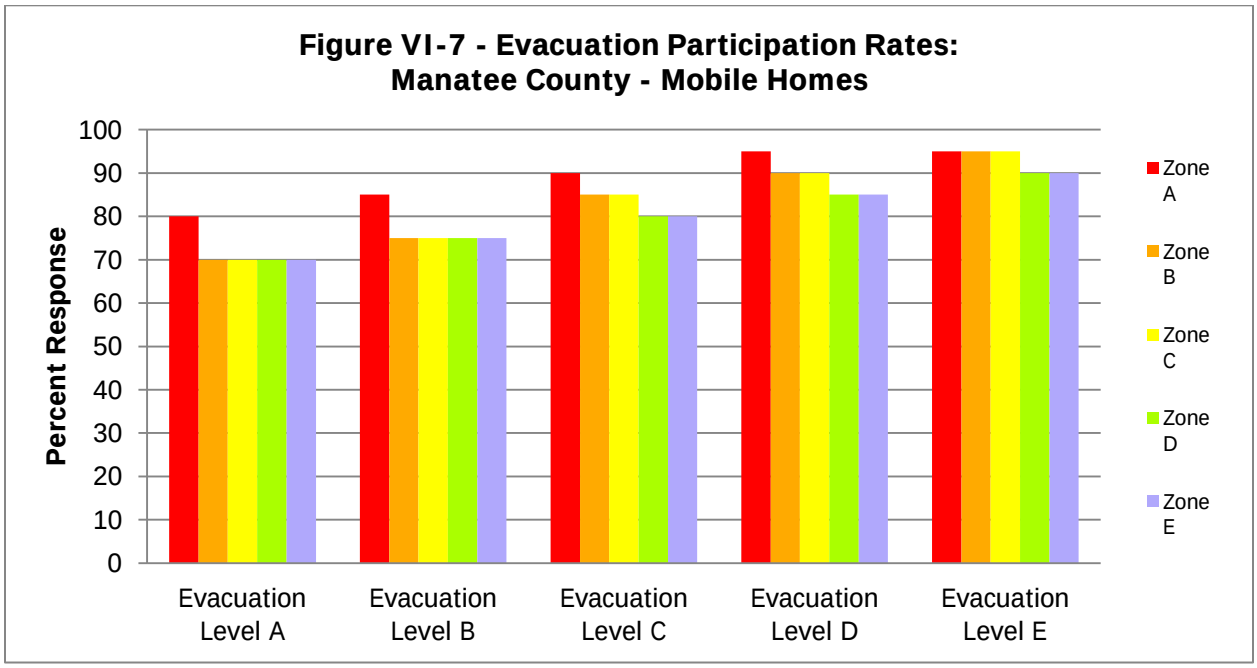


Figure VI-7 - Evacuation Participation Rates:
Manatee County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

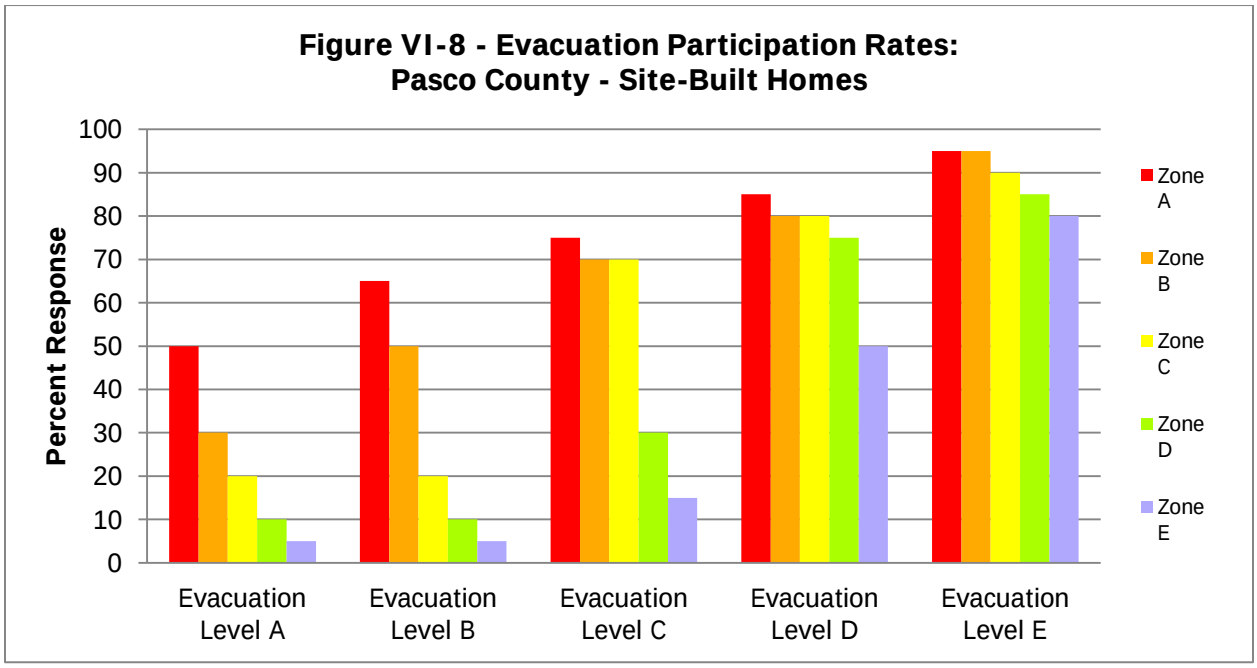


Figure VI-8 - Evacuation Participation Rates:
Pasco County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

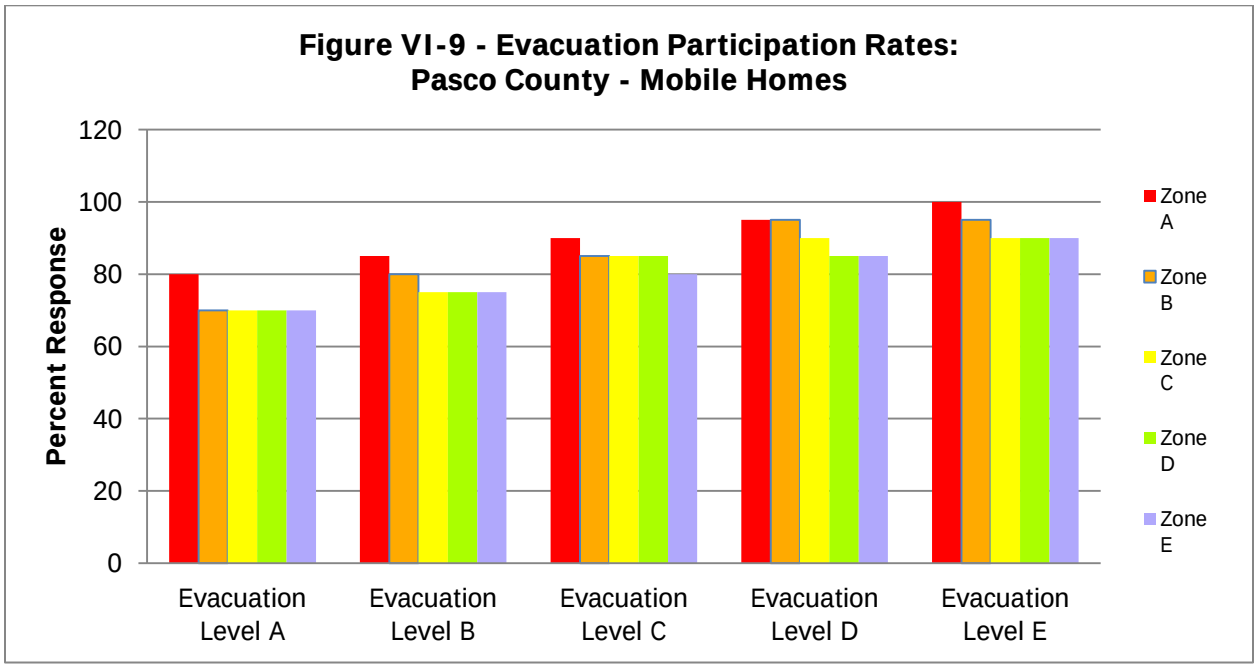


Figure VI-9 - Evacuation Participation Rates:
Pasco County - Mobile Homes
Percent Response
120
100
80
60
40
20
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

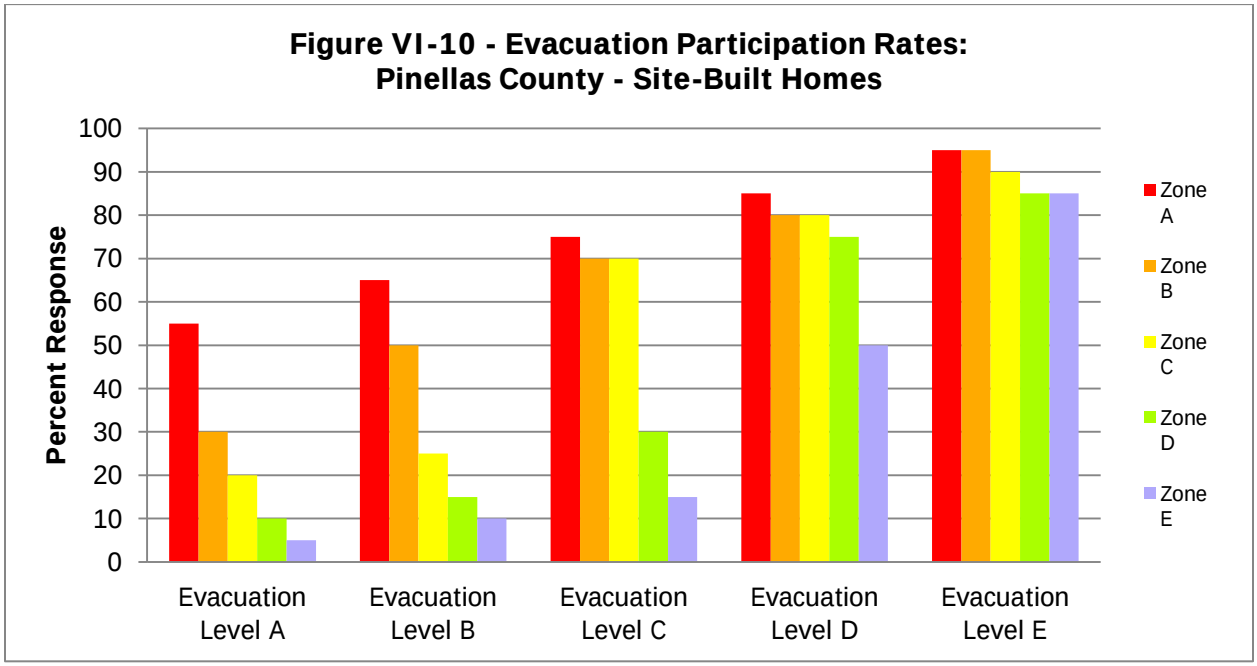


Figure VI-10 - Evacuation Participation Rates:
Pinellas County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

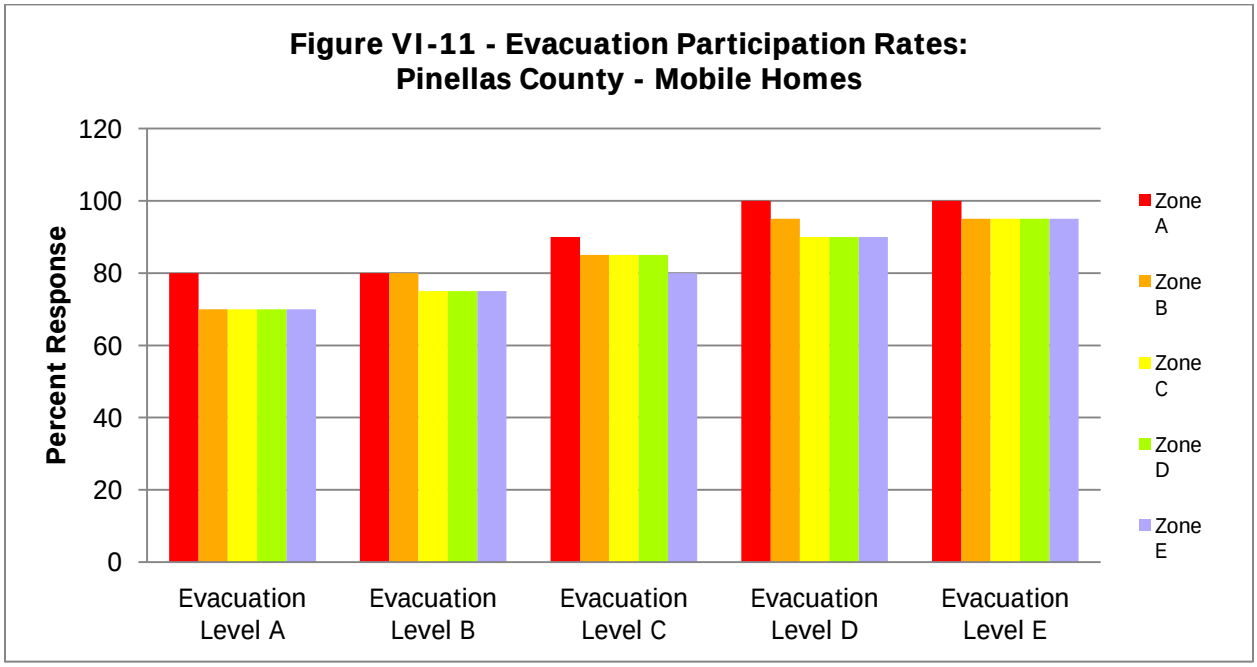


Figure VI-11 - Evacuation Participation Rates:
Pinellas County - Mobile Homes
Percent Response
120
100
80
60
40
20
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

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 four counties within the Tampa Bay region updated and established their evacuation zones in 2010 based on the results of the data and information collected as part of the SRESP. County level evacuation zones are included in Volume 5-8.

G. 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:

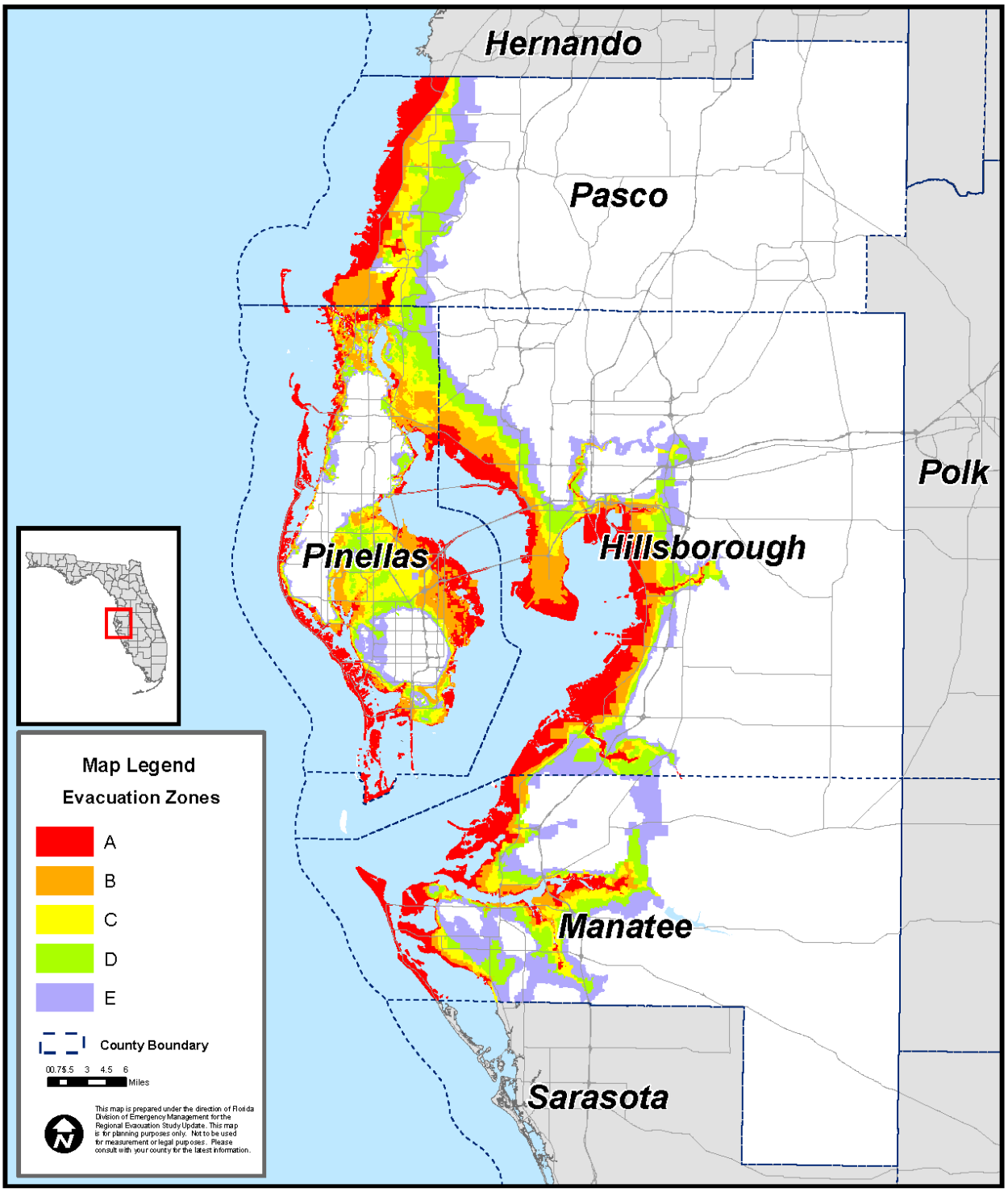
- Analysis time period;
- Highway network;
- Behavioral response;
- One-way evacuation operations;
- University population;
- Tourist occupancy rates;
- Shelters;
- Counties evacuating;
- Evacuation level;
- Response curve hours; and,
- Evacuation Phasing.

H. 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 storm surge flooding during a storm event. The vulnerable population for the Tampa Bay Region for 2015 is identified in **Table ES-4**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2020 is summarized in **Table ES-5**.

Figure ES-12

Tampa Bay Regional Evacuation Zones



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Table ES-4 – Vulnerable Population in the Tampa Bay Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
Site-built Homes	74,902	98,911	61,381	68,433	70,332
Mobile/Manuf. Homes	7,281	6,738	6,060	4,567	5,543
TOTAL	82,183	105,728	67,441	73,000	75,875
Manatee County					
Site-built Homes	28,925	18,341	24,201	45,967	71,921
Mobile/Manuf. Homes	5,790	3,241	6,018	11,826	8,436
TOTAL	34,714	21,582	30,219	57,793	80,357
Pasco County					
Site-built Homes	38,087	46,788	63,053	31,235	22,881
Mobile/Manuf. Homes	3,320	4,359	3,335	3,212	2,103
TOTAL	41,407	51,146	66,388	34,446	24,985
Pinellas County					
Site-built Homes	137,973	115,039	114,351	84,705	50,216
Mobile/Manuf. Homes	3,103	8,572	9,823	8,692	1,999
TOTAL	141,076	123,610	124,173	93,397	52,215

Table ES-5 – Vulnerable Population in the Tampa Bay Region for 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
Site-built Homes	80516	105560	67806	75790	80793
Mobile/Manuf. Homes	7320	6758	6072	4583	5567
TOTAL	87837	112319	73878	80373	86360
Manatee County					
Site-built Homes	29623	19053	25474	48931	75418
Mobile/Manuf. Homes	5671	3136	5869	11690	8231
TOTAL	35294	22189	31344	60621	83648
Pasco County					
Site-built Homes	41718	48809	66917	34890	25423
Mobile/Manuf. Homes	3320	4359	3334	3212	2103
TOTAL	45038	53168	70251	38102	27526
Pinellas County					
Site-built Homes	143096	120200	121480	89533	52434
Mobile/Manuf. Homes	3153	8713	9968	8819	2031
TOTAL	146248	128913	131448	98353	54464

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 Tampa Bay Region are identified in **Table ES-6** for 2015 and in **Table ES-7** for 2020.

The vulnerable shadow population is provided in **Table ES-8** for both 2015 and 2020. 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 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
To Friends and Family	53419	68723	43837	47450	49319
To Hotel/ Motel	16073	20809	13185	10722	11104
To Public Shelter	4473	5623	3675	7528	7865
To Other Destination	8218	10573	6744	7300	7588
Manatee County					
To Friends and Family	21118	13111	18432	35267	48636
To Hotel/ Motel	6653	3237	4533	8669	12054
To Public Shelter	2025	1856	2658	5779	8036
To Other Destination	4918	3377	4596	8078	11632
Pasco County					
To Friends and Family	26417	30470	39666	18785	13636
To Hotel/ Motel	10020	10011	13111	6729	4892
To Public Shelter	2402	2775	6639	3605	2604
To Other Destination	2568	7890	6972	5328	3853
Pinellas County					
To Friends and Family	98443	79918	80221	60274	33840
To Hotel/ Motel	21317	24722	24835	14444	7932
To Public Shelter	7209	6609	6700	7646	4217
To Other Destination	14108	12361	12417	11034	6226

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 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
To Friends and Family	57,094	73,007	48,021	52,242	56,134
To Hotel/ Motel	17,201	22,126	14,472	11,827	12,676
To Public Shelter	4,758	5,954	3,998	8,266	8,914
To Other Destination	8,784	11,232	7,388	8,037	8,636
Manatee County					
To Friends and Family	21,460	13,470	19,100	36,957	50,601
To Hotel/ Motel	6,775	3,328	4,702	9,093	12,547
To Public Shelter	2,048	1,901	2,742	6,062	8,365
To Other Destination	5,011	3,490	4,800	8,509	12,136
Pasco County					
To Friends and Family	28,777	31,683	41,984	20,796	15,034
To Hotel/ Motel	10,928	10,416	13,884	7,460	5,400
To Public Shelter	2,584	2,876	7,025	3,971	2,858
To Other Destination	2,750	8,193	7,359	5,876	4,234
Pinellas County					
To Friends and Family	102,059	83,358	84,943	63,488	35,300
To Hotel/ Motel	22,095	25,783	26,290	15,194	8,271
To Public Shelter	7,470	6,881	7,071	8,045	4,398
To Other Destination	14,625	12,891	13,145	11,626	6,495

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
2015					
Hillsborough County	205,151	175,871	207,510	211,992	252,463
Manatee County	76,514	78,201	82,960	83,427	54,598
Pasco County	99,037	81,078	87,355	82,755	82,492
Pinellas County	149,851	123,202	118,876	103,227	113,955
2020					
Hillsborough County	215,446	185,468	220,127	226,692	267,903
Manatee County	77,939	80,170	85,816	86,832	57,461
Pasco County	103,423	84,933	93,928	89,165	90,053
Pinellas County	157,048	129,803	125,419	109,081	120,594

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

I. 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 Tampa Bay 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 Tampa Bay region are identified in **Table ES-10**.

Because of the numerous possible combinations of variables that can be applied in the model, the TIME evacuation transportation model is available for use through the Tampa Bay RPC to continue testing combinations of options and provide additional information to emergency managers. The latest version of this modeling software is expected to be available by October 2015.

J. Clearance Time Results

Each of the ten base scenarios and ten operational scenarios were modeled for the Tampa Bay 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 2015	Scenario 2 Level B 2015	Scenario 3 Level C 2015	Scenario 4 Level D 2015	Scenario 5 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	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando
	Scenario 6 Level A 2020	**Scenario 7 Level B 2020**	**Scenario 8 Level C 2020**	**Scenario 9 Level D 2020**	**Scenario 10 Level E 2020**
Demographic Data	2020	2020	2020	2020	2020
Highway Network	2020	2020	2020	2020	2020
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	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando

Table ES-10 – Operational Scenarios

	Scenario 1 Level A 2015	Scenario 2 Level B 2015	Scenario 3 Level C 2015	Scenario 4 Level D 2015	Scenario 5 Level E 2015
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015 and Skyway Bridge closes at hour 18	2015 and Skyway Bridge closes at hour 18
One-Way Operations	None	None	None	None	None
University Population	Summer	Summer	Summer	Summer	Summer
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	18-hour	24-hour except Citrus & Hernando 18-hour	24-hour except Citrus & Hernando 18-hour
Evacuation Phasing	None	None	None	1hr – Citrus & Hernando start in hour 6	1hr – Citrus & Hernando start in hour 6
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus
	Scenario 6 Level A 2020	**Scenario 7 Level B 2020**	**Scenario 8 Level C 2020**	**Scenario 9 Level D 2020**	**Scenario 10 Level E 2020**
Demographic Data	2020	2020	2020	2020	2020
Highway Network	2020	2020	2020	2020 and Skyway Bridge closes at hour 18	2020 and Skyway Bridge closes at hour 18
One-Way Operations	None	None	None	Yes, I-4 & I-75	Yes, I-4 & I-75
University Population	Summer	Summer	Summer	Summer	Summer
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	18-hour	24-hour except Citrus & Hernando 18-hour	24-hour except Citrus & Hernando 18-hour
Evacuation Phasing	None	None	None	1hr – Citrus & Hernando start in hour 6	1hr – Citrus & Hernando start in hour 6
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Polk	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus

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 **VI-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 2015 base scenarios range from 21 hours to 65 hours, depending upon the evacuation level. Pasco County has the highest in-county clearance time of 66 hours for the level E scenario due to the influence of trips evacuating from other counties within the region. Clearance time to shelter shows a similar pattern, with clearance times ranging from 13 to 63 hours.

In 2020, in-county clearance times for the base scenarios vary between 21.5 hours for the evacuation level A scenarios and 50 hours for Hillsborough County for the evacuation level E scenario. This shows a slight reduction in clearance time from 2015 due to the completion of several roadway improvement projects throughout the region. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 13 hours for the evacuation level A scenarios to 46.5 hours for Pasco County for evacuation level E scenario in 2020.

Out of county clearance times for the 2015 base scenarios range from 21 to 66 hours, while in 2020 they range from 21.5 hours for Pinellas County for the base evacuation level A scenario to 50.5 hours in Pasco County for the evacuation level E scenario in 2020. Again, the drop in clearance time in 2020 is due to the completion of roadway improvement projects. Regional clearance time in 2020 for the four county TBRPC region ranges from 24 hours to 50.5 hours.

Operational Scenarios

In-county clearance times for the 2015 operational scenarios range from 16 hours to 50.5 hours depending upon the scenario. Clearance Time to Shelter shows a similar pattern, although much reduced, with clearance times for the operational scenarios ranging from 9.5 hours to 46 hours depending upon the county and the scenario.

In 2020, in-county clearance times for the operational scenarios vary from 17 hours to 56.5 hours for the level E evacuation in Pasco County. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 9.5 hours to 56.5 hours depending upon the scenario.

Out of county clearance times for the 2015 operational scenarios range from 17 hours to 58.5 hours for the evacuation level E scenario. The 9-hour response curve for the level A evacuation helps in reducing the clearance time from the base scenario. Out of county clearance times increase for all counties in 2020 to between 11 and 78 hours depending upon the scenario. Regional clearance time for the four county TBRPC region ranges from 17 hours to 51.5 hours in 2015. This time increases to between 18 and 58.5 hours in 2020.

Table ES-11 – 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					
Hillsborough	19.0	21.0	23.5	35.5	53.0
Manatee	13.0	13.0	19.5	41.5	41.5
Pasco	22.5	26.0	33.0	39.0	63.0
Pinellas	13.0	14.0	20.5	36.0	62.0
In-County Clearance Time					
Hillsborough	22.0	24.0	29.5	41.5	65.0
Manatee	21.5	22.5	27.0	41.5	60.0
Pasco	22.5	26.0	33.0	39.0	63.0
Pinellas	21.0	22.0	26.5	39.5	64.0
Out of County Clearance Time					
Hillsborough	22.5	24.0	30.0	42.0	65.5
Manatee	21.5	23.5	29.0	41.5	66.0
Pasco	22.5	28.0	33.0	41.0	65.5
Pinellas	21.0	22.0	26.5	39.5	64.0
Regional Clearance Time					
TBRPC	22.5	28.0	33.0	42.0	66.0

Table ES-12 – 2020 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					
Hillsborough	19.5	22.0	25.5	34.5	42.0
Manatee	13.0	13.5	22.5	35.5	41.0
Pasco	24.0	28.5	35.0	41.0	46.5
Pinellas	13.0	14.5	20.5	31.0	43.5
In-County Clearance Time					
Hillsborough	23.0	25.5	31.5	38.5	50.0
Manatee	21.5	24.5	29.0	35.5	45.5
Pasco	24.0	28.5	35.0	41.0	47.5
Pinellas	21.5	24.0	28.5	34.0	46.5
Out of County Clearance Time					
Hillsborough	23.0	26.0	31.5	38.5	50.0
Manatee	22.5	25.0	29.0	35.5	48.0
Pasco	24.0	28.5	35.0	41.0	50.5
Pinellas	21.5	24.0	28.5	34.0	46.5
Regional Clearance Time					
TBRPC	24.0	28.0	35.0	41.0	50.5

Table ES-13 – 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					
Hillsborough	14.5	18.0	23.5	35.0	41.0
Manatee	10.0	13.0	23.5	38.5	44.0
Pasco	16.5	21.5	32.0	42.5	46.0
Pinellas	9.5	13.0	19.0	25.0	33.0
In-County Clearance Time					
Hillsborough	16.0	20.5	29.0	42.0	50.5
Manatee	16.5	20.5	27.5	42.5	51.0
Pasco	16.5	21.5	32.0	42.5	46.0
Pinellas	16.5	20.0	27.5	36.5	43.5
Out of County Clearance Time					
Hillsborough	16.5	21.0	29.5	42.0	50.5
Manatee	17.0	21.0	28.5	43.0	51.5
Pasco	17.0	21.5	32.0	42.5	46.0
Pinellas	16.5	20.0	27.5	36.5	43.5
Regional Clearance Time					
TBRPC	17.0	21.5	32.0	43.0	51.5

Table ES-14 – 2020 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					
Hillsborough	15.0	18.5	24.5	40.5	46.0
Manatee	10.0	12.5	24.0	37.0	42.5
Pasco	18.0	22.5	33.0	45.0	56.5
Pinellas	9.5	13.0	19.0	26.0	34.5
In-County Clearance Time					
Hillsborough	17.0	21.5	30.0	46.0	54.0
Manatee	17.5	21.0	28.0	46.5	54.5
Pasco	18.0	22.5	33.0	45.0	56.5
Pinellas	17.0	20.5	28.0	41.5	49.0
Out of County Clearance Time					
Hillsborough	17.5	22.0	30.5	46.0	54.0
Manatee	18.0	21.0	28.5	47.0	55.0
Pasco	18.0	22.5	33.0	45.0	58.5
Pinellas	17.0	20.5	28.0	42.0	49.0
Regional Clearance Time					
TBRPC	18.0	22.0	33.0	47.0	58.5

K. 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 2015 is identified in **Table ES-15** and for 2020 in **Table ES-16**. From a transportation standpoint, the number of evacuating vehicles is equally as important as the evacuation populations. Evacuating vehicles for the base scenarios are summarized by county for 2015 in **Table ES-17** and for 2020 in **Table ES-18**.

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.

L. 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 2015

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Hillsborough County					
12-Hour	208,970	181,892	185,145	154,384	120,310
18-Hour	287,334	272,837	370,290	231,576	180,465
24-Hour		363,783	277,718	308,769	240,620
36-Hour			462,863	463,153	360,929
Estimated Evacuating Population Clearing Manatee County					
12-Hour	92,051	68,679	70,128	65,851	50,775
18-Hour	111,228	103,019	105,191	97,601	76,163
24-Hour		134,497	140,255	130,134	101,550
36-Hour			169,475	227,735	152,325
Estimated Evacuating Population Clearing Pasco County					
12-Hour	99,137	74,413	89,562	80,822	55,120
18-Hour	140,444	111,620	134,343	121,234	82,680
24-Hour		173,631	179,124	161,645	110,240
36-Hour			246,296	242,467	165,360
Estimated Evacuating Population Clearing Pinellas County					
12-Hour	249,366	211,575	229,918	177,869	121,580
18-Hour	290,927	317,363	344,877	266,803	182,370
24-Hour		387,888	459,836	355,737	243,160
36-Hour			507,736	585,484	364,740

Table ES-16 – Maximum Evacuating Population by Time Interval for 2020

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Hillsborough County					
12-Hour	158,235	177,980	204,480	181,122	170,081
18-Hour	237,352	266,970	306,721	271,683	255,121
24-Hour	303,283	355,961	408,961	362,244	340,162
36-Hour		385,624	494,161	581,099	708,670
Estimated Evacuating Population Clearing Manatee County					
12-Hour	60,391	66,073	87,322	79,869	72,639
18-Hour	90,586	99,110	130,982	119,804	108,959
24-Hour	113,233	132,147	174,643	159,739	145,279
36-Hour		137,653	174,643	236,280	217,918
Estimated Evacuating Population Clearing Pasco County					
12-Hour	74,231	77,111	77,744	86,553	77,023
18-Hour	111,346	115,667	116,616	129,830	115,534
24-Hour	148,461	154,222	155,487	173,107	154,046
36-Hour		183,139	233,231	259,660	231,069
Estimated Evacuating Population Clearing Pinellas County					
12-Hour	169,281	202,482	327,402	216,721	175,489
18-Hour	253,922	303,723	491,103	325,082	263,234
24-Hour	303,296	404,964	654,804	433,442	350,978
36-Hour			532,028	614,043	526,467

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. 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-17 – Evacuating Vehicles by Base Scenario for 2015

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Hillsborough County					
Site-built Homes	97,774	134,083	182,677	221,170	279,044
Mobile/Manuf. Homes	50,751	50,751	50,751	50,751	50,751
Tourists	2,652	4,798	6,160	6,788	7,064
TOTAL	151,177	189,632	239,588	278,709	336,859
Manatee County					
Site-built Homes	28,976	39,999	54,960	80,800	100,541
Mobile/Manuf. Homes	26,812	26,812	26,812	26,812	26,812
Tourists	3,841	4,100	4,692	5,042	9,101
TOTAL	59,629	70,911	86,464	112,654	136,454
Pasco County					
Site-built Homes	47,633	65,945	105,823	121,772	135,392
Mobile/Manuf. Homes	44,232	44,232	44,232	44,232	44,232
Tourists	210	415	608	609	609
TOTAL	92,075	110,592	150,663	166,613	180,233
Pinellas County					
Site-built Homes	132,156	182,505	244,973	285,222	317,114
Mobile/Manuf. Homes	46,655	46,655	46,655	46,655	46,655
Tourists	5,467	7,035	7,444	7,801	8,013
TOTAL	184,278	236,195	299,072	339,678	371,782

Table ES-18 – Evacuating Vehicles by Base Scenario for 2020

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Hillsborough County					
Site-built Homes	105,362	144,151	197,073	240,302	303,641
Mobile/Manuf. Homes	50,916	50,916	50,916	50,916	50,916
Tourists	2,945	5,460	7,045	7,856	8,381
TOTAL	159,223	200,527	255,034	299,074	362,938
Manatee County					
Site-built Homes	29,805	41,346	57,175	84,495	105,195
Mobile/Manuf. Homes	26,726	26,726	26,726	26,726	26,726
Tourists	4,021	4,294	4,920	5,286	9,577
TOTAL	60,552	72,366	88,821	116,507	141,498
Pasco County					
Site-built Homes	52,218	71,287	114,574	131,949	147,706
Mobile/Manuf. Homes	44,226	44,226	44,226	44,226	44,226
Tourists	352	624	889	890	890
TOTAL	96,796	116,137	159,689	177,065	192,822
Pinellas County					
Site-built Homes	137,223	189,749	255,776	298,112	331,390
Mobile/Manuf. Homes	47,392	47,392	47,392	47,392	47,392
Tourists	6,143	7,904	8,640	9,053	9,301
TOTAL	190,758	245,045	311,808	354,557	388,083

- 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 Tampa Bay 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.

M. 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 TBRPC region include I-75, I-275, and I-4. For large storm events, such as level D and E evacuations, other State facilities also play an important role in evacuations, such as SR 52 and 54 in Pasco County, SR 60 in Pinellas County, and SR 64 in Manatee County. Outside the region, the Turnpike/I-75 interchange in Sumter County is clearly an issue in all evacuation scenarios;

- 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 county, and municipal 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 TBRPC 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. During large storm events in the operational scenarios, evacuations by the vulnerable population in the four TBRPC Counties are impacted by shadow evacuations occurring in other parts of the counties and in areas outside the TBRPC region;

- 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;

- A comparison of the 2015 and 2020 base scenarios clearly indicate that the roadway improvement projects planned for implementation between 2016 and 2020 have an impact in reducing evacuation clearance times. Despite the increased population levels in 2020 within the TBRPC region, clearance times were generally stable to lower between the 2015 and 2020 time periods. The roadway improvement projects were effective in keeping clearance times constant. FDOT, MPOs within the region, and county governments should continue funding roadway improvement projects within the region; State agencies can use the data and information provided in this report (specifically the evacuating vehicle maps in Volume 5-8) 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 west directions; and,

- The counties within the Tampa Bay 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.

- Clearance times for Base Scenarios in 2020 for Level E in particular have a marked reduction in comparison to lower evacuation levels. It appears that planned improvements to the regional evacuation roadway network expected to be complete by 2020 are responsible for these significant reductions in Level E evacuation clearance times. The clearance time reduction is much more pronounced for Level E evacuations because the planned roadway network improvements help to delay the time when critical mass is reached with vehicle loading on the evacuation roadway network. Because of the tremendous volume of vehicles involved in Level E evacuations, a critical mass is typically reached much sooner than with lower level evacuations. Therefore, delaying the time that critical mass is reached during a Level E evacuation has a greater effect on reducing evacuation clearance times than for lower level evacuations. The marked reduction in Level E clearance times for 2020 indicated by the evacuation transportation model in the 2015 Update emphasize the need to ensure that the planned roadway improvements are completed on or ahead of their scheduled completion date.

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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.

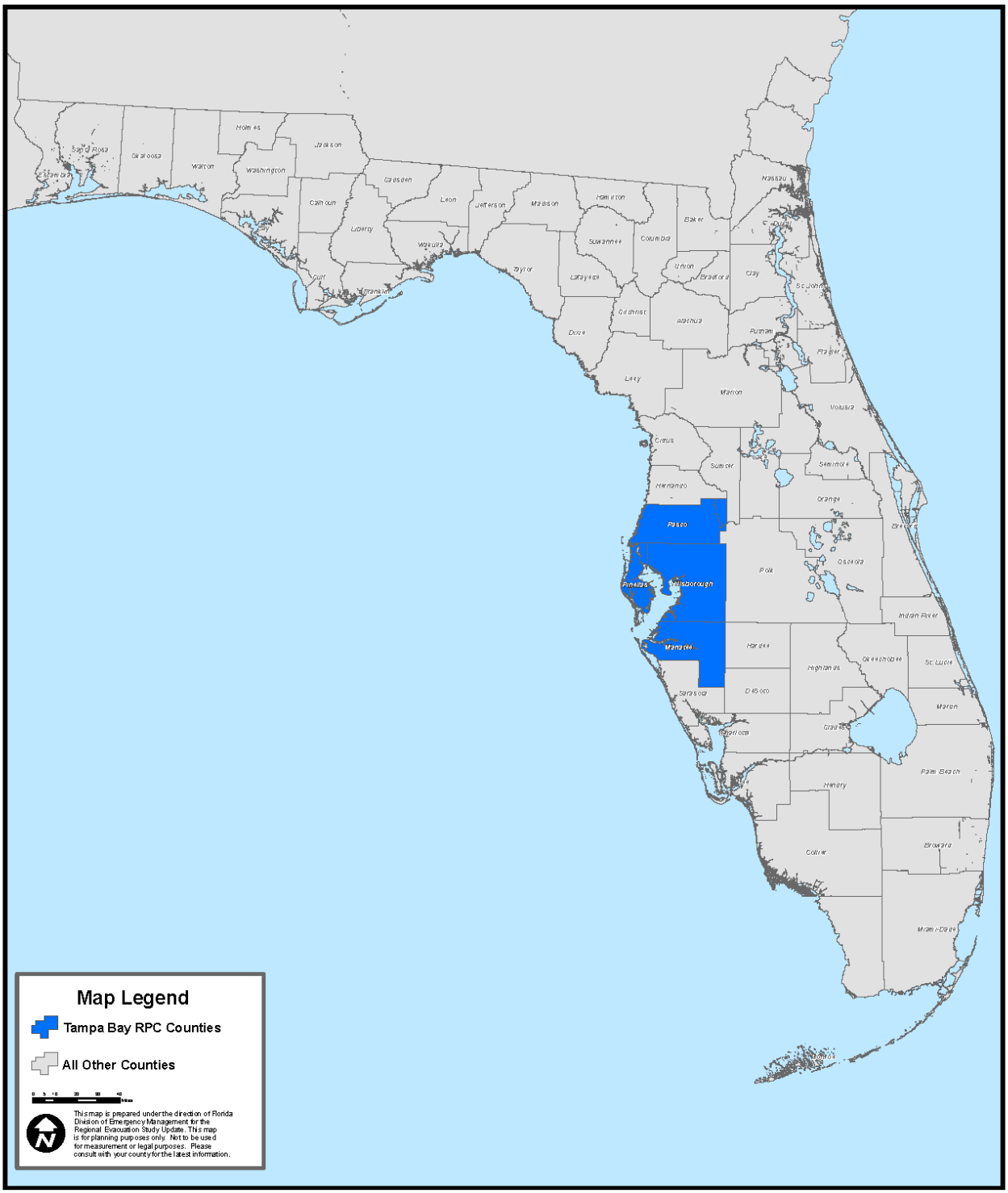
One of the objectives of the SRESP is to create consistent and integrated regional evacuation data and mapping, and by doing so, to facilitate knowledge sharing between state, regional, county, and local partners. To achieve this objective, it is important for all Regional Planning Councils to adopt 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 four-county Tampa Bay 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 Tampa Bay region. While the impact of other regions is included in the Tampa Bay analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the four counties included in the Tampa Bay RPC. Transportation analysis results for other regions and counties are reported in the corresponding Volume 4 report for those regions.

Figure I-1

Tampa Bay Regional Planning Council



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

C. Input and Coordination

The SRESP transportation methodology and framework was developed during 2008 and 2009 in coordination with all eleven regional planning councils in Florida, along with the Division of Emergency Management, Department of Transportation, Department of Economic Opportunity (formerly the Department of Community Affairs), and local county emergency management teams with CDM Smith serving as the transportation consultant.

During the updates to SRESP in 2015, two meetings were held at the local and regional level to receive updated input from local county emergency management and the regional planning council. The two meetings held in the region included the following:

Regional Meeting No. 1 – Scenario Development Update Meeting

The first regional meeting for the Tampa Bay region was held on March 10, 2015 at 1:30 PM. The purpose of the scenario development update meeting was to discuss small area demographics of the Tampa Bay Region, 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. It was decided to keep the same parameters as the 2010 Evacuation Study.

Regional Meeting No. 2 – Transportation Analysis Update Meeting

The second and final regional meeting for the Tampa Bay Region will be held on August 20, 2015 at 2:00 PM. 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.

D. Study Comparisons

It is important to note that this study contains significant updates and revisions in comparison to the 2010 SRESP study for the TBRPC region. These revisions include updates to population projections based on the 2010 census, new evacuation zones based on updated topography data, modifications to the roadway network due to recently completed and planned construction projects, and changes to the location and size of available shelters. These revisions have significant impacts on evacuating vehicle behavior for the region and caused changes to the calculated clearance times in each county. In particular, the proximity to the recent Census update and MPO validated demographic year allowed this Evacuation Transportation Update to reflect closer population and housing numbers to reality. These updates and revisions make comparisons to the previous 2010 study difficult.

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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 (then) eleven Regional Planning Councils and the Division of Emergency Management, and periodically from this time to incorporate features. The methodology used in this Tampa Bay Region Evacuation Transportation Analysis was updated to accommodate new versions of Cube Voyager and Cube Avenue software 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?

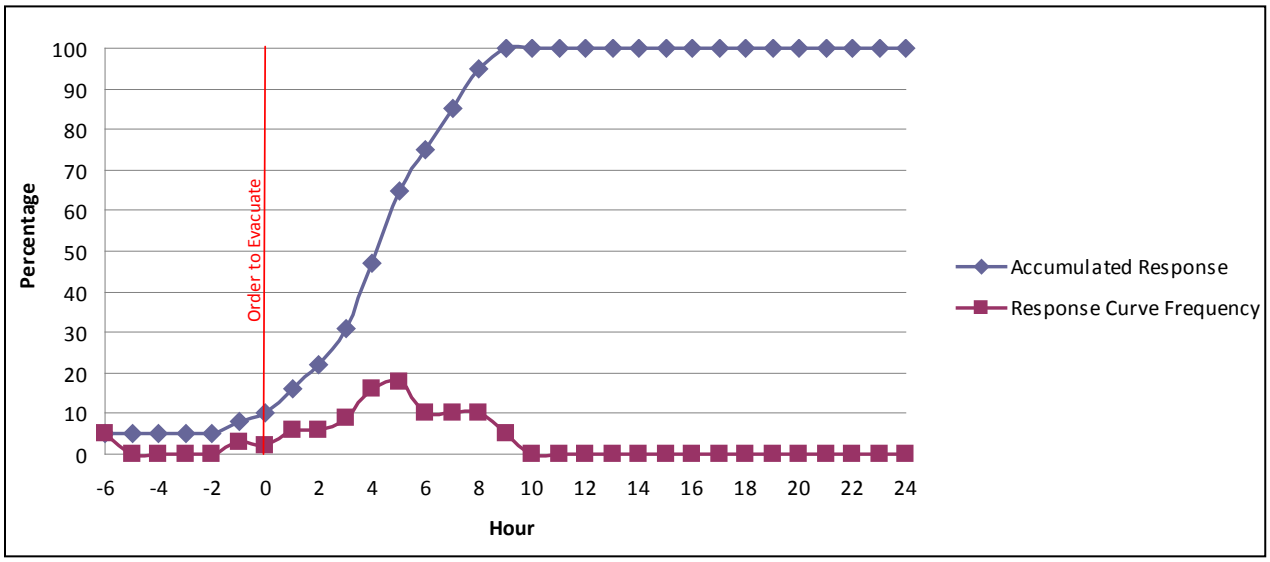
The evacuation rate indicates the percent of residents who will leave their homes to go someplace safer in each storm threat scenario. The evacuation rates are based on the following assumptions: that the storm track passes very close to the area being evacuated; and officials order evacuation for surge 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 Tampa Bay Regional Planning Council developed their small area data by utilizing MPO 2014 TAZ geography. Data were developed for the following years: 2015 and 2020.

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 8,829 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 (latest model available) 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 2010 conditions to correspond to the SRESP base year, and ultimately 2015 and 2020;
- 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

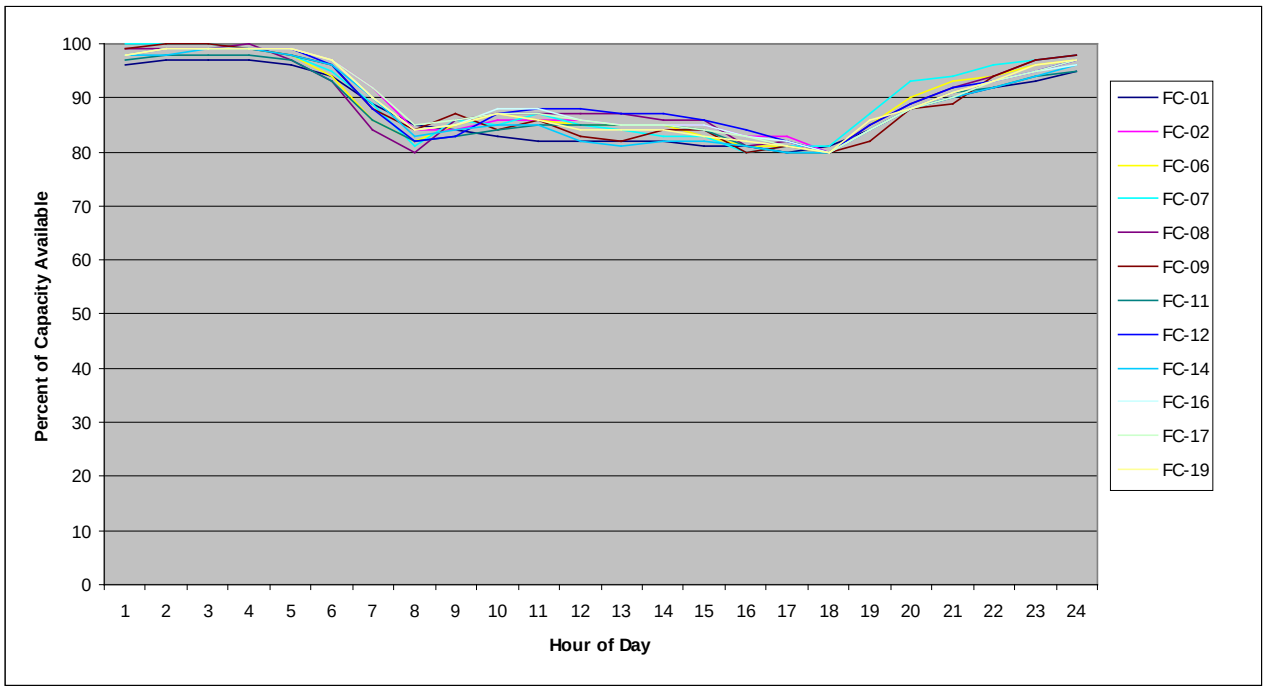
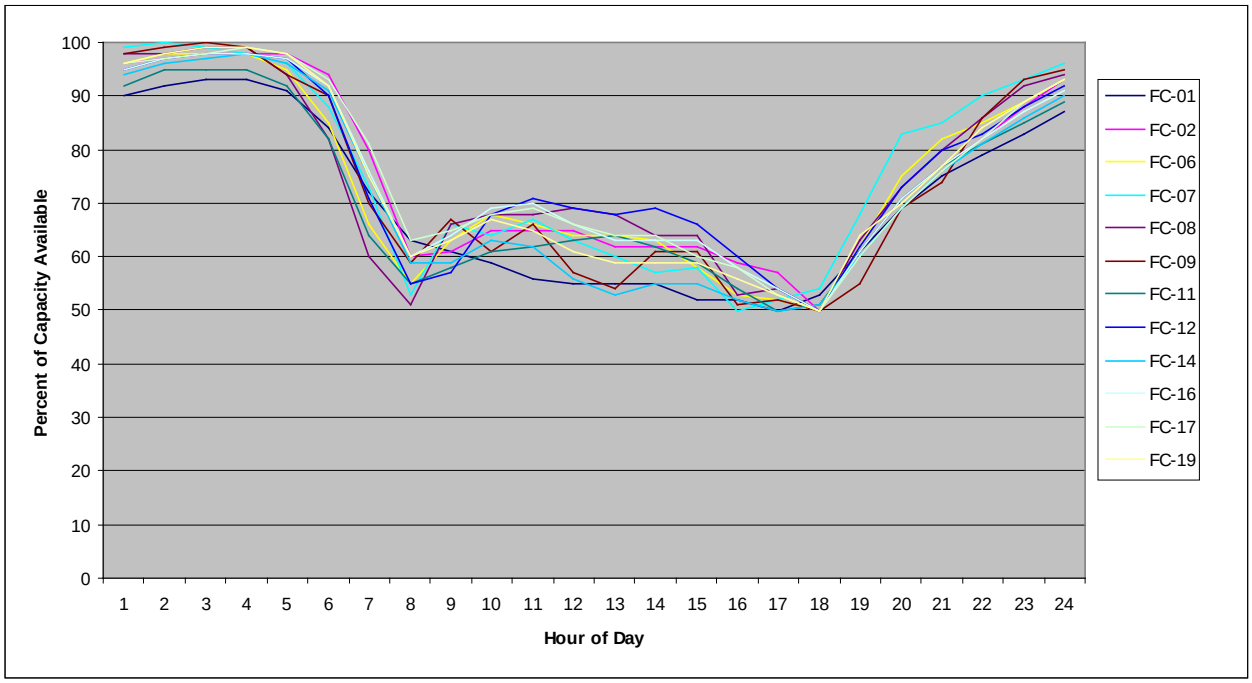


Figure II-3 – Percent of Available Capacity for Other Counties

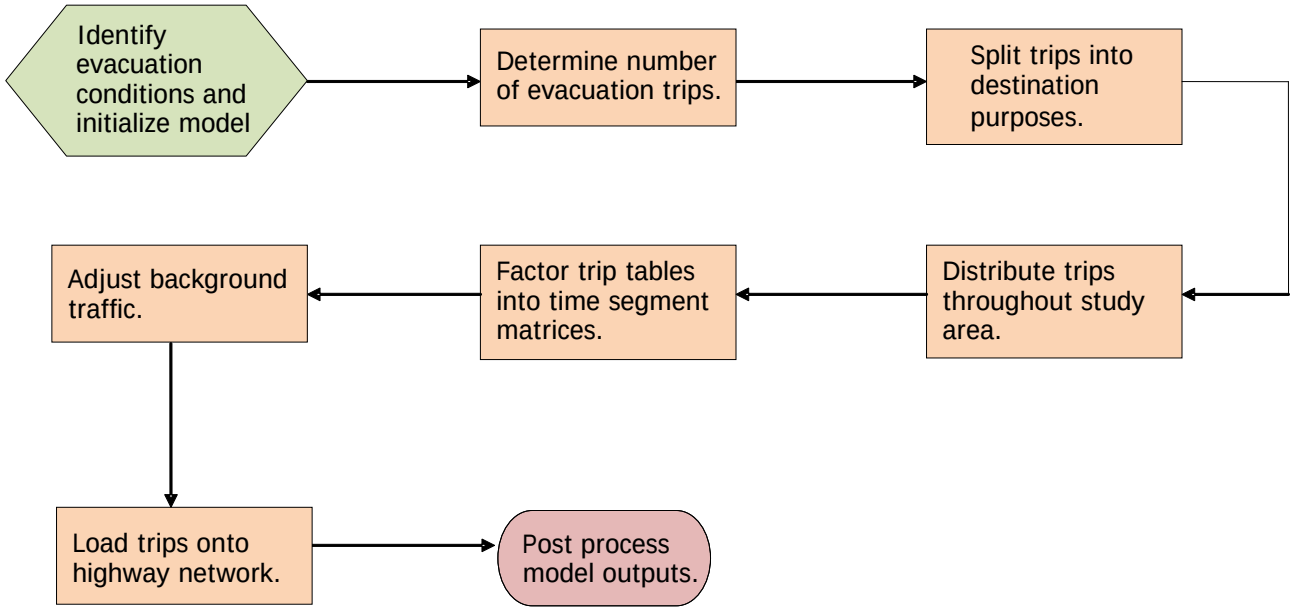


D. Evacuation Traffic

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.

<u>In County Balancing</u> - 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.

<u>Out of County Balancing</u> - 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

CDM Smith 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 Tampa Bay Region, the regional model network includes the seven counties within the Tampa Bay Regional Council area plus 22 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 Tampa Bay Region. It is important to note that the input data discussed in this chapter is included only for the counties within the Tampa Bay Region, as these are the counties that the Tampa Bay Regional Planning Council has direct responsibility for the data. Data for the adjacent counties included in the Tampa Bay 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

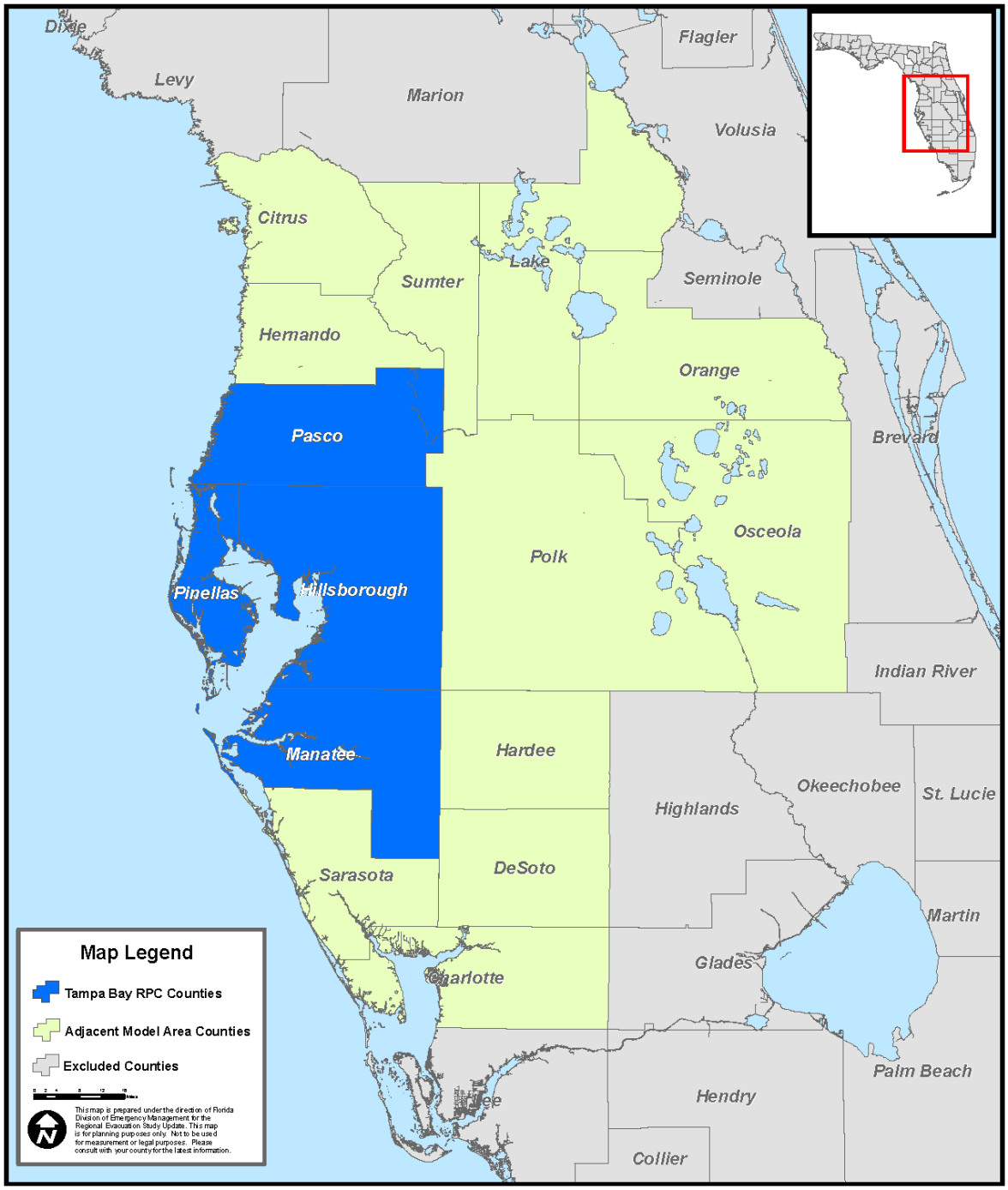
The road network is a key component of the evacuation model. The roadway variables in the network include area type, functional class, number of through lanes, capacity, speed, and several others. The regional model network consists of the RC designated evacuation routes as well as a supporting roadway network that facilitates movement of evacuation traffic. The 2005 Florida Department of Transportation (FDOT) Statewide Model Network (the latest model available) was used as a basis for developing the regional model network, while the evacuation routes were obtained from the Tampa Bay 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 2010 conditions and is referred to as the base model network. The previous Study used 2006. **Figure III-2** identifies the model network and evacuation routes for the TBRPC. County level details of the regional model network are provided in the Volume 5 report. The regional model network for the Tampa Bay region includes key roadways within the seven county region, including I-4, I-75, I-275, US 301, US 19, SR 39, SR 52, and SR 54.

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

Figure III-1

Tampa Bay Regional Model Area

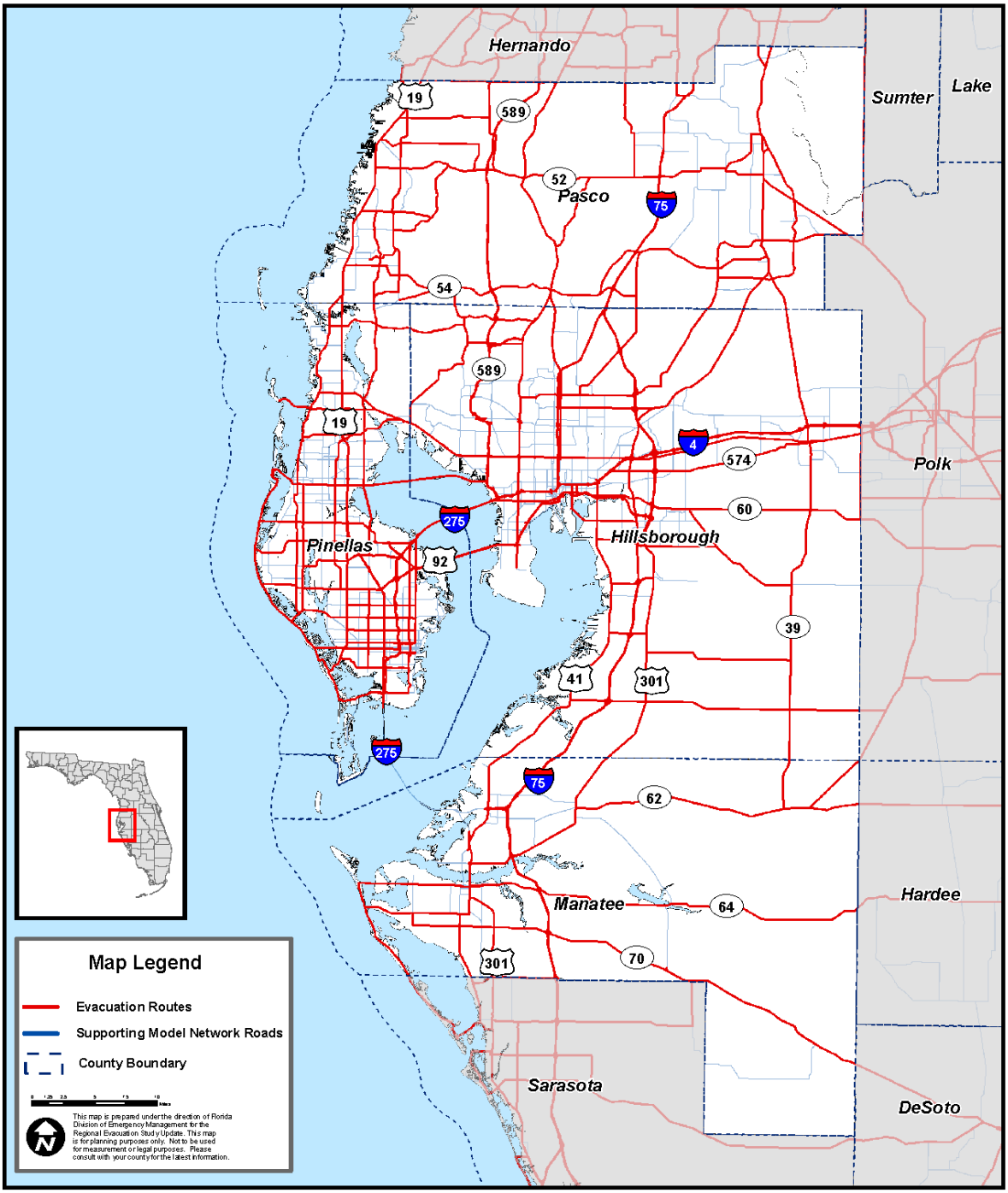


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure VI-2

Tampa Bay Regional Model Network



Sources: Tampa Bay Regional Planning Council, CDM Smith

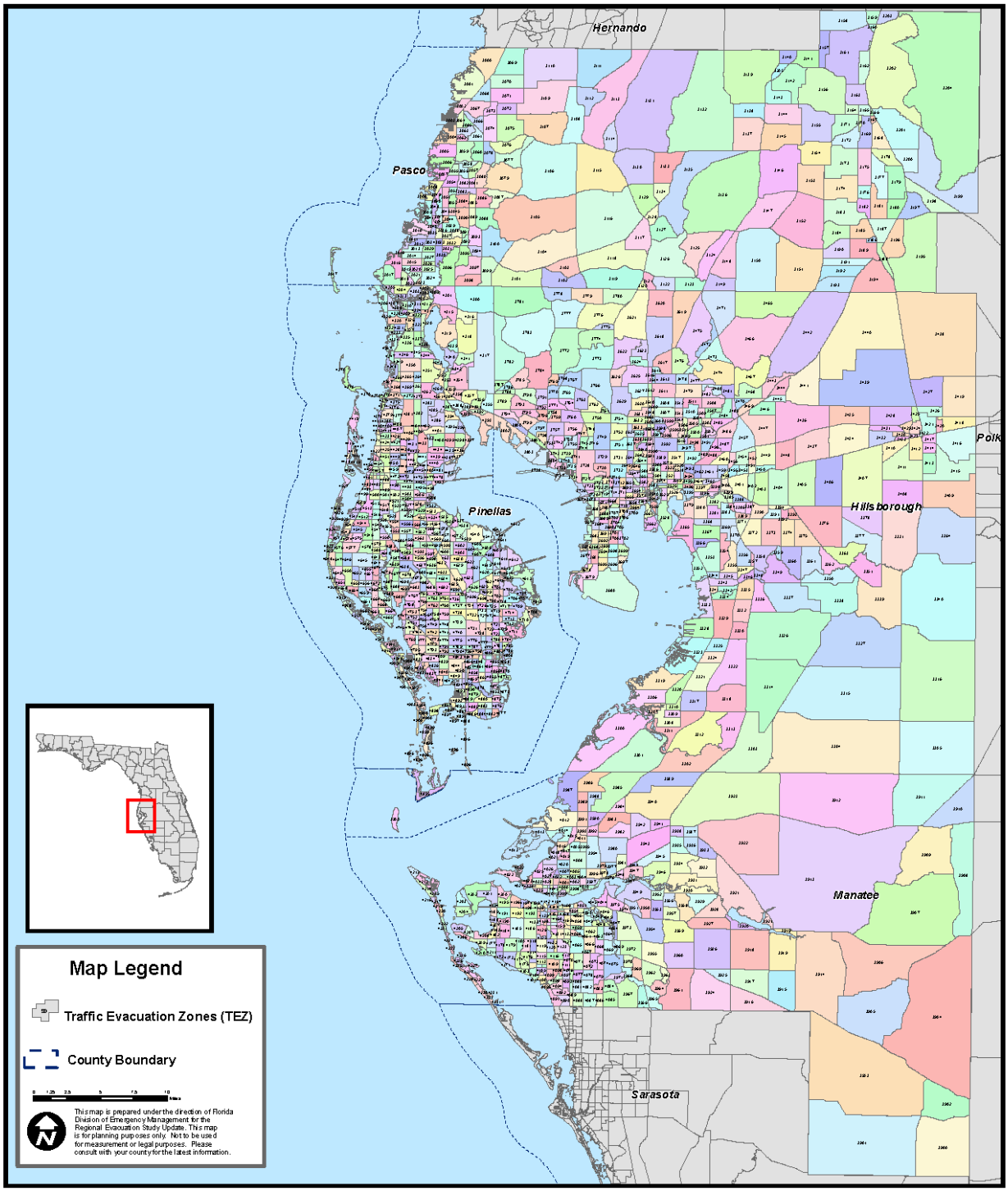
Map Printed: July, 2015

vulnerable populations are located. The TEZs are aggregations of the smaller small area data geographies provided by the RC. Each traffic evacuation zone has a unique identification 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 8,829 zones. Of the total number of zones in Florida, 1,673 of the zones are located within the seven county Tampa Bay Region, as illustrated in **Figure III-3**. In the Tampa Bay region, Pinellas County has the largest number of TEZs with 631, and Hillsborough County follows with 505 TEZs. Manatee and Pasco Counties have the lowest number of TEZs within the RPC with 332 and 205 TEZs, respectively. The larger number of TEZs generally reflects counties with denser urban form and higher population densities. The number of TEZs for each county in the region is listed below:

- Hillsborough – 505
- Manatee – 332
- Pasco – 205
- Pinellas – 631

Figure VI-3
Tampa Bay Regional Model Transportation Evacuation Zone System (TEZ)



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

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: 2015 and 2020.

A snapshot of the key demographic data for each county in the Tampa Bay RPC for 2015 and 2020 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.

Hillsborough County has the largest population in the region during all three time periods. The county is expected to reach over 1.3 million people by 2020. Pinellas County has the second largest population in the region, and this county is far more densely populated than the other counties, including Hillsborough. This is very significant in the behavior of the evacuation transportation model because most of the population in Pinellas lives close to a coastline and in an evacuation zone. Pasco County is forecasted to experience an almost 12% increase in population between 2015 and 2020; Hillsborough and Manatee are close with 8% and 6%, respectively. The lowest rate, Pinellas County is expected to have a nominal 5% increase.

For modeling purposes, the RPC kept the number of mobile homes and population in mobile homes reasonably static for each of the time horizons. The number of actual mobile homes remained the same or decreased slightly. The occupied mobile homes are referenced in the table, which are a portion of the total units in each county. Hillsborough and Pinellas County are quite close in occupied mobile home units around the 35 thousand mark. Pasco and Manatee Counties are also around the same range for occupied mobile homes near the 24 thousand mark.

Table III-1 - Tampa Bay Demographic Characteristic Summary

County	Characteristic	Year	
		2015	2020
Hillsborough	Occupied site-built homes	477,120	515,727
	Population in site-built homes	1,219,576	1,320,729
	Occupied mobile homes	35,083	35,205
	Population in mobile homes	95,704	96,011
	Hotel/motel units	16,769	20,576
Manatee	Occupied site-built homes	120,987	126,729
	Population in site-built homes	284,827	300,548
	Occupied mobile homes	23,349	22,947
	Population in mobile homes	46,698	45,959
	Hotel/motel units	13,535	14,117
Pasco	Occupied site-built homes	195,253	225,087
	Population in site-built homes	467,959	531,523
	Occupied mobile homes	24,789	24,788
	Population in mobile homes	57,818	57,813
	Hotel/motel units	1,834	2,712
Pinellas	Occupied site-built homes	400,874	421,621
	Population in site-built homes	875,362	918,307
	Occupied mobile homes	35,909	36,451
	Population in mobile homes	51,271	52,047
	Hotel/motel units	13,603	16,037

Source: TBRPC, FDOT, MPOs

D. Planned Roadway Improvements

To correspond to the different sets of demographic data, three model networks were ultimately developed. The base 2010 network, discussed in section A, and two future year networks to correspond to the 2015 demographic data and the 2020 demographic data. The 2010 base model network was updated to reflect roadway capacity improvement projects completed between 2011 and 2015 to create the 2015 network. The 2015 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2016 and 2020 to create the 2020 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 2011 and 2015 that were included in the 2015 network. Likewise, **Table III-3** identifies capacity improvement projects planned for implementation between 2016 and 2020. The tables identify each roadway that will be improved as well as the extent of the improvement.

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 - Tampa Bay Region Roadway Improvements, 2011-15

County	Roadway	From	To	Number of Lanes
Hillsborough	Lutz Lake Fern Rd	Suncoast Parkway	TPC Blvd	4
	Lutz Lake Fern Rd	TPC Blvd	Dale Mabry Highway	2
	SR 574	W of Highview	E of Parsons Ave	4
	I-4/Selmon Expressway	S of Selmon Expresswy	7th Ave	4
	I-4/Selmon Expressway	7th Ave	I-4	4
	I-275	Tampa CBD Interchange	ML King Blvd	8
	I-275	MLK	Fowler	6
	N 21st St/N 22nd St	SR 60	I-4	4
	US 301	Balm Rd	SR 674	2
Manatee	I-75	Fruitville Rd	N of University Prkwy	8
Pasco	Clinton Ave.	Ft. King Hwy	U.S.301	4
	Denton Ave	US 19	Shady Hills	2
	CR 587 (Mass Ave)	Congress St	Little Rd (CR 1)	4
	CR 587 (Mass Ave)	Little Rd (CR 1)	SR 52	2
	CR 518 (Trouble Creek Rd)	US 19	Rowan Rd	2
	Mitchell Blvd	CR 77	CR 1	4
	Trinity Blvd	Little Rd (CR 1)	SR 54	2
	I-75	I-275/Pasco County Line	SR 56	10
	I-75	SR 56	SR 54	6
	I-75	SR 54	Hernando County Line	4
Pinellas	Keystone Rd	US 19	East Lake Rd	4
	Bryan Dairy Rd	Starkey Rd	72nd St	6
	US 19 (SR 55)	N of Whitney Rd	S of Seville Rd	10
	US 19 (SR 55)	S of Seville Blvd	N of SR 60	10
	SR 688 (Ulmerton Rd)	W of 38th ST	W of I-275	6
	SR 688 (Ulmerton Rd)	E of 119th ST	W of Seminole Bypass	6
	SR 688 (Ulmerton Rd)	E of Wild Acres Road	El Centro / Ranchero Blvd	6
	SR 688 (Ulmerton Rd)	El Centro Ranchero	W of US 19	6
	Starkey Rd (Park Street)	84th Lane	Tyrone Blvd	4
	Gandy Blvd	4th Street North	28th St (Ext)	4
	Pinellas Bayway/54th Ave South	Gulf Blvd	Bahia Del Mar	4
	Trinity Blvd	East Lake Rd	Little Rd (CR 1)	4

Sources: FDOT, MPOs, Tampa Bay Regional Council
Note: Projects included in this table are roadway improvement projects completed between 2011 and 2015 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 prior to 2015.

Table III-3 - Tampa Bay Planned Roadway Improvements, 2016-20

County	Roadway	From	To	Number of Lanes
Hillsborough	US 301	Balm Rd	SR 674	6
	Bruce B. Downs Blvd	Pebble Creek Dr	Pasco County	8
	I-275 (SR 93)	Himes Ave	Hillsborough River	8
	I-275 (SR 93)	SR 60 (Memorial Hwy)	Himes Ave	8
	I-275 (SR 93)	Howard Frankland	Himes Ave	8
	I-75	S of Fowler Ave	N of CR-581	8
	I-75	N of Fowler Ave	Bruce B Downs	8
	I-275	SR 60/Memorial Interchange	Tampa CBD Interchange	8
	I-75	Bruce B Downs	I-275/Pasco County Line	6
	SR 589 (Veteran's Expy)	S of Gunn Hwy	Sugarwood Mainline Plaza	6
	SR 589 (Veteran's Expy)	Sugarwood Mainline Plaza	Van Dyke Rd	8
	SR 589 (Veteran's Expy)	Memorial Hwy	Barry Rd	6
	SR 589 (Veteran's Expy)	Barry Rd	S of Gunn Hwy	8
	SR 60 (Adamo Dr)	E of US 301	W of FlakenBurg Rd	6
Manatee	I-75	N SR 64	N of 301 Interchange	8
Pasco	SR 52 (Schrader Hwy)	E of Old Pasco Rd	McKendree Rd	4
Pinellas	Starkey Rd	84th Lane	Flamevine Rd	6
	US 19 (SR 55)	N of SR 580 (Main St)	Northside Dr	6
	I-275 (SR 93)	S of 118th Ave	S of 4th St N	8
	Gateway Expy	SR 690 at US 19/ SR 686 Ext at CR 611	W of I-275	4
	SR 688 (Ulmerton Rd)	E of 49th St	W of 38th St N	6

Sources: FDOT, MPOs, Tampa Bay Regional Council
Note: Projects included in this table are roadway improvement projects completed between 2016 and 2020 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 prior to 2015.

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 Tampa Bay Region, 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 5-8.

A review of the evacuation rates for the Tampa Bay 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 Hillsborough 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 an 80 percent participation rate from persons living in mobile/manufactured homes in evacuation zone A (Figure III-5). In addition, Hillsborough County can expect shadow evacuations to occur for persons living in site-built homes at a rate of 35 percent from evacuation zone B, 25 percent from evacuation zone C, 15 percent from evacuation zone D, and 10 percent from evacuation zone E (Figure III-4). Likewise, for persons living in mobile/manufactured homes, Hillsborough County can expect shadow evacuations to occur at a rate of 65 percent from evacuation zone B, and 60 percent each from evacuation zones C, D, and E (Figure III-5).

The evacuation zone systems for Hillsborough, Manatee, Pasco, and Pinellas are listed below:

- Hillsborough – 5 zones: Zone A, Zone B, Zone C, Zone D, Zone E;
- Manatee – 5 zones: Zone A, Zone B, Zone C, Zone D, Zone E;
- Pasco – 5 zones: Zone A, Zone B, Zone C, Zone D, Zone E;
- Pinellas – 5 zones: Zone A, Zone B, Zone C, Zone D, Zone E;

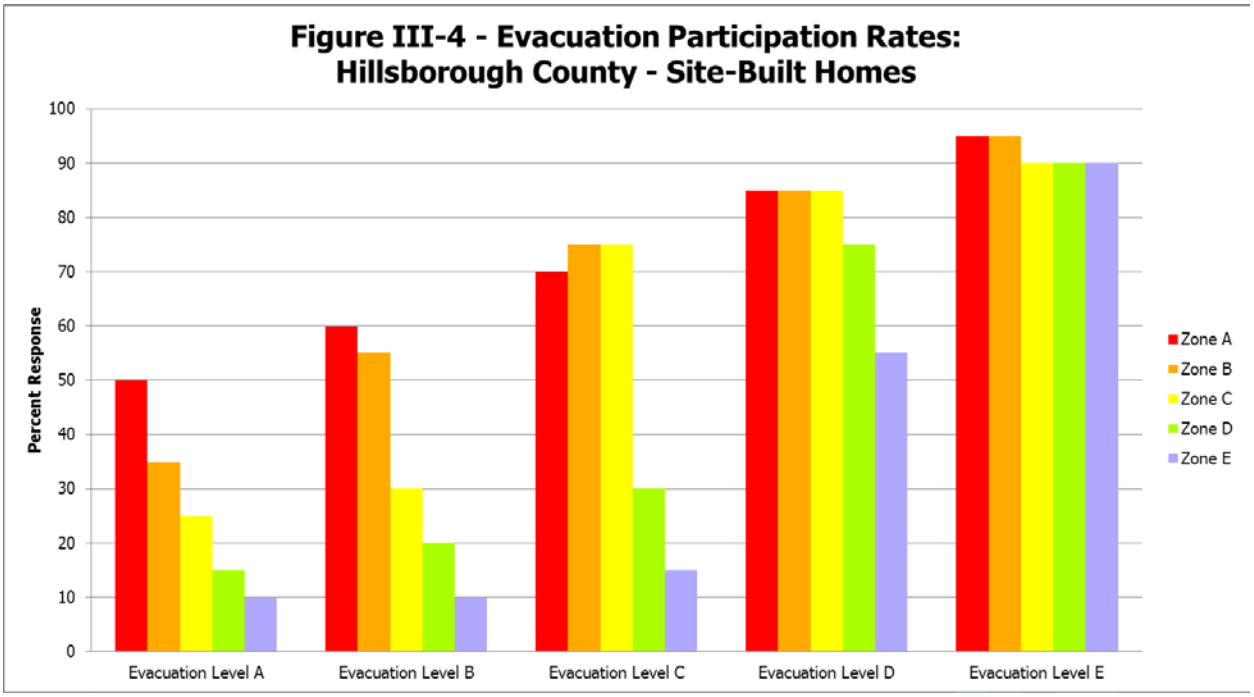
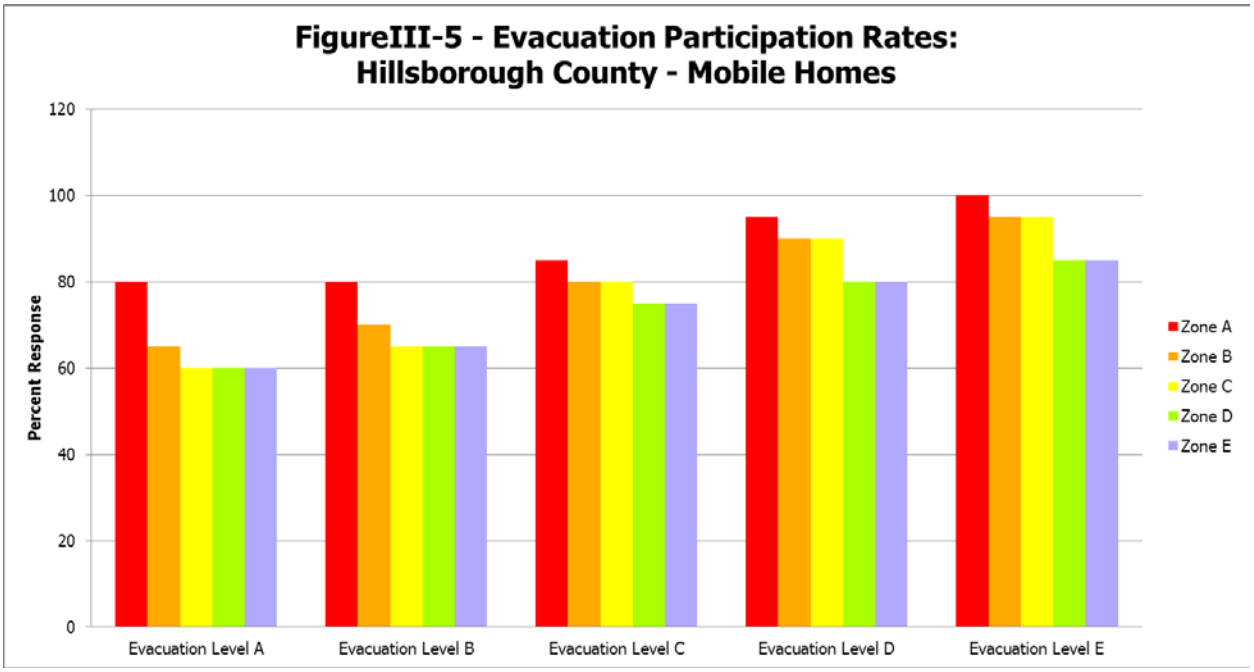


Figure III-4 - Evacuation Participation Rates:
Hillsborough County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E


FigureIII-5 - Evacuation Participation Rates:
Hillsborough County - Mobile Homes
Percent Response
120
100
80
60
40
20
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

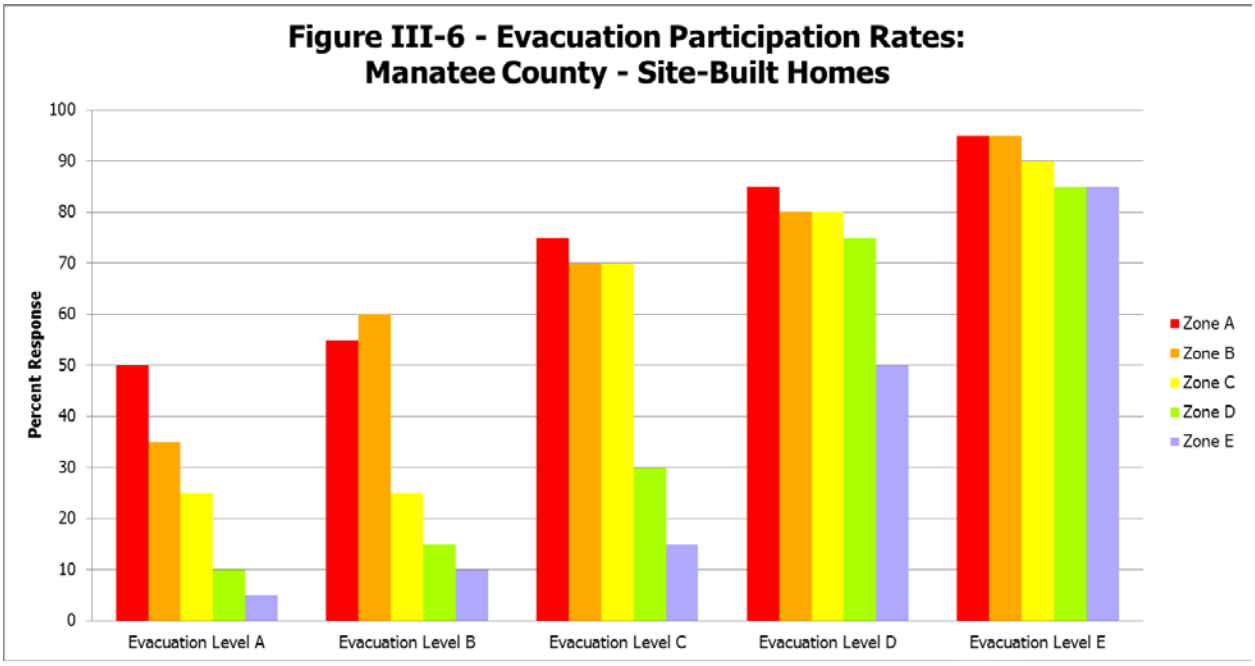


Figure III-6 - Evacuation Participation Rates:
Manatee County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

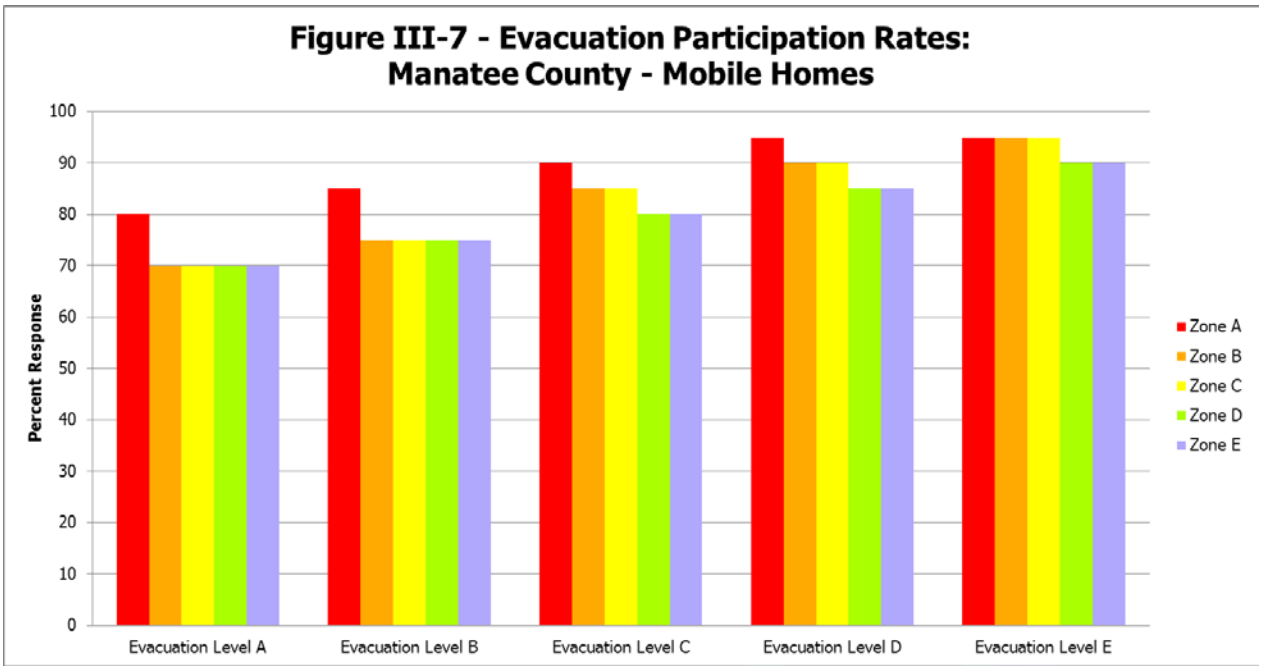


Figure III-7 - Evacuation Participation Rates:
Manatee County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

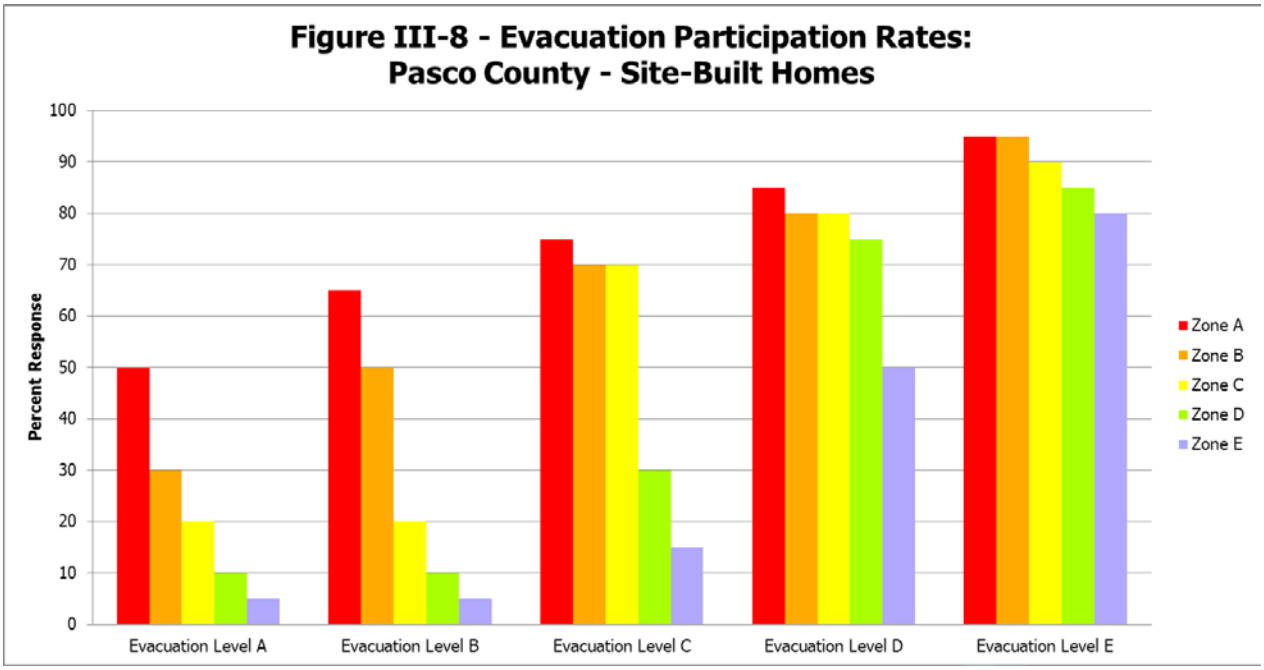


Figure III-8 - Evacuation Participation Rates:
Pasco County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

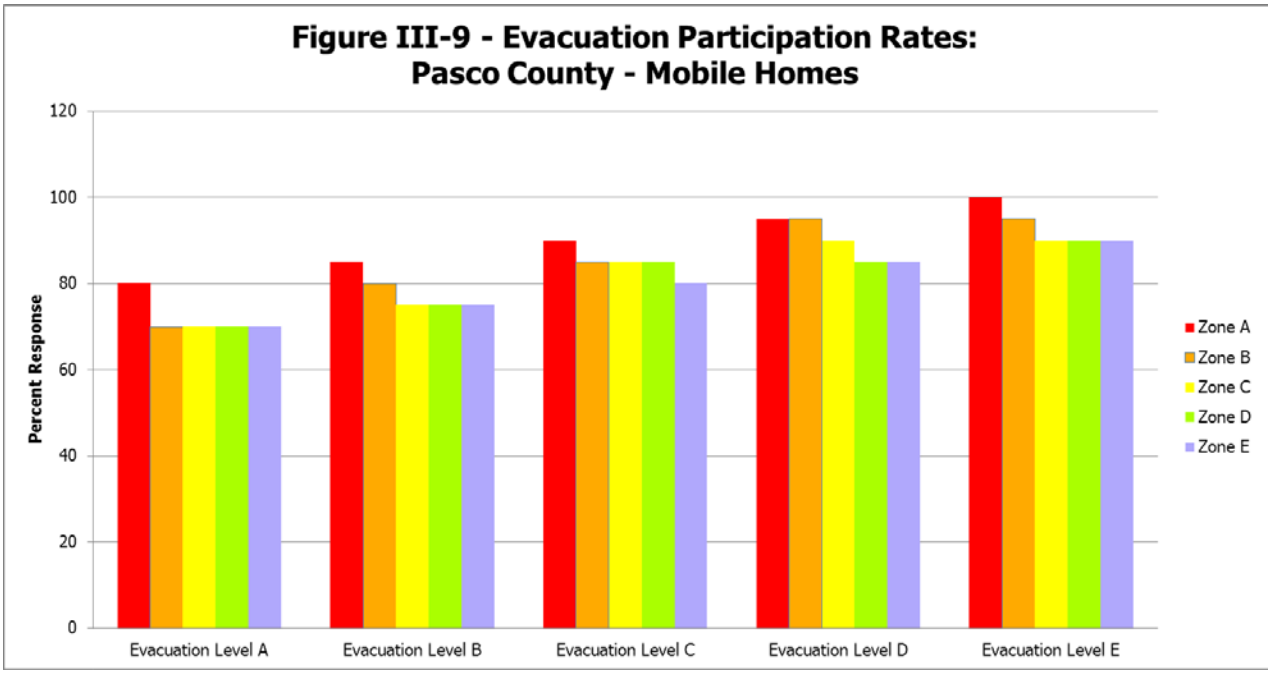


Figure III-9 - Evacuation Participation Rates:
Pasco County - Mobile Homes
Percent Response
120
100
80
60
40
20
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

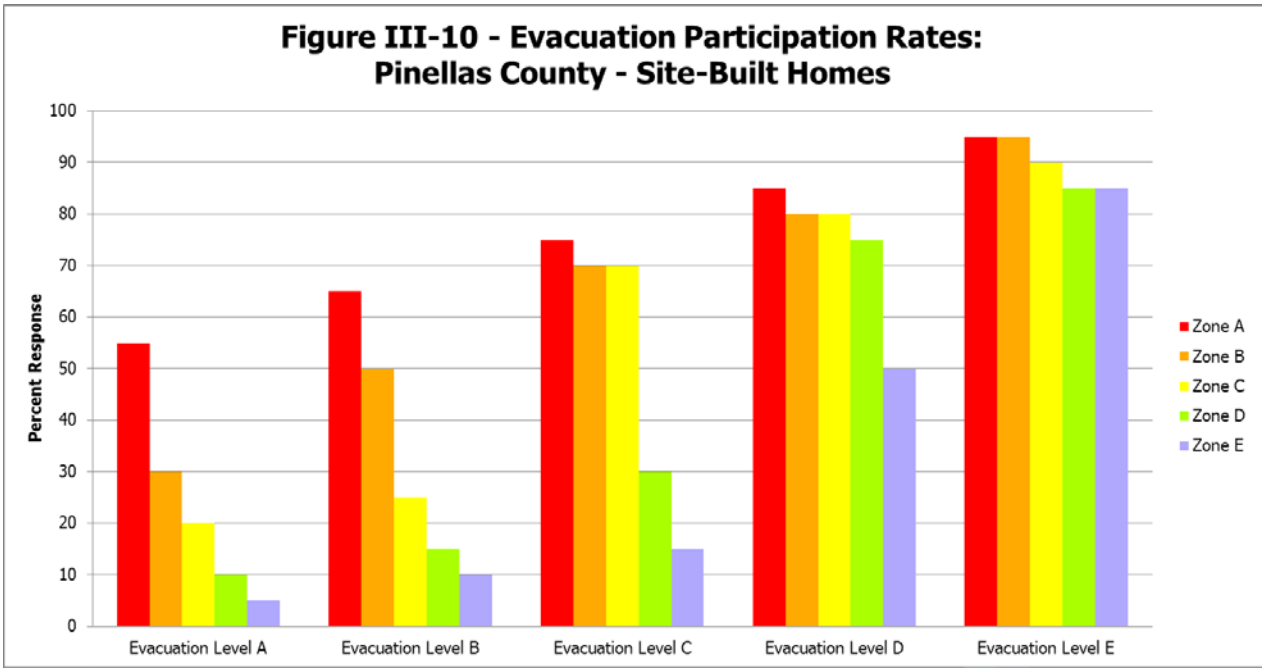


Figure III-10 - Evacuation Participation Rates:
Pinellas County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

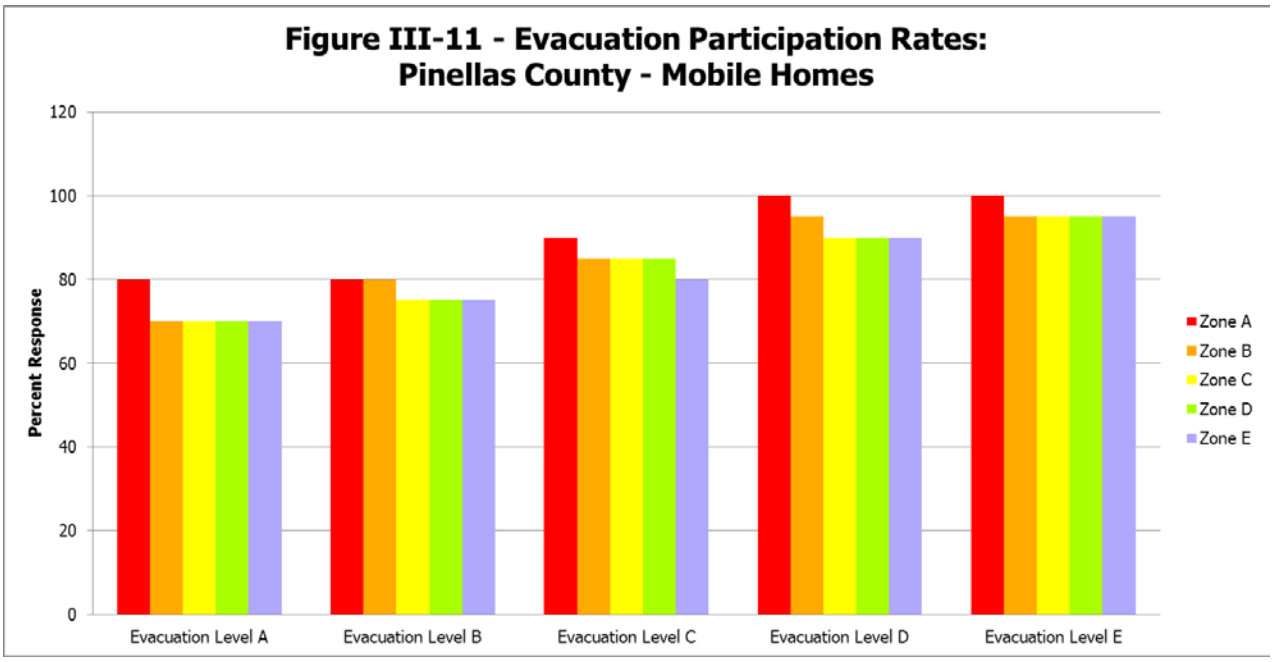


Figure III-11 - Evacuation Participation Rates:
Pinellas County - Mobile Homes
Percent Response
120
100
80
60
40
20
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

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 Tampa Bay 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 four county region there are a total of 135 shelters, including 47 in Hillsborough County, 25 in Manatee County, 29 in Pasco County, and 34 in Pinellas County, almost all of which are classified as primary shelters. All together, the 135 shelters located within the four county region can host more than 180,000 persons during an evacuation event. Detailed lists of the available public shelters by county are included in Volume I, Chapter 5 and Volume 5-8.

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 four counties within the Tampa Bay region have updated and established their evacuation zones based on the results of the data and information collected as part of the SRESP 2010 iteration. Some of the counties have made adjustments to the zones since, but ultimately remains the same as that Study's outcome. Evacuation zones for the Tampa Bay Region are illustrated in Figure III-12. County level evacuation zones are included in Volume 5-8.

H. TIME User Interface

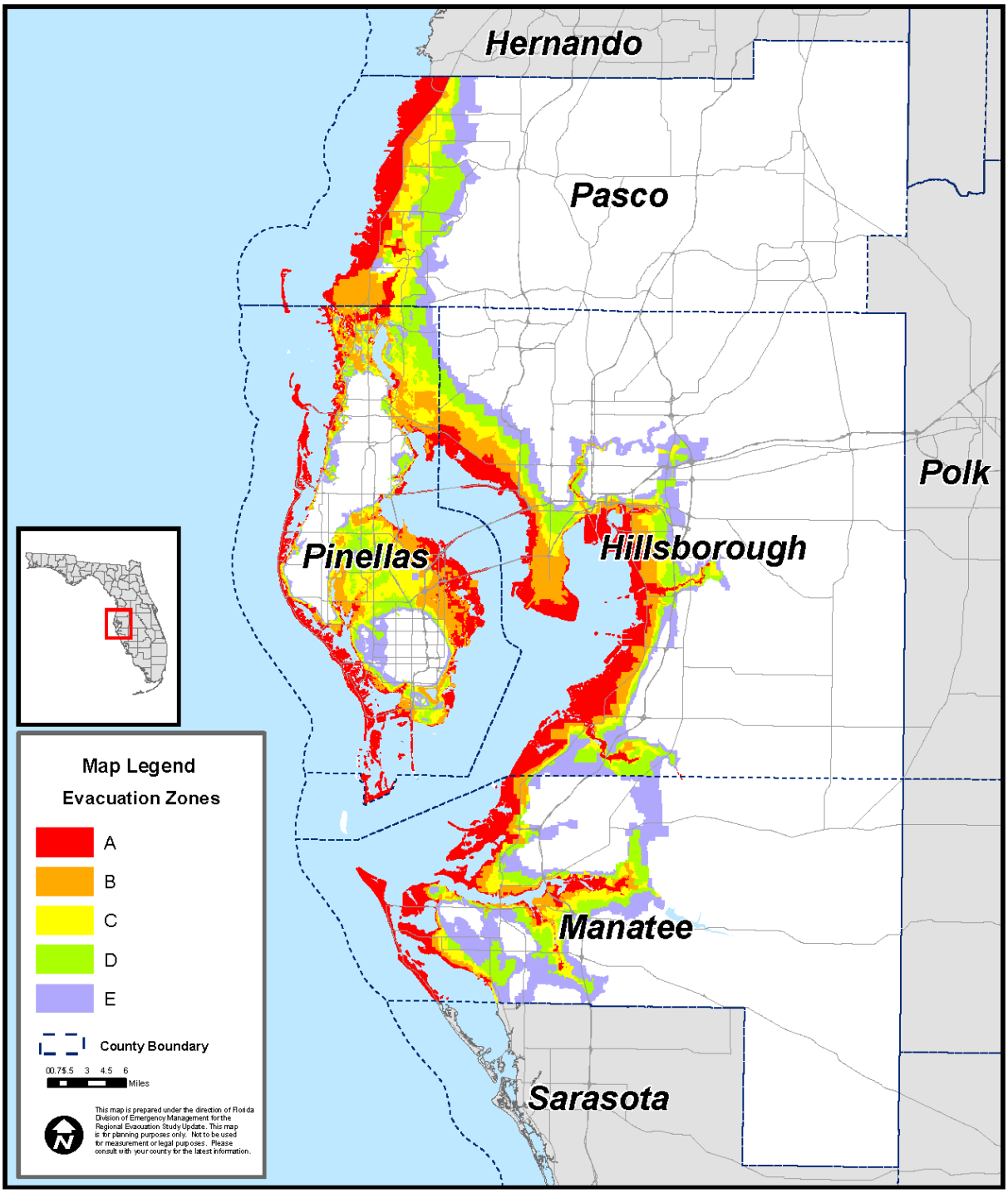
CDM Smith developed the Transportation Interface for Modeling Evacuations (TIME) to make it easier for RPC staff and transportation planners to use the model and implement the evacuation methodology. The TIME interface is based on an ArcGIS platform and is essentially a condensed transportation model, 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 2010, 2015 and 2020. The time period determines which set of demographic data and which version of the model network will be used.

Figure III-12

Tampa Bay Regional Evacuation Zones



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

- **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-10.

- **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. For example, the Tampa Bay RPC may want to take into account additional traffic that would be generated by visitors for a large sporting event. 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 Tampa Bay's model network and include both coastal and inland counties. The coastal counties include Charlotte, Citrus, Hernando, Hillsborough, Manatee, Pasco, Pinellas, and Sarasota Counties. The inland counties are DeSoto, Hardee, Lake, Orange, Osceola, Polk, and Sumter 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 (with an exception with zone F). 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 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.

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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 Tampa Bay Region for 2015 is identified in **Table IV-1**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2020 is summarized in **Table IV-2**.

The vulnerable population in the Tampa Bay Region varies by evacuation zone by county. In all counties in the region, the vulnerable population living in site-built homes far exceeds the vulnerable population living in mobile/manufactured homes.

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 Tampa Bay Region are identified in **Table IV-3** for 2015 and in **Table IV-4** for 2020.

In all cases in the Tampa Bay Region, the vulnerable population is far more likely to stay with friends and family during an evacuation. This is followed by hotel/motel as the second choice and other locations as the third. In all cases, 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 2015 and 2020. 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 IV-1 – Vulnerable Population in the Tampa Bay Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
Site-built Homes	74,902	98,911	61,381	68,433	70,332
Mobile/Manuf. Homes	7,281	6,738	6,060	4,567	5,543
TOTAL	82,183	105,728	67,441	73,000	75,875
Manatee County					
Site-built Homes	28,925	18,341	24,201	45,967	71,921
Mobile/Manuf. Homes	5,790	3,241	6,018	11,826	8,436
TOTAL	34,714	21,582	30,219	57,793	80,357
Pasco County					
Site-built Homes	38,087	46,788	63,053	31,235	22,881
Mobile/Manuf. Homes	3,320	4,359	3,335	3,212	2,103
TOTAL	41,407	51,146	66,388	34,446	24,985
Pinellas County					
Site-built Homes	137,973	115,039	114,351	84,705	50,216
Mobile/Manuf. Homes	3,103	8,572	9,823	8,692	1,999
TOTAL	141,076	123,610	124,173	93,397	52,215

Table IV-2 – Vulnerable Population in the Tampa Bay Region for 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
Site-built Homes	80516	105560	67806	75790	80793
Mobile/Manuf. Homes	7320	6758	6072	4583	5567
TOTAL	87837	112319	73878	80373	86360
Manatee County					
Site-built Homes	29623	19053	25474	48931	75418
Mobile/Manuf. Homes	5671	3136	5869	11690	8231
TOTAL	35294	22189	31344	60621	83648
Pasco County					
Site-built Homes	41718	48809	66917	34890	25423
Mobile/Manuf. Homes	3320	4359	3334	3212	2103
TOTAL	45038	53168	70251	38102	27526
Pinellas County					
Site-built Homes	143096	120200	121480	89533	52434
Mobile/Manuf. Homes	3153	8713	9968	8819	2031
TOTAL	146248	128913	131448	98353	54464

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 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
To Friends and Family	53419	68723	43837	47450	49319
To Hotel/ Motel	16073	20809	13185	10722	11104
To Public Shelter	4473	5623	3675	7528	7865
To Other Destination	8218	10573	6744	7300	7588
Manatee County					
To Friends and Family	21118	13111	18432	35267	48636
To Hotel/ Motel	6653	3237	4533	8669	12054
To Public Shelter	2025	1856	2658	5779	8036
To Other Destination	4918	3377	4596	8078	11632
Pasco County					
To Friends and Family	26417	30470	39666	18785	13636
To Hotel/ Motel	10020	10011	13111	6729	4892
To Public Shelter	2402	2775	6639	3605	2604
To Other Destination	2568	7890	6972	5328	3853
Pinellas County					
To Friends and Family	98443	79918	80221	60274	33840
To Hotel/ Motel	21317	24722	24835	14444	7932
To Public Shelter	7209	6609	6700	7646	4217
To Other Destination	14108	12361	12417	11034	6226

Table IV-4 – Vulnerable Population by Destination for 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Hillsborough County					
To Friends and Family	57,094	73,007	48,021	52,242	56,134
To Hotel/ Motel	17,201	22,126	14,472	11,827	12,676
To Public Shelter	4,758	5,954	3,998	8,266	8,914
To Other Destination	8,784	11,232	7,388	8,037	8,636
Manatee County					
To Friends and Family	21,460	13,470	19,100	36,957	50,601
To Hotel/ Motel	6,775	3,328	4,702	9,093	12,547
To Public Shelter	2,048	1,901	2,742	6,062	8,365
To Other Destination	5,011	3,490	4,800	8,509	12,136
Pasco County					
To Friends and Family	28,777	31,683	41,984	20,796	15,034
To Hotel/ Motel	10,928	10,416	13,884	7,460	5,400
To Public Shelter	2,584	2,876	7,025	3,971	2,858
To Other Destination	2,750	8,193	7,359	5,876	4,234
Pinellas County					
To Friends and Family	102,059	83,358	84,943	63,488	35,300
To Hotel/ Motel	22,095	25,783	26,290	15,194	8,271
To Public Shelter	7,470	6,881	7,071	8,045	4,398
To Other Destination	14,625	12,891	13,145	11,626	6,495

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
2015					
Hillsborough County	205,151	175,871	207,510	211,992	252,463
Manatee County	76,514	78,201	82,960	83,427	54,598
Pasco County	99,037	81,078	87,355	82,755	82,492
Pinellas County	149,851	123,202	118,876	103,227	113,955
2020					
Hillsborough County	215,446	185,468	220,127	226,692	267,903
Manatee County	77,939	80,170	85,816	86,832	57,461
Pasco County	103,423	84,933	93,928	89,165	90,053
Pinellas County	157,048	129,803	125,419	109,081	120,594

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 Tampa Bay 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 2015 time period and five scenarios for the 2020 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 2015 scenarios use the 2015 network and the five 2020 scenarios use the 2020 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 2015 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 Hillsborough, Manatee, Pasco, Pinellas, Sarasota, and Hernando 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;
  - 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; and,
  - For the remaining counties in the Tampa Bay 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 2015	Scenario 2 Level B 2015	Scenario 3 Level C 2015	Scenario 4 Level D 2015	Scenario 5 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	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando
	Scenario 6 Level A 2020	**Scenario 7 Level B 2020**	**Scenario 8 Level C 2020**	**Scenario 9 Level D 2020**	**Scenario 10 Level E 2020**
Demographic Data	2020	2020	2020	2020	2020
Highway Network	2020	2020	2020	2020	2020
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	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando	Hillsborough Manatee Pasco Pinellas Sarasota Hernando

E. Base Scenario Results

Each of the ten base scenarios were modeled for the Tampa Bay 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 2015 in **Table IV-7** and for 2020 in **Table IV-8**.

Within the four county region, total evacuating population ranges from more than 829,000 persons for a base scenario level A evacuation to more than 1.88 million persons for a non-cumulative base scenario level E evacuation in 2015. By 2020, this range increases within the four counties to more than 868,000 persons for a base scenario level A evacuation and more than 2 million persons for a non-cumulative 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 2015 in **Table IV-9** and for 2020 in **Table IV-10**.

The total number of evacuating vehicles within the four county region for the base scenarios also varies by evacuation level. A total of more than 487,000 vehicles evacuate from the four county RPC for a base scenario level A evacuation in 2015, and this number increases to slightly more than one million evacuating vehicles from the four county region for a base scenario level E evacuation in 2015. By 2020, the number of evacuating vehicles is expected to increase to more than 506,000 vehicles for a base scenario level A evacuation and more than 1.08 million 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 four county region ranges from more than 68,000 persons for the base scenario level A evacuation in 2015 to more than 157,000 persons for the base scenario level E evacuation. By 2020, the public shelter demand is expected to increase to more than 70,000 persons for the level A evacuation and nearly 166,000 persons for the level E evacuation.

Table IV-7 – 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	
Hillsborough County					
Site-built Homes	184,549	255,353	350,991	427,105	543,372
Mobile/Manuf. Homes	95,732	95,732	95,732	95,732	95,732
Tourists	7,053	12,698	16,140	17,508	17,587
TOTAL	287,334	363,783	462,863	540,345	656,691
Manatee County					
Site-built Homes	54,359	76,939	110,342	167,673	208,401
Mobile/Manuf. Homes	46,652	46,652	46,652	46,652	46,652
Tourists	10,217	10,906	12,481	13,410	24,210
TOTAL	111,228	134,497	169,475	227,735	279,263
Pasco County					
Site-built Homes	82,306	115,042	187,292	217,138	241,859
Mobile/Manuf. Homes	57,840	57,840	57,840	57,840	57,840
Tourists	298	749	1,164	1,165	1,165
TOTAL	140,444	173,631	246,296	276,143	300,864
Pinellas County					
Site-built Homes	225,172	318,153	437,725	514,567	576,976
Mobile/Manuf. Homes	51,246	51,246	51,246	51,246	51,246
Tourists	14,509	18,489	18,765	19,671	20,205
TOTAL	290,927	387,888	507,736	585,484	648,427

Table IV-8 – Evacuating Population by Base Scenario for 2020

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	
Hillsborough County					
Site-built Homes	199,386	275,119	379,769	465,154	592,639
Mobile/Manuf. Homes	96,006	96,006	96,006	96,006	96,006
Tourists	7,891	14,499	18,386	19,939	20,025
TOTAL	303,283	385,624	494,161	581,099	708,670
Manatee County					
Site-built Homes	56,432	80,121	115,433	176,088	218,866
Mobile/Manuf. Homes	46,025	46,025	46,025	46,025	46,025
Tourists	10,776	11,507	13,185	14,167	25,666
TOTAL	113,233	137,653	174,643	236,280	290,557
Pasco County					
Site-built Homes	90,214	124,353	203,092	236,429	264,843
Mobile/Manuf. Homes	57,831	57,831	57,831	57,831	57,831
Tourists	416	955	1,462	1,464	1,464
TOTAL	148,461	183,139	262,385	295,724	324,138
Pinellas County					
Site-built Homes	234,833	332,170	458,901	539,899	605,270
Mobile/Manuf. Homes	52,068	52,068	52,068	52,068	52,068
Tourists	16,395	20,726	21,059	22,076	22,682
TOTAL	303,296	404,964	532,028	614,043	680,020

Table IV-9 – 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	
Hillsborough County					
Site-built Homes	97,774	134,083	182,677	221,170	279,044
Mobile/Manuf. Homes	50,751	50,751	50,751	50,751	50,751
Tourists	2,652	4,798	6,160	6,788	7,064
TOTAL	151,177	189,632	239,588	278,709	336,859
Manatee County					
Site-built Homes	28,976	39,999	54,960	80,800	100,541
Mobile/Manuf. Homes	26,812	26,812	26,812	26,812	26,812
Tourists	3,841	4,100	4,692	5,042	9,101
TOTAL	59,629	70,911	86,464	112,654	136,454
Pasco County					
Site-built Homes	47,633	65,945	105,823	121,772	135,392
Mobile/Manuf. Homes	44,232	44,232	44,232	44,232	44,232
Tourists	210	415	608	609	609
TOTAL	92,075	110,592	150,663	166,613	180,233
Pinellas County					
Site-built Homes	132,156	182,505	244,973	285,222	317,114
Mobile/Manuf. Homes	46,655	46,655	46,655	46,655	46,655
Tourists	5,467	7,035	7,444	7,801	8,013
TOTAL	184,278	236,195	299,072	339,678	371,782

Table IV-10 – Evacuating Vehicles by Base Scenario for 2020

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	
Hillsborough County					
Site-built Homes	105,362	144,151	197,073	240,302	303,641
Mobile/Manuf. Homes	50,916	50,916	50,916	50,916	50,916
Tourists	2,945	5,460	7,045	7,856	8,381
TOTAL	159,223	200,527	255,034	299,074	362,938
Manatee County					
Site-built Homes	29,805	41,346	57,175	84,495	105,195
Mobile/Manuf. Homes	26,726	26,726	26,726	26,726	26,726
Tourists	4,021	4,294	4,920	5,286	9,577
TOTAL	60,552	72,366	88,821	116,507	141,498
Pasco County					
Site-built Homes	52,218	71,287	114,574	131,949	147,706
Mobile/Manuf. Homes	44,226	44,226	44,226	44,226	44,226
Tourists	352	624	889	890	890
TOTAL	96,796	116,137	159,689	177,065	192,822
Pinellas County					
Site-built Homes	137,223	189,749	255,776	298,112	331,390
Mobile/Manuf. Homes	47,392	47,392	47,392	47,392	47,392
Tourists	6,143	7,904	8,640	9,053	9,301
TOTAL	190,758	245,045	311,808	354,557	388,083

Table IV-11 – Shelter Demand by Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	
2015					
Hillsborough	18,724	22,453	29,519	35,921	55,243
Manatee	9,252	11,309	14,054	17,551	23,340
Pasco	17,680	19,394	26,790	26,005	32,260
Pinellas	22,590	27,595	34,739	43,849	46,178
2020					
Hillsborough	19,717	23,728	31,415	43,671	59,620
Manatee	9,391	11,551	14,458	19,754	24,231
Pasco	18,311	20,104	28,137	31,352	34,266
Pinellas	23,316	28,551	36,119	42,424	48,109

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 four counties within the RPC, for a total of six 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	[illegible]
2015	575,620	720,650	947,085	1,117,804	1,269,958
2020	604,837	758,604	1,003,973	1,189,588	1,355,219

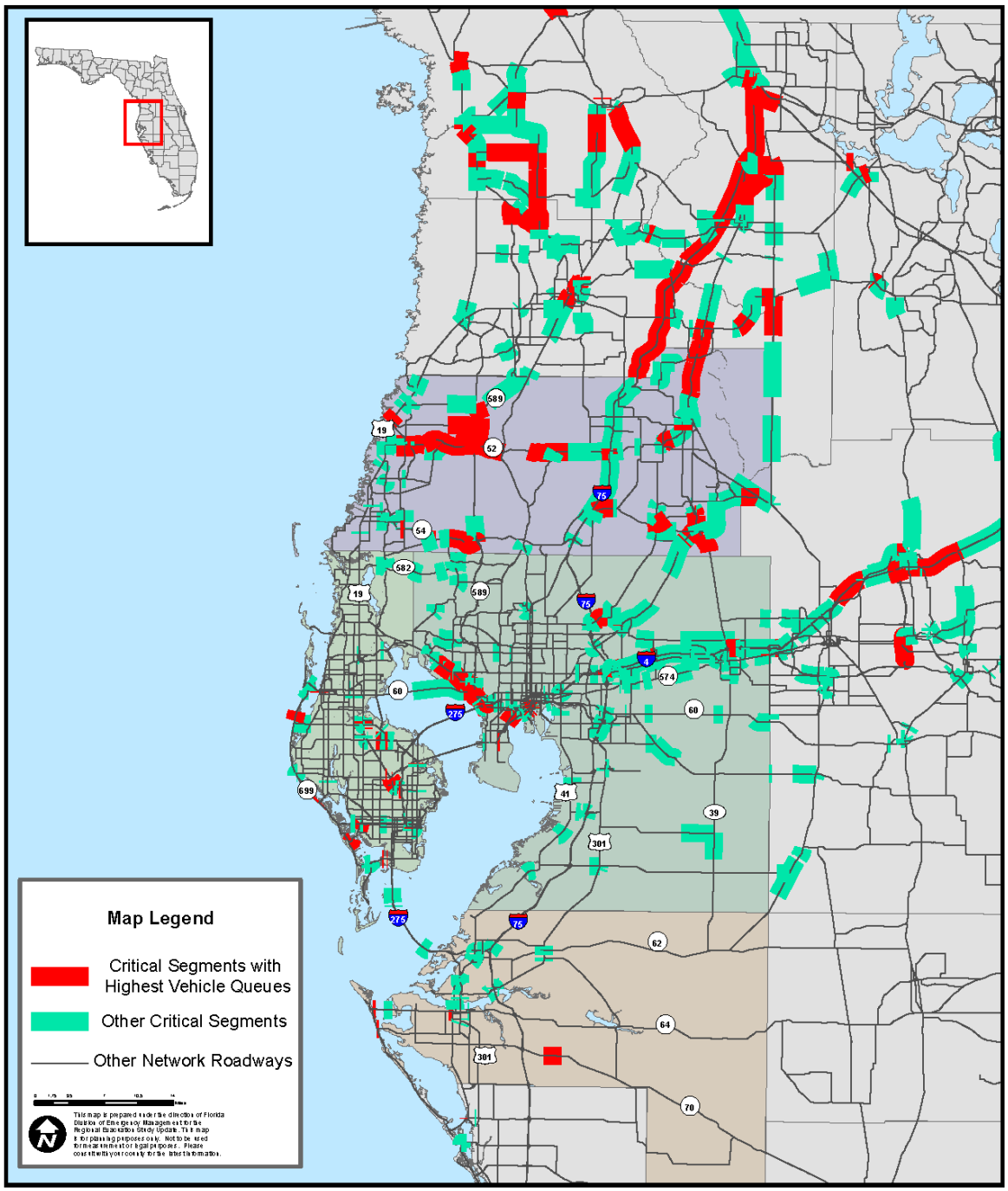
The identification of critical roadways in the evacuation network is also important to assist emergency managers with identifying roadways that have the greatest impact on clearance times. Critical roadways were identified by reviewing roadways in the model network that have the highest vehicle queues 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 Tampa Bay Region are identified in **Figures IV-1** through **IV-10** for each of the base scenarios for 2015 and 2020.

Through a review of the critical roadway segment figures, it is clear that I-75, I-4, and portions of I-275 are critical facilities for all evacuation scenarios. During the level A evacuation scenarios, the roadway segments with the highest vehicle queues are primarily located outside of the four county region, with the exception of I-75 in Pasco County. In contrast, for the level E evacuation scenarios, the roadway segments with the highest vehicle queues extend throughout the region, including I-275 in Hillsborough and Pinellas Counties, I-4 throughout Hillsborough county, and several US and State Highways as well. The Turnpike/I-75 interchange in Sumter County is clearly an issue in all evacuation scenarios.

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 2015 and **Table IV-14** for 2020. In addition, evacuating vehicles entering each county by major evacuation route are identified in **Table IV-15** for 2015 and **Table IV-16** for 2020. Detailed volume figures for all evacuation routes in the Tampa Bay Region for each base scenario are included in Volume 5-8. 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 generally follow the same pattern as the critical segment figures, as locations with higher queues generally have higher traffic volumes.

Figure IV-1

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

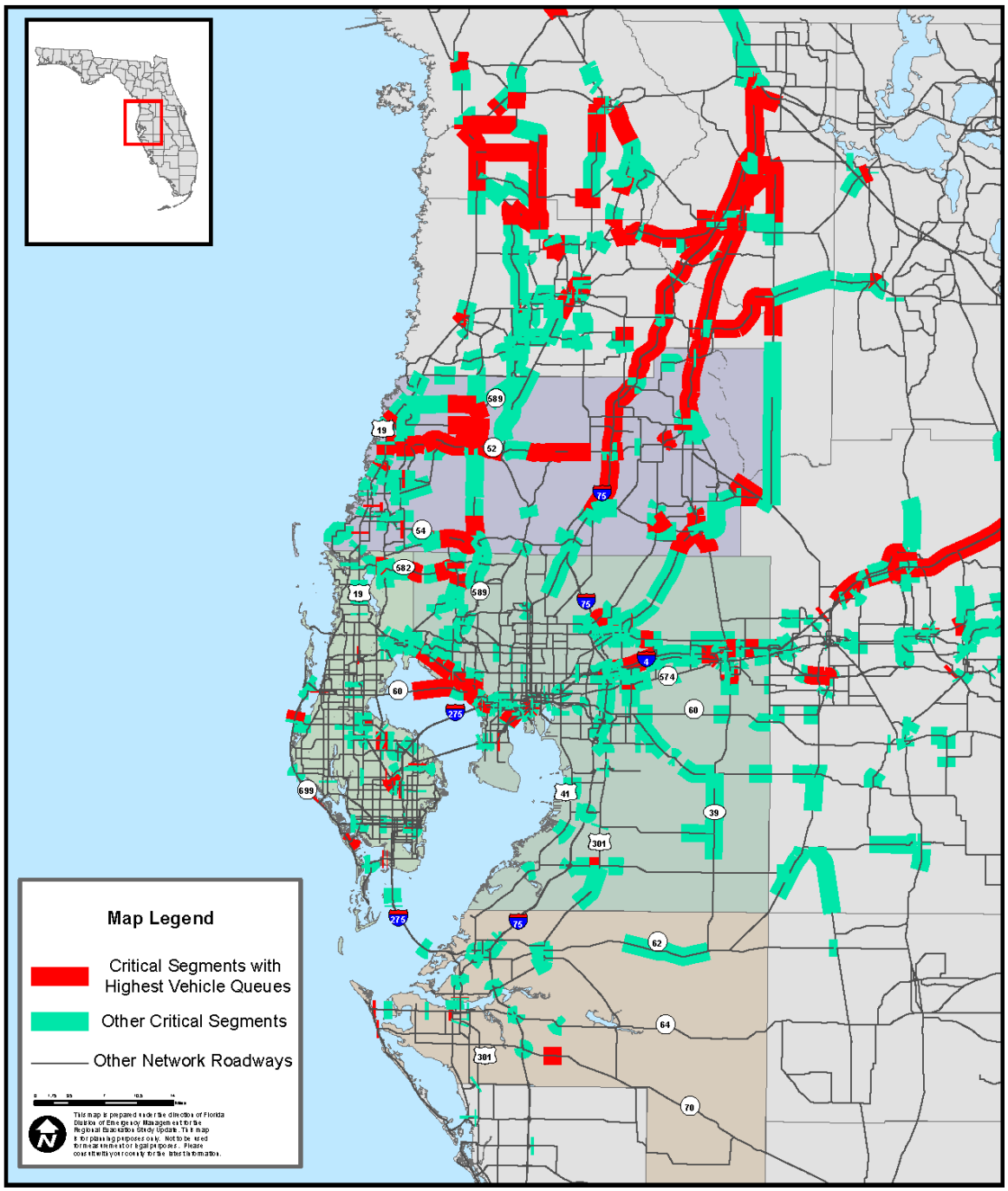


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-2

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

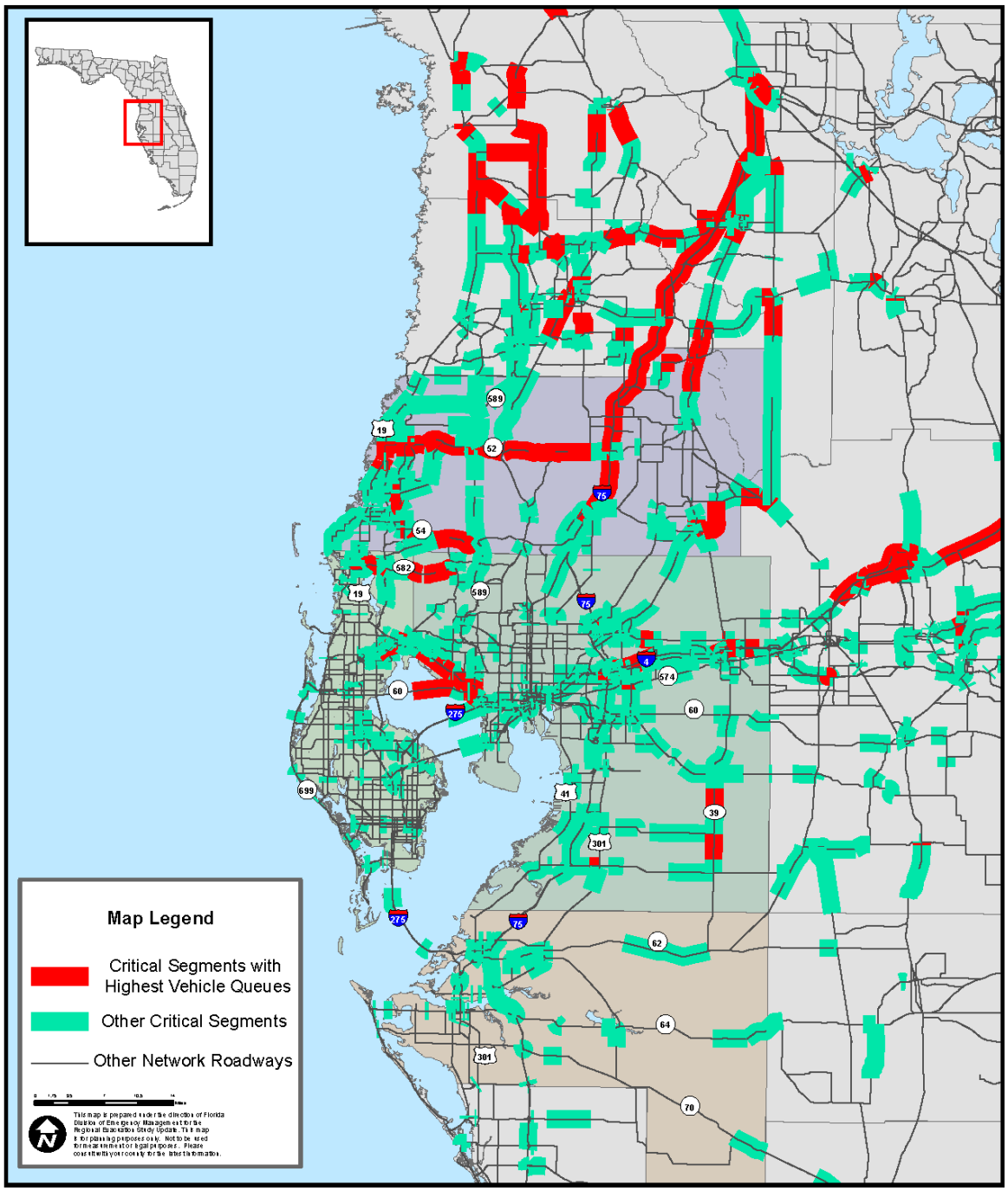


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-3

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

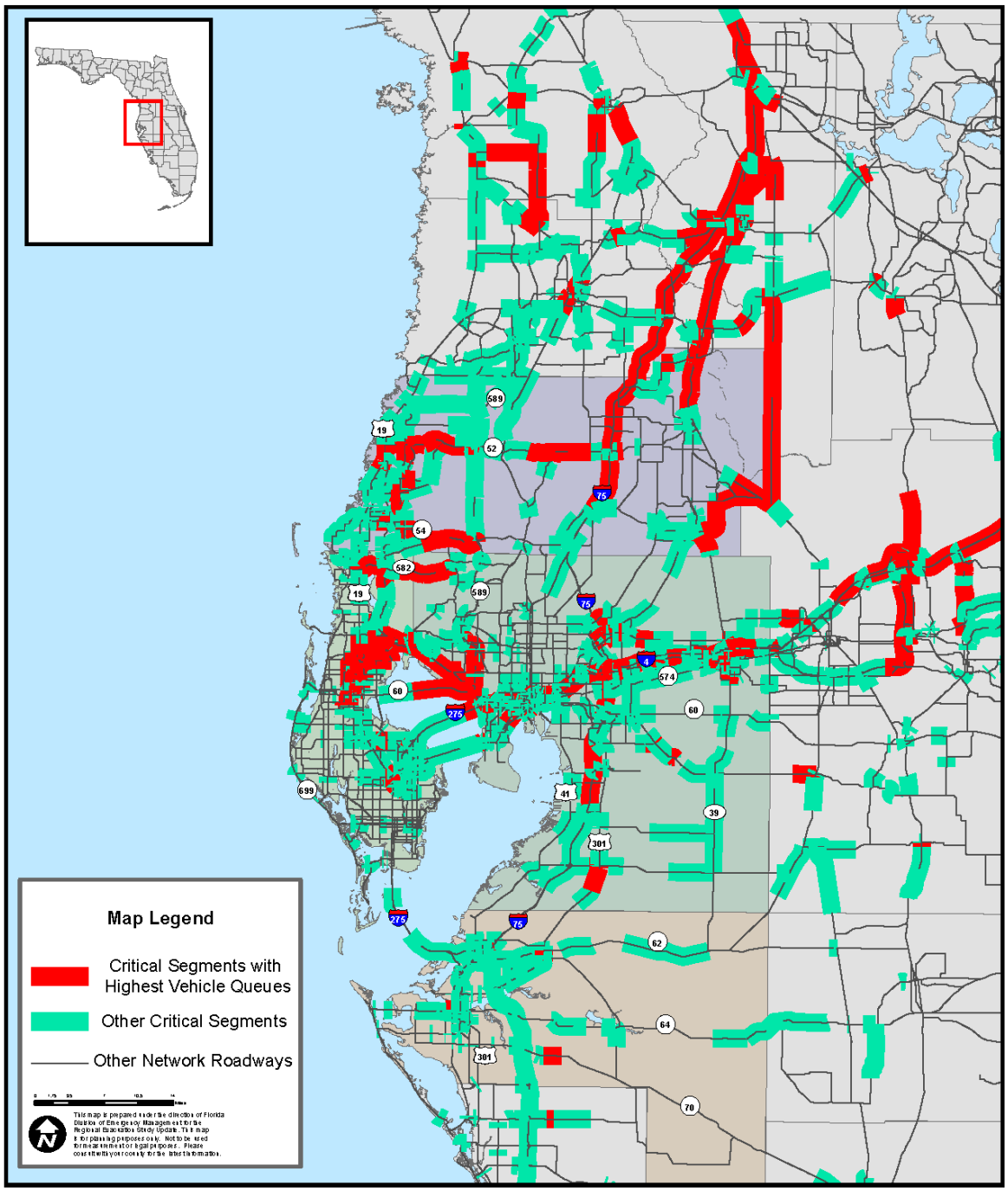


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-4

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

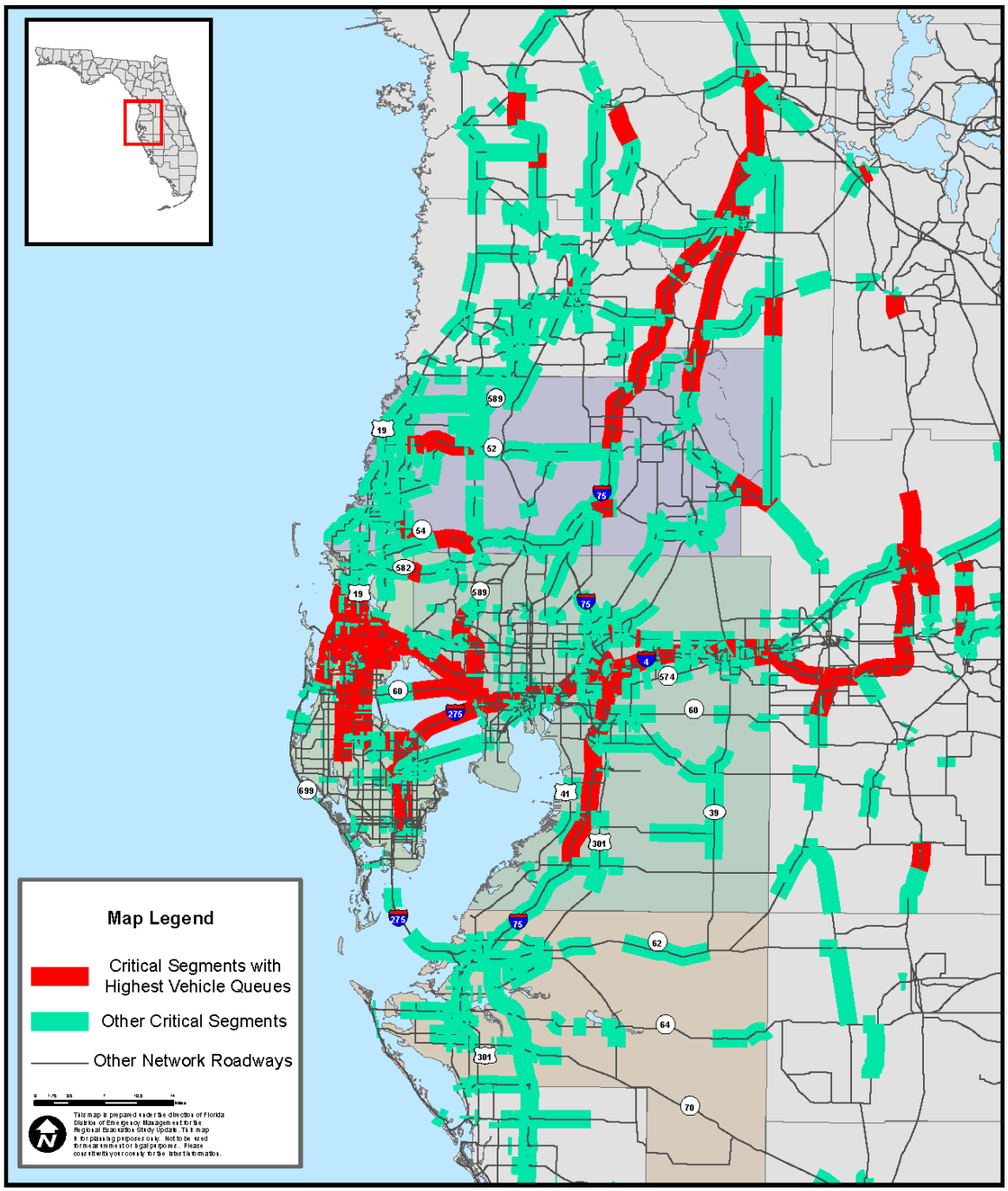


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-5

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

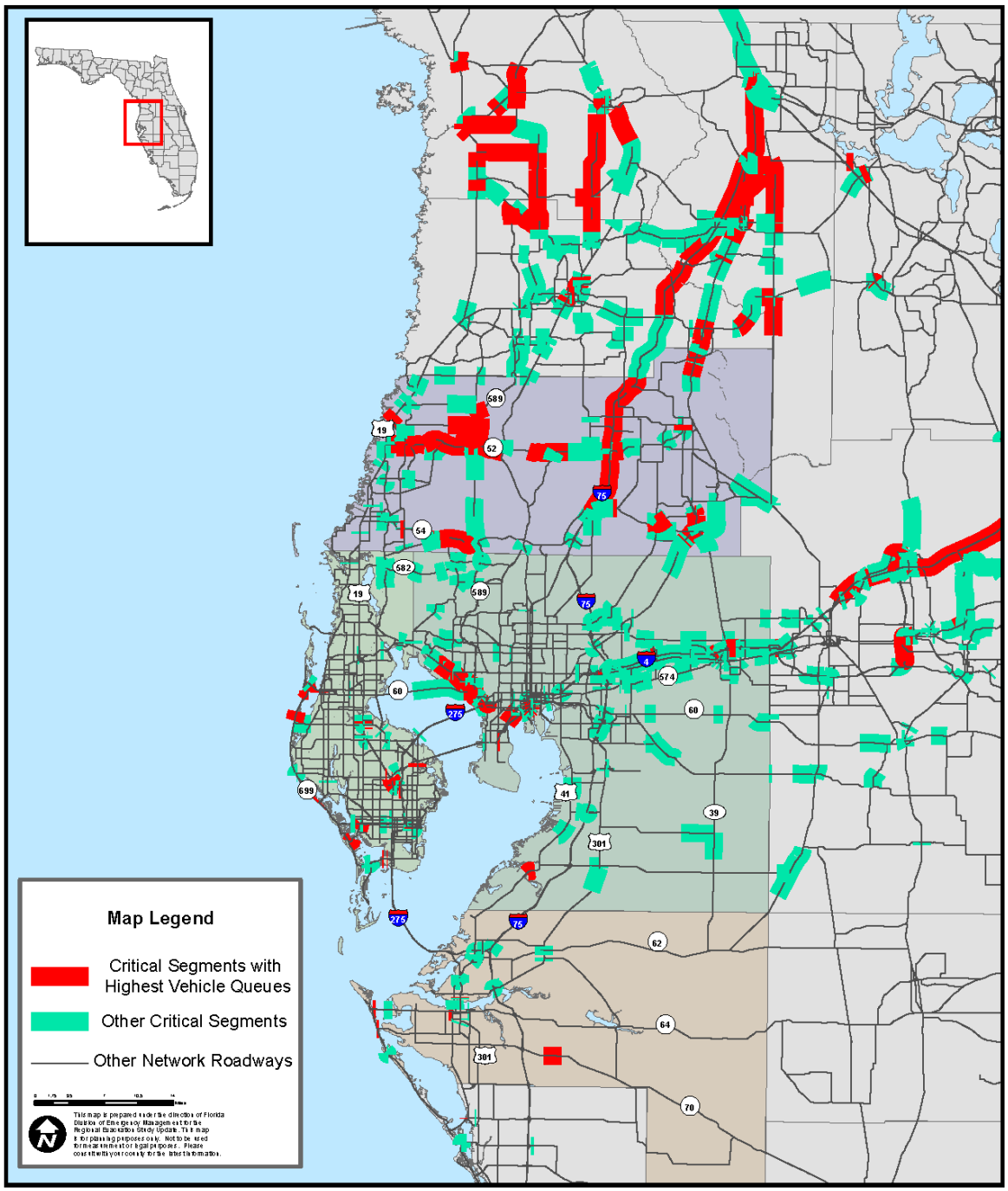


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-6

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Base Scenario Evacuation Level A

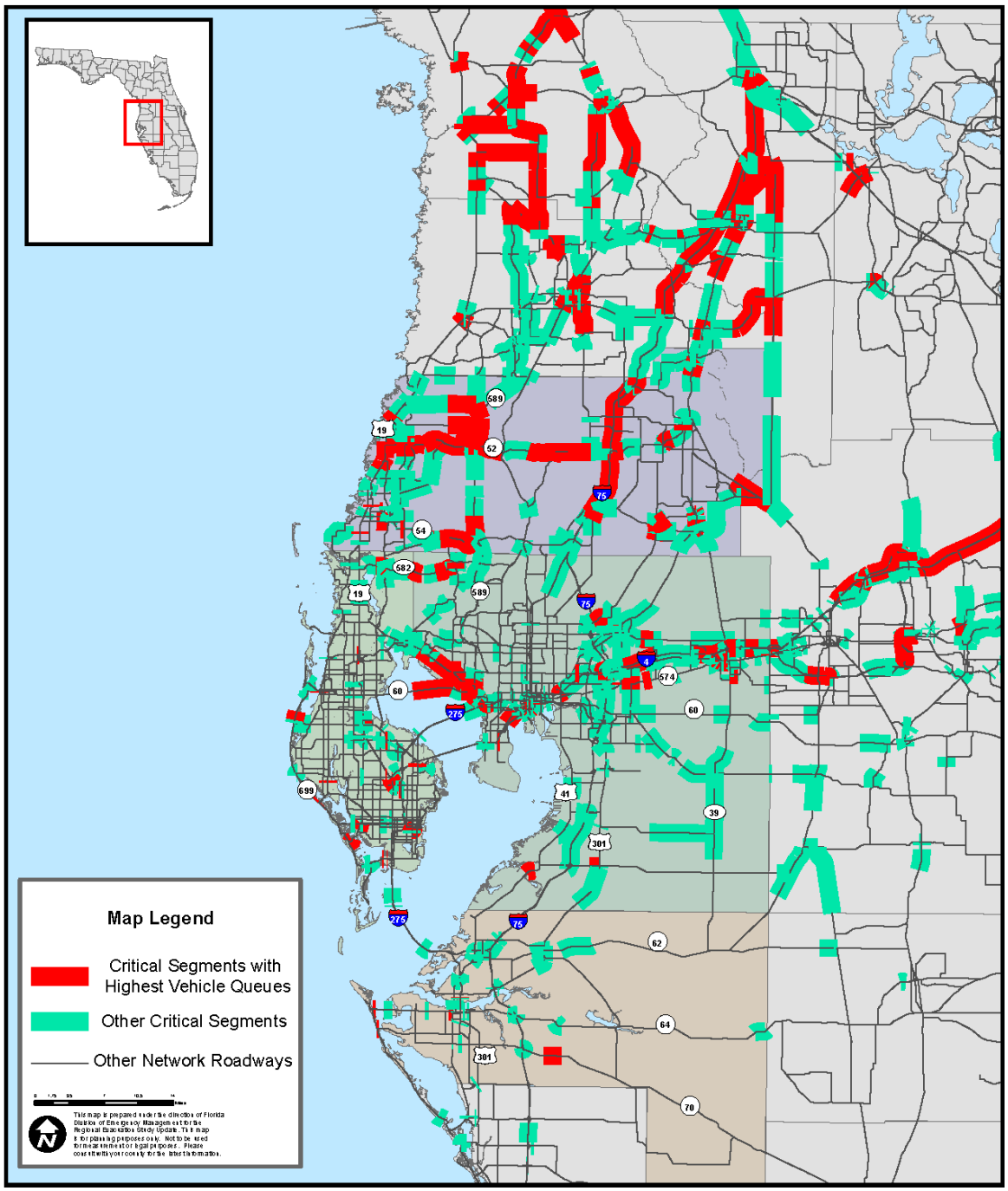


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-7

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Base Scenario Evacuation Level B

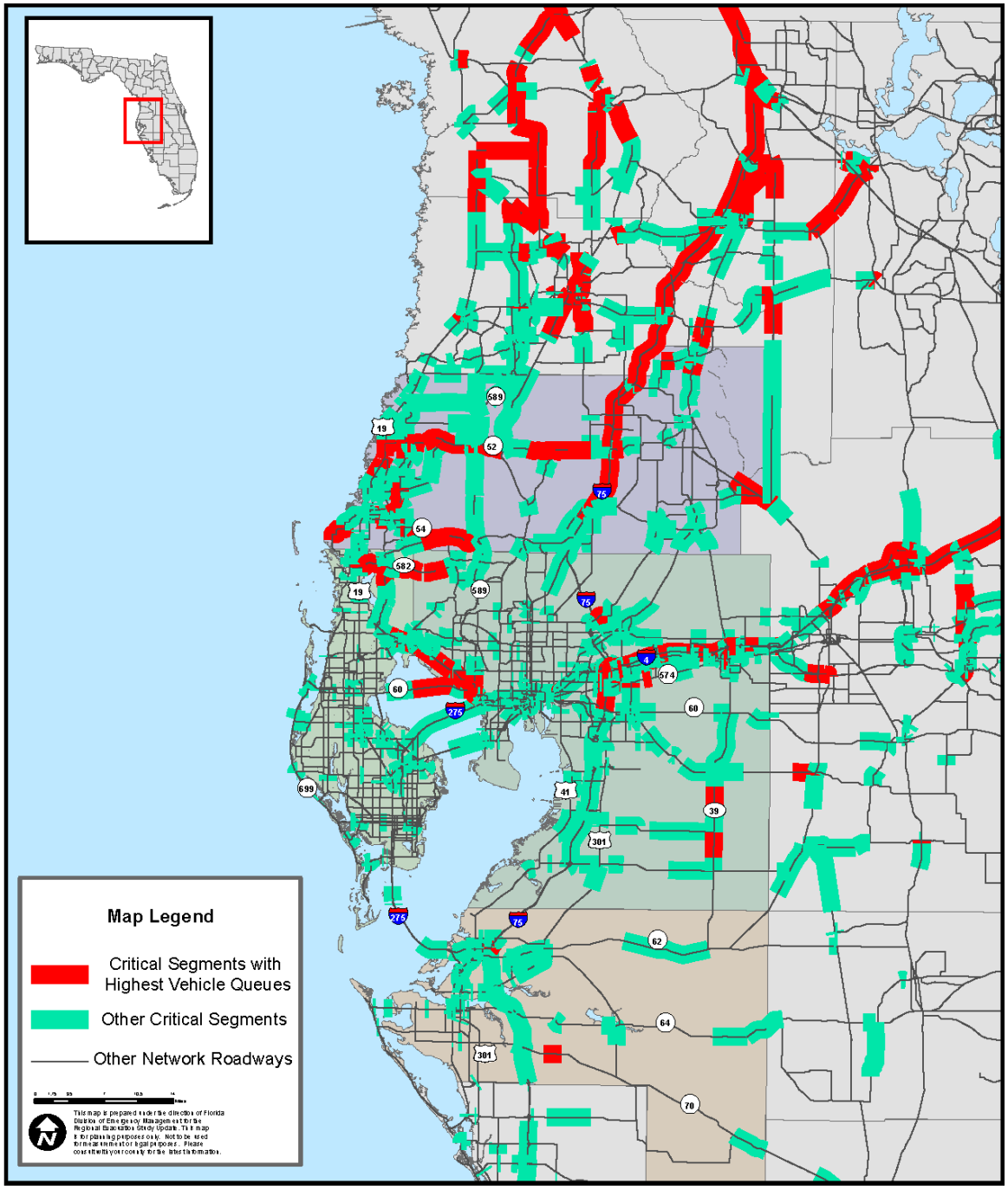


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-8

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Base Scenario Evacuation Level C

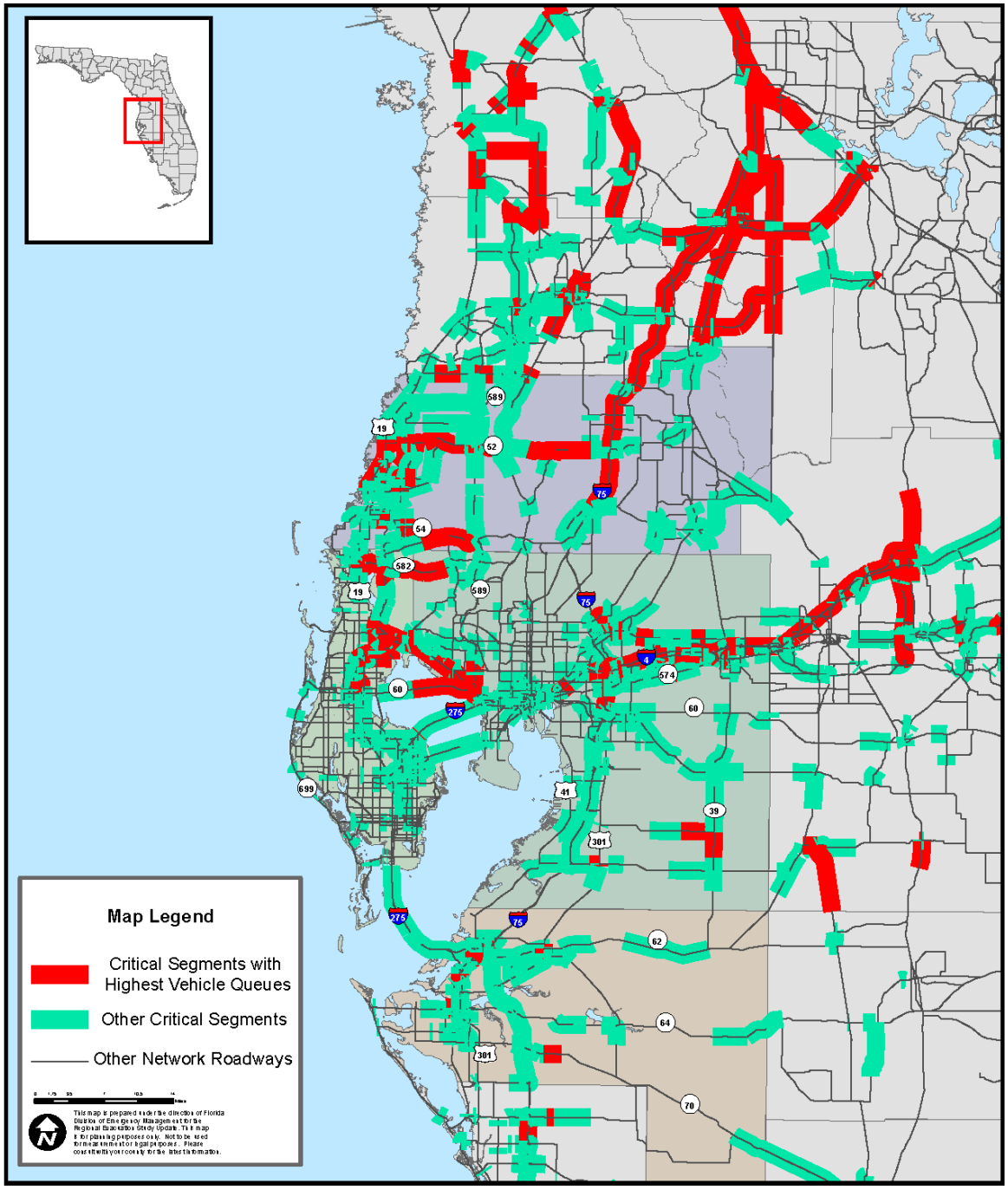


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-9

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Base Scenario Evacuation Level D

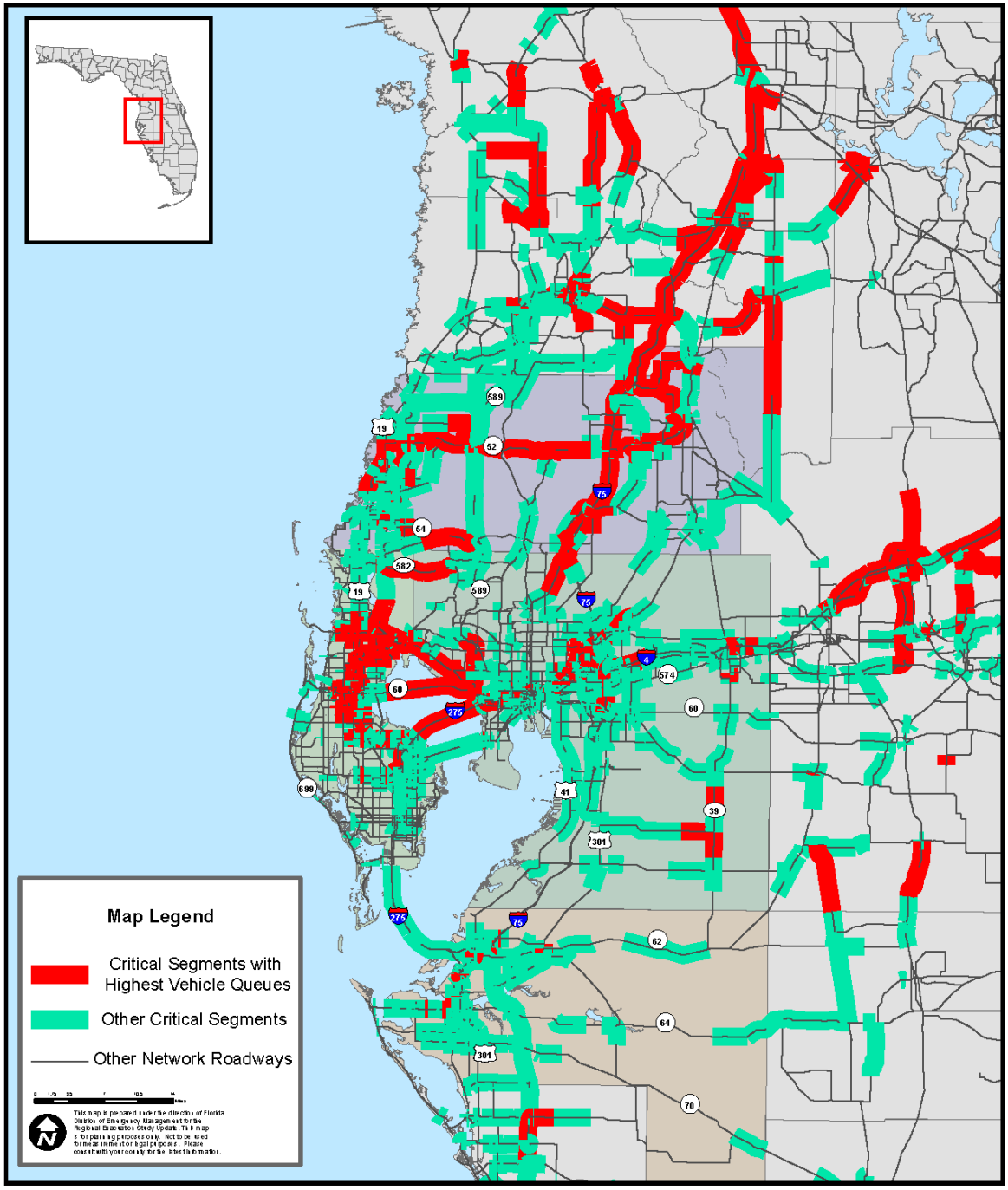


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-10

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Base Scenario Evacuation Level E



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Table IV-13 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2015 Base Scenario

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 589 Northbound	24,500	36,700	47,800	46,700	58,600
US 41 Northbound	800	2,600	4,600	3,400	4,900
I-75 Southbound	2,400	3,200	4,400	5,100	6,700
I-275 Northbound	24,900	27,600	31,600	39,200	39,200
I-75 Northbound	14,400	16,500	20,500	24,400	27,500
US 301 Northbound	5,500	6,000	6,800	8,400	10,800
SR 60 Eastbound	5,700	8,300	16,500	22,100	23,100
SR 674 Eastbound	2,200	2,700	3,700	3,900	4,700
I-4 Eastbound	59,300	70,800	93,600	110,900	132,500
SR 92 Eastbound	4,300	5,400	6,800	6,400	9,800
SR 597 Northbound	5,200	8,500	11,600	15,100	19,100
Manatee County					
I-275 Northbound	2,700	3,600	7,300	7,300	7,300
US 41 Southbound	700	900	2,000	4,000	5,700
US 41 Northbound	600	2,100	8,300	16,200	15,900
I-75 Northbound	35,700	42,100	53,900	58,700	67,300
I-75 Southbound	7,200	10,200	13,800	16,100	18,100
US 301 Northbound	1,800	3,500	5,800	10,000	8,800
SR 70 Eastbound	3,300	3,800	6,400	9,000	12,100
SR 62 Eastbound	1,800	3,000	4,200	5,100	8,800
SR 64 Eastbound	500	2,400	6,400	10,800	16,100
CR 39 Northbound	100	300	1,300	2,700	2,800
SR 37 Northbound	1,800	2,500	4,400	6,300	6,100
Pasco County					
SR 589 Northbound	21,200	31,000	34,600	35,800	37,100
US 41 Northbound	700	2,800	3,800	6,300	7,800
I-75 Northbound	37,100	41,600	49,900	55,200	63,500
US 98 Eastbound	6,200	9,000	13,100	17,500	22,200
US 19 Northbound	17,100	21,900	33,900	31,200	42,400
US 301 Northbound	12,700	12,900	14,800	15,000	12,800
US 98 Northbound	1,900	3,900	6,100	6,400	6,100
Pinellas County					
Alt US 19 Northbound	1,900	2,700	2,000	1,400	1,900
SR 60 Eastbound	6,000	6,600	8,100	9,400	10,600
I-275 Southbound	8,900	13,300	20,700	26,000	28,400
SR 582 Eastbound	3,400	6,900	13,200	18,600	19,900
SR 580 Eastbound	12,100	17,400	26,300	29,100	32,800
I-275 Eastbound	45,500	55,600	67,000	67,700	69,500
US 92 Eastbound	6,100	10,100	14,700	25,100	25,600
US 19 Northbound	2,200	2,900	2,800	2,300	3,000
CR 611 Northbound	1,200	2,700	1,500	1,200	1,200

Table IV-14 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2020 Base Scenario

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 589 Northbound	28,700	36,600	47,000	48,100	55,700
US 41 Northbound	800	3,100	5,400	5,200	10,700
I-75 Southbound	2,500	3,300	5,000	5,500	7,800
I-275 Northbound	25,400	28,800	35,300	46,900	43,600
I-75 Northbound	15,100	17,100	23,700	25,300	28,800
US 301 Northbound	5,400	7,500	6,800	9,100	24,100
SR 60 Eastbound	6,200	8,500	15,800	19,000	24,100
SR 674 Eastbound	2,500	3,100	3,300	4,100	4,700
I-4 Eastbound	61,500	74,600	99,500	124,700	143,600
SR 92 Eastbound	3,300	6,500	7,900	9,500	11,800
SR 597 Northbound	5,100	9,200	11,600	15,900	19,400
Manatee County					
I-275 Northbound	3,500	3,700	5,200	7,900	9,400
US 41 Southbound	800	900	2,000	3,800	5,500
US 41 Northbound	800	1,400	11,600	10,500	13,100
I-75 Northbound	35,800	43,900	54,600	66,200	70,600
I-75 Southbound	7,300	10,600	15,000	17,000	19,900
US 301 Northbound	1,900	3,700	5,800	8,500	8,600
SR 70 Eastbound	3,200	4,000	7,000	12,000	11,800
SR 62 Eastbound	1,900	2,900	3,900	7,200	8,700
SR 64 Eastbound	700	2,800	6,900	12,300	17,300
CR 39 Northbound	100	500	1,400	2,800	7,100
SR 37 Northbound	1,800	2,400	6,200	8,600	11,000
Pasco County					
SR 589 Northbound	24,500	29,700	33,900	32,500	42,800
US 41 Northbound	1,200	1,400	4,600	8,300	7,300
I-75 Northbound	41,200	46,300	58,100	72,900	83,300
US 98 Eastbound	5,800	8,200	10,600	11,700	14,600
US 19 Northbound	18,000	24,800	34,000	30,900	31,600
US 301 Northbound	10,700	11,700	10,500	11,900	13,700
US 98 Northbound	1,400	5,200	8,700	6,000	16,900
Pinellas County					
Alt US 19 Northbound	1,600	1,800	1,200	1,400	1,400
SR 60 Eastbound	5,900	6,700	8,300	9,500	10,800
I-275 Southbound	8,300	13,200	21,800	26,900	28,200
SR 582 Eastbound	3,900	7,600	14,600	18,600	22,200
SR 580 Eastbound	11,400	16,000	21,100	29,400	31,300
I-275 Eastbound	54,400	65,200	74,200	81,300	82,800
US 92 Eastbound	2,700	6,100	13,600	22,800	30,800
US 19 Northbound	2,200	3,400	2,400	2,100	2,100
CR 611 Northbound	800	1,900	1,700	900	900

Table IV-15 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2015 Base Scenario

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 580 Eastbound	12,100	17,400	26,300	29,100	32,800
SR 60 Eastbound	6,000	6,600	8,100	9,400	10,600
I-275 Eastbound	42,100	48,100	52,900	54,100	57,300
US 41 Northbound	600	2,100	8,300	16,200	15,900
I-75 Northbound	35,700	42,100	53,900	58,700	67,300
US 301 Northbound	1,800	3,500	5,800	10,000	8,800
US 92 Eastbound	6,100	10,100	14,700	25,100	25,600
Manatee County					
I-275 Southbound	9,200	13,700	21,700	26,900	29,000
US 41 Northbound	200	400	1,200	1,800	1,100
US 301 Northbound	100	200	1,900	6,300	7,800
US 41 Southbound	500	1,000	1,300	1,700	1,800
I-75 Southbound	2,400	3,200	4,400	5,100	6,700
I-75 Northbound	18,800	25,400	38,800	40,000	39,100
US 301 Southbound	-	100	100	300	700
Pasco County					
Alt US 19 Northbound	1,900	2,700	2,000	1,400	1,900
SR 589 Northbound	24,500	36,700	47,800	46,700	58,600
US 41 Northbound	800	2,600	4,600	3,400	4,900
I-275 Northbound	24,900	27,600	31,600	39,200	39,200
I-75 Northbound	14,400	16,500	20,500	24,400	27,500
CR 581 Northbound	1,500	2,000	8,100	6,200	14,800
CR 579 Northbound	3,500	4,500	6,700	8,500	10,300
US 301 Northbound	5,500	6,000	6,800	8,400	10,800
US 19 Northbound	2,200	2,900	2,800	2,300	3,000
CR 611 Northbound	1,200	2,700	1,500	1,200	1,200
SR 597 Northbound	5,200	8,500	11,600	15,100	19,100
Pinellas County					
I-275 Northbound	3,400	4,100	7,200	7,300	7,500

Table IV-16 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2020 Base Scenario

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 580 Eastbound	11,400	16,000	21,100	29,400	31,300
SR 60 Eastbound	5,900	6,700	8,300	9,500	10,800
I-275 Eastbound	53,900	63,000	68,200	73,300	77,000
US 41 Northbound	800	1,400	11,600	10,500	13,100
I-75 Northbound	35,800	43,900	54,600	66,200	70,600
US 301 Northbound	1,900	3,700	5,800	8,500	8,600
US 92 Eastbound	2,700	6,100	13,600	22,800	30,800
Manatee County					
I-275 Southbound	8,600	13,600	22,200	27,500	28,900
US 41 Northbound	300	500	1,400	1,800	1,300
US 301 Northbound	200	200	3,000	8,100	7,800
US 41 Southbound	600	1,200	1,200	2,400	2,400
I-75 Southbound	2,500	3,300	5,000	5,500	7,800
I-75 Northbound	20,400	26,500	40,800	43,900	41,600
US 301 Southbound	-	100	100	200	400
Pasco County					
Alt US 19 Northbound	1,600	1,800	1,200	1,400	1,400
SR 589 Northbound	28,700	36,600	47,000	48,100	55,700
US 41 Northbound	800	3,100	5,400	5,200	10,700
I-275 Northbound	25,400	28,800	35,300	46,900	43,600
I-75 Northbound	15,100	17,100	23,700	25,300	28,800
CR 581 Northbound	2,300	3,300	9,300	8,800	13,900
CR 579 Northbound	3,100	5,000	6,400	9,900	7,900
US 301 Northbound	5,400	7,500	6,800	9,100	24,100
US 19 Northbound	2,200	3,400	2,400	2,100	2,100
CR 611 Northbound	800	1,900	1,700	900	900
SR 597 Northbound	5,100	9,200	11,600	15,900	19,400
Pinellas County					
I-275 Northbound	4,300	4,200	5,700	8,100	9,600

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 2015 base scenarios range from 21 hours to 65 hours, depending upon the evacuation level. Hillsborough County has the highest in-county clearance time of 65 hours for the level E scenario due to the influence of trips evacuating from other counties within the region, as well as the size of the county. Clearance time to shelter shows a similar pattern, with clearance times ranging from 13 to 63 hours.

In 2020, in-county clearance times for the base scenarios vary between 21.5 hours for the evacuation level A scenarios and 50 hours for Hillsborough County for the evacuation level E scenario. This shows a marked reduction in clearance time from 2015 due to the completion of several roadway improvement projects throughout the region. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 13 hours for the evacuation level A scenarios to 46.5 hours for Pasco County for evacuation level E scenario in 2015.

Out of county clearance times for the 2015 base scenarios range from 21 to 66 hours for Manatee County, while in 2020 they range from 21.5 hours for the base evacuation level A scenario to 50.5 hours in Pasco County for the evacuation level E scenario in 2020. Again, the drop in clearance time in 2020 is due to the completion of roadway improvement projects. Regional clearance time for the four county TBRPC region ranges from 22.5 hours to 66 hours in 2015.

Table IV-17 – 2015 Clearance Times for Base Scenario

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Clearance Time to Shelter					
Hillsborough	19.0	21.0	23.5	35.5	53.0
Manatee	13.0	13.0	19.5	41.5	41.5
Pasco	22.5	26.0	33.0	39.0	63.0
Pinellas	13.0	14.0	20.5	36.0	62.0
In-County Clearance Time					
Hillsborough	22.0	24.0	29.5	41.5	65.0
Manatee	21.5	22.5	27.0	41.5	60.0
Pasco	22.5	26.0	33.0	39.0	63.0
Pinellas	21.0	22.0	26.5	39.5	64.0
Out of County Clearance Time					
Hillsborough	22.5	24.0	30.0	42.0	65.5
Manatee	21.5	23.5	29.0	41.5	66.0
Pasco	22.5	28.0	33.0	41.0	65.5
Pinellas	21.0	22.0	26.5	39.5	64.0
Regional Clearance Time					
TBRPC	22.5	28.0	33.0	42.0	66.0

Table IV-18 – 2020 Clearance Times for Base Scenario

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Clearance Time to Shelter					
Hillsborough	19.5	22.0	25.5	34.5	42.0
Manatee	13.0	13.5	22.5	35.5	41.0
Pasco	24.0	28.5	35.0	41.0	46.5
Pinellas	13.0	14.5	20.5	31.0	43.5
In-County Clearance Time					
Hillsborough	23.0	25.5	31.5	38.5	50.0
Manatee	21.5	24.5	29.0	35.5	45.5
Pasco	24.0	28.5	35.0	41.0	47.5
Pinellas	21.5	24.0	28.5	34.0	46.5
Out of County Clearance Time					
Hillsborough	23.0	26.0	31.5	38.5	50.0
Manatee	22.5	25.0	29.0	35.5	48.0
Pasco	24.0	28.5	35.0	41.0	50.5
Pinellas	21.5	24.0	28.5	34.0	46.5
Regional Clearance Time					
TBRPC	24.0	28.0	35.0	41.0	50.5

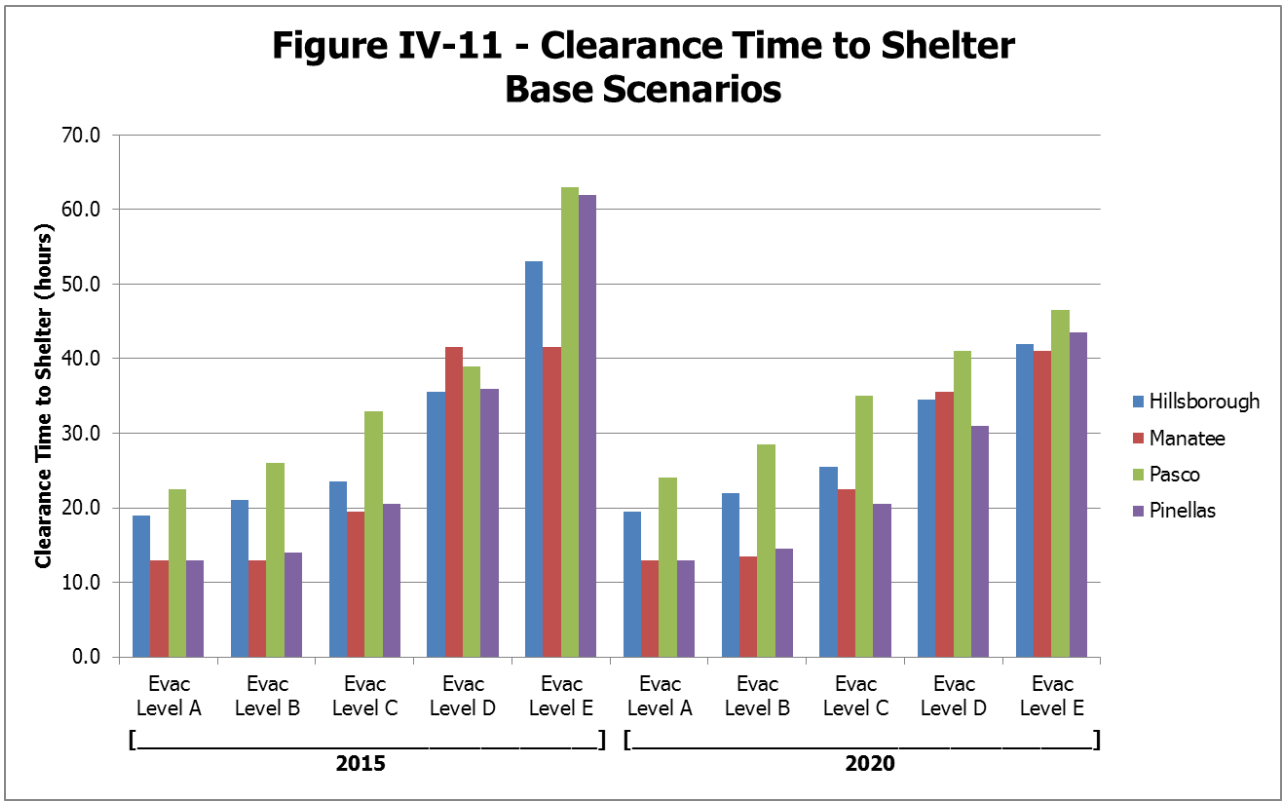


Figure IV-11 - Clearance Time to Shelter
Base Scenarios
Clearance Time to Shelter (hours)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
2015
2020
Hillsborough
Manatee
Pasco
Pinellas

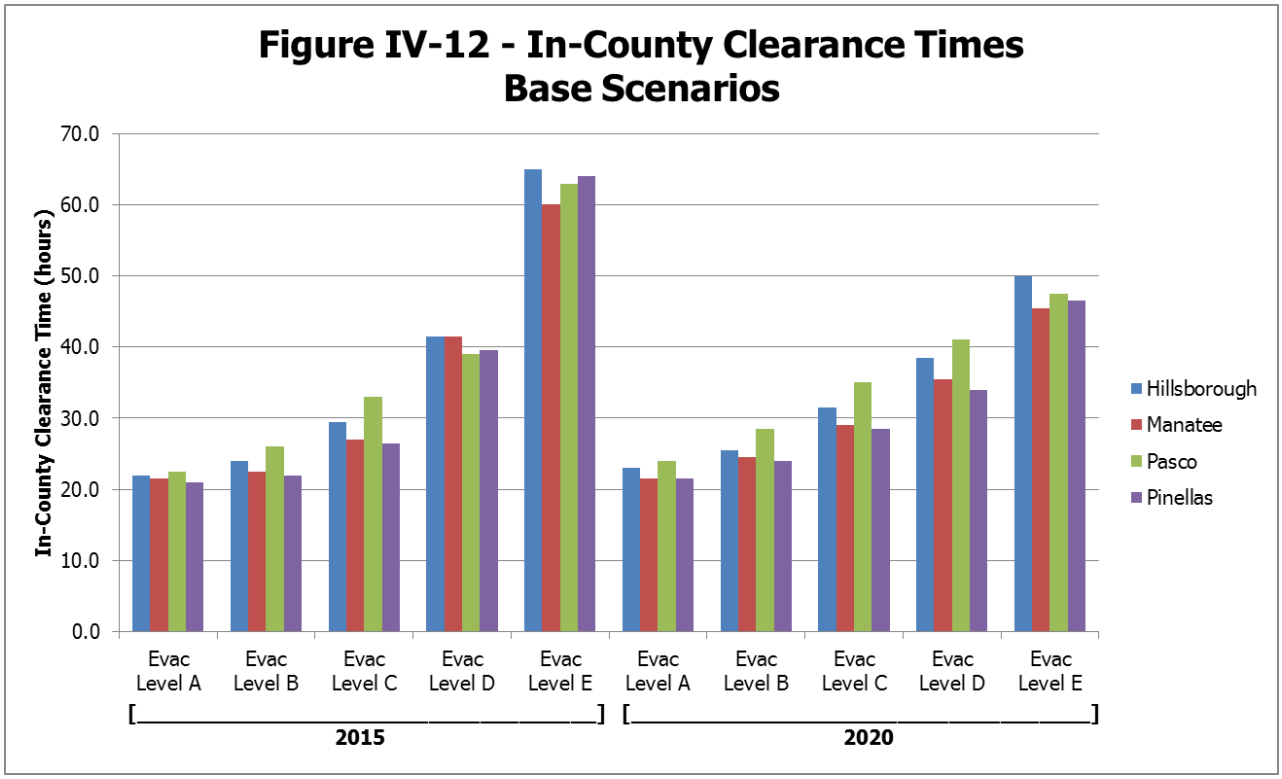
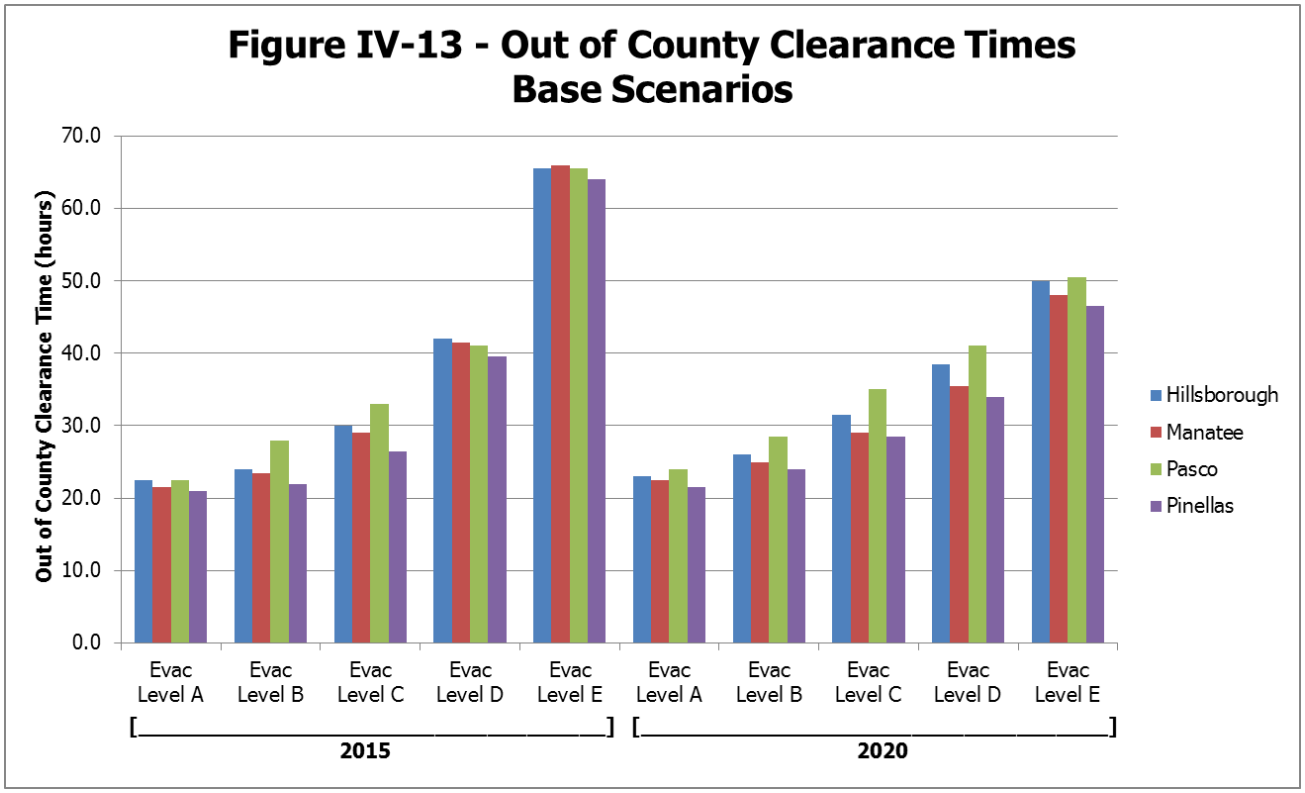


Figure IV-12 - In-County Clearance Times
Base Scenarios
In-County Clearance Time (hours)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
2015
2020
Hillsborough
Manatee
Pasco
Pinellas



F. Operational Scenarios

The transportation analysis also included ten region wide operational scenarios selected by the county emergency managers and RPC staff for the Tampa Bay 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 Tampa Bay Region are illustrated in **Table IV-19**. All ten operational scenarios used the planning assumptions rates, along with the summer session university population. In addition, each of the scenarios used a different response curve, with the level A evacuations using a 9-hour response curve, the level B evacuations using a 12-hour response curve and the level C evacuations using an 18-hour response curve. The level A, B, and C evacuation scenarios also assumed evacuations were ordered in seven counties (Hillsborough, Manatee, Pasco, Pinellas, Sarasota, Hernando, and Charlotte), with the exception of the level C evacuation for 2015 which also added shadow evacuations in Polk County.

The level D and level E evacuation scenarios both used a 24-hour response curve for all counties except Citrus and Hernando, which used an 18-hour response curve. Citrus and Hernando Counties were part of a phased evacuation for both the level D and E evacuation scenarios which started in hour 6 after the rest of the counties began evacuations. Thus, the 18-hour response curve was used for Citrus and Hernando Counties.

The level D and E evacuation scenarios assumed evacuations were ordered in eight counties (Hillsborough, Manatee, Pasco, Pinellas, Sarasota, Hernando, Charlotte, and Citrus). In addition, the level D and E evacuation scenarios included an assumption that the Skyway Bridge (I-275) was closed at hour 18 due to the arrival of tropical storm force winds. The level D and E evacuation scenarios also included a test of the one-way operation of both I-4 and I-75 during the 2015 time period.

(Table follows this page)

Table IV-19 – Operational Scenarios

	Scenario 1 Level A 2015	Scenario 2 Level B 2015	Scenario 3 Level C 2015	Scenario 4 Level D 2015	Scenario 5 Level E 2015
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015 and Skyway Bridge closes at hour 18	2015 and Skyway Bridge closes at hour 18
One-Way Operations	None	None	None	None	None
University Population	Summer	Summer	Summer	Summer	Summer
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	18-hour	24-hour except Citrus & Hernando 18-hour	24-hour except Citrus & Hernando 18-hour
Evacuation Phasing	None	None	None	1hr – Citrus & Hernando start in hour 6	1hr – Citrus & Hernando start in hour 6
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus
	Scenario 6 Level A 2020	**Scenario 7 Level B 2020**	**Scenario 8 Level C 2020**	**Scenario 9 Level D 2020**	**Scenario 10 Level E 2020**
Demographic Data	2020	2020	2020	2020	2020
Highway Network	2020	2020	2020	2020 and Skyway Bridge closes at hour 18	2020 and Skyway Bridge closes at hour 18
One-Way Operations	None	None	None	Yes, I-4 & I-75	Yes, I-4 & I-75
University Population	Summer	Summer	Summer	Summer	Summer
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	18-hour	24-hour except Citrus & Hernando 18-hour	24-hour except Citrus & Hernando 18-hour
Evacuation Phasing	None	None	None	1hr – Citrus & Hernando start in hour 6	1hr – Citrus & Hernando start in hour 6
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Zone	A	B	C	D	E
Counties Evacuating	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Polk	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus	Hillsborough Manatee Pasco Pinellas Sarasota Hernando Charlotte Citrus

G. Operational Scenario Results

Each of the ten operational scenarios were modeled for the Tampa Bay 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 four county region. Evacuating population for the operational scenarios is summarized by county for 2015 in **Table IV-20** and for 2020 in **Table IV-21**.

Within the four county region, total evacuating population ranges from more than 611,000 persons for the operational scenario level A evacuation to more than 1.8 million persons for the operational scenario level E evacuation in 2020. By 2020, this range increases within the four counties to more than 644,000 persons for the operational scenario level A evacuation and more than 1.9 million persons for the operational 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 operational scenarios are summarized by county for 2015 in **Table IV-22** and for 2020 in **Table IV-23**.

The total number of evacuating vehicles within the four county region for the operational scenarios also varies by evacuation level. A total of more than 345,000 vehicles evacuate from the four county region for the operational scenario level A evacuation in 2015, and this number increases to slightly more than 947,000 evacuating vehicles from the four county region for the operational scenario level E evacuation in 2015. By 2020, the number of evacuating vehicles is expected to increase to nearly 361,000 vehicles for the operational scenario level A evacuation to just over 1 million evacuating vehicles for the operational scenario level E 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 four county region ranges from more than 49,000 persons for the operational scenario level A evacuation in 2015 to more than 145,000 persons for the operational scenario level E evacuation. By 2020, the public shelter demand is expected to increase to more than 51,00 persons for the level A evacuation and nearly 154,000 persons for the level E evacuation.

Table IV-20 – 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	[illegible]
Hillsborough County					
Site-built Homes	147,048	180,826	288,381	374,648	514,572
Mobile/Manuf. Homes	52,678	60,378	66,614	75,682	80,468
Tourists	7,053	12,698	16,140	17,508	17,587
TOTAL	206,779	253,902	371,135	467,838	612,627
Manatee County					
Site-built Homes	39,893	56,589	90,354	143,343	185,941
Mobile/Manuf. Homes	32,098	34,431	37,794	40,127	42,170
Tourists	10,217	10,906	12,481	13,410	24,210
TOTAL	82,208	101,926	140,629	196,880	252,321
Pasco County					
Site-built Homes	39,893	56,589	90,354	143,343	185,941
Mobile/Manuf. Homes	32,098	34,431	37,794	40,127	42,170
Tourists	10,217	10,906	12,481	13,410	24,210
TOTAL	82,208	101,926	140,629	196,880	252,321
Pinellas County					
Site-built Homes	162,913	212,176	334,273	426,678	532,509
Mobile/Manuf. Homes	35,229	38,064	42,661	45,906	47,885
Tourists	14,509	18,489	18,765	19,671	20,205
TOTAL	212,651	268,729	395,699	492,255	600,599

Table IV-21 – Evacuating Population by Operational Scenario for 2020

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	[illegible]
Hillsborough County					
Site-built Homes	159,112	195,437	312,258	408,099	560,822
Mobile/Manuf. Homes	52,838	60,557	66,810	75,902	80,703
Tourists	7,891	14,499	18,386	19,939	20,025
TOTAL	219,841	270,493	397,454	503,940	661,550
Manatee County					
Site-built Homes	41,612	59,165	94,667	150,497	195,234
Mobile/Manuf. Homes	31,649	33,950	37,271	39,573	41,590
Tourists	10,776	11,507	13,185	14,167	25,666
TOTAL	84,037	104,622	145,123	204,237	262,490
Pasco County					
Site-built Homes	69,340	85,356	157,953	198,307	243,302
Mobile/Manuf. Homes	36,663	41,847	47,142	48,015	52,597
Tourists	416	955	1,462	1,464	1,464
TOTAL	106,419	128,158	206,557	247,786	297,363
Pinellas County					
Site-built Homes	170,259	221,791	350,441	447,552	558,507
Mobile/Manuf. Homes	35,795	38,676	43,346	46,644	48,654
Tourists	16,395	20,726	21,059	22,076	22,682
TOTAL	222,449	281,193	414,846	516,272	629,843

Table IV-22 – 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	[illegible]
Hillsborough County					
Site-built Homes	76,639	94,349	149,346	193,651	264,152
Mobile/Manuf. Homes	27,841	31,951	35,237	40,031	42,569
Tourists	2,652	4,798	6,160	6,788	7,064
TOTAL	107,132	131,098	190,743	240,470	313,785
Manatee County					
Site-built Homes	20,435	28,629	44,738	69,397	90,014
Mobile/Manuf. Homes	18,405	19,746	21,661	23,002	24,137
Tourists	3,841	4,100	4,692	5,042	9,101
TOTAL	42,681	52,475	71,091	97,441	123,252
Pasco County					
Site-built Homes	36,106	44,796	81,777	101,960	124,504
Mobile/Manuf. Homes	28,134	32,068	36,095	36,799	40,252
Tourists	210	415	608	609	609
TOTAL	64,450	77,279	118,480	139,368	165,365
Pinellas County					
Site-built Homes	93,334	120,962	186,571	236,493	292,992
Mobile/Manuf. Homes	32,113	34,692	38,864	41,843	43,624
Tourists	5,467	7,035	7,444	7,801	8,013
TOTAL	130,914	162,689	232,879	286,137	344,629

Table IV-23 – Evacuating Vehicles by Operational Scenario for 2020

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	(
Hillsborough County					
Site-built Homes	82,697	101,710	161,218	210,453	287,206
Mobile/Manuf. Homes	27,938	32,060	35,355	40,165	42,711
Tourists	2,945	5,460	7,045	7,856	8,381
TOTAL	113,580	139,230	203,618	258,474	338,298
Manatee County					
Site-built Homes	21,163	29,752	46,627	72,550	94,144
Mobile/Manuf. Homes	18,329	19,665	21,579	22,915	24,050
Tourists	4,021	4,294	4,920	5,286	9,577
TOTAL	43,513	53,711	73,126	100,751	127,771
Pasco County					
Site-built Homes	39,621	48,848	89,126	110,875	136,025
Mobile/Manuf. Homes	28,130	32,064	36,091	36,794	40,247
Tourists	352	624	889	890	890
TOTAL	68,103	81,536	126,106	148,559	177,162
Pinellas County					
Site-built Homes	97,120	125,910	194,794	247,103	306,102
Mobile/Manuf. Homes	32,622	35,242	39,479	42,506	44,315
Tourists	6,143	7,904	8,640	9,053	9,301
TOTAL	135,885	169,056	242,913	298,662	359,718

Table IV-24 – Shelter Demand by Operational Scenario

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	(
2015					
Hillsborough	13,945	16,415	24,568	35,964	52,261
Manatee	6,864	8,710	11,805	16,609	21,014
Pasco	12,317	14,190	21,429	24,858	29,409
Pinellas	16,308	19,690	27,896	34,712	42,802
2020					
Hillsborough	14,787	17,433	26,224	38,728	56,410
Manatee	6,997	8,926	12,164	17,199	21,813
Pasco	12,852	14,778	22,594	26,285	31,285
Pinellas	16,874	20,398	29,014	36,147	44,587

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 8 counties stretching from Charlotte County to Citrus 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	
2015	437,355	544,973	792,932	1,061,154	1,299,839
2020	462,454	577,556	931,651	1,133,030	1,389,460

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 Tampa Bay Region are identified in **Figures IV-14** through **IV-23** for each of the operational scenarios for 2015 and 2020.

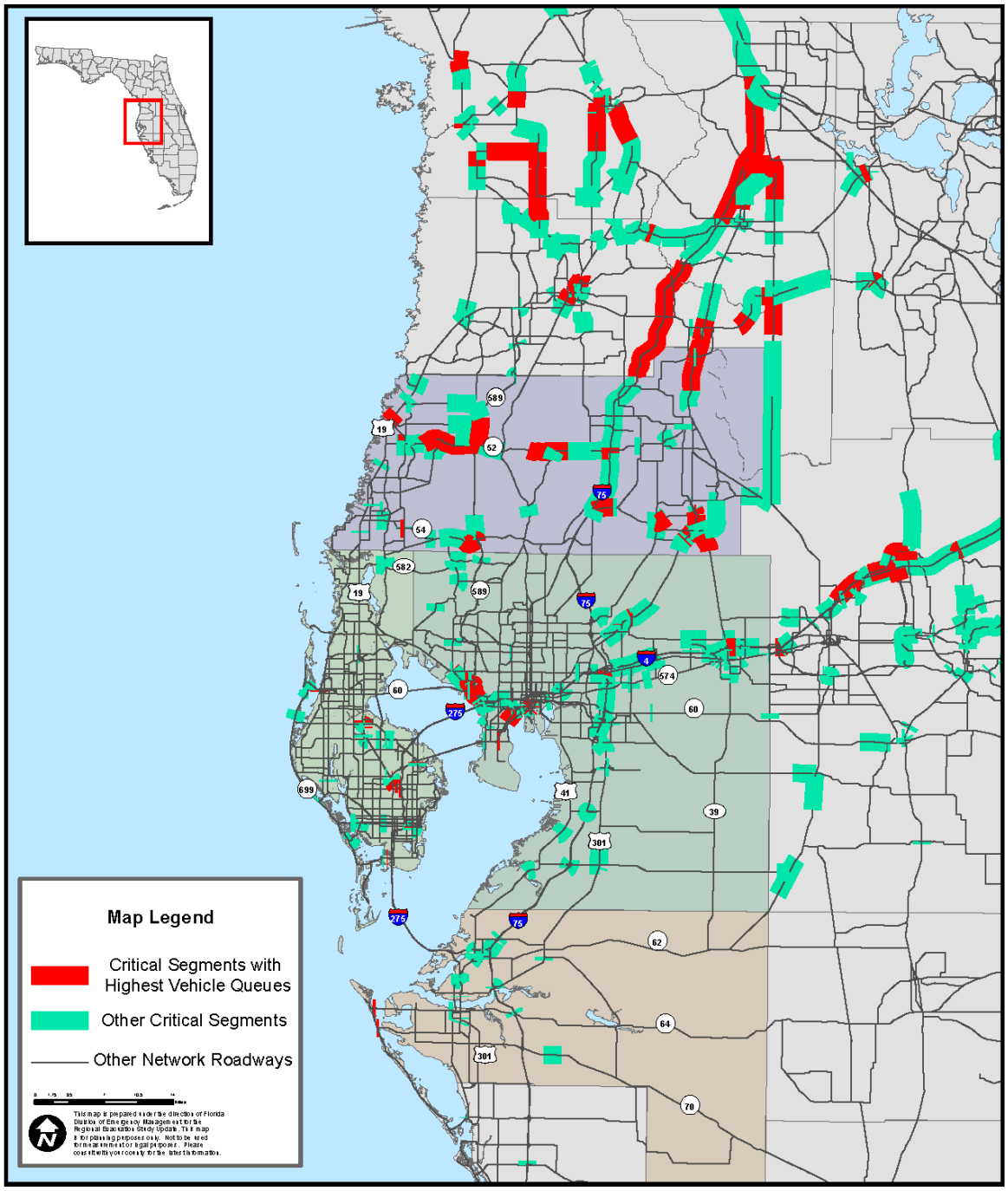
I-75, I-4, and portions of I-275 are critical facilities for the operational scenarios as well. Similar to the base scenarios, during the level A evacuation scenarios the roadway segments with the highest vehicle queues are primarily located outside of the four county region, with the exception of I-75 in Pasco County. In contrast, for the level E evacuation scenarios, the roadway segments with the highest vehicle queues extend throughout the region, including I-275 in Hillsborough and Pinellas Counties, I-4 throughout Hillsborough county, and several US and State Highways as well. The Turnpike/I-75 interchange in Sumter County is clearly an issue in all evacuation scenarios.

Evacuating vehicles exiting each county by major evacuation route are identified in **Table IV-26** for 2015 and **Table IV-27** for 2020. In addition, evacuating vehicles entering each county by major evacuation route are identified in **Table IV-28** for 2015 and **Table IV-29** for 2020. Detailed volume figures for all evacuation routes in the Tampa Bay Region for each operational scenario are included in Volume 5-8.

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-11

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

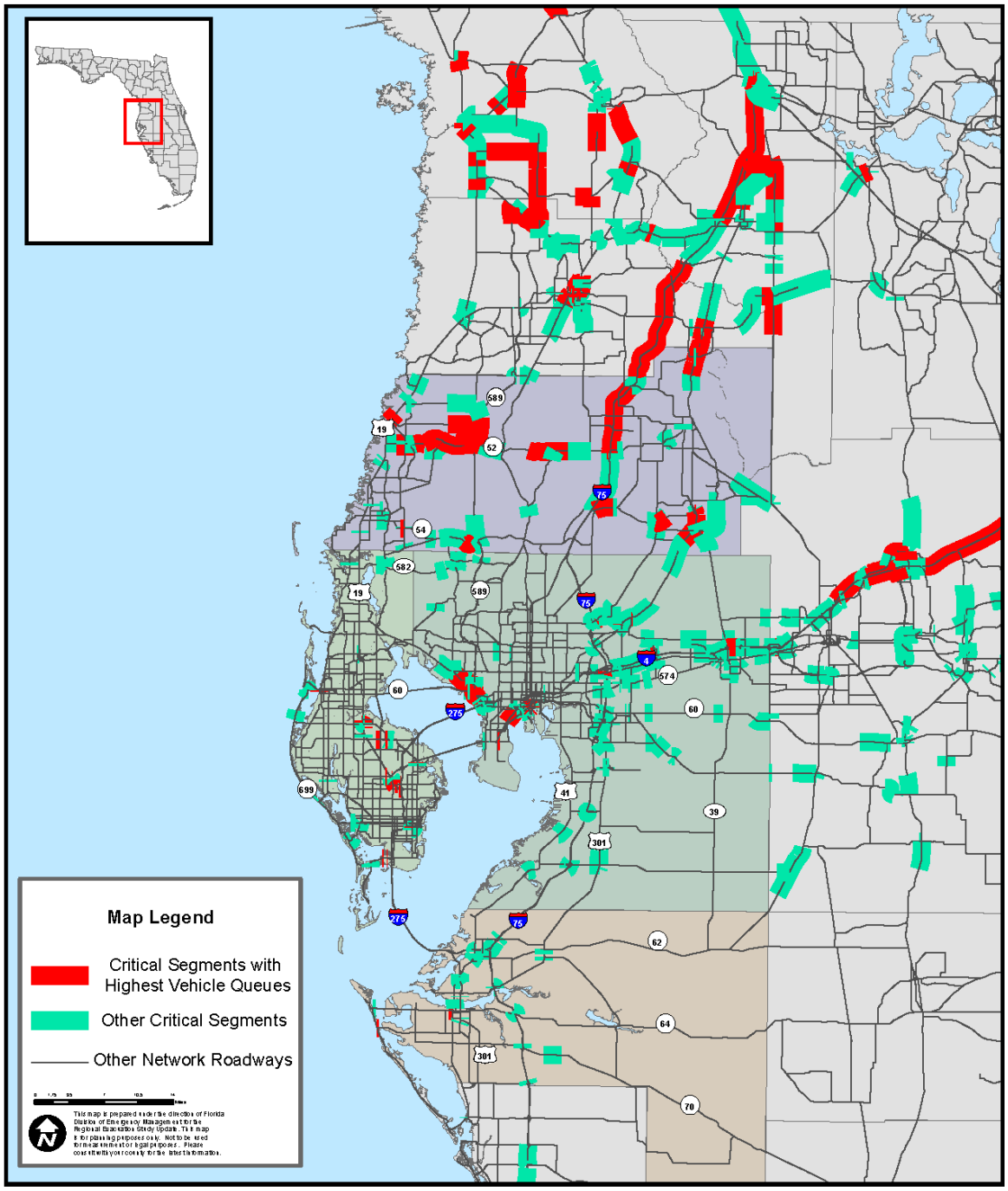


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-12

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

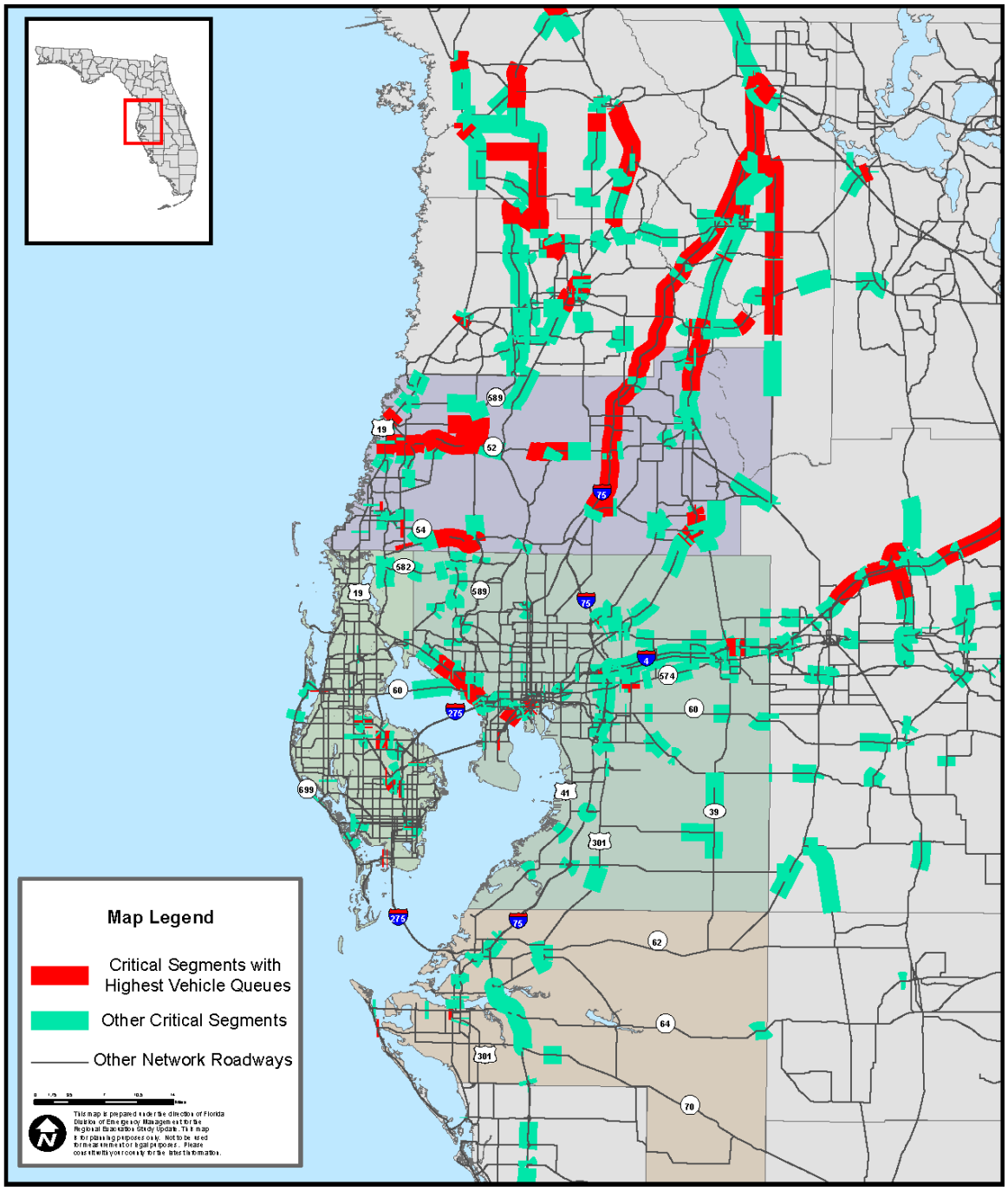


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-13

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

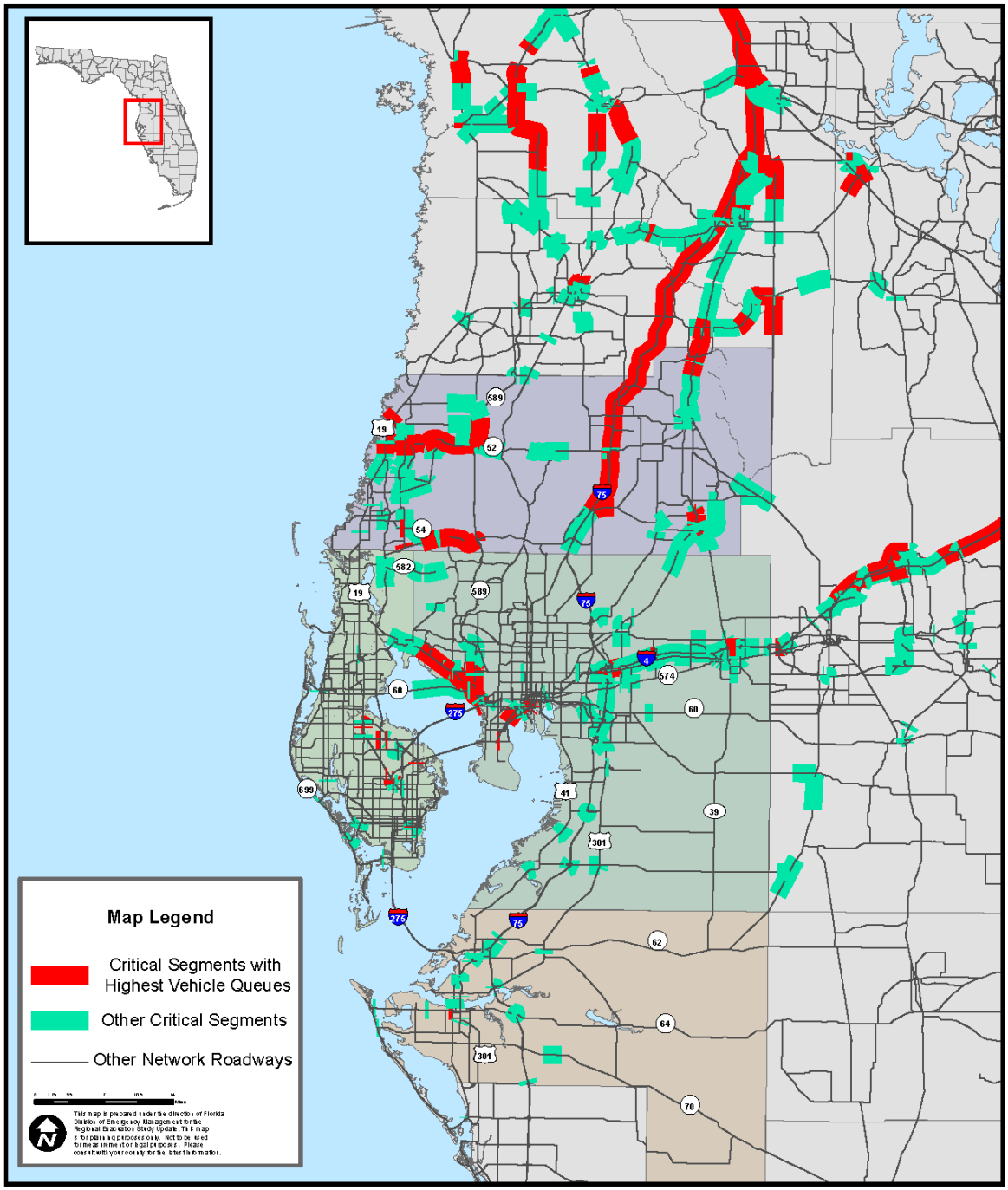


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-14

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

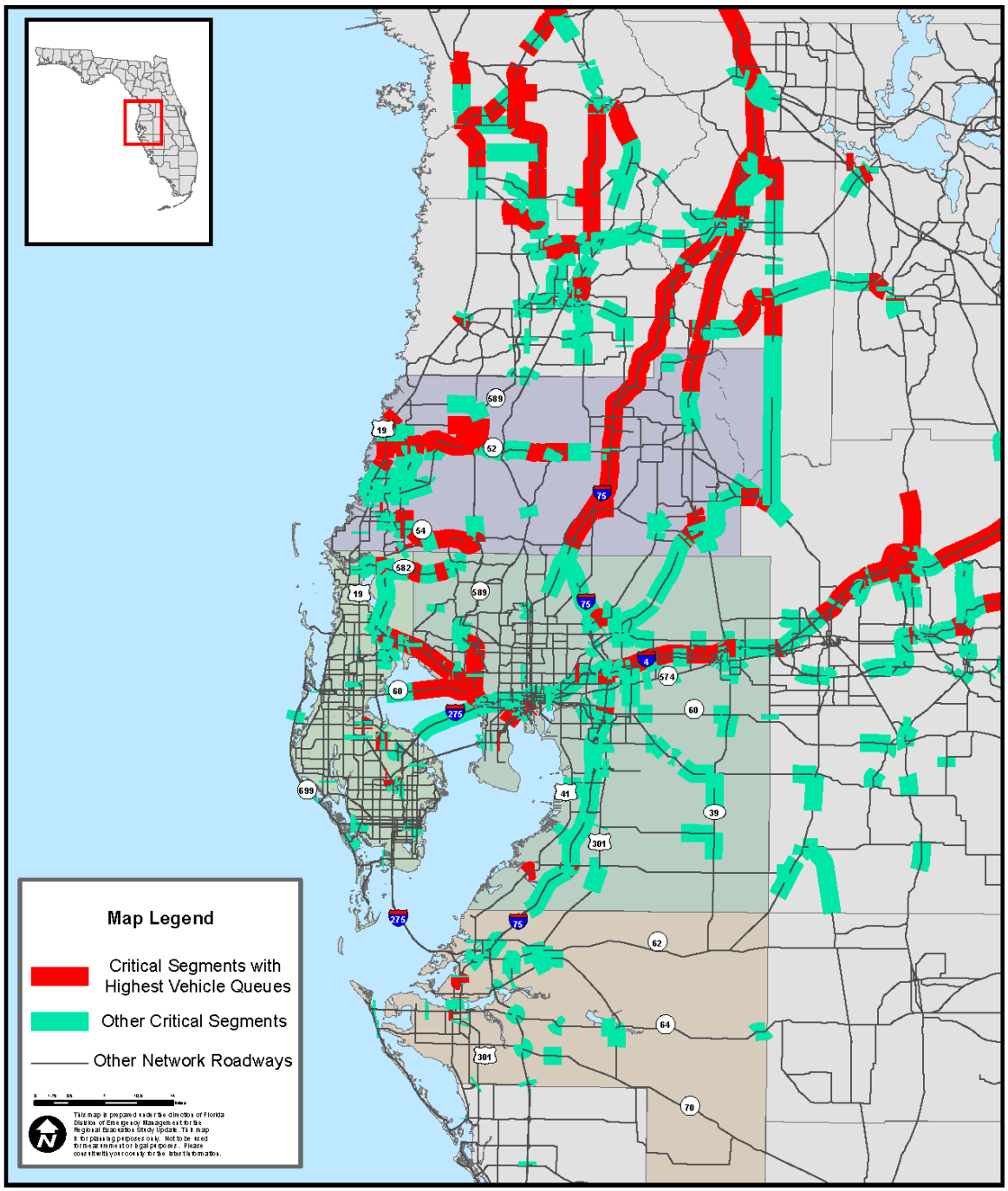


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-15

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

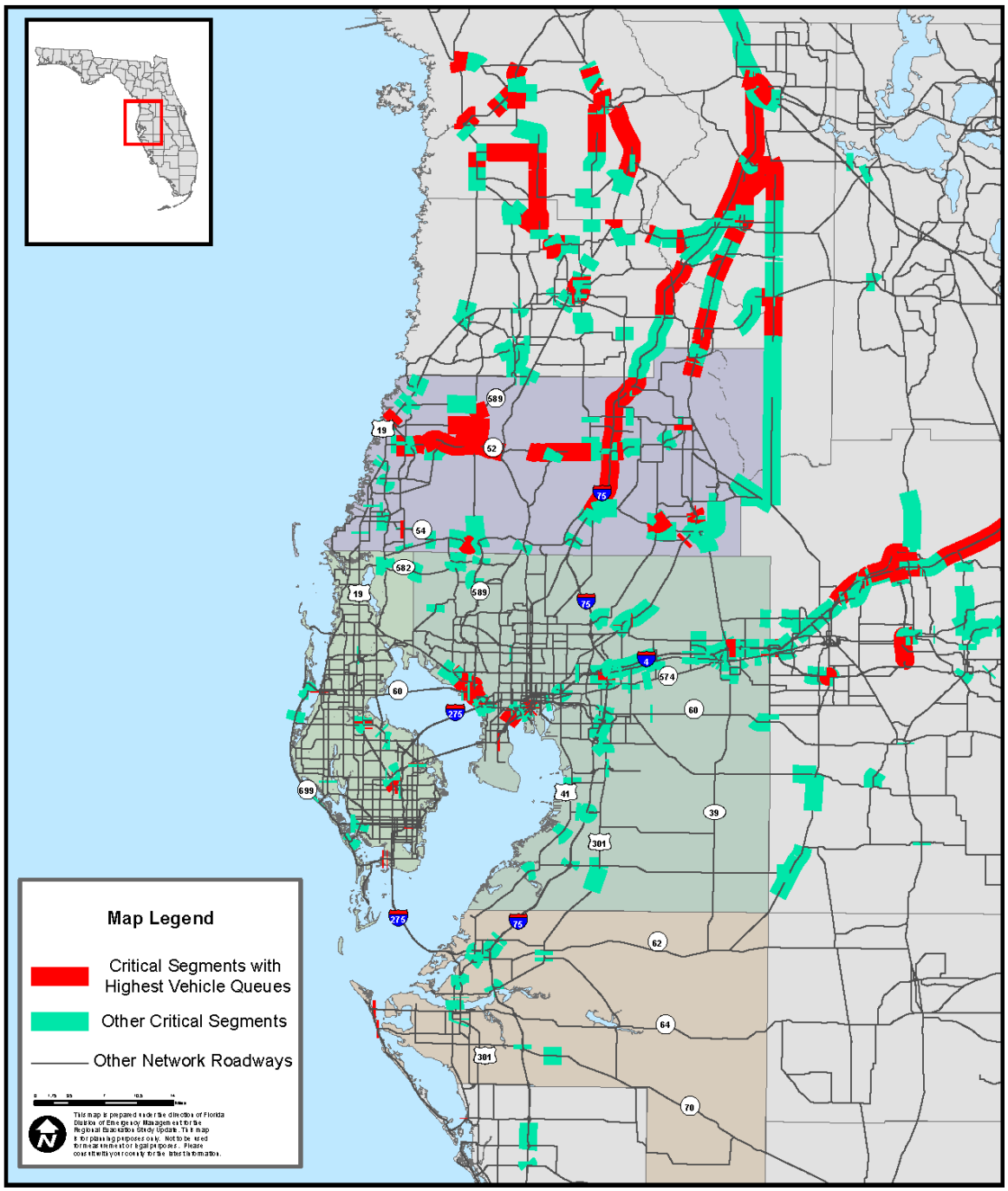


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-16

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Operational Scenario Evacuation Level A

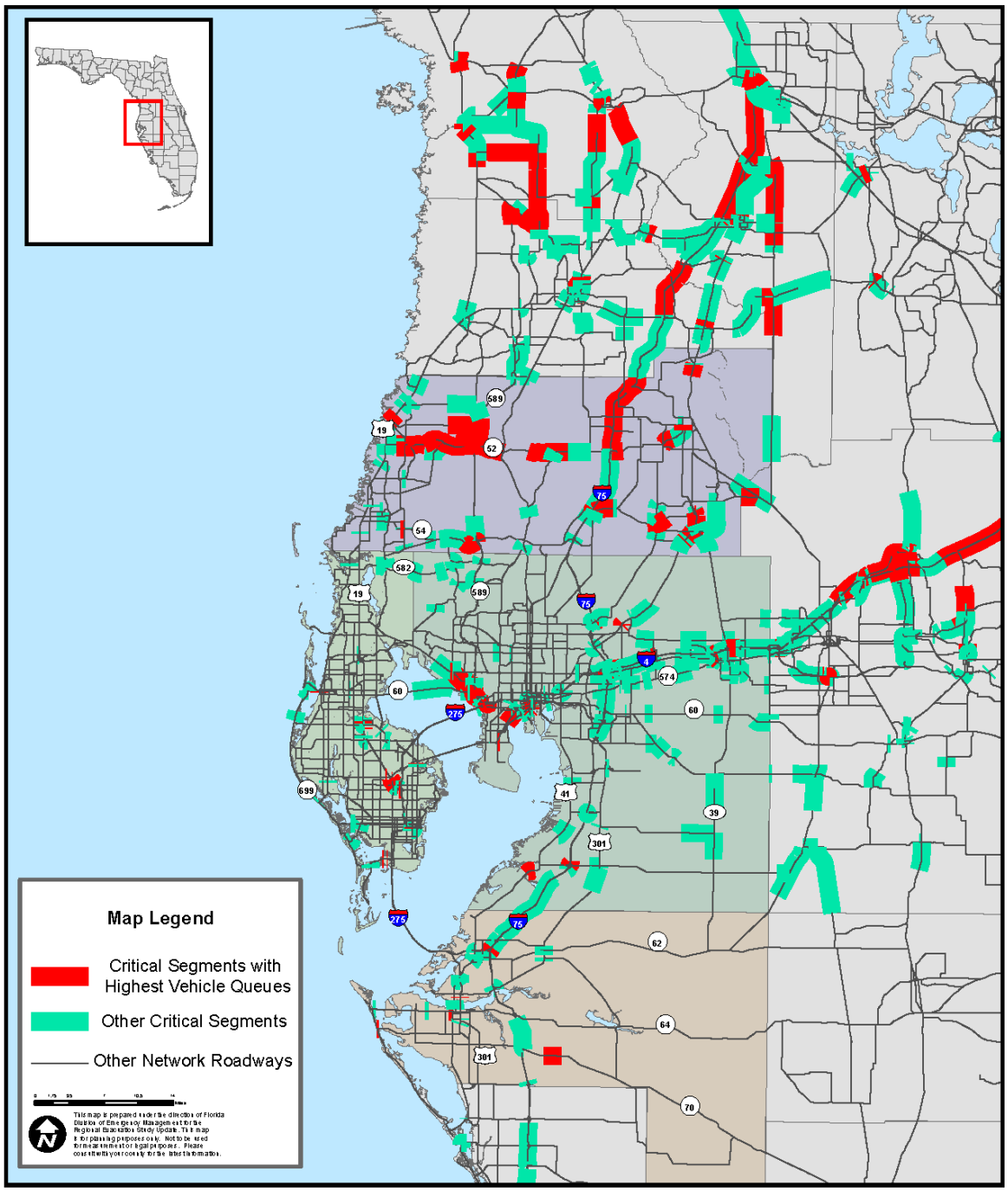


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-17

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Operational Scenario Evacuation Level B

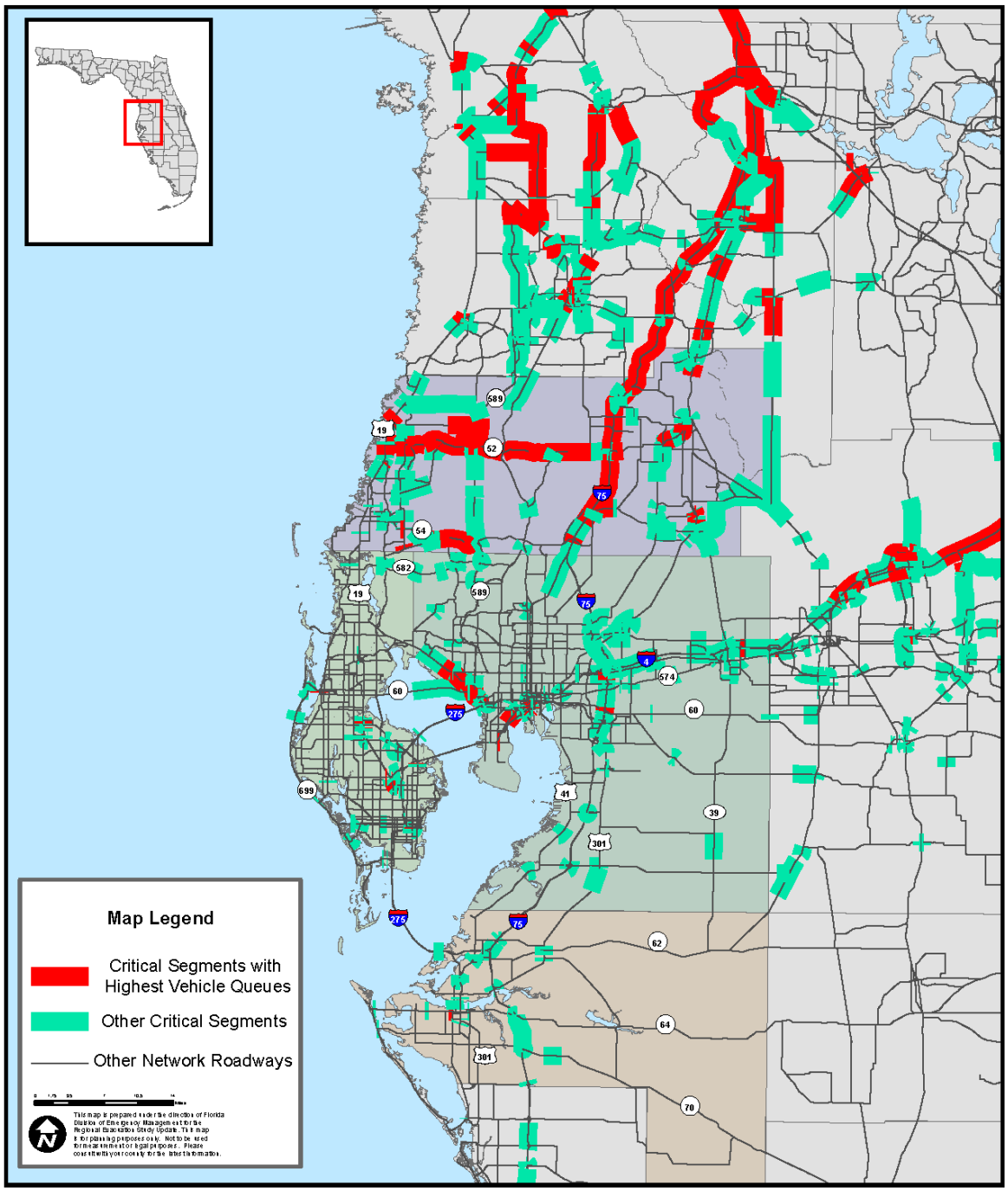


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-18

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Operational Scenario Evacuation Level C

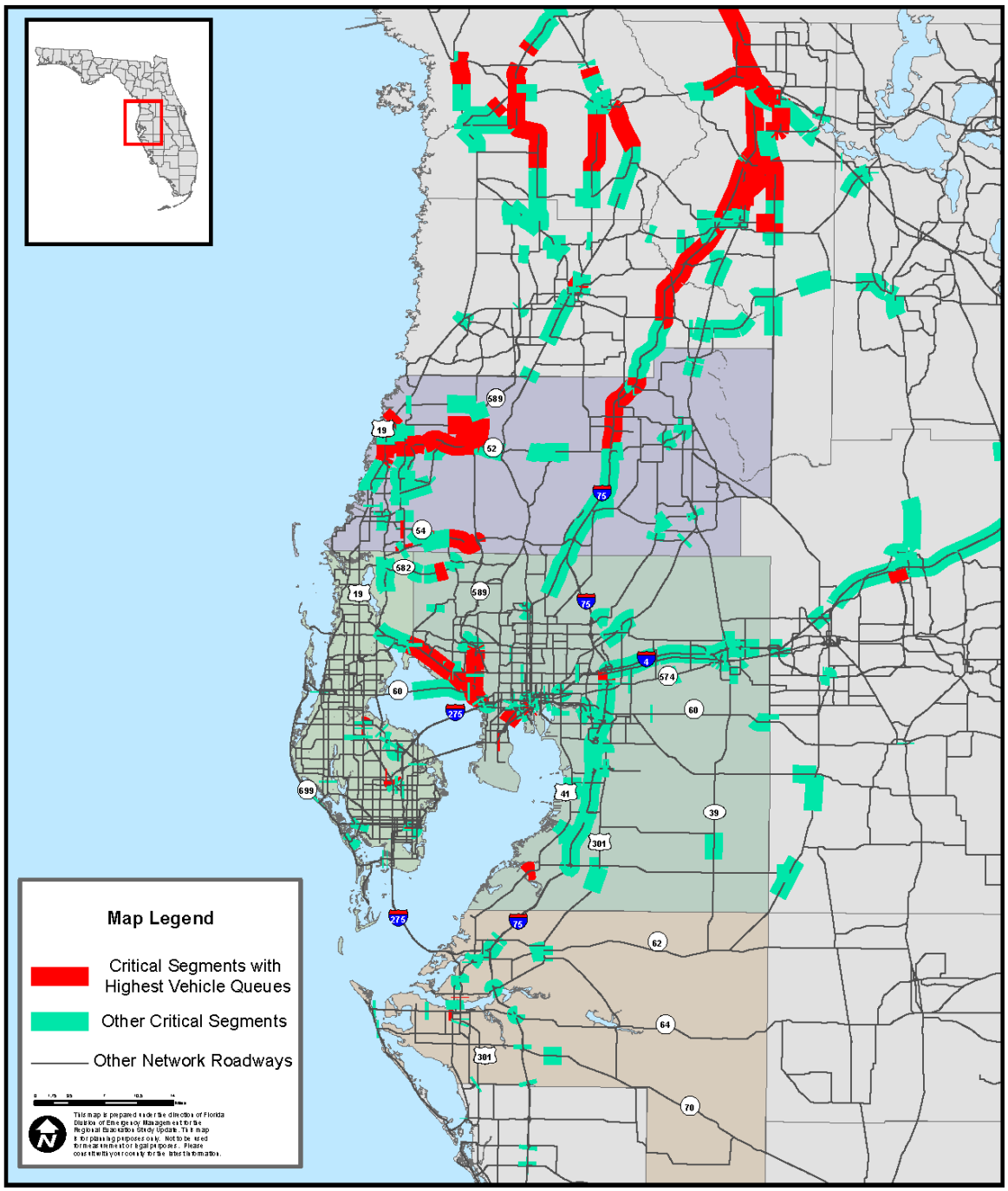


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-19

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Operational Scenario Evacuation Level D

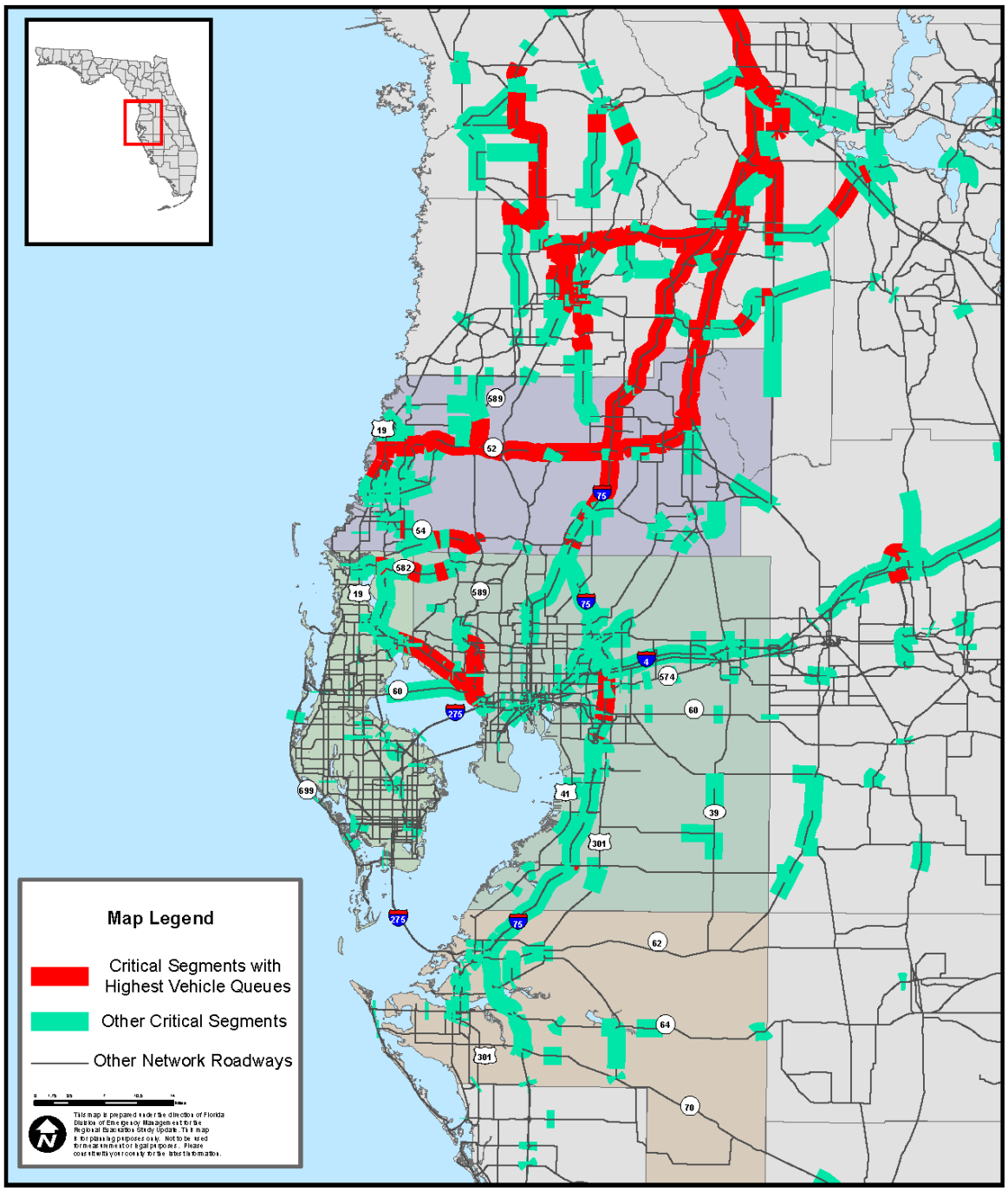


Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Figure IV-20

Critical Roadway Segments with Excessive Vehicle Queues for 2020 Operational Scenario Evacuation Level E



Sources: Tampa Bay Regional Planning Council, CDM Smith

Map Printed: July, 2015

Table IV-26 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2015 Operational Scenarios

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 589 Northbound	21,300	27,500	41,500	52,300	63,400
US 41 Northbound	1,000	1,400	2,000	3,200	5,200
I-75 Southbound	1,500	2,000	3,700	15,800	18,500
I-275 Northbound	15,500	20,100	28,700	38,600	40,300
I-75 Northbound	13,700	18,700	28,400	38,900	44,900
US 301 Northbound	5,200	6,000	6,600	8,400	9,800
SR 60 Eastbound	3,600	6,500	9,400	9,400	16,700
SR 674 Eastbound	2,100	2,000	2,000	5,000	5,200
I-4 Eastbound	44,200	57,000	90,400	130,200	159,000
SR 92 Eastbound	3,100	3,100	4,800	8,700	8,900
SR 597 Northbound	3,700	4,300	7,300	9,000	13,100
Manatee County					
I-275 Northbound	3,800	4,600	7,300	1,100	1,300
US 41 Southbound	500	600	1,100	2,300	3,800
US 41 Northbound	1,500	2,600	3,200	5,300	14,100
I-75 Northbound	33,800	46,400	68,500	101,700	103,600
I-75 Southbound	4,600	6,300	10,300	13,300	16,400
US 301 Northbound	1,900	2,400	4,200	5,700	9,000
SR 70 Eastbound	2,000	2,700	4,500	5,900	7,300
SR 62 Eastbound	700	1,700	1,700	700	5,100
SR 64 Eastbound	300	600	2,800	1,800	9,200
CR 39 Northbound	-	100	1,100	1,200	2,400
SR 37 Northbound	1,300	1,600	3,400	6,000	9,300
Pasco County					
SR 589 Northbound	18,300	23,900	34,400	43,200	50,800
US 41 Northbound	400	800	2,200	1,900	2,100
I-75 Northbound	30,700	39,100	60,400	80,800	91,200
US 98 Eastbound	4,400	5,700	8,200	13,300	16,900
US 19 Northbound	12,400	16,200	25,200	33,100	41,400
US 301 Northbound	9,200	10,300	13,500	16,900	14,500
US 98 Northbound	800	1,400	1,600	2,100	3,500
Pinellas County					
Alt US 19 Northbound	1,500	1,900	1,800	3,100	3,800
SR 60 Eastbound	4,700	5,600	8,000	10,300	12,600
I-275 Southbound	5,400	7,300	11,500	2,400	2,800
SR 582 Eastbound	2,600	3,200	6,800	11,300	16,000
SR 580 Eastbound	7,200	10,000	15,700	19,000	22,300
I-275 Eastbound	34,300	43,000	62,700	84,100	91,100
US 92 Eastbound	3,500	4,800	6,600	10,800	23,900
US 19 Northbound	1,900	2,600	3,300	5,000	5,400
CR 611 Northbound	1,000	1,100	2,600	1,300	1,800

Table IV-27 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2020 Operational Scenarios

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 589 Northbound	22,900	26,000	46,000	45,900	51,200
US 41 Northbound	600	1,300	2,900	2,200	2,500
I-75 Southbound	1,500	2,100	4,200	16,900	20,700
I-275 Northbound	17,700	23,700	38,600	60,700	66,100
I-75 Northbound	14,200	19,900	30,500	46,400	55,100
US 301 Northbound	4,900	5,700	8,300	9,900	13,400
SR 60 Eastbound	4,400	6,300	6,600	8,400	11,700
SR 674 Eastbound	1,600	2,200	3,000	2,600	3,600
I-4 Eastbound	44,900	58,600	87,300	149,800	186,300
SR 92 Eastbound	3,300	3,600	4,900	5,900	6,400
SR 597 Northbound	4,100	5,300	8,100	8,400	15,300
Manatee County					
I-275 Northbound	4,200	5,900	12,700	1,100	2,400
US 41 Southbound	500	600	1,000	1,700	2,600
US 41 Northbound	1,800	2,400	3,500	14,700	20,500
I-75 Northbound	35,800	49,600	69,900	100,200	108,200
I-75 Southbound	4,700	6,400	11,200	14,300	17,900
US 301 Northbound	2,000	2,800	4,600	6,800	10,000
SR 70 Eastbound	2,000	2,800	4,500	6,500	8,200
SR 62 Eastbound	800	1,600	1,600	600	1,300
SR 64 Eastbound	300	800	3,300	4,300	13,400
CR 39 Northbound	300	100	1,000	2,000	2,400
SR 37 Northbound	2,100	2,600	4,300	6,800	10,600
Pasco County					
SR 589 Northbound	19,400	21,600	39,100	38,600	43,800
US 41 Northbound	1,100	800	2,500	3,800	3,200
I-75 Northbound	34,500	44,400	76,200	110,500	131,500
US 98 Eastbound	4,400	6,700	7,800	9,600	15,200
US 19 Northbound	13,400	16,500	27,100	33,000	35,200
US 301 Northbound	8,100	10,200	13,100	14,300	18,200
US 98 Northbound	1,100	1,300	6,200	2,100	4,100
Pinellas County					
Alt US 19 Northbound	1,700	1,900	2,000	1,900	3,600
SR 60 Eastbound	4,600	5,600	8,000	10,100	12,500
I-275 Southbound	5,600	7,500	12,100	2,600	2,700
SR 582 Eastbound	2,600	3,300	6,500	12,200	17,300
SR 580 Eastbound	7,300	10,100	15,400	17,700	20,800
I-275 Eastbound	37,300	48,400	73,800	96,800	110,500
US 92 Eastbound	2,800	3,100	4,400	8,700	17,300
US 19 Northbound	2,200	2,800	4,000	3,900	5,300
CR 611 Northbound	1,000	1,100	3,100	1,100	1,000

Table IV-28 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2015 Operational Scenarios

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 580 Eastbound	7,200	10,000	15,700	19,000	22,300
SR 60 Eastbound	4,700	5,600	8,000	10,300	12,600
I-275 Eastbound	31,300	41,000	58,300	81,100	79,400
US 41 Northbound	1,500	2,600	3,200	5,300	14,100
I-75 Northbound	33,800	46,400	68,500	101,700	103,600
US 301 Northbound	1,900	2,400	4,200	5,700	9,000
US 92 Eastbound	3,500	4,800	6,600	10,800	23,900
Manatee County					
I-275 Southbound	5,500	7,400	11,700	2,400	2,800
US 41 Northbound	300	500	1,300	1,100	2,100
US 301 Northbound	300	600	2,100	2,500	3,400
US 41 Southbound	300	300	600	1,100	1,400
I-75 Southbound	1,500	2,000	3,700	15,800	18,500
I-75 Northbound	25,400	37,200	53,800	73,500	84,400
US 301 Southbound	-	100	100	100	200
Pasco County					
Alt US 19 Northbound	1,500	1,900	1,800	3,100	3,800
SR 589 Northbound	21,300	27,500	41,500	52,300	63,400
US 41 Northbound	1,000	1,400	2,000	3,200	5,200
I-275 Northbound	15,500	20,100	28,700	38,600	40,300
I-75 Northbound	13,700	18,700	28,400	38,900	44,900
CR 581 Northbound	600	900	2,700	1,800	3,100
CR 579 Northbound	2,500	3,400	5,100	6,000	10,000
US 301 Northbound	5,200	6,000	6,600	8,400	9,800
US 19 Northbound	1,900	2,600	3,300	5,000	5,400
CR 611 Northbound	1,000	1,100	2,600	1,300	1,800
SR 597 Northbound	3,700	4,300	7,300	9,000	13,100
Pinellas County					
I-275 Northbound	4,200	4,900	7,700	1,600	1,800

Table IV-29 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2020 Operational Scenarios

Hillsborough County	EVAC A	EVAC B	EVAC C	EVAC D	EVAC E
SR 580 Eastbound	7,300	10,100	15,400	17,700	20,800
SR 60 Eastbound	4,600	5,600	8,000	10,100	12,500
I-275 Eastbound	35,900	46,800	72,900	96,000	107,000
US 41 Northbound	1,800	2,400	3,500	14,700	20,500
I-75 Northbound	35,800	49,600	69,900	100,200	108,200
US 301 Northbound	2,000	2,800	4,600	6,800	10,000
US 92 Eastbound	2,800	3,100	4,400	8,700	17,300
Manatee County					
I-275 Southbound	5,600	7,600	12,300	2,600	2,700
US 41 Northbound	300	600	2,300	2,000	3,400
US 301 Northbound	500	1,100	3,600	3,200	7,400
US 41 Southbound	300	400	700	1,000	1,800
I-75 Southbound	1,500	2,100	4,200	16,900	20,700
I-75 Northbound	28,800	41,600	57,100	82,000	84,800
US 301 Southbound	-	-	-	100	200
Pasco County					
Alt US 19 Northbound	1,700	1,900	2,000	1,900	3,600
SR 589 Northbound	22,900	26,000	46,000	45,900	51,200
US 41 Northbound	600	1,300	2,900	2,200	2,500
I-275 Northbound	17,700	23,700	38,600	60,700	66,100
I-75 Northbound	14,200	19,900	30,500	46,400	55,100
CR 581 Northbound	1,600	1,100	4,700	700	6,300
CR 579 Northbound	2,000	3,400	5,300	3,800	7,200
US 301 Northbound	4,900	5,700	8,300	9,900	13,400
US 19 Northbound	2,200	2,800	4,000	3,900	5,300
CR 611 Northbound	1,000	1,100	3,100	1,100	1,000
SR 597 Northbound	4,100	5,300	8,100	8,400	15,300
Pinellas County					
I-275 Northbound	4,700	6,300	13,100	1,600	2,900

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 2015 operational scenarios range from 16 hours to 51 hours depending upon the scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the operational scenarios ranging from 9.5 hours to 46 hours depending upon the county and the scenario.

In 2020, in-county clearance times for the operational scenarios vary from 17 hours to 56.5 hours for the level E evacuation in Pasco County. The 2020 level E evacuation includes vehicle trips evacuating from as far south as Charlotte County, which causes a large northbound evacuation through Pasco County. Clearance Time to Shelter shows a similar pattern, with clearance times for these scenarios ranging from 9.5 hours to 56.5 hours depending upon the scenario.

Moreover, Out-of-county clearance times for the 2015 operational scenarios range from 17 hours to 58.5 hours for the evacuation level E scenario. The 9-hour response curve for the level A evacuation helps in reducing the clearance time from the base scenario in 2015. Out of county clearance times increase for all counties in 2020 to between 11 and 78 hours depending upon the scenario. Regional clearance time for the four county TBRPC region ranges from 17 hours to 51.5 hours in 2015. The clearance time increases to between 18 and 58.5 hours in 2020.

Table IV-30 – 2015 Clearance Times for Operational Scenarios

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Clearance Time to Shelter					
Hillsborough	14.5	18.0	23.5	35.0	41.0
Manatee	10.0	13.0	23.5	38.5	44.0
Pasco	16.5	21.5	32.0	42.5	46.0
Pinellas	9.5	13.0	19.0	25.0	33.0
In-County Clearance Time					
Hillsborough	16.0	20.5	29.0	42.0	50.5
Manatee	16.5	20.5	27.5	42.5	51.0
Pasco	16.5	21.5	32.0	42.5	46.0
Pinellas	16.5	20.0	27.5	36.5	43.5
Out of County Clearance Time					
Hillsborough	16.5	21.0	29.5	42.0	50.5
Manatee	17.0	21.0	28.5	43.0	51.5
Pasco	17.0	21.5	32.0	42.5	46.0
Pinellas	16.5	20.0	27.5	36.5	43.5
Regional Clearance Time					
TBRPC	17.0	21.5	32.0	43.0	51.5

Table IV-31 – 2020 Clearance Times for Operational Scenarios

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Clearance Time to Shelter					
Hillsborough	15.0	18.5	24.5	40.5	46.0
Manatee	10.0	12.5	24.0	37.0	42.5
Pasco	18.0	22.5	33.0	45.0	56.5
Pinellas	9.5	13.0	19.0	26.0	34.5
In-County Clearance Time					
Hillsborough	17.0	21.5	30.0	46.0	54.0
Manatee	17.5	21.0	28.0	46.5	54.5
Pasco	18.0	22.5	33.0	45.0	56.5
Pinellas	17.0	20.5	28.0	41.5	49.0
Out of County Clearance Time					
Hillsborough	17.5	22.0	30.5	46.0	54.0
Manatee	18.0	21.0	28.5	47.0	55.0
Pasco	18.0	22.5	33.0	45.0	58.5
Pinellas	17.0	20.5	28.0	42.0	49.0
Regional Clearance Time					
TBRPC	18.0	22.0	33.0	47.0	58.5

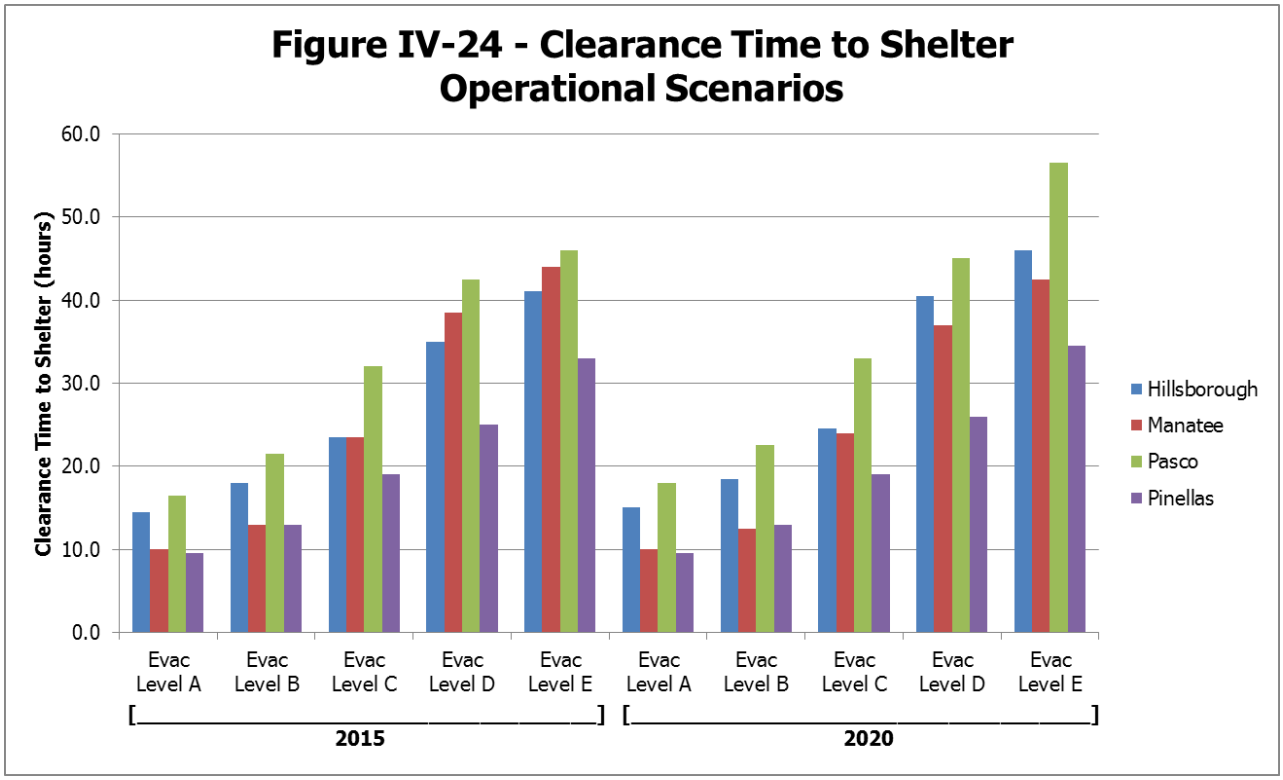


Figure IV-24 - Clearance Time to Shelter
Operational Scenarios
Clearance Time to Shelter (hours)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
2015
2020
Hillsborough
Manatee
Pasco
Pinellas

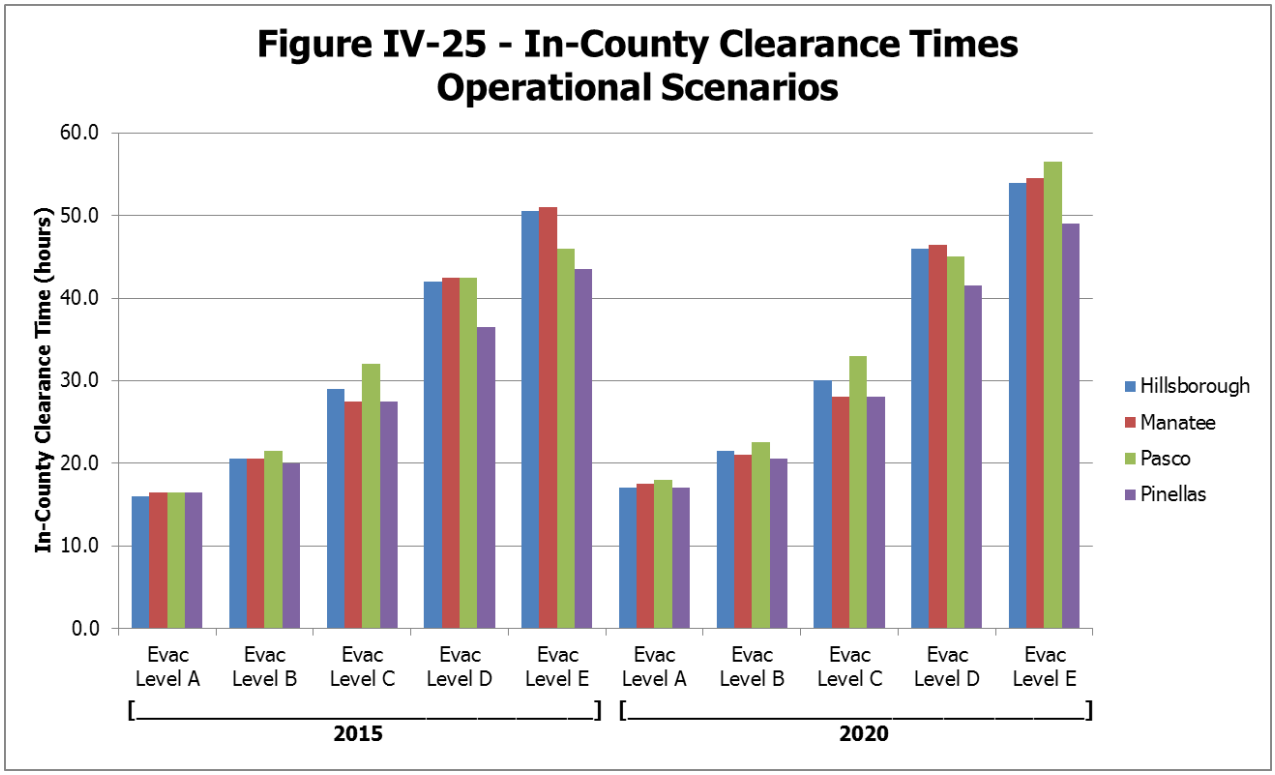


Figure IV-25 - In-County Clearance Times
Operational Scenarios
In-County Clearance Time (hours)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
2015
2020
Hillsborough
Manatee
Pasco
Pinellas

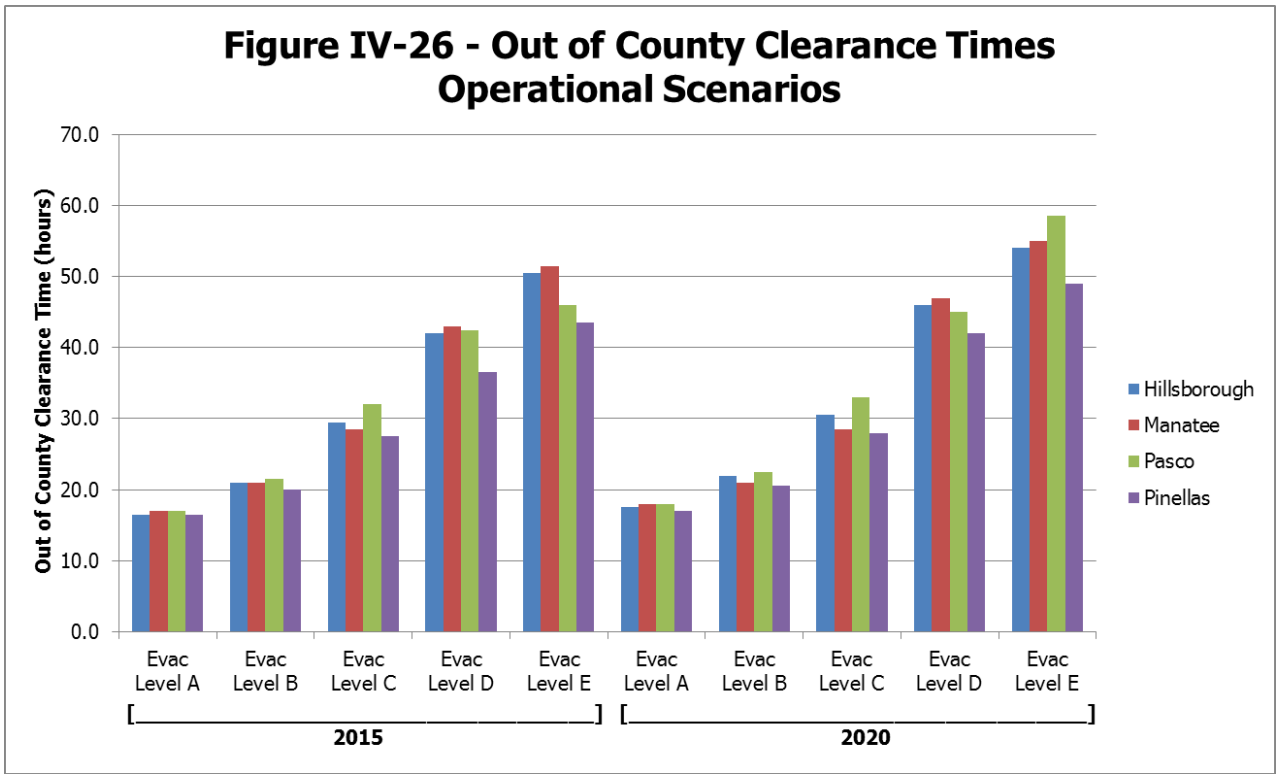


Figure IV-26 - Out of County Clearance Times
Operational Scenarios
Out of County Clearance Time (hours)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
2015
2020
Hillsborough
Manatee
Pasco
Pinellas

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 2015 is identified in **Table IV-31** and for 2020 in **Table IV-32**.

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 2015

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Hillsborough County					
12-Hour	208,970	181,892	185,145	154,384	120,310
18-Hour	287,334	272,837	370,290	231,576	180,465
24-Hour		363,783	277,718	308,769	240,620
36-Hour			462,863	463,153	360,929
Estimated Evacuating Population Clearing Manatee County					
12-Hour	92,051	68,679	70,128	65,851	50,775
18-Hour	111,228	103,019	105,191	97,601	76,163
24-Hour		134,497	140,255	130,134	101,550
36-Hour			169,475	227,735	152,325
Estimated Evacuating Population Clearing Pasco County					
12-Hour	99,137	74,413	89,562	80,822	55,120
18-Hour	140,444	111,620	134,343	121,234	82,680
24-Hour		173,631	179,124	161,645	110,240
36-Hour			246,296	242,467	165,360
Estimated Evacuating Population Clearing Pinellas County					
12-Hour	249,366	211,575	229,918	177,869	121,580
18-Hour	290,927	317,363	344,877	266,803	182,370
24-Hour		387,888	459,836	355,737	243,160
36-Hour			507,736	585,484	364,740

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 2020

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing Hillsborough County					
12-Hour	158,235	177,980	204,480	181,122	170,081
18-Hour	237,352	266,970	306,721	271,683	255,121
24-Hour	303,283	355,961	408,961	362,244	340,162
36-Hour		385,624	494,161	581,099	708,670
Estimated Evacuating Population Clearing Manatee County					
12-Hour	60,391	66,073	87,322	79,869	72,639
18-Hour	90,586	99,110	130,982	119,804	108,959
24-Hour	113,233	132,147	174,643	159,739	145,279
36-Hour		137,653	174,643	236,280	217,918
Estimated Evacuating Population Clearing Pasco County					
12-Hour	74,231	77,111	77,744	86,553	77,023
18-Hour	111,346	115,667	116,616	129,830	115,534
24-Hour	148,461	154,222	155,487	173,107	154,046
36-Hour		183,139	233,231	259,660	231,069
Estimated Evacuating Population Clearing Pinellas County					
12-Hour	169,281	202,482	327,402	216,721	175,489
18-Hour	253,922	303,723	491,103	325,082	263,234
24-Hour	303,296	404,964	654,804	433,442	350,978
36-Hour			532,028	614,043	526,467

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 Tampa Bay 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 TBRPC region include I-75, I-275, and I-4. For large storm events, such as level D and E evacuations, other State facilities also play an important role in evacuations, such as SR 52 and 54 in Pasco County, SR 60 in Pinellas County, and SR 64 in Manatee County. Outside the region, the Turnpike/I-75 interchange in Sumter County is clearly an issue in all evacuation scenarios;

- 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 TBRPC 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. During large storm events in the operational scenarios, evacuations by the vulnerable population in the four TBRPC Counties are impacted by shadow evacuations occurring in other parts of the counties and in areas outside the TBPRC region;

- 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;

- A comparison of the 2015 and 2020 base scenarios clearly indicate that the roadway improvement projects planned for implementation between 2011 and 2015 have an impact in reducing evacuation clearance times. Despite the increased population levels in 2015 within the TBRPC region, clearance times were generally stable between the 2015 and 2015 time periods. The roadway improvement projects were effective in keeping clearance times constant. FDOT, MPOs within the region, and county governments should continue funding roadway improvement projects within the region;

- The State can use the data and information provided in this report (specifically the evacuating vehicle maps in Volume 5-8) 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 west directions; and,

- The counties within the Tampa Bay 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.

- It is important to note that this study contains significant updates and revisions in comparison to the 2010 SRESP study for the Tampa Bay Region. These revisions include updated population projections, modifications to the roadway network due to recently completed and planned construction projects, and changes to the location and size of available shelters. These revisions have significant impacts on evacuating vehicle behavior for the region and caused changes to the calculated clearance times in each county. These updates and revisions make comparisons to the previous 2010 study difficult.

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Funding was provided by the Florida Legislature with funding from the Federal Emergency Management Agency (FEMA) through the Florida Division of Emergency Management. Local match was provided by the Tampa Bay Regional Planning Council and Hillsborough, Manatee, Pasco and Pinellas Counties.

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