

Southwest Florida Region Statewide Regional Evacuation Study Program

**For
Charlotte, Collier, Glades, Hendry, Lee and Sarasota
counties**

Prepared by:
Southwest Florida Regional Planning Council
for the
Florida Department of Community Affairs
Division of Emergency Management



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CREDITS & ACKNOWLEDGEMENTS

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The Statewide Regional Evacuation Study Program was completed by regional planning council staff in all eleven regions of the State. Oversight was provided by a small group, in order to facilitate an overall review of the program. Subject matter expertise was provided by section leads for the major portions of the Study. It was these leaders who ensured that the accepted methodology was utilized across the State and that each section was completed in a consistent manner.

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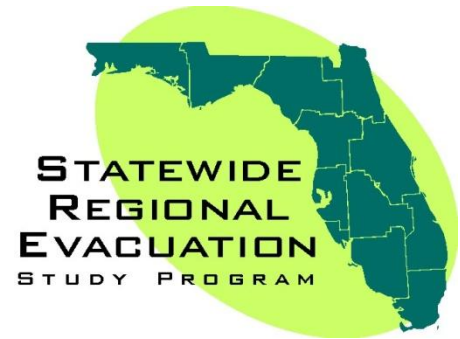
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The Southwest Florida Regional Planning Council (SWFRPC), (Region 9), is one of 11 regional planning councils in Florida established under the authority of Chapter 186, Florida Statutes. It has been in operation since 1973 assisting public, private, and institutional sectors in a six-county area to address regional issues. The Southwest Florida Regional Planning Council offers services to the six counties and participating municipalities of Charlotte, Collier, Glades, Hendry, Lee and Sarasota counties.

The Council is comprised of local government elected officials, gubernatorial representatives and Ex-Officio Members within the region.

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Statewide Regional Evacuation Study Program List of Volumes

Volume 1 – Technical Data Report

The *Technical Data Report (TDR)* is the primary document of the Statewide Regional Evacuation Study Program. The TDR contains the summary analysis of all other supporting research, survey data and modeling.

Volume 2 – Regional Behavioral Analysis

The *Regional Behavioral Analysis* was produced by the behavioral specialist Dr. Earl J. Baker, Hazards Management Group. The report includes a summary of the behavioral survey data and analysis which includes the regional behavioral assumptions incorporated in the calculation of evacuation population, evacuation participation rate (transportation analysis) and anticipated shelter demand.

Volume 3 – Regional Behavioral Survey Report

The *Regional Behavioral Survey Report*, produced by Kerr and Downs, Inc., provides the survey data from the more than 2500 behavioral surveys conducted in 2009 as part of the SRES Program.

Volume 4 – Evacuation Transportation Analysis

The *Regional Evacuation Transportation Analysis* is produced by the evacuation transportation team at Wilbur Smith and Associates. It includes a summary description of the evacuation transportation model, study methodologies and assumptions and growth management impacts assessments on evacuation. The report includes the evacuation clearance times for the counties and the region for 2010 and 2015 under different planning and operational scenarios.

Volume 5 – Evacuation Transportation Supplemental Data Report

The Supplemental Report, prepared by Wilbur Smith and Associates contains the model run inputs and outputs and serves as the source data for the *Evacuation Transportation Analysis*.

Volume 6 – Emergency Management Evacuation Tool Kit

The *Emergency Management Tool Kit* includes locally-selected data pertinent to the county emergency management agency. It is meant to be used as a quick reference guide for operations.

Volume 7 – Storm Tide Atlas

The *Storm Tide Atlas* provides the storm tide boundaries based on the new SLOSH Analysis including the boundaries of the Coastal High Hazard Area (CHHA). It is provided in several formats including GIS files, PDF files and printed copy. There is one Book for each county in the region which has a potential for storm tide flooding.

Volume 8 – Methodology of Evacuation Transportation Modeling for the Statewide Regional Evacuation Study Program, 2010

This volume provides a detailed description of the methodologies, model assumptions and the Transportation Interface for Modeling Evacuations (TIME) developed and utilized in the Statewide Regional Evacuation Study Program.

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Technical Data Report

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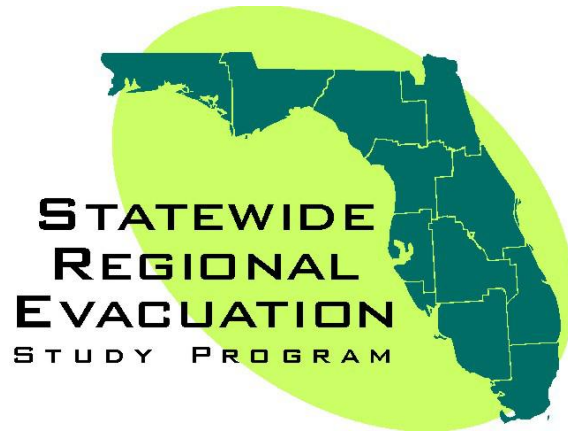
Chapter IV. Regional Population and Vulnerability Analysis

Chapter V. Regional Shelter Analysis

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Volume 1-9

Southwest Florida Region

Technical Data Report

Executive Summary



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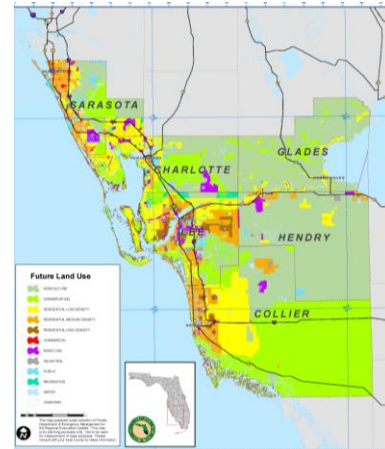
EXECUTIVE SUMMARY

This Executive Summary is provided to state and local governments, volunteer organizations, the media and interested residents to highlight the results of the ***Statewide Regional Evacuation Study for the Southwest Florida Region*** (SRES) and to quantify and to illustrate the challenges of evacuation response in the region and state.

A. DEMOGRAPHIC AND LAND USE ANALYSIS

Located on the west coast of Florida, the Southwest Florida region is approximately 4,148 square miles (land area) with an additional 3,340 square miles of water area and is favored with 4,515 miles of shoreline.

The region consists of six counties: Charlotte, Collier, Glades, Hendry, Lee and Sarasota counties including 16 municipalities. Four of the counties border the Gulf of Mexico and comprise a large portion of the Region's urban area. Two counties are bounded by Lake Okeechobee, the second largest freshwater lake in the United States. According to the 2010 census population estimates, the region's population has reached 1,631,227. Lee County has the largest population in the region and has experienced the largest percent change over the past 10 years at 48%, while the two inland counties, Hendry and Glades, have the lowest population share and experienced the lowest percent growth with 13% and 10%, respectively.



An explosive growth rate had been experienced fueled by people seeking the combination of ample, quality of land and water opportunities and consistent sun that the Southwest Florida region has to offer. All six counties in the region had consistently experienced increases in density (persons per square mile) since 1970. This trend has slowed since 2007 with the economic downturn and, for the first time, the region experienced a decrease in population in 2009¹

Chapter I provides a demographic profile of the region and the counties themselves. Specific socio-economic characteristics that may have an impact on evacuation vulnerability, response and mass care were identified using Census data including recent American Community Survey data.

Information includes:

- Overall Population
- Group Quarters Population
- Housing Units by Type
- Occupied Housing Units (Households)
- Household Size

¹ 2009 Florida Estimates of Population, BEBR

- Seasonal Dwelling Units
- Vehicles per Household
- Age Composition
- Race / Ethnicity
- Place of Birth and Citizenship
- Linguistic Isolation
- Labor Force
- Poverty Status
- Small Area Dwelling Unit and Population Data (TAZ)

The Southwest Florida Region Future Land Use Map is presented on Map I-3. There are 11 categories identified which represent a consolidation of land use categories identified in the local government comprehensive plans in the region (See Table I-17).

- RL Residential Lo (higher than AG < 1DU)
- RH Residential High (more than RM and > 12DU)
- RM Residential Medium (more than RL, < 13DU)
- CONS Conservation, natural and protected
- PUB Public/Semi-Public, government, institutional
- AG Agriculture - rural land, farms (< 0.5DU)
- REC Recreation/Open Space
- COM Commercial, office, tourism, marina
- MU Mixed Use, activity centers, urban village
- WAT Water bodies
- IND Industrial, extractive, transportation

B. REGIONAL HAZARDS ANALYSIS

The Hazards Analyses is the first step in the development of the regional evacuation study. The Hazards Analysis identifies type, extent and probability of those hazards which may confront our region and necessitate a regional evacuation. The Statewide Regional Evacuation Study took an "all-hazards" approach to this evacuation study. The hazards which could necessitate an evacuation at a regional level were identified as (1) tropical storms and hurricanes, (2) flooding, (3) hazardous materials and (4) wildfire.



1. Tropical Storms and Hurricanes

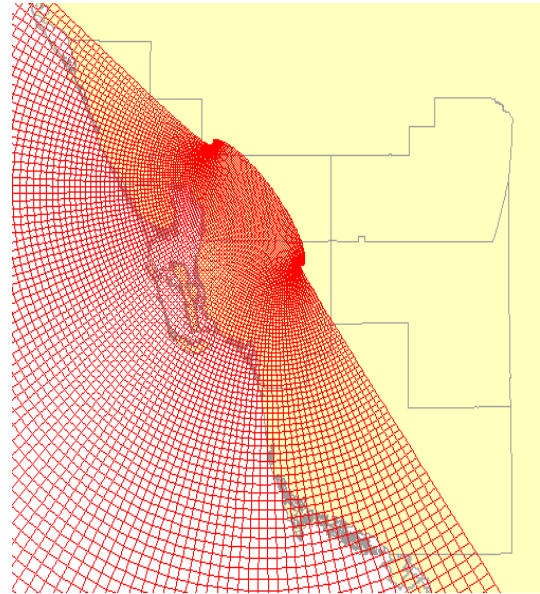
Risks from tropical storms and hurricanes include storm surge, high winds, tornadoes and inland flooding. Storm surge, considered the most deadly hazard, was quantified using the National Oceanic and Atmospheric Administration (NOAA) numerical storm

surge model, SLOSH². The SLOSH modeling system consists of the model source code and model basin or grid. SLOSH model grids must be developed for each specific geographic coastal area individually incorporating the unique local bay and river configuration, water depths, bridges, roads and other physical features. In addition to open coastline heights, one of the most valuable outputs of the SLOSH model for evacuation planning is its predictions of surge heights over land which predicts the degree of propagation of the surge into inland areas.

SLOSH provides the maximum amount of surge expected at approximately 3500 points in the region considering different parameters of 12,000 hypothetical storms (strength, track, size and forward speed) and the topography and the bathymetry of the Southwest Florida basin.

The newest generation of the SLOSH model basin incorporated in the **2010 Statewide Regional Evacuation Study** reflects major improvements, including higher resolution basin data and grid configurations. Faster computer speeds allowed additional hypothetical storms to be run for creation of the MOMs (maximum potential storm surge) values for each category of storm. Storm tracks were run in ten different directions. And for each set of tracks in a specific direction storms were run at forward speeds of 5, 10, 15 and 25 mph. And, for each direction, at each speed, storms were run at two different sizes (20 statute mile radius of maximum winds and 35 statute miles radius of maximum winds.) Finally, each scenario was run at both mean tide and high tide. Both tide levels are now referenced to North American Vertical Datum of 1988 (NAVD88) as opposed to the National Geodetic Vertical Datum of 1929 (NGVD29).

SLOSH and SLOSH related products reference storm surge heights relative to the model vertical datum, in this case NAVD88. In order to determine the inundation depth of surge flooding at a particular location the ground elevation at that location must be subtracted from the potential surge height. As part of the Statewide Regional Evacuation Study, all coastal areas as well as areas surrounding Lake Okeechobee were mapped using remote-sensing laser terrain mapping (LIDAR³) providing the most comprehensive, accurate and precise topographic data for this analysis. As a general rule, the vertical accuracy of the laser mapping is within a 15 centimeter tolerance.



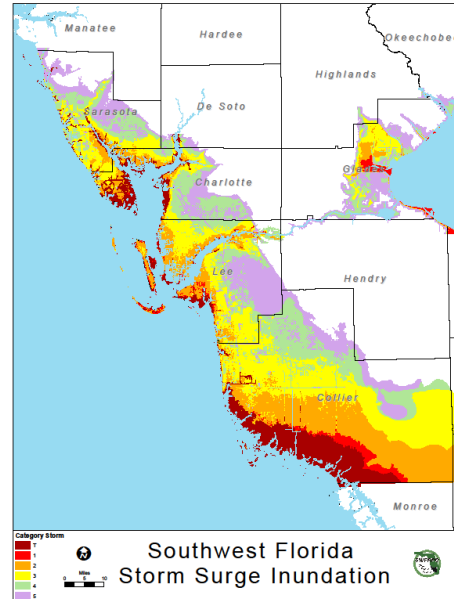
The LIDAR data was incorporated into the SLOSH basin data and used to subtract the land elevation from the storm surge height to develop the storm tide limits. The result of

²SLOSH stands for Sea, Lake and Overland Surges from Hurricanes

³ Light Imaging Detection and Ranging

this storm surge hazard analysis is graphically portrayed in the Storm Tide Atlas which illustrates the storm tide limits based on the maximum storm surge for landfalling categories 1, 2, 3, 4 and 5.

While all residents would be susceptible to some extent from the affects of hurricane-force winds, mobile home residents are far more vulnerable than residents in site-built homes. Mobile home and RV Park data was updated using information from the State of Florida Department of Health, property appraiser data and county planning departments.



Tornadoes are another hazard of tropical storm activity. Because it is impossible to identify where a tornado imbedded in the hurricane wind bands will strike, evacuation does not consider tornado activity, per se. It is recognized, however, that mobile home residents are much more vulnerable to this severe weather event. Therefore, with the evacuation of mobile homes for hurricane winds, it is anticipated that severe injury will also be reduced from any tornado activity. In addition, the public information campaign will include a recommendation that tornado safe rooms (see www.fema.gov) be considered by residents.

While inland flooding had not been considered to be life-threatening in the past, it had, over the last twenty years, become a leading cause of hurricane-related deaths until Hurricane Katrina in 2005. The 100-year flood zone, as designated by the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP), is identified and addressed separately under the Flooding Hazard.

While in Florida counties do not typically evacuate for inland flooding for a hurricane, it is recognized that this may become a major problem during a hurricane evacuation, after a tropical storm passes or after prolonged rainfall. Evacuation routes within the flood zone are identified in an effort to find alternative routes, if necessary. Public information will stress that after the storm (1) residents do NOT attempt to drive on flooded roadways and (2) children are NOT permitted to swim or play in flood waters.

2. Flooding

Both coastal and inland flooding are addressed through FEMA’s NFIP. The 100-year and 500-year floodplain was identified within the region to illustrate the regional and county-level vulnerability to the flood hazard. In addition, communities with repetitive loss properties



were identified by building type to provide an overall assessment of the risk. The areas' risk, historical frequency and estimated population at risk were identified in the hazards and vulnerability analyses. Also identified were dams which could pose a risk to the population which lives below them.

3. Wildfires and the Urban Interface

Florida is home to millions of residents who enjoy the state's beautiful scenery and warm climate. But few people realize that these qualities also create severe wildfire conditions. Each year, thousands of acres of wildland and many homes are destroyed by fires that can erupt at any time of the year from a variety of causes, including arson, lightning and debris burning. Adding to the fire hazard is the growing number of people living in new communities built in areas that were once wildland. This growth places even greater pressure on the state's wildland firefighters. As a result of this growth, fire protection becomes everyone's responsibility (Florida Division of Emergency Management, 2008.



<http://www.floridadisaster.org/bpr/EMTOOLS/wildfire/wildfire.htm>)

A wildfire is any fire occurring in the wildlands (i.e., grasslands, forest, brushland, etc). Wildfires have burned across the woodlands of Florida for centuries and are part of the natural management of much of Florida's ecosystems. (*Statewide Hazard Mitigation Plan*, 2009)

The risk of potential wildfire to the region's population was identified using the data provided by the Florida Division of Forestry (FlamMap) and the population living in the high/very high risk areas was estimated.

4. Hazardous Materials

A hazardous material is generally considered as any item or agent (biological, chemical, physical) which has the potential to cause harm to humans, animals or the environment, either by itself or through interaction with other factors. Almost every community deals with hazardous materials on a daily basis through transport, use, storage and/or disposal. The benefits Chemicals bring into our lives through their designed uses have become vital to our standard of living. Although major chemical emergencies are extremely rare, there always remains a chance that one will occur. In the State of Florida, the county emergency management agencies plan for hazardous material incidents and coordinate regionally for response through the Local Emergency Planning Committees (LEPCs). While the facilities with extremely hazardous materials were identified, the evacuation planning for incidents involving hazardous materials is addressed in the *Regional Hazardous Material Emergency Response Plan*.

No specific emergency sequence can be isolated as the model for which to plan because each emergency could have different consequences, both in nature and degree. As an alternative to defining a specified emergency, the regional plan identifies various parameters for planning which are based upon knowledge of the possible consequences, timing, and release characteristics of a spectrum of emergencies. The ***Regional Hazardous Materials Emergency Response Plan*** then establishes the appropriate response for each level of threat. Therefore, the Statewide Regional Evacuation Study did not specifically address hazardous material incidents.

C. VULNERABILITY ANALYSIS & POPULATION-AT-RISK

Depending upon the strength of the storm, the regional evacuation study calls for the complete evacuation of successively more surge-vulnerable zones inland in addition to all mobile home residents. Using information from the County Property Appraiser's office and the local planning departments, the population, dwelling unit counts and vehicle data for each zone was developed (see Chapter IV, Regional Vulnerability and Population Analysis). County/ Regional population-at-risk for the years 2010 and 2015 are presented in Tables ES-1 and ES-2 below.

Table ES-1: Population-at-Risk from Hurricanes by Evacuation Level, 2010

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

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

Table ES-2: Population-at-Risk from Hurricanes by Evacuation Level, 2015

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

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

If everyone who was ordered to evacuate did so and those who were not ordered to evacuate, secured their homes and stayed put, emergency management could use the population-at-risk statistics. This, however, is not the case.

Post-hurricane behavioral studies conducted along the Atlantic and Gulf coasts illustrate that many people ordered to evacuate will not and, conversely, people who live in site-built homes far outside the coastal areas will pack up and try to "outrun" the storm ("*shadow evacuation*"). How we quantify this behavior is key to an accurate transportation analysis. This study used the general response model (HMG, 2010) as well as the surveys conducted in 2009 (see Chapter III, Regional Behavioral Analysis Summary). Volume 2 of the Statewide Regional evacuation Study Program provides the Regional Behavioral Assumptions based upon the General Response Model and the survey results presented in Volume 3, Behavioral Survey Report

Using the behavioral assumptions discussed in Chapter III, two scenarios were developed. The **Base Scenario** population scenario assumes that 100% of the population-at-risk evacuate plus the anticipated "shadow evacuation" from outside the surge vulnerable areas. The scenario is

considered the most "conservative" estimate and will be used for growth management purposes. Tables ES-3 and ES-4 present these evacuation population estimates for 2010 and 2015.

The second **Operational Scenario** population estimates apply the participation rates presented in the regional behavioral assumptions. They do not assume that 100% of the population at risk evacuate but do include the "shadow evacuation" expected depending on the strength of the hurricane. Tables ES-5 and ES-6 present the evacuation population estimates and projections for 2010 and 2015.

Table ES-3: Hurricane Population by Evacuation Level, Base Planning Scenario 2010

| County | Evacuation Zone A | Evacuation Zone B | Evacuation Zone C | Evacuation Zone D | Evacuation Zone E |
|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Charlotte County | 89,731 | 155,193 | 177,604 | 180,115 | 180,275 |
| Collier County | 159,885 | 259,887 | 321,015 | 328,205 | 329,479 |
| Glades County | 6,668 | 7,114 | 7,765 | 8,335 | 8,644 |
| Hendry County | 21,529 | 22,752 | 25,008 | 26,083 | 27,116 |
| Lee County | 266,761 | 451,504 | 561,508 | 600,955 | 626,078 |
| Sarasota County | 108,516 | 154,378 | 262,304 | 323,399 | 349,525 |
| Southwest Florida Region | 653,090 | 1,050,828 | 1,355,204 | 1,467,092 | 1,521,117 |

Table ES-4: Hurricane Evacuation Population by Evacuation Level, Base Planning Scenarios, 2015

| County | Evacuation Zone A | Evacuation Zone B | Evacuation Zone C | Evacuation Zone D | Evacuation Zone E |
|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Charlotte County | 116,378 | 177,271 | 195,622 | 197,388 | 197,497 |
| Collier County | 211,604 | 291,724 | 352,439 | 361,749 | 362,702 |
| Glades County | 7,310 | 7,767 | 8,483 | 9,028 | 9,330 |
| Hendry County | 23,715 | 24,998 | 27,344 | 28,477 | 29,570 |
| Lee County | 271,069 | 429,482 | 580,133 | 646,743 | 687,293 |
| Sarasota County | 113,409 | 157,352 | 290,143 | 368,155 | 389,878 |
| Southwest Florida Region | 743,485 | 1,088,594 | 1,454,164 | 1,611,540 | 1,676,270 |

Table ES-5: Hurricane Evacuation Population by Evacuation Level, Operational Scenarios, 2010

| County | Evacuation Zone A | Evacuation Zone B | Evacuation Zone C | Evacuation Zone D | Evacuation Zone E |
|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Charlotte County | 0 | 87,258 | 103,585 | 128,494 | 151,442 |
| Collier County | 111,736 | 111,736 | 211,630 | 255,267 | 278,344 |
| Glades County | 3,826 | 3,826 | 4,912 | 5,986 | 6,829 |
| Hendry County | 13,003 | 13,003 | 16,784 | 20,722 | 23,567 |
| Lee County | 199,274 | 258,261 | 372,654 | 453,170 | 516,398 |
| Sarasota County | 0 | 105,251 | 105,251 | 187,361 | 317,297 |
| Southwest Florida Region | 327,839 | 579,335 | 814,816 | 1,051,000 | 1,293,877 |

Table ES-6: Hurricane Evacuation Population by Evacuation Level, Operational Scenarios, 2015

| County | Evacuation Zone A | Evacuation Zone B | Evacuation Zone C | Evacuation Zone D | Evacuation Zone E |
|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Charlotte County | 67,044 | 99,253 | 115,622 | 143,058 | 115,622 |
| Collier County | 0 | 184,227 | 184,227 | 236,992 | 184,227 |
| Glades County | 4,124 | 4,124 | 5,295 | 6,452 | 7,357 |
| Hendry County | 0 | 14,276 | 18,415 | 22,670 | 25,774 |
| Lee County | 206,538 | 263,502 | 397,107 | 492,156 | 397,107 |
| Sarasota County | 88,149 | 88,149 | 207,608 | 295,190 | 207,608 |
| Southwest Florida Region | 365,855 | 653,531 | 928,274 | 1,196,518 | 937,695 |

Chapter IV also presents the vulnerability of critical facilities within the region to (1) tropical storms and hurricanes; (2) flooding (100-year and 500-year); and wildfire (high and very high). The County Appendices provide more detailed data and maps for selected critical facilities including health care facilities (hospitals, nursing homes, etc.), assisted living facilities (ALFs), fire and police stations, and other identified facilities.

D. PUBLIC SHELTER DEMAND

As part of the regional evacuation study, the anticipated demand for public shelter was quantified. The public shelter inventories and the capacities within each county were identified and a comparison was made to determine the status within both the county and the region.

The general response model, post-hurricane behavioral surveys of residents in the Southwest Florida region and past experience was used to determine public shelter demand. The number of evacuees who choose public shelter as their evacuation destination is based on demographic characteristics of the population including income and age, risk area and housing (mobile home vs. site built homes). The planning assumptions regarding anticipated shelter use were presented in the Regional Behavioral Analysis (See Chapter III, Appendices III-A, III-B, III-C, III-D), and were applied to the projected Hurricane Evacuation Population estimates for both the *Base Planning Scenarios* as well as the *Operational Scenarios*.

As discussed in Chapter IV, the Base Planning Scenarios assume 100% compliance of the vulnerable populations (surge-vulnerable and mobile home residents) plus the “shadow evacuation”. The Operational Scenarios use the participation rates from the behavioral analysis to determine the evacuation rates.

**Table ES-7: Public Shelter Demand for Hurricane Evacuation Base Scenarios
2010**

| County | Capacity* | A | B | C | D | E |
|-----------|-----------|--------|--------|--------|---------|---------|
| Charlotte | | 6,327 | 10,967 | 12,563 | 12,819 | 12,826 |
| Collier | 36,250 | 11,955 | 20,874 | 26,562 | 27,284 | 27,380 |
| Glades | 1,590 | 1,114 | 1,180 | 1,282 | 1,365 | 1,408 |
| Hendry | 4,214 | 3,071 | 3,260 | 3,615 | 3,783 | 3,946 |
| Lee | 44,583 | 13,603 | 22,074 | 27,682 | 31,922 | 34,595 |
| Sarasota | 45,895 | 10,917 | 14,193 | 22,557 | 28,738 | 31,285 |
| Region | 132,532 | 46,987 | 72,548 | 94,261 | 105,911 | 111,440 |

Table ES-8: Public Shelter Demand for Hurricane Evacuation Base Scenarios 2015

| County | Capacity* | A | B | C | D | E |
|-----------|-----------|--------|--------|--------|---------|---------|
| Charlotte | | 7,417 | 11,772 | 13,061 | 13,240 | 13,246 |
| Collier | 36,250 | 11,315 | 17,799 | 23,219 | 24,198 | 24,281 |
| Glades | 1,590 | 1,230 | 1,302 | 1,419 | 1,504 | 1,547 |
| Hendry | 4,214 | 3,430 | 3,628 | 3,996 | 4,172 | 4,342 |
| Lee | 44,583 | 14,014 | 21,177 | 29,491 | 37,884 | 42,857 |
| Sarasota | 45,895 | 12,589 | 15,679 | 26,174 | 34,103 | 36,169 |
| Region | 132,532 | 49,995 | 71,357 | 97,360 | 115,101 | 122,442 |

Table ES-9: Public Shelter Demand for Hurricane Evacuation Operational Scenarios 2010

| County | Capacity* | A | B | C | D | E |
|-----------|-----------|--------|--------|--------|--------|--------|
| Charlotte | | 0 | 6,114 | 7,289 | 9,089 | 10,736 |
| Collier | 36,250 | 8,704 | 8,704 | 17,077 | 20,898 | 22,823 |
| Glades | 1,590 | 633 | 633 | 812 | 982 | 1,116 |
| Hendry | 4,214 | 1,859 | 1,859 | 2,401 | 2,990 | 3,404 |
| Lee | 44,583 | 9,972 | 12,841 | 19,033 | 24,316 | 27,672 |
| Sarasota | 45,895 | 0 | 9,766 | 9,766 | 16,578 | 28,244 |
| Region | 132,532 | 21,168 | 39,917 | 56,378 | 74,853 | 93,995 |

Table ES-10: Public Shelter Demand for Hurricane Evacuation Operational Scenarios 2015

| County | Capacity* | A | B | C | D | E |
|-----------|-----------|--------|--------|--------|--------|--------|
| Charlotte | | 4,425 | 6,538 | 7,663 | 9,518 | 7,663 |
| Collier | 36,250 | 0 | 11,209 | 11,209 | 15,174 | 11,209 |
| Glades | 1,590 | 686 | 686 | 879 | 1,066 | 1,212 |
| Hendry | 4,214 | 0 | 2,063 | 2,658 | 3,299 | 3,754 |
| Lee | 44,583 | 10,545 | 13,407 | 21,514 | 29,132 | 21,514 |
| Sarasota | 45,895 | 9,089 | 9,089 | 19,325 | 27,580 | 19,325 |
| Region | 132,532 | 24,745 | 42,992 | 63,248 | 85,769 | 64,677 |

Recognizing the trend toward a reduced reliance on public shelters, the emergency management community remains concerned that the assumption of such a drastic reduction in anticipated need does not take into consideration that many vulnerable residents will choose not to evacuate until there is no longer sufficient time to reach other destinations. This could logically result in a surge of evacuees to the public shelters in the closing hours of the evacuation. In addition if a major hurricane were to impact the region, there would be less capacity in public shelters for those residents who have no home to which to return.

In terms of community resiliency, without the requirement of EHPA standards, new schools may not be built to standards which would insure the schools would survive the hit of major hurricane. In addition, the need for more special needs shelters must also be addressed in both State and local plans.

Therefore, local emergency management may use different assumptions for both public and special needs shelters within the operational plans as reflected in the County Comprehensive Emergency Management Plans (CEMPs).

E. EVACUATION TRANSPORTATION ANALYSIS

The evacuation transportation analysis discussed in Chapter VI 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.

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.

1. Transportation Methodology

The methodology used in the Southwest Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and includes the following components:

- **Behavioral Assumptions**
- **Zone System and Highway Network**
- **Background Traffic**
- **Evacuation Traffic**
- **Dynamic Traffic Assignment**

2. Clearance Times

Based on the analysis, the Clearance Times for the Base Planning Scenario and Operational Scenarios for 2010 and 2015 are provided below.

- **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.
- **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.

- **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.
- **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 the point in time when the evacuation order is given to the point in time when the last vehicle assigned an external destination exits the region.

Table ES-11: 2010 Clearance Times for Base Scenario

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

Table ES-12: 2015 Clearance Times for Base Scenario

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

Table ES-13: 2010 Clearance Times for Operational Scenarios

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

Table ES-14: 2015 Clearance Times for Operational Scenarios

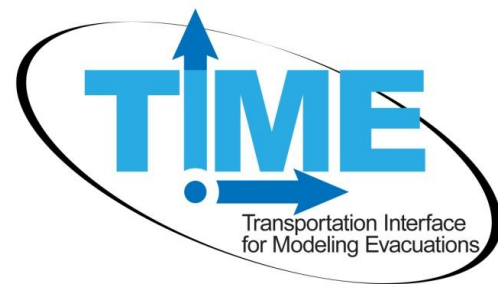
| | Evacuation Level A Operational Scenario | Evacuation Level B Operational Scenario | Evacuation Level C Operational Scenario | Evacuation Level D Operational Scenario | Evacuation Level E Operational Scenario |
|-------------------------------------|--|--|--|--|--|
| Clearance Time to Shelter | |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

3. 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.



It is anticipated that the regional planning council and local governments will be able to use the TIME User Interface to simulate additional scenarios varying behavioral assumptions, reflecting proposed growth in coastal areas, new transportation improvements, etc.

F. GLOSSARY

The Glossary at the back of the Technical Data Report contains the definitions of the terms used throughout the document. In many cases, it represents the legal consensus of the definition of terms in statute pertaining to growth management. The Statewide Regional Evacuation Study Program represents a consistent and coordinated approach to provide tools for both the emergency management as well as the planning community in the State of Florida.

G. CONCLUSIONS AND RECOMMENDATIONS

Obviously, the implementation of a successful hurricane evacuation in the Southwest Florida Region will be complex and challenging. It will require a team effort - not just on the part of the emergency management and response personnel - but of the entire community. We have come

to a point in this metropolitan coastal region that complacency and apathy will have dire consequences.

The update of the *Southwest Florida Region Hurricane Evacuation Study* illustrates that there have been improvements in hurricane evacuation planning including increased public shelter capacity, assistance for the transit dependent, alternatives for evacuees with pets, special needs shelters, route improvements and growth management mitigation strategies helping to reduce the population-at-risk. However, there remain serious challenges in this region if we are to avoid the loss of life and property and human suffering witnessed in the 2005 hurricane season in Mississippi, Louisiana and Texas.

The State of Florida, County Emergency Management agencies, the American Red Cross and many other agencies have worked together to prepare regionally for a disaster – not just the inevitable strike of a hurricane but the impacts of flooding, hazardous material incidents and terrorist attack.

Recent events have tragically demonstrated the power of nature and the horrific results if government and citizens fail to respond appropriately. As public servants and elected officials, it is imperative to address the concerns of our citizens and leaders regarding our ability to manage a major disaster.

1. Public Education

Our citizens' knowledge and understanding of personal risk and appropriate evacuation response remains a serious challenge. The behavioral surveys indicated that many residents – even those in the most surge-vulnerable areas and mobile homes – believe their home would be safe in a major hurricane, do not have a family disaster plan, and many will not evacuate regardless of the intensity of the storm or government actions. This fact means that those who choose to stay behind in mobile homes and areas vulnerable to storm surge and velocity wave action might not survive a storm.



In turn, many residents - well inland of storm surge and in site-built homes - responded that they will try to evacuate -- many out of the region or state. Because of the "shadow evacuation," resulting clearance times are exceedingly high necessitating the planning of refuge shelters along critical evacuation routes, reverse laning of Interstate systems and the potential of evacuation problems seen in Houston, Texas, with Hurricane Rita (2005).

In order to elicit an immediate evacuation response, the population-at-risk must be clearly and conclusively convinced that (1) they are indeed residing in a vulnerable area and (2) that a decision not to leave could well mean their loss of life or injury. Post-

hurricane studies have shown that the most vital piece of information is the information received from the emergency management personnel and local officials. For the most part, people will respond based upon the urgency and seriousness of the threat as conveyed by the emergency response personnel (HMG, 1999 and 2006).

Three key messages have been identified:

- Know your risk (evacuation zone/ mobile homes)
- Make a family plan.
- Obtain emergency supplies for at least 3-5 days.

The accurate formulation and comprehensive dissemination of these critical pieces of information to the public in a simple and understandable form is essential for implementation of an effective hurricane evacuation plan.

Hopefully, irrational emergency decision-making on the part of the population can be decreased if they determine their vulnerability to a hurricane before the emergency occurs. Residents in the Southwest Florida region are encouraged to become familiar with the county plans for evacuation and to make their "family plans" and business plans ahead of time. The State of Florida has partnered with the Florida Broadcasting Association to encourage the "culture of preparedness" including PSAs and billboards. Partnering at the local level is also needed.

Additional notification procedures (of evacuation level) is implemented and repeated throughout the season. The local governments in the region do have programs which provide these services to their residents so it is unclear why so many residents do not know their evacuation level or understand their risk.

- Notification on utility bills (zone designation)
- Notification on tax bills (zone designation)
- Special mailings and deliveries
- Interactive Web sites (zone look up)
- Citizen Information lines (zone look up)

Perhaps the answer lies in a continued strengthen initiative to partner with all levels of government, the private sector, civic and business associations and non-profit/volunteer agencies and the media to "get the word out" about preparedness and mitigation. Businesses have been increasingly active in developing continuity plans and providing information to their employees. Churches and civic associations, neighborhood associations, crime watch and Community Emergency Response Teams (CERT) can provide direct contact and face-to-face communication.

2. Special Needs

Providing shelter for residents with special needs is a critical issue. Partners including the Dept. of Health, home health agencies, hospitals and skilled nursing facilities, to

name just a few, must work with local agencies to (1) register and determine the appropriate level of care and appropriate shelter alternative for each resident and (2) provide the facility, staff, equipment and supplies and transportation assistance in an effective manner in a disaster situation.

Again, we need to develop strong partnerships with those entities in the community that work with our citizens with special needs on a daily basis to ensure they receive the information and support they need before, during and after a disaster.

3. Mitigation Message

As identified, the results of the ***Statewide Regional Evacuation Study for the Southwest Florida Region*** highlight the challenges of the emergency management community in a metropolitan coastal area such as Southwest Florida. If people do not respond correctly when an evacuation order is given, there will be serious implications on the entire emergency response. For example, if residents who live in low-lying surge vulnerable areas or mobile homes do not evacuate, they are putting their safety at risk. Conversely, if residents who live in site-built homes outside the surge-vulnerable areas try to evacuate in significant numbers - as they did during the 1999 Hurricane Floyd evacuation and for Hurricane Rita in 2005 - the resulting traffic congestion may prevent anyone from reaching safety.



The answer is comprehensive consistent public education which focuses on encouraging our residents to do the following (1) know their risk, and (2) plan ahead. Again, key messages include:

- Individual Responsibility – Be disaster resilient. Know your risk, plan ahead and obtain needed supplies.
- Encourage residents to "*Flee from Flood; Hide from Wind*". Obviously, coastal residents in surge vulnerable areas and mobile home residents must evacuate; however, the key message is to seek refuge within "tens of miles, not hundreds of miles."
- Strongly encourage all residents who live in site-built homes outside the surge vulnerable areas to call and invite friends or relatives who must evacuate to come and stay with them if there is a hurricane threat. Once they have committed by inviting their friends or relatives, we will also encourage residents to prepare their homes and mitigate for the potential winds, i.e. window and door protection, braced gable end roofs, and garage doors.
- It is assumed if inland residents take action to protect their homes from wind, they will be less likely to try to "outrun" a hurricane.

4. The Coastal High Hazard Area (CHHA)

In 2006 the Florida Legislature passed a bill changing the definition of the coastal high hazard area (CHHA) from the evacuation zone to the "area defined by the SLOSH model to be inundated from a category one hurricane." This change was welcome as the definition was more defensible tying the land use regulations to a scientific model rather than the zone delineated by roadways and familiar landmarks. However, the limitations of the model must be recognized by the local governments now responsible for its regulation.



As discussed, the SLOSH model does not address wave height and other local processes. It also does not incorporate the danger of isolation in areas surrounded by storm surge with limited access such as barrier islands. These two issues are of serious concern and it is recommended that local governments address them within their comprehensive plans and land development regulations.

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