Volume 1-4
Northeast Florida Region
Technical Data Report

CHAPTER IV

REGIONAL VULNERABILITY AND POPULATION ANALYSIS

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CHAPTER IV REGIONAL VULNERABILITY AND POPULATION ANALYSIS

A. Introduction

In the previous chapter the hazards analysis was presented. The hazards analysis is the first step in effective evacuation planning – going through the process of identifying the hazards that face the community and the level of risk they represent[1]. Once the potential hazards and impacts have been identified, a vulnerability analysis can be conducted to provide information on the location and extent of risk and vulnerability. The vulnerability analysis is the susceptibility of people, property, environment and social and economic activity to injury or damage and the degree to which they are at risk[2].

"Risk is the probability of a hazard occurrence and vulnerability is the susceptibility of people and property to injury or damage. Risk and vulnerability mapping is simply a procedure for locating areas with different degrees of hazard probability and susceptibility."[3] Through the hazards analysis, specific hazards were recognized as having the potential to initiate a regional or multi-jurisdictional evacuation. These included tropical storms or hurricanes, flooding, hazardous materials incidents and wildfires. Therefore, the next step is the vulnerability analysis and risk mapping of these specific hazards.

B. Risk and Vulnerability Assessment

The vulnerable areas within each county can be mapped by risk to determine the potential impact to the population, property, critical facilities, and the environment. This was accomplished using the hazards analysis data for each hazard facing the community, which was determined to have the potential to initiate a regional evacuation; including tropical storms and hurricanes, flooding, and wildfires.

[1] ICMA, *Emergency Management: Principles and Practice for Local Government*, Drabek, Hoetmer, editors, 1991, pg 80.
[2] ICMA, *Emergency Management: Principles and Practice for Local Government*, Drabek, Hoetmer, editors, 1991, pg. 144.
[3] ICMA, *Emergency Management: Principles and Practice for Local Government*, Drabek, Hoetmer, editors, 1991 pg. 143.

The Sea and Lake Overland Surge for Hurricanes (SLOSH) model Maximum of Maximums (MOMs) storm surge runs were utilized to determine the evacuation levels for each category of storm and tropical storm scenarios. The vulnerability analysis for flooding used the FEMA National Flood Insurance Rate Maps (FIRMs) to present the velocity and 100-year flood zones. The vulnerability to hazardous materials relied on the Regional Hazardous Materials Emergency Response Plan (2013) and the County Hazardous Material Facility Hazards Analyses to present a compilation of all vulnerability assessments. The wildfire risk was identified by the Florida Forest Service assessment of the urban wildland interface. The risk and vulnerability assessment for each specific hazard are discussed in further detail.

C. Population Estimates and Projections

1. Small Area Data

The previous Study, released in 2010, used dwelling unit, household, and population estimates and projections for traffic analysis zones (TAZs) from the North Florida Transportation Planning Organization's (TPO) model socio-economic data (ZDATA). This data is no longer maintained by the TPO.

The Small Area Data for the 2013 update to the Regional Evacuation Study was developed using the 2010 Census and the 2008-2010 American Community Survey (ACS). This includes the occupied dwelling unit (single family and multi-family) and permanent population. Block group level data from the 2008-2010 ACS was used to gain general housing and population characteristics. As is usual with each decennial census, boundary lines for block, groups and census tracts were revised in the 2010 Census, which led to some differences with the boundary lines of the TEZs. The 2010 Census data, however, did not provide information regarding the proportion of single-family to multi-family dwelling unit types or site-built to mobile home unit types, as well as the number of vehicles that would be available to each type. This level of detail is found within the ACS. Using BEBR medium projections as the control variable for population (years 2015 and 2020), the number of projected housing units was calculated for the corresponding future years. A proportionate factor from 2010 was used to distribute dwelling units and population by block group. This method also established the percent mobile and site built homes. Absent of specific direction from the counties that some block groups might be expected to grow more or less than the others; this was the most appropriate approach. However, if any information was available to direct more growth into some areas of the counties than others (because the counties themselves project growth that way), it was incorporated (on a county-by-county basis).

The number of mobile homes and number of vehicles associated with mobile homes were unchanged from the 2010 Study. A majority of the local jurisdictions foresee steady but minimal growth.

The hotel/motel data comes from the Department of Business and Professional Regulation (DBPR) Lodging License Files. The data is available by zip code and is not available in GIS format. The hotel and motel data list was geo-coded in GIS by census block group for each county in the Region. The projected hotel/motel data remained constant as the data files indicated no change in the Region over the previous eight years. Hotel/Motel persons per unit remained at 1.5 and the vehicles per unit remained at 1 for the projected years.

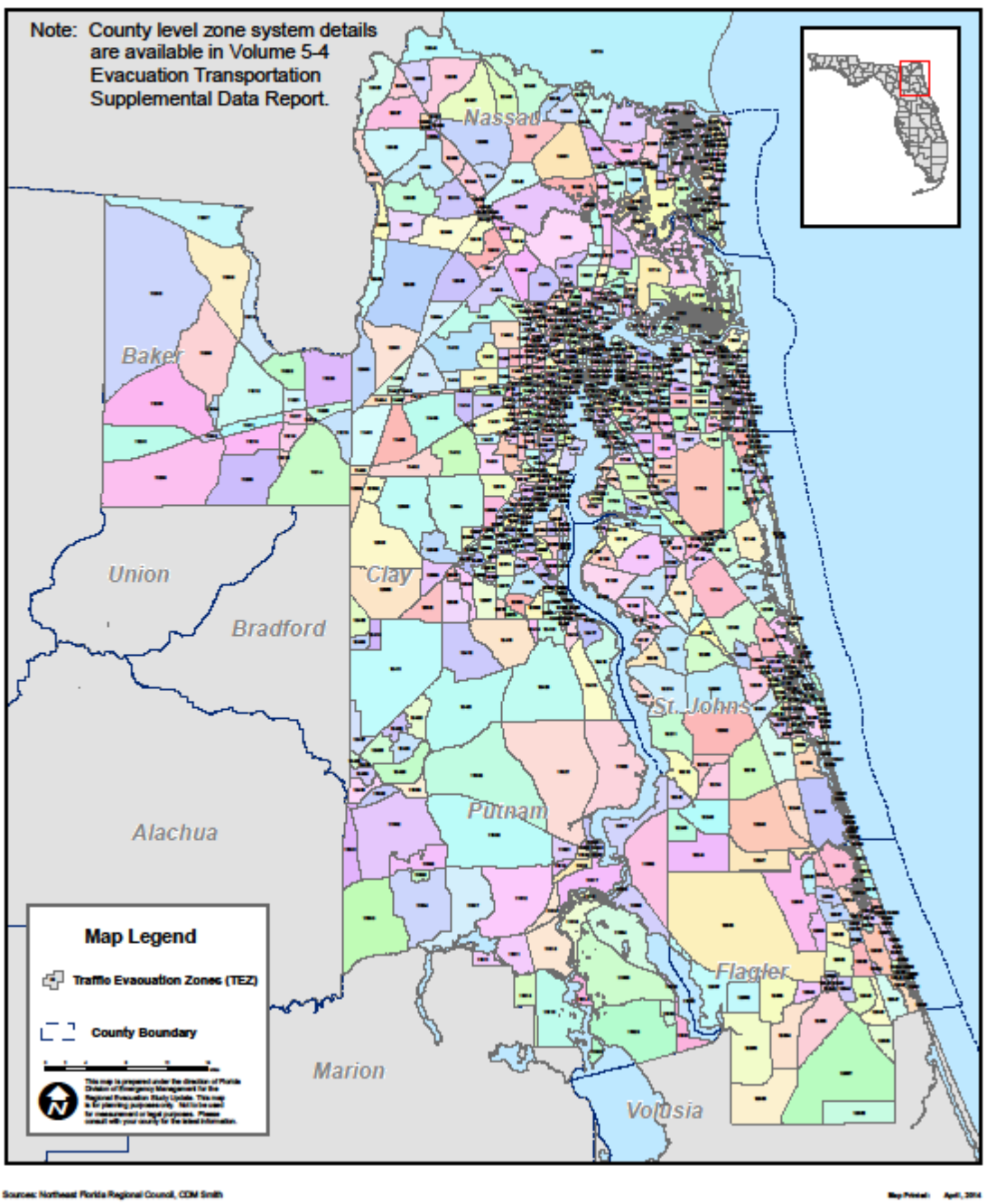
For purposes of this study, seasonal factors as determined by the 2000 Census by housing type augmented with the American Community Survey data of 2008 were applied to determine the number of residents and visitors at different times during the hurricane season. This seasonal fluctuation results in two estimates of population-at-risk - a high and low - for each county evacuation scenario. The high seasonal occupancy factor was used in the Base Planning Scenarios.

2. Traffic Evacuation Zones (TEZs)

The Small Area Data provided the first level of vulnerability and population analysis. In order to facilitate the evacuation transportation analysis, it was necessary to aggregate the small area data into larger zones. Created for the purposes of the Evacuation Transportation Model, Traffic Evacuation Zones (TEZs) form the basic unit of evaluation in the modeling process. The TEZs represent geographic areas and contain the demographic information crucial to modeling evacuation traffic. Each TEZ includes one or more Small Area Data Zone. The Traffic Evacuation Zones offer the model a balance between specificity in traffic assignment. A regional map of the TEZs is presented on **Figure IV-1**. County TEZ Maps are presented in the Appendices IV-A, IV-B, IV-C, IV-D, IV-E, IV-F, and IV-G. The TEZs are discussed further in Chapter VI, Evacuation Transportation Analysis.

Figure IV-1

Northeast Florida Regional Model Transportation Evacuation (TEZ) Zone System



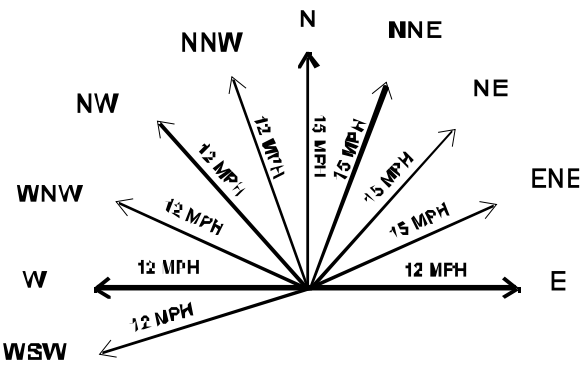
Sources: Northeast Florida Regional Council, CDM Smith

D. Hurricane Vulnerability

1. Hurricane Evacuation Levels

As indicated, the SLOSH model is the basis for the "hazard analysis" portion of coastal hurricane evacuation plans. Thousands of hypothetical hurricanes are simulated with various Saffir-Simpson Wind categories, forward speeds, landfall directions, and landfall locations. An envelope of high water containing the maximum value a grid cell attains is generated at the end of each model run. These envelopes are combined by the National Hurricane Center (NHC) into various composites, which depict the possible flooding. One useful composite is the MEOW (Maximum Envelopes of Water) which incorporates all the envelopes for a particular category, speed, and landfall direction. Once surge heights have been determined for the appropriate grids, the maximum surge heights are plotted by storm track and tropical storm/hurricane category. These plots of maximum surge heights for a given storm category and track are referred to as Maximum Envelopes of Water (MEOWs).

In order to determine a scenario that may confront the county in a hurricane threat 24-48 hours before a storm is expected, a further compositing of the MEOWs into Maximums of the Maximums (MOMs) is usually required.



The MOM (Maximum of the MEOWs) combines all the MEOWs of a particular category. The MOMs represent the maximum surge expected to occur at any given location, regardless of the specific storm track/direction of the hurricane. The only variable is the intensity of the hurricane represented by category strength (Category 1-5).

The MOM surge heights, which were furnished by the NHC, were run at astronomical high tide. All elevations are now referenced to the NAVD88 datum. The range of maximum surge heights (high and low) for each county in the region based upon the model is provided for each category of storm on **Table IV-1**. It should be noted again that these surge heights represent the maximum surge height recorded in the county including inland and riverine areas where the surge can be magnified dependent upon storm parameters.

Table IV-1
Potential Storm Tide Height(s) * By County
(In Feet above NAVD88)

**Storm Strength	Clay	Duval	Flagler	Nassau	Putnam	St. Johns
Category 1	Up to 3.6'	Up to 6.6'	Up to 6.3'	Up to 6.8'	Up to 4.3'	Up to 6.5'
Category 2	Up to 5.6'	Up to 11.0'	Up to 12.6'	Up to 12.2'	Up to 6.7'	Up to 11.9'
Category 3	Up to 9.5'	Up to 19.9'	Up to 18.8'	Up to 16.7'	Up to 9.3'	Up to 19.9'
Category 4	Up to 13.5'	Up to 22.2'	Up to 24.2'	Up to 21.2'	Up to 12.4'	Up to 24.9'
Category 5	Up to 16.3'	Up to 28.2'	Up to 27.3'	Up to 27.7'	Up to 14.4'	Up to 29.6'

**Surge heights represent the maximum values from selected SLOSH MEOWs*
***Based on the category of storm on the Saffir-Simpson Hurricane Wind Scale*

2. Delineation of Hurricane Evacuation Zones

The delineation of evacuation zones is an essential part of any hurricane evacuation plan for two reasons. First, the creation of zones allows for the assignment of population and vehicles for the transportation analysis. Secondly, the creation of zones operationally allows preparedness and response officials to identify areas predicted to receive storm surge that require an evacuation.

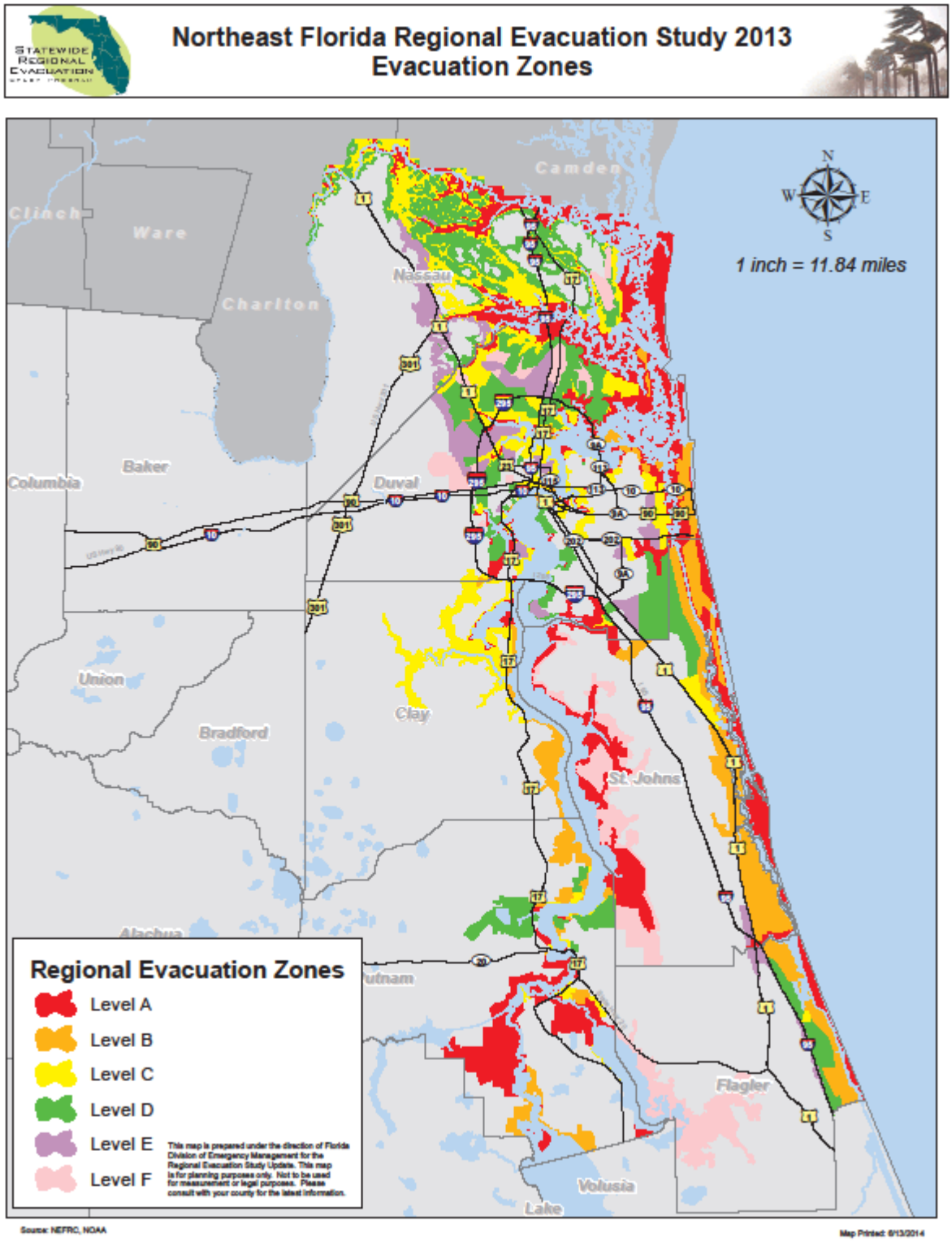
The **storm tide limits** were determined using the maximum surge from land falling hurricanes (Categories 1, 2, 3, 4 and 5). County emergency management agencies delineate the **evacuation zones** based on several factors, including the storm tide limits. However, in order to relay this information to the public in a meaningful way, the emergency management agencies use roadways, waterways, and familiar landmarks as boundaries for the evacuation areas. This is a very deliberate process. It requires knowledge of the area, the land use and population density. In determining evacuation zones, judgments must be made about the potential for isolation in areas, which may not receive storm surge yet are surrounded by areas that will. Potential freshwater flooding is also a consideration in some cases.

The more detailed storm tide limits coupled with the desire to minimize any potential "over-evacuation" results in tighter more detailed evacuation areas in several counties in the region. This is especially true where the LiDAR elevation data provided very detailed topographic data and where, in such a densely populated county, over-evacuation could affect thousands of residents.

Conversely, the inability to forecast exact hurricane track, intensity, size and forward speed as well as the limitation of the SLOSH model, encourage many county emergency management officials to simplify the evacuation zone patterns. This more flexible concept allows a more generalized zone scheme, which may be easier to convey to the public.

County Evacuation Zones in the Region are presented below on **Figure IV-2**. The Evacuation Zones are also presented in the County Appendices.

Figure IV-2


Northeast Florida Regional Evacuation Study 2013
Evacuation Zones
Camden
Clinch
Ware
Charlton
Nassau
Baker
Columbia
Duval
Union
Bradford
Clay
St. Johns
Flagler
Volusia
Lake
Alachua
N
W
E
S
1 inch = 11.84 miles
Regional Evacuation Zones
Level A
Level B
Level C
Level D
Level E
Level F
This map is prepared under the direction of Florida Division of Emergency Management for the Regional Evacuation Study Update. This map is for planning purposes only. Not to be used for measurement or legal purposes. Please consult with your county for the latest information.
Source: NEFRC, NOAA
Map Printed: 6/13/2014

3. Hurricane Wind Vulnerability: Manufactured Housing, Mobile Homes, and RVs

Manufactured, mobile homes and recreational vehicles are extremely vulnerable to hurricane force winds and severe weather. Statistics document that these types of housing stock receive a disproportionate share of the damage from severe weather, and residents are far more likely to be injured or killed in these structures compared to site built homes.[4]

Because of this vulnerability, hurricane evacuation plans in Florida have called for the evacuation of all areas subject to potential storm surge (coastal flooding) and the complete evacuation of all mobile home/RV residents no matter where they are located within the county.

In the 1930s, the beauty of America and the draw of the open road attracted campers and their families to "travel trailers". Later the product and its name evolved into "trailers", and still later "mobile homes[5]". The changes were far more than changes in nomenclature. In 1976, the Department of Housing and Urban Development (HUD) established construction and safety standards for mobile homes, which for many people were now being used as permanent residences. In 1999, HUD added new anchor, strapping, and tie down regulations to make manufactured homes safer[6].

In the 2004 hurricane season, it seemed new manufactured homes held up relatively well, even when compared to site-built homes. Since 1999, manufactured homes have been built and installed to tougher standards but not equivalent to the most recent codes for site-built structures. As required by HUD all manufactured homes sold in Florida's coastal counties since 1994 are engineered to withstand sustained winds of 110 mph and 3-second gusts of 130 to 150 mph. (http://www.builtstronger.com/history.html)

This is good news for state and local mitigation efforts and public safety and it is evidence that we are moving in the right direction; however, it does not alleviate the concern regarding evacuation. While the manufactured home industry may have a case regarding the benefit of

[4] For example, in February 1998, a tornado destroyed many site-built homes, mobile homes and RVs in the Kissimmee/Orlando central Florida area. There were 42 people killed: 34 resided in mobile homes, 7 in RVs and 1 was in an automobile. No one living in a site-built home died; although there were **more** traditional concrete block and stick-built homes destroyed (385) than mobile homes (373) yet without any fatalities.

[5] *Mobile home* is actually a term that was used for manufactured homes produced prior to June 15, 1976, when HUD began to administer the federal code, which governs the construction of all manufactured homes. Note: Modular homes where the walls are constructed off-site but assembled on site and affixed to a permanent foundation are now evaluated and inspected against the Florida Building Code. They are built to the same construction standards as site-built structures in the community and are not subject to evacuation orders for wind only.

[6] Stronger wall sheathing, headers above windows, and multiple studs at windows and doors meet post-1994 requirements and add strength to the structural envelope. The result is a home better able to withstand the buffeting of high wind and the impact of wind-borne missiles than the pre-1994 manufactured housing. http://www.fmha.org/hurricane.html

stricter standards, they need to present it to the Florida Building Code officials. Manufactured homes are not currently evaluated against the Florida Building Code; so no matter how strong the industry says they are built, they are not evaluated using the same construction standards as site-built homes. While it is clear that those homes built and installed after 1999 are more hurricane resistant, they must be measured against the same construction standards as site-built homes. Otherwise, there is no way to confirm how well they will perform.

There are several additional factors to consider:

- Unless a structure is permanently attached to a foundation, there is no way to assume that the structure will remain "tied down" in hurricane force winds. With Florida's climate, salt air, and sandy soils, tie-down systems would not be expected to perform optimally without constant vigilance.
- Currently, most manufactured homes in the region were built prior to 1999 and do not meet current standards for wind load or anchoring systems.
- Additions, such as carports, siding and cladding, and attached storage units did not perform well in hurricane conditions even on newer units.
- Newer manufactured homes would be at risk from flying debris from older units within the same mobile home park.
- It would be difficult, at best, to implement evacuation orders based on the age and maintenance of individual units.

Therefore, no change in evacuation strategy is identified in this report. In addition to residents vulnerable to storm surge, those residents vulnerable to hurricane force winds (74+ mph) must be evacuated in advance of the hurricane. Basically, residents of buildings without traditional structural foundations are more vulnerable to such wind speeds. In the Northeast Florida region, this includes residents of substandard housing, manufactured and mobile homes, and visitors in recreational vehicles and travel trailers. Since hurricane force winds can extend inland many miles, all manufactured and mobile home residents and travel trailer/RV visitors must be evacuated, regardless of their location in the region.

The Florida Department of Health, Bureau of Environmental Health, keeps a geo-coded database of mobile home parks, which is available as a GIS shapefile. The most current year of 2012 was used. County maps identifying the locations of mobile home parks are included in the Appendices (Appendices IV- A, IV-B, IV-C, IV-D, IV-E, IV-F, and IV-G). This database provided an accurate up-to-date inventory of mobile home/ RV spaces within licensed parks

A comparison of the dataset was used to establish a trend for future years. Based on the input from local government and with supporting policies from each County's Comprehensive Plan, the estimates on mobile home units was made. In many cases, this may have been a policy decision on the projected number of mobile homes as a directive in calculating future unit increases or status quo. In majority of the cases the assumption was made that mobile home units remain constant at 2010 level whereas site built homes grew at a proportion to its share of total dwelling units. Estimates of mobile homes units were separated by block group and not Traffic Analysis Zone (TAZ).

Table IV- 2
Mobile Home/ RV Parks in the Northeast Florida Region (2012)

County	# of MH/RV Parks	# of Mobile Homes Spaces	# of RV Unit Spaces	Sum # of Spaces
Baker	29	301	28	**329**
Clay	20	165	253	**418**
Duval	128	8,939	2,074	**11,013**
Flagler	18	1,290	1,012	**2,302**
Nassau	27	362	364	**726**
Putnam	63	1,011	593	**1,604**
St. Johns	71	1,050	1,531	**2,581**
Region	**356**	**13,118**	**5,855**	**18,973**

Source: Florida Department of Health, 2012

4. Wind Vulnerability of Site-Built Residential and Commercial Structures

The existing regional hurricane evacuation studies have focused on the storm surge hazard with detailed evacuation areas based on the potential coastal flooding. Historically, the storm surge hazard has caused nine out of ten hurricane-related deaths. An equally important goal is the evacuation of mobile home/ RV residents regardless of their location due to their life-threatening vulnerability to hurricane force winds. However, hurricane force winds can cause significant injuries and property loss even in conventional site-built structures -- commercial and residential.

The winds of a major hurricane (winds exceeding 120 mph) will have an impact on the safety of **ALL** coastal county residents. There is evidence to support the fact that winds are significantly reduced as the hurricane crosses the coastline. However, the reduction of wind fields and wind speeds to safe limits depends a great deal on the individual parameters of the storm (strength, size, forward speed, etc.), the geography of the area, and the type/ construction of the buildings in harm's way.

Much of the wind damage in hurricanes Andrew, Hugo, and Wilma was not confined to waterfront properties. Andrew literally destroyed many single-family site-built homes 10-20 miles inland. Hugo caused serious wind damage as far inland as Raleigh, North Carolina. Wilma caused significant wind damage as it exited the east coast of Florida.

Results of the recent experiences of Hurricanes Charley, Frances, Jeanne and Wilma indicate that because of the uncertainties of the hurricane and the dangers of the major storm winds, it is imperative that emergency managers:

1) strongly encourage all residents who are not ordered to evacuate to secure their homes before the storm arrival;

2) recommend evacuation policies which address the closure of high-rise buildings with large expanses of glass (even those outside surge vulnerable zones);
3) local governments, in cooperation with school boards, American Red Cross and the private sector should continue to support policies and funding mechanisms to implement the statewide program to upgrade primary and special needs shelters, health care buildings and other critical facilities. This would include window and door protection, generators, roof/truss improvements, etc.

The new Florida Building Code addresses "fortified criteria" designed to make new construction more hurricane-resistant. Ultimately, this will have a positive impact on future storm losses; however, currently, we must rely on retrofit of the more than 1 million existing homes.

Code plus improvements, as defined in the "Blueprint for Safety" developed by the Florida Alliance for Safe Homes (FLASH) in coordination with the Home Builders' Association, covers both new construction and retrofit of existing structures.

The major components of this program are:

- Window protection which meets the Dade County protocol as defined in the Florida Building Code
- Roof and truss connections; reinforcement of gable ends
- Wall and roof connections
- Roof covering
- Garage door and entry door protection
- Safe rooms (FEMA standards)

Through the Local Mitigation Strategies (LMS) and public information campaigns, state and local governments and the Northeast Florida Regional Council are working to encourage residents and businesses to mitigate potential wind and flood losses at the local level. This is no easy task; however, implementing the LMS is a priority in the Northeast Florida Region and efforts to bring together the public and the private sectors are underway to address these major issues.

5. Population-at-Risk

In order to quantify the hurricane evacuation times as well as hurricane response and recovery needs, it is essential to know how many persons must be evacuated from the hazards associated with a tropical storm or hurricane -- the **population-at-risk**. First, it is necessary to enumerate the entire population residing within the areas predicted by the SLOSH model to require total evacuation from storm tide flooding under the five evacuation levels (Evacuation levels A, B, C, D, and E). As discussed in Chapter I and II, these evacuation levels correspond to the maximum storm tide flooding from each category of land falling hurricane on the Saffir-Simpson Hurricane Scale (Category 1, 2, 3, 4 and 5). The Evacuation Zones or areas are defined by the county emergency management agencies based on the expected inundation areas and definable boundaries.

Second, it is also necessary to quantify all mobile homes and RVs throughout the region -- even in areas not vulnerable to storm tide. These structures are particularly vulnerable to property damage and their inhabitants vulnerable to potential injury and loss of life due to hurricane force winds.

While it is clear that we are in a period of more active and intense tropical activity, this also reflects the exponential growth in population and property at risk. A study (Pielke and Landsea, 1999) of coastal development warned *that more and more Americans have put themselves and their property at risk by flocking to vulnerable coastal locations.* There is 400 times the number of people in Florida today as there was at the turn of the century.

The population-at-risk by hurricane evacuation level for the years 2015 and 2020 is presented on **Table IV-3** and **IV-6**.

6. Evacuation Population

The population-at-risk or vulnerable population is the number of persons residing in evacuation areas or mobile home residents who would be directly affected by a future evacuation order. In every evacuation, however, a percentage of persons who live outside of the surge-vulnerable areas and who do not live in mobile homes or substandard housing will evacuate. Whether this is the result of confusion, a desire to be extra cautious, or the desire to avoid the impacts of storm aftermath (loss of power and/or utilities), this phenomenon, termed ***shadow evacuation*** was documented during the post Hurricanes Elena, Georges, Charley, Frances, and Jeanne surveys as well as in other post-storm surveys conducted in other parts of the country over the last few decades (Hazard Management Group (HMG), 2009).

There will also be a percentage of persons inside the evacuation areas who will NOT evacuate and, to a certain degree, a percentage of persons who live in mobile homes who will not evacuate. After the destruction in South Florida following Hurricane Andrew, it was expected that more people would evacuate than ever before. The post 2004 and 2005 season survey seems to contradict this assumption. Regardless, it is expected that there will be a difference in the population-at-risk and the actual **evacuation population.**

In the Evacuation Behavioral Analysis, planning assumptions were identified to assist in the development of the anticipated Evacuation Population under different storm scenarios.

Evacuation participation rates are influenced by the perceived risk and location of the residents. Evacuation rates and shelter use are also influenced by age and income, which, in the Northeast Florida Region, are significant factors. These assumptions are discussed in more detail in Chapter III Regional Behavioral Analysis.

Two sets of behavioral assumptions were made in the Statewide Regional Evacuation Study (SRES) to determine the Evacuation Populations. The first is considered the *Base Scenario*, which represents 100% participation of the population-at-risk plus **shadow evacuation**. The Base Scenario is considered the “planning scenario”, a more conservative estimate that will be used for growth management planning purposes.

The second set of assumptions is termed the *Operational Scenario*. The county behavioral assumptions as presented in Chapter III and in more detail in Volume 2: Regional Behavioral Analysis of the SRES, were used in the calculations for the evacuation population under the Operational Scenarios. Other differences in the two scenarios are presented in Chapter VI Evacuation Transportation Analysis.

The evacuation population by evacuation level for the region for the Base Planning Scenario is presented for the years 2015 and 2020 on **Tables IV-4** and **IV-7**, respectively.

The evacuation population by evacuation level for the region for the Operational Scenario is presented for the years 2015 and 2020 on **Tables IV-5** and **IV-8** respectively.

As indicated, a "real world" response would most likely reflect less than 100% evacuation from surge vulnerable areas and mobile and manufactured homes and a significant "shadow evacuation". These sets of assumptions are used to develop the operational scenarios. However, even a small percentage of a very large population has a significant impact on the population estimates and the resulting evacuation population. The difference between the population at risk and the evacuation population can be as much as 20-40%. Both evacuation population estimates were incorporated into the model to conduct the transportation analysis and determine evacuation times. (See Chapter VI: Regional Evacuation Transportation Analysis for model assumptions and impacts.)

Table IV – 3
Vulnerable Population from Hurricanes by Evacuation Level, 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E	Evacuation Zone F
Clay County*/ **						
Site-built Homes	5,864	6,718	45,522			N/A
Mobile/Manuf. Homes	88	396	1,929			
TOTAL	**5,952**	**7,114**	**47,451**			
Duval County						
Site-built Homes	102,801	38,513	108,463	74,327	40,138	10,151
Mobile/Manuf. Homes	4,307	1,659	6,935	5,923	2,151	2,803
TOTAL	**107,108**	**40,171**	**115,398**	**80,251**	**42,289**	**12,955**
Flagler County						
Site-built Homes	8,071	12,675	684	8,751	3,130	388
Mobile/Manuf. Homes	745	418	0	128	30	475
TOTAL	**8,816**	**13,093**	**684**	**8,879**	**3,160**	**863**
Nassau County*						
Site-built Homes	31,269		5,686	2,196	993	1,788
Mobile/Manuf. Homes	3,933		2,736	1,405	863	658
TOTAL	**35,202**		**8,422**	**3,601**	**1,856**	**2,446**
Putnam County*/ **						
Site-built Homes	5,373	1,418	687	863		N/A
Mobile/Manuf. Homes	3,342	1,293	564	477		
TOTAL	**8,715**	**2,710**	**1,251**	**1,340**		
St. Johns County						
Site-built Homes	54,902	56,968	3,028	1,743	17	14,287
Mobile/Manuf. Homes	3,078	3,794	813	115	8	2,404
TOTAL	**57,980**	**60,762**	**3,841**	**1,858**	**26**	**16,691**

Note: Vulnerable population determined using SRESP small area 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.

** For the purposes of this study, Clay County has a combined C/D/E zone, Nassau County has a combined A/B zone, and Putnam County has a combined D/E zone.*

***In addition, Clay and Putnam Counties are the only counties within the NEFRC region that did not designate a zone F within their jurisdiction.*

Table IV-4
Evacuating Population by Evacuation Level, Base Planning Scenario 2015

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	12,572	51,138	280,225	25,659	57,461	39,137	103,635	569,827
B	13,385	65,410	343,159	38,667	58,812	40,392	148,494	708,319
C	14,198	109,129	468,740	44,747	64,557	44,627	155,093	901,091
D	15,011	120,807	538,750	57,053	66,901	47,046	163,822	1,009,390
E	15,824	126,646	608,903	65,532	69,283	50,577	171,515	1,108,280

Table IV-5
Evacuating Population by Evacuation Level, Operational Scenarios, 2015

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	7,869	35,854	213,207	19,337	32,551	23,064	67,332	399,214
B	9,270	48,834	270,600	27,156	39,052	25,846	90,473	511,231
C	11,259	69,981	363,910	36,311	49,342	35,951	113,171	679,925
C (2)	11,259	69,981	363,910	36,311	49,342	35,951	113,171	679,925
D	12,660	94,878	467,446	49,842	57,918	15,108	143,459	841,311
E	14,648	110,118	554,625	60,636	64,515	46,890	163,521	1,014,953
C+F	11,259	70,290	370,639	36,551	50,208	35,970	121,913	696,830

Table IV-6
Vulnerable Population from Hurricanes by Evacuation Level, 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E	Evacuation Zone F
Clay County*/**						
Site-built Homes	6,533	7,485	50,697			N/A
Mobile/Manuf. Homes	98	443	2,156			
TOTAL	**6,631**	**7,929**	**52,853**			
Duval County						
Site-built Homes	107,495	40,278	113,415	77,714	41,973	10,619
Mobile/Manuf. Homes	4,523	1,746	7,265	6,217	2,261	2,931
TOTAL	**112,019**	**42,024**	**120,680**	**83,931**	**44,234**	**13,550**
Flagler County						
Site-built Homes	9,632	15,120	816	10,438	3,733	465
Mobile/Manuf. Homes	887	503	0	153	36	565
TOTAL	**10,519**	**15,623**	**816**	**10,590**	**3,769**	**1,029**
Nassau County*						
Site-built Homes	33,203		6,082	2,334	1,049	1,832
Mobile/Manuf. Homes	4,243		2,945	1,493	907	685
TOTAL	**37,446**		**9,027**	**3,827**	**1,956**	**2,517**
Putnam County*/**						
Site-built Homes	5,435	1,434	694	871		N/A
Mobile/Manuf. Homes	3,379	1,308	571	483		
TOTAL	**8,815**	**2,742**	**1,265**	**1,354**		
St. Johns County						
Site-built Homes	63,670	66,012	3,506	2,021	20	16,562
Mobile/Manuf. Homes	3,559	4,408	950	132	10	2,791
TOTAL	**67,229**	**70,420**	**4,455**	**2,154**	**30**	**19,353**

Note: Vulnerable population determined using SRESP small area 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.

** For the purposes of this study, Clay County has a combined C/D/E zone, Nassau County has a combined A/B zone, and Putnam County has a combined D/E zone.*

*** In addition, Clay and Putnam Counties are the only counties within the NEFRC region that did not designate a zone F within their jurisdiction.*

Table IV - 7
Evacuating Population by Evacuation Levels,
Base Planning Scenario, 2020

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	13,528	56,971	293,081	30,609	61,374	39,579	120,023	615,165
B	14,405	72,881	358,822	46,057	62,822	40,849	171,899	767,735
C	15,282	121,518	490,064	53,276	68,972	45,136	179,554	973,802
D	16,158	134,529	563,176	67,970	71,467	47,588	189,639	1,090,527
E	17,035	141,034	636,499	78,083	74,015	51,162	198,527	1,196,355

Table IV - 8
Evacuating Population by Evacuation Levels,
Operational Scenarios, 2020

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	8,467	39,943	222,946	23,057	34,758	23,326	77,855	430,352
B	9,977	54,409	282,908	32,333	41,699	26,140	104,528	551,994
C	12,119	77,902	380,411	43,223	52,714	36,361	130,867	733,597
D	13,627	105,641	488,610	59,366	61,868	41,504	165,992	936,608
E (one way)	15,769	122,622	579,725	72,242	68,914	47,432	189,243	1,095,947
E	15,769	122,622	579,725	72,242	68,914	47,432	189,243	1,095,947
C+F	12,119	77,902	386,900	43,507	53,645	36,361	138,335	748,769

7. Property at Risk

Six of the top ten most destructive U.S. hurricanes have made landfall in the past ten years, including Katrina (2005), Charley (2004), Ivan (2004), Wilma (2005), Frances (2004), and Jeanne (2004). Six of these seven made landfall in the state of Florida. The information below dates from 2010, which is the most recent data available. It does not, however, incorporate the landfall and damage associated with Hurricane Sandy that made landfall in 2012.

Table IV-9
The 30 Costliest Tropical Cyclones to Strike the U.S. Mainland, 1900 - 2010

The 30 costliest tropical cyclones to strike the U.S. mainland, 1900-2010 (Damages are listed in US dollars and are not adjusted for inflation.)				
Rank	**Hurricane**	**Year**	**Category**	**Damage**
1	Katrina (FL, MS, LA)	2005	4	108,000,000,000
2	Ike (TX,LA)	2008	2	29,520,000,000
3	Andrew (SE FL, SE LA)	1992	5	26,500,000,000
4	Wilma (FL)	2005	2	21,007,000,000
5	Ivan (AL/NW FL)	2004	3	18,820,000,000
6	Charley (SW FL)	2004	4	15,113,000,000
7	Rita (SW LA, N TX)	2005	3	12,037,000,000
8	Frances (FL)	2004	2	9,507,000,000
9	Allison (N TX)	2001	TS[a]	9,000,000,000
10	Jeanne (FL)	2004	3	7,660,000,000
11	Hugo (SC)	1989	4	7,000,000,000
12	Floyd (Mid-Atlantic & NE U.S.)	1999	2	6,900,000,000
13	Isabel (Mid-Atlantic)	2003	2	5,370,000,000
14	Opal (NW FL, AL)	1995	3	5,142,000,000
15	Gustav	2008	2	4,618,000,000
16	Fran (NC)	1996	3	4,160,000,000
17	Georges (FL Keys, MS, AL)	1998	2	2,765,000,000
18	Dennis (NW FL)	2005	3	2,545,000,000
19	Frederic (AL, MS)	1979	3	2,300,000,000
20	Agnes (FL, NE U.S.)	1972	1	2,100,000,000
21	Alicia (N TX)	1983	3	2,000,000,000
22	Bob (NC, NE U.S.)	1991	2	1,500,000,000
23	Juan (LA)	1985	1	1,500,000,000
24	Camille (MS, SE LA, VA)	1969	5	1,420,700,000
25	Betsy (SE FL, SE LA)	1965	3	1,420,500,000
26	Elena (MS, AL, NW FL)	1985	3	1,250,000,000
27	Dolly (S TX)	2008	1	1,050,000,000
28	Celia (S TX)	1970	3	930,000,000
29	Lili (SC LA)	2002	1	925,000,000
30	Gloria (Eastern US)	1985	3	900,000,000

ADDENDUM (Rank is independent of other events in group)				
19	Georges (USVI, PR)	1998	3	3,600,000,000
19	Iniki (Kaukai, HI)	1992	3	1,800,000,000
19	Marilyn (USVI, PR)	1995	2	1,500,000,000
25	Hugo (USVI, PR)	1989	4	1,000,000,000

Source: NOAA online web site at www.nhc.noaa.gov

E. FLOOD ZONES

1. Delineation of Flood Zones

In order to determine the vulnerability of the flood prone areas, the FEMA DFIRM data[7] was used. This allows the data to be presented in a consistent format with other hazards.

2. Population-at-Risk

The population–at-risk was determined using the small area data to estimate the population within the flood zones. Estimates and projections of the population-at-risk for flood for 2015 and 2020 are presented on **Table IV-10**.

3. Critical Facilities

As indicated previously, the Critical Facility Inventory (CFI) includes a Vulnerability Assessment from (1) Hurricanes and Tropical Storms, (2) the flood zone, and (3) Wildfire Risk. Refer to Appendices for vulnerability of specific county critical facilities.

[7] The Flood Hazard Mapping Program, in the Department of Homeland Security Emergency Preparedness and Response Directorate (FEMA), has created a new flood hazard information product. The Standard DFIRM Database is a digital version of the FEMA flood insurance rate map that is designed for use with digital mapping and analysis software.

Table IV-10
Population-at-Risk from Flooding, 2015 - 2020

	Site Built Population 2015	Mobile / Manufactured Home Population 2015	Site Built Population 2020	Mobile / Manufactured Home Population 2020
Baker County				
100-YEAR FLOODPLAIN	3,790	3,187	4,075	3,427
500-YEAR FLOODPLAIN	71	49	77	53
Clay County				
100-YEAR FLOODPLAIN	40,770	5,750	45,505	6,425
500-YEAR FLOODPLAIN	4,360	372	4,879	422
Duval County				
100-YEAR FLOODPLAIN	112,231	8,130	117,566	8,509
500-YEAR FLOODPLAIN	29,268	1,542	30,669	1,616
Flagler County				
100-YEAR FLOODPLAIN	20,141	1,541	23,978	1,840
500-YEAR FLOODPLAIN	8,381	397	9,975	473
Nassau County				
100-YEAR FLOODPLAIN	20,164	6,759	21,824	7,331
500-YEAR FLOODPLAIN	3,963	632	4,049	662
Putnam County				
100-YEAR FLOODPLAIN	12,581	10,587	12,855	10,813
500-YEAR FLOODPLAIN	256	194	262	199
St. Johns County				
100-YEAR FLOODPLAIN	72,190	6,210	83,362	7,167
500-YEAR FLOODPLAIN	21,642	1,297	25,001	1,497

Source: FEMA, Northeast Florida Regional Council

F. Hazardous Materials

1. Delineation of Hazardous Material Vulnerability Zones (HMVZ)

In order to determine the vulnerability of each County to potential hazardous material incidents, it is necessary to determine the HMVZs[8] of each of the Section 302 Facilities (Facilities that use/store Extremely Hazardous Materials). Through the Local Emergency Planning Committee (LEPC) and the County Hazardous Material Section of the Emergency Management office, detailed vulnerability areas can be determined in real time using the specific chemical, amount of release, wind direction, and wind speed. Due to the specificity of each hazardous material release, it was not possible to determine the HMVZ or population exposure for each County.

2. Population-at-Risk

Due to the specificity of each hazardous material release, it was not possible to determine the HMVZ or population exposure for each county.

3. Critical Facilities

As part of the determination of the HMVZ, critical facilities including hospitals, nursing homes and schools affected are determined at the time of the incident.

[8] Hazardous Material Vulnerability Zones

G. Wildfire Evacuation Levels

1. Delineation of Wildland-Urban Interface (WUI)

In order to determine the vulnerability of the counties to potential wildfire, the assessment from the Florida Forest Service risk maps[9] for wildfire was used to identify areas susceptible to fires.

2. Population-at-Risk

The population–at-risk was calculated using the small area data to determine the population within the Wildland Interface.. The estimates for the population-at-risk for the Wildland Interface within each county for 2015 and 2020 are presented on **Table IV-11**.

3. Critical Facilities

As indicated previously, the Critical Facility Inventory (CFI) includes a Vulnerability Assessment from (1) Hurricanes and Tropical Storms, (2) flood zones and (3) Wildfire risk.

[9] The web-based risk system produces maps for Level of Concern (LOC), Fuels, Wildland Fire Susceptibility Index (WFSI), and the likelihood of the number of fires per 1000 acres per year (FOA).

Table IV-11
Population-at-Risk from Wildfire, 2015 – 2020

	Site Built Population 2015	Mobile/Manufactured Home Population 2015	Site Built Population 2020	Mobile/Manufactured Home Population 2020
Baker County				
HIGH	6204	4169	9214	4544
VERY HIGH	8514	6772	6740	7317
Clay County				
HIGH	66,444	14,334	74,156	15,996
VERY HIGH	59,899	9,892	66,861	11,048
Duval County				
HIGH	179,657	18,185	178,819	19,051
VERY HIGH	135,147	13,309	141,573	13,946
Flagler County				
HIGH	46,189	1,925	54,993	2,289
VERY HIGH	42,734	3,165	50,878	3,770
Nassau County				
HIGH	27,151	11,623	29,351	12,434
VERY HIGH	17,611	7,612	18,762	8,290
Putnam County				
HIGH	11,149	8,506	11,382	8,690
VERY HIGH	22,368	16,045	22,839	16,384
St. Johns County				
HIGH	76,849	10,037	88,757	11,593
VERY HIGH	72,485	9,070	83,722	10,474

Source: Florida Forest Service, Northeast Florida Regional Council

H. Critical Facilities

The identification of critical and sensitive facilities is an important factor for emergency management planning. The Critical Facilities Inventory is maintained by state and local emergency management agencies and updated to ensure that preparedness and protective actions can be focused to provide efficient evacuation, sheltering and recovery operations.

Typically, critical facilities include transportation facilities, including roadways, bus depots, ports, airports; communications facilities; utilities such as power plants, water treatment plants and water distribution systems; wastewater treatment plants and lift stations; health care facilities such as hospitals, nursing homes, hospice and dialysis facilities; assisted living and residential treatment facilities; schools and day cares; correctional facilities and sheriff/police stations; fire stations; and county and municipal buildings. Volunteer and relief agencies, potential staging areas, recovery centers and points of distribution (PODs) were also included in the critical facilities inventories.

The county inventory was obtained, updated and coded by type of facility. Facilities were coded as follows:

Table IV - 12
Critical Facility Types and Codes

Type of Critical Facility	Critical Code
Health Care Facilities	
Assisted Living	
Assisted Living Facilities	11
Adult Family Care Homes	52
Long Term Care	
Skilled Nursing Facilities	35
Intermediate Care Facilities	25
Transitional Living Facilities	34
Hospitals	
Hospitals	23
VA Hospital	24
Residential Treatment Facilities	32
Ambulatory Surgery Center	14
Crisis Stabilization Unit	17
Laboratory	
Clinical Laboratory	26
End Stage Renal Disease Facilities	18
Home Care	
Hospices	22
Critical Response Facilities	
Law Enforcement	74034
Fire Department	74026
Call Center	11318
EMS	74017
EOCs	74044
PODs	90003
Relief Agencies	74002
Disaster Recovery Center	90006
Logistical Staging Area	90002
Military Resources – National Guard	67306
Community Resources	
Designated Shelters	90004
Faith Based Facility	82020
Community Centers	82011
Public Buildings – Local	83026
Public Buildings – State	83034
Public Schools	73002
College	73004
Private School	73007
Correctional Facility	74036
Library	82024
Stadium	82046
Attraction	82002
Transportation	
Transportation – Seaplane Base	81072
Transportation – along evacuation route	72004

Type of Critical Facility	Critical Code
Transportation – FDOT	75018
Transportation – Port	81044
Transportation – Airport	81006
Transportation – Heliport/Helipad	81026
Transportation – Major Intersection	90001
Communication	
Phone/ Satellite/ Cellular Towers, etc.	11303
Electrical Systems	
Electrical Power Plant	75030
Nuclear Power Plant	75034
Electric Substation	75038
Infrastructure	
Solid Waste Facilities	75041
Water Treatment Plants/Public Water Supply	85004
Waste Water Facility	85006
Hazardous Materials	
Hazardous Materials – 302 facilities	10400
Miscellaneous	
Television	88012

Source: Health Care – AHCA online at www.fdhc.state.fl.us and FDEM, 2013
Mobile Homes – FDOH online at www.fdoh.state.fl.us
Schools – County Agencies, 2013
Shelters and PODs – County Emergency Management Agencies, 2013
Hazardous Materials – HMIS, August 2012

These facilities were geo-coded and the risk assessment was conducted to determine potential vulnerability to storm surge flooding, coastal and inland flooding and wildfire. The electronic database was provided to the State Division of Emergency Management and the County Emergency Management for official use only. The lists and vulnerability assessments of selected facilities with the corresponding maps are provided in the back of this report (See Appendix IV-A, B, C, D, E, F, and G).

1. Hospitals and Skilled Nursing Facilities

Particular attention was paid to health care facilities due to their potential need for evacuation support and the special needs of their patients.

In the Northeast Florida Region, there are 20 hospitals and 59 skilled nursing facilities, many of which may require complete patient evacuation from storm surge. The effects of a hurricane's hazards on these residents would be greatly compounded by their lack of mobility and need for continuity of care.

Past experience of medical facility evacuations has pointed out that a medical facility which can serve as an emergency shelter for even twice its normal patient capacity is still more capable of providing the necessary medical care to those sheltered patients than would a public shelter such as a school building. This is due to the medical manpower and equipment already in place in the host facility. As a result, low-lying vulnerable medical facilities are now encouraged by local officials to make individual hurricane contingency plans to evacuate to a similar facility located outside of areas vulnerable to storm surge instead of to a designated public shelter. The surge vulnerability

results are essential for this facility-to-facility concept of planning not only to help determine the need for evacuation, but also for the selection of non-vulnerable host shelter facilities for the reception of the evacuated facility's patients.

Chapter 400, Florida Statutes, and Chapter 10-D29, Florida Administrative Code, (FAC), mandate and provide guidance in the development of evacuation plans for nursing homes. The procedures to be followed include the designation of a host facility and a written agreement from the host facility, as well as the evacuation transportation providers. Chapter 10-D29 also requires nursing homes to exercise both the internal (fire, etc.) evacuation and external (hurricane, tornado, flooding, etc.) evacuation plans annually. The county emergency management agencies must review the disaster plans before a license is granted by the state[10]. In addition, the county emergency management agencies provide training and assistance in the development and maintenance of the nursing home plans.

[10] The state Agency for Health Care Administration (AHCA) administers Florida's $16 billion Medicaid program, licenses and regulates more than 32,000 health care facilities and 37 health maintenance organizations, and publishes health care data and statistics.

Table IV-13
2013 Health Care Facilities in Northeast Florida

Type of Facility	Baker	Clay	Duval	Flagler	Nassau	Putnam	St Johns	Region
Assisted Living								
Assisted Living Facilities/ Adult Family Care Homes	0	11	102	36	5	11	12	17
Long Term Care								
Skilled Nursing Facilities	2	9	32	3	2	3	8	59
Intermediate Care Facilities	0	0	6	0	1	0	1	8
Hospitals								
Hospitals	2	2	12	1	1	1	1	20
Ambulatory Surgery Center	0	3	16	0	0	0	8	27
Laboratory								
Clinical Laboratory	4	13	161	15	14	19	28	254
End Stage Renal Disease Facilities	0	3	12	1	2	1	2	21
Home Care								
Home Health Agencies*	1	16	76	4	4	6	13	120
Hospices	0	0	1	0	0	0	0	1

*Source: AHCA Website – Facility/Provider Search, 2013
Florida Division for Emergency Management and County data, 2013

2. Assisted Living Facilities (ALFs)

In addition to the medical facilities, there are over 170 licensed assisted living facilities (ALFs) in the Northeast Florida region. ALFs are living arrangements where adults live together to receive room, meals, and help with their daily living. ALFs are not nursing homes.

ALFs offer a variety of personal services like supervision of medications, or assistance with daily tasks such as bathing, dressing, etc. Recent administrative changes will allow some ALFs to provide limited nursing services such as injections, prescriptions, dressing changes, etc.

The majority of ALFs were built as private homes and care for four or five residents. In addition to one and two story dwellings, some ALFs are located in high-rise buildings, or multi-unit buildings. Three groups of people live in ALFs: the elderly, the physically disabled, and the mentally disabled. ALFs may also distinguish residents according to specific health problems. For example, providing they can care for themselves, some homes will accept people with Alzheimer's disease, diabetes, incontinence of bowel or bladder and those who require oxygen. While residents of ALFs do not require the constant attention necessary in nursing homes, in a stressful situation such as an emergency evacuation or public shelter stay, residents will need support and continued assistance.

Chapter 10-A5, FAC, requires that ALFs have an evacuation plan (both internal and external) with written agreements with other similar host facilities if evacuation is necessary. The Florida State Department of Health and the Department of Elder Affairs provide guidance in disaster planning for ALFs. In addition, many of the county departments of emergency management

provide training and assistance in the development and maintenance of the hurricane evacuation plans. County ALF facilities serving fifty or more residents and the predicted storm surge under each evacuation level also are presented in the Appendices.

3. End Stage Renal Dialysis Centers

Patients on dialysis face increased risks and challenges in disaster situations. Their treatment requires electrical power and a source of pure water. The Florida Agency for Health Care Administration (AHCA) requires that their providers identify their patients on dialysis and ensure they are dialyzed at their assigned centers within 24 hours of a hurricane warning. They are encouraged to make sure they have an emergency contact number for the dialysis centers, place their patients on their "disaster diets", and provide a list of all dialysis centers in the state as well as patient treatment sheets. After the storm, patients are directed to call the dialysis center to determine if it is operational. If it is not, they are to the call the emergency contact for the facility. If these contacts fail, patients are to call Network 7 at 1-800-826-3773. Health care providers are instructed not to assume that local hospitals will be able to handle their patients' needs. They are also responsible to provide receiving facilities with the appropriate needs, supplies and sufficient staff. (See ***Guidance to Health Care Providers***, AHCA, July 6, 2006)

4. Home Health Care

On any given day in the Northeast Florida region over 120 home health agencies serve the citizens of the Region. Legislation in 2006 has identified the challenges to providing continuity of care especially in a hurricane evacuation. The legislation has assigned responsibility to home health care providers to identify their vulnerable patients, assist them in finding appropriate shelter for the storm depending on their clients' needs and appropriate level of care and to provide sufficient staff and supplies to the receiving facilities.

Each county has established special needs shelters for those residents on the special needs registries as well as plans for transportation of those residents and their care providers. Home health agencies are now required to work with the county emergency management agencies and health departments to augment staff at those shelters if required.

5. Critical Infrastructure (Water Systems, Waste Water Systems, Power, Communications and Transportation)

The Critical Facilities Inventory also includes a listing of critical facilities/infrastructure necessary for response and recovery. County emergency management worked with providers including local government, utility companies, phone and cellular companies and transportation entities in the region.

6. Response and Recovery Facilities

State and county emergency management agencies have pre-identified potential sites for Points of Distribution of emergency supplies in the community as well as potential Staging Areas and Recovery Sites. These facilities are included in the Critical Facilities Inventories and are mapped. In addition, certain community resources such as community/recreation centers and churches were included. This preliminary information will be evaluated looking at key factors such as hazard vulnerability, neighborhood access, and income levels. (See maps in Appendix IV-A, IV-B, IV-C, IV-D, IV-E, IV-F, and IV-G)

7. Other Critical Facilities

The Inventory, as maintained by the Florida Division of Emergency Management, also includes the most current listing of hazardous material (Section 302) facilities, mobile home and RV parks, as well as additional public and private resources.