SECTION 3
HAZARD IDENTIFICATION AND RISK ASSESSMENT

This page intentionally left blank.

HAZARD IDENTIFICATION AND RISK ASSESSMENT

Introduction

This section of the Santa Rosa County LMS summarizes the results of a hazards and vulnerability assessment process undertaken by the Task Force members and includes a description of the types of hazards that may affect Santa Rosa County, their probability of occurrence, the geographic locations that are vulnerable, the number of structures and population affected, and potential loss estimates. This information, gathered from a variety of sources, provides the best available data for describing and quantifying the potential impacts to Santa Rosa County and is consistent with the County's Comprehensive Emergency Management Plan.

Primary attention is given to natural hazards considered reasonably possible to occur in the County as identified thorough research by staff, input from members and citizens, and data provided by FEMA and other sources. These hazards include:

Flooding (Hurricanes, Tropical Storms, and Thunderstorms)
Severe Storms and Lightning (Including Hurricane Winds)
Tornadoes and Waterspouts
Wildfire
Heat Waves and Drought
Winter Storms and Freezes
Erosion

This update of the LMS omits hazards noted in prior versions that are unlikely to occur in Santa Rosa County. Those hazards are earthquake, avalanche, land subsidence, landslide, tsunami, volcano, and sinkholes. The previous LMS also identified dam/levee failure as a separate hazard; however, the dams in Santa Rosa County are fairly small in size and impacts from failures fall within the broader hazard category of flooding. The Task Force discussed adding other man-made or technological hazards in this update and decided to keep the LMS focus on natural hazards.

General Description of Santa Rosa County

Santa Rosa County is located in northwest Florida bordering the Gulf of Mexico and Santa Rosa Sound. The County is bounded on the west by Escambia County, on the east by Okaloosa County and on the north by Escambia County, Alabama. The total area of Santa Rosa County is approximately 751,000 acres, including land and water. Almost 34% of the county consists of military reservation lands and conservation lands (Eglin Air Force Base comprises 10.4%, Naval Air Station Whiting Field and NOLFs comprise almost 1.0%, and Blackwater River State Forest comprises approximately 22.5% of the total county land area). The county's three municipalities comprise only about 1% of the entire county area. The unincorporated area of Santa Rosa County

(including Eglin Air Force Base, Naval Air Station (NAS) Whiting Field and Blackwater State Forest) comprises approximately 416,261 acres, most of which is rural in nature (see Map 3-1 – General Location Map).

TOPOGRAPHIC FEATURES

Santa Rosa County lies within the Coastal Plain, a broad belt consisting primarily of unconsolidated sands, silts and clay. The County is divided into two physiographic divisions, the Western Highlands and the Gulf Coastal Lowlands. Most of the County is located in the Western Highlands, which is a southwardly sloping plateau whose surface has been cut by numerous streams. The three principal streams that drain this area are the Escambia, Blackwater and Yellow Rivers. The many smaller streams that feed these rivers have a trellis drainage pattern and commonly head in small steep sided box canyons known as steepheads. Steepheads form where undermining by springs create steep slopes at the head of smaller streams. Several faults in the northern part of the County, where elevation ranges from 100 to 290 feet above sea level, form steep hills. The Gulf Coastal Lowlands is the low-lying area of southern Santa Rosa County. The Lowlands are a series of parallel terraces consisting of relatively undissected, nearly level plains rising from the coast in successively higher levels. Dunes, barrier islands, beach ridges, and other topographical features were stranded inland as seas receded. The highest terrace has an elevation of about 100 feet. The southern boundary of the Gulf Coastal Lowlands is formed by Santa Rosa Island, which is approximately 50 miles long and varying between approximately 1,000 and 1,500 feet wide and crosses not only Santa Rosa County but also Escambia County to the west and Okaloosa County to the east.

SURFACE WATER RESOURCES

Santa Rosa County has as rich diversity of unique coastal resources as well as a significant amount of water resources including the Blackwater River which is an Outstanding Florida Water, the Escambia River, the Yellow River, the East River, Escambia Bay, Blackwater Bay and East Bay, Santa Rosa Sound as well as the Gulf of Mexico. These major waterways in addition to other tributaries have been identified as major drainage features in Map 3-2.

SIGNIFICANT HABITATS

Santa Rosa Island is the only barrier island within Santa Rosa County and actually crosses several counties. These pristine white sands provide a valuable environmental and economic stimulus to the county.

Upland forest, mixed coniferous/hardwoods, cropland and pastureland, shrub and brushland as well as coastal scrub and beaches are the predominant communities which provide resources for habitat within the county. Managed lands include a large portion of the county. Eglin Air Force Base and NAS Whiting Field provide a large military presence in the community and both agencies cooperate with the county through mutual aid agreements in support of hazardous and emergency conditions.

Map 3-3 portrays the locations of these managed lands as well as sea grass beds which provide habitat for vital marine resources.

CLIMATE

Local temperatures and their seasonal changes reflect climatic conditions characteristic of the northwest Florida. Santa Rosa County has borderline subtropical temperatures with rare, short duration freezing events affecting the County during late December through March.

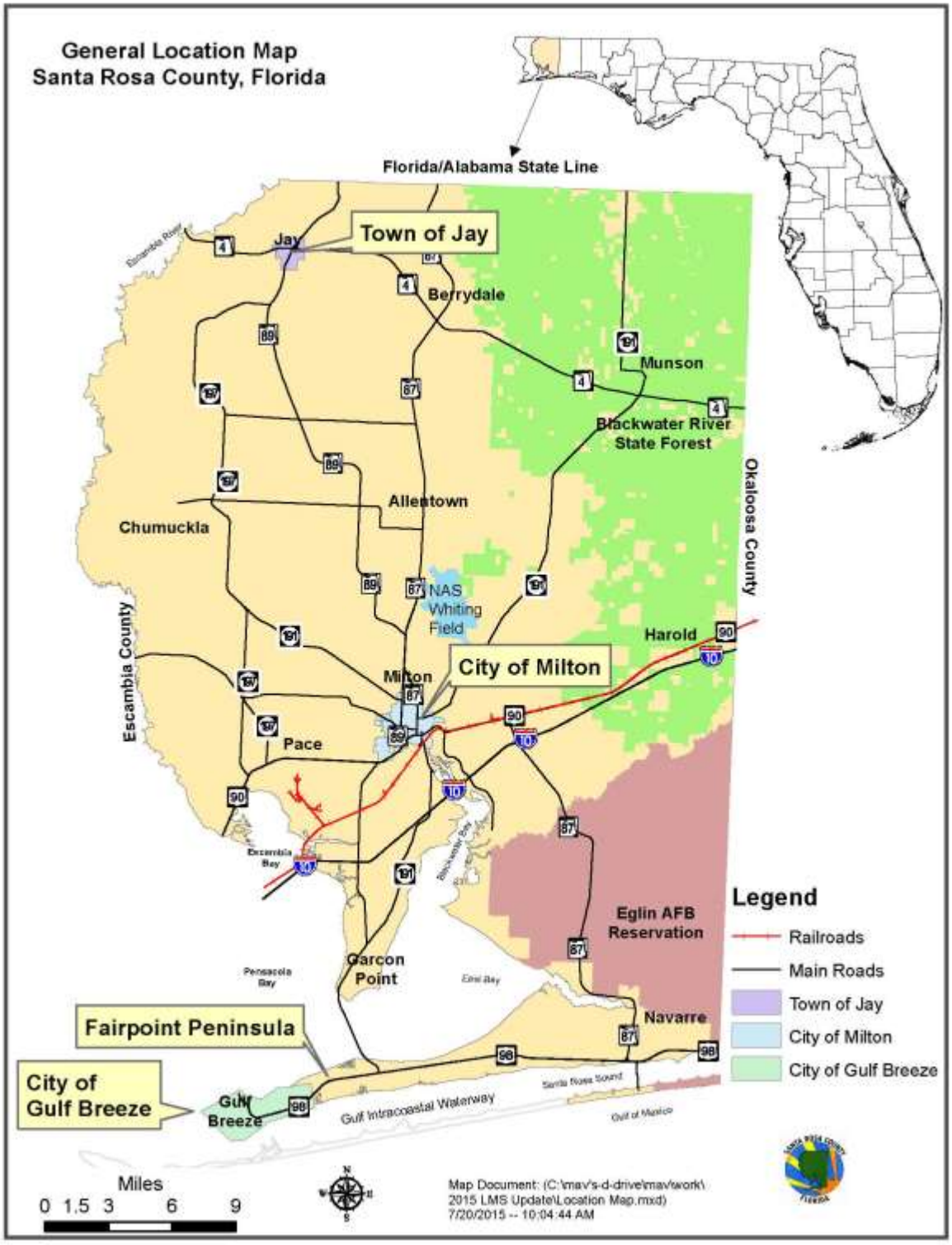
Historical records for Santa Rosa County from the NOAA National Center for Environmental Information indicate the 1981-2010 Climate Normals are NCDC's latest three-decade averages of climatological variables, including temperature and precipitation. This new product replaces the 1971-2000 Climate Normals product, which remains available as historical data.

The average minimum winter temperature is 42’ Fahrenheit. The average maximum summer temperature is 92’. Average participation is 65.27 inches.

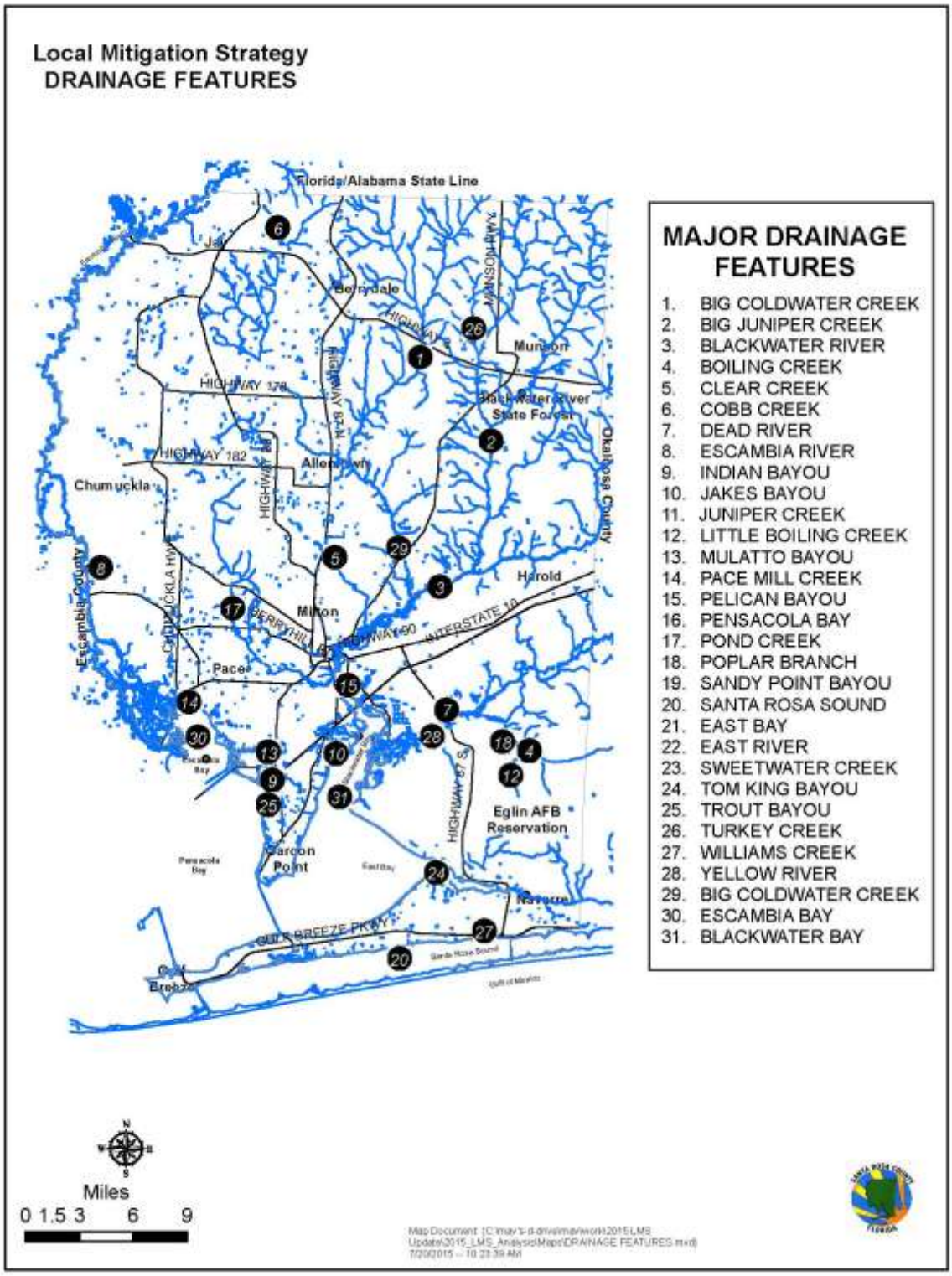
Winter temperatures are cool enough to give a pronounced seasonal character to plant growth. Winter cool temperatures are sufficient to terminate growth cycles of some plants, while many others become dormant

The southern portion of the County has temperatures moderated by the Gulf of Mexico, Santa Rosa Sound, Escambia Bay and East Bay. The western portion of the County has temperatures moderated somewhat by the Escambia River. The interior of the County can expect to have slightly warmer summer temperatures and noticeably cooler winter temperatures than either the southern or western parts of the County.

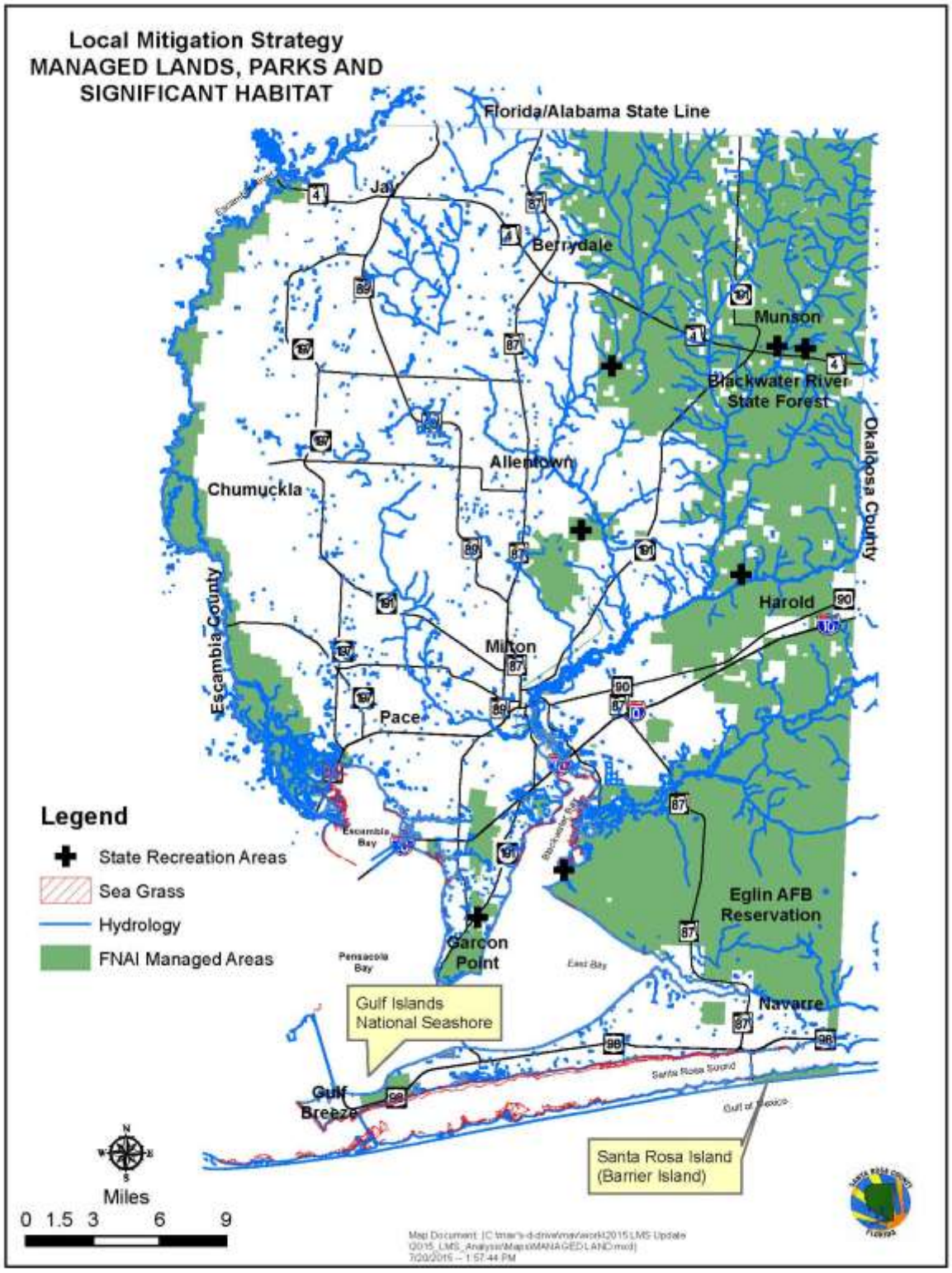
Map 3-1: General Location Map – Santa Rosa County



Map 3-2: Major Drainage Features – Santa Rosa County



Map 3-3: Habitats, Parks and Managed Lands – Santa Rosa County



POPULATION

Santa Rosa County is the 30th most populous county in Florida with a total population of 159,785 in 2014 based on the University of Florida, Bureau of Economic and Business Research (BEBR). The growth rate between 2010 and 2011 was 2.33%. BEBR's estimated the 2014 population at 159,785 which is an increase from 2011 of 9.7%. The population breakdown by municipality in 2014 shows the City of Gulf Breeze with 5,823, the Town of Jay with 529, the City of Milton with 9,316 and the unincorporated portion of the County with the remaining 144,117.

The population comprises 57,368 households with an average household size of 2.59 persons. Map 3-4 is a population density map created from the 2010 US Census Data showing how the population is dispersed within the various Census Block Group in Santa Rosa County.

Table 3-1: Santa Rosa County Population

1980	1990	2000	2010	2011	2014
55,988	81,608	117,743	151,372	144,425	159,785

Source: US Census; Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN University of Minnesota, 2011 & University of Florida Bureau of Economic and Business Research (BEBR) 2014 Population Estimate.

Table 3-2: Santa Rosa County & Municipal Population Estimates

Jurisdiction	Population Estimate – April 1, 2014
Santa Rosa County	159,785
City of Gulf Breeze	5,823
Town of Jay	529
City of Milton	9,316

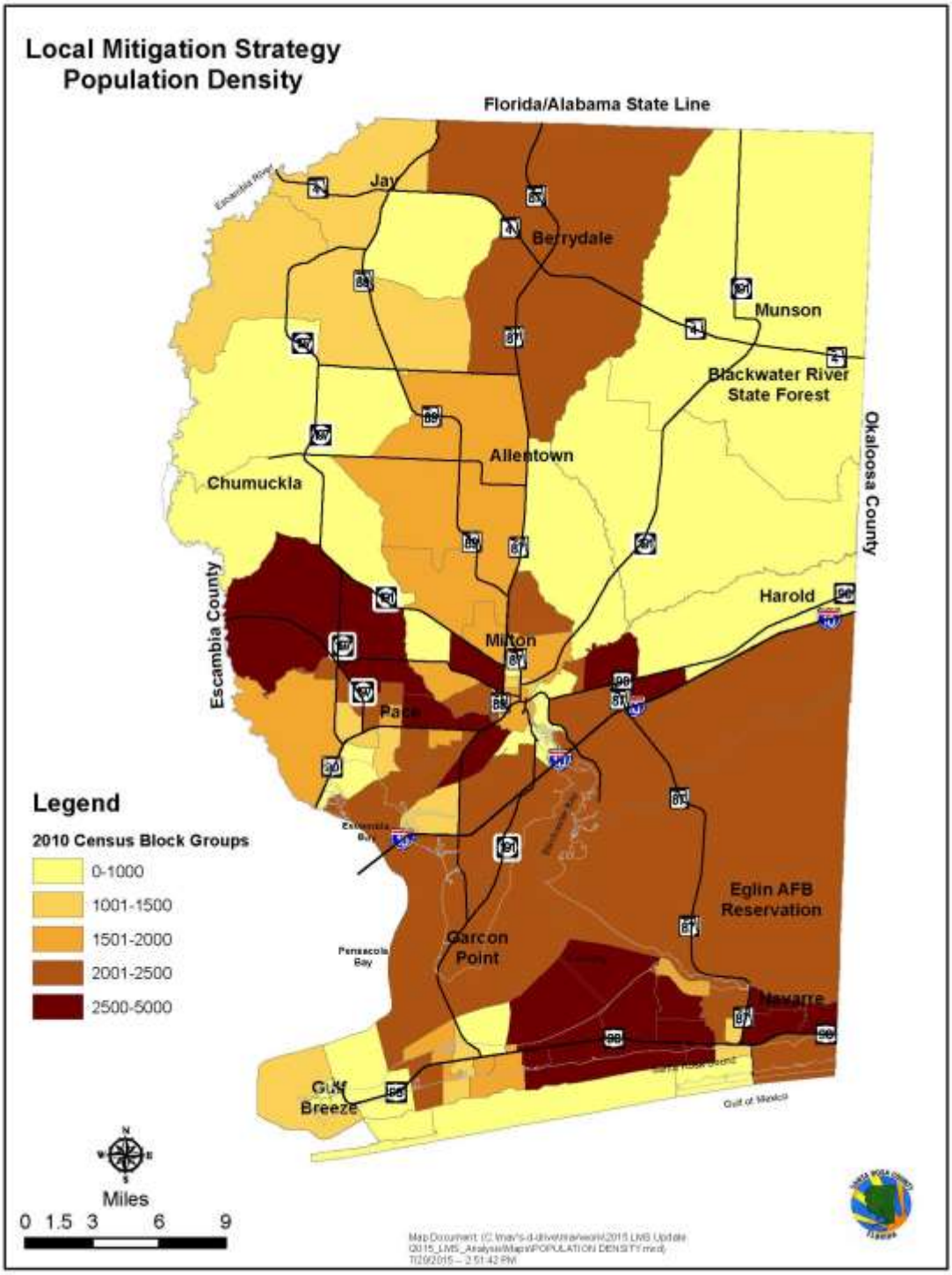
Source: BEBR, 2014

Table 3-3: Santa Rosa County Population Projections 2015-2040

	2015	2020	2025	2030	2035	2040
Low	158,300	166,700	173,900	179,700	184,100	188,000
Medium	163,300	178,300	192,300	205,300	217,400	229,300
High	169,700	189,800	210,200	230,700	251,300	272,800

Source: BEBR, April 2015

Map 3-4: Population Density – Santa Rosa County



ECONOMIC INDICATORS

Income

The average yearly household income in Santa Rosa County is $57,253 and 47.53% of the household earn more than the national average each year (Santa Rosa County Economic Development Office). The 2009-2013 American Community Survey provides the following breakout of number of households by income range.

Table 3-4: Number of Households by Income Range

Income Range	Number	Percent
Total Households	*57,368*	*100.0%*
Less than $10,000	2,983	5.2%
$10,000 - $14,999	2,180	3.8%
$15,000 - $24,999	5,622	9.8%
$25,000 - $34,999	5,393	9.4%
$35,000 - $49,999	8,261	14.4%
$50,000 - $74,999	12,621	22.0%
$75,000 - $99,999	8,376	14.6%
$100,000 - $149,999	7,745	13.5%
$150,000 - $199,999	2,352	4.1%
$ 200,000 or more	1,893	3.3%

Source: U.S. Census Bureau, 2009-2013 American Community Survey, Income and Benefits (in 2013 Inflation-adjusted dollars)

Employment

Over the last decade Santa Rosa County has experienced fairly low unemployment rates and all forecasts indicate that this trend will continue. According to the Santa Rosa County Economic Development Office, the latest unemployment rate for Santa Rosa County is 4.4%. In 2015 the number of employees in Santa Rosa County was 40,204. Professional and business services industry growth is above average and remaining industries are also projected to grow positively (information, professional services, education and financial services, etc.).

LAND USE

Santa Rosa County has adopted a Comprehensive Plan to provide orderly growth management within the unincorporated areas of the County. Goals, objectives and policies are monitored and updated. The policy document addresses growth patterns, existing conditions and land use for the County and the foundation document provides historical and regulatory guidance. Each individual municipality has also adopted plans

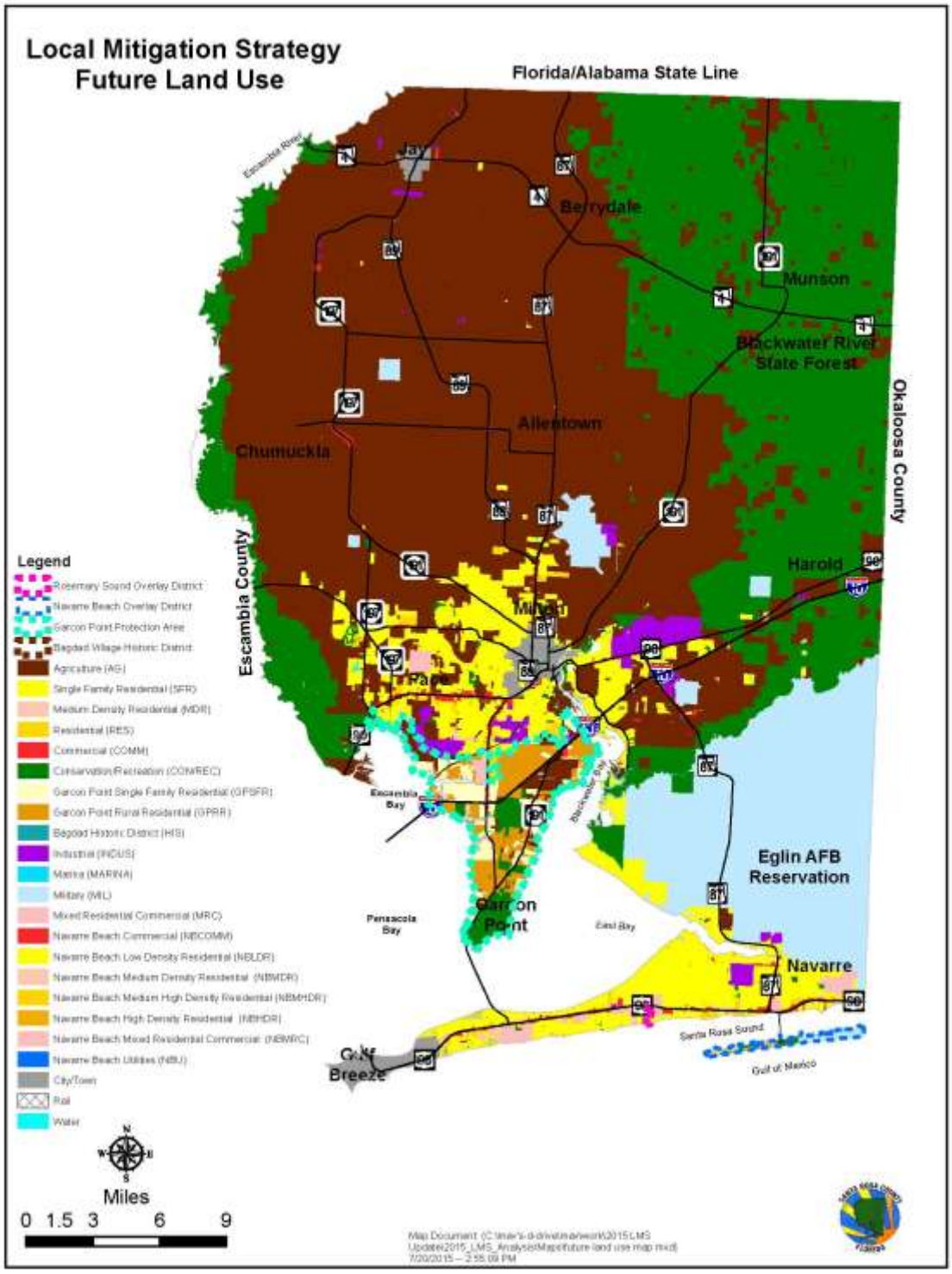
for their respective communities. Map 3-5 identifies future land use categories and overlay zones for Santa Rosa County.

Growth since the LMS submission has been rather limited due to the national economic downturn and overall development patterns have stayed consistent. A comparison of the GIS datasets for existing land use from April 2010 to present reflects the land use changes with the most significant growth occurring in the single family residential land use category as shown in Table 3-5. Map 3-6 shows the location of parcels that have been developed during that timeframe as compared to the evacuation zones.

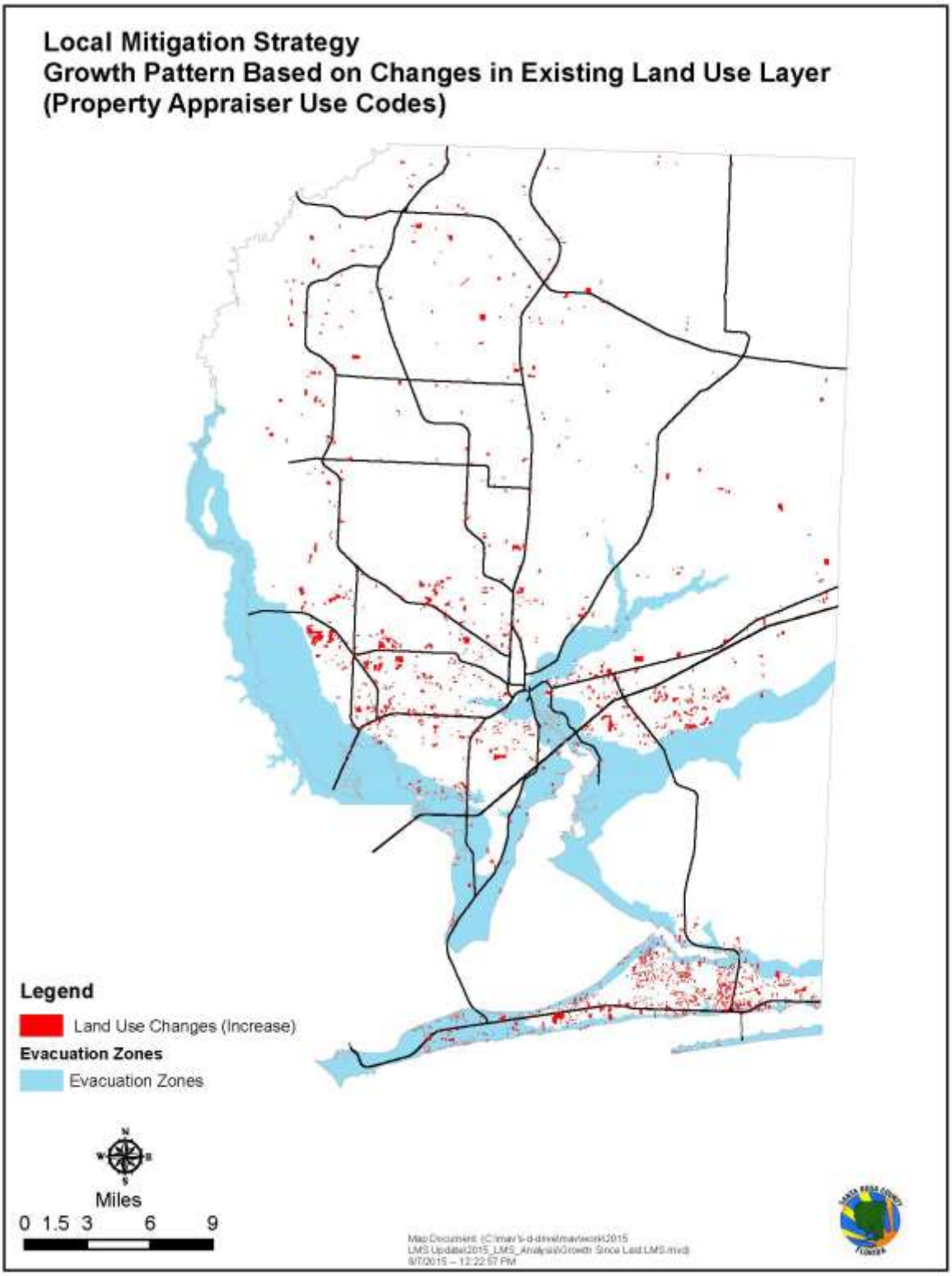
Table 3-5: Land Use Changes April 2010 to July 2015

Previous Land Use Code	New Land Use Code	Acreage
Agriculture	Single Family Residential	604
Silviculture	Single Family Residential	191
Vacant	Single Family Residential	2282
Vacant	Commercial	248
Vacant	Industrial	121
Vacant	Institutional	121
Misc.	Misc.	746
Total		**4,313**
Source: SRC GIS		

Map 3-5: Future Land Use Map – Santa Rosa County



Map 3-6: Growth Patterns Based on Changes in Existing Land Use



TRANSPORTATION

Santa Rosa County has several major highways: I-10, US Highway 98, US Highway 90, State Roads 87 and 89 and several major arterials.

There is one municipal airport as well as Naval Air Station Whiting Field which produces more than 400 flights a day and trains every naval aviator in the US Navy as well as aviators from the US Air Force, Marines and international aviators. In addition to the primary air installation there are six outlying airfields (OLF) used in training operations. Eglin Air Force Base Reservation lies partially within Santa Rosa County and naval and marine corps training missions in the F-35 will occur at OLF Choctaw which is on the reservation. Additional air force missions occur within Santa Rosa County and are monitored through Eglin AFB. The East River Basin is the location for US Army special operations training.

CSX freight rail services travels through Santa Rosa County from the East to the West across the entire county. See Map 3-1, General Location Map, which also includes major thoroughfares and rail.

Hazards Analysis

This section of the Santa Rosa County LMS summarizes the results of a hazards and vulnerability assessment process undertaken by the Task Force members and includes a description of the types of hazards that may affect Santa Rosa County, their probability of occurrence, the geographic locations that are vulnerable, the number of structures and population affected, and potential loss estimates. This information, gathered from a variety of sources, provides the best available data for describing and quantifying the potential impacts to Santa Rosa County and is consistent with the County's Comprehensive Emergency Management Plan.

Primary attention is given to natural hazards considered reasonably possible to occur in the County as identified thorough research by staff, input from members and citizens, and data provided by FEMA and other sources. These hazards include:

Flooding (Hurricanes, Tropical Storms, and Thunderstorms)
Severe Storms and Lightning (Including Hurricane Winds)
Tornadoes and Waterspouts
Wildfire
Heat Waves and Drought
Winter Storms and Freezes
Erosion

FLOODING (Hurricanes, Tropical Storms, and Thunderstorms)

The Santa Rosa County Flood Mitigation Plan (FMP), included in its entirety as Appendix F, includes a thorough hazard and vulnerability assessment. To avoid duplication, this section will only summarize the information found in the plan. Flood problems that occur in the county can be attributed to riverine, coastal surge, overland sheet flow and ponding. Events likely to result in flooding include tropical cyclones (hurricanes and tropical storms) and thunderstorms.

a. History

As noted in Section 5.4 of the FMP, flooding is a common occurrence in the county with damage-producing events recorded almost annually.

b. Probability

There is a “High” probability of flooding in Santa Rosa County with at least one incidence of localized flooding occurring annually. Oftentimes such events occur as a result of thunderstorms, hurricanes, or tropical storm. Upon occurrence, the degree of severity is “Med to High” and is dependent upon how high the water rises above normal, and whether or not structures are involved. (Source: CEMP)

c. Vulnerability

A flood hazard area may or may not have flood *problems*. Flooding is viewed as a natural and even beneficial occurrence. A floodplain is only a problem if human development gets in the way of, or exacerbates, the natural flooding.

Flood prone areas are scattered throughout the county. Older structures tend to be especially vulnerable because they were not built in accordance with the current lot grading requirements or the current finished flood elevation requirements that the county now enforces.

Santa Rosa County has over 81 miles of rivers and streams, numerous lakes and ponds, and 100 miles of tidally affected shoreline. Flooding is the primary emergency concern along the Escambia River, Yellow River, Blackwater River and associated tributaries, lakes, bays, and swamps.

The number of vulnerable properties located within FEMA flood zones and their value was derived from the County’s GIS dataset and the digital FEMA Firm layer (Table 3-6). On a countywide basis (including all municipalities), 12.3% of the parcels in Santa Rosa County are located within the 100 Year, 500 Year or Velocity flood zone. See Map 3-7 for a representation of the 100 and 500 year flood zones. Table 3-7 reflects flood vulnerability for each individual municipality. Table 3-8 reflects storm surge vulnerability for each jurisdiction and Map 3-8 shows storm surge locations.

FMP Section 6.1 details the vulnerability of Santa Rosa County to property damage, to public health and safety, and to adverse economic impacts resulting from the potential of flooding.

Table 3-6: Santa Rosa County Flood Vulnerability (including all municipalities)

Flood Zone	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
100 Year	10,398	771	935	36	1,742
500 Year	741	51	13	2	60
Velocity	860	94	166	5	107
Outside	85,864	5,873	2,963	432	9,545
TOTAL	97,863	6,789	4,077	475	11,453

Source: Santa Rosa County GIS and FEMA Dfirm, 2015.

Table 3-7: Flood Vulnerability by Jurisdiction

Santa Rosa County (Unincorporated Area)

Flood Zone	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
100 Year	9,817	746.23	907.47	26.30	1680.00
500 Year	423	25.71	8.47	0.69	27.95
Velocity	660	46.96	126.38	3.40	18.79
Outside	78,859	5127.67	2360.00	366.19	8129.86
TOTAL	89,759	5,946.57	3,402.32	396.58	9,856.60

City of Gulf Breeze

Flood Zone	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
100 Year	203	9.03	18.53	2.37	29.93
500 Year	0	0.00	0.00	0.00	0.00
Velocity	200	46.96	39.74	1.22	87.92
Outside	2,753	385.58	526.59	16.44	928.60
TOTAL	3,156	441.57	584.86	20.03	1,046.45

Town of Jay

Flood Zone	Number of Properties	Building Value ($Millin)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
100 Year	3	0.20	0.01	0.00	0.21
500 Year	0	0.00	0.00	0.00	0.00
Velocity	0	0.00	0.00	0.00	0.00
Outside	502	34.24	3.38	2.63	40.25
TOTAL	505	34.44	3.39	2.63	40.46

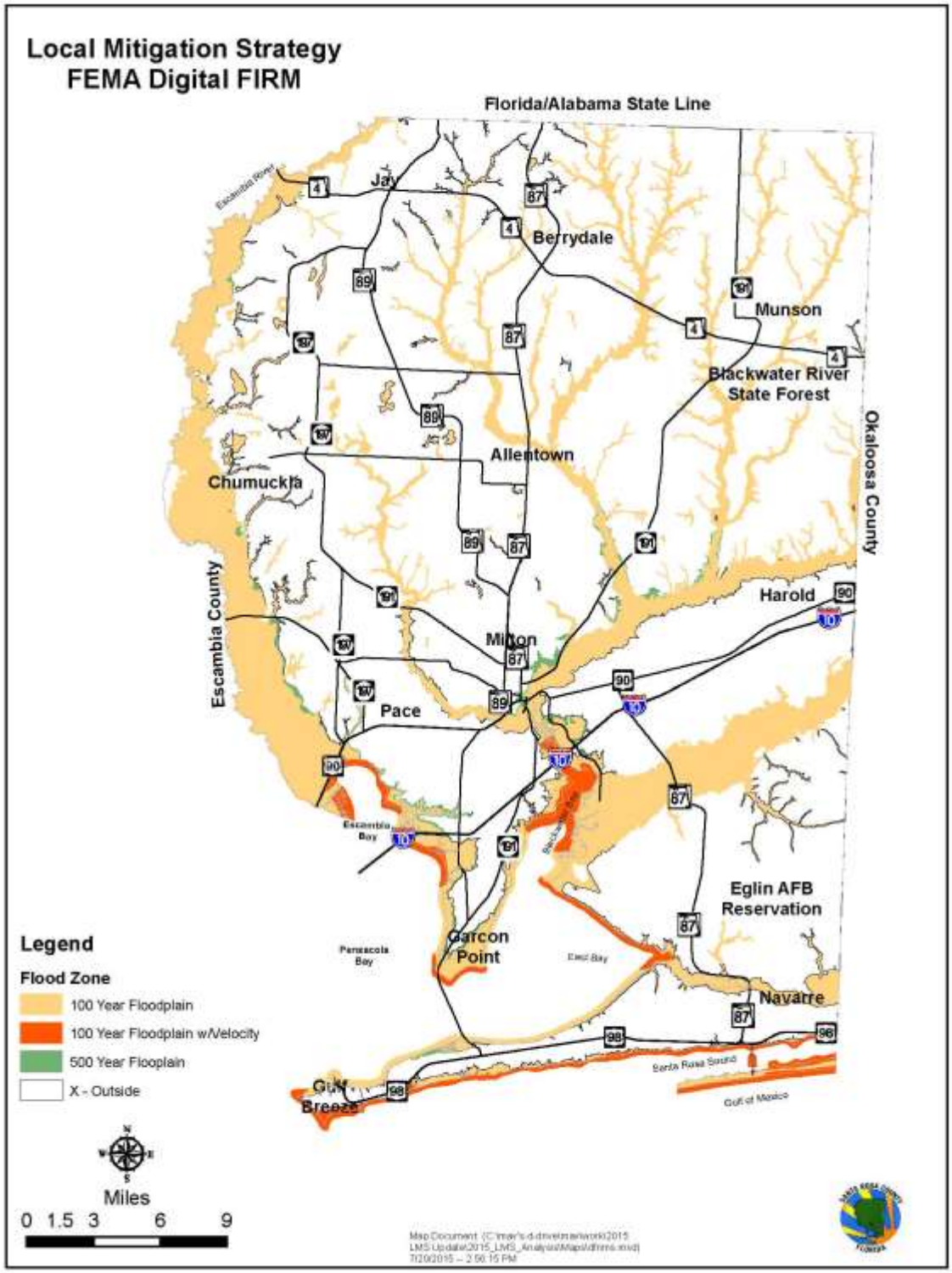
City of Milton

Flood Zone	Number of Properties	Building Value ($Millin)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
100 Year	375	15.33	8.64	7.57	31.54
500 Year	318	25.71	4.98	0.95	31.64
Velocity	0	0.00	0.00	0.00	0.00
Outside	3,750	325.82	73.27	46.84	445.92
TOTAL	4,443	366.86	86.89	55.36	509.10

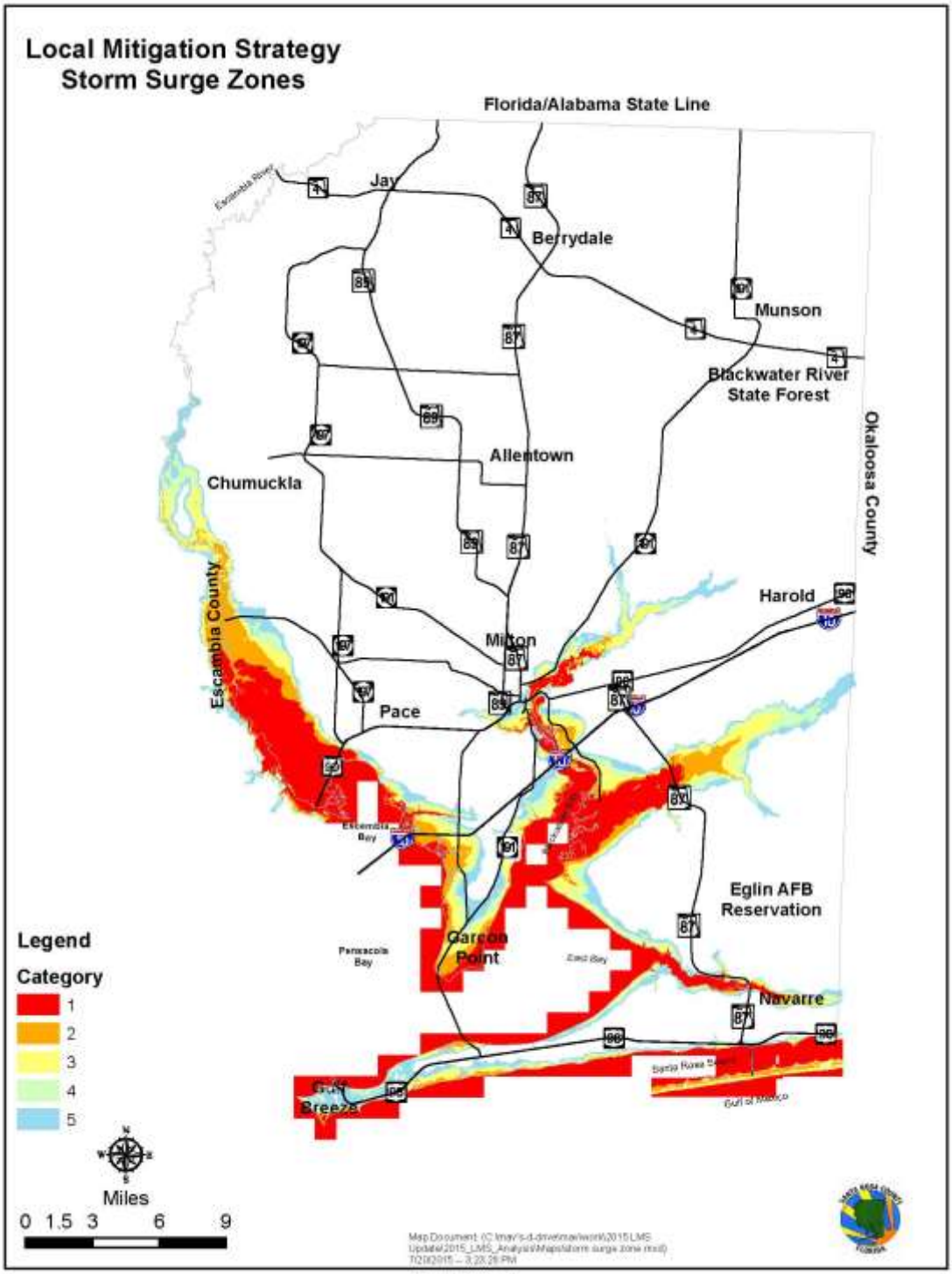
Table 3-8: Storm Surge Vulnerability by Jurisdiction

Santa Rosa County (Unincorporated Area)					
Evacuation Zone	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
A	3,393	390.93	667.15	15.36	1073.43
B	3,657	229.35	186.58	7.88	423.80
C	9,146	604.16	426.67	21.01	1051.83
D	1,658	57.67	42.25	2.73	102.64
E	9,067	714.63	492.84	39.25	1,246.73
Non-Evac	63,150	3,979.99	1,862.86	310.35	6,153.21
Total	90,071	5,976.73	3,678.35	396.58	10,051.64
City of Gulf Breeze					
Evacuation Zone	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
A	118	33.77	29.36	0.80	63.92
B	168	36.32	29.77	2.85	68.94
C	316	62.74	65.53	1.65	129.92
D	1,346	124.33	231.65	4.94	360.93
E	997	184.40	228.55	9.79	422.74
Non-Evac	0	0.00	0.00	0.00	0.00
Total	2,945	441.56	584.86	20.03	1,046.45
Town of Jay					
Evacuation Zone	Number of Properties	Building Value ($Millin)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
A	0	0.00	0.00	0.00	0.00
B	0	0.00	0.00	0.00	0.00
C	0	0.00	0.00	0.00	0.00
D	0	0.00	0.00	0.00	0.00
E	0	0.00	0.00	0.00	0.00
Non-Evac	505	34.44	3.39	2.63	40.46
Total	505	34.44	3.39	2.63	40.46
City of Milton					
Evacuation Zone	Number of Properties	Building Value ($Millin)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
A	4	0.05	0.07	0.00	0.13
B	37	0.07	1.21	0.05	1.33
C	52	1.34	1.11	0.41	2.86
D	119	4.04	1.06	4.12	9.22
E	457	39.26	14.08	4.53	57.87
Non-Evac	3774	322.1	69.35	46.26	437.71
Total	4,443	366.86	86.88	55.37	509.12

Map 3-7: FEMA Flood Zones – Santa Rosa County



Map 3-8: Storm Surge Zones – Santa Rosa County



d. Maximum Threat / Extent

The maximum threat to Santa Rosa County from flooding would be a Category 5 accompanied by heavy rains. Such an event would impact surge and flood zones as noted in the tables above.

SEVERE STORMS AND LIGHTNING (Including Hurricane Winds)

The National Severe Storms Laboratory of the National Weather Service classifies a thunderstorm as severe when it contains one or more of the following phenomena:

Hail 3/4" or greater
Winds gusting in excess of 50 knots (57.5 mph)
A tornado

Santa Rosa County has 70 to 90 thunderstorm days each year. Consistent with averages from around the State of Florida, this is some of the highest frequency in the nation. The vast majority of these days are from May to September. However, thunderstorms may occur during any month of the year.

Aside from being able to produce tornadoes, thunderstorms can cause damage with high winds. These winds are usually caused by cold upper level air descending from the top of a thunderstorm to the ground. If the speed of decent is rapid, these cold “microbursts” can fan out as they come in contact with the ground at a high rate of speed. This is sometimes referred to as “straight line winds.” These winds can cause significant property damage, injuries, and deaths similar to a F0 to F2 tornado or Category 1 or 2 hurricanes.

a. History

Florida leads the nation in lightning strikes per year (closely correlating with the number of thunderstorm days per year). In addition, Florida tops the national list for lightning deaths with 468 deaths between 1959 and 2013. No other state even comes close. Texas was second with 216. Santa Rosa County is estimated to have 12 or more flashes per square kilometer per year throughout the county, based upon data from 2005-2014 (source: U.S. Lightning Detection Network). This ranks as typical for Florida and the Southeast, but well above the average for the nation as a whole. Most thunderstorms in the County occur due to air mass heating during hot summer days. Additionally passage of cold fronts in the autumn, winter and spring can trigger lines of thunderstorms.

Hurricane and high wind damage can be expected anywhere in the County. The greatest damage will be found along coastal areas (Navarre Beach and the entire

Fairpoint Peninsula, and along bay shores along East, Escambia and Blackwater Bays). Inland areas can experience full force winds, regardless of their not being located directly on the coast. Pace, Milton, Jay, Allentown, and Munson can all experience high winds from thunderstorms and hurricanes. Structural damage can be expected in extreme circumstances.

Table 3-9: History of Severe Thunderstorms Resulting in Property Damage, Injury or Death

GENERAL LOCATION	DATE	EVENT	MAGNITUDE (kts)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
NAVARRE	2/19/1996	Thunderstorm Wind	60	0	0	$20,000.00	$0.00
ALLENTOWN	4/14/1996	Thunderstorm Wind	60	0	0	$3,000.00	$0.00
HAROLD	8/4/1996	Thunderstorm Wind	40	0	0	$1,000.00	$0.00
HAROLD	11/25/1996	Thunderstorm Wind	50	0	0	$4,000.00	$0.00
AVALON BEACH	1/9/1997	Thunderstorm Wind	50	0	0	$2,000.00	$0.00
PACE	1/15/1997	Thunderstorm Wind	50	0	0	$3,000.00	$0.00
MUNSON	6/20/1997	Thunderstorm Wind	50	0	0	$1,000.00	$0.00
GULF BREEZE	7/5/1997	Thunderstorm Wind	50	0	0	$3,000.00	$0.00
GULF BREEZE	7/5/1997	Thunderstorm Wind	50	0	0	$3,000.00	$0.00
JAY	7/15/1997	Thunderstorm Wind	50	0	0	$2,000.00	$0.00
MILTON	8/29/1997	Thunderstorm Wind	50	0	0	$5,000.00	$0.00
JAY	8/30/1997	Thunderstorm Wind	55	0	0	$15,000.00	$0.00
MILTON	10/24/1997	Thunderstorm Wind	60	0	0	$5,000.00	$0.00
WALLACE	10/25/1997	Thunderstorm Wind	70	0	0	$50,000.00	$0.00
MILTON	11/1/1997	Thunderstorm Wind	50	0	0	$1,500.00	$0.00
JAY	11/21/1997	Thunderstorm Wind	70	0	2	$25,000.00	$0.00
CHUMUCKLA	1/7/1998	Thunderstorm Wind	60	0	0	$7,000.00	$0.00
NAVARRE	1/7/1998	Thunderstorm Wind	50	0	0	$3,500.00	$0.00
PACE	2/11/1998	Thunderstorm Wind	50	0	0	$5,000.00	$0.00
COUNTYWIDE	6/6/1998	Thunderstorm Wind	60	0	0	$150,000.00	$0.00
BERRYDALE	6/23/1998	Thunderstorm Wind	50	0	0	$2,000.00	$0.00
MILTON	9/27/1998	Thunderstorm Wind	50	0	0	$10,000.00	$0.00
HAROLD	9/29/1998	Thunderstorm Wind	50	0	0	$3,000.00	$0.00
MILTON	1/2/1999	Thunderstorm Wind	60	0	0	$10,000.00	$0.00

GENERAL LOCATION	DATE	EVENT	MAGNITUDE (kts)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
MILTON	1/9/1999	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
JAY	3/3/1999	Thunderstorm Wind	55	0	0	$15,000.00	$0.00
CHUMUCKLA	3/9/1999	Thunderstorm Wind	60	0	0	$25,000.00	$0.00
MILTON	3/13/1999	Thunderstorm Wind	58	0	0	$15,000.00	$0.00
BAGDAD	3/13/1999	Thunderstorm Wind	50	0	0	$5,000.00	$0.00
FLORIDALE	3/13/1999	Thunderstorm Wind	50	0	0	$3,000.00	$0.00
MUNSON	3/13/1999	Thunderstorm Wind	50	0	0	$4,000.00	$0.00
ALLENTOWN	8/14/1999	Thunderstorm Wind	60	0	0	$57,000.00	$0.00
MILTON	4/24/2000	Thunderstorm Wind	65	0	0	$22,000.00	$0.00
JAY	7/11/2000	Thunderstorm Wind	60	0	0	$8,000.00	$0.00
PACE	7/11/2000	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
MILTON	7/13/2000	Thunderstorm Wind	60	0	0	$15,000.00	$0.00
NAVARRE	7/20/2000	Thunderstorm Wind	60	0	0	$15,000.00	$0.00
JAY	7/20/2000	Thunderstorm Wind	65	0	0	$25,000.00	$0.00
JAY	7/22/2000	Thunderstorm Wind	60	0	0	$7,000.00	$0.00
JAY	7/22/2000	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
JAY	8/25/2000	Thunderstorm Wind	65	0	0	$15,000.00	$0.00
MUNSON	8/27/2000	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
JAY	3/12/2001	Thunderstorm Wind	60	0	0	$15,000.00	$0.00
MILTON	3/15/2001	Thunderstorm Wind	50	0	0	$35,000.00	$0.00
GULF BREEZE	7/10/2001	Thunderstorm Wind	52	0	0	$0.00	$0.00
CHUMUCKLA	8/18/2001	Thunderstorm Wind	50	0	0	$5,000.00	$0.00
CHUMUCKLA	10/13/2001	Thunderstorm Wind	60	0	0	$15,000.00	$0.00
CHUMUCKLA	10/13/2001	Thunderstorm Wind	60	0	0	$10,000.00	$0.00

GENERAL LOCATION	DATE	EVENT	MAGNITUDE (kts)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
GULF BREEZE	10/13/2001	Thunderstorm Wind	75	0	0	$50,000.00	$0.00
NAVARRE	1/5/2002	Thunderstorm Wind	70	0	0	$720,000.00	$0.00
MILTON	3/26/2002	Thunderstorm Wind	50	0	0	$10,000.00	$0.00
JAY	6/14/2002	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
HOLLEY	6/14/2002	Thunderstorm Wind	50	0	0	$20,000.00	$0.00
BERRYDALE	7/1/2002	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
BERRYDALE	7/19/2002	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
GULF BREEZE	7/21/2002	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
MILTON	11/5/2002	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
COUNTYWIDE	12/24/2002	Thunderstorm Wind	55	0	0	$20,000.00	$0.00
MUNSON	4/25/2003	Thunderstorm Wind	55	0	0	$5,000.00	$0.00
ALLENTOWN	6/30/2003	Thunderstorm Wind	50	0	0	$7,000.00	$0.00
MILTON	6/2/2004	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
MILTON	6/27/2004	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
MILTON	6/28/2004	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
JAY	7/16/2004	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
BERRYDALE	7/16/2004	Thunderstorm Wind	50	0	0	$8,000.00	$0.00
NAVARRE	3/26/2005	Thunderstorm Wind	60	0	0	$10,000.00	$0.00
MILTON	6/25/2006	Thunderstorm Wind	50	0	0	$10,000.00	$0.00
JAY	8/3/2006	Thunderstorm Wind	50	0	0	$20,000.00	$0.00
WOODLAWN BEACH	10/22/2006	Thunderstorm Wind	55	0	0	$50,000.00	$0.00
MILTON	11/15/2006	Thunderstorm Wind	50	0	0	$12,000.00	$0.00
HAROLD	6/9/2007	Thunderstorm Wind	56	0	0	$0.00	$0.00
HAROLD	7/14/2007	Thunderstorm Wind	50	0	0	$12,000.00	$0.00

GENERAL LOCATION	DATE	EVENT	MAGNITUDE (kts)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
HOLLEY	7/20/2007	Thunderstorm Wind	50	0	0	$10,000.00	$0.00
MILTON	11/21/2007	Thunderstorm Wind	61	0	0	$50,000.00	$0.00
NAVARRE	12/15/2007	Thunderstorm Wind	60	0	0	$40,000.00	$0.00
MILTON	2/12/2008	Thunderstorm Wind	50	0	0	$50,000.00	$0.00
ALLENTOWN	5/15/2008	Thunderstorm Wind	50	0	0	$18,000.00	$0.00
ALLENTOWN	6/10/2008	Thunderstorm Wind	50	0	0	$12,000.00	$0.00
(NSE)NAS WHITNG FLD	6/29/2008	Thunderstorm Wind	50	0	0	$25,000.00	$0.00
ALLENTOWN	12/10/2008	Thunderstorm Wind	58	0	0	$33,000.00	$0.00
CHUMUCKLA	3/27/2009	Thunderstorm Wind	61	0	0	$0.00	$0.00
MILTON	3/28/2009	Thunderstorm Wind	50	0	0	$0.00	$0.00
BERRYDALE	3/28/2009	Thunderstorm Wind	50	0	0	$0.00	$0.00
MUNSON	3/31/2009	Thunderstorm Wind	50	0	0	$25,000.00	$0.00
MUNSON	5/5/2009	Thunderstorm Wind	52	0	0	$10,000.00	$0.00
JAY	12/14/2009	Thunderstorm Wind	50	0	0	$500.00	$0.00
MUNSON	12/14/2009	Thunderstorm Wind	50	0	0	$0.00	$0.00
MILTON	12/12/2010	Thunderstorm Wind	61	0	0	$3,000.00	$0.00
MILTON	12/12/2010	Thunderstorm Wind	61	0	0	$10,000.00	$0.00
MILTON	12/12/2010	Thunderstorm Wind	61	0	0	$5,000.00	$0.00
CHUMUCKLA	2/1/2011	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
ALLENTOWN	2/1/2011	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
MILTON	2/1/2011	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
PACE	2/1/2011	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
FLORIDATOWN	4/4/2011	Thunderstorm Wind	50	0	0	$0.00	$0.00
PACE	6/13/2011	Thunderstorm Wind	52	0	0	$5,000.00	$0.00

GENERAL LOCATION	DATE	EVENT	MAGNITUDE (kts)	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
PACE	7/2/2011	Thunderstorm Wind	60	0	0	$3,000.00	$0.00
BAGDAD	7/2/2011	Thunderstorm Wind	52	0	0	$2,000.00	$0.00
BERRYDALE	5/29/2012	Thunderstorm Wind	52	0	0	$4,000.00	$0.00
MILTON	7/30/2012	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
MILTON	4/11/2013	Thunderstorm Wind	52	0	0	$0.00	$0.00
BAGDAD	3/28/2014	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
MILTON	3/28/2014	Thunderstorm Wind	51	0	0	$30,000.00	$0.00
NAVARRE	3/28/2014	Thunderstorm Wind	70	0	0	$10,000.00	$0.00
NAVARRE	3/28/2014	Thunderstorm Wind	61	0	0	$10,000.00	$0.00
NAVARRE	3/28/2014	Thunderstorm Wind	70	0	0	$25,000.00	$0.00
MUNSON	5/25/2014	Thunderstorm Wind	61	0	0	$5,000.00	$0.00
WALLACE	4/15/2015	Thunderstorm Wind	52	0	0	$5,000.00	$0.00
PACE	4/25/2015	Thunderstorm Wind	50	0	0	$5,000.00	$0.00
(NSE)NAS WHITNG FLD	4/25/2015	Thunderstorm Wind	50	0	0	$0.00	$0.00

Source: www.ncdc.noaa.gov/stormevents

Table 3-10 – History of Hail, High Wind and Lightening in Santa Rosa County

General Location	Date	Event	MAGNITUDE	Deaths	Injuries	Property Damage	Crop Damage
PACE	1/6/1996	Lightning		0	0	$1,000.00	$0.00
MILTON	2/19/1996	Lightning		0	0	$500.00	$0.00
PACE	2/19/1996	Lightning		0	0	$500.00	$0.00
MILTON	3/18/1996	Hail	0.75	0	0	$0.00	$0.00
PACE	4/14/1996	Hail	0.75	0	0	$0.00	$0.00
PACE	4/18/1996	Hail	0.75	0	0	$0.00	$0.00
MUNSON	6/7/1996	Hail	0.75	0	0	$0.00	$0.00
JAY	9/5/1996	Lightning		0	1	$0.00	$0.00
PEA RIDGE	1/24/1997	Hail	0.75	0	0	$0.00	$0.00
BAGDAD	1/24/1997	Hail	1.75	0	0	$0.00	$0.00
HAROLD	1/24/1997	Lightning		0	0	$5,000.00	$0.00
NAVARRE	1/24/1997	Lightning		0	0	$75,000.00	$0.00
NAVARRE	4/23/1997	Lightning		0	0	$1,000.00	$0.00
MIDWAY	4/25/1997	Lightning		0	0	$2,000.00	$0.00
MUNSON	6/20/1997	Hail	0.75	0	0	$0.00	$0.00
MILTON	11/1/1997	Hail	1	0	0	$0.00	$0.00
MILTON	2/16/1998	Hail	1	0	0	$0.00	$0.00
NAVARRE	2/22/1998	Hail	0.75	0	0	$0.00	$0.00
HOLLEY	2/26/1998	Hail	0.75	0	0	$0.00	$0.00
MILTON	3/8/1998	Hail	0.75	0	0	$0.00	$0.00
GULF BREEZE	7/16/1998	Lightning		0	0	$40,000.00	$0.00
NAVARRE	8/1/1998	Lightning		0	0	$15,000.00	$0.00
NAVARRE	8/1/1998	Lightning		0	0	$10,000.00	$0.00
HAROLD	8/9/1998	Lightning		0	3	$0.00	$0.00
MILTON	8/9/1998	Lightning		0	0	$4,000.00	$0.00
MILTON	8/9/1998	Lightning		0	0	$0.00	$0.00
NAVARRE	1/2/1999	Hail	0.75	0	0	$0.00	$0.00
MILTON	1/2/1999	Hail	0.88	0	0	$0.00	$0.00
MILTON	4/29/1999	Hail	0.75	0	0	$0.00	$0.00
JAY	5/18/1999	Hail	0.75	0	0	$0.00	$0.00
MILTON	6/11/1999	Lightning		0	0	$5,000.00	$0.00
PACE	7/29/1999	Lightning		0	0	$5,000.00	$0.00
GULF BREEZE	3/29/2000	Hail	0.88	0	0	$0.00	$0.00
JAY	5/13/2000	Hail	1	0	0	$0.00	$0.00
JAY	7/11/2000	Hail	0.75	0	0	$0.00	$0.00
PACE	7/11/2000	Lightning		0	0	$5,000.00	$0.00
NAVARRE	7/12/2000	Hail	0.75	0	0	$0.00	$0.00
MILTON	8/27/2000	Hail	1	0	0	$0.00	$0.00
HAROLD	3/12/2001	Hail	1.75	0	0	$0.00	$0.00
COASTAL SANTA ROSA (ZONE)	6/11/2001	High Wind	45	0	0	$0.00	$0.00
COASTAL SANTA ROSA (ZONE)	8/19/2001	High Wind	40	0	0	$10,000.00	$0.00
MILTON	5/17/2002	Lightning		0	0	$20,000.00	$0.00
MILTON	7/3/2002	Hail	0.75	0	0	$0.00	$0.00
MUNSON	7/4/2002	Lightning		0	2	$0.00	$0.00

General Location	Date	Event	MAGNITUDE	Deaths	Injuries	Property Damage	Crop Damage
ALLENTOWN	7/8/2002	Lightning		0	1	$0.00	$0.00
BAGDAD	7/19/2002	Lightning		0	1	$0.00	$0.00
PACE	7/26/2002	Lightning		0	1	$0.00	$0.00
HOLLEY	8/1/2002	Lightning		0	1	$0.00	$0.00
CHUMUCKLA	8/22/2002	Lightning		0	1	$0.00	$0.00
MILTON	2/21/2003	Lightning		0	0	$5,000.00	$0.00
GULF BREEZE	3/12/2003	Hail	1	0	0	$0.00	$0.00
NAVARRE	3/12/2003	Hail	0.75	0	0	$0.00	$0.00
MUNSON	5/2/2003	Hail	0.75	0	0	$0.00	$0.00
JAY	5/2/2003	Hail	0.75	0	0	$0.00	$0.00
MILTON	7/17/2003	Hail	0.75	0	0	$0.00	$0.00
PACE	7/18/2003	Hail	0.75	0	0	$0.00	$0.00
MILTON	8/16/2003	Lightning		0	0	$10,000.00	$0.00
BERRYDALE	5/18/2004	Hail	1	0	0	$0.00	$0.00
MILTON	3/26/2005	Hail	1	0	0	$0.00	$0.00
MILTON	3/26/2005	Hail	2.75	0	0	$2,500,000.00	$0.00
NAVARRE	3/26/2005	Hail	1	0	0	$0.00	$0.00
BERRYDALE	3/31/2005	Lightning		0	1	$0.00	$0.00
BERRYDALE	4/1/2005	Lightning		0	1	$0.00	$0.00
CHUMUCKLA	4/6/2005	Hail	0.75	0	0	$0.00	$0.00
MILTON	4/26/2005	Hail	1.75	0	0	$4,000.00	$0.00
MUNSON	5/5/2005	Hail	1	0	0	$0.00	$0.00
MUNSON	5/5/2005	Hail	1.75	0	0	$10,000.00	$0.00
HAROLD	5/5/2005	Hail	0.75	0	0	$0.00	$0.00
PACE	5/5/2005	Hail	0.75	0	0	$0.00	$0.00
NAVARRE	6/15/2005	Lightning		1	1	$0.00	$0.00
MILTON	7/29/2005	Lightning		0	0	$50,000.00	$0.00
MILTON	2/13/2007	Hail	0.75	0	0	$0.00	$0.00
PACE	6/27/2007	Lightning		0	0	$80,000.00	$0.00
PACE	7/14/2007	Lightning		0	0	$15,000.00	$0.00
NAVARRE	7/24/2007	Lightning		0	0	$15,000.00	$0.00
PACE	9/14/2007	Lightning		0	0	$100,000.00	$0.00
BERRYDALE	2/12/2008	Hail	1	0	0	$0.00	$0.00
BERRYDALE	2/21/2008	Hail	1	0	0	$0.00	$0.00
ALLENTOWN	6/10/2008	Lightning		0	1	$0.00	$0.00
NAVARRE	6/29/2008	Lightning		0	0	$10,000.00	$0.00
PACE	7/5/2008	Lightning		0	0	$15,000.00	$0.00
BAGDAD	7/13/2008	Lightning		0	0	$15,000.00	$0.00
WOODLAWN BEACH	7/13/2008	Lightning		0	0	$10,000.00	$0.00
MUNSON	8/7/2008	Lightning		0	1	$0.00	$0.00
MUNSON	2/18/2009	Hail	1	0	0	$0.00	$0.00
ALLENTOWN	3/27/2009	Hail	0.88	0	0	$0.00	$0.00
ALLENTOWN	3/28/2009	Hail	1.75	0	0	$0.00	$0.00
MILTON	3/28/2009	Hail	0.75	0	0	$0.00	$0.00
HOLLEY	4/2/2009	Hail	0.75	0	0	$0.00	$0.00
JAY	5/11/2009	Hail	1.75	0	0	$0.00	$0.00
GULF BREEZE	4/24/2010	Hail	0.88	0	0	$0.00	$0.00

General Location	Date	Event	MAGNITUDE	Deaths	Injuries	Property Damage	Crop Damage
CHUMUCKLA	4/4/2011	Hail	0.75	0	0	$0.00	$0.00
MILTON	4/4/2011	Lightning		0	0	$8,000.00	$0.00
MILTON	4/4/2011	Lightning		0	0	$5,000.00	$0.00
GALT CITY	4/4/2011	Lightning		0	0	$15,000.00	$0.00
BAGDAD	6/13/2011	Hail	1	0	0	$0.00	$0.00
GULF BREEZE	7/11/2011	Lightning		0	1	$0.00	$0.00
ORIOLE BEACH	9/28/2011	Lightning		0	0	$5,000.00	$0.00
CHUMUCKLA	6/11/2012	Lightning		0	0	$2,000.00	$0.00
MILTON	6/11/2012	Lightning		0	1	$0.00	$0.00
PACE	7/6/2012	Lightning		0	0	$5,000.00	$0.00
NAVARRE	7/24/2012	Lightning		0	0	$5,000.00	$0.00
NAVARRE	8/2/2012	Lightning		0	1	$0.00	$0.00
NAVARRE	2/22/2013	Lightning		0	0	$10,000.00	$0.00
MILTON	3/23/2013	Lightning		0	0	$50,000.00	$0.00
PACE	6/10/2013	Lightning		0	0	$2,000.00	$0.00
PACE	7/13/2013	Lightning		0	1	$5,000.00	$0.00
MILTON	8/6/2013	Lightning		0	1	$5,000.00	$0.00
SANTA ROSA CO.	4/5/2014	Hail	1	0	0	$0.00	$0.00
SANTA ROSA CO.	4/14/2014	Lightning		0	0	$50,000.00	$0.00
SANTA ROSA CO.	4/14/2014	Lightning		0	0	$25,000.00	$0.00
MUNSON	5/25/2014	Hail	1.75	0	0	$0.00	$0.00
ALLENTOWN	6/13/2014	Lightning		1	0	$0.00	$0.00
MILTON	8/12/2014	Lightning		0	1	$0.00	$0.00
GULF BREEZE	9/8/2014	Lightning		0	0	$10,000.00	$0.00
GULF BREEZE	4/14/2015	Lightning		0	0	$5,000.00	$0.00
BAGDAD	4/19/2015	Lightning		0	0	$25,000.00	$0.00

Source: http://www.ncdc.noaa.gov/stormevents/

b. Probability

There are historically between 79 and 90 days each year on which a thunderstorm occurs somewhere in Santa Rosa County. The primary aspects of thunderstorms associated with impacts to buildings and infrastructure damage are flooding, lightning and hail. Flooding is covered separately for each jurisdiction. During the period 1996 to 2015 the largest hail observed in the unincorporated portion of Santa Rosa County was 2.75 inches in diameter. There have been no deaths attributed to thunderstorms in Santa Rosa County during the 1996 to 2015 timeframe.

The historic values are used to forecast the future activity of thunderstorms as there is no data available to quantify the probability of thunderstorms and the associated phenomena. Therefore the probability of a thunderstorm is at least one thunderstorm on 79 to 90 days each year. There is a relatively high probability that lightning strikes and thunderstorms will continue to occur in Santa Rosa County (countywide). However, the risk to the population is relatively low concerning injury and death.

c. Vulnerability

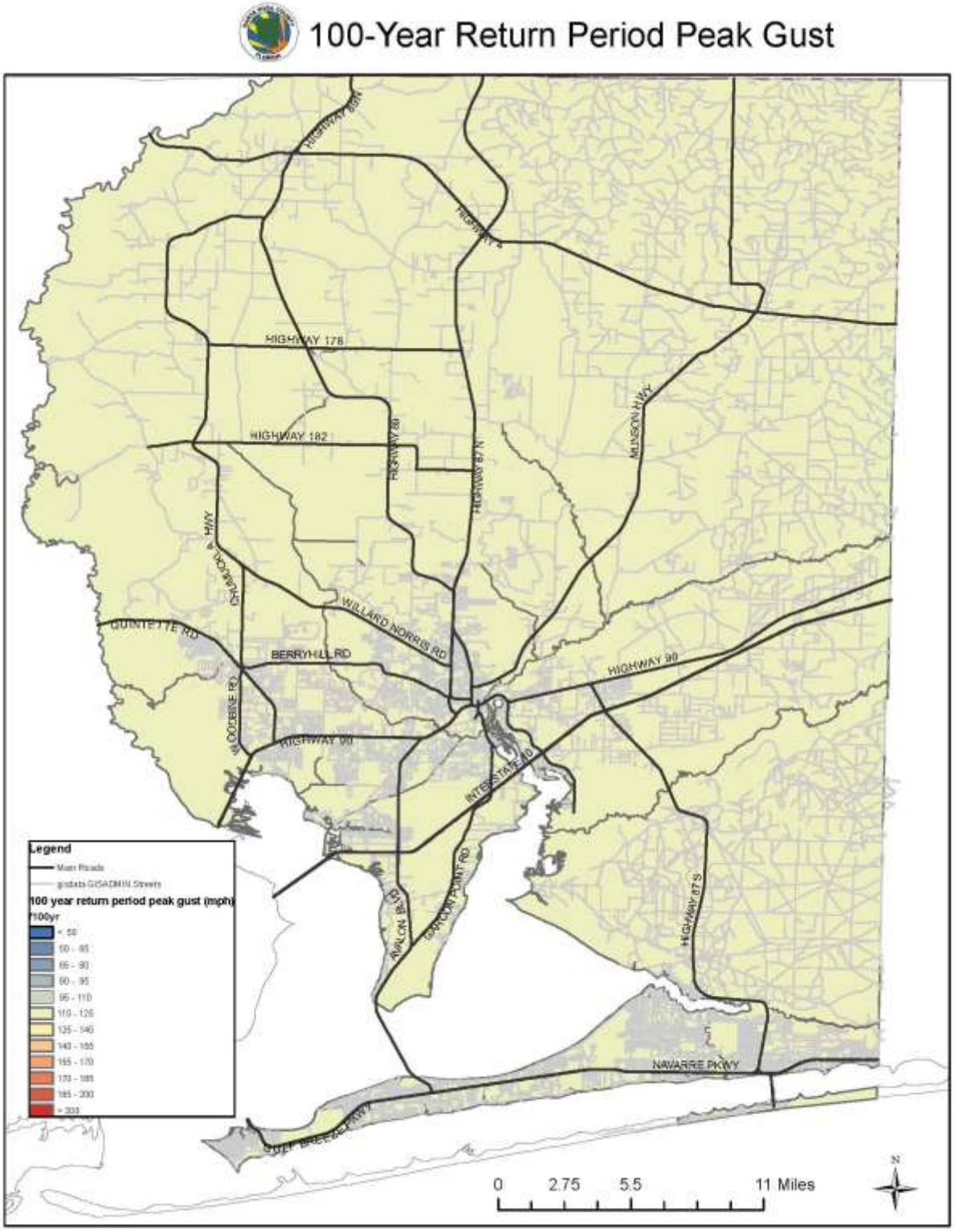
All geographic locations within Santa Rosa County are vulnerable, including the coastline where tornadoes over water or “waterspouts” are possible. Rising floodwaters associated with severe storms, can affect those in low-lying areas, areas of poor-drainage or along bodies of water.

Damage and loss are in direct relation to the population density of the impacted area. Typical injuries may result from: Vehicle accidents, wind-blown debris, falling limbs, lightning strikes, downed power lines, structural collapse, rising flood waters, and mold.

Hurricane winds are a devastating part of hurricane hazards and range from 74 mph to 155 mph. The majority of Santa Rosa County is subject to high winds vulnerability. High winds impact the timing of evacuation orders due to the closing of bridges along evacuation routes. Additionally, all evacuation activities are timed to be complete prior to the arrival of gale force winds (40 mph).

Map 3-9 identifies the wind vulnerability based on the adopted Florida Building Code which adopted an element of stricter building standards based on wind hazard associated with hurricanes.

Map 3-9: Wind Vulnerability from HAZUS Program – Santa Rosa County



d. Maximum Threat / Extent

The maximum storm threat to Santa Rosa County would be a hurricane similar to, or stronger than, Hurricane Ivan.

Hurricane Ivan was a Category 3 "major hurricane" and made landfall just west of Santa Rosa County with the strongest winds occurring near our border. Wind damage was widespread. The National Hurricane Center estimated sustained wind speed at landfall of 121 mph.

Using the same parameter's for storm modeling that matched Hurricane Ivan, modeling was conducted using HAZUS_MH[2.1] which produced the following damage estimates (Table 3-11). The total economic loss estimated for this model hurricane was 36.4 million dollars which is approximately 0.23% of the total replacement value of the county's building stock.

Table 3-11: Category 3 Hurricane Scenario – Building Related Economic Loss Estimates (Thousands of dollars) Wind Damage Only

Category	Residential	Commercial	Industrial	Others	Total
Property Damage					
Building	27,894.59	630.10	90.11	92.32	28,707.12
Content	5,512.81	120.21	23.43	12.92	5,669.37
Inventory	0.00	1.81	4.51	0.55	6.87
Subtotal	**33,407.40**	**752.12**	**118.05**	**105.79**	**34,383.36**
Busineess Interruption Loss					
Income	0.00	126.06	0.49	4.21	130.76
Relocation	1,024.28	80.17	4.33	7.81	1,116.59
Rental	567.67	46.07	0.34	0.38	614.46
Wage	0.00	86.83	0.86	35.48	130.76
Subtotal	**1,591.95**	**339.13**	**6.02**	**47.88**	**1,984.98**
Total					**36,368.34**

Source: HAZUS-MH[2.1] Modeling, 2015

[1] HAZUS-MH[2.1] is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods and hurricanes. Hazus-MH[2.1] uses Geographic Information Systems (GIS) technology to estimate physical, economic and social impacts of disasters. It graphically illustrates the limits of identified high-risk locations due to earthquake, hurricane and floods. Users can then visualize the spatial relationships between populations and other more permanently fixed geographic assets or resources for the specific hazard being modeled, a crucial function in the pre-disaster planning process.

Again, using HAZUS modeling software, a worst case scenario storm was created using the storm path of a previous storm, Hurricane Dennis, and modifying the parameters to allow the storm to make landfall just west of the county line (near Santa Rosa Island on the west side) and increasing the storm category to a Category 5 (catastrophic) with

maximum sustained winds of 185 mph, gusting to over 201 mph. Although rare, several Atlantic storms has reached category 5, including Hurricane Ivan which reach category 5 status before dropping to category 3 before making landfall. The full reports from the HAZUS-MH$^{2.1}$ modeling software are located in Attachments 3-1 and 3-2.

The total building related economic loss estimated for this type hurricane is estimated at over 8 billion dollars which is approximately 50.42% of the total replacement value of the county's building stock. Catastrophic damages include an estimate of 8,642 buildings being completely destroyed, 32,835 buildings will be at least moderately damaged. Hospital beds will be completely unavailable with only 14% of the beds in service after one week. 17,646 households are estimated to be displaced. It is estimated that the largest loss will be sustained by residential structures (81%). The following table outlines the estimated losses.

Table 3-12: Category 5 Hurricane Scenario – Building Related Economic Loss Estimates (Thousands of dollars) Wind Damage Only

Category	Residential	Commercial	Industrial	Others	Total
Property Damage					
Building	4,123,835.44	434,783.45	96,879.16	95,251.28	4,750,749.33
Content	1,738,551.56	365,851.30	93,010.81	71,001.68	2,268,415.35
Inventory	0.00	6,911.88	14,788.83	1,191.05	22,891.76
Subtotal	**5,862,387.00**	**807,546.63**	**204,678.80**	**167,444.01**	**7,042,056.44**
Busineess Interruption Loss					
Income	4,229.26	87,716.56	1,415.41	1,341.62	94,702.85
Relocation	494,049.82	59,418.67	6,542.62	17,379.70	577,390.81
Rental	164,007.46	38,920.81	1,099.42	1,881.72	205,909.41
Wage	9,918.22	97,712.70	2,376.42	5,303.93	115,311.27
Subtotal	**672,204.76**	**283,768.74**	**11,433.87**	**25,906.97**	**993,314.34**
Total					**8,035,370.78**

Source: HAZUS-MH$^{2.1}$ Modeling, 2015

TORNADOES AND WATERSPOUTS

Tornadoes and waterspouts are virtually impossible to predict (in terms of exact location of formation and path), although technologies such as Doppler Radar are enabling weather forecasters to give accurate warnings during formation and identification of an event. Aside from strong building codes (generally developed around the premise of hurricane mitigation and protection), vulnerability to these events will always be present and difficult to mitigate against.

The U.S. National Weather Service has updated the Fujita Scale of tornado intensity to a new Enhanced Fujita Scale. The new Enhanced Fujita Scale continues to use F0-F5 ratings (shown below) but is based on additional calculations of wind and damage. It was implemented in the United States on February 1, 2007.

Table 3-13 Enhanced Fujita Scale

The Enhanced Fujita Scale			
F-Scale Number	Damage	Wind Speed	Type of Damage
F0	Light	65-85 mph	Little to no damage to man-made structures. Breaks Branches off trees; pushes over shallow-rooted trees; damages signs.
F1	Moderate	86-110 mph	Beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; Moderate Damage
F2	Considerable	111-135 mph	Considerable damage. Roofs storm off frame houses; mobile homes demolished; boxcars from trains pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe	136-165 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted and thrown.
F4	Devastating	166-200 mph	Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	Incredible	Over 200 mph	Strong frame houses leveled off foundations and carried considerable distances; automobile-sized missiles fly through the air in excess of 109 yards; trees debarked; steel reinforced concrete structures badly damaged. Complete devastation.

Source: http://development-domain-602.com/fujita-scale/

a. History

Santa Rosa County experienced 23 tornadoes during the 1996 to 2015 timeframe. These tornadoes ranged from F0 to F2 in magnitude and resulted in damages to buildings and infrastructure of between $10,000 and $1,000,000. The strongest tornado was a category F2 which caused property damage at $75,000. In 1999, an F1 tornado struck a heavily populated area and caused approximately $1,000,000 in damages.

Based on this history, of Santa Rosa County should receive no more than 1 tornado per year between 2015 and 2020 which would inflict no more than $500,000 in damages. The probability of tornadoes is considered moderate for Santa Rosa County.

Table 3-14: History of Tornado Events

GENERAL LOCATION	DATE	EVENT	EF Scale	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
NAVARRE	7/30/2000	Funnel Cloud		0	0	$0.00	$0.00
PACE	9/26/2002	Funnel Cloud		0	0	$0.00	$0.00
JAY	8/26/2007	Funnel Cloud		0	0	$0.00	$0.00
(NSE)NAS WHITNG FLD	2/12/2008	Funnel Cloud		0	0	$0.00	$0.00
BROXSON	11/30/1996	Tornado	F2	0	7	$75,000.00	$0.00
MILTON T FLD	1/15/1997	Tornado	F1	0	0	$100,000.00	$0.00
HAROLD	1/2/1999	Tornado	F0	0	0	$0.00	$0.00
HOLLEY	3/3/1999	Tornado	F1	0	0	$1,000,000.00	$0.00
HOLLEY	3/13/1999	Tornado	F0	0	0	$30,000.00	$0.00
GULF BREEZE	7/23/1999	Tornado	F0	0	0	$10,000.00	$0.00
MILTON	10/13/2001	Tornado	F1	0	0	$625,000.00	$0.00
BAGDAD	11/5/2002	Tornado	F0	0	0	$15,000.00	$0.00
MUNSON	12/24/2002	Tornado	F0	0	0	$142,000.00	$0.00
GULF BREEZE	9/15/2004	Tornado	F0	0	0	$3,000.00	$0.00
MILTON	11/24/2004	Tornado	F1	0	0	$75,000.00	$0.00
NAVARRE	6/11/2005	Tornado	F0	0	0	$3,000.00	$0.00
MUNSON	8/29/2005	Tornado	F0	0	0	$8,000.00	$0.00
MUNSON	8/29/2005	Tornado	F0	0	0	$5,000.00	$0.00
MILTON	9/26/2005	Tornado	F0	0	0	$0.00	$0.00
PACE	9/26/2005	Tornado	F0	0	0	$0.00	$0.00
AVALON BEACH	9/26/2005	Tornado	F0	0	0	$0.00	$0.00
BERRYDALE	1/13/2006	Tornado	F1	0	0	$500,000.00	$0.00
INDIAN FORD	3/1/2007	Tornado	EF0	0	0	$8,000.00	$0.00
CHUMUCKLA	2/17/2008	Tornado	EF1	0	0	$200,000.00	$0.00
GULF BREEZE	9/1/2008	Tornado	EF0	0	0	$12,000.00	$0.00
NAVARRE	9/1/2008	Tornado	EF0	0	0	$0.00	$0.00
PACE	3/9/2011	Tornado	EF0	0	0	$0.00	$100,000.00
NAVARRE BEACH	12/19/1996	Waterspout		0	0	$0.00	$0.00
AVALON BEACH	8/20/1997	Waterspout		0	0	$0.00	$0.00
BAGDAD	10/26/1997	Waterspout		0	0	$0.00	$0.00
NAVARRE	7/29/1998	Waterspout		0	0	$0.00	$0.00
NAVARRE	1/2/1999	Waterspout		0	0	$0.00	$0.00
HOLLEY	2/23/1999	Waterspout		0	0	$0.00	$0.00

GENERAL LOCATION	DATE	EVENT	EF Scale	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
NAVARRE	6/16/1999	Waterspout		0	0	$0.00	$0.00
NAVARRE	6/23/1999	Waterspout		0	0	$0.00	$0.00
EAST BAY	6/12/2000	Waterspout		0	0	$0.00	$0.00
GULF BREEZE	6/16/2000	Waterspout		0	0	$0.00	$0.00
NAVARRE	7/8/2000	Waterspout		0	0	$0.00	$0.00
NAVARRE	7/10/2000	Waterspout		0	0	$0.00	$0.00
NAVARRE	8/20/2000	Waterspout		0	0	$0.00	$0.00
ORIOLE BEACH	10/6/2000	Waterspout		0	0	$0.00	$0.00
AVALON BEACH	11/9/2000	Waterspout		0	0	$0.00	$0.00
GULF BREEZE	8/28/2001	Waterspout		0	0	$0.00	$0.00

Source: www.ncdc.noaa.gov/stormevents

b. Probability

The greatest likelihood of tornado occurrence is during April and May. The greatest likelihood of an F2 or greater is in April. (Source: National Severe Storms Laboratory). The most common and active weather threat in Santa Rosa County for the formation of tornadoes is severe thunderstorms associated with frontal boundaries. Frontal boundaries and summertime afternoon air mass thunderstorms can reach severe limits because of atmospheric uplift.

c. Vulnerability

Because of the unpredictable patterns of tornadoes, and because the entire state, including Santa Rosa County, has a relatively high reoccurrence frequency, the entire County is vulnerable to tornado damage. High winds relating to gust fronts and microbursts can create high wind speeds up to 100 MPH. Both buildings and highway traffic are vulnerable to these storms. Typical injuries may result from: Vehicle accidents, wind-blown debris, falling limbs, lightning strikes, downed power lines, structural collapse, rising flood waters, mold-induced illnesses, contaminated waters. The damage potential for a tornado increases as a function of population density. As the number of structures and people increase, the potential damage/injury rate increases.

d. Maximum Threat / Extent

Manufactured housing, poorly constructed or substandard housing or apartment complexes are especially susceptible to damage from a tornado. Manufactured housing and substandard housing are exceptionally susceptible because of their lack of resistance to high winds, and apartment complexes and low rent projects are susceptible because of their size and densities.

WILDFIRE

Wildfire is described as an uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Heavier fuels with high continuity, steep slopes, high temperature, low humidity, low rainfall, and high winds all work to increase risk for people and property located within wildfire hazard areas or along the urban/wildland interface. Wildfires are part of the natural management of forest ecosystems, but most are caused by human factors. Over 80 percent of forest fires are started by negligent human behavior such as smoking in wooded areas or improperly extinguishing campfires. The second most common cause for wildfire is lightning. With probably 85% to 90% of the land in the county vacant, and with most locations outside of floodplains and swamplands consisting of natural vegetation historically related to the Longleaf pine/scrub oak forests of the Southeast (a fire dependent ecology), Santa Rosa County is vulnerable to wildfire.

Natural fires can be caused primarily from lightning. More often, human-induced fires are the likely cause. This includes intentional fire (arson) or accidental causes (escaping trash fires, cigarettes, sparks from passing railcars, motor vehicle fires on roadsides that spread to woodlands, or house fires that expand to wildlands).

Vacant fields, woodlands, lots and acreage connect communities to the wildland urban interface which is a line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. This could allow fires to come into subdivisions and neighborhoods in urban and suburban areas resulting in a potentially catastrophic situation.

A large section of land use in the county is timber plantations with substantial acreage of forest grown for pulpwood and timber production. Prescribed burning alleviates the potential for wildfire in much of the county. It is of agricultural importance to purposely burn (in a controlled manner) understory and fuel on the ground to reduce the potential of a fire going out of control.

The Southern Group of State Foresters (SGSF) has developed a process to determine wildfire risk assessment using new spatial technologies called Southern Wildfire Risk Assessment Portal (SouthWRAP). This is the primary method for local government planners to support mitigation and prevention efforts. This methodology utilizes the wildland/urban interface (WUI). Examples of wildland/urban interface areas are locations where human structures and forests or wildlands meet or intermingle such as:

Where the edge of a community transitions to forest land,
Individual farms or vacation homes surrounded by woodlands, and
Homes around the edge of a (wooded) city park or preserve.

People build homes in the wildland/urban interface for a number of reasons: to enjoy the beauty and solitude of natural surroundings, to escape the stress of city life and to live "close to nature". This creates unique challenges because interface residents frequently expect local government to provide the same level of service they received when they lived in the city (law enforcement, ambulance, fire protection, etc.). In addition, land managers find it increasingly difficult to manage forests for timber, wildlife and watershed when these areas are interspersed with subdivisions and individual homes. Interface homes are frequently vulnerable to wildland fires because fire departments are no longer just minutes away, and are, for the most part, unable to protect homes in outlying areas from wildland fire disasters.

a. History

Between 2009 and 2014 there were 494 reported wildfires burning approximately 9,081 acres.

Table 3-15: History of Reported Wildfires 2009-2014

	Total Fires		*0.1-0.2 Acres*		*0.3-9 Acres*		*10-99 Acres*		*100-299 Acres*		*300-999 Acres*		*1000-4999 Acres*	
Year	# Fires	# Acres	# Fires	# Acres	# Fires	# Acres	# Fires	# Acres	# Fires	# Acres	# Fires	# Acres	# Fires	# Acres
2014	82	3533.50	9	1	48	138.8	22	684.7	1	120	1	413	1	2176
2013	77	1796.8	9	1	44	108.3	22	732.3	1	155	1	800.2	0	0
2012	49	907.1	16	1.5	21	46.1	8	216.5	4	643	0	0	0	0
2011	146	1774.6	43	5	80	176.6	19	550	3	526	1	517	0	0
2010	96	840.8	27	3.2	58	119.1	9	259.5	1	109	1	350	0	0
2009	44	227.8	15	1.5	24	54.3	5	172	0	0	0	0	0	0

Source: Florida Forest Service and State Fire Marshall Annual Reports, 2009-2014

b. Probability

Based on analysis of recent fire histories, Santa Rosa County can expect about 82 wildfires burning approximately 1,514 acres annually.

c. Vulnerability

All geographic locations are vulnerable to fires. At particular risk are those structures and agricultural operations along the wildland urban interface. Vulnerability to structure fires may be increased for the elderly, young children, or those with physical handicaps. Additionally the impoverished, may be more apt to live in conditions favorable for fires, and are subsequently more vulnerable to fires.

Typical injuries include smoke inhalation, toxic inhalation, burns, respiratory distress, structural collapse, trauma, death.

All structures are vulnerable to fire, however vulnerability is increased for those with older or faulty electrical systems, those that lack or have inadequate smoke detectors or alarms, those without interior sprinkler systems, wood structures, etc.

A Southern Wildfire Risk Assessment Summary Report was generated and used as a viable depiction of current wildfire risk conditions for each jurisdiction. Generally, Santa Rosa County is at low risk for wildfires. Using this GIS Risk Layer and the local property appraiser dataset a vulnerability table was created (Table 3-16). Table 3-16a was provided by the local mitigation specialist at the Florida Fire Service will further identifies vulnerable communities at risk for wildfires. Together, this information can be used to help prioritize areas where mitigation, community interaction and education or analyses might be necessary to reduce the risk from wildfires.

Table 3-16: Wildfire Vulnerability by Jurisdiction

Santa Rosa County (Unincorporated Area)

Risk Factor	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
0	8364	627.55	926.32	22.69	1576.56
1	244	5.50	4.35	0.19	10.04
2	2,369	69.04	64.34	4.09	138.48
3	1,933	65.96	47.21	3.30	116.47
4	2,818	88.38	66.00	7.96	162.34
5	15,026	840.41	509.89	107.36	1,457.66
6	3,152	177.33	151.23	15.48	344.04
7	27,623	2,118.05	958.58	100.25	3,176.88
8	18,408	1,467.96	728.30	74.43	2,270.70
9	17,926	1,359.41	896.24	138.86	2,394.51
Total	97,863	6,820	4,352	475	11,648

Gulf Breeze

Risk Factor	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
0	123	30.73	41.13	0.73	72.59
1	0	0.00	0.00	0.00	0.00
2	0	0.00	0.00	0.00	0.00
3	1	0.00	0.94	0.00	0.94
4	3	1.27	3.01	0.03	4.31
5	962	90.71	100.88	5.03	196.61
6	52	4.68	7.77	0.16	12.61
7	1,021	139.91	148.47	5.82	294.20
8	370	69.33	81.29	4.04	154.66
9	624	104.94	201.37	4.22	310.53
Total	1,141	127.39	153.73	5.95	287.06

Table 3-16: Wildfire Vulnerability by Jurisdiction Continued

Jay

Risk Factor	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
0	293	21.97	1.59	0.65	24.20
1	0	0.00	0.00	0.00	0.00
2	4	0.64	0.17	0.00	0.68
3	6	0.82	0.03	0.04	1.02
4	3	0.06	1.01	0.04	0.14
5	150	6.06	0.27	0.40	7.47
6	17	0.96	0.28	1.35	2.58
7	31	3.92	0.01	0.15	4.35
8	1	0.00	0.01	0.00	0.01
9	0	0.00	0.00	0.00	0.00
Total	505	34.44	3.36	2.63	40.46

Milton

Risk Factor	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
0	19	0.75	0.26	0.02	1.03
1	0	0.00	0.00	0.00	0.00
2	2	0.06	0.21	0.01	0.15
3	6	0.42	1.20	0.03	0.66
4	8	3.11	13.05	0.21	4.53
5	1021	49.36	2.57	1.52	63.93
6	153	8.89	24.82	0.46	11.91
7	1230	103.26	16.46	6.22	134.30
8	805	88.45	16.46	10.85	115.76
9	1199	112.55	28.24	36.05	176.84
Total	4,443	366.86	103.26	55.37	509.11

Table 3-16a: Communities at Risk for Wildfires

Place Name	Ranking
Avalon Beach	High
Bagdad	High
Cobbtown	Medium
Dickerson City	Medium
East Milton	High
Faulks Ferry Landing	Medium
Holley	Medium
Indian Hills	High
McLellan	Medium
Midway	High
Muddy Ford	Medium
Navarre	High
Oriole Beach	High
Pea Ridge	Medium
Pine Bluff	Medium
Skyline	Medium
Tiger Point	High
Woodbine Springs	High
Woodlawn Beach	Medium

Source: Florida Forest Service

d. Maximum Threat / Extent

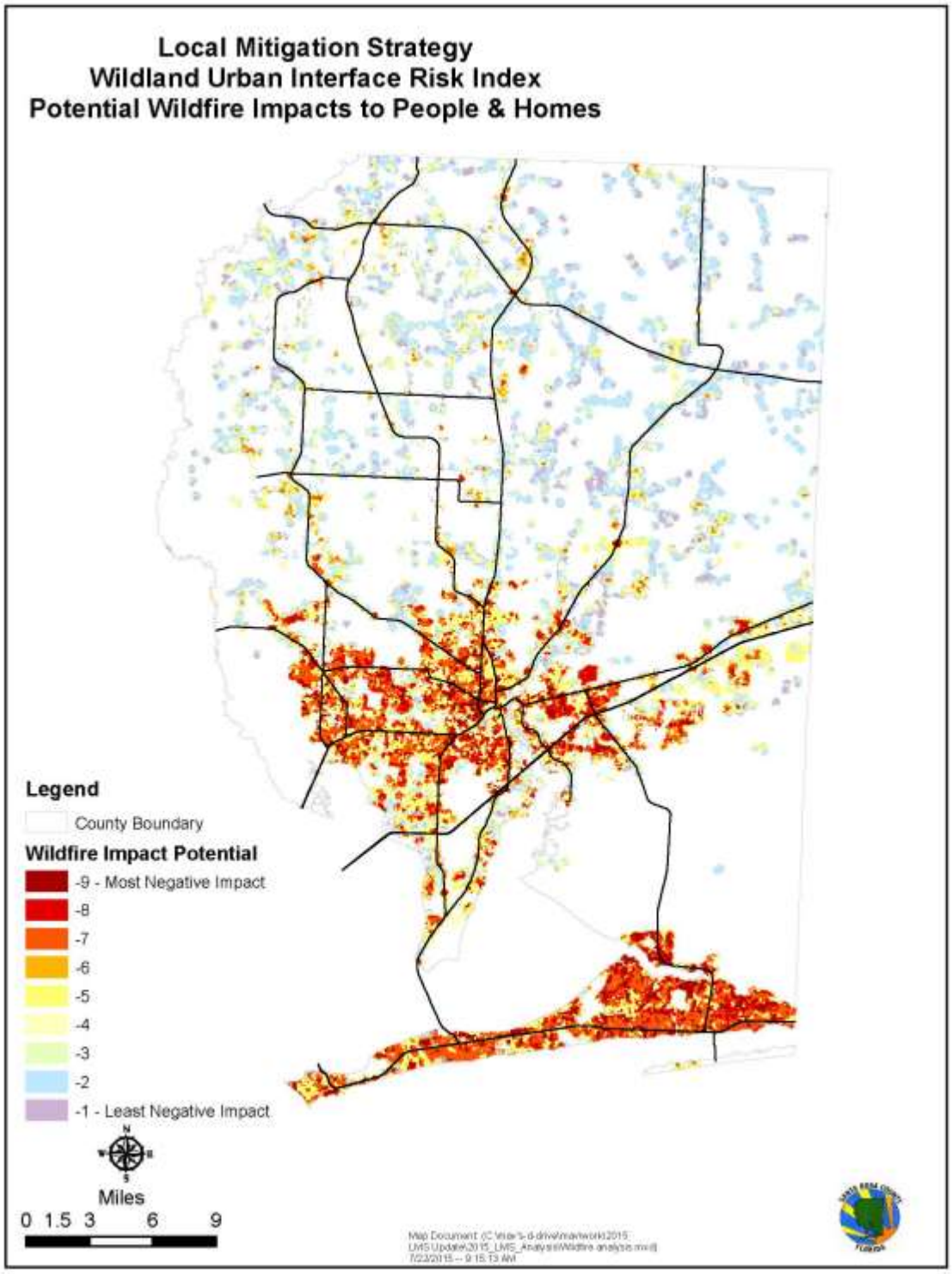
The Wildland Urban Interface (WUI) Risk Index dataset was using to display the rating of the potential impact of wildfire on people and their homes and is shown in Map 3-10. The calculated acreage in the summary report is shown in Table 3-17.

Table 3-17 – Wildland Urban Interface (WUI) Risk Index

	Class	Acres	Percent
	-9 Major Impacts	10,001	5.60%
	-8	15,301	8.60%
	-7	26,172	14.70%
	-6	7,122	4.00%
	-5 Moderate	32,900	18.50%
	-4	15,704	8.80%
	-3	15,552	8.70%
	-2	41,855	23.50%
	-1 Minor Impacts	13,580	7.60%
Total		178,187	100%

Source: Southern Wildfire Risk Assessment Summary Report August 2015

Map 3-10: Wildfire Vulnerability Map – Santa Rosa County



HEAT WAVES AND DROUGHTS

When heat waves occur, large high-pressure systems generally become entrenched over the Southeastern states. Once stagnation occurs and weather systems do not move away, heat can build up in the summer months and cause temperatures to climb into the upper 90° F. range (35° C.) or above. The general threat to the community is to agricultural crops, livestock, poultry, and individuals without adequate cooling systems in their homes, with emphasis on low income and the elderly. Electrical system failures due to demand would only enhance problems for all of these industries and populations. Mitigation efforts might focus on evaluation of vulnerability, providing adequate shelters for people, and maintaining mutual aid agreements to ensure a supply of generators for electrical purposes at critical facilities or agricultural facilities.

Firefighting increases as drought deepens. Since the county is mostly rural and open and forested lands are a prominent part of the landscape, the ability to obtain water from fire hydrants or “dry hydrants” (essentially wells and piping connected to the underlying Floridian Aquifer or surface lakes or ponds to allow for rapid pumping of water by fire trucks) is an important means of combating fire during drought.

Heat waves may cause excessive demand on electrical systems. Air conditioning is a given for most residents. Loss of the ability to cool air in a heat wave could mean the possibilities of opening shelters for vulnerable populations. Although all residents and businesses are vulnerable to heat waves, air conditioning generally mitigates the issue.

a. History

Heat waves usually occur over five to ten continuous days along the northern Gulf Coastal region and West Florida. The Gulf of Mexico’s presence tends to moderate temperatures and form coastal thunderstorms, reducing heat levels and providing coastal sea breeze front rains. To date, the highest recorded temperature in Florida was set in the Town of Monticello at a searing 109 degrees Fahrenheit (ºF) Whereas this record was not set in Santa Rosa County specifically, it should be noted that this temperature was recorded only 180 miles away.

Droughts are more frequent and cyclical in the area. Seasonal climatological droughts occur in April and October. Drought has impacted the county in a number of ways. Agricultural losses occurred primarily with summer crops. Demand on local municipal and private water supply systems to the public caused some generators and pumps to fail at critical moments, creating low or no pressure for critical facilities such as fire hydrants and medical centers. Although mitigation cannot bring about rainfall, reliance on groundwater sources can create harsh conditions for water pumps and generators, especially older models. A need for upgrade of such facilities may exist.

Drought can cause water use restrictions, but does not mean that water is unavailable in the area. Water is delivered in a variety of ways to unincorporated residents and businesses. A majority of locations outside of Blackwater River State Forest in unincorporated areas are delivered water through a number of privately owned water systems. Also, municipalities deliver water to locations outside of their Cities in some cases (especially near Milton). Santa Rosa County provides public water to Navarre Beach. Residents near and within Blackwater River State Forest and in some other remote locations of the County utilize individual private well systems for potable water supplies.

b. Probability

The probability of a heat wave is approximately once every 3 to 5 years and based on the previous history as the basis of probability, a drought during the 2015 to 2020 time period would be less than one occurrence with no loss or damage to buildings or infrastructure.

The last drought was in 2006/2007, with a previous period of drought 4 years earlier. Both heat waves and droughts are considered to be low frequency, incidents, with droughts also considered long duration incidents. Records show 2006 - 2007 were the driest back-to-back calendar years Florida has experienced, based on data dating back to 1932.

c. Vulnerability

All areas of the county are vulnerable to extreme heat and drought conditions. Special populations may be more vulnerable including the elderly, outdoor works and Impoverished who may reduce or eliminate the use of A/C systems due to rising cooling costs.

d. Maximum Threat / Extent

An extended drought or extreme heat conditions could have a significant impact on both potable water supplies as well as water supplies used in fighting wildfires. Agricultural impacts could have devastating consequences if an extended period of drought were to occur.

WINTER STORMS AND FREEZES

Winter weather in Santa Rosa County can include snow, ice, sleet (freezing rain), or a mix of these wintry forms of precipitation, hard freeze temperatures, and frost. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property,

and cause fatalities and injuries to human life. The most common winter event is frost, followed by hard freeze.

A freeze's greatest risk is generally unprotected or under-protected water pipes in homes, businesses and infrastructure. Outdoor irrigation systems and plumbing in homes where insulation is inadequate in walls or in off-grade homes are most vulnerable. Unmitigated older structures are probably the most vulnerable structures, with manufactured housing (due to its off-grade construction and placement technique) is also vulnerable. Mitigation occurs when individuals take actions during construction or for a freeze to protect pipes with wrapping forming a layer of insulation, and/or keeping water moving through pipes by leaving a faucet on.

Home and business heating is accomplished locally with electricity, natural gas, or propane appliances. A few individuals may use other methods, such as kerosene heaters or wood fireplaces or stoves. Temperatures lower than 15° F. (-9.4° C.) for an extended period would likely cause County Emergency Management to open a shelter for those who had inadequate heating of their homes.

a. History

Winter Storms (freezes) occur most every winter, with the average winter minimum low occurring near January 20 with a temperature of 20° F. (-6.6° C.). Generally, the second night following the passage of a strong cold front is the coldest night when skies are clear and humidity is lowest. Most low temperatures involving freezes occur at night and in the hours near dawn. In most instances, temperatures even on the coldest winter days rise above freezing during daylight hours. Such freezes are climatologically expected in this region of Florida.

Icing, glaze, and sleet are rare but real possibilities in the county. A large ice storm affected portions of North Florida in 2014. Freezing rain and sleet were recorded in coastal cities across the southeast United States. Roads were closed, most significantly the Pensacola Bay Bridge between Pensacola and Gulf Breeze. Commuters were stranded in their homes. Businesses were crippled. Schools, government offices, even military bases were closed or operating with limit staffing. Much of Interstate 10 was closed to east and west traffic, as well as others to and from inland areas. Bridges to barrier islands were also closed due to ice, and the almost total lack of deicing equipment and chemicals both for the Florida DOT and for local governments in all affected states. The State of Florida had no means of ice removal in such a situation, and mutual aid resources from neighboring states were needed.

Snow in Santa Rosa County is considered a very rare and exciting event. Neighborhoods come to life with children playing outdoors when it snows. A single snow "event" every five to ten years is feasible. A few big wet flakes and a dusting on the ground on a Christmas Eve (as occurred in 1988) was an occasion worth celebrating

and remembering for young and old across West Florida! During the past fifty years, there have been approximately twenty-five events of “trace amounts” of snow, and about four measurable snowfall events of up to four inches of accumulation. The March 10, 1993 “Super storm” provided one of the heaviest snowfalls on record for the area (4 inches). In February 2010, an area of low pressure moved across the area and snowfall accumulations with 2 inches reported in the northern part of the County. Snow generally will melt off in about six to eight hours; if indeed it takes that long (more often melting occurs in minutes). Such an event will cause schools to close. Snow generally accumulates on natural surfaces, while roadways remain open, albeit slippery on some bridges. Generally, the risk of snow and the chances or needs for mitigation of snow events are virtually zero in the county.

b. Probability

Probability of a winter storm (freeze) is once in most every year. Based on the State Risk Assessment Santa Rosa County is listed at a medium ranking for winter storm hazards and freeze hazards (State Hazard Mitigation Plan 2013).

c. Vulnerability

Since tropical or subtropical crops are generally not grown in northern and western Florida in the winter freeze season, agricultural damage so often associated with winter freezes in the state are all but absent in Santa Rosa County. Ill or old animals, or unprotected animals exposed to a night of freezing wind, are most vulnerable. During a very severe freeze, some ornamental plants may receive damage, and some poultry operations may experience difficulties keeping fowl warm in brooder houses in the county. Mitigation is generally accomplished through farm heating units and allowing animals to enter barns or shelters.

d. Maximum Threat / Extent

During extreme cold/freeze events roads will close, most significantly the Pensacola Bay Bridge between Pensacola and Gulf Breeze. Commuters will be stranded in their homes and businesses will be crippled. Schools, government offices, even military bases will close or operate with limit staffing. Major thoroughfares such as Interstate 10 will close to east and west traffic, as well as others to and from inland areas. Bridges to barrier islands will also close due to ice, and the almost total lack of deicing equipment and chemicals both for the Florida DOT and for local governments in all affected states.

EROSION

Santa Rosa County’s topography and coastline lends itself to both inland and coastal erosion vulnerability. These are addressed separately in this section.

Inland Erosion

Most commonly, erosion is associated with sandy sedimentation on streets, stormwater systems, and ponds or rivers and creeks. Sheet erosion, rills, gullies, and alluvial fans are the most commonly observed features of erosion in the County. Most of these features are associated with disturbances in natural vegetation, poor management of agricultural lands, silviculture operations, building construction, and road construction/maintenance projects. Such erosion, left unchecked, can damage drainage ditches, fill stormwater retention ponds with sediment, harm sensitive ecosystems, and cause erosion into property, including structures.

Riverine erosion is also a concern for Santa Rosa County. Rivers where bluffs occur include Blackwater, Big Coldwater, Big Juniper, and their tributaries. The lower Blackwater (from near the entrance of Clear Creek westward), the Yellow, Escambia and East Bay River are slower rivers with wide floodplains and little, if any, erosion. Though the rivers pose a real threat from flooding, the erosion issues are minimal along these rivers, even in flooding conditions. There is no data available to quantify the amount of erosion.

a. History

Control of erosion on municipal or county property is the responsibility of the local government. Oftentimes, stormwater flow from private property is the source of water flow responsible for these erosion problems. Water also begins as runoff from roadways and as seepage where water tables are high and roads cut into these small elevated aquifers. The County and municipalities either employ or retain professional engineers to evaluate, design, and provide solutions and mitigation to such problems. The public works departments are responsible for following guidance of the engineers, as well as best management practices issued to generally reduce environmental consequences of runoff, to eliminate or reduce erosion on public properties, particularly roads and roadside swales and ditches. Santa Rosa County and Gulf Breeze get credits for their engineered mitigation efforts relating to erosion and stormwater control as participants in the Community Rating System of the NFIP

The Blackwater Soil and Water Conservation District of the Natural Resources Conservation Service (NRCS) has analyzed the potential for erosion in the county for years as a part of its normal duties, in support of the Federal Farm Bill, and the Conservation Reserve Program (CRP). One hundred fourteen (114) contracts were active with NRCS under the CRP program as of June 2015.

Santa Rosa County utilizes the Emergency Watershed Protection Program (EWP) when necessary to relieve imminent hazards to life and property caused by floods, hurricanes, and other natural hazards. Approximately 9.2 million in erosion related projects has

been completed through EWP. In addition to erosion control projects implemented with assistance of Emergency Watershed Protection (EWP) money, the county also routinely repairs eroded areas with funds from other sources. The primary funding source for smaller scale erosion control projects is from the Road and Bridge Department's budget. Examples of this type of work include road-side ditch erosion, minor drainage easement erosion, stormwater pond slope erosion, and the repair of damaged underground stormwater conveyance system erosion that manifests itself at the ground surface. Another funding source utilized by the county for erosion repair is Federal Highway Association (FHWA) money. The FHWA money is sometimes made available to the county for roadway and erosion repairs on roads that were originally constructed with federal funds. The most recent erosion repair projects funded with FHWA money were the replacement of the blown-out portion of East Bay Blvd. (C.R. 399), and repairs to the drainage ditch on Munson Hwy. (C.R. 191), near East Gate Road.

b. Probability

Based on the soils types location within the County it is very likely that erosion will continue. There are 63,949 acres of "highly erodible soils" and 188,007 acres of "potentially highly erodible soils" in the county. Together, this equates to 38.26% of the Table 3-18 identifies the Vulnerability for each jurisdiction based on both highly erodible soils and potentially erodible soils.

c. Vulnerability

Santa Rosa County is vulnerable to approximately $1,410,000,000 (roughly 5,662 parcels) in damages from highly erosive soil conditions. This just value amount is reflecting upon 5.8% of all parcels in the county. By examining the map, it is evident that the overwhelming majority of the erosive soils exist in primarily rural areas, encompassing parcels of wide spatial extent.

It is rare for structures to be impacted by such stormwater erosion, but it is not unheard of. More often, roadways, drainage systems, and natural creeks and water bodies are the recipients of sedimentation problems. Most structures with stormwater-induced erosion can trace the problem to development design problems related to construction of the structure itself, or to overall stormwater management systems in a neighborhood or area.

Erosion management in Santa Rosa County is accomplished in a variety of ways. This includes coordination with engineering departments, the Natural Resource Conservation Service, the Florida Division of Forestry, private landowners and developers, and other parties. A primary means used to control unwanted erosion include screening and hay baling on and near construction sites. Large-scale engineered systems also control erosion, generally through the management of stormwater flow and retention. Santa Rosa County has also implemented a number of multi-million dollar programs to control

stormwater and sedimentation problems. Stormwater retention ponds, now required in virtually all new developments, have greatly reduced problems of erosion and stormwater runoff once construction is completed.

Mitigation measures are generally considered regulatory. However, erosion issues not yet identified could require public expenditure and grant applications to relieve erosion, probably related to stormwater management activities where development occurred before current new development regulations were adopted in building and planning codes.

CITY OF GULF BREEZE

The majority of the City of Gulf Breeze is located on “potentially highly erodible” soils.

There are 2,466 acres of potentially highly erodible soils located within the city limits of Gulf Breeze. This equates to 90.26% of the soils in gulf Breeze resulting in a 90.26% probability for erosion, however due to the high degree of development the chance for erosion is significantly less.

TOWN OF JAY

There are relatively small areas of the Town of Jay located on “highly erodible or potentially highly erodible” soils.

There are 144 acres of potentially highly erodible soils located within the town limits of Jay. There are 122 acres of highly erodible soil types identified in the Town of Jay. The highly erodible and potential highly erodible soils constitute 25.43% of the soils in Jay, resulting therefore in a approximately a 25.43% chance for erosion.

CITY OF MILTON

Milton’s topography lends itself to some land erosion vulnerabilities.

There are 671 acres of “highly erodible soil types” and 654 acres of “potentially highly erodible soil types” in the City of Milton. The majority of these soils are associated with the Blackwater River and its tributaries. These 1,325 acres equate to 41.26% of the soils in Milton which equates to a 41.26% chance of erosion.

d. Maximum Threat / Extent

Santa Rosa County does suffer an exceptionally high potential for erosion, to include sheet, rill, and gully erosion. Rainfall averages 62-64 inches per year, but the distribution of rain over the year is very uneven. Tropical storms and hurricanes from the Gulf of Mexico sometimes stall out over Santa Rosa, dumping 20-40 inches of rain over a few days.

Table 3-18: Erodible Soils Vulnerability

Santa Rosa County (Unincorporated Area)

Erobile Soil Classification	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
Highly	5,297	240.53	376.94	87.04	704.50
Potentially	24,446	1855.58	1116.41	137.80	3109.78
TOTAL	29,743	2,096	1,493	225	3,814

City of Gulf Breeze

Erobile Soil Classification	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
Highly	0	0.00	0.00	0.00	0.00
Potentially	2,529	371.83	514.83	15.83	902.49
TOTAL	2,529	371.83	514.83	15.83	902.49

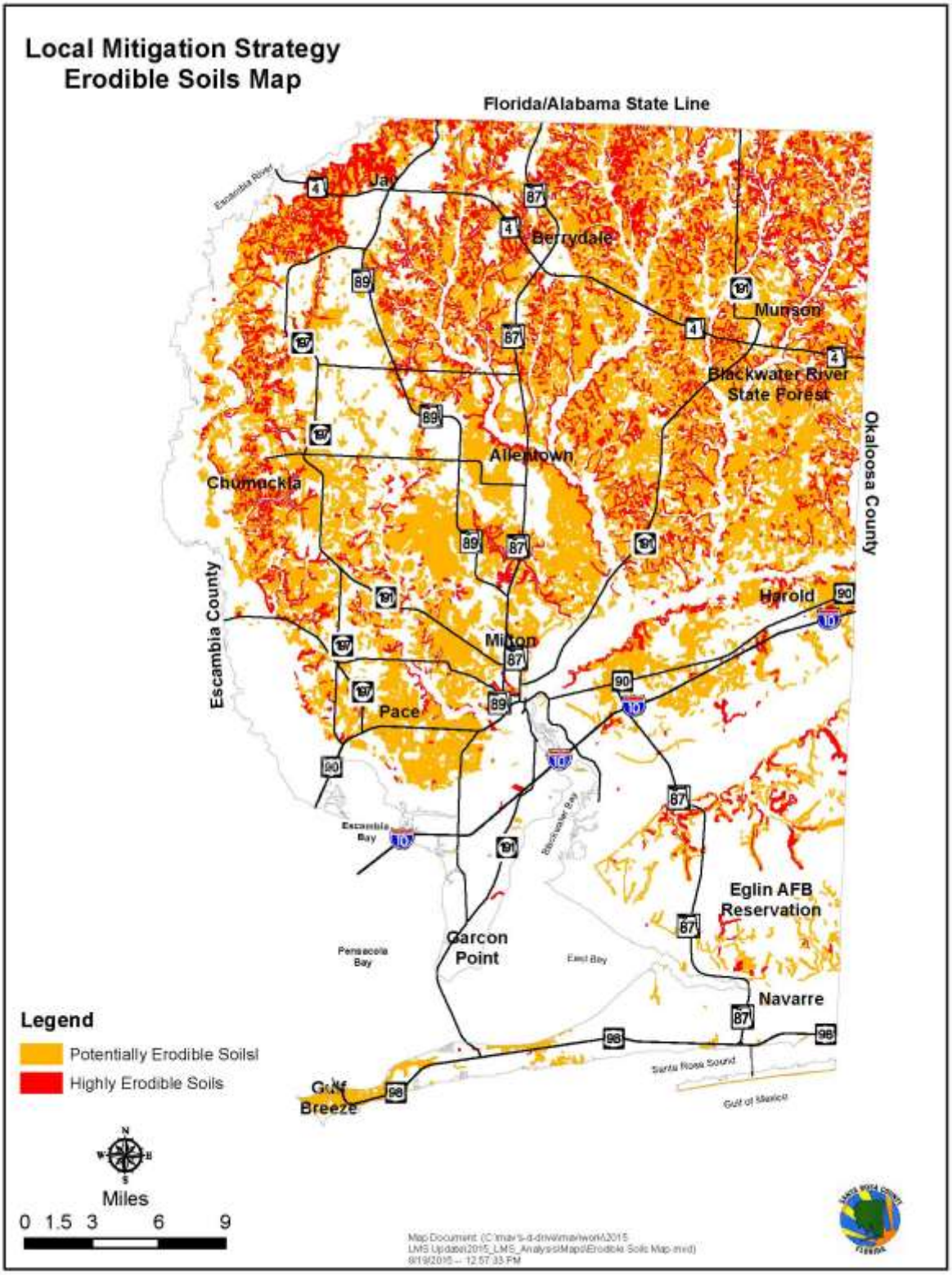
Town of Jay

Erobile Soil Classification	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
Highly	12	0.84	0.26	0.04	1.15
Potentially	19	1.20	0.26	1.34	2.81
TOTAL	31	2.04	0.52	1.38	3.96

City of Milton

Erobile Soil Classification	Number of Properties	Building Value ($Million)	Land Value ($Million)	Extra Feature Value ($Million)	Market Value ($Million)
Highly	353	240.53	376.94	87.04	704.50
Potentially	554	84.49	12.70	10.11	107.29
TOTAL	907	325.02	389.64	97.15	811.79

Map 3-11: Erodible Soils Map



Coastal Erosion

Coastal erosion is also a major consideration for Santa Rosa County, Navarre Beach. Coastal erosion is caused by marine or estuarine wave action and, to some extent, wind action. Santa Rosa Island at Navarre Beach is subject to the greatest potential for coastal erosion on its Gulf of Mexico beaches. Erosion on Santa Rosa Island occurs at a slow, unobservable pace, or rapidly during storms and hurricanes. Such erosion is a natural, daily process of barrier island dynamics.

a. History

Navarre Beach was greatly impacted by erosion from Hurricane Opal in 1995. Gulf water moved thousands of tons of sand over roadways, sidewalks and yards. The erosion of the shoreline at Navarre Beach is approximately 1 foot per year[1]

b. Probability

Beach erosion threatens the very resource that residents and visitors enjoy. Over 409 miles, or approximately 50% of the state's beaches, are experiencing erosion. At present, about 299 of the state's 825 miles of sandy beaches are experiencing "critical erosion", a level of erosion, which threatens substantial development, recreational, cultural, or environmental interests.

c. Vulnerability

One way to restore eroded beaches is through beach re-nourishment. In a typical beach re-nourishment project, sand is collected from an offshore location by a dredge and is piped onto the beach. A slurry of sand and water exits the pipe on the beach and once the water drains away, only sand is left behind. Bulldozers move this new sand on the beach until the beach matches the design profile. Beach re-nourishment is a preferred way to add sand to a system that has been starved by the altered inlets because it provides a significant level of storm protection benefits for upland properties and is the least influencing to the coastal system. An additional benefit of beach restoration projects is that they quickly restore shorebird and marine turtle habitat. (http://www.dep.state.fl.us/beaches/programs/bcherosn.htm)

d. Maximum Threat / Extent

Damages will vary depending on magnitude of erosion, mitigation efforts in and type and number of structures involved. Sudden erosive forces such as those associated

[1] Source: Shoreline Change Rate Estimates, FDEP OB&CS Report BCS-99-03

with hurricanes and storm surge can cost greater than 5 million dollars dependent on the category of the storm as well as other storm factors.

Attachment 3-1

Hazus-MH: Hurricane Event Report
Hurricane Ivan Probabilistic

This page intentionally left blank.

Hazus-MH: Hurricane Event Report

Region Name: Hurricane Ivan Probablistic

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Wednesday, July 29, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

Section	Page #
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facility Inventory	
Hurricane Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Hurricane Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building Losses	
Appendix A: County Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Florida

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,023.40 square miles and contains 25 census tracts. There are over 56 thousand households in the region and has a total population of 151,372 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 63 thousand buildings in the region with a total building replacement value (excluding contents) of 15,936 million dollars (2010 dollars). Approximately 93% of the buildings (and 86% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 63,711 buildings in the region which have an aggregate total replacement value of 15,936 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	13,646,958	85.6%
Commercial	1,519,336	9.5%
Industrial	344,380	2.2%
Agricultural	52,394	0.3%
Religious	224,073	1.4%
Government	63,177	0.4%
Education	85,353	0.5%
Total	**15,935,671**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 4 hospitals in the region with a total bed capacity of 210 beds. There are 42 schools, 11 fire stations, 7 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 54 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	213	98.84	2	0.98	0	0.13	0	0.05	0	0.00
Commercial	2,822	98.37	40	1.40	6	0.22	0	0.01	0	0.00
Education	79	98.88	1	1.04	0	0.08	0	0.00	0	0.00
Government	75	98.67	1	1.25	0	0.08	0	0.00	0	0.00
Industrial	1,025	98.66	13	1.22	1	0.11	0	0.01	0	0.00
Religion	301	98.88	3	1.04	0	0.07	0	0.00	0	0.00
Residential	58,491	98.92	591	1.00	44	0.07	1	0.00	1	0.00
Total	**63,006**		**651**		**52**		**1**		**1**	

Table 3: Expected Building Damage by Building Type : 10 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	2,437	98.47	34	1.38	3	0.14	0	0.00	0	0.00
Masonry	34,950	98.86	371	1.05	33	0.09	1	0.00	0	0.00
MH	8,173	99.94	4	0.04	1	0.01	0	0.00	0	0.00
Steel	1,693	98.35	24	1.42	4	0.22	0	0.01	0	0.00
Wood	13,410	98.82	152	1.12	8	0.06	1	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 210 hospital beds available for use. On the day of the hurricane, the model estimates that 210 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	11	0	0	11
Hospitals	4	0	0	4
Police Stations	7	0	0	7
Schools	42	0	0	42

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 158,703 tons of debris will be generated. Of the total amount, 143,362 tons (90%) is Other Tree Debris. Of the remaining 15,341 tons, Brick/Wood comprises 15% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 90 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 13,102 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 151,372) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 36.4 million dollars, which represents 0.23 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 36 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 96% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	27,894.59	630.10	90.11	92.32	28,707.11
	Content	5,512.81	120.21	23.43	12.92	5,669.37
	Inventory	0.00	1.81	4.51	0.55	6.87
	Subtotal	**33,407.40**	**752.12**	**118.04**	**105.79**	**34,383.35**
Business Interruption Loss						
	Income	0.00	126.06	0.49	4.21	130.76
	Relocation	1,024.28	80.17	4.33	7.81	1,116.59
	Rental	567.67	46.07	0.34	0.38	614.46
	Wage	0.00	86.83	0.86	35.48	123.17
	Subtotal	**1,591.95**	**339.13**	**6.02**	**47.89**	**1,984.99**
Total						
	Total	**34,999.34**	**1,091.25**	**124.07**	**153.67**	**36,368.33**

Appendix A: County Listing for the Region

Florida

- Santa Rosa

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Florida				
Santa Rosa	151,372	13,646,958	2,288,713	15,935,671
Total	**151,372**	**13,646,958**	**2,288,713**	**15,935,671**
Study Region Total	**151,372**	**13,646,958**	**2,288,713**	**15,935,671**

Attachment 3-2

Hazus-MH: Hurricane Event Report
SRC Worst Case Scenario

This page intentionally left blank.

Hazus-MH: Hurricane Event Report

Region Name: SRC Worst Case Scenario 07302015 II

Hurricane Scenario: DENNIS_2005_stm_1907PM

Print Date: Friday, July 31, 2015

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

Section	Page #
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facility Inventory	
Hurricane Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Hurricane Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building Losses	
Appendix A: County Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Florida

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,023.40 square miles and contains 25 census tracts. There are over 56 thousand households in the region and has a total population of 151,372 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 63 thousand buildings in the region with a total building replacement value (excluding contents) of 15,936 million dollars (2010 dollars). Approximately 93% of the buildings (and 86% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 63,711 buildings in the region which have an aggregate total replacement value of 15,936 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	13,646,958	85.6%
Commercial	1,519,336	9.5%
Industrial	344,380	2.2%
Agricultural	52,394	0.3%
Religious	224,073	1.4%
Government	63,177	0.4%
Education	85,353	0.5%
Total	**15,935,671**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 4 hospitals in the region with a total bed capacity of 210 beds. There are 42 schools, 11 fire stations, 7 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name: DENNIS_2005_stm_1907PM

Type: Forcast/Advisory

Maximum Peak Gust in Study Region: 201 mph

Storm Information: HURREVAC Storm Advisory Download; FILE PATH: ftp://ftp.hurrevac2.com/D_2005.stm

User Defined Storm Track Input Data

Point	Latitude	Longitude	Time Step (hour)	Translation Speed (mph)	Radius To Max Winds (miles)	Max. Sustained Wind Speed (mph @ 10m)	Cental Pressure (mBar)	Profile Parameter	Radius to Hurricane Force Winds (miles)
1	26.30	-85.10	118.00	--	--	112.82	942.00	--	30.80
2	26.60	-85.30	120.00	--	--	113.85	941.00	--	30.80
3	27.00	-85.60	122.00	--	--	121.10	937.00	--	30.80
4	27.40	-85.90	124.00	--	--	130.41	934.00	--	30.80
5	27.80	-86.10	126.00	--	--	140.00	932.00	--	30.80
6	28.20	-86.20	128.00	--	--	150.00	920.00	--	30.80
7	28.70	-86.40	130.00	--	--	155.00	918.00	--	30.80
8	29.40	-86.70	132.00	--	--	160.00	915.00	--	30.80
9	29.60	-86.90	134.00	--	--	170.00	910.00	--	30.80
10	30.20	-87.29	136.00	--	--	180.00	909.00	--	30.80
11	30.42	-87.30	138.00	--	--	185.00	908.00	--	17.71
12	30.65	-87.35	140.00	--	--	120.00	930.00	--	0.00
13	30.89	-87.42	142.00	--	--	100.00	935.00	--	0.00
14	30.91	-87.45	144.00	--	--	80.00	960.00	--	0.00

Building Damage

General Building Stock Damage

Hazus estimates that about 32,835 buildings will be at least moderately damaged. This is over 52% of the total number of buildings in the region. There are an estimated 8,642 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	43	19.91	42	19.74	45	21.08	58	27.09	26	12.18
Commercial	618	21.54	392	13.68	635	22.14	1,054	36.75	169	5.89
Education	17	20.82	11	13.92	16	20.56	33	41.05	3	3.65
Government	19	25.20	11	14.91	16	20.79	27	35.83	2	3.27
Industrial	236	22.75	139	13.41	203	19.53	420	40.46	40	3.86
Religion	66	21.69	55	18.19	69	22.63	102	33.59	12	3.89
Residential	15,735	26.61	13,490	22.81	12,206	20.64	9,307	15.74	8,390	14.19
Total	**16,734**		**14,142**		**13,191**		**11,002**		**8,642**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	673	22.92	359	12.22	629	21.41	1,266	43.08	11	0.38
Masonry	8,413	23.21	8,620	23.78	7,783	21.47	6,284	17.34	5,147	14.20
MH	7,499	89.82	156	1.87	213	2.55	66	0.79	415	4.97
Steel	460	21.97	226	10.80	434	20.75	865	41.31	108	5.17
Wood	3,148	22.36	3,490	24.78	3,075	21.83	2,338	16.60	2,031	14.42

Essential Facility Damage

Before the hurricane, the region had 210 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use. After one week, 14.00% of the beds will be in service. By 30 days, 14.00% will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	11	7	1	7
Hospitals	4	3	2	0
Police Stations	7	4	0	5
Schools	42	33	3	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 3,087,443 tons of debris will be generated. Of the total amount, 2,002,242 tons (65%) is Other Tree Debris. Of the remaining 1,085,201 tons, Brick/Wood comprises 69% of the total, Reinforced Concrete/Steel comprises of 8% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 33792 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 240,394 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 17,646 households to be displaced due to the hurricane. Of these, 3,779 people (out of a total population of 151,372) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 8035.4 million dollars, which represents 50.42 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 8,035 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 81% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	4,123,835.44	434,783.45	96,879.16	95,251.58	4,750,749.62
	Content	1,738,551.56	365,851.30	93,010.81	71,001.68	2,268,415.35
	Inventory	0.00	6,911.88	14,788.83	1,191.05	22,891.76
	Subtotal	**5,862,387.00**	**807,546.63**	**204,678.80**	**167,444.31**	**7,042,056.73**
Business Interruption Loss						
	Income	4,229.26	87,716.56	1,415.41	1,341.62	94,702.85
	Relocation	494,049.82	59,418.67	6,542.62	17,379.70	577,390.81
	Rental	164,007.46	38,920.81	1,099.42	1,881.72	205,909.40
	Wage	9,918.22	97,712.70	2,376.42	5,303.93	115,311.26
	Subtotal	**672,204.76**	**283,768.74**	**11,433.87**	**25,906.96**	**993,314.33**
Total						
	Total	**6,534,591.76**	**1,091,315.37**	**216,112.67**	**193,351.27**	**8,035,371.06**

Appendix A: County Listing for the Region

Florida

- Santa Rosa

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Florida				
Santa Rosa	151,372	13,646,958	2,288,713	15,935,671
Total	**151,372**	**13,646,958**	**2,288,713**	**15,935,671**
Study Region Total	**151,372**	**13,646,958**	**2,288,713**	**15,935,671**