Section 4. Summary and Maps of Countywide Hazards and Vulnerabilities

4.1 Introduction

This section of the Bay County Local Hazard Mitigation Plan summarizes the results of the hazard identification and vulnerability assessment process. The intent of this section is to provide a compilation of the information gathered and the judgments made about the hazards threatening Bay County as a whole, and the potential vulnerability to those hazards. Additional information and more specific details on flood issues for each of the municipalities and fire districts are provided in Section 7. In this section, information relevant to the entire planning area is compiled and an overview of the analyses is provided. The process utilized for the development of this plan is very specific to the jurisdictions within Bay County and responsive to the unique characteristics of each. This is because the hazard identification process was implemented independently for each participating jurisdiction, to separately identify the hazards threatening that jurisdiction. Further, once the unique hazard areas of each jurisdiction were identified, and the relative risks that they pose were defined, then organizations representing each jurisdiction conducted a vulnerability assessment of specific neighborhoods and important facilities within the jurisdiction. In this way, each participating jurisdiction's unique hazards, risks and vulnerabilities are defined. This process is described in detail in this section.

The Local Mitigation Strategy provides the answers to a set of key questions for the mitigation of hazards in the communities of Bay County:

Hazard Identification: What hazards exist in Bay County?
Extent: What areas within Bay County are affected by each of these hazards and how severe are the projected impacts?
Vulnerability and Risk: What populations and structures are located in these affected areas?
Mitigation Strategy**:** What can be done to mitigate these hazards and what mitigation has already been occurred?

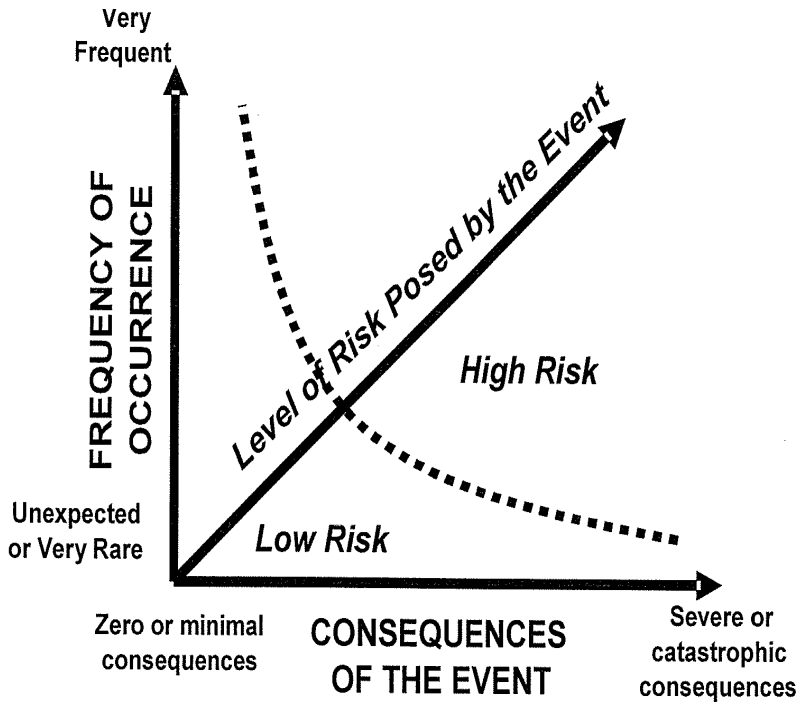
4.2 Hazard Identification and Risk Estimation

The technical planning process started with hazard identification. In this process, the LMS Team identified all of the natural hazards that could threaten the community. When the hazard types were identified as relevant to, or of concern for, that jurisdiction, the participants were then able to make an estimate of the risk each poses to the jurisdiction being evaluated. The estimate of risk was based on the judgment of the planners regarding the frequency of occurrence of the hazard event compared to its probable consequences. For purposes of this analysis, "risk" is defined as a relative measure of the probability that a hazard event will occur in comparison to the consequences or impacts of that event. That is, if a hazard event occurs frequently, and has very high consequences, then that hazard is considered to pose a **high risk** to the affected communities. In comparison, if a hazard event is not expected to occur frequently, and even if it did, the consequences would be minimal, then that hazard is considered to pose a **low risk**.
The LMS Team identified one hazard, wildfire, which was considered to be of **medium risk.** Wildfires**,** which don't occur frequently, and are generally only a threat in the unincorporated

areas, have the potential to cause extensive damage if population densities increase in the unincorporated areas in future years.

This relationship between frequency of occurrence and consequences of an event is illustrated by the following graph which illustrates that some hazards can be defined as "low risk," as they do not occur often enough and/or do not result in significant impacts even when they do. In comparison, other hazards may occur often and/or have sufficiently severe consequences; these are considered "high risk." Each of the hazards considered a threat to the jurisdiction can be assessed for its probability of occurrence and its likely consequences, so that it can be indicated on the graph as falling either above or below a dotted line that can be considered to separate "high" and "low" risk hazards.

CHART 5



For the purpose of defining risks for this plan for Bay County, those hazards with High, Medium, and Low probability of occurrence were defined by the Team as follows:

HIGH - Potential to occur annually
MEDIUM - Potential to occur once in 3 years
LOW - Potential to occur once per hundred years (sinkholes) or once per five hundred years (tsunami)

4.3 Specific Hazards Focus Areas

The 2009/2010 Bay County Local Mitigation Strategy focuses on natural hazards. Several hazards previously identified in the 2004/2005 LMS Plan including avalanche, dam failure, earthquake, and land slides have been reviewed for their probability and relevance to Bay County and its communities. Given their low probability of occurrence in the County, and no known history of occurrences in the area, it was the decision of the LMS committee to remove these hazards from the 2010 LMS Plan. In addition, the updated LMS does not specifically focus on thunderstorms, winter storms, drought, or heat waves. As multi-hazard events, mitigation to reduce their associated impacts is addressed through the analysis and mitigation of flooding (including hurricanes and tropical storm rain events), high winds (including tornados), and wild fire. The threat of tsunamis, and sinkholes, was examined and all relevant data sources were researched. These events were determined to have a very low threat potential. However, since the LMS team has received several questions from citizens regarding these events, a small analysis and maps have been included.

4.4 Critical Facilities

Some facilities and systems in the community are very important to the health, safety and welfare of the community. Therefore, high priority is given to assessing their vulnerabilities to future disasters and proposing mitigation initiatives to address identified vulnerabilities. For purposes of this plan, these facilities are considered to be "critical facilities," and, as a part of the planning process, the participating jurisdictions have identified selected facilities to warrant this designation as "critical." Each jurisdiction has identified facilities that are considered critical in defined situations.

Given the large numbers of facilities that Bay County and each of its municipalities periodically assess for their vulnerabilities, the participating jurisdictions have attempted to identify and assess those of most concern, such as critical facilities. As the planning process continues, the participating jurisdictions will continue to add more facility vulnerability assessments to the database, and to consider those with highest vulnerabilities as warranting proposing of mitigation initiatives, particularly wind hardening mitigation.

The inclusive list of all critical facilities within the jurisdiction was approved by vote during the 2004 LMS preparation and reconfirmed in the public meeting in August, 2009. Critical facilities are identified in Appendix 3.

4.5 Land Use Trends and Potential Vulnerability

The LMS Team recognizes that its efforts, particularly to identify the areas of the participating jurisdictions at risk from various hazards, is a key factor in guiding the careful use of land to minimize future vulnerabilities to disaster. When needed and desired by a specific jurisdiction, modifications to the plans, ordinances, codes and similar policies can be proposed as mitigation initiatives for incorporation into this plan. As the greatest risk to structures in Bay County is from flooding, single family residences located in the storm surge areas would experience the most damage. All coastal communities have ordinances/codes in place to limit density in the Coastal High Hazard Area and the beach areas in general. Special building standards are also in place for VE coastal construction, as well as other flood zones.

The County has also recognized the vulnerability of residents evacuating from populated areas during a storm or hazard event and has taken measures to ensure a safer evacuation process. As

of September 2009 the Bay County Traffic Engineering Department has the ability to adjust traffic signal timing on various routes and intersections and view the results on a bank of monitors from inside the office. Utilizing 41 cameras strategically placed at 93 intersections, including the Hathaway Bridge, the engineers can view congestion and make immediate changes to traffic light timing. From the streaming video on the monitor screens they are continually aware of traffic issues on the roads and can immediately communicate emergency information to the appropriate officials.

This facility also has the capability of remotely changing traffic and emergency information on message boards placed at several points along the evacuation routes to alert travelers to new conditions or to listen to specific radio broadcasts. The Emergency Management Department has worked closely with Traffic Engineering to ensure the optimum utilization of this system.

The shelter capacity for the general public in Bay County is 18,000, which exceeds the projected demand of 13,071 for 2010. The "special needs" demand is projected as 2,033 occupants; however, the current capacity is 931 occupants. In order to rectify this shortfall, Bay County will dedicate the Northside Elementary School as a "special needs" facility. Increased demand is not expected during the next five-year planning cycle.

Chart 6 - Bay County Clearance Times (hours) per Hurricane Category - 2008

Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
5.6	6.5	7.7	10.5	13.1

4.6 The Vulnerability Assessment Process

The LMS Team recognizes that the way in which land is utilized, especially land within known hazard-prone areas, is a key measure of community vulnerability, because some land uses, such as those zoned for residential or industrial development, can be more susceptible to disaster-related damages than others. Therefore, an analysis of land use trends is included in the approach to mitigation plan development, particularly in Sections 7A-H, where the areas most vulnerable to flooding are highlighted. For the Bay County LMS, this analysis is done on a jurisdiction-specific basis as individual jurisdictions have the most knowledge and control over their local development and land use planning. Accordingly, information on land uses and land use trends are detailed for each of the individual jurisdictions.

The vulnerability assessment was conducted for both the incorporated jurisdictions and the unincorporated areas of Bay County. For the incorporated jurisdictions, the LMS Team separately analyzed each of the 7 municipalities of Bay County. Unincorporated areas of Bay County were delineated according to fire districts. It is important to note that Bay County contains two types of fire districts: county fire districts covering unincorporated areas of the County and municipal fire districts covering the incorporated jurisdictions/municipalities of the County. In some cases municipal fire districts are not delineated strictly by the city limits of the municipalities and include portions of unincorporated Bay County. Where municipal fire districts extend beyond the city limits of the municipalities into unincorporated areas of the County, it was necessary to isolate the municipalities from their respective fire districts and analyze the unincorporated areas of the municipal fire districts separately. The following is a list of these areas where the municipal fire districts extend beyond the city limits:

Incorporated Jurisdiction/Municipality	Unincorporated Area/Fire District
Callaway	Unincorporated Callaway – East Bay Fire District
Mexico Beach	Unincorporated Mexico Beach Fire District
Springfield	Unincorporated Springfield Fire District

Distinguishing between incorporated jurisdictions/municipalities and unincorporated areas/fire districts is important for maintaining a clear record of the locations of vulnerable parcels and structures including critical facilities. Bay County and the incorporated jurisdictions each abide by a different set of building codes, land development ordinances, and floodplain regulations, making mitigation efforts different from one location to another. In addition, the location of a parcel, structure, or critical facility may determine the source and allocation of funding for mitigation projects.

4.7 Historical Data Records

One area of concern that was addressed by the LMS Team was the lack of accurate and detailed historical records on past hazard events. This holds true for both the extent of damage, location of damage, and cost estimates. The Team has since instituted the practice of creating a complete "EVENT LOG" to record all necessary information for future review and analysis. This log will be issued on a CD and will include photographs of all locations (residences, roads and other structures) that were damaged, and a GIS map depicting the location, address, municipal jurisdiction of the property. The CD will also include damage reports and estimates, and where/which department the problem was referred to for mitigation. If the event was officially declared a disaster, all the relevant reports and data will be included on the CD. There has been only one major "event" since the last update, and that information is included on the "February 22, 2008 Flood Incident" CD included as Appendix 1. Other events, of less impact, are also noted in Appendix 1, as well as a total storm history, for Bay County. Much of this data was procured online from the National Climatic Data Center at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms. Another topic addressed was that of insufficient mapping and available history of potential wind damage. This will be an area of specific research for the LMS Team during the next few years.

4.8 Approach to Mapping the Identified Vulnerabilities and the Probability of Future Events

The following table explains the 2010 approach to the mapping of vulnerabilities to the identified hazards throughout Bay County and its constituent jurisdictions. Vulnerability assessment maps have been generated using Geographic Information Systems (GIS) to illustrate the geography of Bay County's hazard areas. Each of the identified hazard areas entails one or more natural hazards that are considered probable in that location. The hazards associated with the Coastal High Hazard Area, flood zones, and storm surge zones have been mapped specifically for each municipality and Bay County unincorporated fire district. Projected high winds, sinkhole potential, tornado risk, tsunami risk, and wildfire potential have been mapped on the countywide level, recognizing the variables and unpredictability of these hazards. While the probability of sinkholes and tsunamis is considered low (as mentioned above), and there has not been any

history of occurrences within the County, the LMS Team conceded there is a *small* possibility of future occurrence and; therefore, included a brief description of the hazard and the available map data. For the other major hazards that threaten the county, probabilities of occurrence are based on historical experience of LMS Team members, citizens, and estimates provided by the relevant data sources (such as NOAA, MEMPHIS, and NCDC). For ease of reference, Chart 6 on the following page was developed by the LMS Team after assessing the maps of the areas identified with vulnerabilities, the specific threat to that vulnerable area, the potential magnitude of the hazard event, and the probability occurrence of that natural hazard event. More detailed information on each of these events and vulnerabilities is included under Section 4.9: *Specific Identified Vulnerabilities.*

CHART 7 - Vulnerability and Damage Descriptions

Vulnerability Assessment Maps included in LMS	Natural Hazard Effect	Associated Natural Hazard Event	Potential Cost of Hazard Event* (Damage Impacts)	Probability of Associated Natural Hazard Event **
Coastal High Hazard Area (FLOOD RISK)	- High velocity wave action - Flooding	- Tropical storm - Hurricane - Marine seismic activity	High*	High**
Flood Zones (FLOOD RISK)	- Flooding	- Heavy rainfall	High*	High**
Storm Surge Zones (FLOOD RISK)	- High- velocity wave action - Flooding	- Tropical storm - Hurricane	High* (Except Springfield which is low)	High** (Springfield = low)
Projected High Winds (WIND RISK)	- Wind speeds 63 thru 163 mph	- Tropical storm - Hurricane	High*	High**
Tornado Risk (WIND RISK)	-High speed cyclonic winds	- Thunderstorm - Tropical storm - Hurricane	High*	High**
Wildfire Potential	- Uncontrolled fire	- Dry Conditions - Drought - Lightning	Medium* Bay County low* municipalities	Medium** Bay County low* municipalities
Tsunami Risk (FLOOD RISK)	- High velocity wave action - Flooding	- Marine seismic activity/earthquake	Low*	Low** (no mitigation measures proposed as there have been no historical events)
Sinkhole Potential	- Ground collapse	- Karst subsidence	Low*	Low** (no mitigation measures proposed as there have been no historical events)

***high - potential $ loss-1million to several billion**
***medium - potential $ loss-$500,000 to 1 million**
***low - $0 - $500,000**

****high=potential occurrence - 1 per year**
****medium=potential occurrence - 1 per 3 years**
**** low=once per 100-500 years**

4.9 Specific Identified Vulnerabilities

4.9.A. Flooding

4.9.A.1. Introduction and Description of the Flooding Hazard

The FEMA website *(http:// www.fema.gov)* describes flooding among the most common hazards in the United States, and is considered a major hazard for Bay County and the municipalities due the proximity to the Gulf of Mexico and several bays, and other waterways. Flood effects can be local, impacting a neighborhood or community, or very large, affecting entire river basins or coastlines. Impacts from flooding may include loss of potable water wells, drowning, collapse of structures, undermining structural integrities of roads, bridges, and other critical infrastructure.

A flood is defined by the National Weather Service (NWS) "as any high flow, overflow, or inundation by water which causes or threatens damage". Flood events are categorized according to four levels of severity or extent; minor, moderate, major, and record. Minor flooding entails minimal or no property damage, but possibly some public threat. Moderate flooding entails some inundation of structures and roads near the water source requiring some evacuations of people and/or transfer of property to higher elevations. Major flooding entails extensive inundation of structures and roads requiring significant evacuations of people and/or transfer of property to higher elevations. Record flooding equals or exceeds the highest stage or discharge at a given site during the period of record keeping. Coastal flooding occurs when water is driven onto land from an adjacent body of water. This generally occurs when there are significant coastal storms. Coastal waters include the area from the mean high water line along the mainland or island as far out as 100 nautical miles including the bays, harbors, and sounds (*http:// www.weather.gov/).*

Flood hazards can affect many geographic settings, but are especially probable in low-lying areas located near water. Even, very small streams, gullies, creeks, culverts, dry streambeds, or low-lying terrains that appear safe in dry weather can flood.
(http://www.fema.gov/areyouready/flood.shtm).

4.9.A.2. Causes of Flooding

4.9.A.2(a) Tropical Storm and Hurricane Storm Surge

The greatest potential for structural damages and loss of life related to a tropical storm or hurricane is from the flooding associated with storm surge. Because much of the United States' densely populated Gulf Coast coastlines lie less than 10 feet above mean sea level, the danger from storm surge and its associated hazards is a primary concern for emergency management planning in Bay County.

Storm surge is water that is pushed inland by the force of the storm winds generated by a tropical storm or hurricane, capable of reaching 25 feet high and stretching along the coastlines of multiple counties. Height is measured as the difference between the observed level of the sea surface during the event and the level that would have occurred in the absence of the cyclone (i.e., Storm surge is usually estimated by subtracting the normal or astronomic tide from the observed storm tide). Storm tide is defined as a combination of storm surge and the normal tide (i.e., a 15-foot storm surge combined with a 2-foot normal high tide over the mean sea level amounts to a 17-foot storm tide).

Advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level to heights impacting roads, homes, and other critical infrastructure. In addition, wind driven waves are superimposed on the storm tide. When the storm surge entails wind driven waves in addition to the storm tide, water levels can rise significantly,

resulting in severe flooding along coastal areas, particularly when the storm tide coincides with the normal high tides.

The storm surge combined with wave action can cause extensive damage, severely erode beaches and coastal highways. With major hurricane events similar to Katrina, Camille, or Hugo, complete devastation of coastal communities may occur. Many buildings withstand hurricane force winds until their foundations, undermined by storm surge erosion, are weakened and fail.

(The above mentioned definitions and descriptions of hurricane and storm terms are borrowed from the NOAA website:
http://www.srh.noaa.gov/crp/docs/safety/Aware/reference/terminology.html)

4.9.A.2(b) Localized Rain Events

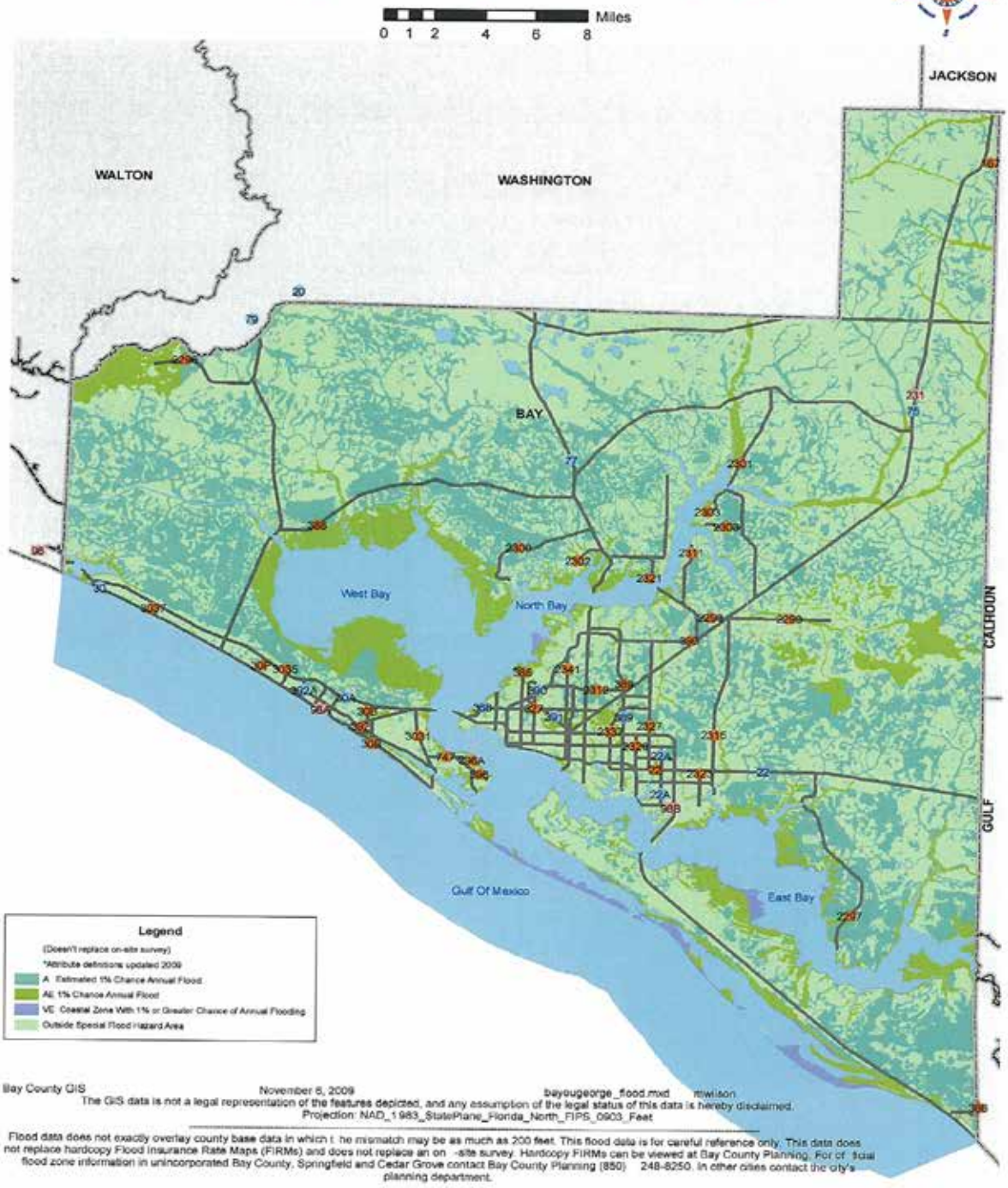
Although flooding in the County is commonly associated with tropical storms and hurricanes, floods can occur under a wide variety of conditions and can develop variably. Some floods develop slowly, sometimes over a period of days, depending on the rate and intensity of rainfall or flow from a water source. Flash floods can develop quickly, sometimes within only a few minutes. Bay County and the municipalities are considered at high risk from flooding.

Bay County experienced a jurisdiction wide record rainfall event in February 2008 (a detailed description of this event is included in Appendix 1 on a CD). Rainfall measured from 3 inches to 11 inches across the County within a 24 hour period. This was considered a 50 - 100 year storm based on DOT criteria. The maximum documented rainfall in such a localized event has been one foot. As evidenced by the flood event occurring on February 22, 2008, or a similar event, 11 inches of rain could cause a flash flood of a depth of over 24" +/-, depending upon time, site percolation capability, water table, elevation, drainage away from the site, and cessation of continued rainfall.

4.9.A.3 <u>Probability Assessment and Potential Damage Estimates from Flooding</u>: Flood damage in Bay County from various flood events has resulted in millions of dollars in individual and public assistance. Probability of flooding in Bay County is considered high. Section 7A-H provides maps and charts that detail the specific Fire District areas of the County and municipalities that are at risk from flooding, the type of structure considered vulnerable, and the dollar amounts of potential loss in each land use category. These maps are found at the end of each municipal and fire district section (the last section prior to the draft ordinances). Map A on the following page displays the general floodplain and FEMA flood zones for Bay County. Map B indicates the areas at risk from Tropical Storm and Hurricane storm surges:

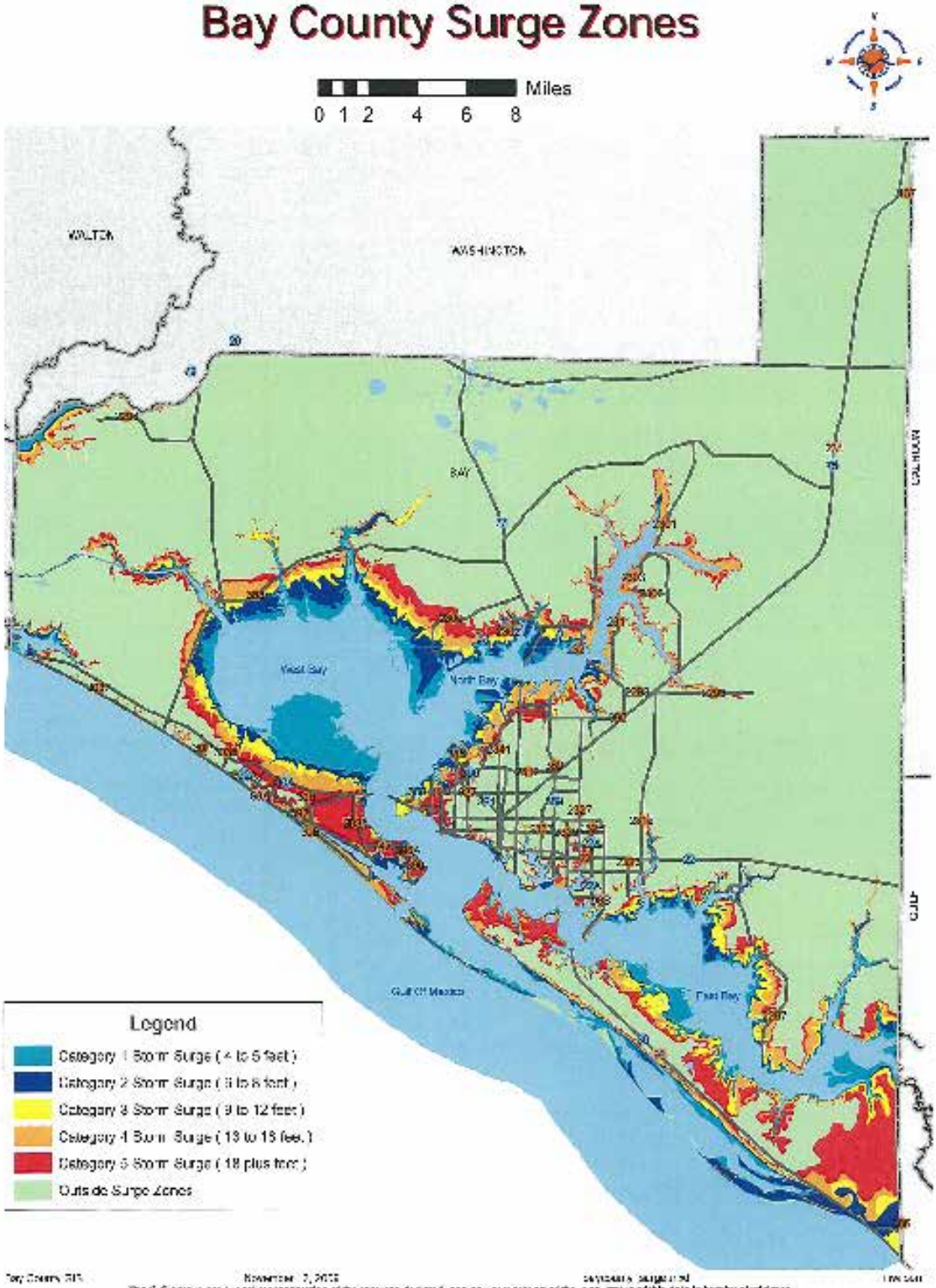
MAP A

Bay County Flood Zones



MAP B

Bay County Surge Zones



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4.9.B. Projected High Winds

4.9.B.1 Tropical Storms and Hurricanes (Tropical Cyclones)

Tropical storms and hurricanes are both types of tropical cyclones, typically entailing heavy rainfall, lightning, storm surge, and wind. Bay County and the municipalities are at high risk from the effects of tropical storms and hurricanes. Tropical cyclones that affect Bay County and other parts of the Florida Panhandle typically originate off the Atlantic coast of Africa or in the Caribbean Sea as tropical disturbances. Tropical disturbances are weather systems consisting of organized clouds and thunderstorm activity that continues for one or more days. If a tropical disturbance develops a surface wind circulating counterclockwise around a low-pressure center, it is described as a tropical depression. If the wind speeds increase to over 39 mph, then it is described as a tropical storm and is identified with a name. If wind speeds exceed 74 mph, then the storm is classified as a hurricane and categorized on a scale of 1 to 5 based on the speed of its sustained winds.

Developing in the atmosphere over tropical ocean waters, tropical storms and hurricanes are among the most severely damaging and disruptive natural hazard events that occur in the United States. The Southeastern states, and the state of Florida in particular, are the most at risk; typically during the Atlantic hurricane season between June 1 and November 30.

Each year on average, ten tropical storms develop over the Atlantic Ocean, Caribbean Sea, or Gulf of Mexico. About six of these typically strengthen enough to become hurricanes. Many of these remain over the ocean with little or no impact on the continental United States. However, about five hurricanes strike the United States coastline every three years. Of these five, two are estimated to become major hurricanes measuring a category 3 or higher (defined as having winds above 111 mph) on the Saffir-Simpson Scale. Hurricane damages can amount to millions or even billions of dollars and halt local and regional economies. (During a tropical storm or hurricane, homes, businesses, public buildings, and infrastructure may be damaged or destroyed by many different storm hazards. Debris can break windows and doors, allowing high winds and rain inside the building. In extreme storms which have had major impact on other areas of the United States (such as Hurricanes Hugo, Andrew and Katrina), the force of the wind alone can cause tremendous devastation, as trees and power lines topple and weak elements of homes and buildings fail. Roads and bridges can be swept away by erosion and the impact of fast moving water. Buildings can be saturated by flooding. Tornadoes can develop within a wide area around the storm center during landfall. Storm Surge poses the highest threat to life and destruction in many coastal areas, including Bay County (with the exception of Springfield, which has a lower vulnerability level as there is no coastal property). Generally speaking these threats are most serious to coastline communities; however, given certain meteorological and geographic conditions, storm surges can extend hundreds of miles inland.

4.9.B.1(a) Terms and Definitions associated with Tropical Storms and Hurricanes

Landfall is defined as the intersection of the surface center of a tropical cyclone with a coastline. Because the strongest winds in a tropical cyclone are not located precisely at the center, it is possible for a cyclone's strongest winds to be experienced over land even if landfall does not occur. Similarly, it is possible for a tropical cyclone to make landfall with its strongest winds remaining over the water. Compare direct hit, indirect hit, and strike.

Direct hit refers to locations closely approached by a tropical cyclone. For locations on the left-hand side of a tropical cyclone's track (looking in the direction of motion), a direct hit occurs when the cyclone passes to within a distance equal to the cyclone's radius of maximum wind. For locations on the right-hand side of the track, a direct hit occurs when the cyclone passes to within a distance equal to twice the radius of maximum wind.

Indirect hit refers to locations that do not experience a direct hit from a tropical cyclone, but do experience hurricane force winds (either sustained or gusts) or tides of at least 4 feet above normal.

For any particular location, a hurricane *strike* occurs if that location passes within the hurricane's strike circle, a circle of 125 nautical miles in diameter, centered 12.5 nautical miles to the right of the hurricane center (looking in the direction of motion). This circle is meant to depict the typical extent of hurricane force winds, which are approximately 75 nautical miles to the right of the center and 50 nautical miles to the left.
(http://www.srh.noaa.gov/crp/docs/safety/Aware/reference/terminology.html)

4.9.B.2. Tropical Storm and Cyclonic winds

4.9.B.2(a) Description of Conditions:

Gale Warning : A warning of 1-minute sustained surface winds in the range 39 mph (34 kt) to 54 mph (47 kt) inclusive, either predicted or occurring and not directly associated with tropical cyclones.

High Wind Warning : A high wind warning is defined as 1-minute average surface winds of 40 mph (35 kt) or greater lasting for 1 hour or longer, or winds gusting to 58 mph (50 kt) or greater regardless of duration that are either expected or observed over land.

Storm Warning: A warning of 1-minute sustained surface winds of 55 mph (48 kt) or greater, either predicted or occurring, not directly associated with tropical cyclones**.**

Tropical Cyclone: A warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center. Once formed, a tropical cyclone is maintained by the extraction of heat energy from the ocean at high temperature and heat export at the low temperatures of the upper troposphere.

Tropical Disturbance: A moving area of thunderstorms in the tropics, described as a discrete tropical weather system of apparently organized convection, generally 100 to 300 nautical miles in diameter, originating over tropical or subtropical waters, having a non-frontal migratory character, and maintaining its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field.

Tropical Depression: An area of low pressure containing an organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of 38 miles per hour (mph) or 33 knots (kt) or less. Sustained winds are defined as one-minute average wind measured at about 33 feet above the surface.

Tropical Storm: An area of low pressure containing an organized system of clouds and strong thunderstorms with a defined surface circulation and maximum sustained winds of 39-73 mph (34 – 63 kt).

Hurricane: An intense tropical weather system of clouds and strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 mph (64 kt) or higher. A major Hurricane is characterized by wind speeds of 111 mph or higher.

4.9.B.3 Tropical Storm and Hurricane High Winds

4.9.B.3(a) Description of Hazard

The intensity of a land-falling hurricane is expressed in terms of categories that relate wind speeds and potential damage. According to the Saffir-Simpson Hurricane Scale, a Category 1 hurricane has lighter winds compared to storms in higher categories. A Category 4 hurricane would have winds between 131 and 155 mph and, on average, would usually be expected to cause 100 times the damage of the Category 1 storm. Depending on circumstances, less intense storms may still be strong enough to produce damage, particularly in areas that have not prepared in advance. No area of Bay County or any municipality has experienced a direct hit from a hurricane higher than a category 2. However, the risk for a category 3 or greater is considered high.

Hurricane-force winds can easily destroy poorly constructed or older buildings and mobile homes. All areas of the County and the municipalities have mobile homes as well as older dwelling units that are particularly susceptible to wind damage. During hurricanes, debris such as signs, roofing material, and small items left outside may be carried by these winds at very high speeds. Extensive wind damage to trees, towers, water and underground utility lines (from uprooted trees), and fallen poles cause considerable disruption.

High-rise buildings over ten stories are vulnerable to hurricane-force winds, particularly at the higher levels since wind speed tends to increase with height. Bay County, Panama City and Panama City Beach have several structures termed as high-rise. It is not uncommon for high-rise buildings to suffer a great deal of damage due to windows being blown out. Consequently, the areas around these buildings can be very dangerous. The strongest winds usually occur in the right side of the eyewall of the hurricane. Wind speed usually decreases significantly within 12 hours after landfall. In some cases winds can remain above hurricane strength after the hurricane has moved inland. *(http://www.fema.gov/hazard/hurricane/hu_winds.shtm)*

Hurricanes are generally measured on the Saffir-Simpson Hurricane Wind Scale which is a 1 to 5 categorization based on the hurricane's intensity at a given point in time. The scale provides examples of the type of damages and impacts associated with winds of the indicated intensity. In general, the severity of a hurricane’s impacts increases by about a factor of four for every category increase. The maximum sustained surface wind speed (peak 1-minute wind at 10 m [33 ft]) is the determining factor in the scale. The historical examples (one for the U.S. Gulf Coast and one for the U.S. Atlantic Coast) provided in each of the categories correspond with the intensity of the hurricane at the time of landfall in the location experiencing the strongest winds, which does not necessarily correspond with the peak intensity reached by the system during its lifetime. The scale does not address the potential for such other hurricane-related impacts, as storm surge, rainfall-induced floods, and tornadoes. These wind-caused impacts are to apply to

the worst winds reaching the coast and the damage would be less elsewhere. It should also be noted that the general wind-caused damage descriptions are to some degree dependent upon the local building codes in effect and how well and how long they have been enforced. For example, recently enacted building codes in Florida are likely to reduce the damage to newer structures from that described below. However, for a long time to come, the majority of existing buildings along the coast will not have been built to higher code, and therein lies the major vulnerability to strong forces winds in the County and municipalities. Hurricane wind damage is also dependent upon such other factors as duration of high winds, change of wind direction, amount of accompanying rainfall, and age of structures.

Earlier versions of this scale incorporated central pressure and storm surge as components of the categories. The central pressure was utilized during the 1970s and 1980s as a proxy for the winds as accurate wind speed intensity measurements from aircraft reconnaissance were not routinely available for hurricanes until 1990. Storm surge was also quantified by category in the earliest published versions of the scale dating back to 1972. However, hurricane size (extent of hurricane force winds), local bathymetry (depth of near-shore waters), and topographic forcing can also be important in forecasting storm surge. Moreover, other aspects of hurricanes - such as the system's forward speed and angle to the coast - also impact the storm surge that is produced. For example, the very large Hurricane Ike (with hurricane force winds extending as much as 125 miles from the center) in 2008 made landfall in Texas as a Category 2 hurricane and had peak storm surge values of 15-20 ft. In contrast, Hurricane Charley, which only extended hurricane force winds 25 miles from the center, struck Florida in 2004 as a Category 4 hurricane and produced a peak storm surge of only 6-7 ft. These storm surge values were substantially outside of the ranges suggested in the original scale. Thus to help reduce public confusion about the impacts associated with the various hurricane categories as well as to provide a more scientifically defensible scale, the storm surge ranges, flooding impact and central pressure statements are being removed from the scale and only peak winds are employed in this revised version - the Saffir-Simpson Hurricane Wind Scale.

Category One Hurricane:
Sustained winds 74-95 mph (64-82 kt or 119-153 km/hr). *Damaging winds are expected.* Some damage to building structures could occur, primarily to unanchored mobile homes (mainly pre-1994 construction). Some damage is likely to poorly constructed signs. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possible death. Large branches of healthy trees will snap. Some trees will be uprooted, especially where the ground is saturated. Many areas will experience power outages with some downed power poles. Hurricane Cindy (2005, 75 mph winds at landfall in Louisiana) and Hurricane Gaston (2004, 75 mph winds at landfall in South Carolina) are examples of Category One hurricanes at landfall.

Category Two Hurricane:
Sustained winds 96-110 mph (83-95 kt or 154-177 km/hr). *Very strong winds will produce widespread damage.* Some roofing material, door, and window damage of buildings will occur. Considerable damage to mobile homes (mainly pre-1994 construction) and poorly constructed signs is likely. A number of glass windows in high rise buildings will be dislodged and become airborne. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possible death.. Numerous large branches will break. Many trees will be uprooted or snapped. Extensive damage to power lines and poles will likely result in widespread power outages that could last a few to several days. Hurricane Erin (1995,

100 mph at landfall in northwest Florida) and Hurricane Isabel (2003, 105 mph at landfall in North Carolina) are examples of Category Two hurricanes at landfall.

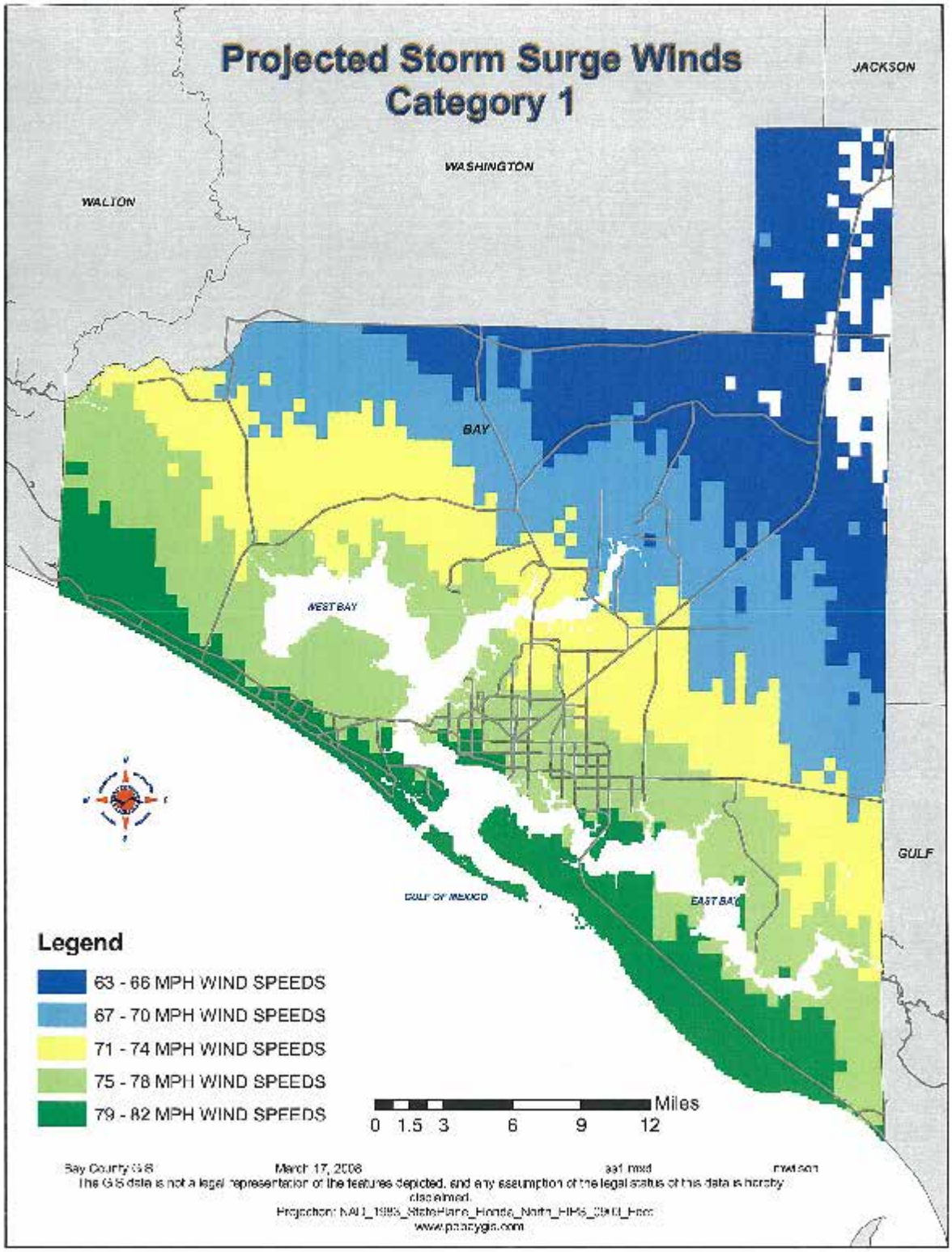
Category Three Hurricane:
Sustained winds 111-130 mph (96-113 kt or 178-209 km/hr). *Dangerous winds will cause extensive damage.* Some structural damage to houses and buildings will occur with a minor amount of wall failures. Mobile homes (mainly pre-1994 construction) and poorly constructed signs are destroyed. Many windows in high rise buildings will be dislodged and become airborne. Persons struck by windborne debris risk injury and possible death. Many trees will be snapped or uprooted and block numerous roads. Near total power loss is expected with outages that could last from several days to weeks. Hurricane Rita (2005, 115 mph landfall in east Texas/Louisiana) and Hurricane Jeanne (2004, 120 mph landfall in southeast Florida) are examples of Category Three hurricanes at landfall.

Category Four Hurricane:
Sustained winds 131-155 mph (114-135 kt or 210-249 km/hr). *Extremely dangerous winds causing devastating damage are expected.* Some wall failures with some complete roof structure failures on houses will occur. All signs are blown down. Complete destruction of mobile homes (primarily pre-1994 construction). Extensive damage to doors and windows is likely. Numerous windows in high rise buildings will be dislodged and become airborne. Windborne debris will cause extensive damage and persons struck by the wind-blown debris will be injured or killed. Most trees will be snapped or uprooted. Fallen trees could cut off residential areas for days to weeks. Electricity will be unavailable for weeks after the hurricane passes. Hurricane Charley (2004, 145 mph at landfall in southwest Florida) and Hurricane Hugo (1989, 140 mph at landfall in South Carolina) are examples of Category Four hurricanes at landfall.

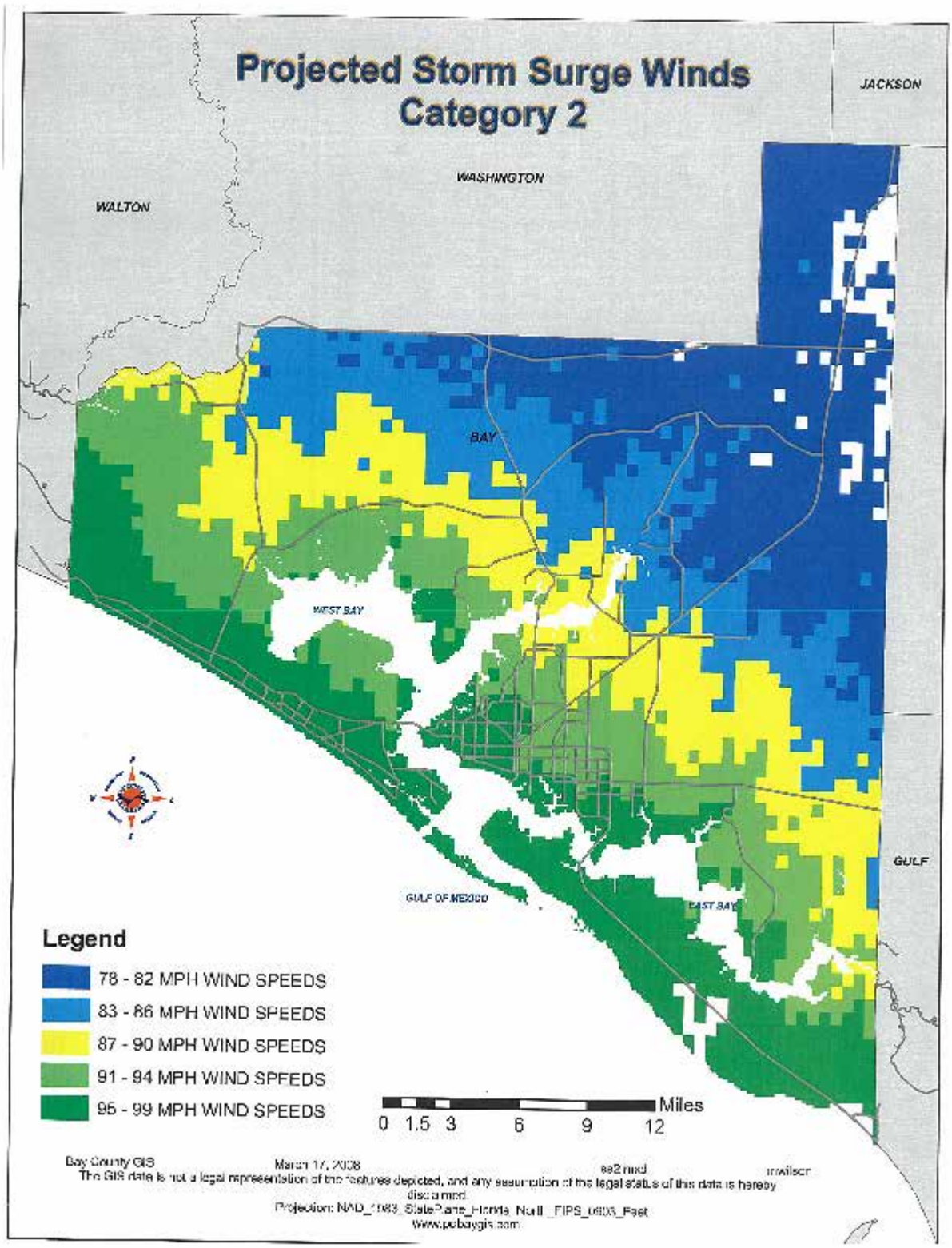
Category Five Hurricane:
Sustained winds greater than 155 mph (135 kt or 249 km/hr). *Catastrophic damage is expected.* Complete roof failure on many residences and industrial buildings will occur. Some complete building failures with small buildings blown over or away are likely. All signs blown down. Complete destruction of mobile homes (built in any year). Severe and extensive window and door damage will occur. Nearly all windows in high rise buildings will be dislodged and become airborne. Severe injury or death is likely for persons struck by wind-blown debris. Nearly all trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Hurricane Camille (1969, 190 mph at landfall in Mississippi) and Hurricane Andrew (1992, 165 mph at landfall in Southeast Florida) are examples of Category Five hurricanes at landfall.
(The above descriptions were obtained from: *http://hurricanes.noaa.gov/pdf/hurricanebook.pdf)*

The following maps (C-G) indicate the projected storm surge winds/ Peak Wind Expectancy for category 1-5 hurricanes and the areas at risk from these winds:

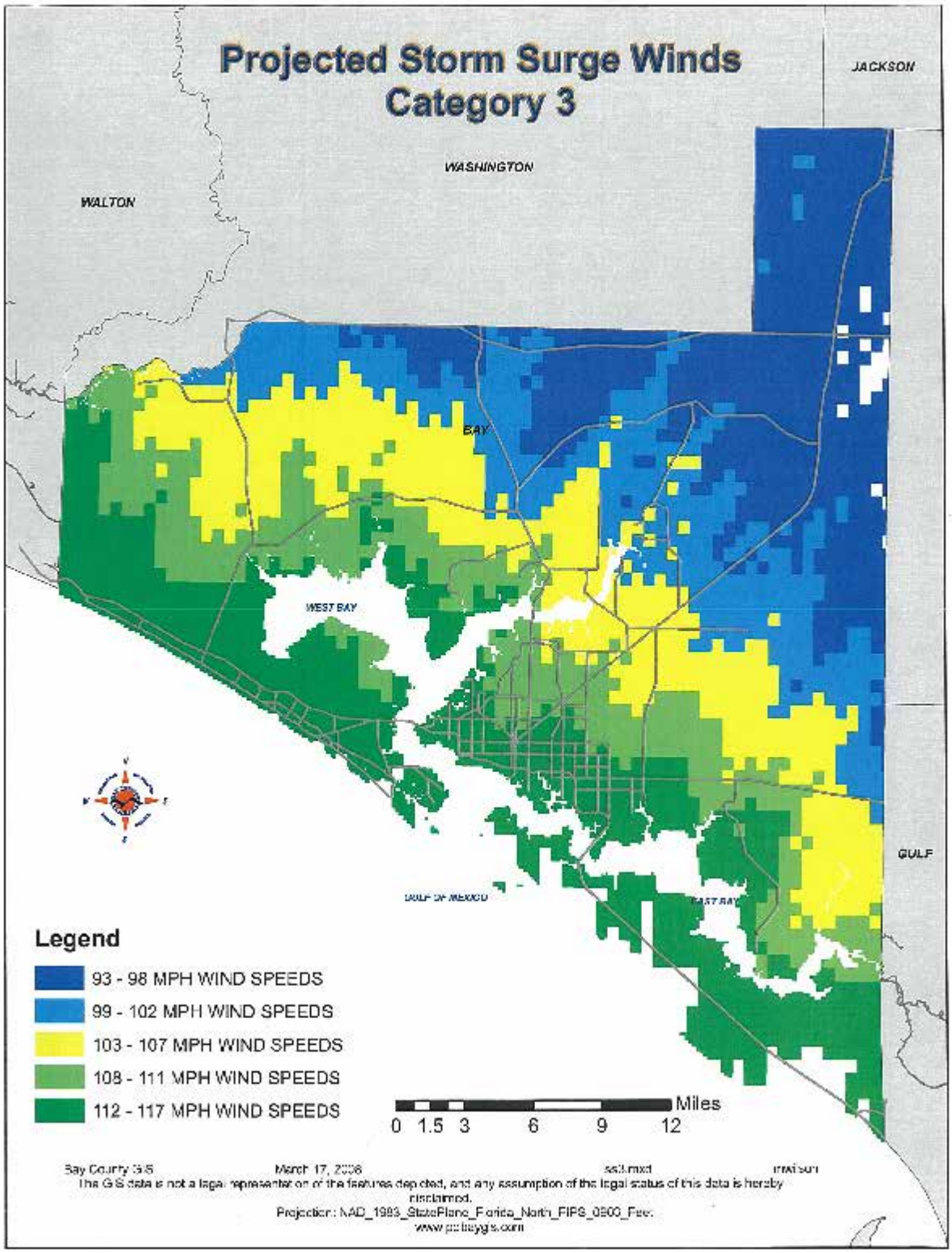
MAP C Peak Wind Expectancy Category 1



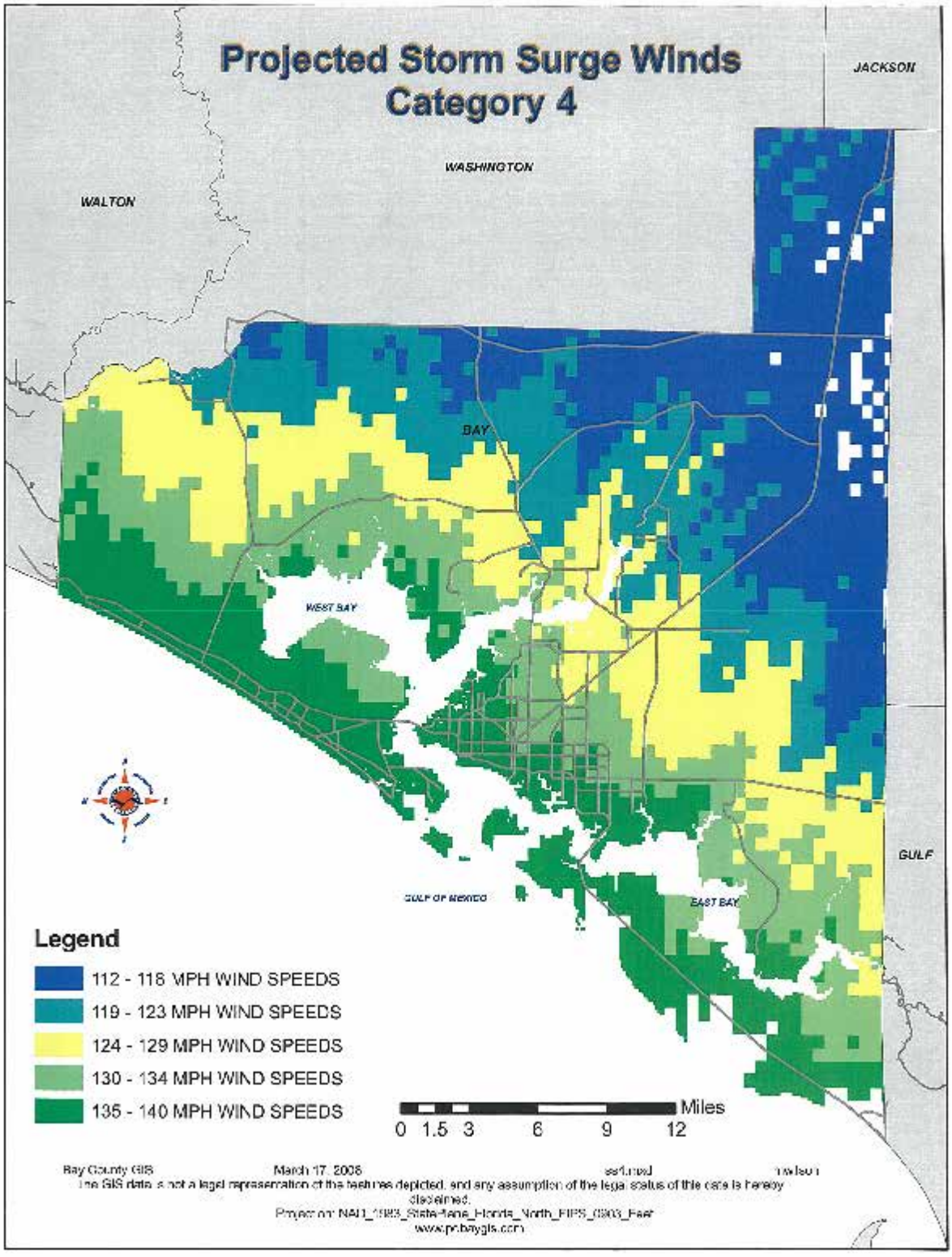
MAP D Peak Wind Expectancy Category 2



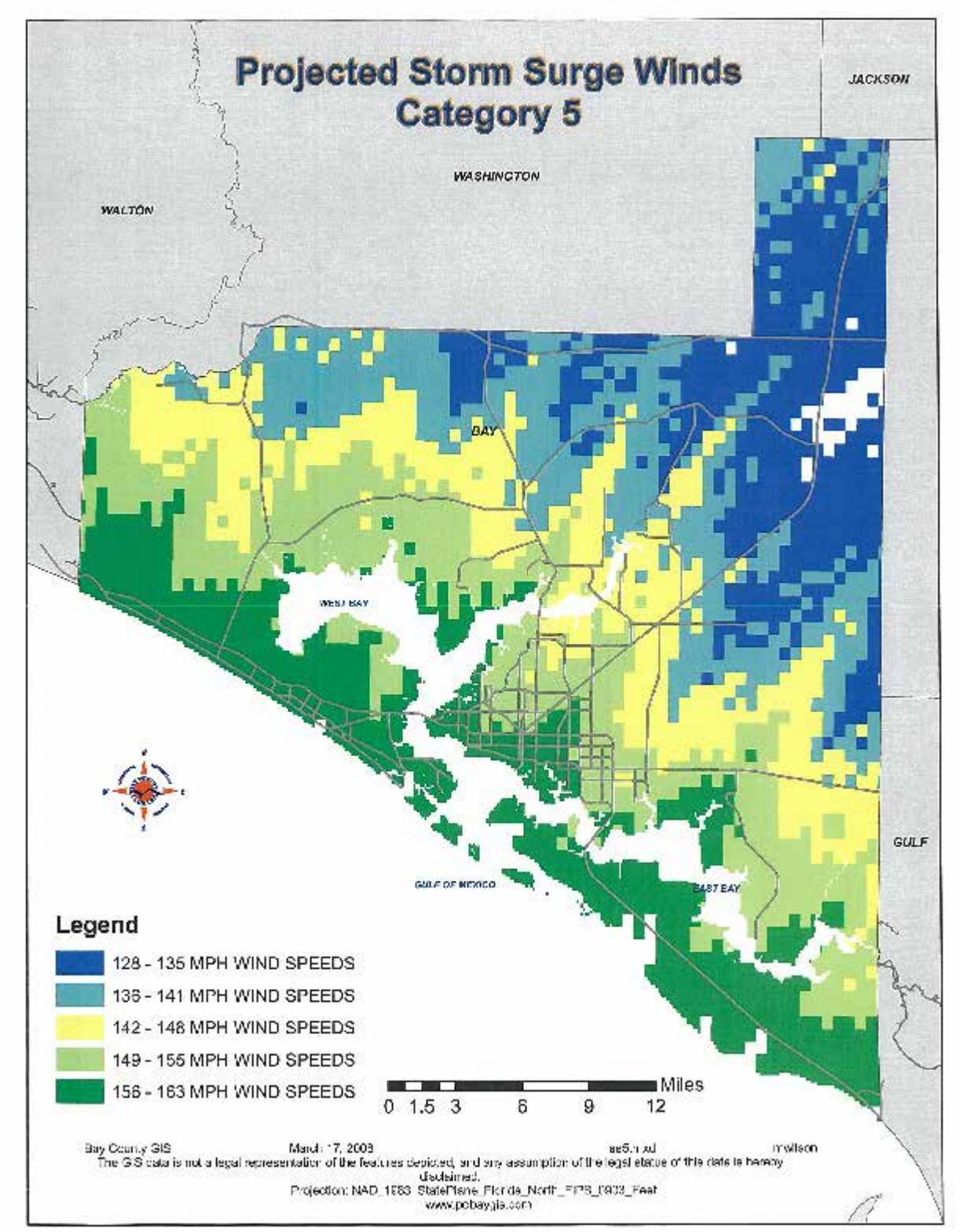
MAP E Peak Wind Expectancy Category 3



MAP F Peak Wind Expectancy Category 4



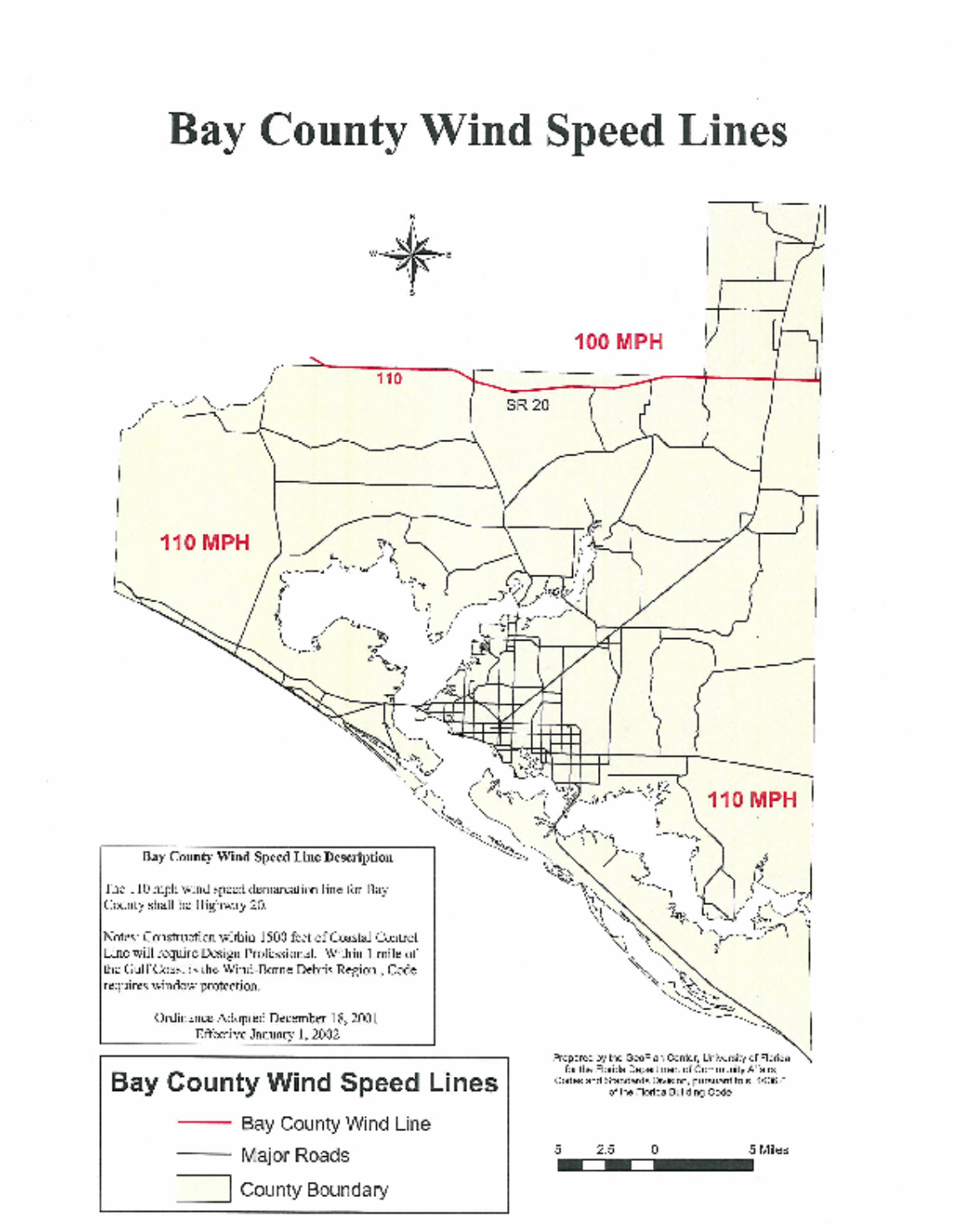
MAP G Peak Wind Expectancy Category 5



4.9. B.4 The Bay County Wind-Borne Debris Region

With the start of the 2007 hurricane season the Panhandle exemption from the Florida Building Code which limited wind-borne debris regions and shutter and impact-resistant glass requirements to one mile from the coastline was dropped. The wind-borne debris region for Bay County now extends much farther inland, five miles more on average from the coastline than in previous years. These winds refer to the effects of hurricanes and tropical storms.
This adoption should provide additional mitigation against wind for new construction within the County and municipalities.

Map H shows the new extent of the area where greater protection measures from damaging winds are in effect:



4.9.C. Tornados

Bay County and the municipalities are considered at high risk from tornados. Tornados can cause structural damage to buildings, trees, power lines, life safety, mobile homes, and vehicles. They are usually associated with or caused by thunderstorms, tropical storms, and hurricanes. Tornados can include heavy rainfall, flooding, lightning, dramatic decreases in temperature and barometric pressures, and can cause loss of power which can lead to other catastrophic health safety issues for those outside the areas directly impacted. Down power lines can increase risk of electrocution. Tornados can propel objects such as vehicle, homes, people, trees, and other debris.

FEMA's website describes tornados are violent cyclonic wind storms that often develop around major thunderstorms. Tornados can cause fatalities and devastate a neighborhood within only seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 mph. Damage paths can be in excess of one mile wide and 50 miles long. Every state in the country is at some level of risk from this hazard.

Some tornados are clearly visible, while rain or nearby low-hanging clouds obscure others. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible.

Before a tornado hits, the wind may die down and the air may become very still. A cloud of debris can mark the location of a tornado even if a funnel is not visible. Tornados generally occur near the trailing edge of a thunderstorm. It is not uncommon to see clear, sunlit skies behind a tornado.

4.9.C.1 Tropical Storm and Hurricane Tornados

Hurricanes can also produce tornadoes that add to the storm's destructive power. Tornados are most likely to occur in the right-front quadrant of the hurricane. However, they are also often found elsewhere embedded in the rain bands, well away from the center of the hurricane.

Some hurricanes seem to produce no tornados, while others develop multiple ones. Studies have shown that more than half of the landfalling hurricanes produce at least one tornado. Since the risk is high for hurricanes, the vulnerability to tornados is considered high. The effects of a tornado, added to the larger area of hurricane-force winds, can produce substantial damage. *http://www.nhc.noaa.gov/HAW2/english/tornadoes.shtml)*

While the NCDC indicates the risk of tornados is low (MAP I), their mapping was based on old historical information where accurate damage estimates and event logs were not kept. The LMS Team believes Bay County is vulnerable to tornados and considers the risk level to be high. One tornado spawned during Hurricane Ivan in 2004 caused over $7 million in property damage. Chart 9 describes the 30-year tornado history for the County and provides the Fujita ranking, injuries, fatalities, and estimated cost of damages.

4.9.C.2 The following are facts about tornadoes:

- They may strike quickly, with little or no warning.
- They may appear nearly transparent until dust and debris are picked up or a cloud forms in the funnel.

- The average tornado moves Southwest to Northeast, but tornados are known to move in any direction.
- The average forward speed of a tornado is 30 MPH, but may vary from stationary to 70 mph.
- Tornados can accompany tropical storms and hurricanes as they move onto land.
- Waterspouts are tornadoes that form over water.
- Tornados are most frequently reported east of the Rocky Mountains during spring and summer months.
- Peak tornado season in the southern states is March through May; in the northern states, it is late spring through early summer.
- Tornados are most likely to occur between 3 p.m. and 9 p.m., but can occur at any time.

Tornados can take a variety of forms and intensities:

Weak Tornados

- 69% of all tornadoes are classified as weak
- Cause less than 5% of tornado deaths
- General duration of 1 – 10+ minutes
- Winds are generally less than 110 mph

Strong Tornados

- 29% of all tornadoes fall in this category
- Cause nearly 30% of all tornado deaths
- General duration of approximately 20 minutes
- Winds are generally between 110-205 mph

Violent Tornados

- Only 2% of all tornadoes are considered violent
- Cause nearly 70% of all tornado related deaths
- These storms can exceed 1 hour in duration
- Winds can be clocked at over 200 mph

(http:// www.fema.gov)

4.9.C.3 Fujita Scale Information

To more uniformly rate the intensity of a tornado, the Fujita Scale *(also known as the F Scale - Chart 8)* is used to assess tornado damage throughout the United States. This scale examines the damage caused by the tornado after it has passed over a man-made structure and/or heavily vegetated areas. Though each damage level is associated with a wind speed, the Fujita scale is a damage scale, and the wind speeds associated with the damage listed are unverified. Previous to the application of the Fujita Scale, all tornadoes were counted as equals. The Enhanced Fujita Scale (EF) was formulated as research suggested that wind speeds for strong tornadoes on the Fujita scale are greatly overestimated. However, being determined by a synthesis of opinions of top engineers and meteorologists, the EF scale wind speeds remain as educated guesses, and are

also biased to United States construction practices. (On the implementation of the enhanced Fujita scale in the USA**,** *Atmospheric Research, Volume 93, Issues 1-3, July 2009, Pages 554-563,* Charles A. Doswell III, Harold E. Brooks, Nikolai Dotzek)

CHART 8 - Fujita Scale Rankings

Scale	Wind Speed Estimates	Potential Damage Impacts
F 0	< 73 MPH	Light – damage to protruding structures such as chimneys, antennas, satellite dishes, signs, balcony railings; windows shattered by debris; broken tree limbs; uprooted trees
F 1	73 – 112 MPH	Moderate – roofing material stripped; mobile homes shifted from foundations or overturned; moving vehicles blown off roads
F 2	113 – 157 MPH	Considerable – roof trusses torn from wall frames; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light- to moderate- weight debris projected at high velocity; vehicles lifted off ground
F 3	158 – 206 MPH	Severe – roof trusses and wall framing dismantled; trains overturned; many trees uprooted; heavy vehicles lifted off ground and projected
F 4	207 – 260 MPH	Devastating – well constructed structures leveled; structures with weak foundations blown away at some distance; heavy objects projected at high velocity
F 5	261 – 318 MPH	Incredible – strong framing leveled off foundations and scattered; large and heavy objects projected at high velocity in excess of 300 feet; bark and limbs stripped from trees

4.9.C.4 Historical Tornado Information

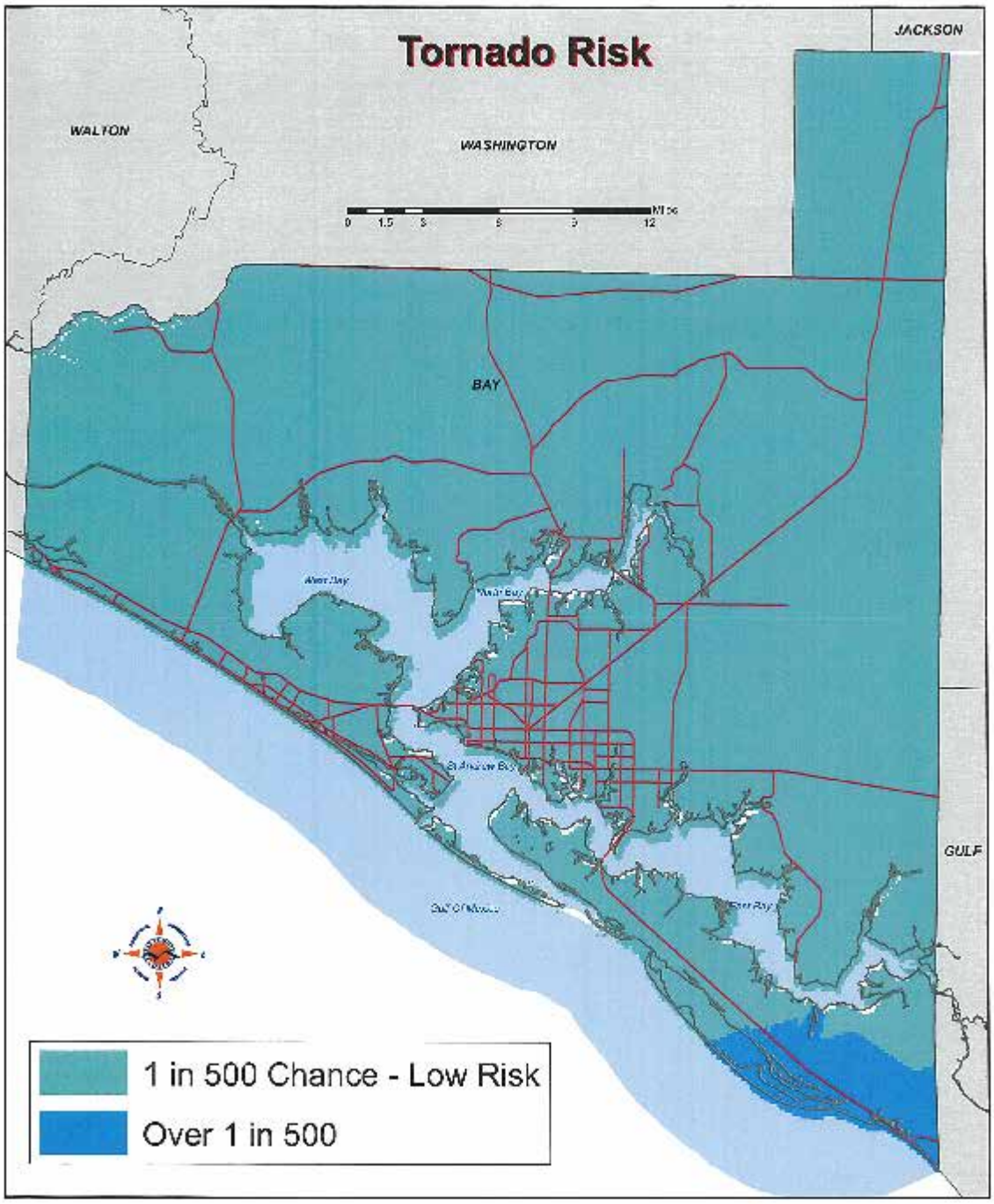
Prior to 1994 accurate Tornado landfall data is not available for Bay County. The NCDC estimates that between 1978 and 1993 approximately $3.5 million in wind damages occurred within the County from tornados; however, the locations or municipalities were not recorded. The chart below provides information on the municipalities/fire districts that received tornado damage between 1994 and 2009. The best available data for the 1978 - 1993 time period is also included.

Chart 9 - Tornado History - Bay County

Location	Date	Fujita	Damages	Fatalities	Injuries
Bay County	1978 (2 tornados)	F0-1	$25K	0	0
Bay County	1980 (3 tornados)	F0-1	$275K	0	7
Bay County	1981 (2 tornados)	F0-1	$28K	0	0
Bay County	1982 (3 tornados)	F0-1	$31K	0	0
Bay County	1983 (3 tornados)	F1	$2M 775K	0	0
Bay County	1984 (1 tornado)	F0	$250K	0	0
Bay County	1985 (2 tornados)	F0-1	$275K	0	1
Bay County	1988 (3 tornados)	F0-1	$278K	0	0
Bay County	1989 (1 tornado)	F1	$0	0	0
Bay County	1991 (1 tornado)	F0	$0	0	0
Bay County	1992 (1 tornado)	F0	$3K	0	0
Panama City Bch	06/25/1994	N/A	$500K	0	0
Laguna Beach	03/07/1996	F0	$0	0	0
Panama City Bch	10/24/1997	F1	$350K	0	2
Callaway	10/24/1997	F1	$35K	0	2
Panama City	10/26/1997	F0	$0	0	0
Hiland Park	10/26/1997	F0	$20K	0	0
Bid A Wee (PCB)	09/28/1998	F1	$250K	0	0
West Bay	09/29/1998	F1	$125K	0	1
Panama City Bch	01/02/1999	F2	$4.0M	0	7
Tyndall AFB	02/16/2003	F1	$250K	0	0
Panama City Bch	06/02/2004	F0	$10K	0	0
Panama City	09/15/2004	F1	$5.0M	1	7
Allanton	09/15/2004	F1	$500K	1	1
Callaway	09/15/2004	F1	$2.0M	0	0
Youngstown	09/15/2004	F0	$15K	0	0
Panama City Bch	11/24/2004	F0	$10K	0	0
Panama City Airport	12/24/2005	F0	$650K	0	0
Bayou George	10/22/2006	F0	$75K	0	0
Hollywood Bch	10/27/2006	F0	$5K	0	0
Bay County (Thomas Dr. FD)	10/08/2008	F0	$500K	0	0

Data obtained from the National Climatic Data Center

Map I



Bay County GIS July 29, 2009 tornado_LMS_2009.mxd mvillson
This GIS data is not a legal representation of the features depicted, and any assumption of the legal status of this data is hereby disclaimed.
Projection: NAD_1983_StatePlane_Florida_North_FIPS_0903_Feet. Reference: Internal KAC Analysis.

4.9.C.5 Probability Assessment and Potential Impacts for wind damage from hurricane high winds and tropical storm winds: **Wind damage in Bay County from various storm events has resulted in millions of dollars in individual and public assistance. Although Bay County has never experienced a direct hit from hurricane winds rated higher than a Category 2, or a tornado ranked higher than an F-2 on the Fujita scale, the probability of wind damage occurring in Bay County is high. Chart 8 provides a 30-year tornado history for the County and municipalities, and indicates that damages have been relatively low cost; however, the LMS Team agreed that the risk remains substantial for a higher ranked storm with an associated tornado to occur in the future. Section 7A, which details the relationship of the CRS program to the LMS, features a description of the most significant hurricanes to impact the County, and Appendix 1 provides a 150 year storm history. However, useful data to draw conclusions for the damage estimates for future events is scant. Therefore, it is one of the goals of the Team over the next planning period to establish an improved methodology of forecasting costs for future wind events.**

Maps C-G on the previous pages indicate the wind speeds for Category 1-5 hurricanes and the areas at risk from these winds. The municipal areas of densest population correspond to the areas of highest risk. A category 3 to 5 hurricane with wind speeds surpassing 160 mph has the potential to cause billions of dollars in property damage.

4.9.D. Tsunami

4.9.D.1 Introduction

Tsunamis are high velocity coastal waters rapidly flowing above the high water line and into urbanized areas. These waves often cause severe structural damages to building due to impacts that are similar to storm surge and flooding.

Bay County and its neighboring communities do not have an historical record of marine seismic activity or tsunami events, but given the severity of the potential impacts and understanding that mitigation of tsunami impacts is similar to the mitigation of storm surge, the Bay County LMS has included a tsunami vulnerability assessment.

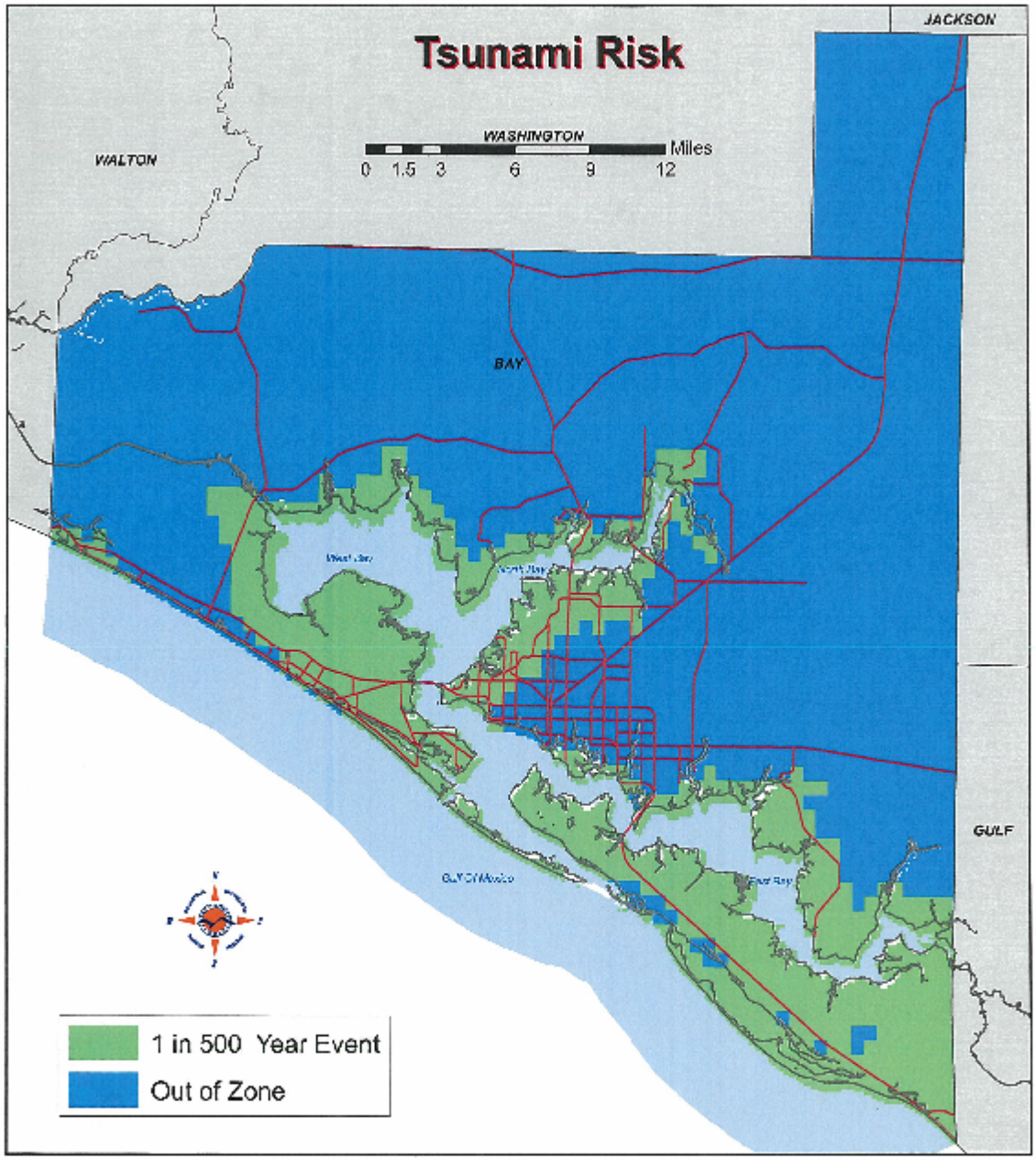
4.9.D.2 Assessment of Potential Risk

The tsunami risk in Florida is difficult to assess, as there are no reliable historical records and few publications on the subject for the Gulf of Mexico. Accordingly, simulation techniques are necessary to generate estimates of the probability, location, and extent of a tsunami event. Simulated events for the Gulf of Mexico include (1) volcanic activity in the Caribbean, (2) seismic activity in Central America, (3) sediment sliding on the continental shelf, (4) small asteroid impacts in the Gulf, and (5) volcanic activity from Cumbre Vieja in the Canary Islands. Estimates based on these simulations indicate that the most severe wave that a tsunami along the Gulf Coast of Florida would generate would reach approximately 4 meters. By contrast, simulations for some areas along the Atlantic Coast have indicated that a tsunami wave could reach 4 to 7 meters. There is no historical record of tsunamis for Bay County; therefore, an exact forecast of damages is impossible to make. However, it is likely that storm damage patterns would model those of the storm surge zones (These maps are located in Section 7, subsection 5 for the County and each of the municipalities). An overall qualitative tsunami hazard assessment based on NGDC and USGS databases indicates that the entire U.S. Gulf Coast area has a low risk for tsunamis.
(Data for this section was obtained from a report prepared for the National Tsunami Hazard Mitigation Program entitled: U.S. States and Territories National Tsunami Hazard Assessment: Historical Record and Sources for Waves, by Paula K. Dunbar, National Oceanic and Atmospheric Administration and Craig S. Weaver, U.S. Geological Survey, August 2008.

4.9.D.3 Probability Assessment and Potential Impacts for Tsunami Inundation would most likely follow the Map B storm surge zones. Damage impact estimates would depend on wave height and can be determined from the storm surge zone maps in Section 7 for the unincorporated fire districts and the municipalities. As the risk is considered extremely low, and there is no history of tsunamis in the area, no mitigation projects are proposed for this hazard. However, projects that mitigate damage from flooding and storm surge would serve to mitigate tsunami risks.

The map (J) on the following page indicates the minimal threat to the County associated with tsunamis:

MAP J



Bay County GIS July 29, 2009 tsunami_LMS_2009.mxd mattson

The GIS data is not a legal representation of the features depicted, and any assumption of the legal status of the data is hereby disclaimed. Tsunami risk in Florida is difficult to assess, as there are no reliable historical records and few publications on the subject. Therefore, simulation techniques were used. Five types of events were simulated: Caribbean volcanic events, Caribbean and Central American earthquakes, continental shelf sediment slumping, small asteroid impacts, and East Atlantic (the Cumbre Vieja volcano, on the island of La Palma, in the Canary Islands) volcanic events. In general, on the Gulf Coast of Florida, these events produced at worst a 4 meter wave, while in some parts of the Atlantic coast this value grew to 6 to 7 meters. Expert Opinion suggests that these would be approximately 1 in 500 year events. Note that these areas are mostly in the Category 5 hurricane zone, which is probably an event of comparable frequency in North Florida. However, a tsunami wave from the worst case La Palma event would more than likely inundate the entire Atlantic coastline, as opposed to only a few dozen miles of coastline in the case of a hurricane. The potential magnitude of such an event is highly controversial, with a minority of researchers suggesting waves as high as 40 meters, with most estimates in the 5 meter range.

Projection: NAD_1983_StatePlane_Florida_North_FIPS_0903_Feet Reference: Inserra GAC Analysis.

4.9.E. Wildfire

4.9.E.1 Introduction

In Bay County the Wildfire Hazard Areas are primarily located within the unincorporated areas of the county as opposed to the municipal districts. Bay County assesses the wildfire risk as medium for the unincorporated areas of the county where there are still large tracts of forested land, and low in the unincorporated areas where forested acreage is minimal. The National Climate Data Center website indicates the following wildfire history for Bay County for the last 30 years as follows:

Chart 10 - 30 Year Wildfire History - Bay County

YEAR	NUMBER OF WILDFIRES	LOCATION	FATALITIES	INJURIES	DAMAGE ESTIMATE
1998	2	Southport	0	0	none recorded
1999	1	Youngstown	0	0	none recorded
1999	1	West Bay	0	0	none recorded
2000	1	Springfield	0	0	none recorded
2000	1	Panama City	0	0	$10,000 property damage
2000	2	Allanton	0	0	none recorded

4.9.E.2 Characteristics of the Threat

There are essentially three distinct types of wildfires that threaten Bay County:

1. Surface Fire: This type of fire burns in the surface fuel layer, above the surface of the soil, but below the tree canopy. Surface fuels include all combustible organic forest material including pine needles, twigs, plant matter, bushes, and even trees smaller than ten feet in height.

2. Crown/Canopy Fire: These fires burn in the organic matter in the tree tops which can include leaves, branches, twigs, wood and lichens. An active crown fire involves the entire canopy of the forest and is generally supported by the heat resulting from fuels burning on the forest floor below. It is also characterized by a solid wall of flame extending from the ground to the area above the treetops. Living canopy fuels usually have a greater moisture content and lower density than other fuels; therefore, are less likely to burn unless fire is channeled to the canopy by excessive heat from a surface fire or by "ladder fuels." Once a fire penetrates the canopy, it becomes difficult to suppress, influenced by winds, and likely to cause greater and longer-lasting damage.

3. Ground Fire: A ground fire burns below the ground in roots, logs, peat and muck that have dried out. Underground fuels are denser than canopy or surface fuels and will burn more slowly, but could also burn at higher relative moisture content. These types of fires can injure the roots of plants and trees. Often, they are started from surface fires that in dry wetland areas. *(Wildfire Mitigation in Florida, Land use planning strategies and best development practices, from the FloridaDisaster.org website)*

4.9.E.3 Exposure Risk

The estimated exposure of Bay County's existing structures to wildfire hazards was determined through MEMPHIS. The estimated number of structures at risk is listed below:

Chart 11 - Potential Impact of Structures Potentially Vulnerable to Wildfire

Structure	Wildfire
Single Family	5,547
Mobile Home	2,683
Multi-Family	1,303
Commercial	709
Agriculture	931
Gov. / Institutional	244
Total	**11,417**

Emergency Management, Parallel Hazard Information System (MEMPHIS)² 2005 data, updated by the County in 2009

(MEMPHIS is an experimental web based system to allow emergency managers to easily access a variety of hazard related data in support of the Florida Local Mitigation Strategy Project, created by Kinetic Analysis Corp.)

4.9.E.4 Mitigation

Wildfires occurring over undeveloped and wooded tracts are a significant hazard for people living in or around rural areas of the County. Dry conditions, and especially drought, increase the potential for wildfires.

Wildfire mitigation is largely the responsibility of individual home and business owners. There are several safety precautions that can be taken to reduce the risk of fire losses. Home and business owners need to consider the fire resistance of their land and structures in terms of the topography of the land, the types of nearby vegetation, and the building materials used in construction. The Emergency Services Department is available to citizens of the county at anytime if they have questions regarding safety measures for their property. In addition, the members of the Emergency Services Department give presentations about fire safety at public meetings and events throughout the year. For example, in recognition of Fire Safety Prevention Week Bay County, in partnership with other municipal fire departments, the Division of Forestry, and numerous other community organizations will host a special family event on October 10th, 2009 - the 2nd Annual Fire Prevention Fest. This will present an opportunity for families to meet with members of different fire departments, learn about fire safety through displays, demonstrations, talks, and games. It is a widely advertised fun occasion where food, drinks, and fun will be served in order to get several important fire safety messages out to the public.

Advanced mitigation planning for structures and natural resources in the more rural, undeveloped areas of the County can lessen the chances of a wildfire. The Emergency Management Division is a member of the Planning and Zoning Department's Internal Review Team. In this capacity the Emergency Management Division reviews all Development Orders and has the capacity to recommend procedures and practices for each subdivision and commercial development that will ensure the lowest vulnerability and susceptibility to risk.

Through the County's partnership with B.E.S.T. (Bay Environmental Study Team) (aka The Friends of St. Andrew Bay), wildfire issues will be examined through a grant application to the US Forest Service. The project, "Hazardous Fuels Woody Biomass Utilization" has two goals:

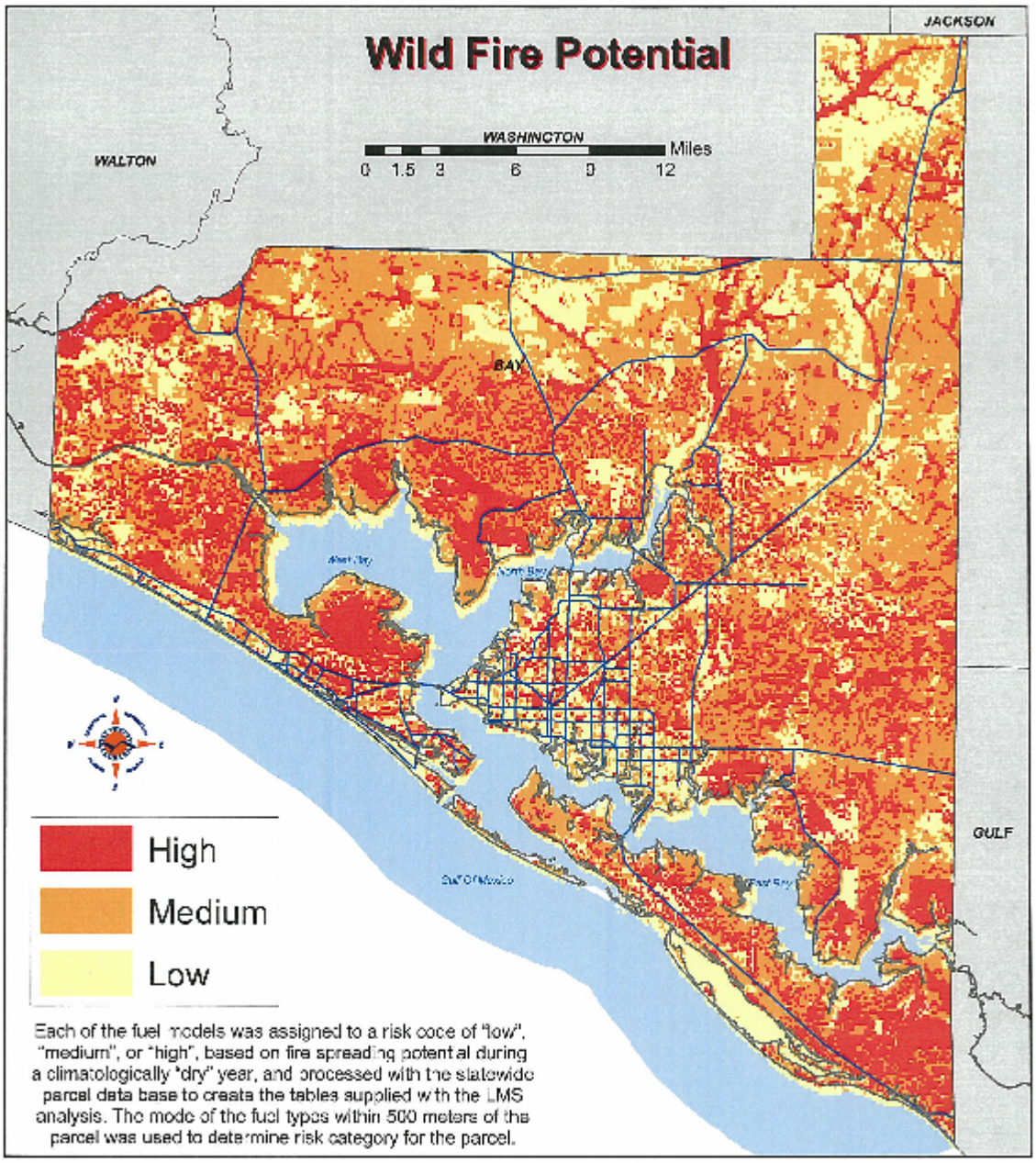
- reduction of hazardous fuels in the form of forest underbrush
- utilization of biomass (woody underbrush) as a resource rather than waste.

The project leader has extensive experience with processing and utilizing woody biomass, as she operated facilities in Ohio that processed the material for use in the community. B.E.S.T. is anticipating a grant award of approximately $350K. If awarded, additional community partners will be sought, including St. Joe, The PC-Bay County Airport Authority, Tyndall Air Force Base, Bay County, and the King Preserve.

4.9.E. 5 Probability Assessment for wildfire damage: Damage from wildfires has a "medium" probability of occurrence and risk, most generally for the unincorporated areas of the County. At the present time the areas subject to wildfire are sparsely populated; therefore, damage assessments are low. As most structures subject to wildfire damage are in the more rural, unincorporated areas of Bay County there are approximately 11,000 structures at risk in total, spread throughout the County (Chart 10). The maximum risk from a given single event would be approximately 100 structures with several million dollars in damages. The municipalities, in general, have a lower amount of forested areas, consequently the risk is minimal.

Map (K) on the following page indicates the potential countywide risk associated with wildfires wildfires as plotted by MEMPHIS. However, based on historic evidence the LMS team believes the risk to be much lower than indicated in this map.

MAP K


Wild Fire Potential
JACKSON
WASHINGTON
WALTON
Miles
0 1.5 3 6 9 12
BAY
GULF
High
Medium
Low
Each of the fuel models was assigned to a risk code of "low", "medium", or "high", based on fire spreading potential during a climatologically "dry" year, and processed with the statewide parcel data base to create the tables supplied with the LMS analysis. The mode of the fuel types within 500 meters of the parcel was used to determine risk category for the parcel.

4.9.F. Sinkholes

4.9.F.1 Introduction

Sinkholes are a common form of geological subsidence occurring in much of north Florida where a karst-limestone substrate is present. While the northern portion of Bay County does have a considerable underlying karst region, the County does not have an historical record of sinkholes, and accordingly, the probability of sinkholes developing where urban or populated areas might be affected is considered low. The May, 2005 report, Natural Hazards Risk Assessment to Support Local Mitigation Strategies in Florida - KAC Sinkhole Risks for Bay County (by Charles C. Watson, Jr. and Mark E. Johnson), supports this belief.

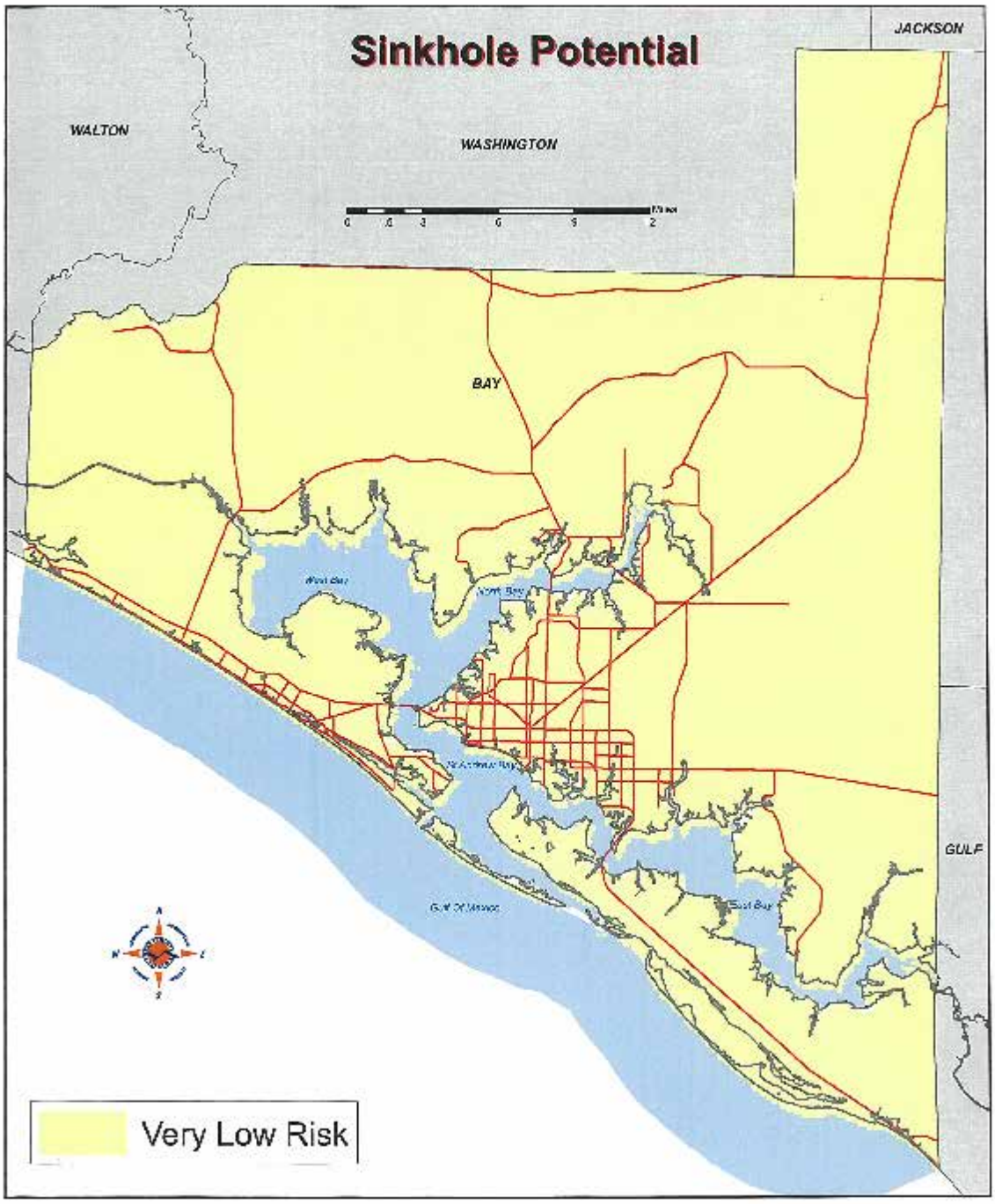
4.9.F.2 **Potential Impact:** Where karst topography becomes undermined by water flowing through the porous limestone substrate and subterranean aquifers, structures such as concrete foundations, roads, or sidewalks may sink and fracture. Damage may not always be obvious at first glance, while potential may exist for collapse of roadways, houses, or any other structure within the affected area. Damages may also include a loss of potable water, as well as contamination of wells and damage to septic tanks. However, as mentioned earlier, at the present time Bay County considers sinkholes to be a very minimal hazard.

4.9.F.3 Probability Assessment for sinkhole damage: There is no history of sinkhole damage in Bay County or any of the municipalities. As the municipalities have no underlying Karst substrate, there is no risk forecast for those areas at this time. While there is karst substrate in some areas of the northern section of Bay County, the NCDC indicates the risk is low for the occurrence of sinkholes in Bay County.

If, a sinkhole were to open, at risk would be one or two structures, or a section of one road per event. Estimated damage may reach $500,000. Due to the very low potential risk, no mitigation projects have been initiated for this event.

4.9.F.4

MAP L



Bay County GIS July 29, 2009 sink_LMS_2009.mxd rnelson
The GIS data is not a legal representation of the features depicted, and any assumption of the legal status of this data is hereby disclaimed.
Projection: NAD_1983_StatePlane_Florida_North_FIPS_0903_Feet Reference: Internal KAC Analysis.