
VII. HAZARDS IDENTIFICATION AND PROFILES

Hazard identification and profiling are conducted as parts of the risk assessment. Risk assessment, which also includes a vulnerability assessment, combines the likelihood of a hazard event (probability) with the potential extent or degree of damage that would result (vulnerability).

Hazard identification and profiling refers to the process of defining hazard-prone areas, estimating the probability and severity of the hazard risk, and evaluating existing mitigation efforts. The process allows us to analyze all types of hazards threatening the County and its communities. It may be preferable to divide some hazards into their component parts. For example, Tropical Cyclones, which include tropical storms and hurricanes, may be divided into wind and surge hazards.

A. HAZARD IDENTIFICATION

In the hazard identification process, the hazards can be categorized as natural, technological/manmade, and societal. The table below consists of the identified hazards by type, the method of which they were identified, and why they were identified. This information was compiled in order to identify various hazards that affect or will have an impact on Levy County in the future.

Following Table VII-1 are descriptions of each hazard.

Table VII-1. Identified Hazards

HAZARD	HAZARD TYPE	HOW IDENTIFIED	WHY IDENTIFIED
Tropical Cyclones	Natural	<ul style="list-style-type: none"> -Review of past disaster declarations. -Review of National Climatic Data Center (NCDC) Severe Storms Database. -National Oceanographic and Atmospheric Association (NOAA) climatology data. -Research including new media and the Internet. -Research including National Hurricane Center (NHC). 	<ul style="list-style-type: none"> -Hurricanes and coastal storms affect Florida every year. -Hurricanes have caused extensive damage and loss of life across the State for the last 50 years. -10 out of the last 14 federally declared disaster events in Florida were hurricanes.
Floods	Natural	<ul style="list-style-type: none"> -Review of past disaster declarations. -Review of Federal Flood Insurance Rate Maps (FIRMs). -Input from State floodplain manager. -Identification of National Flood Insurance Plan repetitive loss properties in the State. 	<ul style="list-style-type: none"> -Florida is affected by flooding nearly every year. -Floods have caused extensive damage and loss of life in the State in the past. -The most recent federally declared disaster event (May 27, 2009) in Florida included flooding from severe storms.
Wildfires	Natural	<ul style="list-style-type: none"> -Florida Division of Forestry statistics and input. -U.S. Department of Agriculture, Forest Service Fire, fuel, and Wildland-Urban Interface mapping. -Input from Florida Division of Emergency Management about wildfires and the Emergency Operations Center activations. -Public input including newspapers and media. 	<ul style="list-style-type: none"> -Florida experiences wildfires every year. -Development in much of the State is occurring at the Wildland-Urban Interface (WUI). -Cyclical drought patterns result in increases of brush and other dry materials. This increases the overall risk for significant fires.
Sinkholes	Natural	<ul style="list-style-type: none"> -Coordination with the Florida Geographical Survey. -The Florida Sinkhole Database. -Coordination with the Florida Department of Transportation. -Input from the Central United States Earthquake Consortium. -U.S. Geological Survey Landslide Hazard maps. 	<ul style="list-style-type: none"> -Sinkholes are a common feature of Florida's landscape. -Growing issues as development continues in high risk areas. -Impact on the roads and physical infrastructure of the State.
Coastal Erosion	Natural	<ul style="list-style-type: none"> -Coordination with the Florida Department of Environmental Protection – Bureau of Beaches and Coastal Systems. -SHMPAT interview and input. -Evaluation of Erosion Hazards, the report from the Heinz Center that was presented to FEMA in April 2000. -Public input including newspapers and media. 	<ul style="list-style-type: none"> -Due to the gradual, long-term erosion, as many as one in four houses along the coast could fall into the ocean in the next 60 years. -80 to 90 percent of the nation's sandy beaches are facing erosion problems. -Significant economic impact due to property damages, loss of actual beach front real estate, and effects on tourism.
Drought/Extreme Heat	Natural	<ul style="list-style-type: none"> -National Weather Service data. -National Oceanographic and Atmospheric Association (NOAA) paleoclimatology data. -The U.S. Drought Monitor. -Keetch Byram Drought Index (KBDI). -Agricultural community throughout the State. 	<ul style="list-style-type: none"> -Significant drought trends during the last 10 years, including the driest back-to-back calendar years in 2006-2007. -Drought has a severe economic impact due to the large amounts of agriculture and livestock.
Tornadoes	Natural	<ul style="list-style-type: none"> -Review of past disaster declarations. -Review of National Climatic Data Center (NCDC) Severe Storms 	<ul style="list-style-type: none"> -Florida experiences a tornado nearly every year. -Tornadoes have caused extensive damage and loss of life to county

HAZARD	HAZARD TYPE	HOW IDENTIFIED	WHY IDENTIFIED
		Database. -National Weather Service input and data. -Research including media and Internet resources.	residents.
Severe Winter Storms / Freeze	Natural	-Review of past disaster declarations. -Review of National Climatic Data Center Severe Storms Database. -National Weather Service input and data. -Public input including newspapers and media.	-Levy County is affected by winter storms cyclically -There have been significant freezes, particularly during the 1980s, that affected the citrus industry -The population is unprepared for cold weather, with many having inadequate heating capabilities
Dam Failure	Natural	-Review of past disaster declarations. -Review of Federal Flood Insurance Rate Maps (FIRMs).	-There are dams that could impact the nearby population.
Tsunamis	Natural	-Input from the National Oceanic and Atmospheric Association Center for Tsunami Research. -Coordination with the Florida Division of Emergency Management. -Input from the United States Geological Survey.	-Tsunamis commonly occur in large bodies of water. -Recent tsunamis from around the world have caused widespread destruction. -Residential and commercial development along coastlines are at risk to the effects of tsunamis.
Hazardous Materials Releases	Technological/ Manmade	-Coordination with the State Emergency Response Commission. -Interaction with the Local Emergency Planning Committees (LEPC). -Communications with the FL Department of Environmental Protection.	-Numerous accidental hazardous material releases occur every year. -Potential for human and environmental impacts.
Nuclear Power Plant Incidents	Technological/ Manmade	-Coordination with the State Emergency Response Commission. -Interaction with the Local Emergency Planning Committees (LEPC). -Coordination with the Nuclear Regulatory Commission (NRC). -Communications with the FL Department of Environmental Protection.	-Threat of radiation from a nuclear related incident. -Potential for human and environmental impacts.
Coastal Oil Spill	Technological/ Manmade	-Coordination with the State Emergency Response Commission. -Communications with the FL Department of Environmental Protection.	-Potential for human, economic, and environmental impacts.
Civil Disturbance	Societal	-Coordination with FEMA and Department of Homeland Security -Coordination with the Florida Department of Law Enforcement (FDLE). -Interaction with local law enforcement agencies.	-National priority with federal government requirements. -Potential for devastating impacts to life and infrastructure. -Protection for the citizens of Florida and the USA.
Mass Immigration	Societal	-Coordination with the US Citizens and Immigration Service (USCIS). -Data from local law enforcement.	-Historic precedence for migration to Florida by boat. -Large amounts of unpatrolled coastlines.

The following are descriptions of the various hazards that may occur in Levy County and were compiled with reference to the Levy County Comprehensive Emergency Management Plan (CEMP), 2008.

1. TROPICAL CYCLONES

Tropical cyclones include tropical storms and hurricanes, and are typically characterized by high winds and heavy rains. A tropical cyclone is any closed circulation developing over tropical waters and around a low pressure center in which the wind rotates counterclockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. As a developing center moves over warm water, pressure drops (measured in millibars or inches) in the center of the storm. As the pressure drops, the system becomes better organized and the winds begin to rotate around the low pressure, pulling the warm and moist ocean air. It is this cycle that causes the wind and rain associated with a tropical cyclone.

- A tropical storm is a warm core tropical cyclone in which the maximum sustained surface wind (1-minute mean) ranges from 39 to less than 74 mph.
- A hurricane is a warm core tropical cyclone in which the maximum sustained surface wind (1-minute mean) reaches at least 74 mph.

Tropical cyclones Season in North America lasts from June 1st to November 30th each year. Four natural hazards are associated with tropical cyclones: **high winds, storm surge, flooding, and tornadoes** (flooding and tornadoes will be further discussed in separate hazard categories “Floods” and “Tornadoes”).

Tropical storm force winds are strong enough to be dangerous to those caught in them; however greater concern is focused on hurricane force winds. Hurricane force winds are by definition sustained winds with a one minute average speed of 74 mph or greater. Sustained wind speed as high as 190 mph have been recorded during hurricanes along with peak wind gusts that are even greater than sustained winds. These tremendous winds are capable of causing roof failure, outward collapse of walls and glass openings, destruction of crops, and the transformation of unsecured objects into speeding projectiles. The strongest winds usually occur in the right side of the eye-wall of the hurricane. Wind speed usually decreases significantly within 12 hours after landfall. Nonetheless, winds can stay above hurricane strength well inland.

As the eye of the tropical cyclone strikes the coast or makes its “closest point of approach” from the sea, the stress of high winds and pressure forces produces a rising wall of water which moves onto the coast. This abnormal rise in water level is known as the “storm surge.” Since the winds of a tropical cyclone spin counterclockwise about its center, the storm surge affecting Levy County will be largely limited to the area south of where the eye approaches the coast. The peak storm surge of a tropical cyclone occurs approximately at the radius of maximum winds from the storm center.

The effect of surge has proven to be deadly, causing 9 out of 10 tropical cyclone related fatalities. The surge is the hazard of greatest damage potential, capable of rendering complete destruction in areas of lower elevation where surge and wind unobstructed by trees and buildings has a synergistic effect. Obviously the higher the storm surge the greater the potential for damage.

The variation in both storm surge and the length of coastline subject to surge inundation is due to: Tidal

effects, storm intensity, the tropical cyclone's forward speed, the radius of maximum winds, the angle of the storm path, the shape of the coastline, and the bathymetry of the ocean off the coast. Spring tides which occur around the full and new moons can add an additional 12 inches to the normal high tide, and hence add an additional 12 inches to the storm surge. The surge will generally be higher for more intense tropical cyclone. The surge will also be higher if the path of the tropical cyclone to the coast is more perpendicular than at other angles. Generally, shallow water off the coast where the tropical cyclone comes ashore increases the surge height. Bays and other coastal inlets produce a "funneling effect" that results in a higher surge than along relatively smooth sections of coastline. The radius of maximum winds has minimal effect on surge height, but does increase the length of coastline subject to surge as the radius increases. The speed of the storm essentially governs how long a particular area will be subject to surge, although faster moving storms produce a slightly higher surge. The maximum height of the surge will occur approximately when the eye of the storm strikes or makes its closest point of approach to the coast.

2. FLOODS

Flooding refers to the general or temporary conditions of partial or complete inundation of normally dry land areas by surface water runoff from any source (Statewide Hazard Mitigation Plan, 2009). Flooding can be divided into two major categories: coastal and riverine. Interrelated hazards can result in both types of flooding, sometimes in different locations.

Coastal flooding is usually the result of a severe weather system such as a tropical cyclone. The damaging effects of coastal floods are caused by a combination of higher water levels of the storm surge, the winds, rains, erosion and battering by debris. Loss of life and property damage are often more severe since it involves velocity wave action and accompanying winds.

Riverine flooding is associated with a river's watershed, which is the natural drainage basin that conveys water runoff from rain. Riverine flooding occurs when the flow of runoff is greater than the carrying capacities of the natural drainage systems. Rainwater that is not absorbed by soil or vegetation seeks surface drainage lines following natural topography lines. These lines merge to form a hierarchical system of rills, creeks, streams and rivers. Generally, floods can be slow or fast rising depending on the size of the river or stream.

Florida is affected by a large number of tropical weather systems. Although storm surge has the greatest potential for loss of life, recent research indicates that inland flooding was responsible for the greatest number of fatalities over the last 30 years. Studies show that 59 percent of the tropical cyclone deaths in the United States resulted from severe inland flooding (see Figure VII-4).

Rainfall from tropical cyclones can be as devastating as the wind. This flooding is entirely separate from the coastal surge. Even if the storm is relatively minor, Levy County will experience freshwater flooding in vulnerable areas. The soils in the 100-year floodplain and its wetland systems create a pre-saturated landscape, made worse with extensive rain.

Leading Causes of Tropical Cyclone Deaths in the U.S. 1970-1999

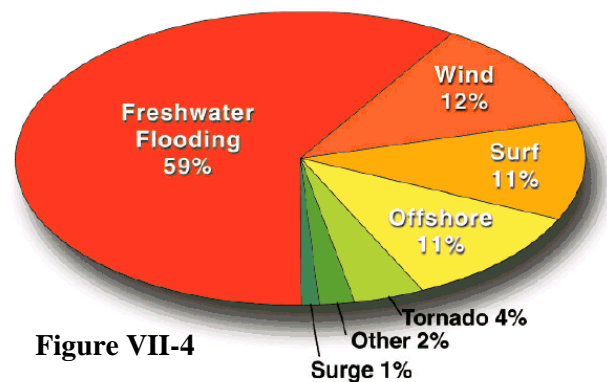


Figure VII-4

Source: Edward Rappaport—Chief, Technical Support Branch, Tropical Prediction Center

A tropical cyclone or heavy rainfall event can be expected to bring 6 to 12 inches of rainfall as it takes about 24 hours to pass an area on average, but the amount does not vary according to storm Category. According to the National Hurricane Center, the amount of rainfall associated with a tropical cyclone is not a function of the size or intensity of the storm. Tropical cyclone rains generally vary with the speed of the storm, with slower moving storms generating more rainfall than faster moving storms. One reasonably accurate way to forecast the amount of rain expected from a tropical cyclone is:

$$\text{Maximum inches of rainfall per 24 hours} = 100 / \text{forward speed of storm (mph)};$$

For example, a storm moving at 25 miles per hour would bring approximately 4 inches of rain per 24 hours. Accordingly a tropical cyclone moving at 10 miles per hour can be expected to generate 10 inches of rain.

Many parts of Florida are poorly drained and, in fact, drainage improvements are often discouraged under the current regulations. Florida's Water Management Districts have adopted policies to encourage percolation of rainfall into the ground wherever possible. Placing fill into low-lying areas is also discouraged through regulatory means. These policies make flooding conditions and situations difficult to mitigate through drainage improvements or engineering solutions. Therefore, avoidance of low-lying areas is the most effective mitigation against flood damage.

3. WILDFIRES

A wildfire is any fire occurring in the wildlands (i.e., grasslands, forest, brushland, etc). Wildfires can be a natural hazard or a manmade hazard. Wildfires have burned across the woodlands of Florida for centuries and are part of the natural management of much of Florida's ecosystems. Florida's typical fire season is from January to May. Wildfires caused by lightning are common in central Florida, especially in association with weather patterns that create intense thunderstorms. The largest numbers of fires caused by lightning occur in July coinciding with the peak of the thunderstorm season.

Forest fires from natural causes (such as lightning) only account for a small percentage of Florida's wildfires. People are still by far the leading cause of wildfires in Florida. A variety of human activities cause wildfires including: controlled burns escaping containment; campfires getting out of control; land clearing activity; vehicle crashes and disposing of lit cigarette butts. Potentially, any human activity that employs combustion can start a wildfire.

4. SINKHOLES

Sinkholes are of interest to Florida because they are one of the predominant landform features of the state. Their development may be sudden and may result in property damage or loss of life. Florida has more sinkholes than any other state in the nation. However, most sinkholes which are of a size or location to be considered very threatening, progress to their maximum size over 2 to 3 days, giving ample time for evacuation of structures and appropriate levels of emergency response. The County's average sinkhole size is 5 feet long, 4 feet wide, and 9 feet deep.

Sinkholes occur in three general types in Florida; collapse, solution and subsidence. The collapse sinkhole is the most common type and the most dangerous. The beginning of sinkhole formation typically occurs slowly as measured in geologic time.

A collapse sinkhole happens when the overburden is thick with soils and heavy clay. Collapse sinkholes are rapidly occurring, steeply-sided holes in the ground triggered by fluctuations in the water-table. As water levels fluctuate, the roof of an underground cave or cavity is repeatedly stressed and weakened. When the water-table drops too far, the cavity is unsupported and the ceiling becomes too weak to hold the overburden above. Eventually, the ceiling collapses causing the ground surface and development supported on the ground surface to rapidly subside, sometimes with disastrous but localized effects.

In contrast, a solution sinkhole is characterized by thin or absent overburden. This leaves exposed limestone which is broken down by the forces of wind, rain and surface water combined with acidic soils. The eroded area gradually forms a bowl shaped depression as chemical and physical erosion continues to break down the rock.

Subsidence sinkholes occur in areas with a thin layer of overburden. This type of sinkhole differs in that rather than limestone being carried away by wind and rain, the erosion happens internally. Dissolving limestone is replaced by overburden soils that recede into the depression and fill the holes. Subsidence sinkholes appear as a concave depression in the ground. Subsidence sinkholes are often only a few feet in depth because the chemical erosion of limestone is stunted when cavities are filled with clay and sand. As the sediments fill the depression, they restrict the percolation of water through the bottom. Where water accumulates, a lake or pond is formed.

5. COASTAL EROSION

Coastal erosion is the wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage; the wearing away of land by the action of natural forces; on a beach, the carrying away of beach material by wave action, tidal currents, littoral currents or by deflation. Waves generated by storms cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely in the temporary redistribution of coastal sediments. Erosion changes are usually gradual, however, can happen instantly during a storm. Even without storms, sediment may be lost to long shore drift (the currents that parallel coastlines), or sediment may be pulled to deeper water and lost to the coastal system.

6. DROUGHT/EXTREME HEAT

Extreme heat occurs when temperatures hover 10 degrees or more above the average high temperature for a region and lasts for several weeks. Generally extreme heat will occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Droughts occur when a long period passes without substantial rainfall. A heat wave combined with a drought is a very dangerous situation. Drought and extreme heat are weather events and, like other weather-related hazards, are unpredictable. However, it is expected that droughts and extreme heat are a normal part of the long-term weather pattern that is typical of Central Florida's climate. These climatic conditions can be deadly to people and animals that are unable to escape the heat or hydrate their bodies properly. When temperatures reach 100+ degrees, special needs populations and households without air conditioning are vulnerable.

7. TORNADOES

Tornadoes are often spawned by tropical cyclone conditions. They are intense storms of short duration formed by winds rotating at a very high speed in a counter-clockwise rotation. Tornado paths are usually no more than a quarter mile wide and seldom more than 16 miles long. The wind threats from tornadoes

are similar to that of tropical cyclones, but tornadoes form quickly and sporadically, so fast in fact, there is virtually no time to evacuate in advance of a tornado. Tornadoes can also come as independent threats separate from a tropical cyclone. Severe thunder storms often spawn tornadoes.

A tornado is characterized by the isolated nature of extremely high winds of up to 500 mph. When compared with other states, Florida ranks #4 in the number of tornado events; #19 in tornado deaths; #11 in tornado injuries; and #18 in damages. These rankings are based upon data collected for all states and territories for tornado events between 1950-2008 (Florida Hazard Mitigation Plan, 2010).

Florida has two tornado seasons: summer and spring seasons. The summer tornado season, from June until September, has the highest frequencies of storm generation, with usual intensities of F0 or F1 on the Fujita Scale (see the Enhanced Fujita-Pearson Intensity Scale in Tornado Profile, Extent section). This includes those tornadoes associated with land-falling tropical cyclones. In general, tornadoes associated with tropical cyclones are less intense than those that occur in the Great Plains. Nonetheless, the effects of tornadoes can produce substantial damage.

The spring season, February through April, is characterized by more powerful tornadoes. This is because of the presence of the jet stream, which digs south into Florida and is accompanied by a strong cold front and a strong squall line of thunderstorms. The jet stream's high level winds of 100 to 200 mph often strengthen a thunderstorm into what meteorologists call a supercell, or mesocyclone. These powerful storms can move at speeds of 30 to 50 mph, produce dangerous downburst winds, large hail, and are usually the most deadly tornadoes.

Sixty-nine percent of all tornadoes are weak tornadoes, EF0-EF2 sizes. Twenty-nine percent of all tornadoes are strong and can last 20 minutes or longer. Two percent of all tornadoes fall into the EF-4 and EF-5 categories. The most powerful tornadoes are spawned by what are called super-cell thunderstorms. These are storms that, under the right conditions, are affected by horizontal wind shears (winds moving in different directions at different altitudes.) These wind shears cause horizontal columns of air to begin to rotate the storm. This horizontal rotation can be tilted vertically by violent updrafts, and the rotation radius can shrink, forming a vertical column of very quickly swirling air. This rotating air can eventually reach the ground, forming a tornado. We have no way at present to predict exactly which storms will spawn tornadoes or where they will touch down. The Doppler radar systems have greatly improved the forecaster's warning capability, but the technology usually provides lead times from only a few minutes up to about 30 minutes. Consequently, early warning systems and preparedness actions are critical.

8. SEVERE WINTER STORMS/FREEZE

Severe winter storms include freeze, snowfall, ice storms, and/or strong winds. Areas where such phenomena are uncommon are typically affected more by severe winter storms than regions that experience them more frequently. Below-freezing temperatures, moisture, and lift are factors in the formation of severe winter storm. Lift is commonly provided by warm and cold air colliding along a weather front. These storms move easterly or northeasterly and use both the southward plunge of cold air from Canada and the northward flow of moisture from the Gulf of Mexico to produce ice, snow, and sometimes blizzard conditions. These fronts may push deep into the interior regions, sometimes as far south as Florida. (Statewide Hazard Mitigation Plan, 2010)

Snowfall is defined by the National Weather Service as a steady fall of snow for several hours or more. The National Weather Service defines an ice storm as a storm which results in the accumulation of at least 0.25 inches of ice on exposed surfaces. However, amounts as little as 1 inch in Florida have significant impact on transportation, special needs populations, and agriculture and livestock throughout the State.

Snowfall and ice storms are very uncommon in Levy County, but freeze occurs much more frequently. A freeze is marked by low temperatures, especially those remaining below the freezing point (32°F) over a widespread area for an extended time period. Florida's agricultural production is seriously affected when temperatures remain below the freezing point. Each winter, Levy County faces the threat of a freeze. This presents a problem for Florida as a whole because of the large amount of agricultural activity conducted throughout the state. For Levy County this activity is centered on the vegetable and livestock industries. Personal injury or death due to severe winter storms is considered a hazard indirectly through fire caused by incorrect or careless use of heating apparatus.

9. DAM FAILURE

A flood event may trigger a dam failure. The dam impounds water in the reservoir or upstream area. The amount of water impounded is measured in acre-feet. Dam failures are not routine but the results can be significant. Two factors influence the potential severity of a dam failure: (1) the amount of water impounded and (2) the density, type and value of the development downstream. (Statewide Hazard Mitigation Plan, 2010)

Failure can occur as a result of natural events, human-induced events, or both. A number of outside forces can cause dam failure, including prolonged periods of rain or flooding, landslides into reservoirs, failure of dams upstream, high winds, and earthquakes. Other factors that may cause failure include improper design and maintenance, inadequate spillway capacity, and internal erosion, or piping, within a dam. According to some national statistics, overtopping of dams due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for 34%; foundation defects, including settlement and slope instability, account for 30%; piping and seepage cause 20% (including internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam); and other means, including conduits and valves, cause the remaining 16% of all dam failures. (Statewide Hazard Mitigation Plan, 2010)

10. TSUNAMIS

A tsunami is a series of waves created when a body of water, such as in an ocean, is rapidly displaced. A tsunami has a much smaller amplitude (wave height) offshore, and a very long wavelength (often hundreds of kilometers long), which is why they generally pass unnoticed at sea, forming only a passing "hump" in the ocean. A tsunami can be caused by several incidents, but they are most commonly from earthquakes. **There are no historical occurrences of tsunamis in Levy County, therefore this is a Natural Hazard that will not be discussed further.**

11. HAZARDOUS MATERIALS RELEASES

A hazardous material is any substance that, if released into the environment, would have a harmful and sometimes fatal effect on persons and animals coming into contact with it. Hazardous materials include highly flammable fuels, herbicides and pesticides, petroleum and related products, natural gas and chemicals. Radioactive substances, although they are frequently included within the category of hazardous materials, were not considered a hazard within this analysis. However, there are relatively few facilities

within Levy County that use these substances. In any case, there are over 3,000 hazardous chemicals licensed for transport by the US Department of Transportation, many of which have a disastrous effect if released in an accident. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants.

In fact, one of the most difficult problems encountered in the management of a hazardous material accident scene is the identification of the product or products involved.

Levy County and its communities are vulnerable to the effects of hazardous materials accidents resulting from both transportation and industry. Light industries present in Levy County store and utilize materials such as natural gas, anhydrous ammonia, petroleum distillates, chlorine and pesticides on a daily basis, and hazardous materials are transported to and through the County by rail, highway and air.

As stated previously the best mitigation for man-made disasters is preparation and an overall expansion of the capacity of all responding agencies to deal appropriately with the unlimited variety of emergency situations.

Each county completes the Hazards Analysis program, consistent with federal laws including the Community-Right-to-Know Act. This analysis creates a database of facilities that are responsible for hazardous materials. These facilities are classified as small quantity and large quantity generators. The number of generating facilities varies from county to county based on the land uses allowed by the counties. Counties with higher levels of industrial, agricultural and commercial land uses will normally have a greater number of hazardous generating facilities.

Hazardous materials could be released at any time and the vulnerability in Levy County ranges from low to moderate. Although Levy County is not a major end user of hazardous materials, several types of chemicals are used for agricultural purposes. The most commonly used chemicals used in Levy County are Chlorine, Sulfuric Acid and Sulfur Dioxide. Many other chemicals are transported through the County, most commonly via US 19 and US 27 (Alternate) both of which traverse through the most densely populated areas of the County near schools and other public buildings.

This is a Technological/Manmade Hazard that will not be discussed further.

12. NUCLEAR POWER PLANT INCIDENTS

Nuclear power plants use the heat generated from nuclear fission in a contained environment to convert water to steam, which powers generators to produce electricity. Although the construction and operation of these facilities are closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents are possible. An accident could result in dangerous levels of radiation that could affect the health and safety of the public living near the nuclear power plant. The potential danger from an accident at a nuclear power plant is exposure to radiation. This exposure could come from the release of radioactive material from the plant into the environment, usually characterized by a plume (cloud-like formation) of radioactive gases and particles. The major hazards to people in the vicinity of the plume are radiation exposure to the body from the cloud and particles deposited on the ground, inhalation of radioactive materials, and ingestion of radioactive materials.

Levy County is within the 10 Mile Emergency Planning Zone of the Crystal River Unit 3, a nuclear generating facility located in Citrus County and owned and operated by Progress Energy Florida Incorporated.

Crystal River Unit 3 is located approximately five miles south of the Levy-Citrus County line. Much of southwest Levy County is within the 50 mile Ingestion Pathway Zone. The remainder of the County lies within the 50-mile Ingestion Pathway Zone from this Unit.

Levy County has a proposed two Unit site in the proximity of Yankeetown/ Inglis off highway U.S. 19. With this addition, Levy County will now contain a greater amount of land area and its associated population within the Plume Exposure Zone as well as the 50-mile Ingestion Pathway Zone.

In case of a radiological accident, residents, livestock and crops will be exposed to radiological impacts. Additionally, if an accident at the nuclear power plant occurs and evacuation in Citrus County is required, the road system in Levy County will be impacted. This situation, combined with the evacuation of Levy County residents within the Plume Exposure Zone, would cause traffic congestion within the County.

This is a Technological/Manmade Hazard that will not be discussed further.

13. COASTAL OIL SPILL

Although the probability is low, an oil release could occur in the Gulf of Mexico and discharge pollutants on Levy County's coastal area and possibly into the river systems. Tourism in the Cedar Key area, fishing, boating and local coastal residents could be adversely impacted. Both the State of Florida and the US Coast Guard have contingency plans to respond to such a situation. **This is a Technological/Manmade Hazard that will not be discussed further.**

14. CIVIL DISTURBANCE & TERRORISM

Civil disturbances are public crises that occur with or without warning and that may adversely impact significant portions of the population. These disturbances may be the actions of any number of persons causing disruption of the populace. Terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." It is the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom.

Although the federal government recognizes that the United States has entered the post-Cold War era, federal planning guidelines on military threats are in transition. For hazard analysis purposes, it is prudent to scale back on the magnitude of nuclear events for other more likely scenarios.

For instance, emergency management attention to other threats of armed violence, such as terrorism, is growing. Terrorism is a serious issue in Florida; the state is particularly vulnerable due to its proximity to Latin America and Cuba. Although potential targets are unpredictable, high-density population centers and military installations are the most likely. Terrorism increases the likelihood of mass casualty and mass evacuation from a target area.

For threats of armed violence, it is very likely that joint jurisdictional management of the operation will take effect, coordinated at the County level between the Sheriff and FDLE. For any of these scenarios, some

degree of state and federal involvement may occur. The lead federal agency may be FEMA or the Department of Justice.

There is no history of civil disturbance or terrorism in Levy County, and the probability of occurrence of a civil disturbance or terrorism is low. The County has a moderately diverse population with the accompanying variety of perceptions on polarizing issues. Other than the corrections facility operated by the Levy County Sheriff's Office and one state operated forestry work camp for women, there are no large inmate populations.

This is a Societal Hazard that will not be discussed further.

15. MASS IMMIGRATION

Mass immigration in South Florida has been continuing since 1980, as Florida's proximity to the Caribbean basin makes it a vulnerable point of entry for a massive influx of refugees entering the United States illegally. However, it has had limited impact on the north-central Florida area including Levy County. The likelihood of immigrants arriving along the Levy County shoreline and the County being used as a relocation center is minimal. Levy County has experienced an increase in permanent population. Currently, the population estimates indicate that the county population is approximately 40,000. This estimate is about 6,000 more people than the 2000 census which showed the population at 34,450.

Due to the climate and natural features, Levy County is the destination for a small but noticeable seasonal snowbird population. Levy County is also hosts a "hidden" population. This term refers to undocumented workers. These workers typically take up work in the agriculture and construction industries. This number will vary based on crop quality and economic conditions however it is believed to range from 250 to 1500 depending on seasons during the year.

This is a Societal Hazard that will not be discussed further.

16. CONCLUSION OF HAZARD IDENTIFICATION

In the hazard identification process, natural, technological/manmade, and societal hazards were identified and described. **For the purposes of this Plan, only the aforementioned Natural Hazards of which there is a reasonable expectation of occurrence and substantial damage will be profiled in more detail in the next section (Hazard Profiles) and addressed later in the Vulnerability Assessment.**

B. HAZARD PROFILES

Hazard profiling includes the following: the location and boundaries of hazard-prone areas; the extent, or potential magnitude of an event of each type; historical occurrences; and the probability, or likelihood of each event to occur in the future. Probability is a function of frequency of occurrence, or return period (period of time in years/number of occurrences), and for the purposes of this Plan, is defined as follows:

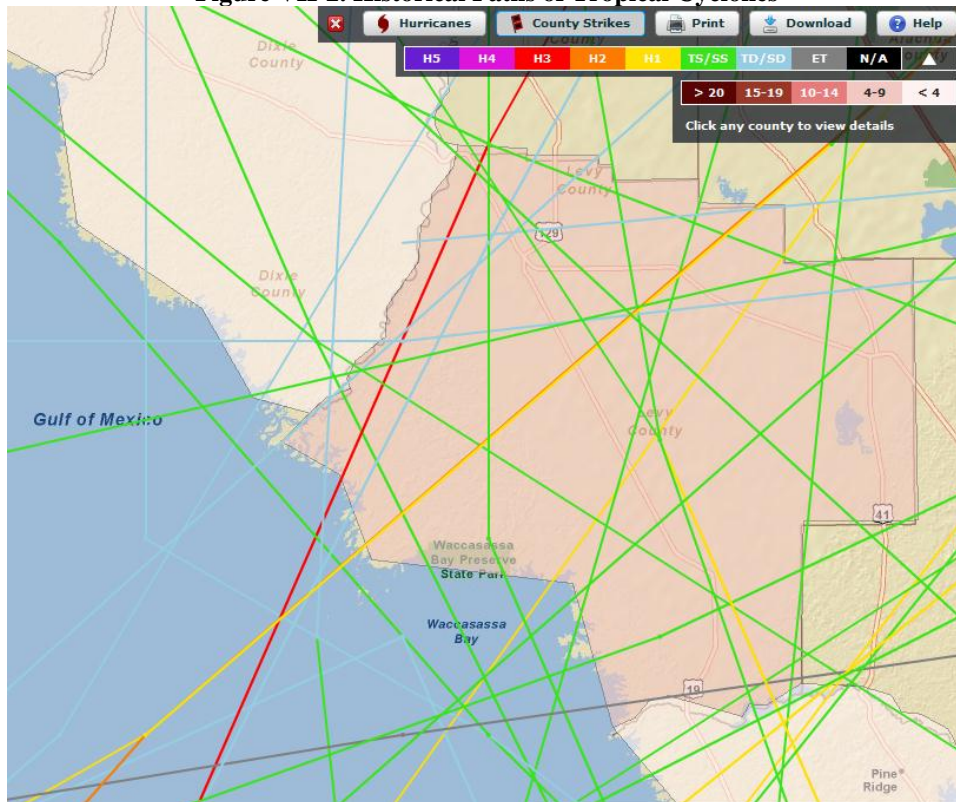
- **Very High Probability** = **0 to 3 year return rate**
- **High Probability** = **4 to 7 year return rate**
- **Moderate Probability** = **8 to 10 year return rate**
- **Low Probability** = **11 to 14 year return rate**
- **Very Low Probability** = **15+ year return rate.**

1. TROPICAL CYCLONES

a. Location

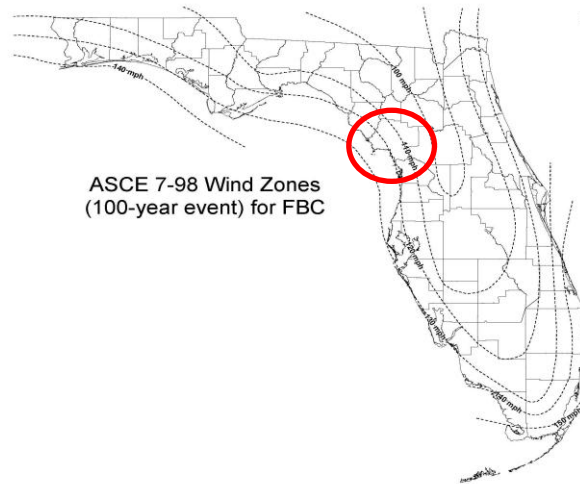
Because of its subtropical location and long coastline, Florida is particularly susceptible to tropical cyclones. Florida’s flat topography also makes it susceptible to the full force of high winds and powerful storm surge. **All of Levy County (including all municipalities) is vulnerable to tropical cyclones** (see Figure VII-2). However, different areas of the County vary in degree of vulnerability, especially to high winds and storm surge from tropical cyclones.

Figure VII-2. Historical Paths of Tropical Cyclones



The American Society of Civil Engineer’s Standard 7-98 (ASCE 7-98) provides wind risk assessments (see Figure VII-3) for areas throughout Florida along with associated building standards based on wind hazard associated with tropical cyclones. According to this wind risk assessment, Levy County lies within 100 mph to 130 mph wind zones in a 100-year event. In March of 2002 a Statewide Building Code was fully adopted and implemented in Florida. The County developed and adopted the Levy County Wind-borne Debris Region and Basic Wind Speed Map (see Map VII-1), attached to Ordinance No. 01-08 in order to comply with the changes in the statewide building code and to further protect residents’ life, property, and general welfare.

Figure VII-3. ASCE 7-98 Wind Zones for Florida Building Code



Levy County’s coastal communities have a higher risk of surge events. Map VII-2 depicts the categories of inland surge of water that can be expected from different categories of tropical cyclones. This information was originally developed by the NOAA as the SLOSH model. In 2010, the Withlacoochee Regional Planning Council, along with all other regional planning councils in Florida, completed the 2010 Statewide Regional Evacuation Study. The study includes a revision of surge zones using new SLOSH data provided by NOAA and a new digital elevation model created with new LiDAR data.

b. Extent

Levy County has not experienced a tropical cyclone greater than a Category 3 hurricane. However, due to the unpredictability of tropical cyclones, it is assumed that a storm as great as a category 5 hurricane may hit the County. The Saffir-Simpson Scale was developed in the early 1970s by Herbert Saffir, a consulting engineer in Coral Gables, Florida, and Dr. Robert Simpson, then Director of the National Hurricane Center. The scale was based primarily on wind speeds and included estimates of barometric pressure and storm surge associated with each of the five hurricane categories. However, the scale was revised in 2009 to only include Sustained Winds per Hurricane Category (see Table and descriptions from NOAA of damage below for the extent of a potential hurricane event). The extent of tropical storm winds is 39-73 miles per hour. Some effects include scattered trees, scattered power outages, and some roads blocked due to downed trees and power lines.

Hurricane Category	Sustained Winds (mph)	Potential Damage
1	74 - 95	Very dangerous winds will produce some damage
2	96 - 110	Extremely dangerous winds will cause extensive damage
3	111 - 130	Devastating damage will occur
4	131 - 135	Catastrophic damage will occur
5	156 +	Catastrophic damage will occur

- Category 1
People, livestock, and pets struck by flying or falling debris could be injured or killed. Older (mainly

pre-1994 construction) mobile homes could be destroyed, especially if they are not anchored properly as they tend to shift or roll off their foundations. Newer mobile homes that are anchored properly can sustain damage involving the removal of shingle or metal roof coverings, and loss of vinyl siding, as well as damage to carports, sunrooms, or lanais. Some poorly constructed frame homes can experience major damage, involving loss of the roof covering and damage to gable ends as well as the removal of porch coverings and awnings. Unprotected windows may break if struck by flying debris. Masonry chimneys can be toppled. Well-constructed frame homes could have damage to roof shingles, vinyl siding, soffit panels, and gutters. Failure of aluminum, screened-in, swimming pool enclosures can occur. Some apartment building and shopping center roof coverings could be partially removed. Industrial buildings can lose roofing and siding especially from windward corners, rakes, and eaves. Failures to overhead doors and unprotected windows will be common. Windows in high-rise buildings can be broken by flying debris. Falling and broken glass will pose a significant danger even after the storm. There will be occasional damage to commercial signage, fences, and canopies. Large branches of trees will snap and shallow rooted trees can be toppled. Extensive damage to power lines and poles will likely result in power outages that could last a few to several days. Hurricane Dolly (2008) is an example of a hurricane that brought Category 1 winds and impacts to South Padre Island, Texas.

- Category 2

There is a substantial risk of injury or death to people, livestock, and pets due to flying and falling debris. Older (mainly pre-1994 construction) mobile homes have a very high chance of being destroyed and the flying debris generated can shred nearby mobile homes. Newer mobile homes can also be destroyed. Poorly constructed frame homes have a high chance of having their roof structures removed especially if they are not anchored properly. Unprotected windows will have a high probability of being broken by flying debris. Well-constructed frame homes could sustain major roof and siding damage. Failure of aluminum, screened-in, swimming pool enclosures will be common. There will be a substantial percentage of roof and siding damage to apartment buildings and industrial buildings. Unreinforced masonry walls can collapse. Windows in high-rise buildings can be broken by flying debris. Falling and broken glass will pose a significant danger even after the storm. Commercial signage, fences, and canopies will be damaged and often destroyed. Many shallowly rooted 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. Potable water could become scarce as filtration systems begin to fail. Hurricane Frances (2004) is an example of a hurricane that brought Category 2 winds and impacts to coastal portions of Port St. Lucie, Florida with Category 1 conditions experienced elsewhere in the city.

- Category 3

There is a high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) mobile homes will be destroyed. Most newer mobile homes will sustain severe damage with potential for complete roof failure and wall collapse. Poorly constructed frame homes can be destroyed by the removal of the roof and exterior walls. Unprotected windows will be broken by flying debris. Well-built frame homes can experience major damage involving the removal of roof decking and gable ends. There will be a high percentage of roof covering and siding damage to apartment buildings and industrial buildings. Isolated structural damage to wood or steel framing can occur. Complete failure of older metal buildings is possible, and older unreinforced masonry buildings can collapse. Numerous windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Most commercial signage, fences, and canopies will be destroyed. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days

to a few weeks after the storm passes. Hurricane Ivan (2004) is an example of a hurricane that brought Category 3 winds and impacts to coastal portions of Gulf Shores, Alabama with Category 2 conditions experienced elsewhere in this city.

- Category 4

There is a very high risk of injury or death to people, livestock, and pets due to flying and falling debris. Nearly all older (pre-1994) mobile homes will be destroyed. A high percentage of newer mobile homes also will be destroyed. Poorly constructed homes can sustain complete collapse of all walls as well as the loss of the roof structure. Well-built homes also can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Extensive damage to roof coverings, windows, and doors will occur. Large amounts of windborne debris will be lofted into the air. Windborne debris damage will break most unprotected windows and penetrate some protected windows. There will be a high percentage of structural damage to the top floors of apartment buildings. Steel frames in older industrial buildings can collapse. There will be a high percentage of collapse to older unreinforced masonry buildings. Most windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Nearly all commercial signage, fences, and canopies will be destroyed. Most 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. Long-term water shortages will increase human suffering. Most of the area will be uninhabitable for weeks or months. Hurricane Charley (2004) is an example of a hurricane that brought Category 4 winds and impacts to coastal portions of Punta Gorda, Florida with Category 3 conditions experienced elsewhere in the city.

- Category 5

People, livestock, and pets are at very high risk of injury or death from flying or falling debris, even if indoors in mobile homes or framed homes. Almost complete destruction of all mobile homes will occur, regardless of age or construction. A high percentage of frame homes will be destroyed, with total roof failure and wall collapse. Extensive damage to roof covers, windows, and doors will occur. Large amounts of windborne debris will be lofted into the air. Windborne debris damage will occur to nearly all unprotected windows and many protected windows. Significant damage to wood roof commercial buildings will occur due to loss of roof sheathing. Complete collapse of many older metal buildings can occur. Most unreinforced masonry walls will fail which can lead to the collapse of the buildings. A high percentage of industrial buildings and low-rise apartment buildings will be destroyed. Nearly all windows will be blown out of high-rise buildings resulting in falling glass, which will pose a threat for days to weeks after the storm. Nearly all commercial signage, fences, and canopies will be destroyed. 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. Long-term water shortages will increase human suffering. Most of the area will be uninhabitable for weeks or months. Hurricane Andrew (1992) is an example of a hurricane that brought Category 5 winds and impacts to coastal portions of Cutler Ridge, Florida with Category 4 conditions experienced elsewhere in south Miami-Dade County.

[Information courtesy of the National Oceanic Atmospheric Administration's National Hurricane Center]

Using NOAA's updated SLOSH model for the Cedar Key Basin (which extends from Sarasota County north to Jackson County), potential surge height is estimated for the County. Potential storm tide heights are associated with each category of tropical cyclone (see Table VII-3 below). **If a category 5 hurricane hit the County, surge height could potentially be as high as 41.3 feet.**

Table VII-3 Potential Storm Tide Height for Levy County (In Feet above NAVD88)

Storm Strength	Storm Tide Height
Tropical Storm	3.0 – 6.4
Category 1 Hurricane	4.5 – 10.8
Category 2 Hurricane	10.2 – 20.1
Category 3 Hurricane	16.8 – 25.4
Category 4 Hurricane	21.4 – 31.4
Category 5 Hurricane	18.1 – 41.3

c. Historical Occurrences

Shown on Figure VII-2 are the tracks of tropical cyclones in Levy County from 1842 to 2008. Below is a table listing direct hits to the County, as well as descriptions of historically significant tropical cyclones and surge. **No tropical cyclones have affected Levy County since 2008.**

Table VII-4. Direct Hits on Levy County

Location or County	Date	Time	Type	Deaths	Injuries	Property Damage	Crop Damage
1 Palmetto	8/16/1994	8:00AM	Tropical Storm Beryl	0	1	\$50.0M	0
2 West Central & Southw	8/2/1995	1:00AM	Hurricane Erin	0	1	\$2.0M	0
3 West Central & Southw	8/23/1995	8:00PM	Tropical Storm Jerry	0	0	\$4.0M	\$15 M
4 West Central & Southw	10/4/1995	7:00AM	Hurricane Opal	0	0	\$571K	0
5 FLZ039 - 042>043 - 048>052 - 055>057 - 060>062 - 065	10/7/1996	8:00 AM	Tropical Storm Josephine	0	1	\$44.6M	0
6 FLZ039 - 042>043 - 048>052 - 055>057 - 060>062 - 065	9/2/1998	12:00 PM	Hurricane Earl	0	2	\$1.1M	0
7 FLZ039 - 042>043 - 048>052 - 055>057 - 060>062 - 065	9/25/1998	12:00 AM	Hurricane Georges	0	0	\$250K	0
8 FLZ039 - 042 - 049>051 - 055 - 060>062 - 065	9/20/1999	9:00 PM	Tropical Storm Harvey	0	0	\$100K	0
9 FLZ039 - 042 - 048>050 - 050>052 - 055>057 - 060>062 - 065	9/17/2000	3:30 AM	Hurricane Gordon	0	0	\$5.1M	0
10 FLZ039 - 042>043 - 048>052 - 055>057 - 060>062 - 065	9/14/2001	3:00 AM	Tropical Storm Gabrielle	0	6	\$16.9M	0
11 FLZ039 - 042 - 048>051 - 055 - 061>062 - 065	9/5/2004	8:00 AM	Tropical Storm Frances	1	0	\$179.4M	0
12 FLZ039 - 042 - 048>051 - 055 - 060>062 - 065	9/25/2004	10:00 PM	Tropical Storm Jeanne	0	0	\$134.8M	0
13 FLZ039 - 042 - 050>051 - 062 - 065	7/9/2005	5:44 AM	Tropical Storm Dennis	0	0	\$32K	0
14 FLZ039 - 042>043 - 048>051 - 055 -	6/13/2006	12:30	Tropical	0	0	\$140K	0

060		AM	Storm Alberto				
15 FLZ039 - 043	8/21/2008	14:00 PM	Tropical Storm Fay	0	0	\$20K	
TOTALS:				1	11	\$438.993M	\$15 M

Source: NOAA National Climatic Data Center

In Levy County, those with first-hand knowledge refer to Hurricane Easy in 1950 as the most severe storm to affect the County. A spiraling path took Easy along the Gulf Coast from the Everglades to just west of Tampa where it made a loop, then made landfall in Citrus County, returned to the Gulf in Waccasassa Bay and greatly impacting Cedar Key, then made landfall again in Hernando County before dissipating in Georgia. A statewide history of other tropical cyclones is also included as examples of the type of damage that is possible from Florida's greatest hazard threat.

September 11 2008, Swells from Hurricane Ike caused above normal tides along the west coast of Florida. In Levy County, the C-MAN station at Cedar Key reported a maximum storm surge of 2.00 feet with a maximum storm tide of 5.80 feet.

August 18, 2008 Tropical Storm Fay: Fay was the sixth named storm of the 2008 Atlantic tropical cyclone season. Formed from a vigorous tropical wave on August 15, and made landfall on the Florida Keys late in the afternoon of August 18 before veering into the Gulf of Mexico. It again made landfall near Naples, Florida, in the early hours of August 19 and progressed northeast through the Florida peninsula, emerging into the Atlantic Ocean near Melbourne on August 20. Extensive flooding took place in parts of Florida as a result of its slow movement. On August 21, it made landfall again near Smyrna Beach, Florida, moving due west across the Panhandle, crossing Gainesville and Panama City, Florida. As it zigzagged from water to land, it became the first storm in recorded history to make landfall in Florida four times. Thirty-six deaths were blamed on Fay. Eleven tornadoes were spawned within the United States due to Fay. Damage from Fay was heavy, estimated at \$560 million.

June 13, 2006 Tropical Storm Alberto: This was the first tropical storm of the 2006 Atlantic tropical cyclone season. Forming on June 10 in the northwestern Caribbean Sea, the storm moved generally to the north, reaching a maximum intensity of 70 mph (110 km/h) before weakening and moving ashore in the Big Bend area of Florida on June 13. Alberto then moved through eastern Georgia, North Carolina, and Virginia as a tropical depression before becoming extra-tropical on June 14.

October 24, 2005 Hurricane Wilma: Hurricane Wilma passed from the south west corner of Florida across the state at a north east direction before exiting to the Atlantic Ocean just north of palm beach. This movement contained Category 3 and later 2 winds prior to its exit from the state.

August 25, 2005 Hurricane Katrina: While better known for the devastating destruction of the new Orleans area, Katrina became a hurricane just before making landfall near the Miami-Dade/Broward county line. Tide levels along Florida's west coast and in Tampa Bay remained about 1 foot above normal the 28th and 29th as Hurricane Katrina moved away. A storm surge of 2.07 feet was recorded at Cedar Key at 5:12 PM EDT on the 29th but the highest storm tide was 5.09 feet and was recorded at 10:06 AM EDT on the 29th. Damage to Florida was relatively minor. Seasonally warm waters led to rapid strengthening of Katrina giving it sustained 175 mile hour winds and its category 5 designation. On August 28 made landfall near Buras, Louisiana.

July 9, 2005 Hurricane Dennis: Hurricane Dennis developed in the eastern Caribbean on the 5th and moved northwest and exited the northwest coast of Cuba early on the 9th. The center of Hurricane Dennis passed 220 miles east of Fort Myers Beach around 9 PM EDT on the 9th and passed 200 miles east of Cedar Key around 10 AM EDT on the 10th. Tropical storm force sustained winds of 39 MPH or greater were intermittent within rain bands around Dennis. These bands did produce 7 tornadoes and 1 waterspout in southwest and west central Florida. No significant wind damage was reported. The maximum storm surge of 3 feet did not affect the area until Sunday the 10th around 4 AM EDT. Cedar Key - Storm Surge 4.81 feet at 11:12 AM EDT, Storm Tide 7.79 feet at 1:54 PM EDT About 3 feet of water covered State Road 23 west of the #4 Bridge and the airport and numerous roads were closed in Cedar Key due to the above normal tides. Yankeetown streets were covered with 10 inches of water and County Road 40A west of the city was closed due to water on the road. Moderate beach erosion was reported on Cedar Key. Water damage at Cedar Key was limited to 20 business and \$500 thousand. Seas were 5 to 7 feet with some waves up to 10 feet. In Levy County, Cedar Key recorded sustained winds of 40 MPH with gusts to 46 MPH. A spotter in Chiefland recorded wind gusts to 56 MPH using his handheld anemometer.

September 26, 2004 Hurricane Jeanne: Hurricane Jeanne followed much the same route as Frances of three weeks prior. With its rapid deterioration from 120 mile wide speeds to tropical depression over a two day period, Jeanne produced heavy rainfall over previously saturated and battered land in central Florida.

September 5-6, 2004 Hurricane Frances: Hurricane Frances formed into a tropical depression in the Atlantic on August 25 prior to its eventual landfall in Stuart as a Category 2 hurricane. Following a general west to north track, Frances traveled through the peninsula of Florida on its way through Georgia and north. Frances produced memorable storm surge, rainfall and tornado activity.

August 13, 2004 Hurricane Charley: Hurricane Charley developed from a tropical wave, developing into a tropical depression in the waters south-southeast of Barbados. Charley eventually would qualify as a category 4 Hurricane after crossing over the western third of Cuba. From there, Charley charted a northerly track crossing over central Florida in approximately the Orlando Area departing Florida through the Daytona beach area towards South Carolina as a weak category 1 storm.

November 4-5, 2001 Hurricane Michelle: Hurricane Michelle passed about 60 miles south of the Florida Keys, causing minimal damage.

September 13-14, 2001 Tropical Storm Gabrielle: Tropical Storm Gabrielle formed in the eastern Gulf of Mexico, moved east-northeast, with the center crossing Florida's west coast near Venice. Gabrielle caused over \$20 million in property damage due to wind damage, storm surge, minor beach erosion and flooding.

August 4-6, 2001 Tropical Storm Barry: Tropical Storm Barry made landfall between Panama City and Destin, Florida. After landfall, Barry rapidly weakened to a tropical depression over southwest Alabama. Scattered wind damage, flooding and power outages were reported. Numerous county and secondary roads across Walton, Washington, and Bay counties were closed to floodwaters.

September 21-22, 2000 Tropical Storm Helene: Tropical Storm Helene made landfall near Fort Walton Beach before weakening to a tropical depression as it accelerated northeast into southeast Alabama. The storm caused flooding, numerous tornadoes and power outages in Florida.

September 16-17, 2000 Tropical Storm Gordon: Tropical Storm Gordon formed in the Gulf of Mexico and moved northeast, briefly intensified to hurricane strength, then moved ashore in the Big Bend area of Florida as a tropical storm. The outer fringes of Gordon moved across South Florida, producing flooding as well as numerous funnel clouds and waterspouts.

October 14-20, 1999 Hurricane Irene: Hurricane Irene was a Category 1 storm as it made landfall in Monroe and Miami-Dade counties, moving southwest to northeast. The storm caused major flooding due to 9-18 inches of rainfall, beach erosion, and minor wind damages. Property damages exceeded \$327 million statewide.

September 20, 1999 Tropical Storm Harvey: Remnants of Tropical Storm Harvey moved parallel along the West Central coast of Florida and produced near tropical storm force wind gusts. Tropical Storm Harvey produced storm surges of one to two feet from Levy south to Sarasota County and two to three feet along the coast of Charlotte and Lee counties.

September 13-22, 1999 Hurricane Floyd: Hurricane Floyd was an enormous Category 4 storm, threatening Florida's east coast from Nassau to Miami-Dade County. Floyd's unpredictable path led to the largest peacetime evacuation in U.S. history as over a million people sought refuge. Floyd did not make landfall in Florida, but created flooding, beach erosion, and resulted in nearly \$68 million in property damages.

November 1998 Tropical Storm Mitch: Tropical Storm Mitch, once a powerful Category 5 storm, crossed South Florida at Monroe and Palm Beach counties at tropical storm strength. The storm caused gusty winds, severe thunderstorms, tornadoes and beach erosion. Property damage was estimated at \$30 million.

September 15-29, 1998 Hurricane Georges: Hurricane Georges hit the Florida Keys with 105 mph winds, destroying mobile homes in the area before moving into the Panhandle, creating storm surge and flood damage. This storm caused nearly \$255 million in damage in South Florida.

September 2-3, 1998 Hurricane Earl: A Category 1 hurricane, Earl made landfall near Panama City causing minor flooding, moderate beach erosion, numerous tornadoes and power outages. Property damage was estimated at over \$7 million.

October 7-8, 1996 Tropical Storm Josephine: Tropical Storm Josephine impacted Florida's West Coast with 70 mph winds before exiting through the northeast portion of the state. Sixteen counties experienced extensive damage, with losses estimated near \$45 million.

March 10-11, 1996 North Easterner: A strong Nor'easter with winds of 50 to 60 mph caused beach erosion damage at Amelia Island, Atlantic Beach, St. Augustine Beach and Flagler Beach.

October 3-4, 1995 Hurricane Opal: Hurricane Opal moved across the Gulf of Mexico, affecting the northwest Florida area until the storm moved ashore. Opal intensified to a Category 4 hurricane but diminished to a Category 3 at the time of landfall near Navarre Beach. Most of the damage from Opal in northwest Florida was from the devastating storm surge, causing dunes to be washed away and coastal homes to be damaged by wave action. Preliminary damage estimates were \$2.1 billion dollars. Almost 300 homes were destroyed with another 1,000 homes suffering major damage.

August 23, 1995 Tropical Storm Jerry: Tropical Storm Jerry moved onshore north of West Palm Beach around noon on the 23rd. Tropical Storm Jerry moved northwest across the state and began to affect Highlands and Polk counties with gusts of 25 to 30 knots by the evening of the 23rd. Although minimal rainfall occurred with the center of Jerry as it moved northwest across the Florida peninsula, significant rainfall from extreme outer rain bands of Jerry occurred over coastal areas of West Central and Southwest Florida on the 24th and 25th. Storm tides averaged one to one and one-half feet above normal mean sea level in Pinellas, Hillsborough, Pasco, Hernando, Citrus and Levy Counties after Jerry moved offshore during the 24th and 25th. Beach erosion from Jerry was minor and occurred from Englewood Beach in Pinellas County to Cedar Key in Levy County.

August 2, 1995 Hurricane Erin: Erin, a minimum category 1 hurricane, moved onshore near Vero Beach, Florida then slowly weakened to tropical storm strength as it moved west-northwest over Central Florida. Erin slowly re-intensified to minimal hurricane strength well after moving offshore of West Central Florida into the northeast Gulf of Mexico. Twenty-four hour rainfall totals averaged between 2.5 and 3.5 inches from the Tampa metro area north to Levy County. Extensive wind damage was experienced in Santa Rosa and Escambia Counties and extensive stormwater flooding occurred in Brevard County.

November 1994 Tropical Storm Gordon: Tropical Storm Gordon impacted Volusia and Brevard counties with extensive rain, high tides and tornadoes. Particularly hard hit was the community of South Daytona Beach along the Nova/Reed Canal System.

August 16, 1994 Tropical Storm Beryl: Tropical Storm Beryl formed in the northeast Gulf of Mexico and moved slowly east northeast, crossing the Florida panhandle coastline near Panama City. Coastal damage included tidal flooding which undermined a few roads and houses and eroded beaches and sea walls. A number of moored boats were damaged and three persons on a fishing boat offshore the panhandle had to be rescued. Winds did minor roof damage and downed trees and signs along the coast. Inland, trees were blown down damaging roofs and power was lost to 20,000 customers. The heavy rain caused flooding of low lying areas which lasted more than a week, damaging houses and vehicles.

July 1994 Tropical Storm Alberto: Tropical Storm Alberto pounded the Florida Panhandle with torrential rains, causing extensive flooding along the Choctawhatchee and Apalachicola Rivers and in the towns of Crayville, Westville, Blountstown and Wewahitchka.

March 3 1993, A surge of 6.1 feet with heavy wave action was reported. Property damage was estimated to be \$5.0M. On the same day, a 9.5-foot storm surge was reported and 120 homes were flooded. An elderly male died while attempting to evacuate the flood. Property damage was estimated to be another \$5.0M.

August 24, 1992 Hurricane Andrew: Hurricane Andrew made a memorable landfall in south Dade County, causing an estimated \$26.5 billion in damages. Andrew produced approximately seven inches of rain, 165 mph sustained winds, a maximum storm tide of 16 feet and a total of 96 deaths (including Louisiana). In all, Andrew destroyed 25,000 homes and significantly damaged more than 100,000 others in South Florida. Two weeks after the hurricane, the U.S. military deployed nearly 22,000 troops to aid in the recovery efforts, the largest military rescue operation in U.S. history. When Hurricane Andrew hit southeast Miami-Dade County, flying debris in the storm's winds knocked out most ground-based wind measuring instruments, and widespread power outages caused electric-based measuring equipment to fail. The winds were so strong many wind-measuring tools were incapable of registering the maximum winds. Surviving wind observations and measurements from aircraft reconnaissance, surface pressure, satellite

analysis, radar, and distribution of debris and structural failures were used to estimate the surface winds. Though originally classified as a Category 4 storm, extensive post-impact research led to the reclassification of Andrew as a Category 5 storm in 2002.

September 10-11, 1990 Hurricane Donna: Hurricane Donna crossed the central Florida Keys before curving northward along Florida's west coast, passing over Naples and Fort Myers before continuing across the central peninsula. The storm produced 10 to 12 inches of rain and caused wind and coastal flooding damages estimated at \$150 million.

1985 Hurricane Elena, Tropical Storm Juan, and Hurricane Kate: Around Labor Day, Hurricane Elena threatened Florida's West Coast and Panhandle before finally making landfall in Louisiana. Losses were estimated at over \$100 million and four lives were lost. Two months after Elena, Tropical Storm Juan caused another \$4.4 million in damages to already weakened coastal structures. Finally, Hurricane Kate entered the Gulf of Mexico on November 30, eventually making landfall at Mexico Beach. Hurricane Kate caused extensive damage to coastal highways and sea walls. The primary impact of these three storms was due to storm surge and wave activity.

1979 Hurricanes David and Frederic: Hurricane David, a category two storm, made landfall north of Palm Beach and caused an estimated \$476 million in damages. Hurricane David was not declared a disaster. However, Category 3 Hurricane Frederic followed behind David, threatening northwest Florida before making landfall in Alabama/Mississippi, causing nearly \$3 billion in damage.

July 28-31, 1975 Hurricane Eloise: Hurricane Eloise dumped nearly 20 inches of rain on the western Panhandle, resulting in severe flooding in some areas of the Choctawhatchee and Escambia River basins.

September 23, 1969 Tropical Storm: A tropical storm centered over Havana and Quincy in North Florida, producing up to 23.4 inches of rainfall during a 72 hour period. Flooding was confined mainly to the Ochlockonee River basin, causing extensive damage to roads and bridges.

September 9-12, 1964 Hurricane Dora: Hurricane Dora crossed Florida from east to west during September 9-12 before turning to southern Georgia. On September 13-16, Dora produced over 20 inches of rainfall and caused flooding throughout one-third of the state of Florida, extensively affecting the St. Mary's, Santa Fe and Steinhatchee River basins. An estimated \$150 million in losses were reported, affecting residential, commercial and agricultural operations.

August 31-September 8, 1935 Labor Day Hurricane: This hurricane is considered to be one of the most severe hurricanes ever recorded in Florida. With winds in excess of 200 miles per hour, the storm passed over the Florida Keys on September 2 with a minimum barometric pressure of 26.35 inches. Three relief-work camps, inhabited by veterans of World War I, were destroyed. The Red Cross estimated that 408 lives were lost.

September 6-20, 1928 Hurricane: The hurricane's eye passed directly over West Palm Beach with a minimum barometric pressure of 27.43 inches. As the storm passed over Lake Okeechobee, a 1.7 mile section of levee gave way, sending a 5 to 10 foot high wall of water into the towns of Pahokee, South Bay, and Belle Glade, killing an estimated 1,836 persons.

September 6-22, 1926 Hurricane: The eye of the hurricane moved directly over Miami on the morning of September 18, leaving approximately 100 dead. The storm continued northwestward across south Florida and entered the Gulf of Mexico at Fort Myers. Northeast winds from the storm raised Lake Okeechobee water levels above the low dike on the south end of the lake near Moore Haven. Approximately three miles of dike failed, sending 10 to 12 foot floodwaters into Moore Haven and at least five foot deep floodwaters into Clewiston, 16 miles to the southeast.

October 11-20, 1906 Hurricane: A hurricane moved across the Florida Keys and passed over Miami on October 18, resulting in the loss of 134 lives.

d. Probability

Using a historical analysis, return intervals were developed for all the tropical storms and hurricanes that have passed through Levy County. From 1842 to 2008 (167 years), 27 tropical storms and hurricanes had passed within 25 nautical miles of the center of Levy County. **Based on this data from NOAA, the overall return period for all tropical cyclones is 6.2 years. Therefore, the probability of a tropical cyclone occurrence is High.** The overriding assumption for hazard mitigation is that tropical cyclones do strike Florida each year and will affect Levy County at some point in the future. Return periods for each category of tropical cyclone are shown below (Table VII-5). If the area of interest is widened, the mean return period is reduced, as seen in data developed by NOAA for the 2010 Statewide Regional Evacuation Study Program. Historical occurrences of coastal storms within a 75-mile radius of Cedar Key were examined (see Figure VII-4).

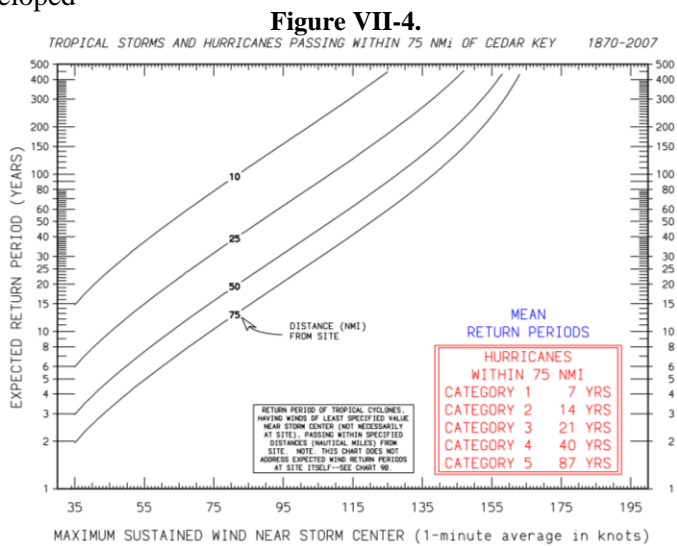


Table VII-5. Tropical Cyclone Return Periods for Levy County

AREA	Overall	TS	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5
Levy	6.2	18.56	16.7	83.5	55.67	55.67	NDE

Note: This data represents the mean recurrence interval, not the amount of years since the last storm of any specific category. Some of the higher intensity storms have not hit Levy County in the 167 years of recorded tropical cyclone. These incidents are described as No Direct Effect or NDE.

2. FLOODS

a. Location

As a weather event, cumulative rainfall amounts could develop anywhere within the County. **All of the County and its municipalities are vulnerable to flooding.** However, the degree of vulnerability may vary throughout the County. Tropical cyclone induced flooding and heavy rainfall present problems for

low-lying areas of Levy County filling up too fast, especially along the Suwannee River in northern Levy County and the Withlacoochee River in southwest Levy County. Also, overflowing water retention areas creates flooding problems. Many of the lakes would be impacted as well, although drainage wells or improved drainage systems have mitigated problems in these areas somewhat.

The Levy County Building and Zoning Department maintains federally provided flood maps, which show the 100 and 500 year flood-prone areas of Levy County (see Map VII-3). The floodplain map is derived from the Flood Insurance Rate Maps (FIRM) as developed by the National Flood Insurance Program. This information generally describes the low-lying areas of the County that are vulnerable to seasonal flooding on a yearly basis. This map clearly shows that a large portion of the County is within the 100-year floodplain and it is valid to assume that flooding is a significant vulnerability. The soils in the 100-year floodplain and its wetland systems create a pre-saturated landscape, made worse with extensive rain. The 500-year floodplain is also included to show secondary flood vulnerability. Much of the floodplain in Levy County is associated with coastal marsh, isolated wetlands, lakes, ponds and river basins. In some cases man-made drainage structures are inadequate and flooding will occur and remain longer in areas subject to drainage obstructions.

Historical flood data and information are important to determine where vulnerable populations and areas of impact are located. Local knowledge regarding past events can be more valuable than other more general sources of information such as the Flood Insurance Rate Maps (FIRM) from the National Flood Insurance Program (NFIP). The FIRM maps are mainly used as part of the building permit process in that special standards for construction are required for structures built in the flood plain. Structures and roads are normally built above the 100-year flood plain elevation. However, due to changes in drainage patterns, new and more specific information is always beneficial. In the LMS project, areas and roads that are known to historically flood have been identified. This is an important issue because some of those roads are evacuation routes and access to homes for residents and responders becomes an issue. The following information and the corresponding map data were gathered from the participants of the Levy County LMS project.

Levy County, as with all coastal counties, has the potential for coastal flooding due to storm surge. However, Levy County is different in that a majority of its coastline is in state ownership. Additionally, many acres of the land within the category 1-5 surge zones has a future land use designation of either "Natural Reservation" or "Recreation and Open Space." This land use designation will help to insure that future development will be limited and this relatively undeveloped coastal area will not be subject to increased storm surge damages. There are currently many residents and businesses in the coastal areas of Levy County and the coastal towns of Inglis, Yankeetown and Cedar Key that are vulnerable to storm surge.

Freshwater flooding in Levy County is of concern within the floodplains of the Suwannee River, the Withlacoochee River and the Waccasassa River. Residents who live in river floodplains are generally prepared for flood events and are aware of the level of vulnerability but make a conscious choice to live on the river.

The historic Suwannee River forms the northwestern border of Levy County spanning approximately 30 miles from the City of Fanning Springs to its mouth at the Gulf of Mexico. The Suwannee floods every few years under normal rainfall cycles in north Florida and south Georgia. People who live on or near

the river have come to expect this eventuality and are educated to listen to the media for cresting reports and monitoring of the river gauge at Branford by Suwannee River Water Management District.

The Withlacoochee River forms the southern border of Levy County and runs through the Town of Inglis and the Town of Yankeetown. Water levels on the Withlacoochee can have a great impact in both towns due to the substantial amount of land within the 100-year floodplain. Water control structures at Lake Rousseau and the Inglis spillway reduce the flood impacts of typical river cresting caused by upstream events. Conversely, the water level of the Withlacoochee at Inglis and Yankeetown is influenced by tides and weather events coursing upstream from the Gulf of Mexico.

The Waccasassa River is a small river in central Levy County with a large floodplain. Currently, there are no population centers in this large flooding area. However, the Town of Otter Creek is within the floodprone area. The large floodprone area within central Levy County is also filled with many areas of closed basin flooding.

Closed basin flooding is common throughout Levy County due to the many small drainage basins and sub-basins. The FIRM Map VII-3 for Levy County displays a complex pattern of thousands of small pockets within the 100-year floodplain. Typically, in a storm event a small drainage sub-basin will fill and spill over through a “saddle” that connects to another sub-basin. The spill-over chain reaction can continue through several sub-basins. During the El Nino disaster of ‘97-’98 (DR 1195) sub-basins flooded that had not flooded for years and new flood-prone areas were discovered or rediscovered. Based on the relatively flat topography of most of Levy County these sub-basins can cover large areas of land and the saddles can be hard to locate or predict without an accurate topographical survey. Understandably, once a closed basin is flooded the only reduction of the water level is through percolation and evaporation. Percolation is usually impeded by soil saturation. Therefore, closed basin flooding in Levy County can be difficult to predict and flood waters can remain for a significant period of time.

Some of the most valuable information regarding flooded roadways was gained from the staff of the Levy County Road Department. The Road Department staff along with the Building Official had a meeting with the Working Group staff to provide information on flooded roadways throughout the County. This information is included on the Historic Flooding Map. An additional database is included in the GIS coverage that displays the frequency, depth and comments about each situation. The database could form the basis for the Road Department to begin to use more GIS capability in road maintenance. County and municipal staff should be consulted again prior to future updates of the LMS.

Below are descriptions of additional areas that historically flood. The below listed information was either submitted by working Group representatives or gained from meetings with staff.

Town of Bronson

The Town of Bronson has two small developed areas that flood causing access problems for the few residents in the specific areas. The Public Works Director thinks flooding in these areas could be reduced but probably not alleviated by drainage improvements. The NFIP map designates larger areas on the south and west side of Bronson as being within the 100-year floodplain. These areas have minimal local population and are currently unimproved. Policy and /or planning initiatives could be adopted to mitigate future growth in the 100-year floodplain.

City of Cedar Key

In December 1998, the City of Cedar Key had 434 flood policies of which 208 policies were claimed amounting to \$2,406,232. Of the total number of flood policies, 414 were in the velocity zone. The total coverage of policies amounts to \$27,945,100 and the total premiums amount to \$250,078. These figures represent a single point in time where flood insurance policies were paid out. With the continued growth and increase in property values, potential insurance losses would most likely exceed the 1998 numbers should a similar event take place again.

Cedar Key is group of islands that are subject to flooding influenced by conditions in the Gulf of Mexico. The map of historic flood problems centers on flooded roadway segments. The LMS Working Group agreed that road access is a problem that needs addressing. Most of the roads shown on the map are inundated at a five or six foot tide. Most importantly, access to and from Cedar Key is blocked at five foot (5') tide at Bridge #4. Rebuilding several bridges and raising several miles of SR 24 could alleviate the access issues, but that is not seen as realistic. Additionally, there are only a few areas in Cedar Key that are outside the 100-year floodplain. Therefore, preparedness for evacuation and early warning are fundamental to life safety issues with regard to all hurricane and tropical storm events.

City of Chiefland

The City of Chiefland reports two main problem areas that have had repeated flooding as listed below. Flooding typically occurs with rainfall events when more than an inch of rain falls within several hours time. Traffic must be directed around these areas and the waters do enter some nearby structures. These two areas could be addressed by a stormwater management study and drainage projects.

- Block 19, parcel 2 on North Main Street
- Intersecting area of Northeast 1st Avenue and Northeast 1st Street by the City Hall

City of Fanning Springs

The City of Fanning Springs is located on the banks of the Suwannee River and is subject to flooding events associated with the river. U.S. Hwy 19 is a major regional evacuation route that crosses the Suwannee River at Fanning Springs. Fanning Springs has identified areas along the Suwannee River as prone to seasonal flooding. The Suwannee River floodplain can be affected by weather events locally and as far away as southern Georgia.

Town of Inglis

The Inglis Stormwater Runoff Investigation conducted in 1992, identified flooding in yards, driveways and/or in the roads near residences. Several of the respondents who participated in the study reported that flooding resulted any time after heavy rainfall occurred. The duration of the flooding varied depending on the storm event, but residents indicated that when flooding occurred it lasted for several days or more than a week. This is indicative of low-lying and depressional areas filling with water and not having an outlet to drain them. A perception indicated by the respondents is that alteration to land use patterns have resulted in some flooding. As new houses and buildings are constructed each one displaces the water that once was absorbed on the property.

The roadway segments on the attached map correspond with the 100-year floodplain map. These roadway segments flood with normal, heavy rainfall events.

Town of Otter Creek

The Town reports flooding problems at the intersection of SW 3rd Ave and SW 3rd Lane which impede safe travel. Additional problems are reported at an RV park on the banks of Otter Creek (the creek). Fortunately, people here can easily leave flooded areas. Approximately half of this very small Town (Population around 131) is considered flood-prone. However, the flood-prone areas have little to no population.

City of Williston

Generally, Williston is not located near any major areas of flooding. However, several small closed basins in the City are shown as being within the 100-year floodplain. These areas are sub-basins near the developed portion of the City and drainage projects may not be feasible. Williston may consider acquisition of these properties for use as drainage retention areas. The worst of the localized flooding is located on NW 4th St. next to the Oak View Care Center (180 bed skilled nursing facility). The area of most frequent flooding within this sub-basin was acquired by the City 2007 and converted into parkland.

Town of Yankeetown

Tidal surge and localized flooding caused by rainfall are the two types of flooding that occur in Yankeetown. Flooding from abnormal tides is the most dangerous of the two and typically accompanies tropical cyclones, tropical depressions or strong and sustained southwesterly winds. The entire Town, with a few minor exceptions, lies within the 100-year floodplain. Flood levels vary from 11 feet NGVD near the eastern corporate limit to about 2 feet NGVD near the County Park at the western end of County Road 40. Low-lying areas less than about 5 feet NGVD are subject to frequent tidal flooding.

Although flooding from coastal surges is unavoidable in low-lying areas, problems are exacerbated by the lack of adequate outfall and drainage infrastructures. Low-lying areas become filled with water as a result of abnormal tides or because of heavy rainfalls. Once filled, they are unable to drain and they must rely on evaporation and slow percolation for relief. In such situations, septic tanks become inoperable and the mosquito population increases dramatically.

Fowlers Bluff

Exceptional heavy seasonal rain in southern Georgia and the panhandle of Florida contributed to flooding along the Suwannee River. The Suwannee River Water management District through decades of research, monitoring and observation was able to predict and warn homeowners on river of impending flooding conditions. On April 20 and 21, 2009 water levels along the Suwannee River at the Fowlers Bluff station peaked at 7.17 and 7.16 feet above National Geodetic Vertical Datum 1929 levels.

Losses due to high water levels occurred between March 26 and May 5. Under Presidential Disaster Declaration, individual assistance was provided to approximately 20 households in this low lying area on the Northern boundary of county. Emergency management terminated the Local State of Emergency Declaration No. 1831 regarding flooding on the Suwannee River on April 21, 2009. Total Public assistance paid to all counties included in this disaster is 36,071,338, however Levy County accounts for a very small amount of this figure.

b. Extent

Areas designated as 100-year flood zones have a 1% chance of being inundated in any given year (see

Table VII-6 for descriptions of FIRM zones). A tropical cyclone is likely to bring rainfall amounts that are above the 100-year flood level. As described earlier, floodplain maps are derived from the Flood Insurance Rate Maps (FIRM) as developed by the National Flood Insurance Program. These floodplain maps include flood zones and base flood elevations (for Zones AE and VE only). Base flood elevations are computed elevations to which floodwater is anticipated to rise during the base flood. **Estimated base flood elevations in Levy County range from 9 to 29 feet. This means that 29 feet is the very highest that floodwater is anticipated to rise.**

Table VII-6. Definitions of NFIP Flood Zones

AE	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances base flood elevations (BFEs) derived from detailed analyses are shown at selected intervals within these zones.
X500	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from the 100-year flooding.
X	Areas outside the 1-% annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in these zones.
A	Flood zone area with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths of base flood elevations are shown within these zones.
ANI	An area that is located within a community or county that is not mapped on any published FIRM.
VE	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
UNDES	A body of open water, such as a pond, lake, ocean, etc., located within a community's jurisdictional limits that has no defined flood hazard.
AO	River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
100IC	An area where the 100-year flooding is contained within the channel banks and the channel is too narrow to show to scale. An arbitrary channel width of 3 meters is shown. BFEs are not shown in this area, although they may be reflected on the corresponding profile.

c. Historical Occurrences

In addition to the areas that historically flood described in the above “Location” section, historical flood occurrences and their respective damages have been recorded by NOAA’s National Climatic Data Center. Below are a table and descriptions of historical flooding occurrences that have affected Levy County. **The last recorded flooding according to NOAA’s NCDC data was in April 2009.**

Table VII-7. Historical Occurrences of Flood in Levy County

Location or County	Date	Time	Type	Deaths	Injuries	Property Damage	Crop Damage
Peninsular	9/15/1994	0	Flooding	0	0	500K	0
West-central Fl	10/2/1994	1600	Flood	0	0	5.0M	0
Chiefland	6/10/1996	8:00 AM	Urban/sml Stream Fld	0	0	0	0
Chiefland	6/15/1996	11:00 AM	Urban/sml Stream Fld	0	0	0	0
Chiefland	10/27/1997	12:00 PM	Urban/sml Stream Fld	0	0	1K	0
Bronson	2/22/1998	5:30 PM	Urban/sml Stream Fld	0	0	10K	0
FLZ039	7/23/2001	6:00 PM	Coastal Flooding	0	0	100K	0
FLZ039 - 042	2/2/2007	12:35 AM	Coastal Flood	0	0	0K	0K
Janney	4/20/2009	12:00 PM	Flood	0	0	13K	0K
TOTALS:				0	0	5.961M	0

Source: NOAA National Climatic Data Center

April 2009, A series of April cold fronts passed through and stalled across the area with the heavies rainfall north of the Suwannee River and in the Florida Pan Handle. Sixteen homes reported flood damage but monetary amounts were low due as the homes were on stilts. Flooding is not uncommon in this low lying area. The Levy County side of the Suwannee River is higher than the Dixie County side and Fowlers Bluff was the only area to report flood damage.

February 22 1998, Heavy rainfall over three to four inches in less than five hours caused localized flooding on roadways between Bronson and Cedar Key. A few vehicles incurred water damage from the floodwaters.

October 27 1997, Four to seven inches of rain caused localized flooding along the U.S. Highway 19 corridor from New Port Richey north across Spring Hill to Crystal River and into Levy county.

June 15 1996, Heavy rainfall of up to five inches in less than two hours caused localized street flooding from Lebanon to Otter Creek along the U.S. Highway 19 corridor.

June 10 1996, Up to five inches of rain in less than two hours produced localized flooding of low lying areas along the U.S. Highway 19 corridor.

October 1994, The remnants of tropical depression number 10 moved from the northeast Gulf of Mexico on October 1 across the Florida Panhandle and into Georgia on October 2. High winds produced rough seas along the west central and northwest Florida coasts causing minor tidal flooding and beach erosion. A total of 18 persons had to be rescued from sinking boats in the northeast Gulf of Mexico. Heavy rains in the Florida Big Bend and Panhandle accompanied the system causing extensive flooding to roadways, creeks and low lying areas and minor flooding of rivers.

September 1994, Two synoptic-scale systems, one tropical and one non-tropical brought heavy rain to most

of peninsular Florida the last half of September. Rivers and streams, particularly in the west central counties of Citrus, Polk, Hillsborough, Sarasota, Hardee, Desoto and Manatee Counties, overflowed, flooding roadways and inundating or isolating residential areas.

d. Probability

Like other weather events discussed in this section, the rainfall amounts that cause flood conditions are considered a normal part of the County's climate. Often heavy rainfall is isolated in a small area of a few square miles with severe consequences to the point where shelter activation is needed. Based on the historical data from NOAA's NCDC, the return period for a flood event is approximately 5 years. However, because most of Levy County lies within a flood zone, and because heavy rainfall events occur at least once per year, the probability of a flood event occurring is **Very High**.

3. WILDFIRES

a. Location

Approximately 2/3 of Levy County is forest land. Additionally, vast portions of the County consist of woods, timber land and agriculture areas. These areas are intermingled with sparsely populated areas as well as eight small municipalities. The rural population of Levy County is very vulnerable to wildfire. Only areas with few trees such as urban areas, pastures and prairies have a low vulnerability to wildfire.

A Wildland Fire Susceptibility Index (WFSI) was developed based on the calculation of the probability of an acre burning and the expected final fire size, which is based on the rate of spread in the four weather percentile categories into a single measure of wildland fire susceptibility. Based on necessary assumptions, this index is not the probability of an acre burning but a relative comparison of index values between areas in the State. The wildland fire susceptibility analysis integrates the probability of an acre igniting and wildland fire behavior. It combines the data from the Fire Occurrence Areas with fire behavior data developed by FlamMap.

Map VII-4 shows the Levels of Concern (LOC) as calculated by the Florida Division of Forestry. The Level of Concern is an integer scaled from 0 to 9 indicating the relative risk of Wildland Fire, and is an output of the Florida Division of Forestry Fire Risk Assessment System (FRAS). **Most of the County and its municipalities are vulnerable to wildfire.** However, the degree of vulnerability varies throughout the County (see Map VII-4).

b. Extent

According to the Florida Division of Forestry, from 2003 to 2010, Levy County experienced 749 wildfires in which approximately 6,267 acres were burned in wildfire. The extent is assumed to be the average number of acres burned per year. **Therefore, using this data, the extent of wildfire is 783.4 acres burned per year.**

c. Historical Occurrences

Below is a Table of occurrences of wildfire in Levy County in 2009 and 2010, by cause of fire and acreage burned. These 2 years are the only ones described, as they have the most complete data. During both of these years, the majority of fires were caused by lightning and non-authorized burning of trash. Lightning was also the greatest contributor to the amount of acres burned during both years.

Table VII-8. Historical Occurrences of Wildfire in Levy County, 2009-2010

Cause	2010				2009				TOTAL
	# incidents	Dates	Acres Burned each incident	Total Acres Burned	# incidents	Dates	Acres Burned each incident	Total Acres Burned	
Campfire	2	June 13, Dec. 14	0.3, 3	3.30	3	March 4, Nov. 7, Dec. 20	2, 0.2, 0.5	2.70	6
Children	1	Nov. 24	0.3	0.30	0	NA	NA	NA	0.3
Debris Burn--Auth--Broadcast/Acreage	2	Jan. 26, Dec. 30	6, 12	18.00	2	Jan. 6, April 30	130, 210	340.00	358
Debris Burn--Auth--Piles	0	NA	NA	NA	2	Feb. 27, Nov. 4	1, 3	4.00	4
Debris Burn--Auth--Yard Trash	0	NA	NA	NA	2	Jan. 4, Nov. 21	1, 1	2.00	2
Debris Burn--Nonauth--Broadcast/Acreage	1	Jan. 27	20	20.00	0	NA	NA	NA	20
Debris Burn--Nonauth--Piles	5	March: 19, 24, April 9, Dec. 16 (2)	1, 2, 0.5, 10, 2	15.50	0	NA	NA	NA	15.5
Debris Burn--Nonauth--Yard Trash	17	Jan: 7, 10 Feb. 18, March: 13, 19, 23, April: 8, 11, 2, May 7, Sept. 15, Oct: 3, 12, Nov.10, Dec: 11(2), 22	1, 2, 1, 0.5, 1.5, 5, 1, 0.1, 0.5, 1, 0.5, 6, 1, 0.1, 2.5, 0.8, 1	25.50	11	Jan: 1, 24, Feb: 7, 20, 21, 26, March 18, April 7, May 1, June 12, Nov. 7	0.1, 7, 12, 7, 3, 3, 1, 0.8, 10, 0.3, 1	45.00	70.5
Equipment--Agriculture	2	Feb. 17, March 6	5, 1	6.00	1	Nov. 6	1	1.00	7
Equipment--Logging	0	NA	NA	NA	1	April 28	0.1	0.10	0.1
Equipment--	1	Dec. 14	53	53.00	0	NA	NA	NA	53

Recreation									
Equipment-- Transportation	2	Sept. 20, Nov. 6	0.1, 0.1	0.20	1	April 27	3	3.00	3.2
Incendiary	9	Jan. 19, Feb. 18, April: 10, 22, May 13, Oct. 18, Dec: 15, 19, 29	25, 2, 2, 5, 2, 6, 0.1, 3, 3.5	48.60	2	Jan. 4, Feb. 10	1, 50	51.00	99.6
Lightning	33	April 26, May: 2, 25, 26, 28(5), 29(2), June: 13(3), 14, 15, 17, 20, 26, 27(5), Aug: 1(2), 2, 5(2), 23 Sept: 5, 6, 16	13.5, 2, 1, 3, 2, 3, 0.5, 0.5, 37, 1, 1, 2, 1.5, 10, 0.5, 7, 50, 1, 10, 5, 5, 175, 30, 5, 1, 0.1, 1, 1, 1, 1, 1, 4, 30	406.60	22	March 29, May: 12(4), 13(2), 14, 16, 17(2), June: 14, 16, 18, 21, 22, Aug: 11, 15, 18, 20, 24, 26	15, 2, 1, 0.3, 1.5, 0.2, 80, 3, 4, 25, 10, 0.1, 50.2, 1, 22.8, 0.1, 1.5, 25, 30, 6, 1, 2	281.70	688.3
Miscellaneous --Power Lines	5	Jan. 7, Feb: 5, 7, March 2, Oct. 9	0.3, 0.4, 10, 0.5, 1	12.20	1	Nov. 8	0.1	0.10	12.3
Miscellaneous-- Other	1	Dec. 9	0.1	0.10	0	NA	NA	NA	
Smoking	0	NA	NA	NA	2	Feb. 8, 13	3, 0.5	3.50	3.5
Unknown	8	Jan: 25, 26, March 8, 11, Oct: 29(2), Nov. 19, Dec. 16	140, 0.1, 241, 0.1, 1, 50, 0.3, 1	33.50	7	Jan. 5, 10, 27, Feb. 26, March 12, June 17, Nov. 15	1, 2, 0.1, 0.5, 4, 0.3, 1	8.90	42.4
TOTAL	89			642.8	57				743

d. Probability

Using the data from the Division of Forestry, it is estimated that Levy County experiences approximately 93 wildfires a year, and the return period is about 0.01 years, or 3.9 days. Therefore, the probability of a wildfire occurrence in Levy County is **Very High**.

4. SINKHOLES

a. Location

All of Levy County (including all municipalities) is vulnerable to sinkholes. However, different areas of the County vary in degree of vulnerability. The areas of higher elevation of Levy County are classified as high recharge areas with an unconfined aquifer. The limestone layer holding aquifer in these areas can give way to sinkholes more frequently than in areas where the aquifer is covered by a clay confining layer. High recharge areas of permeable sands and an “unconfined aquifer” bring about an increased vulnerability to groundwater pollution via HAZMAT or chemical spills. In the high recharge areas of Levy County the material covering the aquifer is 30 to 200 feet thick, consisting mainly of incohesive and permeable sand. Typically, sinkholes develop gradually and are small, shallow and few. Cover collapse sinkholes are most prevalent in high recharge areas. The Chiefland area seems to have the most incidents of sinkhole activity. Map VII-5 shows historical occurrences of sinkholes as well as areas that may be susceptible to sinkholes. Table VII-9 describes sinkholes in Levy County.

b. Extent

The average sinkhole size in Levy County is approximately 5 feet long, 4 feet wide, and 9 feet deep. **The largest sinkhole in Levy County is approximately 20 feet in length and width, and 12 feet deep. It is assumed that this is the greatest extent of a sinkhole in Levy County.**

c. Historical Occurrences

Every year, sinkholes commonly form in roadways. Below is a table with recorded sinkholes in Levy County. **The last recorded sinkhole was in 2007 near the Town of Bronson.** Following the table are descriptions of historically significant sinkholes in Florida.

Table VII-9. Recorded Sinkholes in Levy County, 1948-2009

MONTH	DAY	YEAR	QUAD	NAME	LENGTH	WIDTH	DEPTH
5	25	2007	Ocala		2	0	0
3	9	2005	Fanning Springs	Unknown	0	0	0
11	8	2005	Manatee Springs	Unknown	38		
1	19	2004	Yankeetown	Unknown	4	4	0
9	7	2004	Chiefland	Unknown	4	4	
3	12	2003	Chiefland	Unknown	8	8	40
7	24	2003	Trenton	Mr. Liles	7	7	4
6	11	2003	Chiefland	Fire Chief - Grandma's Pantry	2	2	8
6	14	2003	Chiefland	Chiefland Elementary School	0	0	0
3	14	2002	Newberry	Unknown	6	6	6
10	21	2002	Chiefland	Unknown	0	0	0
12	13	2002	Bronson	Unknown	0	0	0
10	8	2002	Morrison	Terry Posey	5	7	2
5	10	1988	Manatee Spr N-28	Department Of Transportation	8	8	5
9	9	1988	Suwannee River M-28	Department Of Transportation	15	10	6
2	17	1987	Trenton	Department Of Transportation	2	2	15
4	6	1987	Chiefland	Department Of Transportation	20	20	12
2	28	1987	Trenton	Department Of Transportation	15	6	10
4	2	1987	Chiefland N-29	Royal American Mgt.	10	8	7

5	14	1987	Chiefland N-29	Department Of Transportation	2	2	2
5	14	1987	Chiefland N-29	Department Of Transportation	5	5	5
5	14	1987	Chiefland N-29	Department Of Transportation	5	5	20
2	2	1987	Trenton M-29	Department Of Transportation	1	1	14
2	2	1987	Trenton M-29	Department Of Transportation	3	3	14
6	18	1986	Trenton M-29	Department Of Transportation	2	2	8
7	1	1986	Trenton M-29	Department Of Transportation	2	2	11
7	1	1986	Trenton M-29	Department Of Transportation	6	6	11
6	11	1986	Trenton M-29	Department Of Transportation	3	3	4
6	11	1986	Trenton M-29	Department Of Transportation	4	4	6
4	19	1985	Suwannee River	Department Of Transportation	4	4	6
7	27	1985	Chiefland	Unknown	2	3	9
9	15	1985	Trenton M-29	Department Of Transportation	7	14	11
10	18	1985	Trenton M-29	Department Of Transportation	2	2	20
10	18	1985	Trenton M-29	Department Of Transportation	2	2	20
10	18	1985	Trenton M-29	Department Of Transportation	4	4	5
7	12	1984	Suwannee R.	Unknown	2	2	20
1	16	1984	Morrison	Unknown	12	20	2
1	5	1984	Suwannee River	Unknown	5	5	4
9	20	1983	Chiefland	City Of Chiefland	20	4	2
11	23	1983	Suwannee River	Unknown	2	4	17
12	5	1983	Suwannee River	Unknown	2	2	17
5	4	1981	Vista	County (Levy)	25	0	7
9	0	1974	Williston	Department Of Transportation	8	8	6
9	1	1974	Williston	Department Of Transportation	6	6	3
1	2	1973	Yankeetown	Department Of Transportation	6	6	6
6	14	1973	Yankeetown	Department Of Transportation	2	2	5
10	30	1972	Trenton	Department Of Transportation	4	4	90
10	2	1972	Trenton	Department Of Transportation	3	3	9
10	2	1972	Trenton	Department Of Transportation	0	0	59
10	13	1972	Suwannee River	Department Of Transportation	6	6	18
11	2	1972	Otter Creek	Department Of Transportation	4	4	2
3	3	1970	Trenton	Department Of Transportation	0	0	0
1	0	1970	Trenton	Department Of Transportation	0	0	0
1	0	1970	Trenton	Department Of Transportation	0	0	0
3	0	1970	Suwannee River	Department Of Transportation	0	0	0
5	0	1970	Chiefland	Unknown	0	0	0
6	4	1970	Manatee	Department Of Transportation	24	24	5
9	0	1970	Suwannee River	Department Of Transportation	0	0	0
3	0	1970	Suwannee River	Department Of Transportation	0	0	0
10	20	1970	Chiefland	Department Of Transportation	0	0	0
3	0	1969	Chiefland	Department Of Transportation	4	4	3
1	0	1969	Chiefland	Department Of Transportation	5	5	6
10	0	1969	Yankeetown Se	Department Of Transportation	15	15	5
10	99	1969	Yankeetown	Department Of Transportation	2	2	3
10	0	1969	Yankeetown	Department Of Transportation	2	2	3
0	0	0	Manatee	Department Of Transportation	0	0	0
0	0	0	Chiefland	Department Of Transportation	0	0	0

Source: Florida Department of Environmental Protection

In 2004, numerous small and medium sized sinkholes opened up primarily in the area of The City of Chiefland in the aftermath of Hurricanes Charlie, Frances and Jeanne. The sinkhole activity was caused by sustained rains were caused by saturated grounds form a unusually active storm season.

Perhaps the most famous sinkhole in recent US history is the one formed in May 1981 at Winter Park, Florida near Orlando. The sinkhole is roughly circular but elongated, (approximately 300 feet by 300 feet in size) and swallowed one house and shed, half of the municipal swimming pool, a Porsche sports car,

several large oak trees, a section of the crossing street and adjoining street, and an estimated 4 million cubic feet of soil. The sinkhole also damaged three other Porsche sports cars and a pick-up camper that slid into the crater, caused the rear of an auto shop to crack open, and exposed or damaged various utility lines in the vicinity.

Lake Jackson in Tallahassee, a nationally known bass fishing lake, experienced a sinkhole on September 16, 1999 that suddenly drained more than half the lake of every last gallon of water, not to mention every last fish and alligator.

On July 12, 2001, emergency officials for Hernando County investigated 18 confirmed sinkholes that hit in one day across the area, affecting a 15 to 16 block residential area and causing extensive damage to one house. One of the largest holes measured between 50 and 100 feet deep.

In June 2002, a 150-foot-wide sinkhole forced the evacuation of part of a 450-unit apartment building in Orlando, and a Spring Hill woman saw a 40-foot wide hole open in a retention area behind her uninsured home.

d. Probability

The probability of future sinkhole events within the County is considered to be **Very High** due to review of past historical events and the continuation of ongoing reports of sinkhole activity. Approximately 1.08 sinkholes occur per year, and the estimated return period is 0.93 years. Levy County is ranked 11th in Florida in number of sinkholes.

5. COASTAL EROSION

a. Location

The bathymetry of the Gulf Coast is not very conducive to coastal erosion. The water off the shore of Levy County is shallow for several miles out. This shallow water bathymetry does not allow wave energy to build up, thus creating a “low intensity coastline.” The lack of wave action is evidenced by the lack of any natural beaches. However, despite its low intensity coastline, Levy County does have some recorded coastal erosion. Due to the lack of waves in the Gulf of Mexico in the coastal areas of Levy County, erosion is minimal and only occurs during tropical cyclones.

The Florida Department of Environmental Protection develops and publishes annually the *Critically Eroded Beaches Report*. The data from this report is gathered from a set of monitoring locations along the coast throughout the State. The continual reporting and analysis is combined with the historical data for detailed records about the status of the State’s beaches.

The Report found that Atsena Otie Key and Cedar Key are Critical Erosion Areas, while Seahorse Key is Non-critical Erosion Area (see Map VII-6). “Critical Erosion Areas” are defined as segments of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critical erosion areas may also include peripheral segments or gaps between identified critical erosion areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects.

b. Extent

According to the *Critically Eroded Beaches Report*, Levy County had approximately 1.9 miles of eroded coastline in 1999. By 2010, the County's eroded coastline increased by 0.5 miles to 2.4 miles. **The extent of coastal erosion is 0.04 miles per year.**

Table VII-10. Levy County Erosion Data

	Recorded Length, 1999	Recorded length, 2010	Change from 1999-2010	Rate of change
Cedar Key	0.5 miles	0.6 miles	0.1 miles	0.008333 mi/year
Atsena Otie Key	0.2 miles	0.5 miles	0.3 miles	0.025 mi/year
Seahorse Key	1.2 miles	1.3 miles	0.1 miles	0.008333 mi/year
TOTAL	1.9 miles	2.4 miles	0.5 miles	0.041667 mi/year

c. Historical Occurrences

The following is a list of notable tropical cyclones that caused recorded erosion in Levy County. This information is from the National Climatic Data Center and does not include more detailed data, i.e. amount of erosion. The last recorded event that caused coastal erosion was in July 2005.

July 9, 2005 Hurricane Dennis: Moderate beach erosion was reported on Cedar Key.

September 13-14, 2001 Tropical Storm Gabrielle: Gabrielle caused over \$20 million statewide in property damage due to wind damage, storm surge, minor beach erosion and flooding.

August 23, 1995 Tropical Storm Jerry: Beach erosion from Jerry was minor and occurred from Englewood Beach in Pinellas County to Cedar Key in Levy County.

d. Probability

Because coastal erosion in Levy County is related to the occurrence of tropical cyclones, the probability of coastal erosion occurring in the future is **High**. However, because of Levy's low intensity coastline, it is assumed that the rate of erosion per year will remain very low.

6. DROUGHT/EXTREME HEAT

a. Location

All of Levy County (including all municipalities) is vulnerable to drought/extreme heat.

b. Extent

Because no single definition of drought works for all circumstances, we rely on drought indices to detect and measure droughts. The Drought Monitor is a synthesis of multiple indices and impacts that represents a consensus of federal and academic scientists.

The Drought Monitor's drought intensity categories are based on five key indicators and numerous supplementary indicators (see Table VII-11). Because the ranges of the various indicators often don't coincide, the final drought category tends to be based on what the majority of the indicators show. Drought maps also reflect weighted indices according to how well they perform in various parts of the country and at different times of the year.

Table VII-11. Drought Severity Classification

		RANGES					
Category	Description	Possible Impacts	Palmer Drought Index	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	11-20
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2

Source: Drought Monitor

Short-term drought indicator blends focus on 1-3 month precipitation. Long-term blends focus on 6-60 months. Additional indices used, mainly during the growing season, include the USDA/NASS Topsoil Moisture, Keetch-Byram Drought Index (KBDI), and NOAA/NESDIS satellite Vegetation Health Indices.

Indices used primarily during the snow season and in the West include snow water content, river basin precipitation, and the Surface Water Supply Index (SWSI). Other indicators include groundwater levels, reservoir storage, and pasture/range conditions.

The highest recorded temperature in Levy County was 105°F in June 1989. According to data from the Drought Monitor, the worst level drought Levy County has experienced was a **D4 (Exceptional Drought)** in December 2000. **Therefore, it is anticipated that the extent of extreme heat is 105°F and the extent of drought is the Drought Monitor’s D4 Classification.**

c. Historical Occurrences

According to the Southeast Regional Climate Center (SERCC), there are 2 stations in Levy County that keep historical climate data (from 1956 to 2010): Cedar Key 1 WSW and Usher Tower in Chiefland. Data from these 2 stations indicate that the highest temperature recorded was 105°F on June 3rd, 1989. Also, the month of June has the greatest number of days (19.5) in which the recorded temperature was above 90°F. August is the month with the highest average (90.7°F) of maximum monthly temperatures.

Table VII-12. Historical High Temperature Data

	Monthly Averages Max.	Monthly Averages Mean	Daily Extremes High		# Days above 90° F
	°F	°F	°F	Date	
January	67.6	55.2	87	13/1972	0
February	70.2	57.5	87	25/1962	0
March	76.1	63	92	10/1974	0.2
April	81.7	68.3	96	30/1989	1.3
May	87.6	74.5	102	27/1989	10.1
June	90.6	79.2	105	03/1989	19.5
July	91.2	80.7	102	07/1981	23
August	90.7	80.7	100	01/1986	22
September	88.9	78.7	99	22/1986	14.8
October	83.1	71.2	96	02/1986	2.3
November	75.5	63	92	10/1986	0
December	69.5	57	86	13/1972	0

Source: Southeast Regional Climate Center (SERCC), Usher Tower

Below is a Table listing historical occurrences of the greatest severity of drought in each month from 2000 to 2010 in Levy County based on monthly data from the Drought Monitor. Refer to Table VII-11 for Classification definitions.

Table VII-13. Historical Occurrences of Drought

	January	February	March	April	May	June	July	August	September	October	November	December
2010										D0	D0	D2
2009	D0	D1	D1	D1				D0		D0	D0	
2008	D0	D1	D0	D0	D0	D0	D0				D0	D0
2007	D2	D0	D0	D3	D2	D1	D2	D2	D1	D0	D0	D0
2006			D0	D0	D0		D0	D0	D0	D1	D1	D2
2005		D0							D0	D0	D0	
2004					D1							
2003												D0
2002	D0	D0	D0	D0	D0							
2001	D3	D3	D3	D3	D3	D3	D1	D1	D0	D0	D0	D0
2000	D1	D1	D2	D2	D3	D3	D3	D3	D1	D2	D3	D4

Source: Drought Monitor Monthly Animations by Year

d. Probability

The data from Table VII-12 shows that Levy County has had a total of 93.2 days of extreme heat in which temperatures exceeded 90°F from 1956 to 2010. Using this data, Levy County has a return period of 0.6 years for extreme to occur; **therefore the probability of extreme heat affecting the County is Very High.**

The data from Table VII-13 shows that from 2000 to 2010 there were only 3 years in which Levy County did not experience drought conditions (Drought Monitor Classification D1 through D4) during any month. The return period for drought conditions (using the Drought Monitor Index and data) in Levy County is 1.4 years, **therefore the probability of drought conditions occurring in the County is Very High.**

7. TORNADOES

a. Location

All of Levy County (including all municipalities) is vulnerable to tornadoes. Because of the unpredictable pattern of tornadoes, and because the entire state, including Levy County, has a relatively high reoccurrence frequency, the entire County is vulnerable to tornados (see Figure VII-5). The northern portion of the state's Gulf Coast (between Tampa and Tallahassee) along with the Panhandle region have generally experienced more tornadoes than other areas of the state, primarily due to the high frequency of thunderstorms making their way east through the Gulf of Mexico.

b. Extent

The Enhanced F-scale is a set of wind estimates (not measurements) based on damage. Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage (listed at www.spc.noaa.gov/faq/tornado/efscale.html.) These estimates vary with height and exposure. **Important:** The 3 second gust is not the same wind as in standard surface observations. Standard measurements are taken by weather stations in open exposures, using a directly measured, "one minute mile" speed.

Enhanced Fujita-Pearson Tornado Intensity Scale

- **EF0 Gale Tornado** 65-85 mph
 - Some damage to chimneys. Tree branches broken off. Shallow rooted trees uprooted.
- **EF1 Moderate Tornado** 86-110 mph
 - Peels surface off roofs. Mobile homes overturned. Moving autos pushed off roads.
- **EF2 Significant Tornado** 111-135 mph
 - Considerable damage. Roofs torn off frame houses. Large trees snapped or uprooted. Light-object missiles generated.
- **EF3 Severe Tornado** 136-165 mph
 - Severe damage. Roofs and some walls torn off well constructed homes. Trains overturned. Most trees in forests uprooted. Heavy cars lifted off ground.
- **EF4 Devastating Tornado** 166-200 mph
 - Well-constructed houses leveled. Structures with weak foundations blown off some distance. Cars thrown and large missiles generated.
- **EF5 Incredible Tornado** Over 200 mph
 - Strong frame houses lifted off foundations and disintegrated. Automobile-sized missiles fly through the air in excess of 100 mph. Trees debarked.

In general, tornadoes associated with tropical cyclones are less intense than those that occur in the Great Plains. Although the highest intensity tornado to hit the County was an F2 in 1982, an F4 tornado has been recorded within 100 miles of Levy County. **For this reason, it is reasonable to expect a similar strength storm could strike any part of the county.**

c. Historical Occurrences

According to the National Climatic Data Center, the County experienced 22 tornado events from 1950 through 2010. These events caused 3 deaths, 11 injured, and a total of approximately \$56.3 million in property damage (NCDC, 2010). Table VII-14 shows the number of tornadoes documented between 1950 2010 for Levy County. The estimated dollar amount of damages is also included. Damage amounts can be a function of storm intensity or the density of the development pattern.

Figure VII-5. Historical Occurrences of Tornadoes in Levy County

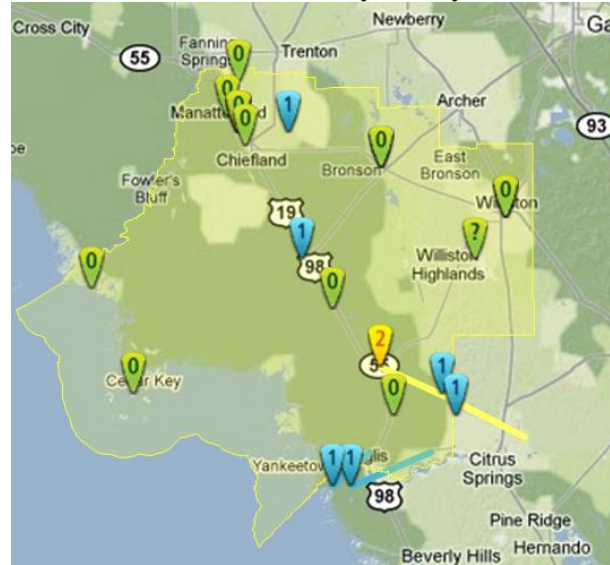


Table VII-14 Historical Occurrences of Tornadoes in Levy County

Table VII-11. Historical Occurrences of Tornadoes in Levy County								
Date	Event #	Time	Dead	Injured	F scale	Property Damage	Path Width feet	Path Length miles
March 12, 1968	006	1130	0	0	F1	0K	10	0
May 12, 1974	018	0630	0	0	F1	25K	50	8
May 14, 1976	023	1415	0	0	F0	25K	10	0
April 08, 1982	012	1800	0	0	F1	25K	20	1
June 11, 1982	026	1530	0	0	F2	250K	60	13
August 25, 1986	040	1347	0	0	F0	0K	30	1
June 16, 1989	046	0920	0	0	F1	25K	50	1
October 03, 1992	053	1640	0	0	F0	25K	10	0
March 12, 1993	010	2238	3	10	F2	50.0M	80	1
October 30, 1993	072	0251	0	1	F1	500K	60	1
October 30, 1993	074	0920	0	0	F0	1K	10	0
October 30, 1993	077	0955	0	0	F1	5.0M	60	1
October 30, 1993	078	1016	0	0	F0	0	10	0
October 30, 1994	069	1135	0	0	F0	5K	10	0
April 23, 1997	16	07:10 AM	0	0	F0	20K	10	1
July 18, 2000	38	12:30 PM	0	0	F0	0	0	0
October 15, 2002	35	01:03 PM	0	0	F1	450K	100	5
July 11, 2004	14	04:44 PM	0	0	F1	25K	50	1
August 14, 2004	40	04:41 PM	0	0	F0	0	30	1
September 15, 2004	81	09:17 PM	0	0	F0	0	30	0
September 15, 2004	82	09:22 PM	0	0	F0	0	30	0
July 24, 2007	36	05:33 AM	0	0	F0	0K	30	0.2

Source: Tornado History Project

d. Probability

Levy County typically has experienced tornadoes as an offshoot of large frontal systems or tropical cyclones. Florida has averaged approximately 75 tornadoes per year since 1950, with an average of 3 deaths and 60 injured per year. The County has experienced approximately 0.36 tornadoes per year, and a return of approximately 2.77 years. Also, because tornadoes in Florida are usually associated with tropical cyclones and severe thunderstorms (which have high probabilities of impacting the County), the probability of tornadoes affecting the County in the future is **Very High**.

8. SEVERE WINTER STORMS/FREEZE

a. Location

All of Levy County (including all municipalities) is vulnerable to severe winter storms/freeze. As a weather event, the location of winter storm conditions could develop anywhere within the central Florida climate including all jurisdictions within Levy County.

b. Extent

The lowest temperature recorded in Levy County was 9°F in January 1985. The worst freeze in Levy County was on January 1, 2001, when temperatures dropped into the lower 20s with durations of below freezing for up to 13 hours. **The the assumed extent of severe winter storms/freeze is below freezing temperature for up to 13 hours.**

c. Historical Occurrences

Historical climate data (from 1956 to 2010) from Cedar Key 1 WSW and Usher Tower in Chiefland stations indicate that the lowest temperature recorded was 9°F on January 22nd, 1985. Also, the month of January has the greatest number of days (6.9) in which the recorded temperature was below 32°F, and the lowest average (42.9°F) of minimum monthly temperatures.

Table VII-15 Historical Low Temperature Data

	Monthly Averages Min.	Monthly Averages Mean	Daily Extremes Low		# Days below 32 °F
	°F	°F	°F	Date	
January	42.9	55.2	9	22/1985	6.9
February	44.8	57.5	17	05/1996	4.4
March	50	63	22	03/1980	1.4
April	54.9	68.3	28	17/1962	0.1
May	61.4	74.5	42	11/1969	0
June	67.9	79.2	44	01/1984	0
July	70.3	80.7	59	01/1981	0
August	70.8	80.7	52	14/1967	0
September	68.5	78.7	44	30/1967	0
October	59.4	71.2	28	29/2008	0.2
November	50.4	63	17	25/1970	1.7
December	44.4	57	12	25/1983	5.8

Source: Southeast Regional Climate Center (SERCC), Usher Tower

The Table below lists all historic occurrences of freeze in Levy County from 1950 to 2009. Despite the extensive crop and property damage, there were no reported deaths or injuries. **According to NOAA's NCDC, the last record of freezing temperatures in Levy County was in October 2008.**

Table VII-16 Historical Occurrences of Freeze in Levy County

Date	Time	Type	Property Damage	Crop Damage
12/18/1998	5:00 AM	Freeze	0	0
1/5/1999	7:00 PM	Freeze	200K	475K
2/14/1999	5:00 AM	Freeze	0	0
12/1/1999	5:00 AM	Freeze	0	0
12/2/1999	3:00 AM	Freeze	0	0
1/22/2000	2:00 AM	Freeze	0	0
1/26/2000	4:00 AM	Freeze	0	0
1/26/2000	9:00 PM	Freeze	0	0
2/5/2000	11:00 PM	Freeze	0	0
11/22/2000	12:00 AM	Freeze	0	0
11/23/2000	12:00 AM	Freeze	0	0
12/6/2000	12:00 AM	Freeze	0	0
12/18/2000	12:00 AM	Freeze	0	0
12/20/2000	7:00 PM	Freeze	0	0
12/20/2000	12:00 AM	Freeze	0	1.0M
12/23/2000	12:30 AM	Freeze	0	0
12/30/2000	9:00 PM	Freeze	0	4.5M
12/31/2000	8:00 PM	Freeze	0	0
1/1/2001	12:00 AM	Freeze	0	5.1M
1/2/2001	4:00 AM	Freeze	0	0
1/3/2001	12:00 AM	Freeze	0	0
1/4/2001	1:00 AM	Freeze	0	0
1/5/2001	12:00 AM	Freeze	0	6.9M
1/7/2001	12:00 AM	Freeze	0	0
1/10/2001	12:00 AM	Freeze	0	4.0M
1/11/2001	1:00 AM	Freeze	0	0
1/21/2001	1:00 AM	Freeze	0	0
1/24/2001	5:30 AM	Freeze	0	0
1/26/2001	12:00 AM	Freeze	0	0
12/27/2001	4:00 AM	Freeze	0	0
3/1/2002	1:00 AM	Freeze	0	0
3/5/2002	3:00 AM	Freeze	0	0
11/24/2002	1:00 AM	Extreme Cold	0	0
11/29/2002	1:00 AM	Extreme Cold	0	0
11/30/2002	2:00 AM	Extreme Cold	0	0
12/1/2002	10:00 PM	Extreme Cold	0	0
12/16/2002	3:00 AM	Extreme Cold	0	0
12/29/2002	3:00 AM	Extreme Cold	0	0
1/19/2003	2:00 AM	Extreme Cold	0	0
1/23/2003	10:00 PM	Extreme Windchill	0	8.5M
1/24/2003	9:00 PM	Extreme Cold	0	0
1/6/2006	3:00 AM	Extreme Cold/wind Chill	0	0
12/9/2006	1:00 AM	Extreme Cold/wind Chill	0K	0K
1/29/2007	3:00 AM	Cold/wind Chill	0K	0K
2/17/2007	1:00 AM	Extreme Cold/wind Chill	0K	0K
2/19/2007	4:00 AM	Extreme Cold/wind Chill	0K	0K
10/29/2008	4:00 AM	Cold/wind Chill	0K	0K
			200K	30.425M

Source: NOAA National Climatic Data Center

The most notable severe winter storm hit the entire state of Florida on March 13, 1993 and has become known as the “Storm of the Century” or the “No-Name Storm.” The storm came across the Gulf of Mexico as a normal late winter cold front, but gathered strength just before landfall. Hitting Levy County in the early morning hours with gale force winds, rain, hail, snow, flooding, power outages and widespread freezing conditions, the storm marched across the State and had strong effects as far south as Cuba. These hazards are dealt with individually each winter, but their combined effects proved too much for recovery resources across the state. Each individual emergency situation was made worse by the lack of warning from the weather forecasters. The storm was a fluke and responders were not prepared. The best mitigation for severe winter storms and freezing conditions is accurate weather forecasting.

The following are descriptions of significant freeze events in Levy County that caused property or crop damage. Because freezes may be widespread, these descriptions may include details about other counties, as well as Levy.

January 6, 1999: Temperatures fell below freezing for up to twelve hours in the winter crop producing counties of Polk, Highlands, Hardee, De Soto, Hillsborough and Manatee, causing \$200,000 in property damage and \$475,000 in crop damage to tomato, squash and strawberry crops. Also, minimum temperatures in the farming areas of Collier County reached 27 to 32 degrees for about four hours, causing approximately \$100,000 in widely scattered damage to vegetable crops.

December 20, 2000: Freezing temperatures were observed over a large portion of west central Florida during the predawn through late morning hours, causing an estimated \$1 million in crop damage. Low temperatures dropped into the lower 20s over Levy County with durations below freezing between nine and eleven hours. In Citrus, Sumter, Hernando and Pasco counties, low temperatures dropped into middle 20s and remained below freezing for durations of three to eight hours. Freezing temperatures in Citrus County damaged an estimated one hundred acres of the local citrus crop. In Polk, Hillsborough, Hardee and Highlands counties, low temperatures dropped into the upper 20s and lower 30s and remained below freezing for durations of two to four hours.

December 30, 2000: Widespread freezing temperatures were observed across most of west central and southwest Florida during the late evening of December 30th through the mid-morning hours of December 31st, 2000, causing \$4.5 million in crop damage. Low temperatures in Levy County dropped from the upper teens to lower 20s with durations below freezing for up to thirteen hours. In Citrus, Sumter, Hernando and Pasco counties, low temperatures dropped into the middle 20s and remained below freezing for nine to twelve hours. In Polk, Hillsborough, Manatee, Sarasota, Hardee, DeSoto and Highlands counties, low temperatures dropped into the middle 20s to upper 20s and remained below freezing for durations of six to nine hours. In Manatee and Hillsborough counties, freezing temperatures may have caused an estimated two million dollars’ worth of damage to the tropical fish industry. In eastern Charlotte, eastern Lee and extreme northern Pinellas counties, temperatures dropped into the lower 30s and remained below freezing for periods of two to five hours. The freeze caused an estimated 25 to 50 percent damage to tomato, pepper and squash crops in Lee and Charlotte counties. Temperatures fell into the mid-20s over Glades, Hendry, eastern Collier, and western portions of Palm Beach and Broward counties and fell to 32 degrees in the farming areas of south Miami-Dade County. Approximately \$2 million in damage to vegetable crops occurred in Hendry and Glades counties.

January 1, 2001: The second and coldest night of a two-night freeze in south Florida saw minimum air temperatures ranging from 25 to 30 degrees over interior sections of the peninsula. In the metropolitan areas of Miami-Dade, Broward and Palm Beach counties temperatures were in the middle 30s over the western suburbs. An estimated \$6 million in crop damage included losses to corn and newly planted sugar cane in Palm Beach County, and to certain vegetables in Hendry and eastern Collier counties. An additional \$5.1 million in crop damage was caused by widespread freezing temperatures across most of In west central and southwest Florida. Low temperatures in Levy County ranged from the low to middle 20s with total durations below freezing for up thirteen hours. In Citrus, Sumter, Hernando and Pasco counties, low temperatures ranged from the middle to upper 20s and remained below freezing for durations of nine to thirteen hours. In Polk, Hillsborough, Highlands, Hardee and DeSoto counties, low temperatures ranged from the middle to upper 20s and remained below freezing for durations of six to nine hours. Isolated pockets of low temperatures in the upper teens were observed in extreme rural southern Highlands County. In Hillsborough County, the freeze caused nearly four million dollars in damage to the tropical fish crop. In Sarasota, Manatee, Charlotte and Lee counties, low temperatures dropped into the upper 20s and lower 30s and remained below freezing for durations of five to seven hours. In Lee County, the freeze caused nearly three million dollars in damage to the squash and cucumber crop. In Charlotte County, the freeze caused at least 100 thousand dollars damage to the pepper crop.

January 5, 2001: A freeze occurred throughout the interior sections of south Florida, causing an estimated \$78 million in damage to certain crops. Hardest hit were certain vegetable crops with 75% losses in Hendry and east Collier counties and 30% losses in the farming areas of south Miami-Dade County. Other crops that were damaged included newly planted sugar cane, ornamentals, and tropical fruits. A heavy frost occurred in the western suburbs of Miami-Dade, Broward and Palm Beach metropolitan areas. Several daily minimum temperature records were broken. Selected minimum temperatures included 27 degrees at Belle Glade, 29 degrees in the Homestead agricultural area, 31 degrees in Naples, 39 degrees at Miami International Airport and 43 degrees in Miami Beach. Widespread freezing temperatures were also observed across most of west central and southwest Florida during the pre-dawn and mid-morning hours, causing \$6.9 million in crop damage.

In Levy, Sumter, Citrus, Hernando and Pasco counties, low temperatures dropped into the upper teens and lower 20s with durations below freezing for up to nine hours. In Hillsborough, Polk, Hardee, DeSoto, and Highlands counties, low temperatures ranged from the low to middle 20s with durations below freezing for up to eight hours. The freeze caused nearly four million dollars' worth of damage to the tropical fish crop in Hillsborough County. In Pinellas, Manatee, Sarasota, Charlotte and Lee counties, low temperatures ranged from the middle 20s inland to the lower 30s along the immediate coast with durations below freezing for up to six hours. In Lee County, the freeze caused nearly 2.6 million dollars' worth of damage to the squash and cucumber crops. In Charlotte County, the freeze caused nearly 250 thousand dollars in damage to the pepper crop.

January 10, 2001: Freezing temperatures were observed over most of west central and parts of southwest Florida during the pre-dawn through mid-morning hours. In Levy, Sumter and Citrus counties, low temperatures dropped into the middle teens to the lower 20s with durations below freezing for up to nine hours. In mainly inland Hernando, Pasco, Hillsborough, Manatee and western Polk counties, low temperatures dropped into lower to middle 20s with durations below freezing for up to seven hours. In Hillsborough County, the freeze caused nearly four million dollars' worth of damage to the tropical fish

crop. In western Hardee, western DeSoto, eastern Sarasota, and northern Charlotte counties, low temperatures dropped into the upper 20s to lower 30s for durations below freezing of up to three hours.

January 23-25, 2003: A strong cold front ushered in cold temperatures and gusty northwest winds into the Florida peninsula, which created some of the coldest weather in several years. Wind chill temperatures ranged from 10 to 15 in Bronson, around 20 in Tampa and Lakeland, to 20 to 25 degrees in Fort Myers. Overnight low temperatures ranged from near 20 in the inland counties north to the upper 20s in the inland counties south, to the lower 30s along the coast near Fort Myers. A hard freeze (temperatures of 27 degrees or less for three or more hours) reached south into northeast Hillsborough and northern Polk counties. Citrus crops fared well because the freeze did not last long enough but strawberries took a \$4.5 million loss and tropical fish a \$4 million loss. Early morning low temperatures on January 24th dropped well below freezing across east central Florida. Temperatures ranged from 24 degrees in Leesburg and 25 in Daytona Beach to 29 in Melbourne and 27 in Orlando. To the south, Ft. Pierce and Vero Beach reported lows near 30. Later that morning, winds shifted off the ocean producing a few snowflakes in the coastal communities from Daytona Beach to Ft. Pierce. On January 25, arctic high pressure settled over the southeastern United States which maintained the clear and cold weather across the Florida peninsula. Overnight lows of 19 to 24 occurred from Bronson to Brooksville with temperatures in the 30s farther south. Northeast winds of 10 to 15 mph produced wind chills down to 25 degrees from Tampa to Lakeland to Fort Myers. Citrus crops fared well during the freeze but strawberries took an estimated \$4.5 million dollar loss and tropical fish an estimated \$4 million dollar loss.

d. Probability

Levy County has a history of freezes. Since 1950, there have been at least 47 recorded freezes. The return period for freezes in Levy County is approximately 1.3 years, therefore the probability of a freeze occurrence in the County is **Very High**.

9. DAM FAILURE

a. Location

Dam failure can also be the cause of flood damages. There are only 2 dams/spillways located within or in close proximity to the County (see Table VII-17 below and Map VII-7). The only dam posing a potential threat to Levy County is the Inglis Bypass Spillway Dam which confines the Withlacoochee River at Lake Rousseau. Dam failure at the Spillway Dam is expected to cause extensive property damage to riverfront and low-lying properties in Inglis and Yankeetown. However, the USGS Inventory of Dams consider both of the dams to be low hazards.

Table VII-6

Dam Name	NDID	County	River	Hazard
Inglis Spillway & Dam	FL00142	Citrus	Withlacoochee	L
Inglis Spillway & Dam	FL00141	Levy/Citrus	Withlacoochee	L

Source: USGS Dam Inventory

The dam hazard is a term indicating the potential hazard to the downstream area resulting from failure or mis-operation of the dam or facilities. According to the USGS National Inventory of Dams, there are 149 major dams in the state of Florida which have been identified by a hazard risk of low, significant and high.

- Low hazard: A dam where failure or mis-operation results in no probable loss of human life and low economic and/or environmental loss. Losses are principally limited to the owner's property.
- Significant hazard: A dam where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities or impact other concerns. These dams are often located in predominantly rural or agricultural area but could be located in areas with population and significant infrastructure.
- High: A dam where failure or mis-operation will probably cause loss of human life. (**Statewide Hazard Mitigation Plan, 2009**)

b. Extent

The Inglis Main Dam and Bypass Channel Dam Action Plan, prepared by SWFWMD (Dam Operator) and FDEP (Dam Owner) includes an examination of conditions resulting from dam failure. The reservoir capacity is **33,600 acre feet. In the event of Main Dam failure, it is estimated that approximately 100 properties (all in Inglis) would be inundated at 1 foot above finished floor elevation in about 4.25 to 6 hours.**

c. Historical Occurrences

There are no historical occurrences of dam failure.

d. Probability

Because there are no historical occurrences of dam failure, the probability of occurrence in Levy County is **Very Low.**