# SECTION III

# HAZARDS ANALYSIS

# A. BACKGROUND

In order to minimize the losses suffered from disasters we must have an understanding of the types and severity of hazards that have the potential to affect Hillsborough County. Although the losses cannot be totally eliminated much can be done to reduce the negative impact of a disaster. The Hazard Identification and Vulnerability Assessment is a tool used to gain the understanding needed to identify hazards, understand their potential severity and plan strategies to lessen the intensity, or mitigate, the damage due to the forces of and aftermath of a disaster. These mitigation strategies are used by the county to develop and maintain the county-wide program called the Local Mitigation Strategy (LMS). Using the LMS mitigation initiatives are determined and prioritized.

The Hazards Analysis includes types and severity of hazards and the areas and populations affected. The information was compiled by Hillsborough County Emergency Management, county and municipal planning departments, the Tampa Bay Regional Planning Council, Port Authority Tampa, National Weather Service, State of Florida DOT, U.S. Geological Survey, National Climatic Data Center, Local Mitigation Strategy Workgroup and other sources.

Consistent with Federal and State Plans and the County Comprehensive Emergency Management Plan (CEMP), the Hillsborough County LMS reflects an "All-Hazards" approach to mitigation. Consequently, the LMS Working Group researched technological, societal and natural hazards that may affect the county.

One of the important additions in this version was to address hazard impacts to vulnerable populations. Addressing the needs and challenges of vulnerable populations in Hillsborough County is essential in mitigation activities to increase the likelihood of improving public health objectives, prevent disaster-related economic costs, and reduce unnecessary loss of life. Vulnerable populations include low income areas, senior citizens, special needs populations, non-English speaking households, and residents living in manufactured homes.

The primary element of this section was the table (Table 3.1) created to give an overview of the probability, potential impact, frequency and distribution of the hazards that could affect the county. The Plan addresses those natural hazards as required by FEMA and the State of Florida. Based on meteorological, geological and topological research three of these hazards do not pose any significant threat to Hillsborough County. However, due to the specific vulnerability of the County to certain technological and societal hazards, five additional hazards were addressed including hazardous material incidents (both transportation and fixed facility), dam or levee failure, power failure and terrorism.

Due to the topography, and geography of Hillsborough County it was determined that landslides and volcanoes pose no threat to the county. It was also found that earthquakes and tsunamis pose little threat to the county and therefore will only have a limited profiled in the 2015 plan update."

## Hazard Event History

In order to gain an understanding of the potential risks faced by Hillsborough County, an understanding of what has previously occurred is necessary. The following tables indicates those events that have occurred, listed in reverse chronological order, since 2009. This time frame corresponds to the last update of the Hillsborough County Local Mitigation Strategy in 2009.

This table provides information on all the natural hazard risks potentially faced in Hillsborough County including; Blizzard, Cold/Wind Chill, Drought, Excessive Heat, Extreme Cold/Wind Chill, Freezing Fog, Frost/Freeze, Hail, Heat, Heavy Snow, Ice Storm, Lightning, Marine Hail, Thunderstorm Wind, Tornado, Wildfire, Winter Storm, and Winter Weather.

The hazards of Erosion, Sea level increase/climate change, and Sinkholes are not included in this data table as that data is not maintained by the National Oceanic and Atmospheric Administration National Climatic Data Center. Those hazard historical events will be detailed in the pages following the table.

A summary of events is provided followed by the chronological list.

### Summary of events 2009-2015

| | |
|---|---|
| Number of County/Zone areas affected: | 2 |
| Number of Days with Event: | 92 |
| Number of Days with Event and Death: | 3 |
| Number of Days with Event and Death or Injury: | 7 |
| Number of Days with Event and Property Damage: | 57 |
| Number of Days with Event and Crop Damage: | 3 |
| Number of Event Types reported: | 7 |

NOAA National Climatic Data Center, 2015

## Table 3.0: List of Recorded Natural Hazard Events January 1, 2009 – January 31, 2015

| Location | County | ST | Date | Time | Zone | Event Type | Magnitude | Deaths | Injuries | Prop. Damage $ | Crop Damage $ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (TPA)TAMPA INTL ARPT | HILLSBOROUGH CO. | FL | 12/21/2014 | 16:10 | EST-5 | Lightning | | 0 | 11 | 1.00K | 0.00K |
| BEACH PARK | HILLSBOROUGH CO. | FL | 08/24/2014 | 16:16 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 2.00K | 0.00K |
| (MCF)MC DILL AFB | HILLSBOROUGH CO. | FL | 08/24/2014 | 16:14 | EST-5 | Thunderstorm Wind | 53 kts. MG | 0 | 0 | 0.00K | 0.00K |
| TOWN N COUNTRY | HILLSBOROUGH CO. | FL | 08/22/2014 | 16:40 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 10.00K | 0.00K |
| BLOOMINGDALE | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:08 | EST-5 | Thunderstorm Wind | 45 kts. EG | 0 | 0 | 5.00K | 0.00K |
| LITHIA | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:08 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| BLOOMINGDALE | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:08 | EST-5 | Lightning | | 0 | 0 | 0.25K | 0.00K |
| RIVERVIEW | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:08 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 10.00K | 0.00K |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BOYETTE | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:08 | EST-5 | Thunderstorm Wind | 45 kts. EG | 0 | 0 | 0.50K | 0.00K |
| LITHIA | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:00 | EST-5 | Thunderstorm Wind | 45 kts. EG | 0 | 0 | 0.50K | 0.00K |
| BOYETTE | HILLSBOROUGH CO. | FL | 07/21/2014 | 16:00 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 0.50K | 0.00K |
| HILLSBOROUGH RIVER STATE | HILLSBOROUGH CO. | FL | 07/20/2014 | 14:25 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 5.00K | 0.00K |
| NOWATNEY | HILLSBOROUGH CO. | FL | 07/16/2014 | 09:45 | EST-5 | Lightning | | 0 | 0 | 100.00K | 0.00K |
| MACDILL AIR FORCE BASE | HILLSBOROUGH CO. | FL | 07/16/2014 | 09:30 | EST-5 | Lightning | | 0 | 1 | 0.00K | 0.00K |
| CORONET | HILLSBOROUGH CO. | FL | 07/11/2014 | 16:05 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| VALRICO | HILLSBOROUGH CO. | FL | 07/01/2014 | 16:17 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| SUN CITY CENTER | HILLSBOROUGH CO. | FL | 06/27/2014 | 17:30 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 10.00K | 0.00K |
| SUN CITY CENTER | HILLSBOROUGH CO. | FL | 06/27/2014 | 17:30 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| BEACH PARK | HILLSBOROUGH CO. | FL | 06/17/2014 | 18:03 | EST-5 | Thunderstorm Wind | 35 kts. EG | 0 | 0 | 0.50K | 0.00K |
| CARROLLWOOD | HILLSBOROUGH CO. | FL | 06/09/2014 | 14:23 | EST-5 | Lightning | | 0 | 0 | 800.00K | 0.00K |
| BOYETTE | HILLSBOROUGH CO. | FL | 05/30/2014 | 15:45 | EST-5 | Tornado | EF0 | 0 | 0 | 50.00K | 0.00K |
| TPA P O KNIGHT ARPT | HILLSBOROUGH CO. | FL | 05/29/2014 | 17:15 | EST-5 | Lightning | | 0 | 0 | 15.00K | 0.00K |
| CARROLLWOOD | HILLSBOROUGH CO. | FL | 05/29/2014 | 16:55 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| VALRICO | HILLSBOROUGH CO. | FL | 05/29/2014 | 16:25 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 0.10K | 0.00K |
| OLD PORT TAMPA PORTS SITE | HILLSBOROUGH CO. | FL | 05/28/2014 | 19:30 | EST-5 | Thunderstorm Wind | 50 kts. MG | 0 | 0 | 0.00K | 0.00K |
| LITHIA | HILLSBOROUGH CO. | FL | 05/28/2014 | 19:00 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 5.00K | 0.00K |
| (TPA)TAMPA INTL ARPT | HILLSBOROUGH CO. | FL | 05/28/2014 | 18:28 | EST-5 | Hail | 0.75 in. | 0 | 0 | 0.00K | 0.00K |
| LAKE MAGDALENE | HILLSBOROUGH CO. | FL | 05/26/2014 | 16:45 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 1.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| LAKE MAGDALENE | HILLSBOROUGH CO. | FL | 05/26/2014 | 16:30 | EST-5 | Hail | 0.75 in. | 0 | 0 | 0.00K | 0.00K |
| TAMPA | HILLSBOROUGH CO. | FL | 05/26/2014 | 16:30 | EST-5 | Lightning | | 0 | 0 | 10.00K | 0.00K |
| GROVE PARK ESTATES | HILLSBOROUGH CO. | FL | 05/25/2014 | 17:20 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 5.00K | 0.00K |
| TARPON | HILLSBOROUGH CO. | FL | 05/25/2014 | 17:19 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| PLEASANT GROVE | HILLSBOROUGH CO. | FL | 05/14/2014 | 16:00 | EST-5 | Lightning | | 1 | 0 | 0.00K | 0.00K |
| SNOWS CORNER | HILLSBOROUGH CO. | FL | 03/17/2014 | 15:05 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 1.00K | 0.00K |
| VALRICO | HILLSBOROUGH CO. | FL | 03/17/2014 | 14:55 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 1.00K | 0.00K |
| BRANDON ARPT | HILLSBOROUGH CO. | FL | 03/17/2014 | 14:50 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 1.00K | 0.00K |
| ADAMSVILLE | HILLSBOROUGH CO. | FL | 03/17/2014 | 14:45 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 1.00K | 0.00K |
| RIVERVIEW | HILLSBOROUGH CO. | FL | 03/17/2014 | 14:45 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 1.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| GOLDSTEIN | HILLSBOROUGH CO. | FL | 03/17/2014 | 14:00 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 2.00K | 0.00K |
| PALM RIVER | HILLSBOROUGH CO. | FL | 03/17/2014 | 13:15 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 1.00K | 0.00K |
| ROCKY CREEK | HILLSBOROUGH CO. | FL | 03/06/2014 | 12:38 | EST-5 | Tornado | EF0 | 0 | 0 | 0.00K | 0.00K |
| CARROLLWOOD | HILLSBOROUGH CO. | FL | 02/12/2014 | 18:00 | EST-5 | Lightning | | 0 | 0 | 10.00K | 0.00K |
| (MCF)MC DILL AFB | HILLSBOROUGH CO. | FL | 10/08/2013 | 14:24 | EST-5 | Tornado | EF0 | 0 | 0 | 0.00K | 0.00K |
| RUSKIN | HILLSBOROUGH CO. | FL | 09/06/2013 | 17:09 | EST-5 | Lightning | | 0 | 0 | 25.00K | 0.00K |
| BRANDON ARPT | HILLSBOROUGH CO. | FL | 08/22/2013 | 15:10 | EST-5 | Lightning | | 0 | 0 | 1.00K | 0.00K |
| THONOTOSASSA | HILLSBOROUGH CO. | FL | 08/20/2013 | 17:22 | EST-5 | Hail | 0.75 in. | 0 | 0 | 0.00K | 0.00K |
| TOWN N COUNTRY | HILLSBOROUGH CO. | FL | 08/20/2013 | 17:15 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 0.00K | 0.00K |
| SEFFNER | HILLSBOROUGH CO. | FL | 08/20/2013 | 16:32 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 0.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| SEFFNER | HILLSBOROUGH CO. | FL | 08/20/2013 | 16:30 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 2.00K | 0.00K |
| COSME | HILLSBOROUGH CO. | FL | 08/19/2013 | 17:40 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 0.00K | 0.00K |
| GROVE PARK ESTATES | HILLSBOROUGH CO. | FL | 08/09/2013 | 17:18 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 0.00K | 0.00K |
| PINECREST | HILLSBOROUGH CO. | FL | 08/09/2013 | 17:15 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 8.00K | 0.00K |
| ROCKY CREEK | HILLSBOROUGH CO. | FL | 08/09/2013 | 17:15 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 3.00K | 0.00K |
| (TPA)TAMPA INTL ARPT | HILLSBOROUGH CO. | FL | 08/09/2013 | 17:15 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 1.00K | 0.00K |
| BRANDON | HILLSBOROUGH CO. | FL | 08/03/2013 | 16:00 | EST-5 | Lightning | | 0 | 0 | 10.00K | 0.00K |
| RATTLESNAKE | HILLSBOROUGH CO. | FL | 07/17/2013 | 15:30 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 2.00K | 0.00K |
| BRANDON | HILLSBOROUGH CO. | FL | 07/17/2013 | 15:12 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 10.00K | 0.00K |
| PLANT CTY HILSBRO AR | HILLSBOROUGH CO. | FL | 07/17/2013 | 15:05 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 5.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| TARPON | HILLSBOROUGH CO. | FL | 07/17/2013 | 15:00 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 2.00K | 0.00K |
| SEFFNER | HILLSBOROUGH CO. | FL | 07/17/2013 | 15:00 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 5.00K | 0.00K |
| BLOOMINGDALE | HILLSBOROUGH CO. | FL | 07/05/2013 | 13:15 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 2.00K | 0.00K |
| TAMPA | HILLSBOROUGH CO. | FL | 07/04/2013 | 15:45 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 0.00K | 0.00K |
| REMLAP | HILLSBOROUGH CO. | FL | 07/04/2013 | 15:27 | EST-5 | Thunderstorm Wind | 40 kts. EG | 0 | 0 | 2.00K | 0.00K |
| TAMPA | HILLSBOROUGH CO. | FL | 06/26/2013 | 17:22 | EST-5 | Lightning | | 0 | 0 | 1.00K | 0.00K |
| SUN CITY CENTER | HILLSBOROUGH CO. | FL | 06/06/2013 | 14:47 | EST-5 | Tornado | EF0 | 0 | 0 | 36.00K | 0.00K |
| SEFFNER | HILLSBOROUGH CO. | FL | 05/20/2013 | 15:00 | EST-5 | Thunderstorm Wind | 45 kts. EG | 0 | 0 | 5.00K | 0.00K |
| SAFFOLD | HILLSBOROUGH CO. | FL | 05/01/2013 | 15:30 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| BOYETTE | HILLSBOROUGH CO. | FL | 04/04/2013 | 11:00 | EST-5 | Lightning | | 0 | 0 | 0.20K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 03/30/2013 | 11:00 | EST-5 | Wildfire | | 0 | 0 | 0.00K | 0.00K |
| TPA P O KNIGHT ARPT | HILLSBOROUGH CO. | FL | 02/26/2013 | 11:19 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 0.00K | 0.00K |
| CRUISE TERMINAL 2 PORT SITE | HILLSBOROUGH CO. | FL | 02/26/2013 | 11:12 | EST-5 | Thunderstorm Wind | 62 kts. MG | 0 | 0 | 0.00K | 0.00K |
| TPA P O KNIGHT ARPT | HILLSBOROUGH CO. | FL | 02/26/2013 | 11:12 | EST-5 | Tornado | EF0 | 0 | 0 | 35.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/18/2013 | 06:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 12/23/2012 | 00:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| BOYETTE | HILLSBOROUGH CO. | FL | 09/18/2012 | 13:42 | EST-5 | Thunderstorm Wind | 35 kts. EG | 0 | 0 | 1.00K | 0.00K |
| CRUISE TERMINAL 2 PORT SITE | HILLSBOROUGH CO. | FL | 08/27/2012 | 15:44 | EST-5 | Tornado | EF0 | 0 | 0 | 2.00K | 0.00K |
| TEMPLE TERRACE | HILLSBOROUGH CO. | FL | 08/21/2012 | 15:43 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| TPA P O KNIGHT ARPT | HILLSBOROUGH CO. | FL | 08/20/2012 | 21:30 | EST-5 | Thunderstorm Wind | 39 kts. EG | 0 | 0 | 1.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| PLANT CITY | HILLSBOROUGH CO. | FL | 08/14/2012 | 14:42 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| HARNEY | HILLSBOROUGH CO. | FL | 08/13/2012 | 13:15 | EST-5 | Lightning | | 0 | 0 | 385.00K | 0.00K |
| CARROLLWOOD | HILLSBOROUGH CO. | FL | 07/21/2012 | 17:45 | EST-5 | Thunderstorm Wind | 50 kts. EG | 0 | 0 | 5.00K | 0.00K |
| TARPON | HILLSBOROUGH CO. | FL | 07/10/2012 | 15:38 | EST-5 | Hail | 1.25 in. | 0 | 0 | 0.00K | 0.00K |
| SOUTH TAMPA | HILLSBOROUGH CO. | FL | 07/10/2012 | 15:00 | EST-5 | Thunderstorm Wind | 56 kts. EG | 0 | 0 | 150.00K | 0.00K |
| TARPON | HILLSBOROUGH CO. | FL | 07/09/2012 | 13:38 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| LUTZ TAMPA DOWNS ARP | HILLSBOROUGH CO. | FL | 06/24/2012 | 15:39 | EST-5 | Tornado | EF0 | 0 | 0 | 90.00K | 0.00K |
| ENON CHURCH | HILLSBOROUGH CO. | FL | 06/14/2012 | 16:15 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| CORONET | HILLSBOROUGH CO. | FL | 06/10/2012 | 18:16 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| SAFFOLD | HILLSBOROUGH CO. | FL | 03/04/2012 | 05:10 | EST-5 | Thunderstorm Wind | 45 kts. EG | 0 | 0 | 5.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/12/2012 | 23:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/12/2012 | 07:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/15/2012 | 03:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/04/2012 | 23:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/04/2012 | 01:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| SULPHUR SPGS | HILLSBOROUGH CO. | FL | 09/10/2011 | 10:45 | EST-5 | Lightning | | 1 | 0 | 0.00K | 0.00K |
| SULPHUR SPGS | HILLSBOROUGH CO. | FL | 07/08/2011 | 12:00 | EST-5 | Lightning | | 0 | 0 | 0.00K | 0.00K |
| PLANT CITY | HILLSBOROUGH CO. | FL | 06/17/2011 | 17:21 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| TEMPLE TERRACE | HILLSBOROUGH CO. | FL | 06/06/2011 | 18:05 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| OLD PORT TAMPA PORTS SITE | HILLSBOROUGH CO. | FL | 05/14/2011 | 13:52 | EST-5 | Thunderstorm Wind | 66 kts. MG | 0 | 0 | 0.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| SULPHUR SPGS | HILLSBOROUGH CO. | FL | 05/14/2011 | 13:40 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 7.00K | 0.00K |
| PORT OF TAMPA PORTS SITE | HILLSBOROUGH CO. | FL | 03/31/2011 | 10:40 | EST-5 | Tornado | EF1 | 0 | 0 | 1.580M | 0.00K |
| (MCF)MC DILL AFB | HILLSBOROUGH CO. | FL | 03/31/2011 | 10:31 | EST-5 | Thunderstorm Wind | 53 kts. MG | 0 | 0 | 0.00K | 0.00K |
| RATTLESNAKE | HILLSBOROUGH CO. | FL | 03/31/2011 | 10:30 | EST-5 | Tornado | EF1 | 0 | 0 | 2.270M | 0.00K |
| THONOTOSASSA | HILLSBOROUGH CO. | FL | 03/31/2011 | 07:45 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 0.00K | 0.00K |
| CHAPMAN | HILLSBOROUGH CO. | FL | 03/31/2011 | 07:38 | EST-5 | Tornado | EF0 | 0 | 0 | 20.00K | 0.00K |
| CITRUS PARK | HILLSBOROUGH CO. | FL | 03/31/2011 | 07:27 | EST-5 | Tornado | EF0 | 0 | 0 | 0.00K | 0.00K |
| ADAMSVILLE | HILLSBOROUGH CO. | FL | 01/25/2011 | 17:40 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 5.00K | 0.00K |
| TPA P O KNIGHT ARPT | HILLSBOROUGH CO. | FL | 01/25/2011 | 17:24 | EST-5 | Thunderstorm Wind | 52 kts. MG | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 12/14/2010 | 21:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 3.280M |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| SULPHUR SPGS | HILLSBOROUGH CO. | FL | 11/04/2010 | 04:55 | EST-5 | Lightning | | 0 | 0 | 10.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 09/12/2010 | 11:00 | EST-5 | Heat | | 1 | 0 | 0.00K | 0.00K |
| TAMPA INTERNATIONAL AIRPORT | HILLSBOROUGH CO. | FL | 08/02/2010 | 16:30 | EST-5 | Lightning | | 0 | 1 | 0.00K | 0.00K |
| WIMAUMA | HILLSBOROUGH CO. | FL | 08/01/2010 | 20:47 | EST-5 | Lightning | | 0 | 0 | 435.00K | 0.00K |
| LITHIA | HILLSBOROUGH CO. | FL | 07/29/2010 | 15:57 | EST-5 | Lightning | | 0 | 0 | 30.00K | 0.00K |
| ORIENT PARK | HILLSBOROUGH CO. | FL | 07/28/2010 | 15:02 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 10.00K | 0.00K |
| ORIENT PARK | HILLSBOROUGH CO. | FL | 07/28/2010 | 15:02 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| PALM RIVER | HILLSBOROUGH CO. | FL | 07/28/2010 | 15:01 | EST-5 | Thunderstorm Wind | 56 kts. EG | 0 | 0 | 7.50K | 0.00K |
| PALM RIVER | HILLSBOROUGH CO. | FL | 07/28/2010 | 15:00 | EST-5 | Thunderstorm Wind | 56 kts. EG | 0 | 0 | 15.00K | 0.00K |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| GARY | HILLSBOROUGH CO. | FL | 07/28/2010 | 15:00 | EST-5 | Thunderstorm Wind | 58 kts. EG | 0 | 0 | 0.00K | 0.00K |
| LEMANON CHURCH | HILLSBOROUGH CO. | FL | 07/15/2010 | 16:58 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 10.00K | 0.00K |
| PLANT CITY | HILLSBOROUGH CO. | FL | 07/15/2010 | 16:55 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 30.00K | 0.00K |
| EAST LAKE-ORIENT PARK | HILLSBOROUGH CO. | FL | 07/14/2010 | 16:30 | EST-5 | Lightning | | 0 | 0 | 1.50K | 0.00K |
| (MCF)MC DILL AFB | HILLSBOROUGH CO. | FL | 06/21/2010 | 17:22 | EST-5 | Thunderstorm Wind | 61 kts. MG | 0 | 0 | 0.00K | 0.00K |
| VALRICO | HILLSBOROUGH CO. | FL | 06/21/2010 | 17:07 | EST-5 | Thunderstorm Wind | 43 kts. EG | 0 | 0 | 2.00K | 0.00K |
| LAKE FERN | HILLSBOROUGH CO. | FL | 06/16/2010 | 14:48 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/26/2010 | 03:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 700.00K |
| TAMPA VANDENBERG ARP | HILLSBOROUGH CO. | FL | 02/05/2010 | 15:02 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 13 | 1.00K | 0.00K |
| CLARKWILD | HILLSBOROUGH CO. | FL | 01/22/2010 | 01:28 | EST-5 | Thunderstorm Wind | 43 kts. EG | 0 | 0 | 3.00K | 0.00K |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/10/2010 | 21:00 | EST-5 | Frost/freeze | | 0 | 0 | 3.020M | 5.280M |
| ROCKY CREEK | HILLSBOROUGH CO. | FL | 07/27/2009 | 10:27 | EST-5 | Tornado | EF0 | 0 | 0 | 0.00K | 0.00K |
| PROGRESS VLG | HILLSBOROUGH CO. | FL | 07/19/2009 | 15:30 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 4.00K | 0.00K |
| SEFFNER | HILLSBOROUGH CO. | FL | 07/01/2009 | 07:00 | EST-5 | Thunderstorm Wind | 43 kts. EG | 0 | 0 | 10.00K | 0.00K |
| RIVERVIEW | HILLSBOROUGH CO. | FL | 07/01/2009 | 06:48 | EST-5 | Tornado | EF0 | 0 | 0 | 5.00K | 0.00K |
| CARROLLWOOD | HILLSBOROUGH CO. | FL | 06/30/2009 | 14:05 | EST-5 | Tornado | EF0 | 0 | 0 | 20.00K | 0.00K |
| RIVERVIEW | HILLSBOROUGH CO. | FL | 06/18/2009 | 15:15 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 30.00K | 0.00K |
| RIVERVIEW | HILLSBOROUGH CO. | FL | 06/18/2009 | 15:11 | EST-5 | Hail | 0.75 in. | 0 | 0 | 0.00K | 0.00K |
| LITHIA | HILLSBOROUGH CO. | FL | 06/17/2009 | 19:45 | EST-5 | Lightning | | 0 | 0 | 20.00K | 0.00K |
| LUTZ | HILLSBOROUGH CO. | FL | 06/17/2009 | 17:26 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LUTZ | HILLSBOROUGH CO. | FL | 06/17/2009 | 16:35 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| LUTZ | HILLSBOROUGH CO. | FL | 06/17/2009 | 16:12 | EST-5 | Hail | 0.88 in. | 0 | 0 | 0.00K | 0.00K |
| BRANCHTON | HILLSBOROUGH CO. | FL | 06/02/2009 | 18:35 | EST-5 | Hail | 0.75 in. | 0 | 0 | 0.00K | 0.00K |
| LUTZ | HILLSBOROUGH CO. | FL | 05/24/2009 | 16:19 | EST-5 | Thunderstorm Wind | 43 kts. EG | 0 | 0 | 52.50K | 0.00K |
| HARNEY | HILLSBOROUGH CO. | FL | 05/13/2009 | 17:33 | EST-5 | Tornado | EF0 | 0 | 0 | 75.00K | 0.00K |
| TEMPLE TERRACE | HILLSBOROUGH CO. | FL | 05/13/2009 | 17:30 | EST-5 | Thunderstorm Wind | 52 kts. EG | 0 | 0 | 0.00K | 0.00K |
| ORIENT PARK | HILLSBOROUGH CO. | FL | 05/13/2009 | 17:20 | EST-5 | Hail | 1.00 in. | 0 | 0 | 0.00K | 0.00K |
| LAKE FERN | HILLSBOROUGH CO. | FL | 04/14/2009 | 07:48 | EST-5 | Thunderstorm Wind | 59 kts. EG | 0 | 0 | 0.00K | 0.00K |
| MORICZVILLE | HILLSBOROUGH CO. | FL | 03/29/2009 | 08:36 | EST-5 | Hail | 0.75 in. | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/21/2009 | 04:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/05/2009 | 23:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 02/05/2009 | 01:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/23/2009 | 01:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/21/2009 | 23:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| HILLSBOROUGH (ZONE) | HILLSBOROUGH (ZONE) | FL | 01/21/2009 | 05:00 | EST-5 | Frost/freeze | | 0 | 0 | 0.00K | 0.00K |
| **Totals:** | | | | | | | | 3 | 26 | 9.517M | 9.260M |

NOAA National Climatic Data Center, 2015

## TABLE 3.1: HAZARDS PROBABILITY ANALYSIS MATRIX

| Hazard\Risk Natural | Probability | Impact | Frequency | Distribution |
|---|---|---|---|---|
| CAT 1-2 Hurricanes (Minor)\ Tropical Storms | High | Structural impact to buildings ranging from light to severe. Older structures could be completely destroyed. Agricultural impacts with damage to crops. | 3-5 years | Areas closer to the coast more susceptible but winds throughout county can occur. Map depicts areas of strongest winds. |
| CAT 3-5 Hurricanes (Major)\ Tropical Storms | Moderate | Structures destroyed and infrastructure damaged. Agricultural impacts with crops being destroyed. | 5-10 years | Areas closer to coast but stronger storms could penetrate farther inland. |
| Drought | Low | Agricultural losses; non structural | Less than 1 per 5 years | Countywide |
| Erosion | | | | |
| Coastal | Moderate | Beach degradation | 10-15 years | Limited to western border of unincorporated county areas and coastal areas of Tampa |
| Riverine | Moderate | Structural damage; Collapse, relocation | 5-10 years | Areas adjacent to rivers such as Hillsborough, Alafia and Little Manatee |
| Suspect Soil | | | | |
| Karst | Moderate | Minor | Several a Year | Countywide |
| Sinkholes | Moderate | Minor | 3+ per year | Countywide; Principally north of Alafia River |
| Subsidence | Moderate | Minor | Several a Year | Countywide; Little Manatee/Ruskin inlet |
| Muck Soil | Moderate | Minor | Several a Year | Countywide |

Indicates inclusion of climate change on risk

Indicates consideration of possible effects

## TABLE 3.1: HAZARDS PROBABILITY ANALYSIS MATRIX (CONTINUED)

| Hazard\Risk Natural | | Probability | Impact | Frequency | Distribution |
|---|---|---|---|---|---|
| Thunderstorm | | High | Damage to buildings, localized flooding | Annually | Countywide |
| | Lightning | High | Damage to buildings and people | Annually | Countywide |
| | Hail | Low | Damage to buildings and people | Annually | Countywide |
| Tornadoes | | Low | Localized but high level of destruction | 3-5 years | Countywide |
| Tsunami | | Low | Coastal Structures and natural resources damaged or destroyed | Very infrequent | Would affect large region statewide. Some areas of the state have been listed as Tsunami Ready by the National Weather Service. |
| Wildfire | | High | Damage\loss to both natural and human made environment | 5+ per year | Localized on urban fringe but can occur countywide based on presence of natural vegetation. |
| Winter Storm | | Low | Agricultural resources affected. Structures not typically impacted as temperature do not reach low enough levels | 3-4 years | Countywide |
| Earthquake | | Low | Very minor | 2-3 mild tremors reported each decade | Countywide |
| Landslide | | Due to the topography and geography of Hillsborough County it was determined that landslides pose no threat to the county. | | | |
| Volcano | | Due to the topography and geography of Hillsborough County it was determined that landslides pose no threat to the county. | | | |

Indicates inclusion of climate change on risk

Indicates consideration of possible effects

## TABLE 3.1: HAZARDS PROBABILITY ANALYSIS MATRIX (CONTINUED)

| Hazard\Risk Technological | | Probability | Impact | Frequency | Distribution |
|---|---|---|---|---|---|
| Civil Disturbance | | Low | Moderate | Infrequent | Countywide |
| Dam/Levee Failure | | Low | Localized | Very infrequent | Countywide |
| Hazardous Material | | | | | |
| | Fixed Facility | Low | Localized | Infrequent | Countywide |
| | Transportation | Low | Area of incident | Low | Countywide |
| | Port Vessel Collision-Coastal Oil Spill | Low | Port area | Infrequent | Countywide |
| Mass Migration | | Low | Countywide | Very infrequent | Countywide |
| Nuclear Power Plant | | Low | Radiation would travel by air, affect entire county | Very infrequent | Countywide |
| Pandemic and Health | | Low | Countywide | Very infrequent | Countywide |
| Terrorism/Cyber | | Low | Localized | Very infrequent | Countywide |
| Transportation | | | | | |
| | Air | Low | Localized to impact area | Very infrequent | Countywide |
| | Rail | Low | Localized to impact area | Very infrequent | Countywide |
| | Sea | Low | Localized to impact area | Very infrequent | Countywide |

Indicates inclusion of climate change on risk

Indicates consideration of possible effects

## TABLE 3.1: HAZARDS PROBABILITY ANALYSIS MATRIX (CONTINUED)

| Hazard\Risk Technological | | Probability | Impact | Frequency | Distribution |
|---|---|---|---|---|---|
| Utility Failure | | | | | |
| | Power Outage | Moderate | Moderate in rural areas, greatest impact in high density areas | Unknown | Localized specific to event |
| | Potable Water Sanitary Sewer | Moderate | Moderate in rural areas, greatest impact in high density areas | Unknown | Localized specific to event |
| | Communication | Low | Moderate in rural areas, greatest impact in high density areas | Unknown | Localized specific to event |
| | Infrastructure | Low | Moderate in rural areas, greatest impact in high density areas | Unknown | Localized specific to event |

Indicates inclusion of climate change on risk

Indicates consideration of possible effects

## TABLE 3.2: HAZARDS VULNERABILITY BY JURISDICTION

| Hazards – Natural | Hillsborough County | Tampa | Temple Terrace | Plant City |
|---|---|---|---|---|
| Coastal /Riverine Erosion | L | H | L | L |
| Category 1-2 Hurricane (Minor) /Tropical Storm | H | H | H | H |
| Category 3-5 Hurricane (Major) /Tropical Storm | M | M | M | M |
| Drought | M | M | M | M |
| Extreme Heat | L | L | L | L |
| Flooding (FEMA FIRM Zones) | H | H | M | M |
| Sinkholes | M | L | L | L |
| Thunderstorms | H | H | H | H |
| Tornadoes | H | H | H | H |
| Tsunami | *** | * | *** | * |
| Wildland Fires | M | L | L | L |
| Winter Storm | L | L | L | L |
| **Hazard – Technological** | | | | |
| Hazardous Materials | M | M | M | M |
| Hazardous Materials Fixed Facility | M | M | L | M |
| Dam/Levee Failure | M | L | L | N |
| Port Vessel Collision or On-Water Hazardous Materials Spill | L | L | L | N |
| Utility Failure/Power Outages | M | M | H | M |
| Terrorism | M | M | L | M |

Jurisdictions with significant coastal areas

Inland communities with some chance of flooding

*** Due to a lack of historical data, the probability, frequency, impact and location of these hazards cannot be quantified. While there is always a statistical probability of occurrence, based on the historical record, these events may not pose a hazard to Hillsborough County and will not be fully profiled

**H** = High: Most of the population affected, major damage to old, poorly maintained, and mobile home structures, some damage to newer structures built to code likely.
**M** = Moderate: Around 50% of the population affected, mobile homes and poorly built or maintained structures most at risk.
**L** = Low: Special portions of the population affected, day-to-day operations not affected, minor cosmetic damage expected to some structures.
**N** = Not a threat.

## 1. NATURAL HAZARDS

Severe weather events are a likely occurrence in the Tampa Bay area. The same tropical climate that attracts people from all over the world to live, work and visit Hillsborough County also offers sporadic tropical storms, tornadoes and flooding events. While the County rarely deals with snow, sleet or ice, winter storms and freezes can significantly impact the agricultural industry and coastal communities. As Hillsborough County grows the development within coastal and riverine areas become more populated and the consequences of storms and other hazards impact more people and the consequences are more severe.

In response and in an effort to prepare and protect its citizens Hillsborough County has developed the Local Mitigation Stagey (LMS). The purpose of the LMS planning process is to identify these hazards and develop cost-effective mitigation strategies to reduce the risk to our community.

Table 3.3 quantifies historical losses from the major natural hazards in Hillsborough County and provides an annual estimate of loss based on the historical frequency of the event. The data was obtained from the on-line National Climate Center Database. Although the database may not include all storm events it is one of the most comprehensive and complete sources of hazard information available. It also provides sufficient information to assess relative hazard impacts on Hillsborough County.

### TABLE 3.3: SEVERE WEATHER OCCURRENCES 1950-2008

| *First Year | Hazard | # of Events | Deaths | Injuries | Property Damage | Crop Damage |
|---|---|---|---|---|---|---|
| 1994 | Funnel Cloud | 8 | 0 | 0 | $0 | $0 |
| 1958 | Hail | 248 | 0 | 0 | $1,175,000 | $15,300,000 |
| 1995 | Hurricane | 18 | 1 | 10 | $470,323,000 | $15,025,000 |
| 1994 | Lightning | 75 | 7 | 54 | $3,330,000 | $0 |
| 1994 | Open Surf | 9 | 4 | 0 | $5,900,000 | $0 |
| 1995 | Precipitation/ Thunderstorms/ High Winds | 23 | 0 | 0 | $11,000 | $0 |
| 1955 | | 364 | 1 | 26 | $16,302,000 | $17,015,000 |
| 1951 | Tornado | 126 | 1 | 129 | $23,882,000 | $0 |
| 1993 | Waterspout | 14 | 0 | 0 | $1,000,000 | $0 |
| 1999 | Wild Fires | 3 | 0 | 2 | 0 | $0 |
| 1996 | Fog | 51 | 1 | 30 | $850,000 | $0 |
| 1993 | Flood | 72 | 1 | 2 | $20,865,000 | 4,401,000 |
| | **Total Events** | **1,011** | **16** | **253** | **$543,638,000** | **$47,741,000** |

** Year in which data first appears in the National Climate Center Database*

***Note**: Not all hazards listed in Table 3.3 are hazards that affect Hillsborough County. The table is included for informational purposes in its entirety.*

## TABLE 3.4: SEVERE STORM EVENTS FREQUENCY

| Total Events Reported | Hazard | Year | Death | Injury | Property Damage | Crop Damage |
|---|---|---|---|---|---|---|
| 8 | Funnel Cloud | 0.53 | 0 | 0 | $0 | $0 |
| 248 | Hail | 6.05 | 0 | 0 | $4,738 | $61,944 |
| 18 | Hurricane | 1.29 | 0.06 | 0.56 | $26,129,056 | $834,722 |
| 75 | Lightning | 5 | 0.09 | 0.72 | $44,400 | $0 |
| 9 | Open Surf | 0.6 | 0.44 | 0 | $655,556 | $0 |
| 23 | Precipitation | 1.64 | 0 | 0 | $478 | $0 |
| 364 | Thunderstorms | 8.27 | 0 | 0.07 | $44,786 | $46,745 |
| 126 | Tornado | 2.63 | 0.01 | 1.02 | $189,540 | $0 |
| 14 | Waterspout | 0.88 | 0 | 0 | $71,429 | $0 |
| 3 | Wild Fires | 0.3 | 0 | 0.67 | $0 | $0 |
| 51 | Fog | 3.92 | 0.02 | 0.59 | $16,667 | $0 |
| 72 | Flood | 4.5 | 0.01 | 0.03 | $289,792 | $5,569 |

**Source:** National Climate Center Database (2009). Retrieved from http://www.ncdc.noaa.gov/cgiwin/wwcgi.dll?wwEvent%7EStorms.

The following natural hazards and mitigation techniques are applicable to all county jurisdictions. However, not all mitigation techniques have been included as projects within Appendix G in categorized objectives.

### a. Coastal or Riverine Erosion

Description / Background: coastal or riverine erosion is defined as the gradual wearing away of the earth's surface by the natural forces of wind and water. In Hillsborough County, erosion along Tampa Bay and river shorelines is most noticeable after a significant rain and/or tidal surge event. Although this is a natural effect, shoreline development is at risk when erosion occurs at a rate greater than the natural rate of soil replenishment.

Location / Risk Assessment: areas of greatest risks of erosion were identified within the applicable Local Government Comprehensive Plans as Coastal High Hazard Areas. These areas are found along the Hillsborough, Alafia, Little Manatee Rivers, associated tributaries and areas illustrated as being within the velocity zones on the Federal Insurance Rate Maps.

Erosion principally affects structures through deteriorating the structural integrity of buildings by undermining the foundation or associated pilings/piers.

History of Events: In May of 2012 during tropical storm Debbie and again in June 2013 during tropical storm Andrea, Bayshore Boulevard had water covering both the north and south lanes. In Hillsborough County frequent wind gusts of up to 51 MPH were measured by the Automated Weather Observing System (AWOS) located at MacDill Air Force Base. Storm total rainfall of greater than 5 inches fell across the county, with the highest report of 11.91 inches at the CoCoRaHS site near Citrus Park. 74 buildings sustained damage with 6 being completely destroyed and damage to public buildings totaled four-hundred-forty nine thousand dollars. The tide gauge at Old Port Tampa measured a peak tide of 5.42 feet. Subtracting the predicted astronomical tide, the highest storm surge was calculated as 3.97 feet late in the evening of the 25th. The tide gauge at McKay Bay measured a peak tide of 4.43 feet MLLW. Subtracting the predicted astronomical tide, the highest storm surge was calculated as 4.07 feet. Storm surge water flooded Bay Shore Boulevard for three days.

Probability: erosion rates and occurrences vary by area and with time. Based on historical trends coastal erosion occurs every 3-6 years.

Severity of Event and Consequences: while erosion itself is not an imminent threat to public safety it does impact the quality of life negatively by causing damage to buildings, roads/bridges and infrastructure. Because of the relationship of flooding to erosion, the same structures affected by one are affected by the other. A worst-case scenario would be a pounding of the coastline from a category 3, 4, or 5 hurricanes that was motionless or moving at a very slow forward speed on a parallel line to the west coast of Florida. Past events, i.e. Hurricane Elena, have caused significant erosion at certain locations outside of Hillsborough County. Although damages to the Gulf Coast are estimated at $1.25 billion (1982 USD) mainly in the form of property damage and beach erosion, Hillsborough County damages were principally from flooding associated with coastal storm surge, which was equivalent to a tropical storm or minor hurricane. Impacts resulted in property damage and economic impacts at the Port of Tampa (Wikipedia). Hillsborough County has 158.27 miles of shoreline that could potentially experience erosion in a storm. In areas where mangrove stands front the bay, waves with heights of 3 feet or greater are dissipated within approximately 200 feet of the shoreline (*Flood Insurance Study, Hillsborough County, Florida and Incorporated Areas, Vol. 1 of 5).*

After the 2004 tropical hurricane events, the Hillsborough County Parks, Recreation and Conservation Department did request funding to assist with minor repairs (1,700 cubic yards of sand) associated with shore restoration of a park. Such minor losses could be expected in the future.

Pursuant to the Flood Insurance Study for Hillsborough County published by the Federal Emergency Management Agency, the County has 17 major watershed basins with no less than 14 riverine systems that account for more than 700 linear miles of floodway that are potentially susceptible to erosion. No severe erosion has occurred within riverine systems due to any one hurricane. See Severity of Event/Consequences for flooding for more information.

Impacts: The impact of erosion in the last five years in Hillsborough County has been felt in two areas; coastal areas and the riverine areas. In the coastal areas, the significant impacts have been recognized at two County parks; the Apollo Beach Nature Preserve and E. G. Simmons. Each of these respective parks is part of a major reconstruction project to address previous natural impacts including erosion.

Existing land uses within the coastal planning area include residential, commercial, industrial, public facilities, natural, agricultural, vacant and mining areas. An analysis of the existing land uses indicates that the residential land use (single and multifamily) is 20% or 25,502 acres of the total existing land uses within the county's coastal planning area. Primary concentrations of residential uses occur in the land mass south of Gunn Highway, south to Tampa Bay, then south of Palm River and west of I-275, Riverview/Gibsonton located along the Alafia River, and the Ruskin and Wimauma area in the southern portion of the county. Many of the areas are often either on low, flood prone uplands, or on land made as the result of dredge and fill operations. Concentrations of this type of development are especially prevalent in the areas of Town and Country, Clair Mel City, Apollo Beach, and Bahia Beach. Problems that are common to these areas are periodic flooding, cumulative adverse impacts to wetlands, soil erosion, non-functioning septic systems, and reduced public access to the shoreline. Although additional development is anticipated, area wide planning process requirements will mitigate the impacts to public facilities and concentrate growth in defined limits (2008, Future of Hillsborough Comprehensive Plan for Unincorporated Hillsborough County, FL Coastal Management). Riverine areas are at risk to the impact of erosion with communities in unincorporated areas of East Hillsborough County including Plant City, Zephyrhills and Thonotosassa are at high risk. Communities in the south east portion of Hillsborough County are at risk as well including Apollo Beach, Riverview, and Gibsonton.

Commercial development in the unincorporated Hillsborough Count coastal planning area is not extensive, encompassing only 6,539 acres or 5% of the Hillsborough County Coastal Management total coastal planning area. Most commercial uses are neighborhood in scale, and do not serve as an attraction for future development in the coastal zone. The Hillsborough Avenue/Memorial Highway area is experiencing extensive commercial development activity, primarily because of the continued residential development in Town n' County and the area's proximity to Pinellas County. Commerce has not served as an attraction to development; rather, it has followed the demand created in that area by residential development.

Approximately 30% or 37,208 acres of the land uses within the coastal planning area are devoted to facilities such as electrical power generating and transmission facilities, wastewater treatment and disposal facilities, governmental complexes, schools, churches, recreating and open space lands, streets and rights-of-way. Much of the heavy industrial development is located in coastal planning areas of Hillsborough County (2008, Future of Hillsborough Comprehensive Plan for Unincorporated Hillsborough County, FL Coastal Management.

Mitigation: while the County has miles of coastline, a large majority of the developed coastal shoreline has been hardened by seawalls. The seawalls, while not an environmentally preferred mitigation option, do minimize erosion from minor to moderate flooding events.

Strategies to protect the more pristine coastal areas of the community against erosion include: acquisition of sensitive coastal areas through either the county-wide Environmental Lands Acquisition Preservation Program or various state programs such as Florida Forever; adherence to current engineering standards, vegetation and setbacks. Having a greater coastal land area will protect flooding and erosion further inland.

**HOMEOWNER MITIGATION**

If flooding occurs:

- Stay away from flood-prone areas, including dips, low spots, valleys, ditches, washes, etc. Get to higher ground.
- Avoid flooded areas or those with rapid water flow. Do not attempt to cross a flowing stream. It takes only six inches of fast flowing water to sweep you off your feet.
- Do not allow children to play near high water, storm drains or ditches. Hidden dangers could lie beneath the water.
- NEVER drive through floodwaters or on flooded roads. Water only two feet deep can float away most automobiles.
- Do not camp or park your vehicle along streams and washes, particularly when threatening conditions exist.
- Use extreme caution at night when it is harder to recognize flood dangers.
- Purchase and monitor a NOAA All-Hazards weather radio or visit www.flashweatheralerts.org to download a severe weather alerts App for your iOS or Android powered device

## b. Hurricanes and Tropical Storms

Description / Background: hurricanes and tropical storms are characterized by torrential rainfalls, tidal flooding and damaging winds can spawn severe thunderstorms, lighting and tornadoes. Tropical storms and hurricanes are differentiated by the intensity of the storm, typically measured by wind speed and wave height based on the Saffir-Simpson Hurricane Wind Scale.

## TABLE 3.5: SAFFIR-SIMPSON HURRICANE WIND SCALE

| Category | Wind Speed (MPH) | Storm Surge (ft.)* | Summary |
|---|---|---|---|
| **5** | ≥156 | >18 | Catastrophic damage will occur |
| **4** | 131–155 | 13–18 | Catastrophic damage will occur |
| **3** | 111–130 | 9–12 | Devastating damage will occur |
| **2** | 96–110 | 6–8 | Very dangerous winds will cause extensive damage |
| **1** | 74–95 | 4–5 | Very dangerous winds will produce some damage |
| **Tropical Storm** | 39–73 | 0–3 | |
| **Tropical Depression** | 0–38 | 0 | |

**Source**: NOAA. (2013). Saffir-Simpson Hurricane Wind Scale. Retrieved from http://www.nhc.noaa.gov/aboutsshws.php.

* While the Saffir-Simpson Hurricane Wind Scale no longer specifically identifies storm surge (Schott, et al, 2012), storm surge estimates have been provided in the table as a general reference.

The scale does not address the potential for other hurricane-related impacts (i.e., storm surge, rainfall-induced floods, and tornadoes) simply wind-caused damage that are dependent on local building codes in effect and how well and how long they have been enforced. For example, building codes enacted during the 2000s in Florida are likely to reduce the damage to newer structures. Hurricane wind damage is dependent on factors such as duration of winds, change of wind direction, and age of structures.

The three major hazards produced by hurricanes and tropical storms are the storm surge, high winds and large rainfall.

Storm surge is the rise in water level in coastal areas caused by the wind and pressure forces of a hurricane. The more intense the hurricane the higher the surge will be. The output of the National Oceanic and Atmospheric Administration (NOAA) storm surge prediction model SLOSH shows that storm surge height of 28 feet or more above sea level could impact certain coastal and river areas under a “worst case” Category 5 hurricane.

The high winds of a hurricane also present significant dangers to the populace. This hazard especially applies to structures unable to withstand the stress and uplift forces from hurricane force winds ranging from 74 to more than 155 miles per hour. Structures most vulnerable to hurricane force winds are manufactured homes and substandard housing. In addition, hurricane winds can create hazardous conditions from flying glass from high-rise buildings and homes unprotected by shutters or plywood boarding.

Rainfall varies with hurricane size, forward speed, and other meteorological factors. Residents must be aware of flooding that may result from a hurricane especially along rivers that are major drainage systems and low-lying areas. Heavy rainfall may continue after the hurricane loses strength. The rainfall associated with a hurricane is from 6 to 12 inches on average with higher amounts common.

Historically, hurricanes and tropical storms are the natural disasters that pose the greatest threat to Florida including Hillsborough County. They have caused the greatest amount of property damage and as more people move to Hillsborough County and more development takes place the potential for hurricane-related deaths and damages, increases each year.

Location / Risk Assessment: the principle tool for analyzing the expected hazards from potential hurricanes that may affect the Tampa Bay Region is the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) numerical storm surge model. The SLOSH model predicts the tidal surge heights that result from test data about hypothetical hurricanes and tropical storms with various combinations of pressure, size, forward speed, track and winds. Coastal areas are most vulnerable to the greatest storm surge, high winds and rainfall impacts; however the entire county is vulnerable to at least high rains and winds.

The vulnerability of Hillsborough County to potential hazards from hurricanes and tropical storms is analyzed prior to each storm. The population at risk and potential for property/economic damages is based on the specific characteristics of the threatening hurricane.

Coastal population are the most at-risk and these coastal areas of Hillsborough County including Westshore, Town & Country, Gibsonton, Apollo Beach, Ruskin, South Tampa and the downtown area including Ybor City, Davis Island, Channelside and the MacDill Air Force Base are most vulnerable. Populations along the Alafia, Hillsborough, and Little Manatee River floodplains are at highest risk of storm surge, rainfall impacts and high wind during a hurricane. These communities are located in the Level A and B evacuation zones near coastal areas of Hillsborough County.

In the event of a Category 5 Hurricane as determined by the Tampa Bay Regional Planning Council in its *2009 Economic Analysis of a Hurricane Event in Hillsborough County, Florida*, industries that will experience the highest number of employee loss include health care, retail trade, administrative and waste services, finance and insurance, and professional and technical services.

Businesses and structures in the downtown Tampa area are vulnerable to hurricanes due to their location on the bay. Many major businesses that are located in the coastal areas that are susceptible to hurricanes include the Tampa Bay Port Authority, Tampa International Airport (TIA), Tampa General Hospital, the Westshore business district, retail stores and restaurants located along these waterways and coastal areas of Hillsborough County. Businesses need to take into consideration the possibility of an interruption in the production of products or services leading to a disruption in the economic activity in these communities specifically and throughout Hillsborough County.

History of Events: because of its unique geographical location and configuration Florida is the most hurricane-prone state in the country. Hurricanes and tropical storms are the greatest natural disaster threat to Hillsborough County.

- The hurricane of record for the 20th century in Tampa Bay was in October 1921 when a Category 3 hurricane passed within 30 miles of Tampa and Hillsborough County causing six deaths and $1 million dollars in damage. Two other hurricanes of note hit Tampa Bay within two and a half weeks of each other in September-October 1948 causing 10 and 15 feet of storm surge.

- September 1985 - Elena threatened the area and caused the Tampa Bay region to conduct a major evacuation of over 500,000 people. In October 1993 the county sustained substantial flooding from Tropical Storm Josephine. Although Hurricane Georges caused a mandatory evacuation of coastal areas and manufactured homes in September 1998, it caused minimal damage. A total of six hurricanes/tropical storms threatened the City from 1995 - 2001 resulting in voluntary evacuation advisories. None of these storms made direct hits, so minimal to no damage resulted. The storms were as follows: Tropical Storm Erin (August 1995), Hurricane Floyd (September 1999), Tropical Storm Harvey (September 1999), Hurricane Irene (October 1999), Hurricane Gordon (September 2000) and Hurricane Gabrielle (2001).

- 2004 hurricane season - unprecedented in modern times in Florida. Hurricanes Charley, Frances, Ivan and Jeanne as well as Tropical Storm Bonnie all hit Florida within a 48 day span - the most tropical activity in one state in 120 years. All four hurricanes either threatened or came close to striking the City of Tampa. Two of the storms, Frances and Jeanne, traversed through the County after making landfall on the East Coast. Both West Coast storms, Charley and Ivan, were projected to directly impact Tampa as they approached Florida. However, Charley struck south of the County and Ivan passed to the west and impacted the northern Gulf Coast. Both of these storms made landfall as Category 4 Hurricanes. Frances and Jeanne caused substantial damage with flooding, extensive amount of debris and significant power outages, though no winds were recorded in the hurricane force category.

- October 24, 2006 - Hurricane Wilma produced tropical force winds for much of southwest and west central Florida. However, much of the damage was limited to downed tree limbs and localized flooding. In Hillsborough County, a Florida mesonet station in Balm recorded a peak wind of 51 MPH at 745 AM EDT. Other peak wind gusts included 44 MPH at the Tampa International Airport and 43 MPH at the MacDill Air Force Base. As of November 18th there were 381 insurance claims that totaled $127,000.

- June 13, 2006 - Tropical Storm Alberto became a storm north of the Yucatan Peninsula on June 11 and made landfall in the Big Bend area of Florida on June 13. The center of Tropical Storm Alberto moved from about 350 miles west of Fort Myers on the morning of August 12 to about 80 miles west of Cedar Key on the morning of August 13. Alberto brought widespread rains of 2 to 5 inches with isolated 7 inches to west central and southwest Florida. In Hillsborough County,

a peak wind gust from the southwest of 49 knots (56 MPH) at 2:37 AM EDT was recorded at the MacDill Air Force Base (KMCF). The storm surge was 3.28 feet at McKay Bay and 2.75 feet at the Old Port Tampa COMPS station. The overspray from the surge combined with fresh water flooding closed parts of Bay Shore Blvd.

- 2012 and 2014 – Hillsborough County was slightly impacted by rainfall and a minor stormsurge during 2012 and 2014 with Tropical Storms Debby and Andrea. Tropical Storm Debby created isolated significant inland flooding situations; whereby, some structures within the University of South Florida area did receive flooding. Flooding within this area to storms less than the one-percent storm will be minimized in the future due to a stormwater project that was completed after 2012. During Tropical Storm Andrea, approximately 3,000 "properties" were slightly affected by coastal stormsurge. However, no structures were identified as having flood water within structures. Additionally, during 2012 and while the Republican National Conference was in process, Hurricane Isaac did come in close proximity to the Tampa Bay area; however, impacts were minor.

Probability: More than 37 hurricanes and tropical storms have passed within 60 nautical miles of Tampa Bay since 1871, which equates to an occurrence every 3.62 years. It is considered that the occurrence of a hurricane in the Tampa Bay area on an annual basis is high.

The coastal regions of the United States are associated with intense winds from tropical storms and thunderstorms. It is not uncommon to have winds exceed 100 mph within these areas. Florida, including Tampa Bay, is susceptible to winds of greater than 100 mph on a regular basis. According to data from the 1982 American National Standards Institute, the Tampa Bay area is identified as having winds in excess of 100 mph return at an annual probability of 0.2% (a 50 year storm event). The probability is greater for an occurrence of a storm with 70 mph winds.

Severity of Event / Consequences: using the 2003 Hurricane Evacuation Zones some of the major commercial, industrial and residential areas impacted would include:

- Category 1 storm: Rocky Point; the western, southern and eastern edges of the Interbay Peninsula including portions of MacDill Air Force Base, Davis Island, Harbour Island; Hookers Point, Port Sutton, Riverview, Gibsonton, Big Bend, Apollo Beach, Ruskin, and portions of the Hillsborough, Alafia and Little Manatee Rivers floodplain.
- Category 3 storm: same as a Category 1 storm; plus portions of Town N' Country, the Westshore business district including a portion of the western- most runway of Tampa International Airport; two-thirds of the Interbay Peninsula including all of MacDill Air Force Base, the eastern and western sides of the Hillsborough River to the Dam including Downtown Tampa and U.S. 41 south of Palm River.
- Category 5 storm: same as a Category 3 storm; plus expanded portions of Town N' Country; the three runways and portions of the terminal at Tampa International Airport, all of the Interbay Peninsula south of Henderson Avenue; area between Hillsborough Avenue and the U.S. 301/I-75 interchange; area east of the By-pass Canal, south of 7th Avenue, and

north of the Crosstown Expressway, areas between U.S. 41 and I-75, and expanded areas of the Hillsborough, Alafia, and Little Manatee River floodplains.

## TABLE 3.6: DEVELOPED PARCELS BY HURRICANE EVACUATION ZONE

| Type of Development | Evacuation Zone A | Evacuation Zone B | Evacuation Zone C | Evacuation Zone D | Evacuation Zone E |
|---|---|---|---|---|---|
| Residential | 17,200 | 20,554 | 18,765 | 16,871 | 12,677 |
| Commercial | 821 | 1,029 | 1,090 | 1,703 | 1,048 |
| Industrial | 452 | 456 | 448 | 449 | 292 |
| Agricultural | 212 | 105 | 234 | 168 | 113 |
| Institutional | 148 | 236 | 208 | 285 | 205 |
| Governmental | 454 | 236 | 330 | 521 | 316 |
| **Assessed Value** | **$3.8 billion** | **$3.2 billion** | **$2.4 billion** | **$2.5 billion** | **$1.5 billion** |

**Source:** Hillsborough County Hazard Mitigation Section and the City of Tampa, GIS CD 99-2 entered from the Hillsborough County Property Appraisers Database

Storm Surge: the storm surge is by far the most dangerous of the three hazards, historically causing nine out of ten hurricane related deaths. This surge when coupled with the breaking waves can cause great destruction. The more intense the hurricane and the more perpendicular its track in relation to the coastline the higher the storm surge and resulting destruction can be. Also impacting on the height of storm surge is the depth of the water along a threatened coastline. Because of the configuration of Tampa Bay and the high shoaling factor (shallow water and gradual slope of the Gulf bottom) off the central west coast of Florida, Hillsborough County will receive higher surges than those indicated in the generalized Saffir/Simpson Hurricane Scale.

Approximately 81% of the 4,213 vacant acres in the Coastal High Hazard Area and 81% of the 71,081 vacant acres in the Hurricane Vulnerability Zone are expected to be developed in the future for residential, commercial, industrial uses or public facilities, indicating that these risk reductions strategies should be considered prior to development of this vacant land (Florida Department of Community Affairs, 2009).

High Winds: high winds will also render segments of the population vulnerable to the passing hurricane. Throughout Hillsborough County, the approximately 56,000 mobile and manufactured homes will be unable to withstand hurricane force winds. High winds will also have an impact on the timing of the evacuation order since they arrive at the coastline several hours before the eye of the storm makes landfall. All evacuation activities must be completed prior to the arrival of sustained gale force winds (40 mph with significantly higher gusts).

Rainfall: since the structure of every hurricane is unique, there is no way to determine the rate and distribution of the expected six to twelve inches of rainfall generally accompanying the storm. However, it is known that the rainfall has only a minor influence on the storm surge water levels. Rainfall, in itself, will not normally require the

emergency evacuation of large numbers of residents during the passage of a hurricane as does the storm surge. However, rain may cause the slowing of traffic and may sever evacuation routes which could severely reduce the number of hours available for the overall evacuation.

The worst case scenario for Hillsborough County is a Category 5 Hurricane heading northeast at less than 15 miles per hour that makes landfall at high tide near Madeira Beach in Pinellas County. A potential 28 foot storm surge in the Back Bay areas would inundate the County several miles inland while the winds would destroy thousands of homes and cause damage to thousands more.

Mitigation Approaches: there is a multitude of approaches to mitigate effects from hurricanes. The following illustrates mitigation initiatives that have been the most effective within the region and throughout the United States.

- *Public awareness and evacuation plans* -- the loss of life due to hurricanes has been reduced due to warning and forecast advances, public awareness programs and the development of evacuation plans. Evacuation efforts and the knowledge of the evacuation process assist in moving residents away from areas vulnerable to storm surge which is historically the major hurricane "killer". However, local officials recognize that public education is a key to the success of any response plan especially in densely population metropolitan communities such as Tampa Bay.

- *Building construction* -- mitigation of property damage has been most successful in areas specifically designated special flood hazard areas through the implementation of construction codes, land-development regulations and growth management policies

- *Special flood hazard area setbacks* -- land-development regulations developed in response to the county and cities participation in the National Flood Insurance Program have ensured structures constructed within the previous 20 years are elevated above base flood elevations and can withstand potential wave action. In addition, the implementation of Comprehensive Plan policies and the creation of a local Environmental Protection Commission have further minimized flooding impacts.

- Development prior to the adoption of various mitigation policies and regulations remains more susceptible to damage. Public education programs have been developed to assist businesses and residents learn about retrofitting techniques. Mitigation strategies have also included repetitive loss acquisitions, structural elevations, wind retrofit projects, critical facility retrofits and acquisition of designated conservation areas.

**HOMEOWNER MITIGATION**

Preparing your home for hurricanes can be as easy as **A-B-C.**

**A**nchor

Bring all unsecured items that could become windborne from outside your home to an inside secure area –ask neighbors to do the same. Replace gravel/rock-landscaping materials with fire-treated, shredded bark or other lightweight mulch to eliminate the potential for them to become windborne missiles. Trim and anchor trees and foliage. Get your home inspected to assure you have wall-to-foundation (anchor bolts/re-bar) connections.

**B**race

Bolt all doors with foot and head bolts with a minimum one-inch bolt throw length. Reinforce the garage door and tracks. Brace all gable end walls with horizontal and/or diagonal braces.

**C**over

Cover all large windows, doors and especially patio doors with securely fastened, tested and approved impact-resistant shutters with proper mounting hardware, or replace them with impact-resistant shutters with proper mounting hardware, or replace them with impact-resistant laminated window and door systems if feasible.
Make sure all doors and windows are properly caulked and/or weather-stripped to reduce potential water intrusion. Install a roof covering that is rated for high wind and impact from hail or debris. Strap, tie-down any free-standing fixtures in your yard. Fasten rafters/trusses to walls with hurricane straps/clips.

## c. Thunderstorms

Description/Background: FEMA estimates the nation experiences approximately 100,000 thunderstorms annually with approximately 10 classified as severe. Florida leads the country with the number of thunderstorms; however, Florida's thunderstorms are shorter in duration than thunderstorms that develop over the western states Arizona, Utah and Nevada. Thunderstorms in Florida routinely last approximately 30 minutes and rarely affect an area greater than 15 miles. However, multiple storms can develop together and act as an integrated system.

Hazardous conditions associated with thunderstorms include tornadoes, lightening, hailstorms, flooding, downburst and microburst winds. Strong "downbursts" (winds) are concentrated, straight-line winds created by falling rain and sinking air that exceed 125 mph. A separate wind phenomenon is the "microburst, which are narrowly-concentrated downdrafts that can exceed speeds of 150 mph. Lightning occurs in all thunderstorms and can strike anywhere, both air and ground.

Thunderstorms are classified with respect to the potential damage that can occur.

## TABLE 3.7: THUNDERSTORM CLASSIFICATIONS

| Types Characteristics | Single Cell Storm | Multi-Cell Cluster | Multi-Cell Line (Squall Line) | Super-Cell |
|---|---|---|---|---|
| **Severe Weather occurs as:** | Brief isolated downburst, small hail, heavy rain, weak tornadoes | Downbursts, moderate size hail, flash floods, weak tornadoes | Downbursts, small-moderate sized hail, occasional flash floods, weak tornadoes | Strong down- bursts, large hail, occasional flash floods, weak-violent tornadoes |
| **Severe Event Predictability** | Low | Moderate | Moderate | High (Once identified as Super-Cell) |
| **Danger to Public** | Low | Moderate | Moderate | Extreme |
| **Danger to Aviation** | Low | Moderate to High | Moderate to High | Extreme |

**Source:** National Oceanic and Atmospheric Agency; Compiled by Hillsborough County.

Location / Risk Assessment: severe storms can (and have) occurred anywhere in the County.

History of Events: during the period from 1955 to 2009 this area experienced 364 thunderstorms. Thirty-two were classified as severe. (Note: A thunderstorm is classified "severe" when one or more of the following hazardous conditions occur: winds greater than 57 miles per hour, hail 3/4" in diameter or greater, or a tornado develops). Since 2006, 64 percent of lightning deaths nationwide (238) occurred when people were participating in leisure activities such as fishing, camping, boating, soccer or golf. Florida averages about 1.4 million lightning strikes a year. The Nationwide average is more than 22 million strikes. Lightning can generate heat up to 60,000 degrees Fahrenheit and several million volts of electricity.

Florida leads the nation in lightning deaths and injuries. Lightning killed 468 people and injured over 1,300 people in Florida during the period 1959-2013. During the same period, lightning caused 25 deaths and 69 injuries in Hillsborough County. Lightning is often called the underrated killer. In an average year, more people die from lightning nationwide than from all hurricanes and tornadoes combined. Lightning may strike people directly or it can cause death and injury from fires it initiates.

Probability: the probability of a thunderstorm occurring depends on atmospheric and climatic conditions. Information collected by the National Weather Service found that the

Tampa Bay has between 100 and 130 storms per year. The principal season for thunderstorms is similar to that associated with hurricanes – when the warmer tropical climate results in unstable air which is conducive to the development of thunderstorms. Severe thunderstorms can occur at any time (within the Tampa Bay area), but mostly between the period from early summer through late fall.

The greater the number of thunderstorms and/or their duration, the higher the number of lightning and hail occurrences. According to the NOAA National Climatic Data Center, central Florida (including portions of Hillsborough County) has the greatest probability of lightning strikes within the continental United States.

Severity of Events/Consequences: thunderstorms produce deadly and damaging tornadoes, hailstorms, intense downburst and microburst winds. Additionally, lightening causes wildfires and damage to property. Damages associated with thunderstorms range from aircraft disasters to millions of dollars of damage from strong winds including tornadoes, wildfires created by lightning, flash or localized flooding, and hail. They can also result in deaths, primarily as a result of lightning strikes.

A review of the National Climate Center Storm Data for the past 5 years for thunderstorms and lightning revealed that most storm events in Hillsborough County produced damages around $50,000 in damage per event and 2 deaths due to lightning.

The vulnerability of the Hillsborough County region to the effects of thunderstorms including lightning and hail is based upon its geographic location on the west-central coast of Florida. The influence of summer weather patterns greatly affects the intensity of thunderstorms. This, in turn affects structures located in the area.

Homes and businesses throughout Hillsborough County are at risk of fire due to lightning strikes igniting debris and materials that have been struck directly. Florida has the largest number of deaths due to lightning strikes in the nation with 471 lightning deaths from 1959 to 2013 and over 1000 injuries (NOAA, 2014/Curran, et al, 2000). Hillsborough County has one of the largest numbers of fatalities in the state. According to the National Weather Service, eighty-five percent of victims are children and young men ages 10-35 in recreational work.

In the case of a hail storm, buildings, vehicles, and pedestrians alike are some of the most vulnerable within a community. Hail can create hazards for motorists on I-275, I-4 and I-75 in Hillsborough County, in addition to small road systems throughout the county.

If a power outage were to occur due to the impact of a thunderstorm, some of the most vulnerable populations are those with special needs including populations that are dependent on electric medical equipment, require medication to be refrigerated, and/or those who are exposed to extreme heat conditions if air conditioning units are not functioning.

Residents and visitors of Hillsborough County part-taking in many outside activities leading to increased vulnerability to lightning and hail that may occur during a thunderstorm. High risk areas include baseball, football, soccer fields, recreational areas, lakes, boats, docks and beaches where populations are exposed to lightning strikes

and/or are directly impacted by hail. Attendees at Raymond James Stadium, George M. Steinbrenner Field, Plant Field, Al Lopez Field, Larry Sanders Progress Village Sports Complex, Lowry Park Zoo, Busch Gardens Amusement Park, MidFlorida Credit Union Amphitheatre, Florida State Fair Grounds, and Curtis Hixon Waterfront Park are at higher risk and are advised to seek shelter when lightning strikes are within close proximity.

Special events that occur annually in the community include numerous music festivals/concerts, races including marathons/half marathons, the Florida State Fair, Strawberry Festival in Plant City, and the Gasparilla Day Parade and the Gasparilla Children's Parade. Various recreational activities that are common in Hillsborough County include fishing, kayaking, biking, skateboarding, swimming, riding motorcycles and golfing.

### TABLE 3.8: LIGHTNING EVENTS IN TAMPA-HILLSBOROUGH COUNTY (1950-2014)

| Type | # | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| Lightning | 93 | 9 | 55 | $5,044,000 |

**Source**: National Oceanic and Atmospheric Administration (NOAA). (2014). National Climate Data Center: Severe Weather Events Database. Retrieved from http://www.ncdc.noaa.gov/stormevents/

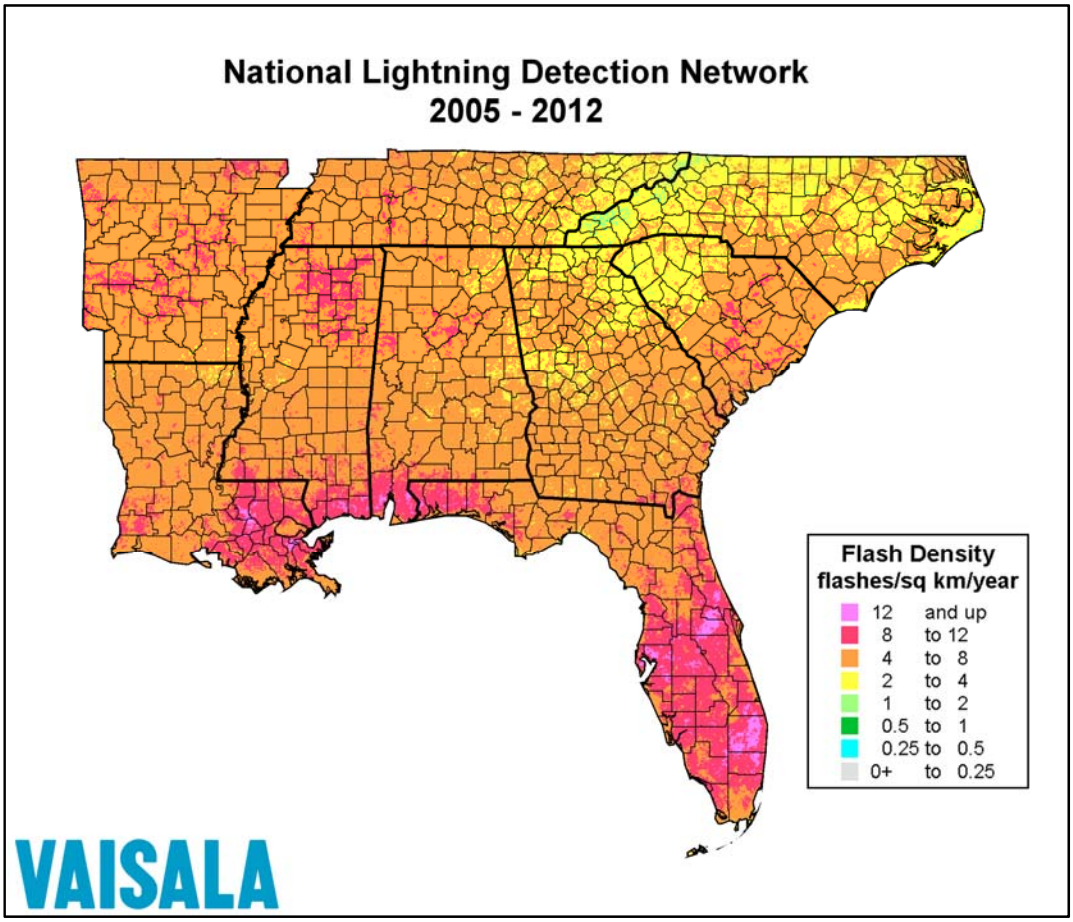
June 2013

For Immediate Release

# Southeast U.S. Lightning Data from National Lightning Detection Network

## Lightning frequency

The following map shows cloud-to-ground flash density for eight years in the southeast states. There is a great deal of detail to be found within this map at 2-kilometer (1.24 mile) resolution. The highest average lightning frequency is in peninsular Florida, and along the Gulf of Mexico coast from Pensacola to the west around New Orleans. The highest density exceeds 12 flashes per square kilometer per year in some of these areas. Less frequent lightning is shown to the northeast, especially over the higher terrain of the Appalachian Mountains in South and North Carolina. Here thunderstorms develop more often on the slopes than over the highest elevations, as seen around the world on higher terrain in humid environments. Most of the lightning occurs in this area during June, July, and August, and between late morning and early evening hours.



## Lightning fatalities

For the entire U.S., 34 people were killed by lightning per year from 2003 to 2012, for a total of 345 during these ten recent years. The number of flashes and fatalities are shown by state in the following table. An average of ten times as many people are injured sufficiently to require medical attention as the number of fatalities. It is apparent that Florida has the largest number of flashes and fatalities. More details on area-weighted flash densities and population-weighted fatality rates are at www.lightningsafety.noaa.gov.

| State | Flashes in 2012 | Average Flashes 1997 to 2012 | Fatalities 2003-2012 | Fatality Rank 2003-2012 |
|---|---|---|---|---|
| Alabama | 744,752 | 821,365 | 11 | 7 |
| Arkansas | 627,880 | 799,034 | 6 | 20 |
| Florida | 901,381 | 1,383,228 | 52 | 1 |
| Georgia | 585,944 | 797,159 | 17 | 5 |
| Louisiana | 899,598 | 909,274 | 9 | 12 |
| Mississippi | 736,152 | 866,997 | 8 | 16 |
| North Carolina | 465,387 | 528,092 | 18 | 4 |
| South Carolina | 358,664 | 447,014 | 10 | 11 |
| Tennessee | 514,979 | 588,187 | 7 | 19 |

## Lightning insurance claims

According to the Insurance Information Institute and State Farm Insurance,186,000 insurance claims were paid for lightning losses in the U.S. in 2011, at an average of $5112 per claim for a total of about one billion dollars from this source alone – see www.vaisala.com/nldn30. There are substantial additional impacts of lightning in a very wide variety of avoidance and mitigation expenses.

## Lightning safety

Safety from lightning involves being inside a large substantial building or a fully-enclosed metal-topped vehicle in the presence of lightning. In the U.S., 99% of lightning deaths in recent years occurred outside of these two safe locations. A simple rule to use for reaching these safe places is “When thunder roars, go indoors.” A substantial expansion on this lightning safety information is located on www.lightningsafety.noaa.gov.

## TABLE 3.9: TORRO HAILSTORM INTENSITY SCALE

| | Intensity Category | Typical Hail Diameter (mm)* | Probable Kinetic Energy, J-m$^2$ | Typical Damage Impacts |
|---|---|---|---|---|
| **H0** | Hard Hail | 5 | 0-20 | No damage |
| **H1** | Potentially Damaging | 5-**15** | >20 | Slight general damage to plants, crops |
| **H2** | Significant | 10-**20** | >100 | Significant damage to fruit, crops, vegetation |
| **H3** | Severe | 20-**30** | >300 | Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored |
| **H4** | Severe | 25-**40** | >500 | Widespread glass damage, vehicle bodywork damage |
| **H5** | Destructive | 30-**50** | >800 | Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries |
| **H6** | Destructive | 40-**60** | | Bodies of grounded aircraft dented, brick walls pitted |
| **H7** | Destructive | 50-**75** | | Severe roof damage, risk of serious injuries |
| **H8** | Destructive | 60-**90** | | (Severest recorded in the British Isles) Severe damage to aircraft bodywork |
| **H9** | Super Hailstorms | 75-**100** | | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |
| **H10** | Super Hailstorms | >100 | | Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open |

Approximate range (typical maximum size in bold), since other factors (e.g. number and density of hailstones, hail fall speed and surface wind speeds) affect severity The TORRO Hailstorm Intensity Scale (H0 to H10) in relation to typical damage and hail size codes. Size codes are presented in following table.

## TABLE 3.10: HAIL SIZE AND DIAMETER IN RELATION TO TORRO HAILSTORM INTENSITY SCALE

| Size code | Maximum Diameter mm | Description |
|---|---|---|
| 0 | 5-9 | Pea |
| 1 | 10-15 | Mothball |
| 2 | 16-20 | Marble, grape |
| 3 | 21-30 | Walnut |
| 4 | 31-40 | Pigeon's egg > squash ball |
| Size code | Maximum Diameter mm | Description |
| 5 | 41-50 | Golf ball > Pullet's egg |
| 6 | 51-60 | Hen's egg |
| 7 | 61-75 | Tennis ball > cricket ball |
| 8 | 76-90 | Large orange > Soft ball |
| 9 | 91-100 | Grapefruit |
| 10 | >100 | Melon |

Impacts: The impacts associated from thunderstorms in the last five years in Hillsborough County have been from hail and lightning. This data is reflected in Table 3.0.

Approximately twenty-five hail storm incidents have been document by the NOAA National Climatic Data Center in the years 2009-2015 (See Table 3.0). These are the documented incidents but being that hail can occur at the micro level scale and affect areas as small as a single neighborhood and even single residence, it is presumed that many more instances of hail occurred that may not have been officially documented. The impact from hail is typically recognized as property damage including that to vehicles suffering from hail impact as well as the roofs of structures; both commercial and residential, than can be significantly damaged if the hail diameter is large enough. This is of particular interest to the insurance industry as related in the work by the Institute of Business & Home Safety (Brown, et. al, 2015). In addition, hail damage to the agricultural industry of Hillsborough County is always a potential threat. While historically in the last five years there has been no documented event with hail large enough on the TORRO scale to cause large scale crop damage, the potential for future impact to the agricultural industry does exist.

Studies conducted by NOAA and the NWS are continually refining the ability to determine the extent and maximum size of hail that could impact specific areas including Hillsborough County. Development has been conducted for years with regards to determining these maximums (Barjenbruch & LaPlante, 1997). NWS utilizes the Probability for Severe Hail (POSH) and most recently the Maximum Expected Hail Size (MESH) methods to predict hail size. Current research includes work being done by NOAA National Severe Storms Laboratory. Analysis of historical records available at the NOAA NCDC online storm event database, found at

http://www.ncdc.noaa.gov/stormevents/ revealed between the years 1950 and 2014, the largest size hail recorded was approximately 4 ½" in diameter. While hail this large is rare and considered anomalous, the potential for hail in the 2" to 3" diameter range is possible.

With regards to lightning, the impacts have been more serious. Two deaths have occurred as the results of lightning strikes and at least three documented structures fires have occurred due to lightning as recently as the summer of 2014 when a three story structure at an apartment complex causing approximately $800,000. damage but fortunately with no injuries. (WFLA, 2014).

The impact of lightning on Hillsborough County is significant. While not always directly measurable by personal injury or financial loss, the fact of Hillsborough County lying in one of the most concentrated areas for lightning strikes in the world leads to effects outside of meteorological documentation. The practice of safety in lightning avoidance is a major impact to the area as this can result to delays in construction, cancelled outdoor events and possible revenue loss based on these delays and cancellations caused by thunderstorm generated lightning. Estimations based upon previous meteorological records reveal that lighting strikes can reach 1,000 per hour in the peak of a sever summer thunderstorm. Although not all of these are cloud-to-ground lightning, the impact can still be severe.

Mitigation: Warning systems. Modernization of weather observation equipment has been linked to early severe-storm warning systems. Within Hillsborough County, more than 800 such connections have been made (Emergency Operations Center, 1999). Additionally, this access has been made available to all residents and businesses through a purchase of a weather radio (available at retail electronic stores).

Severe weather forecasting/detection is employed at the Tampa International Airport to detect conditions favorable for micro-wind bursts or wind downburst and reduce the chance of aircraft accidents due to "wind shear".

Techniques for reducing damage by lightening exist and have been incorporated into building standards. Some of these techniques include grounding various electrical components to lead the lightening away from a structure. Power surge protectors including "whole house protection" are also promoted by utilities to minimize damage.

## HOMEOWNER MITIGATION

### Before

- If reroofing, select an impact-resistant roof covering that has passed the UL2218 or FM4473 impact resistance test with a rating of Class 1 through Class 4. The most impact-resistant rating that is highly effective against hail damage is the Class 4. Select an established, bonded, licensed and insured contractor for reroofing and secure at least two references.
- If hail is forecast, close your drapes, blinds or window shades to prevent potential injury from broken glass blowing inside.

- Install Surge Protective Devices to protect electronic and electrical appliances from all but the most severe electrical surges or direct strikes. They should be installed at all items to be protected.
- Stay alert and listen carefully for the first signs of lightning or thunder. Remember, "If Thunder Roars, Go Indoors™." Seek shelter. Lightning often hits before the rain begins, so don't wait for the rain to start before leaving.

### During

- Do not try to go outside to protect your property during a storm. Stay indoors until the storm has passed. Stay away from skylights, windows and doors.
- If you are outdoors immediately get off elevated areas such as hills, ridges or peaks. Never lie flat on the ground. Never shelter under an isolated tree. Never use a cliff or rocky overhang for shelter. Immediately get out and away from ponds, lakes and other bodies of water. Stay away from objects that conduct electricity (barbed wire fences, power lines, windmills, etc.).
- If you are indoors avoid water and stay away from doors and windows. Do not use the telephone or headsets. Cell phones are ok. Turn off, unplug and stay away from appliances, computers, power tools and televisions sets as lightning may strike exterior electric and phone lines inducing shocks to equipment inside.

### After

- Verify that you can safely move around outside by avoiding any broken or downed branches and power lines.
- Check the trees, shrubs and plants around your house. If they are stripped of their foliage, there is a possibility your roof is damaged. Dented patio covers, screens or soft aluminum roof vents could also indicate roof damage.
- Cover any broken windows and holes in your roof to prevent water intrusion following hail damage.
- Don't resume activities for at least 30 minutes after the last lightning strike or thunderclap.
- Call 911 immediately if anyone is injured and use first aid procedures.
- Administer medical treatment. Lightning victims do not carry an electrical charge, so it is safe to assist.

Whether a power outage in your home is caused by grid failure or severe weather, you can take the following steps to safely prepare and respond:

- Remember to include power outages in your family disaster plan. Keep extra cash on hand since an extended power outage may prevent you from withdrawing money from ATMs or banks.
- Keep a complete disaster supply kit handy with water, non-perishable foods, medicine, baby supplies and pet food and more. See the full list on the "Disaster Safety" FLASH Card.
- Only open your refrigerator or freezer when necessary, and remember that food should be safe to eat so long as the outage lasts no more than four to six hours.

- Have one or more coolers with ample ice for cold food storage in case power outage is prolonged. Perishable foods should not be stored for more than two hours above 40 degrees Fahrenheit.
- Have an emergency power supply for anyone dependent on electric medical equipment.
- Keep a supply of flashlights, batteries, hand-crank cell phone chargers, battery and solar-powered radios on hand. Do not use candles as they pose a fire hazard.
- Connect only individual appliances to portable generators and never plug a generator into wall outlets. Plugging generators into the home's electrical system can feed electricity back into the power lines and endanger both you and line workers. Use gas-powered generators only in well-ventilated outdoor areas
- Be careful when driving through intersections as traffic lights may be out, creating a dangerous situation
- Turn off any electrical equipment that was in use prior to the power outage, but leave one light on to alert you when power resumes
- Check on elderly neighbors, friends or relatives who may need assistance if weather is severe during the outage. See the "People with Disabilities" FLASH Card for additional recommendations
- Keep your car fuel tank at least half-full (gas stations usually rely on electricity to power their pumps)
- When power is restored, wait a few minutes before turning on major appliances to avoid problems caused by a sharp increase in demand

## d. Tornadoes

Description / Background: severe winds are a major cause of fatalities and property loss in the United States. The two principal sources of wind-related loss of life and property damage are tornadoes and hurricanes. Tornadoes, which affect almost every state are more frequent and result in greater property damage in the central United States.

NOAA identifies damaging winds as occurring in two categories: rotational (tornadic) or straight-line (downburst). Both forms of wind are bi-products of a thunderstorm and can cause a similar degree of damage. Tornado wind damage is often highly concentrated over narrow width in relation to their damage length. Downburst wind damage is normally spread out over a broader width but shorter damage length. In either case, both can cause substantial damage to structures.

Tornadoes materialize at the trailing edge of large frontal cyclones that result from the clash of high pressure and low pressure weather systems moving at continental scales across North America. Because of climatic differences, southern states like Florida experience their most violent tornadoes in winter. However a tornado event is not limited to winter. They can also be generated during the summer in association with afternoon thunderstorms. Most tornadoes are of short duration and do not touch down as the Category 4 or 5 that make national headlines.

Location / Risk Assessment: in terms of where tornadoes are most likely to occur, the northern portion of the state's Gulf Coast, between Tampa and Tallahassee, along with the Panhandle region have generally experienced more tornadoes. This is primarily due to the high frequency of thunderstorms making their way east through the Gulf of Mexico. Like thunderstorms, a tornado can occur most anywhere in the County.

History of Events: The National Weather Service ranks the Tampa Bay area as one of the highest areas in Florida for the occurrence of tornadoes. One of the most deadly tornado events in central Florida history occurred on October 3, 1992 when four people died and more than $100 million in property damage occurred. NOAA estimated approximately $14 million dollars in damage from severe wind events between 1987 and 1996 within Hillsborough County. The damage was the result of 22 tornadoes and 112 downbursts. These occurrences resulted in one death and 16 injuries.

Since 1950, the National Climate Data Center has recorded 106 tornadoes in Hillsborough County. These tornadoes resulted in one death, 124 injuries and $24 million dollars in property damage. Research conducted by the City of Tampa staff found that the majority of tornadoes (51%) that struck Hillsborough County between 1950 -1988 had wind speeds of 73 miles per hour or less.

During the past 5 years, 2 tornados in the category EF1 touched down in Hillsborough County. The area around the Tampa Port Authority and Progress Village suffered extensive damage. Numerous roofs were blown off and 40 feet long storage containers were overturned around the Tampa Port Authority. There were 118 homes and businesses with minor damage in Progress Village and 40 that sustained major damage. In addition, 245 homes are being assisted with tree damage in the Progress Village area. Damage totaled almost 4 million.

Impacts: In the years from 2009-2015, Hillsborough County experienced approximately documented hurricanes based on NOAA National Climatic Data Center records. (See Table 3.0) Included with these were the two aforementioned tornadoes that caused significant property damage.

Tornadoes can be of significant impact to Hillsborough County based on their propagation off of thunderstorms that often occur in the Tampa Bay area. One of the major points to consider is the difference of the tornadoes that can occur in the Hillsborough County area compared to other parts of the country. Tornadoes occurring in the Midwest are often large tornadoes staying on the ground for a considerable amount of time and providing more warning than those in the Tampa Bay area. Even a few extra minutes can make a difference. The tornadoes which are experienced in the Hillsborough County area are of a smaller scale yet often appear with very short notice developing without leaving much time for residents' preparation. In addition, very few homes in the Tampa Bay area have basements or other underground parts of the dwelling where residents could seek shelter.

Impacts from tornadoes are recognized first and foremost as risk to personal safety especially if their rapid development catches individuals in areas which are limited for seeking shelter. Mobile homes in the area are particularly at risk due to those structures not offering the same level of protection a single family, site-built home can provide. In addition, property damage and possible risks to the agricultural community also exist.

The greatest vulnerability to be faced would be in the event an EF3 or higher tornado was to hit a high population density of urban Hillsborough County. Substantial damage could incur to government facilities, hospitals and residential areas. The damage to infrastructure could include lost power, water, sewer, gas, and communications leading to hindered emergency response and access to these vital services. This could then lead to increased public health concerns due to poor sanitation, access to clean water, increased susceptibility to foodborne illness, food spoilage and exposure to hazardous materials. Roadways and bridges could be damaged or blocked due to debris, while many people would lose their homes leading to the displacement of the population from their primary residence. People, wildlife and livestock that are most vulnerable would include those located in the direct path of a tornado with the probability of high numbers of injuries and fatalities.

Mobile homes, mostly occupied by lower income residents, are some of the most vulnerable populations in Hillsborough County. Populations that reside in mobile homes make up a high percentage of fatalities following a tornado, in comparison to traditional site-build houses. A large number of mobile homes are located in East Hillsborough County including Zephyrhills, Brandon, Valrico, Thonotosassa, Seffner, Mango, Valrico, Plant City, Progress Village, Riverview, Sun City and Ruskin.

The Hillsborough County Airport System includes a total of 24 public-use airports and heliports. Tampa International Airport (TIA), through direct or connecting flights, links Hillsborough County with national and international flights. Tornados, high winds, hail, and severe weather may lead to physical damage, delays, closures, stranded travelers and workers, emergency work, and large scale debris removal.

Businesses and private residences are vulnerable to structural damage caused by falling trees/limbs due to high wind speeds caused by the occurrence of a tornado. Winds may cause trees and their limbs to break communication and power lines, causing populations in these areas to be exposed to downed power lines and lead to increased vulnerabilities if power outages occur.
Schools, hospitals, grocery stores and other critical need and economically important facilities are damaged and closed for extended periods. Employment my affect the population due to the closure of businesses damaged following a tornado. There are over 250 public schools in Hillsborough County. Damaged schools may disrupt the education of children and a delay in the return to normalcy. Furthermore, there are about 20 universities and colleges in the county with the largest being the University of South Florida located in the Temple Terrace area. The large number of students, faculty and staff in one concentrated area my lead to high numbers of injury or fatalities.

Probability: Florida has averaged approximately 75 tornadoes per year since 1950, with an average of three deaths and 60 injured per year. According to the National Climatic Data Center, Florida experienced 1736 tornado events from 1950 through June of 2014.

It should be noted that during severe storms, multiple tornadoes can form. Thus, using probabilities of tornadoes based on the total number of tornadoes reported may be somewhat higher than by using the number of storms in which a tornado(s) formed.

Thunderstorms spawn more than 1,000 tornadoes annually. Over the last two decades, there have been more than 106 federally declared disasters due to tornado damage. Severe thunderstorm/wind events occur on the average of 2 every year in the Tampa-Hillsborough County area with sufficient force as to cause damage.

Severity of Events / Consequences: tornados with wind speeds ranging from 40 mph to greater than 318 mph can be expected to inflict a considerable amount of damage over a wide area. They also generate a tremendous amount of debris that becomes airborne creating additional damage. Because of extreme winds and the amount of airborne material generated, people living in manufactured or mobile homes are most exposed to damage from a tornado. Additionally, pillared and/or unanchored businesses and residential units are at greater risk of damage from a tornado.

Historically, the strongest tornado to impact Hillsborough County was on April 4, 1966 when an F4 made it was across parts of the County. As for more current expectations, it is believed that an EF4 (measured on the Enhanced Fujita Scale) could impact Hillsborough County as the maximum tornado event possible.

The following observation from the LMS profile for Florida is particularly relevant to Hillsborough County, especially considering the county's anticipated continued growth, particularly in the easternmost unincorporated areas:

> *There have been many tornadoes in Florida that could have killed scores of people and caused millions of dollars in property damage, but most of these tornadoes did not hit heavily populated areas. The most deadly tornado event in the state's history occurred on February 22 and 23, 1998 in which 45 people were killed. As the state's population continues to increase, particularly in the interior part of the state, the threat of a devastating tornado event grows.*

**The Fujita Scale** (also known as the Fujita-Pearson Scale) may not be a perfect system for linking damage to wind speed, but it had distinct advantages over what had gone on before its inception. The scale is also simple enough to use in daily practice without involving much additional expenditure of time or money. From a practical point of view, it is doubtful that any other system would have found its way into widespread accepted use, even to this day. The entire premise of estimating wind speeds from damage to non- engineered structures is very subjective and is difficult to defend from various meteorological perspectives. More recently the **Enhanced Fujita Scale** has been implemented in order to provide for a more developed and detailed method of rating potential tornado damage.

Nothing less than the combined influence and prestige of the late Professor Fujita and Allen Pearson, director of NSSFC (National Severe Storm Forecast Center) in 1971 could have brought this much needed system into widespread use. The FPP scale rates the intensity of the tornado, and measured both the path length and the path width. The Fujita part of the scale is as follows:

## TABLE 3.11: THE FUJITA SCALE

| F-Scale Number | Intensity Phrase | Wind Speed | Type of Damage Done |
|---|---|---|---|
| **F0** | Gale tornado | 40 -72 mph | Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards. |
| **F1** | Moderate tornado | 73 -112 mph | The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed. |
| **F2** | Significant tornado | 113 -157 mph | Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated. |
| **F3** | Severe tornado | 158 - 206 mph | Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted. |
| **F4** | Devastating tornado | 207 -260 mph | Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated. |
| **F5** | Incredible tornado | 261 -318 mph | Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged. |
| **F6** | Inconceivable tornado | 319 -379 mph | Highly unlikely. The small area of damage produced would probably be unrecognizable from the destruction produced by F4 and F5 winds that accompany the F6 winds. Items such as cars and refrigerators become missiles and do serious secondary damage that could not be directly identified as F6 damage. If ever achieved, evidence might only be found in some manner of ground swirl pattern as it may never be identifiable through engineering studies. |

**Source:** The Tornado Project. Retrieved from http://www.tornadoproject.com/fscale/fscale.htm

Mitigation: the techniques used to mitigate the destruction caused by tornadoes are similar to those used for other wind hazards. The potential of extreme damage from a severe tornado will, however, make it difficult to mitigate in a cost-effective manner. The best protection from a tornado is provided by the type of construction and the reinforcement of walls, floors, and ceilings. Proper anchoring of walls to foundations and roofs to walls is essential for a building to withstand certain wind speeds (Residential Retrofitting, FEMA, 1997).

Additionally, there has been modernization of weather observation equipment and its linkage to early severe-storm warning systems.

NOAA has produced standards to assist in reducing the risks associated with tornadoes. These include:

- Improve radio and wire communications with the media,
- Educate the public regarding the “safe room”,
- Equip gathering places with weather radios with an audible alert of warning,
- Continue awareness and preparation efforts in schools, and
- Make special efforts to inform mobile home residents.

The Hillsborough County Emergency Operations Center has implemented the aforementioned programs.

**Tornado Safety:** tornadoes are the most sudden, unpredictable and violent storms on earth. Knowing how to survive a tornado is crucial, as more than 100 million people in the U.S. are at risk.

### Before

- Install a safe room or storm shelter built to FEMA 320 guidelines or the ICC/NSSA 500 standard
- Have a family tornado plan and know where you can take shelter
- Closely monitor NOAA Weather Radio or visit www.flashweatheralerts.org to download a severe weather alerts app for your iOS or Android device

### During

Take refuge in a tested and approved storm shelter, safe room or a community shelter labeled as an official tornado shelter. Community shelters may include stores, malls, churches or even airports.

If no shelter is available:

**Are you indoors?** Go to the lowest floor, to a small, center interior room, under a stairwell or to an interior hallway with no windows. Crouch down as low as possible to the floor, face down and cover your head with your arms. Cover yourself with a blanket, mattress, helmet or other thick covering. Wear footwear with thick soles to your safe location.

**Are you in a mobile home?** Get out. Even if your home is tied down, it is not as safe as a sturdy building. Go to a nearby permanent structure.

**Are you in a vehicle?** Go to a nearby permanent structure. Do not shelter under an overpass, bridge or in a drainage ditch. If you cannot safely exit your vehicle, park it out of traffic lanes. Stay in the vehicle with your seatbelt

on. Put your head below the windows and protect it with your arms and a blanket, coat or other cushion.

**Are you outdoors?** Shelter in a sturdy building and if no shelter is available, lie face down on low ground, protecting the back of your head with your arms.

**After:**

- Keep your family together in a safe location and wait for emergency personnel to arrive
- Stay away from power lines, downed trees and puddles that could hide live wires
- Watch your step to avoid sharp objects
- Stay out of heavily damaged structures, as they may collapse
- Do not use matches or lighters in case of leaking natural gas or fuel tanks
- Listen to your radio for information and instructions

## e. Flooding

Description / Background: flooding can occur in most communities in the United States. Flooding can result from the overflow of major rivers and their smaller tributaries, storm surge from hurricanes and other coastal storms, or inadequate local drainage.

Historically, floods have been a factor in over 80 percent of all Presidential-declared disasters. The Nation's strategy for reducing flood damages has evolved from a reliance almost solely on structural flood control projects to a more comprehensive approach that emphasizes non-structural measures such as local land-use planning and zoning, building codes, and acquisition or relocation of flood prone buildings.

The National Flood Insurance Program (NFIP) has played a critical role in fostering and accelerating this change. NFIP was established by the National Flood Insurance Act of 1968, which makes federally backed flood insurance available in those states and communities that agree to adopt and enforce floodplain management measures that meet or exceed minimum Federal criteria. NFIP was broadened and modified by the Flood Disaster Protection Act of 1973, which requires the purchase of flood insurance as a condition of receiving any form of Federal or federally related financial assistance.

### WHAT IS A 100-YEAR FLOOD?

"100-Year Flood" is a short-hand expression for a flood that has a 1-in-100 chance of being exceeded in any given year. This may also be expressed as the "1% annual chance flood."

This does not mean this level of flooding only happens every 100 years.

Similarly, a 200-year flood has a 1-in-200 (or 0.5%) chance of being exceeded in any given year.

The National Flood Insurance Act of 1968 also requires that the President develop a Unified National Program for Floodplain Management. In 1994, a report on this program was provided by the Federal Interagency Floodplain Management Task Force. The update includes a set of national goals for floodplain management to focus the efforts of all levels of government as well as the private sector. In addition, Executive Order 11988, Floodplain Management, issued in 1977, requires that Federal agencies undertake a planning process prior to taking actions in, or that impact on, floodplains. The Midwest Floods of 1993 resulted in a further evolution in Federal flood policy. There is now a new emphasis on the acquisition or relocation of flood-damaged properties using funding from a number of Federal programs and from state and local governments and the private sector. The National Flood Insurance Reform Act of 1994, strengthened NFIP by providing for mitigation insurance and establishing a grant program for State and community flood mitigation planning and projects.

Forty percent (40%) of the total flood insurance policies are within Florida, with 60% of flood claims being made through the State (Regional Office, FEMA, 1999). In Hillsborough County there are nearly 40,000 structures with coverage in excess of $4.9 billion. More information on NFIP is included in Section V. Of the 700,000 structures in the County, FEMA has identified more than 400 as subject to repetitive flooding.

Location / Risk Assessment: the types of flooding events that have occurred within Hillsborough County include: inland, riverine, local drainage and high groundwater levels, fluctuating lake levels and tidal surge.

- Inland flooding is a localized event associated with heavy rainfall and is usually occurring in areas identified as being within the 100-year floodplain or along recognizable drainage channels. Principal areas most susceptible to flooding in a 100-year event include: the western and southern portions of the Interbay Peninsula, Davis Island, Harbour Island, Hookers' Point and port areas of Tampa, unincorporated areas of Odessa and Ruskin, and the floodplains of the Hillsborough, Alafia and the Little Manatee Rivers.
- Riverine flooding occurs following heavy rainfall events over an extended period of time. Areas in the county susceptible to this kind of flooding can be found along the Alafia and Little Manatee Rivers.

- Drainage/stormwater flooding usually occurs following a heavy rainfall event over a relatively short period of time. This type of flooding is usually localized to urban areas.
- Tidal flooding is the result of the effects of wind and low pressure in coastal areas. The effects are exacerbated when combined with high tide.
- Fluctuating lake levels is associated with either large weather systems and/or a continuous rainy season.

History of Events: Typically, monthly rainfalls in Hillsborough County range between 1.15 inches for April to as high as 7.61 inches for August. It is not unusual for individual, heavy rainfall events to occur. Between 1995 and 1998, there were five instances when the amount of rainfall exceeded 3.5 inches in a 24-hour period. Based on historical patterns, Hillsborough County can expect to receive 1-2 such downpours each year.

The occurrence of flooding in Hillsborough County between 1950 and 2014 has been documented and quantified. The data, however, does not provide an indication of the cause of the flooding. A table listing the flooding events from 1950 to 1998 follows.

### TABLE 3.12: FLOODING EVENTS IN TAMPA-HILLSBOROUGH COUNTY (1950-1998)

| Type | # | Deaths | Injuries | Property Damage |
|---|---|---|---|---|
| Coastal Flooding | 1 | 0 | 0 | $1,700,000 |
| Flash Flood | 4 | 0 | 0 | $200,000 |
| Flood | 14 | 1 | 1 | $7,620,000 |
| Riverine | 21 | 0 | 0 | $5,220,000 |
| Urban/Small Stream Flood | 27 | 0 | 0 | $975,000 |
| **Total** | **67** | **1** | **1** | **$15,715,000** |

**Source**: National Oceanic and Atmospheric Administration (NOAA). (2014). National Climate Data Center: Severe Weather Events Database. Retrieved from http://www.ncdc.noaa.gov/stormevents/

According to the NOAA (2014) Severe Weather Events Database there have been **62 Flood Events** documented from 1950 until 2014; not including Riverine & Urban/Small Stream Flooding.

**Table Updates (1950-2014):**

- **Coastal Flooding: 0 Events – 0 Death – 0 Injured - $0**
- **Flash Flood: 10 Events – 1 Death – 2 Injured - $7,350,000**
- **Flood: 62 Events – 0 Death – 0 Injured - $4,350,000**
- **Storm Surge/Tide: 8 Events – 0 Death – 0 Injured - $350,000**

Between September 2004 - September 2014 there have been 6 Flood events that can be included in the History of Events section above (The dates are: 9/6/2004, 9/26/2004, 10/1/2004, 7/1/2009, 8/6/2012, 9/28/2014). Here are the events listed:

**9/6/2004** –Widespread heavy rain associated with Hurricane Frances across west central Florida lead to record flooding on many of the rivers. In Hillsborough County, the Hillsborough County River at Morris Bridge (flood Stage 32 feet) reached its all-time high of 34.38 feet on the 8$^{th}$, the Alafia River at Lithia (flood stage 13 feet) reached the 5$^{th}$ highest stage at 22.33 feet on the 7$^{th}$, and the Little Manatee River at Wiamauma (flood stage 11 feet) reach 17.09 feet on the 7$^{th}$.

**9/26/2004** –Widespread heavy rain combined with saturated ground and swollen rivers to cause river flooding across west central Florida and lead to record flooding on one of those rivers. In Hillsborough County, the Alafia River at Lithia (flood stage 13 feet) reached 19.19 feet on the 28$^{th}$, and the Little Manatee River at Wiamauma (flood stage 11 feet) reach 14.60 feet on the 28$^{th}$.

**10/1/2004** –Widespread heavy rain from the hurricanes in September combined with saturated ground and swollen rivers continued to cause river flooding across west central Florida. In HC, the Alafia River at Lithia reached 19.19 feet on September 28th and fell below flood stage on October 3rd. The Little Manatee River at Wiamauma reach 14.60 feet on September 28th and fell below flood stage on October 1st.

**2/3/2006** – The combination of tropical moisture flowing into a line of thunderstorms and an approaching upper level disturbance allowed a train of intense thunderstorms to repeatedly cross over parts of the Tampa Bay area. Between 8 and more than 11 inches of rain fell in roughly a five hour period in a five mile wide stripe extending from Madeira Beach northeast through Pinellas Park, then across Old Tampa Bay to west Tampa, including Tampa International Airport. The area of heaviest rain was so concentrated that downtown St. Petersburg, less than 10 miles away, recorded less than an inch of rain during the same period. The torrential rains caused flash flooding in the areas where more than 8 inches fell. The flash flooding prompted the mayor of St. Petersburg to term the event a "hundred year flood". In Lealman, an entire mobile home community was evacuated, and at least 60 of the homes were flooded. A partial roof collapse was reported at a big box store in St. Petersburg. Water pouring into the store washed out several cash register stands and injured one employee as they were washed into the parking lot. Another roof collapsed at Treasure Island. Hundreds of vehicles were stranded by the flood waters.

Hillsborough County Rain Reports: Tampa International Airport: 8.24 inches, Citrus Park: 6.90 inches, Thonotosassa: 4.35 inches

**7/1/2009** –A trough of low pressure was dissipating across the area with high pressure ridging across southern Florida. This kept west to southwest winds in place across the local area and allowed for numerous thunderstorms with heavy rains and a tornado. The river stage on the Little Manatee River near Wimauma reached 14.15 feet during the evening of July 2nd. Flood stage is 11 feet. The flooding was a result of two days of heavy rain. The total rainfall at the National Weather Service in Ruskin from June 30 through July 1 was 4.53 inches. Fire Rescue reported Owens Road was washed away in the area of the river and numerous roads were inaccessible due to flooding. The damage amount listed is a rough estimate of the road damage.

**8/6/2012** –Deep layer moisture allowed seabreeze thunderstorms to develop over west central and southwest Florida, dumping heavy rain with minor flooding. One of these storms produced severe hail. Broadcast media reported roads closed due to flooding near Linebaugh Avenue and Nebraska Avenue. Additionally, one or two inches of water flooded some ground floor units at the Richmond Hill Apartment Complex at the same intersection. Road closures also occurred at 113th Avenue and 15th Street intersection due to a foot of standing water. Near Florida Avenue and Busch Boulevard at the Floriland Business Center, around 30 cars were stuck in standing water from the heavy rain.

**5/2/2014** –A nearly stationary cold front helped generate a squall line that dumped heavy rain over much of West Central Florida. In part of Hillsborough County, training storms produced 6-10 inches of rain, leading to flash flooding. Long durations of heavy rain fell over northern Tampa and the surrounding areas, with radar storm total precipitation

estimates of 6-10 inches being confirmed by mesonet rain gauges in the area. Water levels rose quickly in the areas of heaviest rain, shutting down roads, stranding cars, and entering houses. Hillsborough County Emergency Management reported water entering a house near 56th Street and Fowler Avenue, significant flooding on Fowler Avenue between North 50th and North 56th Streets blocking the entrance to USF, general flooding on North 22nd Street between Busch Boulevard and Fowler Avenue, and flooding at Bougainvillea Avenue and North 30th Street.

**9/28/2014** –A stalled frontal boundary produced localized areas of heavy rain which caused minor flooding in low-lying areas as well as along some area rivers. Flooding of several manufactured homes begins on 32nd and 33rd street in Ruskin when the gauge on the Little Manatee River at Wimauma reaches 14.5 feet. Moderate flooding continued until October 3 and the maximum crest was 14.67 ft. About 10 other homes were cutoff as roads were inundated. This area floods one to five times a year and residents move vehicles and other valuables out of the area when flooding is expected.

Probability: flooding varies within the county. Based on the preceding table, the Tampa-Hillsborough area may have a major flood event on the average of once a year.

It has been determined that structures that are within the 100-year flood elevation have a 26% chance of being flooding in any given year. The actual risk of flooding varies on the height of the "finished floor" elevation. Because of the varied background associated with construction within the county, some structures flood at a two year interval (a severe flooding problem).

FEMA has quantified the probability of flooding through the preparation of Flood Insurance Rate Maps under NFIP. Made available to all jurisdictions, these maps delineate the 100-year floodplain. In using the maps, it is important to note that it is probable that no one storm will inundate all the areas within the flood zone and that areas outside the identified 100-year floodplain may be flooded. Table III. B.10 explains the various flood zones that exist within Hillsborough County.

Through detailed hydrodynamic computer modeling the Hillsborough County Stormwater Management Program has identified areas of flood risk throughout the 17 County watersheds for storms events associated with return periods from mean annual to 100-years. Return periods translate directly into probability of occurrence. At each location the watershed models are capable of providing the expected flow and water surface elevation associated with each event.

The determination of projected flood depth varies with location and type of flooding throughout the County. This is based on three distinctive types of flooding that can occur including coastal, riverine and inland flooding.

**COASTAL**
For coastal areas, depths range from five to seven feet with a category-one stormsurge. For this stormsurge depth with respect to structural flooding, flooding will range from inches to approximately four feet. This is in contrast to an approximate 24' of depth that can be attributed to a category-five stormsurge. The total depth for a category-five stormsurge has a range between 28' to 32' feet within Tampa bay.

**RIVERINE**
With respect to riverine flooding, depths vary with inland rainfall and with the stormsurge event for those areas that are affected by both stormsurge and inland rainfall. Within major riverine systems, such as the Alafia River, areas within the regulatory floodway vary in depth from a few inches to more than eight feet. Some neighborhoods are built withstand the depth by having structures built on piers or pilings (as with coastal areas). With smaller tributaries to major river systems, flooding will vary from a few inches to four to five feet.

**INLAND**
Areas within the County that are affected by inland flooding (non-riverine) are impacted by rainfall and usually the slower conveyance of stormwater. Within these areas, flooding varies from a few inches to usually one to three feet.

Severity of Events / Consequences: For those residents of Hillsborough County who live along the coast, the Hillsborough, Alafia, and Little Manatee River, within the 100-year Special Flood Hazard Area, or urban neighborhoods living with the flooding is a way of life. While the chances of flooding are not a common event, should it occur, the flooding conditions can range from nuisance to catastrophic.

In review of the National Climatic Center database and the National Weather Service Hydrologic Prediction Service websites widespread heavy rain associated with Hurricane Frances across west central Florida lead to record flooding on many of the rivers.

Although improvements have and will be made, floods will continue to occur. The amount of flooding should be reduced as drainage improvements are made and homes built prior to the County's implementation of the National Flood Insurance Program are upgraded/ removed. As Hillsborough County continues to grow, the factors of flood protection becomes more complicated. These factors include the effects on new development downstream, the increased amount of impervious surfaces and loss of natural water storage areas.

## TABLE 3.13: FLOOD ZONES

| Zone | Description |
|---|---|
| **A** | An area inundated by 1% annual chance flooding, for which no Base Flood Elevations (BFEs) have been determined. Depth for the 1% probability event is not provided on the Flood Insurance Rate Map (FIRM), which for Hillsborough County is provided by the Community. Flood depths range from 9 to 120 feet depending on the area being reported |
| **AE** | An area inundated by 1% annual chance flooding, for which BFEs have been determined. Depth for 1% probability event elevation is provided on the FIRM. Flood depths range from 9 to 120 feet depending on the area being reported. |
| **AH** | An area inundated by 1% annual chance flooding (usually an area of ponding), for which BFEs have been determined; flood depths range from 1 to 3 feet. Such areas are not designated within Hillsborough County. |
| **AO** | An area inundated by 1% annual chance flooding, for which average depths and velocities have been determined; flood depths range from 1 to 3 feet. Such areas are not designated within Hillsborough County. |
| **UNDES** | A body of water, such as pond, lake, ocean, etc., located within a community's jurisdictional limits, which has no defined hazard. Such areas are not designated within Hillsborough County. |
| **VE** | An area inundated by 1% annual chance flooding with velocity hazard (wave action), BFEs have been determined. Depths for 1% probability event are provided on the Flood Insurance Rate Map (FIRM). |
| **X** | An area that is determined to be outside the 1% and 0.2% annual chance flood plains. |
| **X500** | An area inundated by 0.2% annual chance flooding; an area inundated by 1% annual chance flooding with average depths of less than 1 foot or with drainage areas of less than 1 square mile; or an area protected by levees for 1% annual chance flooding. Areas are not designated within Hillsborough County. |

Mitigation: the National Weather Service (NWS) and the Florida Division of Emergency Management (DEM) are responsible for executing warnings preceding and during a potential, or actual, flood event. Warning time for flood events may vary significantly. The least warning time would be with severe thunderstorms, which occur frequently in our area, but give little notice as to the extent of rainfall that can be produce in various parts of the County. An average warning time for coastal flooding would be about 12 to 18 hours, however certain systems could allow more or less warning time.

In addition to warnings and public notification there are other measures of protecting against floods.

All the jurisdictions in Hillsborough County participate in the National Flood Insurance Program (NFIP). Through this participation, standards exist for flood mitigation development in areas designated as prone to flooding.

A best practice recommendation for construction in the FEMA Special Flood Hazard Area (SFHA) is to follow accepted ASCE standards including practices such as elevating any new or remodeled construction to a one (1) foot or more "freeboard" above required elevations. These standards are published in documents such as ASCE 24-05 and the most recent version ASCE 24-14.

**HOME OWNER MITIGATION**

- If flooding occurs, get to higher ground. Stay away from flood-prone areas, including dips, low spots, valleys, ditches, washes, etc.
- Avoid flooded areas or those with rapid water flow. Do not attempt to cross a flowing stream. It takes only six inches of fast flowing water to sweep you off your feet.
- Don't allow children to play near high water, storm drains or ditches. Hidden dangers could lie beneath the water.
- Flooded roads could have significant damage hidden by floodwaters. NEVER drive through floodwaters or on flooded roads. Water only two feet deep can float away most automobiles.
- Do not camp or park your vehicle along streams and washes, particularly when threatening conditions exist.
- Be especially cautious at night when it is harder to recognize flood dangers
- Purchase and monitor NOAA All Hazards Weather Radio or visit www.flashweatheralerts.org to download a severe weather alerts App for your iOS or Android powered device.
- Stay away from contaminated water to prevent infection from water borne diseases.
- Empty out collected water to prevent mosquito invasion.

Of the remaining vacant acres to be developed in Hillsborough County, approximately half are located in the Special Flood Hazard Area. These have the designation to be developed for residential, commercial, industrial uses or public facilities, indicating risk reduction strategies should be considered prior to development of this vacant land. Source: Hillsborough County Profile /Integration of the Local Mitigation Strategy into the Local Comprehensive Plan, 2009 LMS update.

Through the NFIP development regulations have been approved that assist in ensuring new development is designed and constructed in a fashion that is more flood-resistant and located outside of the 100-year floodplain.

## f. Winter Storms

Description / Background: severe winter storms can affect the Tampa Bay area. Although Hillsborough County is not affected by snow, significant freezes have occurred with significant impact to the agriculture industry. Winter storms may be accompanied by other hazards, such as coastal flooding, strong winds (tornadoes), wind-chill and power outages. These effects disrupt commerce, transportation and may result in the loss of life; however, freeze events do not have a large scale effect on buildings.

One of the biggest threats from winter storms to Hillsborough County is to the agriculture industry. A significant area of eastern Hillsborough County is agrarian including crops for strawberries and citrus. Portions of southern Hillsborough County contain tomato fields. All of these areas can be severely affected by just a few hours of below freezing temperatures.

Location / Risk Assessment: typically, winters are mild with low temperatures ranging around 50 degrees. Freezing temperatures can occur on one to two mornings per year during December through February. In some years no freezing temperatures occur. Snowfall is very rare. Based on the 1951 – 1980 period, the average first occurrence of 32 degrees F in the fall is December 26 and the average last occurrence in the spring is February 3.

History of Events: between 1999 and 2010, Hillsborough County experienced 23 temperature extremes; 18 freezes, 3 extreme wind chill and 2 wind-chill. The record for the most days in which temperatures went below freezing was set in 2010. This period was also marked with an extreme amount of aquifer pumping, which was also considered to contribute to sinkholes that occurred during that same period. The winter "No- Name" storm that affected Tampa Bay in March 1993 is considered one of the worst non-tropical storms in United States history. Equivalent to a Category 2 hurricane, it caused a significant amount of flooding and power outages within the Tampa Bay area and accounted for more than $2 billion of damage across the eastern United States. According to data from the NOAA National Climate Data Center, Hillsborough County experienced 16 Frost\freeze events from 2010-2014. The severity of each of varied.

Impacts: The impacts associated with a winter storm are recognized as significant to the agricultural community of Hillsborough County but otherwise not as impactful to the remainder of the community. The fundamental reasoning is that essentially only low temperatures are experienced. Snowfall and ice storms do not occur (the last measured snowfall in the Tampa area was in 1977) so the impact from those events which can cause major damage in other parts of the country are not experienced in Hillsborough County. The drop in temperatures can affect some of the vulnerable populations residing in the County including the homeless population. It is typically at the times just prior to a forecasted low temperature event that shelters will be opened and governing authorities such as law enforcement will disseminate the information to those individuals about resources being available.

Commerce that is most vulnerable to winter storms include the large agricultural businesses focusing on strawberry production would sustain one of the largest impacts primarily in east Hillsborough County. Plant City would be heavily impacted by the drop in temperature leading to agricultural losses with direct impacts on the local economy. Strawberries represent 46.6%, while vegetable production is second accounting for 18% of the county's annual agricultural sales. Significant impacts will occur in fisheries located in the Brandon, Riverview and Gibsonton areas.

Hillsborough County is home to about 6,500 acres of citrus groves and is part of the Western Florida commercial citrus production area, according to the U.S. Department of Agriculture statistics released in February 2015. Citrus production in Hillsborough County accounts for over 1.55 million boxes of citrus produced in the state of Florida and includes

oranges, grapefruit, tangelos and tangerines. These groves are located throughout Odessa, Wimauma, Plant City and Ruskin (USDA, 2015).

Extreme cold hazards include infrastructure damage to pipes, power lines and roadways. Despite the low probability of below freezing temperatures in Hillsborough County, even a small accumulation of ice can be extremely dangerous to motorists and pedestrians. Prolonged low temperatures when combined with power outages could be hazardous to vulnerable populations like the elderly and homeless. The events may require the opening of cold-weather shelters to care for adversely impacted individuals. These events may pose a high risk for injuries and loss of life due to traffic accidents on icy roads or hypothermia from prolonged exposure to the cold.

Transportation and economic disruptions may occur even with the slightest impact of icy conditions in Hillsborough County. Roads including I-75, I-275, and I-4 may lead to major traffic accidents or may be an issue for county residents and emergency service providers who are trying access essential services such as hospitals, and when first responders are attempting to reach the scene of an accident. Bridges and overpasses are particularly dangerous because they freeze before other surfaces. In addition, ice accumulation affects rail roads and leads to interference with the public transit systems. Commercial and financial business may see revenue and productivity losses even with short-term impacts.

Probability: the probability of a damaging freeze in any given year is considered low to moderate. Based upon historical trends, it is expected that Hillsborough County will receive a damaging freeze, on an average, approximately once every three to four years.

Severity of Events / Consequences: although the possibility of a major freeze in Hillsborough County is considered rare they have occurred with devastating consequences. Since 1960, the County has experienced three such events in 1962, 1977 and 1983. The latter two resulted in over $163 million in agricultural losses. In addition to the immediate economic impact of these freezes, a secondary impact was its contributing effect of the abandonment of many citrus groves and their conversion to urban uses. Hillsborough County could expect several nights below 30 degrees.

Mitigation: techniques to mitigate the destruction caused by freezes are similar to measures used for other severe-storm hazards. Additionally, there has been modernization of weather observation equipment, which has been linked to early severe-storm warning systems.

To assist with power that may accompany a severe freeze, utility companies and the Hillsborough County Emergency Operation Center have developed a “Response Plan for Power Shortage Emergencies Caused by Extreme Weather Conditions.” The Plan identifies strategies to minimize power outages due to severe weather (either through equipment failures or greater than peak usage of power) and to ensure “critical facilities” operations are maintained.

In addition, the agriculture industry is constantly implementing new measures to protect crops including that of micro jet irrigation. These have made significant progress over the

days when old tires or smudge pots were burned in the orange groves to raise temperatures.

**HOMEOWNER MITIGATION**

**Before**

- Bring pets indoors
- Keep space heaters away from flammable materials and NEVER leave them unattended
- Make sure you have proper ventilation and a carbon monoxide detector in place when using heating sources such as fireplaces and kerosene space heaters
- Install smoke alarms and carbon monoxide detectors and remember to replace batteries every six months
- Move all vehicles inside the garage if possible. Never leave a vehicle running with the garage door down

**During**

- Stay inside and close-off unoccupied rooms in the home
- DO NOT use charcoal-burning devices
- Wear layers of loose-fitting, lightweight, warm clothing. Remove layers as needed to avoid overheating, perspiration and subsequent chill
- Drink plenty of fluids and eat high-caloric foods

**After**

- Clear walkways and sidewalks of snow and ice to prevent injury from slip and fall, but use caution to avoid overexertion
- Identify possible damage and document with photography
- Report damage, such as broken pipes and downed tree branches or power lines, to your utility company and avoid the area to prevent personal injury

## g. Droughts

Description / Background: drought is a normal phenomenon of all climates. The technical identification is a water shortage caused by a deficiency of rainfall. Additionally, a drought can be aggravated by other factors, such as high temperatures, high winds and low humidity. The severity of drought depends on a multitude of factors, which include duration, intensity, geographic extent, water supply of the region and demands by the local community on the existing water supply.

The Federal Emergency Management Agency has identified four types of droughts: meteorological, hydrologic, agriculture, and socioeconomic; however, drought events do not have a large scale effect on buildings.

Location / Risk Assessment: bordered by two oceans, Florida has the longest coastline in the continental United States, the second largest lake in the nation - Lake Okeechobee and 50,000 miles of rivers, streams and waterways. Our waters define our state. Yet, with all of the water that surrounds us Florida is still susceptible to drought. The risks associated with droughts are both social and economic. On the social side, there is the impact on available potable water resources and the subsequent need to take corrective measures. On the economic side there is the impact on agriculture and those businesses which depend on water such as landscaping and recreation. Representing a combination of both social and economic risk is the short and long-term environmental impacts of a drought. Droughts can occur countywide.

History of Events: for Hillsborough County and the Tampa Bay region as a whole, droughts have been a previous occurrence. The area has experienced several drought events over the last ten years. Records show 2006 - 2007 were the driest back-to-back calendar years Florida has experienced, based on data dating back to 1932. Drought has been most pronounced in southwest Florida and the Kissimmee River watershed, with no major conditions in Tampa in the past 5 years although water restrictions are often placed into effect for monitoring purposes.

Impacts: The impact of drought on Hillsborough County directly affects the agricultural community yet also indirectly affects all residents when water use restrictions are implemented. The agrarian impacts are felt by the lack of precipitation and the more concentrated reliance on groundwater for irrigation. This can disrupt the aquifer balance being there is more being drawn out than is being recharged by the natural hydrologic cycle.

Drought conditions may cause soil to compact, decreasing its ability to absorb water, making areas more susceptible to flash flooding, erosion, and wildfires. The impact of a drought would affect people, plants and animals throughout the county leaving many vulnerable. The agricultural business of strawberry production would sustain one of the largest impacts of a drought in east Hillsborough County. Strawberries represent 46.6%, while vegetable production is second accounting for 18% of the county's annual agricultural sales. Plant City would be most susceptible to agricultural loss. Significant impacts will occur in fisheries located throughout east Hillsborough County including the Brandon, Riverview and Gibsonton areas.

The impact outside of the agricultural community while less immediately severe can still have considerable repercussions. Lawn watering is restricted which not only disrupt the aesthetics of a community but can disrupt the balance of the micro ecosystem of that community. Concurrent to that process, lakes and ponds in areas around the County are affected due to the lack of rainwater recharge and thus, the ecosystem existing in or around that lake or pond is impacted. Recreational activities can also experience disruption such has occurred in the past in the County when precipitation levels have fallen low leading to drought conditions. Rivers such as the Alafia had been closed for canoeing

and recreation areas such as Meddard Reservoir in the eastern part of Hillsborough County were impacted for both boating and angling.

Probability: there are no common techniques determining the return of a drought event, so people rely on drought indices to detect and measure droughts. The National and Florida Drought Monitor tracks several indices which can provide a picture of the conditions that can cause and support a drought.

As indicated in Table 3.1, within Hillsborough County the probability of a drought is low based on historical data. Having a drought even occur once approximately every 5-10 years has resulted in a quantitate measure of the actual threat being of low occurrence. Meteorological events of typical summer thunderstorms and climatological data of those events over time have substantiated this low probability indicator.

Severity of Events / Consequences: The Palmer Drought Index is an often-used measurement of dryness based on recent precipitation and temperature. The index has proven most effective in determining long-term drought — a matter of several months. It uses a 0 as normal and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought. The index also is used to describe wet spells using corresponding positive numbers. According to the June 2015 Palmer Drought Index maps available at the United States Drought Monitor, Hillsborough County is currently in a non-drought condition. Historical records have shown that as recently as five years prior, Hillsborough County was in a condition of moderate to severe drought. These conditions are exemplified by crop or pasture losses, water shortages and the imposition of water restrictions. Surface waters of lakes and rivers are also affected due to the lack of precipitation to recharge these water features.

Mitigation: preplanning is the key to drought mitigation. Measures must be considered to both increase available water supplies and improve the efficient use of those supplies.

The Tampa Bay area lies within the Southwest Florida Water Management District. The District has developed a water management plan that is implemented during time of droughts to minimize their adverse effects. The Southwest Florida Water Management District has imposed restrictions on watering as a means to conserve drinking water during the drought. Additionally, the majority of the area's potable water supply is provided by Tampa Bay Water. These two agencies work closely with local governments to ensure mitigation strategies are implemented during a time of drought.

## h. Extreme Heat

Description / Background: extreme heat conditions are defined by summertime weather that is substantially hotter and/or more humid than average for a location at that time of year. The National Weather Service measures extreme heat using the "Heat Index" (HI). The HI, given in degrees F, is a measure of how hot it really feels when relative humidity (RH) is added to the actual air temperature. The HI for any temperature can be found by cross-checking the temperature (found on the top of the table) and the relative

humidity (RH) found on the left of the table. The point of intersection is the measure of how hot it really feels. However, extreme heat events do not have a large scale effect on buildings.

Location / Risk Assessment: extreme heat conditions generally occur throughout Hillsborough County during any single event. People in Tampa, Temple Terrace, Plant City and unincorporated Hillsborough County are vulnerable to the dangers present during these conditions. According to the National Climatic Data Center of the National Oceanic and Atmospheric Administration, Hillsborough County (Tampa) has an average summer high temperature of 90 degrees Fahrenheit. If a rule of thumb assumption provides that 10 degrees Fahrenheit above the average temperature reaches an "extreme heat" threshold, 100 degrees would be considered the point at which an extreme heat event would occur. This quantitative measure falls in line with historical events classified by NOAA including the heat event which occurred on September 9, 2010 which resulted in a fatality from the temperature conditions.

While the general assumption of 10+ degrees above average is an abbreviated measure of the heat index below, it does provide for some general reference for individuals to gauge by if they will be exposed to the conditions. Humidity and other factors can contribute to the measure as indicated in the matrix below.

History of Events: according to data compiled by the National Climate Data Center between 2010 - 2014 there was one recorded excessive heat incident. In 2010 a three year old died after being left in an unattended vehicle. While the data only reveals one recorded incident, localized conditions can promote extreme heat events even when not within the documented parameters.

## TABLE 3.14: LIKELIHOOD OF HEAT DISORDERS WITH PROLONGED EXPOSURE OR STRENUOUS ACTIVITY

Temperature (°F)

| Relative Humidity (%) | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 80 | 81 | 83 | 85 | 88 | 91 | 94 | 97 | 101 | 105 | 109 | 114 | 119 | 124 | 130 | 136 |
| 45 | 80 | 82 | 84 | 87 | 89 | 93 | 96 | 100 | 104 | 109 | 114 | 119 | 124 | 130 | 137 | |
| 50 | 81 | 83 | 85 | 88 | 91 | 95 | 99 | 103 | 108 | 113 | 118 | 124 | 131 | 137 | | |
| 55 | 81 | 84 | 86 | 89 | 93 | 97 | 101 | 106 | 112 | 117 | 124 | 130 | 137 | | | |
| 60 | 82 | 84 | 88 | 91 | 95 | 100 | 105 | 110 | 116 | 123 | 129 | 137 | | | | |
| 65 | 82 | 85 | 89 | 93 | 98 | 103 | 108 | 114 | 121 | 128 | 136 | | | | | |
| 70 | 83 | 86 | 90 | 95 | 100 | 105 | 112 | 119 | 126 | 134 | | | | | | |
| 75 | 84 | 88 | 92 | 97 | 103 | 109 | 116 | 124 | 132 | | | | | | | |
| 80 | 84 | 89 | 94 | 100 | 106 | 113 | 121 | 129 | | | | | | | | |
| 85 | 85 | 90 | 96 | 102 | 110 | 117 | 126 | 135 | | | | | | | | |
| 90 | 86 | 91 | 98 | 105 | 113 | 122 | 131 | | | | | | | | | |
| 95 | 86 | 93 | 100 | 108 | 117 | 127 | | | | | | | | | | |
| 100 | 87 | 95 | 103 | 112 | 121 | 132 | | | | | | | | | | |

Caution  Extreme Caution  Danger  Extreme Danger

Probability: in the 5 year period from January 2009 through June 2014 there was one extreme heat event with one death recorded in Hillsborough County. This indicates a 7% probability that an extreme heat event will occur in Hillsborough County in any given year.

Severity of Events / Consequences: unlike other natural hazard events extreme heat does not leave physical damage. There is little or no damage to buildings. The toll is on people and can lead to extreme medical conditions and death.

Heat related injuries are a major concern as heatstroke is a severe medical condition that requires emergency medical treatment. The most vulnerable are the elderly, infants, young children and people with chronic health problems. Because the concrete and asphalt in urban areas retains heat and releases it at night offsetting any relief that otherwise would have been felt there is a greater concern in these areas. The loss of power can also exacerbate a serious situation

The severity of extreme heat in the Hillsborough County area can be based on historical climatological data. While official records up through 2014 have never recorded a

temperature above 99 degrees Fahrenheit at the official recording stations for Tampa, the presence of summer temperatures up to the 99 degree mark are possible and often reached.

Specific high-risk groups typically experience a disproportionate number of health impacts from extreme heat conditions: low income, homeless, the sick, elderly, individuals under the influence of drugs or alcohol, and special needs populations who have mobility restrictions, are oxygen dependent or have mental impairments.

Age does not always equal vulnerability; however it is a good proxy measure for vulnerability. Twelve percent of the total population of Hillsborough County according to the U.S. Department of Commerce is age 65 years and older. Those at greatest risk of death in extreme heat conditions are urban-dwelling elderly without access to an air-conditioned environment. For example, an elderly person that resides in a high-rise building may have difficulty evacuating following a power outage during a natural disaster; exposing them to this high risk environment. Elderly populations are concentrated in the Sun City in the south portion of the county, and then in the Egypt Lake-Leto and Town 'n' Country communities of West Hillsborough County.

Those with special needs may show trends in geographic location in specific areas but are mostly scattered throughout the county with the map showing high concentrations of special needs populations residing along the east portion of Interstate 275 from downtown Tampa, north to Bearss Avenue.

Recreational activities in fixed site locations and for special events are common throughout Hillsborough County. Baseball, football, soccer fields, parks, and recreational areas expose populations to the potential to heat related emergencies. Attendees at Raymond James Stadium, George M. Steinbrenner Field, Plant Field, Al Lopez Field, Larry Sanders Progress Village Sports Complex, Lowry Park Zoo, Busch Gardens Amusement Park, MidFlorida Credit Union Amphitheatre, Florida State Fair Grounds, and Curtis Hixon Waterfront Park.

Special events that occur annually in the community include numerous music festivals/concerts, races including marathons/half marathons, the Florida State Fair, Strawberry Festival in Plant City, and Gasparilla Day Parade that takes place from downtown Tampa along Bayshore Boulevard to South Tampa. Various recreational activities that are common in Hillsborough County include fishing, kayaking, biking, skateboarding, swimming and golfing.

In addition, vulnerabilities in the environment and the impact of extreme heat can lead to the death of many organisms in the water ecosystem. These changes in water temperature contribute to the degradation of water quality and negatively impacts fish populations. High temperatures are additionally linked to rampant algae blooms that may result in fish kills, and may produce toxins that can sicken or kill people and marine life.

Extreme heat is a combination of high temperatures and high humidity. Conditions of extreme heat are dangerous and can cause injury and death. The body cools itself by sweating because the evaporation of moisture has a cooling effect. High humidity

reduces this evaporation and hinders the body's effort to cool itself. Extreme heat can manifest itself in the following symptoms:

| | |
|---|---|
| **Heat Cramps** | muscular pains and spasms due to heavy exertion. They usually involve the abdominal muscles or legs. It is generally thought that the loss of water from heavy sweating causes the cramps |
| **Heat Exhaustion** | occurs when people exercise heavily or work in a warm, humid place where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to vital organs. This results in mild shock. |
| **Heatstroke/Sunstroke** | LIFE THREATENING. The victim's temperature control system stops working as the body quits producing sweat. The body temperature can rise so high that brain damage and death may result. |

The relationship of heat disorders to heat index (shown above) is summarized below:

| | |
|---|---|
| **Heat Index of 130° OR Higher** | Heatstroke/Sunstroke Highly Likely with continued exposure |
| **Heat Index of 105°- 130°** | Sunstroke, Heat Cramps or Heat Exhausting Likely, and Heatstroke possible with prolonged exposure and/or physical activity |
| **Heat Index of 90°- 105°** | Sunstroke, Heat Cramps or Heat Exhausting Possible with prolonged exposure and/or physical activity |
| **Heat Index of 80° - 90°** | Fatigue possible with prolonged exposure and/or physical activity |

Mitigation: in general, elderly persons, small children, chronic invalids, those on certain medications or drugs (especially tranquilizers and anticholinergic) and persons with weight and alcohol problems are particularly susceptible to heat reactions, especially during heat waves. The National Weather Service (NWS) Weather Forecast Office (WFO) can issue the following heat-related alerts as conditions warrant so that individuals and institutions can plan for potential severe heat impacts.

- Excessive Heat Outlook**:** when the potential exists for an excessive heat event in the next 3 to 7 days. An outlook is used to indicate that a heat event may develop. It is intended to provide information to those who need considerable lead time to prepare for the event, such as public utilities, emergency management and public health officials

- Excessive Heat Watch**:** when conditions are favorable for an excessive heat event in the next 12 to 48 hours. A watch is used when the risk of a heat wave has increased, but its occurrence and timing is still uncertain. It is intended to provide enough lead time so those who need to set their plans in motion can do so, such as established individual city excessive heat event mitigation plans

- Excessive Heat Warning/Advisory**:** when an excessive heat event is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurrence. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property

**HOMEOWNER MITIGATION**

When temperatures soar, follow these safety rules:

The coolest part of the day is normally sunrise, so plan any necessary strenuous activity for the morning

Stay indoors as much as possible. If air conditioning is not available, stay on the lowest floor, out of the sunshine

Drink plenty of water even if you don't feel thirsty as water is most hydrating liquid to drink during a heat wave. Avoid alcohol and caffeine as they can intensify the negative effect of heat on your body

Wear lightweight, light-colored clothing to reflect some of the sun's energy

Never leave children, elderly or pets in the car even with the windows down. Although the outside air temperatures may seem comfortable, temperatures inside a vehicle can rise 40 to 50 degrees and swiftly create deadly, oven-like conditions

Avoid using salt tablets unless directed to do so by a physician

## i. Climate Adaptation Sea Level Increase/ Climate Change

Description / Background: The climate of the Tampa Bay area has been changing in various cycles over time. Changes in climate will impact various areas of risks, which has been illustrated within aforementioned tables and include areas such as wildfires, flooding, droughts.

An area that most within the community are currently discussing and recognize as a risk area that is being affected due to changes in the climate is with changes to the Stillwater elevation of the bay. This particular risk areas is associated with flooding, but it is also a contributing factor to loss of habitat, potential impacts to potable water . . . Changes in the elevation of the Stillwater within the bay may be seen by reviewing data that shows an increase by no less than eight inches in the past 90 to 100 years. The Stillwater elevation in this context is synonymous with "local mean sea level" (LMSL), which is defined as the height of the sea with respect to a land benchmark averaged over a period of time (such as a month or a year) long enough that fluctuations caused by waves and tides are smoothed out. One must adjust perceived changes in LMSL to account for vertical movements of the land, which can be of the same order (mm/yr) as sea level changes.

Location / Risk Assessment: sea level increase is an initial area of review due to the measurability of changes at the current time. As illustrated within the aforementioned and illustrated in tables, there are other areas of risks that are affected by changes in the climate (drought, wildfires, flooding, etc.) Changes with the climate may be first recognized by most of the community through the changing in sea level. This is due to such being noted mostly along the coastline of Florida and Hillsborough County. Estimates vary as to how high the sea will climb in the next 30 years. In Florida, one of the most widely cited estimates of sea level rise is based on a study by the U.S. Army Corps of Engineers and projects three to seven inches by 2030. Even a modest increase has big implications in some places, and the problem of lost shoreline is only the beginning — the most difficult challenges come because sea level rise amplifies many problems that Florida communities already face: flooding during rainstorms, storm surges from hurricanes, and saltwater intrusion into aquifers.

Identified within the Background Section of Chapter III, the Local Mitigation Strategy (LMS) does identify risks that would be exacerbated with an increase in frequency or due to a significant change in climate. Table 3.1 within the Section does illustrate respective risks areas and the table does address vulnerability that includes:

- The probability of occurrence,
- The vulnerability of the community,
- The potential of occurrence – frequency, and
- The distribution of impacts within the community.

In addition to work reviewed by the Local Mitigation Strategy Working Group, the Hillsborough County Climate Adaptation Committee and other groups continue to review scientific information that pertains to changes to risks due to climate change.

Changes to the mean seal level is an area of risk that is currently under researched by regional and Federal agencies for the Tampa Bay area. Respective research is currently under discussion and scientific evidence is under review; whereby, an increase in sea level over time will affect both natural and man-made environments. At this time, the Hillsborough County Climate Adaptation Committee and the Tampa Bay Regional Planning Council have released preliminary information that shares an overall potential change in sea level in the next 60 to 80 years; however, said groups have not provided information that establishes rates of change. Rates of change is a required element to determine the vulnerability of the community.

In response to inquiries regarding potential areas of vulnerability due to changes in sea level submitted to the County's Local Mitigation Strategy (LMS) Working Group and to the County's Hazard Mitigation Program, the LMS document has been updated below to identify areas that would eventually be susceptible to an increase in the stillwater elevation (sea level) of the Hillsborough County portion of the Tampa Bay area. It is also important to note that the total potential elevation change estimated for the proceeding 80 years is approximately four feet. With this elevation change, almost all structures within Hillsborough County would remain above the estimated elevation change; however, this circumstance would increase the probability of flooding within the coastal and some riverine areas. For example, with Tropical Storm Andrea in 2014, there were between 3,000 and 4,000 parcels (not structures) affected by a minimal coastal stormsurge that accompanied the storm. With an increase in four-feet in sea level

elevation over the next 80 years coupled with the same tropical storm stormsurge, the number of affected parcels would be significantly higher and there would be a significant number of impacted structures (in 2014, the same stormsurge had little impact to actual structures).

Areas of impact are equivalent to currently identified coastal floodprone areas. Within Chapter 3 of the LMS document, the following sections identify areas that would be impacted by a change in sea level:

- Section b. Hurricanes and Tropical Storms, and
- Section e. Flooding.

Respective sections do identify areas that are most susceptible to flooding, identify techniques to mitigate the risk of flooding to reduce human and structural vulnerability, and identify consequences of not mitigating within respective areas. These sections within the LMS are to be referenced for details, but examples of affected areas (excerpts) include: principal coastal portions of riverine systems (e.g. Hillsborough River, Alafia River, Little Manatee River, Bull Frog Creek, Rice Creek, Rocky Creek Delaney Creek, Brushy Creek . . . ), Rocky Point, Interbay Peninsula including MacDill Air Force Base, Davis Island, Harbour Island, downtown, Hookers Point, Port Sutton, Riverview, Gibsonton, Big Bend, Apollo Beach, Ruskin, Sun City, Town N' Country, the Westshore business district, . . . Tampa International Airport, Palm River.

Although, sea level increase is occurring, the rate of change within the Tampa Bay area has not been identified by various planning horizons at this time. With a few added years of monitoring, the community may update the LMS to identify alternative mitigation techniques that may be used to address changes within coastal areas.

Climate change will be felt throughout the county as residents can expect to see more public health risks from storms, flooding and waterborne illnesses and infectious diseases like dengue fever, drought, extreme heat waves, and declining air quality. Changes with the climate may be first recognized throughout the county as changes in sea level become evident. This is will have a large impact on neighborhoods along the coastal areas in Hillsborough County including Westshore, Town & Country, Gibsonton, Ruskin, Apollo Beach, Ruskin, South Tampa, Downtown Tampa, Ybor City, Davis Island, Channelside and the MacDill Air Force Base. In addition, populations along the Alafia, Hillsborough, and Little Manatee River floodplains are at high risk of the effects of sea level rise, storm surge, and flooding due to extensive rainfall.

Businesses in Hillsborough County that are particularly vulnerable to the increase in sea level rises include structures in the downtown Tampa area due to their location on the bay. Many major businesses that are located in the coastal areas that are susceptible to sea level rise include the Tampa Bay Port Authority, Tampa International Airport (TIA), Tampa General Hospital, the Westshore business district, retail stores and restaurants located along these waterways and coastal areas of Hillsborough County. Owners of businesses in these areas need to take into consideration the impact of climate change and the future impact on production of products or services in future years. Furthermore, businesses planning on building along coastal areas need to take into consideration the risks associated with sea level rise and the loss to coastal areas.

History of Events: from 1961 to 2003, global average sea levels rose at an average rate of 0.07 inches (in) per year (IPCC, 2007c). From 1993 to 2003, the average rate increased to 0.12 in per year (IPCC, 2007c). These findings suggest global sea level is not only rising but also accelerating due to increasing greenhouse gas (GHG) levels in our environment. Coastal communities will most likely feel the impact of SLR as the intensity of tropical storms rises, with vulnerability increasing as property values rise and population grows (IPCC, 2007b).

Based on the National Climate Assessment (NCA) report from 2013, the rate of global sea level rise measured by satellites since 1992, has been roughly twice the rate observed over the last century. Sea level is projected to rise by another 1 to 4 feet in this century. A wider range of scenarios, ranging from 8 inches to 6.6 feet of rise by 2100, has been suggested for use in risk-based analyses. In general, higher emissions scenarios that lead to more warming would be expected to lead to sea level rise toward the upper end of the projected range. The stakes are high, based upon national information, as nearly five million Americans live within four feet of the local high-tide level.

Probability: Climate change has significant consequences if not properly monitored. Increased periods of droughts will impact risks associated with wildfires, ground subsidence, stormwater management, and much more. If one area of risk that is currently better understood with respect to change is reviewed, a glimpse to the potential probability of impacts may be summarily reviewed. For example, it is known that sea level rise is a critical issue for Florida residents to pay attention. The magnitude of its impacts on the state seem overwhelming if considered all at once, however, with a proper understanding of the issue and the ability to proactively plan, there is a great deal we can do to mitigate worst-case scenarios. In addition to flooded real estate and other infrastructure, sea level rise poses risks of coastal erosion and loss of beaches, salinifying water wells used for drinking and irrigation, potential loss of property value, increased insurance premiums or the potential of the inability to insure property, increased exposure to waterborne pathogens, and more. Local experts in South Florida have analyzed how much the seal level will rise, and concluded that Florida will likely experience an 3 – 7 inch increase by 2030 and an 7 – 17.5 inch increase by 2050.

Severity of Events / Consequences: staying with the area of risk in which some level of probability is known, if sea level rises three to seven inches by 2030, it won't mean every oceanfront home or business will have water lapping at its doorstep. But even a small amount of sea level rise has side effects beyond how much shoreline ends up disappearing:

- Storm surges from a hurricane, for example, that 30 years ago would have been seven feet might be closer to eight feet, sending water farther inland than in the past.
- Both sea level rise and climate changes that produce more rainfall are expected to strain drainage systems. As a result, vital facilities and infrastructure in low-lying areas, such as roads, critical facilities, water utilities and schools, may need to be fortified, elevated or (even eventually) relocated.
- Saltwater intrusion will worsen, with greater pressure for more ocean water leaking into Florida's underground aquifers. This may have an impact to operations

associated with utilities, alternative sources of water, and natural habitats and environmental lands.

Mitigation: as scientists develop a better understanding of the factors and reinforcing feedback mechanisms impacting changes to the climate the community will need to adjust and adapt to changing conditions. To ensure public safety and economic viability in the long run, strategic policy decisions will be needed to develop guidelines to direct future public and private investments to areas less vulnerable to future sea level rise impacts. Planning officials need to consider respective changes and increased risks when consideration is given to development approvals.

There are discussions regarding climate change mitigation that may include reductions in human emissions of greenhouse gases. These discussions include mitigation techniques that may be used to assist with national efforts, which include increasing areas of forest. Mitigation policies can substantially assist in having the community adapt to changing conditions.

Other examples of mitigation and adaption techniques include looking to design and building standards, infrastructure designs, potable and sanitary water use; as well as, working on a holistic scale with other communities in providing consideration to use of low-carbon energy sources, such as renewable energy, expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere. Energy efficiency may also play a role, for example, through improving the insulation of buildings. Another consideration is to climate change mitigation is with climate engineering. Presently, the community will continue to monitor changes and develop recommendations that will assist in the building resilient places to live and work.

## j. Suspect Soils: Sinkholes

Description / Background: for the residents of Florida, the sudden appearance of sinkholes is not an unusual occurrence. Taken from an Issue Paper, the Southwest Florida Water Management District (SWFWMD) noted that sinkholes are as common in Florida as lakes, rivers and warm weather. In fact, many lakes in central Florida were formed by sinkholes. As the name suggests sinkholes result from the ground sinking and creating a depression.

The cause of the depression is underground in the porous limestone base. As rainfall is filtered through the ground to the limestone, it erodes and dissolves the soluble rock and creating cavities in the subsurface. Another cause of sinkholes is the lowering of underground water levels, either by lack of rainfall or over pumping for water supply. In this case, the water in the underground cavities helps support the layers holding up the land surface.

Location / Risk Assessment: within the 17 counties which comprise SWFWMD sinkholes develop more frequently north of Tampa Bay where the limestone base is closest to the land surface and the supporting sand and clay layers are thin.

History of Events: using the Alafia River as a reference point, Hillsborough County is roughly divided in half in terms of the possibility of sinkhole formation. North of the Alafia River, sinkhole formation increases in possibility whereas south of the river, sinkhole formation is rare. These are validated by the fact that SWFWMD has recorded 300 sinkholes in Hillsborough County since 1970 with 290 occurring north of the Alafia River and 10 south of the river.

The Florida Center for Instructional Technology at the University of South Florida has produced a map of sinkhole activity in Hillsborough County. The map depicts the location of more 300 sinkholes and indicates that the central portion of the County is most susceptible to sinkholes. From 2010-2014, 186 sinkholes have been recorded by the Florida Department of Environmental Protection throughout Hillsborough County. During 2010, greater than 140 structures were affected by sinkhole activity, which coincided with a freeze period and the use of pumping to protect crops.

Probability: the difficulty in emergency planning for sinkholes is the fact of not knowing exactly where and when they will occur. Geologists have a good idea where sinkholes are likely to form geographically, but it's much more difficult to accurately predict specifically where sinkholes will occur. As a consequence, while the damage could range from low to high, it is almost impossible to predetermine in Hillsborough County which individual property could be affected by sinkhole activity. All that be ascertained with any certainty is that the likelihood of sinkholes will occur in that portion of the County located north of the Alafia River.

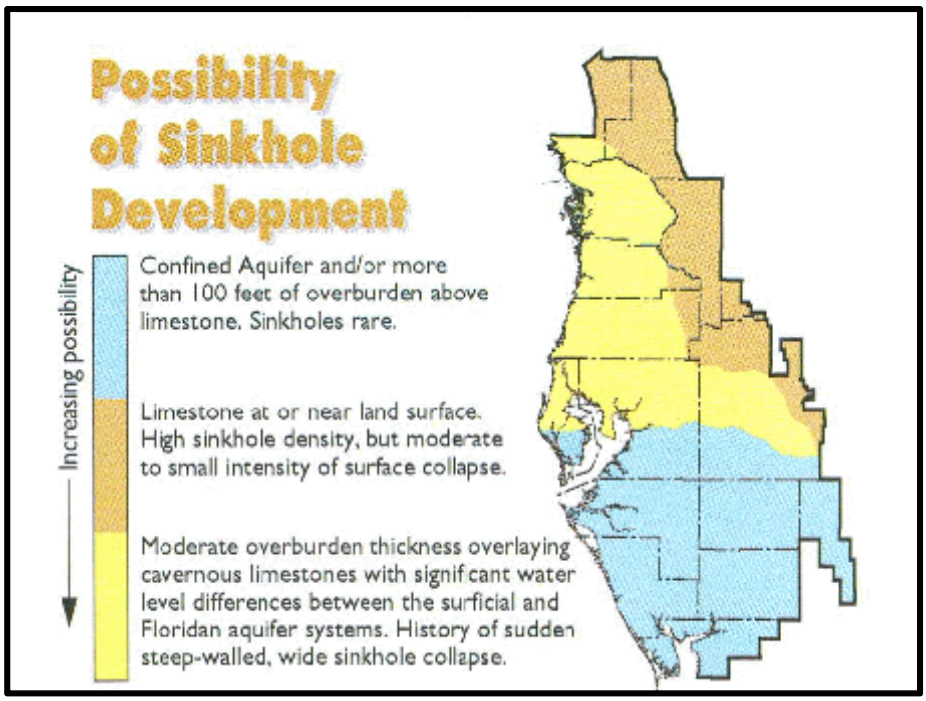
While the predictability of *where* a sinkhole might occur can be difficult, the probability of their occurrence is moderate as indicated in Figure 3.1. This is based on the quantitative data collected by Hillsborough County for building permits to repair sinkhole damage as well as data from the State of Florida Department of Environmental Protection on their occurrence. A sinkhole does not have to be catastrophically deep or wide to have an impact on structures or property. The moderate probability is substantiated by the need for foundation repairs documented in the form of building permits by the County.

Sinkhole dimensions can vary by type as well as location. An analysis of the data available for Hillsborough County taken from the Subsidence Incident Reports collected by the State of Florida Department of Environmental Protection provides an average width of approximately 19' and an average depth of approximately 9'. This is based on the analysis of approximately 350 incidents reported at the state level. Estimation made by the Hillsborough County Professional Geologist indicates the largest size possible to be approximately 150' wide by 100' feet deep. This dimension is dependent on the type of sinkhole as Paleo sinks (those originally forming between 2 and 8 million years ago) could result in a larger dimension. However; it must be understood that the largest dimension is one that may not occur immediately upon the formation of a sinkhole and could take years to reach that largest extent.

Severity of Events / Consequences: sinkholes generally do not cause tremendous damage since their average size is generally small, less than 10 feet in width. Structural cracks, sagging floors, or large potholes in yards or roadways will usually occur due to a sinkhole collapse. The primary risk associated with sinkholes is the collapse of a structure due to the ground giving way underneath.

One known threat to the general population and overall public welfare would result when a sinkhole occurred at a site containing hazardous materials. If severely damaged by a sinkhole chemicals could be released causing severe health risks to nearby residents. There is also a potential risk that a sinkhole, disrupting a facility's foundation, might cause hazardous materials to enter the underground water system.

**FIGURE 3.1: SINKHOLE DEVELOPMENT**




Mitigation: it is difficult to determine where and when a sinkhole will occur. It is possible to detect sinkholes in the early stages of development. Sites can be examined for the sinkhole activity through ground penetrating radar. Once found, preventative measures can be undertaken, such as filling the void, to prevent a collapse of land from occurring. In general, such measures can be costly and are limited to projects that would be significantly impacted financially as a result of a sinkhole.

For residential homes, sinkhole damages are sometimes covered by homeowner's insurance. In such cases, a residential homeowner may not be willing to invest in costly mitigation measures (which may not necessarily ensure a structure's survivability), when in reality the annual insurance premiums already cover the potential risk. Because sinkhole occurrences are few, this may be the most effective form of mitigation for homeowners.

## k. Wildland Fires

Description / Background: as people search for a place to live they often desire two conflicting conditions: country living with urban services. This desire for urban/rural living has been given the name "wildland/urban interface." As described by the Florida Division of Forestry, the wildland/urban interface "refers to that geographical point where two diverse systems – wildland and urban – meet and affect each other and give rise to conflicts between societal values and expectations concerning the management of natural resources." The major problem resulting from the wildland/urban interface is wildfire.

According to the Southern Group of State Foresters, the southern part of the country consistently has the highest number of wildfires per year. Population growth is pushing housing developments further into natural and forested areas where most of these wildfires occur. This situation puts many lives and communities at risk each year. In particular, the expansion of residential development from urban centers out into rural landscapes, increases the potential for wildland fire threat to public safety and the potential for damage to forest resources and dependent industries. This increase in population across the region will impact counties and communities that are located within the Wildland Urban Interface (WUI). Hillsborough County is no exception. In the Hillsborough County area, it is estimated that 1,114,194 people or 91 percent of the total project area population (1,229,061) live within the WUI. (Southwrap, 2015)

**The Wildland Urban Interface (WUI) layer reflects housing density depicting where humans and their structures meet or intermix with wildland fuels.**

Location / Risk Assessment: much of the unincorporated area of Hillsborough County is located in the wildland/urban interface. As the population of unincorporated Hillsborough County continues to grow, the number of residents residing within the wildland/urban interface also grows. The University of Florida's Institute of Food and Agricultural Science has identified the fire characteristics of nine ecosystems found in Florida's wildland/urban interface.

## TABLE 3.15: ECOSYSTEMS IN FLORIDA'S WILDLAND

| Ecosystem | Fire Frequency (Yrs.) | Wildfire Hazard |
|---|---|---|
| Scrub Pine | 10 – 100 | Extreme |
| Pine Rockland | 3 – 10 | Extreme |
| Pine Flatwood | 1 – 8 | Extreme |
| Dry Prairie | 1 – 4 | High |
| Marsh | 1 – 5 | High |
| High Pine/Sandhill | 1 – 8 | Medium |
| Swamp | 5 – 200 | Medium |
| Hardwood Hammock | 30 – 50+ | Low |
| Hardwood Rockland/Tropical Hammock | 59+ | Low |

Three of these ecosystems can be found in Hillsborough County: Pine Flatwood, High Pine/Sandhill and Swamp.

History of Events:

- May 2006 - Interstate 75 was closed for six hours between Gibsonton Drive and Big Bend Road as 130 emergency workers fought the blaze with plows, helicopters, brush trucks and water tankers. Thousands of people were evacuated in developments east of the interstate when the fire jumped the road. A brush fire developed in Ruskin and eventually spread to 50 acres. The fire was reported by print media to have damaged a mobile home, several carnival food trucks, a warehouse, and a few old racing cars. Additionally, smoke from the fire shut down Interstate 75 between mile markers 229 and 240 for several hours.

- According to the Florida Forest Service, for the time period from January 1, 2010 to December 31, 2014, Hillsborough County experienced 170 wildfires which affected 3,643.8 acres. These includes causes based on everything from lightning to campfires which got out of control. (Florida Forest Service – Lakeland District, 2015) These were solely considered wildfires documented by the Florida Forest Service.

Impacts: The impacts of wildfire to Hillsborough County are an ongoing concern based on the high population that lives within the Wildland Urban Interface (WUI). This is especially true when developments are established close to wooded areas and areas of conservation. This process is indeed desirable as it established means of conservation and preservation yet consideration must be made to the risks of having development in

close proximity to natural areas. The impacts can range from loss of the wildland area due to wildfires and extend to structure fires and loss of homes from those same wildfire occurrences.

The impacts can extend beyond the direct and obvious result of the wildfire. These impacts can occur much like the aforementioned example of road closure. When the road is a primary transportation route such as an Interstate, the wildfire not only is recognized as a risk to those persons and structures in its immediate vicinity but the secondary effects from the wildfire such as the smoke and resultant visibility limitations can be great. Safety must be maintained on the roadways to prevent vehicular accidents and the subsequent personal injury that can occur so closures are necessary. These closures are seen as an impact of the wildfire especially as they can be necessary in areas that are far removed from the location of the fire itself.

The wildland/urban interface is primarily located in the areas of southeast Hillsborough County including Riverview, Progress Village, Gibsonton, Apollo Beach, Sun City Center. In addition, neighborhoods in west Hillsborough including Town n Country, Westchase and Lutz (Figure 4.34).

The total amount of land in the wildfire–susceptible areas in Unincorporated Hillsborough County is 63,782.1 acres, which is approximately 11% of the county. Approximately 10% of Plant City, 2% of the City of Tampa, and 3% of Temple Terrace are susceptible to wildfire. (Source: Florida Department of Community Affairs, 2006).

A majority of the areas with the highest level of concern for wildfire are in unincorporated communities including Boyette, Fish Hawk, Progress Village, Valrico, and Wimauma.

Wildfire risk in Hillsborough County is presented through nine Levels of Concern (LOC). Levels 4 through 9 are considered medium to very high risk and can be used to approximate the WUI area of the county. Twenty-two percent of the land within the county is within LOC 4 through 9 and approximately 16.4% of the population resides in these medium to high risk areas. Approximately 15.6% of the total value of structures within the county lies within areas classified as LOC 4 through 9.

Approximately 65% of the population residing within medium to high risk wildfire areas (LOC 4-9) live in single family residences. Sixty-nine percent of all structures countywide within Levels 4 through 9 are single family residences. Of the 20,589 structures within Level 9, or very high risk areas, 67% are single family residences. Total Value of Structures (Millions) 7 Single family residential structures account for 51% of all structures' value within LOC 4 through 9 (Source Data: 2010 Florida Assessor Data, 2000 Census Persons per Household Statistics, 2010 Florida Department of Revenue Parcel Data).

Institutional/government structures and commercial structures each account for $1.4 million, or about 11%, of the total structure value at medium to high risk from wildfire. In addition to structure value at risk, other economic assets in the county, such as agriculture, are also at risk from wildfire damage (2010, Florida Assessor Data).

Additional discussion of the impact, threat and evaluation of wildfire on Hillsborough County can be found in Appendix P of this document in the Southern Wildfire Risk Assessment Summary Report prepared for Hillsborough County.

Probability: While the conditions which are favorable for wildfires are well known, where and when they will occur cannot be predicted. The three principal ingredients for wildfires are topography, fuel and weather. According to the Florida Division of Forestry, Florida is unique in that weather and topography are different from other parts of the country. Here we have relatively flat terrain and abundant rainfall. These factors normally afford firefighters an opportunity to control interface fires in a timely and effective manner. When rainfall in below normal or a killing frost has decimated vegetation or vegetation is allowed to accumulate, the likelihood for a wildfire increases.

According to the State, Florida's typical fire season is from January through May. The potential for wildfires increases dramatically during the dry season as a result of low humidity and high winds. The largest number of lightning caused wildfires occurs in July coinciding with the peak of the thunderstorm season. The top three causes for wildfires in Florida, as determined by the Florida Division of Forestry are arson/incendiary, escaped debris burning and lightning.

Severity of Events / Consequences: the consequences of a wildland/urban interface wildfire were described by the Florida Division of Forestry as follows: Hillsborough County could expect a wildfire with greater than 500 acres burned with evacuations and multiple structures at risk.

"Today, most people's dream home is a place tucked in among the trees with a view of a lake or stream; a place where they can get away from it all, a place that is secure; serene and most of all quiet. Unfortunately, these places…come at a cost; the very real danger of wildfires….Wildfire often begins with little or no warning, spreading quickly, igniting trees, brush and your home."

In addition to homes, wildfires can also damage/destroy commercial structures, public infrastructure, and agricultural activities. In other words, their impact can be far ranging.

Mitigation: the logical method for mitigating the threat of wildland/urban interface wildfires would be to stop development from occurring in the interface - a difficult to impossible thing to accomplish.

About 78% of the 63, 782 vacant acres that are susceptible to wildfire are to be developed for residential, commercial, industrial uses or public facilities, indicating that these risk reduction strategies should be considered prior to development of this vacant land. [Source: Hillsborough County Profile /Integration of the Local Mitigation Strategy into the Local Comprehensive Plan/Florida Department of Community Affairs/2009 update].

One method for mitigating for the dangers of wildfires would be through the application of the development principals outlined through the Firewise Communities program. The concepts of this program include: establishment of defensible space; fire-resistant additions, preparation of a disaster plan; lean, clean, and green landscaping, fire-resistant roof construction; fire-resistant roof construction and emergency access.

For Hillsborough County, a second mitigation measure would be the continued implementation and enforcement of the Hillsborough County Emergency Management's wildfire preparedness guidelines.

## HOMEOWNER MITIGATION

**Remove** fuels that can lead flames to your home or that can become ignited from windblown embers, including:

- Dead grass, leaves, etc. (fine fuels) and dead twigs, branches, etc. (coarse fuels) within 30 feet of buildings
- Dry leaf/pine litter from roofs, rain gutters, decks and walkways
- Dead and dry litter at the base of plants
- Tree branches (ladder fuels) within 6-10 feet of the ground
- Firewood within 30 feet of buildings
- Continuous beds of combustible vegetation (on the ground or in tree tops) that can bring large flames within 100 feet of your home

**Plant** species that retain moisture and resist ignition, including:

- Native, fire-resistant vegetation (check with local forestry agency)
- Fire prone trees and shrubs away from your home and far enough apart, so they won't ignite one another

**Maintain** protect your home and property from wildfire by doing yard work and home maintenance before fire season.

- A lean, clean and green landscape at least 30 feet around buildings
- A legible and clearly marked street number for emergency responders
- Storage sheds containing items including lawn mowers, grills/ gas cans and tanks away from the home

**Install** metal screening that blocks embers from entering your building, including:

- Noncombustible 1/8 inch on attic/crawl space vents, and around low decks
- Noncombustible (metal, etc.) skirting around mobile homes

**Identify** an emergency water supply within 1,000 feet of your home through one of the following:

- Community water/hydrant system, and/or
- Drafting site on a lake
- Cooperative emergency storage tank with neighbors
- Swimming pool

If under a wildfire threat; only remove dead leaves or vegetation when local garbage collection services will have time to pick up the debris. Do not burn vegetation without following local requirements.

## I. Tsunamis

Description / Background: when a person hears the term "tsunamis" odds are that they'll think of a large wall of water resulting from a major earthquake somewhere in the Pacific Ocean. The unfortunate truth is that such a belief is only partially correct. While tsunamis can be very large they can also be only a few meters tall. Tsunamis may be generated by any event which results in the vertical displacement of the water column. Although generally associated with earthquakes, tsunamis may also be caused by underwater landslides, volcanic eruptions, explosions and even the impact of cosmic bodies, such as larger meteorites.

Of equal concern should be danger posed by a rogue wave. Rogue waves are sudden, extreme waves with wave height well above the background waves. The generally occur in rough sea conditions

Location / Risk Assessment: since tsunamis generally result from earthquakes, it is not surprising that they would most frequently occur along the boundaries of tectonic plates as found along the continental Pacific coast, Alaska, and Hawaii. The risk to Tampa Bay is minimal.

This assumption may not be totally true, however. In an article entitled *Tsunamis and Tsunami-Like Waves of the Eastern United States* (Science of Tsunami Hazards, Volume 20, 2002) it was noted that since 1600, forty tsunamis and tsunami-like waves have occurred in the eastern United States. The Atlantic coast of Florida was included among those areas feeling the effects of a tsunami.

According to some scientists certain marine conditions exists which increases the likelihood of the east coast of the United States experiencing a major tsunami. This belief is not shared by all. Tom Hilde of Texas A & M University notes in an article entitled *Tidal Waves, Not Likely In Atlantic* that most of the world's tsunamis are generated at convergent plate margins. The Atlantic margin of the United States is a passive margin, not a plate boundary and so is not tectonically active. This area has few, and generally low magnitude, earthquakes. Even so, some scientist such as George Maul, professor of oceanography at Florida Tech, has noted that it's not a matter of if; it's a matter of when the Atlantic will experience a tsunami. In a *"Florida Today* article, it was noted that although tsunamis are rare in Florida and the Caribbean, geologists say the threat is real."

History of Events: a rogue wave, estimated to be 18 feet tall, hit Daytona Beach on July 3, 1992. It is believed that this particular wave was the result of a series of thunderstorms off the Georgia coast. No other occurrences have been recorded.

Probability: since Florida is not located along the convergent margins of the tectonic plates, there is no likelihood of earthquake-generated tsunamis. While history has

shown that Florida's east coast has experienced some tsunami activity, there is no such record for the Gulf coast. Consequently, it can be assumed that the Gulf coast has little to fear from this natural occurrence.

Severity of Events / Consequences: with power and little warning a tsunami has the potential to be destructive both in terms of property damage and loss of life. However, with little historical evidence of tsunami activity on Hillsborough County, the level of severity cannot be quantified.

Mitigation: as noted above, the likelihood of a tsunamis affecting Florida is slight. Even so, the possibility of a tsunami affecting the eastern coast of Florida is real. Consequently, emergency management professionals should remain on alert to those events which may result in a tsunami.

## 2. Pandemic and Public Health Concerns

### a. Disease Outbreak and Incident

Description / Background: a disease outbreak or incident correlates with the spread of a virus or bacteria affecting the health and well-being of a population. According to the Centers for Disease Control and Prevention (CDC), disease outbreaks are identified by the occurrence of more cases of disease than normally expected within a specific place or among a group of people over a specified period of time (Center for Disease Control and Prevention [CDC], 2014). The diseases that do not result in death produce illness that range anywhere from a few days to a life-time.

The dense and diverse population of Hillsborough County enables disease to spread at an accelerated rate if monitoring systems are not in place. Global interactions and integration among people, commerce, and governments of different nations provides opportunities for businesses to conduct trade in the global market, students to participate in international programs and the popularity of travel to foreign countries to increase. At the same time, this increase in globalization provides the means for a variety of diseases to enter Hillsborough County.

As the diverse population of Hillsborough County grows and increases in tourism not only does the proximity of people living closer together increase, but the proximity to livestock also increases. This leaves the population vulnerable to conditions in which it is possible for new diseases to emerge and for the rapid onset of disease locally. The impact of a new disease is often severe as the newly infected victims lack immunity against the disease. These global outbreaks are termed pandemics. Recent pandemics include the following viruses: SARs, H1N1, and Ebola.

Conversely, when a serious outbreak of a disease affects a single community, population, or region in a disproportionately higher number of individuals than normal at a given time these outbreaks are termed epidemics. Epidemics are often recurrences of past diseases. If not contained, epidemics can quickly escalate to a pandemic. However, over time the word epidemic has developed to include anything that adversely affects the health or wellbeing of the larger population.

Additionally, the term endemic refers to a disease that is present at consistent levels and periods of time in a particular population or geographic region. For example, malaria is endemic to tropical areas of the world, such as those in South America or Africa. However, it is not normally found in cooler regions like Antarctica or Canada.

Location / Risk Assessment: The risk of disease in Hillsborough County is monitored by epidemiologists in collaboration with local health departments, doctors and laboratory professionals. The CDC defines epidemiology as "the study of the distribution and determinants of health problems in specified populations and the application of this study to control health problems. Epidemiology is the scientific method used by 'disease detectives'—epidemiologists—to get to the root of a public health problem or emerging public health event affecting a specific population" (CDC, 2014).

As examples of the public health problems or events that are investigated, the CDC provides the following chart:

| | |
|---|---|
| **Injuries** | • Increased homicides in a community<br>• National surge in domestic violence |
| **Non-infectious Diseases** | • Localized or widespread rise in a particular type of cancer<br>• Increase in a major birth defect |
| **Natural Disasters** | • Hurricanes Katrina and Rita (2005)<br>• Haiti Earthquake (2010) |
| **Terrorism** | • World Trade Center (2001)<br>• Anthrax release (2001) |
| **Environmental Exposures** | • Lead and heavy metals<br>• Air pollutants and other asthma triggers |
| **Infectious Diseases** | • Foodborne illness<br>• Influenza and pneumonia |
| **Source:** Centers for Disease Control and Prevention. (2014). EXCITE: Excellence in Curriculum Innovation through Teaching Epidemiology. *What is Epidemiology?* Retrieved at http://www.cdc.gov/EXCITE/epidemiology.html | |

One of the agencies that use epidemiology to track, report, prevent and prepare for diseases in Hillsborough County is The Florida Department of Health - Hillsborough County.
The following information is a table of hazards/diseases that are being monitored and information pertaining to the risk, frequency, onset and duration of the disease. The table provides data on the number of cases reported in Hillsborough County from January 2011 until September 2014.

## TABLE 3.16: REPORT OF DISEASE IN HILLSBOROUGH COUNTY (2011-2014)

| Hazard/Disease | Risk | Frequency | Onset | Duration | Hillsborough County | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Annual Totals | | | Year-to-date |
| | | | | | 2011 | 2012 | 2013 | Jan-Sept 2014 |
| **CNS Diseases & Bacteremias** | | | | | | | | |
| Meningitis (Bacterial, Cryptococcal, Mycotic) | Low/ Moderate | Annual | 0-72hrs | 0-12 weeks | 21 | 5 | 11 | 10 |
| **Tuberculosis** | | | | | | | | |
| Tuberculosis (TB) | Low/ Moderate | Annual | 1 day-6 months | Months if not treated | 46 | 51 | 54 | 31 |
| **Vectorborne, Zoonoses** | | | | | | | | |
| Chikungunya | Low/ Moderate | Semi-Annual | 3-7 days | Several days- 1 week | N/A | N/A | N/A | 20 |
| Eastern Equine Encephalitis | Low/ Moderate | Annual | 4-10 days | 1-2 weeks | 0 | 0 | 1 | 0 |
| Dengue Fever | Low | Annual | 4-6days | Up to 10 days | 4 | 5 | 4 | 4 |
| Malaria | Low | Annual | 9 days-4 weeks | Several months-years without treatment | 7 | 7 | 8 | 9 |
| Typhus Fever (Epidemic) | Low | Annual | 5-14 days | 3-4 weeks | 2 | 0 | 0 | 0 |
| Yellow Fever | Low | Annual | 3- 6days | 3 days-1 week | 0 | 0 | 0 | 0 |
| **Influenza** | | | | | | | | |
| Influenza, Pediatric Associate Mortality | Low | Annual | 1-7 days | 1-3 weeks | 0 | 0 | 1 | 1 |
| Influenza, Novel or Pandemic Strain | Low | N/A | 1-7 days | 1-3 weeks | 7 | 0 | 0 | 0 |

## TABLE 3.16: REPORT OF DISEASE IN HILLSBOROUGH COUNTY (2011-2014) CONTINUED

| Hazard/Disease | Risk | Frequency | Onset | Duration | Hillsborough County | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Annual Totals | | | Year-to-date |
| | | | | | 2011 | 2012 | 2013 | Jan-Sept 2014 |
| **Viral Hepatitis** | | | | | | | | |
| Hepatitis (A, B, C) | Low | 1-5yrs | 0-6 weeks | Years if not treated | 37 | 70 | 104 | 69 |
| **Enteric Infections** | | | | | | | | |
| Escherichia Coli, Shiga toxin-producing (Ecoli) | Low/ Moderate | 1-3yrs | 0-72hrs | 5-10 days after treatment | 24 | 22 | 30 | 16 |
| Salmonellosis (*Salmonella)* | Moderate | Annual | 12-72hrs | 4-7 days | 349 | 331 | 303 | 234 |
| **Food and Waterborne Illness Outbreaks** | | | | | | | | |
| Food & Waterborne Cases | Low/ Moderate | Annual | N/A | N/A | 46 | 51 | 54 | 31 |
| Food & Waterborne Outbreaks | Low | Annual | N/A | N/A | 3 | 4 | 4 | 2 |
| **Vaccine Preventable Diseases** | | | | | | | | |
| Pertussis (Whooping Cough) | Moderate | Annual | 5days-3 weeks | 2-10 weeks | 31 | 119 | 95 | 55 |
| Varicella (Chicken Pox) | Moderate | Semi-Annual | 0-72hrs | Up to 3 weeks | 46 | 45 | 65 | 45 |

**Source:** Florida Department of Health – Hillsborough County. (October 2014). EpiNotes: Disease Surveillance Newsletter. Retrieved from http://www.hillscountyhealth.org/absolutenm/articlefiles/168-epinotes_october_2014_final.pdf

The above listed diseases are illnesses caused by various organisms, including viruses, protozoa, bacteria, fungi and parasites among others and can be transmitted directly from person-to-person, from animal to person and through routes such as contaminated water, food, insects or infected objects. The reduction of the risk of these diseases depends on the particular disease and its mode of transmission.

History of Events: In 1887, a man named Charlie Turk, a suspected fruit smuggler, was the first known person in Tampa to die of the Yellow Fever Epidemic. Altogether, six Italian fruit dealers who traded with citizens from Cuba had contracted the disease, along with a

few of their customers. The fruit shipments coming in from Cuba were most likely the carriers of the infected *Aedes Aegypti* mosquitoes that lead to the Yellow Fever epidemic. It is estimated by Dr. John P. Wall that there were about 1000 cases of Yellow Fever in Tampa with about 100 deaths due to the disease.

In 1918 an unusually deadly influenza pandemic (largely referred to as the Spanish Flu) involving the H1N1 influenza virus infected 500 million worldwide—making it one of the deadliest natural disasters in human history. Exact statistics are not possible for Hillsborough County since the state of Florida did not report the disease consistently.

In 2003, a viral respiratory illness called Severe Acute Respiratory Syndrome (SARS) impacted two dozen countries in North America, South America, Europe and Asia before the global outbreak was contained. According to the CDC, there were a total of 8 cases in Florida—six suspected cases and two probable cases (CDC, 2003). The Hillsborough County Department of Health was on high alert and had monitoring in place to detect any suspected cases of SARS to insure the spread of the disease was contained before further spread of the disease.

By the end of 2009 there were 140 laboratory-confirmed cases of the H1N1 (Swine) flu pandemic in Hillsborough County. The Hillsborough County Medical Association, Inc. (HCMA) released information on Swine Flu notifying the community of the first two laboratory-confirmed H1N1 (Swine) Flu-related deaths in the county. The identified patients in Hillsborough County were adult males, 44 and 49 years old, who had underlying medical conditions that put them at greater risk of complications from influenza. (Hillsborough County Medical Association, Inc. [HCMA], 2009).

In March of 2013 a case of Eastern equine encephalitis (EEE) was reported in the northwest part of Hillsborough County. The last human case of locally acquired EEE in Hillsborough was in August 2010.

The Florida Department of Health (2014) monitors various incidence of disease throughout Hillsborough County. According to recent reports, there have been 20 cases of Chikungunya reported in Hillsborough County between January and September of 2014. However, these individuals had a travel history to a Chikungunya endemic county or area experiencing an outbreak in the two weeks prior to onset. Furthermore, during this same time period there have been 121 cases of Campylobacteriosis which is an infectious disease caused by eating or handling contaminated foods or drinking contaminated beverages.

From January to September 30$^{th}$ of 2013, county health officials reported 29 cases of cryptosporidium; however in the same period of time in 2014 Hillsborough County has seen 257 new cases. Cryptosporidium is a protozoan parasite that can be found in soil, food, water, or surfaces that have been contaminated with infected human or animal feces.

Much of the increase has been attributed to exposure to a recreational water facility in the greater Tampa Bay area.

Probability: the frequency of occurrence of a disease outbreak is low to moderate. However, due to the dense and diverse population in Hillsborough Counties' urban settings and the large number of people who participate in international travel, monitoring, mitigation and preparedness should always remain a priority. According to the Department of Health (DOH), nearly one third of the population of Florida resides in urban/suburban areas, including large populations of immigrants (Florida Department of Health [DOH], 2014).

Hillsborough County has a large transient population that comes in from around the county to visit not only the city of Tampa, but will pass through the county on their way to beach destinations in Pinellas County or on their way to various destinations in south Florida (Miami/Dade, the Florida Keys, the Everglades, etc.). Thousands of people come to Florida each year via automobile on our interstates and by cruise ships at our ports. Data on passenger traffic collected by the Tampa International Airport concluded that 16,920,086 visitors used air travel in year 2013 (Tampa International Airport, 2014).

Severity of Events / Consequences: The onset of disease, the rate at which it spreads, the severity, and even the duration and consequences vary depending on the type of disease and the characteristics of the specific disease. For example, some viruses can be combated through the use of vaccinations while some bacterial outbreaks can be combated through the use of antibacterial treatment.

The resources a population has to prevent the spread of disease and control the damage using various countermeasures will determine the severity of the event. In addition to the illness of a disease, ranging anywhere between a few days of minor sickness to a life-long infection or even rapid death, the impact of a disease outbreak extends beyond public health itself. The consequence of a disease outbreak may undermine many of the daily functions of the affected community and could significantly weaken the economy and security of a population.

The impact of a disease outbreak could cause complications in Hillsborough County, such as:

- Contaminated water supplies
- Closure of community services, schools and public events
- Fear among the population causing widespread mental health issues
- Overloading of the healthcare systems creating medical supply shortages
- High rate of worker absenteeism triggering threats to critical infrastructure if essential operators are absent in high numbers
- Inability to rely on mutual aid assistance if disease impacts multiple communities

A wide-spread disease outbreak can highlight the inequalities in access to healthcare throughout Hillsborough County. Efforts to distribute vaccines and antiviral drugs amongst vulnerable populations may be hampered by limited availability of resources. The result of

these disparities leads to disproportionate rates of morbidity and mortality among 'at risk' populations (FDOH, 2009).

The climate of a region can be a contributing factor to the vulnerability and severity of a disease outbreak. Climate change affects the spread of disease and infectious disease carriers (i.e., mosquitoes and ticks) that are sensitive to increased temperature and moisture levels. The migration of vectors and animal hosts that cause certain diseases prevalent in Florida (i.e., Lyme disease and Hantavirus) can be contributed to the changes in the ecosystem.

Mitigation: effective risk communication is a critical component in the management of an outbreak. Direct interventions may take time to organize, and treatment options and resources may be limited when the public is at risk of a real or potential health threat.

Pro-active communication between health officials, government agencies and the residence of Hillsborough County increases the level of preparedness, facilitates heightened disease surveillance, reduces confusion and addresses resource allocation—all necessary for a rapid and effective response to the threat (World Health Organization [WHO], 2008).

Epidemiological research provides information that can be applied to controlling disease outbreaks. Monitoring trends for possible outbreaks in an attempt to identify and contain the spread of the disease is an important step toward preventing, controlling and responding to a disease outbreak. Armed with this information communities can be warned and take actions such as vaccinating when possible. Developing or improving warning system is critical in being able to take such actions.

Prevention and control of outbreaks is dependent on the capabilities of the healthcare industry in their ability to educate the public on various diseases and the proper way to prevent high levels of morbidity and mortality within the population. Healthcare professionals working at University of South Florida (USF) Health, the University of Tampa (UT) health center, Florida Department of Health and in local hospitals need to work closely with public health professionals in monitoring disease outbreak trends to address hindrances to disease response such as the identification of the disease itself, securing sufficient levels of medical supplies in the event of a large scale disease outbreak and determine and contain the originating point of the outbreak.

In mitigating and understanding disease outbreaks organizations that focus on Public Health are an exceptional resource. They focus on three major functions:

1. **Health Protection** - Tracking and preventing disease and other threats; regulating dangerous environmental and workplace exposures; and ensuring the safety of water, air and food.

2. **Health Promotion -** Leading efforts to promote health and prevent chronic conditions and injuries.

3. **Health Provision -** Helping ensure access to high quality healthcare for all populations.

The U.S. Department of Health and Human Services (HHS) has developed a mitigation plan to help communities adjust and respond during a pandemic leading to a decrease in the number of people affected. The longer it takes for a pandemic to spread, the more likely effects can be mitigated through strong public health systems, prepared healthcare professionals, informed citizens, and proactive leaders. Ultimately, the application of resources has the greatest impact at the local level where coordination efforts are essential (U.S. Department of Health and Human Services [HHS], 2005).

The elimination of the spread of all diseases is not a probable solution to potential outbreaks. Intervention is a key aspect of the mitigation strategy for a disease outbreak and the subsequent measures should be used as follows:

- Early recognition is critical and monitoring disease trends in local health centers and hospitals insure outbreaks will be identified in a timely manner. This can be done with the use of public health surveillance systems and in collaboration with the Centers for Disease Control and Prevention (CDC) through the National Notifiable Diseases Surveillance System (NNDSS)

- Developing and improving disease reporting processes should be a priority
- Identify cases of disease and develop proper prevention campaigns to control the spread of disease. Public health epidemiologists need to find the causes and origins of the disease outbreak
- Healthcare personnel should follow standard protocols, including the use of appropriate personal protective equipment (PPE) and by notifying infection control personnel
- Promote the use of vaccinations whenever possible. Educate and communicate with the public regarding disease outbreak issues
- Isolation and treatment (as appropriate) with appropriate medications of all persons with confirmed or probable disease. Isolation may occur in the home or healthcare setting, depending on the severity of an individual's illness and/or the current capacity of the healthcare infrastructure
- Voluntary home quarantine of members of households with confirmed or probable case(s) and provide sufficient quantities of effective medications exist and that a feasible means of distributing them is in place
- Dismissal of students from school, school-based activities and the closure of childcare programs
- Reduce contact among children, teenagers and adults in the community with the use of social distancing measures. This may include the cancellation of large public gatherings and alteration of workplace environments and schedules to decrease social density and preserve a healthy workplace to the greatest extent possible without disrupting essential services
- Screening of travelers at borders and airports need to be established in the case of a pandemic

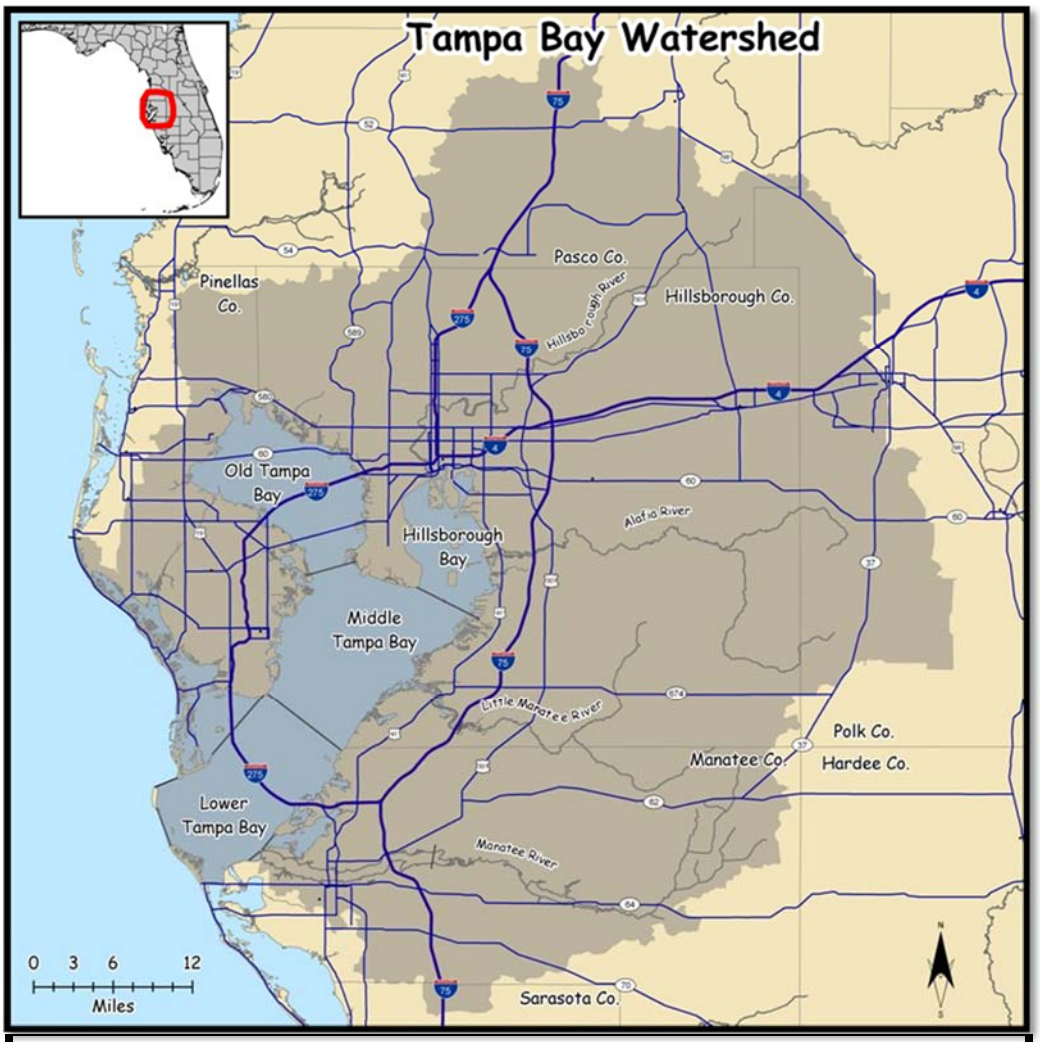
## b. Water Contamination

Description/Background: water contamination is an event, in which ground, aquifers, and surface water are tainted with agents that can harm the human population, wildlife, fish, and all other living creatures. Water sources can become contaminated from hazardous spills, chemical dumping, a terrorist act, or even from a small animal dying in the water supply (Anderson et al., 2002).

Water contamination is caused by water pollution, which directly or indirectly entered into bodies of water without proper treatment. There are many forms and causes of contamination including water pollution, water disinfection, surface water contamination, ground water contamination, mineral water impurities, water turbidity, wastewater contamination, non-biodegradable water contamination, and colloidal water impurities.

The main source of water for Hillsborough County is through blends of river water, desalinated seawater and groundwater. The major points of contamination in Hillsborough County are I75, I4 and Hwy 275, which crosses the Tampa Bypass Canal, Hillsborough River, Alafia River, Palm River, Thirteen mile Run, Little Manatee River, Tampa Bay and Old Tampa Bay. The three major river systems (Hillsborough River, Alafia River, and the Little Manatee River) pass through the county on their way to Tampa Bay (Environmental Protection Commission of Hillsborough County [EPC], 2014). According to the Florida Department of Environmental Protection (2014), these routes are regularly used to transport chemicals and hazardous materials. Storm water runoff carrying fertilizers, chemical and other pollutants continue to threaten the bay.

## FIGURE 3.2: TAMPA BAY WATERSHED




**Source:** Southwest Florida Water Management District. (June 2011). Tampa Bay Estuary Management Overview and Development of Old Tampa Bay Initiatives. Retrieved from http://www.tbaep.org/assets/media/ Old%20Tampa%20Bay%20Restoration.pdf

***Tampa Bay Water Shed:***

- *Size of Basin:* 400 square miles of open water, with a 2,200-square-mile drainage basin.

- *Major Water Features:* More than 100 tributaries and more than 40 meandering, brackish creeks and coastal streams flow into the bay, including the Hillsborough River, Alafia River, Manatee River, Little Manatee River, Palm River, Tampa Bypass Canal, Delaney Creek, Bullfrog Creek, Cross-Bayou Canal, Lake Tarpon Canal, Rocky Creek, Sweetwater Creek, Allen Creek, Alligator Creek, Bishop Creek, Wolf Branch, Cockroach Creek, Booker Creek, and Salt Creek (Florida Department of Environmental Protection [FDEP], 2014).

According to the Florida Department of Environmental Protection in Hillsborough County, the Tampa Bay watershed includes 400 square miles of open water with a 2,200 square mile drainage basin. There are more than 100 tributaries, and over 40 meandering, brackish creeks and coastal streams flow into the bay. Tampa Bay is 5 to 10 miles wide, extending approximately 35 miles inland from the Gulf of Mexico. It is identified as the largest open-water estuary in the state of Florida, having four segments make up the open-water section.

1. Hillsborough Bay: One of the smallest segments which receives runoff from a considerable portion of the city of Tampa. The Hillsborough and Alafia Rivers drain into Hillsborough Bay, as do a number of smaller tributaries.
2. Middle Tampa Bay: This segment receives runoff from the Little Manatee River and drainage from smaller tributaries along the Hillsborough and Pinellas County coastlines.
3. Old Tampa Bay: This segment receives runoff from portions of Clearwater, St. Petersburg, and Tampa.
4. Lower Tampa Bay: The segment with the largest volume, connects the mouth of the bay to the Gulf of Mexico. The Manatee River, which receives runoff from the city of Bradenton, flows into the southern portion of this bay segment (FDEP, 2014).

More than four billion gallons of oil, fertilizer products, and other potentially hazardous materials pass through Tampa Bay each year, creating the potential for spills. In large urban centers, ports, and marinas along the shoreline, a number of potentially toxic substances have been found in relatively high concentrations in sediments. Most enter the bay through urban runoff and atmospheric deposition. Other issues include fish consumption advisories for mercury, invasive exotic species such as the Asian green mussel, and periodic blue-green algae blooms (FDEP, 2014).

In recognition of these impacts, Department of Environmental Protection, the Southwest Florida Water Management District (SWFWMD), and local governmental, scientific, educational, and citizen organizations are working to develop strategies for protecting and restoring water quality in the Tampa Bay watershed (FDEP, 2014).

***Drinking Water:***

Safe, clean drinking water is essential to life. In Florida, about 80% of state residents are provided with drinking water by public water systems. The Federal and State Safe Drinking Water Acts regulate public water systems. The other 20% of Florida's population receives drinking water from private wells. If your water is provided by a public water system, the state of Florida and the US EPA monitor levels of pollutants in your drinking water system. However, there are no laws in Florida that require routine testing of private wells (this is the responsibility of the homeowner) (Florida Department of Health [FDOH], 2014-a).

Some of the chemicals that are monitored in public water systems include arsenic, disinfection byproducts (or DBP's), nitrates and lead. All public water systems in Florida are required to perform routine testing to ensure that they meet state drinking water standards. If a public water system has a chemical violation, it is required to be reported to the Florida Department of Environmental Protection. And, a plan must be developed to correct the violation and provide safe drinking water to the population served (FDOH, 2014a).

<u>Location / Risk Assessment</u>: the types of water contamination events that have occurred within Hillsborough County include: inland, riverine, local drainage and high groundwater, fluctuating lake levels, and tidal surge. The risk of water contamination impacting the public health to the community is low due to the techniques and processes used to treat Hillsborough county water supply. The duration of an incident would be dependent upon the type of contamination. Speed of onset is usually quick. Spatial dispersion for this type of incident is widespread (Anderson et al., 2002). Temporal spacing (occurrence) is random. Drinking water can be contaminated by natural sources, like soil/bedrock, or from man-made sources such as: disinfection chemicals, agricultural run-off, or plumbing fixtures. In addition, contamination can also occur if the water supply/distribution system (reservoir, lake, river, or water treatment system) becomes contaminated. People can be exposed to water contaminants in many ways. Exposure to water contaminants may occur when we drink water, eat food prepared with water, breath water droplets or vapors while showering, and absorb chemicals through our skin while bathing (FDOH, 2014-b).

<u>History of Events</u>

- August, 2014 - a red tide outbreak in the Gulf of Mexico 40 miles off the shore from Pasco and Hernando County killed thousands of fish and affecting thousands more killing animals of all sizes. This affects the food supplies for not only humans but animals of all species on land and in the sea as well.

- April, 2010 - Deep-water Horizon Oil Spill: The Western coast of Florida is devastated by the massive oil spill. The ecosystem for many animals is impacted.

- 1997 - during heavy rains, a dike broke at Mulberry Phosphates in Polk County; 55 million gallons of acidic wastewater flowed into the Alafia River, killing more than 1 million fish.

- 1962 to mid-1983 - Florida Department of Agriculture and Consumer Services conducted widespread field application of a soil fumigant, ethylene dibromide (EDB), to control nematodes in citrus groves. EDB was also used by private citizens on golf courses and on crops such as peanuts and soybeans. EDB is a carcinogenic compound determined by the U.S. Environmental Protection Agency (EPA) to have the potential to produce adverse health effects from prolonged consumption. It is a potential threat to public health when present in drinking water. Discovery of EDB in drinking water wells in other states prompted Florida to test drinking water wells in 1983, and EDB was found to be present.

- 1976 to 1980 - Taylor Road Landfill: The EPA discovered contamination in site monitoring wells at the 42-acre landfill located in Hillsborough County, Florida. Hillsborough County closed all three landfills and began a 30-year maintenance and monitoring program. The plan included the use of monitored natural attenuation to address ground water contamination, the implementation of a quarterly ground water monitoring program, the connection of nearby residences to the public water supply, and the placement of restrictions to prevent the drilling of drinking water wells.

- September 1983 - Tri-City Oil Conservationist, Inc.: Ground water contamination resulting from a 3,000-gallon oil spill at the site. Contaminants of concern include lead and volatile organic compounds (VOCs).

- 1929 to 1981 - Helena Chemical Company: Pesticide manufacturing facility located in Orient Park, a commercial and industrial area of Tampa that lead to contaminated soil and ground water resulting from facility operations.

Both historically and in recent years, Hillsborough Bay has had the poorest water quality of the major bay segments. The bay and its drainage basins have the highest number of point source facilities in the region, including 16 domestic wastewater facilities and 32 industrial facilities, primarily involved in phosphate mining and fertilizer manufacturing.

Other issues in the basin include elevated levels of fecal coliform bacteria from agricultural and urban storm water runoff, sewage treatment plants, septic systems, and sewer overflows; and decreased levels of DO from the breakdown of organic matter (Florida Department of Environmental Protection, 2014).

Probability: occurrence of water contamination is moderate.

Severity of Events / Consequences: if individuals are exposed to high enough levels of a contaminant, they may become ill. Effects can be short-term (where people become sick immediately) and/or long-term (where people get sick after a long period of time). There are many types of health problems that can result from exposure to drinking water contaminants. The type and severity of the health problem depends on the specific contaminant, the level of the contaminant in the water, and the person's individual exposure level (FDOH, 2014-b).

Because people drink and use water every day, contaminants in drinking water have the potential to affect large populations. Drinking water quality is an important public health issue. Community water systems in the U.S. vary greatly in size, and service from twenty-five to over a million people a day (FDOH, 2014-b). If contamination occurs in a single water system, it has the potential to expose many people at once.

Mitigation: water contamination would affect the environment as well as the human population and is an issue that would have to be considered. Depending upon the situation, the effects of the contamination could be long lasting or even permanent. If the drinking water was to be contaminated, maintaining a supply of drinkable water as well as containing and cleaning up the contamination source would be the main focus of the responders and managers (Anderson et al., 2002).

Create and maintain mutual aid agreements for another source of water. Train and equip first responders to work with hazardous materials. Try to contain and clean-up the source of the contamination as soon as possible. Communicate with local, state, and federal agencies about the status of the incident. Advise the population of Hillsborough County about issues regarding any specific precautions that may be necessary.

The Florida Department of Environmental Protection (FDEP) and other state and local agencies work together to help ensure that drinking water contamination levels are as low as possible. This is done by protecting water sources, treating drinking water to remove contaminants, and monitoring water quality to identify problems as quickly as possible. Ultimately, maintaining the highest quality drinking water depends upon protecting our water recharge areas, aquifers, lakes, and rivers from contamination.

If you suspect you have consumed contaminated water from a community water system, or your private well, you should contact your local county health department. In the event that a contaminant occurs in the public water system, federal and state law requires that the water system operator act immediately to notify those affected and report the incident to the Florida Department of Environmental Protection. If you think your private well is susceptible to contamination, you may consult with your local county health department.

For more information on how contaminants may enter drinking water systems, please see the Environmental Protection Agency's Watershed website. For more information on

drinking water exposure risks, please see the Environmental Protection Agencies Source Water Protection website (FDOH, 2014-b).

## c. Chemical Emergencies

Description / Background: a chemical emergency occurs when a hazardous chemical has been released and the release has the potential for harming people's health (Centers for Disease Control and Prevention [CDC], 2014). Chemical releases can be unintentional, such as an industrial accident, or intentional such as a terrorist attack. Chemical agents act rapidly; therefore, fast response is essential.

Location / Risk Assessment: hazardous chemical release in the environment poses a threat county-wide to people, plants, animals, water sources, woodland and wetland environments. The latter provide ecological benefits to human health through water filtration and pollution control. The impact of a hazardous chemical release will vary based on the type of chemical, amount released and the sensitivity of the exposed element. Human health can be affected by hazardous chemicals through water and/or food contamination (ingestion), through direct contact (the skin) and/or through air (inhalation).

Hillsborough County is home to a major seaport, the Port of Tampa, and as the largest seaport in Florida offers a wealth of potential chemical hazards. Additionally, at the entrance to Tampa Bay sits Port Manatee, one of the other lager ports in Florida. These ports, containing potential contaminants ranging from oil to ammonium nitrate, with a variety of potential release agents such as spills, accidental release, weather-related emergencies and terrorism represent one of our largest hazardous chemical threats. Additionally, Hillsborough Counties' abundant phosphate deposits provide fertilizer loads that must be processed onshore and transported, both being potentially hazardous situations. Fertilizer contamination can also occur through the wide-spread use by the agricultural industry.

Phosphates that contaminate soil and water can produce high nitrogen levels. For example, in a two-year period in the late 1990s when El Nino rains caused a dramatic upswing in bay nitrogen loadings from runoff, almost 2,000 acres of sea grass were lost bay wide (Tampa Bay Estuary Program [TBEP], 2006). Hazardous chemicals can enter our environment through air, soil, vegetation and water where the chemicals can travel through waterways and contaminate the groundwater tables. Other potential sources for chemical contamination include: improper and illegal disposal, landfills, and floods causing submerged vehicles to leak gasoline and pumping stations and wastewater treatment plants to back up.

The effects of hazardous material contamination will affect the environment and impact human health in various ways and degrees. In a document this size it is not possible to address every scenario, but as an example of the variety of hazards in quantity and impact consider the following example. At the mention of hazardous spill, "oil spill" is very likely the incident most people will think of. In terms of human health, hazardous chemical materials have a greater potential than an oil spill to negatively impact human health. Hazardous chemical exposure can pose an immediate threat to human health even in small amounts, when generally; oil spills effects are concerns of the long-term damage

and do not usually pose an immediate threat to human life (U.S. Coast Guard [USCG], 2009).

The combination of violent storms in Florida, and the variety and amounts of stored and transported chemicals creates a potential threat commonly referred to as “toxic soup”. As high winds and storm surge wreak havoc on port facilities and vessels, hazardous material storage containers may become compromised and release chemicals that mix together causing a toxic combination that is very difficult to prepare for. This toxic mix poses an all-encompassing major threat to both human health and the environment as this toxic mix infiltrates the water and travels by air. Because this hazard poses a human health risk through water and/or food contamination (ingestion), through direct contact (the skin) and/or through air (inhalation) it requires a high-level of specialized clean-up and restoration, relying on long-term monitoring. Mitigation efforts are vital as chemical emergencies represent so many variables: the type of chemical, amount of chemical, combination of chemicals, etc.

History of Events

On the 10th of August 1993, a freighter and two tug-assisted barges collided. This initiated a fire on one of the barges resulting in an oil spill near the entrance of Tampa Bay. The spill contaminated the waterway with over 32,000 gallons of jet fuel, diesel and gasoline, and about 330,000 gallons of heavy fuel oil. Emergency cleanup procedures were not enough to stop 13 miles of beaches from the oil contamination. This not only impacted the natural environment including injury to birds, sea turtles, mangrove habitat, sea grasses, salt marshes, shellfish beds, water column resources and bottom sediments, but led to a disruption in the recreational use of the waterways causing a strain on the local economy and tourism.

A six foot underground Anhydrous Ammonia pipeline was compromised on May 28, 2003 in Southeastern Hillsborough County at Fishhawk Blvd east of U.S. 301 and the south of Highway 60. This led to an Ammonia leak forcing the evacuation of 2,000 school children after a motorist call the Fire Department after noticing a cloud created by the leak. In-place protection was used for a nearby subdivision of 1200 homes and firefighters used hose lines to disperse the vapors.

On July 19th, 2005, black sludge was discovered in a drainage ditch on Channelside Drive. The dumping of the unknown substance into the drainage ditch was reported, covering an area spanning 100 yards, and found to contain high levels of lead once analyzed.

Three teenage boys drilled a small hole into a 30-mile-long anhydrous ammonia pipeline near the Alafia River and Highway 301 in Riverview on 12 November 2007. The perpetrator obtained burns to the midsection requiring the boy involved in the drilling to be hospitalized. The ammonia leak caused a white cloud of potentially harmful vapors leading to the notification of 3,559 households of the danger through the use of reverse 9-1-1. This chemical emergency prompted Hillsborough County Fire Rescue to evacuate about 300 people in the area.

On August 8th, 2013 a small file in a silo at the Port of Tampa caused the release of chemical fumes in downtown Tampa.

Probability: the combination of the variety and quantity of facilities processing and storing chemicals, the transportation of chemicals in and through Hillsborough County via the ports and interstate system command preparedness regarding human health on both a small and large scale.

Severity of Events / Consequences: the combination of the variety and quantity of facilities processing and storing chemicals, the transportation of chemicals in and through Hillsborough County via the ports and interstate system can cause unexpected events with contamination that ranges from slight to severe, contamination that can be absorbed and dissipated by its environment to contamination that leaves an environment uninhabitable.

Mitigation: Although this report cannot describe the appropriate action to mitigate every hazardous chemical emergency that may affect human health, the action items listed combined with coordination among all members and industries in the community and various governmental agencies of the county, cities and region will lessen the impact associated with a variety of chemical emergencies and improve overall safety.

- Require businesses that operate facilities and vessels to create, implement, maintain and practice emergency response plans that address their internal potential hazards, as well as, external hazards that have a moderate to high probability of impacting their facilities

- Educate the population on emergency preparedness and evacuation procedures, specifically addressing their individual requirements based on factors such as age, disability and health conditions

- Educate the population on the health risks of hazardous chemicals, safe chemical handling, proper chemical disposal and chemical hazard recognition, such as illegal disposal. Provide information on reporting procedures for violations and provide contact information for all agencies and sources pertaining to chemical safety and enforcement

- Expand and improve on communication methods used for notification and updates on hazardous situations

- Provide businesses and industries with information and assistance in designing facilities and storage vessels for hazardous chemicals. As buildings that are high risk for damage due to severe weather and represent a potential hazardous chemical emergency reach the end of their usefulness consider rebuilding in or relocating to a low risk area

- In the event of a chemical emergency know, practice and follow the plans developed on the federal, regional, and local levels accordingly. As chemical events are not contained to county boarders coordinate emergency response measures with boarding counties

- In the event of a chemical emergency requiring evacuation and reentry of an area, one of the most important tools in facilitating a safe return is to assure timely and frequent public communication. Communicate the potential health risks associated

with the chemicals triggering the evacuation. As residents return home and business reopen they need to be educated and equipped to recognize and take cautionary measures regarding potential safety and health hazards

- Develop and prepare for a post-disaster chemical monitoring program. Hazardous chemical contamination can last long after the initial clean-up and such a program will help safeguard human health. It is critical to make monitoring results easy to access and easy to understand. The monitoring reports need to be communicated frequently to ease public fears and anxiety. Before a disaster occurs analyze and identify areas that contain hazardous chemicals and the associated health risks. This is especially important for residential areas that are high risk to chemical contamination, such as the port areas or near facilities that manufacture and/or store chemicals

## d. Radiation Emergencies (Dirty Bomb, Nuclear Blasts, and Accidental Exposure)

Description / Background: radiation emergencies cover a large variety of incidences that vary by size and method of dispersion (World Health Organization [WHO], 2014). They can be catastrophic, affecting a large amount of the local population. Radiation exposure can also be unseen, taking years for victims to develop symptoms. Radiation emergencies mostly occur in the form of Nuclear Incidents, Terrorist Attacks or Occupational/Medical Exposure.

- ***Nuclear Incident*** is when a nuclear device or power plant negatively affects the health of any human being. They can be intentional, in the case of a nuclear device, or unintentional, if a nuclear power plant malfunctions. Nuclear Incidents produce an intense pulse of heat, light, air pressure, and radiation.

- ***Radiological Dispersion Device*** is method of radiation dispersion that combines an explosive, like dynamite, with radioactive material. The RDD or “dirty bomb” is ineffective at exposing enough radiation to be fatal and are often used to incite panic or contaminate the area.

- ***Occupational/Medical Exposure*** is the most common type of radiation emergency in North America. This occurs when a medical procedure, such as an X-ray, is utilized incorrectly, exposing the patient to high amounts of radiation. This can also occur if an accident occurs in any occupation involving radioactive materials.

| Radiation Types | |
|---|---|
| *Alpha Radiation* | • is not able to penetrate human skin or clothing<br>• can be harmful if inhaled or exposed to an open wound<br>• can only travel a few inches through air, not an external hazard<br>• Alpha source examples: radon-222, radium-226, polonium-210 |
| *Beta Radiation* | • can penetrate human skin until germinal layer<br>• can cause skin injury<br>• can travel several feet through air<br>• clothing provides some protection, not reliable<br>• Beta source examples: carbon-14, sulfur-35, hydrogen-3 |
| *Gamma Radiation* | • Electromagnetic radiation<br>• Can penetrate most materials and tissues.<br>• Clothing prevents skin contamination but shielding required for protection.<br>• Easily detectable<br>• Gamma source examples: radioactive materials used in nuclear medicine. |
| **Source:** Health Physics Society (HPS). (August 2014). What Types of Radiation Are There? Retrieved from www.hps.org/ | |

Location / Risk Assessment: risk of a radiation emergency is difficult to determine due to the variety of scale and occurrence. Location of occurrence is also varied. Incidences can occur at any medical or industrial building with radioactive material. The risk for Hillsborough County is low to moderate. There are four Nuclear power plants located in Florida; this is where the risk of nuclear plant malfunction would be highest. Risk targets for a nuclear attack include Theme Parks such as Busch Gardens. MacDill Air Force base acts as the headquarters of the United States Special Operations Command, which carries significant risk as a nuclear target.

History of Events: history expanded to the entirety of the United States, as incident rate in Florida is negligible.

- October 6, 1998 Kansas City, Missouri. Radiotherapy accident. 1 Victim. Patient with unknown pregnancy was administered treatment for thyroid cancer. The treatment consisted of a dose of iodine-131. This radiation exposure increased the chances of many different conditions including mental retardation and childhood cancer

- June 9-11, 2003 Houston, Texas. Radiotherapy accident. 1 Victim. A patient received radiation treatment for breast cancer but due to incorrect placement of radiation source, the patient was exposed to an extremely high dose. This caused an erythema which led to an ulcer that was removed

- November 2-16, 2004 Columbus, Ohio. Accidental Radiotherapy exposure to fetus. 1 Victim. Patient with unknown pregnancy was treated for hyperthyroidism. The exposure led to the fetus developing hyperthyroidism as well

- February 2008 - August 2009 Los Angeles, California. Radiation Overexposure during Computerized Tomography Scans. 250+ victims. Multiple sites in Los Angeles overexposed Stroke patients during Ct scans of their brains. Hair loss and skin redness were some of the effects that were felt

Probability: overall the probability of a radiological event in Hillsborough County is low. Radiation emergencies due to medical hazards have variable to average probability as a result of human error. Larger radiation emergencies which occur from intentional acts of terrorism or nuclear plant disasters carry minimal risk.

Severity of Events / Consequences: the consequences of a radiation emergency vary depending on type of incident. Size of victim population could vary from an entire city to a single patient at a medical clinic. Fallout from a nuclear disaster or health effects from occupational exposure can last much longer than the initial impact.

Mitigation: all efforts to minimize effects of radiation and mitigate the impact from future radiation emergencies must follow these guidelines:

- Minimize time exposed to radiation source
- Maximize distance from the radiation source
- Create shielding to prevent exposure via all routes of transmission, including skin contact and inhalation
- Proper management and dispersal of radiation specific Personal Protective Equipment must be ensured
- Educate the public in protection from radiation and how to behave during a radiation emergency
- Ensure facilities that have radioactive sources are contained and regulated
- Assess type and classification of radiation involved

## e. Foodborne Illness

Description/Background: food poisoning, commonly referred to as a foodborne illness, results from the ingestion of food contaminated with bacteria, parasites, fungi, or viruses. When two or more people experience the same foodborne illness and show similar symptoms or excrete similar pathogens, a foodborne outbreak has occurred. For some foodborne illnesses, such as botulism, mushroom poisoning, and shellfish poisoning, one case is enough to be considered a foodborne outbreak.

Food poisoning that results from pathogens of the gastro-intestinal system is referred to as an *enteric disease*, which includes some of the most common foodborne illnesses that occur in Hillsborough County such as Eschericia coli (E. Coli) and Salmonella. Common symptoms of enteric diseases include nausea, vomiting, abdominal cramps, and diarrhea.

Location / Risk Assessment: food can become contaminated during the production stages. Meat and poultry can be contaminated with microbes during slaughter. Fresh fruits and vegetables can be contaminated with animal manure or human sewage during irrigation. Hens can infect their eggs with Salmonella. Shellfish can be contaminated with Vibrio bacteria from the ocean or with norovirus from human sewage that is dumped in the ocean.

Food can also become contaminated during the preparation stages. Food handled by a person with Shigella bacteria, Hepatitis A virus, or Norovirus can be contaminated if the person does not thoroughly was his or hands prior to preparing the food. Food should be stored in a refrigerator or freezer as soon as possible to prevent any bacteria present from growing. The high use of salt, sugar, or acid levels in food can prevent bacteria from growing as well.

Using the same kitchen equipment to prepare several food items can also cause cross-contamination, specifically in regards to foods that are consumed raw. If foods are consumed cooked, it is important to heat them until they reach an internal temperature of 160 degrees Fahrenheit or 78 degrees Celsius in order to kill off any parasites, bacteria, or viruses. Note that the bacteria Clostridium, commonly present in canned foods, must reach boiling temperatures in order to be killed off. The toxin Staphylococcal, however, cannot be killed off at any temperature.

Any person or facility that produces or handles food has the potential to cause a foodborne illness among consumers of the contaminated products. Public facilities such as restaurants, grocery stores, farmer's markets, cafeterias, and gas stations are prime examples of facilities at risk of foodborne illnesses. Each of the following agencies are responsible for regulating specific types of food-handling facilities:

### Florida Department of Health (FDOH), Division of Environmental Health

- Institutional settings
- Civic and fraternal organizations
- Theaters

### Florida Department of Business and Professional Regulation (DBPR), Division of Hotels and Restaurants

- Public Lodging

### Florida Department of Agriculture and Consumer Services (DACS), Division of Food Safety

- Grocery stores
- Gas stations

There are four groups of people that are considered to be at higher risk of foodborne illness: young children, pregnant women, senior adults, and immune suppressed individuals (i.e., patients undergoing chemotherapy and organ transplants).

History of Events:

Reported Cases in Hillsborough County by Pathogen (2010):

- *C. Perfringens*: 95 cases caused by the consumption of catered chicken
- *Norovirus*: 19 cases caused by the consumption of several restaurant food items
- *B. Cereus*: 12 cases caused by the consumption of several restaurant Mexican food items

Probability: The probability of foodborne disease occurring in Hillsborough County is moderate. The risk of foodborne disease is correlated with a combination of the likelihood of exposure to the pathogen, the likelihood of infection, and the severity of the illness. Some pathogens are more common than others, and some food products have a higher probability of becoming contaminated than others.

The scale of an outbreak may range from a concentrated small number of linked cases with a mild disease to a nationwide or international outbreak of severe disease involving the mobilization of public health resources from all levels.

Severity of Events / Consequences: extreme weather events can negatively impact the protection of crops, fisheries, and produce during the cultivation and transportation process. Increased temperatures and ocean acidification can result in an increase of infectious strains of a disease, as well as the emergence of new pathogens. Specifically, a rise in sea surface temperature can increase the presence of Vibrio bacteria, which increases the likelihood of cholera outbreaks via contaminated seafood. A drought also has the potential to increase foodborne outbreaks by causing an increase in the production of the mold Aspergillus flavus. This mold produces aflatoxin; a toxin associated with the development of liver cancer and contaminates products such as corn and nuts.

Mitigation: The Florida Department of Health (FDOH) investigates all of the foodborne outbreaks reported in Florida via the Florida Food and Waterborne Disease Program (FWDP). The FWDP follows the procedures and goals established by the Florida Public Health Statutes which are stated in the Council to Improve Foodborne Outbreak Responses (CIFOR) Guidelines for Foodborne Disease Outbreak Response. The goal of FWDP is to better comprehend the epidemiology of each illness.

Planning and preparation is particularly important because it improves the process of identifying and controlling the source of an outbreak. A profound understanding of the cause and transmission of foodborne illnesses helps food-handlers and food-consumers take better preventative measures with their food.

Every year, counties across the state follow the FWDP guidelines to summarize their local foodborne illness epidemiologic data which is used in the Food and Waterborne Illness Surveillance and Investigation Annual report for the state of Florida. Hillsborough County's health department facilitates local outbreak investigations from preparation to intervention by following the steps established by the FWDP:

- Planning and Preparation
- Surveillance and Outbreak Detection
- Investigation of Clusters and Outbreaks
- Implementation and Evaluation of Control Measures

## f. Animal and Plant Disease Outbreak

Description / Background: animal disease outbreak also known as zoonotic disease outbreak. According to the Centers for Disease Control and Prevention (CDC), "a zoonotic disease is a disease that can be passed between animals and humans. The spread of animal disease has become overwhelmingly probable in today's day and age due to trade of animals and animal products. Zoonotic diseases can be caused by viruses, bacteria, parasites, and fungi. These diseases are very common. Scientists estimate that more than 6 out of every 10 infectious diseases in humans are spread from animals" (CDC, 2013).

Disease can be spread by coming in contact with urine, feces of an infected animal, saliva, blood, being bitten by a tick or mosquito which is a common vector in the spread of disease. Animals are very susceptible to disease and are often transmit disease-causing microorganisms from an infected person or animal to another leading to the spread of disease. Animal health can become compromised if they do not have freedom from thirst and hunger, freedom from discomfort, freedom from pain injury or disease, freedom fear and distress, freedom from express normal behavior (Heath, 2012).

Location/ Risk Assessment: some invasive species can cause harm to native species, pose health risk to the human health and safety, and can cause economic damage. A single lionfish can diminish a juvenile fish population on a single reef by 80% in 5 weeks.

## TABLE 3.17: INVASIVE SPECIES IN THE STATE OF FLORIDA

| Name | Type | Origin | Extent | Damage |
|---|---|---|---|---|
| Brazilian Pepper | Shrub | Brazil & Paraguay; introduced in 19th century | 700,000 acres of Central & South Florida | Shades out other plants, toxic to wildfire, causes poison ivy-like reaction |
| Melaleuca | Tree | Australia; introduced for windbreaks, timber & landscaping | 400,000 acres of South Florida | Displaces native plants, alters water flow in Everglades, oily leaves promote serious fires |
| Hydrilla | Aquatic | Africa & Southeast Asia; introduced in Tampa area as an ornamental in 1950s | 50,000 acres; 140,000 acres of tubers that could still resprout | Clogs waterways, restricting recreation, kills other aquatic life by blocking sunlight and using oxygen; promotes mosquito breeding |
| Water Hyacinth | Aquatic plant | South America; introduced in 1880s | 120,000 acres in 1960s, reduced to 2000 acres | Kills fish by lowering oxygen in water, promotes mosquito breeding; blocks waterways and crowds out native species |
| Chinese Tallow | Tree | China; introduced in 18th century | 38 counties in Northern & Central Florida | Displaces native trees, falling leaves contribute to nutrient loading in streams; oily seeds toxic to cattle |
| Cane Toad | Amphibian | Amazon basin to Rio Grande Valley; introduced to FL accidentally in 1955 | Spread via canals, found in 21 counties | Toxic secretions can kill pets or native predators; compete with native amphibians, eat insects |
| Cogon Grass | Grass | Southeast Asia; introduced in 1920's and '30s for forage and soil stabilization | Roadsides, fields& woods in Central & North Florida | Displaces native plants; little food value for wildlife, creates severe fire hazards |
| Citrus Canker | Bacteria | Southeastern Asia; first found in U.S. in 1910 | 11 Florida counties currently quarantined | Highly contagious disease causes citrus trees to drop their leaves and fruit, 2.9 million trees destroyed |
| Lion Fish | Aquatic Wildlife | Indo-Pacific region first spotted in Florida waters in the mid-1980s. | Population has spread to the Caribbean, Gulf of Mexico and up the Atlantic coast of the United States | Eat and compete for food of native species. They eat cherished sportfish. The female lionfish will produce over 2 million eggs a year in warm tropical waters. |

**Source**: Delach, A. (2014). Invasive Species in Florida. Retrieved from www.defenders.org/sites/defaul/files/publications/florida.pdf

History of Events: The Florida Department of Agriculture and Consumer Services reported the history of citrus canker in Hillsborough County from 1999 – 2006.

## TABLE 3.18: HISTORY OF CITRUS CANKER IN HILLSBOROUGH COUNTY (1999-2006)

| | | |
|---|---|---|
| **History: Hillsborough County** | **Residential Control Action:**<br>Positive: 235<br>Exposed: 6,942<br>Total: 7,177 | **Commercial Control Action:**<br>Trees: 203,107<br>Acres: 1,591.5 |
| | **November 1999**, *Sun City*: Citrus canker was detected, and survey revealed a total of 57 positive and 46 exposed trees on 27 properties across 4 sq. miles. Control action included destruction of 2,045 dooryard trees on 1,065 properties. | |
| | **December 1999**, Abandoned grove: 8,900 grove trees on 102 high-risk abandoned acres near the county line were destroyed. | |
| | **August 2000**: 1,766 additional abandoned grove trees destroyed for a total of 10,266 trees on 117 acres. | |
| | **12 February 2002**: All restrictions in the 20 sq. mile Sun City Center quarantine area were lifted. | |
| | **9 December 2004**, *Sun City Center*: Citrus canker was confirmed on a sample collected by a USDA Sentinel Survey inspector on routine survey of the area. All positive trees have been removed and control of exposed and additional survey activities are in progress. | |
| | **27 December 2004**, *Ruskin*: Citrus canker was confirmed on a sample collected by a USDA Sentinel Survey inspector. All positive trees were removed and survey and control actions are complete. | |
| | **19 May 2005**: Citrus canker has been confirmed in a commercial grove in Ruskin at 32S18E25. | |
| | **23 May 2005**: Citrus canker has been confirmed in a commercial citrus grove in Ruskin at 32S19E30. | |
| | **2 July 2005**: Four new commercial finds involving approximately 786 acres. | |
| | **6 August 2005**: One new positive find located in 32S19E16. | |
| | **10 September 2005**: Two new positive finds located in 36S30E36, 39S29E32 and 34S26E13. | |
| | **15 October 2005**: One new positive find located in 32S20E04. | |
| | **18 December 2005 - 14 January 2006**: One new positive find located in 32S20E04. | |
| | **10 January 2006**: All CCEP activity ends. Commercial survey continues for fresh fruit certification. | |
| **Source:** Florida Department of Agriculture and Consumer Services. (2012). Comprehensive report on citrus canker in Florida. Retrieved from https://www.freshfromflorida.com/content/download/24084/487233 | | |

Probability: Hillsborough County has a large port, international airport, is a tourist destination and has a transient population that passes through the county. The probability of an invasive species does exist. However, mitigation measures are in place to minimize exposure to the general populace and to the environment. Thus, the probability of a serious event is considered to be low.

Severity of Events / Consequences: the estimated cost to reduce invasive species in the U.S. is $137 billion annually. Thus far, over $300 million dollars has been spent in the state of Florida to control a single invasive species, the citrus canker. The annual cost of invasive plants, animals and diseases in losses to Florida's agriculture is estimated at $179 million (Delach, 2014).

Mitigation: currently, measures are being taken to combat the existence of evasive plants in Hillsborough County and trying to diminish their effects on the natural environment in Florida. The scope to mitigate animal disease outbreaks is determined by the pathogen host environment interaction, policies to control disease, and number of animals in the county. "Eliminating disease is often accomplished through depopulation (euthanasia of animal populations) of all susceptible animals that are known or have potentially been exposed to the agent" (Heath, 2012). Other ways to combat animal disease outbreak is by early detection and herd vaccination. The best way to control invasive species is by human removal. In the case of a lionfish it would be dip-net or spear.

The mitigation strategy for plant disease outbreaks should focus on avoidance, exclusion, eradication, protection, resistance and therapy (American Phytopathological Society [APS], 2014).

Traditional Principles of Plant Disease Control:

1. **Avoidance**: prevent disease by selecting a time of the year or a site where there is no inoculum or where the environment is not favorable for infection
2. **Exclusion**: prevent the introduction of inoculum
3. **Eradication**: eliminate, destroy, or inactivate the inoculum
4. **Protection**: prevent infection by means of a toxicant or some other barrier to infection
5. **Resistance**: utilize cultivars that are resistant to or tolerant of infection
6. **Therapy**: cure plants that are already infected. Thermotherapy and chemotherapy cure plants that were already infected

## 3. Technological Hazards

### a. Hazardous Materials

Description / Background: the threat from hazardous materials exists in two forms. The first is from fixed facilities; the second is from materials transported within or through the city.

Location / Risk Assessment: there are a wide variety of facility sites within the county which use or store hazardous materials.

Accurate data is not available to make a determination as to the magnitude of potential hazards. In addition, hazardous materials releases result from storage tank and

container ruptures or leaks, releases through safety and relief valves, piping ruptures and leaks, fire induced releases, equipment failures, overfills and overflows of storage tanks and human error (FEMA, 1999).

Most facilities have taken passive mitigation efforts (I.e., dikes, berms, etc.) to contain liquid spills that might occur. With most extremely hazardous material facilities, receptacles are protected from Florida's worst-case disasters such as hurricanes.

The Port of Tampa contains the largest concentration of hazardous materials in Hillsborough County. Included are such products as petroleum, chlorine, and ammonia. Although these products are stored within an industrial area, the port is located immediately adjacent to downtown Tampa and large residential concentrations on Harbour Island and Davis Island.

History of Events: there are approximately 6,774 hazardous materials events in the U.S. annually. Of these, the greatest risk of an event is associated with the transportation system (FEMA, 1997).

### TABLE 3.19: NATIONAL ANNUAL HAZARDOUS MATERIALS EVENTS

| AVERAGE ANNUAL OCCURRENCES | 6,774 |
|---|---|
| Percent Transportation | 80% |
| Percent Railroad | 15% |
| Percent Other | 5% |
| **Source**: Federal Emergency Management Agency, 1997; Hillsborough County Emergency Management Operations and Hazard Mitigation Agencies, 1999. | |

The majority of the transportation hazardous materials events involve tanker trucks or trailers and certain types of bulk-cargo vehicles. Because of the number of miles traveled by these vehicles within the County daily transportation is a great area of potential hazardous materials spills. Additionally, rain, high winds and fires can worsen conditions surrounding these hazardous materials events.

For the City of Tampa, approximately 25.3% of the recorded incidents are related to a hazardous condition other than residential gas and fuel spill emergencies. Damage estimates associated with the hazardous conditions are not available. All calls for hazardous incidents within the City are funneled through the Tampa Fire Rescue Department.

## TABLE 3.20: NUMBER OF HAZARDOUS MATERIALS CALLS IN THE CITY OF TAMPA (1993-1998)

| Hazardous Condition | Number | % | 1-year Average |
|---|---|---|---|
| Residential Gas Emergency | 714 | 33.5 | 143 |
| Hazardous Condition | 540 | 25.3 | 108 |
| Fuel Spills | 879 | 41.2 | 176 |
| Total Calls (incidents) | 2133 | 100.0 | 427 |

**Source:** Tampa Fire Rescue Department from records of the number of calls placed to the Department between 1993 -1998

Probability: presently, there is no analysis on the probability of a hazardous material release or accident in the port area (Tampa Bay Regional Planning Council, 1999). The Regional Planning Council reports that under the law SARA Title III/Emergency Planning and Community Right-to-Know Act (EPCRA) every Section 302 facility must have a hazard analysis performed and made available for public inspection. The analysis must identify a circle of vulnerability (identifying populations at risk) for the most-probable worst-case release and a most-probable release scenario from the facility. These analyses will not provide a probability of release - only what would happen if a release occurred. This information is used to identify those populations and significant facilities (schools, government buildings, hospitals, etc.) which may be at risk and the mitigation measures that may be used in event of failure. The hazard analyses use a "High, Medium, and Low" probability of risk of release and a "High, Medium, and Low" probability of danger.

Severity of Event / Consequences: hazardous materials releases pose short and long-term toxicological threats to humans and to terrestrial and aquatic plants and wildlife. Toxic materials affect people through inhalation, ingestion and/or direct contact. As noted previously, should a hazardous material spill or accident occur in the Port of Tampa under favorable weather conditions, a significant number of people working, visiting or living near the port could be adversely affected.

Mitigation: There are two basic types of applications used to avoid hazardous materials events. These are physical and social adjustments.

Physical adjustments include:

- planning and designing facilities to withstand various natural hazards
- identifying and avoiding sites where risks are high
- predicting occurrence
- preventing or altering the characteristics of the potential hazard

Social adjustments for avoiding impacts associated with hazards include:

- Restricting use of land and establishing minimum standards and conditions
- Implementing public awareness programs
- Initiating emergency preparedness and evacuation programs
- Establishing systems of notification
- Spreading economic loss among a larger population through insurance, taxation and monetary grants
- Reconstructing communities to be less vulnerable to future hazard events and releases

Mitigation also involves the continued dialogue between industry and emergency responders.

## b. Dam/Levee Failures

Description / Background: when the term "dam" is used it is normal to think only of structures associated with the impounding of rivers for use a drinking water reservoirs, the production of electricity or flood control. In Florida the term can take on an additional meaning, that of impounding clay settling ponds or phosphogypsum stacks associated with the mining and processing of phosphate. Both types of structures can be found within Hillsborough County. Dam/Levee failure is a collapse or breach in a dam or levee. While most dams have storage volumes small enough that failures have little or no repercussions, dams with large storage amounts can cause significant downstream flooding.

Location / Risk Assessment: located east of 28th Street, just downstream from the City of Temple Terrace, is the City of Tampa's Hillsborough River Reservoir. The Reservoir is approximately 1,300 acres in size and contains up to 1.6 billion gallons of water. The Reservoir has served as the City of Tampa's water source since the mid-1920s.

In southeastern Hillsborough County, near CR 672 and SR 39 and south of the Alafia River, is the Tampa Bay Regional Reservoir. The Reservoir is being built by Tampa Bay Water to provide an additional source of potable water for the residents of the Tampa Bay area. The 1,100-acre Reservoir has a total volume of 15 billion gallons.

During the 1950s and 1960s residents along the Hillsborough River experienced several serious flood events. As a consequence, in the 1960s and 1970s, the Tampa Bypass Canal was constructed. Following the course of Palm River, the 14 mile waterway, with its flood-control structures, is intended to redirect rising waters from the Hillsborough River to McKay Bay. In addition to the Tampa Bypass Canal, flood control structures can be found along several of the creeks in the western portions of Hillsborough County. These creeks flow into the northern reaches of Tampa Bay.

Phosphate mining activities can be found in the eastern portions of the County. As noted above, phosphate mining and processing requires the need for water impoundments associated with clay settling ponds at the mining site and phosphogypsum stacks associated with the phosphate processing plant. Generally, phosphate processing plants are located in proximity to the mine sites. The exception to this is the Cargill Plant located at the mouth of the Alafia River on Hillsborough Bay.

History of Events: the construction and safety of dams and levees in Florida is governed by Chapters 62 and 373, FS. Through design and permitting there is little danger of failure from the Hillsborough River Reservoir, Tampa Bypass Canal or Tampa Bay Regional Reservoir.

Unfortunately, the same cannot be said for clay settling ponds and phosphogypsum stacks. Since 1988, there have been four failures of such facilities either in or directly impacting Hillsborough County. The following is a summary of these events:

- 1988 and 1993 - Riverview, unincorporated Hillsborough County. Acidic water spill at the Cargill (aka Gardinier) phosphate processing plant located at the mouth of the Alafia River

- November 1994 - Hopewell, unincorporated Hillsborough County. Failure of a clay settling pond at the Hopewell Mine spilled approximately 1.9 million gallons of water into the Alafia River. In addition, some flooding occurred in the Keystone area

- December 1997 - unincorporated Polk County. Failure of a phosphogypsum stack at Mulberry Phosphates resulted in 2.0 million gallons of phosphogypsum process water entering the Alafia River

- September 5, 2004 - Riverview, Florida, a dike at the top of a 100-foot- high gypsum stack holding 150-million gallons of polluted water broke after waves driven by Hurricane Frances bashed the dike's southwest corner. Nearly 60 million gallons (227,000 m3) of acidic liquid spilled into Archie Creek that leads to Hillsborough Bay

Probability: there is no method of determining the probability of a dam failure or a historical frequency that can be used to calculate a return interval of an earthen dam failure. Working together, the phosphate industry and the State have proven that a dam monitoring program can be successful in minimizing the risk associated with dam failures through periodic inspections and repair programs. Additionally, a failure due to a single rainstorm or tropical storm event is minimal due to the design of a respective dam and the periodic monitoring such areas receive.

Severity of Events / Consequences: residents of Tampa living downstream of the Hillsborough River Reservoir are the most vulnerable should there be a dam failure. The exact number of residents which would be affected by such an event would be dependent upon the degree of the failure.

Concern with flooding was a major issue of residents and elected officials during the permitting of the Tampa Bay Regional Reservoir. The potential for such an event was deemed to be slight during the review of the Reservoirs Environmental Impact Statement by the U.S. Environmental Protection Agency and construction permit by the Florida Department of Environmental Protection.

Although it is possible, it is not probable that the failure of clay settling pond or phosphogypsum stack would adversely impact county residents. This determination can be made based on the general isolated nature of these operations. Still, as noted in the 1994 event, flooding of residences can occur. As a result of their general isolation it is not possible to determine the potential number of residents in the unincorporated county who could be affected. The major consequence of a failure event would be the resulting environmental damage should contaminated water reached a creek or river or infiltrate into the groundwater supply.

Mitigation: the State and industry have in-place federally approved dam inspection processes (Federal Insurance Agency, 1998). Areas associated with mining have been identified on growth management maps and within the Hillsborough County Comprehensive Plan. Use of these programs and continued cooperation between the County, State, and industry will serve to minimize the risks of dam failures within Hillsborough County.

## c. Port Vessel Collision or On-Water Hazardous Materials Spill

Description / Background: in any mishap within the port, there is a need for one focus point to ensure efficient efforts are taken to minimize risk and to ensure an effective response is given. The U.S. Coast Guard is the principal authority at the Port of Tampa with respect to oil spills or vehicle collisions.

Location / Risk Assessment: Port Vessel collisions and on-water hazardous material spills are most likely to occur in the shipping lanes serving the Tampa Port Authority.

History of Events: Port of Tampa and Port Manatee are major terminuses for petroleum products for west Florida. Accordingly, Tampa Bay is vulnerable to oil spills from shipping accidents. The last major oil spill in August 1993 was caused by a collision of a freighter and two tugs, one pushing a barge carrying 255,000 barrels of Jet A gasoline and one pushing a barge containing 88,000 barrels of diesel fuel. This spill caused significant ecological and economic damage to shoreline and beaches of Pinellas County.

Probability: as a major port, the probability of an accident involving hazardous materials does exist. However, mitigation measures for in-route transportation are in place to minimize exposure to the general populace and to the environment. Thus, the probability of a serious event is considered to be low.

Severity of Events / Consequences: as an active port, two factors are present which contribute to the need for vigilance. First, as a port, hazardous materials will always be present, either in transit or storage. Second, as a port, the potential for accidents is always present, either in the transfer of hazardous materials from ship-to-shore to storage or transfer from storage to overland transport. Given the amount of hazardous materials found at the port and its location should a spill or fire/explosion occur the impact on the surrounding community could be catastrophic!

Mitigation: maintaining safety of port operations is the responsibility of the U.S. Coast Guard's Marine Safety Office. To improve overall safety, this office coordinates its activities with the various governmental agencies of the county, city, region and industry. This coordination has resulted in several programs being put into place which will improve the overall safety of the port's operation.

In response to the growth of the Port facility multiple avenues of communications have been obtained and ongoing cross-agency training of personnel has been instituted. In addition, fire-fighting contingency plans have been developed and vessel-response plans have been incorporated to ensure resources are available for operations in the event a major catastrophe should occur.

## d. Terrorism / Homeland Security / Cyber Security

Description / Background: as the tragic events of September 11 2001 demonstrated the United States is not exempt from the threat of terrorist attack on its home shore. While the kinds of weapons a terrorist may use are varied, the most fearful are those classified as weapons of mass destruction (WMD). Of these, the greatest threat comes from those classified as CBERN or chemical, biological, explosives, radiological and nuclear. In addition, terrorist attacks may be as common as explosives and as sophisticated as global cyber-attacks.

Location / Risk Assessment: Tampa contains numerous targets of opportunity for potential terrorist groups. Being one of the top 15 media markets in the country, containing a major seaport and international airport, hosting major NFL, MLB and NHL sports teams are all among the factors which could attract terrorist activity to the area. Tampa houses MacDill Air Force Base, a major military base with a worldwide orientation. MacDill is the headquarters for two major commands; special U.S. Operations Command and U.S. Central Command.

Additionally, it houses Coalition Village which is comprised of representatives from 65 nations who are working together to combat terrorism. An incident involving weapons of mass destruction (WMD) by a terrorist organization using chemical, biological, or nuclear substances is a distinct possibility in light of the contemporary worldwide terrorist threat.

Probability: the probably of an event cannot be quantified.

Severity of Events / Consequences: the impact of a single terrorist attack would vary depending on the attack. A terrorist attack which is successful could kill or injure a large number of people. There are also potential long-term environmental and/or economic impacts of an attack.

Mitigation: post 9/11 has placed a greater urgency on the need for vigilance and preparation. Federal, state, and local law enforcement, public safety, emergency management officials and agencies are working in greater cooperation to coordinate pre-event preparation and potential post-event response.

A renewed interest in Community Emergency Response Teams (CERT) as part of the Citizen Corps has been identified by the LMS Working Group and the community as an invaluable asset in homeland security (see Resolution supporting the Citizen Corps Council and CERT training).

## e. Utility Failure/Power Outages

Description / Background: as growth continues in Hillsborough County, there is an increasing demand for electrical power. Through the 10-year Site Plan process Tampa Electric Company (TECO) addresses growth in their expansion plans. There may be situations where power generating capability may not meet total demand during extreme weather conditions or after a severe storm.

Location / Risk Assessment: p o w e r outages can occur anywhere in the County

History of Events: Christmas weekend of 1989 the extremely cold weather caused extended power outages throughout the county.

Probability: it is difficult to predict when a power outage may occur, as the northeast power failure showed in 2003.

Severity of Events / Consequences: a power failure is most likely to occur during an extreme weather event. Local governments must be prepared to respond in order to maintain the public safety and health and welfare of its citizens.

Mitigation: TECO actively manages power distribution during shortages. During these periods, one of TECO's power management techniques is to rotate outages among users. There are various facilities in the County that are highlighted as critical users of TECO power during power shortages.

A committee of representatives from the County, the three municipalities and TECO have developed and categorized a critical facility list for the County. All critical facilities have been placed in priority categories. From this critical facility list TECO has developed a restoration priority that will be used during any power shortage emergency.

TECO's goal during any future power shortage emergency is to limit power outages to any circuit in the county to 15 minute power restoration.

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