Section 5: Thunderstorm Wind

JURISDICTION	DATE	TIME	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Cameron County	5/16/2008	2:50 AM	70 knots	0	0	$55,258	$0
Cameron County	5/16/2008	3:00 AM	75 knots	0	0	$221,033	$0
Rio Hondo	6/24/2008	11:08 AM	50 knots	0	0	$277	$0
Cameron County	6/24/2008	11:08 AM	50 knots	0	0	$277	$0
Port Isabel	5/24/2009	5:00 AM	46 knots	0	0	$11,091	$0
Cameron County	5/27/2009	4:25 PM	52 knots	0	0	$2,210	$0
Cameron County	6/1/2009	2:16 PM	53 knots	0	0	$1,109	$0
Los Fresnos	10/26/2009	1:50 PM	49 knots	0	0	$1,109	$0
Cameron County	12/24/2009	4:25 AM	42 knots	0	0	$1,105	$0
Port Isabel	5/18/2010	9:25 AM	56 knots	0	0	$27,280	$0
Cameron County	5/18/2010	8:20 AM	52 knots	0	0	$5,435	$0
Cameron County	5/18/2010	9:05 AM	50 knots	0	0	$10,870	$0
Bayview	2/9/2011	1:00 PM	42 knots	0	0	$527	$0
Port Isabel	2/9/2011	1:00 PM	42 knots	0	0	$527	$0
South Padre Island	11/26/2011	10:00 PM	36 knots	0	0	$2,107	$0
San Benito	5/15/2012	8:49 PM	48 knots	0	0	$3,097	$0
Cameron County	1/29/2013	12:17 PM	42 knots	0	0	$1,017	$0
Rancho Viejo	4/28/2013	12:19 PM	52 knots	0	2	$2,043	$0
Cameron County	4/28/2013	12:23 PM	56 knots	0	6	$51,071	$0
Cameron County	4/28/2013	12:25 PM	52 knots	0	0	$2,043	$0
South Padre Island	11/22/2013	4:00 PM	33 knots	0	0	$5,087	$0
Cameron County	11/22/2013	2:40 PM	34 knots	0	0	$3,052	$0
Cameron County	12/21/2013	5:34 AM	42 knots	0	0	$1,017	$0
Cameron County	12/21/2013	10:58 AM	42 knots	0	0	$5,087	$0
Bayview	1/24/2014	3:54 AM	42 knots	0	0	$1,252	$0
Laguna Vista	1/24/2014	3:54 AM	42 knots	0	0	$1,252	$0

JURISDICTION	DATE	TIME	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Port Isabel	1/24/2014	3:54 AM	42 knots	0	0	$1,252	$0
South Padre Island	1/24/2014	3:54 AM	42 knots	0	0	$1,252	$0
Cameron County	4/14/2014	2:00 PM	44 knots	0	0	$1,001	$0
Primera	4/24/2015	10:25 PM	52 knots	0	0	$10,000	$0
San Benito	4/24/2015	10:25 PM	52 knots	0	0	$5,000	$0
Cameron County	4/24/2015	10:20 PM	52 knots	0	0	$2,000	$0
Cameron County	5/12/2015	12:25 AM	52 knots	0	0	$1,000	$0
Cameron County	8/17/2015	5:05 PM	52 knots	0	0	$15,000	$0
Cameron County	8/17/2015	5:17 PM	56 knots	0	0	$30,000	$0

Table 5-4. Summary of Historical Thunderstorm Wind Events, 1955-2015

JURISDICTION	NUMBER OF EVENTS	MAGNITUDE	INJURIES	FATALITIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Bayview	6	41 knots	0	0	$2,329	$0
Indian Lake	0	N/A	0	0	$0	$0
Laguna Vista	3	65 knots	0	0	$6,908,972	$0
Los Fresnos	5	34 knots	0	0	$3,965	$0
Port Isabel	19	50 knots	0	0	$60,366	$0
Primera	1	52 knots	0	0	$10,000	$0
Rancho Viejo	1	52 knots	0	0	$2,043	$0
Rio Hondo	9	32 knots	0	0	$277	$0
San Benito	10	40 knots	0	0	$13,188	$0
South Padre Island	6	39 knots	0	0	$22,694	$0
County	87	70 knots	2	0	$795,220	$1,623
Total Losses	147	(Max Extent)	2	0	$7,821,929	

Section 5: Thunderstorm Wind

Significant Past Events

May 2, 2000 – Laguna Vista

A very strong heavy precipitation type supercell did extensive straight line wind damage to Laguna Vista, Laguna Heights, Port Isabel and South Padre Island on the evening of May the 2nd. The storm first struck the Laguna Heights and Laguna Vista communities then Port Isabel and South Padre Island. The storms damaging winds knocked down 50 power poles. In addition, the damaging thunderstorm winds knocked down power lines and trees. Approximately 8,800 customers were left without power and schools were closed in Port Isabel on May 3rd and 4th. Many residents reported damage to roofs, awnings, signs, canopies, marinas, and garage doors. Windows were shattered by the strong winds. The United States Coast Guard Office reported 106 knots or 122 mph winds before power failed at the Coast Guard station. Several recreational vehicles parked at Isla Blanca Park on South Padre Island were blown on their sides. Hail the size of golf balls was reported at South Padre Island. Total damage to the utility lines and poles was estimated to be around 3 million dollars. Total damage done to the rest of the area was around 2 million dollars. In all, it was estimated that approximately 5 million dollars of damage was done to the Bayfront communities and South Padre Island.

May 16, 2008 – Cameron County

A severe thunderstorm which caused structure, vehicle, and power line damage struck the northern portion of Harlingen, producing an 86 mph wind gust at Valley International Airport, damaging three hangar roofs on the airport grounds. Pieces from one of these roofs, made of heavier asphalt underlines, knocked out at least two large windows in the control tower. In a nearby neighborhood just west of the airport, dozens of large tree limbs were snapped and some fences were partially blown down. The storm continued to produce damages as it moved farther east, with a 25 square foot portion of one residence's roof ripped away by the winds in Las Yescas. The storm gradually weakened as it headed through largely uninhabited eastern Cameron County, on its way to dissipation in the Gulf.

May 18, 2010 – Port Isabel

A severe thunderstorm generated strong, damaging winds as it moved across southeast Cameron County, affecting Bayview, Port Isabel, and South Padre Island. The strongest wind core passed through Port Isabel across the southern portion of the Town of South Padre Island. At Port Isabel, numerous power outages were the result of power lines and poles blown down at several locations throughout the city. As the storm reached South Padre Island, the U.S. Coast Guard Station located in the Bayside recorded a 64 mph wind gust. A 60 mph gust was recorded by a Citizen Weather Observer Program sensor on Sheepshead Street. In the same area, palm trees were blown down along Coral Street; large metal signs were blown from their mounts along the Queen Isabella Causeway Bridge, and more power lines and a transformer were blown down at the intersection of Constellation Dr. and Laguna Boulevard.

Probability of Future Events

Most thunderstorm wind events occur during the spring, in the months of March, April and May, and in the fall, during the month of September. Based on available records of historic events, 147 events in a 60 year reporting period provides a frequency of occurrence of 2 to 3 events every year. Even though the intensity of thunderstorm wind events is not always damaging for the Council of Cities planning area, the frequency of occurrence for a thunderstorm wind event is highly likely, meaning that an event is probable within the next year for the planning area.

Vulnerability and Impact

Vulnerability is difficult to evaluate since thunderstorm wind events can occur at different strength levels, in random locations, and can create relatively narrow paths of destruction. Due to the randomness of these events, all existing and future structures, and facilities in the planning area could potentially be impacted and remain vulnerable to possible injury and property loss from strong winds.

The following critical facilities would be vulnerable to thunderstorm wind events in each participating jurisdiction, respectively.

Table 5-5. Critical Facilities by Jurisdiction

Jurisdiction	Critical Facilities
Bayview	Town Hall, Fire Station, 2 Bridges (north and south side)
Indian Lake	Town Hall, Police Station, Community Center, 2 Water Utility Facilities, Main Water Meter, Henderson Road Bridge, Resaca Shores Bridge
Laguna Vista	City Hall/Police Station, Fire Station, Library
Los Fresnos	City Hall, Water Plant, Sewer Plant, Raw Water Meter Station, 20 Lift Stations
Port Isabel	14 Lift Stations, AEP Electrical Substations, Texas Gas Service, EOC, City Hall, Police Department, Fire Department, Port Isabel EMS, Port Isabel Health Clinic, Port Isabel Medical Clinic, H.E.B., Walmart, Harbor-Pampano Park, 3 Main Harbor Entrances
Primera	City Hall
Rancho Viejo	Town Hall, Fire Station, Valley Municipal Utilities Department
Rio Hondo	Rio Hondo Bridge, Water Plant, Reservoir Dam, Sewer Plant, Fertilizer Plant, Police Station
San Benito	2 Water Plants, 2 Water Towers, Waste Water Treatment Plant, Waste Water Wetlands, City Hall, Municipal Building, Public Works, School administration, School Campuses, AT&T Hub Location, Police Station, 2 Fire Stations, Cameron County Annex, 2 Power substations
South Padre Island	City Hall, Water Tower, AT&T Hub, Fire Station, 2 Water Towers, 2 Power substation, US Coast Guard Station, Queen Isabella Causeway

Trees, power lines and poles, signage, manufactured housing, radio towers, concrete block walls, storage barns, windows, garbage recepticles, brick facades, and vehicles, unless reinforced, are vulnerable to thunderstorm wind events. More severe damage involves windborne debris, in some instances, patio furniture and other lawn items have been reported to have been blown around by wind and, very commonly, debris from damaged structures in turn have caused damage to other buildings not directly impacted by the event. In numerous instances roofs have been reported as having been torn off of buildings. The US Census data indicates a total of 2,519 manufactured homes located in the Council of Cities planning area including all participating jurisdictions (Table 5-6). In addition, approximately 10,175 of the residential structures in the planning area were built before 1980. These structures would typically be built to lower or less stringent construction standards than newer construction and may be more suseptible to damages during significant wind events.

Table 5-6. Structures at Greater risk by Jurisdiction

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
Bayview	5	86
Indian Lake	440	178
Laguna Vista	24	338
Los Fresnos	58	592
Port Isabel	455	821
Primera	125	352
Rancho Viejo	13	512
Rio Hondo	119	481
San Benito	1255	5002
South Padre Island	25	1813
COUNCIL TOTAL	2519	10,175

A thunderstorm wind event can also result in traffic disruptions, injuries and in rare cases, fatalities. Impact of thunderstorm winds experienced in the Council of Cities planning area has resulted in 2 injuries and no fatalities. Impact of thunderstorm wind events experienced in the planning area would be "Limited," injuries and/or illnesses are treatable with first aid, with shutdown of facilities and services for 24 hours or less, and less than 10% of property destroyed or with major damage. Overall, the average loss estimate (in 2015 dollars) is $7,821,929, having an approximate annual loss estimate of $130,365 (Table 5-7), which would be considered negligible annual damages.

Table 5-7. Historical Events Summary and Potential Annualized Losses[4]

JURISDICTION	FREQUENCY	PROBABILITY OF FUTURE EVENTS	AVERAGE ANNUALIZED LOSSES
Bayview	0.10	Unlikely	$38
Indian Lake	0.00	Unlikely	$0
Laguna Vista	0.05	Unlikely	$113,282
Los Fresnos	0.08	Unlikely	$65
Port Isabel	0.32	Likely	$990
Primera	0.02	Unlikely	$164
Rancho Viejo	0.02	Unlikely	$33
Rio Hondo	0.15	Occasional	$5
San Benito	0.17	Occasional	$216
South Padre Island	0.10	Unlikely	$372
County	1.45	Highly Likely	$13,063

Assessment of Impacts

Thunderstorm wind events have the potential to pose a significant risk to people, and can create dangerous and difficult situations for public health and safety officials. Impacts to the planning area can include:

- Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees causing serious injury or death.
- Structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.
- Significant debris and downed trees can result in emergency response vehicles being unable to access areas of the community.
- Damaged bridges in and out of Bayview and South Padre Island (Causeway) could prevent or delay emergency response, strand or prevent entry of tourists, commuters, supply delivery, or goods and services.

[4] *Even though the jurisdictions may have experienced more thunderstorm wind events, NCDC data only records events reported and they are generally reported on a County level. The data in this chart is based on events only recorded in the respective jurisdiction. As a result, the overall probability for the Council of Cities planning area is determined using County level data as it more accurately reflects risk for each participating jurisdiction.*

- Driving conditions in all jurisdictions may be dangerous during thunderstorm wind events, especially over the Causeway or other elevated bridges.
- Manufactures homes of portable buildings in each jurisdiction may suffer more significant damage during a thunderstorm wind event than a site built structure.
- Thunderstorm wind may damage or erode an already fragile dune system.
- Downed power lines may result in roadways being unsafe for use, which may prevent first responders from answering calls for assistance or rescue.
- During exceptionally heavy wind events, first responders may be prevented from responding to calls, as the winds may reach a speed in which their vehicles and equipment are unsafe to operate.
- Thunderstorm wind events often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage often results in an increase in structure fires and carbon monoxide poisoning, as individuals attempt to cook or heat their homes with alternate, unsafe cooking or heating devices, such as grills.
- First responders are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.
- Emergency operations and services may be significantly impacted due to damaged facilities and/or loss of communications.
- Critical staff may be unable to report for duty, limiting response capabilities.
- City or county departments may be damaged, delaying response and recovery efforts for the entire community.
- Private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Economic disruption negatively impacts the programs and services provided by the community due to short and long term loss in revenue.
- Some businesses not directly damaged by thunderstorm wind events may be negatively impacted while roads are cleared and utilities are being restored, further slowing economic recovery.
- Older structures built to less stringent building codes may suffer greater damage as they are typically more vulnerable to thunderstorm winds.
- Large scale wind events can have significant economic impact on the affected area, as it must now fund expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-day operating expenses.
- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.

The economic and financial impacts of thunderstorm wind on the area will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by the community, local businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of any thunderstorm wind event.

Section 6: Hurricane/Tropical Storm

Hazard Description

Hurricanes often begin as tropical depressions that intensify into tropical storms when maximum sustained winds increase to between 35-64 knots (39 – 73 mph). At these wind speeds the storm becomes more organized and circular in shape and begins to resemble a hurricane. Tropical storms can be equally problematic without ever becoming a hurricane, resulting in heavy rainfall, high winds and tidal surge in coastal communities. When maximum sustained winds reach or exceed 39 mph, the system becomes a tropical storm. Once sustained winds reach or exceed 74 mph, the storm becomes a hurricane.

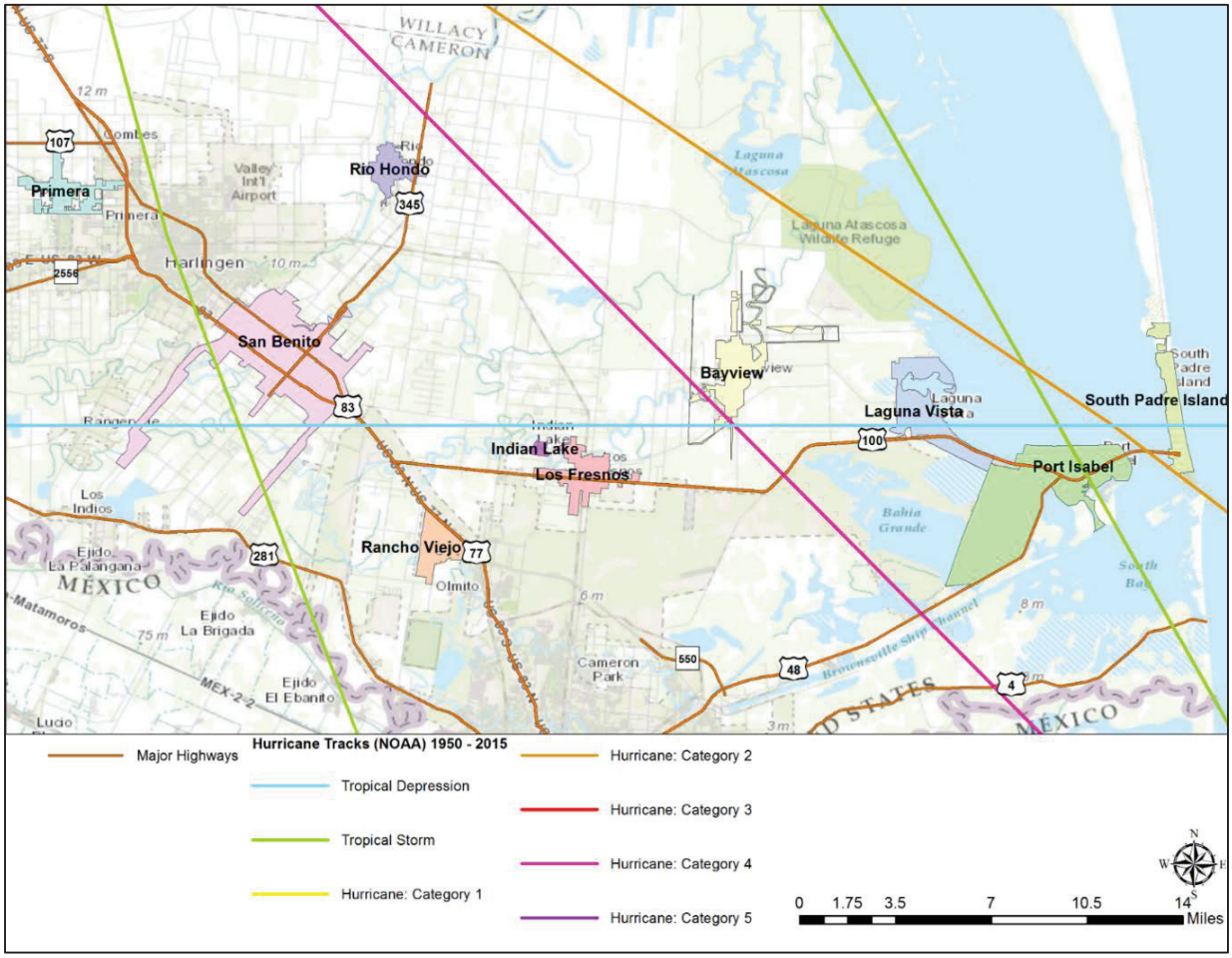
The intensity of a land falling hurricane is expressed in categories relating wind speeds and potential damage. Tropical storm-force winds are strong enough to be dangerous to those caught in them. For this reason, emergency managers plan to have evacuations completed and personnel sheltered before winds of tropical storm-force arrive, which precedes the arrival of hurricane-force winds.

According to the National Hurricane Center, the greatest potential for loss of life related to a hurricane is from storm surge. This happens when low pressure and high circular winds “pile” the water into a dome shape that can be 50-100 miles wide. The surge travels with the storm and is most severe on the right side of the storm, relative to the direction the storm travels. The surge can be 15 feet deep, topped by waves, and make landfall ahead of the center, or “eye”, of the hurricane. Wind-driven waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with normal high tides.

Location

As a coastal community, the Council of Cities is vulnerable to threats directly and indirectly related to a hurricane event, such as high-force winds, storm surge, flooding, and coastal erosion. Hurricanes and/or tropical storms can impact Cameron County from June to November, the official Atlantic U.S. hurricane season. The Council of Cities is in a moderate to high risk area for hurricane wind speeds up to 155 miles per hour (mph) as shown in Figure 6-1.

Figure 6-1. Location of Historical Hurricane Tracks



Extent

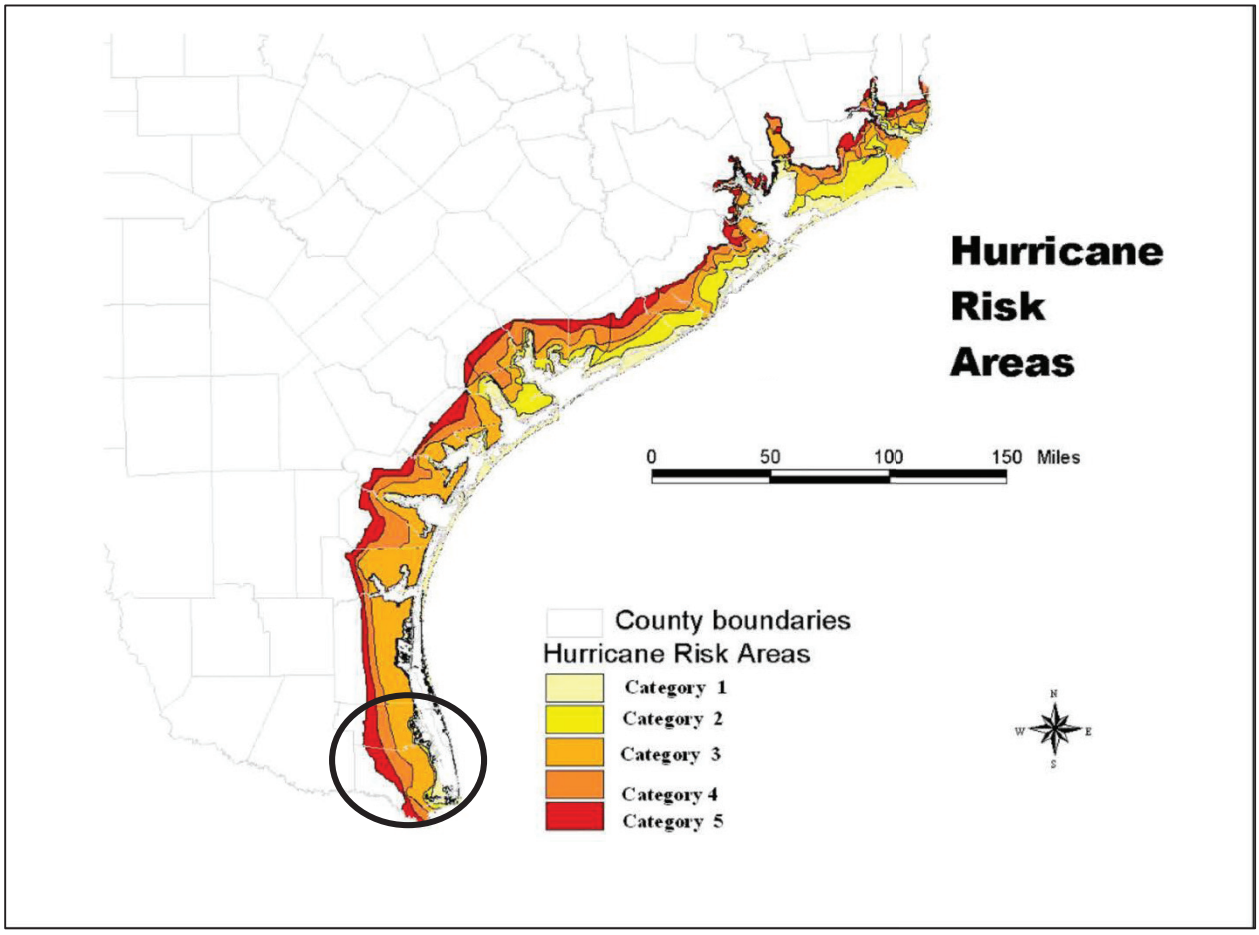
Hurricanes are categorized according to the strength and intensity of their winds using the Saffir-Simpson Hurricane Scale (See Table 6-1). A Category 1 storm has the lowest wind speeds, while a Category 5 hurricane has the highest. This scale only ranks wind speed, but lower category storms can inflict greater damage than higher category storms depending on where they strike, other weather they interact with and how slow they move.

Table 6-1. Extent Scale for Hurricanes

CATEGORY	MAXIMUM SUSTAINED WIND SPEED (Mph)	MINIMUM SURFACE PRESSURE (Millibars)	STORM SURGE (Feet)
1	74 – 95	Greater than 980	3 – 5
2	96 – 110	979 – 965	6 – 8
3	111 – 130	964 – 945	9 – 12
4	131 – 155	944 – 920	13 – 18
5	155 +	Less than 920	19 +

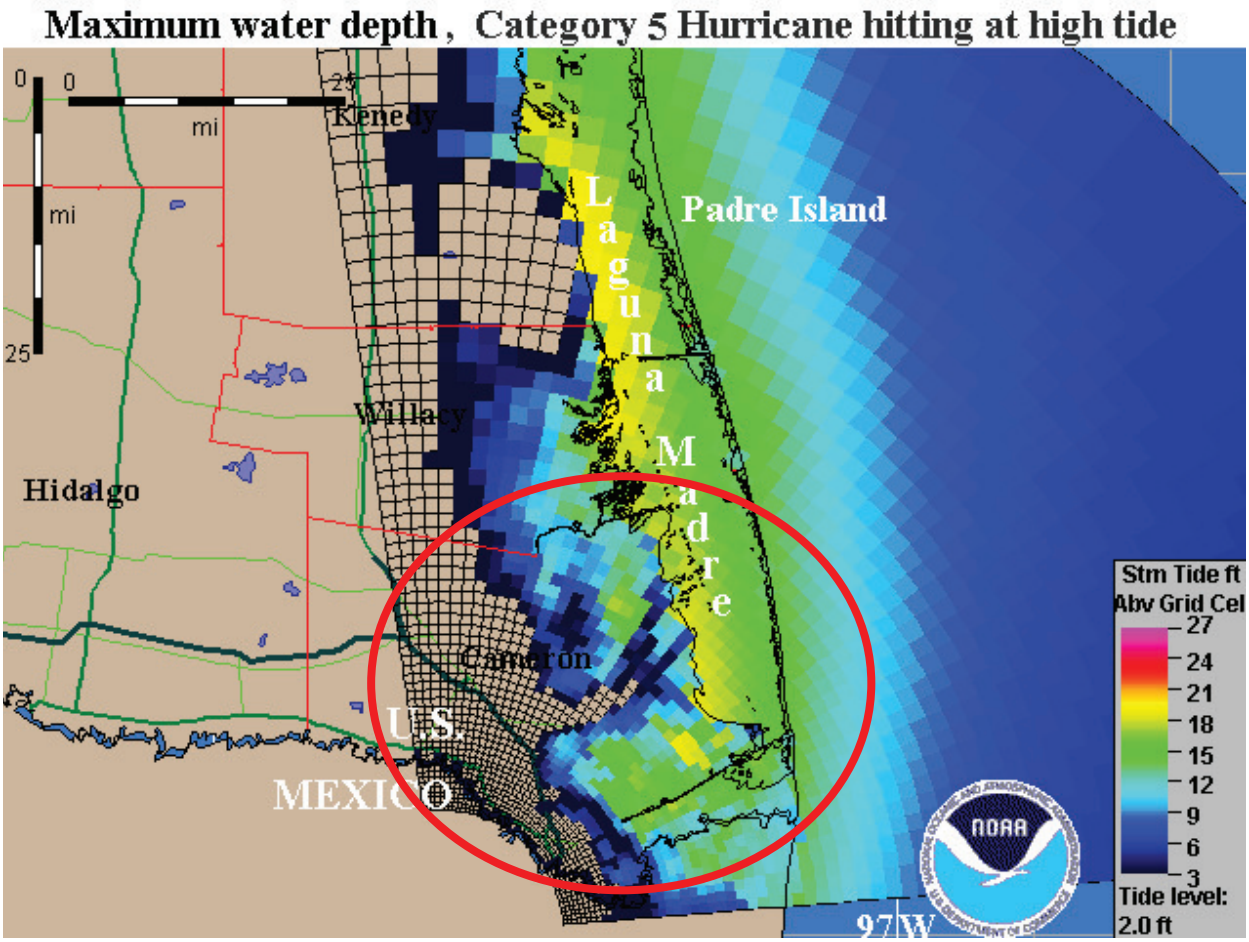
Based on the historical storm tracks for hurricanes and tropical storms, as well as the coastal location of the Council of Cities, the average extent to be mitigated for is a Category 4 storm. The Council of Cities planning area has experienced wind speeds up to 155 mph, therefore a Category 4 that should be mitigated in the event of a hurricane. Figure 6-2 displays the location of hurricane risk by storm category along the Gulf Coast.

Figure 6-2. Location of Hurricane Risk along the Texas Coast



The worst-case scenarios of potential extent of a Category 5 hurricane of storm surge in the Council of Cities planning area is displayed in Figure 6-3; the Council of Cities study area is indicated by the red circle. The map reflects a general geographic analysis that does not consider specific factors such as levee system.

Figure 6-3. Maximum Storm Surge Water Depths, Category 5 Hurricane[1]



The planning area is located along the coast, and therefore all participating jurisdictions have a greater risk, with all land and buildings being vulnerable to all storms, category 1 through 5.

The planning area coastline is also vulnerable to the effects of coastal erosion from the Gulf of Mexico. In Cameron County there are no stable (vegetated) dunes in the undeveloped area located as close to the mean low water (MLW) line. Through experience it has proven that barrier island development imposes risks on private property owners, investors, and to taxpayers statewide. The average rate of retreat is estimated between 3 and 12 feet per year according to the study for the Erosion Protection Dune System (EPDS). Coastal erosion is addressed in seperately in Section 15 of the Plan.

[1] *Source: NOAA SLOSH (Sea, Lake, and Overland Surge from Hurricanes).*

Historical Occurrences

Previous occurrences include events that had a direct path through the Cameron County study area, and the tracks near the county. Table 6-2 below lists the storms that have impacted the Cameron County planning area during the years of 1960-2015.

Table 6-2. Historical Hurricane Events for Cameron County Including the Council of Cities Planning Area, 1960-2015[2]

JURISDICTION	DATE	MAGNITUDE	FATALITIES	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Countywide	9/8/1961	Hurricane Carla	0	4	$4,019,209	$4,019,209
Countywide	9/16/1963	Hurricane Cindy	0	0	$971,998	$97,200
Countywide	9/5/1967	Hurricane Beulah	0	1	$245,466,250	$0
Countywide	6/23/1968	Tropical Storm Candy	0	0	$310,799	$310,799
Countywide	7/31/1970	Hurricane Celia	0	6	$4,034,609	$414,368
Countywide	9/9/1971	Hurricane Fern	0	0	$481,571	$481,571
Countywide	9/14/1971	Hurricane Edith	0	0	$5,153	$5,153
Countywide	9/4/1973	Tropical Storm	0	0	$223,299	$22,329,675
Countywide	7/31/1980	Hurricane Allen	0	0	$15,360,014	$1,536,001
Countywide	11/12/1980	Tropical Storm Jeanne	0	0	$9,024	$0
Countywide	9/16/1988	Hurricane Gilbert	0	0	$257,830	$2,579
Countywide	7/23/2008	Hurricane Dolly	0	2	$469,694,454	$0
Countywide	9/12/2008	Storm Surge/Tide	0	0	$22,103	$0
Countywide	6/30/2010	Storm Surge/Tide	0	0	$163,681	$0
Countywide	9/6/2010	Tropical Storm Hermine	0	0	$13,094,526	$0
Total			**8**	**18**	**$783,311,073**	

[2] *Only recorded events with fatalities, injuries, and/or damages are listed.*

Section 6: Hurricane/Tropical Storm

Significant Events

Tropical Storm Hermine on September 6, 2010

Hermine arrived with frequent gusty feeder band showers followed by relatively calm conditions through the day and early evening of September 6th. Between 9:30 and 10:00 PM CDT, the action got underway as the central core of Hermine brought a rapid increase in sustained winds and gusts, along with increasingly heavy rainfall. Between 11:00 PM and 12:00 AM CDT, the northern doughnut crossed the Rio Grande over lower populated southwest Cameron County. Meanwhile, intense feeder bands east of the center, where some of the strongest winds were sampled, pounded Brownsville with sustained winds of 40 to 55 mph and gusts as high as 69 mph at the Brownsville/SPI International Airport. Between 1 and 1:30 AM, a very intense band would reform around the center, curling from just south of Harlingen to north of Brownsville. This band would cross Harlingen just prior to 2:00 AM, and produced near hurricane force gusts (72.5 mph) along with brief sustained winds of 59 mph, which damaged a number of roofs, knocked down limbs and uprooted trees, and wiped out power to more than 14,000 residents, many in the Harlingen/San Benito area. In all, between 46,000 and 50,000 customers in Cameron County were without power during the peak of the storm, including those in the AEP Texas, Brownsville PUB, and Magic Valley Electric Co-op service areas.

After the inner core of Hermine sliced through, winds quickly diminished below tropical storm force from south to north across the county, between 1:30 AM CDT near the river and 2:30 CDT near the Willacy County line. Significant damage included the roof collapsing at two apartment complexes, displacing at least two families. A large part of an industrial building roof collapsed in north Harlingen, and other poorly constructed lightweight roofs were blown off in Brownsville and the Port of Brownsville. Hundreds of medium to large tree limbs fell along the Highway 77 corridor from Brownsville through San Benito and the central and east side of Harlingen. Boaters, particularly Mexican shrimping vessels, did their best to seek refuge in the Port of Brownsville prior to the arrival of the storm. The sharp increase in waves broke as high as the windows of the Harbormaster office. Sixty-four vessels reached the Port, but 5 others became stranded at the coast, including three running aground in Texas and two in Mexico when buoys floated toward the beach and guided the boats toward the rocks. Each boat was able to beach safely, with no human casualties.

Hurricane Dolly on July 23, 2008

The approach of Hurricane Dolly to the barrier shoreline of South Padre Island early on the morning of July 23rd brought sustained tropical storm force winds inland to the east side of Brownsville, including the Port, just before 7:30 AM on the 23rd. Prior rain bands had produced frequent gusts to 40 mph, but the arrival of sustained tropical storm winds was soon followed by wind damage and power outages, particularly during the afternoon. Prior to Dolly's landfall along the Cameron/Willacy County line, the western and southern eyewall intensified. The core of the eyewall traversed northern Cameron County, where impacts were more substantial than in southern Cameron County.

Northern Cameron (Harlingen, San Benito, Rio Hondo): A period of estimated and measured sustained winds between 60 and 70 mph, with frequent gusts to hurricane force (at least 78 mph measured at 2.25 meters), developed around 1:00 PM and continue through around 5:00 PM, beginning in northeast Cameron County near Arroyo City and extending west through Las Yescas, Rio Hondo, Harlingen, San Benito, Palm Valley, and La Feria, not only created widespread freshwater flooding, but created notable damage to poorly fastened roofs and some walls, particularly at industrial parks, strip centers, and farm buildings, especially from Harlingen to points east. Otherwise, numerous large limbs, power lines and power poles, highway signs and billboards, were blown down across the area during this time period. As Dolly's center eased slowly from southern Willacy into northern Hidalgo County, the last of the sustained tropical storm force winds began to exit Cameron County from Palm Valley to Santa Rosa and La Feria, just after midnight on the 24th.

Southern Cameron: Along and just north of the Rio Grande, from the Kellers Corner/Brownsville Airport area through Brownsville and to points west, roughly along federal highway 281 through Los Indios out toward the Hidalgo/Cameron County line, conditions were a bit more benign, as the core of the southern and western eyewall generally missed the area. Here, sustained tropical storm force winds persisted from around 8:30 AM until 6:00 PM, though gusts above 40 mph persisted until near midnight. In this area, sustained wind generally peaked between 45 and 55 mph, with peak gusts just below hurricane force between 11:30 AM and 2:00 PM. Here, damage was primarily to thousands of tree limbs, hundreds of power lines, and many elevated highway signs and billboards, but structural damage was primarily to unfastened shingles of roofs of moderate to well-constructed buildings, and occasional failures of more poorly constructed roofs at industrial parks and farm buildings.

At the peak of the storm, power was out to just about all of Cameron County, with an estimated 115,000 customers down during the middle of the afternoon. Across northern Cameron County, power recovery took days to more than a week, while many locations in southern Cameron County returned to power within a few days after Dolly's passage.

Probability of Future Events

Due to the location on the Gulf Coast, and the previous history of hurricanes and tropical storms for the area, the likelihood or future probability of a tropical storm or hurricane in the Council of Cities planning area is likely, meaning an event is probable in the next five years.

Vulnerability and Impact

Hurricane-force winds can cause major damage to large areas; hence all existing buildings, facilities and populations are equally exposed and vulnerable to this hazard and could potentially be impacted. Warning time for hurricanes has lengthened due to modern and early warning technology. Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes, as well as debris such as signs, roofing materials, and small items left outside become extremely hazardous in hurricanes and tropical storms.

Extensive damage to trees, towers, and underground utility lines (from uprooted trees) and fallen poles cause considerable civic disruption. Older structures may suffer greater damages from storm surge along the coast due to lower elevation of foundations.

The Council of Cities planning area includes manufactured homes and parks located sporadically throughout each jurisdiction which would also be more vulnerable. The US Census data indicates a total of 2,519 manufactured homes located in the Council of Cities planning area including all participating jurisdictions (Table 6-3). In addition, approximately 10,175 of the single family residential (SFR) structures in the Council of Cities planning area were built before 1980.[3] These structures would typically be built to lower or less stringent construction standards than newer construction and may be more suseptible to damages during significant events.

Table 6-3. Structures at Greater Risk by Jurisdiction

JURISDICTION	MANUFACTURED HOMES	SFR STRUCTURES BUILT BEFORE 1980
Bayview	5	86
Indian Lake	440	178
Laguna Vista	24	338
Los Fresnos	58	592
Port Isabel	455	821
Primera	125	352
Rancho Viejo	13	512
Rio Hondo	119	481
San Benito	1255	5002
South Padre Island	25	1813
TOTAL	**2,519**	**10,175**

The following critical facilities would be vulnerable to hurricane/tropical storm wind events in each participating jurisdiction, respectively.

[3] Source: US Census Bureau data estimates for 2014.

Table 6-4. Critical Facilities by Jurisdiction

Jurisdiction	Critical Facilities
Bayview	Town Hall, Fire Station, 2 Bridges (north and south side)
Indian Lake	Town Hall, Police Station, Community Center, 2 Water Utility Facilities, Main Water Meter, Henderson Road Bridge, Resaca Shores Bridge
Laguna Vista	City Hall/Police Station, Fire Station, Library
Los Fresnos	City Hall, Water Plant, Sewer Plant, Raw Water Meter Station, 20 Lift Stations
Port Isabel	14 Lift Stations, AEP Electrical Substations, Texas Gas Service, EOC, City Hall, Police Department, Fire Department, Port Isabel EMS, Port Isabel Health Clinic, Port Isabel Medical Clinic, H.E.B., Walmart, Harbor-Pampano Park, 3 Main Harbor Entrances
Primera	City Hall
Rancho Viejo	Town Hall, Fire Station, Valley Municipal Utilities Department
Rio Hondo	Rio Hondo Bridge, Water Plant, Reservoir Dam, Sewer Plant, Fertilizer Plant, Police Station
San Benito	2 Water Plants, 2 Water Towers, Waste Water Treatment Plant, Waste Water Wetlands, City Hall, Municipal Building, Public Works, School administration, School Campuses, AT&T Hub Location, Police Station, 2 Fire Stations, Cameron County Annex, 2 Power substations
South Padre Island	City Hall, Water Tower, AT&T Hub, Fire Station, 2 Water Towers, 2 Power substation, US Coast Guard Station, Queen Isabella Causeway

Storm track data was available for the past 150 years; however, property and crop loss data is only available from 1960 to the present. Table 6-4 shows impact or loss estimation for storms impacting the county. Damages are reported on a countywide basis and are not available for each participating jurisdiction. Annual loss estimates were based on the 55 year reporting period for such damages (Table 6-4). The average annual loss estimate for Cameron County is approximately $14.5 million.

Table 6-4. Potential Annualized Losses Cameron County, 1960-2015

JURISDICTION	NUMBER OF EVENTS	PROPERTY & CROP LOSS (2015 DOLLARS)	ANNUAL LOSS ESTIMATES (2015 DOLLARS)
Cameron County	28	$783,311,073	$14,505,761

Council of Cities[4]	$29,844,152	$552,669

The potential severity of impact from a hurricane for the Council of Cities planning area is classified as substantial; meaning multiple deaths, complete shutdown of critical facilities and services for 30 days or more, and more than 50 percent of property would be destroyed or have major damage.

Assessment of Impacts

Hurricane events have the potential to pose a significant risk to people, and can create dangerous and difficult situations for public health and safety officials. Impacts to the planning area can include:

- Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees causing serious injury or death.
- Structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants.
- Coastal communities may suffer substantial damage, requiring immediate shelter and long term displacement assistance.
- Damaged bridges in and out of Bayview and South Padre Island (Causeway) could prevent or delay emergency response, strand or prevent entry of tourists, commuters, supply delivery, or goods and services for extended periods.
- Driving conditions in all jurisdictions may be dangerous during a hurricane event, especially over the Causeway or other elevated bridges, elevating the risk of injury and accidents during evacuations if not timed properly.
- Additional resources may be required for emergency preparedness and response during the summer months due to increases in populations along the coast.
- Emergency evacuations may be necessary prior to a hurricane landfall, requiring emergency responders, evacuation routing and temporary shelters.
- Significant debris and downed trees can result in emergency response vehicles being unable to access areas of the community.
- Downed power lines may result in roadways being unsafe for use, which may prevent first responders from answering calls for assistance or rescue.
- During hurricane landfall, first responders may be prevented from responding to calls, as the winds may reach a speed in which their vehicles and equipment are unsafe to operate.
- Hurricane events often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage often results in an increase in structure fires and carbon monoxide poisoning, as individuals attempt to cook or heat their homes with alternate, unsafe cooking or heating devices, such as grills.

[4] *Calculated as a percentage (3.81) of the county*

- Extreme hurricane events may rupture gas lines and down trees and power lines, increasing the risk of structure fires during and after a storm event.
- Extreme hurricane events may lead to prolonged evacuations during search and rescue, and immediate recovery efforts requiring additional emergency personnel and resources to prevent entry, and protect citizens and property.
- First responders are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.
- Emergency operations and services may be significantly impacted due to damaged facilities and/or loss of communications.
- Critical staff may be unable to report for duty, limiting response capabilities.
- City or county departments may be damaged, delaying response and recovery efforts for the entire community.
- Private sector entities that the city and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Economic disruption negatively impacts the programs and services provided by the community due to short and long term loss in revenue.
- Some businesses not directly damaged by the hurricane may be negatively impacted while roads are cleared and utilities are being restored, further slowing economic recovery.
- Older structures built to less stringent building codes may suffer greater damage as they are typically more vulnerable to hurricane damage.
- Large scale hurricanes can have significant economic impact on the affected area, as it must now fund expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-day operating expenses.
- Businesses that are more reliant on utility infrastructure than others may suffer greater damages without a backup power source.

The economic and financial impacts of a hurricane on the area will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by the community, local businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of any hurricane event.

Section 7: Flood

Hazard Description

Floods generally result from excessive precipitation. The severity of a flood event is determined by a combination of several major factors, including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. Typically, floods are long-term events that may last for several days.

The primary types of general flooding are inland and coastal flooding. Inland or riverine flooding is a result of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. Inland or riverine flooding is overbank flooding of rivers and streams, typically resulting from large-scale weather systems that generate prolonged rainfall over a wide geographic area, thus it is a naturally occurring and inevitable event. Some river floods occur seasonally when winter or spring rainfalls fill river basins with too much water, too quickly. Torrential rains from decaying hurricanes or tropical systems can also produce river flooding.

Coastal flooding occurs when normally dry, low-lying land is flooded by seawater. The extent of coastal flooding is a function of the elevation inland flood waters penetrate which is controlled by the topography of the coastal land exposed to flooding.

Coastal flooding is largely a natural event, however human influence on the coastal environment can exacerbate coastal flooding. Extraction of water from groundwater reservoirs in the coastal zone can enhance subsidence of the land increasing the risk of flooding. Engineered protection structures along the

coast such as sea walls alter the natural processes of the beach, often leading to erosion on adjacent stretches of the coast which also increases the risk of flooding. Coastal flooding is covered in detail under the profile for Hurricanes, located in Section 6. Coastal erosion is covered in detail under the profile for Coastal Erosion, located in Section 15.

Location

The Digital Flood Insurance Rate Mate (DFIRM) data provided by FEMA for the Council of Cities planning area shows the following flood hazard areas:

- Zone A: Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance requirements and floodplain management standards apply.
- Zone X: Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones.

Locations of flood zones in the planning area based on the digital Flood Insurance Rate Map (DFIRM) from FEMA are illustrated in Figures 7-1 to 7-11.

Figure 7-1. Estimated Flood Zones Council of Cities

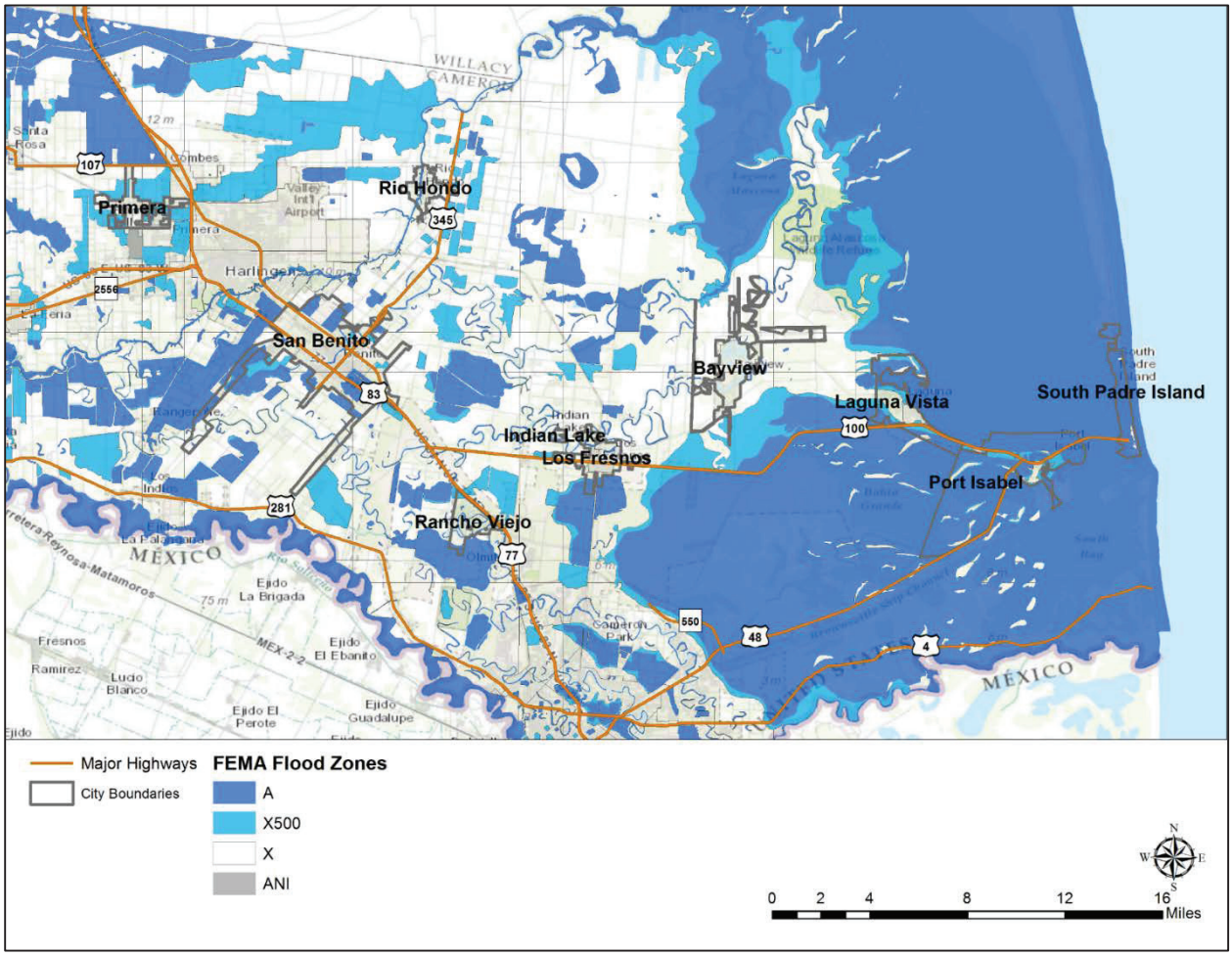


Figure 7-2. Estimated Flood Zones in the Town of Bayview

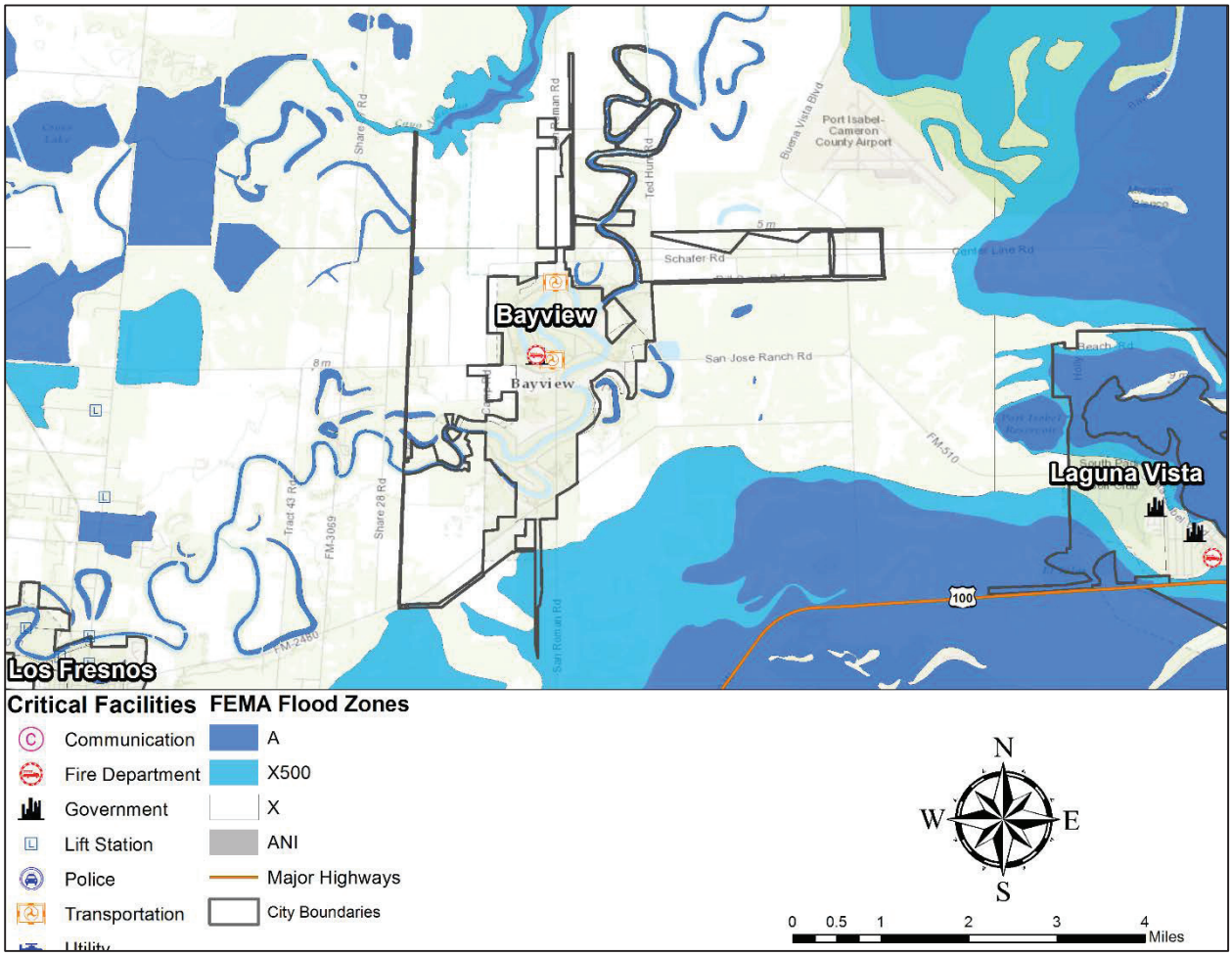


Figure 7-3. Estimated Flood Zones in the Town of Indian Lake

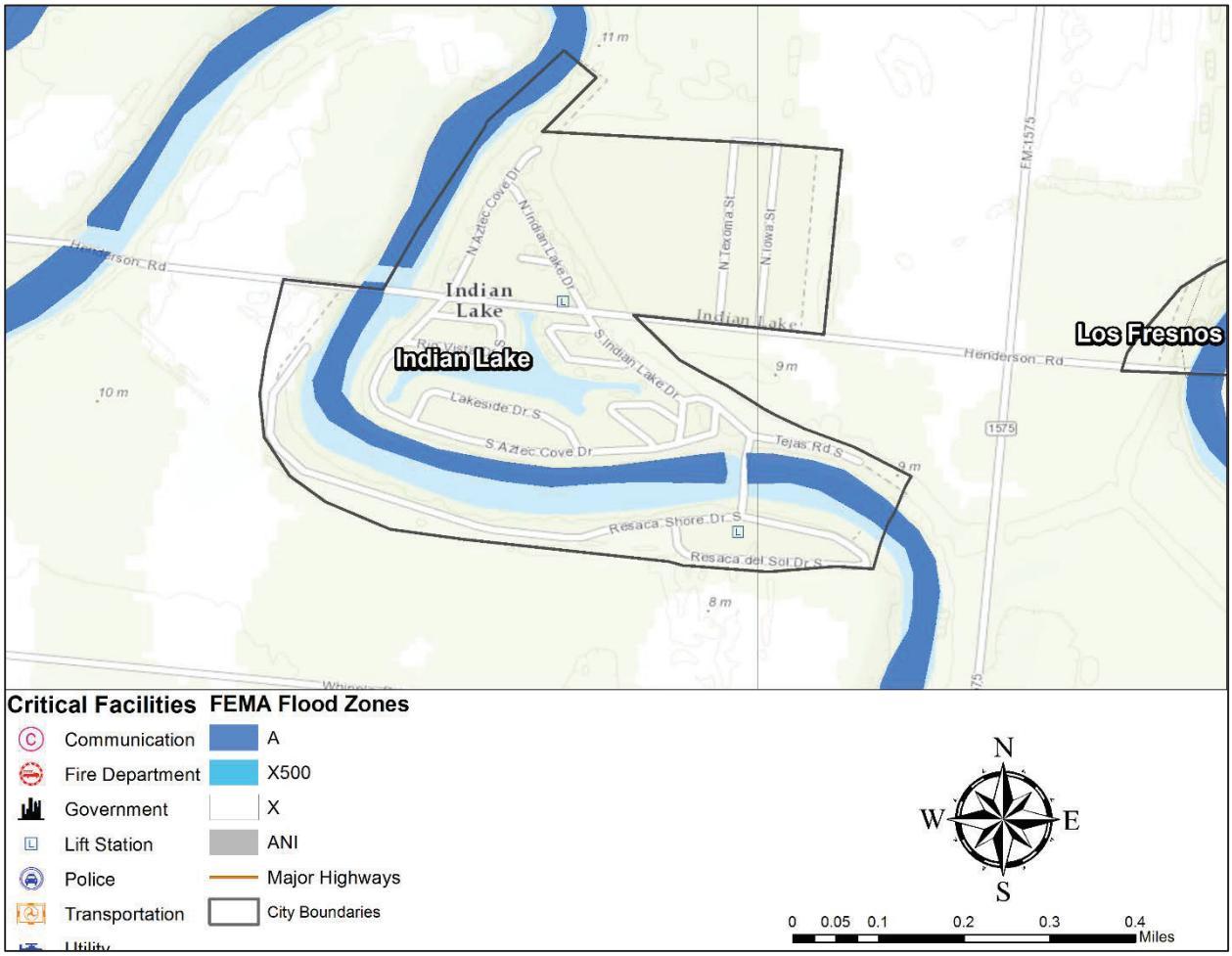


Figure 7-4. Estimated Flood Zones in the Town of Laguna Vista

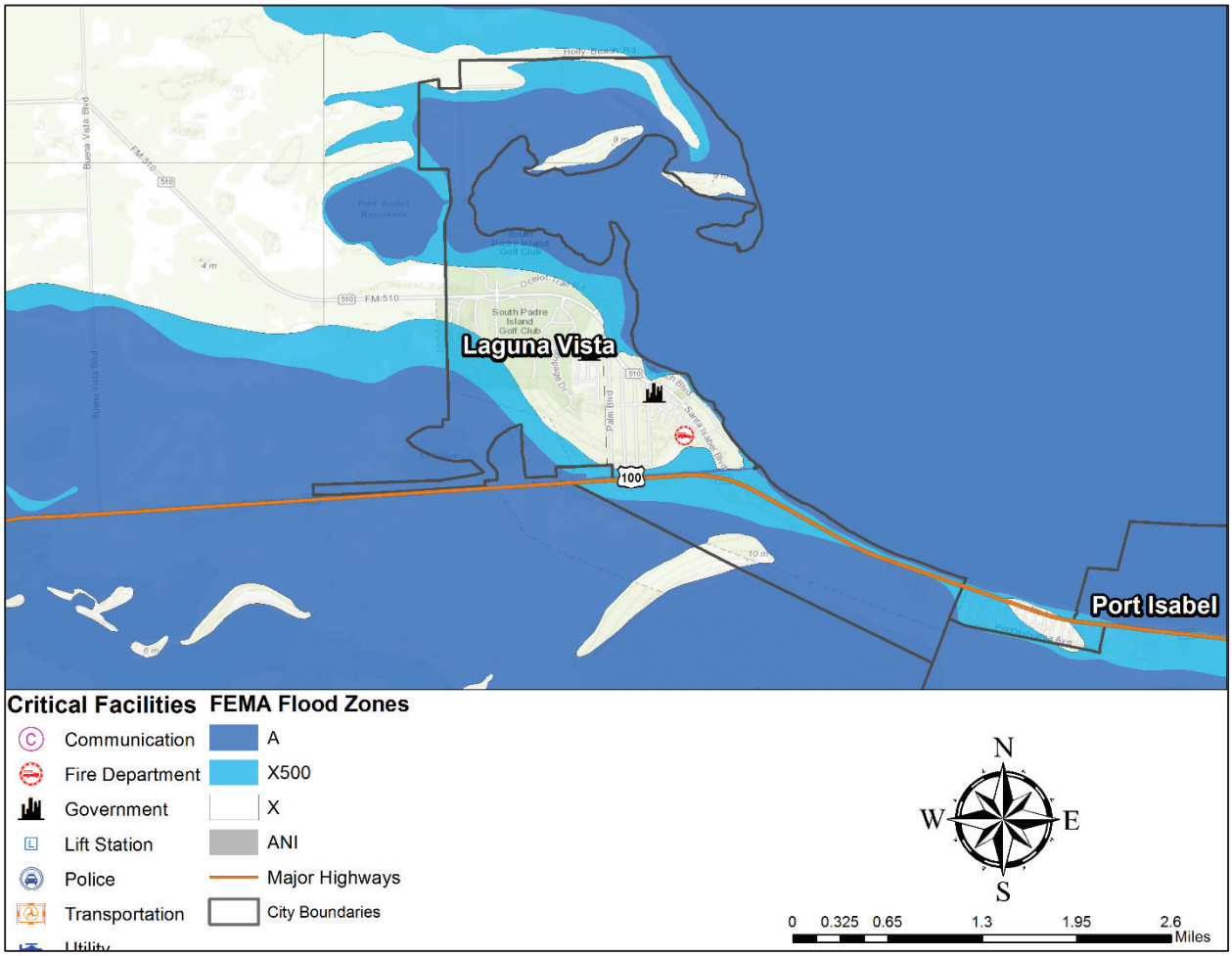


Figure 7-5. Estimated Flood Zones in the City of Los Fresnos

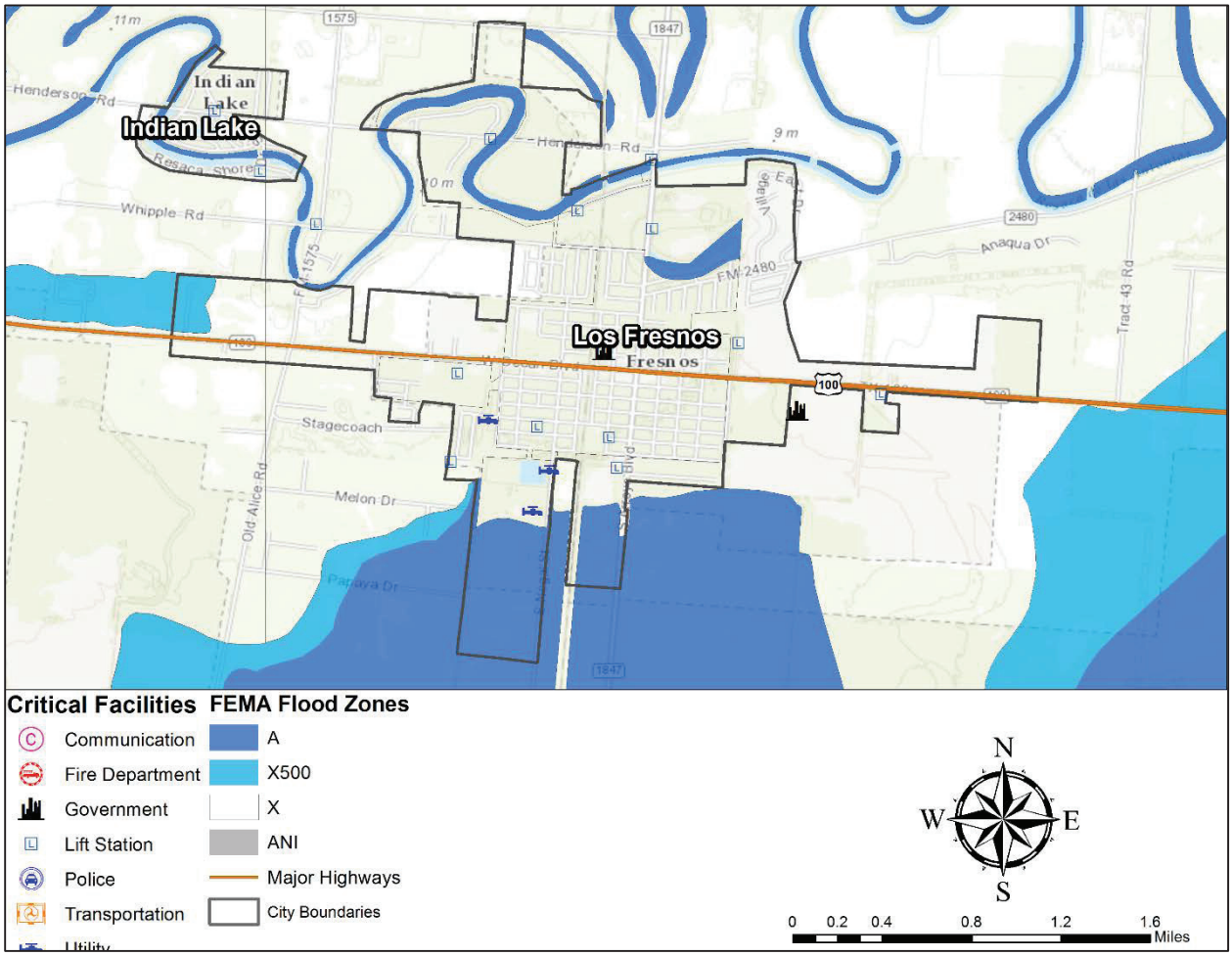


Figure 7-6. Estimated Flood Zones in the City of Port Isabel

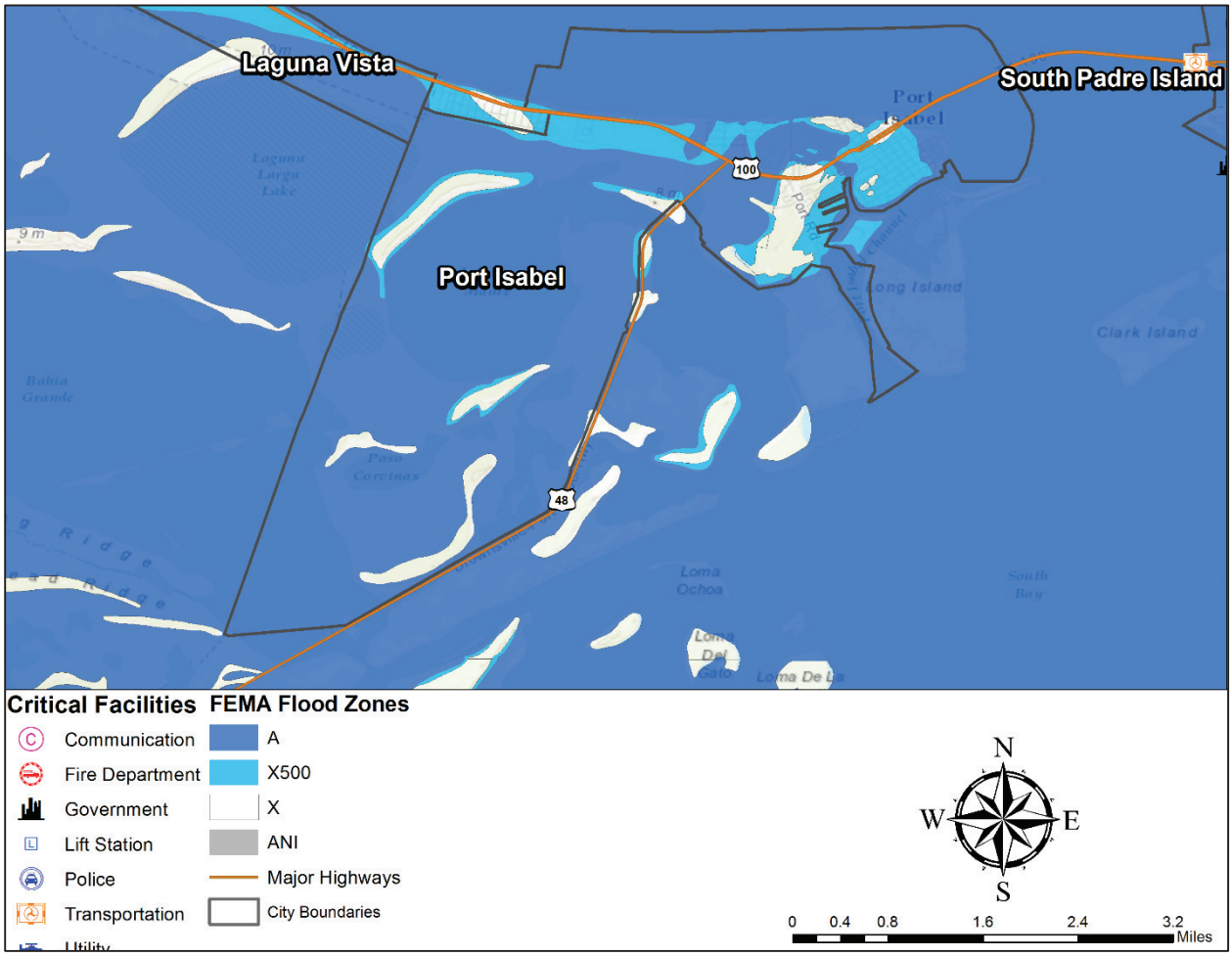


Figure 7-7. Estimated Flood Zones in the Town of Primera

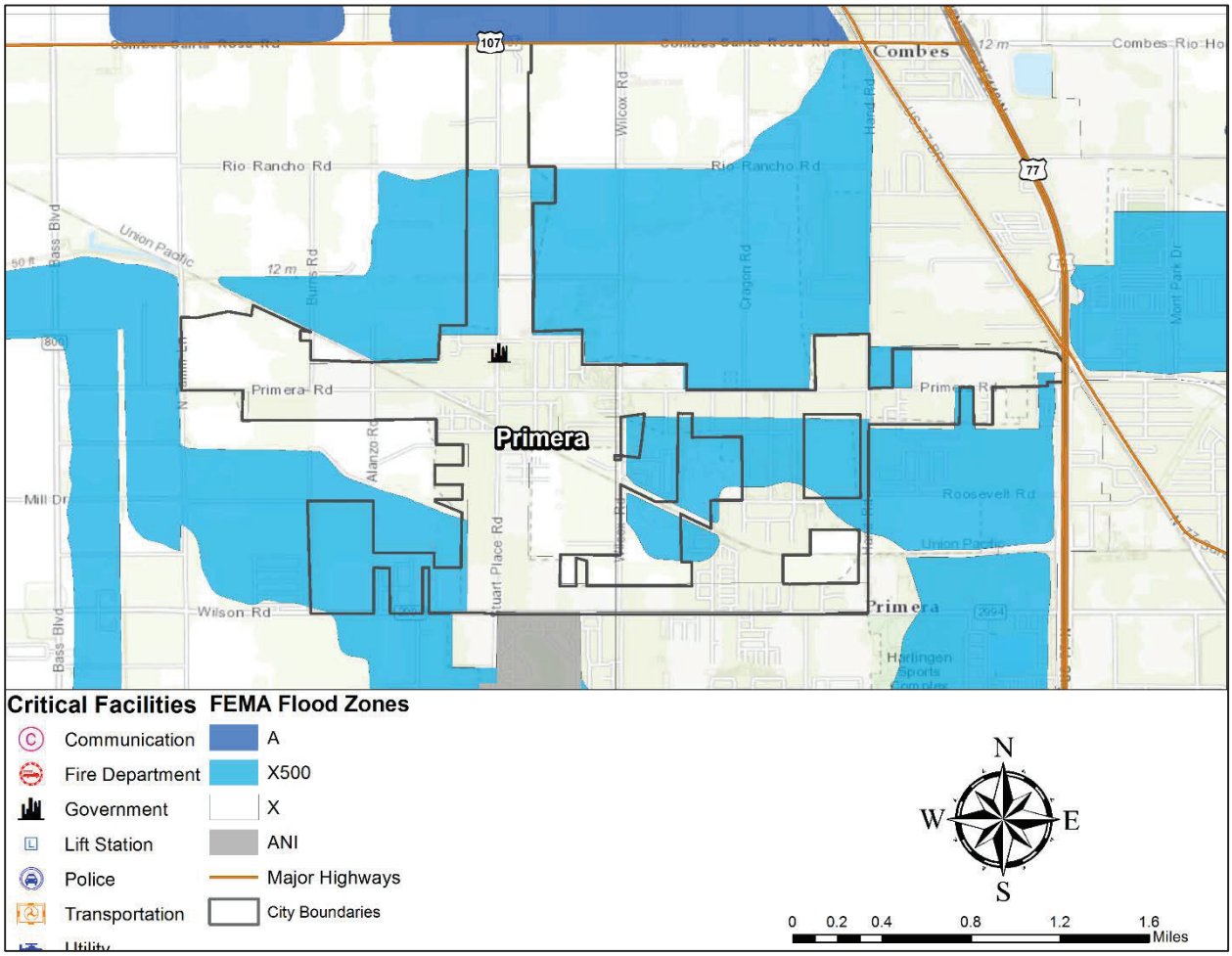


Figure 7-8. Estimated Flood Zones in the City of Rancho Viejo

Figure 7-9. Estimated Flood Zones in the City of Rio Hondo

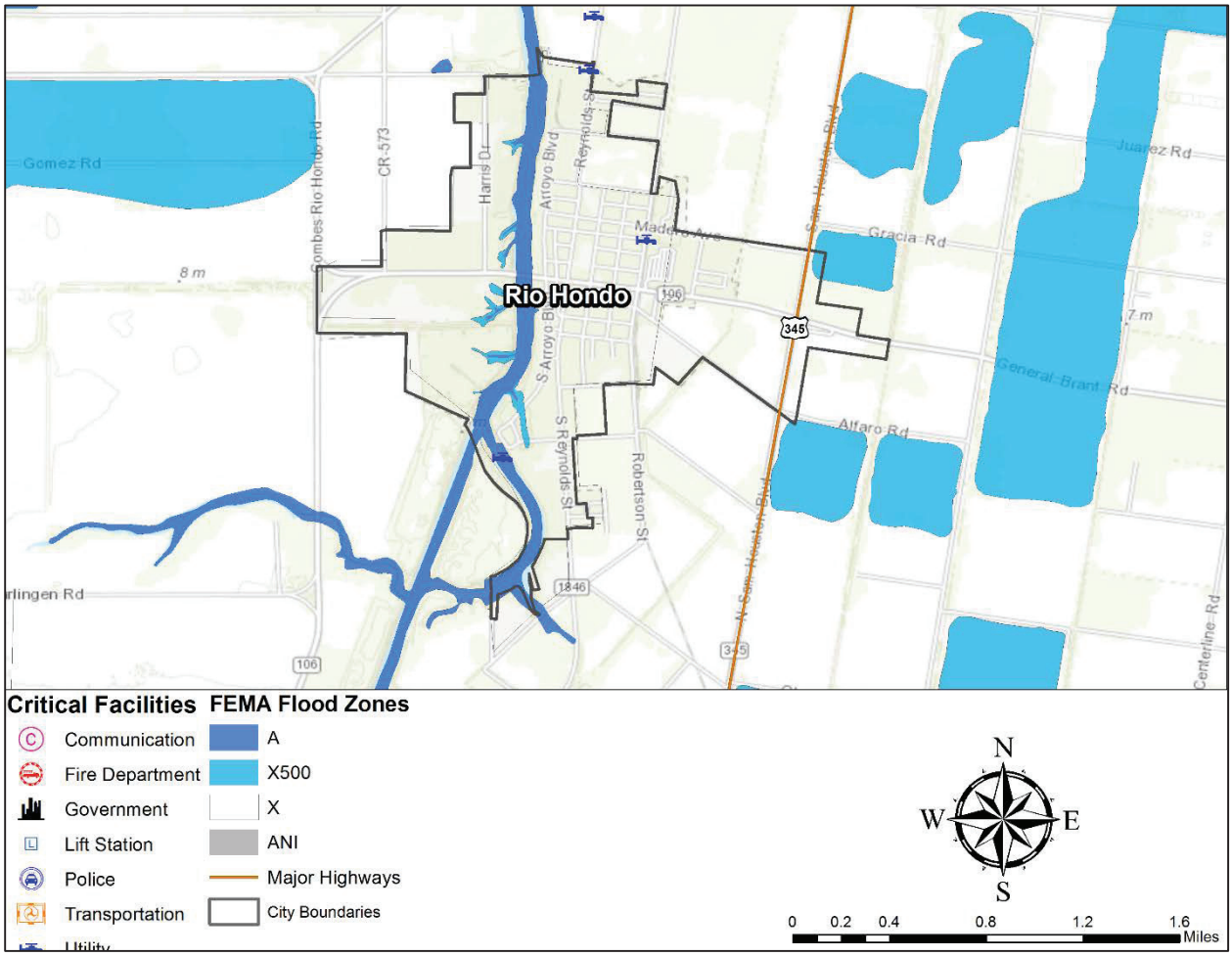


Figure 7-10. Estimated Flood Zones in the City of San Benito

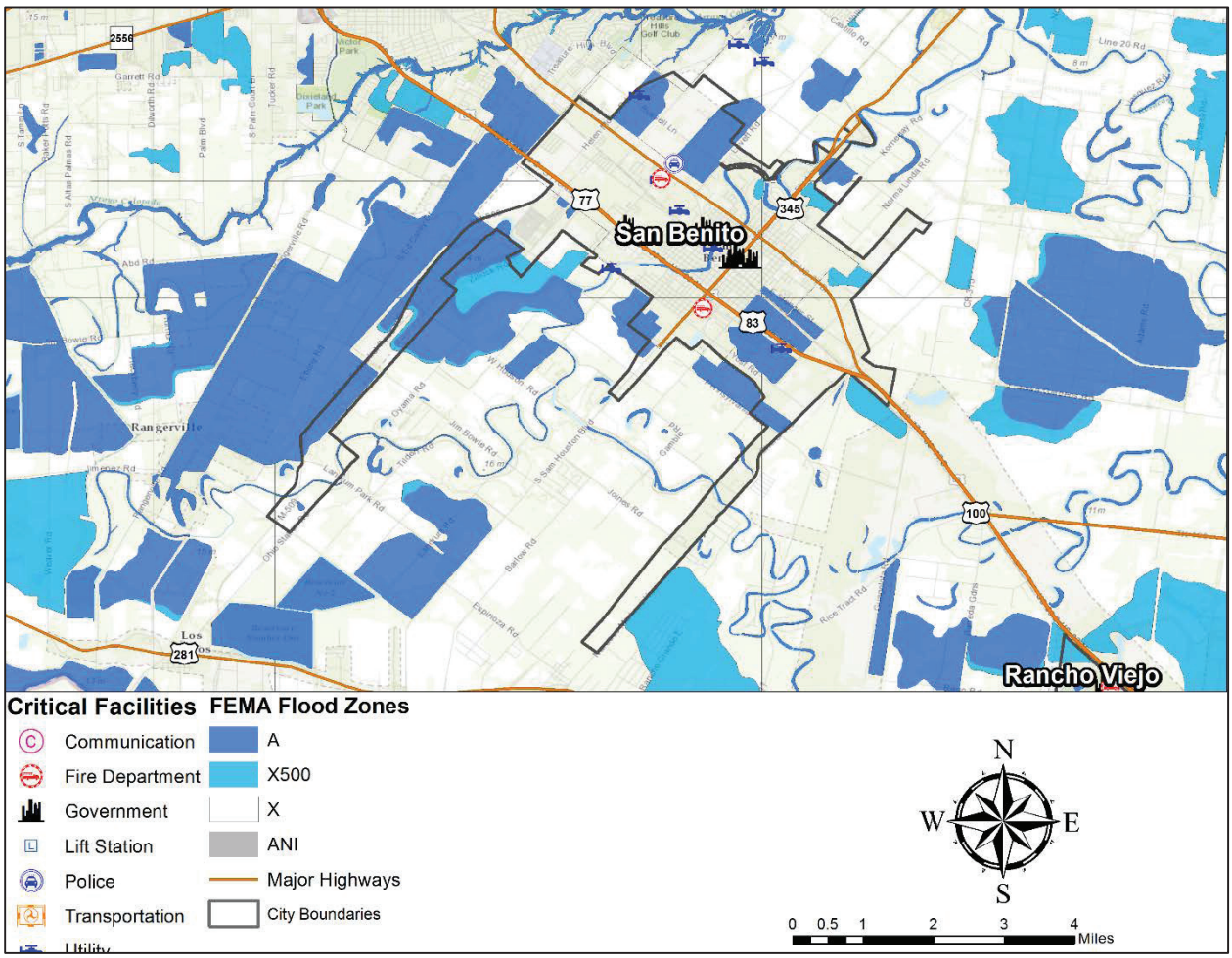
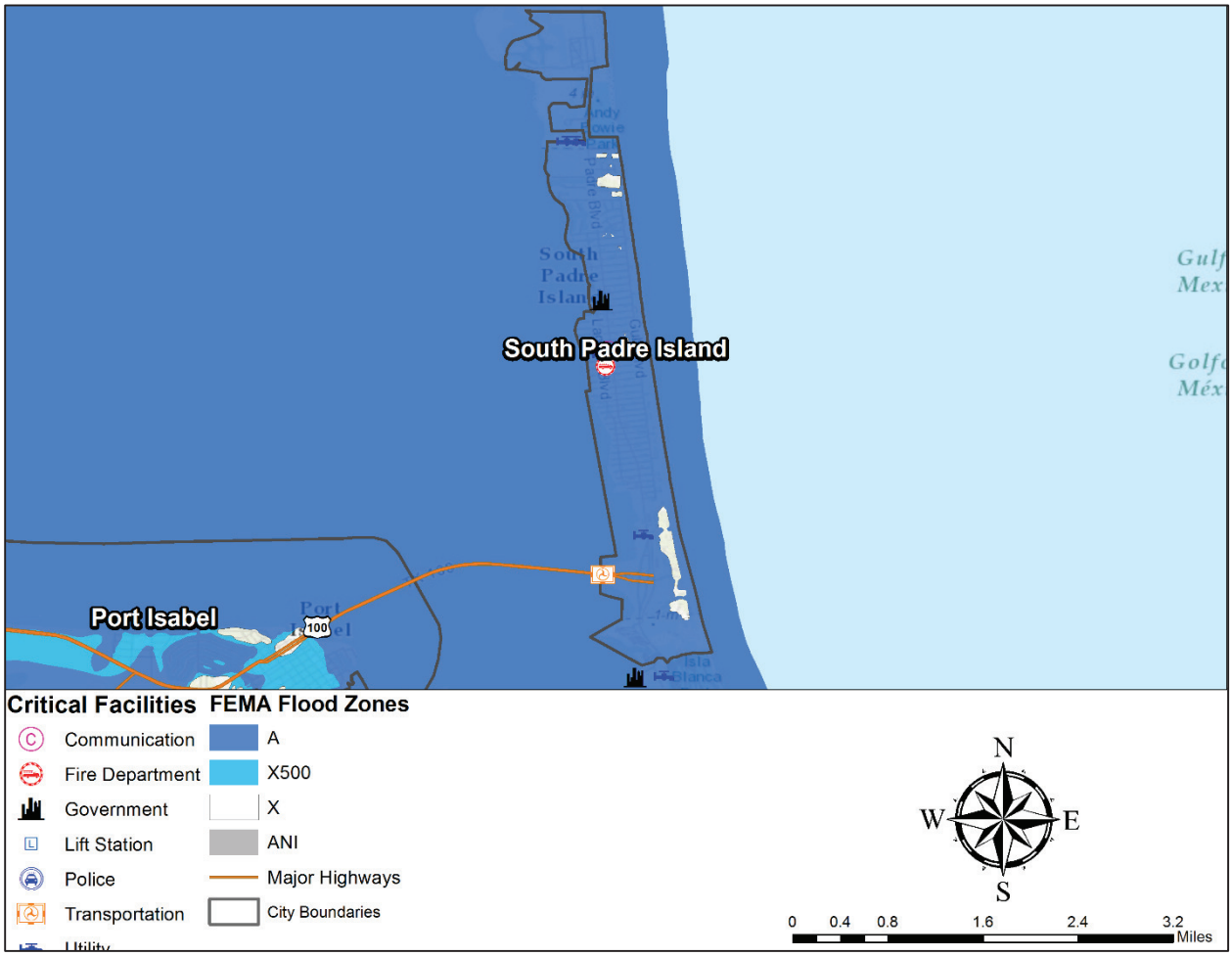


Figure 7-11. Estimated Flood Zones in the Town of South Padre Island



Extent

The severity of a flood event is determined by a combination of several factors including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and degree of vegetative clearing and impervious surface. Typically, floods are long-term events that may last for several days.

Determining the intensity and magnitude of a flood event is dependent upon the flood zone and location of the flood hazard area in addition to depths of flood waters. Extent of flood damages can be expected to be more damaging in the areas that will convey a base flood. FEMA categorizes areas on the terrain according to how the area will convey flood water. Flood zones are the categories that are mapped on Flood Insurance Rate Maps. Table 7-1 provides a description of FEMA flood zones and the flood impact in terms of severity or potential harm. Flood Zones A and X are the only hazard areas mapped in the region. Figures 7-1 through 7-11 should be read in conjunction with the extent for flooding in Tables 7-1, 7-2, and 7-3 to determine the intensity of a potential flood event.

Table 7-1. Flood Zones

INTENSITY	ZONE	DESCRIPTION
HIGH	ZONE A	Areas with a one percent annual chance of flooding and a 26 percent chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
	ZONE A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a Base Flood Elevation (BFE) (old format).
	ZONE AE	The base floodplain where base flood elevations are provided. AE Zones are now used on the new format FIRMs instead of A1-A30 Zones.
	ZONE AO	River or stream flood hazard areas and areas with a one percent or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from one to three feet. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
	ZONE AH	Areas with a one percent annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from one to three feet. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
	ZONE A99	Areas with a one percent annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
	ZONE AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
MODERATE to LOW	ZONE X 500	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than one foot or with drainage areas less than one square mile; or an area protected by levees from 100-year flooding.

Zone A is interchangeably referred to as the 100-year flood, the one-percent-annual chance flood, or the Special Flood Hazard Area (SFHA), or more commonly, the base flood. This is the area that will convey the base flood and constitutes a threat to the planning area. The impact from a flood event can be more damaging in areas that will convey a base flood.

Structures built in the SFHA are subject to damage by rising waters and floating debris. Moving flood water exerts pressure on everything in its path and causes erosion of soil and solid objects. Utility systems, such as heating, ventilation, air conditioning, fuel, electrical systems, sewage maintenance systems and water systems, if not elevated above base flood elevation, may also be damaged.

The intensity and magnitude of a flood event is also determined by the depth of flood waters. Table 7-2 below describes the category of risk and potential magnitude of an event in correlation to water depth. The water depths depicted in Table 7-2 are an approximation based on elevation data. Table 7-3 describes the extent associated with stream gauge data provided by the United States Geological Survey (USGS).

Table 7-2. Extent Scale – Water Depth

SEVERITY	DEPTH (in feet)	DESCRIPTION
BELOW FLOOD STAGE	0 to 15	Water begins to exceed low sections of banks and the lowest sections of the floodplain.
ACTION STAGE	16 to 23	Flow is well into the floodplain, minor lowland flooding reaches low areas of the floodplain. Livestock should be moved from low lying areas.
FLOOD STAGE	24 to 28	Homes are threatened and properties downstream of river flows or in low lying areas begin to flood.
MODERATE FLOOD STAGE	29 to 32	At this stage the lowest homes downstream flood. Roads and bridges in the floodplain flood severely and are dangerous to motorists.
MAJOR FLOOD STAGE	33 and above	Major flooding approaches homes in the floodplain. Primary and secondary roads and bridges are severely flooded and very dangerous. Major flooding extends well into the floodplain, destroying property, equipment and livestock.

Table 7-3. Extent for Cameron County[1]

JURISDICTION[2]	ESTIMATED SEVERITY PER FLOOD EVENT	PEAK FLOOD EVENT[3]
Cameron County	Major Flood Stage, 33 feet and above	Major Action Stage: Rio Grande near San Benito had floodwaters reach 61.05 feet in September 1967, as well as 33.24 feet near Brownsville in September 1942.

The range of flood intensity that the planning area can experience is high, or Zone A. Based on reporting from the USGS, a flood event can place the County at the extent of "Major Flood Stage" as shown in Tables 7-2 and 7-3. Based on historical occurrences, Council of Cities planning area could expect to experience from 6 inches up to 4 feet of water from storm surges, causing flooding effects within a 2 to 3 hour period.

Reading the Tables 7-1 through 7-3 together with Figures 7-1 through 7-11 provides estimated and potential magnitude and severity for the County. For example, the City of Rancho Viejo, as shown in Figure 7-8, has areas designated as Zone A. Reading this figure in conjunction with Table 7-1 means that there is a high risk for flood in these areas.

Historical Occurrences

Historical evidence indicates that areas within the planning area are susceptible to flooding, especially in the form of flash flooding. It is important to note that only flood events that have been reported have been factored into this risk assessment, therefore it is likely that additional flood occurrences have gone unreported before and during the recording period. Table 7-4 identifies historical flood events that resulted in damages, injuries, or fatalities within the Council of Cities planning area. Table 7-5 provides the historical flood event summary by jurisdiction.

Historical Data is provided by the Storm Prediction Center (NOAA) and NCDC databases for Cameron County.

Table 7-4. Historical Flood Events, 1996-2015

JURISDICTION	DATE	TIME	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Los Fresnos	10/11/1997	3:30 PM	$5,930	$0
San Benito	10/11/1997	3:30 PM	$5,930	$2,965

[1] *Severity estimated by averaging floods at certain stage level over the history of flood events.*

[2] *Severity is provided for jurisdictions where peak data was provided.*

[3] *Severity and peak events are based on U.S. Geological Survey data.*

JURISDICTION	DATE	TIME	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Los Fresnos	10/13/1997	10:00 AM	$55,446	$27,723
San Benito	10/13/1997	10:00 AM	$55,446	$27,723
Bayview	9/19/2003	6:00 PM	$1,810,451	$603,484
Los Fresnos	9/19/2003	6:00 PM	$1,810,451	$603,484
Port Isabel	9/19/2003	6:00 PM	$1,810,451	$603,484
Cameron County	9/19/2003	10:20 AM	$32,329	$0
Cameron County	10/7/2003	3:10 PM	$64,659	$0
Cameron County	10/13/2003	6:00 PM	$5,819,307	$0
Cameron County	3/15/2004	5:30 AM	$31,491	$0
San Benito	5/8/2004	2:00 PM	$2,519,269	$2,519,269
Cameron County	5/25/2007	2:00 PM	$22,952	$0
Cameron County	5/25/2007	3:03 PM	$114,760	$0
Port Isabel	7/23/2008	10:45 AM	$47,246	$41,443
Port Isabel	7/24/2008	4:01 PM	$47,246	$47,246
Cameron County	8/23/2008	3:00 PM	$5,526	$0
Cameron County	8/27/2008	2:17 PM	$1,105	$0
Cameron County	4/16/2010	5:00 PM	$2,182	$0
Port Isabel	6/30/2010	12:00 PM	$10,912	$10,912
Rancho Viejo	6/30/2010	3:00 PM	$163,682	$0
Rancho Viejo	7/1/2010	12:00 AM	$546	$0
Cameron County	7/13/2010	3:30 PM	$109,121	$109,121
Cameron County	9/6/2010	11:30 PM	$0	$10,912
Cameron County	9/19/2010	2:00 AM	$5,456,053	$0
Cameron County	6/30/2012	3:45 PM	$77,728	$0
Cameron County	11/6/2013	9:20 PM	$10,214	$0
Los Fresnos	8/31/2015	1:00 PM	$200,000	$200,000
Cameron County	10/30/2015	11:00 AM	$100,000	$0

Table 7-5. Summary of Historical Flood Events, 1996-2015

JURISDICTION	EVENTS	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Bayview	1	0	0	$603,484	$0
Indian Lake	0	0	0	$0	$0
Laguna Vista	3	0	0	$0	$0
Los Fresnos	7	0	0	$834,172	$0
Port Isabel	6	0	0	$708,887	$82,887,257
Primera	0	0	0	$0	$0
Rancho Viejo	3	0	0	$164,227	$0
Rio Hondo	0	0	0	$0	$0
San Benito	8	0	0	$2,549,957	$0
South Padre Island	2	0	0	$0	$0
County	47	0	0	$11,847,427	$120,033
Total Losses	**78**	**0**	**0**	**$99,515,445**	

Significant Events

Flash Flood on May 8, 2004 – San Benito

Slow-moving thunderstorms with torrential rainfall developed over central and eastern Cameron County, exceeding the previous daily rainfall record with 4.56 inches of rain reported at the Brownsville-South Padre Island Airport. Locations along the storm path experienced anywhere from 5 to 9 inches of rainfall over a period of approximately 3-4 hours. Flooding of homes and businesses was reported in Los Fresnos, and in homes between Los Fresnos and San Benito. An estimated 200-250 homes were affected by flooding, and the standing water resulted in many road closures across the county

Flash Flood on July 24, 2008 – Port Isabel, Bayview, Laguna Vista

A little before noon on the 23rd, the southern and western eyewall of Hurricane Dolly began to flare up, with severe and intense torrents of rain. These torrents, falling on top of already heavy rainfall earlier that morning, began to produce high water levels, likely 3 feet or more, starting in Port Isabel, Bayview, and Laguna Vista. Soon after the eyewall intensification, Dolly's center made landfall along the Cameron/Willacy County line, then very slowly edged west through southern Willacy County through the rest of the afternoon and evening, reaching the Hidalgo County line at around 9 PM CDT. Throughout the afternoon, blinding, torrential rains persisted over northern and eastern Cameron County, and flash

flooding of increasingly high water - as high as 5 feet in some places - spread west into Las Yescas, Rio Hondo, Harlingen, Combes, Santa Rosa, San Benito, and La Feria.

Measured and estimated rainfall totals in the flash flood areas from Dolly ranged from 14 to 18 inches, though there was one unconfirmed report of more than 20 inches along the Cameron/Willacy County line north of Rio Hondo. Hundreds of homes sustained some level of inundation, and farmland was inundated across the flood zone as well. High water and general flooding would continue for another day or two, except much longer in backed up drainage areas.

Flash Flood on September 19, 2010 – Cameron County

Upper level energy, low level convergence, and a possible overnight low level jet stream of extremely moisture laden air from the Gulf of Mexico produced prolonged torrential rains across south central Cameron County September 19th. The area shifted to the east and northeast by early morning, but not before dumping 5 to 7 inches of rain from Brownsville to San Benito and creating extensive flooding, impacting 100 or more structures, particularly in poorly draining areas. Dozens of roads were closed temporarily or, in some cases, through the day. Though the rains ended between 8 and 9 AM CST, significant poor drainage flooding continued through 11 AM CST and pockets of flooding remained into the morning of September 20th. Dozens of pumps were borrowed from Hidalgo County to assist with clearing water in poor drainage locations for the next few days. Damage estimates for the event exceeded five million. No fatalities or injuries were reported as a direct consequence of the rains.

Probability of Future Events

Based on recorded historical occurrences and extent within the Council of Cities planning area, flooding is highly likely for the entire planning area on average and an event will occur within the next year. Probability is determined by jurisdiction in Table 7-7, however, since NCDC data is typically reported on a county-wide basis, the entire planning area was assumed to have a probability of future occurrence similar to the county.

Vulnerability and Impact

A property's vulnerability to a flood depends on its location and proximity to the floodplain. Structures that lie along banks of a waterway are the most vulnerable and are often repetitive loss structures. All participating jurisdictions encourage development outside of the floodplain, although there are some critical facilities, homes, and businesses already located in the floodplain. Table 7-6 includes critical facilities in the planning area that are located in the floodplain and are vulnerable to flooding

Table 7-6. Critical Facilities in the Floodplain by Jurisdiction

Jurisdiction	Critical Facilities
Bayview	None

Jurisdiction	Critical Facilities
Indian Lake	None
Laguna Vista	None
Los Fresnos	None
Port Isabel	None
Primera	None
Rancho Viejo	None
Rio Hondo	Abbott Dam
San Benito	Police Station, 1 Power substations
South Padre Island	City Hall, Water Tower, AT&T Hub, Fire Station, 2 Water Towers, 2 Power substation, US Coast Guard Station, Queen Isabella Causeway

Impact of floods experienced in the planning area has resulted in no injuries and no fatalities supporting a limited severity of impact meaning shutdown of facilities for 24 hours or less, and less than 10% of property may be destroyed.

Historic loss estimates due to flood are presented in Table 7-7 below. Considering 78 flood events over a 19-year period, frequency is approximately three to four events every year.

Table 7-7. Potential Annualized Losses by Jurisdiction, 1996-2015

JURISDICTION	FREQUENCY	PROBABILITY OF FUTURE EVENTS	ANNUAL LOSS ESTIMATES (2015 DOLLARS)
Bayview	0.05	Unlikely	$30,174
Indian Lake	0.00	Unlikely	$0
Laguna Vista	0.15	Occasional	$0
Los Fresnos	0.35	Highly Likely	$41,709
Port Isabel	0.30	Likely	$4,179,807
Primera	0.00	Unlikely	$0
Rancho Viejo	0.15	Occasional	$8,211
Rio Hondo	0.00	Unlikely	$0
San Benito	0.40	Highly Likely	$127,498
South Padre Island	0.10	Unlikely	$0

JURISDICTION	FREQUENCY	PROBABILITY OF FUTURE EVENTS	ANNUAL LOSS ESTIMATES (2015 DOLLARS)
County	2.40	Highly Likely	$598,373

The severity of a flooding event varies depending on the relative risk to citizens and structures located within each city. Table 7-8 depicts the level of impact for Cameron County and each participating city.

Table 7-8. Impact by Jurisdiction

JURISDICTION	IMPACT	DESCRIPTION
Bayview	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Indian Lake	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Laguna Vista	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Los Fresnos	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Port Isabel	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Primera	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Rancho Viejo	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
Rio Hondo	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it

JURISDICTION	IMPACT	DESCRIPTION
		is expected that less than 10 percent of property would be destroyed or damaged in the city.
San Benito	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
South Padre Island	Limited	Any injuries or illnesses would be treatable with first aid, with minor quality of life lost. If critical facilities are shut down it would be for 24 hours or less, and it is expected that less than 10 percent of property would be destroyed or damaged in the city.
County	Limited	Cameron County could have injuries that would be treatable with first aid. Critical facilities would be shut down for 24 hours or less, and less than 10 percent of property would be destroyed or damaged.

Assessment of Impacts

Flooding is the deadliest natural disaster that occurs in the U.S. each year, and it poses a constant and significant threat to the health and safety of the people in the planning area. Impacts to the planning area can include:

- Flood-related rescues may be necessary at swift water and low water crossings or in flooded neighborhoods where roads have become impassable, placing first responders in harm's way.
- Evacuations may be required for entire neighborhoods because of rising floodwaters, further taxing limited response capabilities and increasing sheltering needs for displaced residents.
- Health risks and threats to residents are elevated after the flood waters have receded due to contaminated flood waters (untreated sewage and hazardous chemicals) and mold growth typical in flooded buildings and homes.
- Significant flood events often result in widespread power outages increasing the risk to more vulnerable portions of the population who rely on power for health and/or life safety.
- Extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals attempt to cook or heat their home with alternate, unsafe cooking or heating devices, such as grills.
- Floods can destroy or make residential structures uninhabitable, requiring shelter or relocation of residents in the aftermath of the event.
- First responders are exposed to downed power lines, contaminated and potentially unstable debris, hazardous materials, and generally unsafe conditions, elevating the risk of injury to first responders and potentially diminishing emergency response capabilities.
- Emergency operations and services may be significantly impacted due to damaged facilities.
- Significant flooding can result in the inability of emergency response vehicles to access areas of the community.

- Critical staff may suffer personal losses or otherwise impacted by a flood event and unable to report for duty, limiting response capabilities.
- City or county departments may be flooded, delaying response and recovery efforts for the entire community.
- Private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers may not be fully operational and may require assistance from neighboring communities until full services can be restored.
- Damage to infrastructure may slow economic recovery since repairs may be extensive and lengthy.
- Some businesses not directly damaged by the flood may be negatively impacted while utilities are being restored or water recedes, further slowing economic recovery.
- When the community is affected by significant property damage it is anticipated that funding would be required for infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-day operating expenses.
- Displaced residents may not be able to immediately return to work, further slowing economic recovery.
- Residential structures substantially damaged by a flood may not be rebuilt for years and uninsured or underinsured residential structures may never be rebuilt, reducing the tax base for the community.
- Large floods may result in a dramatic population fluctuation, as people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area.
- Large floods may dramatically impact the revenue produced from tourism along the coast, causing further economic loss for the affected communities.
- Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community and a potential increase in the unemployment rate.
- Recreation activities may be unavailable and tourism can be unappealing for years following a large flood event, devastating directly related local businesses and negatively impaction economic recovery.
- Flooding may cause significant disruptions of clean water and sewer services, elevating health risks and delaying recovery efforts.
- The psycho-social effects on flood victims and their families can traumatize them for long periods of time, creating long term increases in medical treatment and services.
- Extensive or repetitive flooding can lead to decreases in property value for the affected community.
- Flood poses a potential catastrophic risk to annual and perennial crop production and overall crop quality leading to higher food costs.
- Flood related declines in production may lead to an increase in unemployment.
- Large floods may result in loss of livestock, potential increased livestock mortality due to stress and water borne disease, and increased cost for feed.

The overall extent of damages caused by floods is dependent on the extent, depth and duration of flooding, and the velocities of flows in the flooded areas. The level of preparedness and pre-event planning done by government, businesses and citizens will contribute to the overall economic and financial conditions in the aftermath of a flood event.

National Flood Insurance Program (NFIP) Participation

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against the flood hazard. All of the jurisdictions located in Council of Cities planning area participate in the NFIP. It is noted that the participating jurisdictions of Bayview and Primera have no Special Flood Hazard Areas (SFHA).

As an additional indicator of floodplain management responsibility, communities may choose to participate in FEMA's Community Rating System (CRS). This is an incentive-based program that allows communities to undertake flood mitigation activities that go beyond NFIP requirements. Currently, none of the communities in the Council of Cities planning area participate in CRS, but this is also a goal and objective of the Plan that was discussed during Planning Team meetings. Participating jurisdictions in the NFIP currently have in place minimum NFIP standards for new construction and substantial Improvements of structures, but are considering adopting higher regulatory NFIP standards. Additional freeboard would minimize flooding caused by flash flooding and many drainage issues as a result of generally flat terrain typical of the area.

The flood hazard areas throughout the planning area are subject to periodic inundation, which may result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, and extraordinary public expenditures for flood protection and relief, of which adversely affect public safety.

These flood losses are created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazard areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, flood-proofed or otherwise protected from flood damage. Mitigation actions are included to address flood maintenance issues as well, including routinely clearing debris from roadside ditches and bridges, and expanding drainage culverts and storm water structures to more adequately convey flood waters.

It is the purpose of NFIP jurisdictions participating in the Hazard Mitigation plan to continue to promote the public health, safety and general welfare by minimizing public and private losses due to flood conditions in specific areas. Each of the NFIP participating jurisdictions in the Plan are guided by their local Flood Damage Prevention Ordinance. These communities will continue to comply with NFIP requirements through their local permitting, inspection, and record-keeping requirements for new and substantially developed construction. Further, the NFIP program for each of the participating jurisdictions promotes sound development in floodplain areas and includes provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
- Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
- Ensure that potential buyers are notified that property is in a flood area.

In order to accomplish these tasks, participating NFIP jurisdictions seek to follow these guidelines to achieve flood mitigation by:

- Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, such as filling or dumping, that may cause excessive increases in flood heights or velocities;
- Require that uses vulnerable to floods, including facilities, which serve such uses, be protected against flood damage at the time of initial construction, as a method of reducing flood losses;
- Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters;
- Control filling, grading, dredging and other development, which may increase flood damage; and
- Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

NFIP Compliance and Maintenance

As mentioned, participating jurisdictions have developed mitigation actions that relate to either NFIP maintenance or compliance. Compliance and maintenance actions can be found in Section 21.

Flooding was identified by the majority of the communities as a moderate risk hazard during hazard ranking activities at the Risk Assessment Workshop. However, many of the mitigation actions were developed with flood mitigation in mind. A majority of these flood actions address compliance with the NFIP and implementing flood awareness programs. Throughout the planning area, communities recognize the need and are working towards adopting higher NFIP regulatory standards to further minimize flood risk in their community. Smaller no-growth communities that typically do not have personnel or funds to implement more stringent NFIP compliance measures are focusing on NFIP public awareness activities. This includes promoting the availability of flood insurance by placing NFIP brochures and flyers in public libraries or public meeting places.

Repetitive Loss

The Severe Repetitive Loss (SRL) Grant Program under FEMA provides federal funding to assist states and communities in implementing mitigation measures to reduce or eliminate the long-term risk of flood

damage to severe repetitive loss residential structures insured under the NFIP. The Texas Water Development Board (TWDB) administers the SRL grant program for the State of Texas.

Severe Repetitive Loss properties are defined as residential properties that are:

- Covered under the NFIP and have at least four flood related damage claim payments (building and contents) over $5,000.00 each, and the cumulative amount of such claims payments exceed $20,000; or
- At least two separate claim payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

In either scenario, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.[4] Table 7-9 shows repetitive loss and severe repetitive loss properties for six participating jurisdictions. The remaining four jurisdictions do not currently have any repetitive loss properties including Bayview, Indian Lake, Laguna Vista, and Primera.

Table 7-9. Repetitive Loss and Severe Repetitive Loss Properties

JURISDICTION	PROPERTY #	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR[5]
Los Fresnos	0196269	Yes	Single Family	2	$54,962.02	-
Port Isabel	0047792	No	Single Family	2	$5,807.18	-
Port Isabel	0039159	Yes	Single Family	2	$26,682.88	-
Port Isabel	0125527	No	Single Family	4	$37,053.11	-
Port Isabel	0047730	No	Single Family	2	$14,090.58	-
Port Isabel	0026797	No	Single Family	2	$12,941.02	-
Rancho Viejo	0094536	No	Single Family	2	$9,540.21	-
Rio Hondo	0016006	No	Single Family	2	$19,612.41	-
Rio Hondo	0013268	No	Single Family	2	$5,295.05	-
San Benito	0177031	No	Single Family	2	$8,755.94	-

[4] *Source: Texas Water Development Board*

[5] *In this column: "V" stands for "Validated"; "VN" stands for "Validated Nonresidential"; "VU" stand for "Validated Uninsured"; "VNU" stands for "Validated Nonresidential Uninsured"; "P" stands for "Pending"; "PU" stands for "Pending Uninsured"; and "PN" stands for "Pending Nonresidential".*

JURISDICTION	PROPERTY #	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR[5]
San Benito	0094898	Yes	Single Family	3	$139,665.29	-
San Benito	0091537	No	Single Family	2	$44,366.31	-
San Benito	0088769	No	Single Family	5	$44,917.38	-
San Benito	0008643	No	Single Family	5	$77,670.60	VU
San Benito	0176331	No	Single Family	2	$21,665.31	-
San Benito	0177230	No	Single Family	2	$9,673.03	-
San Benito	0177311	No	Single Family	2	$70,432.21	-
San Benito	0093888	No	Single Family	4	$26,621.17	-
San Benito	0126809	No	Single Family	2	$9,200.22	-
San Benito	0093937	No	Single Family	3	$19,540.65	-
San Benito	0095528	No	Single Family	3	$38,207.53	-
San Benito	0177212	Yes	Single Family	2	$60,124.79	-
San Benito	0176595	No	Single Family	2	$44,299.74	-
San Benito	0176707	No	Single Family	2	$12,693.57	-
San Benito	0172937	No	Single Family	4	$79,972.54	VU
San Benito	0176407	No	Single Family	2	$19,754.31	-
San Benito	0126239	No	Single Family	3	$35,517.49	-
San Benito	0172275	No	Single Family	3	$85,136.51	VU
San Benito	0176221	Yes	Single Family	2	$72,402.50	-
San Benito	0176220	No	Single Family	2	$90,315.71	-
San Benito	0176758	No	Single Family	2	$33,148.19	-
San Benito	0004331	Yes	Single Family	6	$46,112.98	-
San Benito	0178828	No	Single Family	2	$7,001.21	-
South Padre Island	0181145	No	Single Family	2	$42,855.72	-
South Padre Island	0176406	No	Single Family	2	$5,732.72	-

JURISDICTION	PROPERTY #	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR[5]
South Padre Island	0076754	No	Single Family	2	$5,561.94	-
South Padre Island	0025530	No	Single Family	5	$26,686.51	-
South Padre Island	0173752	SDF	Single Family	4	$83,588.50	V
South Padre Island	0044891	No	2-4 Family	2	$10,358.67	-
South Padre Island	0068201	Yes	Other Residence	3	$33,072.96	-
South Padre Island	0026188	No	Single Family	2	$61,928.84	-
South Padre Island	0089803	Yes	2-4 Family	3	$26,552.73	-
South Padre Island	0018578	No	2-4 Family	2	$15,772.32	-
South Padre Island	0068214	No	Single Family	2	$13,730.44	-
South Padre Island	0102477	No	Other Nonresidence	11	$253,233.51	VNU
South Padre Island	0046018	No	Other Nonresidence	3	$47,876.28	-
South Padre Island	0049851	No	Other Nonresidence	6	$51,592.76	VNU
South Padre Island	0050940	Yes	Other Nonresidence	2	$5,899.54	-
South Padre Island	0068204	No	ASSMD Condo	2	$7,170.89	-
South Padre Island	0002855	No	Single Family	3	$31,146.24	-
South Padre Island	0048386	No	ASSMD Condo	2	$326,923.06	-
South Padre Island	0026330	No	Single Family	2	$5,566.23	-
South Padre Island	0016054	Yes	Single Family	2	$6,466.76	-
South Padre Island	0235765	Yes	Other Nonresidence	2	$127,563.97	-

Section 8: Extreme Heat

Hazard Description

Extreme heat is a prolonged period of excessively high temperatures and exceptionally humid conditions. Extreme heat during the summer months is a common occurrence throughout the State of Texas, and Cameron County is no exception. The Council of Cities planning area typically experience extended heat waves. A heat wave is an extended period of extreme heat, and is often accompanied by high humidity.

Although heat can damage buildings and facilities, it presents a more significant threat to the safety and welfare of citizens. The major human risks associated with severe summer heat include: heat cramps; sunburn; dehydration; fatigue; heat exhaustion; and even heat stroke. The most vulnerable population to heat casualties are children and the elderly or infirmed, who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being.

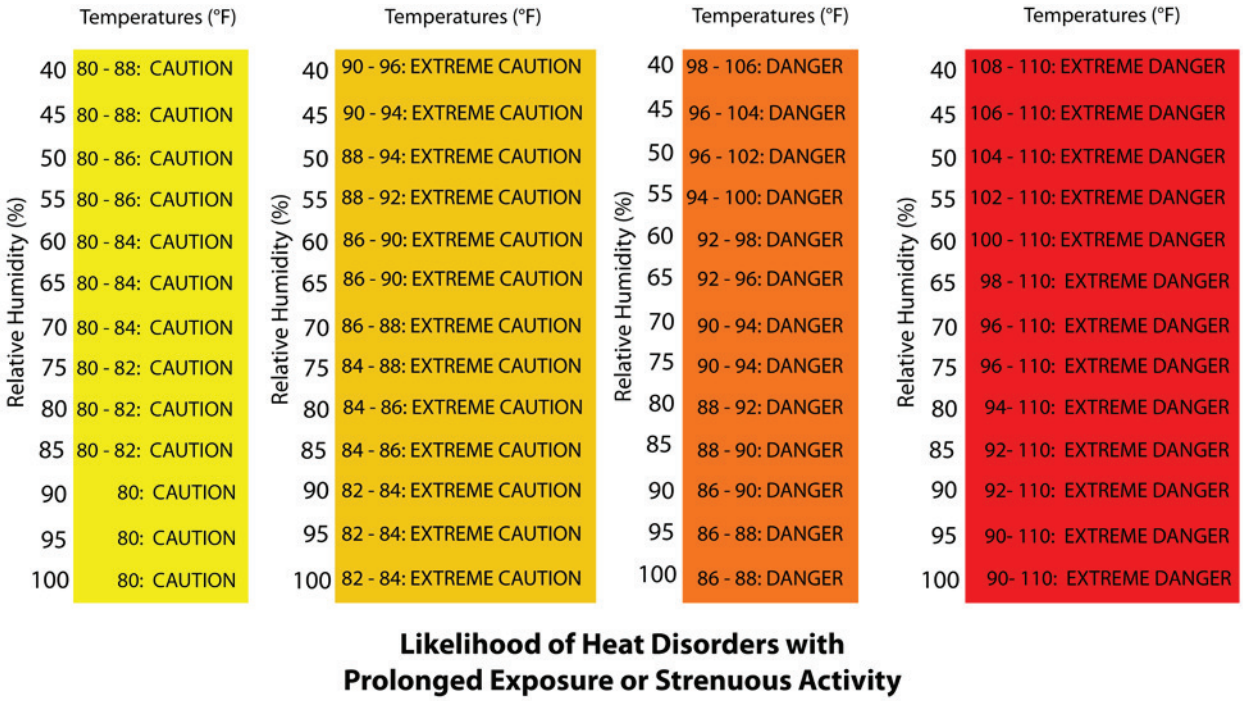
Location

Though injuries or deaths from extreme heat have been recorded at different locations throughout the planning area, there is no specific geographic scope to the extreme heat hazard. Extreme heat could occur anywhere within the Council of Cities planning area.

Extent

The magnitude or intensity of an extreme heat event is measured according to temperature in relation to the percentage of humidity. According to the National Oceanic Atmospheric Administration (NOAA), this relationship is referred to as the "Heat Index," and is depicted in Figure 8-1. This index measures how hot it feels outside when humidity is combined with high temperatures.

Figure 8-1. Extent Scale for Extreme Summer Heat[1]



The Extent Scale in Figure 8-2 displays varying categories of caution depending on the relative humidity combined with the temperature. For example, when the temperature is at 90 degrees Fahrenheit (°F) or lower, caution should be exercised if the humidity level is at or above 40 percent.

The shaded zones on the chart indicate varying symptoms or disorders that could occur depending on the magnitude or intensity of the event. "Caution" is the first category of intensity and it indicates when fatigue due to heat exposure is possible. "Extreme Caution" indicates that sunstroke, muscle cramps or heat exhaustion are possible, and a "Danger" level means that these symptoms are likely. "Extreme Danger" indicates that heat stroke is likely. The National Weather Service (NWS) initiates alerts based on the Heat Index as shown in Table 8-1.

[1] *Source: NOAA*

Table 8-1. Heat Index & Warnings

CATEGORY	HEAT INDEX	POSSIBLE HEAT DISORDERS	WARNING TYPE
Extreme Danger	125°F and higher	Heat stroke or sun stroke likely.	A heat advisory will be issued to warn that the Heat Index may exceed 105°F.
Danger	103 – 124°F	Sunstroke, muscle cramps, and/or heat exhaustion are likely. Heatstroke possible with prolonged exposure and/or physical activity.	
Extreme Caution	90 – 103°F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.	An Excessive Heat Warning is issued if the Heat Index rises above 105°F at least 3 hours during the day or above 80°F at night.
Caution	80 – 90°F	Fatigue is possible with prolonged exposure and/or physical activity.	

Most of the County is a flat plain, gently sloping to the northeast. The area is known as the Rio Grande Plains in South Texas. The vegetation along the eastern coast is typical Gulf Prairie and Marsh areas, the majority being marsh grasses, bluestems, and grama grasses. The rest of the County has small trees, brush, and weeds. There are a few naturally occurring trees, the majority of which are mesquite and oaks. Due to its geography, and its subtropical and subhumid climate, the Council of Cities planning area can expect an extreme heat event each summer. Citizens, especially children and the elderly should exercise caution by staying out of the heat for prolonged periods when a heat advisory or excessive heat warning is issued. Also at risk are those working or remaining outdoors.

Figure 8-2 displays the daily maximum heat index as derived from NOAA based on data compiled from 1838 to 2015. The black circle shows the Council of Cities planning area. The colors brown and purple indicates a daily maximum heat index of over 100 degrees F. All participating jurisdictions could experience extreme heat from 100°F to more than 105°F and should mitigate to the extent of “extreme danger”, which can include sunstroke, muscle cramps, and heat exhaustion.