



SECTION 4. RISK ASSESSMENT

4.3 Hazard Profiles

4.3.3 Extreme Temperatures

The following section provides the hazard profile and vulnerability assessment for extreme temperatures in Fort Bend County.

Hazard Profile

Hazard Description

Extreme temperatures include both heat and cold events, which can have a significant impact on human health, commercial/agricultural businesses, and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes *extreme cold* or *extreme heat* can vary across different areas of the country, based upon what the population is accustomed to.

Extreme Heat

Extreme heat events are defined by the U.S. Environmental Protection Agency (EPA) as “weather that is much hotter than average for a particular time and place- and sometimes more humid too” (EPA 2016). Criteria defining an extreme heat event may differ among jurisdictions and within the same jurisdiction, depending on the time of year. In Texas, extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature during the summer months (Texas Extension Disaster Education Network 2023).

Extreme heat events are often a result of more than just ambient air temperature. Heat index tables (see **Error! Reference source not found.**) are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Because heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15 degrees Fahrenheit (°F). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous (State of Texas 2018).

Texas is often affected by extreme heat in the summer months based on its geographical location. Extreme heat happens when the upper atmosphere contains high pressure that stays stationary over a region, which can trap more heat and reduce convection currents. As a result, heat and high humidity accumulate with little to no precipitation, which creates abnormally high temperatures for an area (World Atlas 2018).

Extreme Cold

The thresholds for extreme cold differ greatly by geographic location and temperatures that the area is typically used to experiencing. Extreme cold temperatures are typically associated with winter storms and often occur in the winter months. These temperatures can last for a few hours or multiple days (NCHH 2022). Texas tends to experience fewer extreme cold events because of its southern location; however, extreme cold is considered any temperature below freezing (below 32°F) (University of North Texas 2023).



Location

Extreme Heat

All of the state is vulnerable to extreme heat. In addition, large metropolitan areas, such as Dallas/Fort Worth and Houston, may experience extreme heat since they have an abundance of concrete that absorbs and then radiates solar energy. This effect is known as an urban heat island and can be dangerous to those without air conditioners (State of Texas 2018). All of Fort Bend County is at risk for extreme heat events; however, these events may be exacerbated in urban areas, where reduced airflow, reduced vegetation, and increased generation of waste heat can contribute to temperatures that are several degrees higher than in surrounding rural or less urbanized areas. The record highs for Texas typically occur from May through October. Fort Bend County experiences average summers in the mid 90s°F.

Extreme Cold

Extreme cold can happen anywhere in the state, although its levels can range extensively. In the panhandle, extreme cold means days below 0°F, while in the Rio Grande Valley, it means reaching temperatures below freezing (State of Texas 2018).

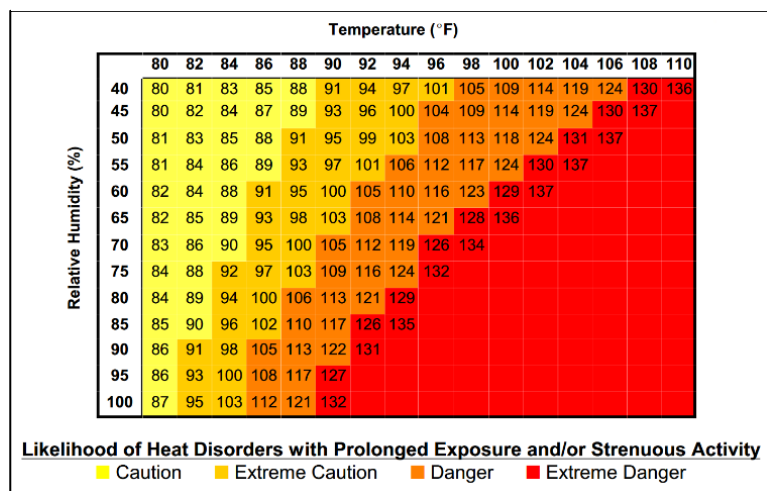
Fort Bend County is susceptible to extremely cold temperatures, especially severe winter storms. As a result of the changing climate, Fort Bend is more susceptible to extreme cold and has experienced a record wind chill in 2021. The record lows for Texas typically occur during October through March. The average first freeze in the 2023 Hazard Mitigation Plan (HMP) update area usually occurs from late November to early December, and the last freeze usually occurs from late February to early March, according to data recorded by the National Weather Service.

Extent

Extreme Heat

The extent of extreme heat temperatures generally is measured through the Heat Index. Heat index tables (see Figure 4.3.3-1) are commonly used to provide information about how hot it feels, which is based on the interactions between several meteorological conditions. Since heat index values were devised for shady, light wind conditions, exposure to full sunshine can increase heat index values by up to 15 degrees Fahrenheit (°F). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous. Extreme heat is defined as a combination of very high temperatures and, usually, exceptionally humid conditions. When persisting over a period of time, it is called a heat wave (State of Texas 2018).

Figure 4.3.3-1. Heat Index Table



Sources: NOAA 2022

Each NWS office issues some or all of the following heat-related products as conditions warrant (Table 4.3.3-1).



Table 4.3.3-1. NWS Alerts for Extreme Heat

Alert	Criteria
Excessive Heat Warning—Take Action!	An Excessive Heat Warning is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Warning is when the maximum heat index temperature is expected to be 105° or higher for at least 2 days and nighttime air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas not used to extreme heat conditions. If you don't take precautions immediately when conditions are extreme, you may become seriously ill or even die.
Excessive Heat Watches—Be Prepared!	Heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
Heat Advisory—Take Action!	A Heat Advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Advisory is when the maximum heat index temperature is expected to be 100° or higher for at least 2 days, and nighttime air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas that are not used to dangerous heat conditions. Take precautions to avoid heat illness. If you don't take precautions, you may become seriously ill or even die.
Excessive Heat Outlooks—Be Aware!	The outlooks are issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead-time to prepare for the event.

Source: NWS n.d.

Worst-Case Scenario

An extreme multi-year drought with extreme heat conditions could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout the Planning Area, increasing the need for water. Surrounding communities, also in drought and extreme heat conditions, could increase their demand for water supplies relied upon by the Planning Partnership, causing social and political conflicts. A worst-case scenario in Fort Bend County would be drought conditions combined with temperatures exceeding 100°F over multiple days. Based on history of occurrence, the County can experience approximately four days above 100°F each year. If such conditions persisted for several years, the economy of Fort Bend County could experience setbacks, especially in water-dependent industries. The following are extreme heat-related issues:

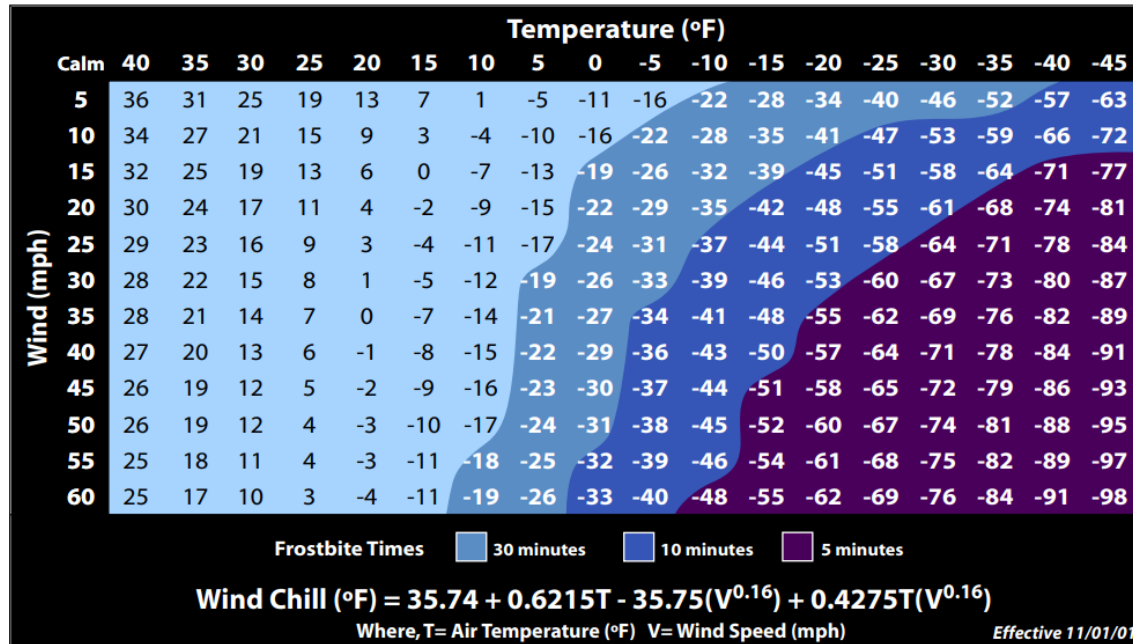
- Identification and development of alternative water supplies.
- Utilization of groundwater recharge techniques to stabilize the groundwater supply.
- The probability of increased drought frequencies and durations due to climate change.
- The promotion of active water conservation even during non-drought periods.
- Increasing vulnerability to drought over time as demand for water from different sectors increases.
- The effects of climate change may result in an increase in frequency of extreme heat events.
- The effects of recent droughts have exposed the vulnerability of the planning areas economy to drought events.
- Environmental and erosion control impact analysis for transportation projects.
- Wildlife habitat management for landowners.
- Human health impacts from droughts and extreme heat.
- Monitoring and evaluating risks to power supply and water rights.
- Development of mitigation- or response-based state drought plans.



Extreme Cold

In 2001, the NWS implemented an updated wind chill temperature index (Figure 4.3.3-2). This index describes the relative discomfort or danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature (NOAA 2022).

Figure 4.3.3-2. NOAA Wind Chill Chart



Sources: NOAA 2022

The NWS provides alerts when Wind Chill indices approach hazardous levels. Table 4.3.3-2 explains these alerts.

Table 4.3.3-2. National Weather Service Alerts for Extreme Cold

Alert	Criteria
Wind Chill Warning – Take Action!	NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring. If you are in an area with a wind chill warning, avoid going outside during the coldest parts of the day. If you do go outside, dress in layers, cover exposed skin, and make sure at least one other person knows your whereabouts. Update them when you arrive safely at your destination.
Wind Chill Watch – Be Prepared	NWS issues a wind chill watch when dangerously cold wind chill values are possible. As with a warning, adjust your plans to avoid being outside during the coldest parts of the day. Make sure your car has at least a half a tank of gas and update your winter survival kit.
Wind Chill Advisory – Be Aware	NWS issues a wind chill advisory when seasonably cold wind chill values, but not extremely cold values are expected or occurring. Be sure you and your loved one’s dress appropriately and cover exposed skin when venturing outdoors.

Source: NWS n.d.

Worst-Case Scenario

Primarily, the extreme cold faced in Fort Bend County is coupled with severe winter weather. A worst-case event would involve prolonged high winds during a winter storm. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high



winds and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Extended power outages during cold temperatures can lead to freezing pipes, disruption to heating systems, and health impacts. A worst-case scenario in Fort Bend County would be consecutive days of 32°F and colder. Based on history of occurrence, the County experienced 789 days with the minimum temperature of 32°F and lower. The County can experience approximately nine days below 32°F each year. Important issues associated with a winter storm in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to winter weather, particularly freezing temperatures, high winds, and ice.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- Future efforts should be made to identify populations at risk and determine special needs during a winter storm event.

Previous Occurrences and Losses

FEMA Disaster Declarations

Between 1954 and 2022, Fort Bend County was included in two disaster (DR) or emergency (EM) declarations for extreme temperature-related events; the two declarations, FEMA DR-4586 and FEMA-3554-EM, were for the same event, Winter Storm Uri, which impacted the County between February 11–21, 2021 (FEMA 2022). Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

USDA Disaster Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2022, Fort Bend County was not included in extreme temperature-related agricultural disaster declarations (USDA FSA 2022).

Previous Events

For this 2023 HMP update, known extreme cold events that impacted the project area between 2017 and 2022 are discussed below. The National Climatic Data Center lists one extreme cold event that impacted Fort Bend County, which was a severe winter storm in February of 2021. Despite severe winter storms being a separate hazard listed for this HMP update, this event was included as an extreme cold temperature event since Winter Storm Uri caused extreme cold temperatures (FEMA 2022) (Donald 2021).

Table 4.3.3-3. Extreme Temperature Events in the Planning Area (2017–2022)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Description
February 15–16, 2021	Cold/Wind Chill	FEMA DR-4586, FEMA-3554-EM	Very cold air and gusty winds overspread SE Texas behind an Arctic front with wind chill indices from near zero to single digits for much of the period from Sunday night to Tuesday morning. Increased power demand, wind, and ice led to widespread power outages. Bursting pipes caused many to be without water as well. The event resulted in three fatalities and \$1.6 million in property damage in Fort Bend County.

Sources: NOAA NCEI 2022; FEMA 2022





Probability of Future Occurrences

For the 2023 HMP update, the most up-to-date data was collected to calculate the probability of future occurrence of extreme temperature events for the project area. Information from the NOAA-NCEI storm events database, the 2018 State of Texas HMP, and the 2018 Fort Bend County HMP were used to identify the number of extreme temperature events that occurred between 1942 and 2023. Table 4.3.3-4 presents the probability of future events for extreme temperatures in Fort Bend County.

Table 4.3.3-4. Probability of Future Extreme Temperature Events, Fort Bend County

Hazard Type	Number of Occurrences Between 1942 and 2023	% Chance of Occurring in Any Given Year
Extreme Heat ($\geq 100^{\circ}\text{F}$)	329	100%
Extreme Cold ($\leq 32^{\circ}\text{F}$)	796	100%
Total	1,125	100%

Sources: NOAA NCEI 2022; State of Texas 2018; Fort Bend County 2018; Midwestern Regional Climate Center 2023

In Section 4.4, the identified hazards of concern for Fort Bend County were ranked (Table 4.4-2). The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for extreme temperatures in the County is considered “frequent”.

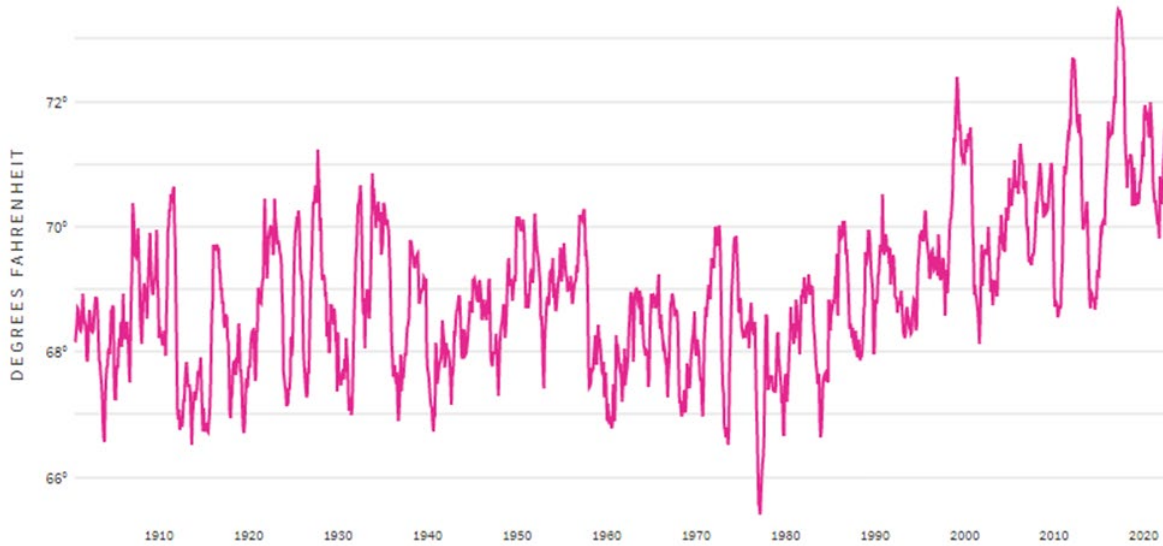
Climate Change Impacts

The Intergovernmental Panel on Climate Change indicates that the global average temperature has increased by at least 0.72°F since the 1970s and continues to increase, making extreme temperatures a more common problem (National Geographic n.d.). The effects of climate change are most commonly seen in increased extreme heat events, more severe weather events, and precipitation patterns.

Temperature trends in the project area, like the rest of the globe, are increasing and will continue to do so at alarming rates. The 12-month average temperature increased by 3.4°F from September 1900 to August 2022. From September 1900 to August 2022, the 12-month average temperature was 68.9°F (NCEI 2022).



Figure 4.3.3-3. NCEI 12-Month Temperature Average



Source: NOAA

Vulnerability Assessment

Impact on Life, Health, and Safety

The most common problems associated with extreme temperature events are negative health effects on the population and loss of utilities. Power outages can be life-threatening to those dependent on electricity for life support.

The impact of extreme temperatures on life, health, and safety is dependent upon several factors, including the severity of the event and the population's access to food, water, and shelter. Heat exhaustion and frostbite are common health-related risks in terms of extreme temperatures. In addition, residents can also be displaced or require temporary to long-term sheltering depending on the viability of utilities.

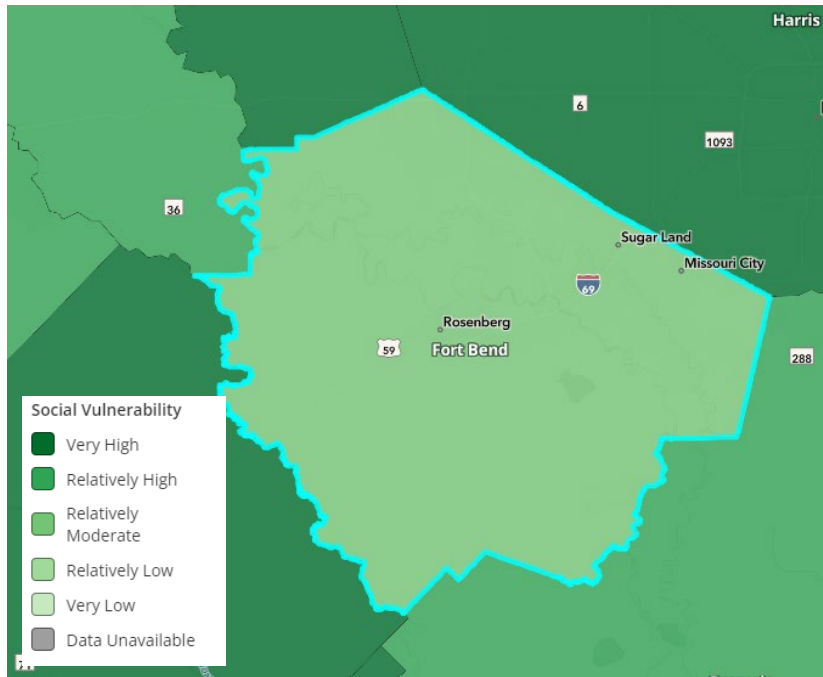
Socially Vulnerable Populations

Social vulnerability is defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards.

Although the entire population of Fort Bend is exposed to strong extreme temperature events, some populations are more vulnerable. Vulnerable populations include the elderly, low-income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. In general, populations who lack adequate shelter during an extreme temperature event, those who are reliant on sustained sources of power to survive, and those who live in isolated areas with limited ingress and egress options are the most vulnerable. People with no air conditioning in their homes are especially vulnerable to extreme heat events. Refer to Figure 4.3.3-4 for the social vulnerability index for natural hazards.



Figure 4.3.3-4. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA NRI

Impact on General Building Stock

All of the building stock in the County is exposed to the extreme temperature hazard; however, direct impacts are expected to be minimal. Extreme temperature swings can crack and break building materials, so building construction plays a major role in the extent of damage resulting from extreme temperatures. Due to differences in construction, residential structures are generally more susceptible to extreme temperatures than commercial and industrial structures, especially homes and buildings that may lack air conditioning. Wood and masonry buildings, in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings.

Impact on Critical Facilities

Overall, all critical facilities in Fort Bend County are vulnerable to being affected by extreme temperatures. Utility infrastructure could suffer damage from high heat or cold temperatures, resulting in the loss of power or another utility service. Loss of service can impact residents, critical facilities, and business operations alike. Loss of power can impact other public utilities, including potable water, wastewater treatment, and communications. In addition to public water services, property owners with private wells might not have access to potable water until power is restored. Lack of power to emergency facilities, including police, fire, EMS, and hospitals, will inhibit a community's ability to effectively respond to an event and maintain the safety of its citizens.

Impact on Economy

Extreme temperature events also have impacts on the economy, including loss of business function and damage and loss of inventory. Business owners may be faced with increased financial burdens due to unexpected repairs caused to the building (pipes bursting), higher than normal utility bills, or business



interruption caused by power failure (loss of electricity and telecommunications). Extreme heat events can lead to drought events, which can make potential fires worse. In turn, this would also affect crop production.

Impact on Environment

Extreme temperature events can have a major impact on the environment. For example, freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS 2020). Extreme heat events can have particularly negative impacts on aquatic systems, contributing to fish kills, aquatic plant die-offs, and increased likelihood of harmful algal blooms. Extreme cold events may launch animals into early hibernation or disrupt their natural cycle of life. Intense cold events can also freeze and kill plants and crops.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability in the Planning Area can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures. The Planning Area considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Projected Development

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. Areas targeted for potential future growth and development could be potentially impacted by extreme temperatures since the entire County is exposed. However, due to increased standards and codes, new development can be less vulnerable to extreme temperatures in comparison with the aging building stock currently in Fort Bend.

Projected Changes in Population

Fort Bend County experienced an increase in population between the 2010 Census (585,375) and the 2020 Census (822,779). The population of the County is expected to increase over the next few years. The increase in population will expose more people to tornadoes (US Census Bureau 2022).

Climate Change

The Intergovernmental Panel on Climate Change indicates that the global average temperature has increased by at least 0.72°F since the 1970s and continues to increase making extreme temperatures a more common problem (National Geographic n.d.). The effects of climate change are most commonly seen in increased extreme heat events, more severe weather events, and precipitation patterns.

Change in Vulnerability Since 2018 HMP

Due to population growth in Fort Bend County, the number of people who could be impacted by extreme temperature events is increasing. Climate change is creating warmer climates, making extreme heat more probable than in the previous plan. As existing development and infrastructure continue to age, they can be at



increased risk of failed utility and transportation systems if they are not properly maintained and do not adapt to the changing environment.