5.4.5 Extreme Temperature

This section provides a hazard profile (description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment of the extreme temperature hazard for the Erie County Hazard Mitigation Plan (HMP).

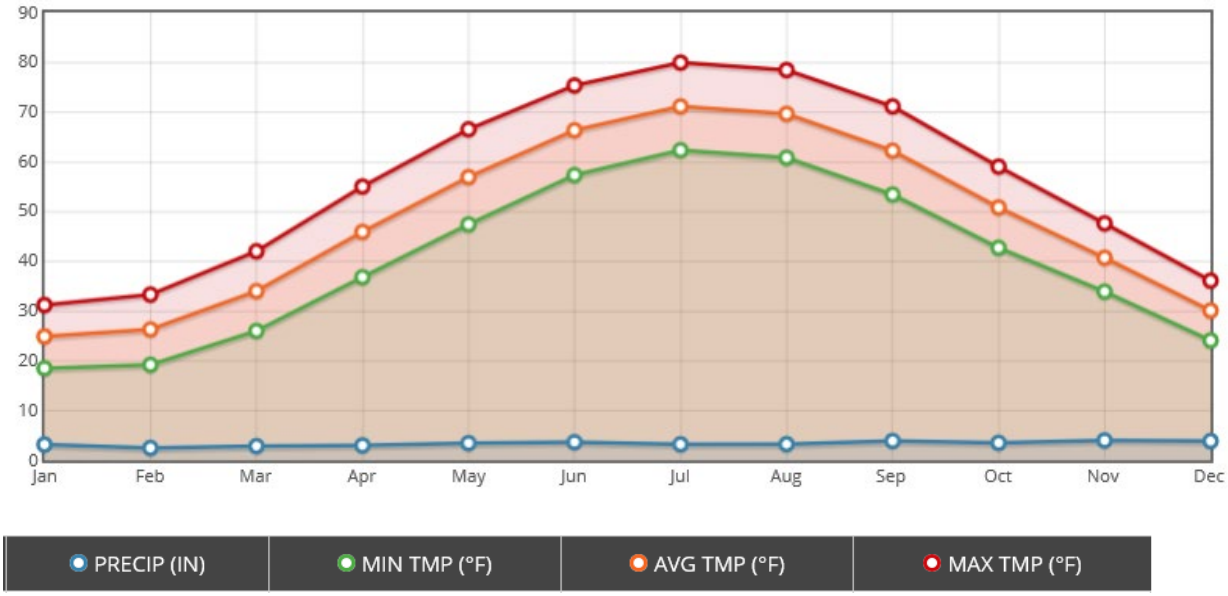
5.4.5.1 Hazard Profile

This section presents information regarding the extreme temperature hazard (heat and cold) description, extent, location, previous occurrences and losses, and probability of future occurrences.

Hazard Description

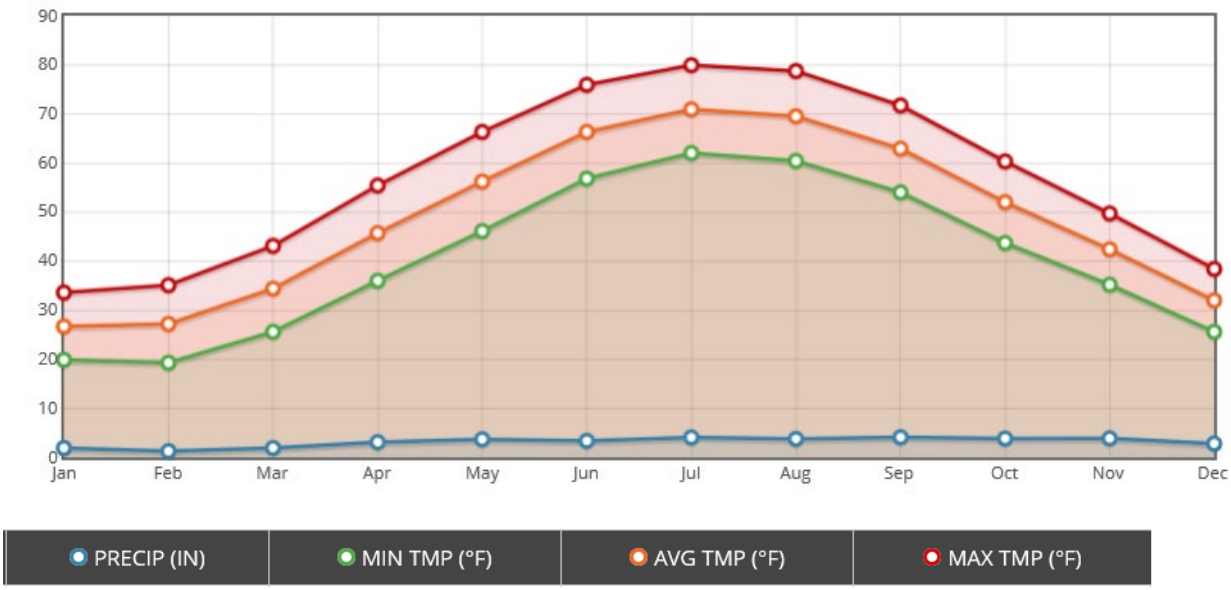
Extreme temperature includes both heat and cold events, which can have a significant impact to human health, commercial/agricultural businesses, and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes "extreme cold" or "extreme heat" can vary across different areas of the country, based on what the population is accustomed to. Figure 5.4.5-1 and Figure 5.4.5-2 show the average low and high temperatures each month at the Buffalo Niagara International station and Dunkirk Chautauqua County Airport station located in Erie County.

Figure 5.4.5-1. Average Temperatures at Buffalo Niagara International



Source: NOAA NCEI 2020

Figure 5.4.5-2. Average Temperatures at Dunkirk Chautauqua County Airport



Source: NOAA NCEI 2020

Extreme Cold

Extreme cold events are when temperatures drop well below normal in an area. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold temperatures are characterized by the ambient air temperature dropping to approximately 0 degrees Fahrenheit (ºF) or below (National Weather Service [NWS] 2015). Extensive exposure to extreme cold temperatures can cause frostbite or hypothermia and can become life-threatening. Infants and the elderly are most susceptible to the effects of extreme changes in temperatures. Extreme cold also can cause emergencies in susceptible populations, such as those without shelter, those who are stranded, or those who live in a home that is poorly insulated (such as a mobile home) or without heat. Infants and the elderly are particularly at risk, but anyone can be affected (Centers of Disease Control and Prevention [CDC] 2007). In New York State, extreme cold days are defined to reflect the state's regional climate variations. Extreme cold days in the state are defined as individual days with minimum temperatures at or below 32° F or 0° C (NYSERDA 2014).

Several health hazards are related to extreme cold temperatures and include wind chill, frostbite, and hypothermia.

- *Wind chill* is not the actual temperature but rather how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature.
- *Frostbite* is damage to body tissue caused by extreme cold. A wind chill of -20°F will cause frostbite in just 30 minutes. Frostbite can cause a loss of feeling and a white or pale appearance in extremities.
- *Hypothermia* is a condition brought on when the body temperature drops to less than 95°F and it can be deadly. Warning signs of hypothermia include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness and apparent exhaustion.

Extreme Heat

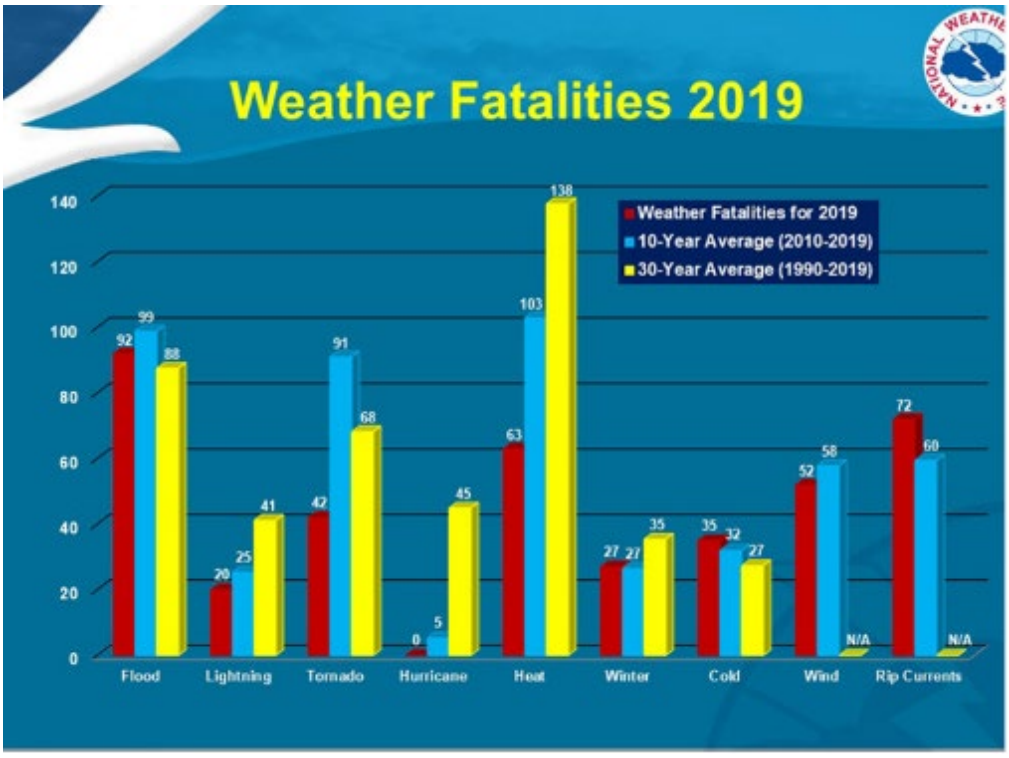
Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for a region and that last for several weeks (CDC 2016). Humid or muggy conditions occur when a 'dome' of high

atmospheric pressure traps hazy, damp air near the ground. An extended period of extreme heat of three or more consecutive days is typically called a heat wave and is often accompanied by high humidity (NWS 2013). In New York State, high temperatures and heat waves are defined in several ways to reflect the diversity of conditions experienced across the state. Extreme hot days in New York State are defined as individual days with maximum temperatures at or above 90° F. Heat waves are defined as three consecutive days with maximum temperatures above 90° F (NYSERDA 2014).

Depending on severity, duration, and location; extreme heat events can create or provoke secondary hazards including, but not limited to, dust storms, droughts, wildfires, water shortages and power outages (CDC 2016). This could result in a broad and far-reaching set of impacts throughout a local area or entire region. Impacts could include significant loss of life and illness; economic costs in transportation, agriculture, production, energy, and infrastructure; and losses of ecosystems, wildlife habitats, and water resources (Adams n.d.; Meehl and Tebaldi 2004; CDC 2016; NYS DHSES 2014).

Extreme heat is one of the leading weather-related causes of death in the United States. On a 10-year average, 103 people die each year from excessive heat. Figure 5.4.5-3 shows the number of weather fatalities based on a 10-year average and 30-year average. Heat had the highest average of weather-related fatalities between 1990 and 2019.

Figure 5.4.5-3. Average Number of Weather Related Fatalities in the United States



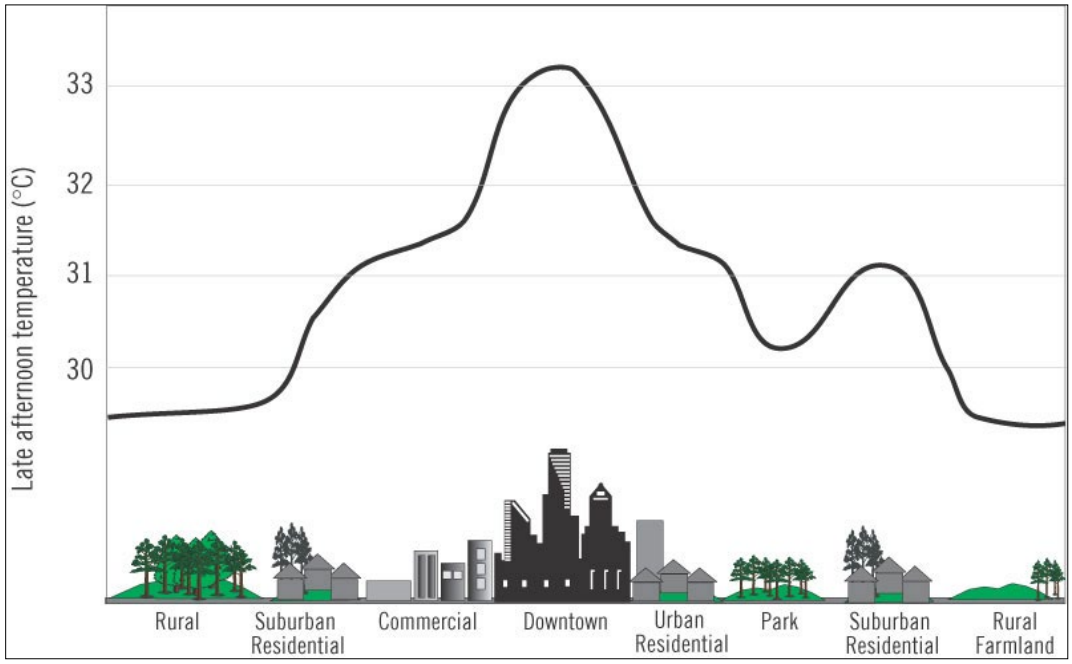
Source: NWS 2019

Urbanized areas and urbanization create an exacerbated type of risk during an extreme heat event, compared to rural and suburban areas. As these urban areas develop and change, so does the landscape. Buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas. This forms an 'island' of higher temperatures (U.S. Environmental Protection Agency [EPA] 2019).

The term 'heat island' describes built-up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with more than 1 million people can be between 1.8 ºF and 5.4ºF warmer than its surrounding areas. In the evening, the difference in air temperatures can be as high as 22ºF. Heat islands occur on the surface and in the atmosphere. On a hot, sunny day, the sun can heat dry, exposed urban surfaces to temperatures 50ºF to 90ºF hotter than the air. Heat islands can affect communities by increasing peak energy demand during the summer; thereby escalating air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and death, and water quality degradation (U.S. EPA 2019).

Figure 5.4.5-4 below illustrates an urban heat island profile. The graphic demonstrates that heat islands are typically most intense over dense urban areas. Further, vegetation and parks within a downtown area may help reduce heat islands (U.S. EPA 2019).

Figure 5.4.5-4. Urban Heat Island Profile



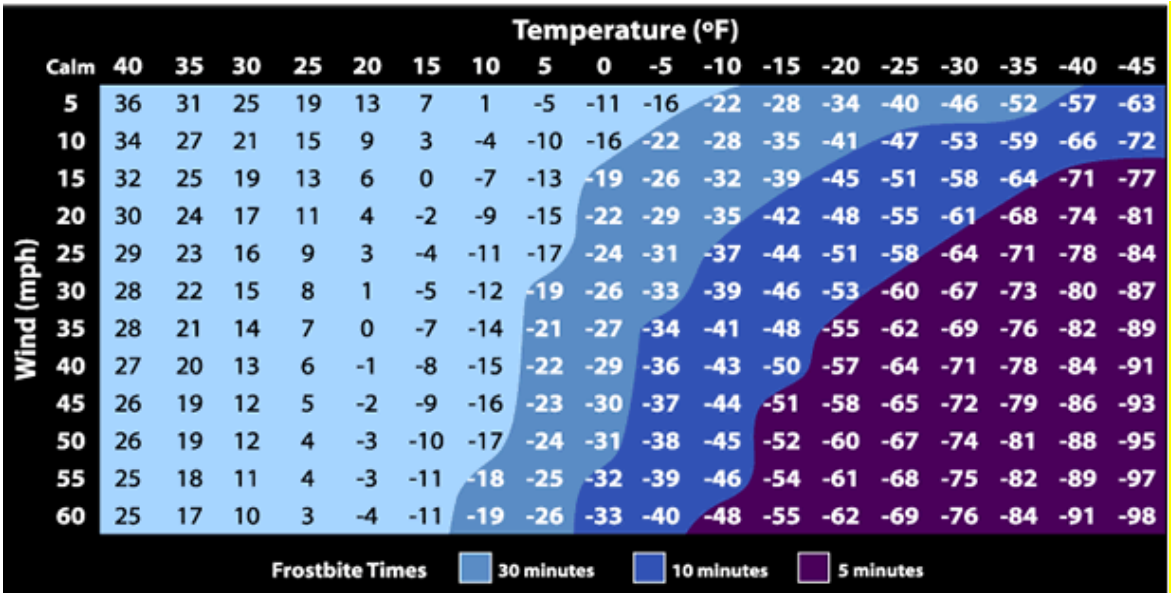
Source: EPA 2019
ºC degrees Celsius

Extent

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature (WCT) Index. The Index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from wind chill. For details regarding the WCT, refer to: https://www.weather.gov/safety/cold-wind-chill-chart. The WCT is presented in Figure 5.4.5-5.

Figure 5.4.5-5. NWS Wind Chill Index



Source: NWS 2016b

The National Weather Service (NWS) issues the nation's Wind Chill Warning, Watch, and Advisory:

- Wind Chill Warning: NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring.
- Wind Chill Watch: NWS issues a wind chill watch when dangerously cold wind chill values are possible.
- Wind Chill Advisory: NWS issues a wind chill advisory when seasonably cold wind chill values, but not extremely cold values, are expected or occurring (NYS DHSES 2019)

Cold weather can also impact the County's crops. In late spring or early fall, cold air outbreaks can damage or kill produce for farmers, as well as residential plants and flowers. A freeze occurs when the temperature drops below 32°F. Freezes and their effects are significant during the growing season. Frost develops on clear, calm nights and can occur when the air temperature is in the mid-30s. Each plant species has a different tolerance to cold temperatures (NYS DHSES 2019).

The NWS issues the nation's Freeze Watch, Warning, and Frost Advisory:

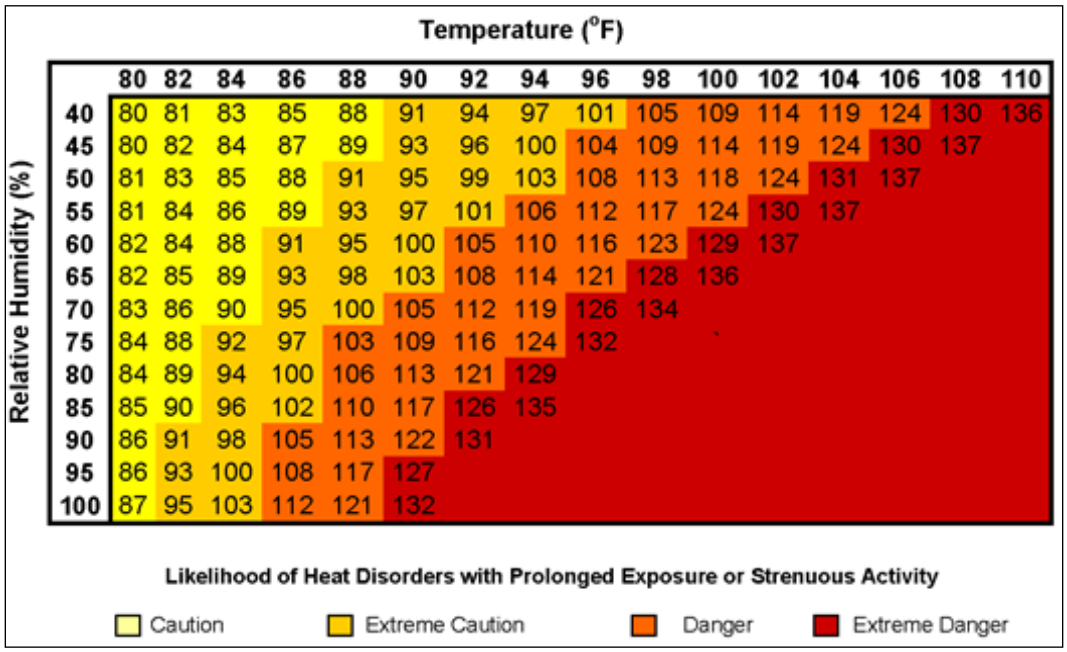
- Hard Freeze Warning: NWS issues a hard freeze warning when temperatures are expected to drop below 28°F for an extended period of time, killing most types of commercial crops and residential plants.
- Freeze Warning: When temperatures are forecasted to go below 32°F for a long period of time, NWS issues a freeze warning. This temperature threshold kills some types of commercial crops and residential plants.
- Freeze Watch: NWS issues a freeze watch when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours. A freeze watch is issued in the autumn until the end of the growing season and in the spring at the start of the growing season.
- Frost Advisory: A frost advisory means areas of frost are expected or occurring, posing a threat to sensitive vegetation (NYS DHSES 2019).

Extreme Heat

The extent of extreme heat temperatures is generally measured through the Heat Index, identified in Table 5.4.5-1. Created by the NWS, the Heat Index is a chart that accurately measures apparent temperature of the air

as it increases with the relative humidity. To determine the Heat Index, the temperature and relative humidity are needed. Once both values have been identified, the Heat Index is the corresponding number of both values (as seen in Table 5.4.5-1). This provides a measure of how temperatures actually feel; however, the values are devised for shady, light wind conditions. Exposure to full sun can increase the Index by up to 15 degrees (NYS DHSES 2014).

Table 5.4.5-1. Heat Index Chart



Source: NWS 2016c

Table 5.4.5-2 describes the adverse effects that prolonged exposure to heat and humidity can have on an individual.

Table 5.4.5-2. Adverse Effects of Prolonged Exposures to Heat on Individuals

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke / Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Source: NYS DHSES 2014

The National Weather Service (NWS) provides alerts when Heat Indices approach hazardous levels. Table 5.4.5-3 explains these alerts. In the event of an extreme heat advisory, the NWS:

- Includes Heat Index values and city forecasts
- Issues special weather statements including who is most at risk, safety rules for reducing risk, and the extent of the hazard and Heat Index values
- Provides assistance to state/local health officials in preparing Civil Emergency Messages during severe heat waves (NYS DHSES 2019).

Table 5.4.5-3. National Weather Service Alerts

Alert	Criteria
Heat Advisory	Issued 12-24 hours before the onset of the following conditions: heat index of at least 100°F but less than 105°F for at least 2 hours per day
Excessive Heat Watch	Issued by the NWS when heat indices of 105°F or greater are forecast in the next 24 to 72 hours
Excessive Heat Warning	Issued within 12 hours of the onset of the following criteria: heat index of at least 105°F for more than 3 hours per day for two consecutive days, or heat index more than 115°F for any period of time

Source: NYS DHSES 2014

Location

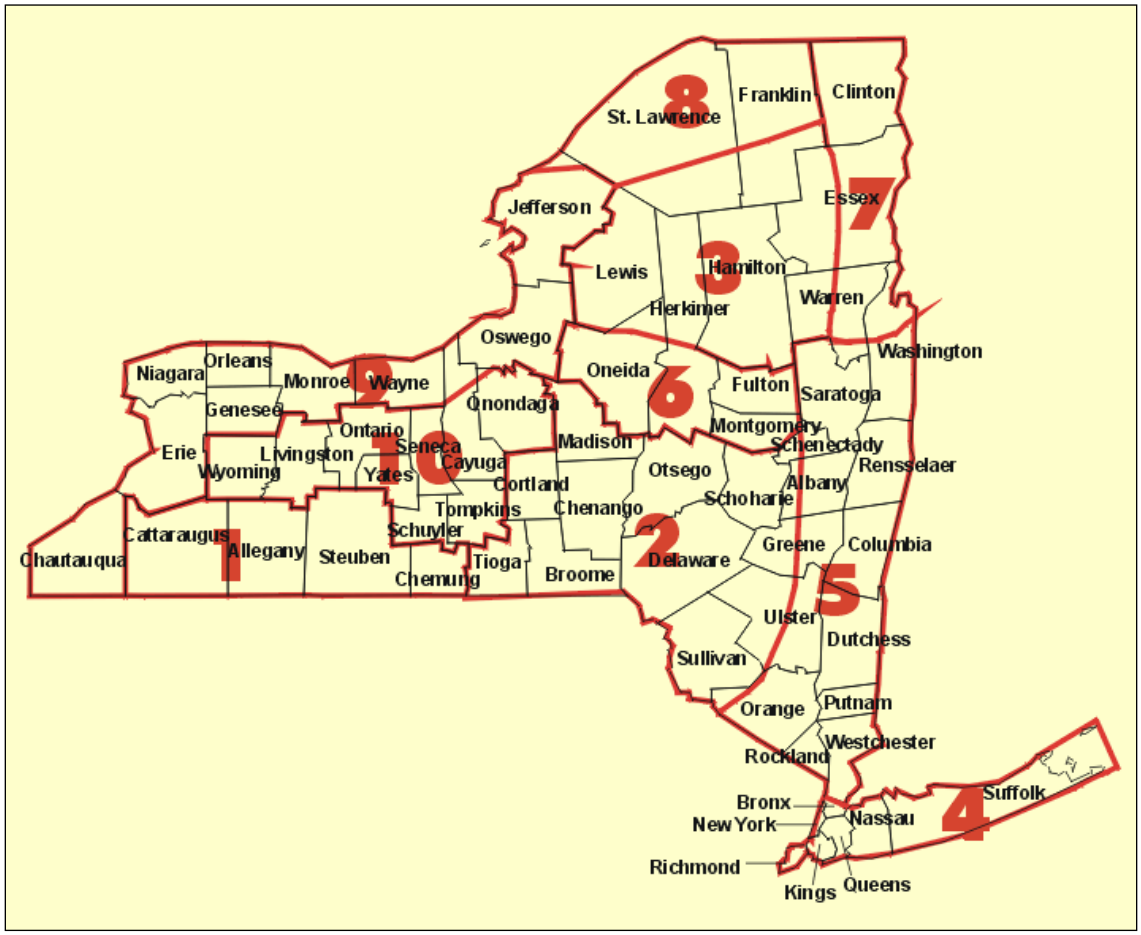
Varying land elevations, character of the landscape, and proximity to large bodies of water play a significant role in the state's temperatures. Erie County is susceptible to both extreme cold and extreme heat temperature events.

Extensive periods of extreme cold temperatures are a result from movement of great high-pressure systems into and through the eastern United States. Under higher than normal atmospheric pressures when arctic air masses are present, extreme winter temperatures hover over New York. New York State's location in the northeast makes it highly susceptible to extreme cold that can cause impact to human life and property (NYS DHSES 2019). Extreme cold temperatures occur throughout most of the winter season and generally accompany most winter storm events throughout the state. The NYSC Office of Cornell University indicates that cold temperatures prevail over the state whenever arctic air masses, under high barometric pressure, flow southward from central Canada or from Hudson Bay (Cornell University Date Unknown).

Excessive heat can occur anywhere, and occurrences of excessive heat are generally widespread and will cover an entire county. However, there can be spot locations that are somewhat cooler (e.g. a shady park near a stream) or hotter (e.g. urban areas because of their built environment holds the heat) (NYS DHSES 2019). Extreme heat temperatures of varying degrees exist throughout the state for most of the summer season, except for areas with high altitudes (Cornell University Date Unknown).

New York State is divided into 10 climate divisions: Western Plateau, Eastern Plateau (Catskill Mountains), Northern Plateau (Adirondack Mountains), Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and Central Lakes. According to NCDC, "Climatic divisions are regions within each state that have been determined to be reasonably climatically homogeneous" (CPC 2005). Erie County is located within the Great Lakes Division (Division 9); Figure 5.4.5-6 depicts the climate divisions in New York State.

Figure 5.4.5-6. New York State Climate Divisions



Source: CPC, 2005

Notes: (1) Western Plateau; (2) Eastern Plateau (Catskill Mountains); (3) Northern Plateau (Adirondack Mountains); (4) Coastal; (5) Hudson Valley; (6) Mohawk Valley; (7) Champlain Valley; (8) St. Lawrence Valley; (9) Great Lakes; and (10) Central Lakes

Previous Occurrences and Losses

Between 1954 and 2020, New York State and Erie County did not experience any extreme temperature FEMA disaster (DR) or emergency (EM) classifications. The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2014 and 2020, Erie County has been included in three USDA disaster declarations in relation to extreme temperature in 2016: S4023, S4031, and S4037: Drought; Wind, high winds; Fire, wildfire; Heat, excessive heat, high temperature; and insects.

USDA tracks drought losses on agriculture that often accompany extreme heat events. In 2016, heat-related crop losses totaled $5,096. In 2017, heat-related crop losses totaled $6,867. In 2018, heat-related crop losses totaled $27,811. In 2020, heat-related crop losses totaled $47,778 (USDA 2021).

Table 5.4.5-4 summarizes the known extreme temperature events that have impacted Erie County from 1999 to 2020.

Table 5.4.5-4. Extreme Temperature Events in Erie County, 1999 to 2020

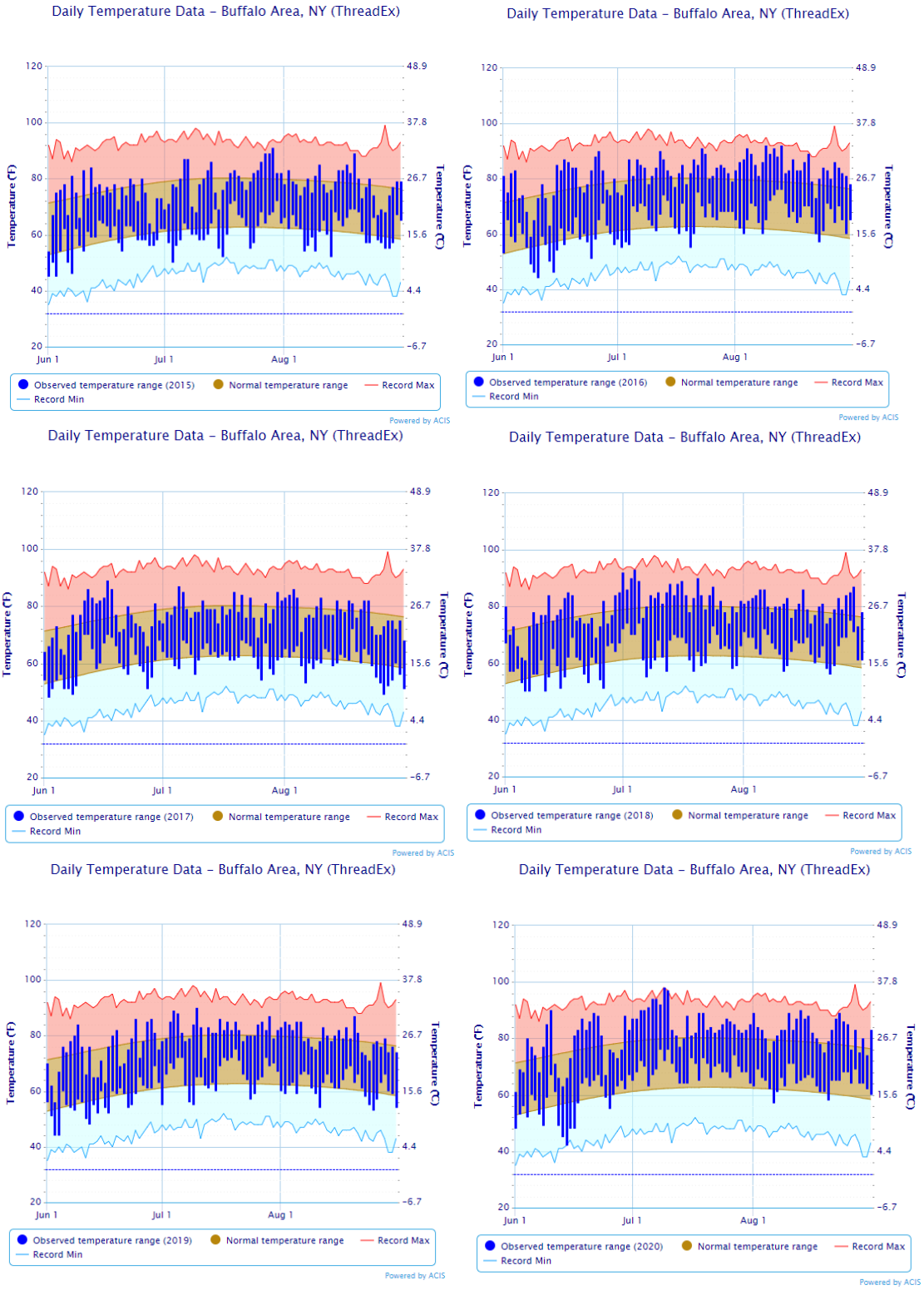
Dates of Event	Event Type	FEMA Declaration Number (if applicable)	Erie County Designated?	Location	Description
January 30, 2019	Extreme Cold/Wind Chill	N/A	N/A	Northern Erie, Southern Erie	Blowing and drifting snow across Northern Erie, temperatures dipped below zero. Wind gusts of 35-50 mph dropped winds chills substantially below zero. One homeless man died of exposure in Williamsville during the cold outbreak. Most schools and churches closed in the area.
January 5, 2018	Extreme Cold/Wind Chill	N/A	N/A	Southern Erie	A bitterly cold artic airmass entrenched across the region brought cold temperatures and dangerous wind chills across the southern tier and north country. Low temperatures dropped to -15 to -35 degrees Fahrenheit across the southern tier and as low as -50 degrees across the north country.
February 13, 2016	Extreme Cold/Wind Chill	N/A	N/A	Northern Erie, Southern Erie	Cold and brisk westerly winds produced wind chills of -25 to -30 degrees Fahrenheit. Warming shelters were opened and some outdoor activities were cancelled. Minimum wind chill temperatures reached -26 degrees.
July 13, 2005	Heat	N/A	N/A	Northern Erie	A 25-year old construction worker collapsed and died from heat stroke as he was walking home from his construction job.
February 1, 2003	Extreme Cold	N/A	N/A	Erie County	Extreme cold event reported to have caused $50,000 in crop damage.

Source: NOAA NCEI 2020; FEMA 2020

Note: With temperature documentation for New York State and Erie County being so extensive, not all sources have been identified or researched. Therefore, Table 5.4.4-4 may not include all events that have occurred in the County.

Figure 5.4.5-7 shows daily temperatures for the summer months from 2015 to 2020. The record highs and record lows are shown by the far top and bottom red and blue lines.

Figure 5.4.5-7. Daily Temperatures for Summer Months from 2015 to 2020



Source: National Weather Service 2021

Probability of Future Occurrences

It is estimated that Erie County will continue to experience extreme temperatures annually that may induce secondary hazards and associated impacts such as snow, hail, ice or wind storms, thunderstorms, drought, utility failure and transportation accidents. Some of these secondary hazards could affect human health.

According to the NOAA-NCEI database, Erie County experienced five extreme temperature events between 1950 and 2020. Table 5.4.5-5 summarizes the annual average number of events and the percent chance of these individual extreme temperature events occurring in Erie County in future years (NOAA NCEI 2021).

Table 5.4.5-5. Probability of Occurrences of Extreme Temperature Events

Hazard Type	Number of Occurrences Between 1950 and 2020	Recurrence Interval (in years) (# Years/Number of Events)	Percent (%) chance of occurrence in any given year
Cold/Wind Chill	0	0.00	0.00
Excessive Heat	0	0.00	0.00
Extreme Cold/Wind Chill	4	17.50	5.71
Heat	1	70.00	1.43
Total	**5**	**14.00**	**7.14**

Source: NOAA NCEI 2020
Note: Probability was calculated using the available data provided in the NOAA-NCEI storm events database.

Based on historical records and input from the Planning Committee, the probability of occurrence for extreme temperatures in Erie County is considered "rare."

Climate Change Impacts

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the state (NYSERDA 2014). The total number of hot days in New York State is expected to increase as this century progresses. The frequency and duration of heat waves, defined as three or more consecutive days with maximum temperatures at or above 90 ˚F, are also expected to increase (Table 5). In contrast, extreme cold events, defined both as the number of days per year with minimum temperature at or below 32 ˚F and those at or below 0 ˚F, are expected to decrease as average temperatures rise (NYSERDA 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be uniquely affected by climate change. Erie County is part of Region 1. In Region 1, it is estimated that temperatures will increase by 3.0ºF to 5.5ºF by the 2050s and 4.5ºF to 8.5ºF by the 2080s (middle range estimate, baseline of 48ºF).

The frequency of heat waves is projected to increase while cold events are projected to fall in Region 1. With the increase in temperatures, heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality and agriculture (NYSERDA 2014). Table 5.4.5-6 displays the projected changes in extreme events and includes the minimum, central range, and maximum days per year.

Table 5.4.5-6. Changes in Extreme Events in Region 1 – Heat Waves and Intense Precipitation

Event Type	# Days Per Year	Baseline	2020s	2050s	2080s
Heat Waves	**Number of Days per year with maximum temperature exceeding minimum, (central range), and maximum**				
	90°F	8	8 (10 to 17) 23	12 (17 to 30) 44	16 (22 to 52) 68
	Number of heat waves per year	0.8	0.9 (1 to 2) 3	2 (2 to 4) 6	2 (3 to 7) 8
	Average duration	4	4 (4 to 4) 5	4 (4 to 5) 5	4 (4 to 5) 7
Extreme Cold	**Number of days per year: minimum, (central range), and maximum**				
	Below 32°F	133	99 (104 to 116) 124	76 (90 to 103) 108	55 (75 to 97) 106

Source: *NYSERDA 2014*
Note: *Based upon the middle range (25th to 75th percentile estimate)*

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable to the identified hazard. The following discusses Erie County's vulnerability, in a qualitative nature, to the extreme temperature hazard.

Impact on Life, Health and Safety

The entire population of Erie County is exposed to extreme temperature events (population of 917,296 people, according to the 2015-2019 ACS population estimates). Extreme temperature events may cause potential health impacts, including injury or possibly death. According to the CDC, populations most at risk to extreme cold and heat events include the following: 1) the elderly, who are less able to withstand temperatures extremes because of their age, health conditions, and limited mobility to access shelters; 2) infants and children up to 4 years of age; 3) individuals with chronic medical conditions (e.g., heart disease, high blood pressure); 4) low-income persons that cannot afford proper heating and cooling; and 5) the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC 2016).

According to the 2019 ACS 5-Year population estimate, persons over the age of 65 are more vulnerable to extreme temperature events, which accounts for approximately 17.6-percent of Erie County's total population (161,498 persons). Furthermore, the homeless and residents below the poverty level might not have access to housing or their housing could be less able to withstand extreme temperatures (e.g., homes with poor insulation and heating supply). As of 2019, a total of 126,041 persons were living in poverty in the County (ACS 2019).

The CDC 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Erie County's overall score is 0.3986, indicating that its communities have low vulnerability (CDC 2016). This map shows that areas likely to be more vulnerable to extreme temperature events are fairly distributed throughout the County but are generally concentrated in the interior and southern coastal municipalities.

Risk of structural fire in the winter months is elevated with approximately 30 percent of all deaths caused by fire occurring in the winter months. Cooking and heat sources too close to combustible materials are leading factors in winter home fires (U.S. Fire Administration 2018). Often times, power outages occur during extreme cold events. Individuals powering their homes with generators are subjected to carbon monoxide poisoning if proper ventilation procedures are not followed (NYC 2019). Improperly connected portable generators are capable of 'back feeding' power lines, which may cause injury or death to utility workers attempting to restore power and may damage house wiring and/or generators.

Meteorologists can accurately forecast extreme heat and cold event development and the severity of the associated conditions with several days of lead time. These forecasts provide an opportunity for public health

and other officials to notify vulnerable populations, implement short-term emergency response actions, and focus on surveillance and relief efforts on those at greatest risk. Adhering to extreme temperature warnings can significantly reduce the risk of temperature-related deaths.

Impact on General Building Stock

All buildings are exposed to the extreme temperature hazard. Extreme heat generally does not impact buildings; however, elevated summer temperatures increase the energy demand for cooling. Losses can be associated with the overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperature events can damage buildings through freezing/bursting pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities can have inadequate capabilities to withstand extreme temperatures.

Older buildings constructed under less stringent building codes are more vulnerable to extreme cold events because of cracks and leaks in the walls. Roof damage can also occur after excessive snow fall and extreme temperature change. Extreme heat may also be damaging to older structures. Further, structures with glass exposed to sunlight and structures exposed to heat on all four sides are more susceptible to damage, including interior damage from overheating (NYC 2019).

Impact on Critical Facilities and Lifelines

All critical facilities and lifelines in the County are exposed to the extreme temperature hazard. Impacts to critical building facilities will experience similar issues as described for the general building stock. It is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as *brown-outs*, because of increased usage from air conditioners and other energy-intensive appliances. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can cause power interruption. Backup power is recommended for critical facilities and infrastructure.

Transportation infrastructure may experience damage from extreme temperature events. This is particularly the case with ground transportation systems at risk of cracking, buckling, or sagging during periods of high temperatures (NYC 2019). This can cause disruptions to essential services that travel along these routes.

Impact on Economy

Extreme temperature events also impact the economy, including loss of business function and damage to and loss of inventory. Business owners can be faced with increased financial burdens from unexpected repairs needed to the building (e.g., pipes bursting), higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity, telecommunications). Disruptions in public transportation service will also impact the economy for both commuters and customers alike.

Impact on the Environment

Extreme temperature events can also impact 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 n.d.). Likewise, rain-on-snow events also exacerbate runoff rates with warming winter weather.

Extreme heat events can have particularly negative impacts on coastal marine aquatic systems, contributing to fish kills, aquatic plant die offs, and increased likelihood of harmful algal blooms.

Cascading Impacts to Other Hazards

Extreme heat events can increase the potential risk of wildfires. Refer to Section 5.4.13 for more information about the impacts of wildfires.

Future Changes that May Impact Vulnerability

Understanding future changes that may impact County vulnerability can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The County considered the following factors 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

As discussed in Section 4, areas targeted for future growth and development have been identified across Erie County. The ability of new development to withstand extreme temperature impacts lies in sound land use practices, building design considerations (e.g. Leadership in Energy and Environmental Design [LEED]), and consistent enforcement of codes and regulations for new construction. New development will change the landscape where buildings, roads, and other infrastructure potentially replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas forming heat islands (as described above). Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

Projected Changes in Population

According to the U.S. Census Bureau, the population in Erie County has remained stable between 2010 and 2019 (917,173 persons in 2010 and 917,296 persons in 2019). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will decrease into 2040, decreasing the total population to approximately 769,396 persons (Cornell Program on Applied Demographics 2017). While vulnerable populations (i.e., persons over 65) are decreasing, a number of people are still at great risk of impacts from extreme temperature events, which will increase.

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures (NYC 2019). As the climate warms, extreme cold events might decrease in frequency, while extreme heat events might increase in frequency; the shift in temperatures could also result in hotter extreme heat events. With increased temperatures, susceptible populations could face increased vulnerability to extreme heat and its associated illnesses, such as heatstroke and cardiovascular and kidney disease. Additionally, as temperatures rise, more buildings, facilities, and infrastructure systems may exceed their ability to cope with the heat.

Change of Vulnerability Since the 2015 HMP

The 2015 HMP included a quantitative assessment of the County's population and number of events. Extreme temperature events (heat and cold) were included in Erie County's 2015 HMP. As existing development and infrastructure continue to age, utility and transportation systems will be at increased risk to fail if they are not properly maintained and do not adapt to the changing environment.