4.3.16 Utility Interruption

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the utility interruption hazard in Gloucester County.

2021 HMP Update Changes

- Utility Interruption was discussed as a characteristic of severe weather, severe winter weather, hurricane/tropical storm, and nor'easter in their respective hazard profiles. Given the frequency of utility interruption, utility interruption is being included as a stand-alone hazard of concern for 2022.

4.3.16.1 Profile

Hazard Description

Utility interruption is defined as any disruption or loss of a public service which includes, but is not limited to: electrical service, potable water, and natural gas caused by disruption of power transmission caused by accident, sabotage, natural hazards, or equipment failure (also referred to as a utility failure or utility outage). A significant utility interruption is defined as any incident of a long duration, which would require the involvement of the local and/or State emergency management organizations to coordinate provision of food, water, heating, cooling, and shelter.

Utility interruption is commonly caused by the impacts of natural hazard events on the utility system. For more information on extreme temperature events, refer to Section 4.3.6. For more information on severe weather events, refer to Section 4.3.13. For more information on severe winter weather events, refer to Section 4.3.14. For more information on hurricanes and tropical storms, refer to Section 4.3.10. For more information on nor'easters, refer to Section 4.3.12.

Widespread power outages can occur without warning or as a result of a natural disaster. Generally warning times will be short in the case of technological failure, such as a fire at a sub-station, traffic accident, human error or terrorist attack. In cases where a power failure is caused by natural hazards, greater warning time is possible. For example, high wind events such as tornados and hurricanes often cause widespread power failure and are often forecasted before they affect a community. Additionally, severe winter weather conditions such as ice storms, blizzards, and snowstorms often cause power failure. Incidents such as these often have plenty of warning time, thus utility response crews can stage resources to prepare for utility failure.

Power failures can cause secondary hazards and have an effect on the health of residents. One potential secondary hazard is chemical accidents that occur after power is restored to industrial facilities. Power interruptions at chemical handling plants are of particular concern because of the potential for a chemical spill

during restart (EPA 2001). Chemical spills in turn can have significant health and environmental impacts. For more information on hazardous material spills, refer to Section 4.3.9.

Another secondary hazard that can result from power failure is a loss of communications capability by first responders, which may in turn have negative impacts on public safety. Amateur radio operators may be used to supplement emergency communications during events of power outage. Power outages can also lead to instances of civil disturbance, including looting. Power failure may also lead to an increase in traffic accidents. Traffic accidents may increase because of the lack of traffic control devices such as stoplights and railroad crossing advisory signals. Power outages lasting a long duration will force law enforcement officials to man traffic control points to prevent accidents.

Power failure can have vast secondary impacts on the health of the community. During periods of extreme heat or extreme cold, vulnerable populations such as the elderly and medically frail can be affected and are susceptible to hypothermia or heat stroke. Additionally, power failure can lead to food spoilage, which has negative impacts on public health.

Wastewater and potable water utility interruption may occur as a result of a power failure or due to equipment failure. These critical utilities are essential to community continuity, emergency services and recovery. Their interruption of service may have cascading economic, environmental, and emergency response impacts.

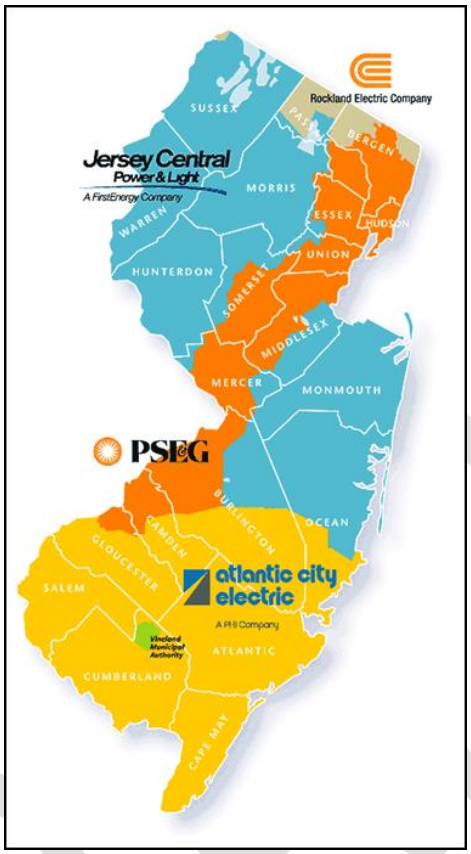
Interruption of water utilities can lead to disruption in daily life for the residents (i.e., loss of potable water) and can have also have serious impacts on firefighting and emergency response capabilities. Failures can occur from natural hazards or due to aging utility infrastructure.

Location

Power failures in New Jersey are usually localized and are usually the result of a natural hazard event involving high winds or ice storms. New Jersey's power systems are overseen by the State of New Jersey Board of Public Utilities. Under New Jersey law, consumers can shop for electric suppliers through a variety of third-party vendors. While the *supply* portion of energy is open to competition, the *delivery* of electricity is limited geographically to the following service providers:

- Atlantic City Electric
- Jersey Central Power and Light (JCP&L)
- Rockland Electric Company
- Public Service Electric and Gas (PSE&G)

Figure 4.3.16-1. Electric Service Delivery Companies in New Jersey



Source: New Jersey Clean Energy Program 2013

These service providers are responsible for maintaining power throughout their respective regions. Figure 4.3.16-1 shows the locations of electric service delivery providers across New Jersey. This figure indicates that Gloucester County is serviced primarily by Atlantic City Electric with a small northern portion of the county serviced by PSE&G.

Water interruptions can range from localize events to larger scale water outages. Water interruptions can occur from a direct impact from a natural hazard or a failure due to the age of the utility infrastructure. Water supply throughout Gloucester County is provided through both private and municipally operated water providers.

- Aqua New Jersey Inc.
- Borough of Glassboro Water and Sewer
- Swedesboro Water Department

Extent

The extent and severity of a utility interruption depends on the cause, location, duration, and time of year. It can range from a small, localized event to a countywide power outage. Impacts from a utility failure can be

significant to the County and its residents. Utility interruptions typically occur because of, or in combination with, aging infrastructure, other emergency or disaster incidents, such as severe weather and flooding, and can exacerbate such emergencies. It also depends on the utility distribution system affected.

Power failures lead to the inability to use electric-powered equipment, such as: lighting; heating, ventilation, and air conditioning (HVAC) and necessary equipment; communication equipment (telephones, computers, etc.); fire and security systems; small appliances such as refrigerators, sterilizers, etc.; and medical equipment. This all can lead to food spoilage, loss of heating and cooling, basement flooding due to sump pump failure, and loss of water due to well pump failure.

Utility gas failures can lead to a drastic reduction for residents of Gloucester County to heat their homes as previously mentioned. Current procedures of shutting off utility gas distribution before severe weather events could also hinder the ability to provide backup power if residents have generators power by utility gas. Interruptions of water supply can lead to decreased potable water supply and also a decreased firefighting capability.

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with flooding throughout Gloucester County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events may vary. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2021, FEMA included the State of New Jersey in one power outage-related disaster (DR) or emergency (EM) declaration. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Gloucester County was not included in this disaster. However, the County has been included in declarations for numerous events which resulted in power outages. Refer to Sections 4.3.10 (Hurricane), 4.3.12 (Nor'Easters), 4.3.13 (Severe Weather), and 4.3.14 (Severe Winter Weather) for declarations relating to severe weather, severe winter weather, nor'easter, and hurricane/tropical storm.

U.S. Department of Agriculture 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. Utility interruption is a non-natural hazard and is not responsible for any agricultural impacts that could lead to disaster declarations. However, the natural hazard events that may cause utility failure may also result in agricultural damages that result in declarations.

Utility Failure Events

For the 2021 HMP update, utility failure events that have impacted Gloucester County between 2015 and 2021 are identified in Table 4.3.16-1. With flood documentation for New Jersey and Gloucester County being so extensive, not all sources have been identified or researched. Therefore, Table 4.3.16-1 may not include all events that have occurred in the County. Please see Section 9 (Jurisdictional Annexes) for detailed information regarding impacts and losses to each municipality.

Table 4.3.16-1. Utility Interruption Events in Gloucester County, 2015 to 2021

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Gloucester County Designated?	Description
April 22, 2015	Thunderstorm Wind	N/A	N/A	An approaching cold front helped trigger a line of showers and thunderstorms that produced some wind damage as it moved through central New Jersey during the afternoon of the 22nd. Even though they weakened, the gust front from the storm continued to produce strong wind gusts all the way to the coast. The severe thunderstorm caused wind damage to a few homes and also resulted in about 1,200 Atlantic City Electric customers losing power.
June 23, 2015	Thunderstorm Wind	DR-4231	Yes	The combination of an unseasonably hot and humid air mass, an approaching cold front and strong winds aloft caused a squall line of severe thunderstorms to move through southern New Jersey during the very late afternoon and early evening of the 23rd. Estimated wind gusts as high as around 85 mph knocked down thousands of trees and caused structural damage to homes and vehicles, mainly from fallen trees. Four direct injuries were reported. Many roadways were closed because of downed trees into the 24th. Hardest hit were Burlington, Camden, Atlantic and in particular Gloucester County. Gloucester County declared a state of emergency. The region suffered approximately 31 million dollars in property damage and was declared a presidential disaster area. A couple of severe thunderstorms also occurred in northwest New Jersey during the afternoon of the 23rd. While there was one report of a funnel cloud and a waterspout in Barnegat Bay, no confirmed tornadoes occurred. About 410,000 homes and businesses in southern New Jersey lost power. The 280,000 customers that lost service in the Atlantic City Electric's service area represented a greater number than what occurred during Superstorm Sandy (220,000) and the Derecho of 2012 (206,000). The utility reported that several high transmission lines, five substations, twenty other transmission lines, hundreds of poles as well as 372 incidents of wire damage occurred. The utility received assistance from repair crews as far away as Ohio and New England. About 210,000 of its customers were still without power on the morning of the 24th, 180,000 the afternoon of the 24th, 121,500 the afternoon of the 25th, 84,000 the morning of the 26th and 48,000 the evening of the 26th. Thunderstorms on the 27th slowed restoration efforts and full restoration did not occur until the 30th. Public Service Electric & Gas reported 130,000 of its customers lost power. Full restoration occurred on the 26th. The utility's substations in Collingswood, Maple Shade, Medford and Southampton were damaged.

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Gloucester County Designated?	Description
				Because of the prolonged power outages, water and ice distribution centers were opened and the American Red Cross assisted with displaced families. In Gloucester County, two comfort stations were opened by the Red Cross. The worst wind damage occurred from Greenwich Township east through Mantua Township. About 11,000 homes and businesses were still without power on the morning of the 28th. In Camden County, the county dispatch office fielded ten times the normal call volume for assistance. The County Public Safety Office fielded 3,522 calls vs 2,432 calls for the entire duration of Superstorm Sandy. Hardest hit was the central part of the county from Gloucester Township east through Cherry Hill and Voorhees Township. In Burlington County, Evesham and Medford Townships were hardest hit. Crop damage impacted mainly Camden and Gloucester Counties. Most of the initial damage was physical in nature to buildings, facilities and ditches. Verizon cell phone service was also lost in parts of southwest New Jersey on the 23rd and restored by the 24th.
July 9, 2015	Thunderstorm Wind	N/A	N/A	A line of strong to severe thunderstorms formed in the warm sector of the Susquehanna Valley and moved through southern New Jersey during the during the evening on the 9th. In addition, some flash flooding occurred with the line of thunderstorms. About 7,000 homes and businesses lost power in the southern half of New Jersey. A warm front lifted northeast into central New Jersey during the afternoon of the 9th. This permitted sufficient daytime heating preceding an approaching cold front for thunderstorms to gain strength and severity.
January 22, 2016	Winter Storm	DR-4264	No	An impulse from the west coast traversed the midsection of the country, then developed into a low pressure system as it tracked across the Gulf states before intensifying along the Carolina coast into a major nor'easter, producing record snowfall in parts of New Jersey on January 23rd. At one point during the storm, up to 270,000 customers were without power. Outages were concentrated closer to the coast where the strongest winds occurred.
February 16, 2016	Thunderstorm Wind	N/A	N/A	A strong cold front moved west to east through New Jersey late Tuesday morning and early Tuesday afternoon. Heavy downpours associated with this front brought strong to severe wind gusts down to the surface, causing property damage in some places. Thousands were left without power due to the strong wind gusts. Around 30,000 customers lost power.
June 5, 2016	Thunderstorm Wind	N/A	N/A	A cold front moving into an unstable air mass over New Jersey set off numerous showers and thunderstorms during the late afternoon hours on the 5th. Lightning with these thunderstorms was somewhat limited, so straight-line winds and heavy downpours were the

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Gloucester County Designated?	Description
				major threat as these storms moved through the area. Thousands of people lost power as a result of the storms. Many wind gusts from 60 to over 70 MPH were recorded across the region. The highest gust was in Gloucester TWP at 74 mph.
June 8, 2016	Thunderstorm Wind	N/A	N/A	A trough of low pressure moving through the region produced a quick moving line of thunderstorms around noontime. These thunderstorms produced widespread wind damage across most of Southern and Central NJ with numerous power outages.
January 23, 2017	Strong Wind	N/A	N/A	An area of low pressure over North Carolina on the 23rd strengthened and moved northeast to a location just off the New Jersey Coastline on the morning of the 24th. With a very tight pressure gradient, winds increased ahead of the storm reaching in excess of 50 mph that led to some damage reports. Power outages from the storm were estimated at around 20,000.
February 25, 2017	Thunderstorm Wind	N/A	N/A	Several days of record warmth came to an abrupt end as a strong cold front moved through the state. Moisture and instability were sufficient to develop a line of showers and thunderstorms ahead of the front. These showers and thunderstorms produced damaging winds and hail across western portions of the state. Several thousand people lost power as well.
June 24, 2017	Tropical Storm Cindy	N/A	N/A	A band of gusty convective showers moved through during the morning hours in association with the remnants of Tropical Storm Cindy. Several reports of damage were reported from the winds. Thousands lost power.
July 23, 2017	Thunderstorm Wind	N/A	N/A	A stalled frontal boundary was the focus for several rounds of thunderstorms that produced damaging winds and flooding in spots. Several thousand people lost power throughout the state.
August 2, 2017	Thunderstorm Wind	N/A	N/A	A hot and humid airmass with weak boundaries led to slow moving strong to severe thunderstorms with damaging winds, hail and flooding. Over 2,000 people lost power.
October 24, 2017	Strong Wind	N/A	N/A	A strong low pressure system over the Great Lakes and a departing high pressure system to our east lead to a tight pressure gradient and a round of strong winds. Over 25,000 homes and businesses lost power. Several school districts had to close because of the power loss.
January 4, 2018	Winter Storm	N/A	N/A	An area of low pressure tracked up the east coast interacting with a cold front which lead to rapid development of a winter storm across the state. This storm quickly moved out by the 5th. However, snowfall accumulations and gusty winds occurred with the storm. Top wind gusts were generally around 40 mph across the state. Snow amounts were highest in southern and coastal New Jersey with over 6 inches, totals were only a few inches further northwest. A state of Emergency was declared during the height of the storm. Several

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Gloucester County Designated?	Description
				hundred vehicles were stranded and hundreds of thousands were without power at some point.
March 2, 2018	Winter Weather, High Wind	N/A	N/A	A large and very deep area of low pressure moved slowly east over the open waters of the North Atlantic Ocean through Sunday March 4th. This lead to a variety of weather hazards during this time frame. Strong Northwest winds with gusts up to around 60 mph occurred on March 2nd and 3rd. This led to widespread damage to trees and power lines, causing extensive power outages across the region.
March 6, 2018	Winter Storm	DR-4368	No	A broad area of low pressure extending from the Ohio Valley to the Piedmont of South Carolina consolidated off the Virginia Capes during the early morning of March 7th. This new primary low moved northeast and gradually deepened as it passed east of the Delaware and New Jersey coasts on March 7th. Precipitation gradually overspread the region during the overnight hours of March 6th to the 7th. To the east of the NJ Turnpike/Interstate 95, precipitation began as rain or a mix of rain and snow. Further west, precipitation fell mainly as snow. During the daylight hours of the 7th, precipitation to the east of the NJ Turnpike/Interstate 95 turned over to snow, as colder air worked in from the north and west. The snow fell heavy at times away from the coast. The snow contained large amounts of liquid, making it heavy and wet. This resulted in downed trees, limbs, and wires, leading to numerous power outages across portions of New Jersey, especially where the heaviest snow was reported. Many customers were still without power from the previous storm when this storm struck. Governor Murphy estimated about 350,000 customers state-wide lost power as a result of this second storm.
June 3, 2020	Strong Wind	N/A	N/A	A derecho developed just southeast of Lake Erie during the early morning hours of June 3, 2020, then moved rapidly southeast across Pennsylvania before exiting the central New Jersey coast during the early afternoon hours, approximately 130 PM. Damaging winds in excess of 60 MPH were sporadic over western and central Pennsylvania, but as the thunderstorm complex moved into increasingly unstable air in the eastern part of the state just before noon, wind damage reports became more numerous and widespread. Most of these reports were confined within a 50-mile wide swath extending from Berks County eastward to the Philadelphia metro area, then further east to the Ocean County shoreline in New Jersey. Wind gust reports between 60 and 70 MPH were common within this swath. In addition to these destructive wind gusts, frequent to continuous cloud to ground lightning and heavy downpours were also reported throughout the area. Over 112,000 power outages were reported in southern New Jersey as a result of fallen trees on power lines. Some

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	Gloucester County Designated?	Description
				localities were without power for several days. Because this derecho moved off the coast by 200 PM, the warm afternoon sun was able to sufficiently destabilize the atmosphere for the formation of another round of severe thunderstorms over some of the same areas that experience them earlier in the day. Reported wind gusts associated with these thunderstorms generally ranged between 45 and 65 MPH.

Source: NOAA-NCEI 2021; FEMA 2021

Note: Events recorded to NOAA-NCEI as resulting in "scattered" power outages were considered minor and not included.

Probability of Future Occurrences

While the probability of future utility interruption incidents in Gloucester County is difficult to predict, the historic record indicates that significant failures have occurred as a result of high winds, lightning, severe weather, winter weather, technological failures, and age of utility infrastructure. As infrastructure ages beyond its intended lifespan, it is likely to become less reliable leading to a higher likelihood of failure Data were not readily available on the frequency of smaller utility interruptions across the County; however, it is reasonable to assume that utility failure events of shorter duration will continue to occur in the future. In addition, future changes in climate may also impact the frequency and probability of future utility failure occurrences.

In Section 4.4, the identified hazards of concern for Gloucester County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Steering Committee and Planning Committee, the probability of occurrence for utility interruptions in the County is considered 'frequent'.

Climate Change Impacts

Several implications for climate change are related to the utility interruption hazard. Providing projections of future climate change for a specific region is challenging. Shorter term projections are more closely tied to existing trends making longer term projections even more challenging. The further out a prediction reaches the more subject to changing dynamics it becomes.

Providing projections of future climate change for a specific region is challenging. Shorter term projections are more closely tied to existing trends making longer term projections even more challenging. The further out a prediction reaches the more subject to changing dynamics it becomes.

Climate change includes major changes in temperature, precipitation, or wind patterns, which occur over several decades or longer. Due to the increase in greenhouse gas concentrations since the end of the 1890s, New Jersey has experienced a 3.5° F (1.9° C) increase in the State's average temperature (Office of the New Jersey State Climatologist 2020), which is faster than the rest of the Northeast region (2° F [1.1° C]) (Melillo et al. 2014) and the world (1.5° F [0.8° C]) (IPCC 2014). This warming trend is expected to continue. By 2050, temperatures in New Jersey are expected to increase by 4.1 to 5.7° F (2.3° C to 3.2° C) (Horton et al. 2015). Thus, New Jersey can expect to experience an average annual temperature that is warmer than any to date (low emissions scenario) and future temperatures could be as much as 10° F (5.6° C) warmer (high emissions scenario) (Runkle et al. 2017). New Jersey can also expect that by the middle of the 21st century, 70 percent of summers will be hotter than the warmest summer experienced to date (Runkle et al. 2017). The increase in temperatures is expected to be felt more during the winter months (December, January, and February), resulting in less intense cold waves, fewer sub-freezing days, and less snow accumulation. Changes in winter temperatures could result in a change in the frequency of utility failure events. Extreme temperatures are predicted to increase as well. During the hot summer months, the potential for power overload will increase as demand for power increases.

As temperatures increase, Earth's atmosphere can hold more water vapor which leads to a greater potential for precipitation. Currently, New Jersey receives an average of 46 inches of precipitation each year (Office of the New Jersey State Climatologist 2020). Since the end of the twentieth century, New Jersey has experienced slight increases in the amount of precipitation it receives each year, and over the last 10 years there has been a 7.9 percent increase. By 2050, annual precipitation in New Jersey could increase by 4 percent to 11 percent (Horton et al. 2015). By the end of this century, heavy precipitation events are projected to occur two to five times more often (Walsh et al. 2014) and with more intensity (Huang et al. 2017) than in the last century. New Jersey will experience more intense rain events, less snow, and more rainfalls (Fan et al. 2014, Demaria et al. 2016, Runkle et al. 2017). Also, small decreases in the amount of precipitation may occur in the summer months, resulting in greater potential for more frequent and prolonged droughts (Trenberth 2011). New Jersey could also experience an increase in the number of flood events (Broccoli et al. 2020). An increase in precipitation, particularly winter precipitation, may lead to more frequent power failures.

A warmer atmosphere means storms have the potential to be more intense (Guilbert et al. 2015) and occur more often (Coumou and Rahmstorf 2012, Marquardt Collow et al. 2016, Broccoli et al. 2020). In New Jersey, extreme storms typically include coastal nor'easters, snowstorms, spring and summer thunderstorms, tropical storms, and on rare occasions hurricanes. Most of these events occur in the warmer months between April and October, with nor'easters occurring between September and April. Over the last 50 years, in New Jersey, storms that resulted in extreme rain increased by 71 percent (Walsh et al. 2014) which is a faster rate than anywhere else in the United States (Huang et al. 2017). More storms with higher winds will increase the chance that the power infrastructure will be impacted.

4.3.16.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable to the identified hazard. The following discusses Gloucester County's vulnerability, in a qualitative nature, to the utility interruption hazard.

Impact on Life, Health and Safety

The entire population in Gloucester County is vulnerable to utility interruption events. Refer to Section 3 (County Profile) for a summary of population statistics for the County.

Utility failure is particularly problematic for homes that are heated with electricity. Widespread power outages during the winter months can directly impact vulnerable populations such as the elderly and medically frail. According to the 2015 – 2019 American Community Survey, 106,705 (78.4 percent) homes across Gloucester County are heated with utility gas, 11,035 (10.3 percent) homes are heated with fuel oil and kerosene; and 8,368 (78.4 percent) are heated by electricity. PSE&G currently maintains databases for homes/facilities with individuals that need power supplied for medical reasons. Utility interruption events have potential health impacts including injury and death. Other issues from power outages include food safety from lack of refrigeration and carbon monoxide poisoning from misuse of generators.

Individuals with medical needs are vulnerable to power failures, because medical equipment such as oxygen concentrators requires electricity to operate. The elderly and low-income populations of Gloucester County are also vulnerable to the effects of power failure, as power failure has the potential to expose them to extreme heat or extreme cold. During power failure events, water purification systems may not be functioning. Further, populations on private wells will not have access to potable water. Many power outage events are caused by storm events that can lead to flooding. Without electricity, residents would be unable to pump water from their basements potentially causing structural and content damage to their homes.

Individuals powering their homes with generators are subjected to carbon monoxide poisoning if proper ventilation procedures are not followed. Improperly connected portable generators are capable of 'back feeding' power lines which may cause injury or death to utility works attempting to restore power and may damage house wiring and/or generators (NJOEM 2019).

As noted above, interruptions of water supply can lead to decreased potable water supply and a decreased firefighting capability. Interruption of potable water distribution also has a considerable impact on the firefighting capabilities of many fire departments within Gloucester County. Should frequent or widespread water interruption occur, there will be an increased risk for structural fire and wildfire occurrence within the County.

Water systems and thus distribution may also be impacted by other hazards such as extreme weather events. A good example is Superstorm Sandy where storm surge damaged critical water supply infrastructure along the coast and high winds impacted energy distribution across the State which in turn impacted the ability to supply water. As a result, NJDEP has developed new guidance aimed to ensure that repairs, reconstruction, new facilities and operations/maintenance are focused on enhancing the resilience of critical infrastructure (NJOEM 2019).

Impact on General Building Stock

All of the building stock in the County is exposed to the utility interruption hazard. Refer to Section 3 (County Profile) which summarizes the building inventory in Gloucester County. Impacts sustained from utility interruption are likely to be secondary impacts. Should potable water distribution be reduced or not available, then structures could be at increased risk for structural fire since current fire suppression is dependent accessing water supply from hydrants.

Impact on Critical Facilities

All critical facilities in the County are exposed to the utility interruption hazard. It is essential that critical facilities remain operational during natural hazard events. Backup power is recommended for critical facilities and infrastructure. Loss of power can have serious impacts on the health and welfare of residents, continuity of business, and the ability of public safety agencies to respond to emergencies. Interruption of utility gas or water distribution could also reduce the effectiveness of critical facilities to operate at full capacity.

Impact on Economy

During a utility interruption event, the County may experience losses because of an interruption of critical services. Further, increased costs such as providing shelters, and costs related to cooling and heating centers may be incurred. Extended power outages will require officials to shelter victims who require heat and power for activities of daily living.

A prolonged power failure in Gloucester County may impact the County's economy. The County possesses an extensive transportation network, including many ports and bus services (Gloucester 2021). Transportation systems include freight rail lines and roadways. Major highways accessible to Gloucester County include the New Jersey Turnpike, and Routes 40, 45, 44, 130, 295, and 322. The County also has 6 small-scale airports. All of these systems and supporting resources provide services locally, regionally, nationally, and internationally. Disruption in any of these services would mean that many workers, residents, and travelers would not be able to go where needed.

Power interruptions can cause economic impacts stemming from lost income, spoiled food and other goods, costs to the owners/operators of the utility facilities, and costs to government and community service groups. FEMA's benefit-cost analysis methodology measures the loss of electrical service on a per-person-per-day-of-lost-service basis for the service area affected.

Interruption of utility gas or potable water distribution could also cause significant economic impacts such as: additional costs for bringing in water tenders to maintain fire suppression capabilities; opening additional warming centers should electric and utility gas utility be interrupted to residential areas; and distribution of potable water for public consumption. There could be significant costs associated with reimbursing fire departments from other counties within New Jersey to travel, staff, and maintain water tenders within Gloucester County during the duration of a water outage event.

Potential modeling of economic impacts from utility interruption would be calculating interruption of service costs which is derived from a standard value per person per day multiplied out by the number of customers served. This would help to provide an estimate of the impact of the interrupted utility service but may not be representative of the complete economic impact of a prolonged utility interruption.

The FEMA BCA Toolkit version 5.3 uses the following standard values per person per day:

- Electric: $148.00
- Potable Water: $105.00
- Wastewater: $49.00

Future Changes that May Impact Vulnerability

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. The county 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 and Change in Population

As discussed in Sections 4 and 9, areas targeted for future growth and development have been identified across Gloucester County. Any areas of growth could be potentially impacted by the utility interruption hazard because the entire County is exposed and vulnerable. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

According to population projections from the State of New Jersey Department of Labor and Workforce Development, Gloucester County will experience an increase in population through 2034 (approximately 20,000 people between 2019 and 2034). An increase in population within Gloucester County could potentially lead to a higher likelihood of utility failure due to an increased demand on aging infrastructure. If utility infrastructure is not maintained and enhanced to accommodate for future demands, then there is a higher likelihood for more frequent utility interruptions. Increased frequency of utility interruptions will lead to an increased risk for socially vulnerable populations and also a heighted risk for structural and wildfire because of the current reliance of fire hydrants for fire suppression in Gloucester County.

Climate Change

Several implications for climate change are related to the power failure hazard. Providing projections of future climate change for a specific region is challenging. Shorter term projections are more closely tied to existing trends making longer term projections even more challenging. The further out a prediction reaches the more subject to changing dynamics it becomes.

Climate Change in New Jersey: Trends and Projections describes changes in temperature, precipitation, and sea level rise. Each section of the report summarizes observed recent changes in climate in New Jersey. Observations are based on recorded climate data collected by the ONJSC and other institutions, and on other reports summarizing climate change in the northeastern United States. Each section also presents a synthesis of the most current projections for future climate changes based on climate science modeling and techniques. The projections reflect potential average climate over a span of future years (2020, 2050, and 2080). The projections in the report illustrate the potential climate changes that could impact the northeastern United

States based on future emissions scenarios (A2, A1B, and B1 – high, medium, and low scenarios). Each emissions scenario would result in a range of potential climate outcomes in the State (Rutgers 2013).

Climatologists predict an increase in the number and intensity of severe weather events. More storms with higher winds will increase the chance that the power infrastructure will be impacted. Extreme temperatures are predicted to increase as well. During the hot summer months, the potential for power overload will increase as demand for power increases. Additionally, climatologists predict an increase in precipitation, which may lead to more winter weather thus causing additional power failures and utility interruptions.

Change of Vulnerability Since the 2016 HMP

Overall, the County's vulnerability has not changed, and the entire County will continue to be exposed and vulnerable to the utility interruption events.