CHAPTER 10: WINTER STORM

2022 PLAN UPDATE

Chapter 10: visual and thematic updates were included throughout the chapter, including updates to fonts, colors, and the addition of a cover page.

Page 10-1: Definitions for heavy snowstorm, sleet storm, ice storm, blizzard, severe blizzard, wind chill, frostbite, and hypothermia were added.

Page 10-2: Section 10.2 History, Table 10-1 was updated with winter storm events occurring from 2010 to present.

Page 10-5: Section 10.3 County Perspective, the risk ranking from the 2021 State Hazard Mitigation Plan was added. The state ranked winter storm as a "medium" risk in Somerset County. The 2022 HMPC agreed with this risk ranking.

Page 10-6: Figure 10-2 has been updated to reflect the Rate of Temperature Change in the U.S. from 1901 to 2021. Data is provided by NOAA/NCEI.

Page 10-7: Section 10.5 Essential Facilities has been updated to reflect changes made to the County's Critical & Public Facilities Database within the last five years.

Page 10-8: Table 10-2 has been updated to include new improvement values per the most recent MdPropertyView.

Page 10-9: Added a new section – **10.7 Future Conditions**.

Chapter 10: Winter Storm

10.1 Hazard Profile

The typical winter storm in Maryland usually brings heavy snowfall (6+ inches), sleet or freezing rain accompanied by cold temperatures and occasionally high winds. A storm usually starts as a mid-latitude depression in the central U.S. and moves north and east between the Appalachians and the east coast. Depending on the speed at which these storms travel and the air mass temperature, heavy amounts of snow, sleet, freezing rain or some combination thereof will be the result. Typically, a winter storm will last for 24 – 48 hours and move out of the area into New England. Then, depending on the controlling air mass, temperatures will continue to be cold, and the snow or ice will linger for days or sometimes weeks, or conversely, the temperature will warm quickly, and the snow or ice will melt in a short time. According to *Figure 10-1: Maryland Average Snowfall*, portions of western Maryland average 104 inches of snowfall annually, while the central portions of Maryland average 22 inches annually. The eastern shore receives 15 inches of snowfall on average annually.

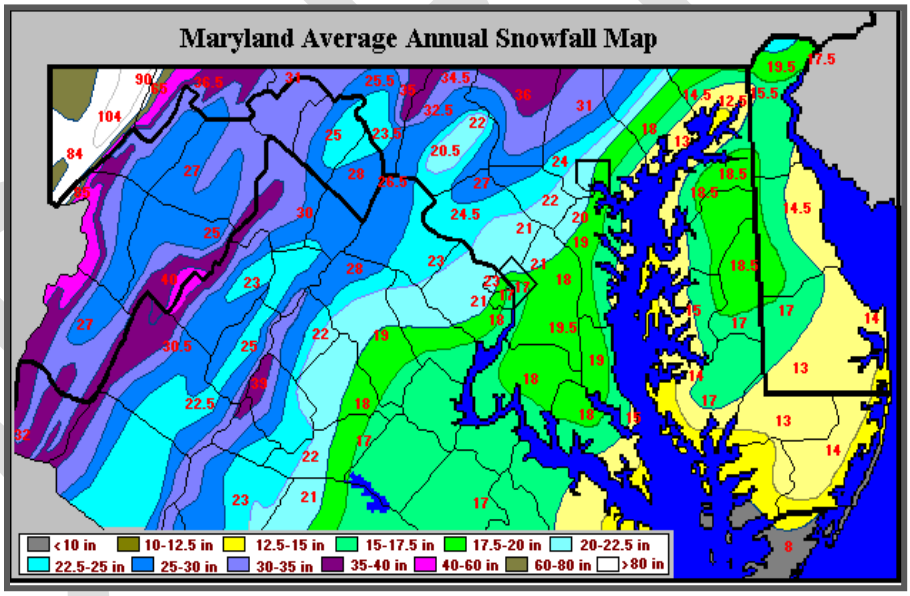


Figure 10-1: Maryland Average Snowfall

Note: This is the most recent version of this map. All yellow shown on this map indicates an average snowfall range of 12.5-15in.

Source: National Weather Service

Winter weather can take many forms including snow, freezing rain, sleet, and extreme cold. Some of the most significant winter storms that affect Maryland are known as “Nor’easters” because they are accompanied by strong northeast winds. The following types of winter weather are generally considered part of the winter storm hazard.

1. **Heavy Snowstorm:** Accumulations of four inches or more in a six-hour period; or six inches or more in a 12-hour period. The most common impacts are traffic accidents, interruptions in power supply and communications; and the failure of inadequately designed and/or maintained roofing systems.
2. **Sleet Storm:** Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes, resulting in slippery surfaces and posing

hazards to pedestrians and motorists.

3. **Ice Storm:** Significant accumulations of rain or drizzle freezing on objects such as trees, power lines and roadways, causing slippery surfaces and damage from the sheer weight of ice accumulation.
4. **Blizzard:** Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile, prevailing over an extended period.
5. **Severe Blizzard:** Wind velocity of 45 miles an hour or more, temperatures of 10 degrees or lower, a high density of blowing snow with visibility frequently measured in inches, prevailing over an extended period.
6. **Freezing Temperatures**: Dangerously cold temperatures in the teens and single digits pose a hazard risk and are often associated with winter weather.
7. **Wind Chill:** a measure of what the temperature *feels* like when accounting for the wind speed. As the wind increases, more heat is removed from your body by the wind.

10.2 History

NOAA defines winter storms as 'conditions that are favorable for hazardous winter weather conditions including heavy snow, blizzard conditions or significant accumulations of freezing rain or sleet.'

While each winter season brings with it the possibility of major snow and ice storms, some winter storms do standout for their severity and duration. Storms of note include the winter storm of 1979 that dropped more than two feet of snow on the eastern shore in Ocean City, an ice storm in February 1994 that resulted in widespread power outages, the Presidents Day storm in 2003 that resulted in more than 8 inches of snow in Princess Anne, and more recently, the January 2022 snowstorm that placed the County under a blizzard warning and dropped between 6 and 10 inches of snow across the County and over 10 inches in areas near Princess Anne. In terms of cold weather, in 1912, temperatures dropped to nearly –20 F over much of the state. During a prolonged cold spell in 1977, much of the Chesapeake Bay froze over for an extended period of time.

According to the NCEI Storm Event Database, a total of 77 winter storm events have occurred in Somerset County since 1996. This equates to an annual average of 2.85 winter storm events. Table 10-1 includes the more recent winter storm events recorded within the NCEI Storm Event Database.

Table 10-1: Winter Storm Events, 2010 to 2022

Date	Event	Event Narrative
January 30 to 31, 2010	Winter Storm	Snowfall amounts were generally between six and eleven inches across the county. Crisfield reported 11.0 inches of snow. Princess Anne reported 9.5 inches of snow.
February 5 to 6, 2010	Winter Storm	Snowfall amounts were generally between ten and twenty inches across the county.
February 9, 2010	Blizzard	Snowfall amounts were generally between five and eight inches across the county. Princess Anne reported 8.0 inches of snow. Deal Island

Table 10-1: Winter Storm Events, 2010 to 2022		
Date	**Event**	**Event Narrative**
		reported 6.5 inches of snow. Snow, heavy at times, occurred with northwest winds 30 to 40 mph with gusts to 50 mph, resulting in poor visibilities and even whiteout conditions.
December 16, 2010	Winter Weather	Snowfall amounts were generally between one inch and three inches across the county.
December 25 to 27, 2010	Winter Storm	Snowfall amounts were generally between four and seven inches across the county.
March 27, 2011	Winter Weather	Snowfall amounts were generally between one and two inches across the county.
February 11 to February 12, 2012	Winter Weather	Snowfall amounts were generally between one and two inches across the county. Princess Anne reported 2.0 inches of snow. Crisfield reported 1.0 inch of snow.
February 19 to February 20, 2012	Winter Weather	Snowfall amounts were generally between one and two inches across the county.
January 17 to January 18, 2013	Winter Weather	Snowfall amounts were generally between one and two inches across the county. Venton reported 1.5 inches of snow.
January 24, 2013	Winter Weather	Snowfall amounts were generally between one and three inches across the county. There was, however, a narrow band straddling the Virginia/Maryland line, where up to 4 inches of snow fell. Princess Anne reported 2.5 inches of snow.
January 25, 2013	Winter Weather	Snowfall amounts were generally between one and two inches across the county. Princess Anne reported 1.8 inches of snow.
January 2 to January 3, 2014	Winter Weather	Snowfall amounts were generally between two inches and three and a half inches across the county. Oriole reported 3.5 inches of snow and Princess Anne reported 1.9 inches and 3.5 inches of snow.
January 21 to January 22, 2014	Winter Weather	Snowfall amounts were generally between one inch and three inches across the county. Princess Anne reported 3.0 inches of snowfall. Crisfield reported 1.0 inches of snowfall.
January 28 to January 29, 2014	Winter Storm	Snowfall reports of 4.5 inches and 4.3 inches of snow were reported 4 miles west southwest and 2 miles south southwest of Princess Anne.
March 3, 2014	Winter Storm	Snowfall amounts were generally between three inches and five inches across the county. Westover reported 3.0 inches of snowfall.
March 16 to March 17, 2014	Winter Weather	Snowfall of 3.4 inches occurred 4 miles west-southwest of Princess Anne and snowfall of 3.2 inches occurred in 2 miles south-southwest of Princess Anne.
March 25, 2014	Winter Weather	A snowfall report of 3.5 inches occurred 2 miles south of Princess Anne.
February 16 to February 17, 2015	Winter Storm	Snowfall amounts were generally between four inches and seven inches across the county. Crisfield reported 6.0 inches of snow.
February 26, 2015	Winter Storm	Snowfall amounts were generally between three inches and eight inches across the county. Westover reported 8.0 inches of snow. Princess Anne and Marion reported 6.5 inches of snow. Crisfield reported 6.0 inches of snow.
March 1, 2015	Winter Weather	Ice accumulations ranged from a trace to .10 inch.

Table 10-1: Winter Storm Events, 2010 to 2022		
Date	**Event**	**Event Narrative**
March 5, 2015	Winter Weather	Snowfall amounts were generally between one inch and four inches across the county. Princess Anne (4 WSW) reported 3.7 inches of snow. Princess Anne reported 1.8 inches of snow.
January 22 to January 23, 2016	Winter Storm	Snowfall totals were generally between 3 inches and 8 inches across the county.
February 15, 2016	Winter Storm	Snowfall totals were generally between 3 inches and 5 inches across the county. Princess Anne reported 5.1 inches of snow.
March 3 to March 4, 2016	Winter Storm	Snowfall totals were generally between 4 inches and 7 inches across the county. Princess Anne reported 6.7 inches of snow.
April 5 to April 6, 2016	Frost/Freeze	Freezing temperatures between 25 and 28 degrees occurred. The average duration was around 10 hours. Widespread damage to fruit trees and bushes was noted across the county. Winter wheat, barley, and hay grasses were also damaged.
April 10, 2016	Frost/Freeze	Freezing temperatures between 28 and 30 degrees occurred. The average duration was around 4 hours. Widespread damage to fruit trees and bushes was noted across the county. Winter wheat, barley, and hay grasses were also damaged.
January 7, 2017	Heavy Snow	Snowfall totals were generally between 8 inches and 11 inches across the county. Strong north winds affected the area, producing some blowing snow and reduced visibilities. Princess Anne reported 10.5 inches of snow.
December 8, 2017	Winter Storm	Snowfall totals ranged between three inches and five inches across the county. Princess Anne (4 WSW) reported 5.0 inches of snow. Oriole (2 E) reported 3.9 inches of snow. Deal Island reported 3.1 inches of snow.
January 3, 2018	Blizzard	Snowfall totals ranged between six inches and twelve inches across the county. Very strong north to northwest winds of 30 to 45 mph affected the area, producing blowing snow and poor visibilities. Eden reported 11.5 inches of snow. Travel and clean up were severely hampered by significant drifting of snow.
March 21, 2018	Winter Weather	Snowfall totals ranged between one inch and three inches across the county. Princess Anne (2 SSW) reported 2.0 inches of snow.
December 9, 2018	Winter Weather	Snowfall totals generally ranged between one half inch and two inches across the county.
January 12, 2019	Winter Storm	Snowfall totals generally ranged between two inches and four inches across the county. Monie (2 ENE) reported 3.5 inches of snow. Princess Anne (2 SSW) reported 2.3 inches of snow.
February 1, 2019	Winter Weather	Snowfall totals generally ranged between one half inch and one inch across the county. Princess Anne reported 0.9 inch of snow.
January 31, 2021	Winter Weather	Snowfall totals generally ranged between one inch and three inches across the county. Snowfall total of 3.0 inches was reported at (2 S) Marion Station and (2 SSW) Princess Anne. Snowfall total of 2.6 inches was reported at (1 ENE) Crisfield.
February 6, 2021	Winter Weather	Snowfall totals generally ranged between one half inch and one inch across the county.
February 11, 2021	Winter Weather	Snowfall totals generally ranged between two inches and four inches across the county. Snowfall total of 3.5 inches was reported at (1 NE) Princess Anne. Snowfall total of 3.1 inches was reported at (2.1 SSW)

Table 10-1: Winter Storm Events, 2010 to 2022		
Date	**Event**	**Event Narrative**
		Princess Anne. Snowfall total of 2.0 inches was reported at (2 NNW) Marion Station.
February 13, 2021	Winter Weather	Light freezing rain or freezing drizzle resulted in ice accretion between a trace and 0.20 inch across the county. A few trees and power lines were downed, with scattered power outages reported due to the ice accretion.
February 18, 2021	Winter Weather	Ice accretions between a trace and 0.20 inch, along with sleet accumulations between 0.5 inch and 1.0 inch were reported. A few trees and power lines were downed, with some scattered power outages reported.
January 3, 2022	Winter Storm	Snowfall totals generally ranged between three inches and six inches across the county. Snowfall total of 5.8 inches was reported at Marion Station.
January 21, 2022	Winter Storm	Snowfall totals generally ranged between one inch and two inches across the county. Snowfall total of 1.5 inches was reported at (1 ENE) Crisfield. Snowfall total of 1.5 inches was reported at Marion Station. Snowfall total of 1.4 inches was reported at (2 SSW) Princess Anne.
January 28, 2022	Winter Storm	Snowfall totals generally ranged between six inches and ten inches across the county. Snowfall total of 10.0 inches was reported at (2 NNW) Marion Station. Snowfall total of 8.0 inches was reported at Princess Anne.
Source: NWS, NCEI (NOAA) Storm Events Database, 2010 to June 2, 2022.		

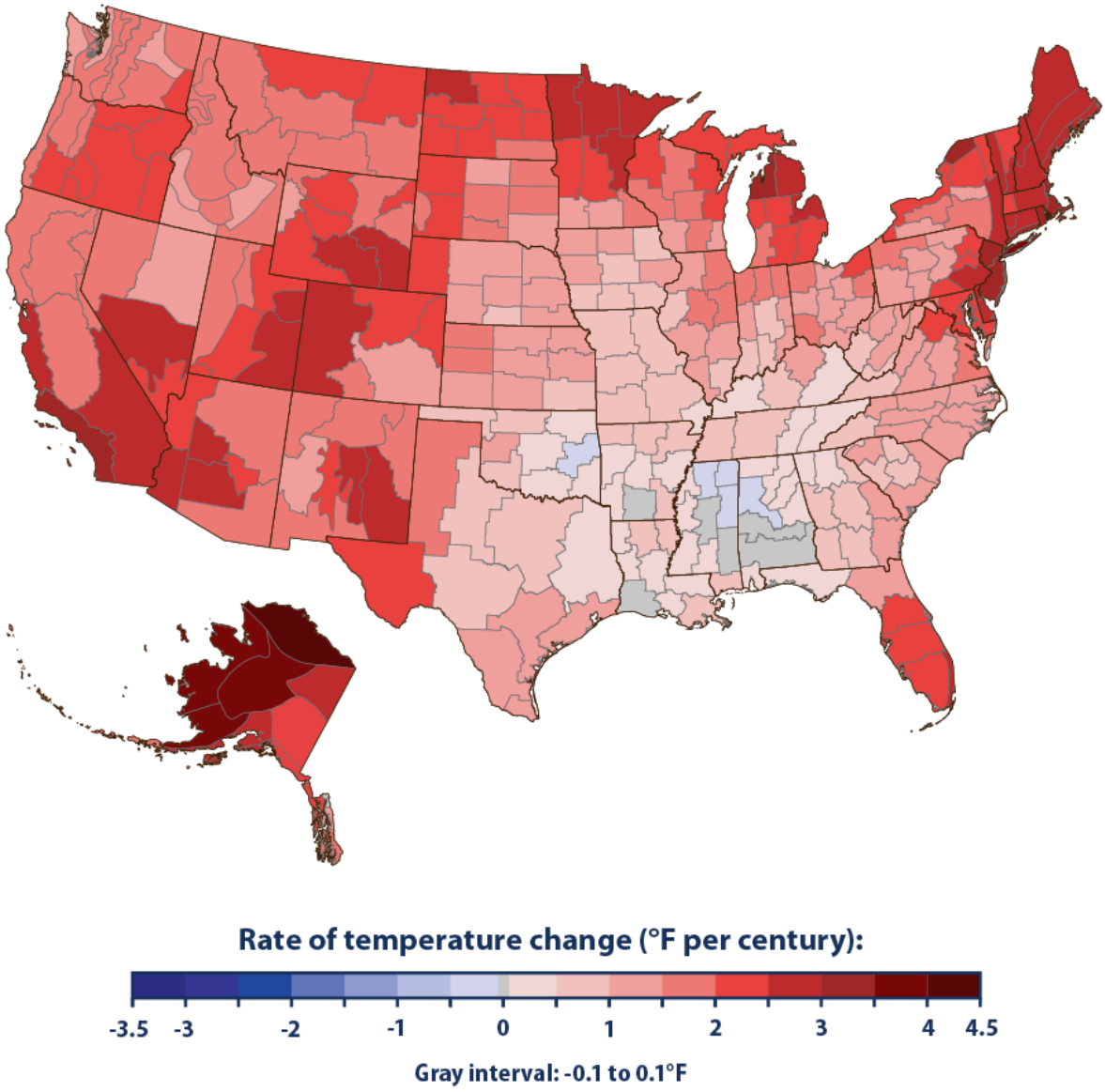
10.3 County Perspective

Due to the normally warmer temperatures and low snowfall amounts experienced by Somerset County, the *2021 State of Maryland Hazard Mitigation Plan* ranked the winter storm hazard as "Medium" risk. The 2022 HMPC agreed and assessed the winter storm hazard as a "Medium" risk.

Note: Full results of the hazard identification and risk assessment completed for winter storm and other natural hazards identified within this plan are included in *Appendix A*.

The Environmental Protection Agency (EPA), utilizing National Center for Environmental Information (NCEI) data, has published data regarding the rate of annual average temperature change in the United States from 1901 to 2021. As depicted in Figure 10-2 on the following page, the rate of annual average temperature change for Somerset County has changed (increased) between 2.0 and 2.5 degrees Fahrenheit.[i]

According to NCEI data, a significant winter storm occurs almost three times annually. Significant snowstorms can be hazardous to the County considering essential services, such as emergency services, and critical facilities could be disrupted. Additionally, inadequate snow removal equipment could exacerbate the effects of snow events in the County, particularly severe winter storm events.



Source: NOAA (National Oceanic and Atmospheric Administration). 2021. Climate at a glance. www.ncei.noaa.gov/cag

Furthermore, residential structures built prior to 1967 are highly vulnerability to the effects of winter storms. This is due to the lack of building codes in effect at the time they were built, the type of construction utilized, and the potential state of disrepair/lack of maintenance of these structures. Even though the average snowfall is between 10-15 inches, depending on the stability of these structures, the slightest snow-load could cause considerable damage to the structure.

In terms of critical roadways, many of the local waterways are tidally influenced and consist of brackish water which rarely freezes on roads. However, although an extremely rare occurrence, sometimes the waterway between Smith Island and the mainland can freeze over during a severe winter storm, requiring the services of an ice-breaker and/or rescue vessel courtesy of the Department of Natural Resources (DNR) or the U.S. Coast Guard.

Finally, as discussed in *Chapter 2: County Profile*, the non-English speaking segment of the population has increased in the past twenty five years. The English language barrier adds an isolation factor when power outages occur during severe storms. This causes a challenge for proper information dissemination to all segments of the County's population. Therefore, public awareness efforts should accommodate both English and non-English speaking communities. Public outreach campaigns to target non-English speaking communities should be conducted periodically.

10.4 Municipal Perspective

Winter storms in Somerset County are normally widespread and affect the municipalities in much the same way as they do the County in general. There are occasions when ice or snow may be heavier in one part of the County, but for the most part the towns are similar to the County in terms of winter storm effects.

In recent years, the most significant winter storm recorded for the municipalities in terms of snow fall totals, high winds, and overall wintry conditions occurred on January 7, 2017. Princess Anne reported up to 10.5 inches of snowfall and the City of Crisfield reported high wind and white out conditions. Another notable winter storm in the last decade occurred on January 30, 2010. The City of Crisfield reported 11 inches of snow, while the Town of Princess Anne received 9.5 inches. Heavy snowfall such as this can be detrimental to these areas by immobilizing emergency vehicles or closing evacuation routes. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold, which can result in closed highways, flooding, downed power lines, hypothermia, and more. Refer to Table 10-1 for more winter storm event narratives.

Pictured above: January 30, 2010, Snowstorm.

10.5 Essential Facilities

Vulnerability to the effects of winter storms on buildings depends on the age of the building (and the building code in effect or lack of building code at the time of construction), type of construction, and condition of the structure (how well it has been maintained). Facilities with flat roofs may be considered vulnerable, as well. Low slope roofs retain snow more so than pitched roofs. However, roof pitches as low as 10 degrees have been observed to shed snow. Therefore, essential facilities constructed prior to the current building codes that also have flat roofs are at-risk to winter storm events. Essential facilities are those facilities that must continue to operate for a community to effectively respond to, and recover from, a hazard

incident. Essential facilities include: Emergency Operation Center(s), Fire and Rescue Stations, Police, Schools, and Medical facilities. As shown on Table 10-2, one (1) of the four (4) essential facilities located within the unincorporated areas of the County was constructed in 1967 or prior, has a flat roof, and therefore may be at a higher risk.

Two (2) essential facilities located in Crisfield are at-risk to winter storm impacts, while five (5) essential facilities are within the Town of Princess Anne. Improvement value of all essential facilities that could be impacted by a winter storm event is $92,012,700.

Table 10-2: Essential Facilities Constructed Prior to 1967 by Roof Design

Location	Facility Type	Facility Name	Flat Roof	Improvement Value
County	Fire	Marion Fire Dept.	Yes	$301,700
County	Medical	Somerset County Health Dept.	No	$2,189,600
County	Fire	Deal Island/Chance Fire Dept.	No	$149,600
County	Fire	Ewell Fire Dept.	No	$350,600
Crisfield	School	Crisfield H.S.	Yes	$3,992,500
Crisfield	Fire	Crisfield Fire Dept.	Yes	$262,100
Crisfield	Police	Crisfield Police	No	$125,200
Princess Anne	EOC	EOC	Yes	$888,900
Princess Anne	School	Princess Anne E.S.	Yes	$1,905,300
Princess Anne	School	Greenwood E.S.	Yes	$1,142,400
Princess Anne	Medical	TidalHealth FamilyLab	Yes	$262,800
Princess Anne	Police	Princess Anne Police	No	$239,100
Princess Anne	Fire	Mt. Vernon Fire Dept.	No	$202,900
Princess Anne	School	U. of MD Eastern Shore	*Yes	$80,000,000
			Total Value:	**$92,012,700**

**The campus is a mixture of structures with flat and sloped roofs.*

Source: Somerset County 2022 Critical & Public Facilities Database and Improvement Values From 2017 Maryland Property View (last updated July 2020).

10.6 Mitigation Efforts

The Maryland Department of Transportation (MDOT) State Highway Administration (SHA) and the County's Roads and Waterways Department, as well as the City of Crisfield and the Town of Princess Anne, have dealt with occasional winter storms for many years and are trained and equipped to do so. The County's Roads Department does not normally use salt on County roadways, but the SHA uses salt and/or brine water on state-owned highways and prioritizes treating bridges first as they freeze first during a winter storm event. The County's Department of Emergency Services and the local police, fire, and rescue departments are also trained to deal with winter storms and the types of situations that result from these storms.

According to FEMA, most buildings are not at risk of snow-induced failure. Often, attempting to remove snow from a roof is more hazardous than beneficial, posing a risk to both personnel and the roofing structure. Buildings may be vulnerable to structural failure and possible collapse if basic preventative steps are not taken in advance of a snow event. The County's Building Code contains snow-loading and wind-load requirements for new structures.

Essential facilities listed in Table 10-2 above should assess and ensure proper maintenance is enforced to mitigate winter storm related issues. Disruption may be avoided through mitigation strategies and action implementation.

In recent years, an Energy Code was mandated that has significantly reduced impacts from severe winter storms. The County's electrical providers (e.g., Delmarva Power, Choptank Electric, and Old Dominion) have made major safety improvements to their transmission lines and substations which has dramatically reduced the risk of power outages.

Finally, the County has increased public outreach to the local non-English speaking population, as introduced in Section 10.3. The County's Code Red notification system can be set to Spanish, and news releases are sent to the Spanish-speaking radio stations.

10.7 Future Conditions

According to Climate Communication Science and Outreach (www.climatecommunication.org), climate change is fueling an increase in the intensity and snowfall of winter storms. The atmosphere now holds more moisture, and that in turn drives heavier than normal precipitation, including heavier snowfall in the appropriate conditions.

The following list[ii] includes known U.S. winter storm trends as it relates to climate change:

- National Oceanic and Atmospheric Administration (NOAA) scientists, examining 120 years of data, found that there were twice as many extreme regional snowstorms in the U.S. between 1961 and 2010 compared to 1900 to 1960.
- According to the U.S. Fourth National Climate Assessment, "Heavy precipitation events [defined as the heaviest 1 percent of all daily events] in most parts of the United States have increased in both intensity and frequency since 1901."[iii]
- From 1958 to 2016, the amount of precipitation falling in very heavy events (the top 1 percent of all daily precipitation events) increased by 55 percent in the Northeast.[iv]
- The 5th Assessment Report of the Intergovernmental Panel on Climate Change states: It is likely that since about 1950 the number of heavy precipitation events over land has increased in more regions than it has decreased. Confidence is highest for North America and Europe where there have been likely increases in either the frequency or intensity of heavy precipitation with some seasonal and regional variations. It is very likely that there have been trends towards heavier precipitation events in central North America.[v]

Given the above information, planning for more extreme winter weather conditions in the future makes good sense. Undertaking preparedness campaigns, as well as infrastructure and utilities upgrades, and preparedness initiatives will strengthen the County's resilience.

[i] www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature
[ii] www.climatesignals.org/climate-signals/winter-storm-risk-increase

[iii] Donald Wuebbles, David Fahey, and Kathleen Hibbard. U.S. Global Change Research Program. Published date November 3, 2017
[iv] Ibid.
[v] Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.). Cambridge University Press. Published date September 1, 2013