CHAPTER 8: THUNDERSTORM

2022 PLAN UPDATE

Chapter 8: visual and thematic updates were included throughout the chapter, including updates to fonts, colors, and the addition of a cover page.

Page 8-3: Section 8.2 History, Table 8-1 was updated with new thunderstorm wind events occurring within the previous five year planning period (2017 to present).

Page 8-4: Section 8.2.2, Table 8-2 was updated to reflect the addition of two lighting events that have caused property damage within the previous five year planning period (2017 to present).

Page 8-5: Map 8-1 Thunderstorm Wind Events With a Magnitude of 50 Knots or Greater has been added.

Page 8-6: Section 8.2.3, Table 8-3 was updated with new hail events occurring within the previous five year planning period (2017 to present).

Page 8-6: Section 8.3 County Perspective has been updated with the thunderstorm risk ranking from the 2021 State Hazard Mitigation Plan. The State ranks thunderstorm "medium" risk for Somerset County. Somerset County stakeholders rank thunderstorm as "Medium-High" risk.

Page 8-8: Table 8-4 has been reviewed and updated as necessary to reflect changes in the 2022 Critical and Public Facility Database.

Page 8-9: Added Section 8.7 Future Conditions. This section combines the annualized averages for thunderstorm wind events, lighting events, and hail events. It also forecasts the impacts that climate change may have on the rate of severe thunderstorms in the County.

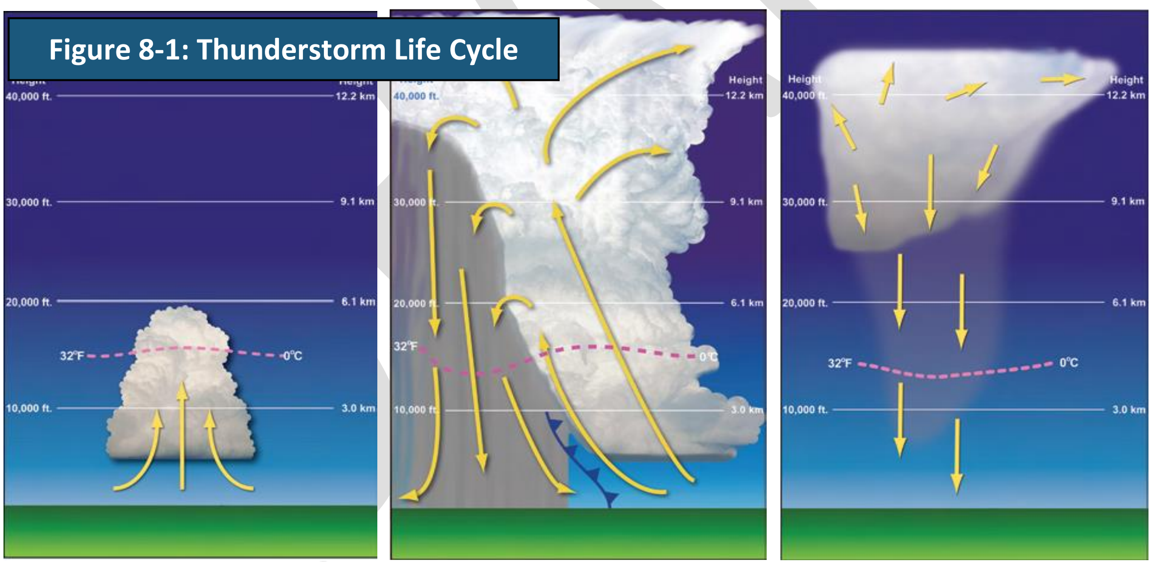
Chapter 8: Thunderstorm

8.1 Hazard Profile

Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that either is forced to rise by mountainous terrain or by colliding with a cooler dense air mass. The process of convection in the atmosphere brings about the release of moisture from the warm air mass as it rises, cools, and condenses. This condensation proceeds until most of the moisture in the air mass has been precipitated. Since the motion of the air is nearly vertical, and attains high velocities, rainfall is intense and generally concentrated over a small area in a short time frame. This formation process, called the “thunderstorm life cycle” is depicted in Figure 8-1. Thunderstorms can be 10-15 miles in diameter and normally last 20 to 30 minutes. Lightning, high winds, and occasionally tornadoes are associated with thunderstorms.

When wind speeds exceed 58 mph, thunderstorms are considered severe. A downburst or sudden descent of cold air during a severe thunderstorm can result in straight line winds up to 134 mph. One of the most extreme hazards from thunderstorms is a lightning strike. Lightning has been known to strike up to 6-10 miles from the storm in an area of clear sky. It is estimated that more than 30,000,000 points on the ground in the continental 48 states are hit by lightning in a single year.

Figure 8-1: Thunderstorm Life Cycle



Developing Stage

- Towering cumulus cloud indicates rising air
- Usually little if any rain during this stage
- Lasts about 10 minutes
- Occasional lightning

Mature Stage

- Most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes
- Storm occasionally has a black or dark green appearance
- Lasts an average of 10 to 20 minutes but some storms may last much longer.

Dissipating Stage

- Downdrafts, downward flowing air, dominate the storm
- Rainfall decreases in intensity
- Can still produce a burst of strong winds
- Lightning remains a danger

Source: Thunderstorm Life Cycle. Available at: www.nssl.noaa.gov/education/svrwx101/thunderstorms/. 2022.

8.1.1 Lightning

Lightning is defined as a sudden and violent discharge of electricity from within a thunderstorm due to a difference in electrical charges and represents a flow of electrical current from cloud-to-cloud or cloud-to-ground. Nationally, lightning strikes cause extensive damage to buildings and structures, kills or injures people and livestock, starts untold numbers of forest fires and wildfires, and disrupts electromagnetic transmissions. Lightning strikes are extremely dangerous during dry lightning storms because people remain outside due to the lack of precipitation; however, lightning is still present during the storm. Lightning strikes usually occur as a result of the thunderstorms that move through the area during the summer months. Peak months for lightning strikes are between May and September.

8.1.2 Hail

Hail is a form of solid precipitation that mostly consists of water (ice) and has been measured between 0.20 inches to 5.9 inches in diameter. The larger hail stones come from severe thunderstorms and can occur within two miles of the parent thunderstorm. Thunderstorms provide the strong, upward motion of air and lower heights for freezing from which hail is formed. The hail stones are suspended in the air by the strong upward motion of air until the weight of the hail overcomes the updraft and falls to the ground. As depicted by Figure 8-2, thunderstorms exhibiting a characteristic green coloration are often capable of producing hail. The velocity at which hail falls to the ground is dependent on several factors: size of the stone, friction in the air, motion of the wind, collisions with other precipitation, and the melting factor. A hail stone measured at 0.39 inches falls at a rate of 20 mph while a larger stone, 3.1 inches in diameter, falls at a rate of 110 mph.

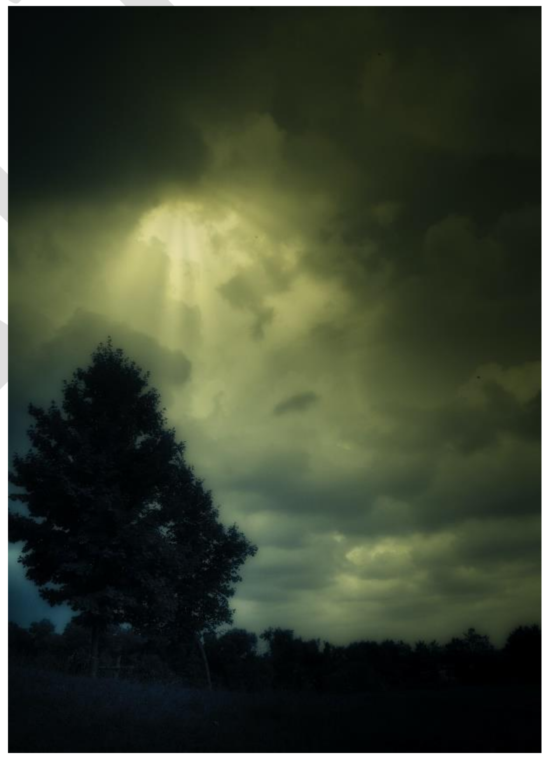


Figure 8-2: Thunderstorms containing hail can exhibit a characteristic green coloration.

8.2 History

8.2.1 Thunderstorm Wind

The NCEI Storm Events Database defines **thunderstorm wind** as “winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage.”

According to the NCEI Storm Events Database, a total of forty-nine (49) thunderstorm wind events have occurred in Somerset County since 1969. This equates to an annual average of 0.91 thunderstorm wind events. Table 8-1 includes only those more recent events with recorded property damage.

Table 8-1: Thunderstorm Wind Events, 2010 to 2022

Location	Date	Event Narrative	Property Damage
Wenona	August 5, 2010	Wind gust of 58 knots (67 mph) was measured at Deal Island CWOP site.	$1,000
Princess Anne	August 5, 2010	Trees and power lines were downed on Warwick Lane.	$2,000
Rehobeth	August 12, 2010	Trees were downed at the intersection of Rehobeth Road and Coventry Road. Power outages were reported.	$2,000
Upper Fairmount	April 5, 2011	A tree was downed on a house.	$2,000
Westover	April 5, 2011	Trees were downed.	$2,000
Manokin	April 5, 2011	Trees and power lines were downed in the Upper Fairmont and Manokin areas.	$2,000
Upper Fairmount	April 16, 2011	Large tree was downed and blocking a roadway.	$1,000
Princess Anne	April 16, 2011	Large tree was downed and blocking a roadway.	$1,000
Crisfield	June 29, 2012	Numerous trees were downed.	$5,000
Westover	June 13, 2012	A downed tree was blocking US Route 13 near Landon Station.	$1,000
Deal Is	June 28, 2013	Wind gust of 52 knots (60 mph) was reported.	$2,000
Eden	June 28, 2013	Trees were downed in Eden. One tree was downed on power lines.	$2,000
Eden	June 28, 2013	Several trees were downed.	$2,000
Crisfield	June 18, 2015	Wind gust of 50 knots was measured at Crisfield.	$1,000
Princess Anne	June 23, 2015	Large tree was downed along Ocean Highway northeast of Princess Anne.	$1,000
Crisfield	August 4, 2015	Several trees were downed.	$2,000
Hopewell	August 4, 2015	Numerous trees were downed between Crisfield and Marion.	$2,000
Princess Anne	June 21, 2016	Trees were downed.	$2,000
Kings Creek	June 21, 2016	Large tree was downed on Princess Anne Road.	$1,000
Crisfield	July 1, 2016	Numerous trees and power lines were downed around Crisfield. A 73 mph wind gust was reported from the Crisfield Weatherflow platform located a couple miles west of town.	$2,000
Marion	July 28, 2016	Phone and power lines were downed.	$2,000
Crisfield	April 26, 2019	Roof was blown off of a building at Somers Cove in Crisfield. Winds were estimated at 60 mph or stronger. Boats on trailers were overturned.	$8,000
Marion	April 26, 2019	Wind gust of 57 knots (66 mph) was measured near Marion Station.	$2,000

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Table 8-1: Thunderstorm Wind Events, 2010 to 2022			
Location	**Date**	**Event Narrative**	**Property Damage**
Jason	June 2, 2019	Trees were downed onto power lines in the area of Wildwood Trail.	$2,000
Cokesbury	June 2, 2019	Trees were downed along Courthouse Hill Road between Cokesbury and Pocomoke City.	$2,000
Princess Anne	June 5, 2019	Trees were blown down at a residence just east of Princess Anne.	$2,000
St. Stephen	July 22, 2019	Numerous trees were downed between Deal Island and Dames Quarter. Several power outages were also reported in the area.	$2,000
Upper Hill	July 28, 2020	Tree was downed onto a power line at Hood Road.	$1,000
Princess Anne	August 25, 2020	Tree was downed near the intersection of Route 13 and Stewart Neck Road.	$1,000
		Total:	**$58,000**
Source: NWS, NCEI (NOAA) Storm events Database, 2010 to July 6, 2022.			

The locations of these thunderstorm wind events are depicted on Map 8-1, on the following page. These events are well dispersed throughout the County and its municipalities.

8.2.2 Lightning

The NCEI Storm Events Database defines **lightning** as "a sudden electrical discharge from a thunderstorm, resulting in fatality, injury, and/or damage." The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud.

According to the NCEI Storm Events Database, a total of three (3) lightning events causing property damage have occurred in Somerset County since 2010. This equates to an annual average of 0.23 lightning events. Table 8-2 includes descriptive information for these three events.

Table 8-2: Lighting Events, 2010 to 2022			
Location	**Date**	**Event Narrative**	**Property Damage**
Mt. Vernon	August 12, 2010	Lightning struck the Mount Vernon Fire Department building which caused the loss of power and communications.	$3,000
Eden	June 21, 2016	Lightning strike produced a house fire.	$5,000
Costen	July 23, 2017	Lightning strike caused damage to a storage shed.	$3,000
		Total:	**$11,000**
Source: NWS, NCEI (NOAA) Storm events Database, 2010 to July 6, 2022. Note: No lighting events are recorded within the NCEI database prior to 2010.			

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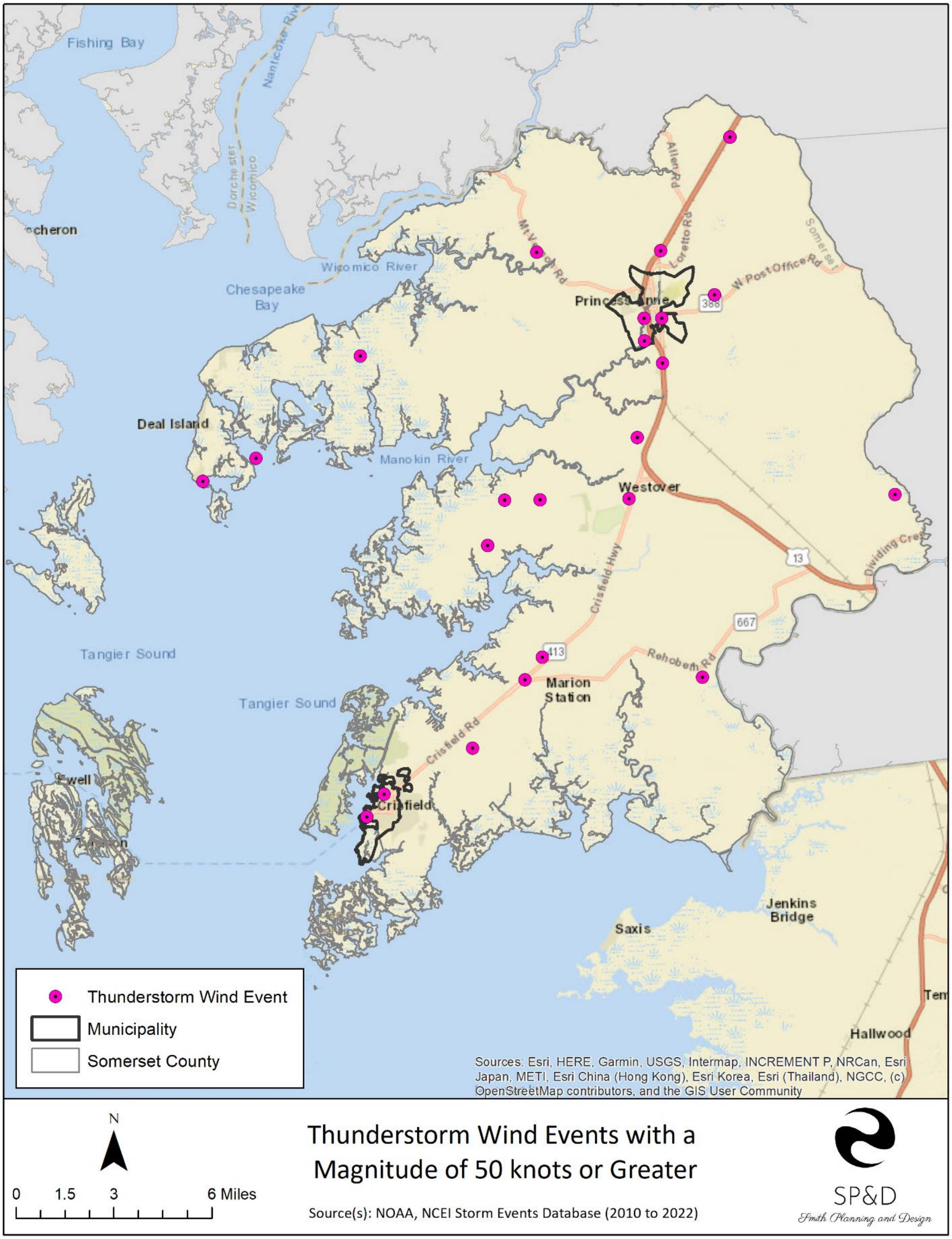
Map 8-1: Significant Thunderstorm Wind Events



8.2.3 Hail

The NCEI Storm Events Database defines **hail** as "frozen precipitation in the form of balls or irregular lumps of ice."

According to the NCEI Storm Events Database, a total of fifteen (15) hail events have occurred in Somerset County since 1962. This equates to an annual average of 0.25 hail events. Table 8-3 details hail events occurring within the last thirty years.

Table 8-3: Hail Events, 2000 to 2022

Location	Date	Event Narrative	Magnitude (inches)
Somerset	June 24, 1992	No Report.	1.75
Somerset	June 24, 1992	No Report.	1.75
Westover	May 1, 1997	No Report.	1.75
Princess Anne	June 16, 1998	No Report.	1.75
Princess Anne	April 9, 1999	No Report.	1.25
Crisfield	May 24, 1999	No Report.	0.75
Princess Anne	April 21, 2000	0.75 inch hail reported at Princess Anne	0.75
Manokin	April 21, 2000	1.00 inch diameter hail reported at Manokin.	1.00
Princess Anne	May 22, 2001	No Report	0.75
Crisfield	June 12, 2007	Quarter size hail fell at Crisfield Marina. Scattered thunderstorms produced large hail over southern Maryland.	1.00
Loretto	June 4, 2008	Nickel to quarter size hail was reported just north of Princess Anne. Scattered severe thunderstorms produced damaging winds and large hail across portions of the Lower Maryland Eastern Shore.	1.00
Princess Anne	June 4, 2008	Quarter size hail was reported in Princess Anne. Scattered severe thunderstorms produced damaging winds and large hail across portions of the Lower Maryland Eastern Shore.	1.00
Princess Anne	June 19, 2008	Nickel size hail was reported. Isolated severe thunderstorm produced large hail across portions of the Lower Maryland Eastern Shore.	0.88
Crisfield	August 2, 2008	Penny size hail was reported at Crisfield marina. Isolated severe thunderstorm in advance of a cold front produced large hail across portions of the Lower Maryland Eastern Shore.	0.75
Crisfield	August 2, 2008	Nickel size hail was covering the ground. Isolated severe thunderstorm in advance of a cold front produced large hail across portions of the Lower Maryland Eastern Shore.	0.88
Crisfield	June 2, 2009	Nickel size hail was reported at Crisfield Marina. Isolated severe thunderstorm well in advance of a cold front produced large hail in Somerset County on the Lower Maryland Eastern Shore.	0.88
Westover	May 12, 2018	Ping pong ball size hail was reported.	1.50

Source: NWS, NCEI (NOAA) Storm events Database, 1992 to July 6, 2022.

8.3 County Perspective

Somerset County is affected primarily by thunderstorm activity through the interaction of warm and cool air masses along frontal systems. Thunderstorms are more common in the spring when frontal zones are passing over the County from west to east and during the summer months when warm, moist air is lifted over the eastern shore by differential heating of the land and surrounding water. Intense thunderstorms can result in rapid runoff, particularly in the headwaters of small stream basins.

The *2021 State Hazard Mitigation Plan* ranks Somerset County's risk for thunderstorm as "Medium." As part of this plan update, a Hazard Identification and Risk Assessment (HIRA) was conducted for the thunderstorm hazard.

A composite scoring method was utilized to rank natural hazards, which included five (5) key components: historical impacts (in terms of human lives and property), geographic extent, historical occurrences, future probability, and community perspective.

Based on this method, thunderstorm was assigned a ranking of "Medium-High" during the 2022 plan update. This represents a slight increase compared to thunderstorm's ranking of "medium" in the 2017 Plan. The future probability of a thunderstorm event is considered "highly likely", as determined by the HIRA.

Note: Full results of the HIRA, including method, are included within *Appendix A: Hazard Identification and Risk Assessment* of this plan.

8.4 Municipal Perspective

The municipalities in Somerset County face the same threat from thunderstorms as the County. In some cases, inadequate stormwater management facilities in older developed areas contribute to damage from flash flooding in low-lying residential areas downslope from new construction.

8.5 Critical & Public Facilities

Regarding critical and public facilities at-risk, communication towers are especially vulnerable to lightning strikes. According to IWCE's Urgent Communications, the consequences of a loss are not simply related to the cost of replacing the equipment, but also to the loss of service. When contemplating protection against these losses, the site's transmission lines are a critical consideration, as they provide direct conductive paths from the top of the tower to the equipment below.[i]

A communication tower may be hit by lightning at its highest point, the antenna, however this will not only "fry" the antenna but, without surge protection, can travel into the very expensive base station equipment housed in the equipment building. Surge events are not only caused by hits to towers or antennas. At base transceiver station (BTS) sites, lightning strikes within a few hundred yards of a tower are just as dangerous as direct hits, as they may induce high-energy electromagnetic fields onto the feeder lines. Therefore, it is necessary to design a system that protects the electronic equipment from a surge on the feeder lines, regardless of the source.

Critical and/or public facilities, specifically communication towers, have been assessed for vulnerability to lightning events. A total of eight (8) communication towers are within the unincorporated areas of the County. The Town of Princess Anne contains eleven (11) communication towers, while three (3) are located within the City of Crisfield. These at-risk critical and public facilities are included in Table 8-4, below.

Table 8-4: Critical and Public Facilities At-Risk			
Location	**Facility Type**	**Facility Name**	**Address**
County	Utility	Verizon Telephone	10157 Deal Island Road
County	Utility	Telephone	20884 Caleb Jones Road
County	Utility	Marion 911 Tower	25873 Hudson Corner Road
County	Utility	Communication	28927 Irene Whittington Road
County	Utility	Telecom Tower	31330 Eden Allen Road
County	Utility	Telecom Verizon Tower	5718 Tullis Corner Road
County	Utility	Telephone	5722 Tulls Corner Road
County	Utility	Telecom Verizon Tower	Kingston Lane
Crisfield	Utility	Crisfield 911 Tower	600 W Main Street
Crisfield	Utility	Telephone	Charlotte Avenue
Crisfield	Utility	Telephone & Wireless Tower	N. Of Potomac St @ Myrtle Street
Princess Anne	Utility	Telephone	11732 Church St
Princess Anne	Utility	Telecom Verizon Tower	11916 Somerset Ave
Princess Anne	Utility	Telecom Tower	12611 Recycle Dr.
Princess Anne	Utility	Communication	27440 Mt Vernon Road
Princess Anne	Utility	Communication	28490 Deal Island Road
Princess Anne	Utility	State Police Telecom Tower	30581 Perry Road
Princess Anne	Utility	Telecom Verizon Tower	30880 W Post Office Road
Princess Anne	Utility	Telecom Tower	30939 McCormick Swamp Road
Princess Anne	Utility	Telecom Tower	31305 Peggy Neck Road
Princess Anne	Utility	Telecom Tower	9600 Arden Station Road
Princess Anne	Utility	Telephone	Old Westover Marion Road
Source: 2022 Somerset County Critical and Public Facility Database.			

8.6 Mitigation Efforts

As mentioned in the *Chapter 4: Flood,* the County enforces its Floodplain Ordinance in mapped floodplain areas which are prone to stormwater runoff and requires a setback from un-mapped streams. In addition, the Stormwater Management Ordinance requires storage and release of runoff at predetermined rates in newly developing areas. Erosion and sediment control measures are required of new development to protect downstream properties during construction.

Impacts to communication towers are especially problematic during a hazard event; however, actions have been implemented to address and mitigate this issue from reoccurring. The twenty-one (21) communication towers listed above should be assessed for proper grounding and surge protection. A properly grounded transmission system and surge protection should be installed to ensure service is not interrupted during a thunderstorm (i.e., lighting strike) event. Proper grounding and surge protection are small investments compared to the system replacement cost following a lightning strike. This has been completed for the Somerset County Department of Emergency Services, 9-1-1 communications center.

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8.7 Future Conditions

The thunderstorm hazard is comprised of thunderstorm wind events, lighting events, and hail events. Combining the annualized averages for each of these events provides a potential probability of future occurrence for the thunderstorm hazard as a whole. Events gathered from the NCEI Storm Events Database indicate that, in total, 67 thunderstorm events have occurred in Somerset County since 1962. Therefore, Somerset County can expect to experience approximately 1.10 thunderstorm events per year.

Climate modeling predicts that conditions conducive to severe thunderstorms will arise more often as the Earth warms[ii]. Modeling suggests that weather conditions which lead to severe storms will arise 5% to 20% more often per one degree Celsius of global temperature change, primarily due to increased atmospheric instability[iii].

However, because severe storms do not always arise even in the most favorable conditions, any associated increase in severe thunderstorms is expected to be smaller. Compared with other regions, the Northern Hemisphere is predicted to experience the largest increase in convective environments (i.e., environments favorable to creating severe storms)[iv].

Given this information, the future annual average rate of thunderstorms can be estimated for Somerset County given two possible scenarios. The most conservative scenario – a 5% increase in severe weather conditions – would mean Somerset County would average approximately 1.16 thunderstorm events per year. In the most extreme scenario – a 20% increase in severe weather conditions – Somerset County would average approximately 1.32 thunderstorm events per year.

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[i] urgentcomm.com/2007/12/01/dont-mess-with-mother-nature/

[ii] eos.org/research-spotlights/rising-trend-predicted-for-conditions-linked-to-severe-storms

[iii] Projecting Global Mean Sea-Level Change Using CMIP6 Models. Tim H. J. Hermans, Jonathan M. Gregory, Matthew D. Palmer, Mark A. Ringer, Caroline A. Katsman, Aimée B. A. Slangen.

[iv] Ibid.

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