4.9 Hailstorm

4.9.1 Hazard Profile

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and subsequent cooling of the air mass. During summer months, when the difference between ground and upper-level temperatures is significant, hail may develop. The size of the hailstones is directly related to the severity and size of the storm. Hail is described as chunks of ice, often in a spherical or oblong shape, that is produced by thunderstorms. The size of the hail greatly affects the magnitude or severity of the damage.

4.9.1.1 Geographic Location and Extent

Hailstorms are not confined to any specific geographic location and can vary greatly in terms of size, location, intensity, and duration. The entire CVPDC area is considered to be exposed to this hazard equally.

4.9.1.2 Magnitude or Severity

The National Weather Service classifies a storm as "Severe" if hail of three-quarters of an inch in diameter (approximately the size of a penny) or greater is present. The size determination is based on radar intensity or as seen by observers. The intensity category of a hailstorm depends on its size and the potential damage it could cause, as depicted in the NCEI Intensity Scale (Table 4-133). [52]

4.9.1.3 Previous Occurrences

NOAA releases monthly and annual severe weather report summaries about tornadoes, wind damage, and large hail (Figure 4-123). In 2019, among the 1,199 total severe weather reported in Virginia, there were 88 large hail events.[53] There were 167 hail events reported between 2009 and 2019 in the CVPDC area, including two occurrences of large hail with more than two inches in diameter.

On July 23, 2016, there were severe thunderstorms that impacted this area. A nearly stationary boundary over Bedford County interacted with a very warm and unstable air mass, triggering multiple rounds of severe storms. This prolonged severe weather event started in the morning and continued well into the evening. Multiple reports of hail ranging from a quarter to baseball-sized were reported. Some cars were damaged.[54]

Table 4-133 Hail Intensity and Magnitude

Size Code	Intensity Category	Size (Diameter Inches)	Descriptive Term	Typical Damage
H0	Hard Hail	Up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33 - 0.60	Marble	Slight damage to plants and crops
H2	Potentially Damaging	0.60 - 0.80	Dime	Significant damage to plants and crops

[52] Since the 2013 plan, the National Climatic Data Center – NCDC – has been renamed as the National Centers for Environmental Information, or NCEI

[53] https://www.spc.noaa.gov/climo/online/monthly/states.php?month=00&year=2019&state=VA

[54] https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=642765

Size Code	Intensity Category	Size (Diameter Inches)	Descriptive Term	Typical Damage
H3	Severe	0.80 - 1.20	Nickel	Severe damage to plants and crops
H4	Severe	1.2 - 1.6	Quarter	Widespread glass and auto damage
H5	Destructive	1.6 - 2.0	Half dollar	Widespread destruction of glass, roofs, and risk of injuries
H6	Destructive	2.0 - 2.4	Ping pong ball	Aircraft bodywork dented and brick walls pitted
H7	Very Destructive	2.4 - 3.0	Golf ball	Severe roof damage and risk of serious injuries
H8	Very Destructive	3.0 - 3.5	Hen egg	Severe damage to all structures
H9	Super Hailstorms	3.5 - 4.0	Tennis ball	Extensive structural damage could cause fatal injuries
H10	Super Hailstorms	4.0 +	Baseball	Extensive structural damage could cause fatal injuries

Figure 4-124, Figure 4-125, Figure 4-126, Figure 4-127, Figure 4-128, and Figure 4-129 are maps of recorded hail events between 1959 and 2018 provided by the Storm Prediction Center Severe Weather GIS (SVRGIS) for CVPDC area and each jurisdiction. [55] The color gradient represents a kernel density calculated using wind magnitudes of occurrence points of all historical hail events. The darker color represents areas that have experienced an increased number of events and severity. Highlighted points represent occurrence in the CVPDC area. Please note that the more rural parts of the CVPDC area may be underrepresented due to how the data is collected (using observations).

[55] The latest SVRGIS data doesn't map the hail events for 2019.

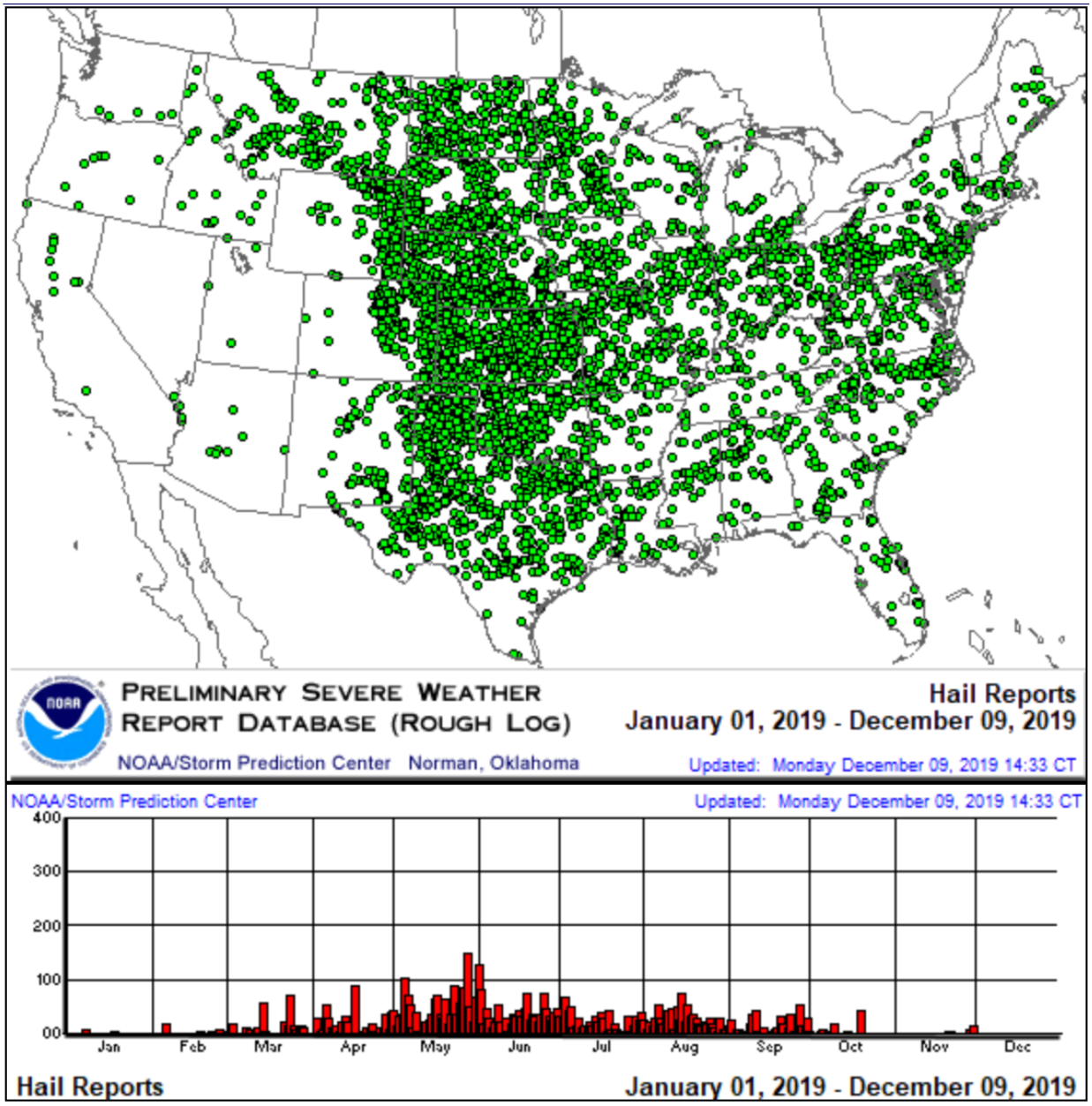


Figure 4-123 Large Hail Event in the United States in 2019.

(Source: NOAA Annual Severe Weather Report Summary)

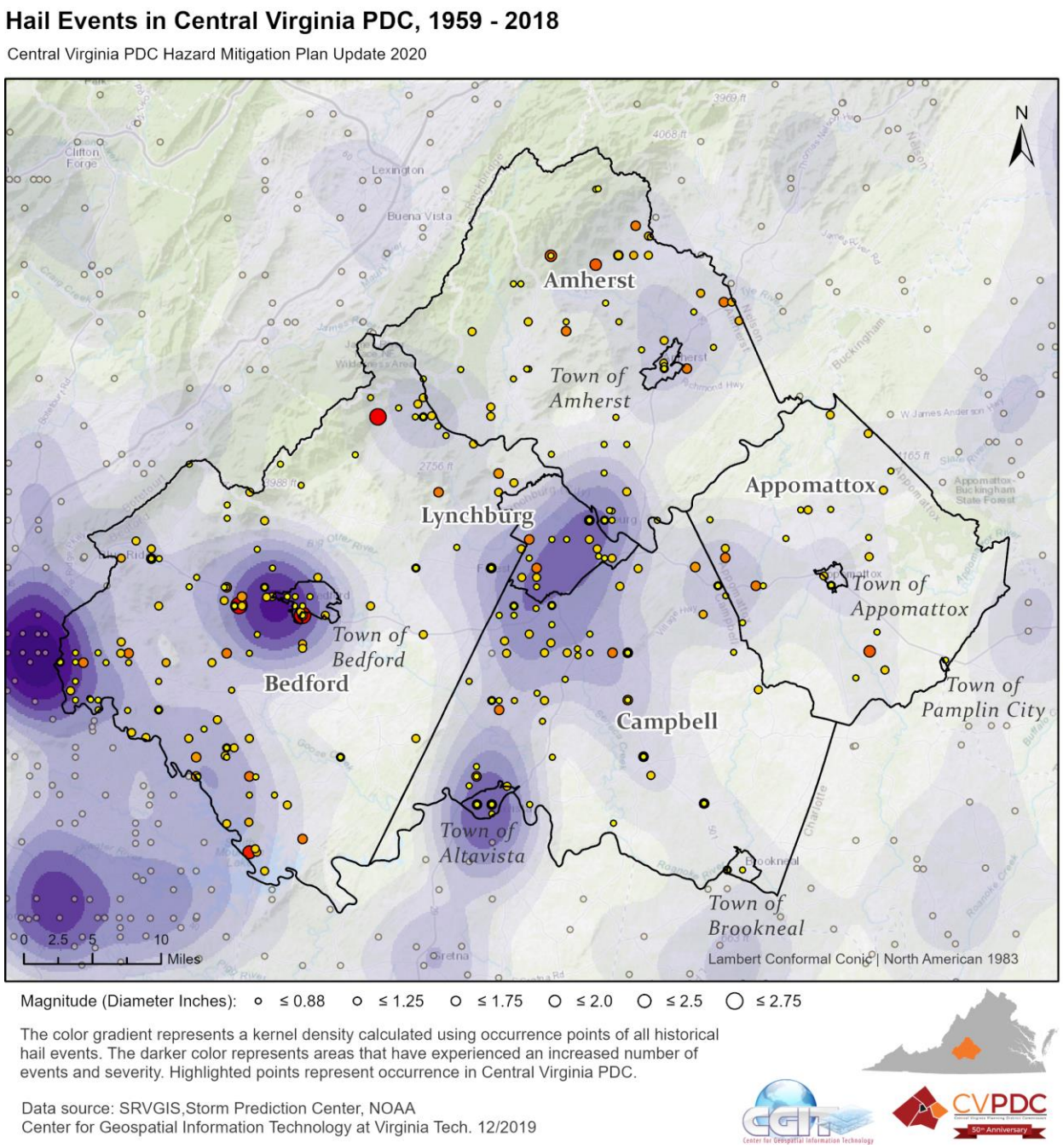


Figure 4-124 Hail Events in CVPDC Area, 1959 - 2018

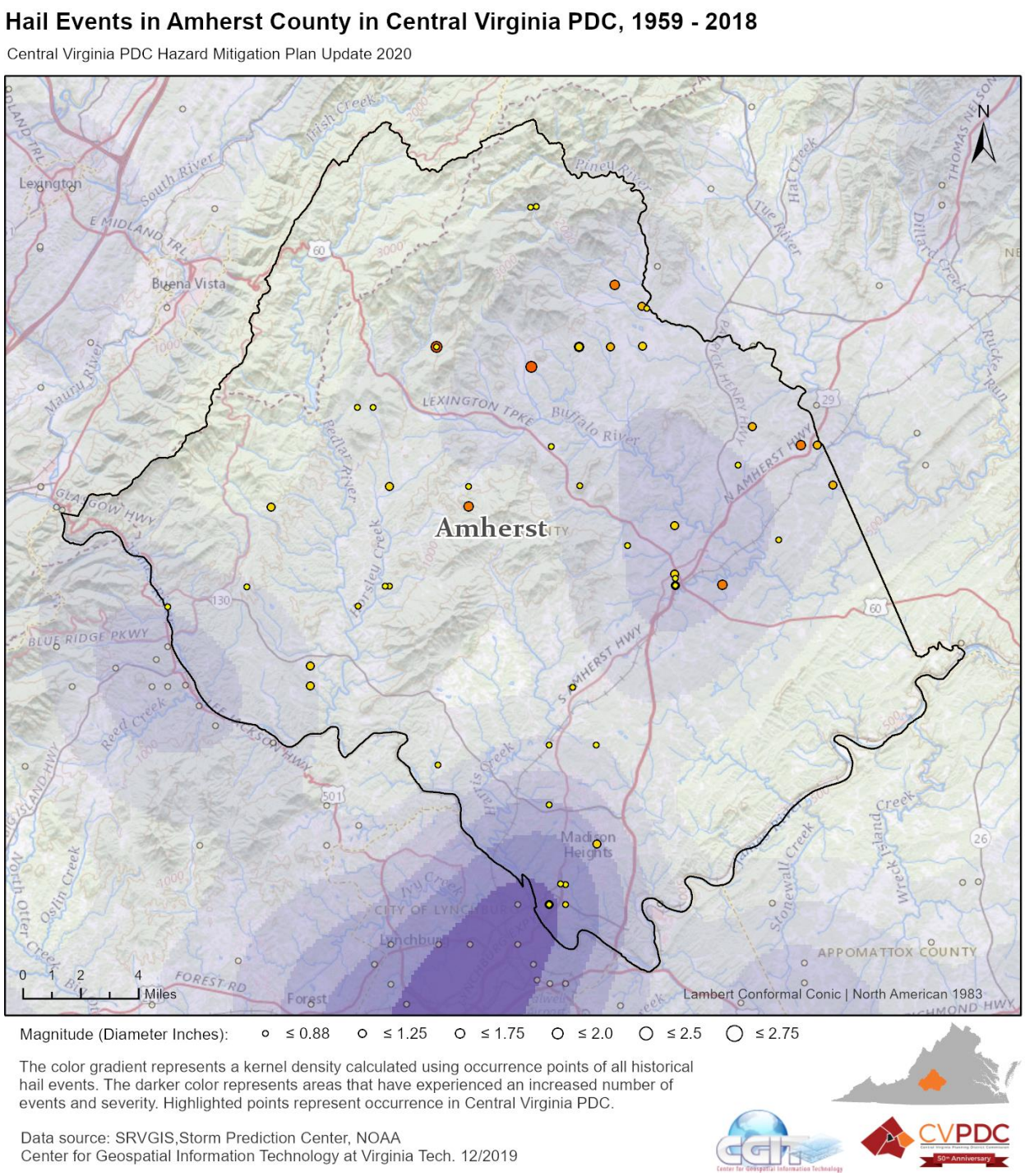
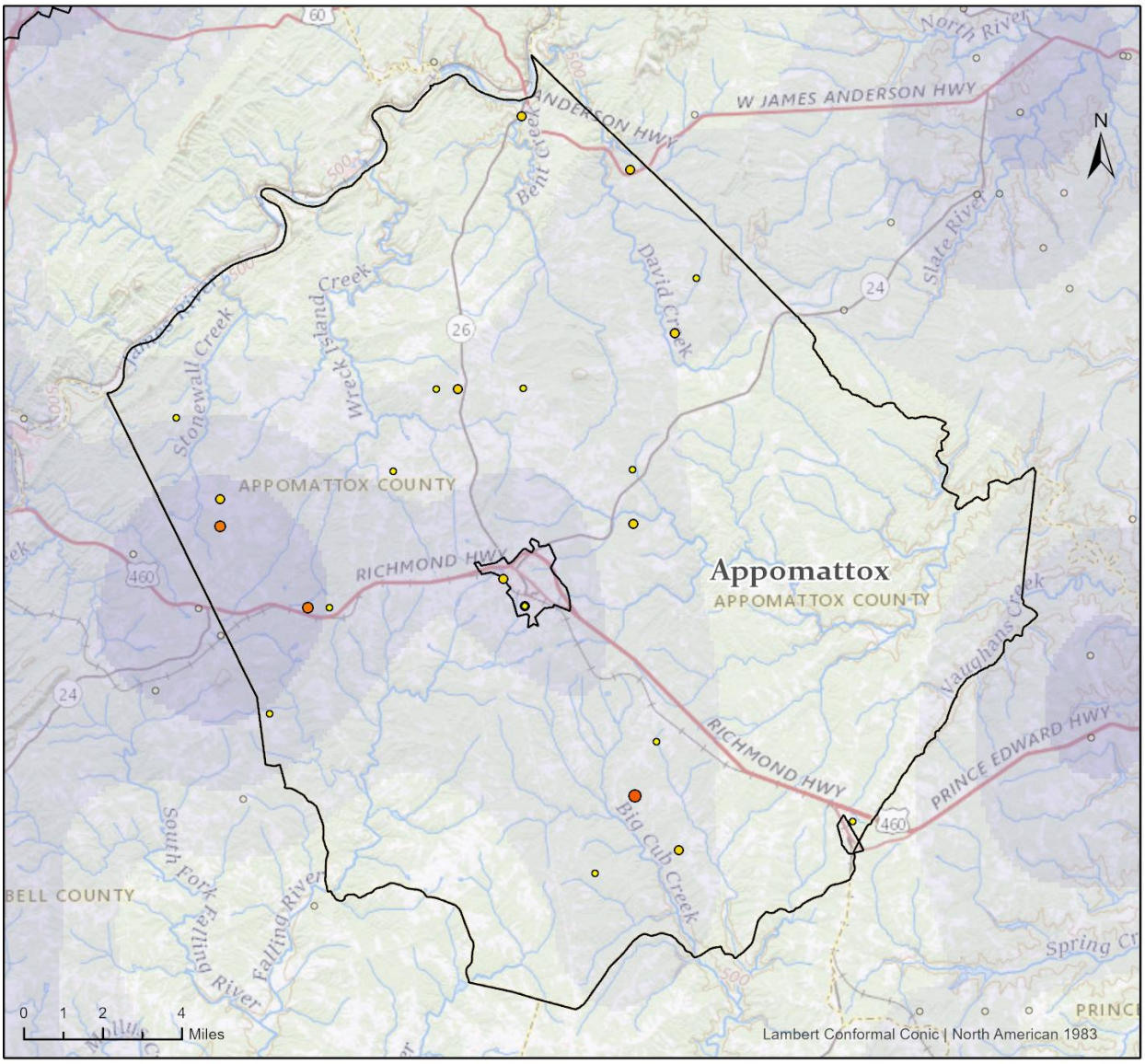


Figure 4-125 Hail Events in Amherst County in CVPDC Area, 1959 - 2018

Hail Events in Appomattox County in Central Virginia PDC, 1959 - 2018

Central Virginia PDC Hazard Mitigation Plan Update 2020



Magnitude (Diameter Inches): ≤ 0.88 ≤ 1.25 ≤ 1.75 ≤ 2.0 ≤ 2.5 ≤ 2.75

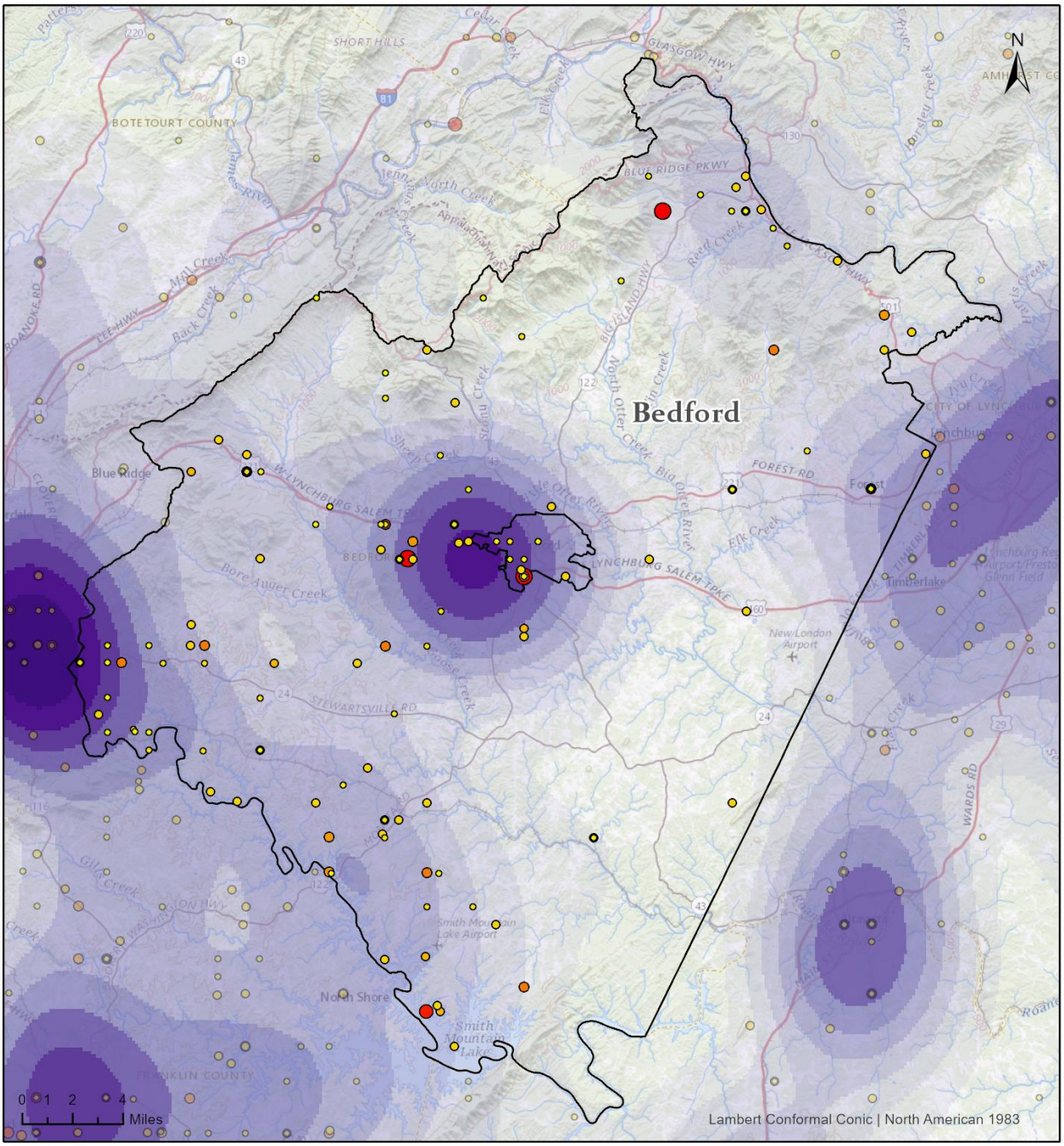
The color gradient represents a kernel density calculated using occurrence points of all historical hail events. The darker color represents areas that have experienced an increased number of events and severity. Highlighted points represent occurrence in Central Virginia PDC.

Data source: SRVGIS,Storm Prediction Center, NOAA
Center for Geospatial Information Technology at Virginia Tech. 12/2019

Figure 4-126 Hail Events in Appomattox County in CVPDC Area, 1959 - 2018

Hail Events in Bedford County in Central Virginia PDC, 1959 - 2018

Central Virginia PDC Hazard Mitigation Plan Update 2020



Magnitude (Diameter Inches): ≤ 0.88 ≤ 1.25 ≤ 1.75 ≤ 2.0 ≤ 2.5 ≤ 2.75

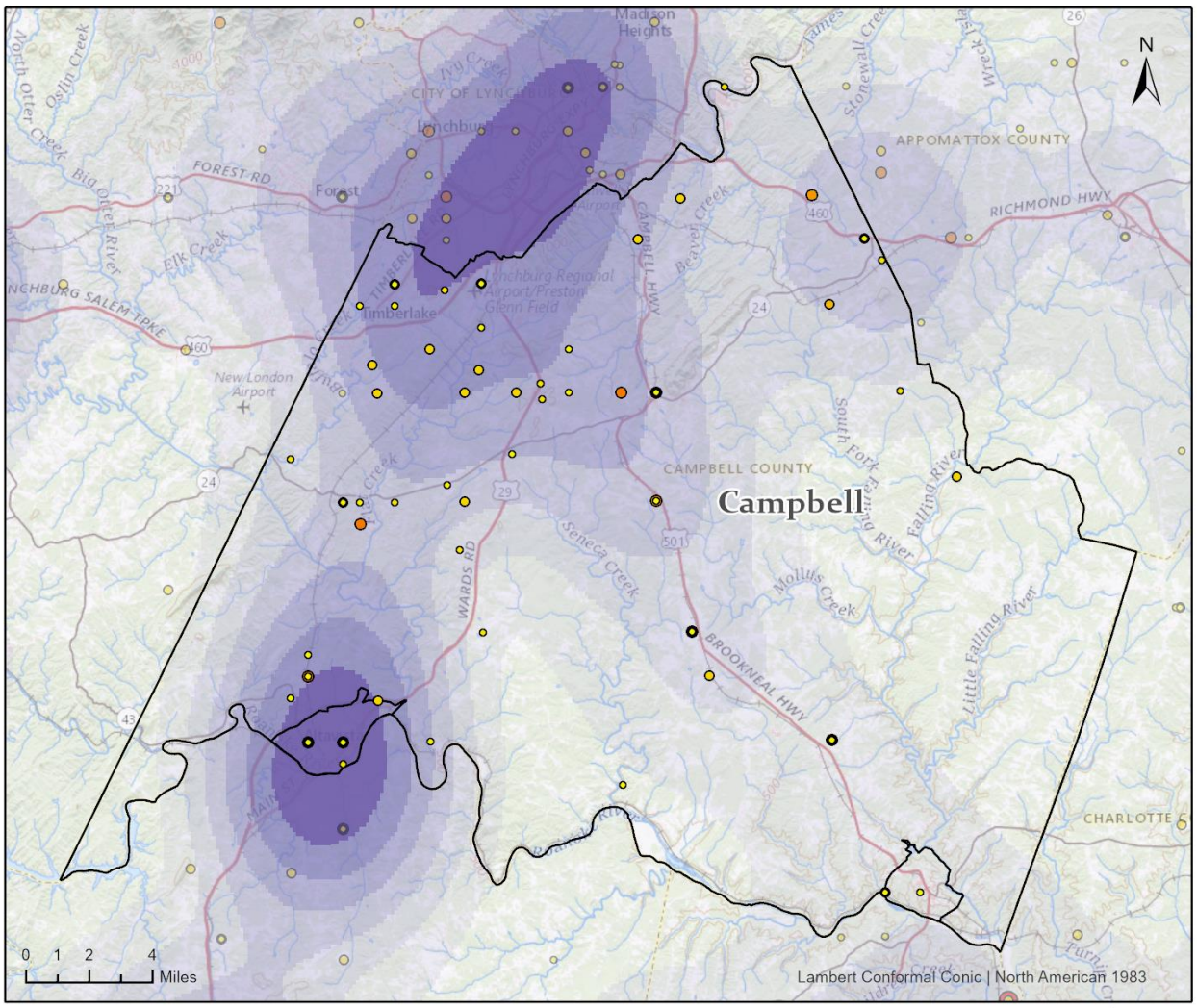
The color gradient represents a kernel density calculated using occurrence points of all historical hail events. The darker color represents areas that have experienced an increased number of events and severity. Highlighted points represent occurrence in Central Virginia PDC.

Data source: SRVGIS,Storm Prediction Center, NOAA
Center for Geospatial Information Technology at Virginia Tech. 12/2019

Figure 4-127 Hail Events in Bedford County in CVPDC Area, 1959 - 2018

Hail Events in Campbell County in Central Virginia PDC, 1959 - 2018

Central Virginia PDC Hazard Mitigation Plan Update 2020



Magnitude (Diameter Inches): ≤ 0.88 ≤ 1.25 ≤ 1.75 ≤ 2.0 ≤ 2.5 ≤ 2.75

The color gradient represents a kernel density calculated using occurrence points of all historical hail events. The darker color represents areas that have experienced an increased number of events and severity. Highlighted points represent occurrence in Central Virginia PDC.

Data source: SRVGIS,Storm Prediction Center, NOAA
Center for Geospatial Information Technology at Virginia Tech. 12/2019

Figure 4-128 Hail Events in Campbell County in CVPDC Area, 1959 - 2018

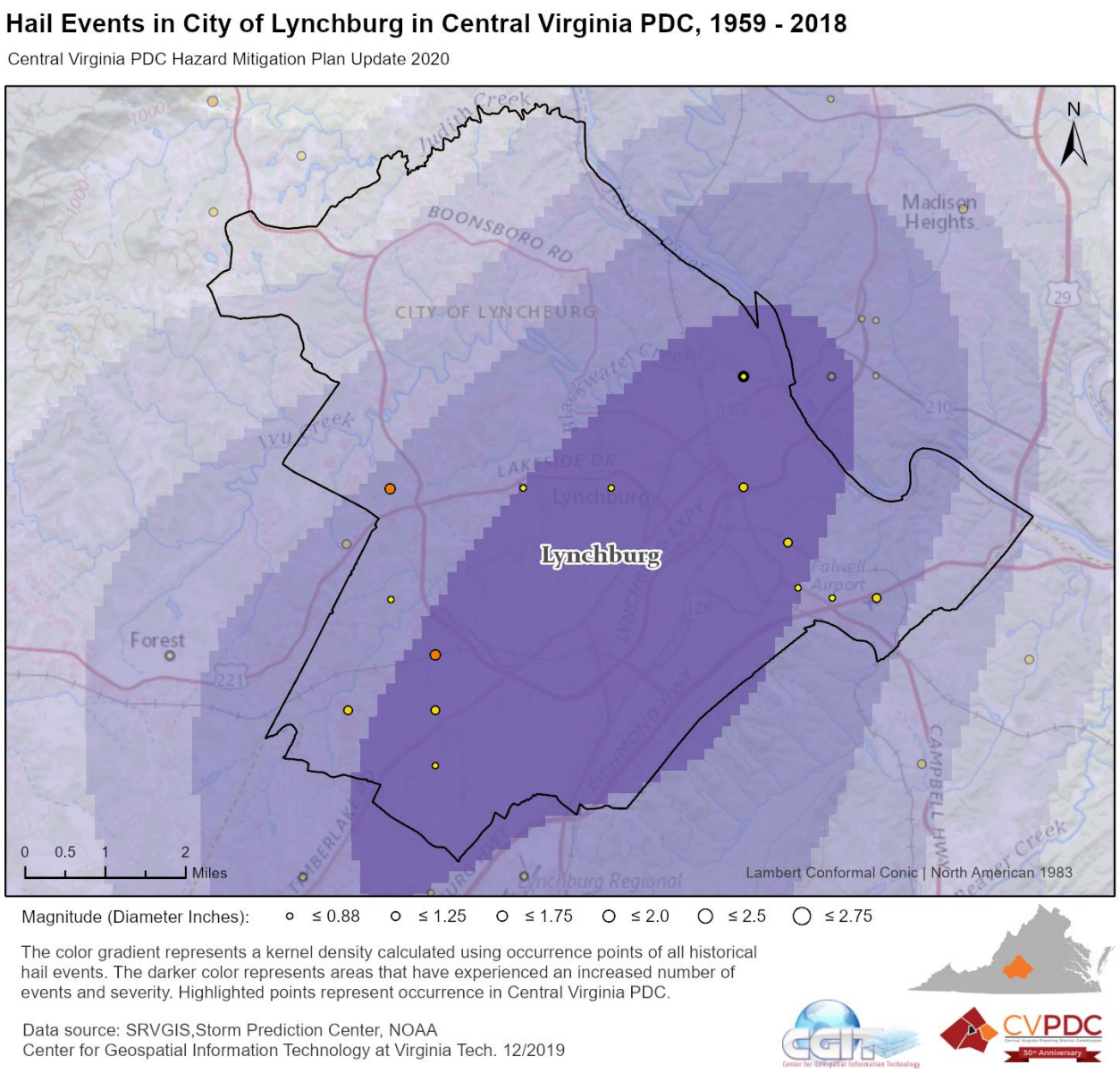


Figure 4-129 Hail Events in City of Lynchburg in CVPDC Area, 1959 - 2018

4.9.1.4 Relationship to Other Hazards

Figure 4-130 shows the interrelationship (causation, concurrence, *etc*.) between this hazard and other hazards discussed in this plan update.

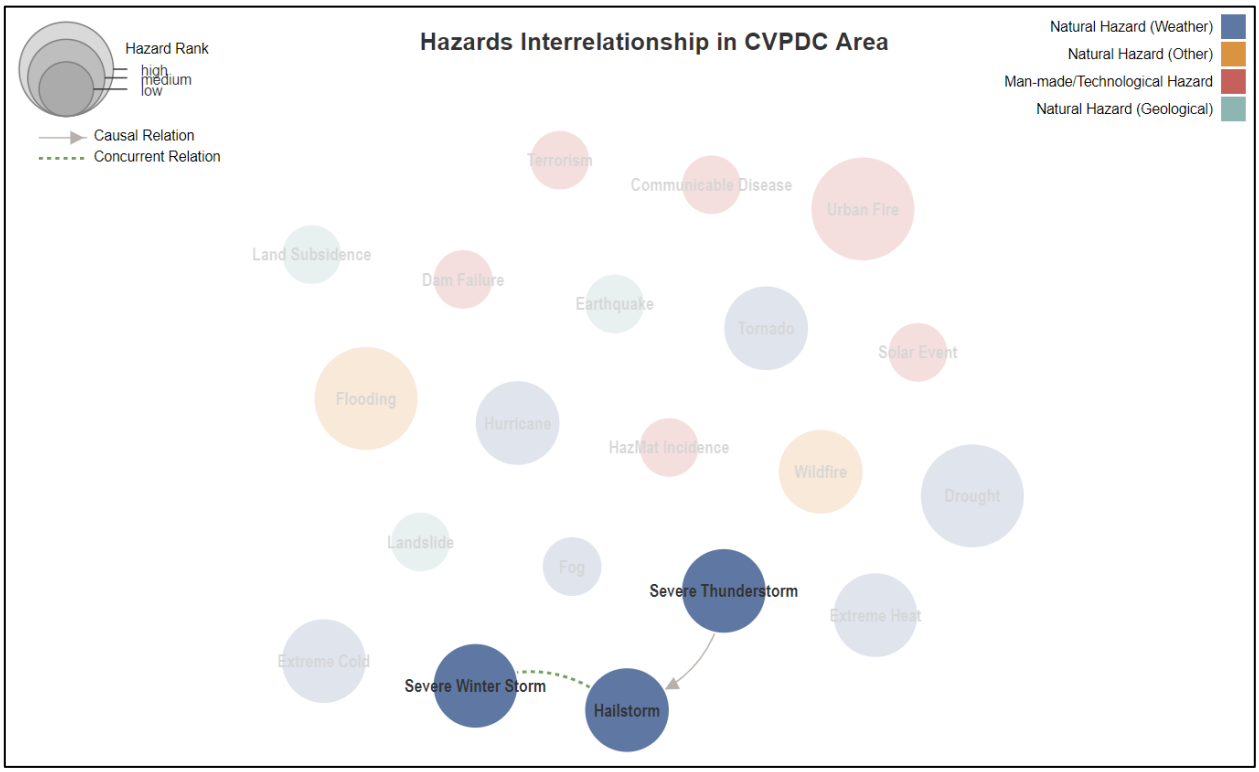


Figure 4-130 Hazards interrelationship

4.9.2 Impact and Vulnerability

Hail causes considerable damage to crops and property and occasionally causes death to farm animals, but seldom causes loss of human life in the United States. Hail causes billions of dollars in damage to crops and property each year (Table 4-134). In Virginia, there were approximately 400,529 properties experiencing damaging hail events in 2017. [56] The damaging aspects of hail include hailstone sizes (average and maximum), number of hailstones per unit area, and associated winds, and hail risk is a combination of these factors, plus the frequency of hail at a point or over an area. [57]

4.9.3 Risk Assessment and Jurisdictional Analysis

According to NCEI Storm database about hail events from 1959 to 2019, hail occurred every year in the past decade in the CVPDC area. There were 174 reports of on-the-ground hail events in which 10 events caused property damage. The magnitude of hail ranges from 0.75 to 2.75 (H2 - H7). Total property damage from hail events is 119,800 dollars.

[56] https://www.iii.org/fact-statistic/facts-statistics-hail

[57] https://sciencepolicy.colorado.edu/socasp/weather1/changnon.html

Storms can produce hail from as small as a quarter inch in diameter to up to four and a half inches. The potential damage depends on the size of the hail stone. Table 4-135 shows total storms above 1 inch in the CVPDC area. Bedford County is by far the most at risk for heavy hail storms, totaling 19 since 2000 (Bedford County also recorded the most tornadoes). Campbell County follows with the second most hail storms, and tornado occurrences as well. However, the normalized data by land area of jurisdiction indicates Lynchburg is also at higher risk.

Table 4-134 Hail Fatalities, Injuries and Damage in U.S., 2014-2018

Year	Fatalities	Injuries	Property damage ($ millions)	Crop damage ($ millions)	Total damage ($ millions)
2014	0	23	1,416.9	293.2	1,710.1
2015	0	0	586.0	133.0	719.0
2016	0	21	3,512.7	23.7	3,536.4
2017	0	14	1,722.2	59.5	1,781.8
2018	0	11	722.8	87.4	810.2

Data includes the 50 states, Puerto Rico, Guam and the U.S. Virgin Islands. Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service.

Table 4-135 Total Storms Events above 1 inch, 2000 - 2019

County	Total Storms Above 1 Inch	Jurisdiction Size (Square Miles)	Events per Square Mile
Amherst	7	479	0.015
Appomattox	0	334	0
Bedford	19	769	0.025
Campbell	10	507	0.020
Lynchburg	2	50	0.040

Note: The hailstorm events for the Towns of Amherst, Appomattox, Altavista, and Brookneal are found in their respective county's totals.

4.9.4 Probability of Future Occurrences

Based on the reported past history over the last 60 years (1959-2019) for the CVPDC area, hail events are highly likely, meaning that an event is probable due within the next year.

4.9.5 References

- Insurance Information Institute. *Facts + Statistics: Hail*. 2019. https://www.iii.org/fact-statistic/facts-statistics-hail. (Accessed on December 9, 2019)
- National Centers for Environmental Information. Storm Events Database. https://www.ncdc.noaa.gov/stormevents/listevents.jsp?hailfilter=0.00&sort=DT&statefips=51%2CVIRGINIA&county=AMHERST%3A9&county=APPOMATTOX%3A11&county=BEDFORD%3A19&county=BEDFORD+%28C%29%3A515&county=CAMPBELL%3A31&county=LYNCHBURG+%28C%29%3A680&eventType=%28C%29+Hail&beginDate_yyyy=2009&beginDate_mm=05&beginDate_dd=01&endDate_yyyy=2019&endDate_mm=05&endDate_dd=31
- Stanley Changnon. *Trends in Hail in the United States.* https://sciencepolicy.colorado.edu/socasp/weather1/changnon.html. (Accessed on December 9, 2019)