



Atlantic States Weather, Inc.
1912 Amity Hill Ct
Raleigh, NC 27612
803-840-5694 (c)
tcmoores@asweather.com
www.asweather.com

Analysis of Hail Occurrence
at 1234 and 5678 Frontage Rd, Mustang Ranch, TX 75555
on June 2, 2017

Prepared for:
Smith and Jones, LLP
7514 Rocky Trail, St 100
Converse, TX, 78109

Prepared by:
Thomas C. Moore
Atlantic States Weather Inc.
1912 Amity Hill Ct
Raleigh, NC 27612

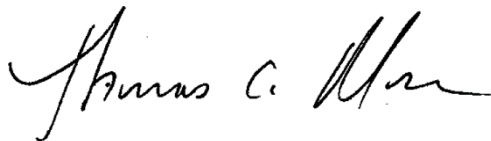
May 1, 2019

This report is subject to revisions based on new information and data if any becomes available

This report is an analysis of the hail event which occurred at 1234 and 5678 Frontage Rd, Mustang Ranch, TX 75555 on June 2, 2017. This report is subject to revisions based on new information and data if any becomes.

This report was prepared by Thomas C. (TC) Moore, Consultant Meteorologist. Mr. Moore has been a practicing meteorologist for over 30 years, and specializes in providing forensic meteorological services for a wide variety of clients as President, Atlantic States Weather. Clients of this firm have included the U.S. Department of Justice, the North Carolina Attorney General's Office, and over 100 law offices and other clients representing both plaintiffs and defendants in legal cases in 26 states, the District of Columbia, Puerto Rico, the United Kingdom, and Greece.

Submitted by,

A handwritten signature in black ink, appearing to read "Thomas C. Moore". The signature is fluid and cursive, with the first name "Thomas" being the most prominent.

Thomas C. Moore
Consultant Meteorologist
President, Atlantic States Weather Inc.
Raleigh, North Carolina

May 1, 2019

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I. Summary

An analysis of observed hail reports indicates that large hail between 2” to 2.5” in size occurred at the property at 1234 and 5678 Frontage Rd, Mustang Ranch, TX (hereafter referred to as “the property”) between 5:00 and 5:15 pm CDT on June 2, 2017. NWS Doppler radar products provide strong supporting evidence that large hail impacted the property at this time, for a period of up to 15 minutes.

II. Report Preparation Process

Two sources of data were analyzed to determine the potential occurrence of hail at the property on June 2, 2017.

NOAA/National Center for Environmental Information (NCEI) Storm Event Database

All National Weather Service (NWS) offices across the country gather reports of severe weather occurrences falling into three categories:

- a. The occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce;
- b. Rare, unusual, weather phenomena that generate media attention, such as snow flurries in South Florida; and
- c. Other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occur in connection with another event.

After vetting the reports to ensure accuracy, these reports are then archived at NCEI where they are available for review. Note that since 2010, the NWS has defined severe hail as being 1” in diameter or larger. Previously, the definition was 0.75” in diameter (about the size of a quarter), however, scientific research and archived damage reports indicated that property damage is more likely with hail one inch in diameter or larger. Golf ball-sized hail (1.75” in diameter) can dent vehicles, and hail as large as tennis balls or baseballs (2.5” to 2.75”) can break windshields.

For this report, the hail reports from the storm event database for Dallas County TX were analyzed to determine the occurrence of large hail at the property on June 2, 2017.

NWS Doppler Radar Imagery

The NWS Doppler radars generate numerous products to help analyze the weather for a specific time and location. For this report, three types of Doppler radar products were reviewed.

The most familiar product is called “*Base Reflectivity*” and is what you see on television

or on the Internet. The radar sends out a signal and when it hits precipitation, part of the signal is reflected back to the radar. For areas of light precipitation, less of the signal is returned, and is indicated on base reflectivity products as the “cool” colored pixels (blue, green). As the precipitation gets heavier, more of the signal is returned to the radar and is shown as increasingly “warm” colored pixels (yellow, orange, red) in the image. On a base reflectivity product, the leading edge of a thunderstorm (where wind gusts often occur) is indicated by transition from blue/green pixels to the red pixels associated with the heavy precipitation.

Among the numerous derived products constantly produced by the Doppler radars is one especially useful in locating hail. It is called “*Vertically Integrated Liquid*” or VIL. VIL calculates the amount of liquid water in a vertical column of the atmosphere where precipitation is falling. Although VIL is computed assuming all echoes are liquid water, the precipitation several thousand feet above the ground is snow or hail. When hail is present, being solid ice, much of the radar signal is reflected back to the radar. So very high values of VIL almost always indicates that hail is present.

In approximately 2010, the NWS upgraded the VIL product to “*Digital Vertically Integrated Liquid*” or DVIL. Both VIL products use the same equation to calculate the product however the DVIL product used all of the return signal while the VIL product does not use the very high values of the returned signal. This was an attempt to remove ice from the calculations and was shown to not be needed.

Bottom line, when a VIL or DVIL product shows areas with very high values, hail is likely to be present. When the Doppler radars were deployed over 20 years ago, forecasters immediately recognized the value of using the VIL products to determine areas of hail.

Dual-polarization radar technology, now installed on NWS radars across the U.S., can clearly identify rain, hail, snow or ice pellets. Using the dual pole technology, the “*Hydrometeor Classification product*” indicates the type of precipitation the radar is detecting, and is quite useful in determining the likely existence of large hail (esp. when used in conjunction with DVIL and base reflectivity images). The hydrometeor classification product uses shows bright red pixels to indicate where hail is likely occurring.

III. Analysis of June 2, 2017 Hailstorm at 1234 and 5678 Frontage Rd, Mustang, TX

Figure 1 is a plot of the storm events database hail reports for Dallas County for the afternoon of June 2, 2017. The hail reports were received by the National Weather Service office between 5:12 pm and 5:25 pm CDT. A meteorological scalar analysis in a plane was performed on the plotted hail size data and is shown in Fig. 1. A scalar analysis is the drawing of continuous curves, or isolines, on a data field connecting the same value for each curve drawn.

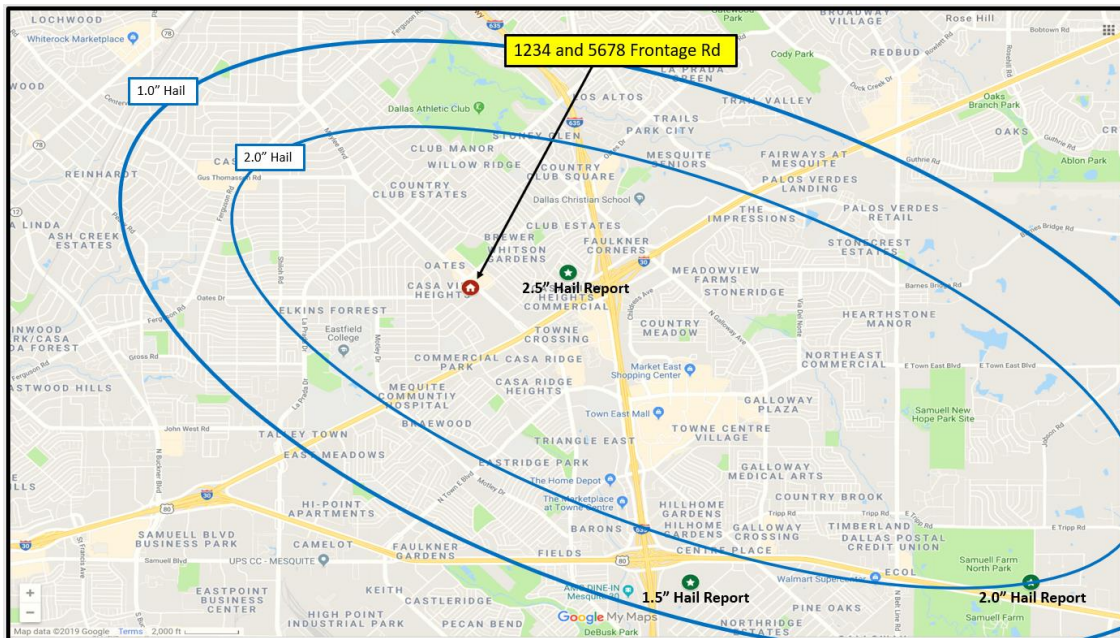


Fig. 1. Observed hail sizes (green stars) and the associated meteorological scalar analysis. Note that the property lies less than a mile from the 2.5" hail report, and is within the 2" hail size contours.

Figures 2 and 3 show radar images from the Dallas TX Doppler radar at approximately 5:10 pm CST, indicating the core of the storm is over the property.

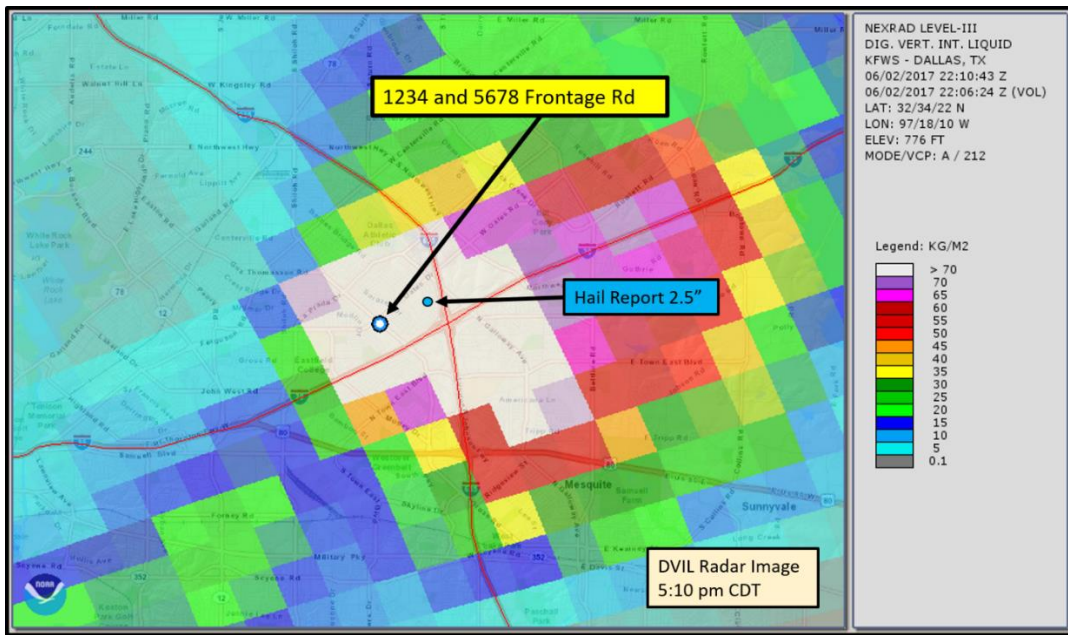


Fig. 2. DVIL image from the Dallas TX NWS Doppler radar at 5:10 pm CDT showing high levels of DVIL over both the property and the location of the 2.5” hail report.

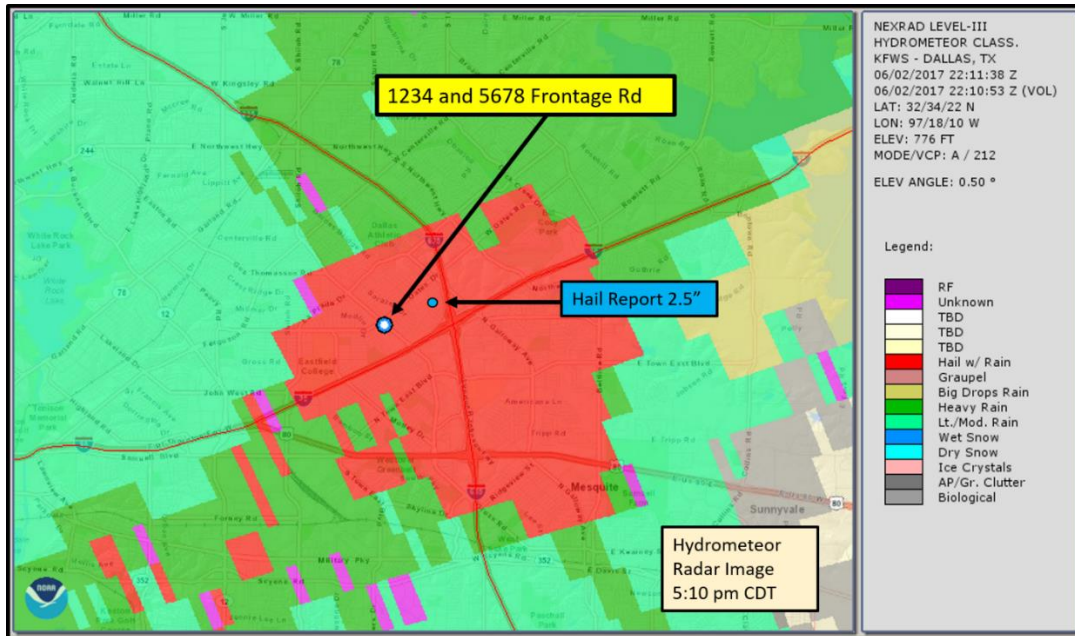


Fig. 3. Hydrometeor classification Doppler radar image from 5:11 pm CDT showing area of hail (red pixels) over both the property and the location of the 2.5” hail report.

IV. Findings

- An analysis of observed hail reports indicates that large hail between 2” to 2.5” in size occurred at the property at 1234 and 5678 Frontage Rd, Mustang Ranch, TX between 5:00 and 5:15 pm CDT on June 2, 2017.
- NWS Doppler radar products provide strong supporting evidence that large hail impacted the property at this time, for a period of up to 15 minutes.

V. References

NOAA/National Centers for Environmental Information, NCEI: NWS Dallas Doppler radar images for June 2, 2017. Available online at: <https://www.ncdc.noaa.gov/nexradinv/>

NOAA/National Centers for Environmental Information, NCEI: Storm event database results for Dallas County, Texas for June 2, 2017. Available online at: <http://www4.ncdc.noaa.gov/cgiwin/wvcgi.dll?wwEvent~Storms>