



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

May 23, 2019

Factual Report

METEOROLOGY

WPR19FA103

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A. ACCIDENT

Location: Near Farmington, New Mexico
Date: March 31, 2019
Time: 1439 mountain daylight time
2039 Coordinated Universal Time (UTC)
Aircraft: Cirrus SR22, Registration: N173CT

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are mountain daylight time (MDT) on March 31, 2019, and are based upon the 24-hour clock, where local time is -6 hours from UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 36.2183° N, longitude 108.0164° W, at an approximate elevation of 6,185 feet (ft).

D. WEATHER INFORMATION

1.0 Synoptic Situation

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H.¹

¹

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

1.1 Surface Analysis Chart

The southwestern section of the NWS Surface Analysis Chart for 1500 MDT is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart identified a surface high pressure center located over northern New Mexico with a surface pressure of 1024-hectopascals (hPa). A surface trough² was located from central Colorado extending southwestward into western New Mexico, and was located in the vicinity of the accident site. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present.

The station models around the accident site depicted air temperatures in the upper 30's to upper 40's degrees Fahrenheit (°F), dew point temperatures in the mid 20's to low 30's °F with temperature-dew point spreads of 6° F or more, with a northeast wind of 10 to 20 knots, partly cloudy to overcast sky cover, with light rain being reported southwest of the accident site.

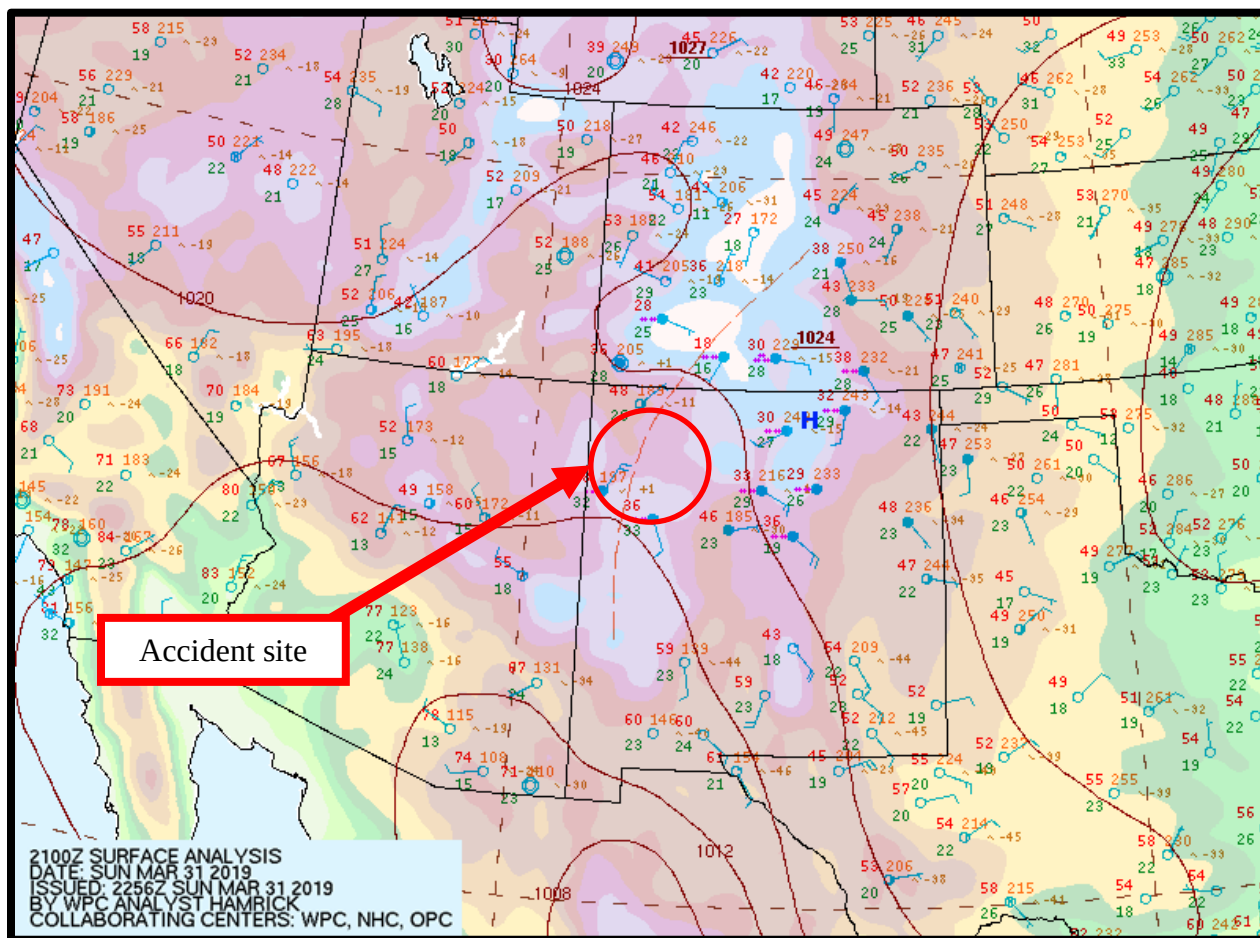


Figure 1 – NWS Surface Analysis Chart for 1500 MDT

² Trough – An elongated area of relatively low atmospheric pressure or heights.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1800 MDT at 700-, 500-, and 300-hPa are presented in figures 2 through 4. There was a mid- and upper-level trough located above the accident site at 1800 MDT. There was a variable wind at 10 knots at 700-hPa (figure 2) with the wind becoming southwesterly by 500-hPa (figure 3) at 25 knots. By 300-hPa, the wind above the accident site was from the west at 50 knots (figure 4).

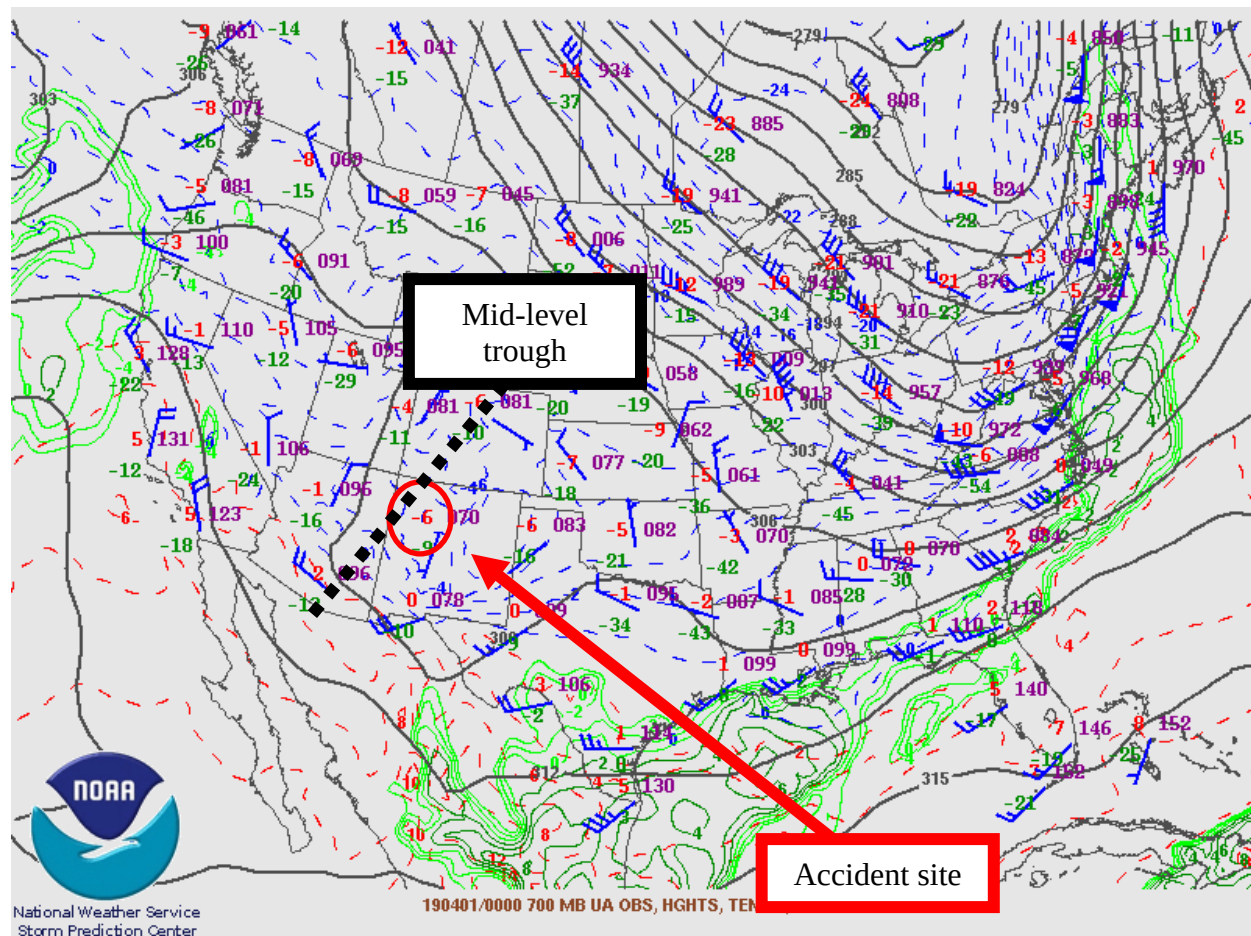


Figure 2 – 700-hPa Constant Pressure Chart for 1800 MDT

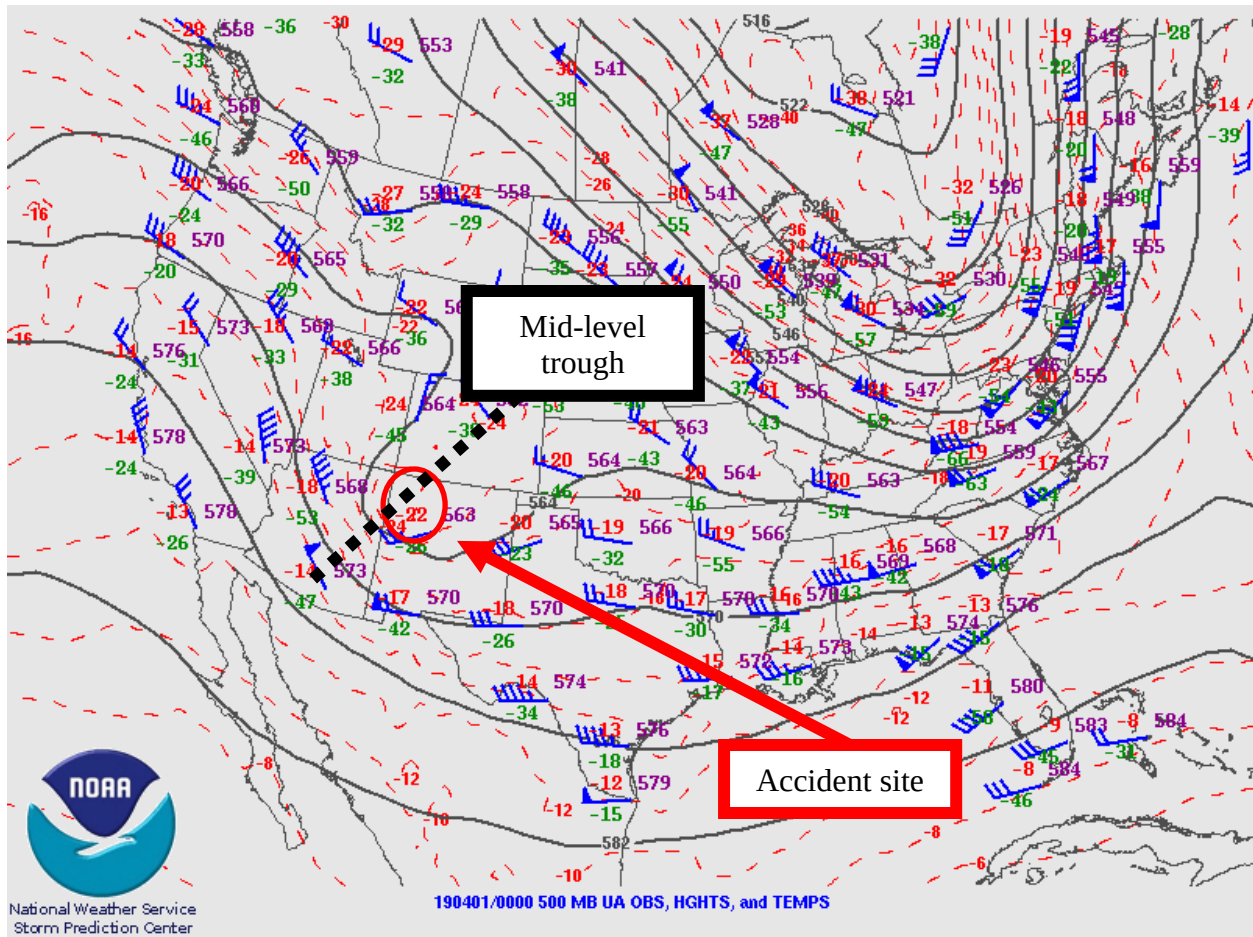


Figure 3 – 500-hPa Constant Pressure Chart for 1800 MDT

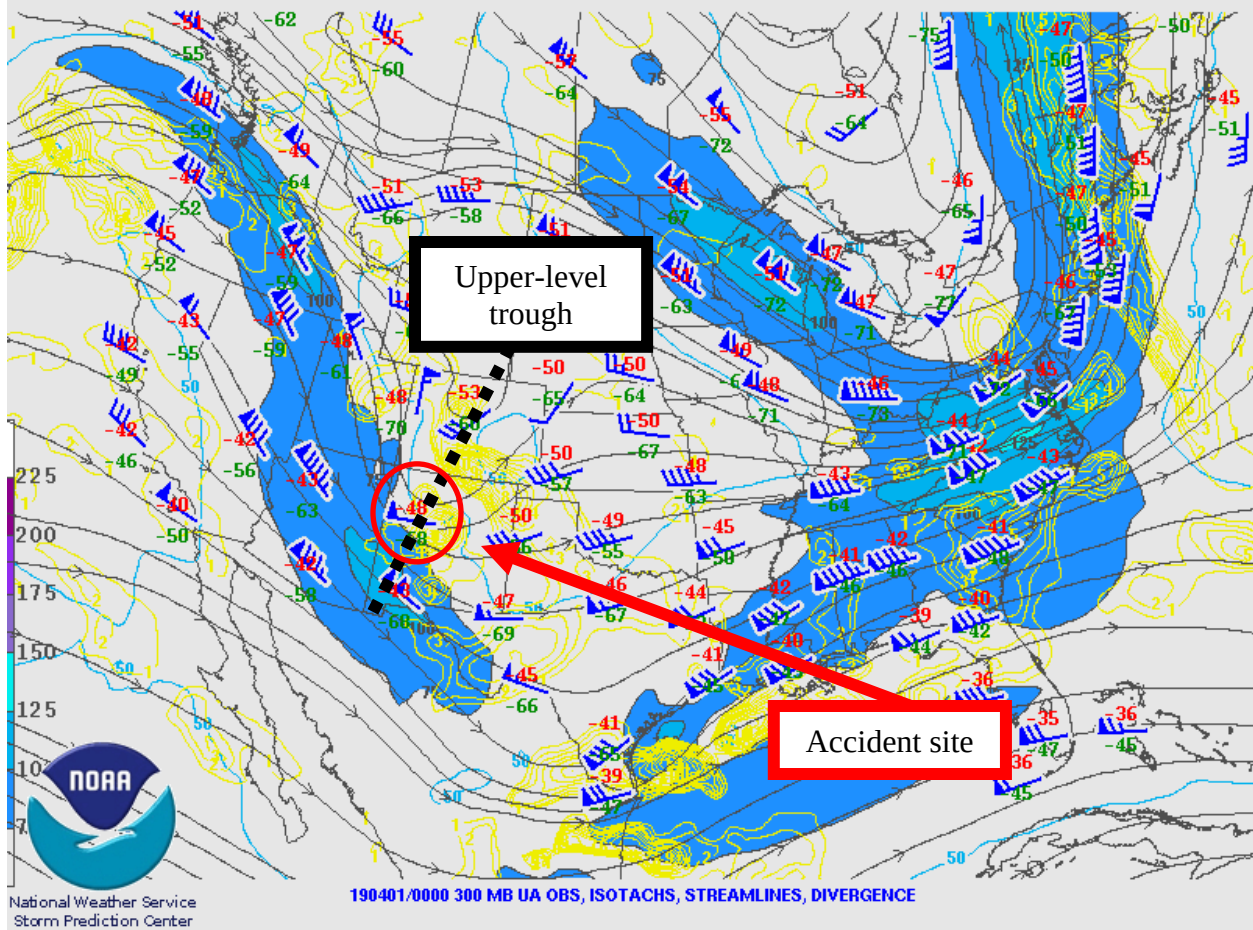


Figure 4 – 300-hPa Constant Pressure Chart for 1800 MDT

2.0 SPC Products

SPC issued the following Day 1 Convective Outlook at 1330 MDT (figure 5) with areas of general thunderstorms forecast for the accident site. SPC defines the “TSTM” area as an area that encloses where a 10% or higher probability of thunderstorms is forecast during the valid period. The 1030 MDT Day 1 Convective Outlook forecast had a similar forecast of areas of general thunderstorms forecast for the accident site. The 1330 MDT SPC Day 1 Convective Outlook text follows figure 5:

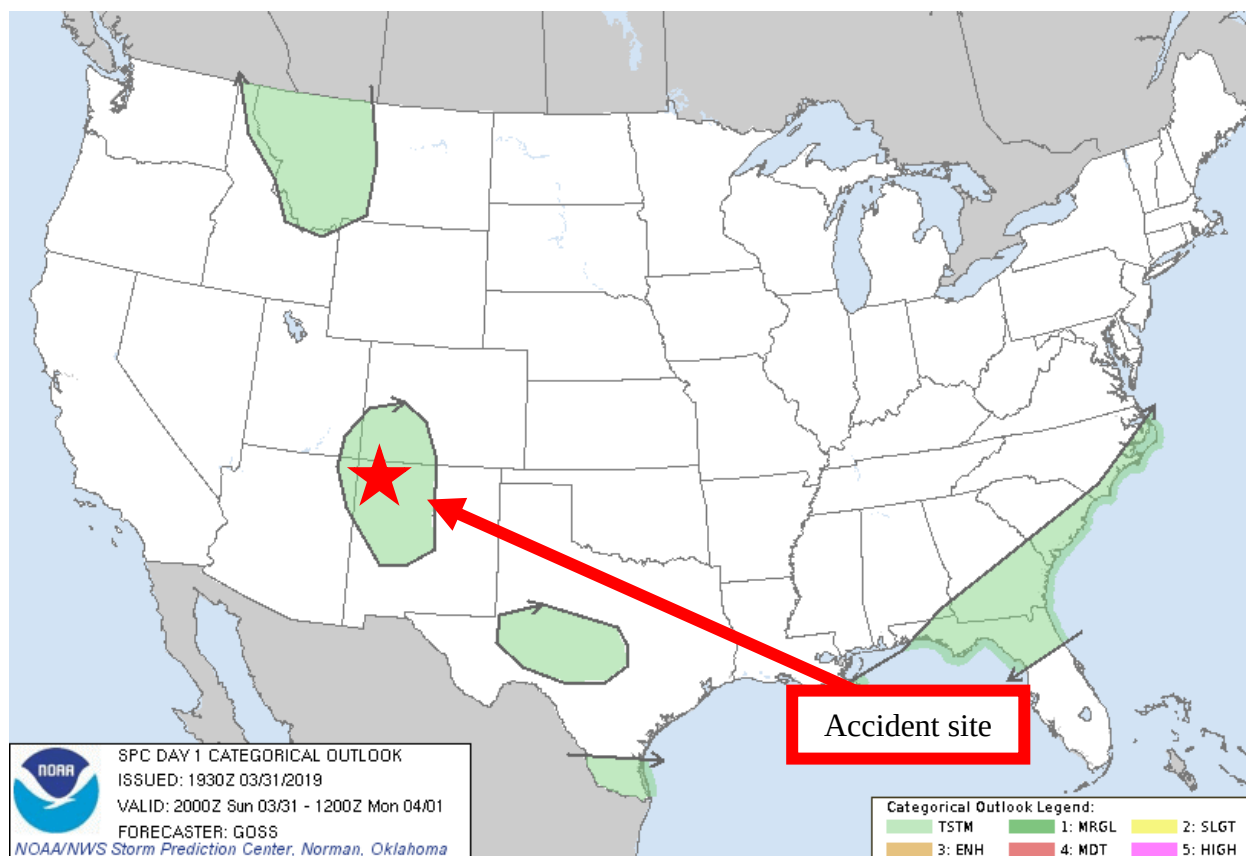


Figure 5 – SPC day 1 Convective Outlook valid at the time of the accident

SPC AC 311930

Day 1 Convective Outlook
NWS Storm Prediction Center Norman OK
0230 PM CDT Sun Mar 31 2019

Valid 312000Z - 011200Z

...NO SEVERE THUNDERSTORM AREAS FORECAST...

...SUMMARY...

Severe thunderstorms are not expected over the contiguous U.S. through tonight.

...Discussion...

A few minor line adjustments to ongoing thunder areas are being implemented, per latest convective evolution. Otherwise, with forecast reasoning consistent with the prior outlook, no substantive changes appear necessary at this time.

..Goss.. 03/31/2019

.PREV DISCUSSION... /ISSUED 1059 AM CDT Sun Mar 31 2019/

...Discussion...

Isolated thunderstorms will remain possible along a trailing cold

front in the Southeast this afternoon. A poor combination of buoyancy and shear will mitigate an organized severe threat. Farther west, a pair of shortwave troughs over the Four Corners and northern Rockies regions may support isolated, low-topped thunderstorms this afternoon. In TX, warm advection and meager buoyancy rooted from the 700-600 mb layer should foster isolated thunderstorms in the Lower Rio Grande Valley this afternoon and overnight across the Edwards Plateau.

[CLICK TO GET WUUS01 PTSDY1 PRODUCT](#)

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 0100Z

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 6 is a local sectional chart with the accident site and the closest weather reporting location marked.

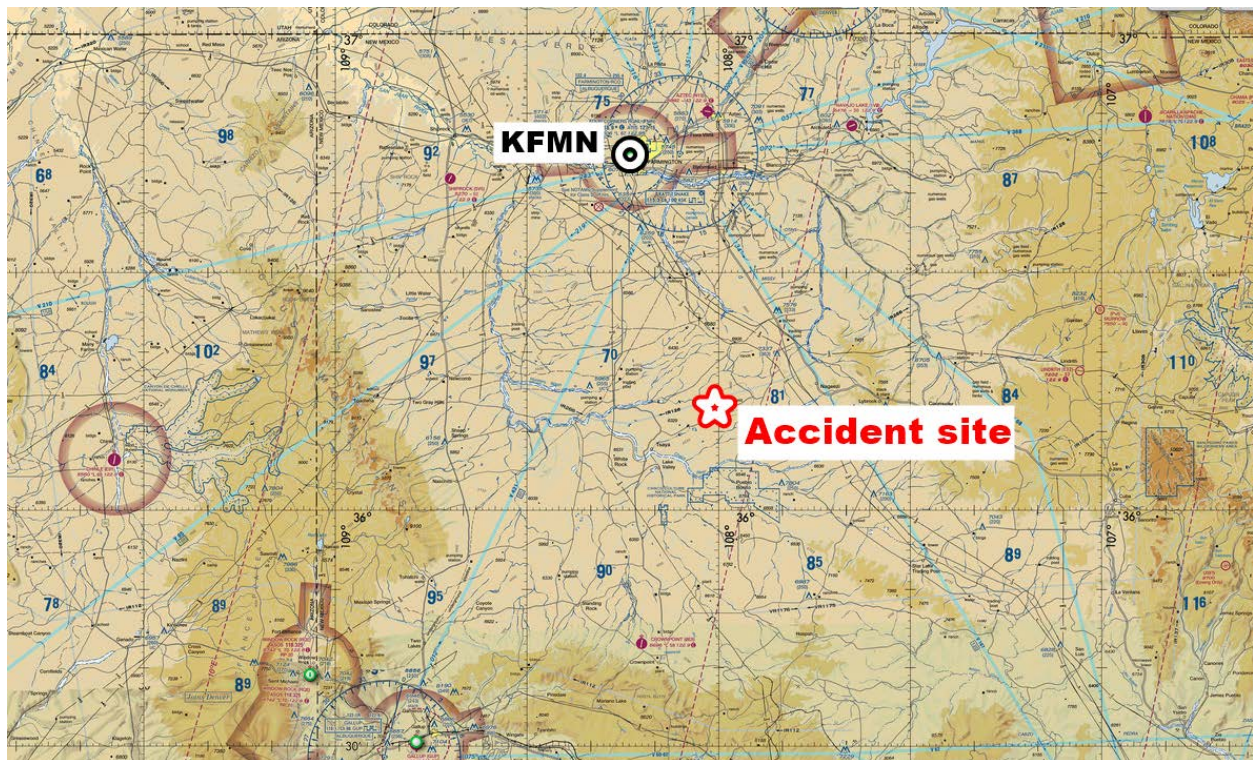


Figure 6 – Sectional map of the accident area with the location of the accident site and surface observation sites

Four Corners Regional Airport (KFMN) had the closest official weather station to the accident site and was located 1 mile northwest of Farmington, New Mexico. KFMN had Automated Surface Observing System (ASOS³) whose reports were supplemented by air traffic control (ATC) during hours of operation.⁴ KFMN was located 33 miles north-northwest of the accident site, at an elevation of 5,506 ft, and had a 10° easterly magnetic variation⁵ (figure 6). The following observations were taken and disseminated during the times surrounding the accident:⁶

[0653 MDT] METAR KFMN 311253Z 14006KT 10SM SCT065 BKN120 04/M07 A3016
RMK AO2 SLP201 T00391072=

[0753 MDT] METAR KFMN 311353Z 14009KT 10SM FEW060 OVC100 04/M07 A3017
RMK AO2 SLP207 T00441067=

[0853 MDT] METAR KFMN 311453Z 12015KT 10SM SCT060 BKN100 05/M07 A3018
RMK AO2 SLP212 T00501067 51009=

[0953 MDT] METAR KFMN 311553Z 12014G19KT 10SM SCT100 07/M06 A3017 RMK
AO2 SLP206 T00671061=

[1053 MDT] METAR KFMN 311653Z 14006G15KT 10SM BKN050 OVC060 06/M06 A3018
RMK AO2 SLP209 T00561061=

[1153 MDT] METAR KFMN 311753Z 08010KT 10SM FEW033 BKN041 OVC060 05/M04
A3016 RMK AO2 SNB19E27 SLP207 P0000 60000 T00501039 10067
20039 58006=

**[1253 MDT] METAR KFMN 311853Z 19006KT 10SM OVC043 06/M04 A3015 RMK AO2
SLP203 T00611039=**

**[1353 MDT] METAR KFMN 311953Z VRB03KT 10SM SCT036 07/M03 A3013 RMK AO2
SLP195 T00671028=**

ACCIDENT TIME 1439 MDT

**[1453 MDT] METAR KFMN 312053Z 05006KT 10SM BKN040 09/M03 A3012 RMK AO2
SLP189 T00891033 56011=**

³ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

⁴ KFMN ATC hours of operation were 0600 to 2200 local time.

⁵ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

⁶ The bold sections in this NWS product and the rest of the products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

[1553 MDT] METAR KFMN 312153Z 33020G26KT 10SM -RA FEW044 OVC065 05/M01 A3012 RMK AO2 PK WND 33029/2128 RAB48 SLP197 P0000 T00501006=

[1653 MDT] METAR KFMN 312253Z 34006KT 10SM SCT075 BKN085 07/M03 A3011 RMK AO2 PK WND 32028/2202 RAE2158 SLP188 P0000 T00671028=

[1753 MDT] METAR KFMN 312353Z 28006KT 10SM CLR 08/M05 A3010 RMK AO2 SLP186 60000 T00831050 10094 20044 58005=

KFMN weather at 1253 MDT, wind from 190° at 6 knots, 10 miles or greater visibility, an overcast ceiling at 4,300 ft above ground level (agl), temperature of 6 °Celsius (C), dew point temperature of -4 °C, and an altimeter setting of 30.15 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, sea level pressure 1020.3 hPa, temperature 6.1 °C, dew point temperature -3.9 °C.

KFMN weather at 1353 MDT, wind variable at 3 knots, 10 miles or greater visibility, scattered clouds at 3,600 ft agl, temperature of 7 °C, dew point temperature of -3 °C, and an altimeter setting of 30.13 inHg. Remarks: automated station with a precipitation discriminator, sea level pressure 1019.5 hPa, temperature 6.7 °C, dew point temperature -2.8 °C.

KFMN weather at 1453 MDT, wind from 050° at 6 knots, 10 miles or greater visibility, a broken ceiling at 4,000 ft agl, temperature of 9 °C, dew point temperature of -3 °C, and an altimeter setting of 30.12 inHg. Remarks: automated station with a precipitation discriminator, sea level pressure 1018.9 hPa, temperature 8.9 °C, dew point temperature -3.3 °C, 3-hourly pressure decrease of 1.1 hPa.

KFMN weather at 1553 MDT, wind from 330° at 20 knots with gusts to 26 knots, 10 miles or greater visibility, light rain, few clouds at 4,400 ft agl, an overcast ceiling at 6,500 ft agl, temperature of 5 °C, dew point temperature of -1 °C, and an altimeter setting of 30.12 inHg. Remarks: automated station with a precipitation discriminator, peak wind from 330° at 29 knots at 1528 MDT, rain began at 1548 MDT, sea level pressure 1019.7 hPa, a trace of precipitation since 1453 MDT, temperature 5.0 °C, dew point temperature -0.6 °C.

The observations from KFMN surrounding the accident time indicated VFR⁷ conditions. Light rain and gusting winds to 26 knots were observed at KFMN by 1553 MDT (peak wind of 29 knots observed at 1528 MDT).

⁷ Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. VFR criteria means a ceiling greater than 3,000 feet agl and greater than 6 miles visibility.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for the accident site for 1500 MDT with station elevation of 6,119 ft.⁹ The 1500 MDT HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ with the derived stability parameters included in figure 7 (with data from the surface to 500-hPa (or approximately 19,000 ft msl). This data was analyzed using the RAOB¹¹ software package. The sounding depicted the convective condensation level (CCL)¹² at 5,067 ft agl (11,186 ft msl), the lifted condensation level (LCL)¹³ and the level of free convection (LFC)¹⁴ at 5,810 ft agl (11,929 ft msl). The freezing level was located at 8,132 ft msl. The precipitable water value was 0.29 inches.

⁸ The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one hour period.

⁹ HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

¹⁰ Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

¹¹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹² CCL – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

¹³ LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁴ LFC – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

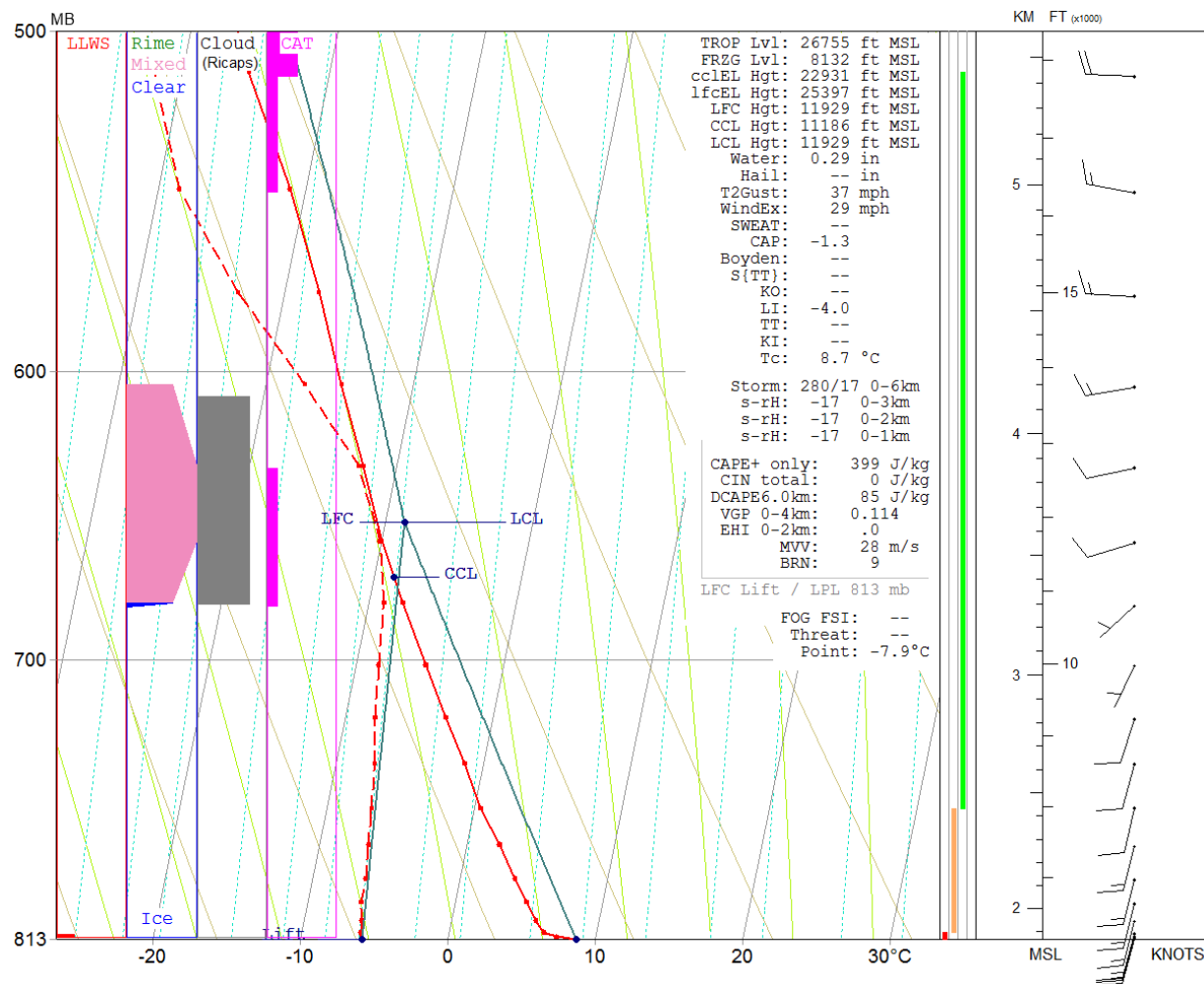


Figure 7 – 1500 MDT HRRR sounding

The 1500 MDT HRRR sounding for the accident site indicated an unstable to conditionally unstable environment from the surface through 19,000 ft, with a Lifted Index of -4. RAOB identified the possibility of clouds from 11,000 ft msl through 14,000 ft msl (~5,000 ft to 8,000 ft agl). A positive CAPE¹⁵ value of 399 Joules/kilogram (J/kg) was indicated on the sounding and the maximum vertical velocity (MVV) for this atmosphere was calculated as 28 meters/second (about 5,510 ft per minute).¹⁶ Downdraft CAPE (DCAPE; 6 kilometers agl)¹⁷ was measured at 85 J/kg. If rain showers or thunderstorms formed in this environment, the 1500 MDT HRRR sounding indicated that the strongest wind speeds possible at the surface (due to, for example, a microburst, outflow boundary, or gust front) would have been 37 mph (32 knots) according to the T2 Gust parameter, or 29 mph (25 knots) according to the WindEx parameter.

¹⁵ Convective Available Potential Energy (CAPE) – CAPE is a measure of the amount of energy available for convection and is directly related to the maximum potential vertical speed within an updraft.

¹⁶ MVV is not usually considered a realistic estimate for maximum vertical velocity in a storm. Anecdotes suggest considering a value of MVV/2, however it is not well understood when or where such a half-value should be applied.

¹⁷ The DCAPE can be used to estimate the potential strength of rain-cooled downdrafts within thunderstorm convection, and is similar to CAPE. Larger DCAPE values are associated with stronger downdrafts.

The 1500 MDT HRRR sounding wind profile indicated a surface wind from 194° at 13 knots with the wind remaining from the south through 10,000 ft, and then veering¹⁸ to the west by 15,000 ft. Wind speeds remained between 5 and 15 knots through 15,000 ft. RAOB indicated the small possibility of low-level wind shear (LLWS) outside of rain shower or thunderstorm activity from the surface through 500 ft agl. RAOB indicated a chance of light to moderate clear-air turbulence existed in several layers between 11,000 ft and 19,000 ft. The mean storm motion vector was from 280° at 17 knots.

5.0 Satellite Data

Data from the Geostationary Operational Environmental Satellite number 16 (GOES-16) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Visible and infrared (bands 2 and 13) imagery at wavelengths of 0.64 microns (μm) and 10.3 μm were retrieved for the period. Satellite imagery surrounding the time of the accident, from 1100 MDT through 1700 MDT at approximately 5-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 8 and 9 present the GOES-16 visible imagery from 1430 and 1445 MDT at 2X magnification with the accident site highlighted with a red square. The GOES-16 imagery indicated a band of cumuliform clouds located above the accident site at the accident time. The accident flight flew directly into the cumuliform band (attachment 1). The cloud cover and cumuliform bands were moving from northwest to southeast with the cloud cover increasing in areal coverage with time (attachment 2).

Figure 10 presents the GOES-16 infrared imagery from 1445 MDT at 4X magnification and with a temperature enhancement curve applied with the accident site highlighted with a red square. Inspection of the infrared imagery indicated abundant cloud cover over the accident site at the accident time with the lowest brightness temperatures (green and blue colors, higher clouds) located over and to the east and north of the accident site. Based on the brightness temperatures above the accident site (247° Kelvin) and the vertical temperature profile provided by the 1500 MDT HRRR sounding, the approximate cloud-top heights over the accident site were 18,000 ft at 1445 MDT. It should be noted these figures have not been corrected for any parallax error.

¹⁸ A clockwise turning of the wind with height in the northern hemisphere.

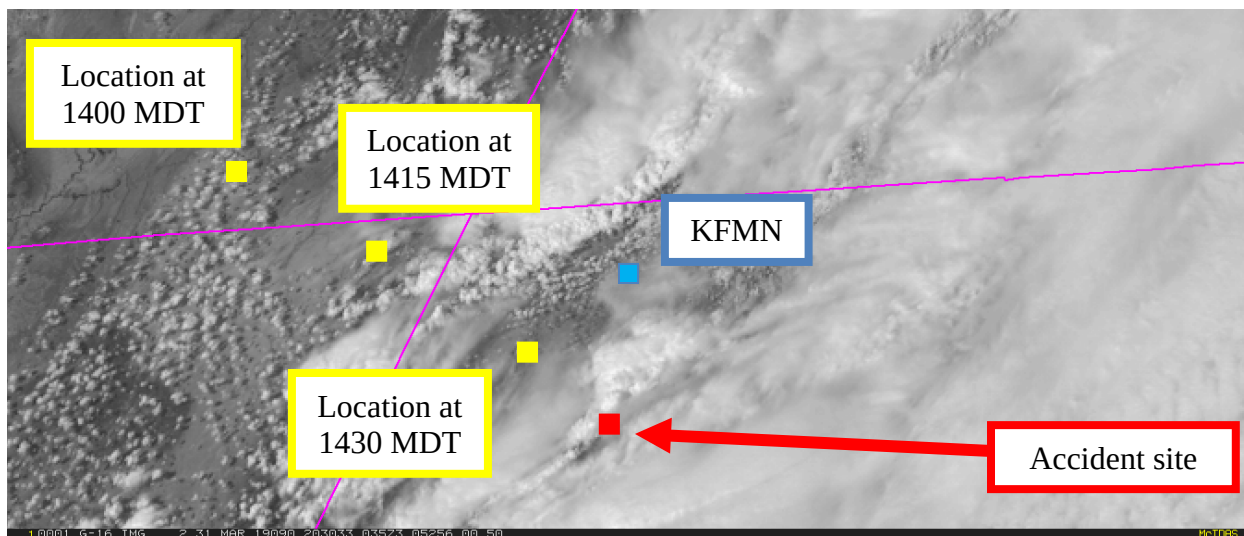


Figure 8 – GOES-16 visible image at 1430 MDT

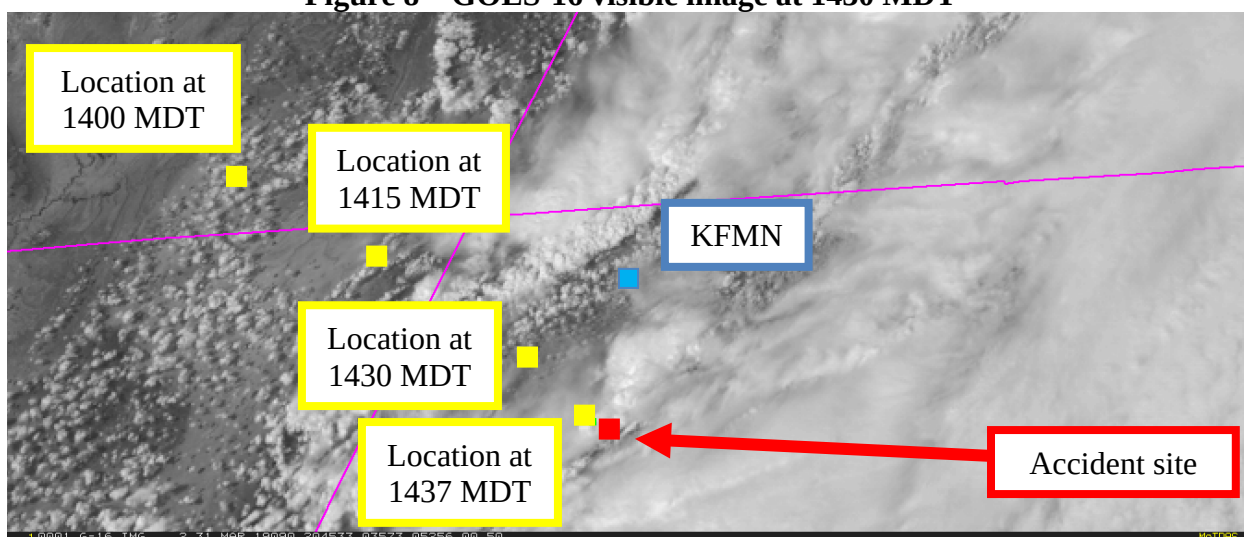


Figure 9 – GOES-16 visible image at 1445 MDT

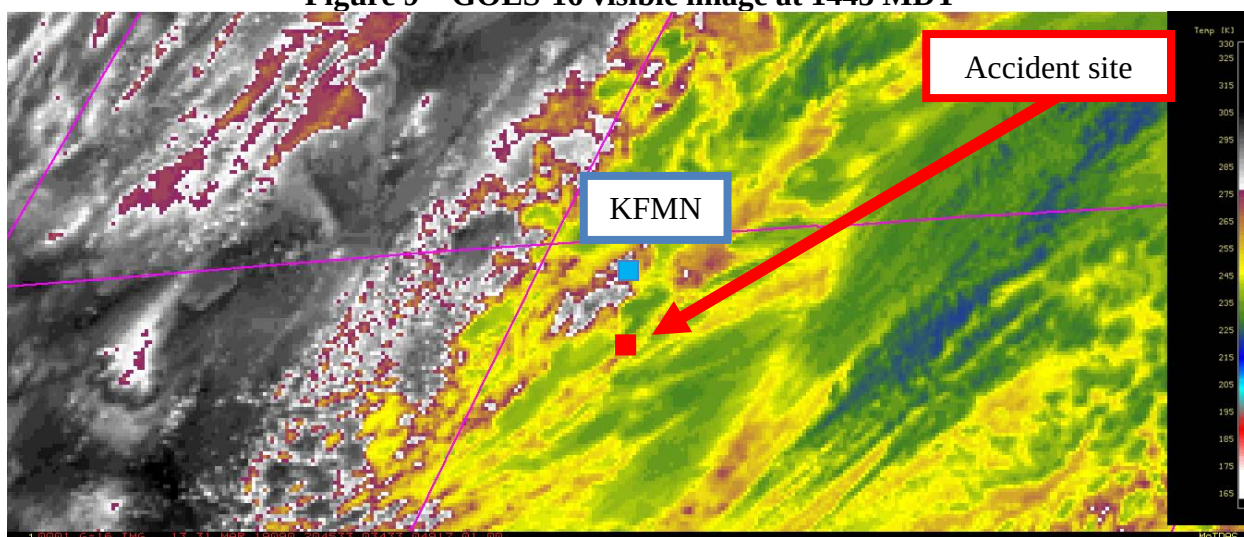


Figure 10 – GOES-16 infrared image at 1445 MDT

6.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 11 for 1440 MDT with the approximate location of the accident site marked within a red circle. The image depicted echoes from 20 to 30 decibels (dBZ)¹⁹ echoes above the accident site at the accident time.

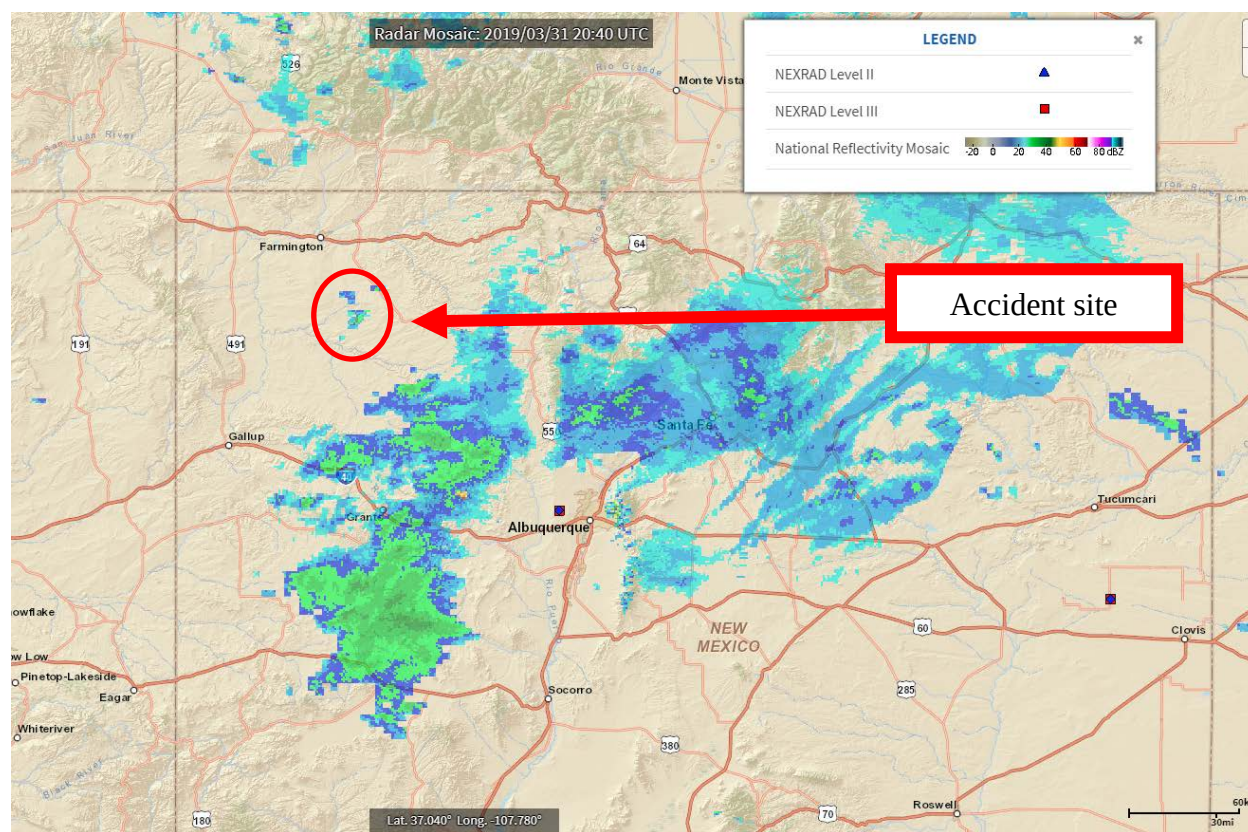


Figure 11 – Regional Composite Reflectivity image for 1440 MDT

7.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)²⁰ to the accident site was Albuquerque, New Mexico, (KABX) and was located 87 miles southeast of the accident site. Level II archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA’s Weather and Climate Toolkit software.

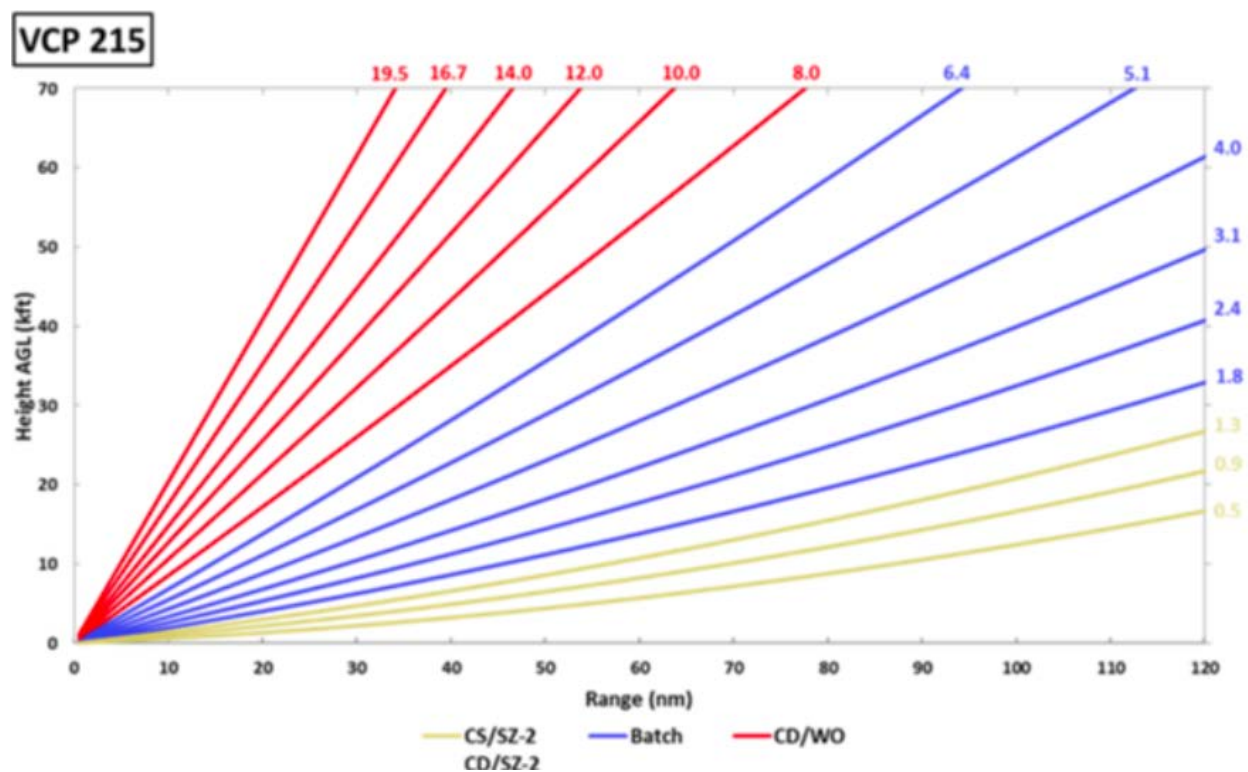
¹⁹ dBZ – A non-dimensional “unit” of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

²⁰ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

7.1 Volume Scan Strategy

The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available. Products that require data from multiple elevation scans are not available until the end of the five to ten-minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has three common scanning strategies. The most common is where the radar makes 15 elevation scans from 0.5° to 19.5° every six minutes. This particular scanning strategy is documented as volume coverage pattern 215 (VCP-215). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten-minute period. During the period surrounding the accident, the KABX WSR-88D radar was operating in the precipitation mode VCP-215. The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



VCP-215 Precipitation Mode Scan Strategy²¹

²¹ Contiguous Surveillance (CS)--The low Pulse Repetition Frequency (PRF) scan of the split cut. Gives a high R_{max} value to determine proper target location and intensity, but a low V_{max} value limits the velocities that can be measured. Contiguous Doppler (CD)--The high PRF scan of the split cut. Gives a low R_{max} value causing more range folded (multiple trip) echoes, but a high V_{max} value to get higher, more accurate velocity values.

Batch Mode – Uses alternating low and high PRFs on each radial for one full rotation at each elevation angle. The two resulting data sets (low PRF and high PRF) are combined to resolve range ambiguity. Used in the middle elevation angles.

W – With range unfolding (W)

WO – Without range unfolding (WO)

7.2 Beam Height Calculation

Assuming standard refraction²² of the WSR-88D radar beam with the antenna elevation at 5,951 ft (KABX), and considering a beamwidth²³ of 0.95°, the following table shows the approximate heights for the radar beam center, top and base for antenna elevations over the accident site. These heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
KABX 0.5°	16,050 ft	11,760 ft	20,340 ft

Based on the radar height calculations, the elevation scan listed in the above table depicted the conditions between 11,760 ft and 20,340 ft msl over the accident site and these scans “saw” the closest altitudes to the ground.

7.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²⁴ it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in dBZ, and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C²⁵, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be “light.” For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.” From the NWS, precipitation conditions at the surface can be inferred from VIP Levels described in the chart below:

²² Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

²³ Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

²⁴ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth’s surface; also, any water particles blown by the wind from the earth’s surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth’s surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glazed ice.

²⁵

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1020774

- VIP 1 (Level 1, 18-30 dBZ) - Light precipitation
- VIP 2 (Level 2, 30-38 dBZ) - Light to moderate rain
- VIP 3 (Level 3, 38-44 dBZ) - Moderate to heavy rain
- VIP 4 (Level 4, 44-50 dBZ) - Heavy rain
- VIP 5 (Level 5, 50-57 dBZ) - Very heavy rain; hail possible
- VIP 6 (Level 6, >57 dBZ) - Very heavy rain and hail; large hail possible

7.4 Base Reflectivity and Lightning Data

Figures 12, 13, and 14 present the KABX WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1432:43, 1438:24, and 1444:03 MDT, respectively, with a resolution of 0.5° X 250 m. Reflectivity values between 15 and 25 dBZ or light intensity echoes were located over the flight track and at the time of the accident. The reflectivity bands were moving from west to east (attachment 3) and expanding in areal coverage with time.

There were no lightning strikes around the accident site at the accident time.²⁶

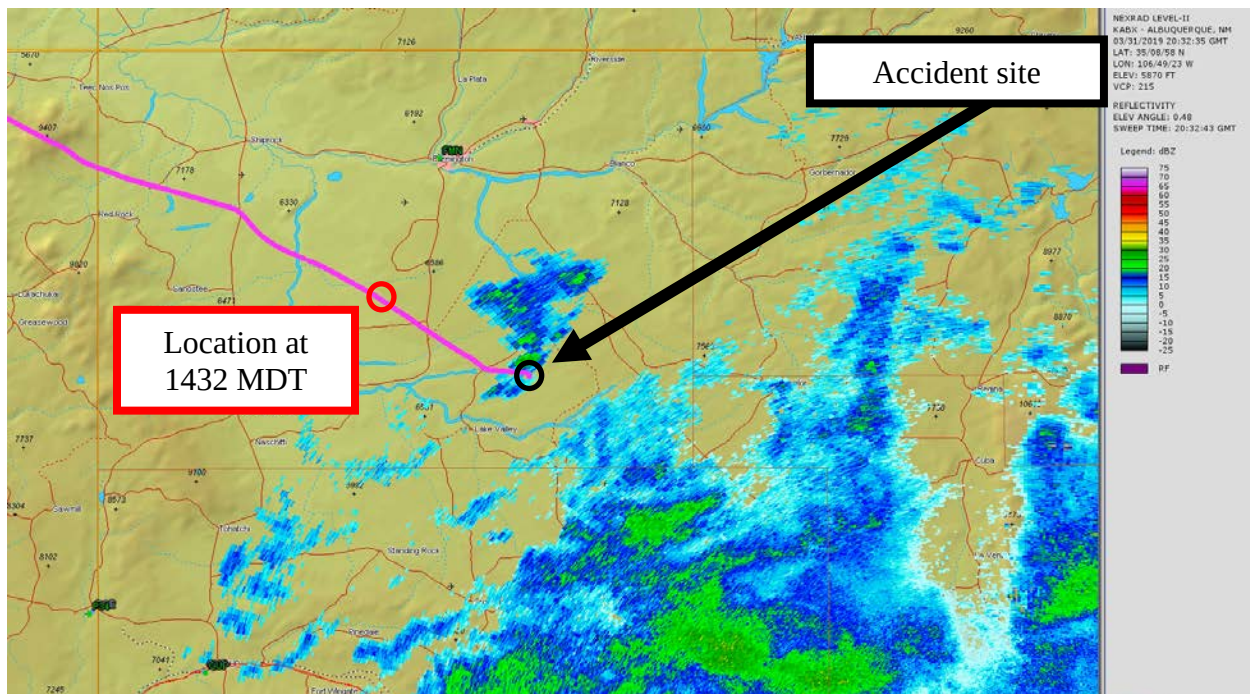


Figure 12 – KABX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1432:43 MDT with the accident site marked with black circle

²⁶ A review of Earth Networks Total Lightning Network was done.

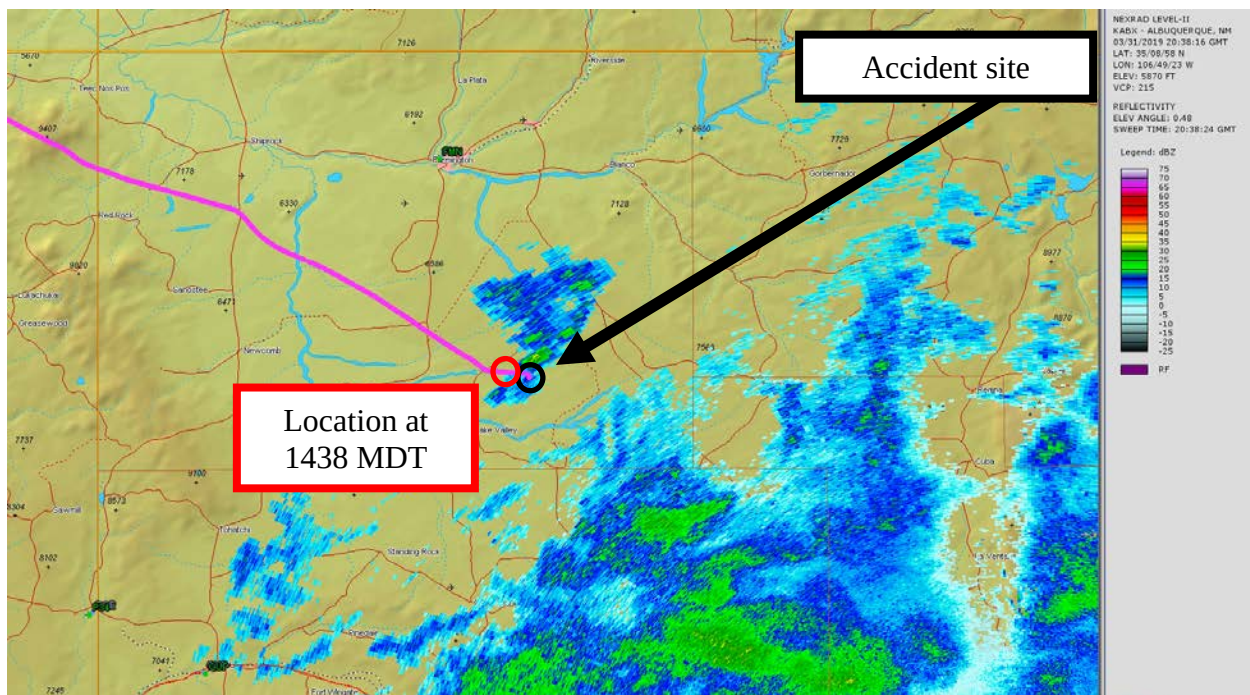


Figure 13 – KABX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1438:24 MDT with the accident site marked with black circle

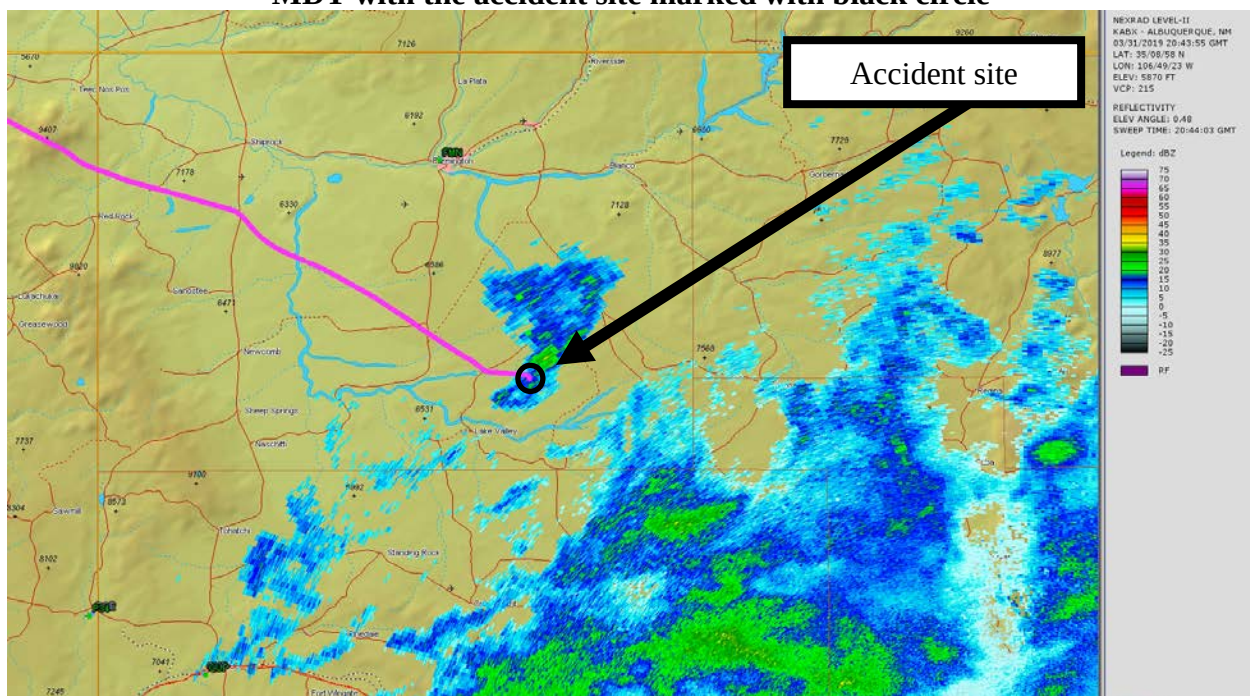


Figure 14 – KABX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1444:03 MDT with the accident site marked with black circle

8.0 Pilot Reports²⁷

Only one pilot report (PIREP) was reported in the national airspace within 100 miles of the accident site from about two hours prior to the accident time to about three hours after the accident time for below FL180²⁸ are provided below:

ABQ UA /OV 15 SOUTH/TM 2259/FL90/TP B350/TA 0/IC LGT RM

The report in plain language taken from standard code and abbreviations, with time converted to local were as follows:

Albuquerque International Sunport Airport, New Mexico (ABQ) routine pilot report (UA); Over – 15 miles south of ABQ; Time – 1659 MDT (2259Z); Altitude – 9,000 ft; Type aircraft – Beechcraft Super King Air; Temperature – 0 °C; Icing – Light rime.

9.0 SIGMET

The NWS Aviation Weather Center had issued Convective Significant Meteorological Information (SIGMET) advisory 1W at 1255 MDT which was valid until 1455 MDT over the area. SIGMET 1W warned of an area of embedded thunderstorms with tops to FL290 with the SIGMET 1W warning area moving from 330° at 20 knots between 1255 and 1455 MDT:

WSUS33 KPCI 311855
SIGW
-MKCW WST 311855
CONVECTIVE SIGMET 1W
VALID UNTIL 2055Z
CO UT
FROM DVC-40E DVC-20NNW RSK-50SSW DVC-DVC
AREA EMBD TS MOV FROM 33020KT. TOPS TO FL290.

10.0 CWSU Products

There were no Center Weather Service Unit (CWSU) Meteorological Impact Statements (MIS) or Center Weather Advisories (CWA) valid for the accident site at the accident time.

²⁷ Only pilot reports with the World Meteorological Organization headers UBNM**, UBAZ**, UBUT** and UBCO** were considered.

²⁸ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the standard sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

11.0 AIRMETS

Airmen's Meteorological Information (AIRMET) advisories Sierra and Zulu were valid for the accident flight's track and accident site at the accident time. The AIRMETS warned of IFR²⁹ conditions due to precipitation and mist, mountain obscuration conditions due to clouds, precipitation, and mist, and moderate icing between 8,000 ft and FL180:

WAUS45 KPCI 311445

WA5Z

-SLCZ WA 311445

AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 312100

.
AIRMET ICE...UT CO AZ NM

FROM 60SSW LAR TO 20SW DEN TO 30ESE DEN TO 30N LAA TO 40W GCK TO

50W LBL TO 30ESE TBE TO 20S TXO TO 50NW CME TO 40SSE SJN TO 60E

TBC TO 20SSE HVE TO 30WNW JNC TO 60SSW LAR

MOD ICE BTN 080 AND FL180. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET ICE...ID MT

FROM 30SSE YQL TO 20W LWT TO 50W BIL TO 20E DLN TO 20ESE LKT TO

60N LKT TO 60NNE GEG TO 30SSE YQL

MOD ICE BTN FRZLVL AND 160. FRZLVL 050-070. CONDS DVLPG 18-21Z.

CONDS CONTG BYD 21Z THRU 03Z.

.
OTLK VALID 2100-0300Z...ICE ID MT WY

BOUNDED BY 30NNE HVR-50NNW GGW-40SSE GGW-20SSE MLS-60NE CZI-20W

BOY-20WNW BPI-20ESE LKT-70NNW LKT-60SW YXC-60SE YXC-50NNW

GGW-30NNE HVR

MOD ICE BTN FRZLVL AND FL180. FRZLVL SFC-080. CONDS CONTG THRU

03Z.

.
FRZLVL...RANGING FROM SFC-125 ACRS AREA

MULT FRZLVL 040-060 BOUNDED BY 20SE LWT-40WSW DIK-70NNW RAP-

30S MLS-30WSW BIL-20SE LWT

MULT FRZLVL 040-120 BOUNDED BY 70SW SJN-20NW TCS-50SW CME-

70SSW TXO-INK-ELP-60SSE SSO-70SW SJN

SFC ALG 60SSW YXH-50W HVR-60SSE MLP-90SSE GEG-70NNW DNJ

SFC ALG 50SW BOI-30S ABQ-60S FTI-30ESE FTI-CYS-50S HVR-60NW

ISN

040 ALG 30S YQL-20NE GTF-40ESE LWT-60WSW DIK

080 ALG 20NW FMG-20SW OAL-50E INW-40ENE SSO-40SSE DMN

120 ALG 50ESE BZA-50S TUS

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²⁹ Instrument Flight Rules (IFR) – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 ft agl and/or less than 3 miles visibility.

WAUS45 KPCI 311445
 WA55
 -SLCS WA 311445
 AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 312100
 .
AIRMET IFR...UT CO NM
FROM 30NW DBL TO 20WSW DEN TO 40WSW PUB TO 20N CIM TO 40WSW CIM
TO 60WNW ABQ TO 30NW DVC TO 40ENE JNC TO 30NW DBL
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.
 .
 AIRMET MTN OBSCN...MT
 FROM 30SSW YQL TO 60W HVR TO 20NNW HVR TO 50ESE LWT TO 60WSW BIL
 TO 20SE HLN TO 20E MLP TO 30S YXC TO 30SSW YQL
 MTNS OBSC BY CLDS/PCPN/BR. CONDS DVLPG 18-21Z. CONDS CONTG BYD
 21Z THRU 03Z.
 .
AIRMET MTN OBSCN...UT CO AZ NM
FROM 40SSE LAR TO 30WSW AKO TO 20SSE TBE TO 30NW CME TO 70N SJN
TO 20SSW DVC TO 40SW JNC TO 30NNW JNC TO 40SSW CHE TO 40SSE LAR
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.
 .
 AIRMET MTN OBSCN...ID MT
 FROM 90SE MLP TO 40WNW DBS TO 70E BOI TO 40ESE DNJ TO 70NNE DNJ
 TO 90SE MLP
 MTNS OBSC BY CLDS/BR. CONDS ENDG 15-18Z.

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight are shown in attachment 4. The GFA surface forecast products indicated IFR to MVFR³⁰ surface visibilities at the accident site and along the intended flight path and a northeasterly surface wind at 10 knots. Likely (greater than 60 percent chance) rain shower activity was indicated for south of the accident flight, but along the intended flight path. The GFA cloud forecast valid before departure for around the accident time indicated an overcast ceiling between 6,000 and 9,000 ft msl with clouds top between FL270 and FL290. G-AIRMETS³¹ Sierra and Zulu were also located on the figures. For more information please see attachment 4.

13.0 Terminal Aerodrome Forecast

KFMN was the closest airport to the accident site with a NWS Terminal Aerodrome Forecast (TAF). The KFMN TAF valid at the time of the accident was issued at 1125 MDT and was valid for a 24-hour period beginning at 1200 MDT. The TAF for KFMN was as follows:

³⁰ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling 1,000 to 3,000 ft agl and/or 3 to 5 miles visibility.

³¹ Graphical AIRMETS (G-AIRMETS) - <https://aviationweather.gov/gairmet>

TAF KFMN 311725Z 3118/0118 **12008KT P6SM -SHRA BKN040**
FM312200 33011KT P6SM VCSH BKN025
FM010500 06005KT P6SM SCT025 SCT040
FM011300 VRB04KT P6SM FEW040=

Between 1200 and 1600 MDT, the forecast expected a wind from 120° at 8 knots, greater than 6 miles visibility, light rain showers, and a broken ceiling at 4,000 ft agl.

14.0 NWS Area Forecast Discussion

The NWS office in Albuquerque, New Mexico, issued the following Area Forecast Discussion (AFD) at 1148 MDT (closest AFD to the accident time). The aviation section of the AFD discussed areas of expected moving across western and central New Mexico with mountain obscuration conditions:

FXUS65 KABQ 311748
AFDABQ

Area Forecast Discussion
National Weather Service Albuquerque NM
1148 AM MDT Sun Mar 31 2019

.AVIATION...

18Z TAF CYCLE

An upper low over the Four Corners late this morning will move southeast across northern New Mexico today and continue across east central New Mexico tonight. Light snow is falling from the northern mountains southward to a KSAF to KLVS line with MVFR and IFR ceilings and visibilities common across this area. MVFR to IFR conditions will persist through the late evening hours across these areas, before snowfall diminishes. As the upper level low moves southeastward this afternoon areas of rain and elevation snow will move southward across western and central New Mexico late this afternoon and evening and diminish late tonight across the northeast and central highlands. In the Albuquerque area late this afternoon and this evening, rain will quickly change to snow at KAEG with IFR conditions and to a mix of rain and snow at KABQ with MVFR conditions. Mountain obscurations will predominate across the northern mountains this afternoon through Monday morning, and develop late this afternoon across the Sandia and Manzano mountains and continue through Monday morning. Clouds will scatter out a few hours after sunrise on Monday with VFR conditions returning to the entire area.

28

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.PREV DISCUSSION...1118 AM MDT Sun Mar 31 2019...

.UPDATE...

Quick update to lower high temperatures for today. Cloud cover and light snow, with heavier precipitation to come, will likely keep temperatures lower than previously predicted. Will continue to watch to see how these lower temps impact snow amounts. Updates out

shortly.

34

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.PREV DISCUSSION...329 AM MDT Sun Mar 31 2019...

.SYNOPSIS...

Continued cooling today and tonight as an upper level low pressure system crosses New Mexico from the northwest with rain and snow showers, and a few thunderstorms. The northern and central mountains can expect a few to several inches of snow, with an inch or two in the surrounding highlands, upper Rio Grande Valley and south central mountains. Warmer and drier weather are expected Monday and Tuesday, then an upper trough crossing the central Rockies will strengthen winds over New Mexico toward mid week. Gusts to 50 mph and fire weather concerns will be possible mainly along and south of I-40 Wednesday. An upper level low pressure system passing south of the state will bring a slight chance of showers and thunderstorms to some areas Friday and Saturday.

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.DISCUSSION...

An upper level low pressure system over UT early this morning will sag southeastward across the forecast area today and tonight with colder temperatures, rain and snow showers, and some thunderstorms. Temperatures will be cold enough for the northern mountains to accumulate several inches of snow, with a few to several inches in the central mountains and Mount Taylor. The surrounding highlands, upper Rio Grande Valley and south central mountains should also accumulate an inch or two of snow. Nearly a quarter inch of rain is expected in the Albuquerque metro area.

Warmer temperatures are expected Monday and Tuesday as a low amplitude ridge of high pressure crosses. Highs should reach near and above normal by Tuesday afternoon, when southwest winds will become breezy as an upper level trough moves into the western US and strengthens the flow aloft over NM. The upper trough will cross the central Rockies on Wednesday steering a moderate jetstream over southern NM and inducing a surface low pressure system over the northeast corner of the state. The potential exists for west and northwest winds to gust in the 35 to 50 mph range along and south of I-40, where fire weather concerns are expected. Winds will be lighter farther north, but it will still be breezy. The upper trough will also bring cooler temperatures central and west, and a chance of rain showers, thunderstorms and snow showers across northern NM.

Another ridge of high pressure will cross Thursday with lighter winds, dry weather, and warming temperatures most places. An exception will be on the far eastern plains, where a back door cold front will produce a few degrees of cooling from Wednesday's readings. A weak upper level low pressure system is then forecast to pass south of NM Friday through Saturday with isolated showers mainly over the mountains, and a chance for thunderstorms on the eastern plains.

44

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.FIRE WEATHER...

A low pressure system moving across NM today will bring rain and mountain snow to the northern and western high terrain. Snowfall accumulations of 4 to 8" are likely above 7,500 ft with wetting rainfall expected in lower elevations along and west of the central mt chain. Northwest flow aloft will develop in the wake of this system for Monday with high temperatures 5 to 10F below normal.

Southwest winds will increase Tuesday and Wednesday ahead of the next weather system passing through Colorado. Winds will become strong enough with low humidity Wednesday to support a few hours of marginal critical conditions over southern portions of the area. A few more valley rain and mountain snow showers are possible for the northern mts Wednesday afternoon. Thursday and Friday will trend warmer with relatively lighter winds.

Guyer

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.ABQ WATCHES/WARNINGS/ADVISORIES...

Winter Weather Advisory until midnight MDT tonight for the following zones... NMZ510>515-521.

&&

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15.0 Winds and Temperature Aloft Forecast

The NWS 1359 MDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWN0 311959

FD1US1

DATA BASED ON 311800Z

VALID 010000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
FMN		3307-02	3213-10	2908-25	1813-38	333646	334849	305254	

The accident site was located closest to the Farmington, New Mexico, (FMN) forecast point. The 1359 MDT FMN forecast for use between 1400 MDT and 2100 MDT indicated a wind at 9,000 ft from 330° at 7 knots with a temperature of -2° C, a wind at 12,000 ft from 320° at 13 knots with a temperature of -10° C, and a wind at 18,000 ft from 290° at 8 knots with a temperature of -25° C.

16.0 Pilot Weather Briefing

The accident pilot did not request a weather briefing from Leidos, however, the accident pilot did call Leidos at 1351 MDT to active his flight plan (attachments 5 and 6) and responded that he did have the AIRMETs Sierra and Zulu valid along the intended route of flight. In addition, Leidos did archive the text of the weather briefings from around 2112 MDT on March 30, when the accident pilot requested an online weather briefing from Aerovie (attachments 7, 8, and 9). The accident pilot did not request any other weather information after 2144 MDT on March 30 from Aerovie (attachment 11).

A search of archived ForeFlight information indicated that the accident pilot did request weather information and filed a flight plan via ForeFlight (attachment 10) on March 29 for a flight at 1500 MDT on March 31. The weather briefing information contained all the standard weather information valid at 2112 MDT on March 30 (same time of weather briefing request from Aerovie), but none of the weather forecast information was valid past 1200 MDT on March 31. From 1337 MDT to 1428 MDT on March 31 the accident pilot entered numerous routes into the ForeFlight app which updated the route string and winds aloft information (attachment 10). The accident pilot last viewed weather imagery on the ForeFlight app on March 27 (attachment 10). There is no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight.

17.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on March 31, 2019, indicated the following:

SUN	
Begin civil twilight	0634 MDT
Sunrise	0700 MDT
Sun transit	1316 MDT
Accident time	1439 MDT³²
Sunset	1933 MDT
End civil twilight	1959 MDT

E. LIST OF ATTACHMENTS

Attachment 1 – GOES-16 visible satellite animation from 1400 to 1445 MDT with accident flight track points in green

Attachment 2 – GOES-16 visible satellite animation from 1302 to 1602 MDT

³² Inserted accident time for reference and context.

Attachment 3 – Animation of KABX WSR-88D base reflectivity images for the 0.5° elevation scans between 1415 and 1455 MDT

Attachment 4 – GFA products valid for the accident flight

Attachment 5 – Accident pilot activated flight plan through Leidos

Attachment 6 – Flight plan text

Attachment 7 – Communication with Leidos regarding Aerovie online weather briefing

Attachment 8 – Leidos archive of accident pilot requesting information from Aerovie

Attachment 9 – Text weather briefing information from Aerovie online weather briefing

Attachment 10 – Weather information received from ForeFlight by the accident pilot

Attachment 11 – Additional Aerovie weather information received by the accident pilot on March 30

Submitted by:

Paul Suffern
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