NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 21, 2021

Specialist's Factual Report

METEOROLOGY

PLD21FR002

Table Of Contents

A. ACCIDENT

Location: Farmersville, Texas
Date: June 28, 2021
Time: 1535 central daylight time
2035 coordinated universal time (UTC)
Pipeline: Atmos contractors pipeline explosion

B. SENIOR METEOROLOGIST

Don Eick
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are central daylight time (CDT) based upon the 24-hour clock, local time is -5 hours from UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles (sm) and fractions of statute miles.

The accident site was at latitude 33.2121372° N and longitude 96.391797° W at an elevation of approximately 520 ft.

D. WEATHER INFORMATION

1.0 Synoptic Condition

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the southcentral United States for 1600 CDT is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a low-pressure system of 1011-hectopascals (hPa)[1] over north central Texas along a stationary front which extended northward across northern Texas and then northeastward into Oklahoma. The accident site was located south and east of the frontal system in the warm air sector of the front, where station models identified east-southerly winds of 5 to 15 knots, overcast clouds, and

[1] Hectopascals is the standard unit for reporting sea level pressure and is interchangeable with the former term millibar (mb) with the same units. Standard sea level pressure is 1013.25-hPa at 59° F or 15° Celsius (C).

temperatures in the mid 70's to 80's degrees Fahrenheit (F). Several stations surrounding the accident site also reported light to moderate rain.

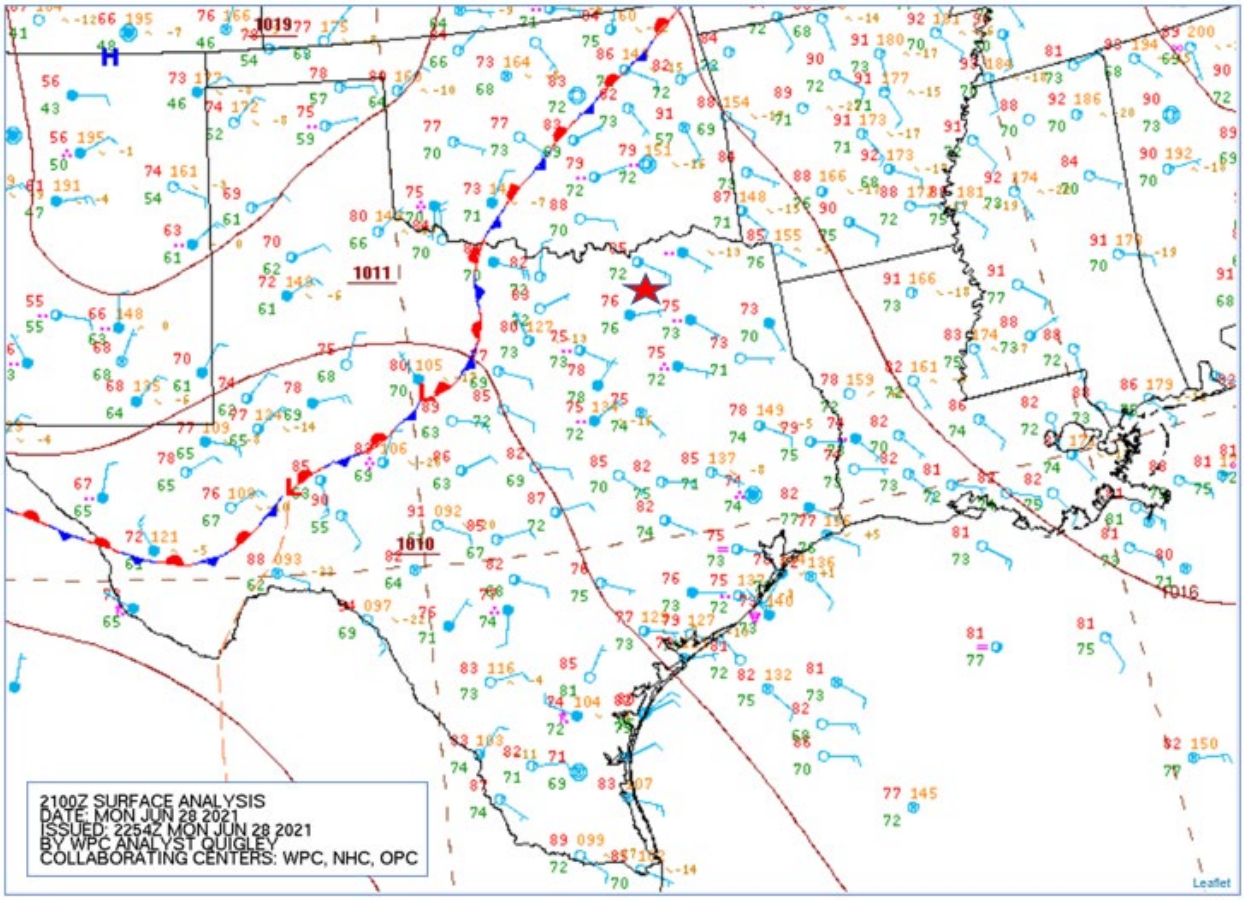

Figure 1 - NWS Surface Analysis Chart for 1600 CDT with the accident site marked by the red star.

1.2 Regional Mosaic Radar Imagery

A review of the National Composite Radar Mosaic for 1535 CDT is included as figure 2, with the approximate accident site marked by a red star and the closest weather reporting station noted. The radar mosaic depicted a band of precipitation over the area with the accident site and the closest reporting site under echoes near 40 dBZ.

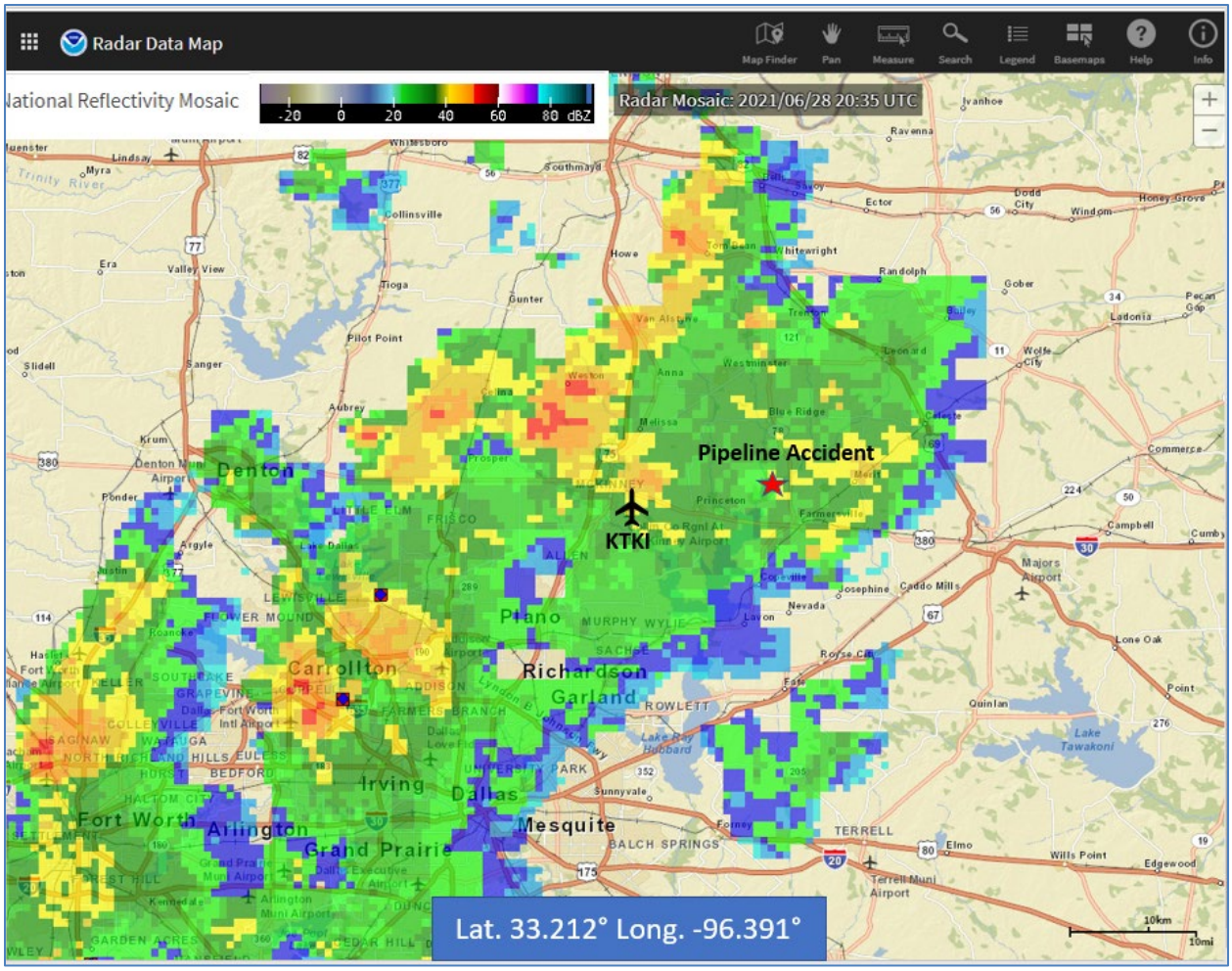

Figure 2 - National Composite Radar Mosaic over the region for 1535 CDT with accident site.

2.0 Surface Observations

The closest National Weather Service (NWS) reporting location was from McKinney National Airport (KTKI), in Dallas, Texas, approximately 10 miles west-southwest of the accident site at an elevation of 589 ft. The airport had an Automated Surface Observation Systems (ASOS), which was augmented by air traffic control personnel during normal operating hours. The following conditions were reported surrounding the time of the accident. Wind speeds are in miles per hour (mph), and cloud heights are reported above ground level (agl) in this section.

Special weather observation for KTKI at 1514 CDT, wind from 120° at 17 mph gusting to 33 mph, visibility 1 ¾ miles in heavy rain and mist, a few clouds at 2,000 ft, scattered clouds at 3,600 ft, broken clouds at 6,500 ft, temperature 75° F, dew point temperature 72° F, altimeter 29.97 inches of mercury. Remarks: automated station with a precipitation discriminator, peak wind from 130° at 29 knots occurred at 1506 CDT, hourly precipitation 0.08 inches, temperature 23.9° Celsius (C), dew point temperature 22.2° C.

Weather observation for KTKI at 1553 CDT, wind from 130° at 7 mph, visibility 5 miles in light rain and mist, a few clouds at 2,300 ft, scattered clouds at 7,000 ft, and overcast clouds at 8,500 ft, temperature 74° F, dew point temperature 72° F, altimeter 29.97 inches of mercury. Remarks: automated station with a precipitation discriminator, peak wind from 130° at 29 knots occurred at 1506 CDT, lightning distant southwest through northwest of the station, rain began at 1510 CDT, sea level pressure 1014.6-hPa, hourly precipitation 0.47 inches, 6-hour precipitation total 0.47 inches, temperature 23.3° C, dew point temperature 22.2° C, 3-hour pressure tendency fallen 0.7-hPa.

A review of the observations surrounding the time of the accident indicated light southeasterly winds, with light to heavy rain showers and mist, with mostly cloudy to overcast cloud cover. The temperature was between 74° and 75° F, with 100% relative humidity. The high temperature of 87° F occurred near noontime. The total precipitation reported on June 28, 2021, was 0.51 inches.

A summary of the conditions surrounding the time of the accident in table format is included below with wind speed in mph. The sky condition is the total cloud cover with cloud heights omitted (FEW-few; SCT-scattered: BKN-broken; OVC-overcast), with weather type which includes precipitation type and intensity (intensity: (-) light, ( ) moderate, (+) heavy) where RA=rain, TS=thunderstorm, and BR=mist.

Time (CDT)	Sky Condition	Visibility (sm)	Weather Type	Temp (°F)	Td (°F)	RH (%)	Wind Dir(deg)	Wind Speed (mph)	Altimeter (inHg)	Precip (in)
0653	CLR	10		73	71	90	100	3	29.99	0.00
0753	OVC	10		75	71	88	110	7	29.99	0.00
0853	BKN/OVC	10		75	71	90	110	5	29.99	0.00
0953	BKN/OVC	10		78	72	82	130	6	30.02	0.00
1053	BKN	10		81	72	74	000	0	30.01	0.00
1153	FEW/BKN	10		83	71	67	040	6	30.01	0.00
1253	FEW/SCT	10		85	69	59	070	9	29.98	0.00
1353	BKN/OVC	10		86	71	61	050	8	29.98	0.00
1453	BKN/OVC	10		83	72	70	160	10	29.96	T
1511	SCT/BKN	3	-RA	77	72	85	130	17G33	29.97	0.04
1514	FEW/BKN	1.75	+RA BR	75	72	90	120	17G33	29.97	0.08
1551	**BKN/OVC**	**5**	**RA BR**	**73**	**72**	**94**	**130**	**9**	**29.97**	
1553	**SCT/OVC**	**5**	**-RA BR**	**74**	**72**	**94**	**130**	**7**	**29.97**	**0.48s**
1653	FEW/BKN	10		76	73	91	000	0	29.97	T
1753	BKN	10		78	74	87	110	3	29.95	0.00
1851	SCT	10	-RA	75	72	89	140	8	29.96	
1853	SCT	10	-RA	75	72	90	130	7	29.96	0.03
1940	BKN/OVC	10	-RA	75	72	90	130	8	29.96	0.01
1953	BKN	10	-RA	75	72	90	130	7	29.98	T
2053	BKN	7		75	72	90	140	6	29.98	0.00
2055	BKN/BKN	6	BR	75	72	90	130	6	29.98	

Attachment 1 is the official NWS NCEI Local Climatology Data of Hourly Observations for McKinney on June 28, 2021, with time reported in local standard time (LST).

3.0 Sounding

A High-Resolution Rapid Refresh (HRRR) numerical[2] model sounding was obtained from the NOAA Air Resource Laboratory to determine the vertical structure of the atmosphere over the area. The data were then plotted on a standard Skew T log P diagram[3] using the Universal Rawinsonde Observation (RAOB) program[4] software. Figure 3 is the sounding for 1500 CDT plotted from the surface to 400-hPa or approximately 24,000 ft over the Farmersville area.

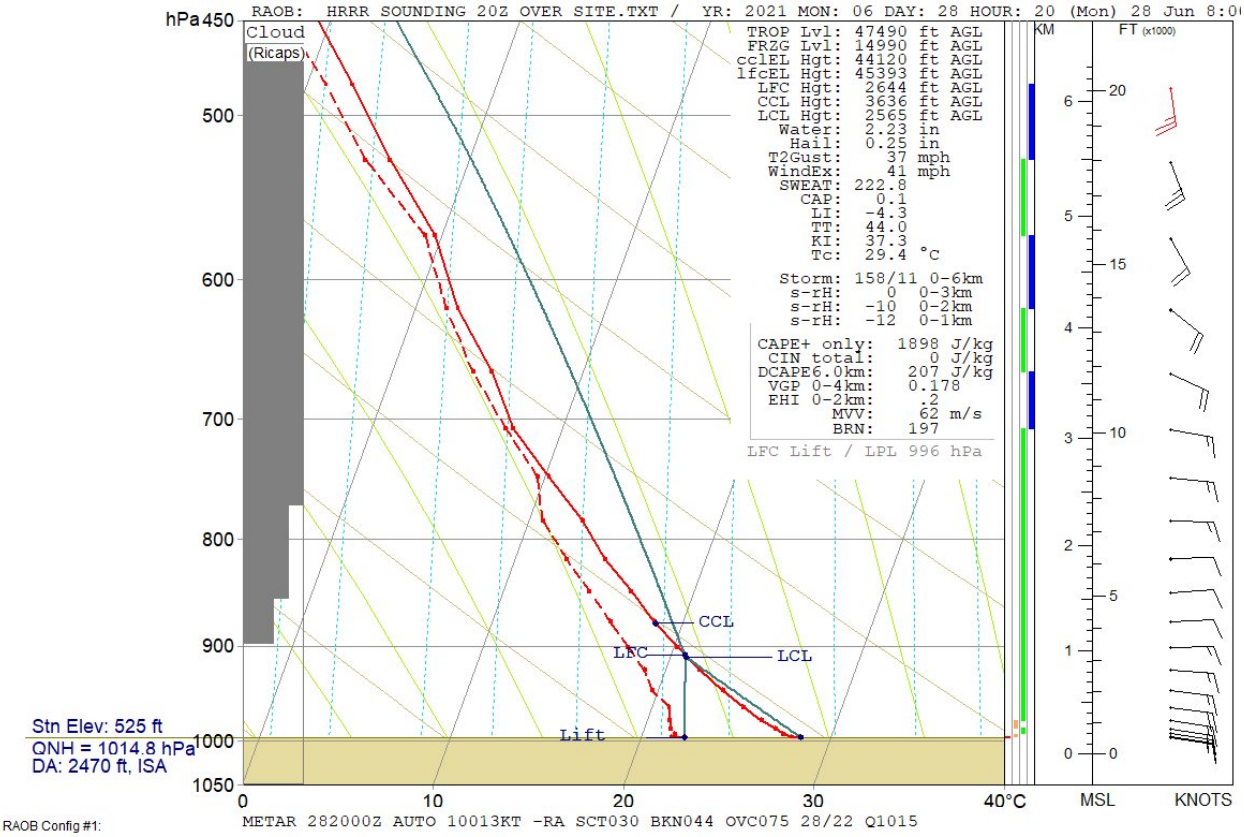

Figure 3 - HRRR numerical model sounding over Farmersville for 1500 CDT.

The HRRR sounding for 1500 CDT depicted an elevation of 525 ft over the area with a near surface temperature of 83° F (28.4° C), a dew point temperature of 72° F (22.3° C), with a 70% relative humidity, a precipitable water content of 2.23 inches, and with surface wind from the east at 15 mph. The lifted condensation level (LCL)[5] and level of free convection (LFC)[6] were

[2] The HRRR is a National Oceanic and Atmospheric Administration (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.

[3] Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram 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.

[4] RAOB – (The Universal RAwinsonde OBservation program) is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

[5] Lifted Condensation Level - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

[6] Level of Free Convection - the last level where a parcel becomes buoyant, or "warmer" than the environmental

identified at approximately 2,500 ft agl, with the convective condensation level (CCL)[7] at about 3,600 ft agl. The sounding supported a deep layer of clouds with tops near 45,000 ft based on the equilibrium level (EL)[8]. The atmosphere was characterized as unstable with a lifted index[9] of -4.3, and a convective available potential energy (CAPE)[10] of 1,898 Joules/kilogram and favored multicellular type thunderstorms. The storm motion was expected to be from 160° at 12 mph.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite number 16 (GOES-16) imagery were obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared and visible imagery were reviewed surrounding the period, and the closest images to the accident time documented. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μm) provided radiative cloud top temperatures with a nominal spatial resolution of 2 kilometers (km). The visible imagery (band 2) at a wavelength of 0.64 μm also provided the highest resolution of 0.5 km.

Figure 4 is the GOES-16 infrared image for 1536 CDT at 4X magnification with a standard MB temperature enhancement curve applied to highlight the colder cloud tops typically associated with high cirriform clouds and deep convection associated with thunderstorms. The image depicted a cluster of enhanced clouds over the Farmersville area and the accident site. The radiative cloud top temperature over the accident site was 229° Kelvin or -44° C, which corresponded to cloud tops near 37,000 ft. Other higher cloud tops associated with the strong storms (yellow-light blue enhancements) showed cloud tops near 41,000 ft at the time. Figure 5 is the GOES-16 visible image for the same period at 1536 CDT at 4X magnification and depicted a cluster of cumulonimbus clouds over the area.

temperature at the same level. The LFC represents the bottom of the layer containing CAPE.

[7] Convective Condensation Level (CCL) – the level at which condensation will occur if sufficient lifted. Found at the intersection of the saturation mixing ratio line and the environmental temperature.

[8] Equilibrium Level (EL) - the level where the lifted parcel again equals the environmental temperature, working upward from the LFC. The EL represents the top of the layer containing CAPE.

[9] Lifted Index (LI) - the difference between the lifted parcel temperature at 500-hPa and the 500-hPa temperature in the sounding. Negative values denote parcels that are warmer than the background 500-hPa temperatures and are thus buoyant or "unstable".

[10] Convective Available Potential Energy - is the integrated amount of work that the upward (positive) buoyancy force would perform on a given mass of an air parcel if it rose vertically through the entire atmosphere. Positive CAPE will cause the air parcel to rise, while negative CAPE will cause the air parcel to sink.

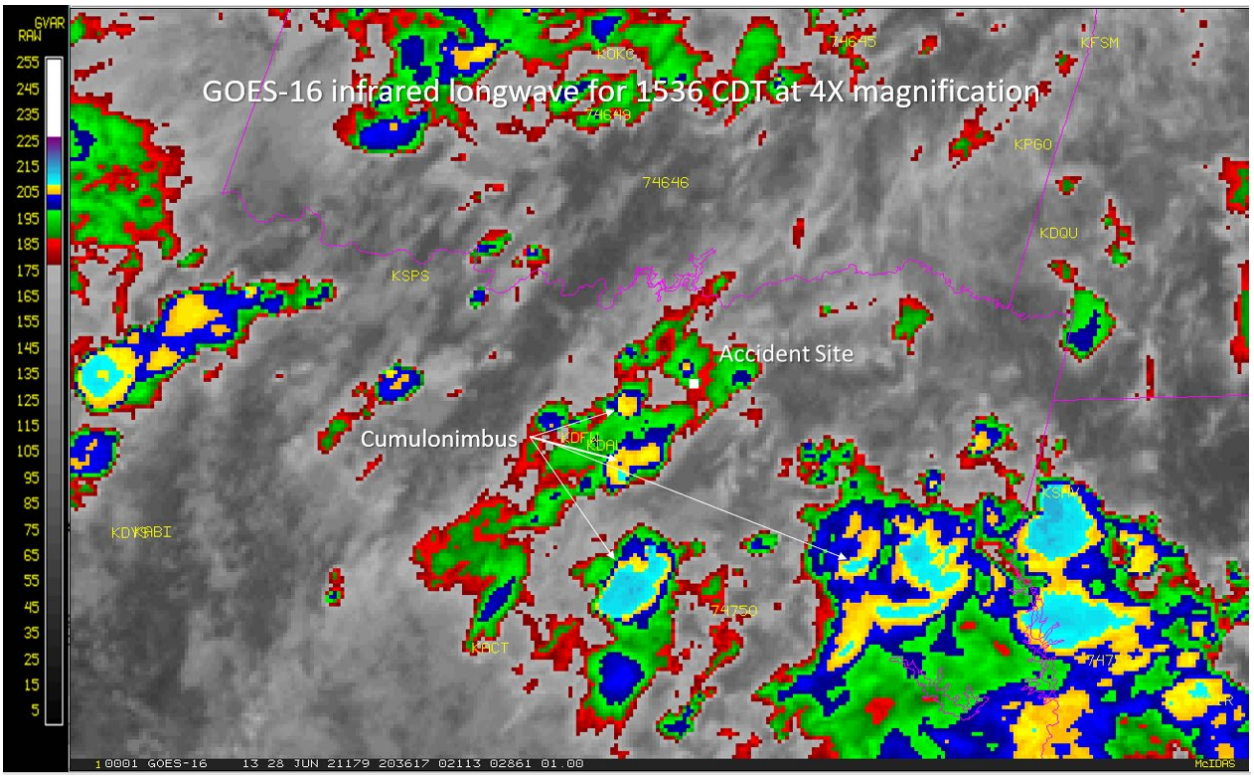

Figure 4 - GOES-16 infrared image for 1536 CDT at 4X magnification.

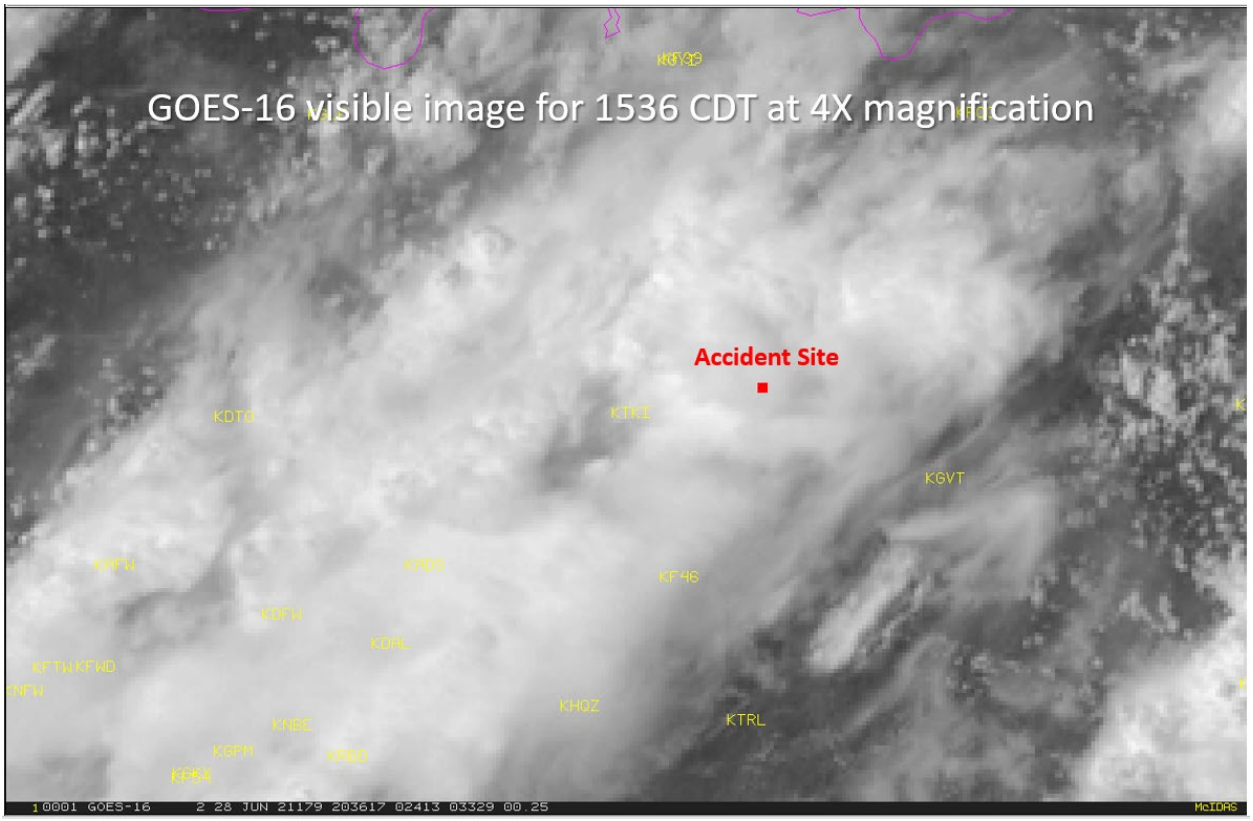

Figure 5 - GOES-16 visible image for 1536 CDT at 4X magnification with accident site.

5.0 Weather Surveillance Radar Imagery

The closest Weather Surveillance Radar 1988 Doppler (WSR-88D[11]) was located 60 miles southwest of the accident site at Dallas/Fort Worth (KFWS). The level II and level III archive data were obtained from the NCEI and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

5.1 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[12], 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 decibels (dBZ) and is a general measure of echo intensity. Figure 6 relates the NWS former video integrator and processor (VIP) intensity levels (1-6) versus the WSR-88D's display levels (0-15), precipitation mode reflectivity in decibels (DBZ), and rainfall rates.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0 1 2	< 5 5 to 9 10 to 14	
1 Very Light	3 4 5	15 to 19 20 to 24 25 to 29	.01 in/hr .02 in/hr .04 in/hr
2 Light to Moderate	6 7	30 to 34 35 to 39	.09 in/hr .21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11 12 13 14 15	55 to 59 60 to 64 65 to 69 70 to 74 > 75	>5.67 in/hr

Figure 6 - WSR-88D reflectivity levels and rainfall rates.

Current radar phraseology generally describes echoes less than 30 dBZ as "light", "moderate" echoes of 30-40 dBZ, "heavy" with echoes of >40-50 dBZ, and "extreme" echoes above >50 dBZ.

[11] The WSR-88D is a S-band 10-centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products reflectivity, radial velocity, and spectral width.

[12] Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at 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.

5.2 Composite Reflectivity Imagery

Figure 7 is the NWS KFTW WSR-88D composite reflectivity[13] image for 1533:54 CDT with the accident site noted by the white circle. The image depicted a large area of echoes with maximum echoes of 57 dBZ, which were moving northwestward at about 12 mph. At the time of the image echoes of 30 dBZ or "moderate intensity" were depicted over the accident site. During the period from 1445 through 1546 CDT echoes from 25 to 45 dBZ were observed over the station.

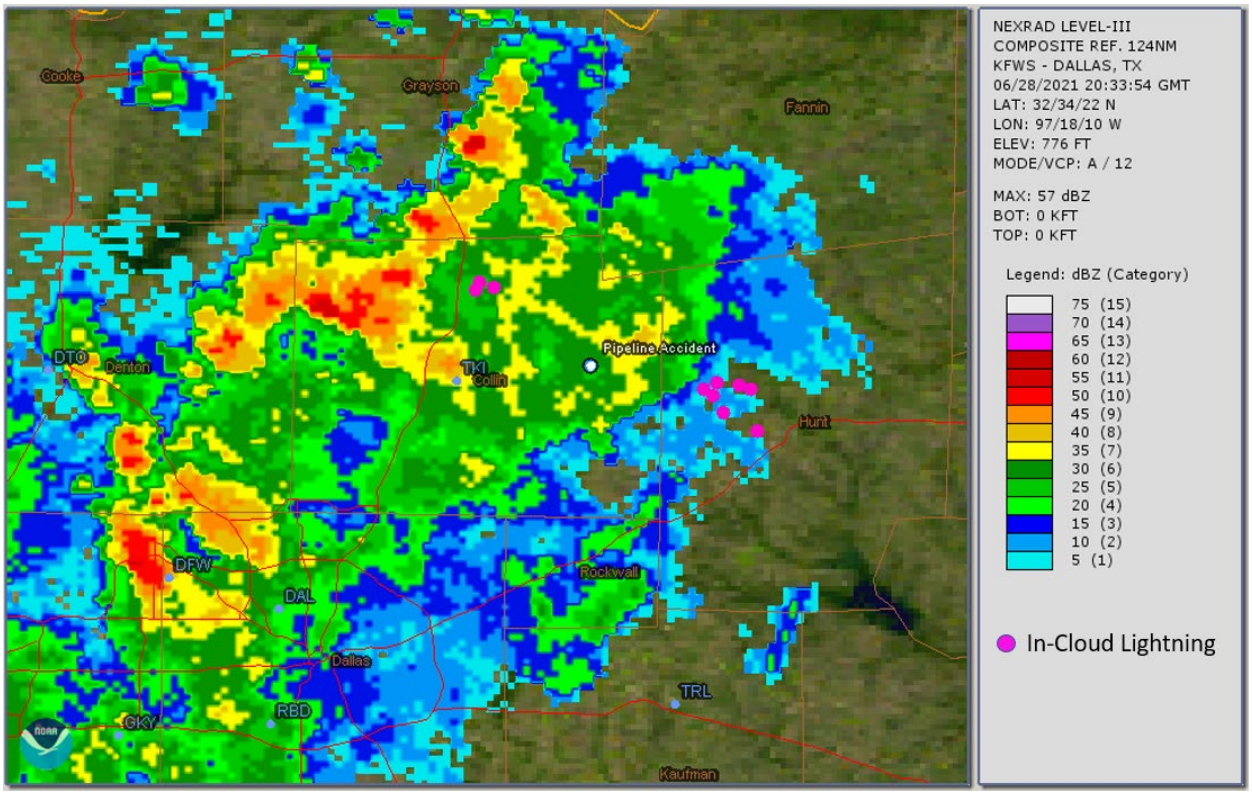

Figure 7 - NWS KFTW WSR-88D composite reflectivity image for 1533:54 CDT with accident site marked.

5.3 Lightning Data

The Earth Networks Total Lightning Network (ENTLN)[14] archive lightning database was accessed to determine if there were any lightning activity in the area surrounding the time of the accident.

The Earth Networks lightning data indicated that between 1435 through 1545 CDT, there were only 2 main flashes[15] within 20 miles of the accident site, which occurred at 1506 and 1534 CDT. Those two flashes further broke down into 10 in-cloud pulses, which are included in KFWS WSR-

[13] Composite reflectivity is the maximum dBZ reflectivity from any of the reflectivity angles of the WSR-88D.
[14] The ENTLN detects radio waves emitted by lightning and utilized waveform shapes to differentiate between pulses. Total lightning is the combination of cloud-to-ground and in-cloud lightning strikes.
[15] A lightning flash: A pulse is a surge of electric current in lightning usually accompanied by a burst of light. Pulses are classified as In-Cloud (IC) or Cloud-to-Ground (CG). A lightning flash is a collection of pulses close in space and time that approximates the continuous ionized channels of a complete bolt of lightning.

88D composite image (figure 7) above as a pink circles. The closest in-cloud flash was located about 10 miles east-southeast and 12 miles northwest of the accident site. No cloud-to-ground lightning strikes were recorded within 15 miles of the accident site during the period.

The following table provides with the time of the in-cloud flash, coordinates, peak current (amps), and height of the flash.

Time (CDT)	Latitude	Longitude	Peak Current	IC Height
1455:42.2551	33.14193	-96.1948	2,623	19,485 ft
1455:42.4906	33.11646	-96.1449	-2,348	11,983 ft
1506:14.8120	33.17688	-96.154	3,690	9,064 ft
1506:14.8161	33.18265	-96.1702	5,067	12,844 ft
1506:14.8590	33.16764	-96.2102	3,010	15,140 ft
1506:14.9015	33.16764	-96.2102	-2,850	11,301 ft
1506:14.9059	33.17625	-96.2236	-1,753	15,962 ft
1534:37.7311	33.33658	-96.5575	4,720	15,402 ft
1534:37.7356	33.32857	-96.5345	2,507	11,911 ft
1534:37.8364	33.3237	-96.5631	1,904	13,361 ft

6.0 NWS Forecasts

The accident occurred in the city of Farmersville, which was located in Collin County Texas, which is under the NWS Dallas Weather Forecast Office's (WFO) area of responsible, which issued the following forecasts and advisories.

6.1 Zone Forecast

The NWS Zone Forecast for Collin County issued at 0537 CDT and at 1116 CDT were as follows:

FPUS54 KFWD 281037
ZFPFWD

Zone Forecast Product for Texas
National Weather Service Fort Worth TX
537 AM CDT Mon Jun 28 2021

TXZ104-282145-
Collin-
Including the cities of Plano, McKinney, Allen, and Frisco
537 AM CDT Mon Jun 28 2021

.TODAY...A chance of showers and thunderstorms this morning, then showers and thunderstorms this afternoon. Highs in the mid 80s. Southeast winds 5 to 10 mph, increasing to 10 to 15 mph this afternoon. Chance of rain 80 percent.

.TONIGHT...Mostly cloudy with a 50 percent chance of showers and thunderstorms. Humid with lows in the lower 70s. Southeast winds 10 to 15 mph, diminishing to 5 to 10 mph after midnight.

.TUESDAY...Mostly cloudy in the morning, then becoming partly sunny. A 50 percent chance of showers and thunderstorms. Humid with highs in the mid 80s. Southeast winds 5 to 10 mph.

.TUESDAY NIGHT...Mostly cloudy. A 20 percent chance of showers and thunderstorms in the evening. Humid with lows in the lower 70s. Southeast winds 5 to 10 mph.

.WEDNESDAY...Partly sunny with a slight chance of showers and thunderstorms in the morning, then mostly sunny with a chance of showers and thunderstorms in the afternoon. Humid with highs around 90. Southeast winds 5 to 10 mph. Chance of rain 30 percent.

.WEDNESDAY NIGHT...Mostly cloudy in the evening, then becoming partly cloudy. Lows in the mid 70s.

The update at 1116 CDT was as follows:

FPUS54 KFWD 281616
ZFPFWD

Zone Forecast Product for Texas
National Weather Service Fort Worth TX
1116 AM CDT Mon Jun 28 2021

TXZ104-282330-
Collin-
Including the cities of Plano, McKinney, Allen, and Frisco
1116 AM CDT Mon Jun 28 2021

.THIS AFTERNOON...Showers and thunderstorms. Highs in the mid 80s. Southeast winds 10 to 15 mph. Chance of rain 90 percent.

.TONIGHT...Cloudy with a 50 percent chance of showers and thunderstorms. Humid with lows in the lower 70s. Southeast winds 5 to 10 mph.

.TUESDAY...Mostly cloudy with a 50 percent chance of showers and thunderstorms. Humid with highs in the mid 80s. Southeast winds 5 to 10 mph.

.TUESDAY NIGHT...Mostly cloudy. A 20 percent chance of showers and thunderstorms in the evening. Humid with lows in the lower 70s. Southeast winds 5 to 10 mph.

.WEDNESDAY...Partly sunny. A slight chance of showers and thunderstorms in the morning, then a chance of showers and thunderstorms in the afternoon. Humid with highs in the upper 80s. Southeast winds 5 to 10 mph. Chance of rain 30 percent.

.WEDNESDAY NIGHT...Mostly cloudy in the evening, then becoming partly cloudy. Lows in the lower 70s.

6.2 Area Forecast Discussion

The Area Forecast Discussion issued at 0548 CDT was as follows:

FXUS64 KFWD 281048
AFDFWD

Area Forecast Discussion
National Weather Service Fort Worth TX

548 AM CDT Mon Jun 28 2021

...New Short Term, Aviation...

.SHORT TERM... /NEW/
Deep Gulf moisture continues to arrive within southeasterly flow with 2" PW values now in place near and east of I-35. These will continue to climb to anomalously high values of up to 2.3" later today and will support very heavy rainfall with the anticipated numerous showers and thunderstorms. The main threat continues to be the potential for flooding with this activity, and can't rule out some isolated pockets of 2-3 in/hr hour rainfall amounts. This could certainly support instances of minor flooding and perhaps an occurrence or two of flash flooding depending on cell evolution or training convection. The remainder of the previous forecast below remains valid with only minor refinements to PoPs made with this update.

-Stalley

6.3 Hazardous Weather Outlook

The following Hazardous Weather Outlooks were issued for Collin County on June 28, 2021.

FLUS44 KFWD 280853
HWOFWD

Hazardous Weather Outlook
National Weather Service Fort Worth TX
353 AM CDT Mon Jun 28 2021

TXZ091>095-100>107-115>123-129>135-141>148-156>162-174-175-290900-
Montague-Cooke-Grayson-Fannin-Lamar-Young-Jack-Wise-Denton-Collin-Hunt-Delta-Hopkins-Stephens-
Palo Pinto-Parker-Tarrant-Dallas-Rockwall-Kaufman-Van Zandt-Rains-Eastland-Erath-Hood-Somervell-
Johnson-Ellis-Henderson-Comanche-Mills-Hamilton-Bosque-Hill-Navarro-Freestone-Anderson-
Lampasas-Coryell-Bell-McLennan-Falls-Limestone-Leon-Milam-Robertson-
353 AM CDT Mon Jun 28 2021

This Hazardous Weather Outlook is for North and Central Texas.

.DAY ONE...Today and Tonight.
Widespread showers and thunderstorms are expected today, especially in the afternoon and evening hours. Heavy rain and minor flooding will be the main concerns, but we can't rule out some small hail and strong winds. Coverage of storms is expected to decrease late tonight.

.DAYS TWO THROUGH SEVEN...Tuesday through Sunday.
Thunderstorm chances will continue through next week for most of North and Central Texas. The severe weather threat remains low, but brief periods of heavy rain will be possible.

.SPOTTER INFORMATION STATEMENT...
Spotter activation is not expected at this time.

FLUS44 KFWD 281620
HWOFWD

Hazardous Weather Outlook
National Weather Service Fort Worth TX
1120 AM CDT Mon Jun 28 2021

TXZ091>095-100>107-115>123-129>135-141>148-156>162-174-175-291145-
Montague-Cooke-Grayson-Fannin-Lamar-Young-Jack-Wise-Denton-Collin-Hunt-Delta-Hopkins-Stephens-
Palo Pinto-Parker-Tarrant-Dallas-Rockwall-Kaufman-Van Zandt-Rains-Eastland-Erath-Hood-Somervell-
Johnson-Ellis-Henderson-Comanche-Mills-Hamilton-Bosque-Hill-Navarro-Freestone-Anderson-
Lampasas-Coryell-Bell-McLennan-Falls-Limestone-Leon-Milam-Robertson-
1120 AM CDT Mon Jun 28 2021

This Hazardous Weather Outlook is for North and Central Texas.

.DAY ONE...This Afternoon and Tonight. Widespread showers and thunderstorms are expected through this evening. Heavy rain and minor flooding will be the main concerns, but we can't rule out some small hail and strong winds. Coverage of storms is expected to decrease late tonight.

.DAYS TWO THROUGH SEVEN...Tuesday through Sunday. Thunderstorm chances will continue through next week for most of North and Central Texas. The severe weather threat remains low, but brief periods of heavy rain will be possible.

.SPOTTER INFORMATION STATEMENT...
Spotter activation is not expected at this time.

FLUS44 KFWD 281954
HWOFWD

Hazardous Weather Outlook
National Weather Service Fort Worth TX
254 PM CDT Mon Jun 28 2021

TXZ091>095-100>107-115>123-129>135-141>148-156>162-174-175-291230-
Montague-Cooke-Grayson-Fannin-Lamar-Young-Jack-Wise-Denton-Collin-Hunt-Delta-Hopkins-Stephens-
Palo Pinto-Parker-Tarrant-Dallas-Rockwall-Kaufman-Van Zandt-Rains-Eastland-Erath-Hood-Somervell-
Johnson-Ellis-Henderson-Comanche-Mills-Hamilton-Bosque-Hill-Navarro-Freestone-Anderson-
Lampasas-Coryell-Bell-McLennan-Falls-Limestone-Leon-Milam-Robertson-
254 PM CDT Mon Jun 28 2021

This Hazardous Weather Outlook is for North and Central Texas.

.DAY ONE...This Afternoon and Tonight. Widespread showers and thunderstorms are expected through this evening. Heavy rain and minor flooding will be the main concerns, but we can't rule out some small hail and strong winds. Coverage of storms is expected to decrease late tonight.

.DAYS TWO THROUGH SEVEN...Tuesday through Sunday.
Isolated to scattered showers and thunderstorms will remain in the forecast through the end of the week. Most thunderstorm activity can be expected during the afternoon, with frequent cloud-to-ground lightning strikes and heavy downpours being the main hazards. Severe weather is not anticipated.

Thunderstorms may become more widespread by Friday and Saturday as a cold front approaches the region. Severe weather is unlikely, but any thunderstorms that develop will be capable of producing frequent lightning and heavy downpours.

.SPOTTER INFORMATION STATEMENT...
Spotter activation is not expected at this time.

7.0 Astronomical Conditions

The United States Naval Observatory's Multiyear Interactive Computer Almanac (MICA) software was used to determine the astronomical conditions over the accident site on June 28, 2021. The accident time is added in bold italic type for reference.

Sun	Time	Azimuth
Begin of civil twilight	0550 CDT	
Sunrise	0619 CDT	061°
Cumulative	1229 CDT	
Accident	***1535 CDT***	
Sunset	2039 CDT	299°
End of civil twilight	2108 CDT	

At the approximate time of the accident the Sun was 60° above the horizon at azimuth of 258°.

E. Attachments

Attachment 1 – NWS Local Climatology Data of Hourly Observations for McKinney, Texas on June 28, 2021.

Submitted by:

_____

Don Eick
Senior Meteorologist