

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA22FA314

METEOROLOGY

Specialist's Factual Report

October 20, 2022

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A. ACCIDENT

Location: Shelby, Michigan
Date: July 15, 2022
Time: 1815 eastern daylight time
2215 coordinated universal time (UTC)
Airplane: Cessna 210C; Registration: N3659Y

B. METEOROLOGY SPECIALIST

Specialist Paul Suffern
National Transportation Safety Board
Washington, DC

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 remotely, collecting data from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This Specialist's Factual Report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are eastern daylight time (EDT) and are based upon the 24-hour clock, where local time is -4 hours from UTC. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at latitude 43.62304° N, Longitude 86.30351° W, at approximate elevation of 910 feet (ft).

D. FACTUAL 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 WPC, 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

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the Great Lakes region of the United States for 1700 EDT is provided as figure 1 with the location of the accident site within the black circle. The chart depicted a low-pressure system in Iowa with a pressure of 1011-hectopascals (hPa), associated with a cold front and stationary front that stretched from Nebraska into eastward through Kentucky. High pressure systems were located in southern Ontario and western Pennsylvania.

The closest station model depicted near the accident site depicted a light easterly wind, an air temperature of 65° Fahrenheit (°F), with a dew point temperature of 64°F, moderate rain, and overcast clouds.

¹ https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

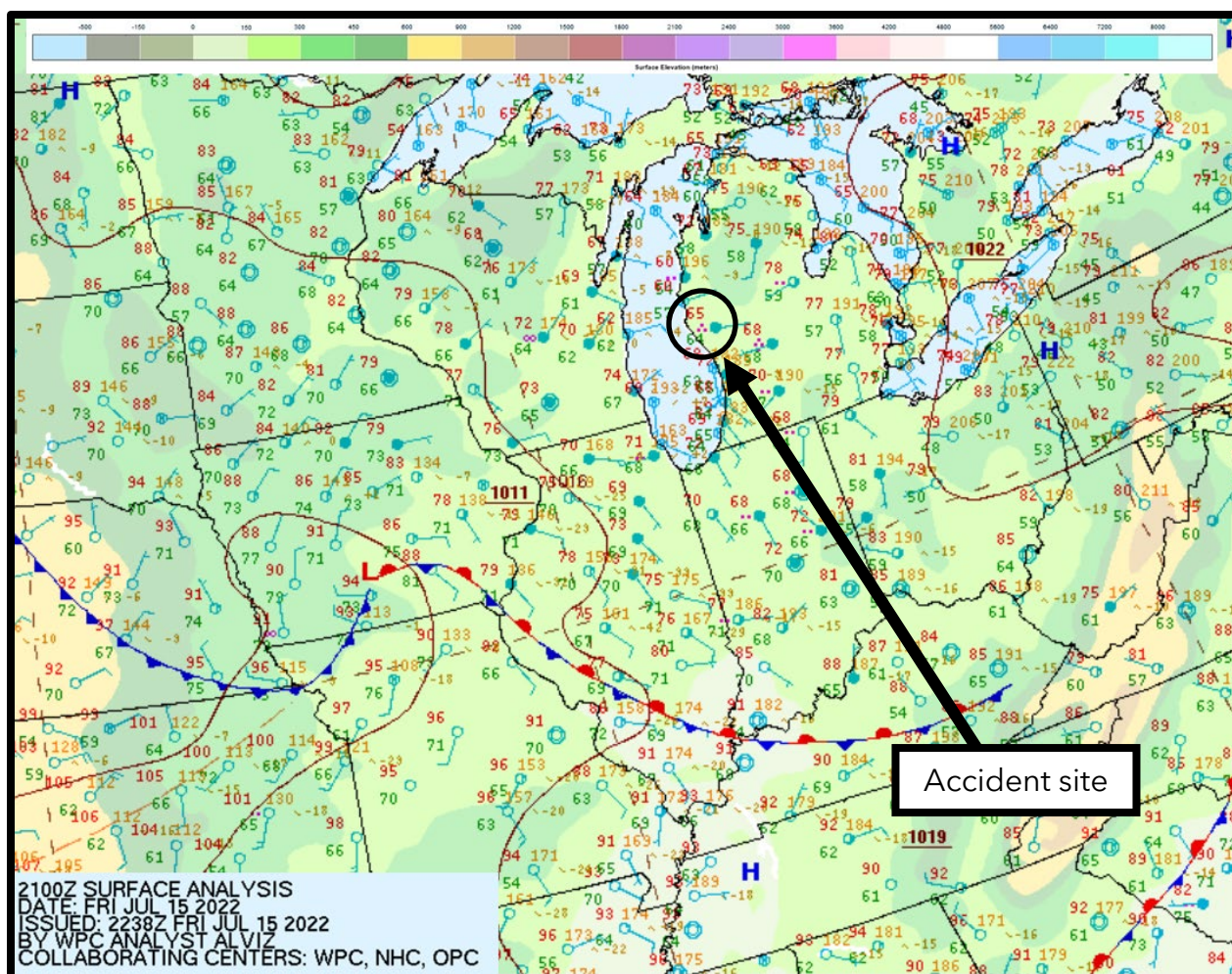


Figure 1. NWS Surface Analysis Chart for 1700 EDT.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 2000 EDT at 925-, 850-, 700-, and 500-hPa are presented in figures 2 through 5. A mid-level trough² was located above the accident at 700- and 500-hPa (figures 4 and 5). Troughs and fronts can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The 925-, 850-, and 700-hPa constant pressure charts depicted variable winds at or below 10 knots above the accident site at 2000 EDT. A west wind of 30 knots was located above the accident site by 500-hPa (figure 5).

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

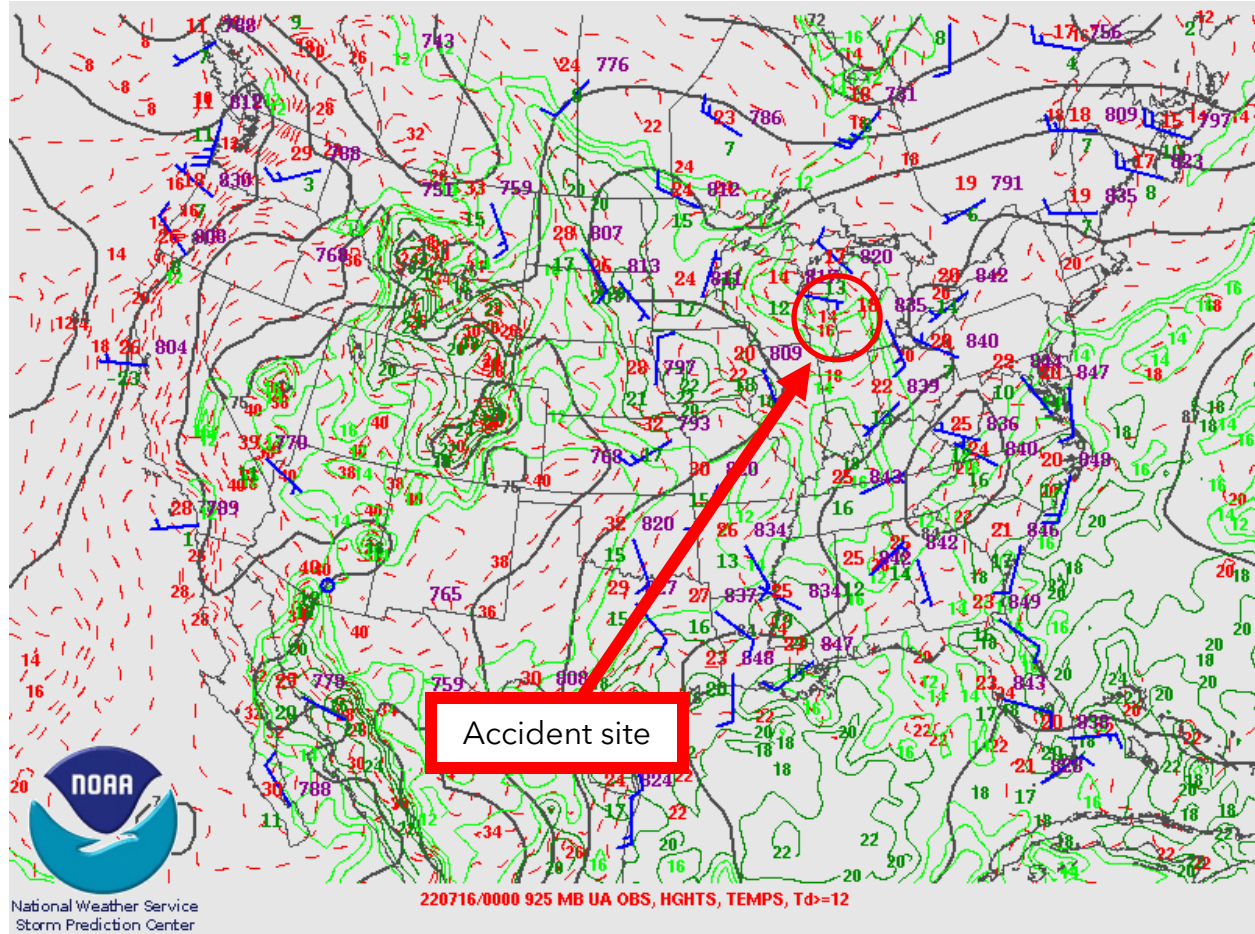


Figure 2. 925-hPa Constant Pressure Chart for 2000 EDT.

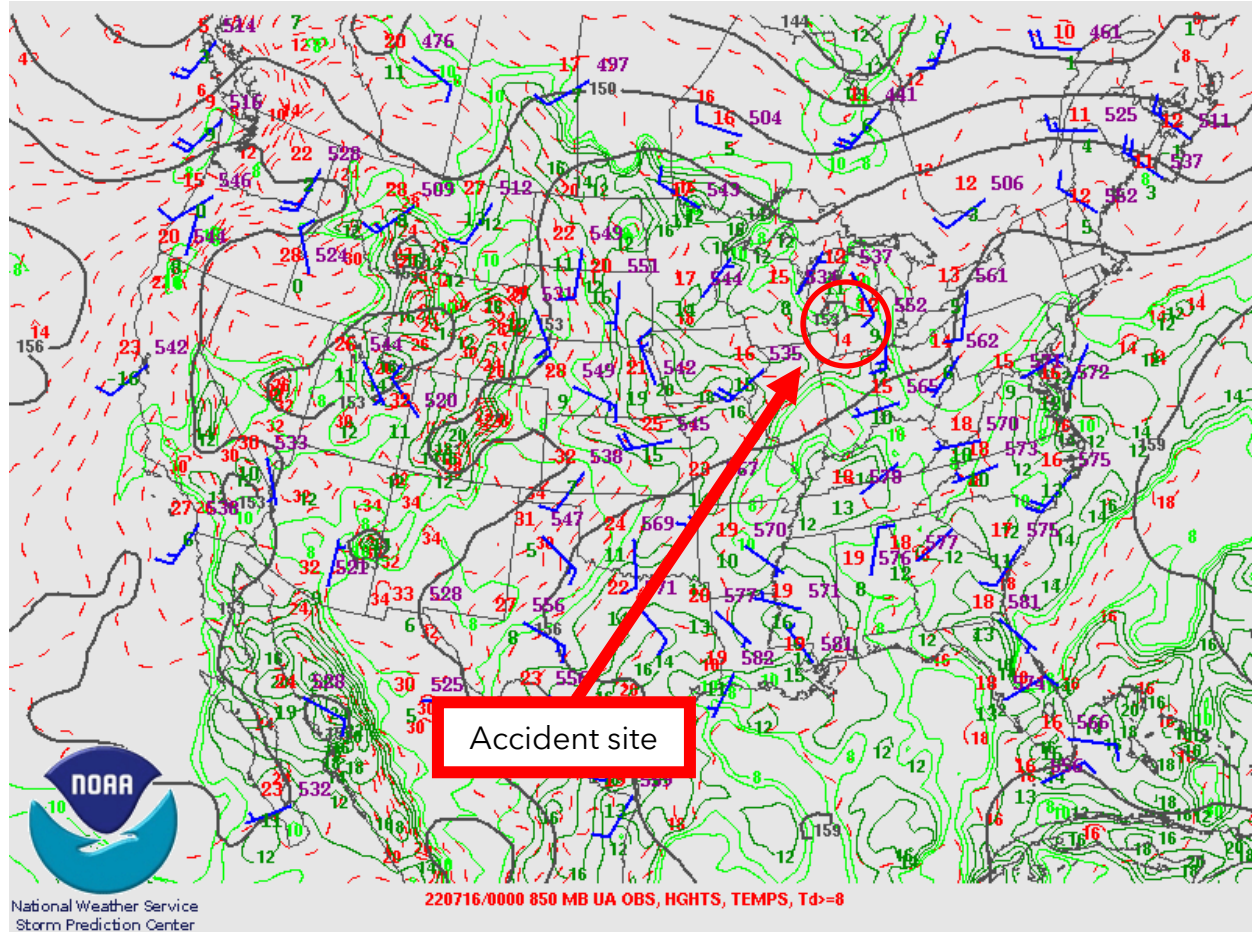


Figure 3. 850-hPa Constant Pressure Chart for 2000 EDT.

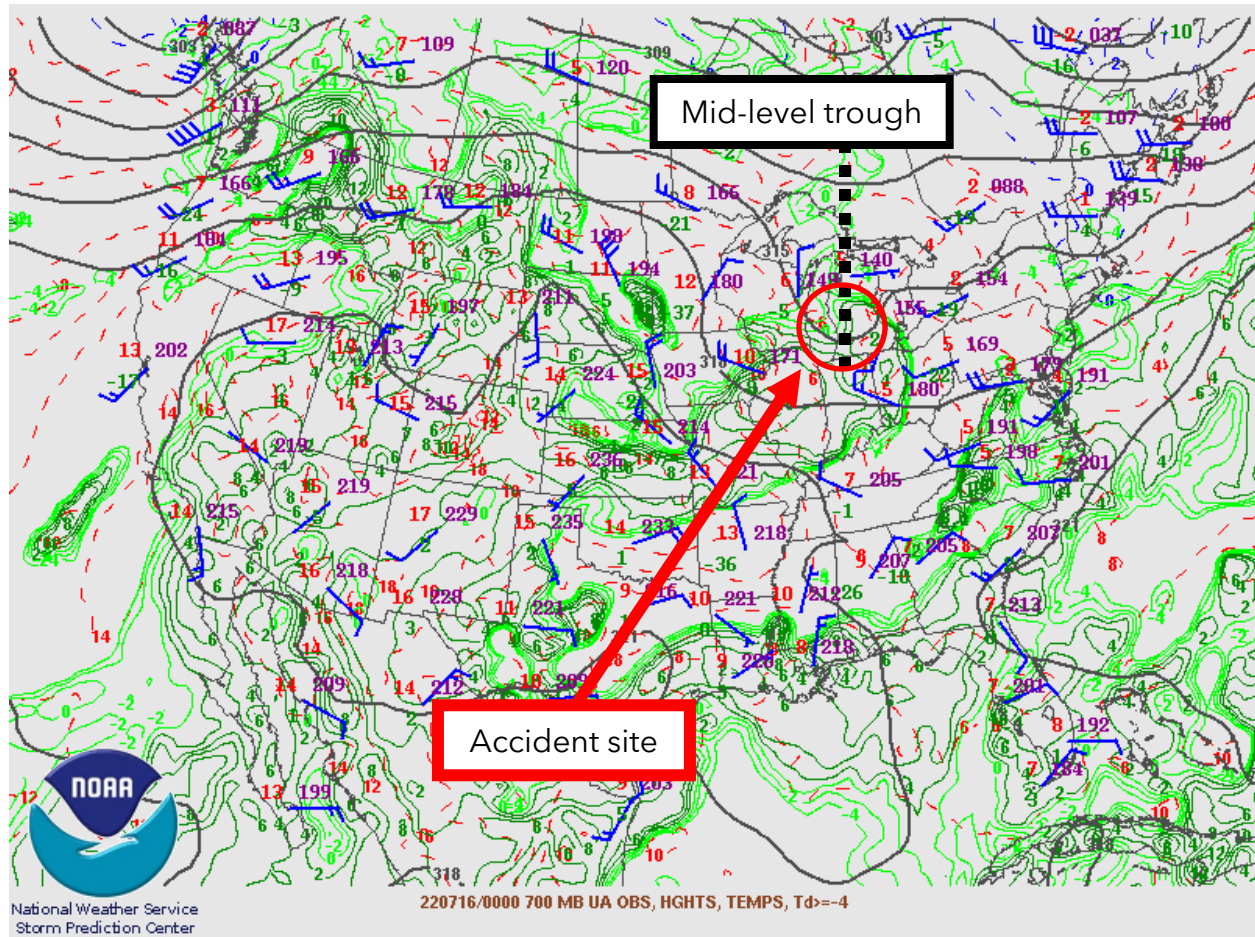


Figure 4. 700-hPa Constant Pressure Chart for 2000 EDT.

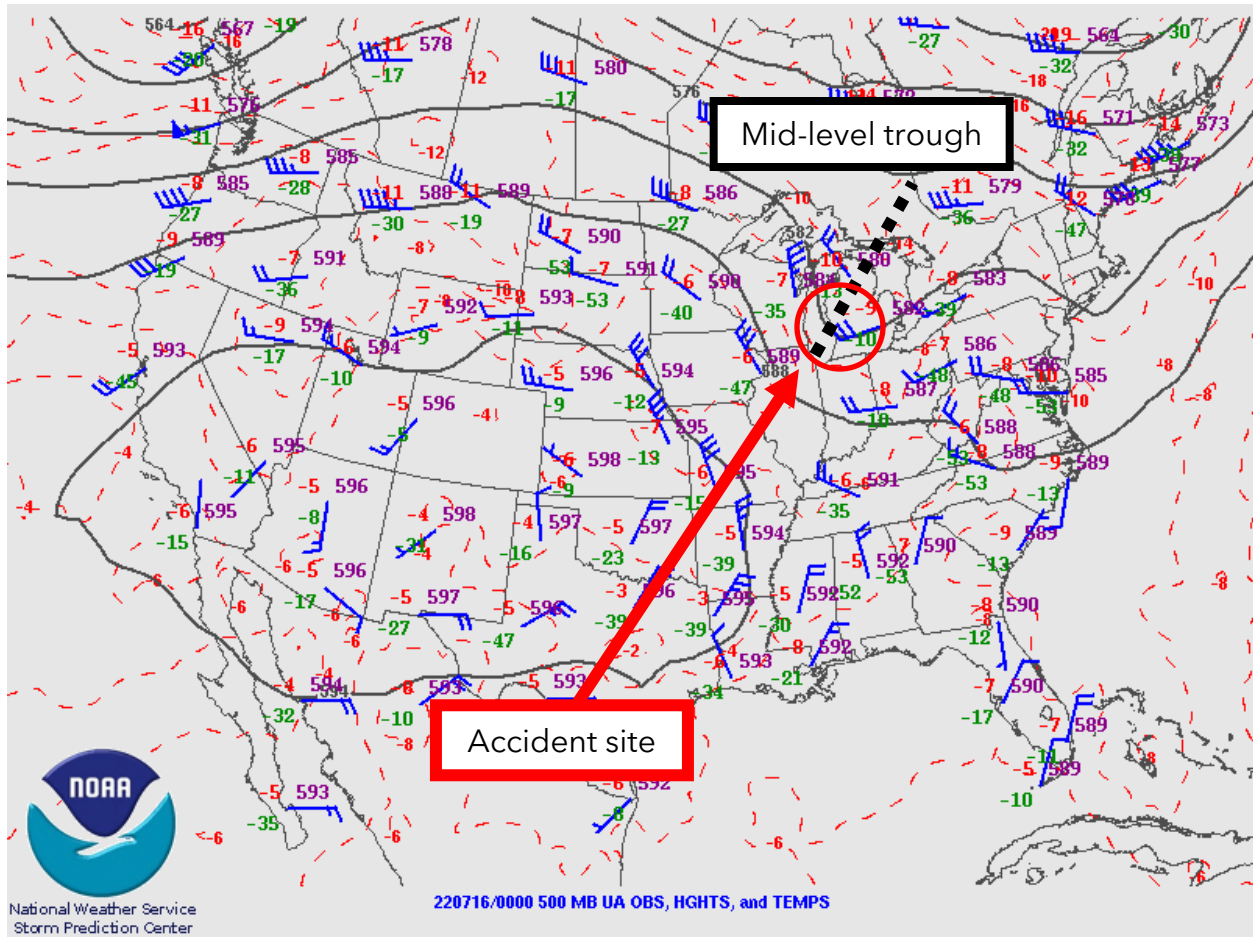


Figure 5. 500-hPa Constant Pressure Chart for 2000 EDT.

2.0 Storm Prediction Center Convective Outlook

The SPC issued a Day 1 Convective Outlook at 1542 EDT (figure 6) with areas of general thunderstorms forecast for the accident site. The SPC defines the "TSTM" area as an area that encloses where a 10% or higher probability of thunderstorms is forecast during the valid period.

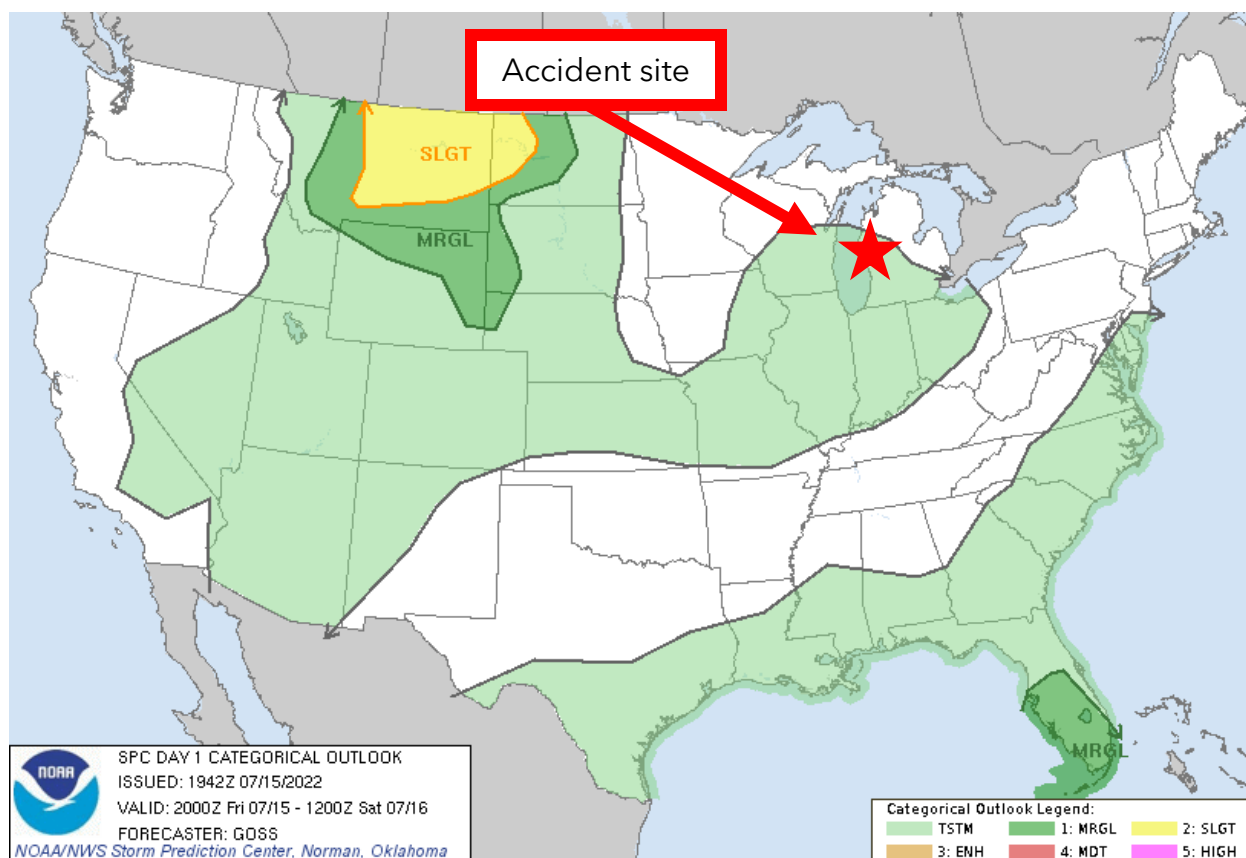


Figure 6. SPC day 1 Convective Outlook valid at the time of the accident.

3.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Specials Reports (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 7 is a local sectional chart with the accident site and the closest weather reporting locations marked. The chart depicted the magnetic variation³ of 5° west over the area.

³ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

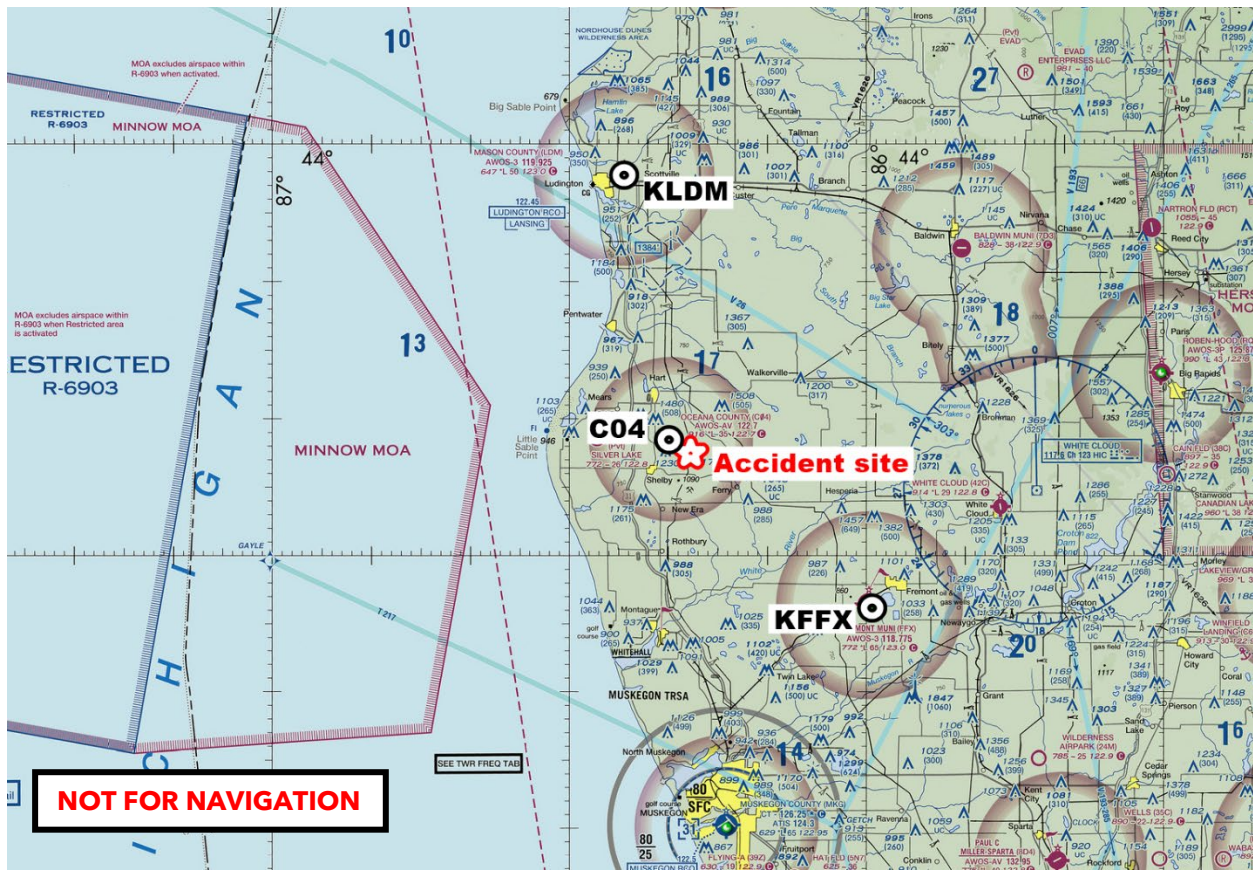


Figure 7. FAA sectional aeronautical chart of the accident area with the location of the accident site and surface observation sites.

The accident airplane departed from Oceana County Airport (C04). The airport had the closest official weather station to the accident site (figure 7). C04 had an Automated Weather Observing System (AWOS⁴) whose non-augmented reports were not sent longline⁵, but were provided by the airport (C04) manager to the investigation. The C04 AWOS was located 2 miles northwest of the accident site at an elevation of 910 ft. The C04 AWOS recorded observations surrounding the period of the accident are found in figure 8.

⁴ AWOS - Automated Weather Observing System is equipped with meteorological instruments to typically observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to 12,000 feet, and altimeter setting. AWOS are maintained by the FAA. Certain AWOS may have different reporting or observational equipment.

⁵ "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline dissemination of weather observations is the primary vehicle through which the weather observations are distributed.

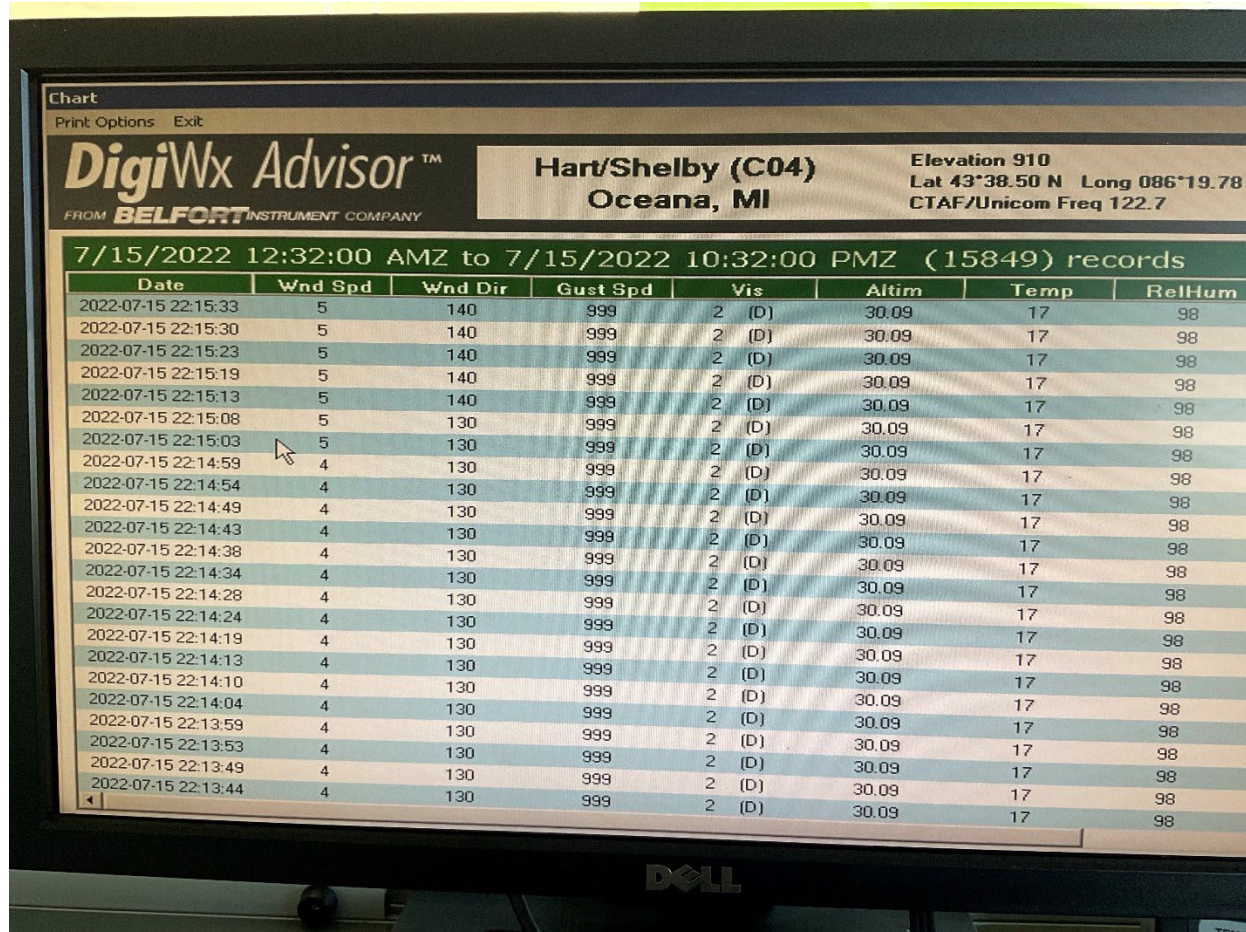


Figure 8. Observations from C04 AWOS surrounding the accident time.

C04 weather at 1815:03 EDT indicated, wind from 130° at 5 knots, visibility 2 miles, temperature of 17° Celsius (C), a relative humidity of 98%, and an altimeter setting of 30.09 inches of mercury (inHg).

Fremont Municipal Airport (KFFX) had the next closest official weather station to the accident site. KFFX had an AWOS whose longline reports were not augmented. The KFFX AWOS was located 17 miles southeast of the accident site (figure 7), at an elevation of 772 ft, and issued the following observations surrounding the period of the accident:⁶

[1635 EDT] METAR KFFX 152035Z AUTO 10003KT 2SM +RA OVC006
18/17 A3009 RMK AO2 VIS 1 1/4V3 T01810172=

⁶ The bold sections in this NWS product and the rest of the products in this report are intended to highlight the text 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.

[1655 EDT] METAR KFFX 152055Z AUTO 10003KT 2 1/2SM RA SCT006
BKN012 OVC034 18/18 A3009 RMK AO2 VIS 2V5 T01830175=

[1715 EDT] METAR KFFX 152115Z AUTO 09005KT 4SM DZ SCT006
BKN016 OVC027 18/18 A3008 RMK AO2 T01830176=

[1735 EDT] METAR KFFX 152135Z AUTO 10003KT 5SM +DZ SCT004
BKN010 OVC015 18/18 A3008 RMK AO2 T01830175=

**[1755 EDT] METAR KFFX 152155Z AUTO 00000KT 5SM RA BKN005
OVC010 18/18 A3008 RMK AO2 T01830175=**

ACCIDENT TIME 1815 EDT

**[1815 EDT] METAR KFFX 152215Z AUTO 10005KT 10SM SCT005
OVC010 18/18 A3007 RMK AO2 T01830175=**

[1835 EDT] METAR KFFX 152235Z AUTO 09005KT 10SM OVC010
18/17 A3007 RMK AO2 T01830174=

The bold type observations decoded in plain language were as follows:

KFFX weather at 1755 EDT, automated, wind calm, visibility 5 miles, moderate rain, broken ceiling at 500 ft above ground level (agl), overcast skies at 1,000 ft agl, temperature of 18°C, dew point temperature 18°C, and an altimeter setting of 30.08 inHg. Remarks, automated station with a precipitation discriminator, temperature 18.3°C, dew point temperature 17.5°C.

KFFX weather at 1815 EDT, automated, wind from 100° at 5 knots, visibility 10 miles or greater, scattered clouds at 500 ft agl, overcast ceiling at 1,000 ft agl, temperature of 18°C, dew point temperature 18°C, and an altimeter setting of 30.07 inHg. Remarks, automated station with a precipitation discriminator, temperature 18.3°C, dew point temperature 17.5°C.

Mason County Airport (KLDM) had the next closest official weather station to the accident site. KLDM had an AWOS whose longline reports were not augmented. The KLDM AWOS was located 21 miles north-northwest of the accident site (figure 7), at an elevation of 647 ft, and issued the following observations surrounding the period of the accident:

[1635 EDT] METAR KLDM 152035Z AUTO 10006KT 5SM RA BKN035
OVC042 16/15 A3010 RMK AO2 T01560148 P0011=

[1655 EDT] METAR KLDM 152055Z AUTO 08006KT 4SM RA SCT035
OVC042 15/14 A3009 RMK AO2 60030 T01500142 P0019=

[1715 EDT] METAR KLDM 152115Z AUTO 10007KT 3SM +RA SCT042
OVC048 15/14 A3009 RMK AO2 T01470141 P0011=

[1735 EDT] METAR KLDM 152135Z AUTO 09006KT 4SM +RA BKN040
OVC049 15/14 A3008 RMK AO2 T01450140 P0020=

**[1755 EDT] METAR KLDM 152155Z AUTO 09006KT 4SM RA
OVC040 15/14 A3007 RMK AO2 T01470143 P0029=**

ACCIDENT TIME 1815 EDT

**[1815 EDT] METAR KLDM 152215Z AUTO 10006KT 4SM RA
OVC044 15/15 A3007 RMK AO2 T01500147 P0005=**

[1835 EDT] METAR KLDM 152235Z AUTO 10006KT 3SM +DZ OVC044
16/15 A3007 RMK AO2 T01560152 P0008=

The bold type observations decoded in plain language were as follows:

KLDM weather at 1755 EDT, automated, wind from 090° at 6 knots, visibility 4 miles, moderate rain, overcast ceiling at 4,000 ft agl, temperature of 15°C, dew point temperature 14°C, and an altimeter setting of 30.07 inHg. Remarks, automated station with a precipitation discriminator, temperature 14.7°C, dew point temperature 14.3°C, 0.29 inches of precipitation since 1655 EDT.

KLDM weather at 1815 EDT, automated, wind from 100° at 6 knots, visibility 4 miles, moderate rain, overcast ceiling at 4,400 ft agl, temperature of 15°C, dew point temperature 15°C, and an altimeter setting of 30.07 inHg. Remarks, automated station with a precipitation discriminator, temperature 15.0°C, dew point temperature 14.7°C, 0.05 inches of precipitation since 1755 EDT.

The observations from C04, KFFX, and KLDM surrounding the accident time indicated IFR⁷ conditions with moderate rain reported at both KFFX and KLDM.

⁷ As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) - ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) - ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) - ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) - ceiling greater 3,000 ft agl and visibility greater than 5 miles.

4.0 Upper Air Sounding

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for the approximate accident site coordinates for 1800 EDT.⁹ The HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ from the surface to 700-hPa (or approximately 10,000 ft) using the RAOB¹¹ software package and is included as figure 9. The sounding depicted an elevation of 879 ft over the grid point with a near surface temperature of 18.9°C and a dew point temperature of 17.3°C, with a relative humidity of 90%. The sounding depicted the lifted condensation level (LCL)¹² and the level of free convection (LFC)¹³ at 675 ft agl, and the convective condensation level (CCL)¹⁴ at 1,500 ft agl. The freezing level was located at 12,579 ft. The precipitable water value at 1.71 inches.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

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 Esonde Research Services, The Villages, Florida.

¹² LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

¹⁴ 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.

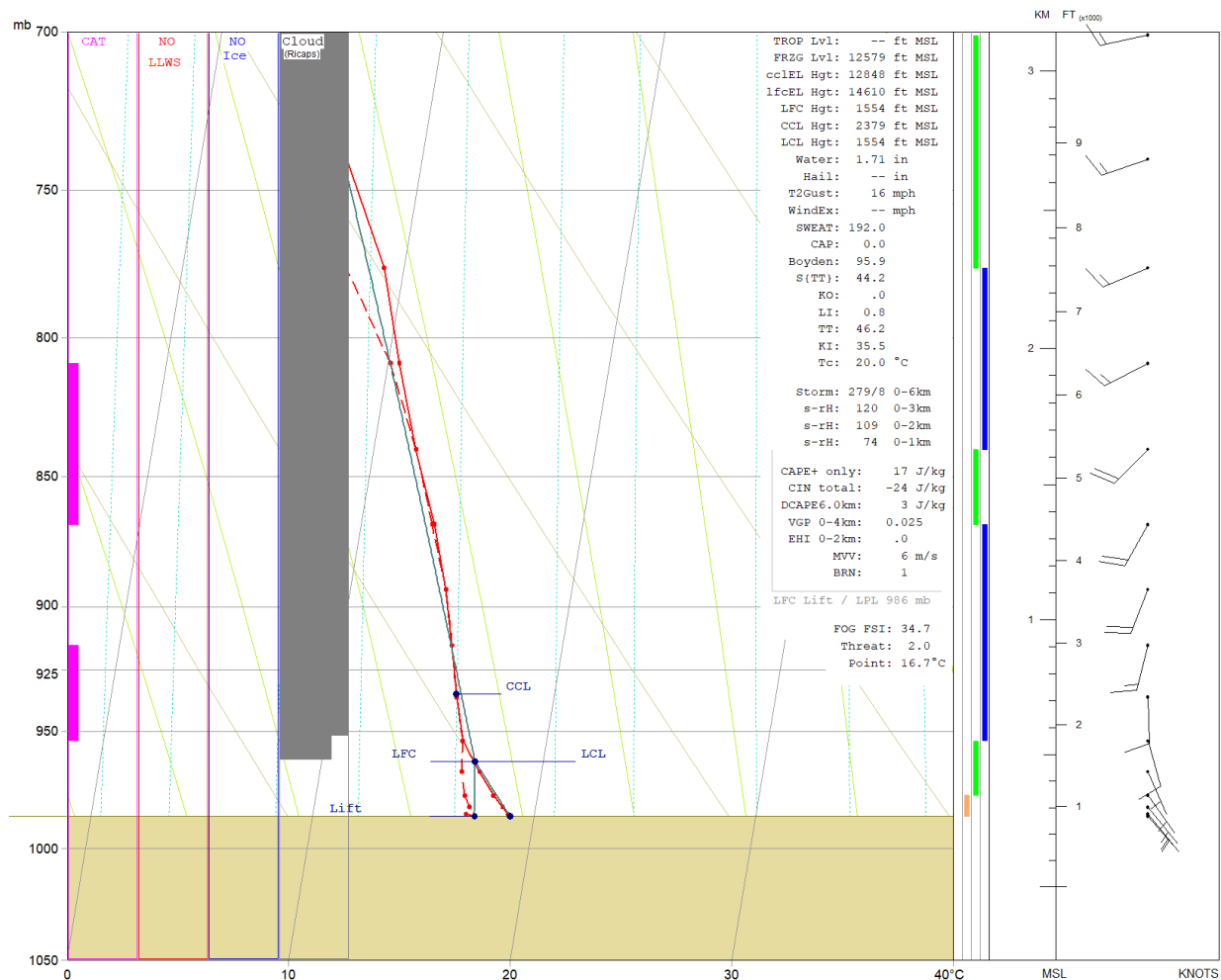


Figure 9. 1800 EDT HRRR sounding.

The 1800 EDT HRRR sounding indicated an unstable to conditionally unstable environment from the surface through 900 ft agl with a stable layer from 900 ft agl through 4,500 ft msl. No icing was indicated by RAOB below 10,000 ft. RAOB indicated cloud cover from 700 ft agl through 10,000 ft msl.

The 1800 EDT HRRR sounding wind profile indicated a near surface wind from 140° at 4 knots with the wind veering to the southwest by 3,000 ft. The wind speed increased to 20 knots by 4,000 ft. RAOB did not indicate the possibility of low-level wind shear (LLWS). Two areas of very light clear air turbulence (CAT) were indicated by RAOB around 2,000 to 3,000 ft, then from 4,500 to 6,000 ft.

5.0 Satellite Data

Geostationary Operational Environmental Satellite number 16 (GOES-16) visible and infrared data were 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 imagery (GOES-16 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm , respectively, were retrieved for the period from 1500 EDT through 2100 EDT and reviewed, and the closest images to the time of the accident were documented.

Figure 10 presents the GOES-16 visible imagery from 1816 EDT at 2X magnification with the accident site highlighted with a red square and cloud cover indicated above the accident site. Figure 11 presents the GOES-16 infrared imagery from 1816 EDT at 6X magnification with the accident site highlighted with a red square. The lower cloud top temperatures (green colors; higher cloud tops) were located southeast and northeast of the accident site at the accident time. The cloud cover had a radiative cloud top temperature of 253 Kelvin above the accident site. The cloud tops would have been near 26,000 ft based on the vertical temperature profile provided by the 1800 EDT HRRR sounding (not shown). It should be noted these figures have not been corrected for any parallax error.

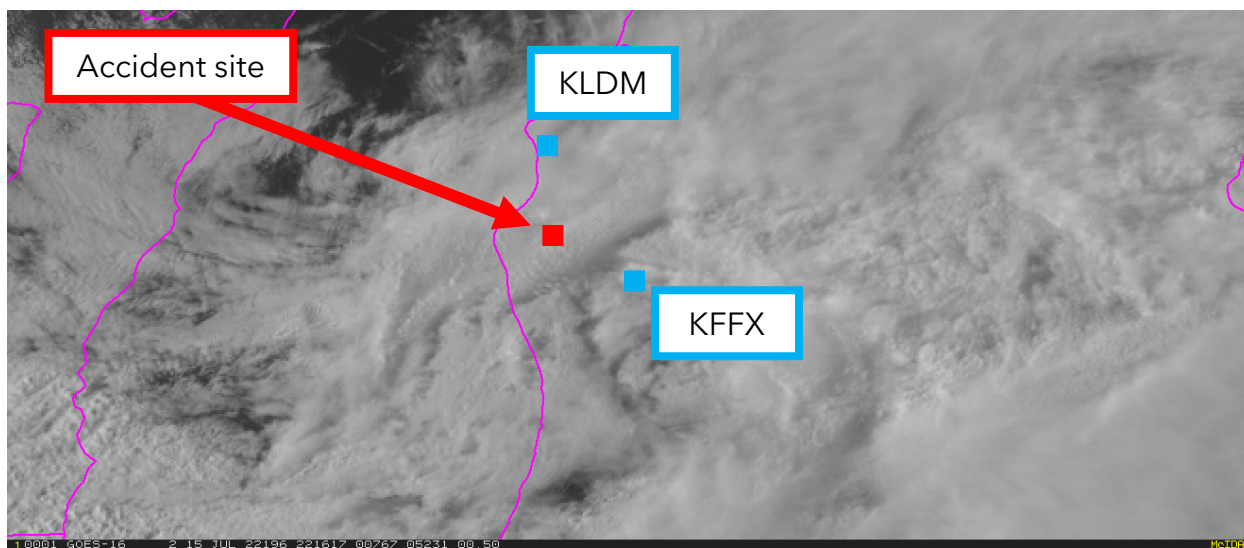


Figure 10. GOES-16 visible image at 1816 EDT.

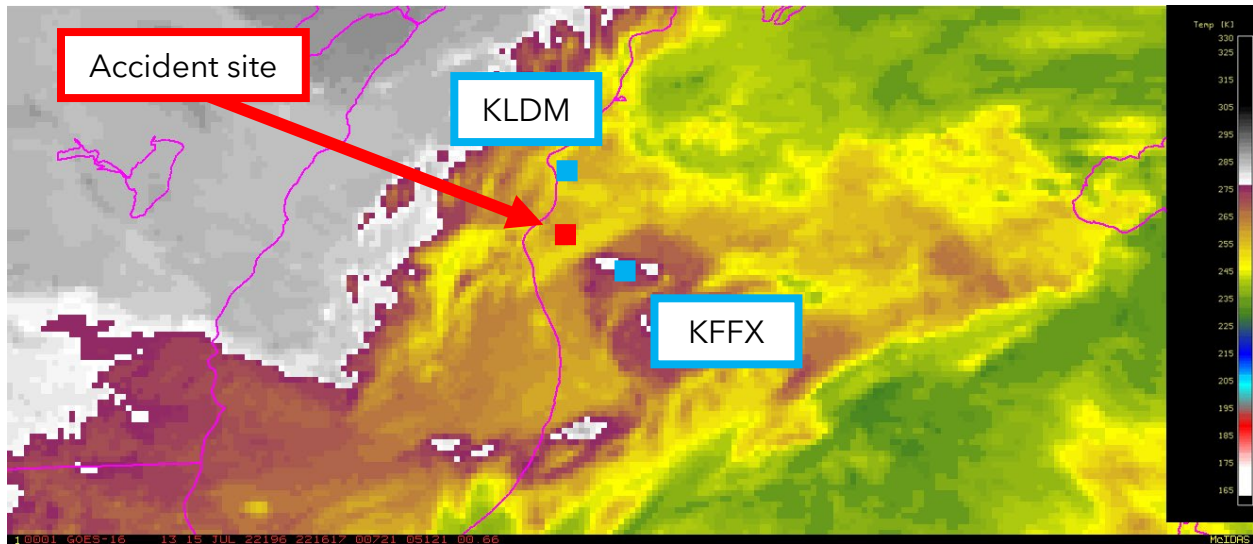


Figure 11. GOES-16 infrared image at 1816 EDT.

6.0 National Radar Imagery

A regional view of the NWS National Reflectivity Mosaic is included as figure 12 for 1815 EDT with the approximate location of the accident site marked by a red circle. The image depicted 10 to 30 dBZ¹⁵ echoes above the accident site.

¹⁵ 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.

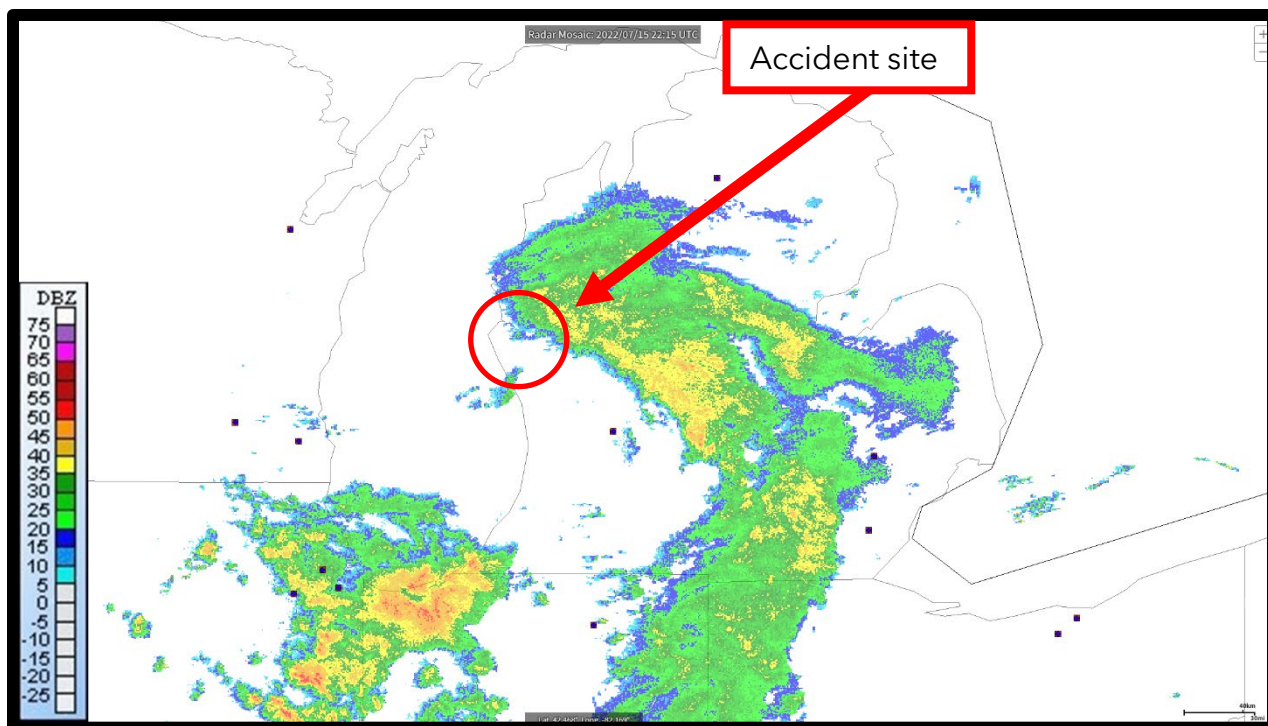


Figure 12. National Reflectivity Mosaic for 1815 EDT.

7.0 Weather Surveillance Radar Imagery

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁶ to the accident site was Grand Rapids, Michigan, WSR-88D, (KGRR) located 55 miles southeast of the accident site. The Level II archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

7.1 Volume Scan Strategy

During the period surrounding the accident, the KGRR WSR-88D radar was operating in the precipitation mode VCP-215 (figure 13). The following figure 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.¹⁷

¹⁶ 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.

¹⁷ KGJX also had the 0.0° elevation angle available.

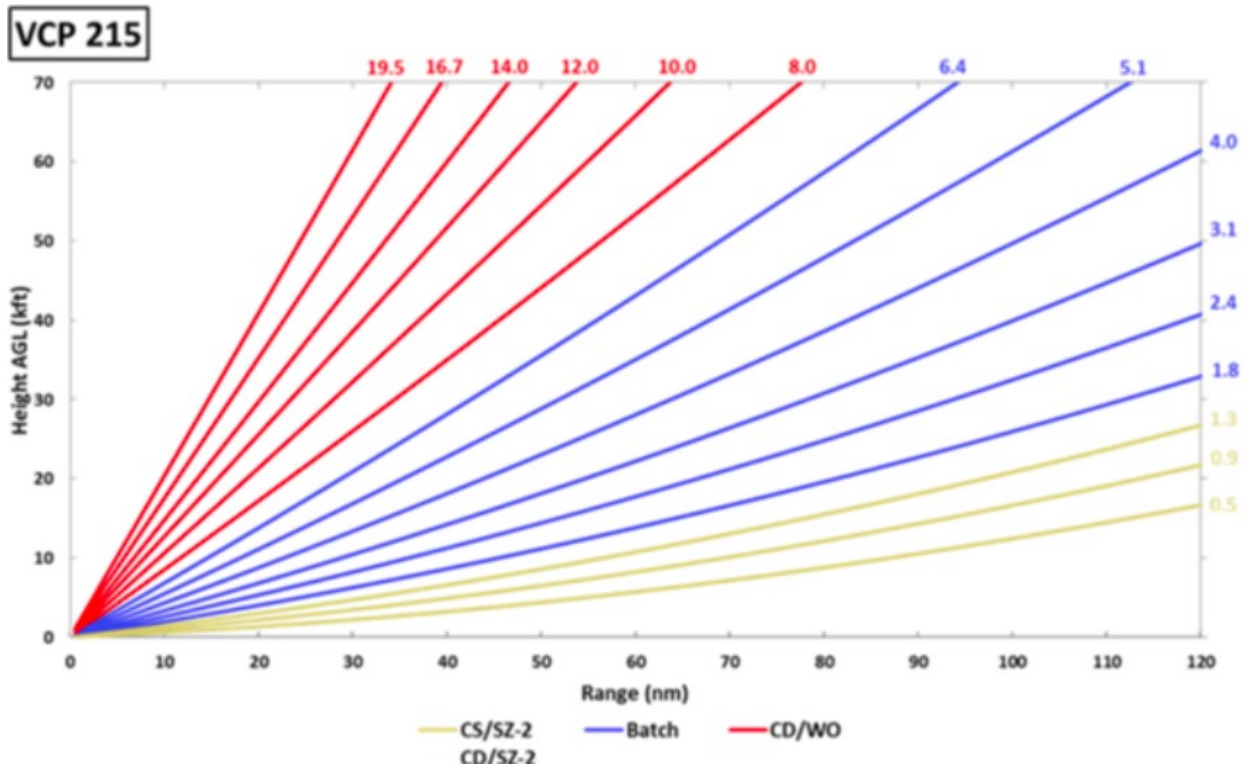


Figure 13. VCP-215 Precipitation Mode Scan Strategy¹⁸.

7.2 Beam Height Calculation

Assuming standard refraction¹⁹ of the KGRR WSR-88D radar beam with the antenna elevation at 875 ft, and considering a beamwidth²⁰ 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.

¹⁸ 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)

¹⁹ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

²⁰ Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
KGRR 0.5°	5,990 ft	3,280 ft	8,700 ft

Based on the radar height calculations, the elevation scans reviewed from KGRR listed in the above table depicted the conditions between 3,280 ft and 8,700 ft over the accident site and this elevation scan “saw” the closest weather radar information to the ground.

7.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²¹ 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 00-24C²², “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 to 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.”

7.4 Base Reflectivity and Lightning Data

Figure 14 presents the KGRR WSR-88D base reflectivity images for the 0.5° elevation scan initiated at 1814:10 EDT, with a resolution of 0.5° X 250 m. The image depicted reflectivity values between 5 and 25 dBZ above the accident site with the precipitation moving from west to east (attachment 1).

²¹ 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.

²²

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

There were no lightning flashes²³ reported within 50 miles of the accident site within 30 minutes prior to or following the accident time.²⁴

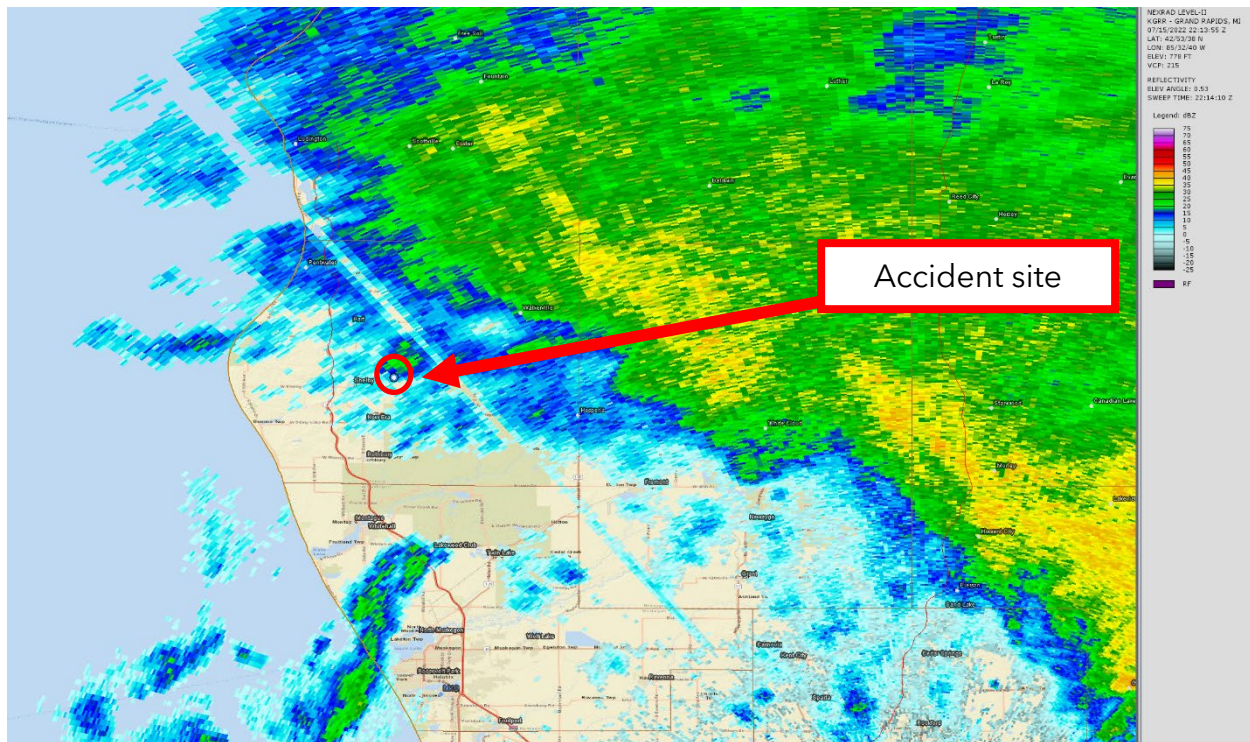


Figure 14. KGRR WSR-88D reflectivity for the 0.5° elevation scan initiated at 1814:10 EDT with the accident site marked with the red circle.

8.0 Pilot Reports

The longline-disseminated pilot reports²⁵ (PIREPs) distributed into the national airspace system (NAS) were reviewed for about two hours on either side of the accident time and the PIREPs issued into the NAS within 100 miles of the accident site for below 19,000 ft are shown below:

ENW UA /OV ENW/TM 2033/FL030/TP GLF4/RM BASES RPTD RAGGED / 030 5 E
ENW

ORD UA /OV ORD040050/TM 2036/FL090/TP B767/TA 20/TB LT TURB/IC NEG

Y31 UA /OV Y31/TM 2044/FL050/TP PC12/SK BASE 050 BKN/IC NEG

²³ Lightning Flash – This is one contiguous conducting channel and all the current strokes/pulses that flow through it. There are two types of flashes: ground flashes and cloud flashes.

²⁴ A review of Earth Networks Total Lightning network and GOES-16 Geostationary Lightning Mapper was done.

²⁵ Only pilot reports with the World Meteorological Organization headers UBMI**, UBWI**, and UBIN** were considered. These do not include pilot reports only broadcast via radio.

MKG UA /OV KMKG/TM 2045/FLDURGD/TP BE30/SK B015/TB SMOOTH
MKG UA /OV MKG/TM 2105/FL015/TP LJ75/SK BKN015/RM DURD
ENW UA /OV ENW/TM 2106/FL020/TP C340/RM BASES RPTD 020 MSL 2 E ENW
ORD UA /OV ORD045035/TM 2107/FL040/TP GLF4/TB SMOOTH
LAN UA /OV LAN220010/TM 2139/FL050/TP E145/SK B050 TUKN/TB SMOOTH
GRR UA /OV GRR/TM 2150/FL022/TP PC12/SK BASES 022
MKG UA /OV MKG/TM 2227/FL016/TP CRJ2/SK BKN016/RM DURD
GRR UA /OV 5 WEST GRR/TM 2303/FL040/TP C56X/SK BASES 030 TOPS 040
MKG UA /OV KMKG/TM 2318/FLDURGD/TP C650/SK BASES 014
MKG UA /OV MKG/TM 0002/FL010/TP BE55/SK BKN010/RM DURD
MKE UA /OV MKE135015/TM 0002/FL120/TP CRJ2/TB MDT CHOP

9.0 Significant Meteorological Information

There were no non-convective or convective Significant Meteorological Information (SIGMET) advisories valid for the accident site at the accident time.

10.0 Center Weather Service Advisories

The Chicago (ZAU) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. There was no Center Weather Advisory (CWA) valid from ZAU CWSU at the accident time.

11.0 Airmen's Meteorological Information

There was text Airmen's Meteorological Information (AIRMET) advisory Sierra valid for the accident site at the accident time. The text AIRMET Sierra was issued at 1645 EDT and forecast IFR conditions due to mist and fog:

WAUS43 KPCI 152045
WA3S
-CHIS WA 152045
AIRMET SIERRA UPDT 6 FOR IFR AND MTN OBSCN VALID UNTIL 160300

**AIRMET IFR...WI LM MI IL IN
FROM 40NNE GRB TO 30WSW TVC TO 40WSW DXO TO 40SSW FWA TO 50SE
BDF TO 50SSE DBQ TO 20NNW DLL TO 40NNE GRB
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.**

OTLK VALID 0300-0900Z
AREA 1...IFR MN IA WI LM LS MI LH IL IN

BOUNDED BY YQT-80NE SAW-20ESE SAW-20SE ECK-FWA-40NW IOW-50NW DLH-
YQT
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 09Z.

.
AREA 2...MTN OBSCN KY TN
BOUNDED BY HNN-HMV-30SSW VXV-50WSW LOZ-HNN
MTNS OBSC BY CLDS/PCPN/BR. CONDS DVLPG 06-09Z. CONDS CONTG THRU
09Z.
....

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products issued before the accident flight and valid at 1700 EDT are shown in attachment 2. The GFA surface forecast applicable to the accident site that was valid before the accident flight's departure for times surrounding the accident time indicated MVFR to IFR surface visibilities, scattered (between 30 to 50 percent chance) thunderstorms, and a west surface wind at 5 knots. The GFA cloud forecast applicable to the accident site that was valid before departure for times surrounding the accident time indicated few to broken cloud coverage with bases at 1,700 to 2,300 ft, cloud tops at 10,000 ft, then layered clouds to FL400²⁶. The Graphical AIRMETS²⁷ (G-AIRMET) Sierra valid for the accident site at accident time are shown on the GFA surface forecast figures in attachment 2. The only human-generated information reflected in the two GFA products were the G-AIRMETS. For more information, please see attachment 2.

²⁶ 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.

²⁷ **Graphical AIRMETS (G-AIRMETS)**, found on the Aviation Weather Center webpage at <http://aviationweather.gov>, are graphical forecasts of en-route weather hazards valid at discrete times no more than 3 hours apart for a period of up to 12 hours into the future (for example, 00, 03, 06, 09, and 12 hours). G-AIRMETS are snap shots at discrete time intervals as defined above. The text AIRMET is the result of the production of the G-AIRMET but provided in a time smear for a 6hr valid period.

13.0 Terminal Aerodrome Forecast

The closest Terminal Aerodrome Forecast²⁸ (TAF) to the accident site was from Muskegon County Airport (KMKG) located 27 miles south of the accident site. The KMKG amended TAF was issued 1551 EDT and was valid for a 22-hour period beginning at 1600 EDT. The 1551 EDT TAF for KMKG was as follows:

FTUS43 KGRR 151951 AAA
TAFMKG
TAF AMD
KMKG 151951Z 1520/1618 17008KT 6SM -RA BR BKN012
FM152200 VRB04KT P6SM VCSH OVC010
FM160800 10005KT 5SM BR OVC015=

Between 1800 EDT and 0400 EDT July 16, the forecast expected a variable wind at 4 knots, greater than 6 miles visibility, showers in the vicinity²⁹, and an overcast ceiling at 1,000 ft agl.

14.0 National Weather Service Area Forecast Discussion

The NWS weather forecast office in Grand Rapids, Michigan, (WFO GRR) was responsible for the public forecast in the region of the accident site. WFO GRR issued the following Area Forecast Discussion (AFD) at 1547 EDT, the closest AFD to the accident time with an aviation section:

FXUS63 KGRR 151947
AFDGRR

Area Forecast Discussion
National Weather Service Grand Rapids MI
347 PM EDT Fri Jul 15 2022

LATEST UPDATE...
Discussion/Marine

.DISCUSSION...(This evening through next Friday)
Issued at 347 PM EDT Fri Jul 15 2022

...Rain Chances Tonight and into the Weekend...

Meso-low currently bringing some much needed rain to the forecast

²⁸ According to NWS Instruction 10-813: "An NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."

www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

²⁹ In the vicinity of the airport is defined as a weather phenomenon within 5-10 statute miles of the airfield.

area, although QPF is disappointingly light across most places except the northwest. We have removed thunder from the forecast tonight as instability is marginal at best. Current radar trends suggest the convection across southern Wisconsin will miss our southwest zones.

There will be another surface low tracking across southeast Lower Michigan on Saturday night into Sunday as the next shortwave trough rounds the top of the upper high centered over the southwest CONUS. This low is expected to bring rain to roughly the southern third of the forecast area with scattered showers north of there. Potential for convection with LIs to minus 4 and CAPE close to 2000 J/kg Sunday afternoon across the southeast zones. Shear profiles are very weak suggesting pulse type storms with heavy rain rates as p-wat spikes up close to 2 inches.

...Severe Storms Possible Mid-Week...

The next shortwave trough closes off at 500 mb and traverses along the U.S./Canada border Tuesday and Wednesday and brings the chance for severe storms, especially across northern and central Lower Michigan Wednesday evening with 40 kts of deep layer shear and LIs down to minus 5. The trends will have to be watched with this feature but at this point it looks like a strong signal that at least parts of Lower Michigan could be affected by storms during Wednesday to early Thursday.

&&

**.AVIATION...(For the 18Z TAFS through 18Z Saturday afternoon)
Issued at 140 PM EDT Fri Jul 15 2022**

VFR conditions will slowly lower to MVFR this afternoon and evening as rain and lower ceilings move in from the west. The rain is expected to decrease as it moves into drier air across Lower Michigan through 21Z. There could also be a few embedded thunderstorms, especially later this afternoon into early evening from MKG to AZO, but these were taken out of the forecast because instability is limited.

Areas of IFR conditions are possible tonight as ceilings lower to near or just below 1000 feet AGL.

&&

.MARINE...

Issued at 347 PM EDT Fri Jul 15 2022

Winds and waves will remain relatively light over the weekend. We expect areas of fog to form and persist over the waters tonight and into Saturday morning as surface dew points rise into the mid to upper 60s.

&&

.GRR WATCHES/WARNINGS/ADVISORIES...

ML...None.

LM...None.

&&

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15.0 Winds and Temperature Aloft Forecast

The NWS 1559 EDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWNO 151959

FD1US1

DATA BASED ON 151800Z

VALID 160000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

MKG 1108 2611+11 3018+08 3226+03 3325-09 3225-19 262536 252045 284052

The closest forecast point to the accident site was Muskegon, Michigan, (MKG). The 1559 EDT MKG forecast for use between 1600 EDT and 2300 EDT indicated a wind from 110° at 8 knots at 3,000 ft, a wind at 6,000 ft from 260° at 11 knots with a temperature of +11°C, and a wind at 9,000 ft from 300° at 18 knots with a temperature of +8°C.

16.0 Witness Information

Two witnesses were located at C04 when the accident plane departed and the pilot rated witnesses stated the weather was "very, very, poor", the ceiling was "very low", and the visibility was "very bad." In addition, they stated it was raining with ceilings no higher than 100 ft. For more witness information please see the docket in this accident.

17.0 Pilot Weather Briefing

A search of archived information indicated that the accident pilot did not request weather information³⁰ from Leidos Flight Service or via ForeFlight. It is unknown what, if any, additional weather information the accident pilot viewed before or during the accident flight.

18.0 Astronomical Data

The astronomical data obtained for the accident site on July 15, 2022, indicated the following:

SUN

Begin civil twilight 0543 EDT

Sunrise 0617 EDT

Sun transit 1351 EDT

Accident time 1815 EDT³¹

Sunset 2125 EDT

End civil twilight 2159 EDT

At the time of the accident the Sun was located at an altitude of 31.81° and azimuth of 270.16°.

E. LIST OF ATTACHMENTS

Attachment 1 - KGRR base reflectivity animation between 1750 and 1819 EDT

Attachment 2 - GFA information valid at the accident time

Submitted by:

Paul Suffern
Senior Meteorologist

³⁰ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf

³¹ Inserted accident time for reference and context.