

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN23FA031

METEOROLOGY

Specialist's Factual Report

November 31, 2022

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A. ACCIDENT

Location: Bignell, Nebraska
Date: November 9, 2022
Time: 0934 central standard time (CST)
1534 coordinated universal time (UTC)
Aircraft: Piper PA-46-500; Registration: N234PM

B. METEOROLOGY SPECIALIST

Donald Eick
Senior Meteorologist
National Transportation Safety Board
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C. SUMMARY

On November 9, 2022, about 0934 central standard time, a Piper PA46-500TP, N234PM, was destroyed when it was involved in an accident near Bignell, Nebraska. The pilot and passenger sustained fatal injuries. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 business flight. The accident airplane had departed Lincoln, NE at about 0830 CST and was destined for North Platte Airport.

D. 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 report documents the general weather products and forecasts over the region during the period and documents the pertinent meteorological parameters to the accident. All times are reported as central standard time (CST) based upon the 24-hour clock, local time is -6 hours from UTC, and UTC=Z. Airport and 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. 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

and fractions of statute miles. The accident site was located at latitude 41.081515° North and longitude 100.61328° West, at an elevation of about 2,740 ft.

E. FACTUAL INFORMATION

1.0 Synoptic Conditions

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 (NCEP) and the WPC located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H change 2¹.

1.1 Surface Analysis Chart

The north-central NWS Surface Analysis Chart for 0900 CST is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a low-pressure system with a central pressure of 1012-hectopascals (hPa²) over southwestern Minnesota associated with a frontal wave. A warm front extended eastward from the low across Minnesota and Wisconsin, while a cold front extended southwest from the low across Nebraska and became a stationary front with another low-pressure system at 1005-hPa located along the front over eastern Colorado. A second stationary frontal system was located behind the first identified front and extended north-northeast to south-southwest across Minnesota into South Dakota where a third low-pressure system at 1013-hPa system was located. The accident site was on the cold air side and north of the stationary front and northeast of the 1005-hPa low-pressure system over Colorado. A cold-core high pressure system was located over Canada just off the northern portion of the chart with a ridge extending southward across the Dakotas into Nebraska.

The station model on the surface analysis chart for North Platte depicted a wind from the north at about 10 knots, light freezing rain, overcast clouds, with a temperature from 31° F and a dew point temperature of 28° F. Numerous other station models along and north of the frontal system across Minnesota, South Dakota, and Nebraska depicted overcast sky conditions, mist or drizzle, with temperature-dew

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

² Hectopascal (hPa) is the standard unit for reporting sea-level pressure and is interchangeable with the former term millibar (mb) with the same units. The International Standard Atmosphere (ISA) is based on a sea-level pressure of 1013.25-hPa at a temperature of 15° Celsius (C) or 59° Fahrenheit (F).

point spreads of 3° or less. A cold polar airmass was indicated behind the frontal system with low temperatures in the teens to the 20's °F over the Dakotas to the north, and warm temperatures in the 70's °F south of the front over Kansas, with an almost 30 °F temperature gradient along the front.

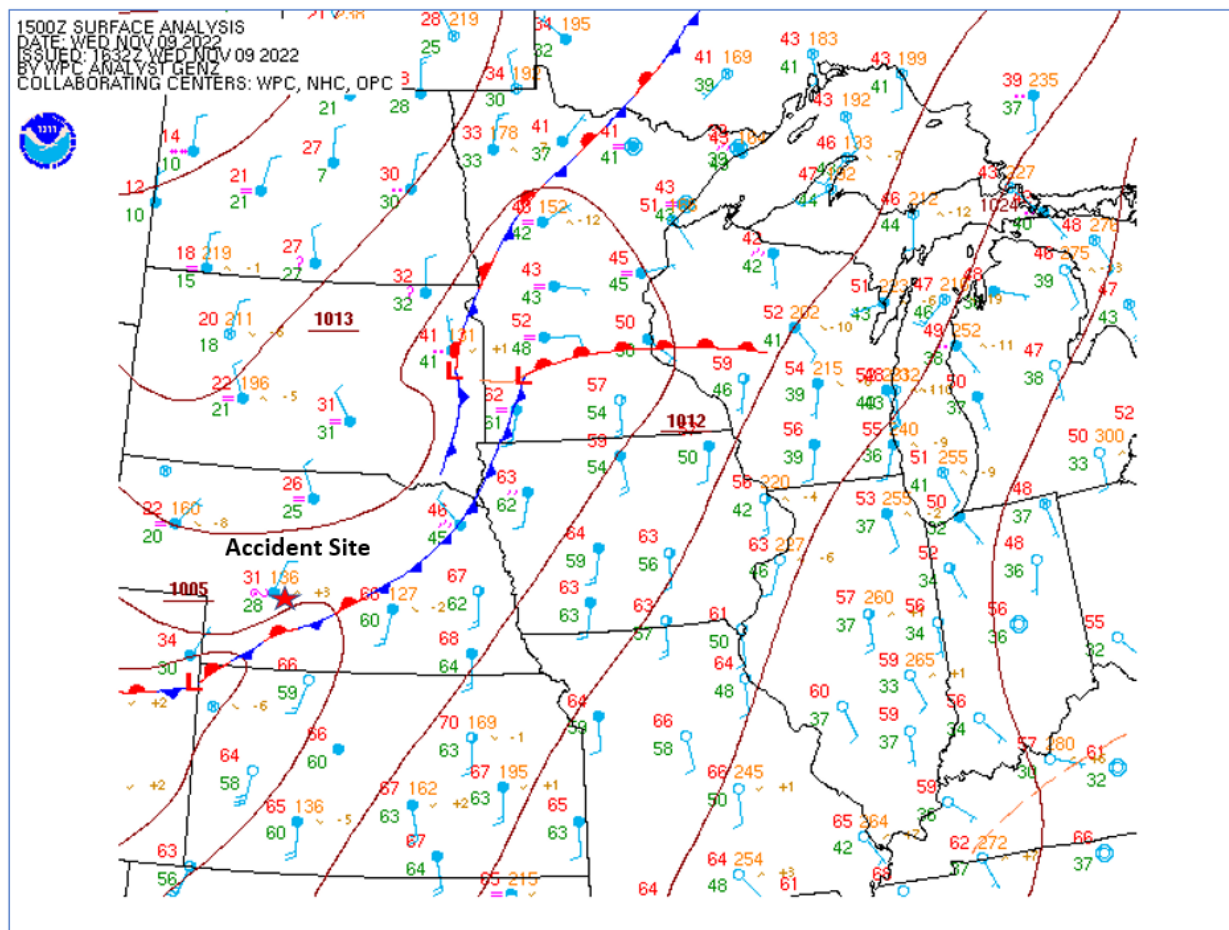


Figure 1 - NWS Surface Analysis Chart for 0900 CST with accident site marked by the red star.

1.2 Short Term Prognostic Chart

The NWS 6-hour Surface Prognostic Chart valid for 1200 CST is included as figure 2 with the approximate accident site marked by the red star. There were three major areas of precipitation expected during the period; (1) an area associated with Hurricane Nicole approaching Florida with rain and thunderstorms, (2) a developing winter storm approaching the Rockies west of the accident site, (3) an area associated with rain over Wisconsin, Minnesota, into northeast Nebraska, with mixed freezing precipitation over North Dakota associated with the low-pressure system and associated frontal system. To the west of the accident site the low-pressure system

over Colorado continued to be depicted, with a dry line³ indicated extending south of the low across eastern Colorado, eastern New Mexico, and extreme western Texas. No significant precipitation was depicted over the accident site, which was depicted in the immediate vicinity of the stationary to cold front.

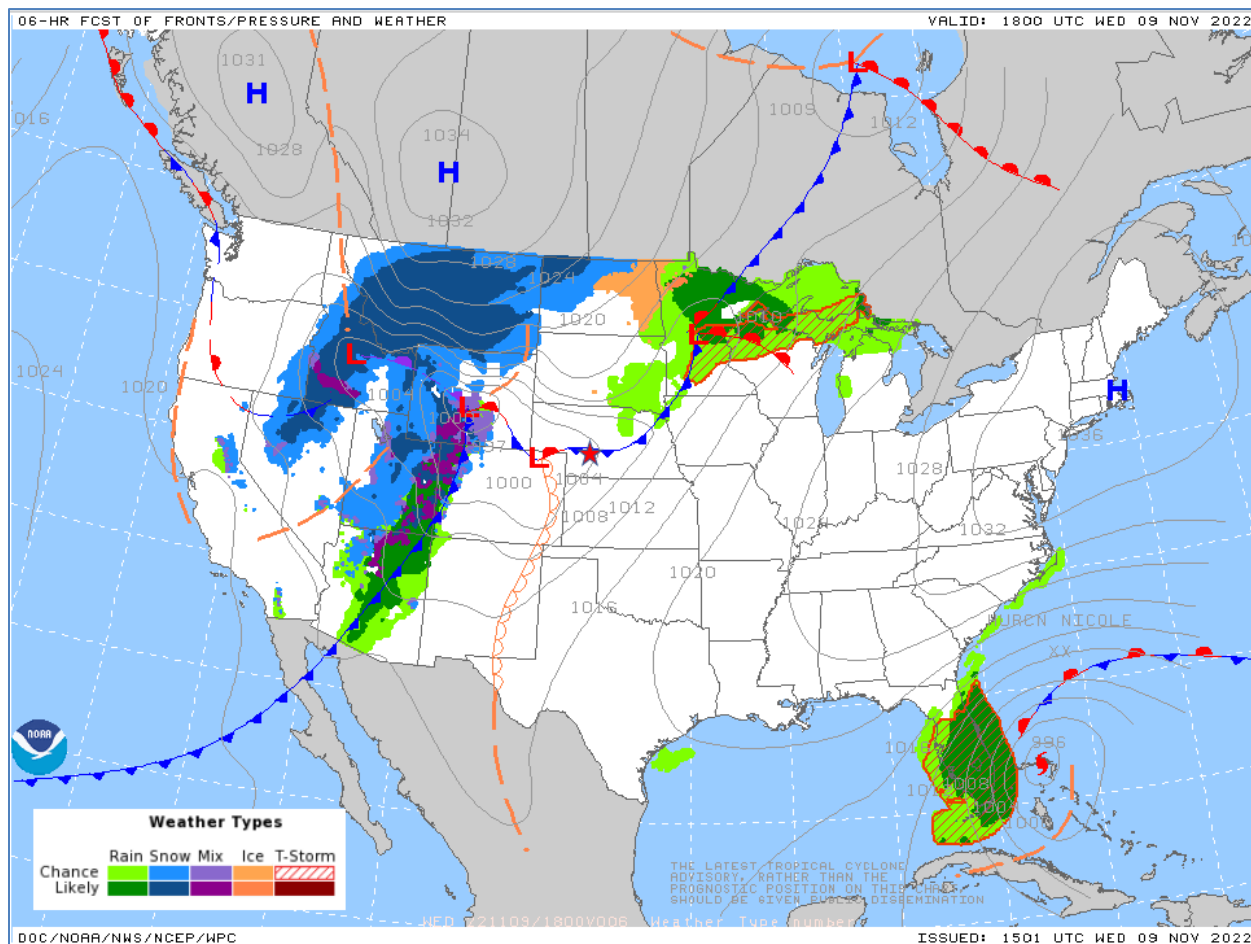


Figure 2 - NWS 6-hour Surface Forecast valid for 1200 CST with accident site marked by star.

1.3 Low Level Significant Weather Prognostic Chart

The 12-hour Low Level Significant Weather Prognostic Chart valid for 1200 CST on November 9, 2022, is included as figure 3 with the approximate accident site marked by the red star. The chart depicted the general flight categories⁴ of IFR (red

³ Dry Line - A boundary separating moist and dry air masses, and an important factor in severe weather frequency in the Great Plains. It typically lies north-south across the central and southern high Plains states during the spring and early summer, where it separates moist air from the Gulf of Mexico (to the east) and dry desert air from the southwestern states (to the west). A typical dry line passage results in a sharp drop in humidity (hence the name), clearing skies, and a wind shift from south or southeasterly to west or southwesterly.

⁴ As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the

line), MVFR (blue scalloped line) and VFR conditions (outside of scalloped line). In addition, the freezing level was provided (light blue dashed line or zig zagged line depicting the freezing line at the surface) and expected areas of turbulence (brown dashed lines) from the surface through 24,000 ft or Flight level 240 (FL240). The chart depicted an extensive area of IFR conditions extending over northern Wisconsin, Minnesota, eastern North and South Dakota, into central and northern Nebraska, and bordered the accident site. A larger area of MVFR conditions encompassed the rest of Nebraska and included the accident site, the Dakotas, Iowa, western Missouri and Arkansas, and eastern Kansas. The freezing level was depicted between 8,000 and 12,000 ft with no significant turbulence depicted over the accident site.

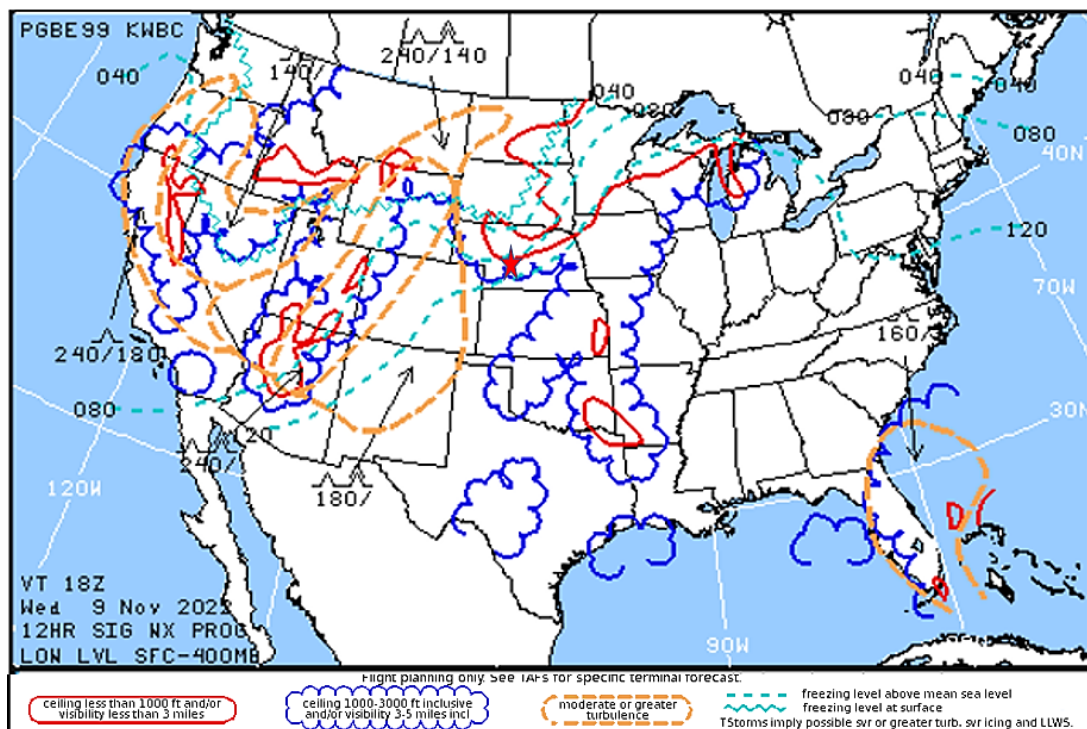


Figure 3 - 12-hour Low Level Significant Weather Prognostic Chart valid for 1200 CST.

following general flight categories:

- Low Instrument Flight Rules (LIFR*) - ceiling or the lowest layer of clouds reported as broken or overcast, or the vertical visibility into a surface based obscuration 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.

* 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.

1.4 Convective Outlook

The NWS Storm Prediction Center's (SPC) Convective Outlook issued at 0656 CST is included as figure 4. The SPC expected a general to marginal risk of severe thunderstorms over Nebraska and Kansas. The main concern of the day was a slight risk of severe thunderstorm development over coastal regions of Florida and eastern Georgia as Tropical Storm Nichole approached the east coast.

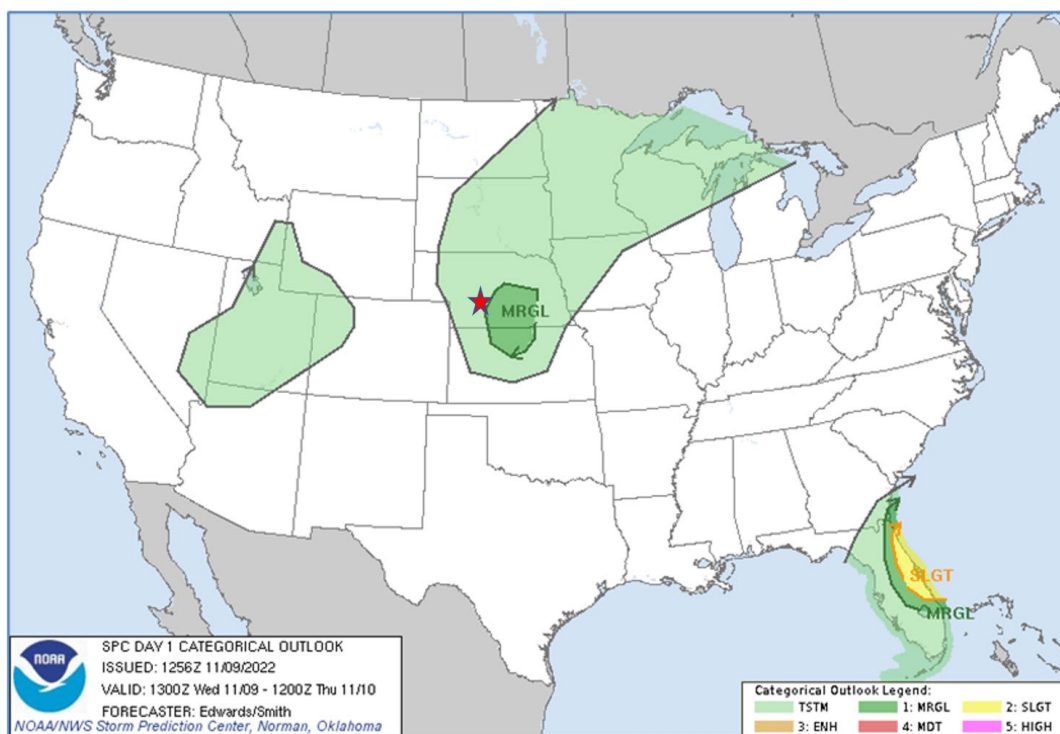


Figure 4 - Convective Outlook valid for the period.

The associated convective outlook text bulletin with the graphic is included below with the section related to the central plains highlight in bold type.

SPC AC 091256

Day 1 Convective Outlook
NWS Storm Prediction Center Norman OK
0656 AM CST Wed Nov 09 2022

Valid 091300Z - 101200Z

...THERE IS A SLIGHT RISK OF SEVERE THUNDERSTORMS OVER NEAR-COASTAL PARTS OF EAST-CENTRAL AND NORTHEASTERN FLORIDA...

...SUMMARY...

A tornado threat is expected to develop this evening and persist tonight over parts of eastern Florida. Isolated damaging thunderstorm gusts may occur before dawn tomorrow in parts of the central Plains.

...Synopsis...

In mid/upper levels, a large, complex cyclone -- currently centered near the NV/OR border -- is forecast to move northeastward across the north-central Rockies to eastern MT by 12Z tomorrow, as the trailing synoptic-scale trough assumes a more positive tilt. A strong, basal shortwave trough is expected to pivot northeastward from southern CA, with its 500-mb vorticity axis near a RAP-AIA-LIC-FMN line by 12Z.

At the surface, 11Z analysis showed a low between HON-FSD, with slow-moving cold front across central/southwestern NE and northeastern CO, to near DEN. The initial low should move northeastward across central MN and weaken today. Approach of the intense mid/upper trough will foster cyclogenesis along the central High Plains segment of the front, which may retreat slightly northward over northeastern CO today before the newer, stronger low moves northeastward along the front overnight. By 12Z, this second, better-organized low should reach southwestern MN, with a much more progressive cold front extending southwestward over eastern NE, central/southwestern KS and northeastern NM.

Meanwhile, what now is T.S. Nicole is forecast to proceed across the northern Bahamas today, and into central FL by the end of the period. See latest NHC advisories for tropical watch/warning info on Nicole, as well as track/intensity forecast guidance.

...Eastern FL Peninsula...

Latest NHC track guidance shows the center of Nicole ashore in the PBI-VRB corridor tonight, then veering northwestward across central FL into early day-2. Once it reaches the Atlantic Coast, tornado potential will extend relatively far from center, given the large size of this system's favorable low-level wind field. A very moist airmass advecting off the Gulf Stream is expected, especially near and after landfall as near-surface flow veers from northeasterly to east and east-southeast, loses some cooler trajectories now evident north and northwest of center, and emanates from maximized upstream theta-e. Large hodographs below 2 km are expected near the coast -- accordingly pivoting clockwise around the western sector of hodograph origin with time, as the center moves inland. Associated effective SRH in the 200-400 J/kg range should become common, with locally higher values, and increasing surface-based buoyancy near the coast overnight.

The greatest supercell/tornado threat prior to 12Z tomorrow should be in the middle-outer circulation sector north-northwest through east of center. Based on the latest NHC forecast track, this portion of Nicole's circulation will remain offshore through the day, then will begin impinging on the East Coast near the time of its central landfall tonight (given the north-northwest orientation of the coastline poleward of center). Because of Nicole's large size and expansive wind fields, much of coastal east-central and northeast FL could begin experiencing a tornado threat around the same time tonight, which will shift further northwestward/inland day-2/Thursday based on the NHC forecasts for track and wind radii.

...Central Plains...

After 06Z, as the strengthening and accelerating cold front impinges on the northwest rim of a narrow warm/moist sector tonight, a thin band of scattered convection (including embedded thunderstorms) may develop along it. This activity should form initially over portions of central NE, backbuilding down the front across parts of northern and perhaps central KS before 12Z. Most forecast soundings suggest the buoyancy will begin as elevated -- rooted between 750-850 mb. However, a narrow tongue of surface-based effective lifted parcels is possible immediately ahead of the front, with dewpoints in the low 60s F as already observed in the area (and not expected to diminish). That, plus a shallow dry layer beneath the CAPE, and the presence of strengthening deep-layer winds,

suggests a small but not negligible potential for a few gusts near severe limits to reach the surface.

..Edwards/Smith.. 11/09/2022

1.5 Regional Composite Radar Mosaic

The north-central section of the NWS National Composite Radar Mosaic was reviewed to determine if there were any significant areas of precipitation in the vicinity at the time of the accident surrounding the period. The radar mosaic for 0935 CST with the approximate accident site and North Platte Airport marked is included as figure 5. The chart depicted several bands of very light intensity echoes of 15 dBZ⁵ or less extending northeast-to-southwest over Nebraska to the west through north of the accident site. No significant weather echoes were depicted over the accident site or over eastern Nebraska; however, the closest NWS weather radar will be further reviewed and documented in section 6.0 of this report.

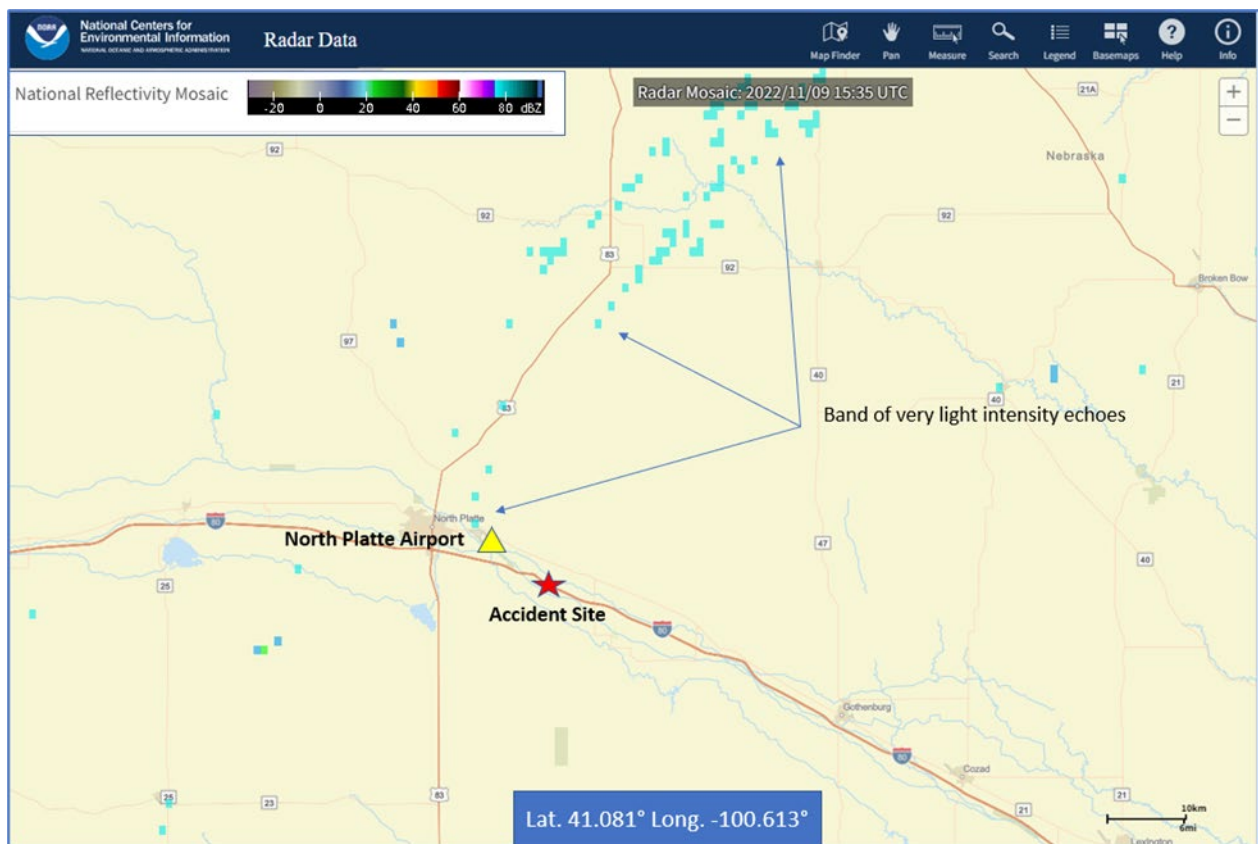


Figure 5 - NCEI Regional Composite Radar Mosaic for 0935 CST with accident site marked.

⁵ dBZ - Nondimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels, or dB) with respect to radar reflectivity factor, Z.

2.0 Surface Observations

The area was documented using official Aviation Routine Weather Reports (METAR⁶) and Aviation Selected Special Weather Reports (SPECI). Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation was estimated at 6° east based on the latest sectional chart for the area.

2.1 North Platte, NE

The closest official weather reporting location was from the planned destination of Nort Platte Regional Airport/Lee Bird Field (KLBF), North Platte, NE, located about 4 miles northwest of the accident site at an elevation of 2,777 ft. The airport had a Federally installed and maintained Automated Surface Observation System (ASOS) whose reports were not augmented by any human observer surrounding the period. The following observations for KLBF with the general flight categories were disseminated longline⁷ between 0000 and 1200 CST. The observations immediately surrounding the time of the accident time are highlighted by bold text.

VFR *METAR KLBF 090553Z AUTO 17016G26KT 10SM CLR 19/14 A2985 RMK AO2 PK WND 16028/0525 SLP091 T01890139 10222 20189 402440056 58008=*

VFR *METAR KLBF 090653Z AUTO 17014G24KT 10SM CLR 18/13 A2986 RMK AO2 SLP091 T01830133=*

MVFR *SPECI KLBF 090741Z AUTO 04012KT 10SM BKN026 14/09 A2990 RMK AO2 T01390094=*

MVFR *METAR KLBF 090753Z AUTO 06009KT 10SM OVC026 12/07 A2990 RMK AO2 SLP110 T01220072=*

MVFR *METAR KLBF 090853Z AUTO 04017G22KT 10SM OVC026 08/01 A2990 RMK AO2 SLP110 T00830006 52014=*

MVFR *METAR KLBF 090953Z AUTO 03013KT 10SM OVC021 07/M01 A2990 RMK AO2 SLP111 T00671011=*

MVFR *METAR KLBF 091053Z AUTO 01010G17KT 10SM OVC017 04/M02 A2992 RMK AO2 SLP122 T00441022=*

MVFR *SPECI KLBF 091144Z AUTO 35008KT 10SM OVC014 02/M03 A2993 RMK AO2 T00221028=*

MVFR *METAR KLBF 091153Z AUTO 35009KT 10SM OVC012 02/M03 A2993 RMK AO2 SLP128 T00171033 10189 20017 53008=*

⁶ Abbreviation for Meteorological Aerodrome Report.

⁷ Longline dissemination refers to official transmission of the observation into publicly accessible database. The ASOS is capable of issuing reports locally on very high frequency (VHF) radio broadcasts locally or through telephone contacts.

IFR SPECI KLBF 091224Z AUTO 35009KT 10SM OVC009 01/M03 A2994 RMK AO2 T00061033=

IFR METAR KLBF 091253Z AUTO 02010G19KT 10SM OVC007 00/M03 A2993 RMK AO2 CIG 006V011 SLP132 T00001028=

LIFR METAR KLBF 091353Z AUTO 02009KT 9SM OVC003 M01/M02 A2994 RMK AO2 SLP135 T10061022=

LIFR METAR KLBF 091453Z AUTO 02009KT 4SM -FZRA BR OVC003 M01/M02 A2993 RMK AO2 UPB37E51FZRA51 SLP136 P0000 60000 I1001 I3001 T10061022 50003=

LIFR **SPECI KLBF 091502Z AUTO 02010KT 5SM BR OVC003 M01/M02 A2994 RMK AO2 FZRAE1456 P0000 I1000 T10061022=**

Accident 1534Z

LIFR **SPECI KLBF 091546Z AUTO 03008KT 4SM -FZRA BR OVC003 M01/M02 A2993 RMK AO2 UPB35E40FZRAE1456B40 P0000 I1000 T10061017=**

LIFR METAR KLBF 091553Z AUTO 04008KT 5SM -FZRA BR OVC003 00/M02 A2993 RMK AO2 UPB35E40FZRAE1456B40 SLP133 P0000 I1000 T00001017=

LIFR SPECI KLBF 091613Z AUTO 05006KT 9SM OVC003 00/M02 A2992 RMK AO2 FZRAE07 P0000 I1000 T00001017=

LIFR METAR KLBF 091653Z AUTO 05009KT 10SM OVC003 01/M01 A2991 RMK AO2 FZRAE07 SLP126 P0000 I1001 T00061011=

LIFR SPECI KLBF 091733Z AUTO 04008KT 1 3/4SM BR OVC002 01/M01 A2989 RMK AO2 T00061006=

The observation surrounding the time of the accident in bolt type above, are decoded and provided in plain language were as follows:

Special weather observation for KLBF at 0902 CST, automated, wind from 020° at 10 knots, visibility 5 statute miles in mist, ceiling overcast at 300 ft agl, temperature -1° Celsius (C) (31°F), dew point temperature -2° C (28°F), altimeter 29.94 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, freezing rain ended at 0856 CST, hourly precipitation (from 0855 CST) less than 0.01 of an inch, hourly ice accretion less than 0.01 of an inch of ice, temperature -0.6°C, dew point temperature -2.2°C.

Accident 0934 CST

Special weather observation for KLBF at 0946 CST, automated, wind from 030° at 8 knots, visibility 4 miles in light freezing rain⁸, and mist, ceiling overcast

⁸ The freezing rain report was based on the report of precipitation occurring with the surface temperature being reported below 0° C, and not necessarily as precipitation freezing or producing a glaze icing on surface objects or ice accretion.

at 300 ft agl, temperature -1° C (31°F), dew point temperature -2° C (29°F), altimeter 29.93 inHg. Remarks: automated station with a precipitation discriminator, unknown precipitation began 0935 CST and ended at 0940 CST, freezing rain ended at 0856 and began at 0940 CST, hourly precipitation (from 0855 CST) less than 0.01 of an inch, ice increment less than 0.01 of an inch of ice, temperature -0.6°C, dew point temperature -1.7°C.

2.2 ASOS High Resolution Data

The ASOS 1-minute and 5-minute observations from KLBF were obtained from the NWS and are included as Attachment 1. The 5-minute data provided a standard METAR observation with four additional fields that were included after the altimeter setting: the pressure altitude, relative humidity, density altitude, and magnetic wind direction and wind speed, followed by the remarks. The reports from 0830 through 0945 CST were as follows.

11/09/22 08:30:31 5-MIN KLBF 091430Z AUTO 02009KT 5SM BR OVC003 M01/M02 A2994 2760 88
1600 010/09 RMK AO2 T10061022

11/09/22 08:35:31 5-MIN KLBF 091435Z AUTO 03011KT 5SM BR OVC003 M01/M02 A2994 2760 88
1600 020/11 RMK AO2 T10061022

11/09/22 08:40:31 5-MIN KLBF 091440Z AUTO 02010KT 3SM UP BR OVC003 M01/M02 A2994 2770
88 1600 010/10 RMK AO2 UPB37 P0000 I1000 T10061022

11/09/22 08:45:31 5-MIN KLBF 091445Z AUTO 02010KT 3SM UP BR OVC003 M01/M02 A2994 2760
88 1600 020/10 RMK AO2 UPB37 P0000 I1000 T10061022

11/09/22 08:50:31 5-MIN KLBF 091450Z AUTO 03008KT 3SM UP BR OVC003 M01/M02 A2993 2770
88 1600 020/08 RMK AO2 UPB37 SLP136 P0000 60000 I1000 I3/// T10061022 53008

11/09/22 08:55:31 5-MIN KLBF 091455Z AUTO 02009KT 4SM -FZRA BR OVC003 M01/M02 A2993 2770
88 1600 010/09 RMK AO2 P0000 I1000 T10061022

11/09/22 09:00:31 5-MIN KLBF 091500Z AUTO 01009KT 5SM BR OVC003 M01/M02 A2994 2770 88
1600 010/09 RMK AO2 FZRAE1456 P0000 I1000 T10061022

11/09/22 09:05:31 5-MIN KLBF 091505Z AUTO 03009KT 5SM BR OVC003 M01/M02 A2994 2770 88
1600 020/09 RMK AO2 FZRAE1456 P0000 I1000 T10061022

11/09/22 09:10:31 5-MIN KLBF 091510Z AUTO 02009KT 6SM BR OVC003 M01/M02 A2994 2770 92
1600 010/09 RMK AO2 FZRAE1456 P0000 I1000 T10061017

11/09/22 09:15:31 5-MIN KLBF 091515Z AUTO 02007KT 6SM BR OVC003 M01/M02 A2993 2770 88
1600 010/07 RMK AO2 FZRAE1456 P0000 I1000 T10061022

11/09/22 09:20:31 5-MIN KLBF 091520Z AUTO 03008KT 6SM BR OVC003 M01/M02 A2993 2770 92
1600 020/08 RMK AO2 FZRAE1456 P0000 I1000 T10061017

11/09/22 09:25:31 5-MIN KLBF 091525Z AUTO 02010KT 7SM OVC003 M01/M02 A2993 2770 92 1600
020/10 RMK AO2 FZRAE1456 P0000 I1000 T10061017

**11/09/22 09:30:31 5-MIN KLBF 091530Z AUTO 02008KT 7SM OVC003 M01/M02 A2993 2770
88 1600 020/08 RMK AO2 FZRAE1456 P0000 I1000 T10061022**

Accident 0934CST (1934Z)

**11/09/22 09:35:31 5-MIN KLBF 091535Z AUTO 04007KT 7SM UP OVC003 M01/M02 A2993
2770 88 1600 030/07 RMK AO2 UPB35FZRAE1456 P0000 I1000 T10061022**

11/09/22 09:40:31 5-MIN KLBF 091540Z AUTO 02005KT 6SM -FZRA BR OVC003 M01/M02 A2993 2770
92 1600 020/05 RMK AO2 UPB35E40FZRAE1456B40 P0000 I1000 T10061017

11/09/22 09:45:31 5-MIN KLBF 091545Z AUTO 03009KT 5SM -FZRA BR OVC003 M01/M02 A2993 2770
92 1600 020/09 RMK AO2 UPB35E40FZRAE1456B40 P0000 I1000 T10061017

Based on the 5-minute ASOS observations for KLBF the conditions closest to the time of the accident were reported as follows.

KLBF 5-minute ASOS observation at 0930 CST, wind from 020° at 8 knots, visibility 7 miles, ceiling overcast at 300 ft agl, temperature -1° C, dew point temperature -2° C, altimeter 29.93 inHg, with the pressure altitude of 2,770 ft, 88% relative humidity, density altitude 1,600 ft, with a magnetic wind from 020° at 8 knots. Remarks: automated station with a precipitation discriminator, freezing rain ended at 0856 CST, hourly precipitation (since 0853 CST) less than 0.01 of an inch, ice accretion less than 0.01 of an inch, temperature -0.6° C, dew point temperature -2.2° C.

KLBF 5-minute observation at 0935 CST, wind from 040° at 7 knots, visibility 7 miles in unknown precipitation, ceiling overcast at 300 ft agl, temperature -1° C, dew point temperature -2° C, altimeter 29.93 inHg, with the pressure altitude of 2,770 ft, 88% relative humidity, density altitude 1,600 ft, with a magnetic wind from 030° at 7 knots. Remarks: automated station with a precipitation discriminator, unknown precipitation began at 0935 CST, freezing rain ended at 0856 CST, hourly precipitation (since 0853 CST) less than 0.01 of an inch, ice accretion less than 0.01 of an inch, temperature -0.6° C, dew point temperature -2.2° C.

A review of the KLBF ASOS 1-minute ASOS data of time, weather (WX), precipitation (P), temperature (T), dew point temperature (Td), the average wind, and peak wind surrounding the period in table format is presented here. The weather column (WX) codes were no-precip (NP), rain (R), unknown precipitation (P?), or snow (S) and the intensity of the precipitation from 0915 through 0940 CST are included below.

Time CST	WX	P	T °C	Td °C	Wind deg/kt	Peak Wind
0915	NP	0.00	31	29	017° 7	001° 11
0916	NP	0.00	31	29	012° 7	016° 11
0917	NP	0.00	31	29	015° 7	022° 10
0918	NP	0.00	31	29	024° 8	036° 12
0919	NP	0.00	31	29	029° 8	029° 11
0920	NP	0.00	31	29	025° 8	017° 9
0921	NP	0.00	31	29	026° 7	030° 11
0922	NP	0.00	31	29	028° 8	027° 11
0923	NP	0.00	31	29	027° 8	013° 12
0924	NP	0.00	31	29	024° 9	021° 13
0925	NP	0.00	31	28	023° 10	021° 13
0926	NP	0.00	31	28	024° 9	021° 11
0927	NP	0.00	31	28	022° 8	020° 10
0928	NP	0.00	31	28	019° 7	030° 10
0929	NP	0.00	31	28	020° 7	022° 8
0930	NP	0.00	31	28	024° 8	021° 11
0931	NP	0.00	31	28	025° 8	028° 11
0932	NP	0.00	31	28	024° 7	030° 9
0933	NP	0.00	31	28	029° 7	045° 8
0934	R-	0.00	31	29	036° 7	038° 10
0935	R-	0.00	31	29	039° 7	036° 10
0936	R-	0.00	32	29	035° 7	036° 10
0937	R-	0.00	31	29	029° 6	031° 8
0938	R-	0.00	31	29	033° 5	020° 6
0939	R-	0.00	31	29	030° 4	013° 8
0940	R-	0.00	31	29	024° 5	033° 8

The 1-minute ASOS raw data at 0934 CST reported light rain with a temperature of 31° C, dew point temperature of 29° C, 2-minute average wind from 036° at 7 knots, with the peak 5-second wind from 038° at 10 knots. Based on the temperature and dew point below freezing this precipitation would have been reported as freezing precipitation. Light rain or precipitation was reported from 0934 through 0958 CST.

2.3 NWS METAR Display

A depiction of the observations and the general flight conditions surrounding the approximate time of the accident from the NWS Aviation Weather Center's (AWC) METAR website⁹ is included as figure 6 with the approximate accident site marked by a red star, and the general route of flight by a dashed orange line. The image depicted generally MVFR conditions over the route from the departure point of Lincoln, NE (KLNK) to immediately east and south of the accident site, where LIFR to IFR with conditions were reported. A distinct wind shift was evident in the stations where the cold front was depicted in figure 1 with southerly winds of 15 knots gusting to 25 knots south of the boundary and northerly winds of 10 knots north of the boundary. Several stations north of the route of flight depicted precipitation from light snow, light rain,

⁹ <https://www.aviationweather.gov/metar>

and light freezing drizzle, with mist and fog reported over KLBF and many other stations in Nebraska and northeast Colorado.

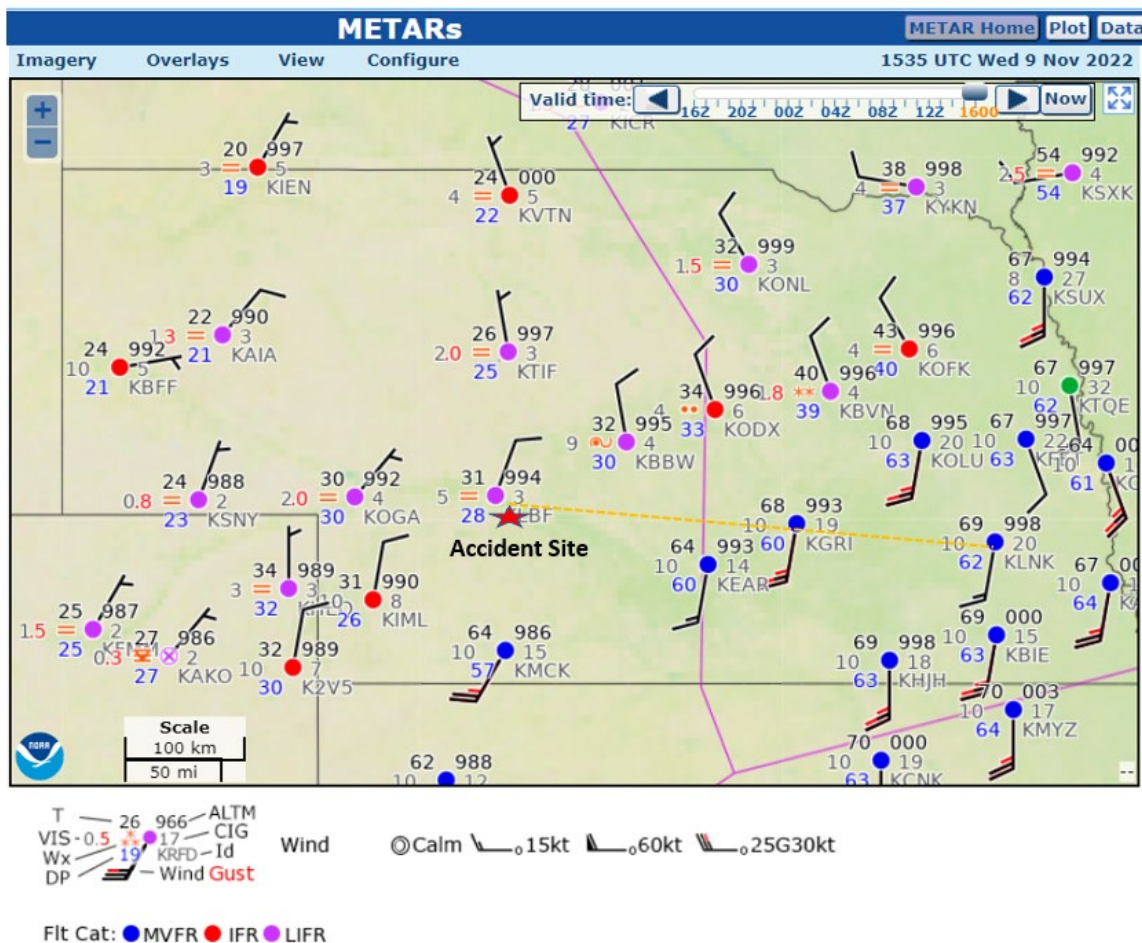


Figure 6 - NWS Aviation Weather Center METAR display at 0935 CST with accident site.

3.0 Pilot Reports

The following pilot reports (PIREPs) were reported¹⁰ from 0600 through 1130 CST below 18,000 ft and within 100 miles of KLBF.

EAR UA /OV EAR/TM 1507/FL030/TP C208/SK BASE035-TOP050/TB NEG

EAR UA /OV EAR005010/TM 1717/FL064/TP PC12/SK OVC064-BASE041/TA 13/RM DURD

¹⁰ Includes PIREPs disseminated longline and may not include "ride reports" or other reports made on radio frequency to air traffic control.

4.0 Upper Air Sounding

A High-Resolution Rapid Refresh (HRRR)¹¹ numerical model for 0900 CST was obtained from the NOAA Air Resource Laboratory database using the closest grid point¹² to the accident site. The HRRR sounding was then plotted on a standard Skew T log P diagram¹³ utilizing the RAOB software program¹⁴ and is included as figure 7.

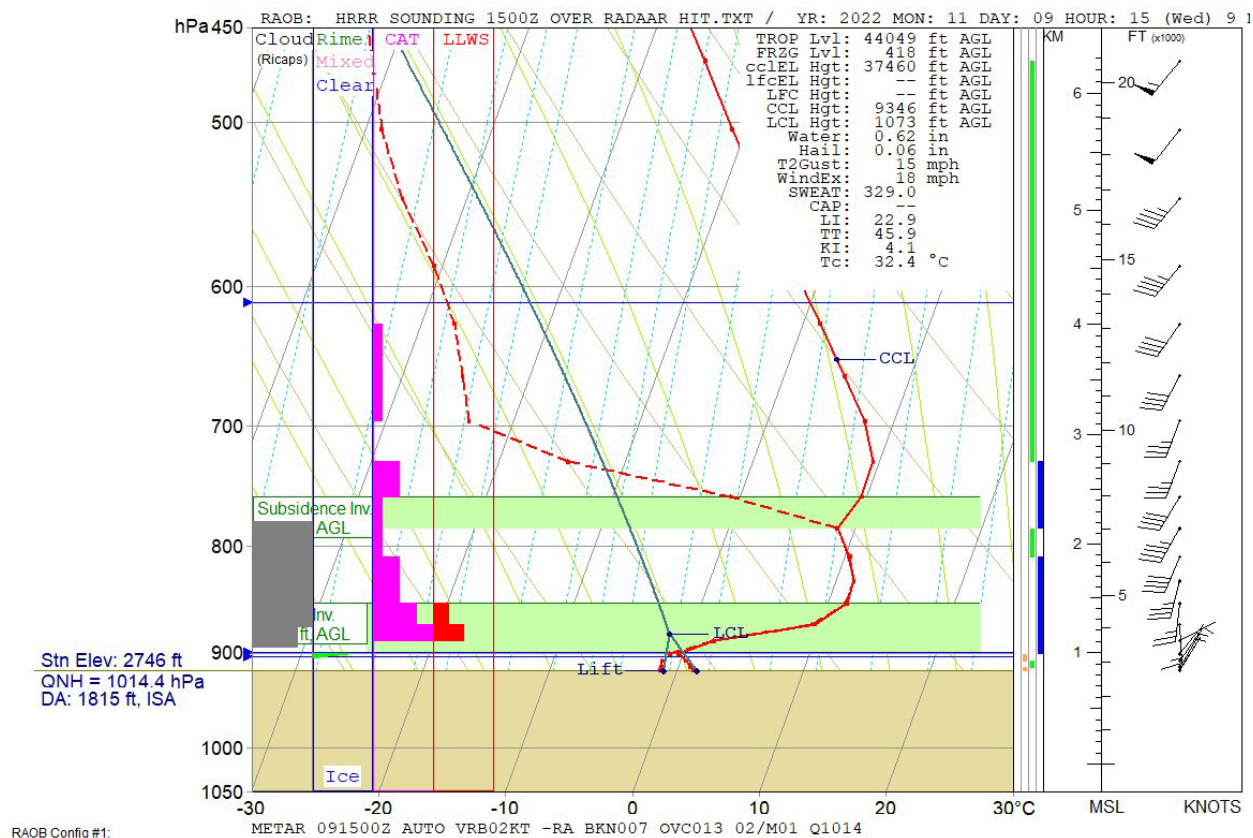


Figure 7 - HRRR numerical sounding over the closest grid point to the accident site for 0900 CST.

The HRRR sounding for 0900 CST depicted an elevation of 2,746 ft, with a near-surface temperature of 1.6° C (35° F), a dew point temperature of -1.0° C (30° F), with

¹¹ 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.

¹² The grid point was at latitude 41.08° N and longitude 100.62° W.

¹³ 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.

¹⁴ RAOB -The Universal RAOBsonde OBservation program is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

a relative humidity of 83%. The lifted condensation level (LCL)¹⁵ was identified at 1,073 ft agl, with the convective condensation level (CCL)¹⁶ at 9,346 ft agl. A frontal inversion was noted immediately above the surface through approximately 5,000 ft (depicted in green shade across sounding) with another inversion due to subsidence from 7,000 through 8,000 ft where temperatures increased above freezing. The sounding depicted two freezing levels, one at the surface with a shallow layer of below freezing temperatures and the other at about 14,000 ft (depicted as a blue horizontal line) above the inversion. The precipitable water content was 0.64 inches. The Lifted Index was 22.9 and indicated a stable atmosphere. The RAOB analysis software depicted a broken to overcast layer of nimbostratus type clouds from 700 ft agl through 7,000 ft where the relative humidity exceeded 90 to 100% and was capable of producing light rain.

The HRRR wind profile indicated a near surface wind from the north at 10 knots or less, which shifted to the south immediately above the surface with increasing wind speeds to 35 knots within 2,000 ft above the surface. The wind then veered to the southwest with height with increasing wind speeds. The mean 0 to 6 kilometer (or 18,000 ft) wind was from 210° at 39 knots.

A table of the HRRR sounding parameters of height, pressure, temperature, dew point temperature, relative humidity, wind direction and speed, and derived Clear Air turbulence (CAT), Low-Level Wind Shear (LLWS), and icing potential from the surface to about 21,000 ft were as follows.

Height (ft-msl)	Pres (hPa)	T (°C)	Td (°C)	RH (%)	DD/FF (deg/kt)	CAT (FAA)	LLWS (FAA)	ICING (FAA)
2746	918	1.6	-1.0	83	028/ 2			
2775	917	1.3	-1.3	83	030/ 2			
2862	914	1.0	-1.3	85	029/ 2			
3036	908	0.5	-1.4	87	032/ 3			
3240	901	-0.3	-1.0	95	036/ 4			
3624	888	2.1	2.1	100	059/ 5	XTR	MODRT	LGT Rime
4113	872	9.6	9.4	99	178/ 17	SVR	LIGHT	
4749	852	11.5	11.4	99	187/ 27	MDT		
5436	831	11.4	11.4	100	194/ 34	MDT		
6173	809	10.4	10.3	99	202/ 40	LGT		
7030	784	8.6	8.6	100	208/ 43	LGT		
7984	757	9.6	-0.7	49	209/ 39	MDT		
9047	728	9.5	-14.5	17	199/ 36			
10265	696	7.7	-23.5	9	199/ 37	LGT		
11610	662	4.8	-25.3	9	206/ 38	LGT		
13137	625	1.4	-27.4	10	213/ 40			

¹⁵ Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

¹⁶ Convective Condensation Level (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.

14826	586	-2.4	-30.7	9	217/ 43
16746	544	-6.7	-35.1	8	218/ 47
18686	504	-11.1	-38.7	8	217/ 51
20591	467	-15.2	-41.4	9	217/ 53

The RAOB analysis program indicated a high potential for moderate or greater turbulence between 3,600 and 5,500 ft (depicted in pink on left axis) in the inversion where the sounding identified strong vertical wind shear. Only light rime icing was indicated in a shallow layer near 3,240 ft (green on left axis).

5.0 Satellite Imagery

The NOAA Geostationary Operational Environmental Satellite number 16 (GOES-16) infrared and visible imagery were obtained and documented surrounding the period of the accident and depicted an extensive area of low to middle level clouds extending over the area surrounding the period. The infrared band 13 at a wavelength of 10.3 μm provided a resolution of 2 kilometers with radiative cloud top temperatures, and the visible band 2 imagery provided a wavelength of 0.64 μm with a resolution of 0.5 km. Figure 8 is the GOES-16 infrared image at 4X magnification with a standard MD temperature enhancement curve applied with the frontal positions from 0800 CST overlaid. The image depicted an extensive area of low clouds with a mid-level band of higher altostratus type clouds over the accident site with a radiative cloud top temperature of 270 Kelvin or -3.16°C , which corresponded to cloud tops near 15,000 ft. Figure 9 is the GOES-16 visible image for 0931 CST at 2X magnification, which further depicted the area of low nimbostratus to stratiform clouds over the accident site, with a scattered mid-level band of clouds over the lower clouds. An animation of the GOES-16 infrared and visible imagery surrounding the period are included as Attachments 2 and 3 respectively.

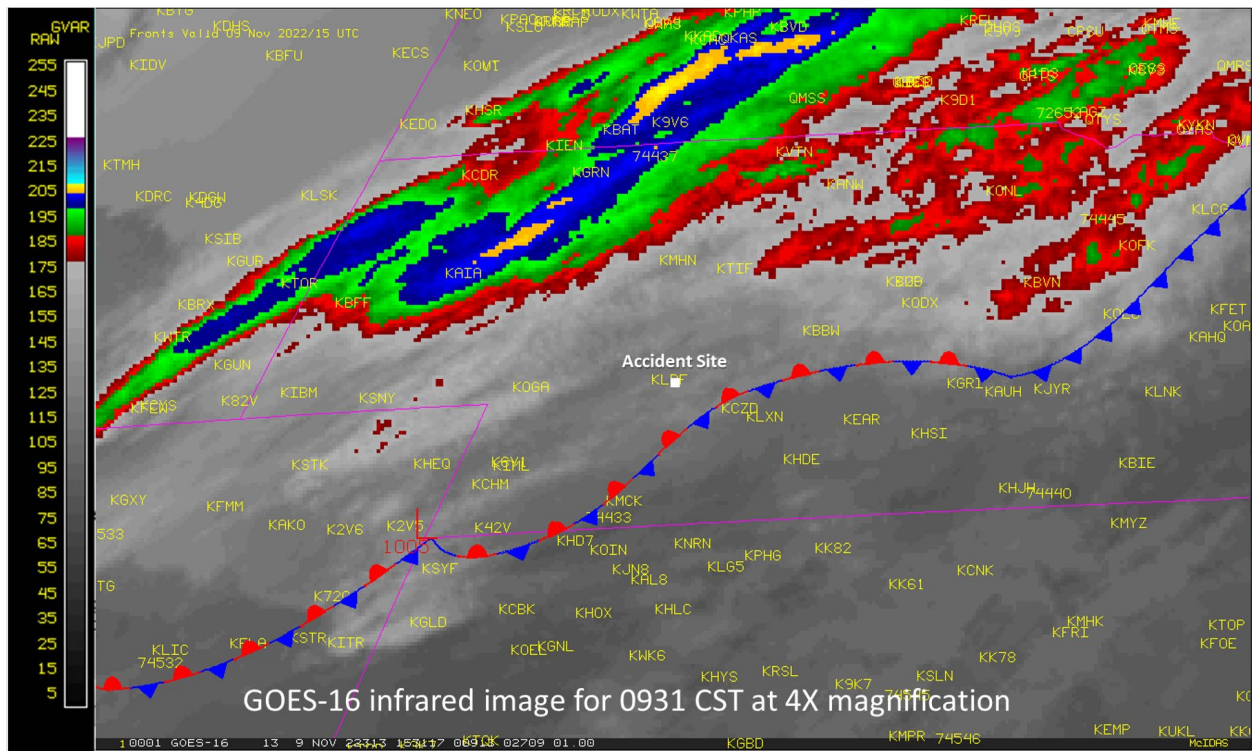


Figure 8 - GOES-16 infrared image for 0931 CST at 4X magnification with fronts overlaid.

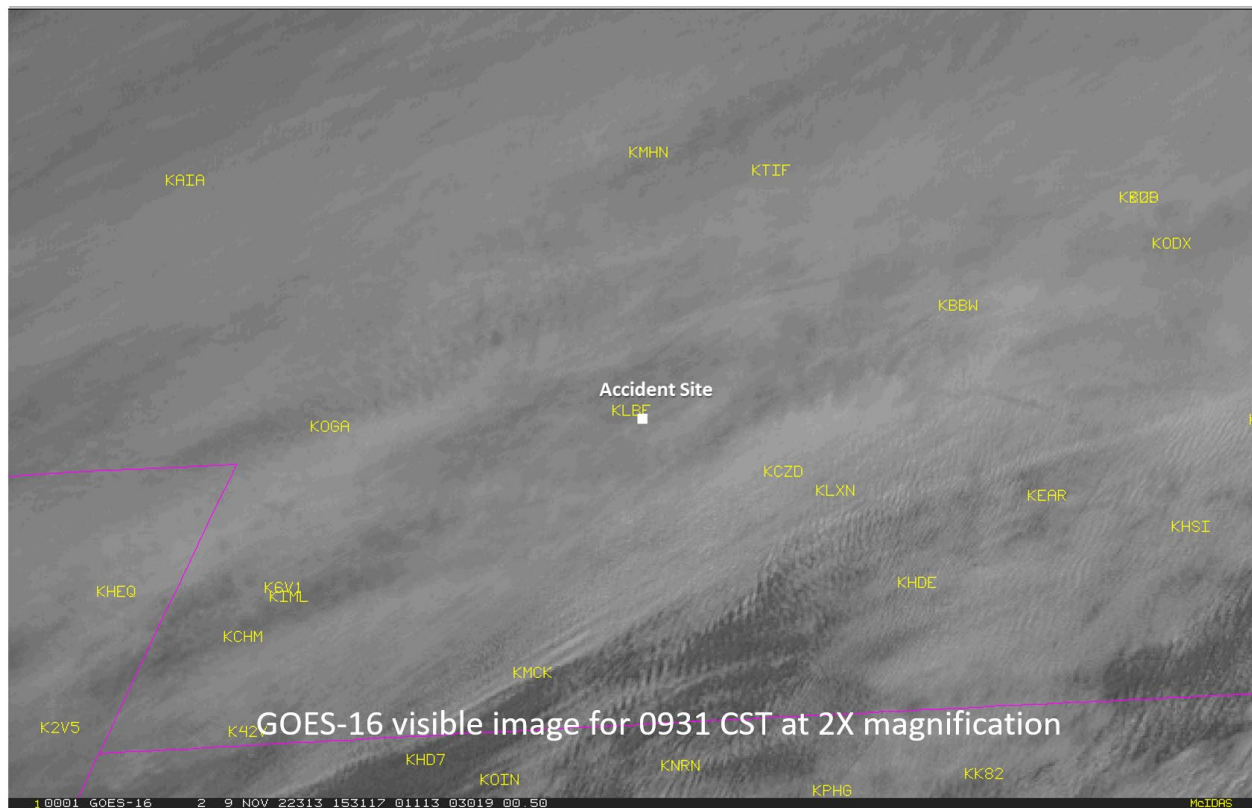


Figure 9 - GOES-16 visible image for 0931 CST at 2X magnification.

6.0 Weather Radar Imagery

The closest NWS North Platte (KLNK)¹⁷ Weather Surveillance Radar 1988 Doppler (WSR-88D)¹⁸ was located about 53 miles north of the accident site. The level II archive data were obtained from the NCEI using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software. During the period, the KLNK WSR-88D was operating in the standard clear air mode identified as volume scanning pattern 32 (VCP-32) where the radar makes 5 different elevation scans during the 10 minute scan.

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors¹⁹, 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. The FAA Advisory Circular AC 00-24C - "Thunderstorm" defines echoes less than 30 dBZ as "light" in intensity, "moderate" echoes 30-40 dBZ, "heavy" with echoes of >40-50 dBZ, and "extreme" intensity with echoes above >50 dBZ. These are the new standard radio phraseology terms used by air traffic controllers to describe weather conditions to pilots as shown in the following table. Light rain is typically reported at the surface when reflectivities reach 20 dBZ, while air traffic control will not display echoes less than 30 dBZ or light intensity echoes on their weather displays.

Reflectivity Ranges (dBZ)	Weather Radar echo Intensity Terminology
< 30 dBZ	Light
30 to 40 dBZ	Moderate
>40 to 50 dBZ	Heavy
>50 dBZ	Extreme

The KLNK WSR-88D 0.5° base reflectivity image for 0933 CST with the flight track of N234PM overlaid (purple) along with the accident site is included as figure 10. The image depicted no significant meteorological echoes along the flight track. However,

¹⁷ The NWS North Platte Weather Forecast Office (WFO) is co-located at the KLBF airport, while the WSR-88D Radar Data Acquisition (RDA) system associated with the radar's antenna is located north of the airport in Thedford, NE, with the station code of KLNK.

¹⁸ 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.

¹⁹ 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.

a defined band of very light intensity echoes of 15 dBZ or less was depicted extended west of KLBF to the northeast. An animation of the radar imagery depicted this band of light intensity echoes remaining relatively stationary over the area during the period.

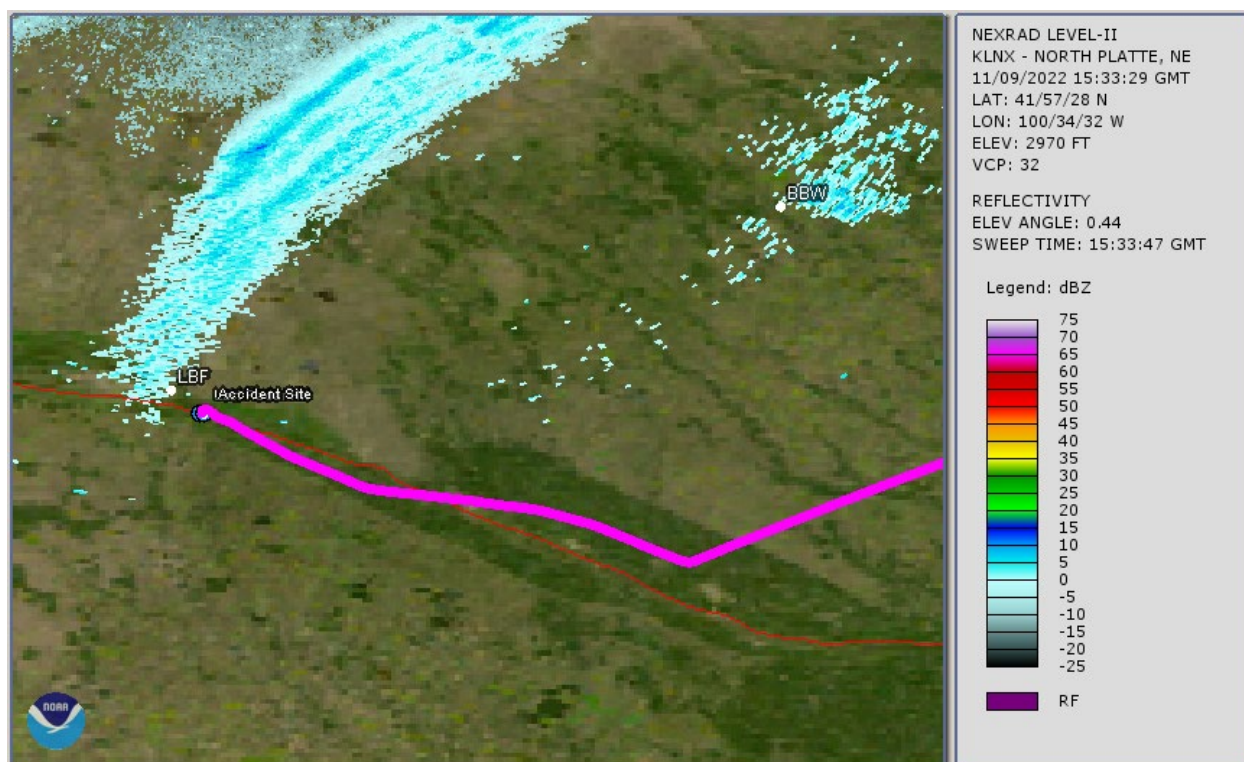


Figure 10- KLNX WSR-88D 0.5° base reflectivity image for 0933 CST with flight track of N234PM.

7.0 NWS Forecasts and Advisories

The NWS North Platte Weather Forecast Office (WFO) was responsible for the local forecast and general public weather warnings for the area, while the NWS AWC was responsible for the aviation weather images and products documented below.

7.1 Terminal Aerodrome Forecast

The Terminal Aerodrome Forecast (TAF) is a concise statement of the expected meteorological conditions significant to aviation for a specified time period and within 5 statute miles of the center of the airport's runway complex (terminal). The TAFs issued during the period available for preflight and the latest forecast current at the time of the accident are documented below. The bold type reflects the period current at the time of the accident.

TAF KLBF 091138Z 0912/1012 03010G18KT P6SM OVC015
FM091800 15014G28KT P6SM BKN035

FM100000 16021G35KT P6SM SCT050
TEMPO 1004/1006 3SM SHRA OVC030
FM100600 31018G28KT P6SM OVC020=

The initial forecast for KLBF issued at 0538 CST and used by the pilot in his preflight weather briefing indicated that MVFR conditions were expected to prevail through 1200 CST with north-northeasterly winds. After 1200 CST VFR conditions were expected to prevail with southerly winds gusting to 28 knots. The forecast did not include any forecast for low-level wind shear.

AMD TAF KLBF 091242Z 0913/1012 02010G18KT P6SM OVC008

FM091800 15014G28KT P6SM BKN035
FM100000 16021G35KT P6SM SCT050
TEMPO 1004/1006 3SM SHRA OVC030
FM100600 31018G28KT P6SM OVC020=

The forecast was amended at 0642 CST for KLBF with IFR conditions expected to prevail between 0700 and 1200 CST with winds from 020° at 10 knots gusting to 18 knots, visibility better than 6 miles, ceiling overcast at 800 ft agl.

AMD TAF KLBF 091400Z 0914/1012 02010G18KT P6SM OVC003

FM091800 15014G28KT P6SM BKN035
FM100000 16021G35KT P6SM SCT050
TEMPO 1004/1006 3SM SHRA OVC030
FM100600 31018G28KT P6SM OVC020=

The forecast was amended shortly prior to the flight's departure at 0800 CST with LIFR conditions expected to prevail with a ceiling overcast at 300 ft agl through 1200 CST, with visibility unrestricted at 6 miles or more.

7.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short-term weather conditions within their region with an aviation section that includes the general conditions as they relate to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF and provide some reasoning behind the forecast. These are generated roughly every 6 hours and correspond to the release of the latest TAFs for that office. The AFD issued by the KLBF WFO at 0908 CST was as follows.

FXUS63 KLBF 091508
AFDLBF

Area Forecast Discussion
National Weather Service North Platte NE
908 AM CST Wed Nov 9 2022

...9 AM UPDATE...

.SYNOPSIS...

Issued at 406 AM CST Wed Nov 9 2022

Key Messages:

-A strong storm system is expected to impact the area this evening into tomorrow, with the potential for light snow, icing, strong winds, and thunderstorms.

-A Winter Weather Advisory is in effect for northern Nebraska this afternoon through tomorrow for the threat for icing.

-Much colder air remains in place into next week, with well below average high temperatures.

-Slight chances for wintry precipitation return Monday night into Tuesday.

.UPDATE...

Issued at 903 AM CST Wed Nov 9 2022

Given recent observations and model soundings, a freezing potential exists on elevated surfaces and roadways leading to slick and hazardous travel. Have decided to expand the current Winter Weather Advisory to include Boyd, Holt, Thomas, Hooker, and Grant counties with an earlier start time of 9 AM CST this morning.

.SHORT TERM...(Today through Thursday)

Issued at 406 AM CST Wed Nov 9 2022

Currently, a cold front continues to slope southward through the area and is located from just north of Imperial to near Bartlett. North of this front, temperatures have rapidly cooled into the 20s to lower 30s under an expansive stratus deck. Winds remain gusty from the south ahead of the front, with widespread gusts of 25 to 35 miles per hour.

Attention for the short term revolves around a strong low pressure system with multiple hazards anticipated. The upper low, currently centered over far northern California, is expected to quickly progress eastward today, reaching the Dakotas by tomorrow morning. Guidance has continued to point towards a more progressive solution, and as a consequence, a somewhat weaker system. The upper low looks to remain more positively tilted as it ejects across the Plains, leading to lesser forcing for ascent (albeit still ample to drive precipitation locally). As the upper low ejects eastward tonight, a surface low is anticipated to bisect the area, tracking from southwest into central Nebraska.

The progression of the surface front today leads to a very low confidence temperature forecast, with wide variance in guidance. This is largely tied to just how far north the cold air retreats, as a differential heating boundary (effective warm front) lifts gradually north on the southern periphery of the expansive stratus deck. Will preface the discussion with this, high uncertainty exists, especially along the I-80 corridor into the Sandhills, with very large standard deviations (widespread values of 8-14F!) indicated in guidance. This suggests the high temperature forecast this afternoon will be very difficult to pin down. The current forecast leans heavily on a slower erosion of the stratus deck, with cold air only retreating to near/just north of I-80. This leads to highs ranging from the 70s along and south of the Interstate to near freezing along the SD/NE border. This will completely hinge on how quickly the stratus erodes. Should the stratus erode quicker (and more expansively) than forecast, high temperatures could be some 10-15F too low

across the Sandhills. This will need to be monitored closely for trends going forward. South of the front, a deeply mixed boundary layer will keep winds elevated as well as tapping into very warm air aloft. H85 temperatures remain near the 90th percentile climo in the prefrontal environment, so any areas that remain clear this afternoon will warm quickly. Higher momentum flow will be mixed down as well, with southerly gusts approaching 45 miles per hour south of the boundary. Areas to the north should remain cloudy with at least weak CAA persisting before a secondary cold front sweeps through the entire area tonight.

With multiple hazards anticipated, each will be covered in its own section below.

Wintry precipitation:

Guidance continues to come into better agreement with the placement of measurable wintry precipitation, generally north of HWY 2. Very brief periods of wintry precip is possible as far south as I-80, though should lead to little to no impacts. As for p-type, should see a transition from freezing rain -> brief sleet -> snow. This is well supported by forecast soundings, showing a stout warm nose positioned near H85, at the top of the cloud bearing layer. Additionally, no ice is anticipated to be present in the cloud, with the entire column above freezing. Will also have to monitor the potential for convective enhancement, with lapse rates quickly steepening aloft and leading to non-zero MUCAPE. With surface temperatures already near/below freezing for much of the Sandhills and northern Nebraska, all indications point to precipitation starting out as freezing rain north of HWY 2 as forcing increases late this afternoon. Just how efficiently ice accretion can occur remains low confidence, though at least a glazing of ice is looking increasingly likely for areas north of an Alliance to Brewster line. The greatest threat for icing will likely exist on elevated and untreated surfaces. Additionally, should ice amounts occur heavier than forecast (more than 0.10") there could be a threat for tree damage when factoring in wind gusts in the 40-45mph range. A gradual changeover to briefly sleet and then snow will occur as the column rapidly cools with the approach of the upper level low. However, believe any sleet/snow will be rather brief, with the upper low rapidly pulling off to the north and east coinciding with the cooling aloft. This looks to limit snow totals to just a couple tenths of an inch across northern Nebraska, with around 0.5-1.0" in close proximity to the Pine Ridge. This should also limit any widespread blowing snow threat, cutting down on widespread low visibility issues. With this general thinking in mind, have issued a Winter Weather Advisory for much of northern Nebraska, largely driven by the threat for icing. The highest ice amounts look to occur near/south of the HWY 20 corridor and west of HWY 83.

Strong Winds:

Strong winds remain a threat through tomorrow, though are not expected to approach High Wind Warning (gusts of 60mph+) criteria. This is yet another consequence of a faster and less deep storm system. That said, widespread wind gusts of 40 to 45mph are anticipated, both ahead and behind the approaching cold front. The first corridor was mentioned previously, with high momentum southerly flow being mixed down ahead of the surface cold frontal boundary. The second regime will occur tomorrow afternoon across north central Nebraska, in closest proximity to the deepening surface low over the upper Midwest. This keeps the surface pressure gradient tight, as continuing CAA and a unidirectional wind profile promotes higher momentum flow reaching the surface. Again, widespread gusts of 40 to 45mph are expected.

Thunderstorms:

Confidence remains low in thunderstorm activity, with uncertainty remaining in the progression of the surface cold front and available instability tonight. The most likely corridor to see

thunderstorms looks to be for areas east of HWY 83 and south of HWY 91. Some high- res guidances hints towards a highly forced squall line developing just ahead of the front around and just after Midnight tonight. The development of a southerly LLJ overnight helps to promote ample clockwise curvature in the lowest few kilometers of hodographs and deep layer shear remains strong (40-50kts). However, meager instability and time of day puts any strong storm threat very much in question. Should any storm become surface based however, can't rule out a strong wind gusts or two.

The storm system begins to quickly exit the area by tomorrow afternoon, with dry conditions persisting through the rest of the day. Though gradual clearing is expected from south to north through the day, strong CAA will keep highs primarily in the 20s to 30s.

**.AVIATION...(For the 12Z TAFS through 12Z Thursday morning)
Issued at 645 AM CST Wed Nov 9 2022**

Poor flight conditions this TAF period.

A cold front will bisect central and western Nebraska through today and into tonight before pushing through and moving off to the east late tonight.

KVTN will be north of the front through the entire period. Expect CIGs to remain IFR with a VSBY restriction to 3 miles in fog this morning. With fog and temperatures below freezing some icing is also expected on aircraft surfaces. Chances for precipitation will increase late in the day and into early tonight before low pressure pulls the frontal boundary away from the area late tonight. Winds will be northerly with an occasional gust until becoming northwest and quite gusty late tonight as the low pulls away.

KLBF is currently north of the front with MVFR CIGs, but the boundary will buckle and move back to the north later this morning, placing KLBF back into the warm sector. The wavering frontal boundary will cause a good degree of variability in winds between a northerly direction and southerly. Once in the warm sector, CIGs will become VFR and southerly winds will become quite gusty. The frontal boundary will finally surge back through KLBF early tonight with some showers and possibly some thunder. Winds will then become northwesterly behind the front and CIGs will sink to MVFR through the end of the valid period.

.LBF WATCHES/WARNINGS/ADVISORIES...

Winter Weather Advisory until noon CST Thursday for NEZ004>010-023>025-094.

7.3 Public Zone Forecast

The NWS KLBF Zone Forecast (ZFP) that covered the North Platte issued at 0556 CST issued to the public was as follows.

FPUS53 KLBF 091156
ZFPLBF

Zone Forecast Product for Nebraska
National Weather Service North Platte NE
556 AM CST Wed Nov 9 2022

NEZ059-092215-

Lincoln-
Including the city of North Platte
556 AM CST Wed Nov 9 2022

.TODAY...Windy. Mostly cloudy with patchy freezing drizzle in the morning, then mostly sunny in the afternoon. Highs around 71. Northeast winds 15 to 25 mph, becoming southeast 15 to 30 mph in the afternoon. Gusts up to 45 mph.

.TONIGHT...Windy. Partly cloudy. A slight chance of rain showers in the evening, then a chance of rain showers and a slight chance of thunderstorms after midnight. Lows in the upper 20s. South winds 15 to 30 mph, becoming northwest 20 to 30 mph after midnight. Gusts up to 45 mph. Chance of precipitation 50 percent.

.THURSDAY...Breezy, sunny. Highs in the upper 30s. Northwest winds 15 to 25 mph.

7.4 NWS Hazardous Weather Outlook

The NWS KLBH Hazardous Weather Outlook (HWO) issued at about 0900 CST to the general public for the North Platte area was as follows.

FLUS43 KLBH 091509
HWOLBF

Hazardous Weather Outlook
National Weather Service North Platte NE
909 AM CST Wed Nov 9 2022

NEZ004>010-022>029-035>038-056>059-069>071-094-101515-
Sheridan-Eastern Cherry-Keya Paha-Boyd-Brown-Rock-Holt-Garden-Grant-Hooker-Thomas-
Blaine-Loup-Garfield-Wheeler-Arthur-McPherson-Logan-Custer-Deuel-Keith-Perkins-Lincoln-
Chase-Hayes-Frontier-Western Cherry-
909 AM CST Wed Nov 9 2022 /809 AM MST Wed Nov 9 2022/

This Hazardous Weather Outlook is for portions of western and north central Nebraska.

.DAY ONE...Today and tonight.

Elevated fire weather conditions are expected across portions of southwest Nebraska this afternoon.

A strong storm system will start to impact central and western Nebraska tonight. Light precipitation will begin as rain and freezing rain with a gradual transition to snow as a cold front moves across the region. A glaze to a tenth of an inch of ice will be possible across portions of the Sandhills and north central Nebraska with a Winter Weather Advisory area is in effect for hazardous slick conditions. Strong gust winds are expected ahead of the front mainly along and south of Interstate 80.

.DAYS TWO THROUGH SEVEN...Thursday through Tuesday.

A Winter Weather Advisory for hazardous slick conditions continues through Thursday morning for portions of the Sandhills and north central Nebraska. Windy and much colder through the weekend.

.SPOTTER INFORMATION STATEMENT...

Spotter activation is not expected at this time.

7.5 Graphic Forecast for Aviation

The NWS Graphic Forecast for Aviation (GFA) is a graphical depiction of surface wind, thunderstorms, precipitation, color coded general flight categories, and cloud cover bases and tops, from graphical output from the NWS's National Digital Forecast Data (NDFD) with the Graphic-Airmen's Meteorological Information (G-AIRMET)²⁰ for IFR conditions, mountain obscuration, icing conditions, and strong surface wind overlaid. The GFA provides a forecast for the enroute phase of flight and for locations without a TAF. The GFA is available at the NWS AWC website and through other weather briefing services. The GFA 6-hour forecast issued at about 0400 CST and available at the time of the pilot's preflight briefing valid for 0900 CST for the central United States are included as figures 11 and 12, cloud heights are depicted in ft msl. The GFA 6-hour forecast charts depicted easterly winds at 10 to 15 knots over the region with visibility unrestricted, while a G-AIRMET for IFR conditions extended over the area. The GFA Cloud forecast (figure 12) depicted overcast clouds with bases at 3,500 ft msl (about 520 ft agl) with tops between 7,000 and 8,000 ft. These charts were available prior to the accident flight's departure.

The GFA 3-hour forecast charts issued at about 0700 CST and valid for 0900 CST are included as figures 13 and 14 respectively and continued to depict similar conditions.

²⁰ AIRman's METeorological Information (AIRMET) is a concise description of weather phenomena that are occurring or may occur (forecast) along an air route that may affect aircraft safety. Compared to SIGMETs, AIRMETs cover less severe weather: moderate turbulence and icing, sustained surface winds of 30 knots or more, low-level wind shear, or widespread restricted visibility.

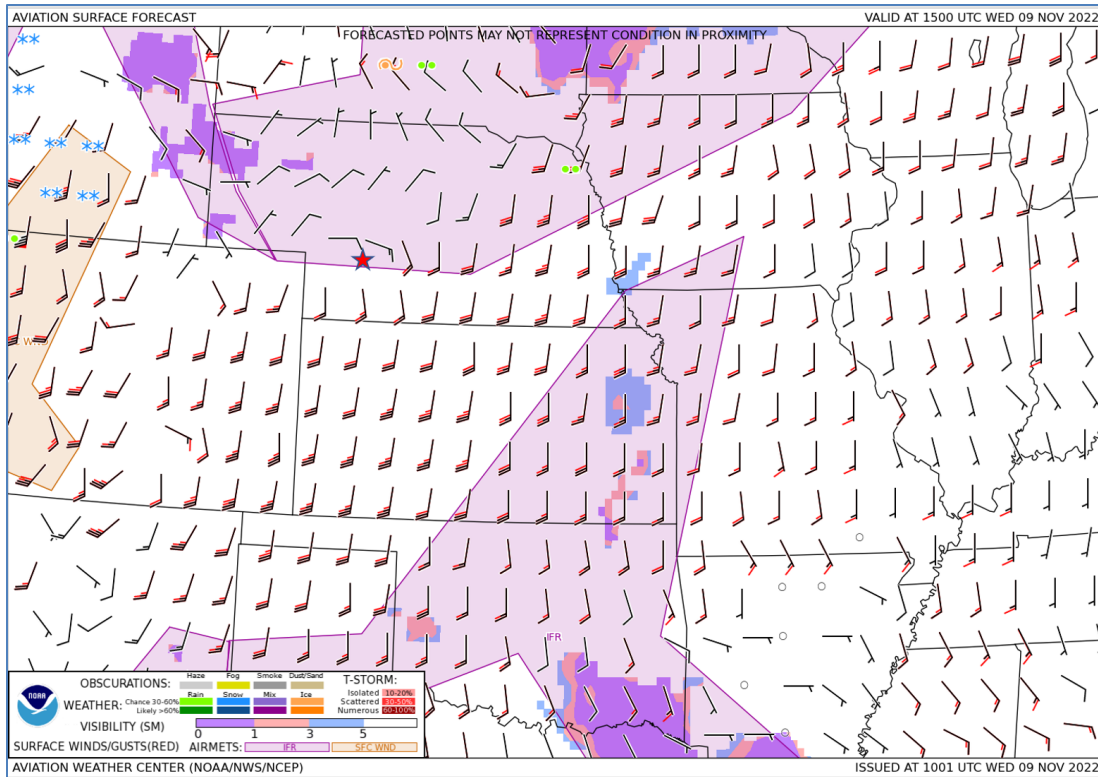


Figure 11 - NWS 6-hour central GFA Surface forecast valid for 0900 CST.

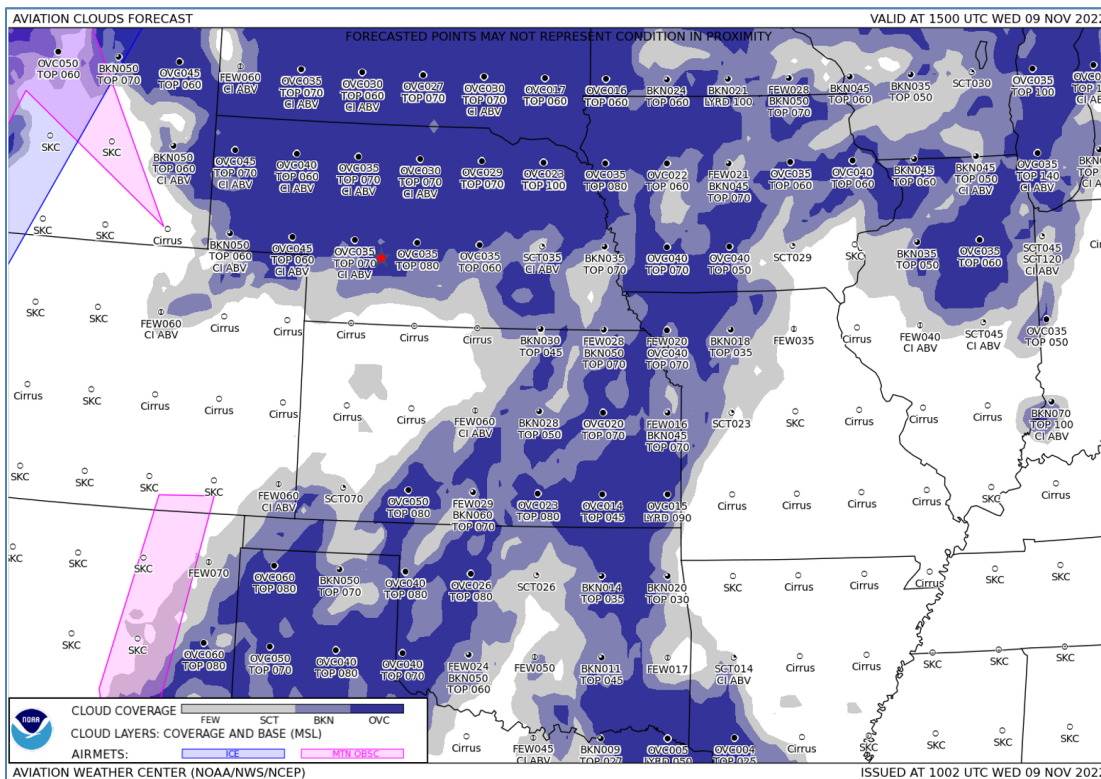


Figure 12 - NWS 6-hour central GFA Cloud forecast valid for 0900 CST.

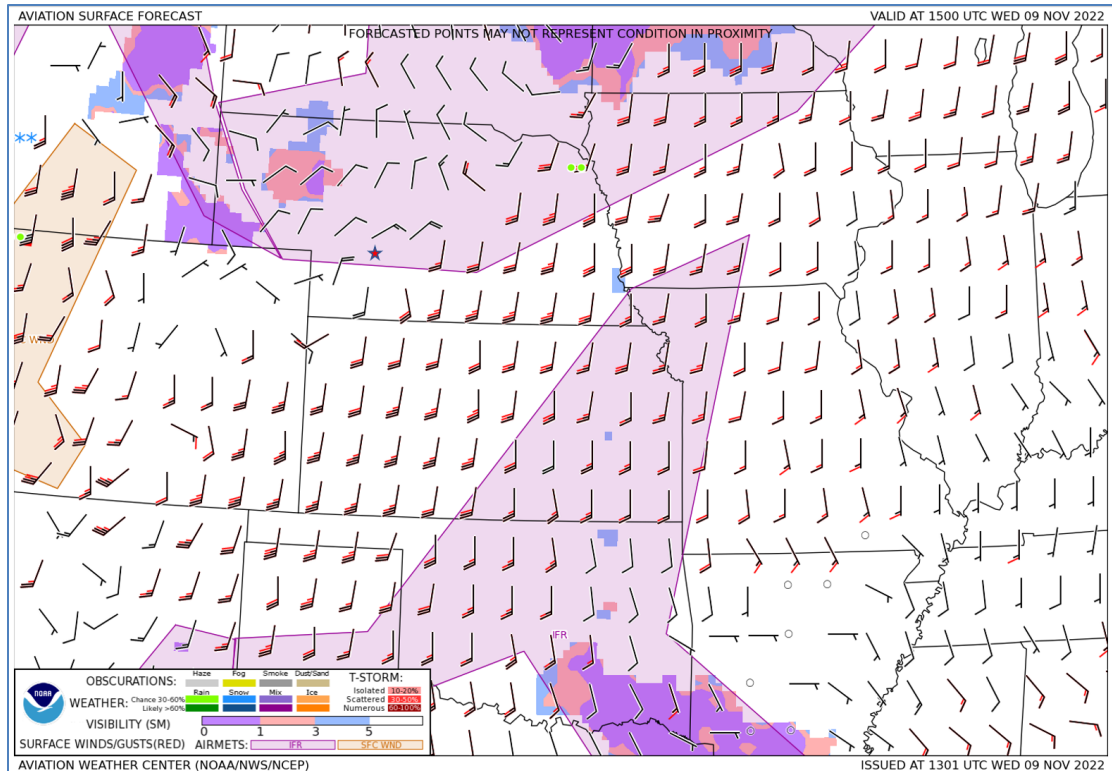


Figure 13 - NWS 3-hour central GFA Surface Forecast valid for 0900 CST.

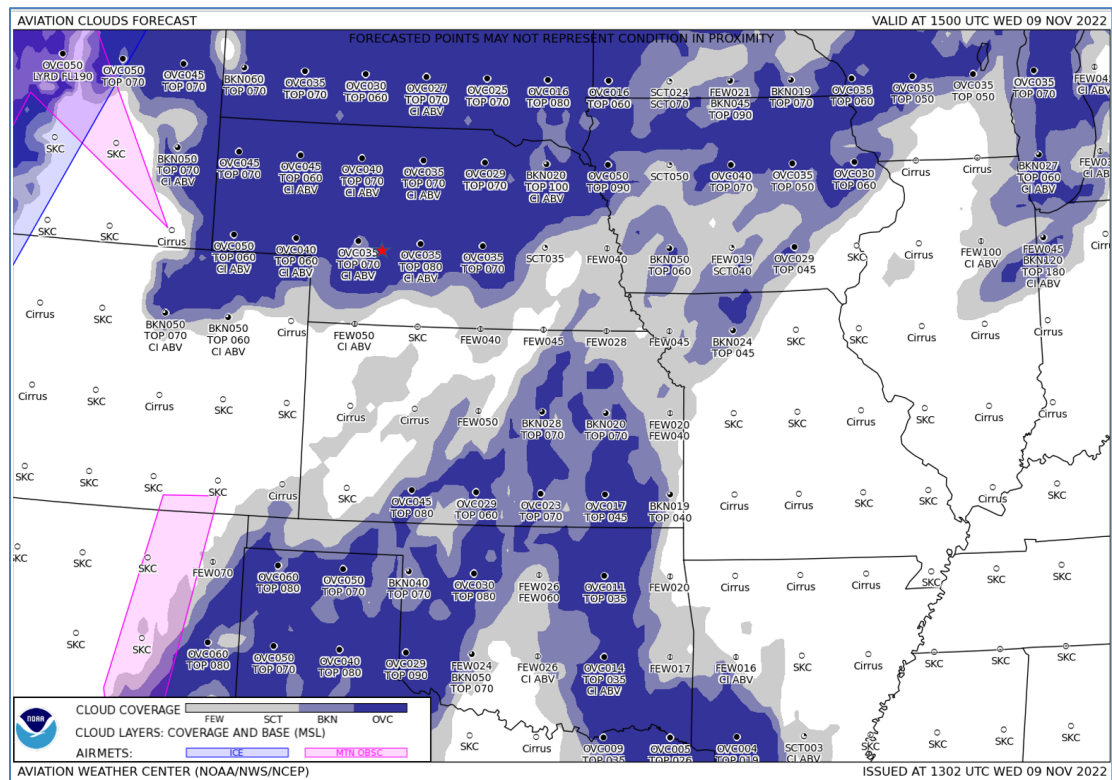


Figure 14 - NWS 3-hour central GFA Cloud Forecast valid for 0900 CST.

7.6 Winds and Temperatures Aloft Forecast

The NWS Winds and Temperature Aloft Forecast current during the period for the general route of flight issued at 0759 CST was as follows. The three forecast points around the route were Grand Island, NE (GRI), located about 100 miles east of the accident site, O'Neill, NE (ONL) about 120 miles northeast, and Scottsbluff, NE (BFF) about 140 miles west-northwest. The forecast for GRI is highlighted in bolt blue type below.

FBUS31 KWN0 091359

FD1US1

DATA BASED ON 091200Z

VALID 091800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
GRI		2244+14	2245+09	2347+04	2251-12	2145-23	226139	235850	245859
ONL		2243+10	2146+08	2246+03	2256-11	2259-24	237140	237450	247759
BFF		2025	2128+08	2124+00	2265-13	2180-23	219140	219950	720160

The accident airplane's enroute cruise altitude was at 16,000 ft between KLNK and KLBF, with the last indicated altitude at about 3,900 ft immediately prior to the accident. The forecast for GRI for 6,000 ft expected wind from 220° at 44 knots with a temperature of 14° C, at 9,000 ft wind from 220° at 45 knots with a temperature of 9° C, for 12,000 ft wind from 230° at 47 knots with a temperature of 4° C, and for 18,000 ft a wind from 220° at 51 knots with a temperature of -12° C.

7.7 Current and Forecast Icing Products

The NWS AWC Current Icing Product (CIP) analysis of the icing potential for 0600 CST or the approximate time of the preflight briefing of maximum icing severity is included as figure 15 with the approximate accident site marked by the red star. The image depicted the potential for light icing over extreme northwest Nebraska and a trace of ice immediately north of the accident site with little to no supercooled large droplets (SLD) expected over the accident site. SLD conditions were depicted in red further north over South Dakota into Minnesota, and Wisconsin where the previous Surface Prognostic Charts had depicted the likelihood of mixed freezing precipitation.

Maximum icing severity (1000 ft. MSL to FL300)

Analysis valid 1200 UTC Wed 09 Nov 2022

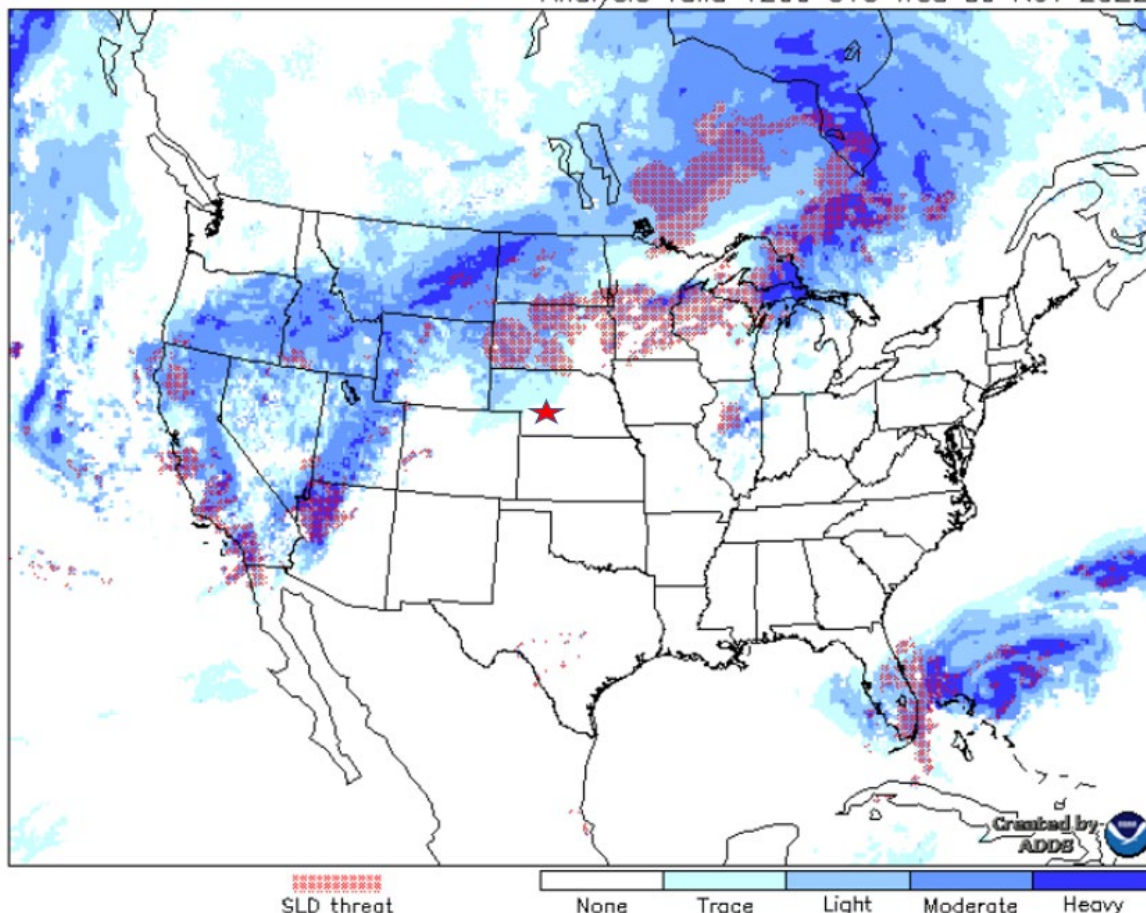


Figure 15 - NWS Current icing Product (CIP) Icing Severity for 0600 CST current during the morning before departure with the approximate accident site marked by the red star.

The NWS AWC 3-hour Forecast Icing Products (FIP) available for the period are included as figures 16 and 17 of the icing severity or best intensity category and icing probability. Except for a small area immediately north of the accident site, no icing conditions were depicted over the accident site.

Maximum icing severity (1000 ft. MSL to FL300)

03 hr forecast valid 1500 UTC Wed 09 Nov 2022

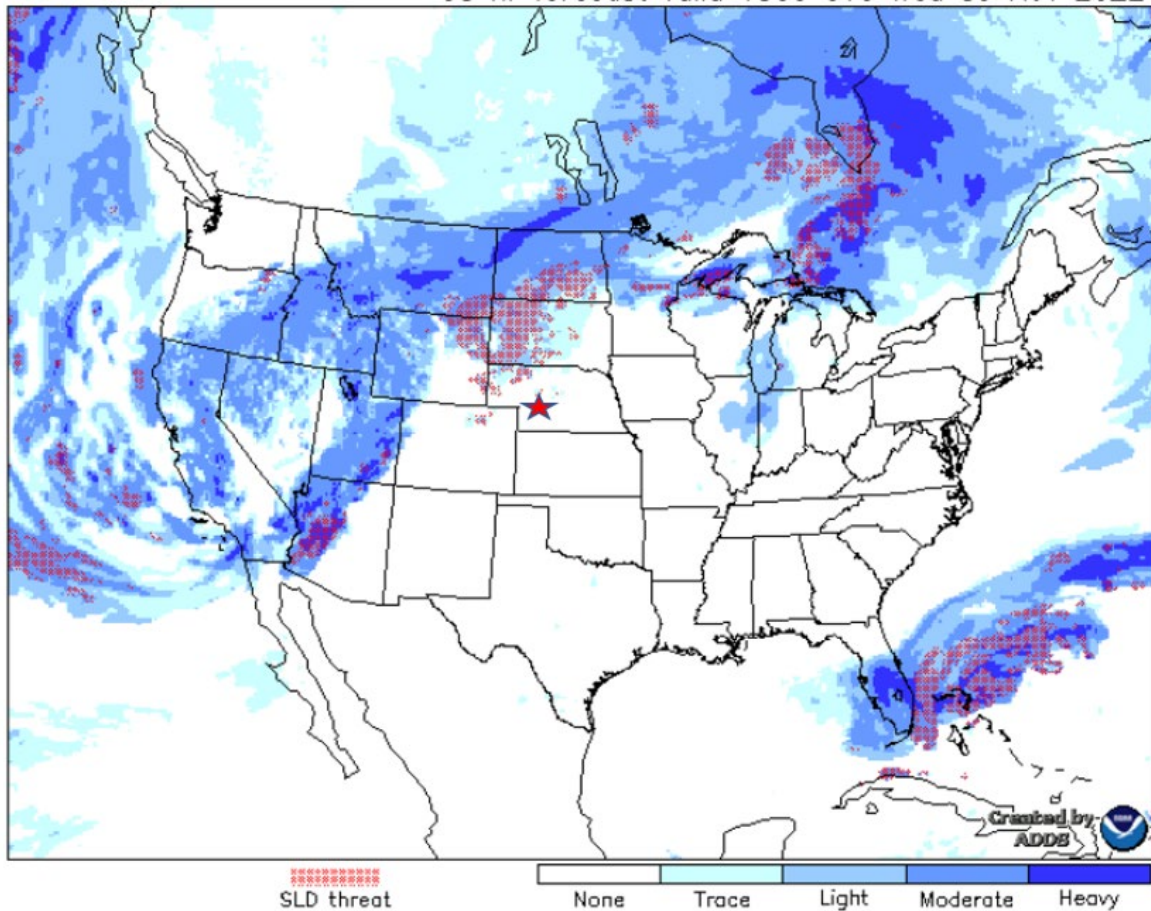


Figure 16 - 3-hour Forecast Icing Potential (FIP) Icing Severity valid for 0900 CST with the approximate accident site marked by the red star.

Maximum icing probability (1000 ft. MSL to FL300)

03 hr forecast valid 1500 UTC Wed 09 Nov 2022

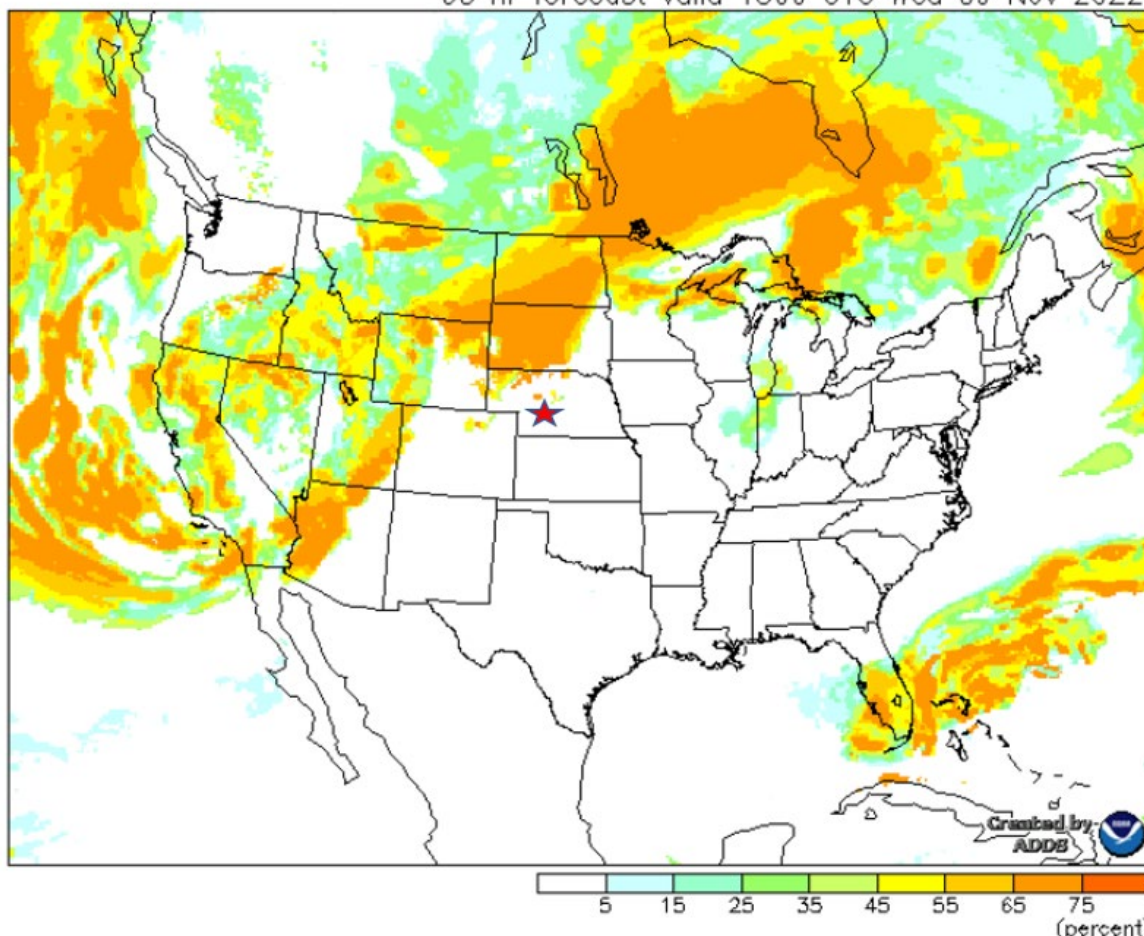


Figure 17 - FIP Icing Probability valid for 0900 CST with the approximate accident site marked by the red star.

7.8 Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of the development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the CWSU at the various Air Route Traffic Control Centers (ARTCCs). There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the G-AIRMET, and the Center Weather Advisory (CWA). Inflight advisories serve to notify en-route pilots of the possibility of encountering hazardous flying conditions that may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate based on experience and the operational limits of the aircraft. Once issued they are broadcast by FAA controller upon issuance and available on inflight weather broadcasts.

During the period surrounding the accident, the NWS had no SIGMETs, Convective SIGMETs, or CWA's current for the area. The NWS AWC did have G-AIRMETs current for IFR conditions and low-level wind shear below 2,000 ft agl which are depicted below as figures 18 and 19. There were no G-AIRMETs current for icing over the route of flight.

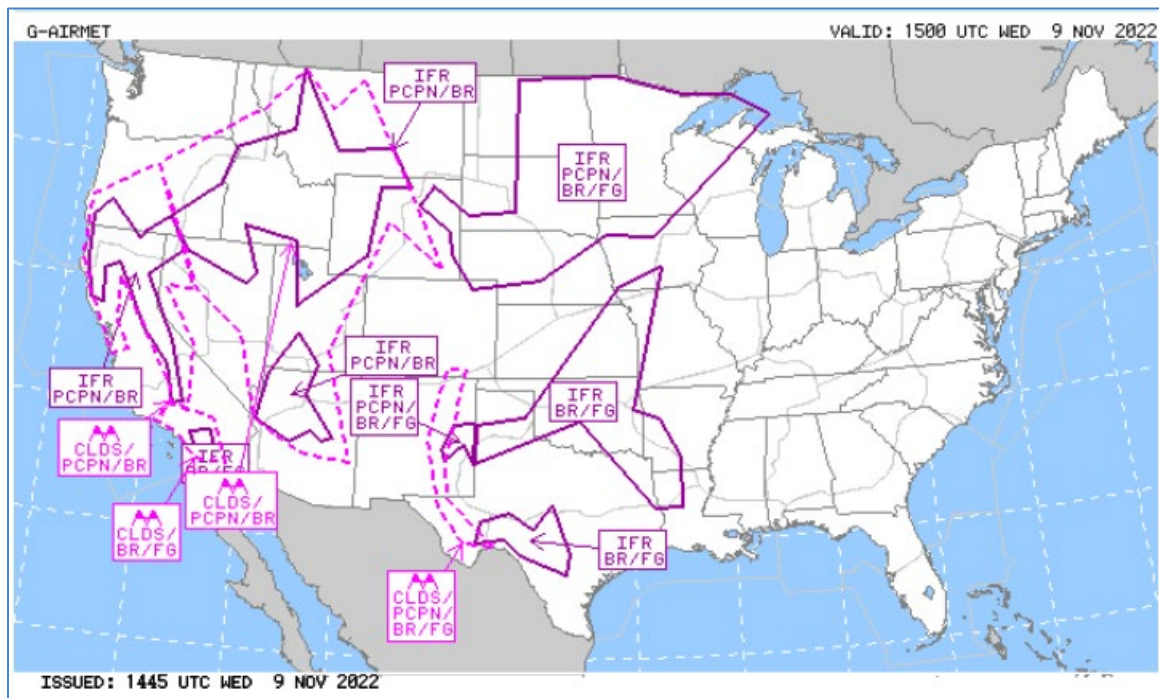


Figure 18 - G-AIRMET for IFR and mountain obscuration conditions valid for 0900 CST.

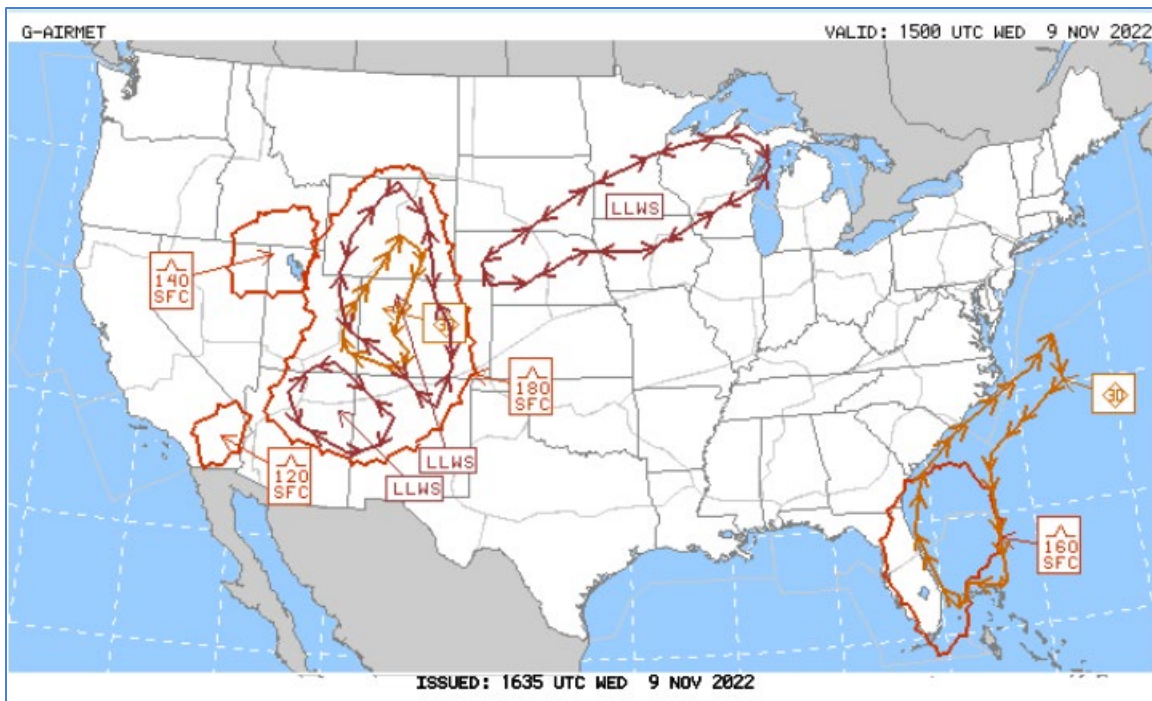


Figure 19 - G-AIRMET for low-level turbulence and Low-Level Wind Shear valid for 0900 CST.

8.0 Preflight Weather Briefing

A search of the FAA contract Automated Flight Service Station (AFSS) provider Leidos indicated that the accident pilot filed an IFR flight plan at 0604 CST, for the flight between KLNK and KLBF with an estimated time of departure of 0730 CST, with the route direct to KLBF at 16,000 ft, with an alternate of Lexington (KLXN), NE.

The standard route briefing generated for the flight is included as Attachment 4. That briefing provided the current hazards as a G-AIRMET for IFR and LLWS conditions extending over the route and accident site. The freezing level was noted between 8,000 and 12,000 ft over the route, with no icing expected below 16,000 ft. The briefing also included METARs for KLBF and for other airports along the route from 0353 through 0553 CST, and the TAF issued for KLBF at 0832 CST. The briefing also included the GFA forecasts issued at 0402 CST and valid for 0900 CST, along with the winds and temperatures aloft forecast, Convective Outlook and Notices to Air Missions (NOTAMs).

9.0 Witness Statement

A pilot operating a Cessna 208B²¹ for a regional freight carrier from Omaha (KOMA) to KLBF was the next aircraft on approach into KLBF immediately behind the

²¹ A Cessna 208B Grand caravan is a turboprop strutted, high wind utility aircraft with fixed landing gear

accident aircraft. The pilot of that flight provided a statement of the conditions he encountered during that period, with his full statement can be found in the docket. The pilot indicated that he was cleared to hold over the initial approach fix for the KLBF RNAV runway 30 approach at 8,000 ft. He recalled the weather being reported for KLBF was a ceiling near 200 ft agl with visibility 1 to 2 miles with occasional freezing rain, with winds from the north-northeast at 5 to 10 knots. He indicated the cloud tops were between 7,500 to 7,900 ft with cumulus type clouds, with temperatures between 8° to 10° C at the holding pattern altitude. While the winds at 8,000 ft enroute were from the south-southwest at 50 to 60 knots, he was in smooth conditions on top of the overcast clouds. He indicated that he had anticipated a turbulent approach with a potential tailwind landing on runway 30 and anticipated potential icing on the approach. He indicated that he made two loops in the holding pattern and heard that the previous aircraft could not be accounted for, with the report of light freezing precipitation he decided to divert to McCook Ben Nelson Regional Airport (KMCK), McCook, NE, to the south and in generally better (VFR) weather conditions south of the stationary frontal position.

He also indicated that the NWS TAFs that he had received were somewhat behind the actual reported weather conditions and did not reflect the actual conditions encountered after 1200 CST. He believed the front had moved through faster than expected. When he departed KMCF at 1230 CST for the trip back to KLBF he indicated the cloud tops were lower near 4,200 ft, with KLBF reporting ceilings at 200 ft with visibility better than 2 miles, with a surface temperature of 36° F. There was light to occasional moderate turbulence on approach and the pilot indicated that it was still a demanding approach even with use of the autopilot.

10.0 Astronomical Conditions

The United States Naval Observatory's website²² provided the following astronomical conditions for North Platte, NE on the day of the accident. The time of the accident has been added in bold italic type for reference.

<u>SUN</u>	<u>Time (CST)</u>
Begin civil twilight	0655
Sunrise	0724
<i>Accident</i>	<i>0934</i>
Transit	1227
Sunset	1730
End civil twilight	1759

produced by Cessna.

²² <https://aa.usno.navy.mil/data/index>

At the time of the accident the Sun was 19.5° above the horizon at an azimuth of 136°.

F. LIST OF ATTACHMENTS

Attachment 1 - ASOS 1-minute and 5-minute raw observations for KLBF

Attachment 2 - GOES-16 infrared satellite animation surrounding the period.

Attachment 3 - GOES-16 visible satellite imagery surrounding the period.

Attachment 4 - Weather Briefing generated for N234PM between KLNK-KLBF.

Submitted by:

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