



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 7, 2021

Specialist's Factual Report

METEOROLOGY

WPR21LA032

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A. ACCIDENT

Location: Billings, Montana
Date: October 30, 2020
Time: 1905 mountain daylight time
0105 Coordinated Universal Time (UTC) October 31, 2020
Airplane: Cessna 172; Registration: N124TW

B. METEOROLOGIST

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

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are mountain daylight time (MDT) on October 30, 2020, and are based upon the 24-hour clock, where local time is -6 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS airport and 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 45.8124° N, Longitude 108.5200° W, with an approximate elevation of 3,320 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 Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H.¹

¹

1.1 Surface Analysis Chart

The northcentral section of the NWS Surface Analysis Chart for 1800 and 2100 MDT are provided as figures 1 and 2 with the approximate location of the accident site marked within the red circle, and color shaded topography. The 1800 MDT chart identified a trough² located east of the accident site in eastern Montana and a cold front west of the accident site located across central Montana. A high pressure system was located over western Wyoming at 1800 MDT with a pressure of 1018-hectopascals (hPa). At 1800 MDT the accident site was located east of the cold front on the warm side of the boundary. At 2100 MDT, the cold front had moved through the Billings, Montana, area and was located east of the accident site (figure 2).

The Billings station model depicted air temperature of 62° Fahrenheit (°F), dew point temperature of 25°F with temperature-dew point spreads of 37°F, a southwest wind of 15 knots, and mostly clear sky cover at 1800 MDT. By 2100 MDT, the temperature had decreased to 53°F and the wind had become northwesterly at 20 knots.

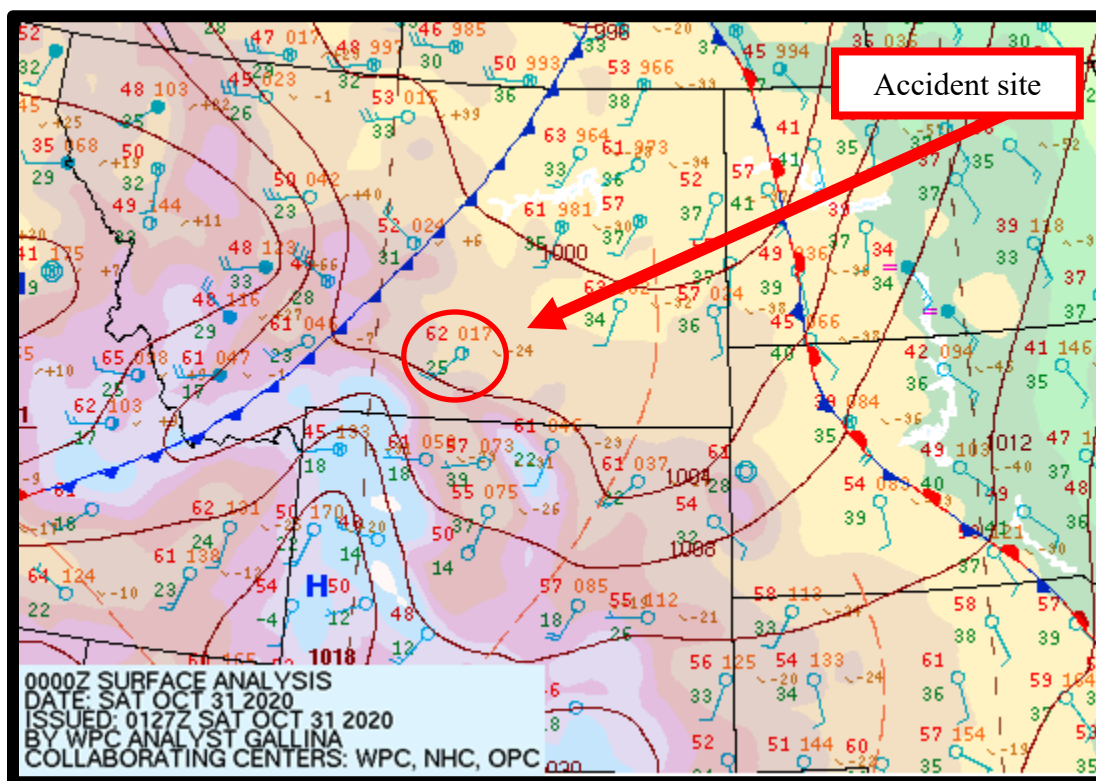


Figure 1 – NWS Surface Analysis Chart for 1800 MDT

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

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

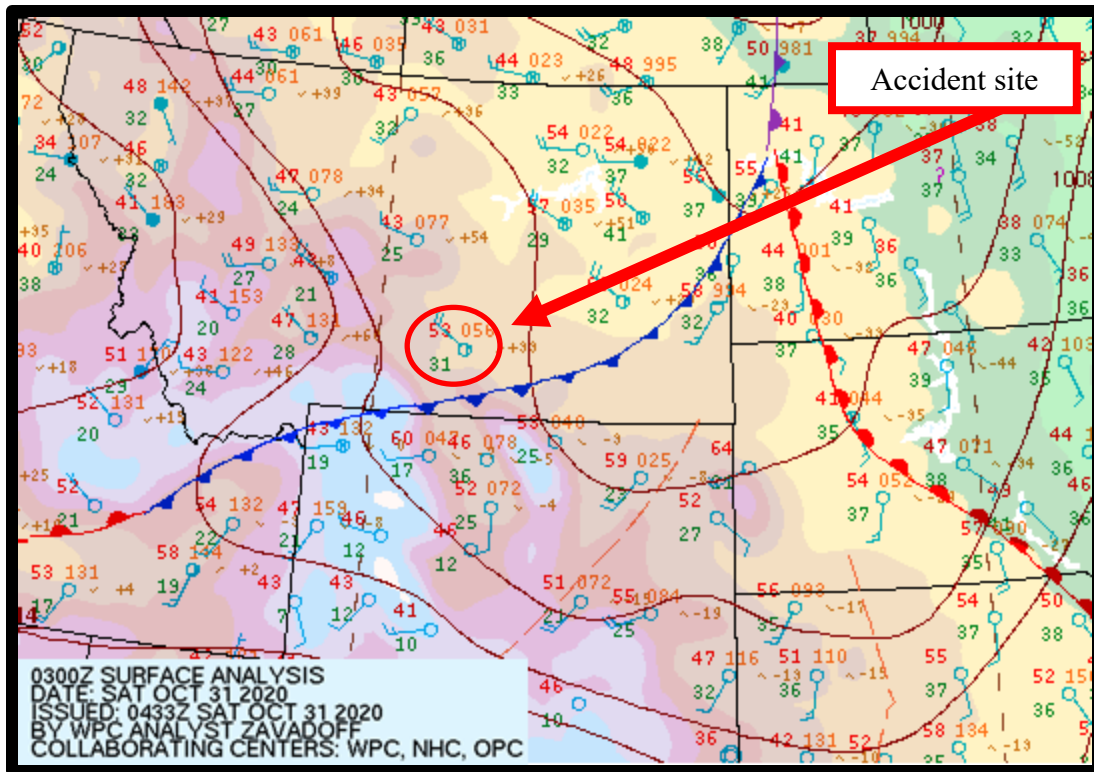


Figure 2 – NWS Surface Analysis Chart for 2100 MDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1800 MDT at 850-, 700-, 500-hPa are presented in figures 3 through 5. A trough was located above and just to the west of the accident site at 850-, 700-, and 500-hPa (figures 3 through 5). Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. There was a southwest wind between 35 and 50 knots at 850-hPa (figure 3) with the wind becoming westerly between 65 and 85 knots by 500-hPa (figure 5).

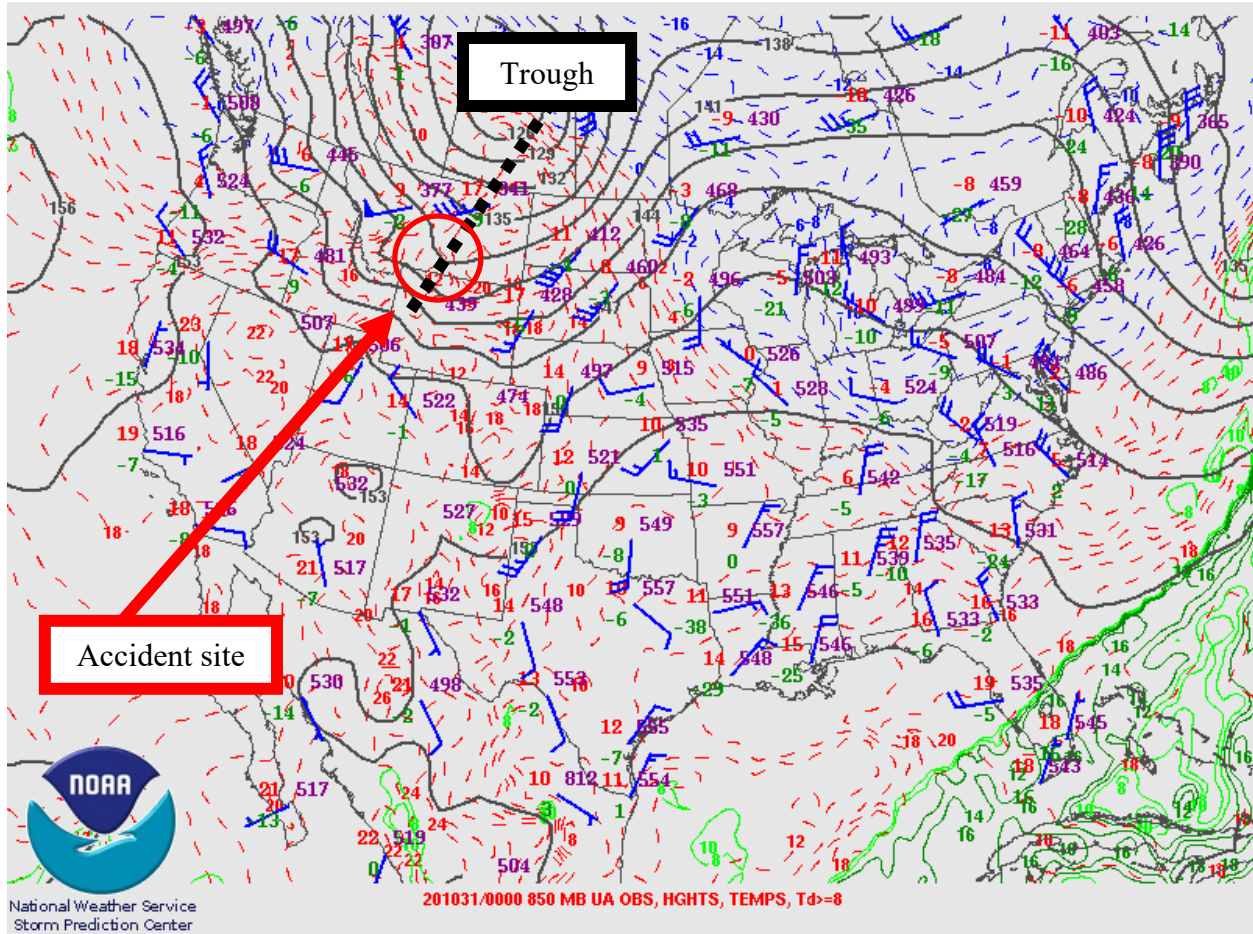


Figure 3 – 850-hPa Constant Pressure Chart for 1800 MDT

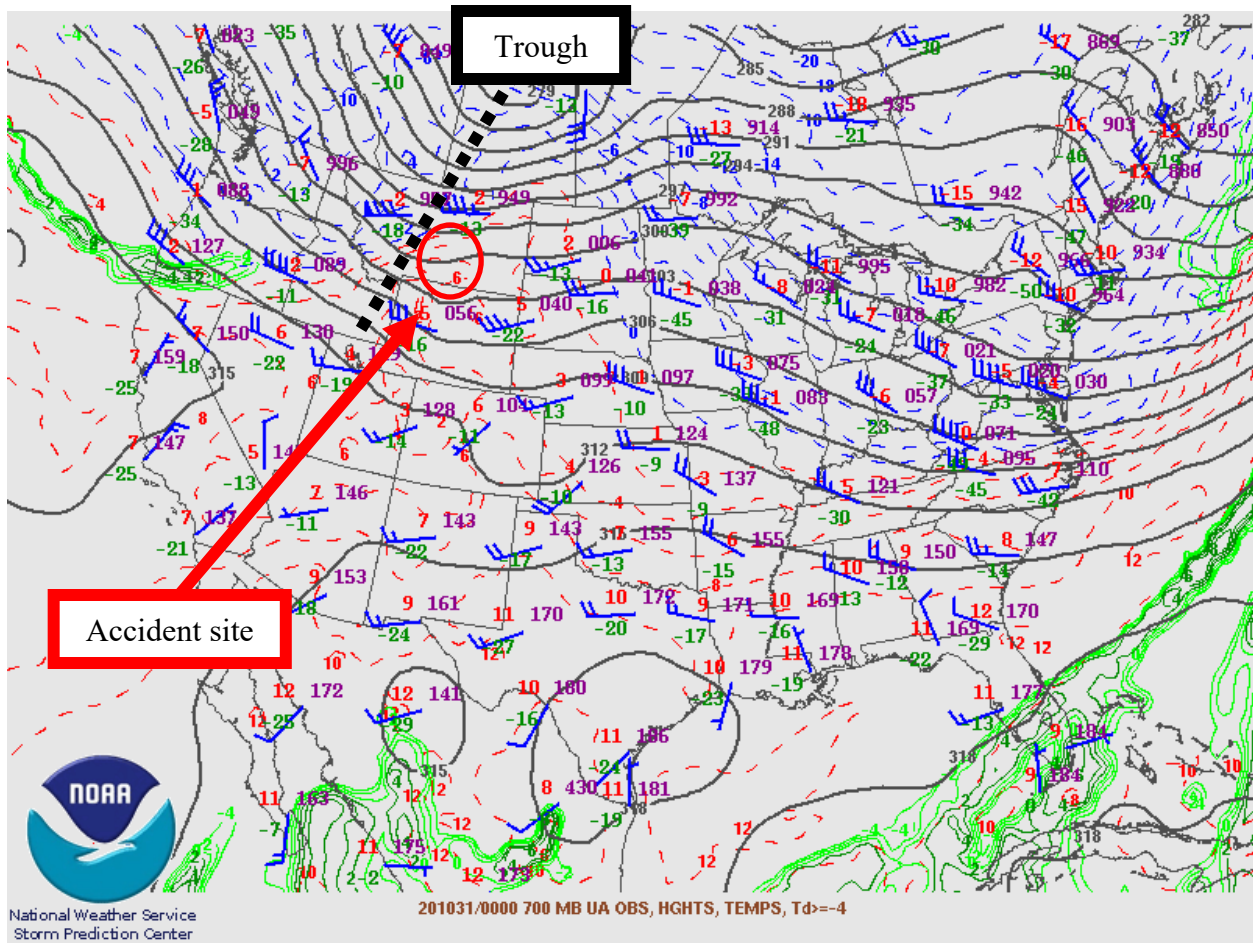


Figure 4 – 700-hPa Constant Pressure Chart for 1800 MDT

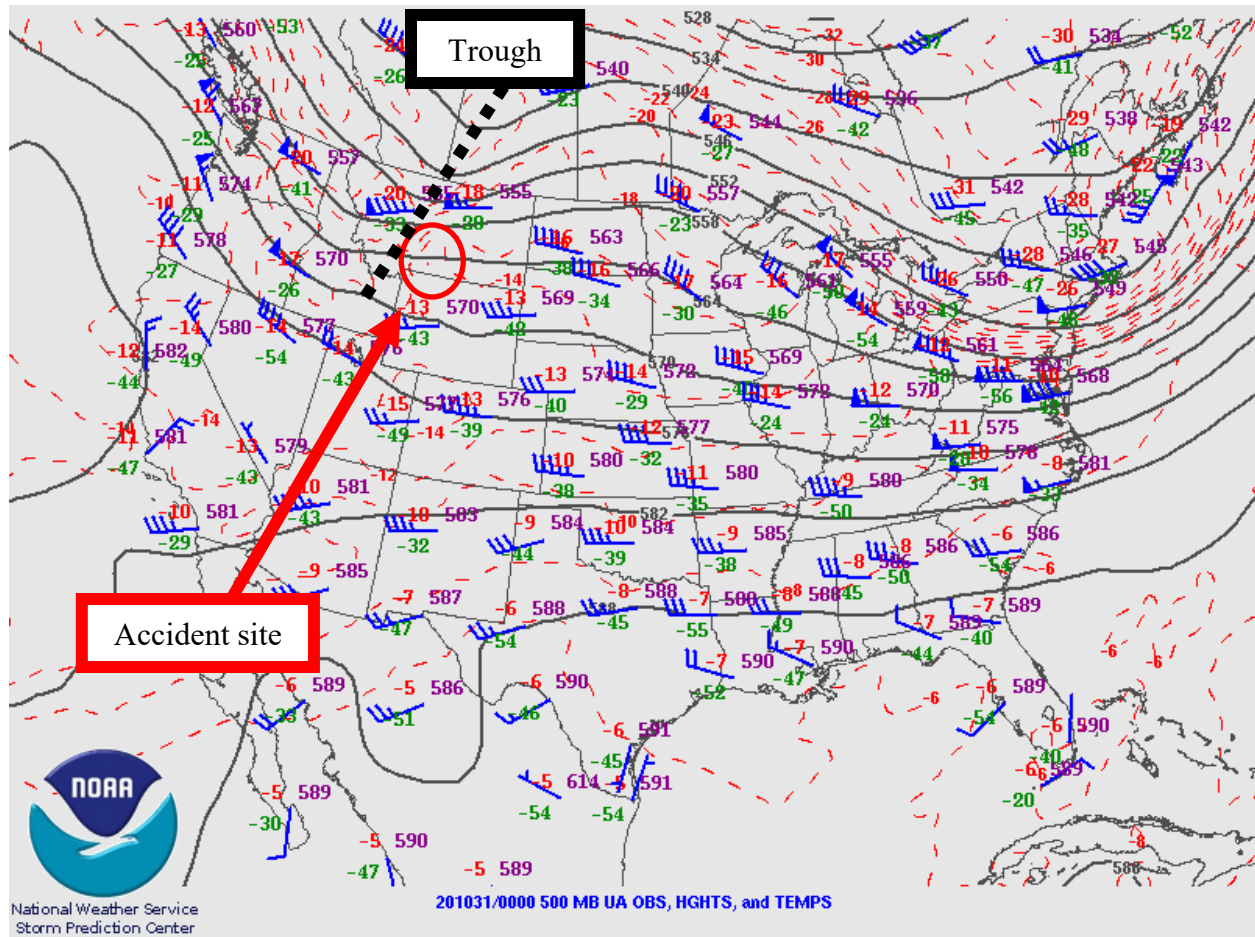


Figure 5 – 500-hPa Constant Pressure Chart for 1800 MDT

2.0 Surface Observations

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



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

Billings Logan International Airport (KBIL) had the closest official weather station to the accident site. KBIL had an Automated Surface Observing System (ASOS³) whose longline⁴ reports were supplemented by an official weather observer. KBIL ASOS site was located within a mile of the accident site, at an elevation of 3,662 ft, and had an 11° easterly magnetic variation⁵. The following observations were taken and disseminated during the times surrounding the accident:⁶

[1453 MDT] METAR KBIL 302053Z 23013G27KT 10SM SCT110 BKN170 19/M04 A2967
RMK AO2 PK WND 23031/2010 SLP034 ACSL DSNT E S-NW
T01891039 56051=

[1553 MDT] METAR KBIL 302153Z 22018G27KT 10SM SCT110 BKN180 18/M04 A2963

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

⁴ “Longline” refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) 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 general global public has access to surface weather observations, particularly outside of the aviation community.

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

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

RMK AO2 PK WND 22027/2106 SLP024 ACSL DSNT S NW T01831044=

[1653 MDT] METAR KBIL 302253Z 23013G22KT 10SM SCT110 SCT180 19/M04 A2961
RMK AO2 PK WND 22026/2213 SLP015 ACSL DSNT S W-N T01891044=

[1753 MDT] METAR KBIL 302353Z 23015G24KT 10SM SCT085 SCT130 17/M04 A2959
RMK AO2 SLP017 ACSL DSNT S-NE T01671039 10200 20161 56024=

***[1853 MDT] METAR KBIL 310053Z 25012KT 10SM FEW090 FEW130 SCT200 14/M02
A2960 RMK AO2 SLP022 T01391017=***

ACCIDENT TIME 1905 MDT

***[1917 MDT] SPECI KBIL 310117Z 24014KT 10SM FEW090 FEW130 SCT200 14/M02
A2960 RMK AO2 T01391022=***

[1950 MDT] SPECI KBIL 310150Z 32028G42KT 10SM BKN130 13/M02 A2966 RMK
AO2 PK WND 31042/0144 WSHFT 0130=

KBIL weather observation at 1853 MDT, wind from 250° at 12 knots, visibility 10 miles or greater, few clouds at 9,000 ft above ground level (agl), few clouds at 13,000 ft agl, scattered clouds at 20,000 ft agl, temperature of 14°Celsius (C), dew point temperature of -2°C, and an altimeter setting of 29.60 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, sea level pressure 1002.2 hPa, temperature 13.9°C, dew point temperature -1.7°C.

KBIL special weather observation at 1917 MDT, wind from 240° at 14 knots, visibility 10 miles or greater, few clouds at 9,000 ft agl, few clouds at 13,000 ft agl, scattered clouds at 20,000 ft agl, temperature of 14°C, dew point temperature of -2°C, and an altimeter setting of 29.60 inHg. Remarks: automated station with a precipitation discriminator, temperature 13.9°C, dew point temperature -2.2°C.

The observations from KBIL surrounding the accident time indicated VFR⁷ conditions with a southwest wind gusting to 27 knots in the hours leading up to the accident time, and the wind becoming northwesterly at 1930 MDT and gusting to 42 knots at the surface at 1944 MDT. The observer also noted alto-cumulus standing lenticular (ACSL) clouds in the distance from the south, west, through the northeast prior to the accident.

3.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for the accident site for 1900 MDT with station elevation of 3,415 ft.⁹ The HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ with the derived stability parameters included in figure 7 with data from the surface to 600-hPa (or approximately 14,000 ft msl). This data was analyzed using the RAOB¹¹ software package. The sounding depicted the lifted condensation level (LCL)¹² at 8,088 ft msl and the convective condensation level (CCL)¹³ at 14,428 ft msl. The freezing level was located at 10,474 ft msl. The precipitable water value was 0.43 inches.

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.

* 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 Eosonde Research Services (ERS) previously known as Environmental 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 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.

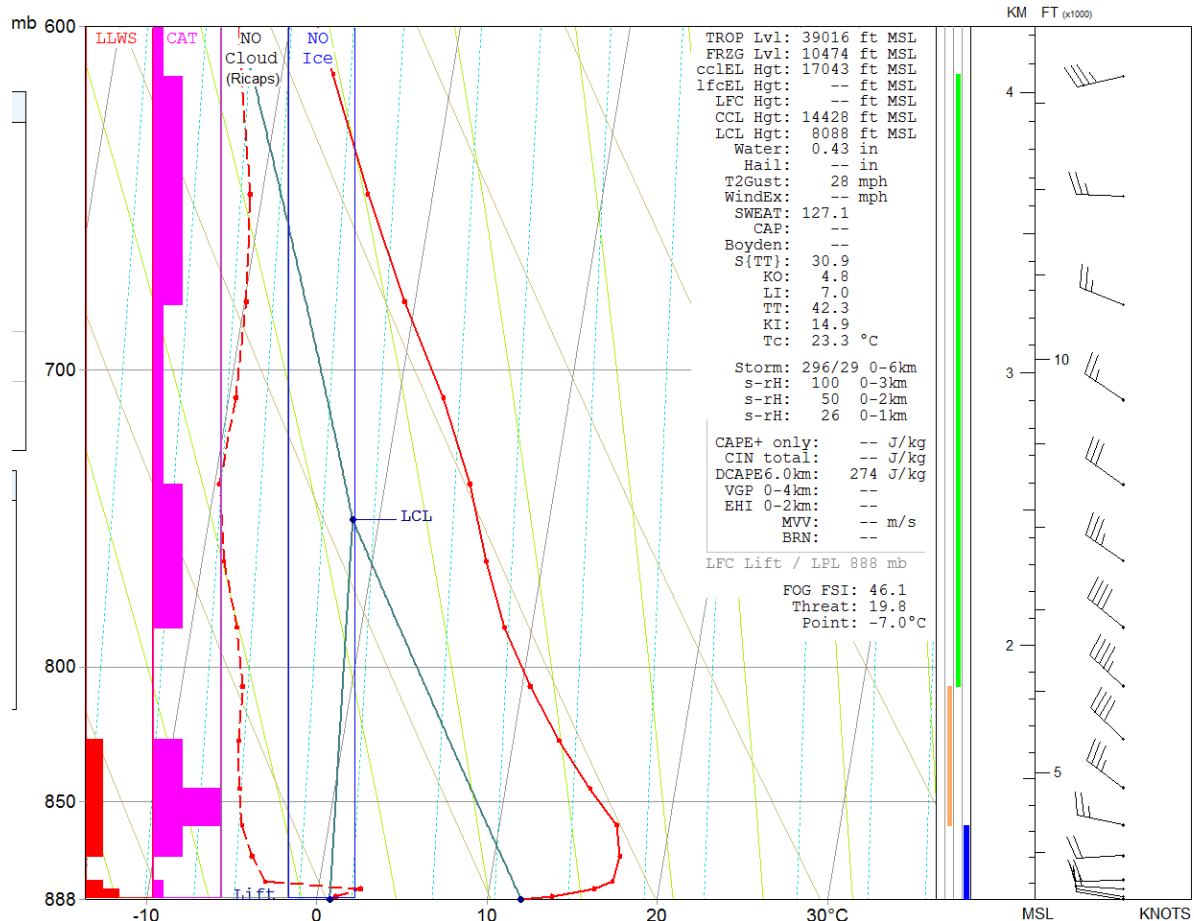


Figure 7 – 1900 MDT HRRR sounding

The 1900 MDT HRRR sounding for the accident site indicated a stable environment from the surface through 4,250 ft above msl with a surface based temperature inversion¹⁴, with an unstable and conditionally unstable environment from 4,250 ft through 14,000 ft above msl. RAOB did not identify the possibility of clouds or icing below 14,000 ft above msl.

The 1900 MDT HRRR sounding wind profile indicated a near surface wind from 280° at 10 knots with the wind remaining westerly through 5,000 ft above msl. The wind speed increased to 25 knots by 4,300 ft above msl (~900 ft agl) and increased to 35 knots by 4,800 ft above msl (~1,400 ft agl). The wind veered¹⁵ to the northwest by 5,500 ft above msl and the wind increased in speed to 45 knots by 6,000 ft above msl. RAOB indicated the possibility of moderate low-level wind shear (LLWS) between the surface and 5,500 ft above msl. RAOB algorithm also indicated that moderate or greater clear-air turbulence existed in several layers between the surface and 14,000 ft above msl, with the potential for severe turbulence between 4,000 to 5,000 ft.

¹⁴ Inversion – A departure from the usual decrease of the value of an atmospheric property with increasing altitude; also, the layer through which this departure occurs (the "inversion layer"), or the lowest altitude at which the departure is found (the "base of the inversion").

¹⁵ A clockwise turning of the wind with height in the northern hemisphere.

4.0 Satellite Data

The 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 1600 MDT through 2200 MDT and reviewed, and the closest images to the time of the accident were documented. Given the sun angle and time of day the visible imagery (band 2) did not provide useful information.

Figure 8 presents the GOES-16 infrared imagery from 1910 MDT at 4X magnification with the accident site highlighted with a red square. The lower brightness temperatures (green and blue colors; higher cloud tops) were located to the northeast and southeast of the accident site. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1900 MDT HRRR sounding, the approximate cloud-top heights over the accident site were 11,000 ft above msl at 1910 MDT (273 Kelvin). It should be noted these figures have not been corrected for any parallax error.

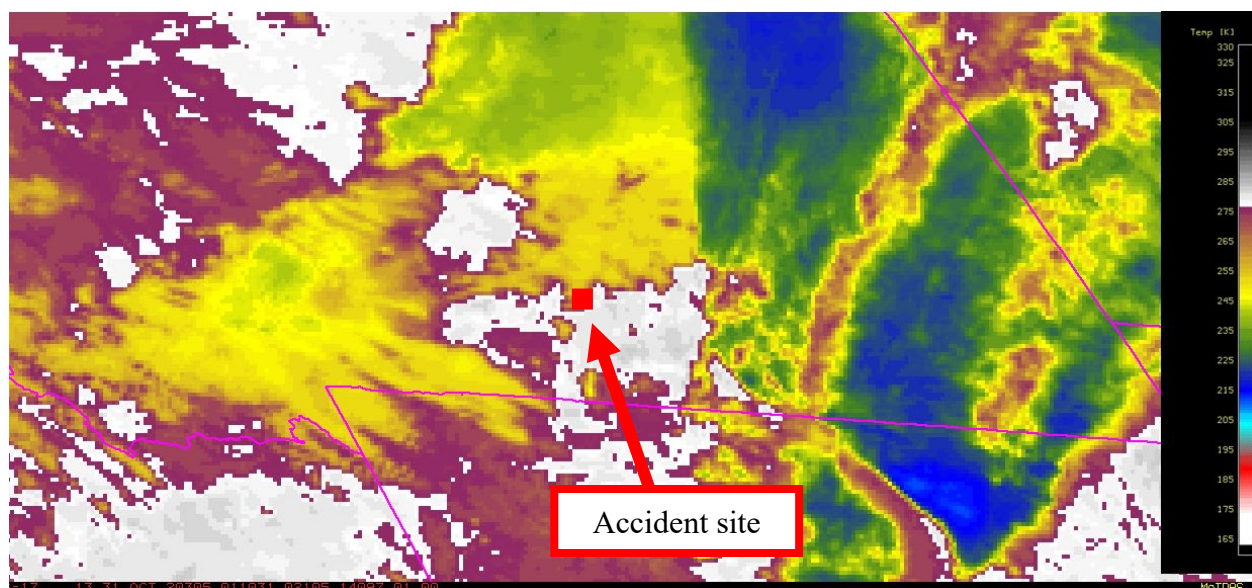


Figure 8 – GOES-16 infrared image at 1910 MDT

5.0 Regional Radar Imagery Information

A regional view of the NWS National Composite Radar Mosaic is included as figure 9 for 1905 MDT with the approximate location of the accident site marked within a red circle. The image depicted no precipitation echoes above the accident site.

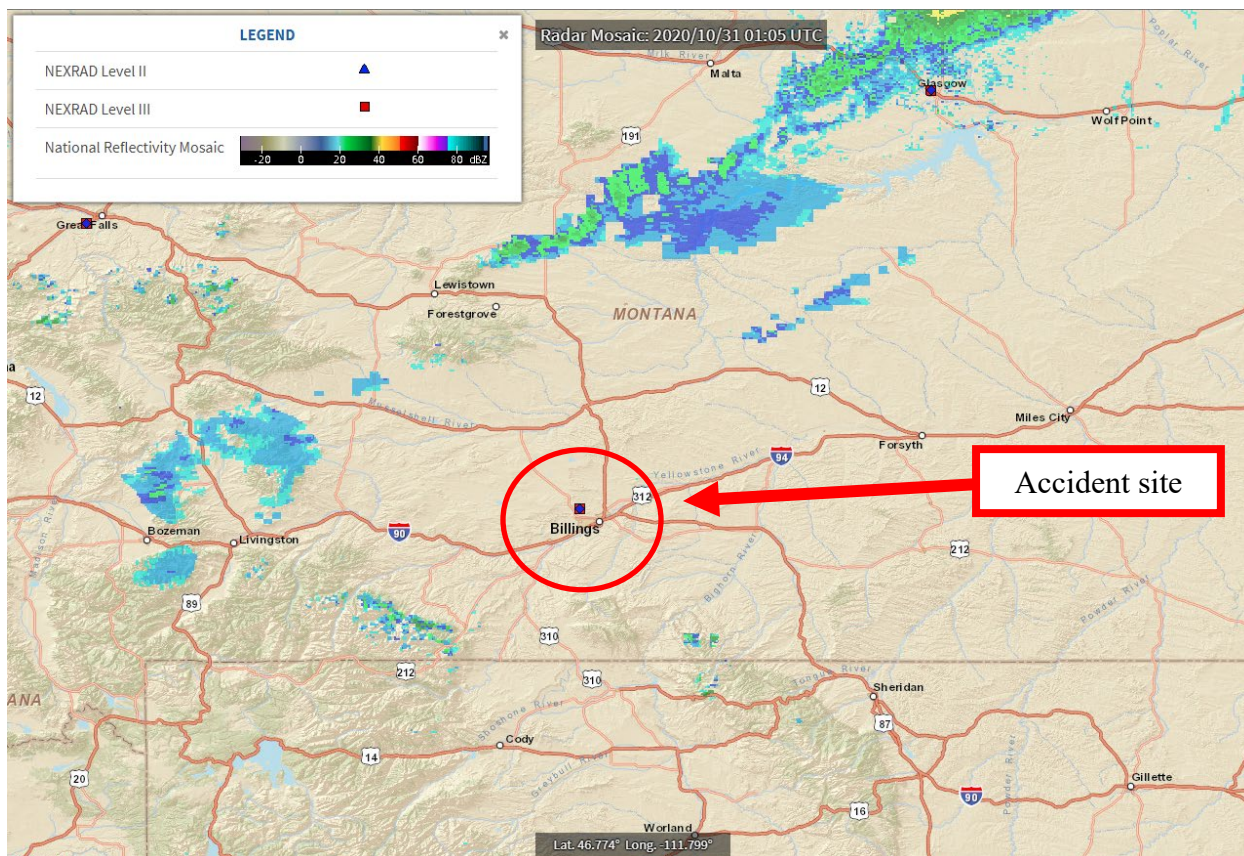


Figure 9 – Regional Composite Reflectivity image for 1905 MDT

6.0 Pilot Reports

The following is the publicly longline-disseminated pilot report¹⁶ (PIREPs¹⁷) distributed into the national airspace (NAS) within 150 miles of the accident site from about two hours prior to the accident time to two hours after the accident time and they are reported below for below 18,000 ft above msl.

SHR UA /OV GCC-SHR/TM 0208/FL105/TP BE55/TB MOD CHOP

Additional PIREPs were received by air traffic control (ATC) in Billings, Montana, but those PIREPs were not distributed into the NAS (attachment 1).

7.0 SIGMET

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

¹⁶ These do not include pilot reports only broadcast via radio.

¹⁷ Only pilot reports with the World Meteorological Organization headers UBMT**, UBWY**, UBID**, and UBND** were considered.

8.0 CWSU Advisories

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

9.0 AIRMETs

Airmen's Meteorological Information (AIRMET) advisories Tango and Zulu were valid for the accident site at the accident time. The AIRMETs warned of moderate turbulence below 18,000 ft above msl and LLWS conditions expected, along with moderate icing between the freezing level¹⁸ and 18,000 ft:

WAUS45 KPCI 302045

WA5Z

-SLCZ WA 302045

AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 310300

.
AIRMET ICE...ID MT WY WA OR

**FROM 80SSW YYN TO 50NNW ISN TO 70SSW ISN TO 20SSW MLS TO 40NNW
JAC TO 60SSE BKE TO 60E DSD TO 20WSW PDT TO 30SE MLP TO 40ENE FCA
TO 80SSW YYN**

**MOD ICE BTN FRZLVL AND FL180. FRZLVL 070-100. CONDS CONTG BYD 03Z
ENDG BY 09Z.**

.
FRZLVL...RANGING FROM 050-160 ACRS AREA

080 ALG 50SW DNJ-50S LWT-70E LWT-50NE GGW-50NNW ISN

120 ALG 70SSE LKV-20WNW SLC-40ESE SLC-60SSW HBU-40WNW ALS-
20SSE AKO-20NNW GLD

....

WAUS45 KPCI 302045

WA5T

-SLCT WA 302045

AIRMET TANGO UPDT 3 FOR TURB STG WNDZ AND LLWS VALID UNTIL 310300

.
AIRMET TURB...ID MT WA OR AND CSTL WTRS

**FROM 30NE HUH TO 50WSW YXC TO 60SSW YXH TO 50NNW ISN TO 50WSW
DIK TO BIL TO 50SE HLN TO 70ESE REO TO 30SW REO TO 60SSW BKE TO
60SSW DSD TO 30NNE BTG TO 30SSE HQM TO 30NW TOU TO 30NE HUH
MOD TURB BTN FL200 AND FL390. CONDS CONTG BYD 03Z THRU 09Z.**

.
AIRMET TURB...ID MT WY NV UT CO NM

**FROM 60WSW YXC TO 60SSW YXH TO 50NNW ISN TO 70SW RAP TO 20SSW
BFF TO 30W LAA TO 40S TBE TO 50S FTI TO ABQ TO 40SW HBU TO 50N
JNC TO 50ESE SLC TO 40SE TWF TO 60S BOI TO 50W BOI TO 60WSW YXC
MOD TURB BLW FL180. CONDS CONTG BYD 03Z THRU 09Z.**

.
AIRMET STG SFC WNDZ...MT WY

FROM 40NW HVR TO 30SW HVR TO 50NE LWT TO 70S BIL TO 20NE BOY TO
30NW OCS TO BPI TO 70E DLN TO FCA TO 40S YQL TO 40NW HVR
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS CONTG BYD 03Z
ENDG BY 09Z.

¹⁸ Freezing level was between 7,000 and 10,000 ft above msl.

.
LLWS POTENTIAL...ID MT WY UT
BOUNDED BY 70WSW YXC-60SSW YXH-50NNW ISN-70SW RAP-20W BFF-30N
CHE-20E MLD-60ESE BOI-20WSW LKT-60NNW DNJ-70WSW YXC
LLWS EXP. CONDS CONTG BYD 03Z THRU 09Z.

.
OTLK VALID 0300-0900Z
AREA 1...TURB ID MT WY NV UT CO WA OR
BOUNDED BY 30SW YDC-60SSW YXH-50NNW ISN-70NW RAP-30ESE BOY-70SSE
BOY-40NE MTU-60SSE BVL-20W BVL-60SSE TWF-40WSW REO-20S BKE-40SE
YKM-30SW YDC
MOD TURB BTN FL200 AND FL350. CONDS CONTG THRU 09Z.

.
AREA 2...STG SFC WNDS WY CO
BOUNDED BY 40NNW BFF-CYS-40WNW DEN-50W LAR-70SSW DDY-40NNW BFF
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS DVLPG AFT 06Z.
CONDS CONTG THRU 09Z.

....

10.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight and valid at 1800 and 2100 MDT are shown in attachment 2. The GFA surface forecast products indicated VFR surface visibilities with no precipitation and a surface wind from the west at 20 to 25 knots with gusts to 35 knots at 1800 MDT and a surface wind from the northwest at 20 knots with gusts to 25 knots at 2100 MDT. The GFA cloud forecast valid before departure for around the accident time indicated clear skies above the accident site at 1800 MDT and overcast skies at 14,000 above msl with cloud tops FL200¹⁹ at 2100 MDT. A graphical-AIRMET (G-AIRMET)²⁰ was valid for icing conditions at 2100 MDT. For more information please see attachment 2.

11.0 Terminal Aerodrome Forecast

KBIL was the closest airport to the accident site with an NWS²¹ Terminal Aerodrome Forecast (TAF). The KBIL TAF valid at the time of the accident was issued at 1736 MDT and was valid for a 24-hour period beginning at 1800 MDT. The TAF for KBIL was as follows:

TAF KBIL 302336Z 3100/3124 **24016G24KT P6SM SCT120**
FM310200 30018G28KT P6SM SCT100 BKN250
FM311200 28012KT P6SM FEW250=

¹⁹ 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.

²⁰ <https://aviationweather.gov/gairmet>

²¹ According to NWS Instruction 10-813: "A 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

Between 1800 and 2000 MDT, the forecast expected a wind from 240° at 16 knots with gusts to 24 knots, greater than 6 miles visibility, and scattered clouds at 12,000 ft agl.

The KBIL TAF valid before departure was issued at 1131 MDT and was valid for a 24-hour period beginning at 1200 MDT. The 1131 TAF for KBIL was as follows:

TAF KBIL 301731Z 3018/3118 **25020G28KT P6SM FEW120**
FM310200 30022G35KT P6SM SCT100 BKN250
FM310400 28015G22KT P6SM FEW100 SCT250
FM311200 28012KT P6SM FEW250=

Between 1200 and 2000 MDT, the forecast expected a wind from 250° at 20 knots with gusts to 28 knots, greater than 6 miles visibility, and few clouds at 12,000 ft agl.

12.0 NWS Area Forecast Discussion

The NWS office in Billings, Montana, (WFO BYZ) issued the following Area Forecast Discussion (AFD) at 1355 MDT (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed high winds impacting aviation terminals over the next 24 hours with strong wind gusts and a frontal passage expected between 1800 and 2100 MDT:

FXUS65 KBYZ 301955
AFDBYZ

Area Forecast Discussion
National Weather Service Billings MT
155 PM MDT Fri Oct 30 2020

.DISCUSSION...

Tonight through Sunday night...

Shortwave and associated cold front were approaching the region from the west this afternoon. Winds were gusting into the 50s along portions of the western foothills with 30 to 40 mph gusts into central zones. Along the Bighorn mountain foothills, Sheridan could see a period of gusty 30 to 45 mph) downslope winds late this afternoon and early evening ahead of the approaching cold front. The Wind Advisory for the Livingston area and the Beartooth foothills is in effect until 10pm. The aforementioned cold front arrives early this evening and pushes through the area by midnight, with winds turning northwest, producing wind gusts of 30 to 40 mph. This front will be mostly dry with only increasing cloud cover, but can't rule out a few sprinkles this evening/overnight.

Expect cooler conditions for Saturday with gusty post frontal winds. Highs will range from the 40s to lower 50s, with northwest winds gusting up to 55 mph over far southeast Montana (Baker, Ekalaka). Winds back off fairly quickly Saturday night, with dry conditions and slightly warmer temperatures expected for Sunday as ridging builds over the region. Expect highs mainly in the 50s on

Sunday. STP

Monday through Thursday...

Warm and dry conditions remain to be the pattern through the work week before a pattern change is set to move in.

Winds will be breezy throughout the afternoons mainly along the western foothills. Wind gusts appear to be under advisory levels at this time but this could change as we move closer. Otherwise, warm and dry conditions will continue as ridging builds into the area. The pattern looks to change Friday with a trough swinging through southeastern Montana, bringing cooler temps and a chance for snow. The details are sparse at this time and we will continue to monitor as this system evolves.

High temperatures will be in the 60s Monday through Thursday. Low temperatures will drop into the mid 30s to low 40s.

Carrothers

&&

.AVIATION...

High winds will impact all terminals over the next 24 hours. Winds at KLVM will continue gusting near 50 kts through this evening, with all other terminals gusting to 25 kts. Frontal passage will shift winds west- northwesterly between 6-9 PM MDT this evening, then post frontal winds tomorrow will gust up to 45 kts by the late morning, with strongest gusts near the Dakota border. Vertz

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.PRELIMINARY POINT TEMP/POPS...

	Sat	Sun	Mon	Tue	Wed	Thu	Fri
BIL	037/051	030/058	039/065	041/065	042/063	040/061	038/054
	00/U	00/U	00/U	00/U	00/B	11/B	22/R
LVM	032/050	028/060	034/064	034/065	037/062	037/059	036/055
	10/U	00/N	00/U	00/N	01/N	11/N	23/R
HDN	035/051	025/060	031/067	034/067	036/065	037/062	035/057
	00/U	00/U	00/U	00/U	00/B	11/B	12/R
MLS	037/047	024/055	032/065	039/067	038/064	039/060	036/053
	00/N	00/U	00/U	00/U	00/B	00/B	11/B
4BQ	037/047	024/058	033/068	036/068	037/065	038/062	037/057
	00/N	00/U	00/U	00/U	00/U	00/U	01/B
BHK	034/044	021/052	031/064	038/065	038/063	038/059	034/051
	00/N	00/U	00/U	00/U	00/U	00/U	11/B
SHR	033/048	023/059	032/068	034/067	035/064	034/062	032/059
	10/U	00/U	00/U	00/U	00/B	11/U	11/B

&&

.BYZ WATCHES/WARNINGS/ADVISORIES...

MT...Wind Advisory in effect until 10 PM MDT this evening FOR
ZONES 65-66.
WY...None.

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13.0 NWS Hazardous Weather Outlook

WFO BYZ issued the following Hazard Weather Outlook (HWO) at 0422 MDT:

FLUS45 KBYZ 301022
HWOBYZ

Hazardous Weather Outlook
National Weather Service Billings MT
422 AM MDT Fri Oct 30 2020

MTZ034-040-042-056-063>068-138-139-141-169>172-228-235-WYZ198-199-
310600-

Northern Stillwater-Northern Park-Golden Valley-
Red Lodge Foothills-Judith Gap-Paradise Valley-Livingston Area-
Beartooth Foothills-Absaroka/Beartooth Mountains-Crazy Mountains-
Southern Big Horn-Southeastern Carbon-Northern Sweet Grass-
Bighorn Canyon-Northern Carbon-Pryor/Northern Bighorn Mountains-
Melville Foothills-Southern Wheatland-Southwestern Yellowstone-
Northeast Bighorn Mountains-Sheridan Foothills-
422 AM MDT Fri Oct 30 2020

This Hazardous Weather Outlook is for portions of central
Montana...south central Montana and north central Wyoming.

* WHAT...Gusty southwest to west winds 30 to 50 mph, locally near
60 mph around Livingston and Nye, turning northwest behind cold
front this evening.

* WHERE...South Central Montana and North Central Wyoming.

* WHEN...through this evening.

* ADDITIONAL DETAILS...Strongest winds will occur in the foothills
of area mountains late this afternoon through early evening.

* ADDITIONAL HAZARD CONCERNS...Difficult to occasionally dangerous
crosswinds will cause travel issues for high profile vehicles and
those towing trailers.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A Hazardous Weather Outlook is issued when hazardous weather could
impact the region within the next week. Be sure to stay tuned for
future updates as locations, timing, and impacts could change.
Begin preparations to mitigate any impacts that could result from
the hazardous weather.

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14.0 Winds and Temperature Aloft Forecast

The NWS 1354 MDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

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FBUS31 KWNO 301954
FD1US1
DATA BASED ON 301800Z
VALID 310000Z    FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT  3000    6000    9000    12000    18000    24000    30000    34000    39000
BIL          2543   2754+06 2758-02 2555-16 2658-28 256144 257153 267560
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The accident site was located closest to the Billings, Montana, (BIL) forecast point. The 1354 MDT BIL forecast for use between 1400 MDT and 2100 MDT indicated a wind at 6,000 ft from 250° at 43 knots, a wind at 9,000 ft from 270° at 54 knots with a temperature of 6°C, and a wind at 12,000 ft from 270° at 58 knots with a temperature of -2°C

15.0 Pilot Weather Briefing

The accident pilot did not request a weather briefing from Flight Service provider Leidos.

A search of archived ForeFlight information indicated that the accident pilot did not request weather information via ForeFlight. There is no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight.

16.0 KBIL LLWAS Information

Low-level windshear alert system (LLWAS) data was provided around the time of the accident. The LLWAS wind data was captured every 10 seconds via the 7 LLWAS sensors located around KBIL (figure 10). An example of what the LLWAS display looks like for the Billings ATC personnel is provided in figure 11. The LLWAS wind data around the accident time is provided in attachments 3 and 4 with wind magnitudes in knots and wind directions in reference to magnetic north.

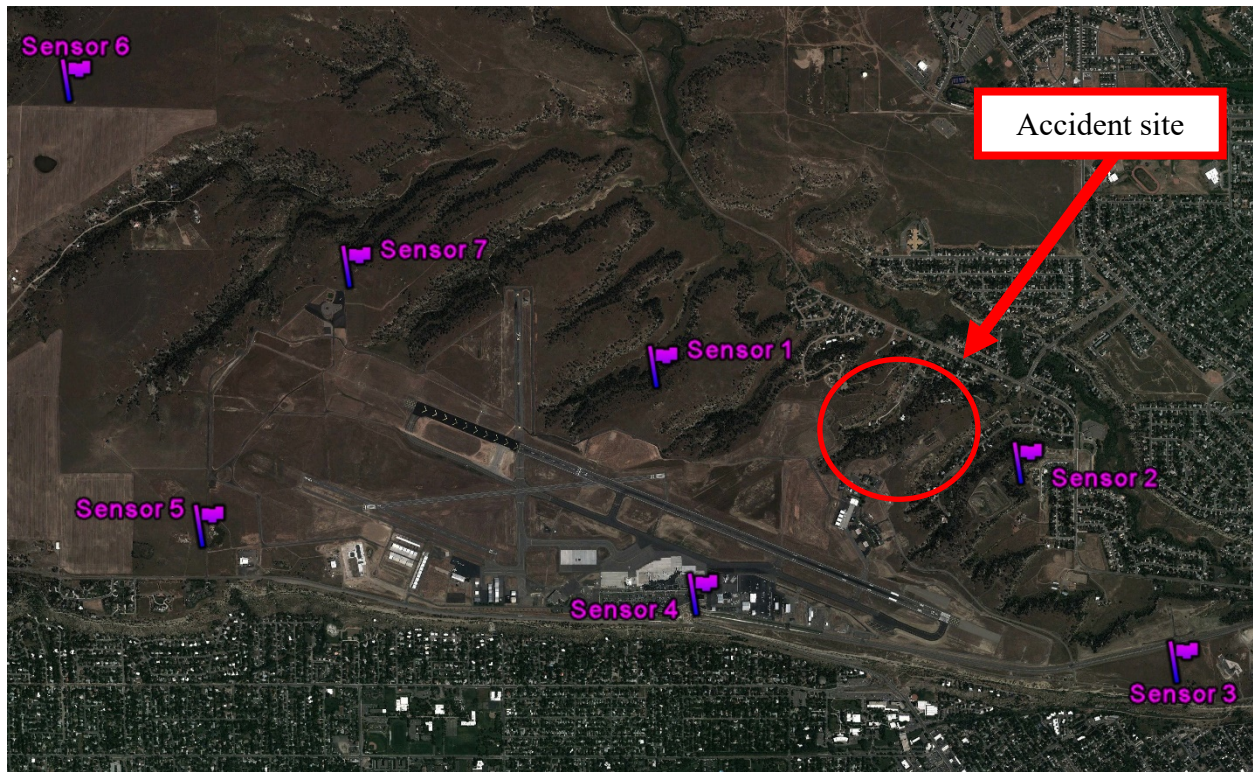


Figure 10 – LLWAS Sensor locations around KBIL



Figure 11 – Example of the LLWAS display for the Billings ATC

17.0 Astronomical Data

The astronomical data obtained for the accident site on October 30, 2020, indicated the following:

SUN

Begin civil twilight	0721 MDT
Sunrise	0752 MDT
Sun transit	1258 MDT
Sunset	1803 MDT
End civil twilight	1834 MDT
Accident time	1905 MDT²²

MOON

Moon rise	1802 MDT
Accident time	1905 MDT²³
Moon culmination	0007 MDT
Moon set	0643 MDT

At the time of the accident, the Moon was about 10° above the horizon at an azimuth of 89°, and was 99.6% illuminated.

E. LIST OF ATTACHMENTS

Attachment 1 – Additional PIREPs received by ATC in Billings, Montana

Attachment 2 – GFA products valid for the accident flight

Attachment 3 – KBIL LLWAS data around the accident time

Attachment 4 – KBIL LLWAS data around the accident time part 2

Submitted by:

Paul Suffern
Senior Meteorologist

²² Inserted accident time for reference and context.

²³ Inserted accident time for reference and context.