

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR22FA354

METEOROLOGY

Specialist's Factual Report

November 18, 2022

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A. ACCIDENT

Location: Sisters, Oregon
Date: September 22, 2022
Time: 1439 Pacific daylight time
2139 coordinated universal time (UTC)
Airplane: Piper PA-28-140; Registration: N7063R

B. METEOROLOGY SPECIALIST

Specialist Paul Suffern
National Transportation Safety Board
Washington, DC

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist did not travel for this investigation, but gathered all data remotely. Data for this investigation was collected from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This Specialist's Factual Report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are Pacific daylight time (PDT) and are based upon the 24-hour clock, where local time is -7 hours from UTC. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at approximate latitude 45.5694° N, Longitude 121.8054° W, and elevation of 6,500 feet (ft).

D. FACTUAL INFORMATION

1.0 Synoptic Situation

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

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the northwestern United States for 1400 PDT is provided as figure 1 with the location of the accident site within the black circle. The chart depicted a low-pressure system over northcentral Washington with a pressure at 1009-hectopascals (hPa), with a trough² of low-pressure extending north and south from the low. Troughs and fronts can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. A high-pressure system was located at the intersection of Nevada, California, and Oregon borders at a pressure of 1022-hPa. The accident site was located immediately ahead or east of the surface trough.

The station model closest to the accident site depicted air temperatures in the upper 60s to near 70 degrees Fahrenheit (°F), dew point temperatures of the upper 30s °F, mostly clear skies, and a west wind of 10 knots.

¹ 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.

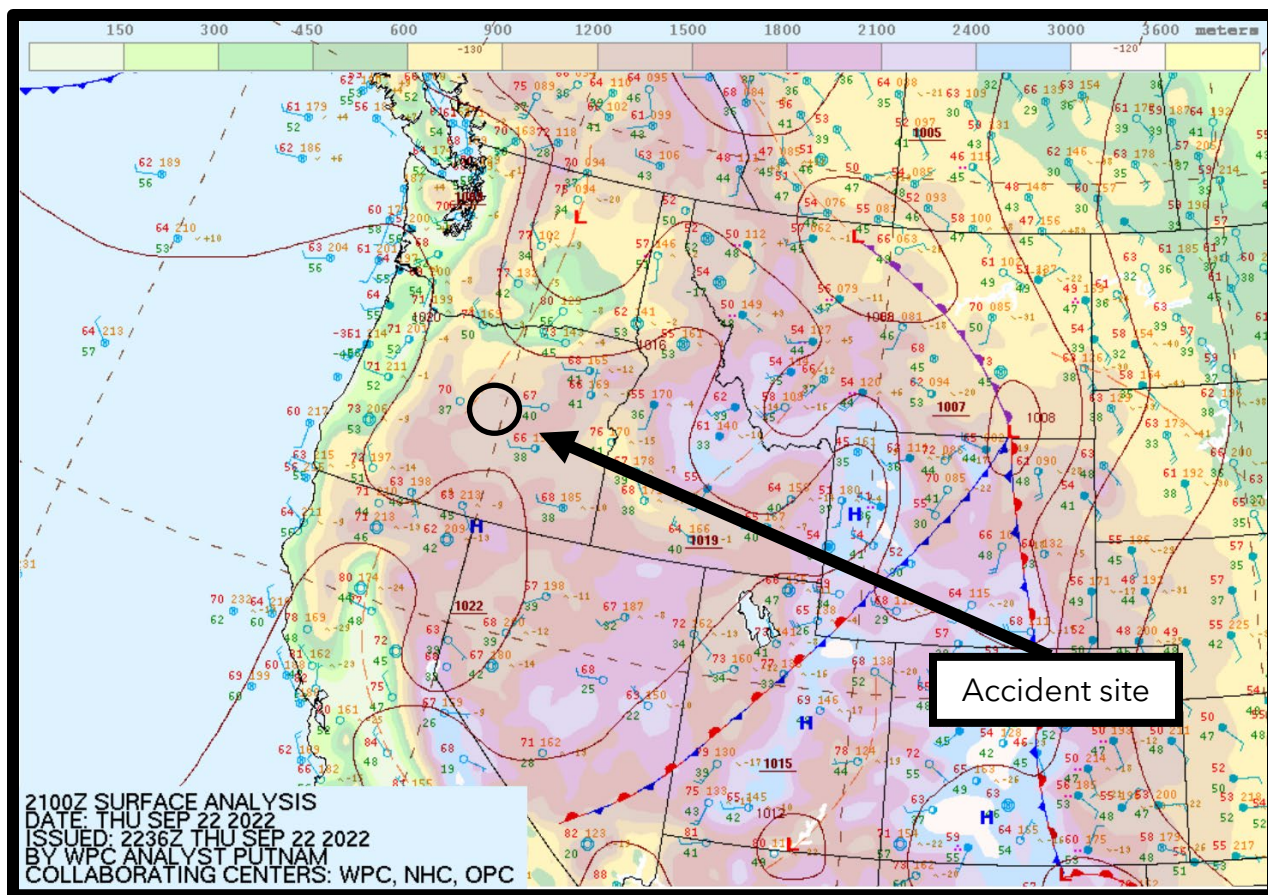


Figure 1. NWS Surface Analysis Chart for 1400 PDT.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1700 PDT at 850-, 700-, and 500-hPa are presented in figures 2, 3, and 4. The accident site was located below a mid-level ridge³. The 850-hPa constant pressure chart depicted a variable wind of 10 knots near the accident site (figure 2) with the wind becoming westerly by 700-hPa. The wind speed increased to 30 knots by 500-hPa (figure 4).

³ Ridge - An elongated area of relatively high atmospheric pressure or heights.

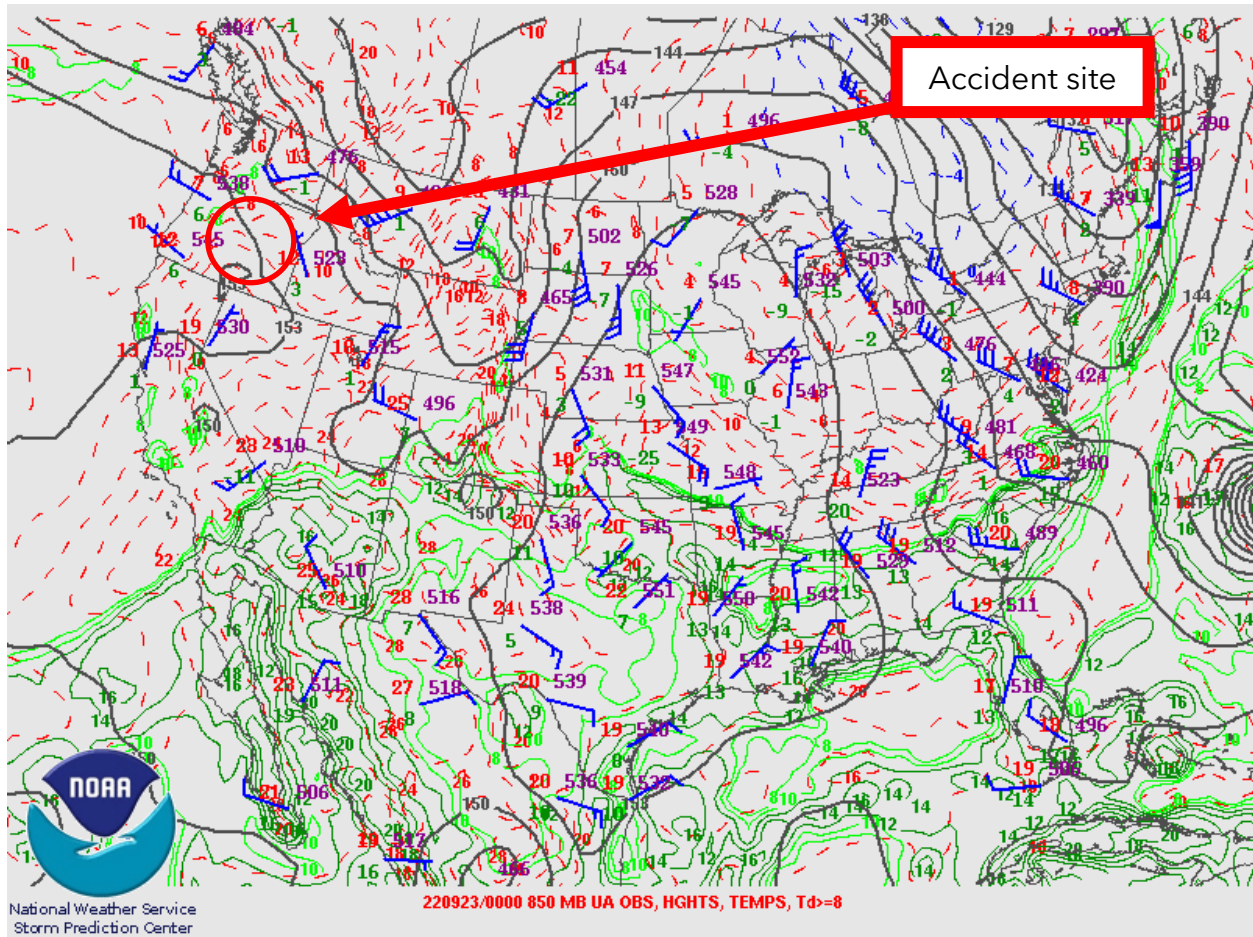


Figure 2. 850-hPa Constant Pressure Chart for 1700 PDT.

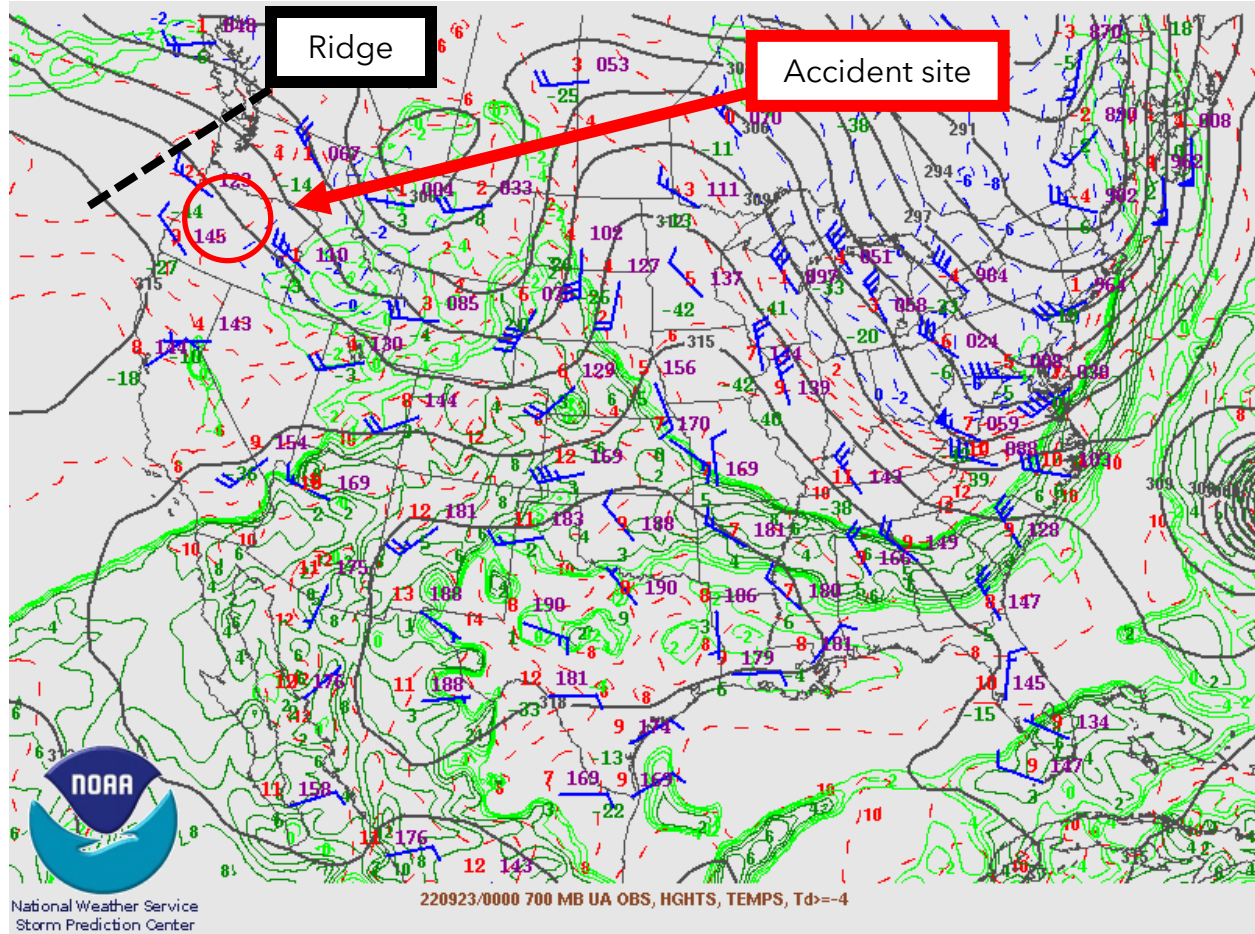


Figure 3. 700-hPa Constant Pressure Chart for 1700 PDT.

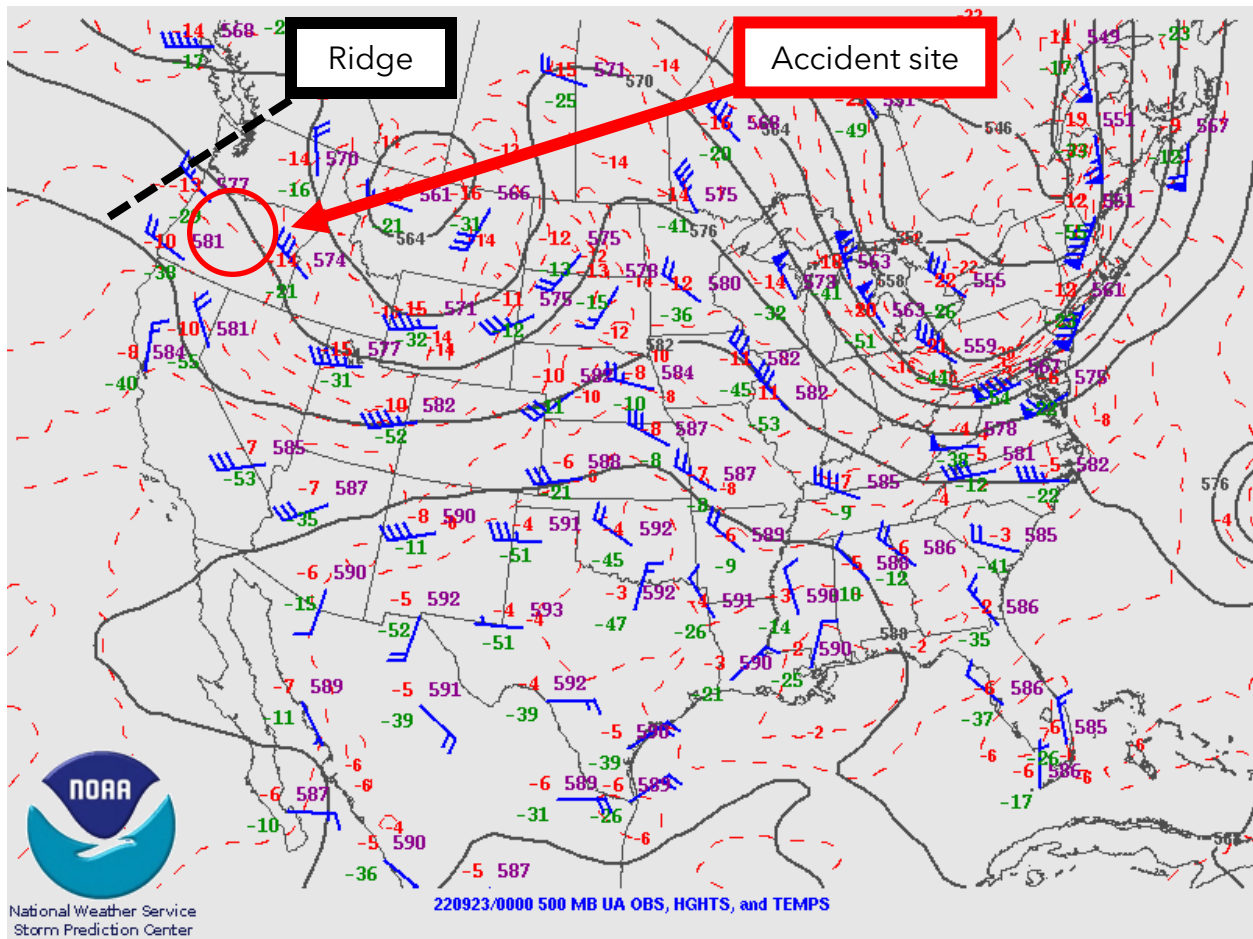


Figure 4. 500-hPa Constant Pressure Chart for 1700 PDT.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Special Reports (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 5 is a local sectional chart with the accident site and the closest weather reporting location marked. The chart depicted the magnetic variation⁴ of 15° east over the area.

⁴ Magnetic variation - The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>



Figure 5. FAA sectional aeronautical chart of the accident area with the location of the accident site and surface observation site.

Madras Municipal Airport (KS33) had the closest official weather station to the accident site. KS33 had an Automated Weather Observing System (AWOS⁵) and longline⁶ reports were not augmented. The KS33 AWOS was located 28 miles east-northeast of the accident site, at an elevation of 2,438 ft, and issued the following observations surrounding the period of the accident:⁷

[1315 PDT] METAR KS33 222015Z AUTO 22007G15KT 10SM SCT055
21/05 A3012 RMK AO2

⁵ AWOS - Automated Weather Observing System is equipped with meteorological instruments to typically observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to 12,000 feet, and altimeter setting. AWOS are maintained by the FAA. Certain AWOS may have different reporting or observational equipment.

⁶ "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline dissemination of weather observations is the primary vehicle through which the weather observations are distributed.

⁷ The bold sections in this NWS product and the rest of the products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

[1335 PDT] METAR KS33 222035Z AUTO 17007KT 10SM BKN055 21/05
A3011 RMK AO2

[1355 PDT] METAR KS33 222055Z AUTO 17005KT 10SM BKN055 22/05
A3011 RMK AO2

[1415 PDT] METAR KS33 222115Z AUTO 21004KT 10SM SCT055 21/05
A3011 RMK AO2

**[1435 PDT] METAR KS33 222135Z AUTO 21008KT 10SM CLR 22/05
A3010 RMK AO2**

ACCIDENT TIME 1439 PDT

**[1455 PDT] METAR KS33 222155Z AUTO 21009KT 10SM CLR 22/06
A3010 RMK AO2**

[1515 PDT] METAR KS33 222215Z AUTO 20005KT 10SM CLR 22/06
A3010 RMK AO2

[1535 PDT] METAR KS33 222235Z AUTO 23005G15KT 10SM CLR 22/05
A3010 RMK AO2

[1555 PDT] METAR KS33 222255Z AUTO 21013G16KT 10SM CLR 21/05
A3010 RMK AO2

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

KS33 weather at 1435 PDT, automated, wind from 210° at 8 knots, visibility 10 miles or greater, clear skies below 12,000 ft above ground level (agl), temperature of 22° Celsius (C), dew point temperature 5°C, and an altimeter setting of 30.10 inches of mercury (inHg). Remarks, automated station with a precipitation discriminator.

KS33 weather at 1455 PDT, automated, wind from 210° at 9 knots, visibility 10 miles or greater, clear skies below 12,000 ft agl, temperature of 22°C, dew point temperature 6°C, and an altimeter setting of 30.10 inHg. Remarks, automated station with a precipitation discriminator.

The observations from KS33 surrounding the accident time indicated VFR⁸ conditions prevailed with clouds above KS33 at 5,500 ft agl before the accident time.

⁸ 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.

3.0 Upper Air Sounding

Salem/McNary, Oregon, had an upper air sounding (KSLE) that had a station ID of 72694, with a surface elevation of 200 ft. KSLE sounding was located 55 miles west-northwest of the accident site. The 1700 PDT KSLE sounding was plotted on a standard Skew-T Log P diagram⁹ using the RAOB software¹⁰ from the surface to 600-hPa (or approximately 14,000 ft) along with the derived stability parameters and is included as figure 6. The sounding depicted the convective condensation level (CCL)¹¹ at 5,111 ft, and the lifted condensation level (LCL)¹² and the level of free convection (LFC)¹³ at 5,130 ft. The freezing level was located at 12,979 ft with the precipitable water value at 0.78 inches.

-
- 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.

⁹ 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.

¹⁰ RAOB - (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Eosonde Research Services, The Villages, Florida.

¹¹ 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.

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

¹³ LFC - The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

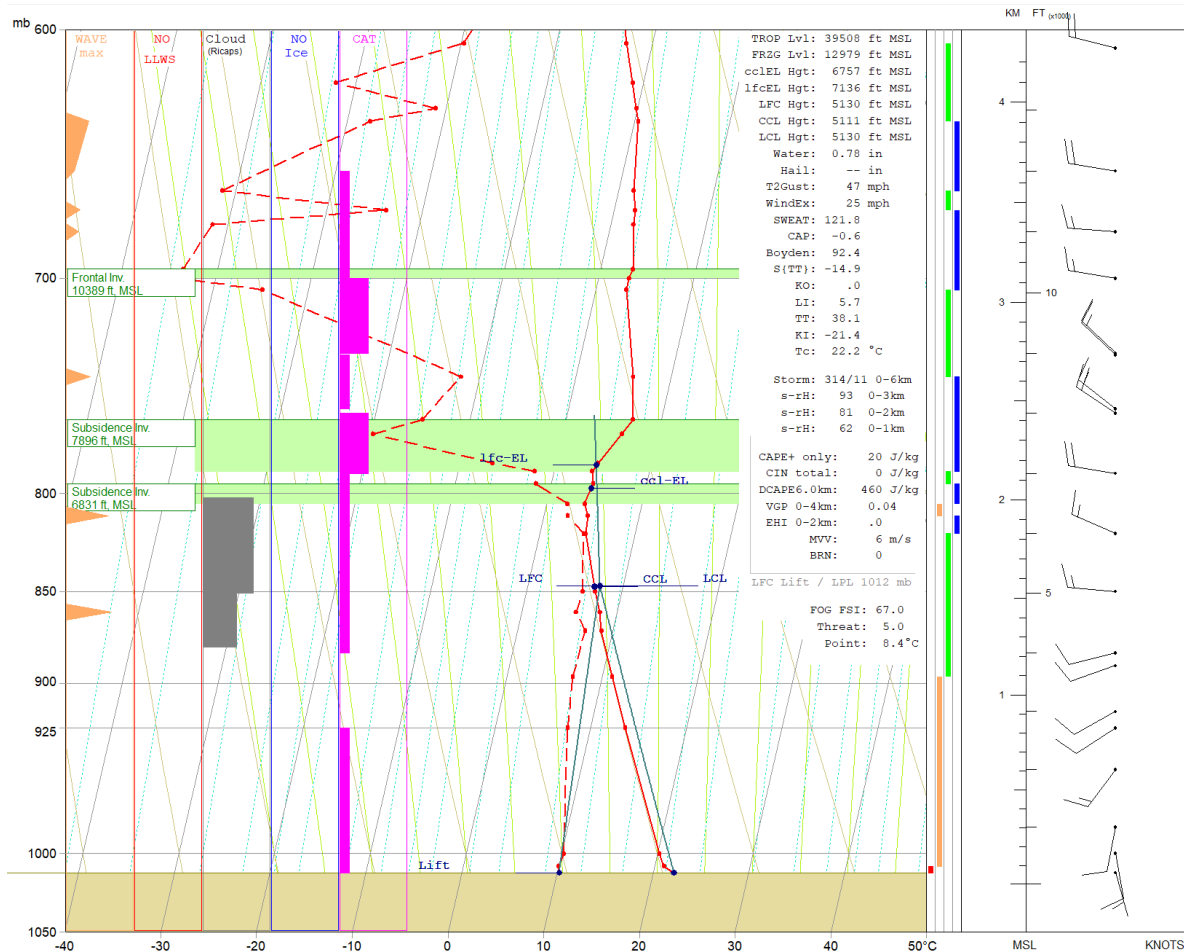


Figure 6. 1700 PDT KSLE sounding.

The 1700 PDT KSLE sounding indicated an unstable environment from the surface through 3,500 ft, with a combination of conditional unstable layer and stable layers between 3,500 ft and 14,000 ft. Clouds were indicated by the RAOB analysis software to be present from 4,000 ft through 6,750 ft. Several inversions¹⁴ were noted on the KSLE sounding with the inversion tops at 6,831, 7,896, and 10,389 ft. No icing potential was indicated by RAOB below 14,000 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").

The 1700 PDT KSLE sounding wind profile indicated a near surface wind from 165° at 5 knots with the wind becoming westerly by 5,000 ft. The wind speed increased to 15 knots by 2,000 ft and as high as 20 knots by 7,000 ft. The RAOB analysis program did not indicate low-level wind shear (LLWS) below 2,000 ft, but RAOB did indicate with several layers of light to moderate clear air turbulence (CAT) from the surface through 14,000 ft. Areas of mountain waves were noted by RAOB with 1,000 ft/min downdrafts¹⁵ indicated around 4,500 and 6,400 ft. At the accident elevation of 6,500 ft, the temperature was 4.0°C, the dew point temperature was 2.2°C, the wind from 285° at 17 knots, with a relative humidity of 88%.

4.0 Satellite Data

The Geostationary Operational Environmental Satellite number 17 (GOES-17) 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-17 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm, respectively, were retrieved for the period from 1100 PDT through 1700 PDT and reviewed, and the closest images to the time of the accident were documented.

Figure 7 presents the GOES-17 visible imagery from 1441 PDT at 2X magnification with the accident site highlighted with a red square and cloud cover indicated above the accident site and more abundant cover cloud west of the higher terrain ridgeline. Figure 8 presents the GOES-17 infrared image at 1441 PDT at 6X magnification with the accident site highlighted with a red square. The image depicted cloud cover over the accident site. The lower brightness temperatures (red colors; higher cloud tops) were located above and to the north of the accident site at the accident time. The brightness temperature of 276 Kelvin above the accident site would have been near 10,500 ft based on the vertical temperature profile provided by the 1700 PDT KSLE sounding. It should be noted these figures have not been corrected for any parallax error.

¹⁵ Default mountain parameters used by RAOB.

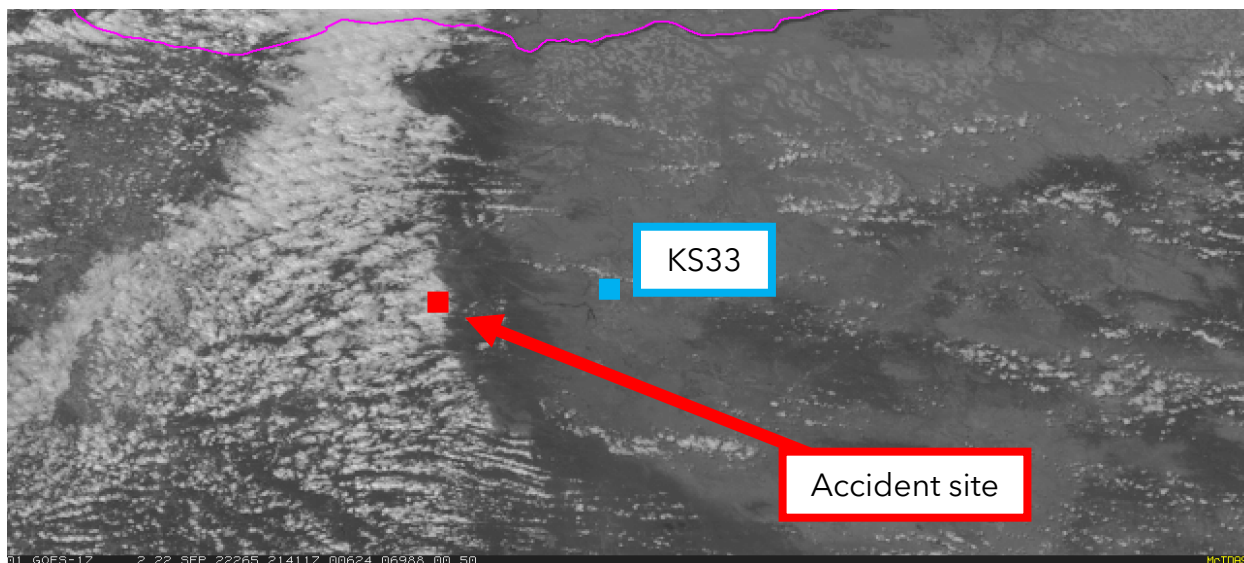


Figure 7. GOES-17 visible image at 1441 PDT.

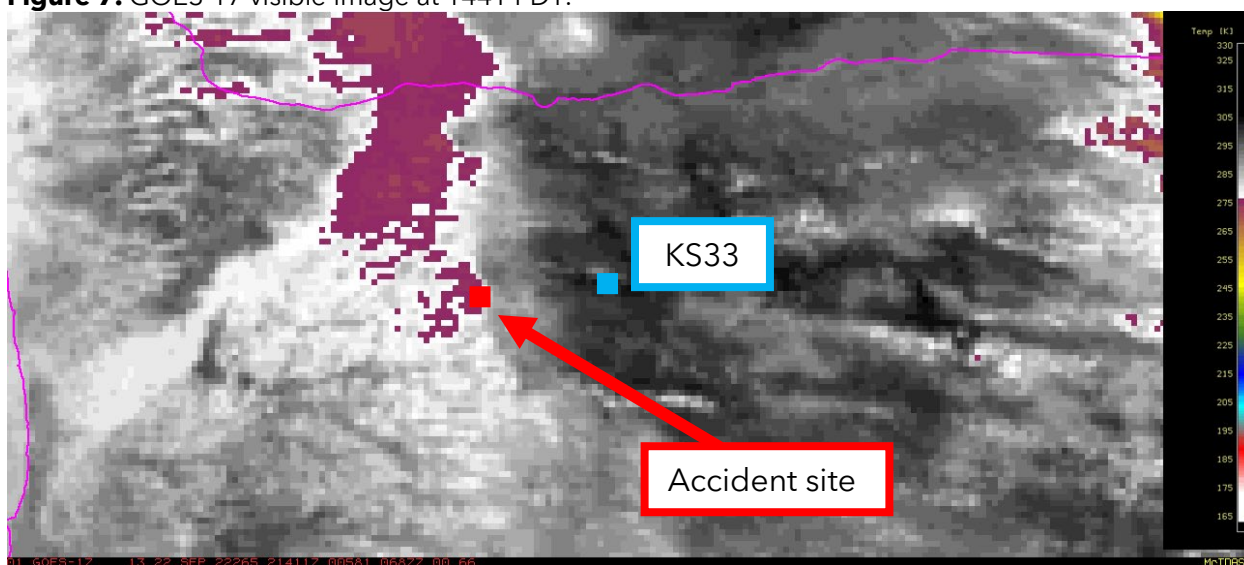


Figure 8. GOES-17 infrared image at 1441 PDT.

5.0 National Radar Imagery

A regional view of the NWS National Reflectivity Mosaic is included as figure 9 for 1440 PDT with the approximate location of the accident site marked by a red circle. The image depicted no precipitation echoes above the accident site.

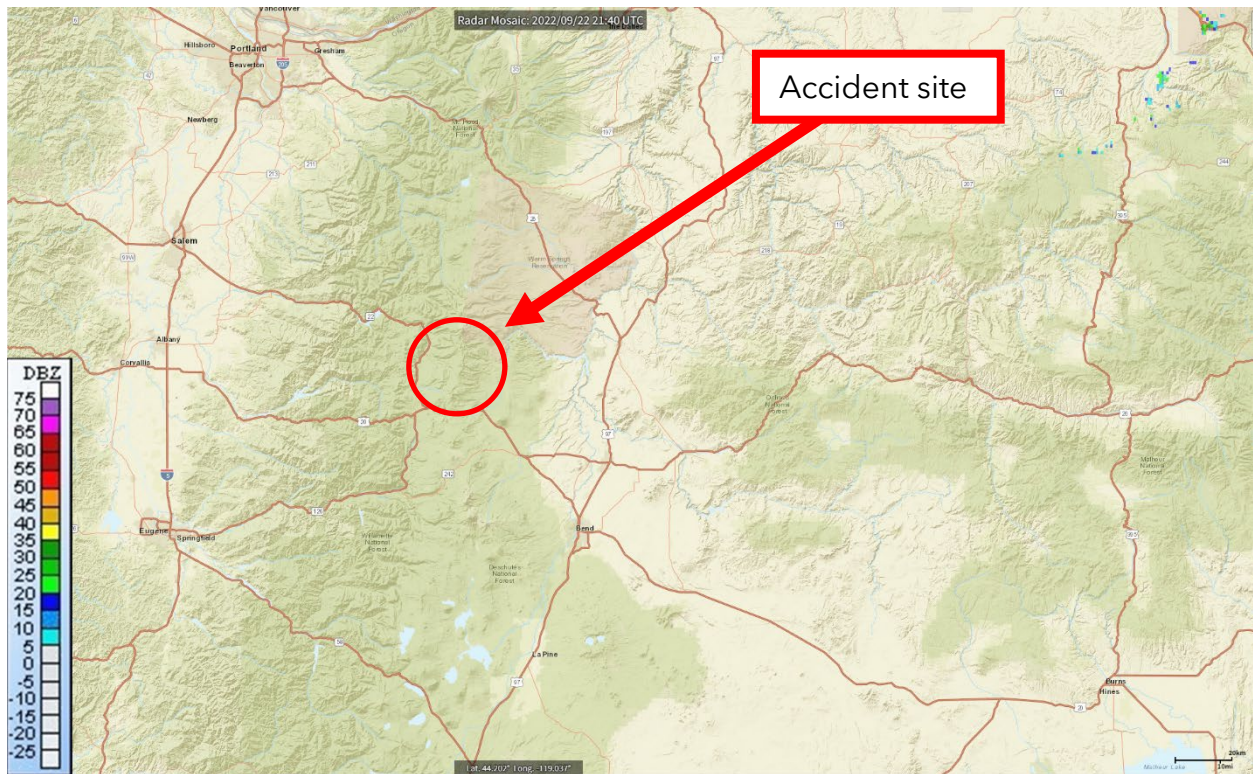


Figure 9. National Reflectivity Mosaic for 1440 PDT.

6.0 Pilot Reports

The longline-disseminated pilot reports¹⁶ (PIREPs) distributed into the national airspace system (NAS) were reviewed for about two hours on either side of the accident time and the PIREPs issued into the NAS within 100 miles of the accident site for below 19,000 ft are shown below:

UAO UA /OV UAO090010/TM 2007/FL050/TP TBM9/SK OVC050-TOP061/RM DURC RY17=

PDX UA /OV PDX100010/TM 2045/FL022/TP B748/SK BKN040 TOPUNKN=

PDX UA /OV PDX100005/TM 2131/FL020/TP B739/SK OVC045 TOPUNKN/TB LT CHOP/RM BASES ESTIMATED=

PDX UUA /OV PDX100003/TM 2134/FL002/TP B739/WV +/-5 KT BLO 010/RM LLWS=

HIO UA /OV HIO/TM 2156/FL042/TP PA46/SK BKN042/RM DURC RY13R=

PDX UUA /OV PDX100002/TM 2301/FL006/TP B767/TB +10/RM LLWS=

PDX UUA /OV PDX1000005/TM 2309/FL010/TP B757/WV +/-10/RM LLWS DURD=

¹⁶ Only pilot reports with the World Meteorological Organization headers UBWA** and UBOR** were considered. These do not include pilot reports only broadcast via radio.

7.0 Significant Meteorological Information

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

8.0 Center Weather Service Advisories

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

9.0 Airmen's Meteorological Information

The NWS Aviation Weather Center did not have any Airmen's Meteorological Information (AIRMET) advisories valid for the accident site at the accident time.

10.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products issued before the accident flight and valid at 1400 PDT are shown in attachment 1. The GFA surface forecast applicable to the accident site that was valid before the accident flight's departure for times surrounding the accident time indicated VFR surface visibilities and a west wind of 10 knots with gusts to 20 knots. The GFA cloud forecast applicable to the accident site that was valid before departure for times surrounding the accident time indicated scattered to broken cloud coverage with cloud heights around 6,000 ft. There were no Graphical AIRMET¹⁷ (G-AIRMET) valid for the accident site. The only human-generated information reflected in the two GFA products were the G-AIRMETs. For more information, please see attachment 1.

¹⁷ **Graphical AIRMETs (G-AIRMETs)**, found on the Aviation Weather Center webpage at <http://aviationweather.gov>, are graphical forecasts of en-route weather hazards valid at discrete times no more than 3 hours apart for a period of up to 12 hours into the future (for example, 00, 03, 06, 09, and 12 hours). G-AIRMETs are snap shots at discrete time intervals as defined above. The text AIRMET is the result of the production of the G-AIRMET but provided in a time smear for a 6hr valid period.

11.0 Terminal Aerodrome Forecast

There were no NWS Terminal Aerodrome Forecast¹⁸ (TAF) located within 30 miles of the accident site.

12.0 National Weather Service Area Forecast Discussion

The NWS weather forecast office in Pendleton, Oregon, (WFO PDT) was responsible for the public forecast in the region of the accident site. WFO PDT issued the following Area Forecast Discussion (AFD) at 1401 PDT, the closest AFD to the accident time with an aviation section:

FXUS66 KPDT 222101
AFDPDT

Area Forecast Discussion
National Weather Service Pendleton OR
201 PM PDT Thu Sep 22 2022

.SHORT TERM...Thursday through Friday...Latest visible satellite imagery showing a large shield of cloud cover and moisture just to our east over the Idaho-Montana border. Skies are clearing over our area, as the center of a closed upper-level low continues to shift to our east, leaving a drier air mass in its wake. The precip threat has ended across our forecast area, but in its place, the pressure gradient between these two airmasses will make for breezy to windy conditions through the early evening. Much of the Basin, Gorge, and Kittitas Valley have recorded gusts in the 30 mph range today, with a few obs of 40+ mph observed as well. Such higher-end gusts have been intermittent enough to preclude any advisories, but anyone outside or on the road will certainly feel the impacts from the winds, going along with the increased fire spread potential. The winds have thus far remained out of the vicinity of our current wildfires, with RHs still elevated due to recent moisture, so any impacts on the fire weather side are expected to be minimal.

Ridging will then begin to build over the region Friday, lasting through much of the next week. We'll start to see warming temperatures, with highs in the 70s across much of the area, admittedly a little cooler than today in the absence of the warming effect from strong downsloping winds. That being said, as the ridge persists over the course of the next several days, will start to see temps climb into the 80s across our population centers, close to 10 degrees above average for the time of year. Conditions will be

¹⁸ According to NWS Instruction 10-813: "An NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."
www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

drier, however winds under the high pressure will be light, so sensible weather impacts look to be limited beyond today. Evans/74

.LONG TERM...Saturday through Thursday...Deterministic and ensemble models in good agreement through the extended period. An upper level ridge will build over the western USA over the weekend pushing up into and including the Pacific Northwest. This will provide a dry weather pattern with light winds and warming temperatures through the weekend and into the first of next week reaching 10-15 degrees above normal. The ridge begins to shift to the east on Tuesday as an upper level trough approaches the Pacific Northwest. However, this trough weakens as it moves onshore Wednesday but it will flatten the ridge and provide a cooler westerly flow heading into late next week. NBM has a dry forecast Wednesday and Thursday with the main impact of the passing trough being breezy westerly winds and the return to seasonal temperatures.

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.AVIATION...18z TAFs (Previous Discussion)...Clouds will decrease becoming mostly clear most areas by this afternoon. Winds are increasing and will predominantly come from the SW-W at 12-25 kts with gusts 25-35 kts during the day then winds diminish overnight.

&&

.PRELIMINARY POINT TEMPS/POPS...

PDT	45	75	46	76	/	0	0	0	0
ALW	50	77	49	78	/	0	0	0	0
PSC	53	78	52	78	/	0	0	0	0
YKM	43	76	46	77	/	0	0	0	0
HRI	50	79	49	79	/	0	0	0	0
ELN	48	75	48	77	/	0	0	0	0
RDM	38	75	41	78	/	0	0	0	0
LGD	41	75	45	77	/	0	0	0	0
GCD	40	78	44	82	/	0	0	0	0
DLS	52	80	53	82	/	0	0	0	0

&&

.PDT WATCHES/WARNINGS/ADVISORIES...

OR...None.

WA...None.

&&

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13.0 Winds and Temperature Aloft Forecast

The NWS 1301 PDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWNO 222001
FD1US1
DATA BASED ON 221800Z
VALID 230000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
RDM	2716+08	2914+05	3018+01	3125-12	3133-25	303640	304050	295057	

The closest forecast point to the accident site was Redmond, Oregon, (RDM). The 1301 PDT RDM forecast for use between 1300 PDT and 2000 PDT indicated a wind at 6,000 ft from 270° at 16 knots with a temperature of +8°C, a wind at 9,000 ft from 290° at 14 knots with a temperature of +5°C, and a wind at 12,000 ft from 300° at 18 knots with a temperature of +1°C.

14.0 Pilot Weather Information

Title 14 CFR 91.103 states that "Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight." FAA AC 91-92 "Pilot's Guide to a Preflight Planning" (dated March 15, 2021) provided pilot guidance on preflight self-briefings, including planning, weather interpretation, and risk identification/mitigation skills. The AC further stated in part:

Pilots adopting these guidelines will be better prepared to interpret and utilize real-time weather information before departure and en route, in the cockpit, via technology like Automatic Dependent Surveillance-Broadcast (ADS-B) and via third-party providers.¹⁹

A search of archived information indicated that the accident pilot did not request weather information from Leidos Flight Service or ForeFlight. The accident pilot did use their ForeFlight account to update a route string on the day of the accident, but no airport information or weather imagery was viewed inside the ForeFlight App (attachment 2). It is unknown what, if any, additional weather information the accident pilot viewed before or during the accident flight.

¹⁹ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf. The AC also listed multiple online FAA resources for aviation flight planning services for adverse weather.

15.0 Astronomical Data

The astronomical data obtained for the accident site on September 22, 2022, indicated the following:

SUN

Begin civil twilight 0625 PDT

Sunrise 0654 PDT

Sun transit 1300 PDT

Accident time 1439 PDT²⁰

Sunset 1905 PDT

End civil twilight 1933 PDT

At the time of the accident the Sun was located at an altitude of 40.36° and azimuth of 213.39°.

E. LIST OF ATTACHMENTS

Attachment 1 - GFA information valid at the accident time

Attachment 2 - ForeFlight Information

Submitted by:

Paul Suffern
Senior Meteorologist

²⁰ Inserted accident time for reference and context.