NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 8, 2022

Group Chairman's Factual Report

METEOROLOGY

ANC21FA069

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A. ACCIDENT

Location: Ketchikan, Alaska
Date: August 5, 2021
Time: 1050 Alaska daylight time
1850 Coordinated Universal Time (UTC)
Aircraft: DeHavilland DH-2 MK.1 (Beaver); Registration: N1249K

B. METEOROLOGY GROUP

Group Chairman	Paul Suffern Senior Meteorologist/NTSB Washington, DC
Subject Matter Expert	David Lawrence Operations Investigator/NTSB Washington, DC
Subject Matter Expert	David Kochevar Alaska Regional Aviation Meteorologist/NWS Anchorage, AK

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist and Meteorology Group traveled to Juneau and Ketchikan, Alaska, for this investigation. In addition, information was gathered for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources and also from the National Centers for Environmental Information (NCEI). This factual report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are Alaska daylight time (AKDT) on August 5, 2021, and are based upon the 24-hour clock, where local time is -8 hours from UTC, and UTC=Z. 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 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 and "P" for OCONUS[1] airports.

The accident site was at approximate latitude 55.48258° N, Longitude 131.22532° W, at an approximate altitude of 1,750 feet (ft).

[1] OCONUS - Outside Continental United States or Overseas, refers to any country of place beyond CONUS. Alaska, Hawaii, and the U.S. territories are considered overseas.

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 (NCEP) and the Weather Prediction Center (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.[2]

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over southeastern Alaska for 1000 AKDT is provided as figure 1 with the approximate location of the accident site within the red circle. The chart depicted an occluded low-pressure system centered over the eastern Gulf of Alaska with a pressure of 1007-hectopascals (hPa). The associated occluded front was located east of the accident site in British Columbia.

The station models around the accident site depicted air temperatures in the high 50's degrees Fahrenheit (°F), dew point temperatures in the mid 50's °F with temperature-dew point spreads of 2°F or less, a south to southwest wind between 5 and 20 knots, and overcast skies with light rain.

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

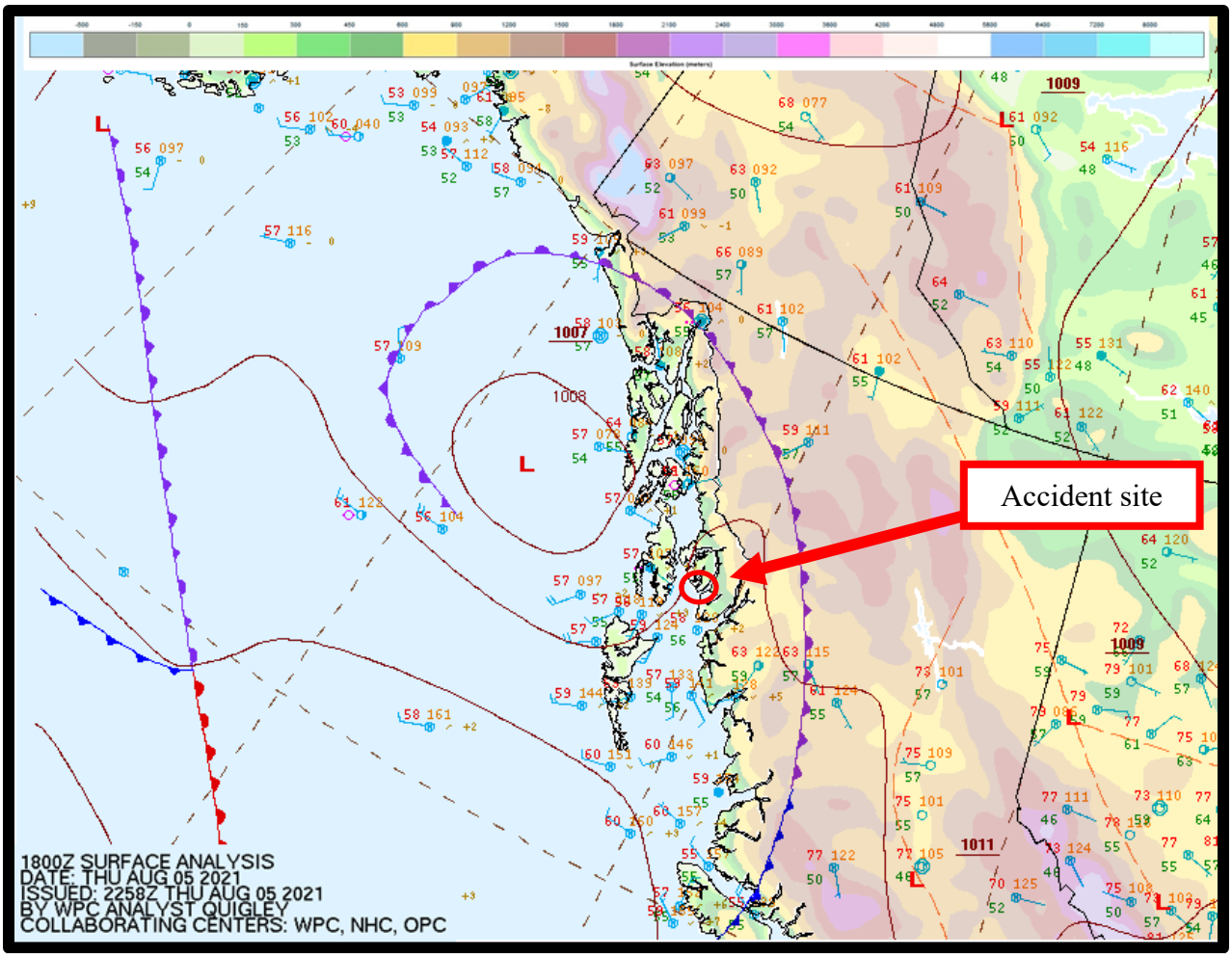

Figure 1 – NWS Surface Analysis Chart for 1000 AKDT.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 2 is a local sectional chart with the accident site and the closest weather reporting location marked.

Figure 2 – Sectional map of the accident area with the location of the accident site and surface observation site.

Ketchikan International Airport (PAKT) had the closest official airport weather station to the accident site. PAKT had an Automated Surface Observing System (ASOS[3]) whose longline[4] reports were supplemented by Ketchikan Alaska Flight Service Station (KTN FSS)[5]. PAKT ASOS was located 18 miles southwest of the accident site, at an elevation of 92 ft, and had an 18° easterly magnetic variation[6] (figure 2). The following automated longline observations were disseminated during the times surrounding the accident:[7]

[3] ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, weather phenomena, 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] For more information on KTN FSS and PAKT ASOS wind information please see the Air Traffic Control (ATC) factual located in docket for this accident. Per KTN FSS when the sustained wind magnitude is above 25 knots, the "roof wind" information will be added to the remarks section of the METAR.

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

[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.

[0909 AKDT] SPECI PAKT 051709Z 13008KT 9SM FEW017 SCT028 OVC036 14/12 A2989 RMK AO2 T01390122=

[0920 AKDT] SPECI PAKT 051720Z 12008KT 5SM -RA BR FEW008 BKN015 OVC025 14/13 A2989 RMK AO2 RAB18 P0000 T01390128=

[0953 AKDT] METAR PAKT 051753Z 14008KT 5SM -RA BR FEW008 BKN015 OVC025 13/13 A2990 RMK AO2 RAB18 SLP125 HARBOR WIND 11010KT P0002 60002 T01330128 10144 20122 53003=

[1009 AKDT] SPECI PAKT 051809Z 14008KT 2SM -RA BR SCT005 BKN015 OVC022 13/13 A2990 RMK AO2 HARBOR WIND 13010KT VIS 1V3 P0000 T01330128=

[1048 AKDT] SPECI PAKT 051848Z 15007KT 3SM R11/6000VP6000FT -RA BR FEW007 BKN018 OVC025 13/13 A2990 RMK AO2 HARBOR WIND 13010KT VIS 1V3 P0003=

ACCIDENT TIME 1050 AKDT

[1053 AKDT] METAR PAKT 051853Z 15006KT 3SM -RA BR FEW007 BKN018 OVC025 13/13 A2990 RMK AO2 SLP127 HARBOR WIND 13010KT VIS 2V4 P0003 T01330128=

[1153 AKDT] METAR PAKT 051953Z 13009KT 8SM -RA FEW007 BKN018 OVC025 14/13 A2991 RMK AO2 SLP128 HARBOR WIND 15010KT P0004 T01390128=

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

PAKT weather at 1048 AKDT, wind from 150° at 7 knots, visibility 3 miles, runway visual range on runway 11 varying between 6,000 ft and greater than 6,000 ft, light rain, mist, few clouds at 700 ft above ground level (agl), broken ceiling at 1,800 ft agl, overcast skies at 2,500 ft agl, temperature of 13° Celsius (C), dew point temperature of 13°C, and an altimeter setting of 29.90 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, harbor wind[8] from 130° at 10 knots, visibility varying between 1 and 3 miles, 0.03 inches of precipitation since 0953 AKDT.

PAKT weather at 1053 AKDT, wind from 150° at 6 knots, visibility 3 miles, light rain, mist, few clouds at 700 ft agl, broken ceiling at 1,800 ft agl, overcast skies at 2,500 ft agl, temperature of 13°C, dew point temperature of 13°C, and an altimeter setting of 29.90 inHg. Remarks: automated station with a precipitation discriminator, sea level pressure 1012.7 hPa, harbor wind from 130° at 10 knots, visibility varying between 2 and 4 miles, 0.03 inches of precipitation since 0953 AKDT, temperature 13.3°C, dew point temperature 12.8°C.

[8] For more information please see the ATC factual located in docket for this accident.

The observations from PAKT surrounding the accident site time indicated MVFR to IFR[9] conditions with light rain, mist, and visibilities as low as 1 mile.

3.0 Upper Air Sounding

Annette Island Airport, Alaska, had an upper air sounding (PANT) that had a station ID of 70398 with PANT located 29 miles south-southwest of the accident site at an elevation of 108 ft. The 1600 AKDT PANT sounding was plotted on a standard Skew-T Log P diagram[10] with the derived stability parameters included in figure 3 with data from the surface to 700-hPa (or approximately 10,000 ft msl). These data were analyzed using the RAOB[11] software package. The sounding depicted the lifted condensation level (LCL)[12] and the level of free convection (LFC)[13] at 128 ft agl (236 ft msl), and the convective condensation level (CCL)[14] at 1,901 ft agl (2,009 ft msl). The freezing level was located at 7,548 ft. The precipitable water value was 1.03 inches.

[9] 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.

[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, The Villages, Florida.

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

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

[14] CCL – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

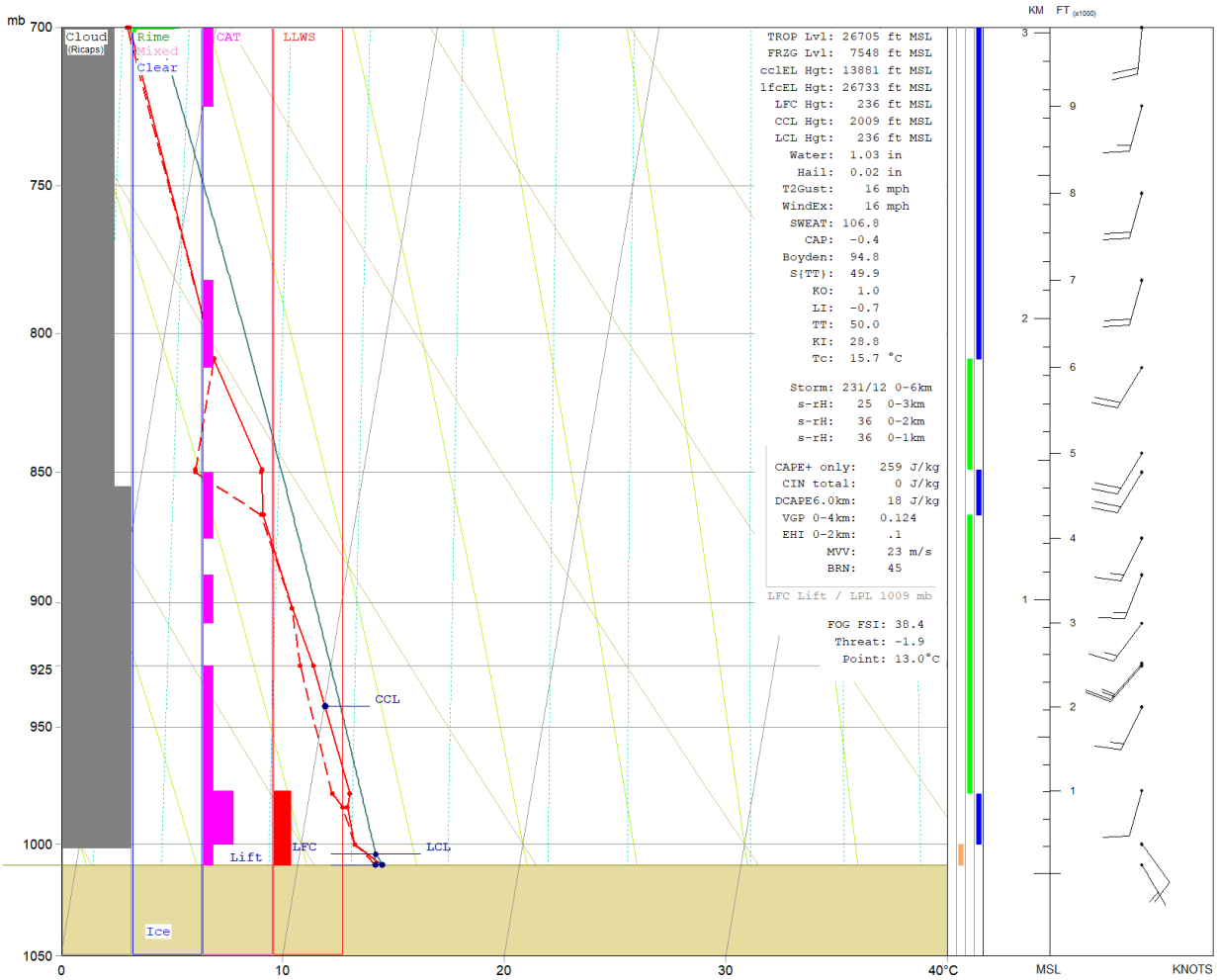

Figure 3 – 1600 AKDT PANT sounding.

The 1600 AKDT PANT sounding indicated a combination of unstable, stable, and conditional instability in several layers from the surface to 6,000 ft. RAOB indicated clouds from 300 ft agl through 10,000 ft and no icing conditions below 9,500 ft.

The 1600 AKDT PANT sounding wind profile indicated a surface wind from 150° at 5 knots with the wind increasing in speed to 15 knots from the southwest by 2,000 ft. RAOB indicated the possibility of light low-level wind shear (LLWS) between the surface and 1,000 ft. RAOB indicated the possibility of light to moderate clear-air turbulence in several layers between the surface and 10,000 ft. Near the accident site elevation (around 1,750 ft)[15] the wind was from 200° at 14 knots with a temperature near 10.5°C and a dewpoint temperature near 9.8°C with a relative humidity of 95%.

[15] For more information please the docket of this accident.

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 0800 AKDT through 1400 AKDT and reviewed, and the closest images to the time of the accident were documented.

Figures 4 and 5 present the GOES-17 visible imagery from 1040 and 1050 AKDT at 2X magnification with the accident site highlighted with a red square. There was cloud cover above the accident site at the accident time with the cloud cover moving north-northeastward. Figures 6 and 7 present the GOES-17 infrared imagery from 1030 and 1050 AKDT at 6X magnification with the accident site highlighted with a red square. The lower brightness temperatures (green colors; higher cloud tops) were located near to and southwest of PAKT and east of the accident site in British Columbia. A band of lower brightness temperatures (yellow colors) increased in coverage and moved across the accident site between 1030 and 1050 AKDT. The brightness temperature of about 254 Kelvin would have been near 17,000 ft based on the vertical temperature profile provided by the 1600 AKDT PANT sounding (not shown in Figure 3). It should be noted these figures have not been corrected for any parallax error.

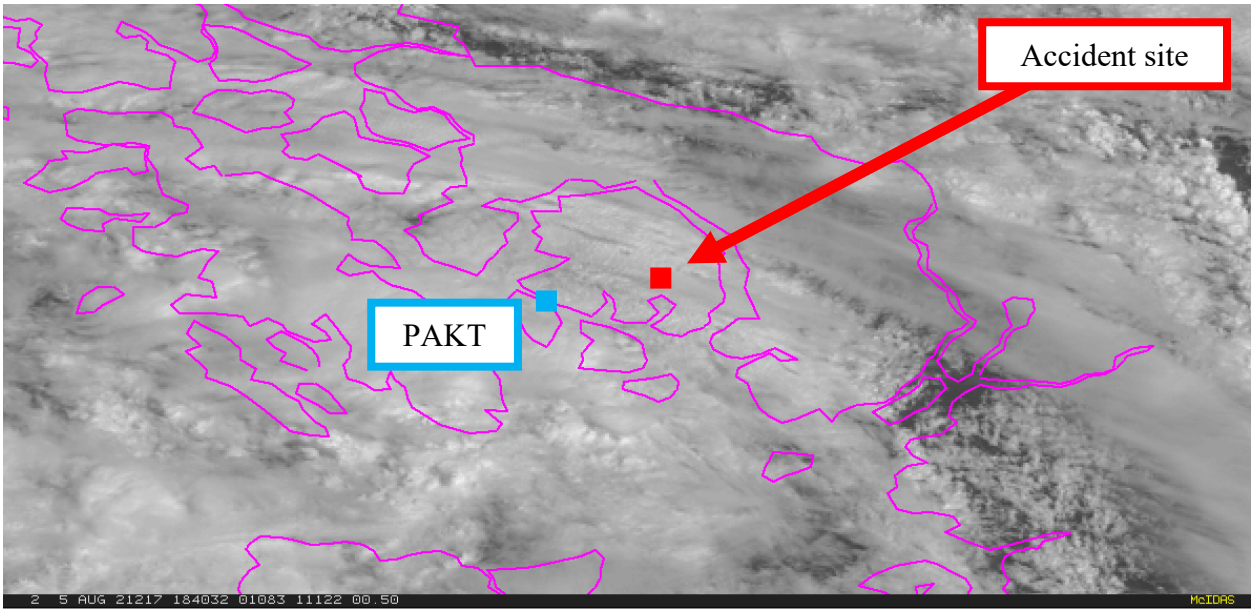

Figure 4 – GOES-17 visible image at 1040 AKDT.

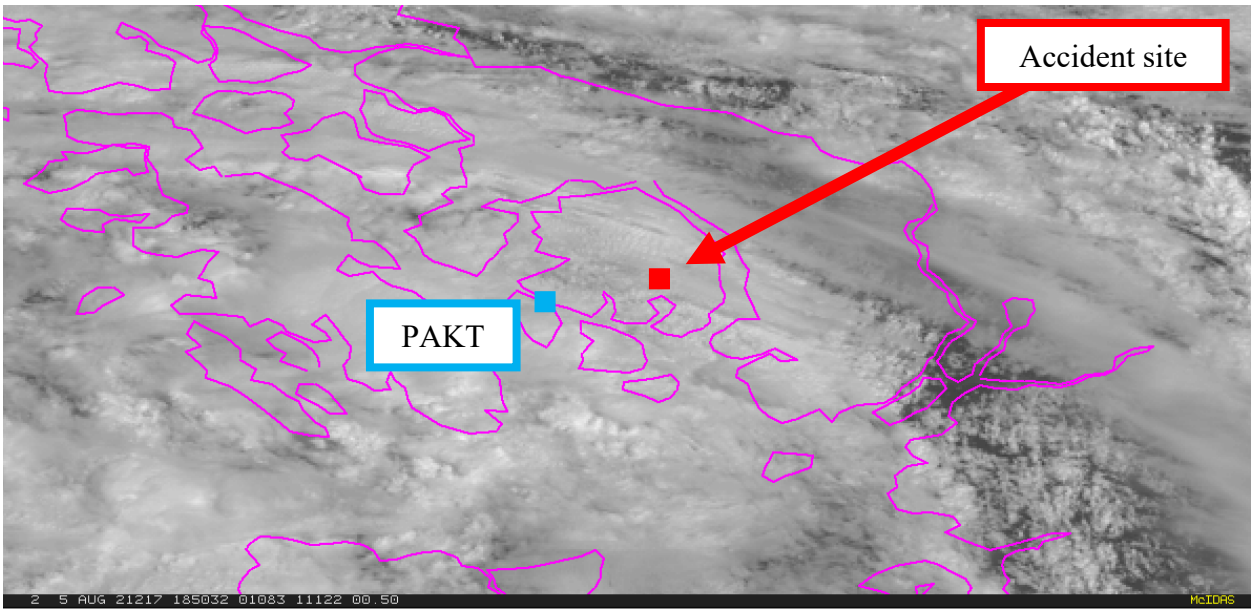

Figure 5 – GOES-17 visible image at 1050 AKDT.

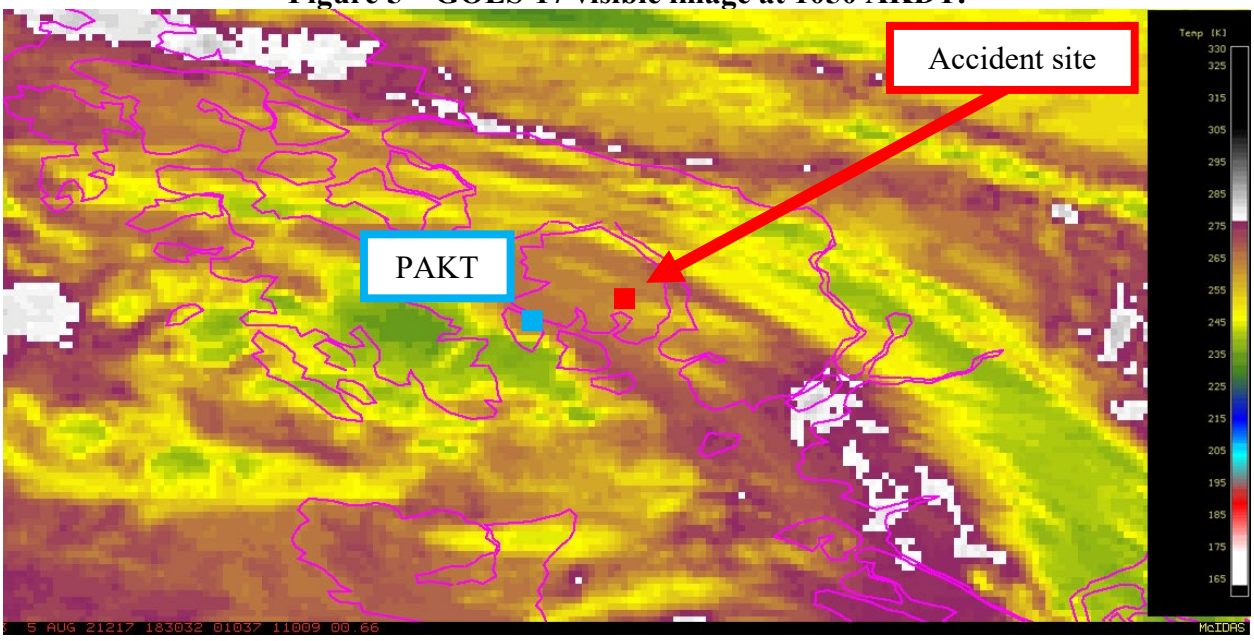

Figure 6– GOES-17 infrared image at 1030 AKDT.

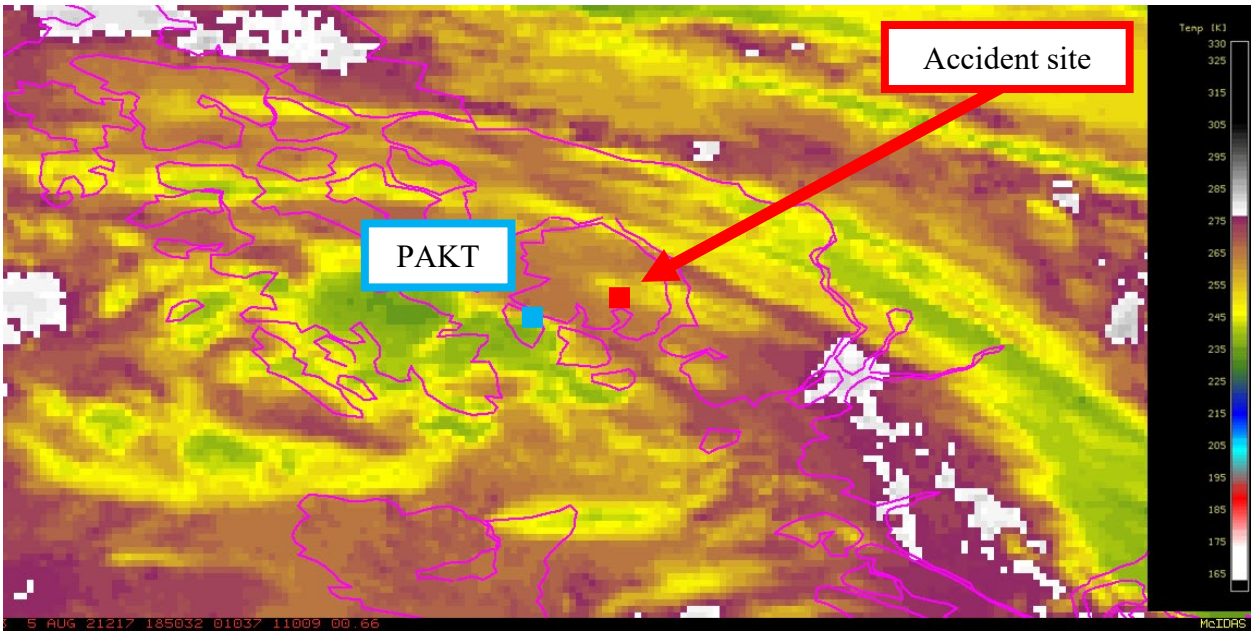

Figure 7– GOES-17 infrared image at 1050 AKDT.

5.0 Regional Radar Imagery Information

The closest weather radar was near Biorka Island (Sitka), (PACG), Alaska, which was 166 miles northwest of the accident site. Level II archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. Based on the radar height calculations, the lowest elevation scan from PACG depicted the conditions between roughly 21,000 ft and 38,000 ft and these altitudes were above the top of the cloud cover.

6.0 Pilot Reports

The longline-disseminated pilot reports[16] (PIREPs) distributed into the national airspace (NAS) were reviewed from about two hours prior to the accident time to two hours after the accident time within 100 miles of the accident site for below 20,000 ft and those PIREPs are shown below:

KTN UA /OV KTN/TM 1706/FL025/TP B737/RM DURC RY11 SMOOTH THROUGH FL025 /AKFSS/

AKW UA /OV AKW/TM 1730/FL015/TP PC12/SK OVC015/RM /AKFSS/

AKW UA /OV AKW/TM 1738/FL021/TP C208/SK OVC021/RM /AKFSS/

KTN UA /OV KTN/TM 1914/FL018/TP C208/RM LIGHTS IN SIGHT 018/5SM ILS Y11 /AKFSS/

KTN UA /OV KTN/TM 2030/FL004/TP PA34/RM AIRPORT IN SIGHT 400FT ILS Y11 /AKFSS/

KTN UA /OV KTN/TM 2053/FL005/TP B737/RM LGT IN SIGHT 500-600FT ILS 11 /AKFSS/

[16] Only pilot reports with the World Meteorological Organization headers UBAK** 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 Unit Advisories

The Anchorage (ZAN) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. ZAN CWSU did not issue a Meteorological Impact Statement (MIS) or a Center Weather Advisory (CWA) valid for the accident site at the accident time.

9.0 Airmen's Meteorological Information

There was an Airmen's Meteorological Information (AIRMET) advisory Sierra valid for the accident site at the accident time that was issued at 0422 AKDT. This AIRMET Sierra was issued for mountain obscuration due to clouds and precipitation and occasional ceilings below 1,000 ft and visibilities below 3 miles in light rain showers and mist.

WAAK47 PAWU 051222
WA7O
JNUS WA 051215
AIRMET SIERRA FOR IFR AND MT OBSC VALID UNTIL 052015
.
LYNN CANAL AND GLACIER BAY JB
MTS OCNL OBSC IN CLDS/PCPN. NC.
.
CNTRL SE AK JC
MTS OBSC IN CLDS/PCPN. NC.
.
SRN SE AK JD
OCNL CIGS BLW 010/VIS BLW 3SM -SHRA BR/BR. NC.
.
SRN SE AK JD
MTS OBSC IN CLDS/PCPN. NC.
.
ERN GLF CST JE
OFSHR OCNL CIGS BLW 010/VIS BLW 3SM -RA BR/BR. NC.
.
SE AK CSTL WTRS JF
OFSHR OCNL CIGS BLW 010/VIS BLW 3SM -RA BR/BR. NC.
.
SE AK CSTL WTRS JF
MTS OBSC IN CLDS/PCPN. NC.
.
=JNUT WA 051215
AIRMET TANGO FOR TURB/STG SFC WINDS VALID UNTIL 052015
.
LYNN CANAL AND GLACIER BAY JB
OCNL MOD TURB FL320-FL380. NC.
.
CNTRL SE AK JC
OCNL MOD TURB FL320-FL380. NC.

.
SRN SE AK JD
OCNL MOD TURB FL320-FL380. NC.
.
ERN GLF CST JE
ICY BAY S AND E OCNL MOD TURB FL320-FL380. NC.
.
SE AK CSTL WTRS JF
OCNL MOD TURB FL320-FL380. NC.
.
=JNUZ WA 051215
AIRMET ZULU FOR ICING VALID UNTIL 052015
.
LYNN CANAL AND GLACIER BAY JB
AFT 15Z LYNN CANAL OCNL MOD ICEIC 130-FL180.
FZLVL 100. INTSF.
.
CNTRL SE AK JC
15Z TO 18Z CST MTS OCNL MOD ICEIC 130-FL180.
FZLVL 090. WKN.
.
SE AK CSTL WTRS JF
S PAAP OCNL MOD ICEIC 130-FL180.
FZLVL 090. NC.
.

10.0 Area Forecast

The Area Forecast valid for the accident site issued at 0422 AKDT is presented below. This Area Forecast included the AIRMET Sierra and provided a forecast of scattered clouds at 800 ft, broken clouds at 1,200 ft, overcast clouds at 2,000 ft with cloud tops at FL200[17], occasional visibilities to 3 miles, light rain showers and mist and isolated IFR ceilings:

SRN SE AK JD...VALID UNTIL 060000
...CLOUDS/WX...
*****AIRMET IFR***OCNL CIGS BLW 010/VIS BLW 3SM -SHRA BR/BR. NC...**
*****AIRMET MT OBSC***MTS OBSC IN CLDS/PCPN. NC...**
SCT008 BKN012 OVC020 TOP FL200. OCNL VIS 3SM -SHRA BR/BR.
ISOL CIGS BLW 010/VIS BLW 3SM BR.
OTLK VALID 060000-060600...MVFR CIG SHRA BR.

FAAK47 PAWU 051222
FA7H
JNUH FA 051215
EASTERN GULF COAST AND SE AK...
.
AIRMETS VALID UNTIL 052015
CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HEIGHTS NOTED BY AGL OR CIG.

[17] 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.

.
SYNOPSIS VALID UNTIL 060600
A 1005 MB LO PRES 150NM SW PASI WL SLOLY MOV EWD DURG FCST PD.
ASSOCD SFC FNT OVR ERN GULF AND PANHANDLE WL DSIPT OVR NE GULF
AFT 21Z.
.
LYNN CANAL AND GLACIER BAY JB...VALID UNTIL 060000
...CLOUDS/WX...
AIRMET MT OBSCMTS OCNL OBSC IN CLDS/PCPN. NC...
FEW008 SCT012 BKN025 OVC035 TOP FL200 LYRS ABV TO FL300 -RA.
OCNL BKN012/VIS 3-5SM -RA BR.
ISOL CIG BLW 010/VIS 3SM BR.
OTLK VALID 060000-060600...MVFR CIG RA BR.
PASSES...
WHITE...CHILKOOT...MVFR CIG RA BR.
...TURB...
AIRMET TURBOCNL MOD TURB FL320-FL380. NC...
...ICE AND FZLVL...
AIRMET ICEAFT 15Z LYNN CANAL OCNL MOD ICEIC 130-FL180.
FZLVL 100. INTSF...
TIL 18Z LYNN CANAL ISOL MOD ICEIC 130-FL180.
.
CNTRL SE AK JC...VALID UNTIL 060000
...CLOUDS/WX...
AIRMET MT OBSCMTS OBSC IN CLDS/PCPN. NC...
SCT005 BKN015 OVC035 TOP TO FL200. OCNL -SHRA BR.
ISOL CIGS BLW 010/VIS BLW 3SM BR.
OTLK VALID 060000-060600...IFR CIG SHRA BR.
...TURB...
AIRMET TURBOCNL MOD TURB FL320-FL380. NC...
TIL 21Z SW PAOH-PAPG LN ISOL MOD TURB BLW 050.
...ICE AND FZLVL...
AIRMET ICE15Z TO 18Z CST MTS OCNL MOD ICEIC 130-FL180.
FZLVL 090. WKN...
TIL 21Z SW PAFE ISOL MOD ICEIC 130-FL180.
.
SRN SE AK JD...VALID UNTIL 060000
...CLOUDS/WX...
*****AIRMET IFR***OCNL CIGS BLW 010/VIS BLW 3SM -SHRA BR/BR. NC...**
*****AIRMET MT OBSC***MTS OBSC IN CLDS/PCPN. NC...**
SCT008 BKN012 OVC020 TOP FL200. OCNL VIS 3SM -SHRA BR/BR.
ISOL CIGS BLW 010/VIS BLW 3SM BR.
OTLK VALID 060000-060600...MVFR CIG SHRA BR.
...TURB...
AIRMET TURBOCNL MOD TURB FL320-FL380. NC...
TIL 21Z CLARENCE STRAIT SW ISOL MOD TURB BLW 050.
...ICE AND FZLVL...
AFT 15Z CLARENCE STRAIT SW ISOL MOD ICEIC 130-FL180.
AFT 21Z OUTER CST PAHY S OCNL MOD ICEIC 130-FL180.
FZLVL 090.
.

11.0 Alaska Aviation Weather Unit Graphics

The Alaska Aviation Weather Unit (AAWU) produced graphical forecast information valid at the accident time and that information can be found in attachment 1.

12.0 Terminal Aerodrome Forecast

PAKT was the closest airport to the accident site with an NWS Terminal Aerodrome Forecast (TAF)[18]. The last PAKT TAF issued before the accident time was issued at 1037 AKDT and was valid for a 23-hour period beginning at 1100 AKDT. The 1037 AKDT TAF for PAKT was as follows:

PAKT 051837Z 0519/0618 **13009KT 4SM -SHRA BR SCT008 OVC015**
FM060900 15004KT P6SM -SHRA BKN007 OVC015
FM061600 15004KT P6SM VCSH SCT007 OVC015=

The forecast expected a wind from 130° at 9 knots, 4 miles visibility, light rain showers, mist, scattered clouds at 800 ft agl, and an overcast ceiling at 1,500 ft agl.

The PAKT TAF valid at the time of the accident was issued at 0923 AKDT and was valid for a 24-hour period beginning at 1000 AKDT. The 0923 AKDT TAF for PAKT was as follows:

TAF PAKT 051723Z 0518/0618 **13008KT 6SM -SHRA BR SCT008 OVC015**
TEMPO 0518/0520 P6SM NSW SCT008 OVC045
FM052200 13009KT 4SM -SHRA BR SCT008 OVC025
FM060900 15004KT P6SM -SHRA BKN007 OVC015
FM061600 15004KT P6SM VCSH SCT007 OVC015=

For the accident time the forecast expected a wind from 130° at 8 knots, 6 miles visibility, light rain showers, mist, scattered clouds at 800 ft agl, and an overcast ceiling at 1,500 ft agl. Temporary conditions[19] of greater than 6 miles visibility, no significant weather, scattered clouds at 800 ft agl, and overcast ceiling at 4,500 ft agl were forecast for between 1000 and 1200 AKDT.

The PAKT TAF valid at 0400 AKDT was issued at 0322 AKDT and was valid for a 24-hour period beginning at 0400 AKDT. The 0322 AKDT TAF for PAKT was as follows:

TAF PAKT 051122Z 0512/0612 18004KT P6SM VCSH SCT007 BKN030 OVC045
TEMPO 0512/0516 SCT008 OVC045
FM051800 13008KT 4SM -SHRA BR OVC008
FM052300 13009KT 4SM -SHRA BR SCT008 OVC025
FM060900 15004KT P6SM -RA BKN007 OVC015=

Between 1000 and 1500 AKDT, the forecast expected a wind from 130° at 8 knots, 4 miles visibility, light rain showers, mist, and an overcast ceiling at 800 ft agl.

[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
[19] pd01008013curr.pdf (noaa.gov)

13.0 NWS Area Forecast Discussion

The NWS office in Juneau, Alaska, (WFO AJK) issued the following Area Forecast Discussion (AFD) at 0640 AKDT and this was the AFD valid at the accident time:

FXAK67 PAJK 051440
AFDAJK

Southeast Alaska Forecast Discussion
National Weather Service Juneau AK
640 AM AKDT Thu Aug 5 2021

.SHORT TERM...Low pressure centered over the SE corner of the gulf has multiple frontal bands rotating about it and across the panhandle. One band of showers lies between Juneau and Haines as of this writing and is tracking N-NW. Another band near the low center (2nd wrap) is pushing into POW early this morning. The showers across the south will continue to move onshore through the afternoon due to the proximity of the low. Some of the showers are more convective and may have moderate rates and gusty winds at times. Have included a slight chance of lightning near Hydaburg this afternoon/evening. Hyder could also see some enhanced showers from storms that develop in Canada, but have left out the thunder mention for now.

On Friday, some showers will continue to pass over the region despite the low pressure weakening. Models are depicting an easterly wave moving across the Coast Mtns. and over Juneau to Icy Strait early Friday morning and lasting for most of the day. How broad this band of showers ends up being is less certain. Models range across a fairly large portion of the northern panhandle, BUT many times convective easterly waves end up being much more narrow and will need to monitor how it develops and update the forecast as needed.

.LONG TERM.../Saturday through Wednesday night/...As of 10pm Wednesday. A low-amplitude upper level trough over the panhandle Saturday moves into B.C. by Sunday and is replaced by a weak transitory upper level ridge. The upper ridge is forced south by Monday morning as a 140kt jet sets up over the top of the remains of the ridge. There are model differences on exactly where the jet max sets up, but flow at all levels is onshore. Models are also showing a moisture source in the tropical Pacific, so confidence is increasing in a potential atmospheric river event Monday into Tuesday, possibly longer. Approximately 80% of GEFS ensemble members are showing IVT values of 500 kg/m/s or greater aimed at the northern / central panhandle by 18z Tuesday. To complicate things, technical issues at the office limited the changes to the forecast, so the latest model runs were not fully incorporated into the forecast. This leaves plenty of things to look at for tomorrow's evening shift.

Getting back to the weekend, a ridge builds briefly, and models have backed off on the easterly wave hints, so a diminishing trend in the showers across the panhandle is expected, but the

cloudy skies and the chance of showers will not completely go away
with weak onshore flow. Temperatures are expected to remain
seasonal with no impactful winds through the weekend. -BFL

&&

.AJK WATCHES/WARNINGS/ADVISORIES...
PUBLIC...None.
MARINE...Small Craft Advisory for PKZ041.

&&

$$

14.0 Winds and Temperature Aloft Forecast

The NWS 0557 AKDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

```
FBAK31 KWNO 051357
FD1AK1
DATA BASED ON 051200Z
VALID 051800Z   FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT  3000    6000    9000   12000   18000   24000  30000  34000  39000
ANN 1814 1916+03 1917-02 1820-07 1729-20 1736-31 154243 182338 211240
```

The closest forecast point to the accident site was Annette Island, Alaska (ANN). The 0557 AKDT ANN forecast for use between 0600 AKDT and 1300 AKDT indicated a wind at 3,000 ft from 180° at 14 knots and a wind at 6,000 ft from 190° at 16 knots with a temperature of 3°C.

15.0 National Weather Service Juneau Information

The Meteorology Group met at WFO AJK on September 27, 2021, to gather information. WFO AJK personnel stated one of the largest challenges for weather forecasting in southeast Alaska is the variable terrain and the relatively large resolution of the weather computer model data. They mentioned there is a relatively sparse weather observation network on which to base weather forecasts, but there are "citizen weather observations" (CWOP)[20] sites but siting, quality, and reliability are unknown.

When forecasting for the Ketchikan area and aviation forecast in particular the WFO AJK personnel stated they use Aviation Forecast Preparation System (AvnFPS) as a software tool to make the TAF and are trained to use additional tools on Advanced Weather Interactive Processing System (AWIPS) to include the use of BUFKIT[21] and Wind Rose climatology-based resources (figure 8) when writing the TAFs. WFO AJK mentioned most of the TAF locations (including Ketchikan) in Southeast Alaska have a bimodal wind flow regime. WFO AJK stated forecasters are trained that the first 6 hours of the TAF are the most important, along with consistency with

[20] Citizen Weather Observer Program: Citizen Weather Observer Program
[21] NWS\OCLO Warning Decision Training Division: BUFKIT (weather.gov)

the observations, and due to rapidly changing conditions even in the first 6 hours TEMPO groups in TAFs can be used. WFO AJK personnel mentioned that the airport amendment and category criteria[22], for each of the 10 TAFs sites WFO AJK is responsible for, is available via the WFO AJK local aviation documents page and referenced. WFO AJK stated when airport amendment criteria are updated, these criteria are provided by NWS headquarters and checked on the 56-day FAA update cycle. WFO AJK mentioned that outside of the local Ketchikan TAF area of responsibility, the AAWU and CWSU provide additional weather forecast information for pilots and aviation users. WFO AJK personnel stated that before a new NWS forecaster is allowed to submit TAFs on their own, there are 55 hours of aviation course-based training along with TAF on-the-job-training. WFO AJK mentioned it takes around 6 months before a new NWS forecaster is checked out on the aviation training criteria and allowed to submit a TAF on their own. WFO AJK stated a typical WFO in the lower 48 has around 5 TAF sites, while WFO AJK forecasts for 10 TAF sites. WFO AJK had a similar office staffing environment to a lower 48 WFO. WFO AJK stated over the past 13 years, WFO AJK personnel were 22% better than the "gold standard" of weather computer model guidance for TAFs for the Ketchikan Airport (figures 9 and 10).

WFO AJK stated since the beginning of the SARS-CoV-2 pandemic, there have been no requests to WFO AJK by commercial operators or from the FAA for aviation outreach in the southeast Alaska area. WFO AJK mentioned aviation outreach tended to occur most often during the summer months. Pre-SARS-CoV-2 pandemic, WFO AJK stated they would typically get pre-summer flying season visits from local Juneau aviation operators. NWS Alaska had scheduled a large workshop for aviation partners throughout Alaska for spring 2020, which included some Ketchikan aviation operations, but that had to be cancelled because of the SARS-CoV-2 pandemic. NWS Alaska mentioned that the limited virtual aviation outreach that NWS Alaska has been able to do since the beginning of SARS-CoV-2 pandemic has been met by little aviation community interest, possibly due to internet connectivity and bandwidth issues within the greater Alaska aviation community. WFO AJK stated they would never say no and would be happy to provide aviation outreach training if requested. WFO AJK mentioned that individual general aviation pilots and dispatchers from part 121 and 135 aviation carriers have called WFO AJK even after the beginning of the SARS-CoV-2 pandemic for understanding of the "why" behind the aviation forecast and WFO AJK confidence in the forecast. WFO AJK stated there has been no face-to-face outreach since the beginning of the SARS-CoV-2 pandemic.

WFO AJK stated challenges for preparing aviation weather forecasts at the various Southeast Alaska TAF sites over the past year were due to FAA communication issues at several ASOS and AWOS sites within Southeast Alaska. WFO AJK mentioned there have been times over the past few years where WFO AJK has had to "NIL[23]" at TAF site, because the weather observations from the ASOS or AWOS were not being broadcast due to FAA communications issues. WFO AJK mentioned the FAA is in charge of the ASOS or AWOS weather dissemination which utilizes an aging copper wire infrastructure nearing the end of its expected lifecycle and the NWS Alaska Region would support any change by the FAA to install more modern and reliable circuits for ASOS/AWOS dissemination. WFO AJK stated they had not seen these communication or equipment issues as much at Ketchikan ASOS (PAKT), because the Alaska Flight Service (AK FSS) has an official FAA certified weather observer on site and that the weather observer augments

[22] CAC_Instructions.pdf (weather.gov)
[23] AWC - Terminal Aerodrome Forecasts (TAFs) (aviationweather.gov)

weather observations from PAKT. WFO AJK mentioned that AK FSS certified weather observer has a backup observation transmission route that does not use the aging copper wire infrastructure. However, WFO AJK personnel mentioned they have had to NIL TAFs at Ketchikan for short periods of time in 2021 during overnight hours when the KTN FSS was not staffed.

WFO AJK personnel stated the FAA weather cameras are an invaluable resource for WFO AJK for TAFs and "critical public service." WFO AJK mentioned the FAA weather cameras are critical when preparing and monitoring TAFs as well as the forecast preparation and monitoring as a whole. WFO AJK stated weather information (wind speed and direction, wind gust, ceiling, and visibility) from all the FAA weather camera locations would be beneficial as their current locations provide valuable supplements to other weather resources and allowing the weather cameras to have night vision capability would be beneficial for WFO AJK use. WFO AJK stated Visibility Estimation through Image Analytics (VEIA) is a resource that a few WFO AJK forecasters have signed up for with the FAA evaluation, but most WFO AJK personnel are not yet using VEIA. WFO AJK and NWS Alaska stated they had not been included in the FAA's 9/30/2021 season-ending safety briefing for Ketchikan aviation community users.

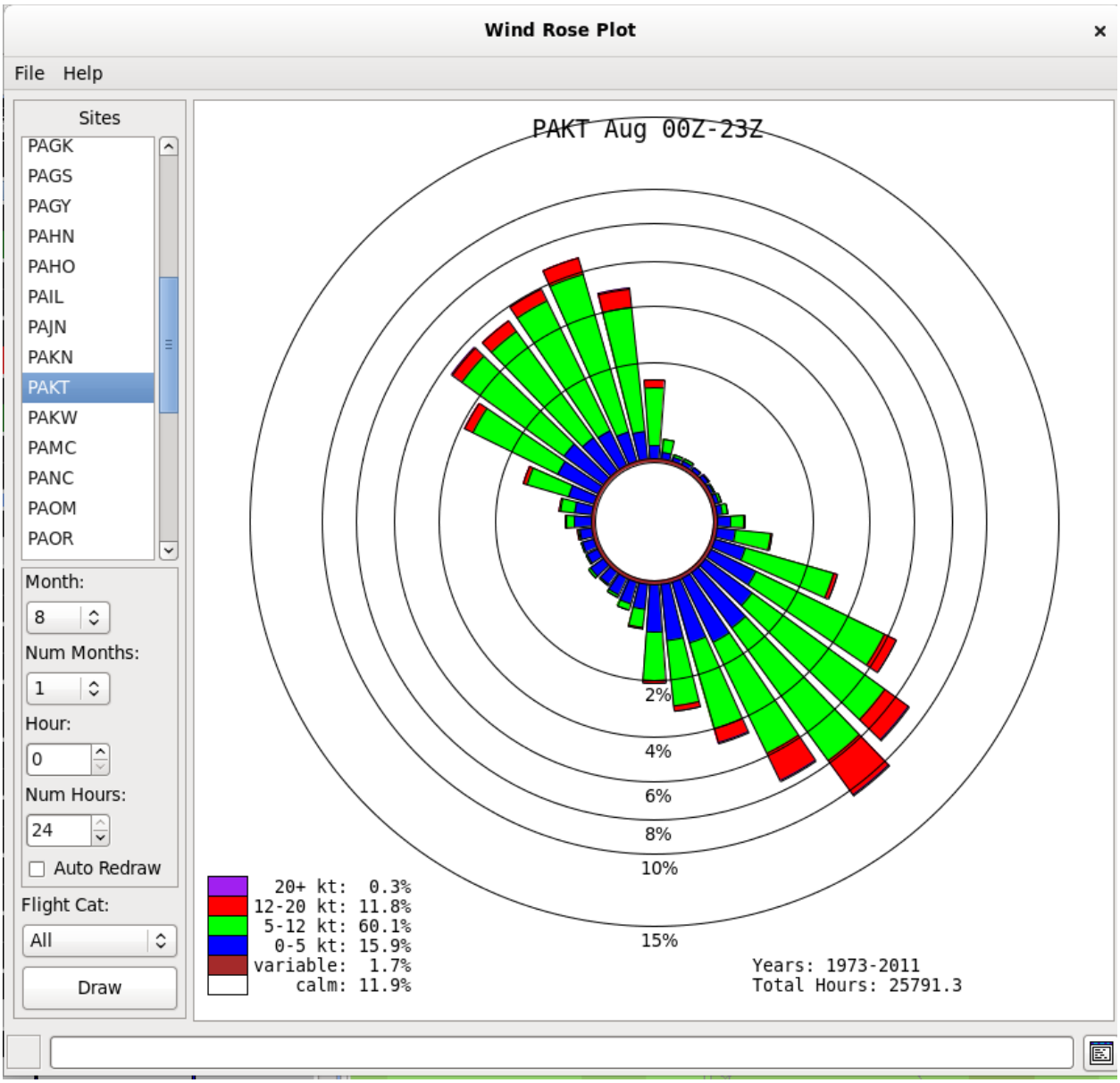

Figure 8 – PAKT Wind Rose Information from 1973 to 2011

Category/Scores	% Improvement TAF CSI over GFS LAMP
VLIFR	25.33
LIFR & Below	55.20
IFR & Below	22.51
MVFR & Below	0.64
LIFR Slice	80.30
IFR Slice	24.53
MVFR Slice	5.51
VFR	-0.09

Figure 9 – PAKT TAF Verification Information zoomed.

Category/Scores	Probability of Detection (POD) [?]	False Alarm Ratio (FAR) [?]	Critical Success Index (CSI) [?]	% Improvement TAF CSI over GFS LAMP
VLIFR	0.250 / 0.287	0.536 / 0.748	0.194 / 0.155	25.33
LIFR & Below	0.348 / 0.273	0.541 / 0.724	0.247 / 0.159	55.20
IFR & Below	0.428 / 0.418	0.565 / 0.674	0.275 / 0.224	22.51
MVFR & Below	0.817 / 0.807	0.263 / 0.260	0.633 / 0.629	0.64
LIFR Slice	0.272 / 0.172	0.669 / 0.818	0.175 / 0.097	80.30
IFR Slice	0.328 / 0.314	0.697 / 0.777	0.187 / 0.150	24.53
MVFR Slice	0.727 / 0.675	0.359 / 0.359	0.516 / 0.490	5.51
VFR	0.799 / 0.805	0.136 / 0.141	0.710 / 0.711	-0.09

Figure 10 – PAKT TAF Verification Information.

16.0 Pilot Weather Briefing

The accident pilot did not request nor receive weather information[24] from Alaskan Flight Services[25]. For more information regarding the accident pilot and any weather information checked on the accident day please see the Operational Factors Factual Report located in the docket of this accident.

17.0 Web Camera Images

Images from the FAA's Aviation Weather Cameras are shown in figures 13 through 20 and provide pictures of the weather conditions surrounding the accident site at the accident time. Figures 11 and 12 identify the web camera locations included in attachment 2.

[24] https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf
[25] https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/fs/alaskan/alaska/

The weather cameras (figures 13 through 20) from Misty Fjords, located 11 miles east-northeast of the accident site, showed the weather conditions surrounding the accident time with the south-facing camera images provided in figures 14 through 16 with times at 1034, 1054, and 1114 AKDT. The south-facing camera images from Misty Fjords depicted a large amount of cloud cover with bases above the 750 ft msl hilltop, but the visibility below the cloud cover was less than 8.5 miles at 1034 AKDT, less than 6.0 miles at 1054 AKDT, and the visibility was less than 3 miles by 1114 AKDT (figure 16) as noted when compared with clear day visual reference markers (figure 13). The west-facing camera images are provided in figures 18 through 20 with times at 1041, 1051, and 1101 AKDT. The west-facing camera images from Misty Fjords also depicted a large amount of cloud cover with cloud bases near mountain tops at 2,000 ft msl. In addition, the visibility was greater than 5.0 miles at 1041 and 1051 AKDT, but the visibility dropped to between 2.5 and 1.0 miles between 1051 and 1101 AKDT (figure 19 and 20) as noted when compared with clear day visual reference markers (figure 17). Similar weather conditions were observed at the Ketchikan, Minx Island, and Twin Island weather cameras, with visibility and ceiling reductions observed as earlier as 0937 AKDT on the Twin Island weather cameras. Based on the southeast-facing camera images from PAKT between 0932 and 0952 AKDT, the accident pilot departed on the accident flight in visibility conditions less than 2.5 miles and precipitation (attachment 2, as noted when compared with clear day visual reference markers). For more information, images, and camera locations please see attachment 2.

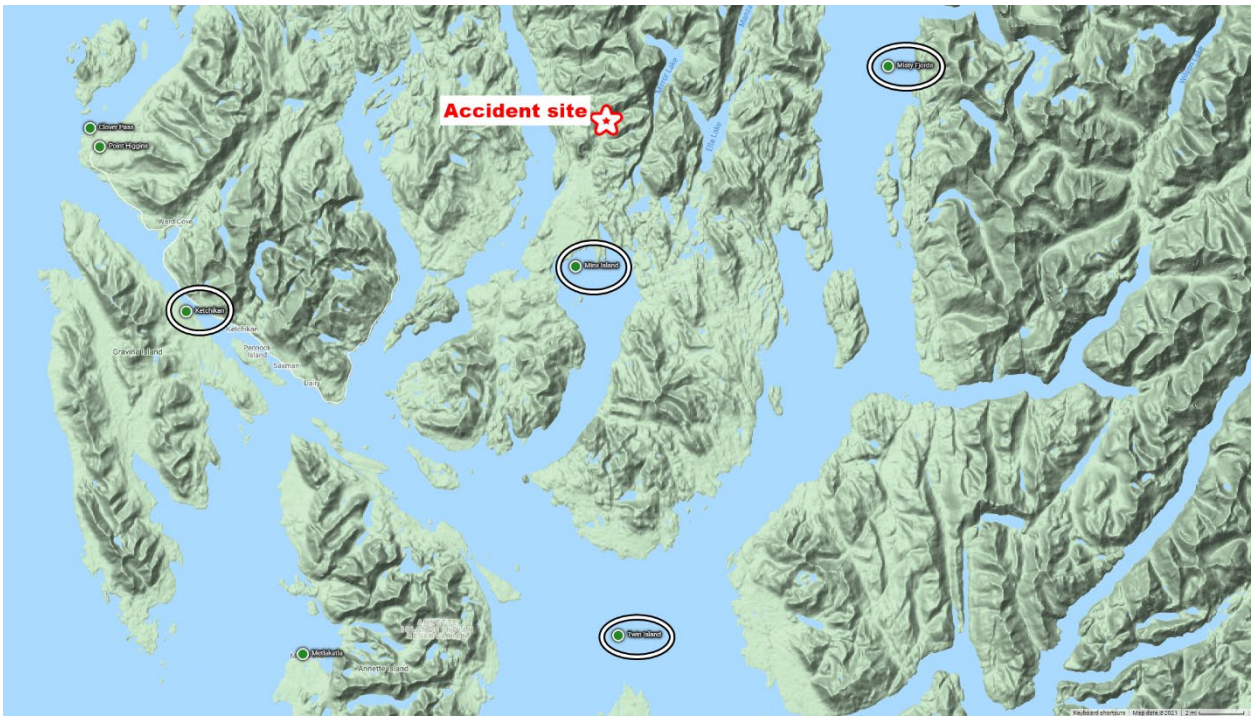

Figure 11 – Map of the closest FAA weather camera sites and the accident site.

Figure 12 – FAA weather camera Misty Fjords location on sectional chart with the direction the different camera angles with the accident site marked.

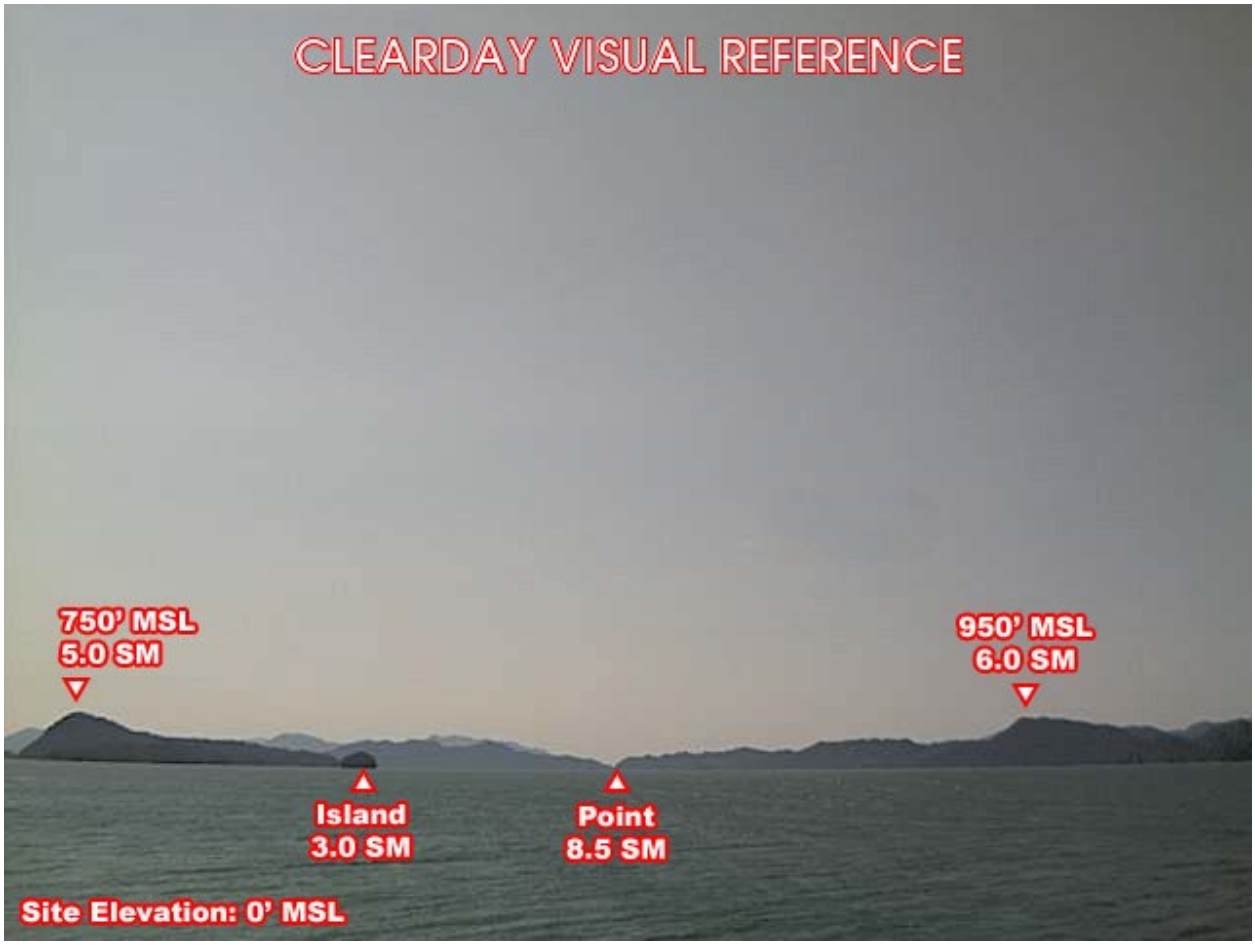

Figure 13 – FAA weather camera from Misty Fjords south view from a standard clear sky weather day.

Figure 14 – FAA weather camera from Misty Fjords south view from 1034 AKDT.

Figure 15 – FAA weather camera from Misty Fjords south view from 1054 AKDT.

Figure 16 – FAA weather camera from Misty Fjords south view from 1114 AKDT.

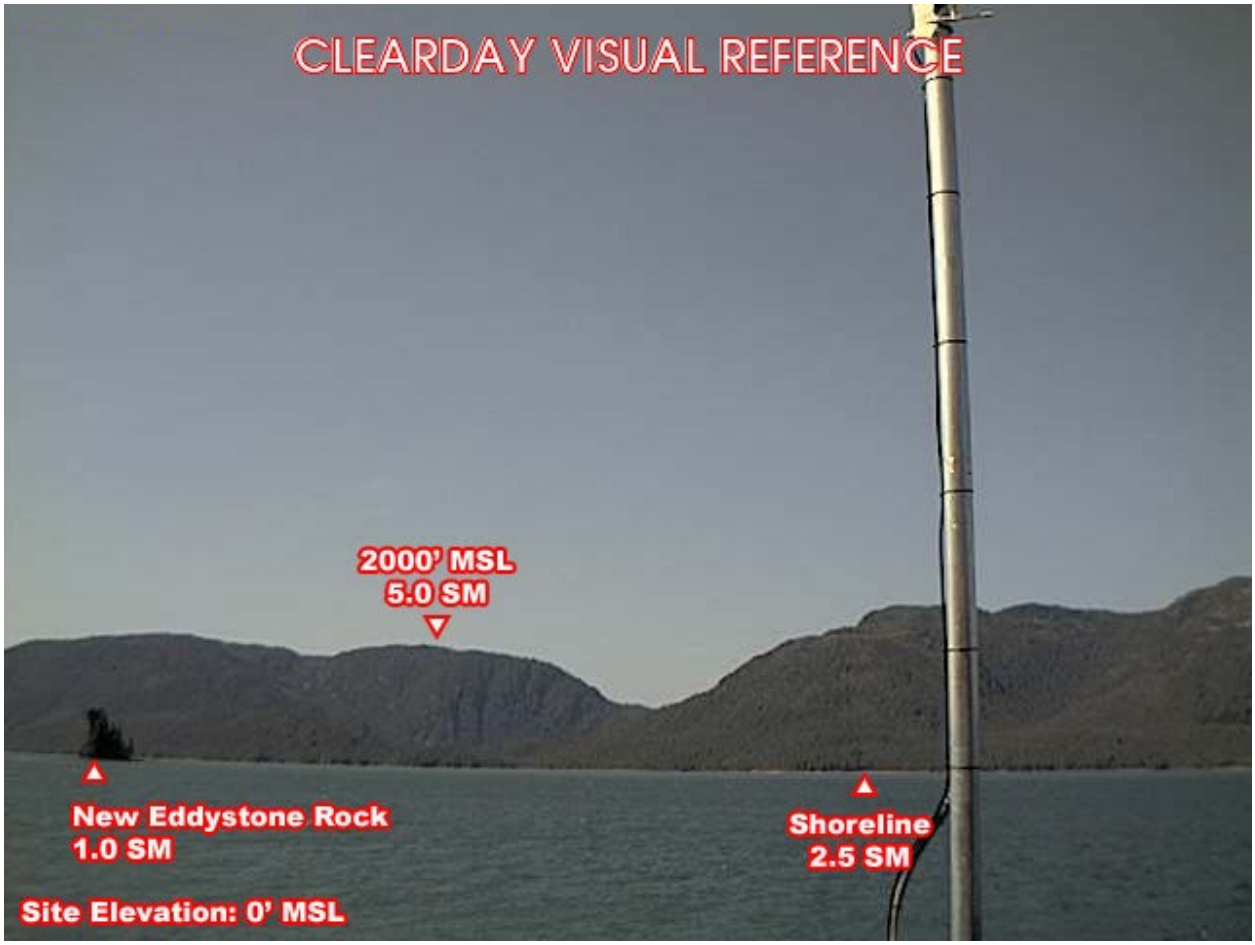

Figure 17 – FAA weather camera from Misty Fjords west view from a standard clear sky weather day.

Figure 18 – FAA weather camera from Misty Fjords west view from 1041 AKDT.

Figure 19 – FAA weather camera from Misty Fjords west view from 1051 AKDT.

Figure 20 – FAA weather camera from Misty Fjords west view from 1101 AKDT.

In addition to the FAA's current weather camera network, the FAA has several projects in process to include both Visual Weather Observation System (VWOS) and VEIA. For more information on these, and more FAA weather camera developments please see attachment 3, which is the latest information as of August 24, 2021.

Figures 21 through 28 provide the VEIA imagery captured around the accident timeframe from the 4 FAA weather camera locations noted in figure 11. The VEIA algorithm uses the FAA weather camera imagery to produce a visibility estimate every ten minutes. VEIA data was not available operationally at the time of the accident; however, VEIA experimental data was provided by the FAA Aviation Weather Research Program. The estimated visibilities from each of the four cameras are plotted as black symbols. The prevailing visibility estimated by VEIA is plotted as a red line.

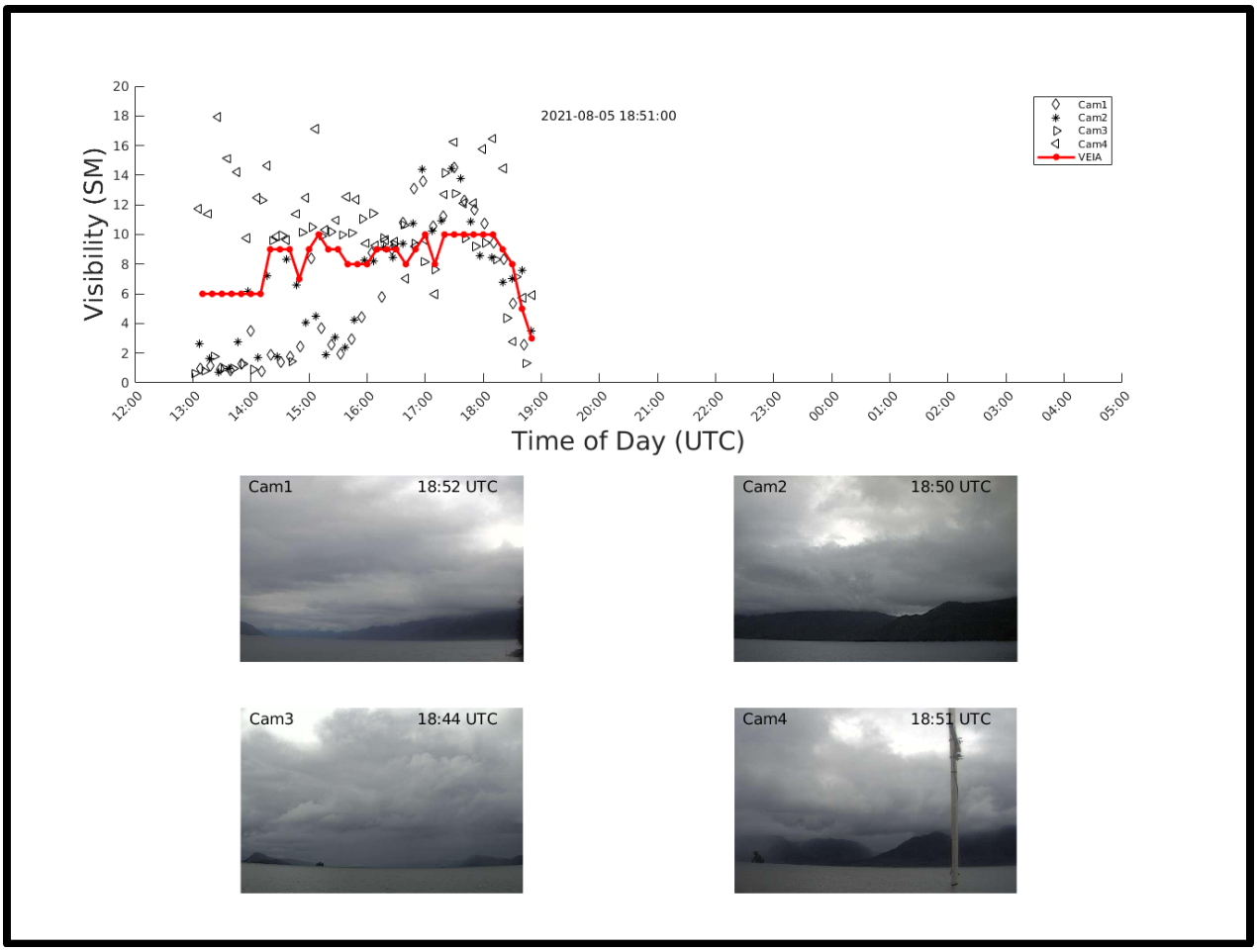

Figure 21 – FAA weather cameras from Misty Fjords; VEIA data through 1050 AKDT.

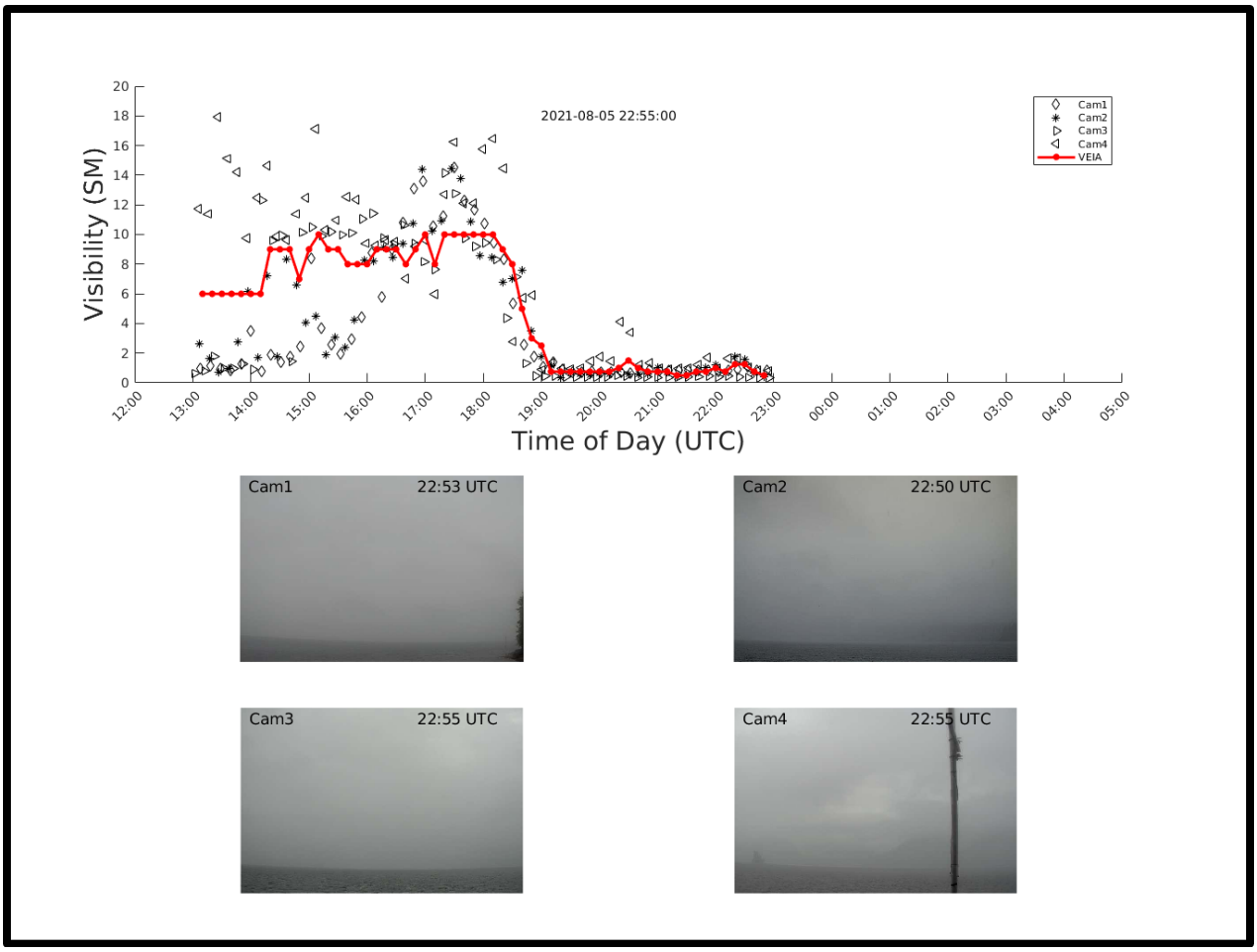

Figure 22 – FAA weather cameras from Misty Fjords; VEIA data through 1500 AKDT.

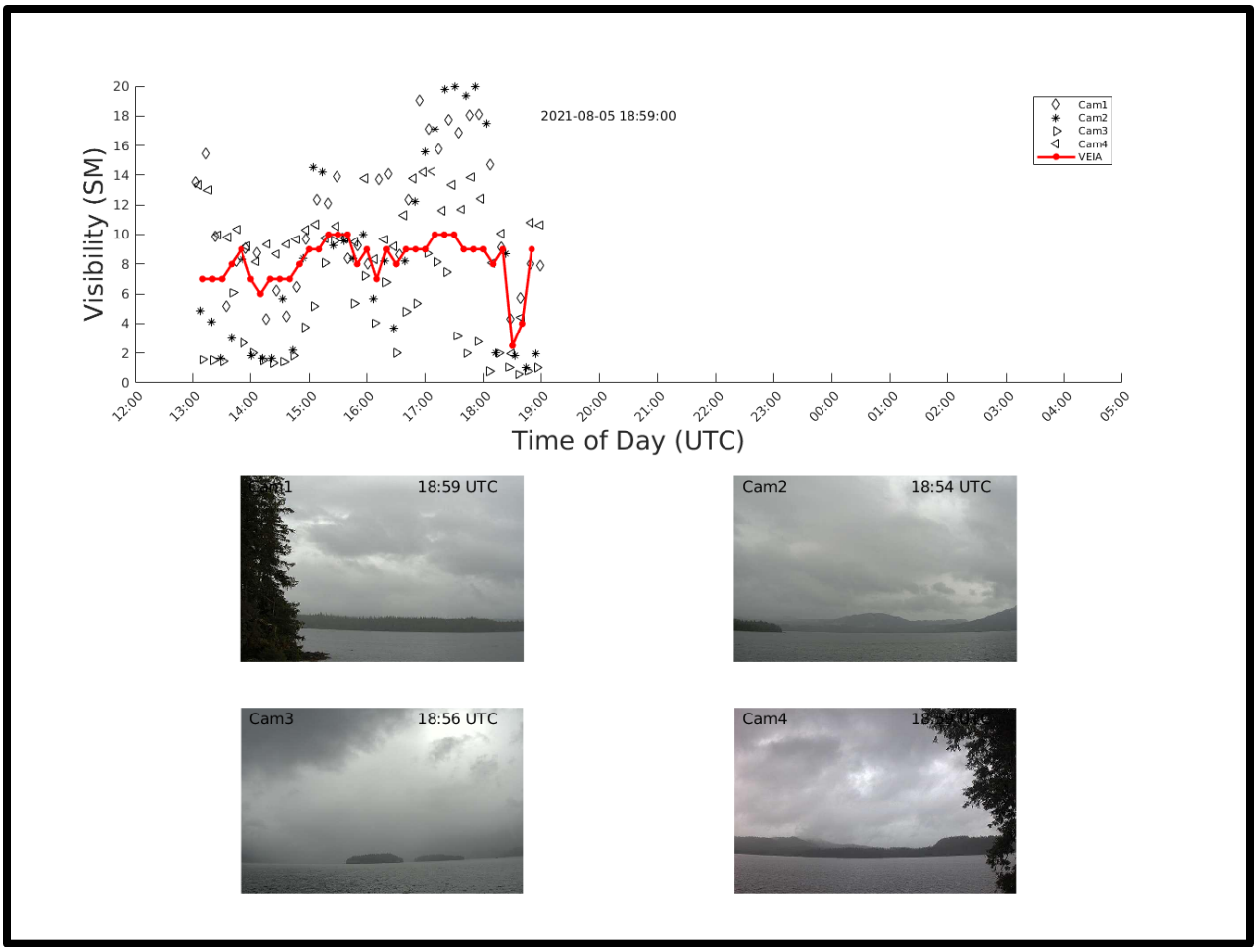

Figure 23 – FAA weather cameras from Minx Island; VEIA data through 1050 AKDT.

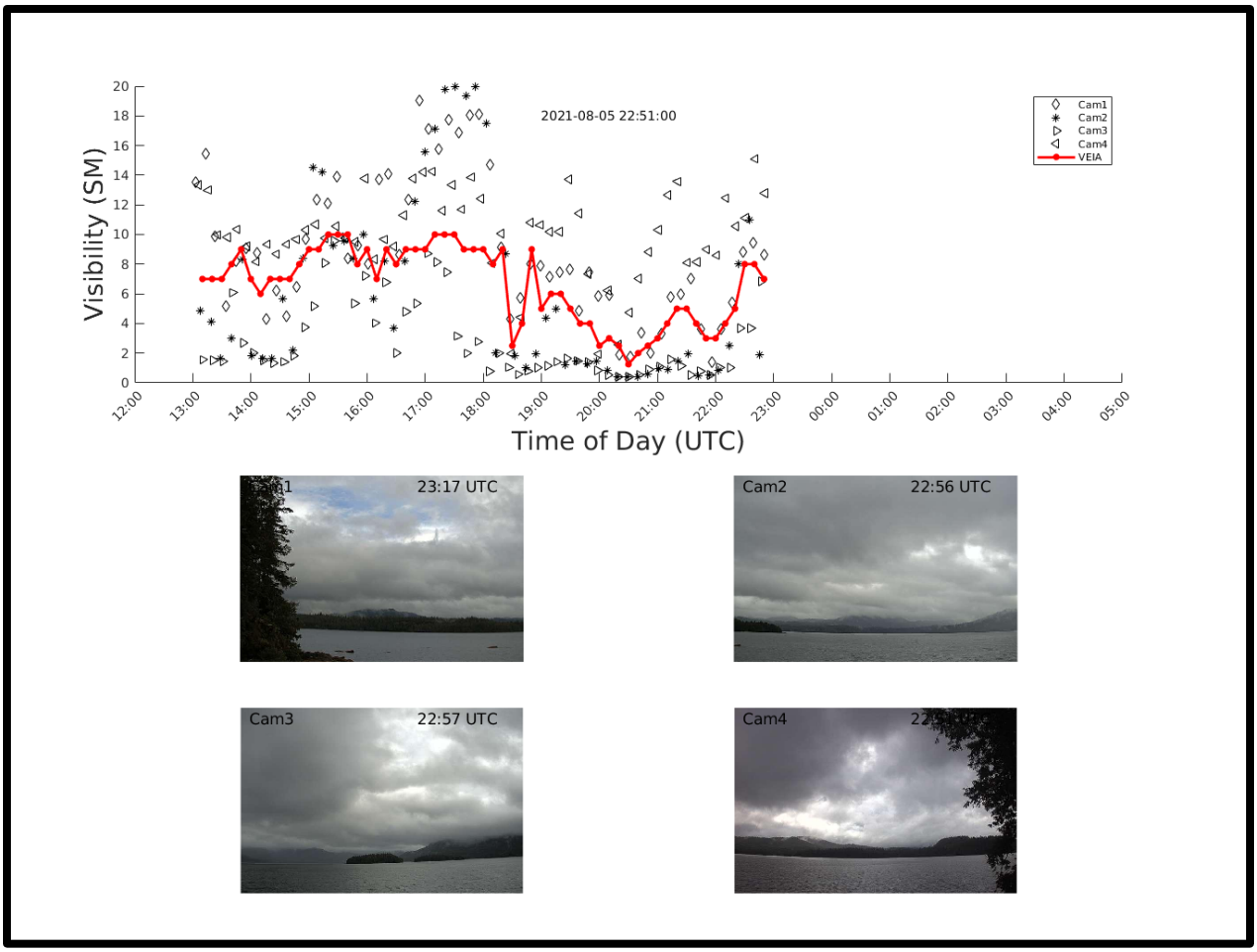

Figure 24 – FAA weather cameras from Minx Island; VEIA data through 1500 AKDT.

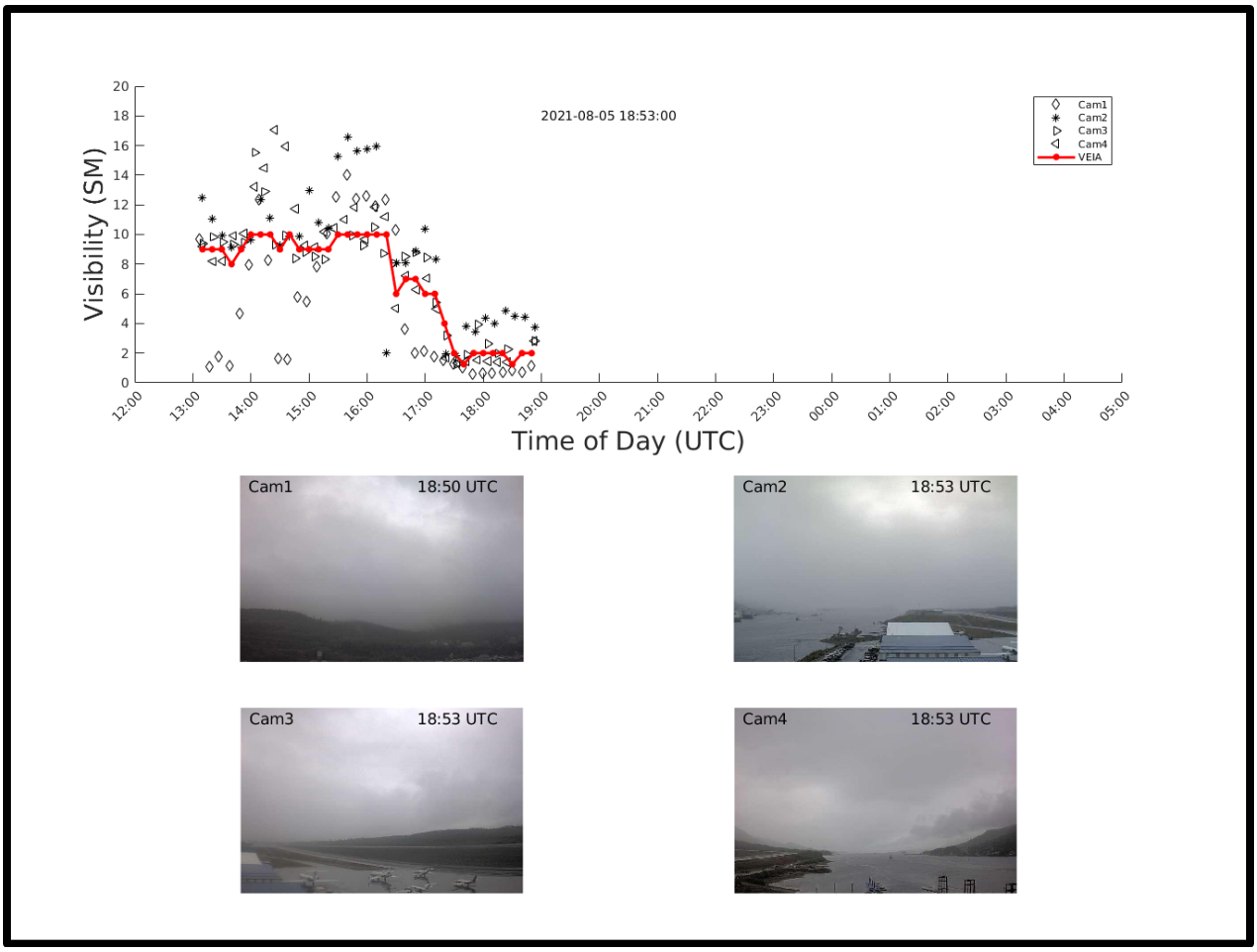

Figure 25 – FAA weather cameras from Ketchikan; VEIA data through 1050 AKDT.

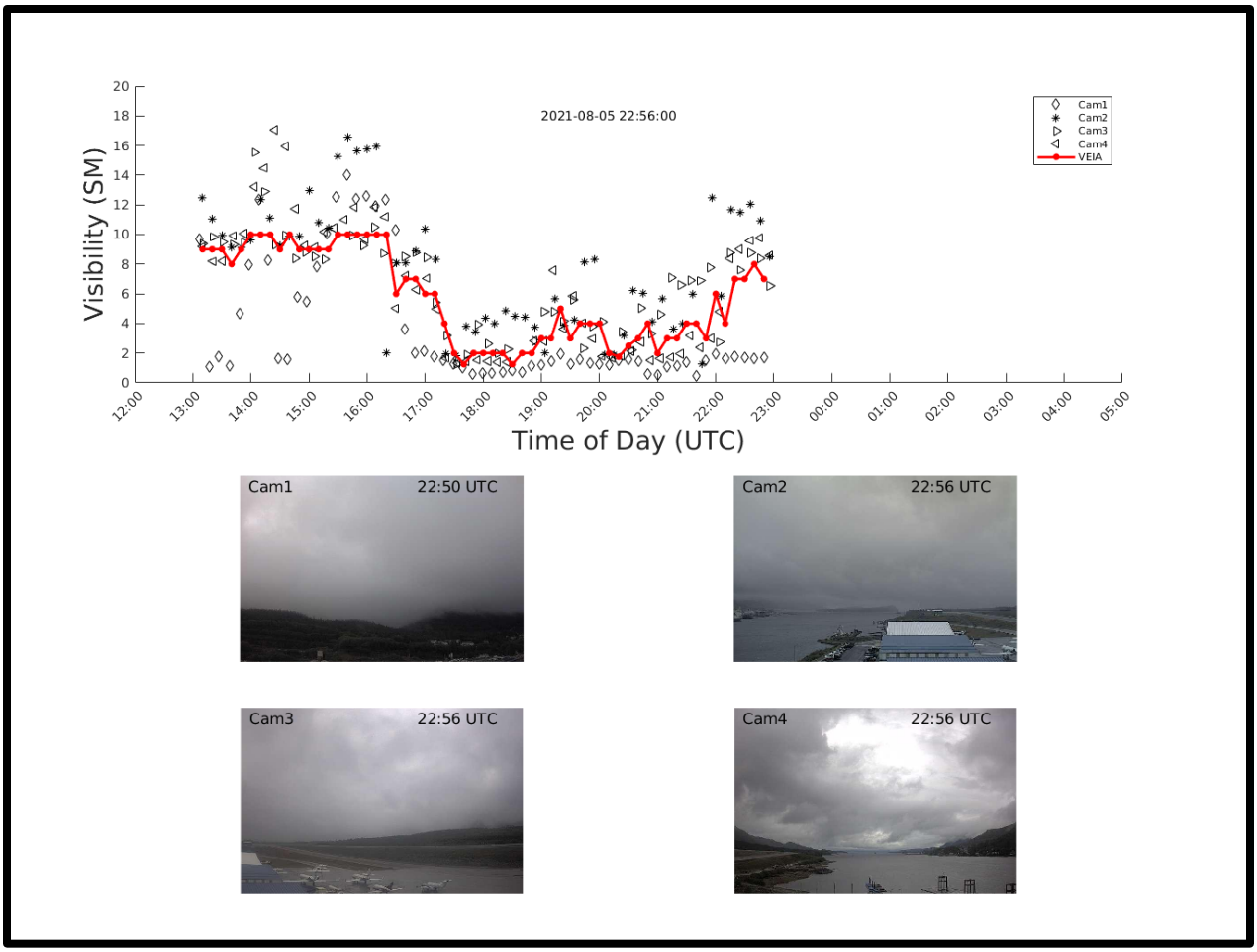

Figure 26 – FAA weather cameras from Ketchikan; VEIA data through 1500 AKDT.

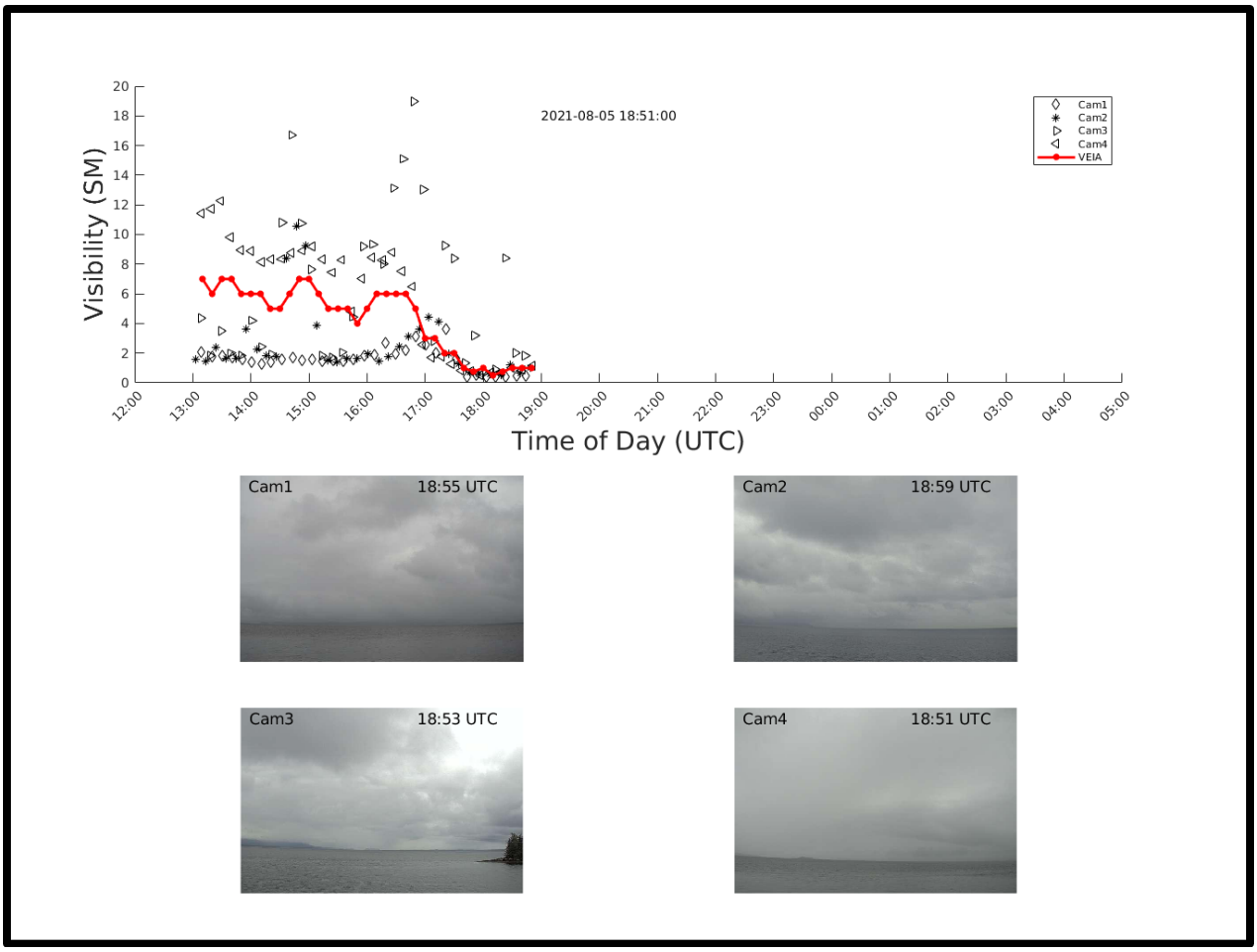

Figure 27 – FAA weather cameras from Twin Island; VEIA data through 1050 AKDT.

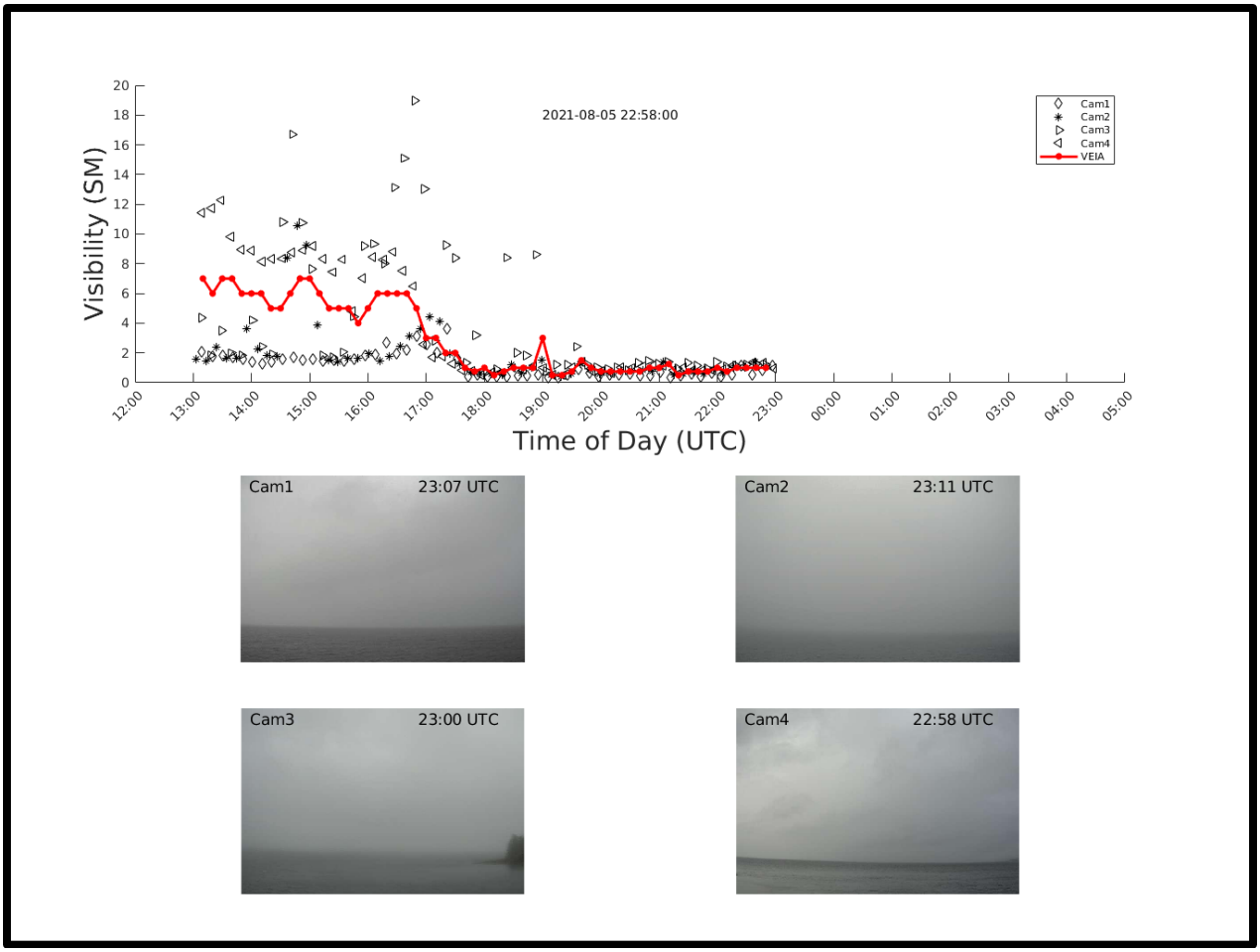

Figure 28 – FAA weather cameras from Twin Island; VEIA data through 1500 AKDT.

18.0 Airborne Images Showing Sky Conditions

Images with information about cloud cover, precipitation, and visibility conditions along the route of the accident flight were reviewed. The investigation recovered multiple personal electronic devices (PEDs) at the accident site, which were sent to the NTSB Recorders Laboratory in Washington, DC for download and review.[26] Please see the docket material for accident flight track location and timing. Figure 29 is a geographic summary of the accident flight track data with the locations and times of the imagery viewed from the recovered PEDs for the following figures in Section 18.0.

[26] Recovered PEDs from the accident site included an iPhone XR, an iPhone 11, and an iPhone 8.

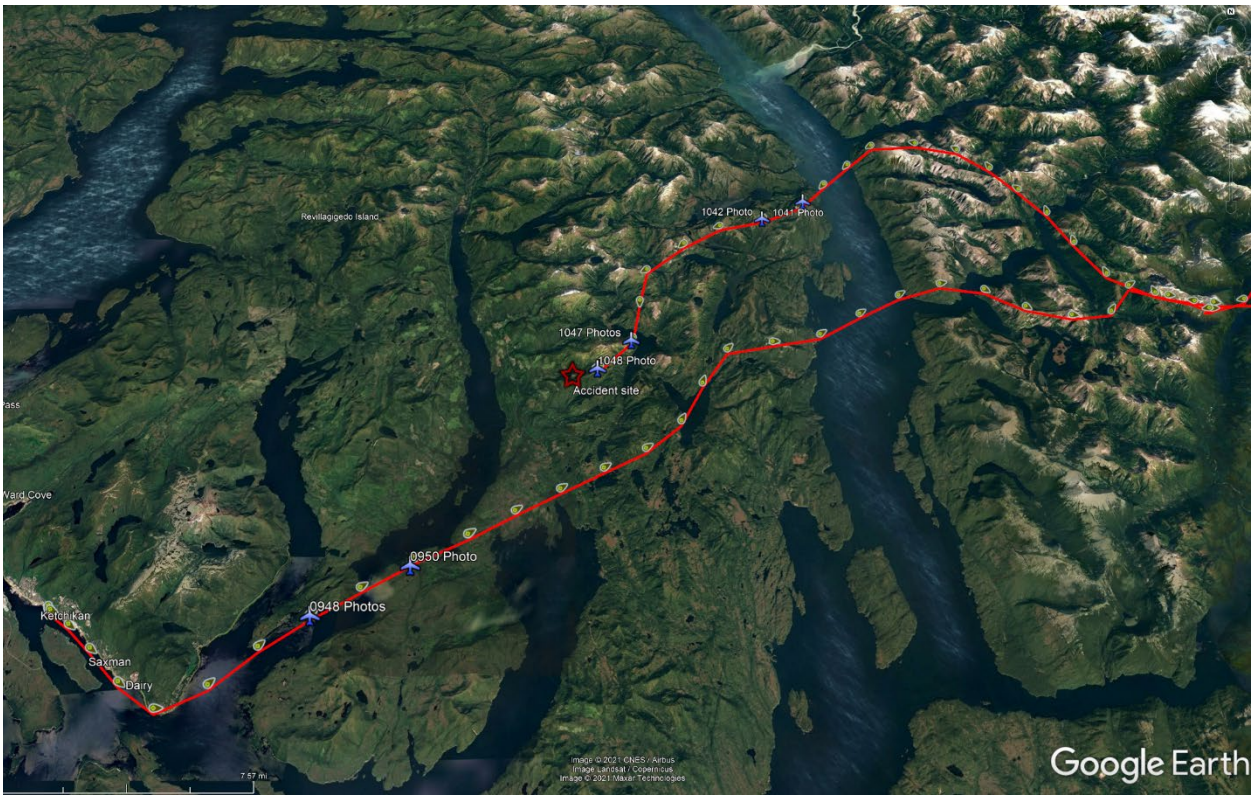

Figure 29 – Accident flight track data and locations and times of imagery from recovered PEDs.

The following is a photo (figure 30) out of the right side of the accident airplane taken by a passenger on the accident flight with an iPhone XR at 0948 AKDT.

Figure 30 – Photo taken from an iPhone XR at 0948 AKDT from the right side of the accident airplane. It shows the western arm of Carroll Inlet looking to the southeast.

The following is a photo (figure 31) out of the left side of the accident airplane taken by a passenger on the accident flight with an iPhone 8 at 0948 AKDT.

Figure 31 – Photo taken from an iPhone 8 at 0948 AKDT from the left side of the accident airplane. It shows the western arm of Carroll Inlet and California Cove looking to the north.

The following is a photo (figure 32) out of the right side of the accident airplane taken by a passenger on the accident flight with an iPhone 11 at 0950 AKDT.

Figure 32 – Photo taken from an iPhone 11 at 0950 AKDT from the right side of the accident airplane. It shows Brunn Point looking southeast towards Throne Arm.

The following is a photo (figure 33) out of the left side of the accident airplane taken by a passenger on the accident flight with an iPhone 8 at 1041 AKDT.

Figure 33 – Photo taken from an iPhone 8 at 1041 AKDT from the left side of the accident airplane. It shows Behm Canal looking to the southwest.

The following is a photo (figure 34) out of the left side of the accident airplane taken by a passenger on the accident flight with an iPhone XR at 1042 AKDT.

Figure 34 – Photo taken from an iPhone XR at 1042 AKDT from the left side of the accident airplane. It shows Behm Canal from Sargent Bay southward with image facing to the southwest.

The following is a photo (figure 35) out of the right side of the accident airplane taken by a passenger on the accident flight with an iPhone 11 at 1047 AKDT.

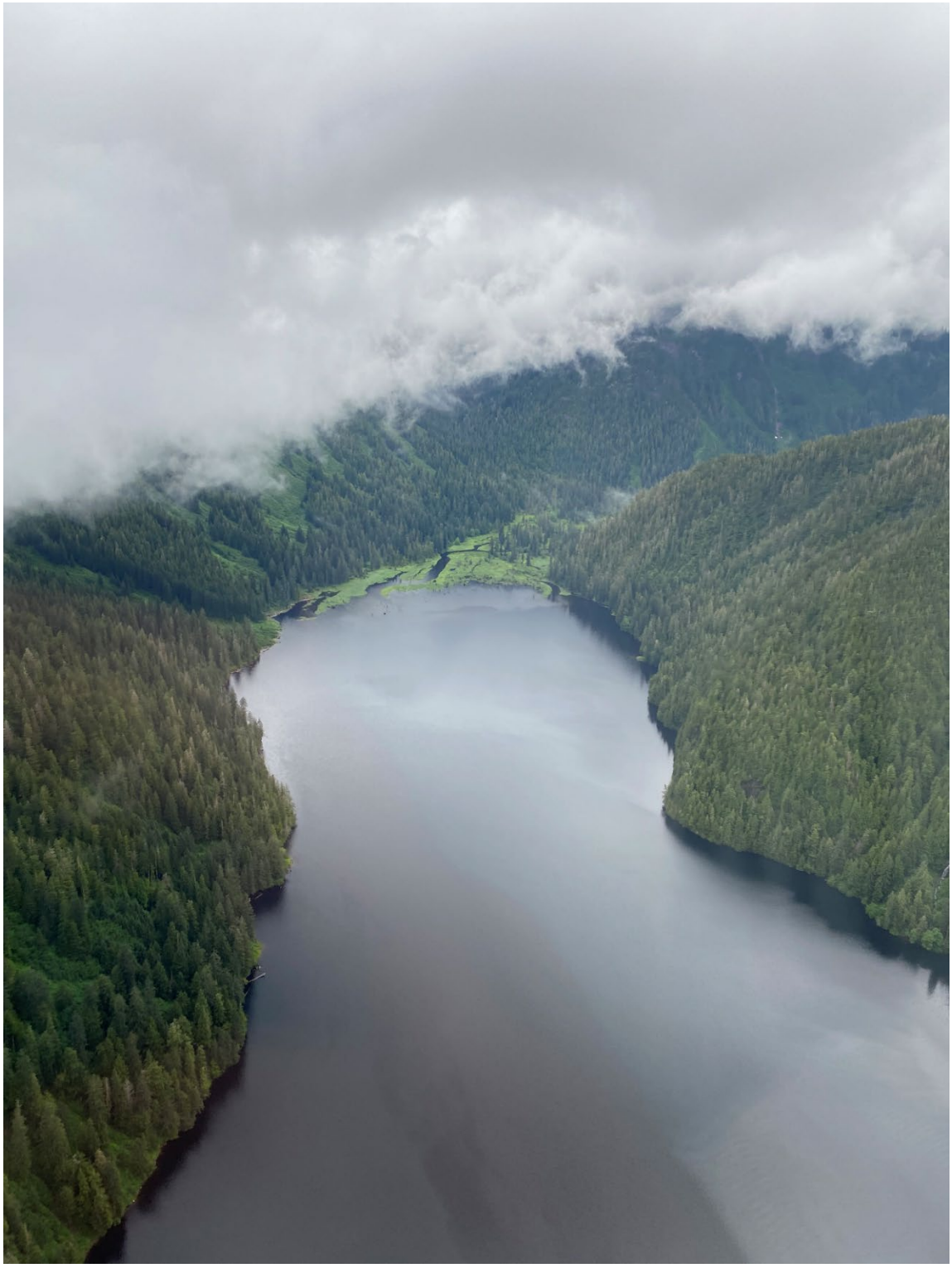

Figure 35 – Photo taken from an iPhone 11 at 1047 AKDT from the right side of the accident airplane. It shows the northern arm of Mirror Lake looking to the northwest.

The following is a photo (figure 36) out of the left side of the accident airplane taken by a passenger on the accident flight with an iPhone 8 at 1047 AKDT.

Figure 36 – Photo taken from an iPhone 8 at 1047 AKDT from the left side of the accident airplane. It shows the northwestern arm of Ella Lake looking to the southeast.

The following is a photo (figure 37) out of the left side of the accident airplane taken by a passenger on the accident flight with an iPhone 8 at 1048 AKDT.

Figure 37 – Photo taken from an iPhone 8 at 1048 AKDT from the left side of the accident airplane. It shows portions of the terrain in between Mirror Lake and Big Lake looking to the south.

19.0 Astronomical Data

The astronomical data obtained for the accident site on August 5, 2021, indicated the following:

SUN	
Begin civil twilight	0514 AKDT
Sunrise	0559 AKDT
Accident time	**1050 AKDT**[27]
Sun transit	1351 AKDT
Sunset	2141 AKDT
End civil twilight	2226 AKDT

At the time of the accident the Sun was located at an altitude of 38.32° and azimuth of 120.00°.

E. LIST OF ATTACHMENTS

Attachment 1 – AAWU graphical forecast information valid at the accident time

Attachment 2 – FAA Weather Camera data around the accident time

Attachment 3 – FAA Weather Camera Information as of August 24, 2021

Submitted by:

_____

Paul Suffern
Senior Meteorologist

[27] Inserted upset time for reference and context.