



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

March 13, 2017

### **Weather Study**

# **METEOROLOGY**

ANC17FA010

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## **A. ACCIDENT**

Location: Near Port Alsworth, Alaska  
Date: December 7, 2016  
Time: 0935 Alaska standard time  
1835 Coordinated Universal Time (UTC)  
Airplane: Piper PA-28-180, N8648N

## **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 the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are Alaska standard time (AKST) on December 7, 2016, and are based upon the 24-hour clock, where local time is -9 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.

The accident site was located at latitude 60.2972° N, longitude 154.1172° W, at an approximate elevation of 250 feet.

## **D. WEATHER 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 Surface Analysis Chart

The NWS Surface Analysis Chart for 0900 AKST is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart depicted a stationary front over the accident site with the stationary front located from Bristol Bay, Alaska, stretching northeastward to the central Alaska Mountain range (figure 1). There was a surface low pressure center located in the central Alaska Mountain range with a pressure of 1022-hectopascals (hPa). Another surface low pressure center with a pressure of 1009-hPa was located in the western Gulf of Alaska. The station models around the accident site depicted air temperatures near 5 Fahrenheit (°F), with dew point temperatures near 0° F, and temperature-dew point spreads of 4° F or less, a northerly surface wind around 15 knots and broken to overcast sky cover. With a stationary front acting as a lifting mechanism in the mountainous terrain and relatively moist surface conditions, clouds would be expected.

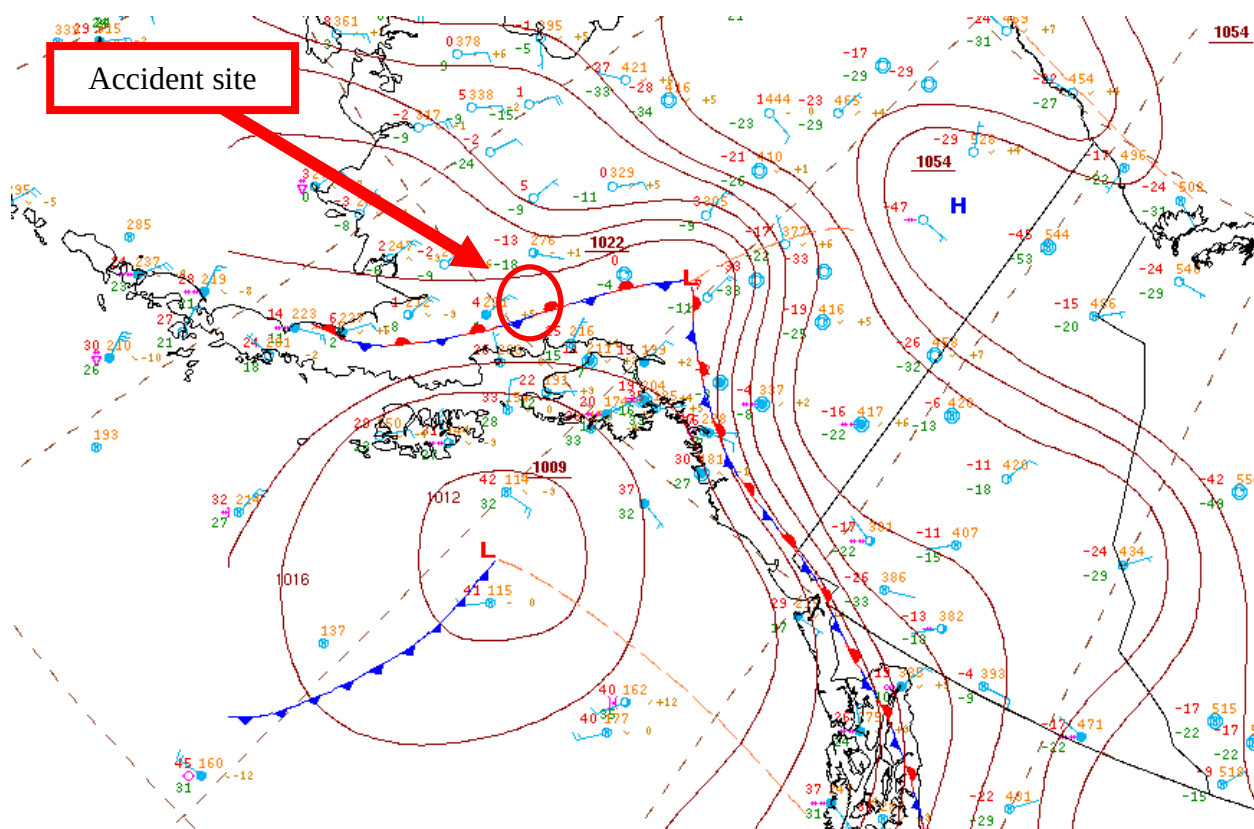
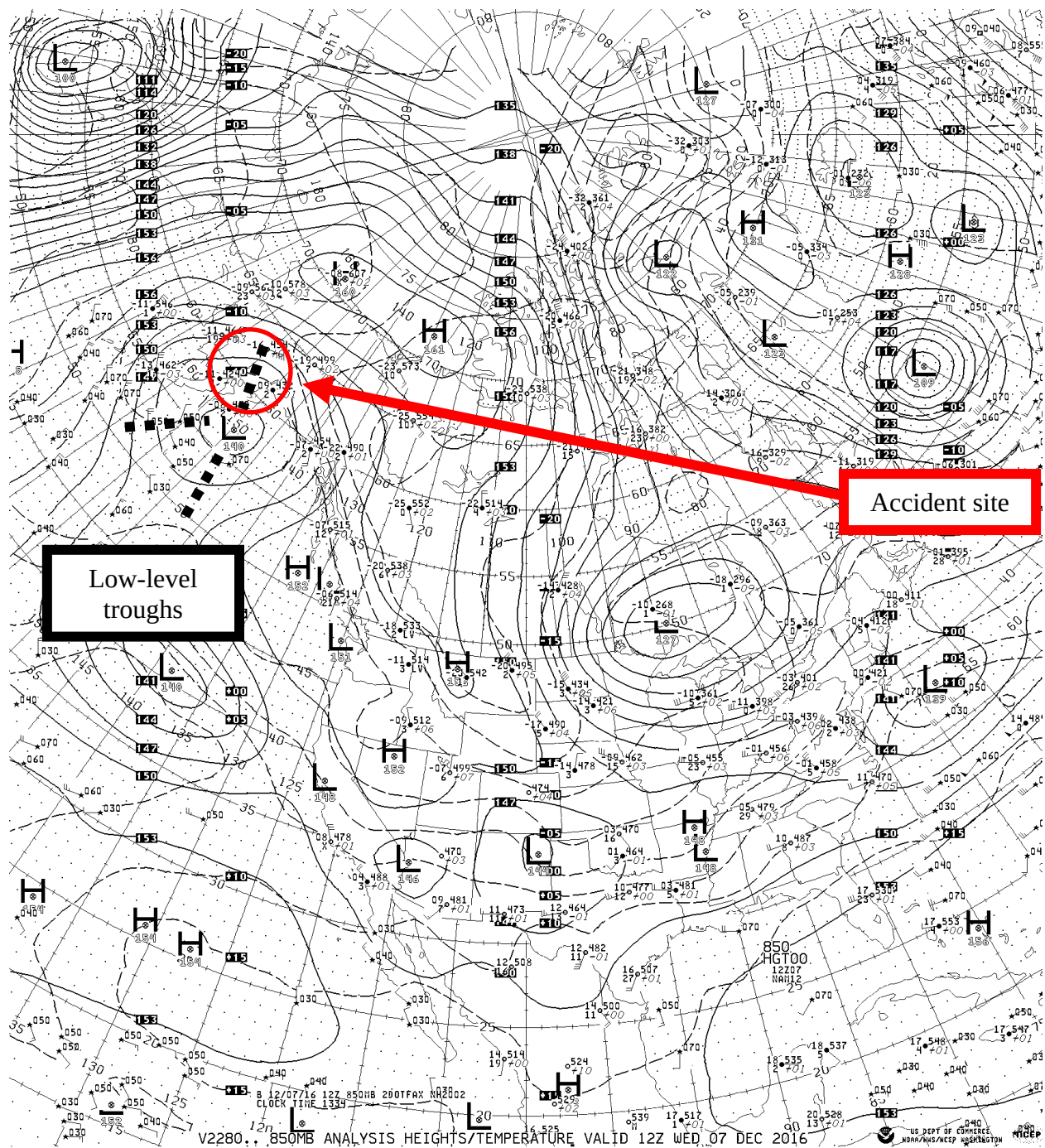


Figure 1 – NWS Surface Analysis Chart for 0900 AKST

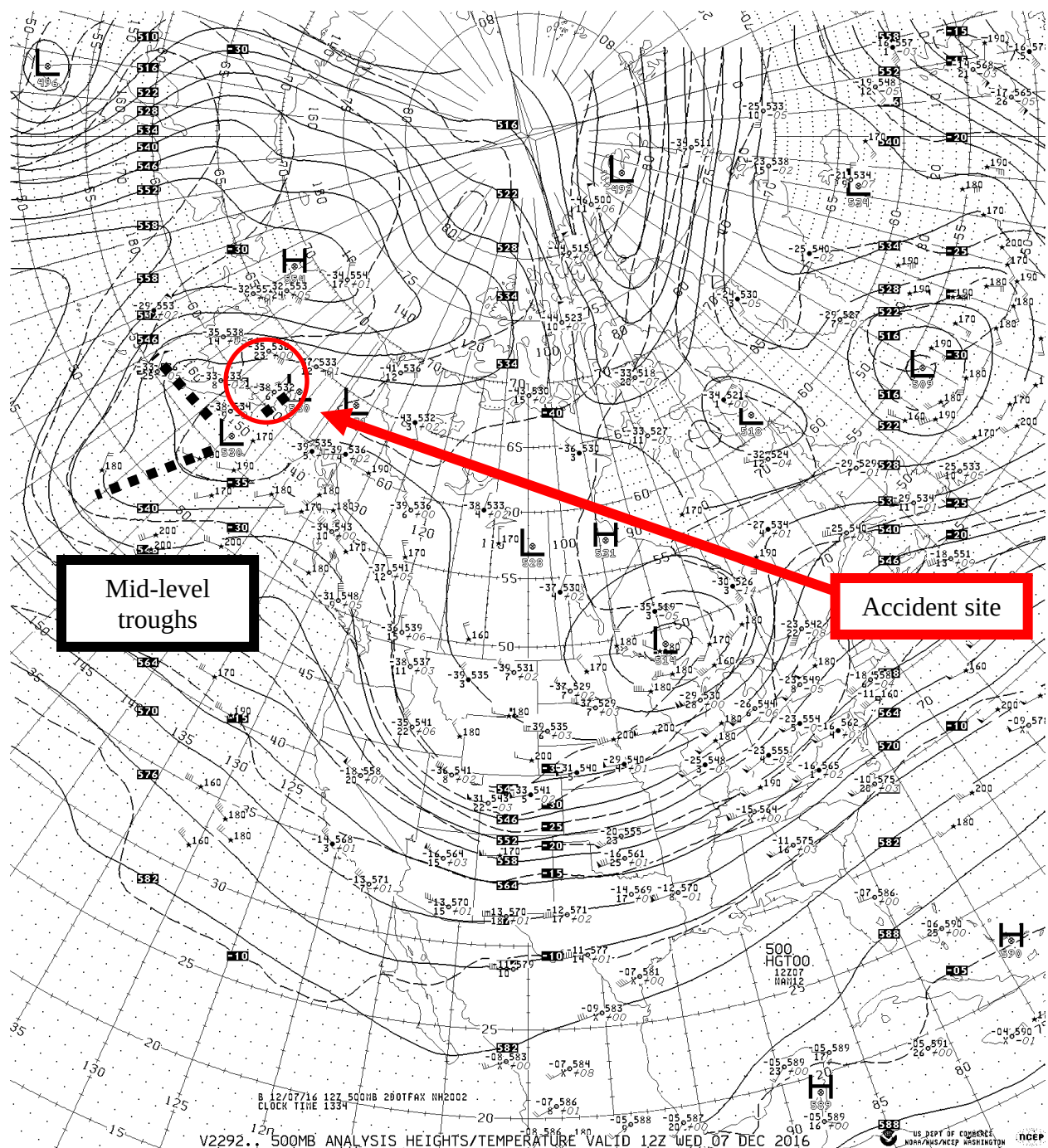
## 1.2 Upper Air Charts

The NWS Constant Pressure Charts for 0300 AKST at 850- and 500-hectopascals (hPa) are presented in figures 2 and 3. Low- and mid-level troughs<sup>1</sup> were located over the accident site around the accident time with additional troughs located in the Gulf of Alaska. These troughs would have acted as lifting mechanisms to help produce clouds and precipitation, especially in mountainous terrain.

<sup>1</sup> Trough – An elongated area of relatively low atmospheric pressure or heights.



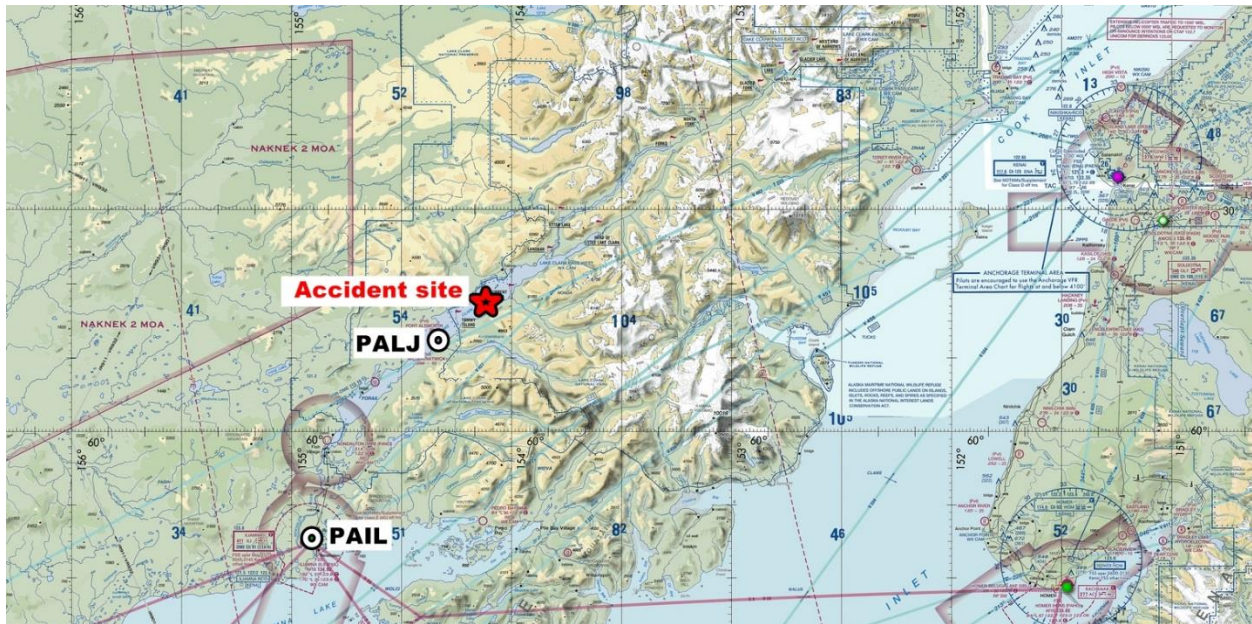
**Figure 2 – NWS 850-hPa Constant Pressure Chart for 0300 AKST**



**Figure 3 – NWS 500-hPa Constant Pressure Chart for 0300 AKST**

## 2.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language with visibility in statute miles for this section. Figure 4 is a sectional chart with the accident site and the closest weather reporting locations marked.



**Figure 4 – Sectional chart of accident area with the location of the accident site and surface observation sites**

Port Alsworth Airport (PALJ) was the closest official weather station to the accident site. PALJ had an Aviation Paid Weather Observer (A-Paid) who would provide weather observations on the accident day. More information on A-Paid can be found in section 17.0. PALJ was located 8 miles southwest of the accident site, at an elevation of 280 feet, and had a 22° easterly magnetic variation<sup>2</sup> (figure 4). The following observations were taken and disseminated during the times surrounding the accident:<sup>3</sup>

[1452 AKST on December 5]

METAR PALJ 052352Z 00000KT 30SM BKN060  
M12/M16 A3019 RMK EST PASS OPEN NOSPECI

<sup>2</sup> Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1985, latest measurement taken from <http://www.airnav.com/airport/PALJ>

<sup>3</sup> The bold sections in this NWS product and the rest of 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 section 3.0 next to the METARs are provided for quick reference between UTC and local times around the accident time.

**[1655 AKST on December 5]**

**METAR PALJ 060155Z 00000KT 25SM OVC060  
M10/M12 A3016 RMK LAST 411001172 EST  
PASS OPEN NOSPECI**

**[0858 AKST on December 6]**

**METAR PALJ 061758Z 00000KT 7SM SCT060 M09/M12  
A3012 RMK FIRST NOSPECI**

**ACCIDENT TIME 0935 AKST on December 7**

**[1459 AKST] METAR PALJ 072359Z 15004KT 7SM OVC005 M16/M18 A3018 RMK EST  
PASS CLOSED / NOSPECI**

PALJ weather at 1655 AKST on December 5, wind calm, 25 miles visibility, overcast ceiling at 6,000 feet above ground level (agl), temperature -10° Celsius (C), dew point temperature -12° C, and altimeter setting 30.16 inches of mercury. Remarks, last observation, 24-hour maximum temperature of -10.0° C, 24-hour minimum temperature -17.2° C, estimate pass open, no specials.

PALJ weather at 0858 AKST on December 6, wind calm, 7 miles visibility, scattered clouds at 6,000 feet agl, temperature -9° C, dew point temperature -12° C, and altimeter setting 30.12 inches of mercury. Remarks, first observation, no specials.

PALJ weather at 1459 AKST on December 7, wind from 150° at 4 knots, 7 miles visibility, overcast ceiling at 500 feet agl, temperature -16° C, dew point temperature -18° C, and altimeter setting 30.18 inches of mercury. Remarks, estimate pass closed, no specials.

The 4 total observations above were the only 4 observations taken by the A-Paid observer on December 5, 6, and 7.

Iliamna Airport (PAIL) was the next closest official weather station to the accident site, located 2 miles northwest of Iliamna, Alaska. PAIL had Automated Surface Observing System (ASOS<sup>4</sup>) whose reports were supplemented by air traffic control. PAIL was located 40 miles southwest of the accident site, at an elevation of 192 feet, and had a 17° easterly magnetic variation<sup>5</sup> (figure 4). The following observations were taken and disseminated during the times surrounding the accident:

**[0553 AKST] METAR PAIL 071453Z 36017G24KT 10SM OVC013 M15/M17 A3015 RMK  
PK WND 36026/1422 SLP216 T11501172 55001 VIA AUTODIAL=**

**[0653 AKST] METAR PAIL 071553Z 36015G21KT 10SM OVC012 M15/M18 A3015 RMK  
AO2 SLP217 T11501178=**

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<sup>4</sup> ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

<sup>5</sup> Magnetic variation – The angle (at a particular location) between magnetic north and true north. 2010, latest measurement taken from <http://www.airnav.com/airport/PAIL>

[0753 AKST] METAR PAIL 071653Z 36015G21KT 10SM OVC010 M15/M17 A3016 RMK  
AO2 SLP218 T11501172=

[0815 AKST] SPECI PAIL 071715Z 36017G25KT 10SM OVC009 M15/M17 A3016 RMK  
AO2 T11501172=

**[0853 AKST] METAR PAIL 071753Z 36016G23KT 10SM OVC009 M16/M17 A3017 RMK  
AO2 SLP221 T11561172 11139 21156 53005=**

**[0911 AKST] SPECI PAIL 071811Z 36013G23KT 10SM OVC011 M16/M17 A3017 RMK  
AO2 T11561172=**

**ACCIDENT TIME 0935 AKST**

**[0953 AKST] METAR PAIL 071853Z 36016G22KT 10SM OVC012 M16/M17 A3016 RMK  
AO2 SLP221 T11561172=**

**[1053 AKST] METAR PAIL 071953Z 36016KT 10SM OVC013 M16/M17 A3018 RMK  
AO2 SLP225 T11561172=**

[1153 AKST] METAR PAIL 072053Z 36015G21KT 10SM OVC010 M16/M17 A3018 RMK  
AO2 SLP225 T11611172 53004=

[1248 AKST] SPECI PAIL 072148Z 36015G21KT 10SM SCT010 M16/M17 A3018 RMK  
AO2=

PAIL weather at 0853 AKST, wind from 360° at 16 knots with gusts to 23 knots, 10 miles visibility, overcast ceiling at 900 feet agl, temperature of -16° C, dew point temperature of -17° C, and an altimeter setting of 30.17 inches of mercury. Remarks, station with a precipitation discriminator, sea-level pressure 1022.1 hPa, temperature -15.6° C, dew point temperature -17.2° C, 6-hourly maximum temperature of -13.9° C, 6-hourly minimum temperature of -15.6° C, 3-hourly pressure increase of 0.5 hPa.

PAIL weather at 0911 AKST, wind from 360° at 13 knots with gusts to 23 knots, 10 miles visibility, overcast ceiling at 1,100 feet agl, temperature of -16° C, dew point temperature of -17° C, and an altimeter setting of 30.17 inches of mercury. Remarks, station with a precipitation discriminator, temperature -15.6° C, dew point temperature -17.2° C.

PAIL weather at 0953 AKST, wind from 360° at 16 knots with gusts to 22 knots, 10 miles visibility, overcast ceiling at 1,200 feet agl, temperature of -16° C, dew point temperature of -17° C, and an altimeter setting of 30.16 inches of mercury. Remarks, station with a precipitation discriminator, sea-level pressure 1022.1 hPa, temperature -15.6° C, dew point temperature -17.2° C.

PAIL weather at 1053 AKST, wind from 360° at 16 knots, 10 miles visibility, overcast ceiling at 1,300 feet agl, temperature of -16° C, dew point temperature of -17° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, sea-level pressure 1022.5 hPa, temperature -15.6° C, dew point temperature -17.2° C.

The observations from PALJ and PAIL surrounding the accident time indicated IFR<sup>6</sup> to MVFR<sup>7</sup> conditions prevailed during the period with the lowest cloud cover of 500 feet agl at 1459 AKST at PALJ.

### 3.0 Upper Air Data

The closest official upper air sounding to the accident site was from King Salmon, Alaska, (PAKN), located 124 miles southwest of the accident site, with a site number 70326, and an elevation of 46 feet. The 0300 AKST sounding was plotted on a standard Skew-T log P diagram<sup>8</sup> with the derived stability parameters included in figure 5 (with data from the surface to 700-hPa, or 9,500 feet msl.) This data was analyzed utilizing the RAOB<sup>9</sup> software package. The sounding depicted the lifted condensation level (LCL)<sup>10</sup> at 1,264 feet msl and a convective condensation level (CCL)<sup>11</sup> of 5,379 feet. The freezing level was at the surface. The precipitable water value was 0.25 inches.

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<sup>6</sup> Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 feet agl and/or less than 3 miles visibility.

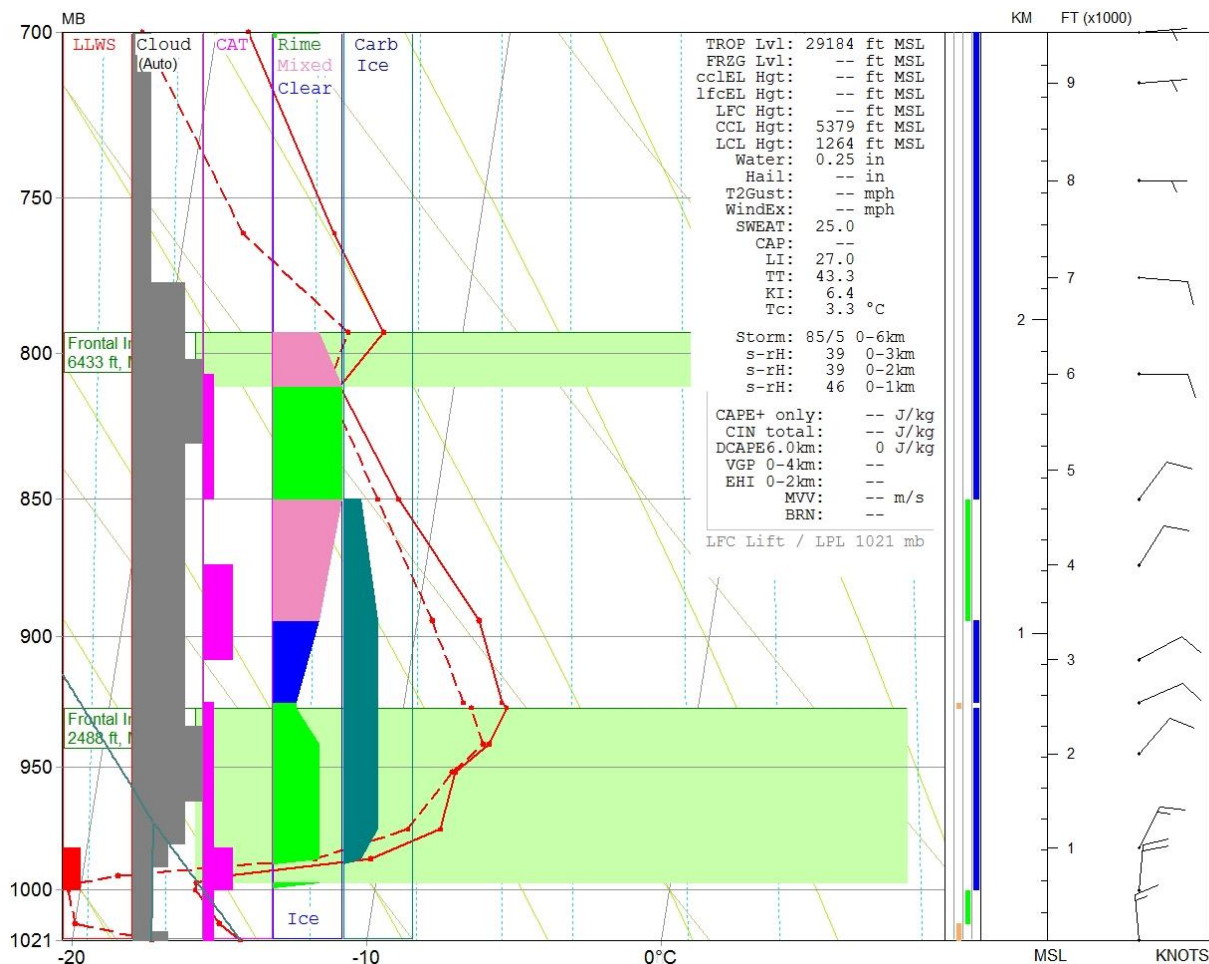
<sup>7</sup> Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling between 1,000 and 3,000 feet agl and/or 3 to 5 miles visibility.

<sup>8</sup> 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.

<sup>9</sup> RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

<sup>10</sup> Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

<sup>11</sup> Convective Condensation Level (CCL) – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

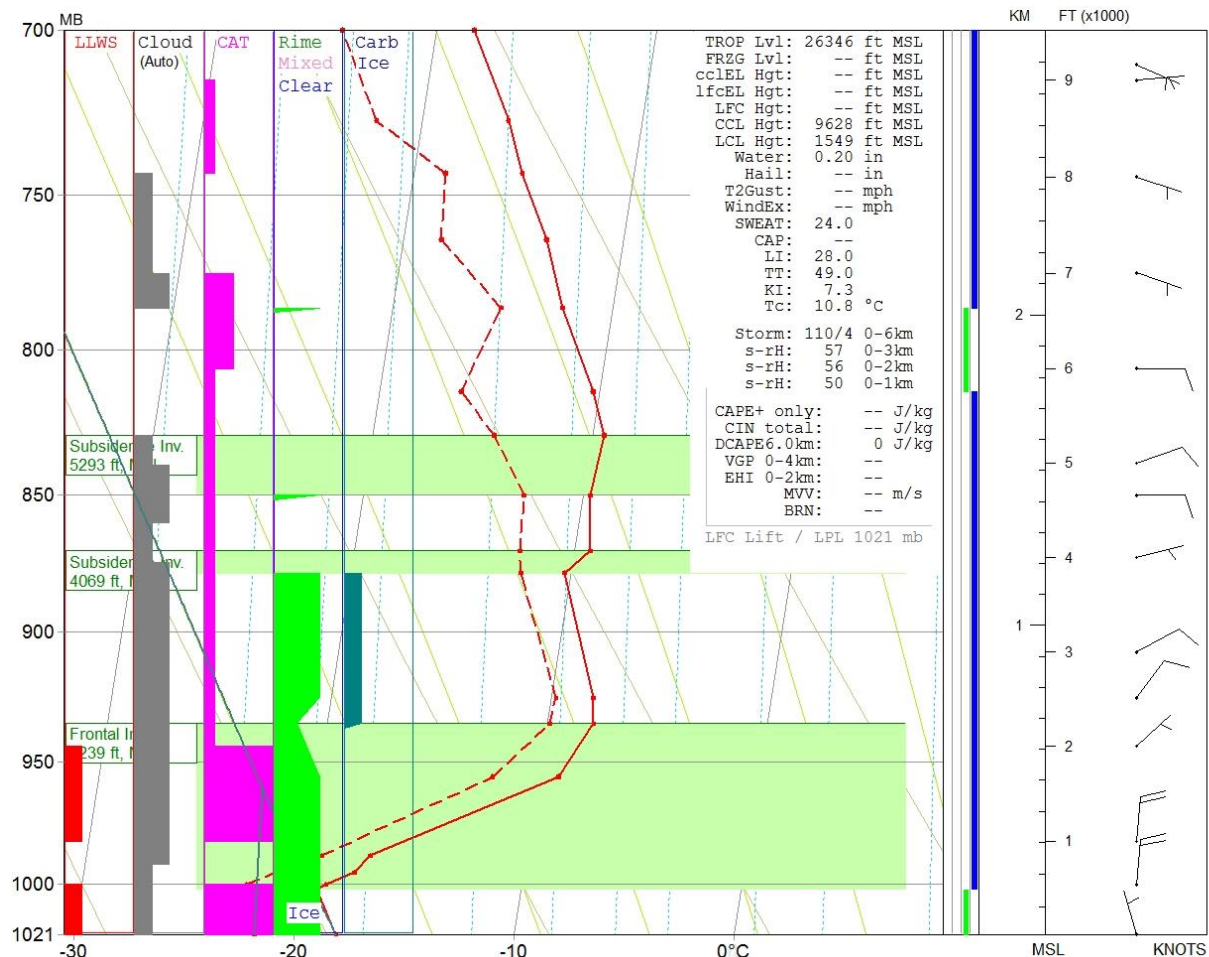


**Figure 5 – 0300 AKST PAKN sounding**

The 0300 AKST PAKN sounding indicated a conditionally unstable layer between the surface and 750 feet with a stable layer from 750 feet through 3,250 feet. An inversion (increase in temperature with height) was located immediately above the surface to 2,488 feet and this inversion would have kept any clouds that formed below the inversion in place if the background wind environment was relatively light. With the relative humidity greater than 80% from the surface to 10,000 feet, RAOB indicated that clouds were likely from the surface through 10,000 feet. Moderate or greater icing conditions were indicated by RAOB in the cloud cover between 750 feet and 6,500 feet. Given the abundant moisture from the surface to 10,000 feet, the surface frontal boundary (section 1.1), and the low- and mid-level troughs acting as lifting mechanisms (section 1.2), clouds and icing conditions would be expected near the accident site at the accident time.

The 0300 AKST PAKN sounding wind profile indicated a surface wind from 355° at 17 knots with the wind remaining north to northeasterly through 5,000 feet between 10 and 20 knots. Above 5,000 feet the wind became easterly and remained easterly through 10,000 feet. The wind speed decreased above 5,000 feet, with the wind remaining between 5 and 10 knots between 5,000 and 10,000 feet. RAOB indicated the possibility of low-level wind shear (LLWS) between 800 and 1,000 feet with clear-air turbulence possible in several layers between the surface and 6,000 feet.

Another PAKN sounding was taken at 1500 AKST and was plotted on a standard Skew-T log P diagram with the derived stability parameters included in figure 6 (with data from the surface to 700-hPa, or 9,500 feet msl.) The sounding depicted the LCL at 1,549 feet msl and a CCL of 9,628 feet. The freezing level was again located at the surface. The precipitable water value was 0.20 inches.



**Figure 6 – 1500 AKST PAKN sounding**

The 1500 AKST PAKN sounding continued to depict a stable atmosphere with a defined inversion to approximately 2,200 feet. This inversion would have kept any clouds that formed below the inversion in place if the background wind environment was relatively light. With the relatively moist atmosphere between the surface and 5,500 feet RAOB indicated that clouds were likely from the surface through 5,500 feet. Moderate or greater icing conditions were indicated by RAOB in the cloud cover between the surface and 4,000 feet. Much like the 0300 AKST PAKN sounding conditions, the 1500 AKST PAKN sounding indicated that clouds and moderate or greater icing within those clouds was likely from the surface through 4,000 feet.

The 1500 AKST PAKN sounding wind profile indicated a surface wind from 345° at 7 knots with the wind remaining north to northeasterly through 3,000 feet between 10 and 20 knots. Above 3,000 feet the wind became easterly and remained easterly through 10,000 feet. The wind speed decreased above 3,000 feet, with the wind remaining between 5 and 10 knots between 3,000 and 10,000 feet. RAOB indicated the possibility of LLWS between the surface and 2,000 feet with clear-air turbulence possible in several layers between the surface and 9,000 feet.

#### 4.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 15 (GOES-15) data was 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-15 bands 1 and 4) at wavelengths of 0.65 microns ( $\mu\text{m}$ ) and 10.7  $\mu\text{m}$ , respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 0800 AKST through 1300 AKST at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 7 and 8 present the GOES-15 infrared imagery from 0930 and 0945 AKST at 4X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery indicated overcast cloud cover over the accident site at the accident time. The lower brightness temperatures (green color, higher cloud tops) were located in the Gulf of Alaska and in the Alaska Mountain Range. The brightness temperature above the accident site at the accident time was  $-18^{\circ}\text{C}$  and with the vertical temperature profile provided by the 0300 and 1500 AKST PAKN soundings passing  $-18^{\circ}\text{C}$  twice below 10,000 feet, the approximate cloud-top heights over the accident site cannot be reliably determined via infrared satellite imagery. It should be noted these figures have not been corrected for any parallax error.

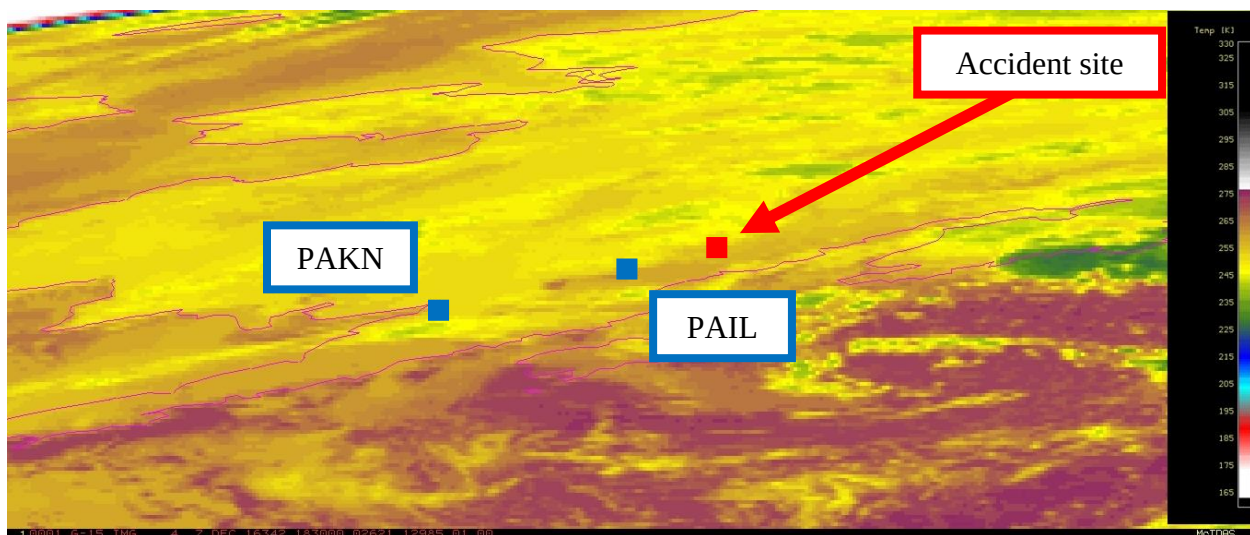
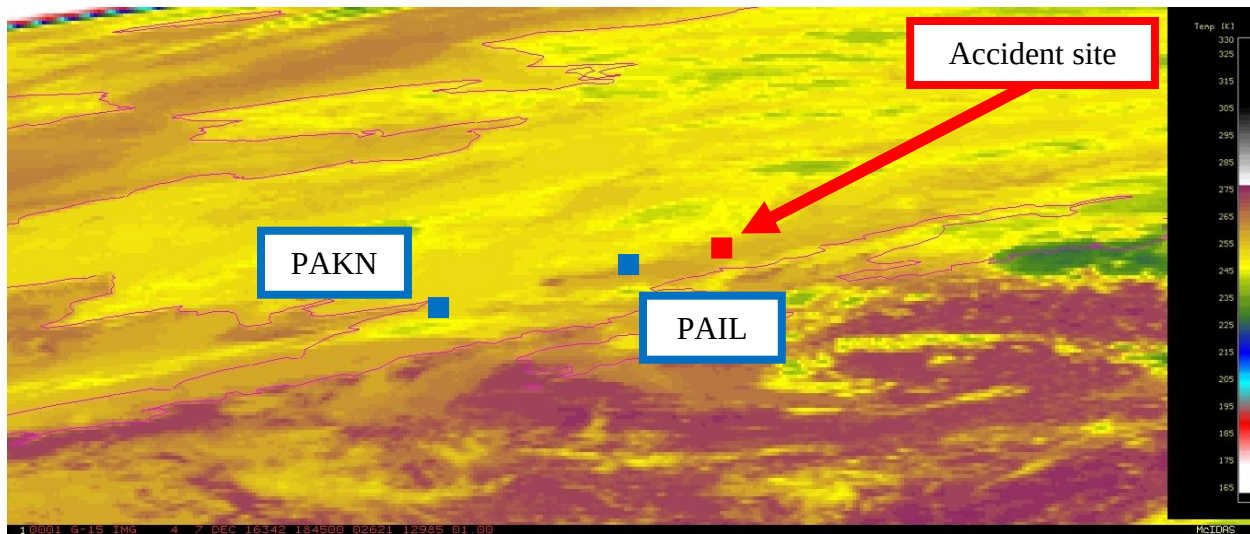


Figure 7 – GOES-15 infrared image at 0930 AKST



**Figure 8 – GOES-15 infrared image at 0945 AKST**

## 5.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)<sup>12</sup> to the accident site was the Anchorage/Nikiski, Alaska, radar (PAHG), which was located 86 miles east-northeast of the accident site at an elevation of 243 feet. Level II and III 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. No reflectivity targets were located above the accident site at the accident time.

## 6.0 Pilot Reports<sup>13</sup>

All pilot reports (PIREPs) close to the accident site from about three hours prior to the accident time to about three hours after the accident time were reviewed. Only PIREPs for below FL200<sup>14</sup> are provided below:

HOM UA /OV HOM360040 /TM 1933 /FL080 /TP B190 /TA M10 /IC LGT RIME 080-050=

AKN UA /OV SHORT FINAL/TM 2050/FL001/TP C207/WV GAIN OF 15-20KTS/RM PILOT RPTD WIND SHEAR +15-20 KTS=

Routine pilot report (UA); 40 miles from Homer, Alaska, on the 360° radial; Time – 1033 AKST (1933Z); Altitude – 8,000 feet; Type aircraft – Beechcraft 1900; Temperature – -10° C; Icing – Light rime between 8,000 and 5,000 feet.

<sup>12</sup> The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

<sup>13</sup> Only pilot reports with the WMO header UBAK\*\* identifier were considered.

<sup>14</sup> Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average 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.

Routine pilot report (UA); Over King Salmon, Alaska; Time – 1150 AKST (2050Z); Altitude – 100 feet; Type aircraft – Cessna 207; Wind – Gain of 15 to 20 knots; Remarks – Pilot reported wind shear + 15 to 20 knots.

## **7.0 SIGMET and CWSU Advisory**

No SIGMETs valid for the accident site at the accident time.

No Center Weather Service Unit (CWSU) Center Weather Advisories (CWA)s were valid for the accident site at the accident time. No CWSU Meteorological Impact Statements (MIS)s were valid for the accident site at the accident time.

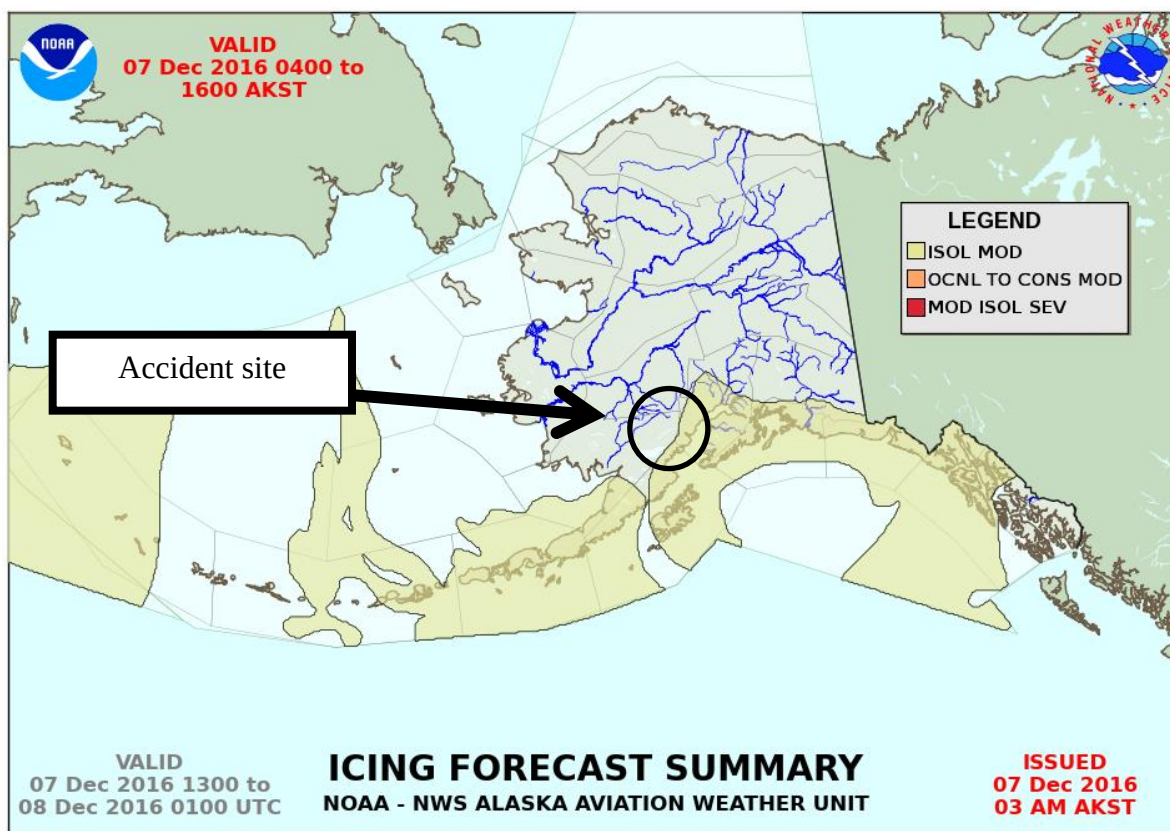
## **8.0 AIRMETs**

The Alaska Aviation Weather Unit (AAWU) issued AIRMET Sierra for mountain obscuration at 0440 AKST which forecast mountains occasionally obscured by clouds from King Salmon to Iliamna southeastward along the mountains. Conditions were forecast to improve through 1215 AKST:

DME DEC 2016 AAWU  
WAAK48 PAWU 071340  
WA8O  
ANCS WA 071315  
**AIRMET SIERRA FOR IFR AND MT OBSC VALID UNTIL 072115**  
.  
**BRISTOL BAY AH**  
**SE PAKN-PAIL LN MTS OCNL OBSC CLDS. IMPR.**  
.

## **9.0 AAWU graphics**

The AAWU icing forecast, flying weather, and low-level turbulence forecast graphics valid around the accident time are provided in figures 9 through 12. The graphics depicted isolated moderate icing conditions between 4,000 and 10,000 feet just east of the accident site with the graphic valid at 0900 AKST and the forecast issued at 0300 AKST (figures 9 and 10). The flying weather graphic depicted MVFR conditions likely towards the mountainous terrain east of PAKN and PAIL between 0400 and 1000 AKST (figure 11). All low-level turbulence conditions were forecast well away from the accident site for 0900 AKST from the 0400 AKST forecast (figure 12).



**Figure 9 – Icing Forecast Summary graphic from the AAWU valid between 0400 and 1600 AKST**

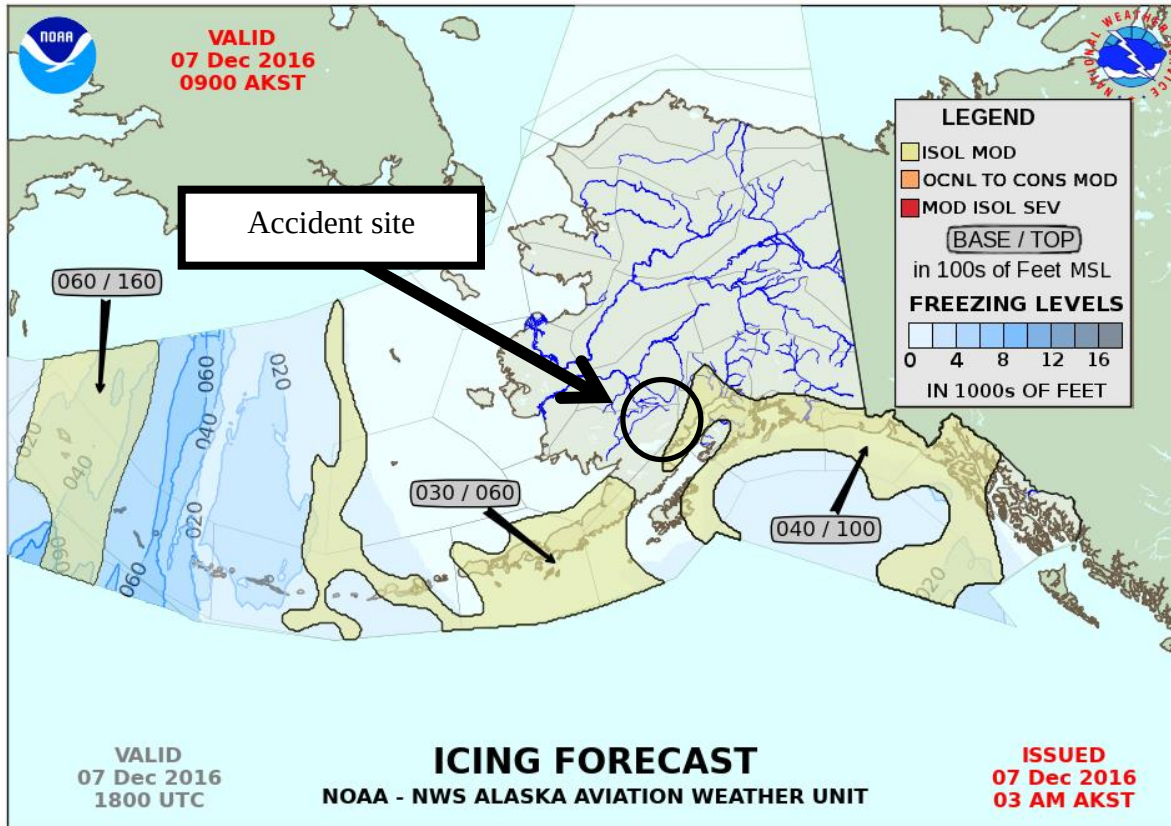


Figure 10 – Icing Forecast graphic from the AAWU valid at 0900 AKST

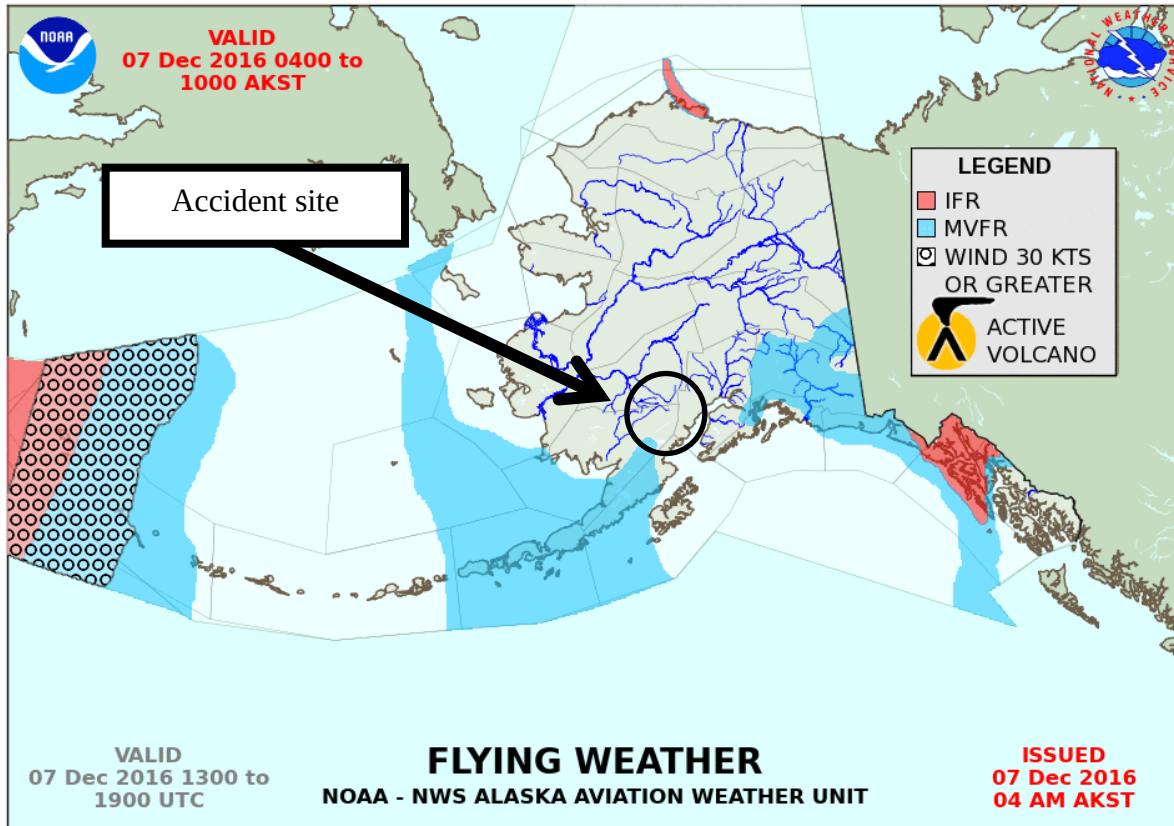


Figure 11 – Flying Weather graphic from the AAWU valid between 0400 and 1000 AKST

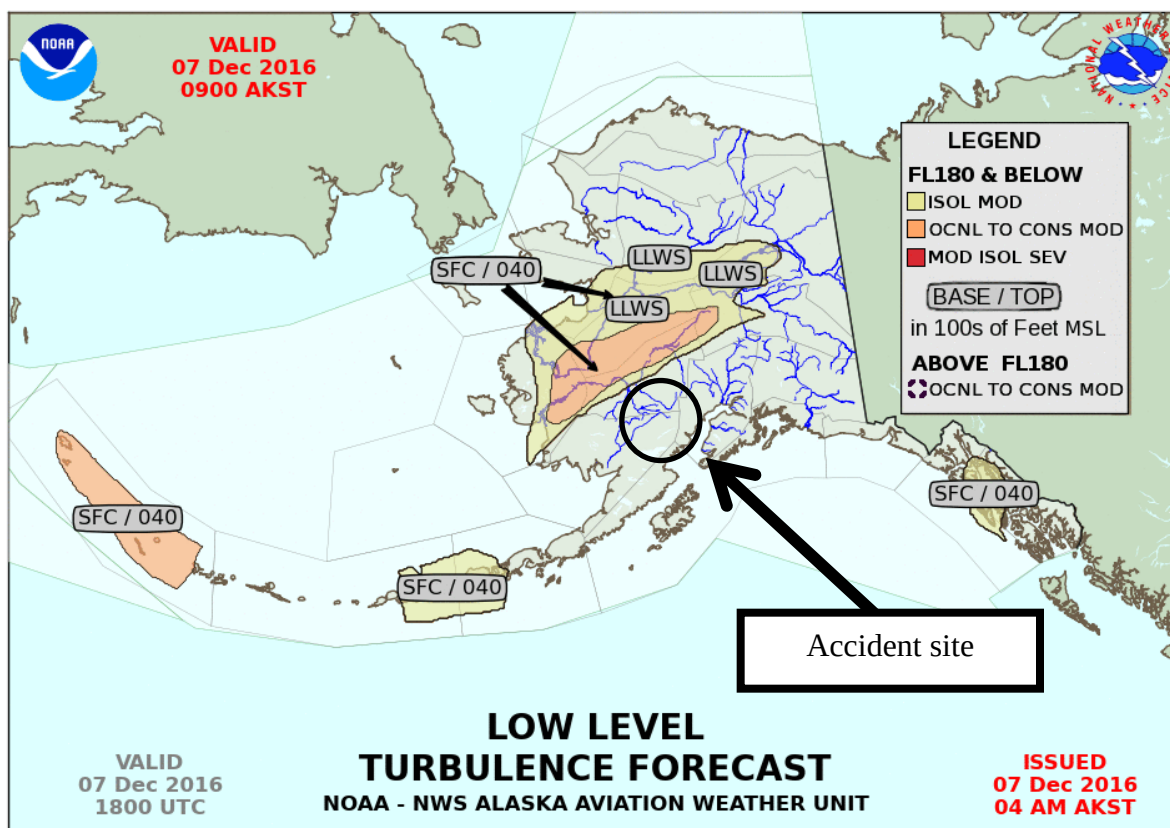


Figure 12 – Low-Level Turbulence Forecast graphic from the AAWU valid at 0900 AKST

## 10.0 Area Forecast

The Area Forecast issued at 0440 AKST, valid at the accident time, forecasted scattered clouds at 500 feet, a broken ceiling at 2,500 feet, with cloud tops at 6,000 feet, and isolated light snow south of PAKN and PAIL and along the Aleutian Mountain Range with clear skies elsewhere. Moderate icing conditions were forecast below 5,000 feet until 2300 AKST with the freezing level at the surface:

DME DEC 2016 AAWU

FAAK58 PAWU 071340

FA8W

ANCC FA 071315

AK SRN HLF EXCP SE AK...

.  
AIRMETS VALID UNTIL 072115

CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HEIGHTS NOTED BY AGL OR CIG.

.  
BRISTOL BAY AH...VALID UNTIL 080100

...CLOUDS/WX...

\*\*\*AIRMET MT OBSC\*\*\*SE PAKN-PAIL LN MTS OCNL OBSC CLDS. IMPR...

S PAKN AND ALUTN RNG S PAIL SCT005 BKN025 TOP 060 ISOL -SN.

VCY CAPES ISOL CIG BLW 010. ELSW SKC.

OFSHR W PAEH SFC WND N 20G30 KTS.  
OTLK VALID 080100-080700...SW PAKN IFR CIG. ELSW MVFR CIG.  
...TURB...  
NIL SIG.  
...ICE AND FZLVL...  
**TIL 08Z ISOL MOD ICEIC BLW 050. FZLVL SFC.**  
.

## 11.0 Terminal Aerodrome Forecast

PAIL was the closest site to the accident site with a NWS Terminal Aerodrome Forecast (TAF). The TAF valid at the time of the accident was issued at 0829 AKST and was valid for a 24-hour period beginning at 0900 AKST. The TAF for PAIL was as follows:

TAF PAIL 071729Z 0718/0818 **36013G20KT P6SM OVC010**  
FM080000 35009KT P6SM FEW015 SCT050 BKN120=

The forecast expected a wind from 360° at 13 knots with gusts to 20 knots, greater than 6 miles visibility, and an overcast ceiling at 1,000 feet agl.

## 12.0 NWS Area Forecast Discussion

The NWS Office in Anchorage, Alaska, issued the following Area Forecast Discussion (AFD) at 0458 AKST (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed only conditions surrounding Anchorage International Airport. The short term forecast for southwest Alaska discussed conditions in the Bristol Bay region (which included the area of the accident site). The southwest Alaska short term discussion mentioned lingering low clouds, stratus, and flurries across the Bristol Bay region (including the accident site):

049  
FXAK68 PAFC 071358  
AFDAFC

Southcentral and Southwest Alaska Forecast Discussion  
National Weather Service Anchorage AK  
458 AM AKST Wed Dec 7 2016

### .ANALYSIS AND UPPER LEVELS...

The western Gulf has a weak 1011 mb low pressure system located east of Kodiak Island, and is remaining almost stationary. This is resulting in a showery weather regime extending from the aforementioned region northward along the northern coastal communities. While the upper levels are depicting an elongated deformation zone located over the Tanana Valley extending into the Bristol Bay interior. This has been kicking off light snow showers in the Copper River Basin, Mat-su Valleys, and the Bristol Bay interior last night through this morning. The surface observations in these regions have been reporting light snow showers with intermittent MVFR ceiling conditions. Otherwise, an amplified ridge extends through the Central Aleutians/Bering northward into the Eastern Siberian region, and through the Brooks Range into the Beaufort Sea. This massive ridge is bringing cooler air from the

north accompanied by clear skies into the Southwest/Southcentral region, except for the mostly cloudy condition along the northern coastal communities. Meanwhile, the northern/eastern Bering is under the influence of the upper level ridge with northerly flow. The satellite imagery is showing a large swath of low stratus in the aforementioned region. While upstream a 962 mb storm force low is tracking across the Kamchatka Peninsula with the associated weather front pushing through the Western Aleutians/Bering this morning. This synoptic feature is bringing warmer temperatures with gusty gale force southeasterly to the Chain, and the western Bering.

&&

.MODEL DISCUSSION...

The models remain in good agreement with the Nam/GFS being the preferred models of choice this morning. The forecast confidence remains above average through the next several days.

&&

.AVIATION...

PANC...VFR conditions and light winds will persist.

&&

.SHORT TERM FORECAST SOUTHCENTRAL ALASKA (Days 1 and 2)...

A weak low centered in the gulf of Alaska will continue to support widespread but light showers along the northern Gulf of Alaska coast today. A few snow showers are expected to sneak across the mountains into Anchorage today, but generally dry conditions are expected across the Anchorage Bowl and western Kenai Peninsula. Although the low is fairly weak, the surface high centered in the north Alaska mainland remains nearly stationary and potent. The pressure gradient generated by these two features will sustain offshore flow along the Gulf Coast, especially across Thompson Pass. The combination of cold air and gusty gap winds will support cold wind chills especially in the vicinity of Thompson Pass into at least Thursday. By Thursday afternoon a new wave will push along the north Gulf Coast, which will result in more organized and steady snowfall along the northern Gulf Coast and southern Copper River Basin. However, there is still a lot of uncertainty in the track of this system.

&&

.AVIATION...

PANC...VFR conditions and light winds will persist.

&&

.SHORT TERM FORECAST SOUTHWEST ALASKA (Days 1 and 2)...

**Aside from some lingering stratus and flurries this morning across the Bristol Bay region, the pattern for the southwest mainland will largely be characterized by dry offshore flow through Thursday on the backside of the trough centered over the western**

**Gulf.** This will yield frigid temperatures beneath mostly clear skies, although numerous disturbances embedded in the upper level flow will continue to provide chances for increased cloud cover over the Bristol Bay region. Persistent gusty winds will lead to very cold wind chill values across the Kuskokwim Delta, although these conditions are not expected to meet advisory criteria at this time.

&&

.SHORT TERM FORECAST BERING SEA/ALEUTIANS (Days 1 and 2)...

An upper level disturbance dropping southward across the Alaska Peninsula will enhance snow shower activity through this morning before departing into the Pacific. Scattered showers will persist through Thursday in cold northerly flow on the western periphery of the gulf trough, with Small Craft Advisory level winds and freezing spray continuing to impact the coastal waters of the southeast Bering. The other main feature of interest in the Bering is the front bringing rain and storm force winds to the far Western Aleutians this morning. This front will gradually weaken as it moves towards Adak and Atka by Thursday, then dissipate Thursday night as it encounters the ridge responsible for a relatively prolonged stretch of benign conditions over the central Bering.

&&

.LONG TERM FORECAST (Days 3 through 7...Fri through Tue)...

The big story in the long term will be continued dry conditions. On Friday, a weak area of low pressure will drift from the northern Gulf of AK towards Bristol Bay. This will bring an end to the last vestiges of any light snow showers along the Gulf Coast. Into the weekend, a dominant Arctic High will build in from Chukotka region across mainland AK. This will make for clear and continued dry conditions. Forecast confidence is high in this scenario. One difference that will be noticeable will be slightly warmer temperatures. Climatology puts Anchorage at 10F for a low and 23F for a high. While things may not be quite this warm, they should be warmer than last weekend. And while there will still be an offshore gradient, it will be markedly less than last weekend as well. Thus, winds through the gaps such as Whittier and Thompson Pass will be less gusty.

There is some uncertainty in how the ridge breaks down early next week (12-13 Dec). All models indicate that some energy will make it over or through the ridge and punch through Prince William Sound. But there is uncertainty in what happens with said energy thereafter. At this point, it looks like there will not be sufficient moisture with that energy to produce any snow, but it certainly could bring some gusty winds.

&&

.AFC WATCHES/WARNINGS/ADVISORIES...

PUBLIC...Wind Chill Advisory for Thompson Pass...131.

MARINE...Storm Warning...178.  
Gale Warning...127 177.  
Heavy Freezing Spray Warning...140 160 180 181.

&&

\$\$

SYNOPSIS AND MODEL DISCUSSION...PD  
SOUTHCENTRAL ALASKA...EN  
SOUTHWEST ALASKA/BERING SEA/ALEUTIANS...CB  
LONG TERM...ML

### 13.0 NWS Zone Area Forecast

The NWS Office in Anchorage, Alaska, issued the following Alaska Zone Weather Forecasts (ZFP) at 0348 AKST. The ZFP forecast partly cloudy skies for all of the Bristol Bay forecast region (including the accident site) with flurries in the morning and a north wind between 10 to 20 mph. Skies were forecast to become mostly sunny by the afternoon:

201  
FPAK52 PAFC 071248  
ZFPALU

ALASKA ZONE WEATHER FORECASTS  
NATIONAL WEATHER SERVICE ANCHORAGE AK  
348 AM AKST WED DEC 7 2016

SPOT TEMPERATURES AND PROBABILITIES OF MEASURABLE PRECIPITATION  
ARE FOR TODAY...TONIGHT...AND THURSDAY.

AKZ161-080145-  
BRISTOL BAY-  
INCLUDING THE CITIES OF...KING SALMON...DILLINGHAM...NAKNEK...  
PILOT POINT  
348 AM AKST WED DEC 7 2016

**.TODAY...PARTLY CLOUDY IN THE MORNING THEN BECOMING MOSTLY SUNNY.  
FLURRIES IN THE MORNING. HIGHS ZERO TO 15 ABOVE. NORTH WIND 10 TO  
20 MPH. WIND CHILLS 5 BELOW TO 20 BELOW IN THE MORNING.**  
.TONIGHT...PARTLY CLOUDY. LOWS 5 BELOW TO 5 ABOVE. NORTH WIND  
10 TO 20 MPH. WIND CHILLS 5 BELOW TO 20 BELOW.  
.THURSDAY...PARTLY SUNNY. HIGHS ZERO TO 15 ABOVE. NORTH WIND  
10 TO 20 MPH. WIND CHILLS 5 BELOW TO 20 BELOW IN THE MORNING.  
.THURSDAY NIGHT...MOSTLY CLOUDY. LOWS 10 BELOW TO 5 ABOVE. NORTH  
WIND 15 MPH.  
.FRIDAY...PARTLY SUNNY. A SLIGHT CHANCE OF SNOW SHOWERS IN THE  
AFTERNOON. HIGHS ZERO TO 15 ABOVE. NORTH WIND 15 MPH.  
.FRIDAY NIGHT...MOSTLY CLOUDY WITH A SLIGHT CHANCE OF SNOW  
SHOWERS. LOWS 5 BELOW TO 5 ABOVE.  
.SATURDAY...PARTLY CLOUDY. HIGHS 5 TO 15.  
.SATURDAY NIGHT THROUGH MONDAY NIGHT...MOSTLY CLEAR. LOWS 5 BELOW  
TO 5 ABOVE. HIGHS 5 TO 15.  
.TUESDAY...PARTLY CLOUDY. HIGHS IN THE TEENS.

&&

TEMPERATURE / PRECIPITATION

KING SALMON 3 -6 4 / 10 0 10  
DILLINGHAM 6 -1 8 / 10 0 0  
ILIAMNA 15 5 16 / 0 10 10

\$\$

## 14.0 Winds and Temperature Aloft Forecast

The NWS 0456 AKST Winds and Temperature Aloft forecast valid for the accident flight is included below:

FBAK31 KWN0 071356  
FD1AK1  
\_DATA BASED ON 071200Z  
VALID 071800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000  
FT 3000 6000 9000 12000 18000 24000 30000 34000 39000  
  
AKN 0306 9900-12 9900-18 9900-24 3613-34 3219-45 341954 011952 361850  
  
HOM 0414 0905-10 1106-17 1407-24 1605-38 3610-48 011154 011151 351050

The accident site was closest to the AKN (King Salmon) and HOM (Homer) forecast points. The 0456 AKST AKN forecast indicated a wind from 030° at 6 knots at 3,000 feet and a calm wind at 6,000 feet with a temperature of -12° C. The 0456 AKST HOM forecast indicated a wind from 040° at 14 knots at 3,000 feet and a wind at 6,000 feet from 090° at 5 knots with a temperature of -10° C.

## 15.0 Pilot Weather Briefing and Witness Information

The accident pilot did not receive an official weather briefing from sources, such as Lockheed Martin Flight Service and Direct User Access Terminal Service.

A pilot operating in the area of Port Alsworth around the accident time spoke with the accident pilot.<sup>15</sup> This pilot stated that he spoke with the accident pilot a couple minutes after the accident pilot departed the Port Alsworth airport and this pilot told the accident pilot that the tops of the clouds were about 2,000 feet and from this pilot's perspective, it looked open at Miller Valley. The accident pilot replied "looking good under here, I'm gonna keep going." Neither of these comments or observations were reported or available in the national airspace as PIREPs. It is unknown if the accident pilot checked or received anymore weather information before or during the accident flight.

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<sup>15</sup> For more information see Witness Statements and Interview Summaries contained in the docket for this accident.

## 16.0 A-Paid Information

As mentioned above PALJ was an A-Paid station. As described in attachment 1, the observers at PALJ have expressed a desire to quit the program. As such, PALJ only provides 2 to 3 observations per day. The NWS Alaska Region is currently working to establish a lease deal that will allow the NWS Alaska to install an automated station to replace the A-Paid station at PALJ. It is expected this automated station at PALJ could be installed as soon as summer 2017. The new automated station to be installed by NWS Alaska at PALJ will contain the full suite of weather instruments for standard METAR observations, however, it will not be a full Automated Weather Observing System (AWOS<sup>16</sup>) or ASOS station. At this time, the FAA considers weather observations from these new types of automated stations to be “unofficial” (attachment 1), and so a pilot’s only access to this type of METAR observation would be on the Internet. NWS Alaska is hopeful that an agreement with the FAA can be reached so that this type of METAR information would be available in the “traditional METAR channels.” Then this METAR information would be available for Flight Service weather briefers and others to use operationally.

In follow up communication with NWS Alaska (attachment 5), the lease for PALJ was crafted and signed as of March 6, 2017 with the planned installation of the automated observing system in the May to June 2017 timeframe. In addition, in communication between NWS Alaska and FAA headquarters, the FAA was not willing to grant the waiver that FAA Alaska region requested (attachment 5). Without the waiver, observations, such as the new one coming from PALJ in the summer 2017, will never be disseminated as METAR reports through the traditional METAR channels.

## 17.0 Web Camera Images

Images from the FAA’s Aviation Weather Cameras are shown in figures 13 through 28 along with attachments 3 and 4 providing images of the weather conditions surrounding the accident site at the accident time. The weather cameras (figure 13 and 19) from Lake Clark Pass West, located 8 miles east-northeast of the accident site (figure 14), showed the weather conditions surrounding the accident time with the south facing camera images provided in figures 15 through 18 with times from 0931 AKST through 1001 AKST. On the south facing camera images depicted a complete surface based obscuration with visibilities less than 3 miles with an indefinite ceiling from 0931 through 1001 AKST. The images further suggest complete mountain obscuration conditions prevailed during the entire time with fog (figures 15 through 18).

The northeast facing weather camera from Lake Clark Pass West (figures 19 through 22) indicated a similar obscuration conditions as the southward facing camera with visibilities under a mile between 0928 and 0948 AKST (figures 20 through 22). In addition, the northeast facing weather camera indicated ceiling heights less than 100 feet or near the top of the trees directed next to the camera site.

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<sup>16</sup> AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand feet, and altimeter setting.

The Nondalton cameras were located 29 miles southwest of the accident site (figure 23). On the northeast facing weather camera from Nondalton (figures 24 through 28), an area of low stratus clouds is seen in the direction of Port Alsworth and the accident site between 0917 and 0947 AKST. The cloud ceilings were below 2,150 feet msl with visibilities to the northeast of the Nondalton camera less than 8.5 miles. The low clouds moved across the Nondalton camera site by 1047 AKST (attachment 4).

The weather camera observations, surface observations (section 3.0), and upper air observations (section 4.0), indicated a high probability the accident airplane encountered the area of reduced visibility in likely freezing fog with instrument meteorological conditions at the accident time.

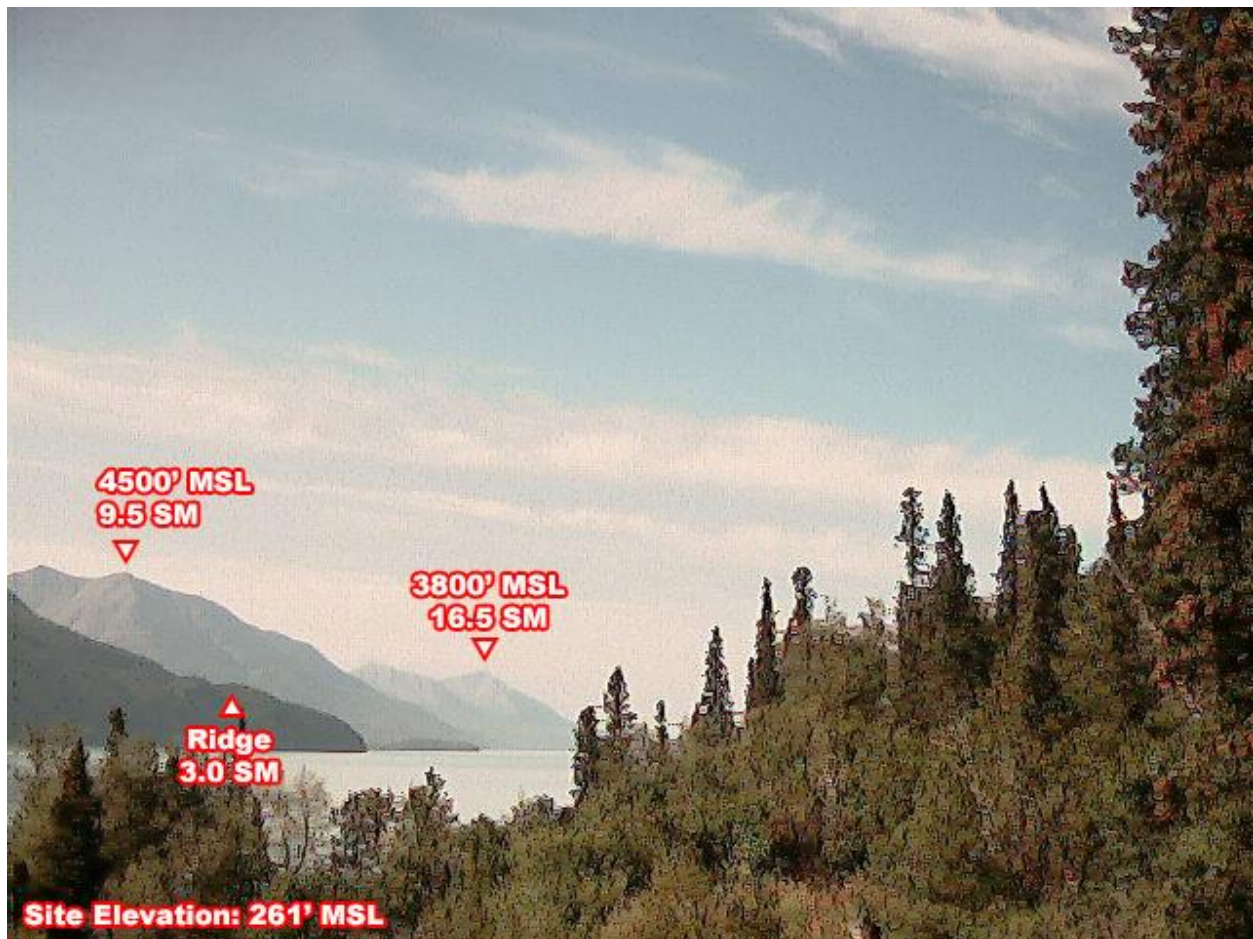
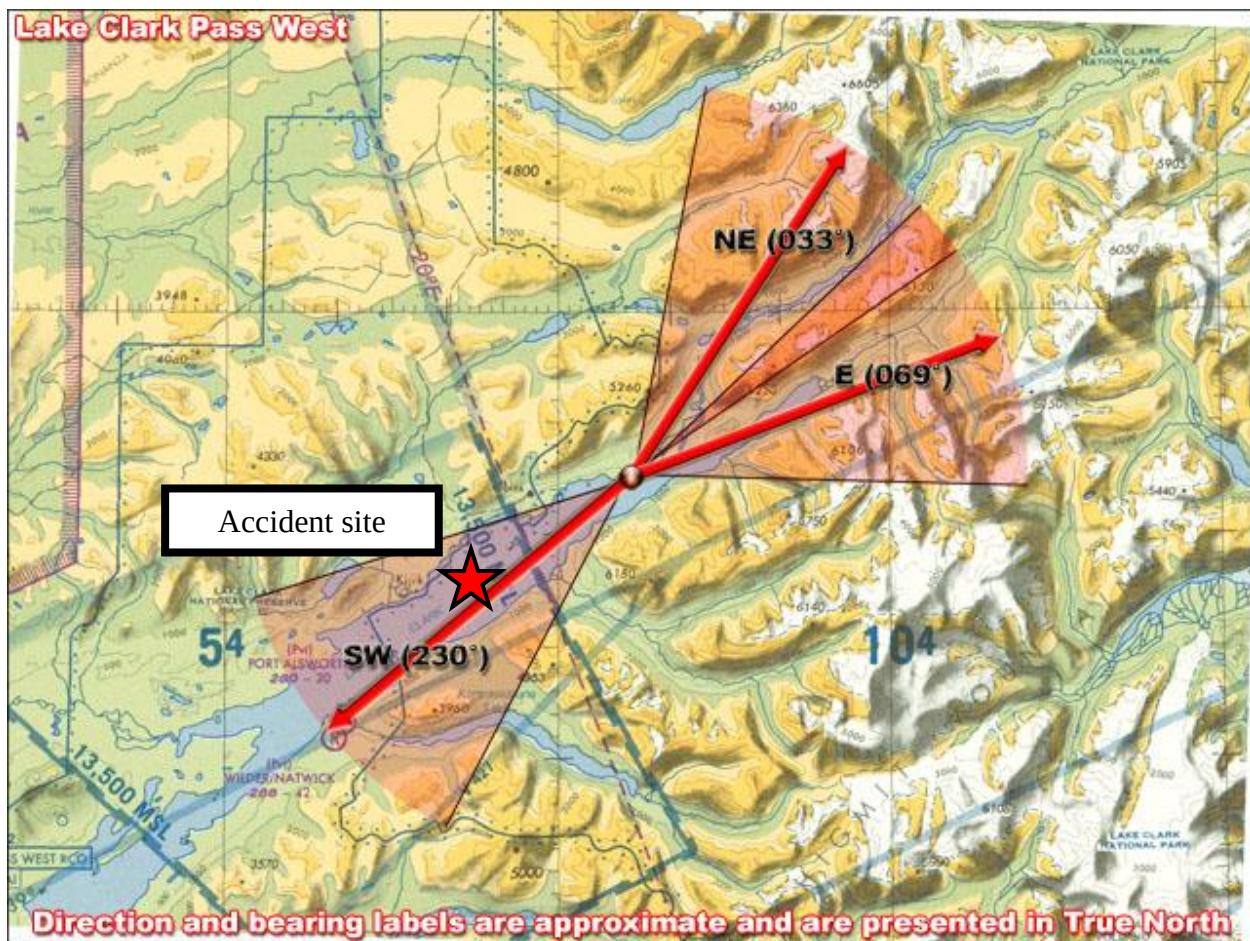


Figure 13 – FAA weather camera from Lake Clark Pass West south looking view from a standard clear sky weather day



**Figure 14 – FAA weather camera Lake Clark Pass West location on sectional chart with the direction the different camera angles face with the accident site marked**

Wed 07 Dec 2016 18:31:21 UTC  
Wed 07 Dec 2016 09:31:21 AKST

Lake Clark Pass West - South  
See <http://avcams.faa.gov> for more information



FAA advisory weather product

**Figure 15 – FAA weather camera from Lake Clark Pass West south looking view from 0931 AKST**

Wed 07 Dec 2016 18:41:22 UTC  
Wed 07 Dec 2016 09:41:22 AKST

Lake Clark Pass West - South  
See <http://avcams.faa.gov> for more information



FAA advisory weather product

**Figure 16 – FAA weather camera from Lake Clark Pass West south looking view from 0941  
AKST**

Wed 07 Dec 2016 18:51:22 UTC  
Wed 07 Dec 2016 09:51:22 AKST

Lake Clark Pass West - South  
See <http://avcams.faa.gov> for more information



FAA advisory weather product

**Figure 17 – FAA weather camera from Lake Clark Pass West south looking view from 0951 AKST**

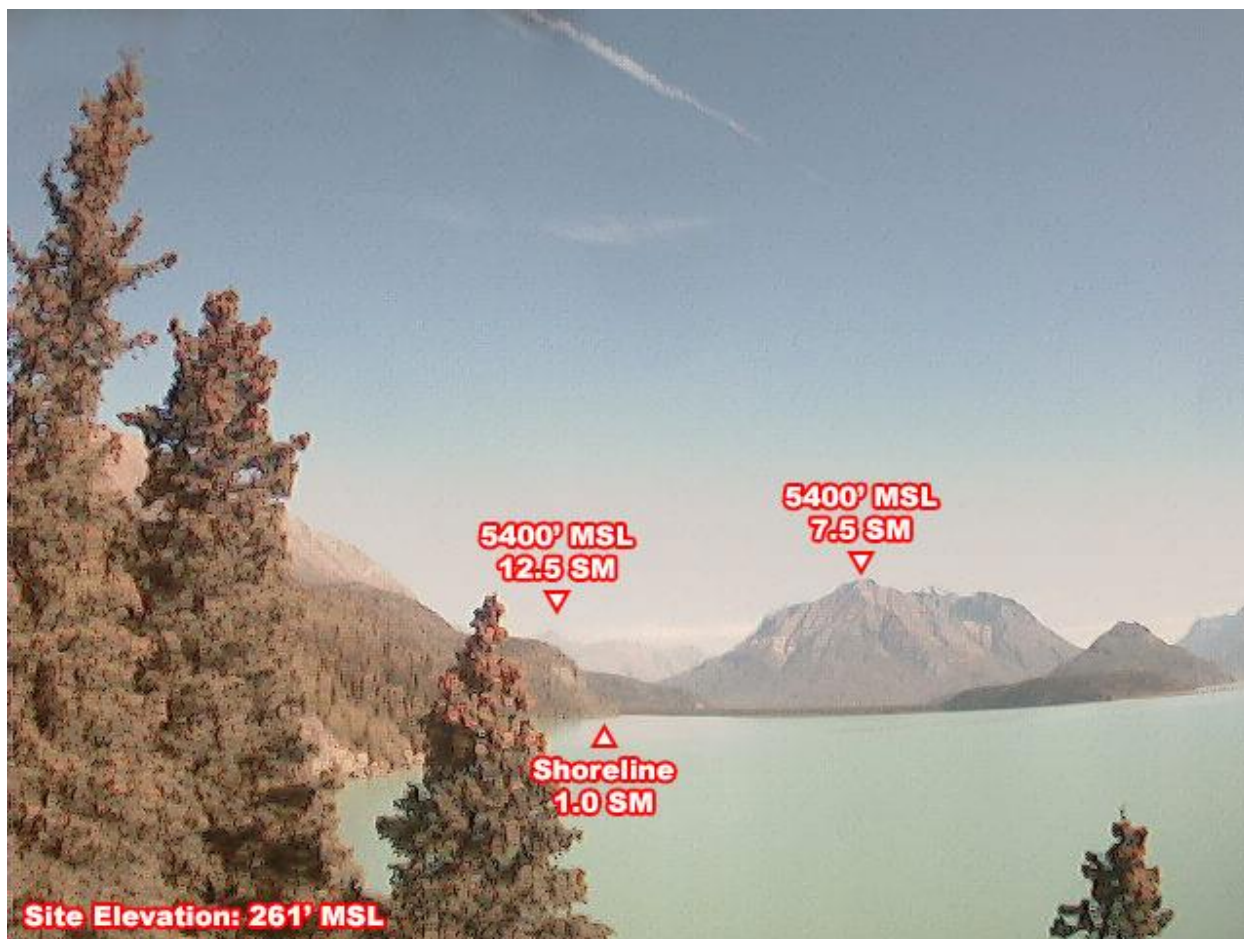
Wed 07 Dec 2016 19:01:20 UTC  
Wed 07 Dec 2016 10:01:20 AKST

Lake Clark Pass West - South  
See <http://avcams.faa.gov> for more information



FAA advisory weather product

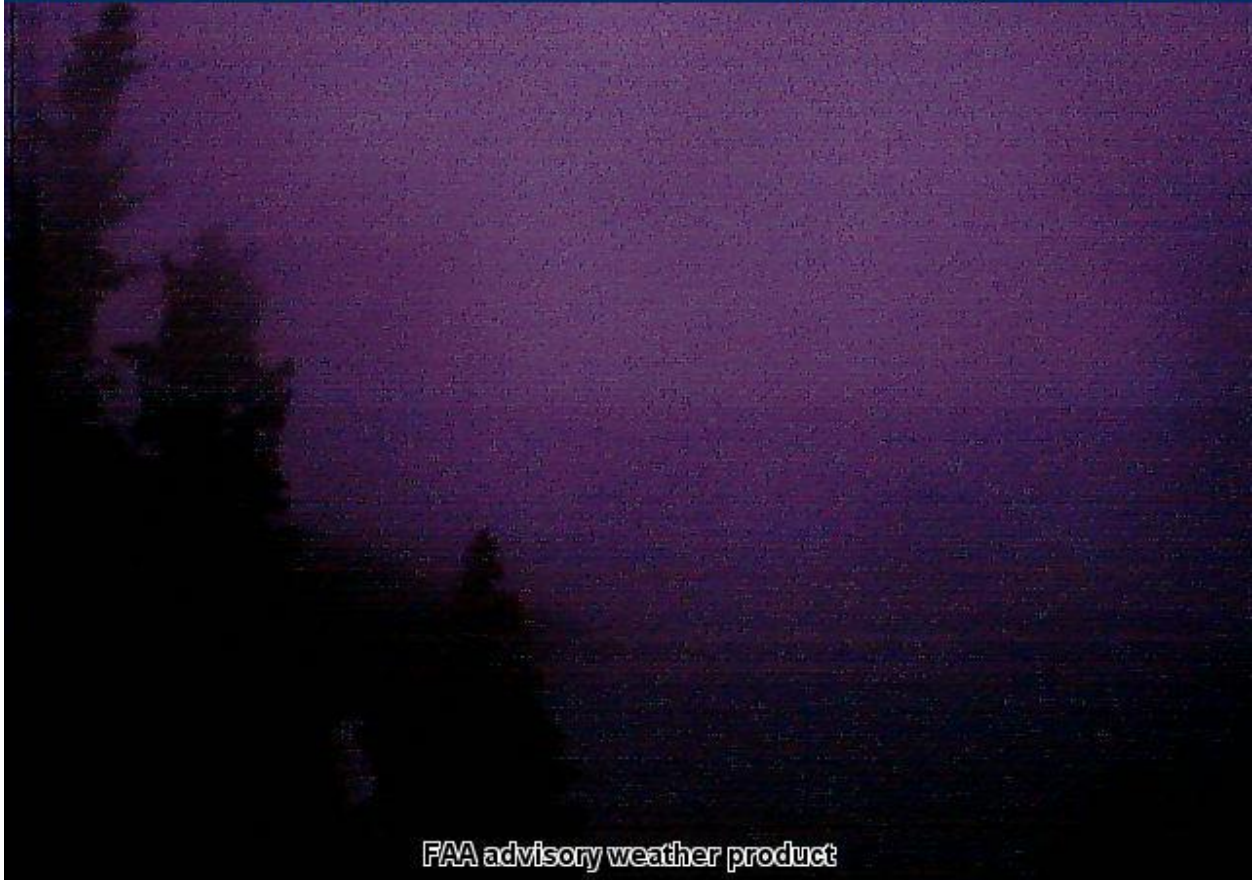
**Figure 18 – FAA weather camera from Lake Clark Pass West south looking view from 1001  
AKST**



**Figure 19 – FAA weather camera from Lake Clark Pass West northeast looking view from a standard clear sky weather day**

Wed 07 Dec 2016 18:28:20 UTC  
Wed 07 Dec 2016 09:28:20 AKST

Lake Clark Pass West - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 20 – FAA weather camera from Lake Clark Pass West northeast looking view from 0928 AKST**

Wed 07 Dec 2016 18:38:22 UTC  
Wed 07 Dec 2016 09:38:22 AKST

Lake Clark Pass West - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 21 – FAA weather camera from Lake Clark Pass West northeast looking view from 0938 AKST**

Wed 07 Dec 2016 18:48:22 UTC  
Wed 07 Dec 2016 09:48:22 AKST

Lake Clark Pass West - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 22 – FAA weather camera from Lake Clark Pass West northeast looking view from 0948 AKST**

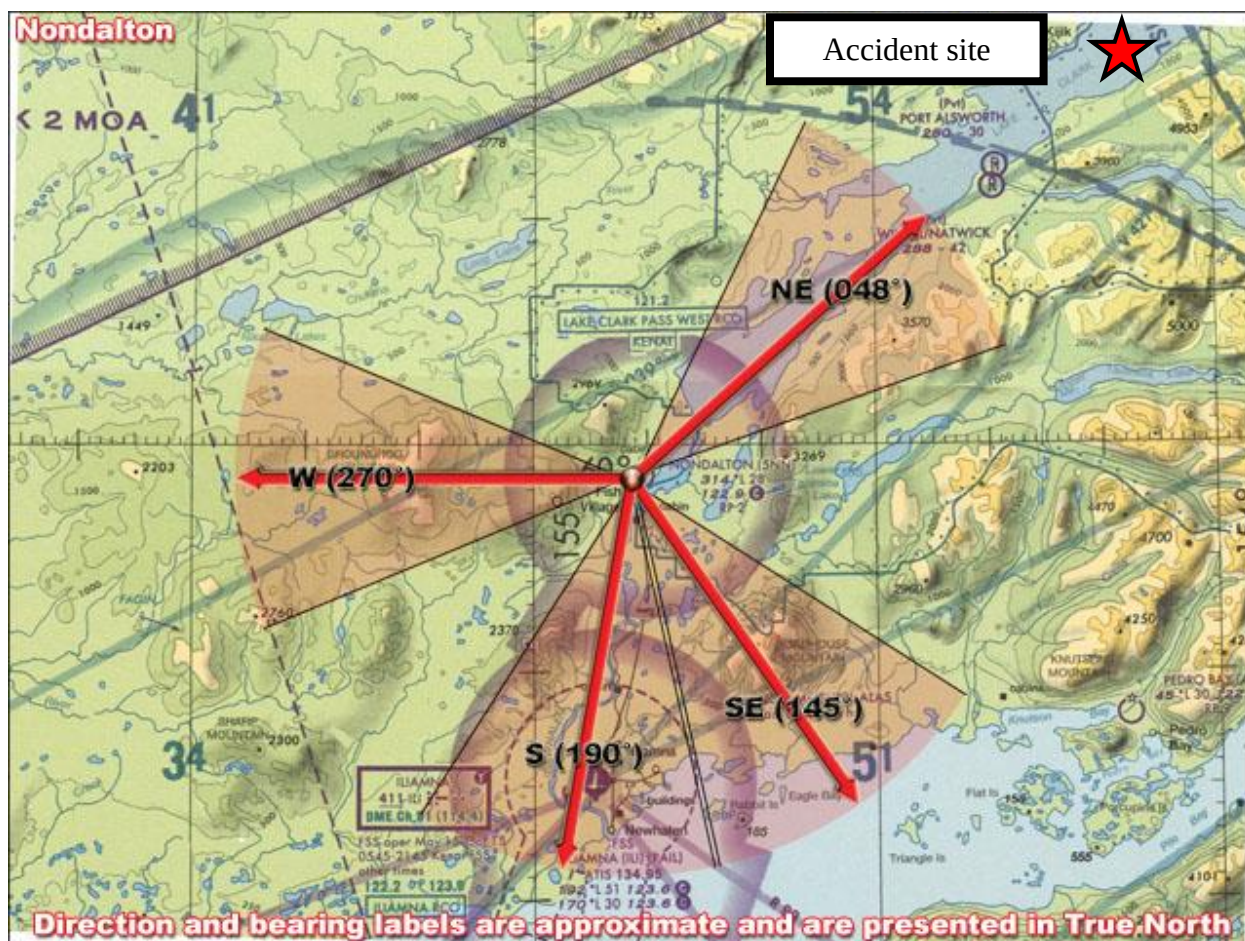
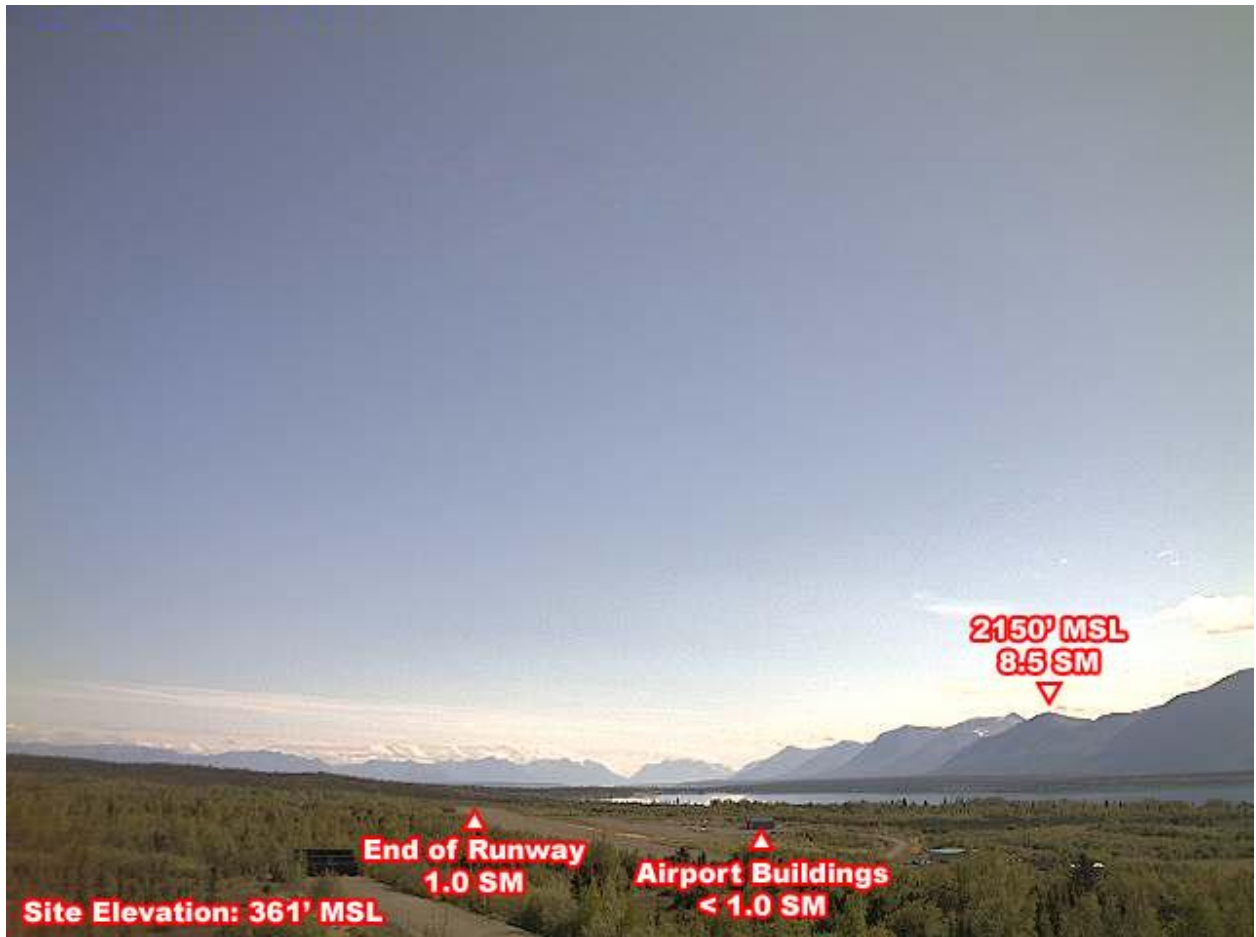


Figure 23 – FAA weather camera Nondalton location on sectional chart with the direction the different camera angles face with the accident site marked



**Figure 24 – FAA weather camera from Nondalton northeast looking view from a standard clear sky weather day**

Wed 07 Dec 2016 18:17:19 UTC  
Wed 07 Dec 2016 09:17:19 AKST

Nondalton - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 25 – FAA weather camera from Nondalton northeast looking view from 0917 AKST**

Wed 07 Dec 2016 18:27:18 UTC  
Wed 07 Dec 2016 09:27:18 AKST

Nondalton - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 26 – FAA weather camera from Nondalton northeast looking view from 0927 AKST**

Wed 07 Dec 2016 18:37:21 UTC  
Wed 07 Dec 2016 09:37:21 AKST

Nondalton - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 27 – FAA weather camera from Nondalton northeast looking view from 0937 AKST**

Wed 07 Dec 2016 18:47:18 UTC  
Wed 07 Dec 2016 09:47:18 AKST

Nondalton - NorthEast  
See <http://avcams.faa.gov> for more information



**Figure 28 – FAA weather camera from Nondalton northeast looking view from 0947 AKST**

## **18.0 Astronomical Data**

The astronomical data obtained from the United States Naval Observatory for the accident site on December 7, 2016, indicated the following:

|                      |           |
|----------------------|-----------|
| <b>SUN</b>           |           |
| Begin civil twilight | 0910 AKST |
| Accident             | 0935 AKST |
| Sunrise              | 1007 AKST |
| Sun transit          | 1308 AKST |
| Sunset               | 1610 AKST |
| End civil twilight   | 1707 AKST |

## **E. LIST OF ATTACHMENTS**

Attachment 1 – NWS Alaska information about the A-Paid station at PALJ

Attachment 2 – Aviation Weather Reporting in Alaska document from May 2016

Attachment 3 – FAA’s Aviation Web Camera images from Lake Clark West Pass around the accident time

Attachment 4 – FAA’s Aviation Web Camera images from Nondalton around the accident time

Attachment 5 – Follow up communication with NWS Alaska information about the A-Paid station at PALJ

Submitted by:

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Paul Suffern  
Senior Meteorologist

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