NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

November 17, 2016

Group Chairman's Factual Report

METEOROLOGY

ANC15MA041

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A. ACCIDENT

Location: Approximately 20 miles northeast of Ketchikan, Alaska
Date: June 25, 2015
Time: About 1215 Alaska daylight time (2015 UTC[1])
Airplane: Promech Air de Havilland DHC-3T Turbo Otter; registration N270PA

B. METEOROLOGY GROUP

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C. SUMMARY

On June 25, 2015, about 1215 Alaska daylight time, a single-engine, turbine-powered, float-equipped de Havilland DHC-3 (Otter) airplane, N270PA, sustained substantial damage when it impacted mountainous tree-covered terrain, about 20 nautical miles northeast of Ketchikan, Alaska. The airplane was being operated under the provisions of 14 Code of Federal Regulations (CFR) Part 135, as an on-demand visual flight rules (VFR) sightseeing flight when the accident occurred. The airplane was owned by Pantechnicon Aviation, of Minden, Nevada, and operated by Promech Air, Inc., of Ketchikan. The commercial pilot and eight passengers were fatally injured. Marginal visual meteorological conditions were reported in the area at the time of the accident. The flight departed a floating dock located in Rudyerd Bay about 44 miles northeast of Ketchikan about 1200 for a tour through Misty Fjords National Monument Wilderness. A company VFR flight plan was in effect. At the time of the accident, the flight was returning to the operator's base at the Ketchikan Harbor Seaplane Base, Ketchikan.

The flight was a sightseeing flight for passengers of a cruise ship that was docked in Ketchikan. The tour, named Cruise/Fly, consisted of two groups of passengers. One group departed Ketchikan onboard a marine vessel and the other group departed via airplane, with a predetermined rendezvous at the floating dock in Rudyerd Bay. Once at the floating dock, the two groups would switch transportation modes for the return trip to Ketchikan.

The operator reported that the accident airplane departed Rudyerd Bay as the third of four float-equipped airplanes on air tour flights over the Misty Fjords National Monument Wilderness. The airplanes departed about 5 minutes apart, and the standard route of flight was southwest, over an area of remote inland fjords, coastal waterways, and mountainous tree-covered terrain.

[1] UTC – is an abbreviation for Coordinated Universal Time.

When the airplane failed to return to Ketchikan, the operator initiated a search for the missing airplane and heard an emergency locator transmitter (ELT) signal along the accident pilot's anticipated route of flight. A helicopter from Temsco Helicopters, Inc., of Ketchikan, was dispatched to the suspected accident site to search for the missing airplane. However, the helicopter pilot said that he was unable to search the upper levels of the mountainous areas due to low ceilings and poor visibility. The helicopter pilot said that, after waiting for the weather conditions to improve, he was able to search the upper elevations of the search area and located the wreckage about 1429. The Ketchikan Volunteer Rescue Squad (KVRS) team members reached the accident site and confirmed that the airplane's occupants had sustained fatal injuries.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Alaska Aviation Weather Unit (AAWU) and the National Climatic Data Center (NCDC). All times are Alaska daylight time (AKDT) based upon the 24 hour clock, local time +8 hours to 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 airport and station identifiers use standard International Civil Aviation Organization (ICAO) 4-letter station identifiers versus International Air Transport Association (IATA) 3-letter identifiers which deletes the initial country code designator "P" for Alaska airports. Both codes are both used intermittently in this report.

The accident site was located at latitude 55.45638° N and longitude 131.14616° W at an elevation of approximately 1,600 feet.

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

1.1 Surface Analysis Chart

The NWS Alaska Surface Analysis Chart for 1300 AKDT (2100Z) on June 25, 2015 created by the Weather Prediction Center (WPC) is included in figure 1. The chart depicted a series of low pressure systems in the Gulf of Alaska and the Pacific Ocean, with one low off the southeast Alaska coast at 1008-hectopascals (hPa) to the southwest of the accident site, with a trough of low pressure extending southeastward off the southeast Alaska and British Columbia, Canadian

coast. The trough was previous being depicted associated with a dissipating occluded frontal system.

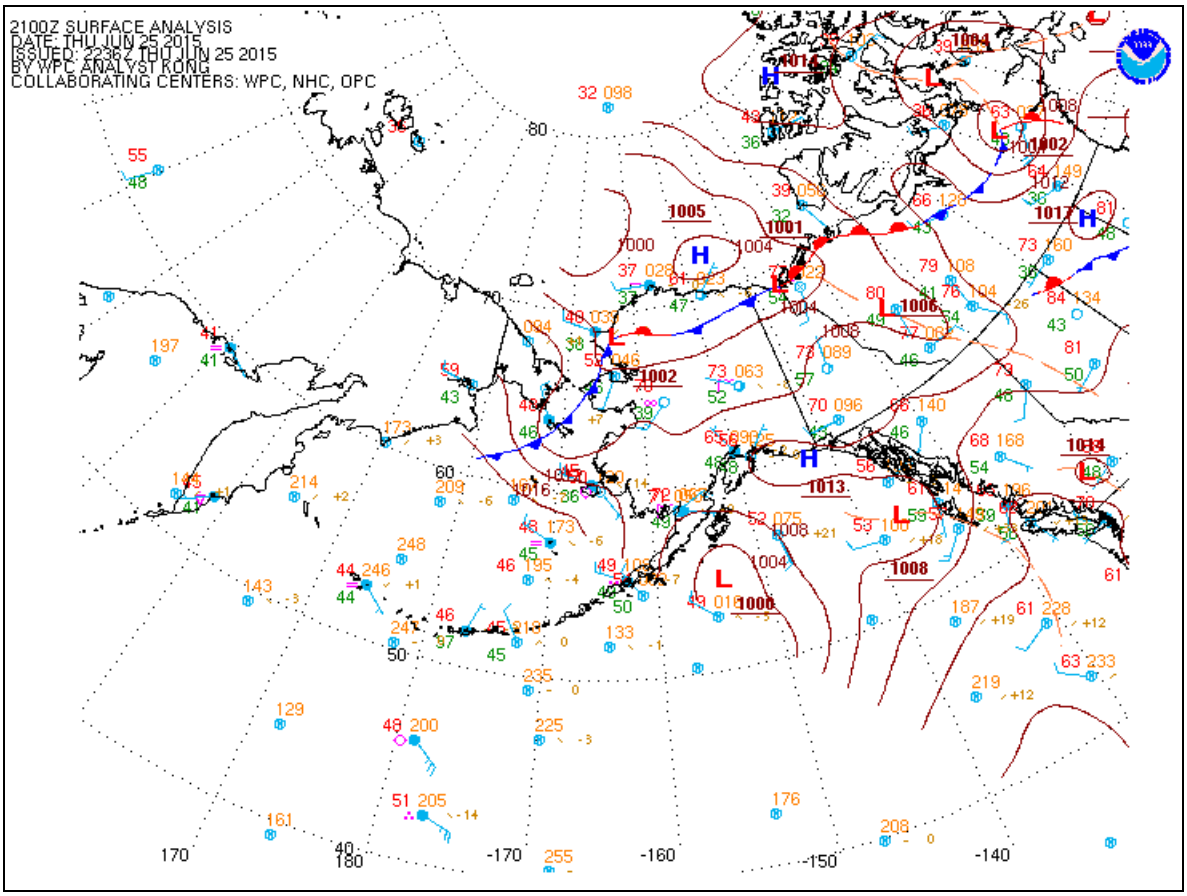

Figure 1 - NWS Surface Analysis Chart for 1300 AKDT

An enlarged version of the Alaska Surface Analysis Chart for 1300 AKDT is included as figure 2, with the low pressure system at 1008-hPa immediately southwest of the Ketchikan area added in for reference. The chart depicted the trough of low pressure off the southeast Alaska coast and station models, which indicated winds from the southeast at 10 to 15 knots, visibility restricted in rain showers, and broken to overcast sky conditions.

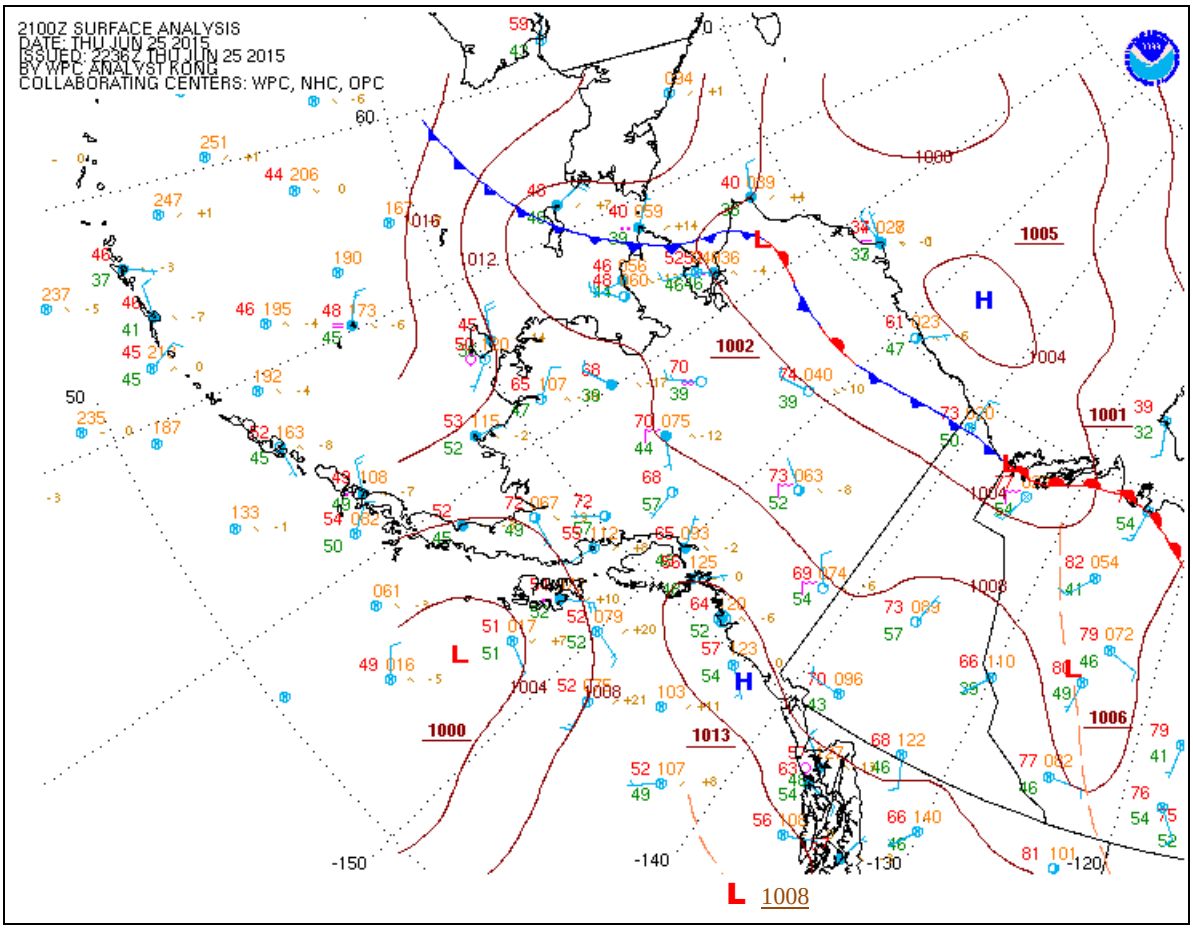

Figure 2 - Surface Analysis Chart for 1300 AKDT

A close up of the NOAA Sectional Chart for the Ketchikan area is included as figure 3 with the accident site marked by a star to the east-northeast of the Ketchikan International Airport. The spot elevation approximately a mile south of the accident site was 2,540 feet, and to the southeast along the route of flight was 2,724 feet. The Maximum Elevation Figure (MEF) for the quadrant to maintain a safe altitude from terrain between the Misty Fjord and Ketchikan area was noted as 3,900 and 3,700 feet. That altitude would allow a 200 to 300 feet agl safety clearance for trees and/or vegetation over the highest terrain noted in the quadrant, rounded up to the nearest 100 feet, which was located immediately east of Ketchikan at 3,383 feet and at 3,591 feet to the southeast, and east of Annette Island.

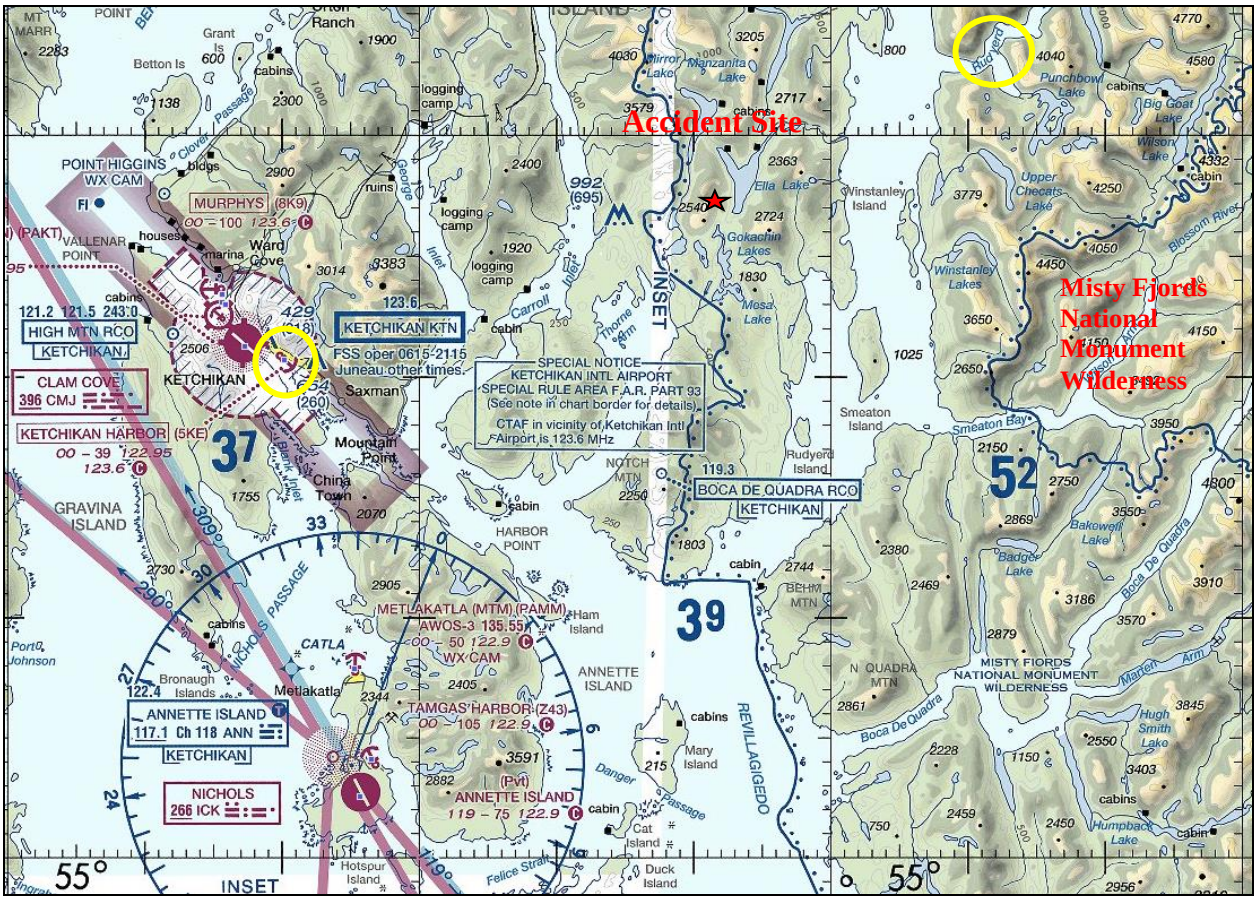

Figure 3 - Sectional chart of the area

2.0 NWS Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECIs) surrounding the period were documented for Ketchikan International Airport (PAKT), located 20 miles southwest of the accident site at an elevation of 92 feet. The airport had an Automated Surface Observation System (ASOS) and was augmented by NWS certified weather observers. The airport lists a magnetic variation of 21° East. The following weather conditions were reported surrounding the time of the accident, with cloud heights are reported above ground level (agl).

Ketchikan International Airport weather at 1153 AKDT (1953Z), wind from 130° true at 15 knots gusting to 23 knots, visibility 6 miles, runway 11 visual range 4,000 variable better than 6,000 feet[2], weather moderate rain and mist, a few clouds at 800 feet agl, ceiling broken at 1,200 feet, overcast at 2,700 feet, temperature 16° Celsius (C), dew point 14° C, altimeter 29.91 inches of mercury. Remarks: automated observation system, sea level pressure 1012.9-hectopascals

[2] The RVR for runway 11 during the period from 0800 through the time of the accident at 1200 AKDT indicated some restricted visibility over the airport, with the prevailing or greater than 50% of the area seeing approximately 6 miles.

(hPa), roof observation wind 100° at 25 knots gusting to 35 knots, hourly precipitation 0.17 inches, temperature 16.1° C, dew point 14.4° C.

The following weather observations and general flight categories[3] were reported surrounding the period:

IFR *METAR PAKT 251353Z AUTO 16003KT 2 1/2SM RA BR SCT021 OVC031 15/14 A2992 RMK AO2 SLP131 P0011 T01500139 TSNO*

MVFR *SPECI PAKT 251355Z 15003KT 4SM RA BR SCT021 OVC031 15/14 A2992 RMK AO2 P0000 T01500139*

MVFR *METAR PAKT 251453Z 15011KT 4SM R11/6000VP6000FT RA BR FEW010 BKN023 OVC047 15/14 A2991 RMK AO2 SLP130 P0012 60028 T01500139 56008*

MVFR *METAR PAKT 251553Z 17005KT 6SM -RA BR BKN015 BKN022 OVC033 16/14 A2990 RMK AO2 SLP127 P0011 T01560139*

MVFR/IFR METAR PAKT 251653Z 16006KT 3SM R11/4500VP6000FT -RA BR SCT010 OVC014 16/14 A2990 RMK AO2 SLP126 VIS 2SM V 4SM P0008 T01560144

MVFR *METAR PAKT 251753Z 17006KT 5SM R11/5500VP6000FT -RA BR BKN015 OVC025 16/14 A2989 RMK AO2 SLP123 P0010 60057 T01560144 10156 20144 58007=*

MVFR *METAR PAKT 251853Z 15011KT 5SM R11/6000VP6000FT -RA BR BKN018 OVC025 17/14 A2989 RMK AO2 SLP123 P0012 T01670144=*

MVFR *METAR PAKT 251953Z 13015G23KT 6SM R11/4000VP6000FT RA BR FEW008 BKN012 OVC027 16/14 A2991 RMK AO2 SLP129 ROOF WIND 10025G35KT P0017 T01610144=*

Accident ~2015Z

MVFR *METAR PAKT 252053Z 13011KT 8SM -RA SCT015 OVC021 16/15 A2993 RMK AO2 SLP135 P0006 60035 T01610150 53012=*

MVFR *METAR PAKT 252153Z 14012KT 10SM SCT014 BKN021 OVC028 17/14 A2994 RMK AO2 RAE13 SLP139 P0003 T01670144=*

MVFR *METAR PAKT 252253Z 15015G22KT 10SM FEW013 BKN025 OVC031 17/14 A2996 RMK AO2 SLP145*

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[3] 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 or lowest layer of clouds reported as broken, overcast or the vertical visibility into a surface based obscuration below 500 feet 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 feet agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 feet agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 feet 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 feet agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

T01670139=

MVFR PAKT 252326Z 14015KT 10SM FEW013 BKN025 OVC031 16/14 A2997 RMK AO2 T01610139=

MVFR SPECI PAKT 252328Z 15017G26KT 10SM FEW013 BKN025 OVC031 16/14 A2997 RMK AO2 PK WND 13026/2327 ACFT MSHP T01610139=

MVFR METAR PAKT 252353Z 15017G25KT 10SM SCT013 BKN025 OVC033 16/13 A2998 RMK AO2 PK WND 13026/2327 SLP151 ACFT MSHP 60038 T01610133 10167 20156 53017=

MVFR METAR PAKT 260053Z 14018G24KT 3SM RA BR BKN025 OVC030 15/13 A3000 RMK AO2 PK WND 16026/0026 RAB29 SLP158 P0005 T01500128=

IFR METAR PAKT 260153Z 14016KT 1 3/4SM R11/5000VP6000FT RA BR BKN007 BKN014 OVC020 14/13 A3001 RMK AO2 PK WND 15027/0054 SLP161 P0018 T01440133=

IFR SPECI PAKT 260157Z 13022G32KT 2SM R11/5500VP6000FT RA BR SCT007 BKN012 OVC016 14/13 A3001 RMK AO2 PK WND 13032/0156 P0001 T01440133=

2.1 Surrounding Observations - Metlakatla

The next closest official weather reporting location to the accident site was from Metlakatla Seaplane Base (PAMM) approximately 14 miles south of Ketchikan and 24 miles southwest from the accident site, at sea level. The seaplane base had an Automated Weather Observation System (AWOS) without a precipitation discriminator, which could not report weather type. The following conditions were reported at the approximate time of the accident:

Metlakatla Seaplane Base weather observation at 1216 AKDT, wind from 150° at 9 knots gusting to 17 knots, visibility 10 miles, ceiling broken at 1,800 feet agl, overcast at 2,400 feet, temperature and dew point missing, altimeter 29.93 inches of Hg. Remarks: automated observation system without a precipitation discriminator, hourly precipitation 0.03 inches.

An image from the FAA weather camera at 1218 AKDT is included as figure 4 depicting the conditions at the approximate time of the observations. The mountain peaks 3 ½ SM away at 2,550 feet and at 5 ½ SM at 2,200 feet are obscured by the clouds in the image.

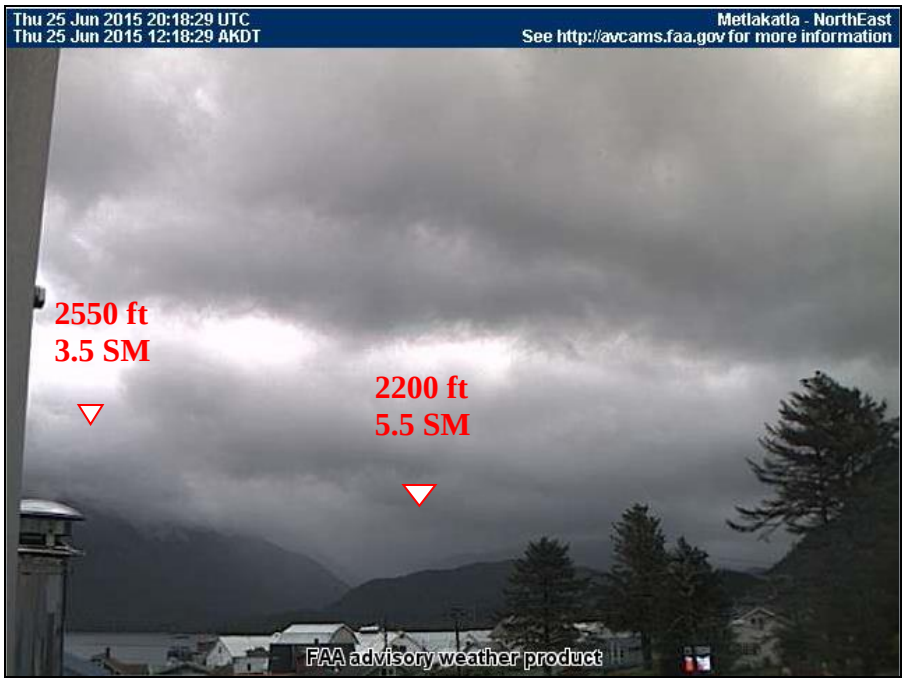

Figure 4 - Weather camera image at 1218 AKDT looking northeast

The raw observation surrounding the period and general flight categories were as follows:

VFR *METAR PAMM 251856Z 14005G18KT 7SM SCT029 BKN040 OVC049 A2990 RMK AO1 P0002*

MVFR *METAR PAMM 251916Z 13012G19KT 10SM SCT019 BKN027 OVC042 A2991 RMK AO1 P0003*

MVFR *METAR PAMM 251956Z 14011G21KT 10SM BKN021 OVC026 A2993 RMK AO1 P0003*

MVFR *METAR PAMM 251936Z 13012G18KT 10SM BKN019 OVC026 A2992 RMK AO1*

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MVFR *METAR PAMM 252016Z 15009G17KT 10SM BKN018 OVC024 A2993 RMK AO1 P0003*

MVFR *METAR PAMM 252036Z 15009G18KT 110V170 10SM SCT018 BKN024 OVC036 A2993 RMK AO1 P0003*

MVFR *METAR PAMM 252056Z 15015G20KT 10SM SCT014 BKN022 OVC043 A2994 RMK AO1 60005 52014*

MVFR *METAR PAMM 252116Z 15010G16KT 10SM SCT016 BKN024 OVC060 A2994 RMK AO1*

MVFR *METAR PAMM 252136Z 16007G17KT 10SM SCT016 BKN024 OVC045 A2995 RMK AO1*

MVFR *METAR PAMM 252156Z 15008G14KT 120V190 10SM SCT016 BKN022 OVC040 A2995 RMK AO1*

VFR *METAR PAMM 252216Z 15014G24KT 130V190 10SM FEW014 SCT022 OVC037 A2996 RMK AO1*

VFR *METAR PAMM 252236Z 17012G20KT 10SM FEW014 FEW021 OVC035 A2996 RMK AO1*

VFR *METAR PAMM 252256Z 17013G22KT 140V200 10SM FEW013 SCT029 OVC035 A2997 RMK AO1*

2.2 Surrounding Stations – Annette Island

The next closest weather reporting location was from Annette Island Airport (PANT) located 19 miles south of Ketchikan and 29 miles south-southwest of the accident site, at an elevation of 119 feet. The airport had an ASOS and reported the following conditions at the approximate time of the accident:

Annette Island Airport weather observation at 1211 AKDT, wind from 140° at 14 knots gusting to 26 knots, visibility 10 miles, ceiling overcast at 900 feet agl, temperature 17° C, dew point 16° C, altimeter 29.92 inches of Hg. Remarks: peak wind from 140° at 28 knots occurred at 1155 AKDT, temperature 16.7° C, dew point 15.6° C, obtained through autodial.

The raw observations and general flight category surrounding the period were as follows:

IFR SPECI PANT 251814Z 12011G20KT 1 1/2SM RA BR SCT014 OVC020 16/15 A2989 RMK P0002 T01610150 VIA AUTODIAL

IFR SPECI PANT 251829Z 12011G18KT 1 3/4SM RA BR BKN014 OVC019 16/16 A2989 RMK P0003 T01610156 VIA AUTODIAL

IFR SPECI PANT 251833Z 13013G18KT 2SM RA BR FEW009 BKN014 OVC019 16/16 A2989 RMK P0004 T01610156 VIA AUTODIAL

IFR METAR PANT 251853Z 13014G20KT 2SM RA BR SCT008 BKN012 OVC016 16/16 A2990 RMK SLP124 P0013 T01610156 VIA AUTODIAL

MVFR SPECI PANT 251904Z 14012G22KT 6SM -RA BR FEW008 OVC013 16/15 A2990 RMK P0003 T01610150 VIA AUTODIAL

MVFR METAR PANT 251953Z 14017G29KT 10SM OVC013 16/15 A2991 RMK PK WND 15029/1937 RAE08 SLP130 P0003 T01610150 VIA AUTODIAL

IFR SPECI PANT 252011Z 14014G26KT 10SM OVC009 17/16 A2992 RMK PK WND 14028/1955 T01670156 VIA AUTODIAL

Accident 2015Z

IFR METAR PANT 252053Z 14014G25KT 10SM OVC009 16/15 A2993 RMK PK WND 14028/1955 SLP135 60016 T01610150 53016 VIA AUTODIAL

IFR METAR PANT 252153Z 14014G25KT 10SM BKN008 OVC035 17/15 A2994 RMK SLP139 T01670150 VIA AUTODIAL

IFR METAR PANT 252253Z 15014G26KT 10SM OVC008 16/14 A2996 RMK PK WND 16027/2201 SLP147 T01610144 VIA AUTODIAL

2.3 NWS METAR Displays

The NWS Aviation Weather Center (AWC) website display of hourly observations at 1230 AKDT is included as figure 4. The chart depicted the general flight categories by the color coded station models, with green for VFR, blue for MVFR conditions, red for IFR, and pink for LIFR conditions.

The station model for Ketchikan indicated MVFR conditions with wind from the southeast at 12 knots gusting to 23 knots, visibility 6 miles in moderate rain, overcast skies, temperature 61° Fahrenheit (F), dew point 58° F, sea level pressure 999.1-hPa.

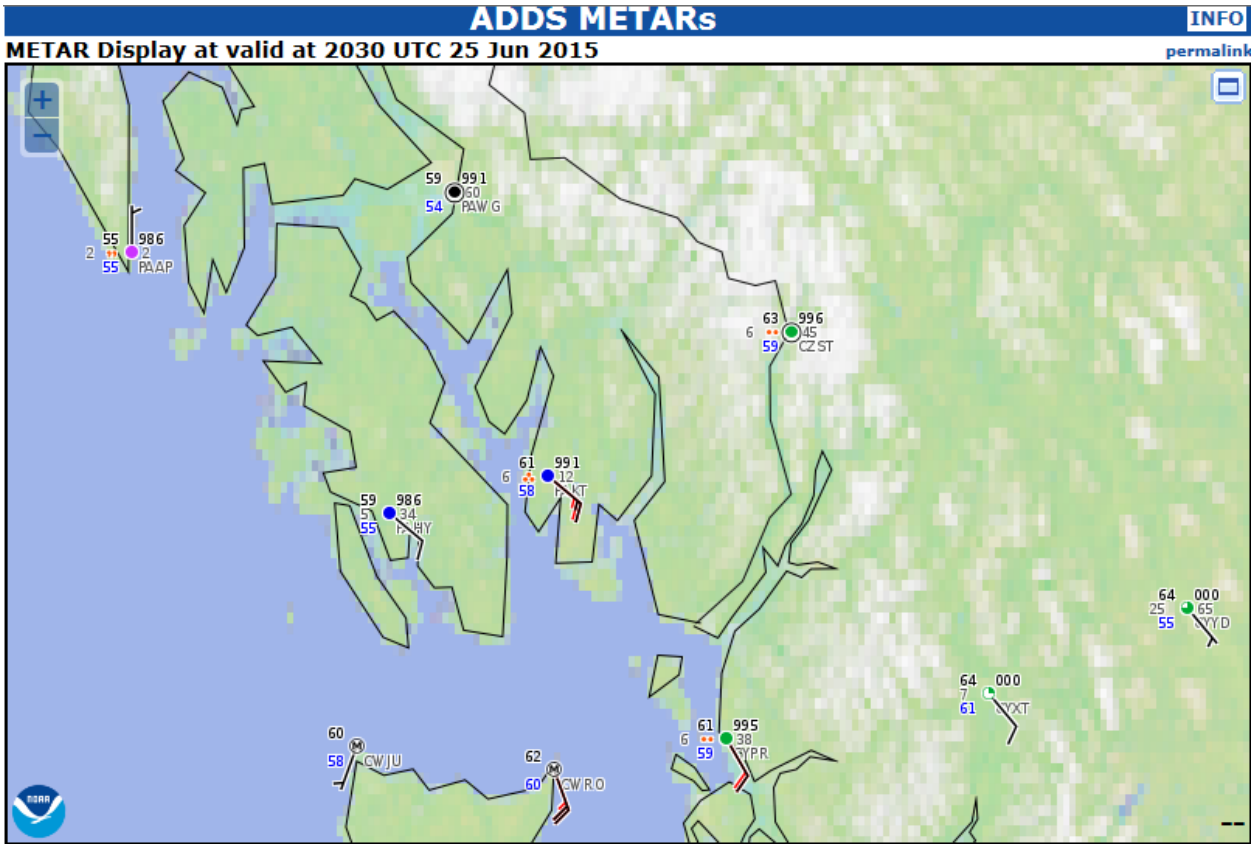

Figure 5 - NWS display of Weather observations in the area at 1230 AKDT

3.0 Pilot Reports

The following pilot reports or PIREPs were reported to the FAA and entered into the NWS database surrounding the period of the accident:

Sitka Rocky Gutierrez Airport (PASI/SIT) routine pilot report (UA); Over – Sitka or approximately 150 miles northwest of the accident site; Time – 0655 AKDT; Flight level – 11,000 feet; Type aircraft – Canadair Regional Jet (CRJ7); Sky cover – scattered clouds at 4,000 feet with tops at 8,500 feet, overcast layer at 9,500 feet with tops at 11,000 feet; Turbulence – occasional light turbulence; Remarks – during climb to higher cloud layer above.

Kake Airport (PAFE/AFE) routine pilot report (UA); Over – 235° and 22 miles from Level Island VORTAC (located approximately 120 miles northwest of the accident site); Time – 0800 AKDT; Flight level – 1,000 feet; Type aircraft – De Havilland Otter (DHC3); Sky cover – overcast at 2,000 feet; Weather – flight visibility 10 statute miles; Turbulence – light turbulence; Remarks – over Point Berrie.

Ketchikan International Airport (PAKT/KTN) urgent pilot report (UUA); Over – Ketchikan; Time – 1144 AKDT; Flight level – 300 feet; Type aircraft – Boing 737 air carrier jet; Remarks – low-level wind shear loss of 10 knots of airspeed between 200 and 300 feet on final approach to runway 11.

4.0 NWS Terminal Aerodrome Forecast

The closest NWS Terminal Aerodrome Forecast (TAF) to the accident site was for Ketchikan International Airport. The forecast was valid for a 5 miles radius of the airport. The forecast issued at 0920 AKDT and valid for the period was as follows:

TAF PAKT 251720Z 2518/2618 16009KT 6SM -RA BR SCT010 BKN025 OVC050 WS020/16030KT
TEMPO 2518/2521 2SM RA BR BKN010 OVC020
FM252100 15015G25KT 5SM -RA BR FEW010 BKN020 OVC035
FM260600 15008KT P6SM -SHRA OVC025 AMD LTD TO CLD VIS AND WIND 2606/2615=

The forecast expected from 1000 through 1300 AKDT, winds from 160° at 9 knots, visibility 6 miles in light rain and mist, with scattered clouds at 1,000 feet agl, ceiling broken at 2,500 feet, overcast at 5,000 feet, with wind shear at 2,000 feet with winds from 160° at 30 knots. The forecast also included a temporary period of visibility 2 miles in moderate rain and mist, ceiling broken at 1,000 feet, and overcast at 2,000 feet.

The forecast was amended at 1204 AKDT immediately prior to the accident and increased the winds to 140° at 16 knots gusting to 26 knots, with continued MVFR to IFR conditions expected during the period. The forecast was as follows:

TAF AMD PAKT 252004Z 2520/2618 14016G26KT 6SM -RA BR FEW008 BKN015 OVC030 WS020/16030KT
TEMPO 2520/2524 2SM RA BR BKN010 OVC020
FM260600 15008KT P6SM -SHRA OVC025 AMD LTD TO CLD VIS AND WIND 2606/2615=

5.0 Upper Air Data

The closest upper air sounding or rawinsonde observation (RAOB) was from the NWS Annette Island (PANT), Annette Island, Alaska, site number 70398, located approximately 30 miles south-southwest of the accident site at an elevation of 108 feet. The 1600 AKDT (0000Z on June 26, 2015) sounding was plotted on a standard Skew-T log P diagram[4] utilizing RAOB[5] software is included as figure 5 from the surface to 500-hPa or 18,000 feet.

[4] 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

The Annette Island sounding indicated a moist low level environment with a relative humidity greater than 80% from the surface to 5,000 feet supporting clouds, with the base of clouds indicated by the lifted condensation level (LCL) [6] and the level of free convection (LFC) [7] at 988-hPa or 626 feet agl. The freezing level was identified at 8,775 feet, with an inversion or increase in temperature due to subsidence at 10,000 feet, with drier air above. The sounding indicated a Lifted Index (LI) of 1.0 and indicated a conditional unstable atmosphere supporting nimbostratus type clouds. The precipitable water content was 0.89 inches.

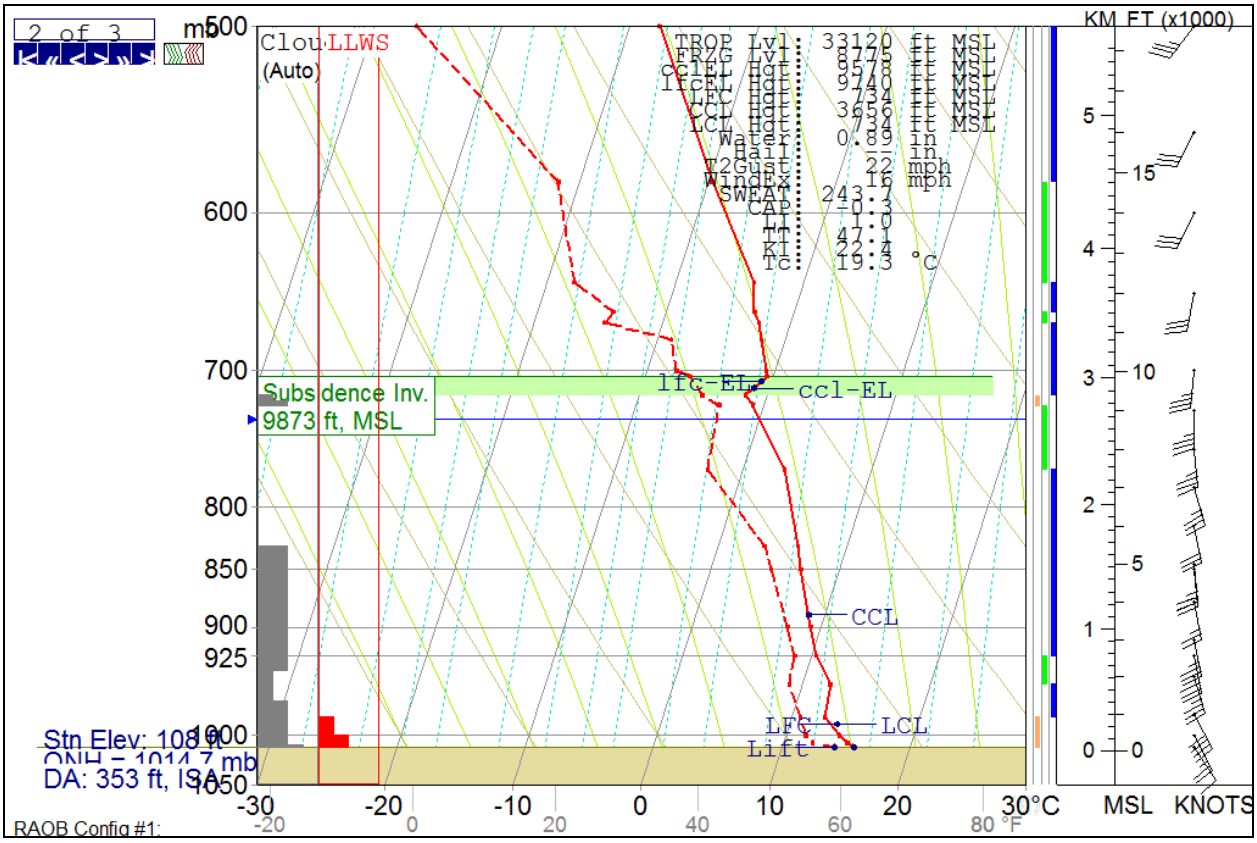

Figure 6 – Annett Island sounding at 1600 AKDT

The Annette Island sounding wind profile indicated a surface wind from 150° at 11 knots, with winds veering to the south and south-southwest with height, with wind speeds increasing with height. A low level jet was identified immediately above the surface at 800 feet with winds from

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of the atmosphere.

[5] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.

[6] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

[7] Level of Free Convection (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.

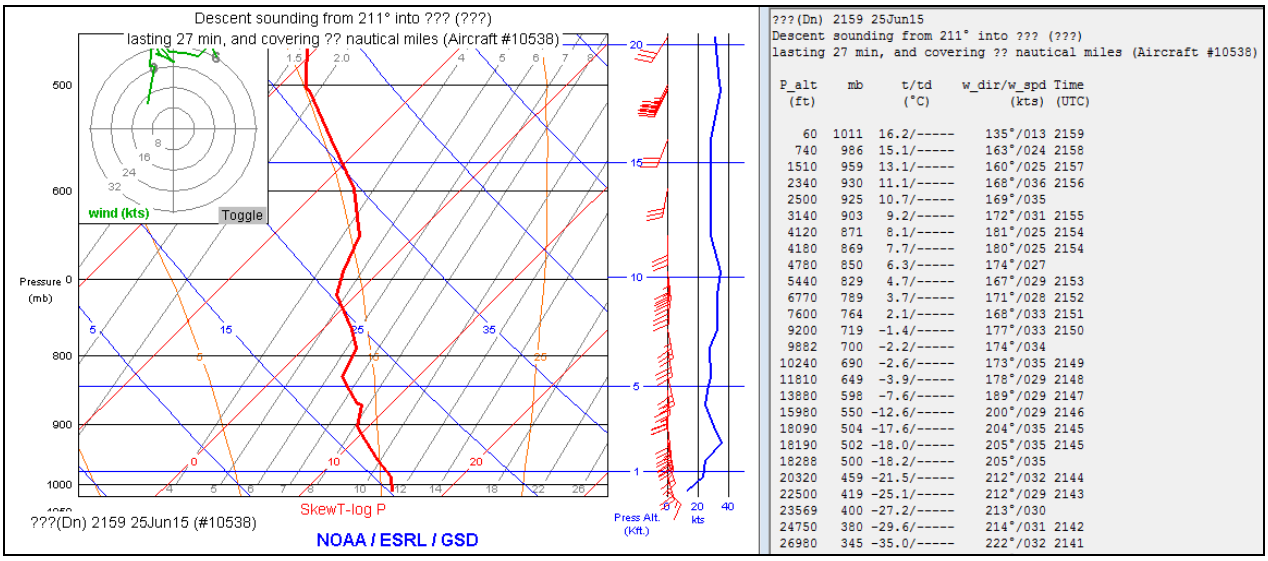
155° at 39 knots. The mean 0 to 6 kilometer or 18,000 feet wind was from 188° at 30 knots. The sounding indicated a high probability of encountering light to moderate low level turbulence and wind shear below 3,000 feet, due to the increase in winds immediately above the surface and strong vertical shear.

Height (ft-AGL)	Pres (mb)	T (C)	Td (C)	RH (%)	DD/FF (deg/kts)	CAT (AF)	LLWS	Icing - Type (S-F clouds)
0	1011	15.6	14.1	91	150/11			
111	1007	15.0	12.3	84		L-M	MODRT	
305	1000	14.2	11.6	84	155/24	L-M	LIGHT	
808	982	12.6	10.7	88	155/39			
1692	951	12.2	9.0	81		LGT		
1892	944				165/37	LGT		
2453	925	10.4	8.7	89	170/35			
2892	910				170/34			
3232	899	9.2	7.4	88		L-M		
3892	877				170/27	LGT		
4753	850	7.0	4.7	85	175/24			
4892	846				175/23			
5363	831	6.2	3.6	83		L-M		
5892	815				170/30	LGT		
6892	785				165/33			
7370	771	3.2	-2.8	65		LGT		
7892	756				175/35	LGT		
8892	728				180/33			
9032	724	-0.9	-3.5	82				TRC Clear
9286	717	-1.7	-5.1	78				TRC Clear
9765	704	-0.5	-6.5	64				
9915	700	-0.7	-7.7	59	185/33			
10712	679	-1.9	-8.9	59				
11138	668	-2.5	-14.5	39				

Figure 7 - Sounding parameters

6.0 Aircraft Sounding

A search of the NOAA Earth System Research Laboratory/Global Systems Division (ESRL/GSD) website (http://amdar.noaa.gov/) for Aircraft Meteorological Data Reports (AMDAR) provided an upper air data closer to the time of the accident from aircraft identified as #10538 that descended into Ketchikan International Airport at 1359 AKDT (2159Z). Figure 7 is a plot of the aircraft's descent sounding.



???(Dn) 2159 25Jun15
Descent sounding from 211° into ??? (???)
lasting 27 min, and covering ?? nautical miles (Aircraft #10538)

P_alt (ft)	mb	t/td (°C)	w_dir/w_spd (kts)	Time (UTC)
60	1011	16.2/-----	135°/013	2159
740	986	15.1/-----	163°/024	2158
1510	959	13.1/-----	160°/025	2157
2340	930	11.1/-----	168°/036	2156
2500	925	10.7/-----	169°/035	
3140	903	9.2/-----	172°/031	2155
4120	871	8.1/-----	181°/025	2154
4180	869	7.7/-----	180°/025	2154
4780	850	6.3/-----	174°/027	
5440	829	4.7/-----	167°/029	2153
6770	789	3.7/-----	171°/028	2152
7600	764	2.1/-----	168°/033	2151
9200	719	-1.4/-----	177°/033	2150
9882	700	-2.2/-----	174°/034	
10240	690	-2.6/-----	173°/035	2149
11810	649	-3.9/-----	178°/029	2148
13880	598	-7.6/-----	189°/029	2147
15980	550	-12.6/-----	200°/029	2146
18090	504	-17.6/-----	204°/035	2145
18190	502	-18.0/-----	205°/035	2145
18288	500	-18.2/-----	205°/035	
20320	459	-21.5/-----	212°/032	2144
22500	419	-25.1/-----	212°/029	2143
23569	400	-27.2/-----	213°/030	
24750	380	-29.6/-----	214°/031	2142
26980	345	-35.0/-----	222°/032	2141

Figure 8 - AMDAR aircraft sounding from Ketchikan at 1359 AKDT

The aircraft sounding indicated a similar temperature and wind profile as the Annette Island sounding. The freezing level was identified near 8,000 feet, and ruled out any icing threat to the accident airplane. The aircraft did not have a moisture sensor and did not provide any indication on potential cloud layers. The wind profile also confirmed a low-level wind maximum at 2,340 feet within wind from 168 at 36 knots, and indicated a light to moderate low-level wind shear condition.

7.0 Satellite Data

The Geostationary Operational Environmental Satellite number 15 (GOES-15) data was obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison (UW) in Madison, Wisconsin, and processed using the Safety Board's Man-computer Interactive Data Access System (McIDAS) software. Both the infrared long wave and visible band imagery were obtained surrounding the time of the accident. The infrared long wave imagery (band 4) at a wavelength of 10.7 microns (μm) provided standard satellite image with radiative cloud top temperatures with a resolution of 4 km. The visible imagery (band 1) at a wavelength of 0.65 μm provided a resolution of 1 km.

Figure 8 is the GOES-15 infrared image at 1215 AKDT at 4X magnification, with a standard MB temperature enhancement curve applied to highlight the higher and colder cloud tops. The image depicted an extensive area of low clouds over the area. The radiative cloud top temperature over the accident site was 271° Kelvin or -2.16° C, which corresponded to cloud tops near 11,000 feet based on the upper air sounding. Figure 9 is the GOES-15 visible image at 2X magnification for the same time period highlighting the extent of the stratiform to nimbostratus type clouds over the area, with overcast clouds over the accident site.

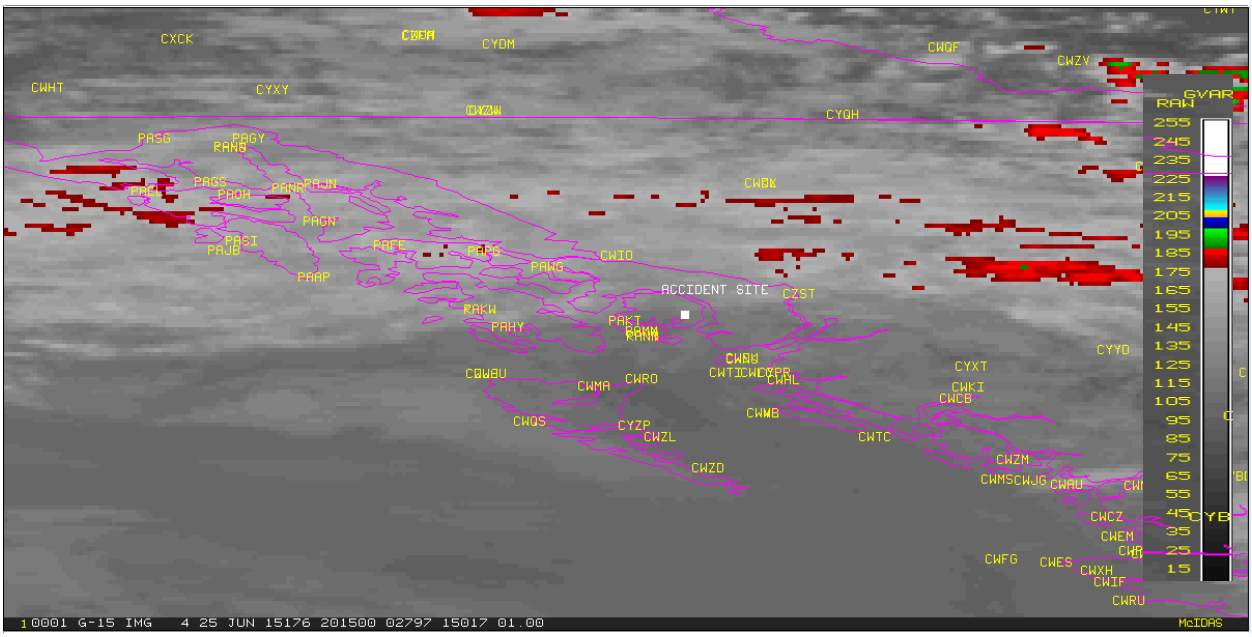


Figure 9 - GOES-15 infrared image at 1215 AKDT

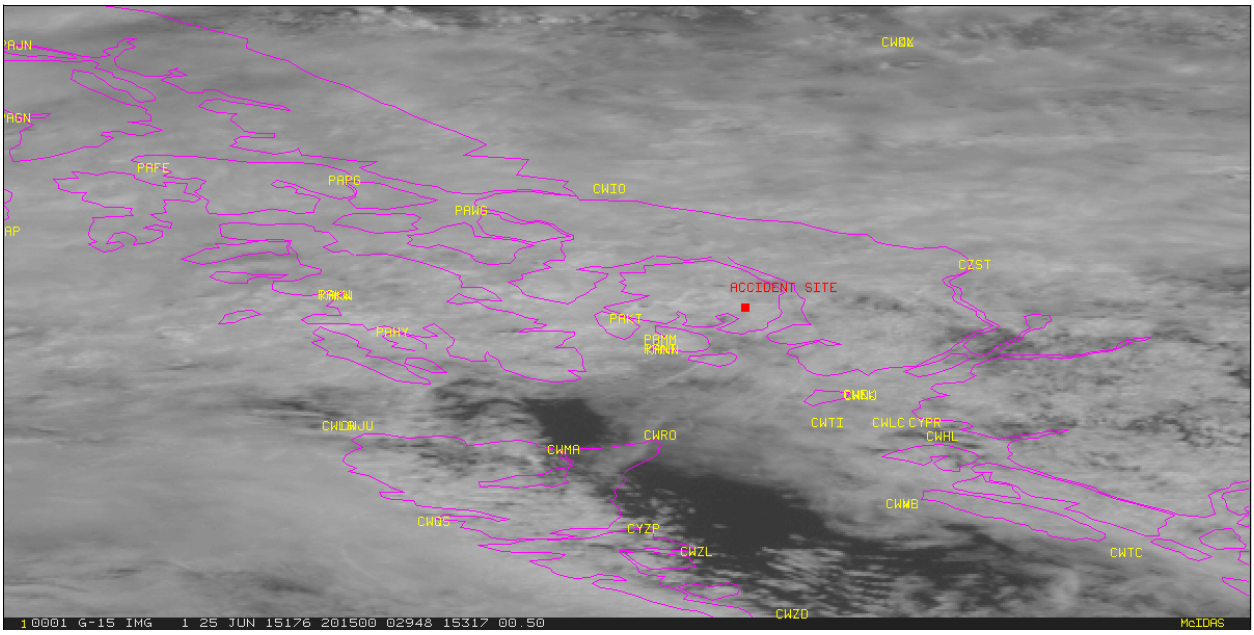


Figure 10 - GOES-15 visible image at 1215 AKDT

8.0 Weather Radar Information

The closest Weather Surveillance Radar-1988, Doppler (WSR-88D) to the accident site was from the NWS Sitka (PACG) located on Biorka Island approximately 170 miles northwest of the accident site. The level II and III archive data was obtained from the National Climatic Data Center (NCDC) utilizing the Hierarchical Data Storage System (HDSS) and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software. The radar coverage was

extremely limited over the area. Assuming standard refraction[8] of the 0.95° radar beam of the PACG WSR-88D with an antenna height of 114 feet the radar was scanning a layer between 19,700 to 36,840 feet over the accident site, and thus was overshooting any lower level showers.

8.1 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[9] it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ[10]), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1	3	15 to 19	.01 in/hr
Very Light	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2	6	30 to 34	.09 in/hr
Light to	7	35 to 39	.21 in/hr
Moderate			
3	8	40 to 44	.48 in/hr
Strong			
4	9	45 to 49	1.10 in/hr
Very			
Strong			
5	10	50 to 54	2.49 in/hr
Intense			
6	11	55 to 59	>5.67 in/hr
Extreme	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

[8] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

[9] Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glaze ice.

[10] dBZ - 10 log Ze

8.2 Composite Reflectivity

Figure 10 is the NWS Sitka WSR-88D composite reflectivity image at 1231 AKDT. The radar image depicted numerous rain showers with echoes in the range of 20 to 35 dBZ over the Alaska Pacific coastal sections to the west and northwest.

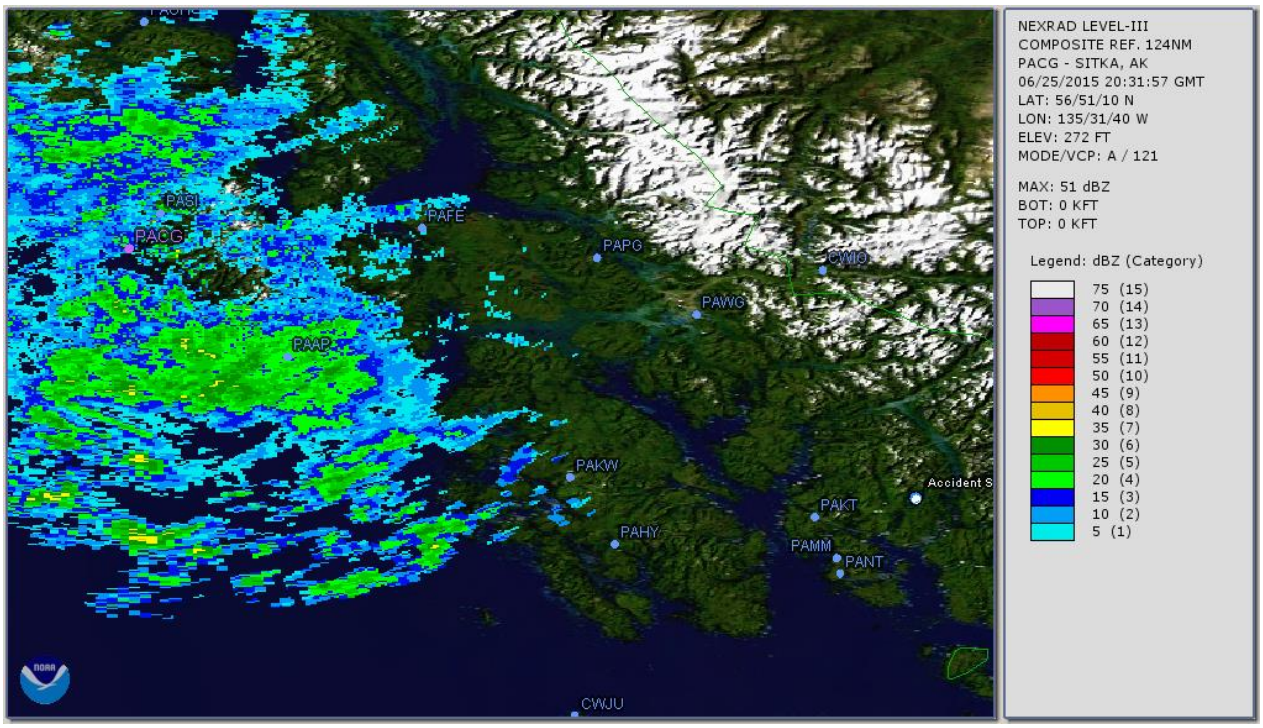


Figure 11 - Sitka WSR-88D composite reflectivity image at 1231 AKDT

9.0 FAA Weather Camera Images

The FAA manages several weather cameras to help pilots monitor weather conditions across Alaska. The weather cameras are defined as a supplementary weather product for monitoring current weather conditions and for planning purposes. A supplemental weather product must be used in conjunction with one or more primary weather product. The cameras are a tool that helps forecasters, AFSS flight service specialists, and pilot's maintain a continuous weather watch throughout the region and to become aware of trends that may not be reflected in the current forecasts. There were two weather cameras in the area to help monitor conditions in the area, one at the Ketchikan International Airport (KTN/PAKT) and the other at Misty Fjords identified as QA6B. Both stations were documented surrounding the period to help identify the weather conditions over the area.

9.1 Misty Fjord Weather Camera

The weather camera at Misty Fjords (QA6B) was location at 55.5125° N and 130.9098° W at sea level, with camera views to the North, Northeast, South, and the West. The camera views are depicted in figure 11 over a sectional chart and with the accident site marked by a red star. The

reference points in the four camera views provided in statute miles are provided in figures 12 and 13. The camera facing to the West or towards 259° best captured the accident site, which was on an azimuth of 248° and 10 statute miles (8.8 NM) from the camera site. New Eddystone Rock is located on the left side of the West camera viewing angle at the 240° azimuth and 1 statute mile from the camera.

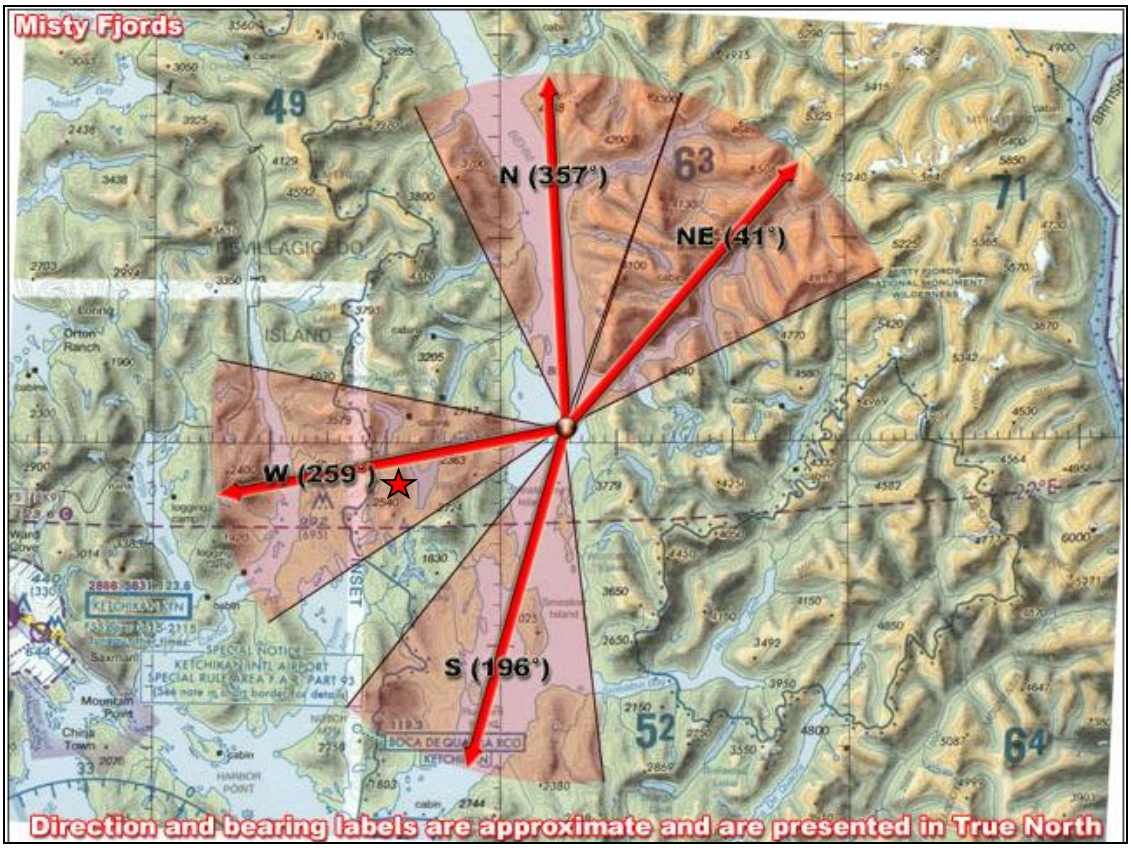


Figure 12 - Camera views for Misty Fjords

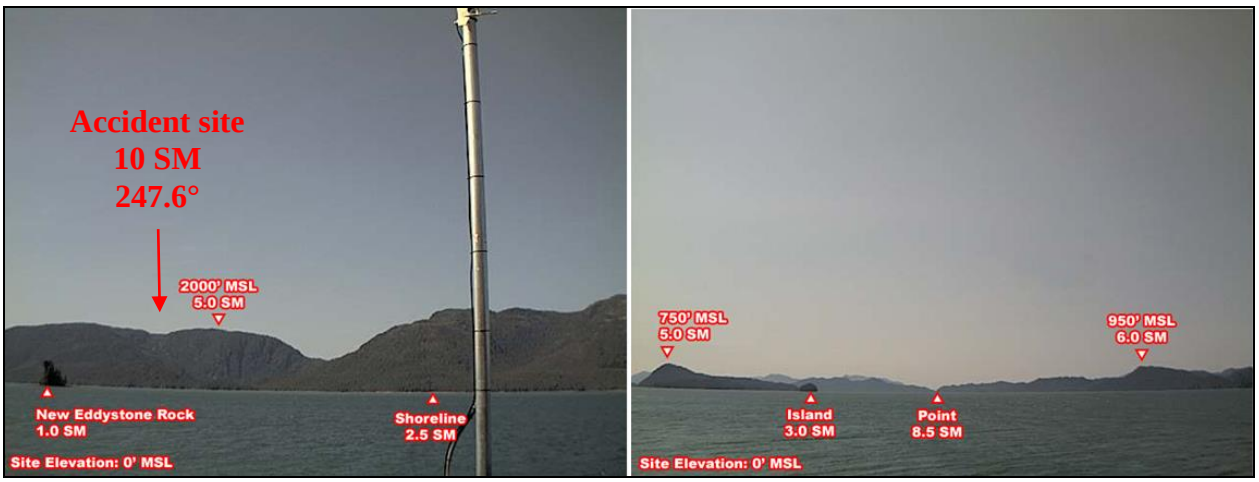


Figure 13 - Misty Fjord reference points West and South

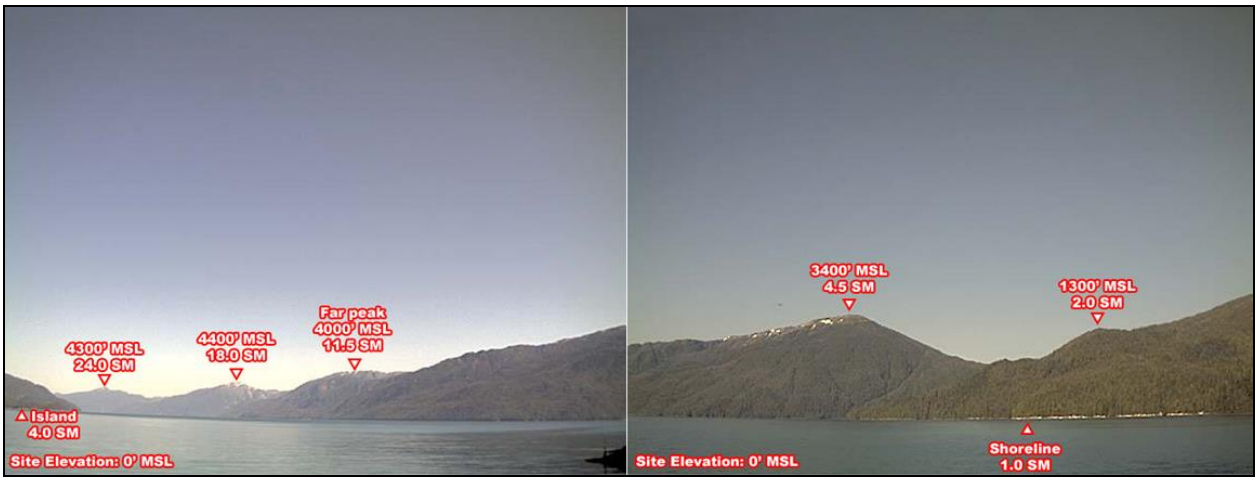


Figure 14 - Misty Fjords reference points North and Northeast

A review of the Misty Fjords camera between 0909 through 1500 AKDT detected an aircraft flying over the site at 1108 AKDT heading southward and again at 1213 AKDT heading westward. The images are included as figures 15 and 16 respectively. This camera view is not normally broadcasted, and is looking at the instrumentation towards the southwest.

Figures 17 through 26 are the Misty Fjords West camera images from 1121 through 1423 AKDT, at approximately 12 minute increments. The higher ridge elevations are obscured during the period, with a layer of stratiform clouds below the peaks. Visibility is also noted to decrease to less than 3 statute miles during the period, where the shore line is not clearly identifiable.

Figures 27 through 29 are the images from the North, Northeast, and South between 1208 and 1209 AKDT. The images also show broken to overcast cloud over the area with most of the higher terrain obscured by clouds, and with several lower stratiform clouds over the terrain and scattered rain showers.

Figure 15 - Misty Fjords camera view of aircraft passing overhead at 1108 AKDT

Figure 16 - Misty Fjords camera image at 1213 AKDT with aircraft heading eastward

Figure 17 - Misty Fjords West image at 1121 AKDT

Figure 18 - Misty Fjords West image at 1134 AKDT

Figure 19 - Misty Fjords West image at 1146 AKDT

Figure 20 - Misty Fjords West image at 1158 AKDT

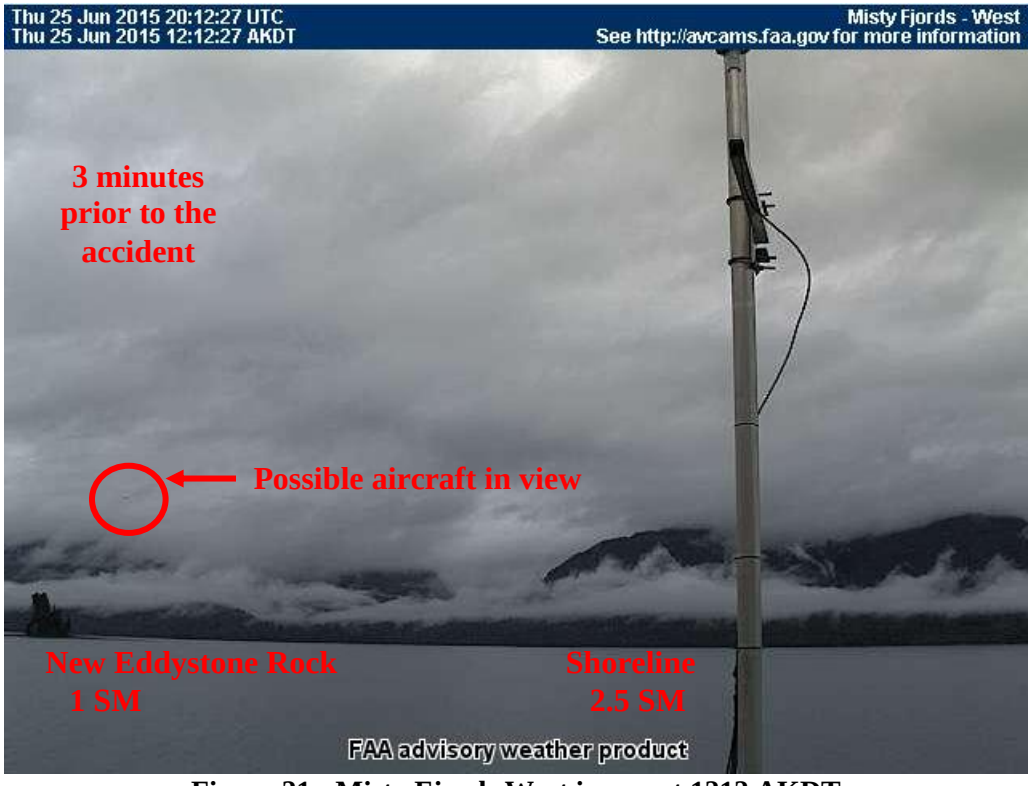


Figure 21 - Misty Fjords West image at 1212 AKDT

Figure 22 - Misty Fjords West image at 1225 AKDT

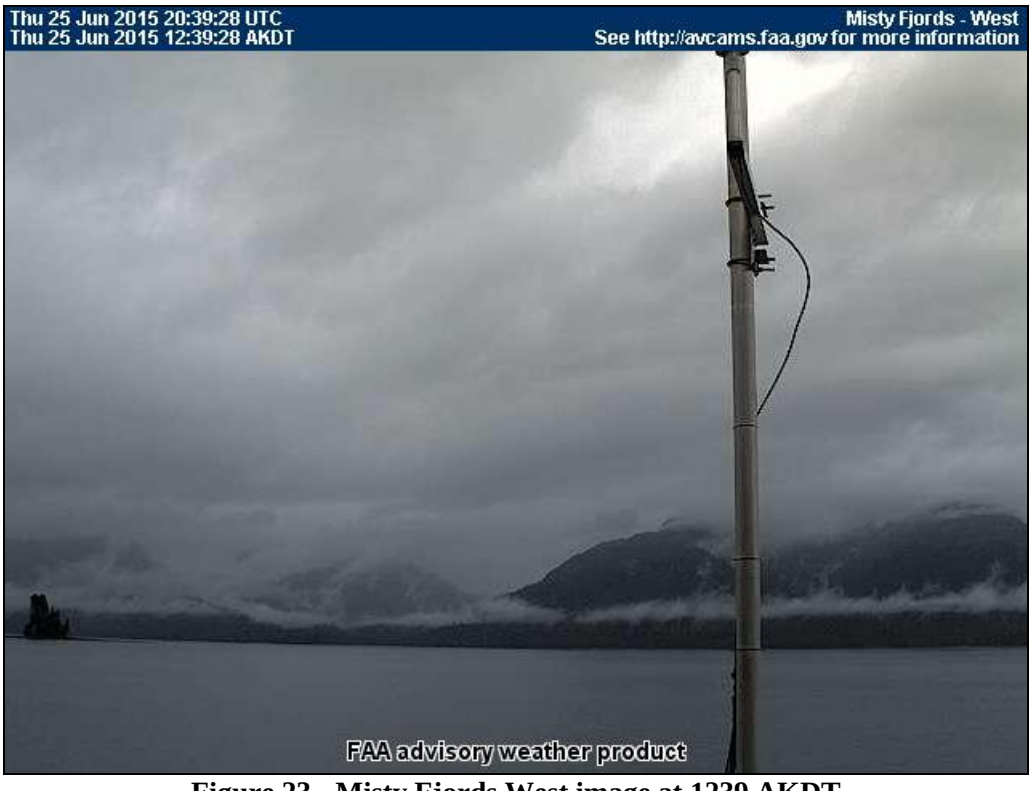


Figure 23 - Misty Fjords West image at 1239 AKDT

Figure 24 - Misty Fjords West image at 1252 AKDT

Figure 25 - Misty Fjords West image at 1317 AKDT

Figure 26 - Misty Fjords West image at 1423 AKDT

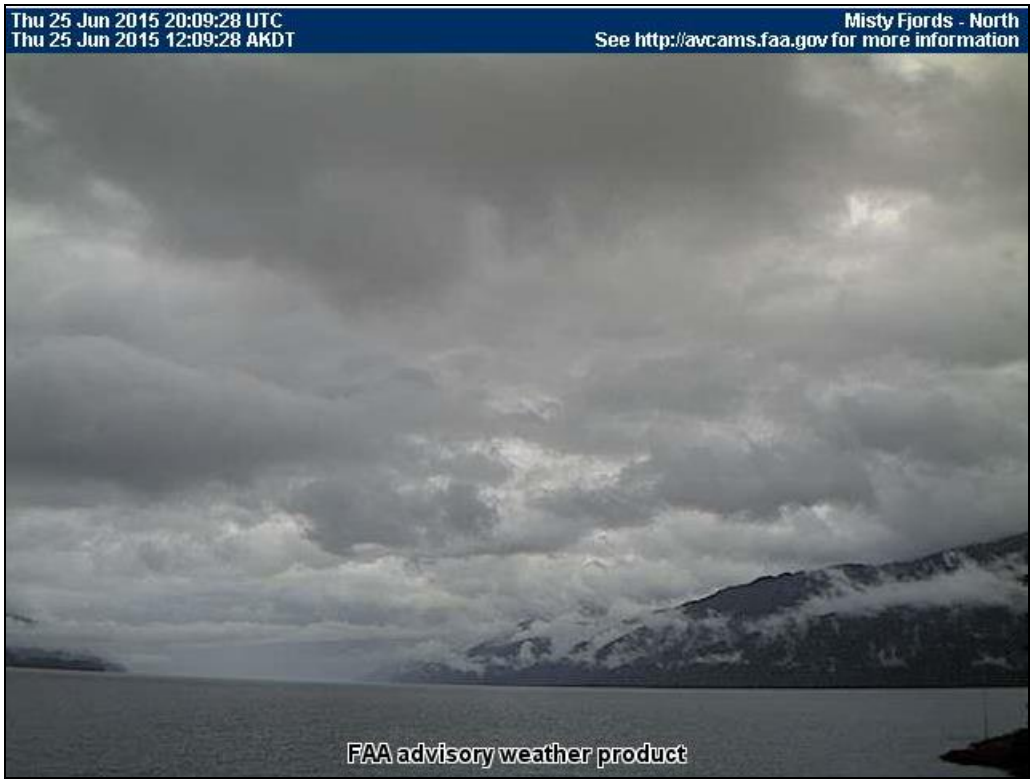


Figure 27 - Misty Fjords North image at 1209 AKDT

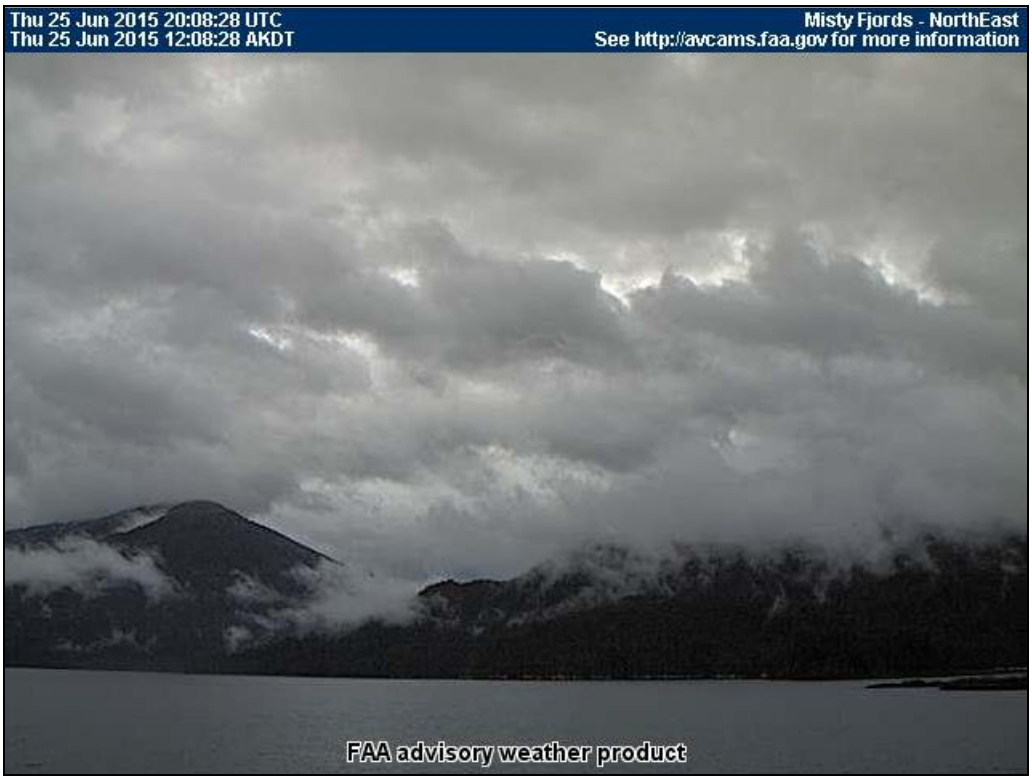


Figure 28 - Misty Fjords Northeast image at 1208 AKDT

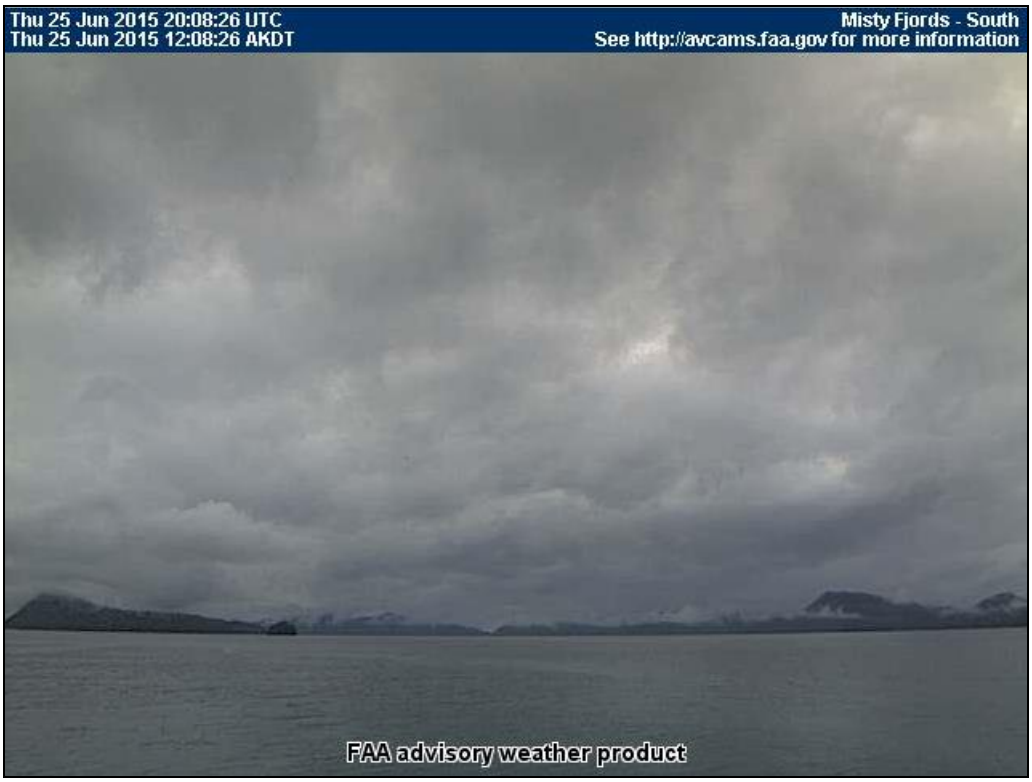


Figure 29 - Misty Fjords South image at 1208 AKDT

9.2 Ketchikan Weather Camera

Figure 30 is the Ketchikan weather camera viewing location with the accident site marked, followed by figures 31 and 32 providing the reference points for the various views. The weather conditions in the vicinity of the accident site were best captured on the extreme right hand side of the Northeast camera view, with the accident site located at 23 statute miles at an azimuth of 71°.

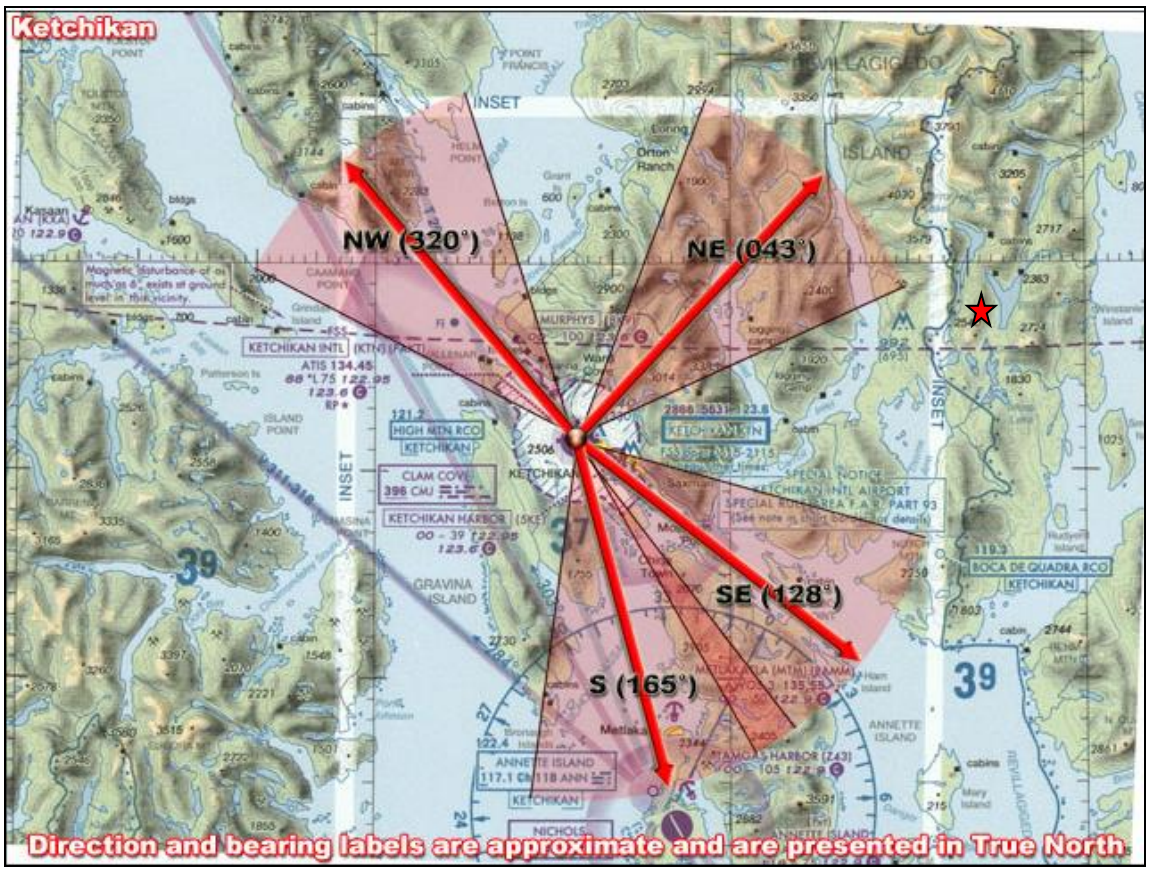


Figure 30 - FAA weather camera views from Ketchikan

Figure 31 are the Ketchikan weather camera reference points to the Northwest and Northeast, and figure 32 the reference points to the south and southeast. The northeast camera best depicted the conditions in the direction of the accident site, but did not capture the accident at 23 statute miles at an azimuth of 72° from Ketchikan.

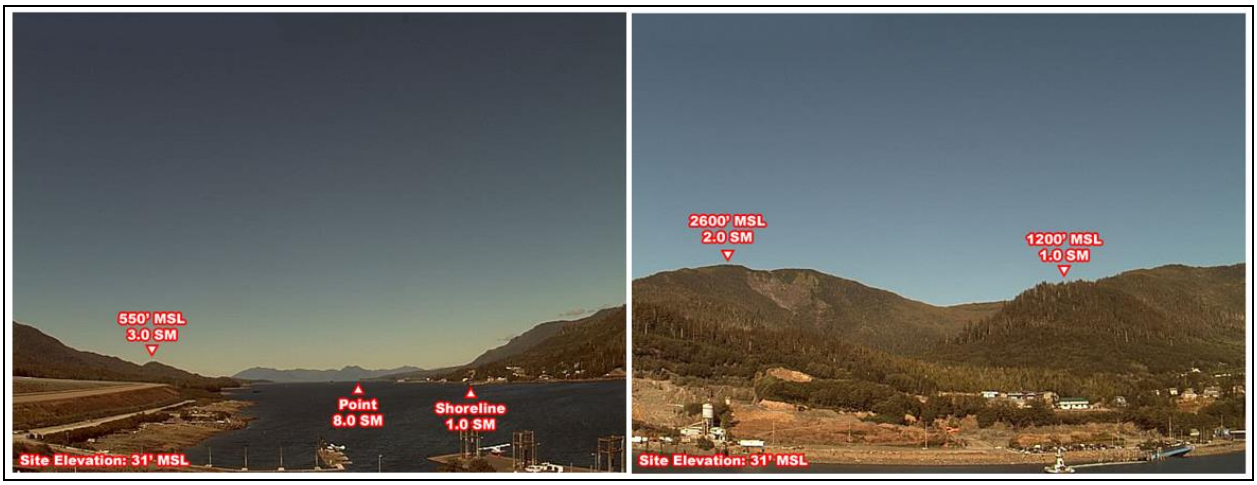


Figure 31 - Ketchikan camera view reference points to the Northwest and Northeast

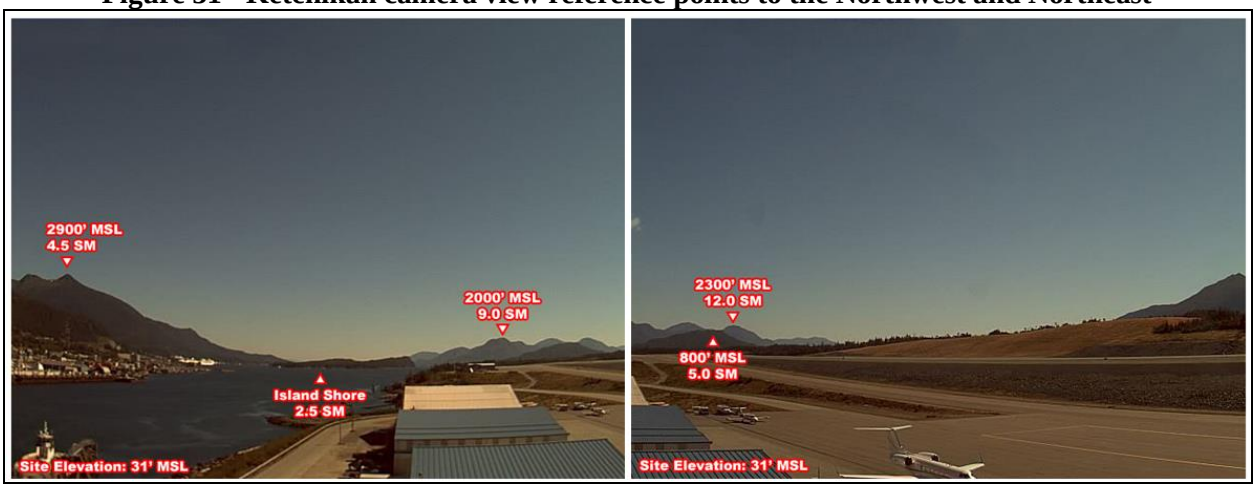


Figure 32 - Ketchikan camera reference points to the South and Southeast

Figures 33-38 are the Ketchikan northeast camera views at 1158 through 1304 AKDT at approximately every 12 minutes, and depicted the higher terrain 2 miles away completely obscured by clouds during the period, and the ridges at 1,200 feet and 1 mile away occasional obscured by clouds and poor visibility. Figure 39 is the southeast camera view at 1212 AKDT.

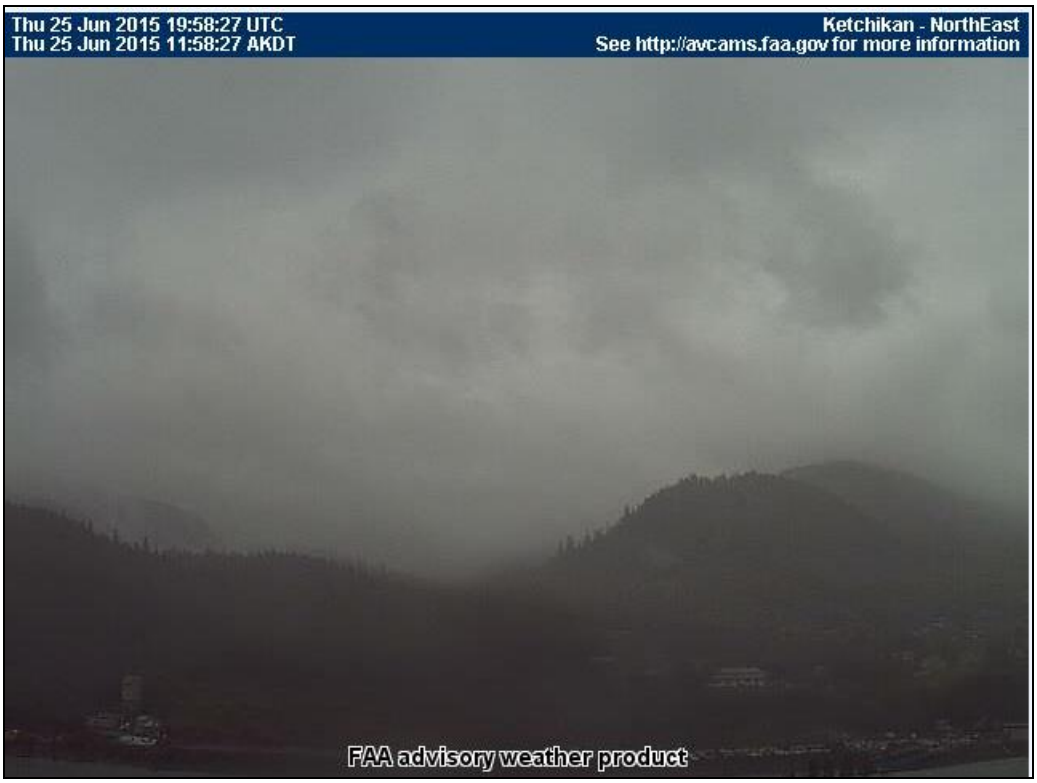


Figure 33 - Ketchikan Northeast view at 1158 AKDT

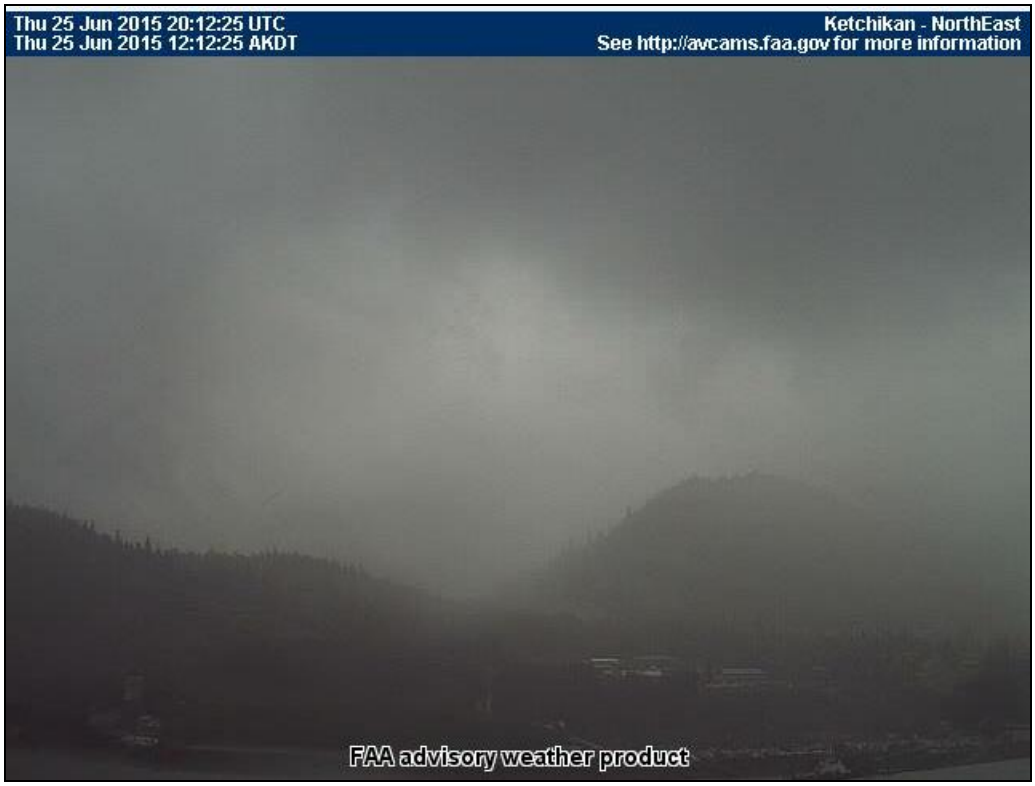


Figure 34 - Ketchikan Northeast view at 1212 AKDT

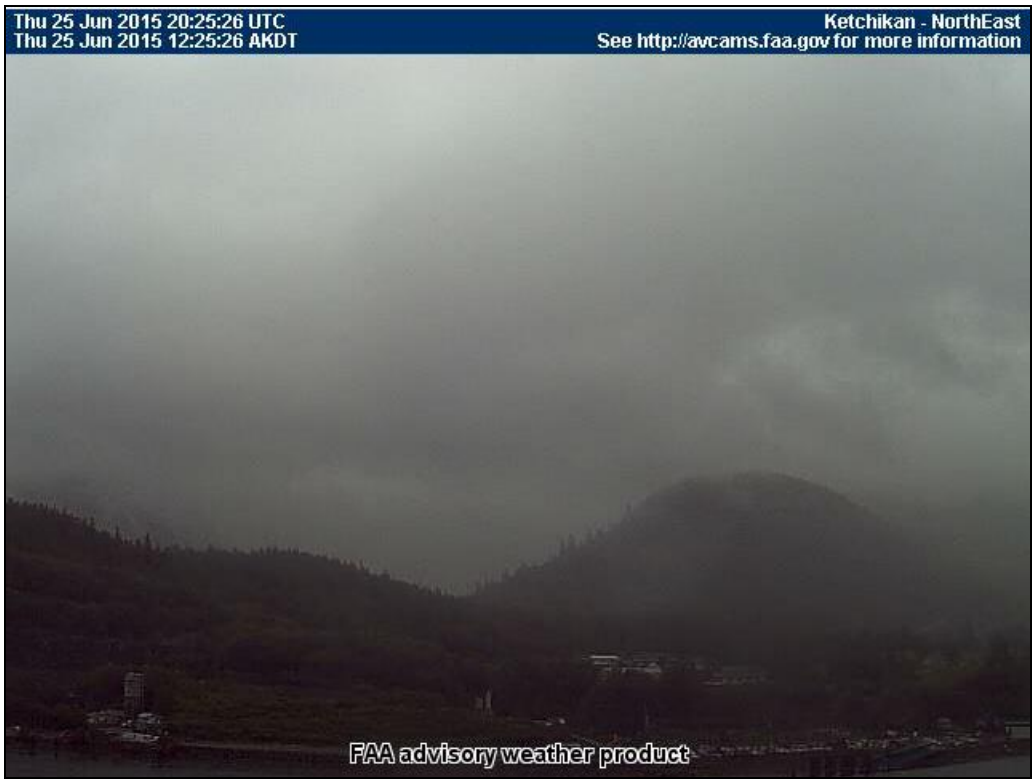


Figure 35 - Ketchikan Northeast view at 1225 AKDT

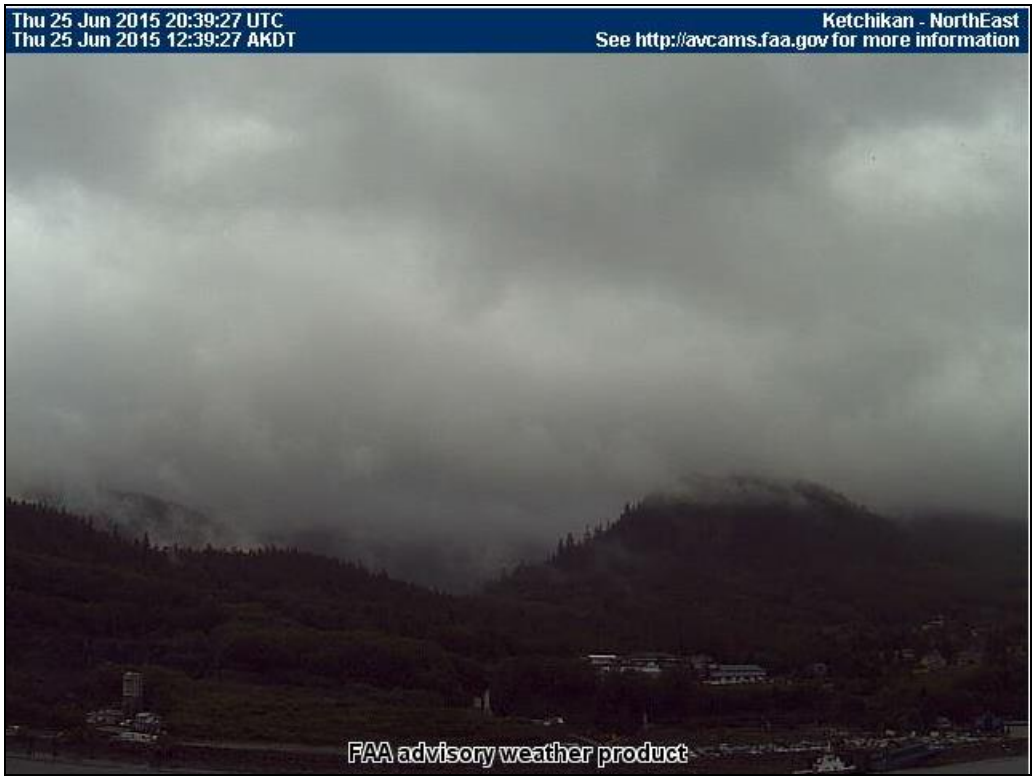


Figure 36 - Ketchikan Northeast view at 1239 AKDT

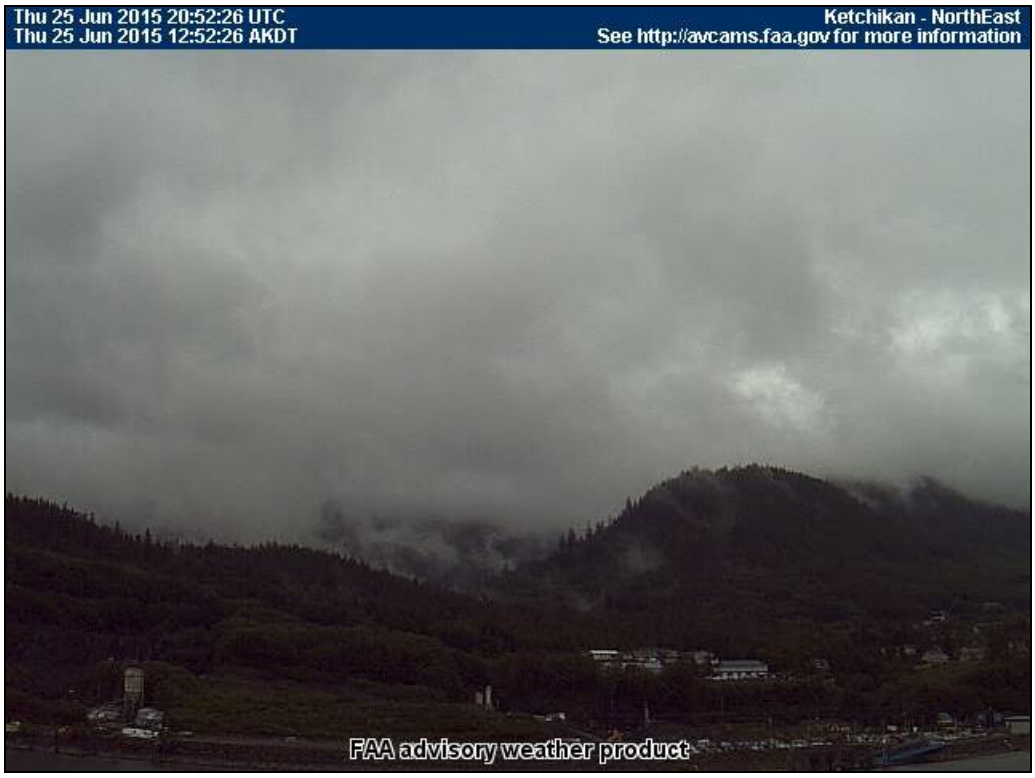


Figure 37 - Ketchikan Northeast view at 1252 AKDT

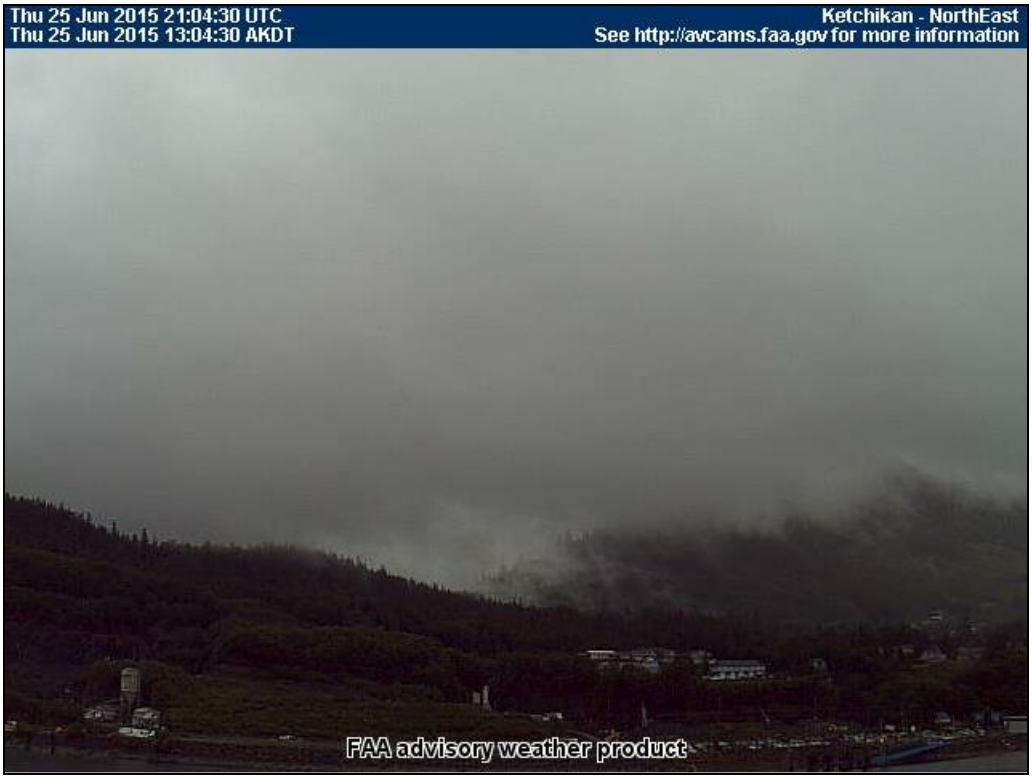


Figure 38 - Ketchikan Northeast view at 1304 AKDT

Figure 39 - Ketchikan Southeast view at 1212 AKDT

10.0 NWS Forecast Products

The following aviation weather products were issued surrounding the period from the NWS Alaska Aviation Weather Unit (AAWU) located in Anchorage and the NWS Juneau Forecast Office.

10.1 Area Forecast

The NWS AAWU issued the southeast Alaska Area Forecast (FA) issued at 0410 AKDT and was valid until 1215 AKDT. The forecast includes any Airmen Meteorological Information (AIRMET) advisories and a general forecast for conditions over a region, and is typically used to determine forecast enroute weather conditions and conditions at airports that do not have a Terminal Aerodrome Forecast (TAF). The following is the southeast forecast current during the period:

FAAK47 PAWU 251210 2015176 1210
JNUH FA 251215
EASTERN GULF COAST AND SE AK...
.
AIRMETS VALID UNTIL 252015
CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HEIGHTS NOTED BY AGL OR CIG.
.

SYNOPSIS VALID UNTIL 260600
WK HI PRES PRSTS ACROSS CENTRAL AND ERN GULF COASTS THRU PD. 1005MB LOW 180NM SW DIXON ENTRANCE WL MOV TO 110NM W PASI AT 1011MB BY 06Z. ASSOC OCFNT FM LOW TO JUST W QUEEN CHARLOTTES WKNS ACROSS OFFSHR COASTAL WATERS GENLY SW PASI THRU PD.
.
LYNN CANAL AND GLACIER BAY JB...VALID UNTIL 260000
...CLOUDS/WX...
****AIRMET MT OBSC***MTS OCNL OBSC IN CLDS/PCPN. NC...*
SCT035 BKN-OVC060 TOPS 090 LYRD TO FL200. OCNL BKN-OVC035 -RA.
OTLK VALID 260000-260600...MVFR CIG RA.
PASSES...WHITE...MVFR CIG RA. CHILKOOT...VFR RA.
...TURB...
NIL SIG.
...ICE AND FZLVL...
ISOL MOD ICEIC 100-170. FZLVL 090.
.
CNTRL SE AK JC...VALID UNTIL 260000
...CLOUDS/WX...
****AIRMET MT OBSC***S PAFE MTS OBSC IN CLDS/PCPN. NC...*
SCT035 BKN-OVC060 TOPS 090 LYRD TO FL230. OCNL BKN-OVC035 -RA.
S PAFE OCNL BKN025 -RA. ISOL CIGS BLW 010.
OTLK VALID 260000-260600...MVFR CIG RA.
...TURB...
NIL SIG.
...ICE AND FZLVL...
ISOL MOD ICEIC 100-170. FZLVL 090.
.
SRN SE AK JD...VALID UNTIL 260000
...CLOUDS/WX...
******AIRMET MT OBSC***MTS OBSC IN CLDS/PCPN. NC...***
SCT025 BKN-OVC050 LYRD ABV TO FL250. OCNL BKN025 VIS 3-5SM -RA BR. ISOL CIGS BLW 010.
OTLK VALID 260000-260600...MVFR CIG RA.
...TURB...
NIL SIG.
...ICE AND FZLVL...
ISOL MOD ICEIC 100-170. FZLVL 100.

The synopsis section indicated that a low pressure system at 1005-hPa was off the Dixon Entrance to the southwest with an associated occluded frontal system, which was expected to move eastward and weaken off shore.

The forecast for southern southeast Alaska valid until 1800 AKDT warned of mountain obscuration condition in clouds and precipitation, with no change expected during the period. The forecast expected scattered clouds at 2,500 feet msl, and broken to overcast clouds at 5,000 feet layered with tops above 25,000 feet, with occasional broken conditions at 2,500 feet with visibility 3 to 5 miles in light rain and mist, with isolated ceilings below 1,000 feet. The outlook from 1600 to 2200 AKDT expected MVFR conditions to prevail due to low ceilings and visibility in rain.

No significant turbulence was expected during the period. The freezing level was identified near 10,000 feet, and the forecast expected isolated moderate icing in-clouds between 10,000 and 17,000 feet.

11.0 Graphic Products

The NWS AAWU also issues several different weather graphics to depict the weather conditions over the region. Figure 40 is the NWS AAWU Surface Analysis issued at 0600 AKDT and depicted the low pressure system at 1005-hPa off the southwest coast of Alaska associated with the dissipating occluded front. A large area of light continuous rain over 50% of the area was expected during the period.

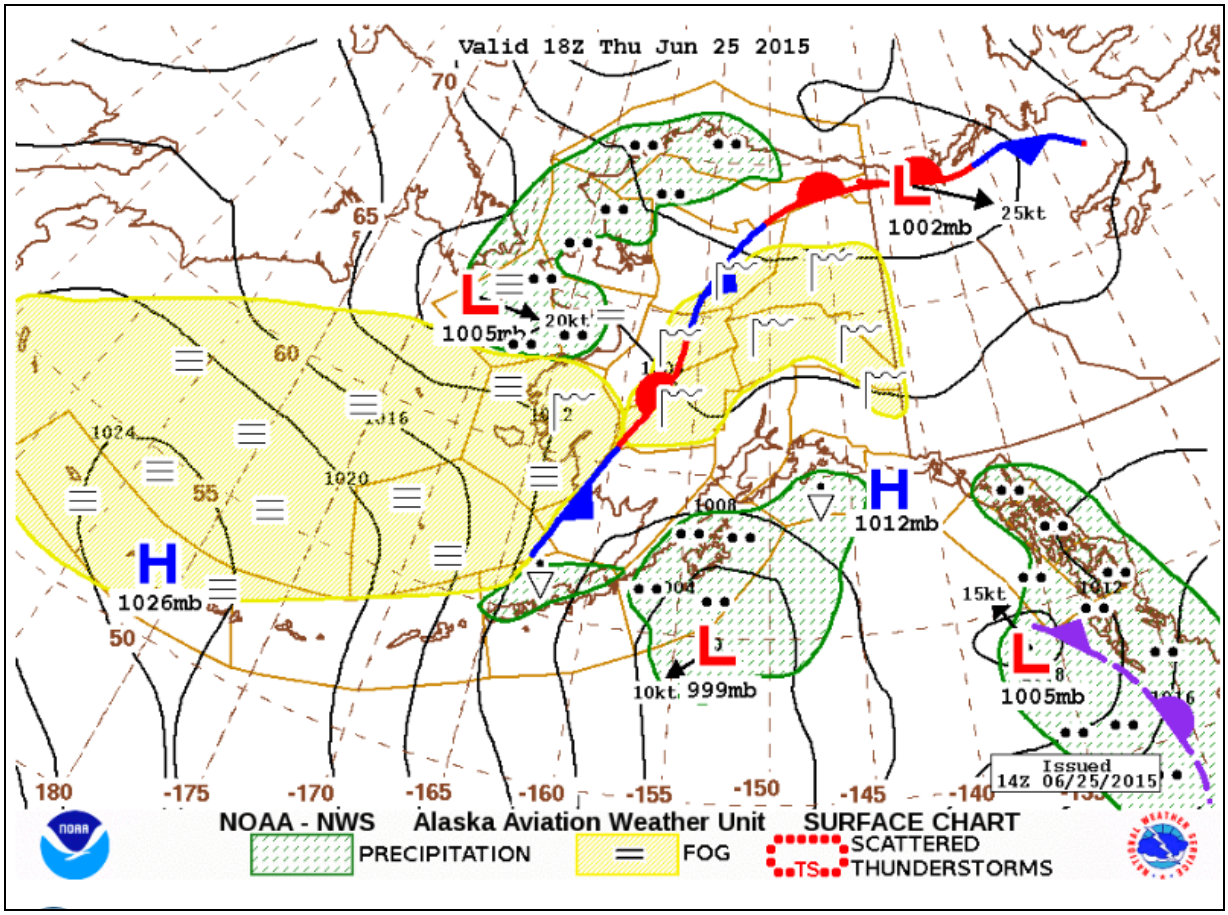


Figure 40 - The NWS Surface Forecast issued at 0600 AKDT and valid for 1000 AKDT

Figures 41 and 42 are the NWS AAWU Flying Weather graphics which depicted the general flight categories expected during the period. Both charts covering the period from 1000 through 1800 AKDT expected MVFR conditions to prevail over southeast Alaska during the period.

Figures 43 and 44 are the NWS AAWU turbulence forecasts for the period, with no significant turbulence expected for the southeast section of Alaska during the period.

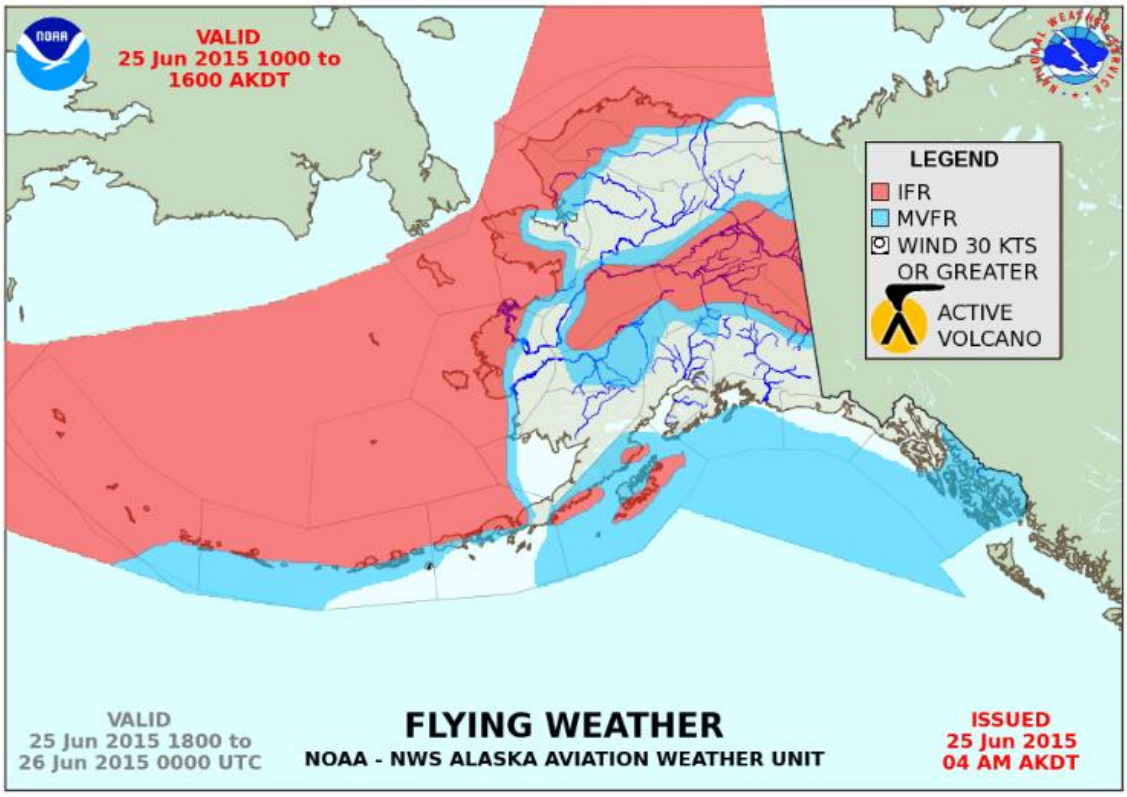


Figure 41 - AAWU Flying Weather for 1000 to 1600 AKDT

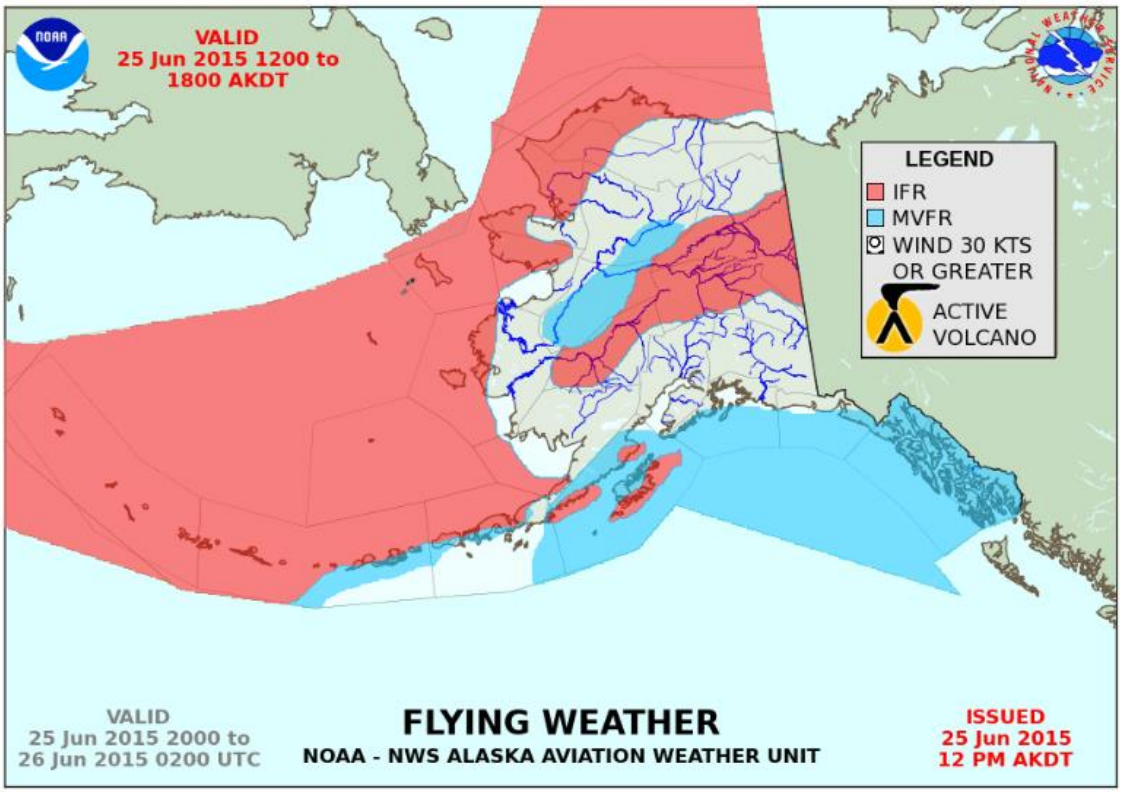


Figure 42 - AAWU Flying Weather for 1200 to 1800 AKDT

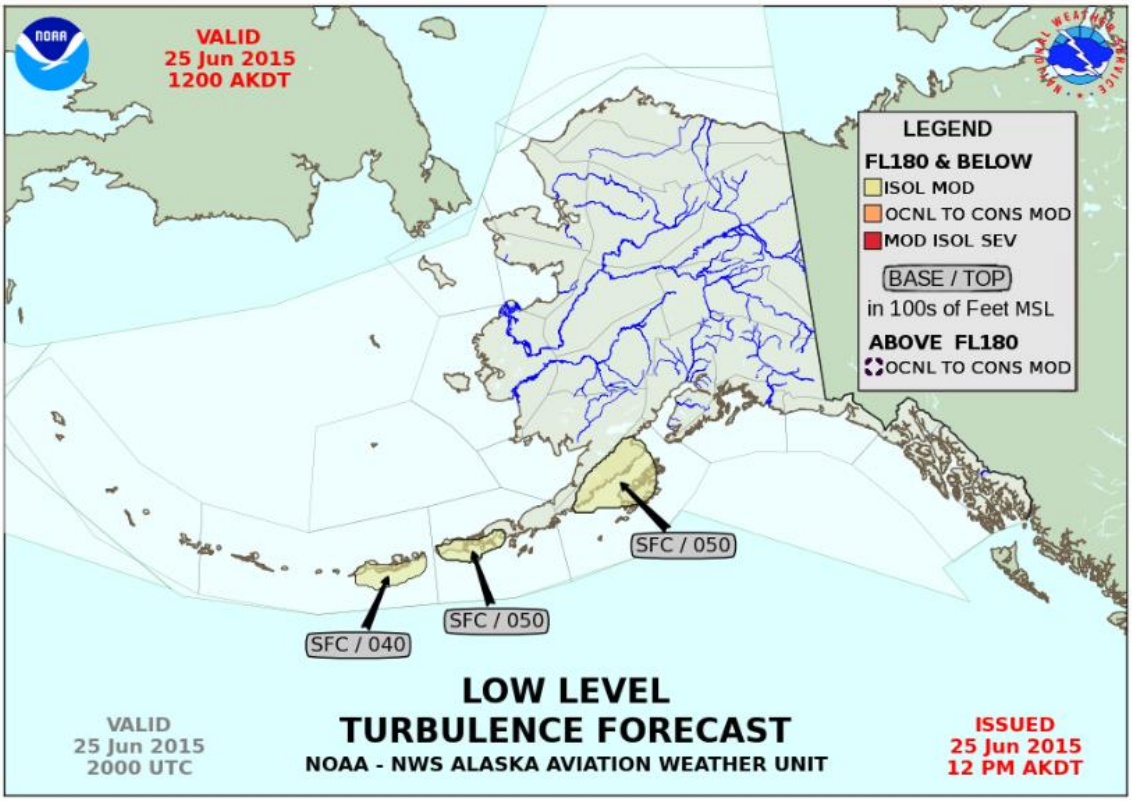


Figure 43 - NWS AAWU Low-Level Turbulence Forecast for June 25, 2015

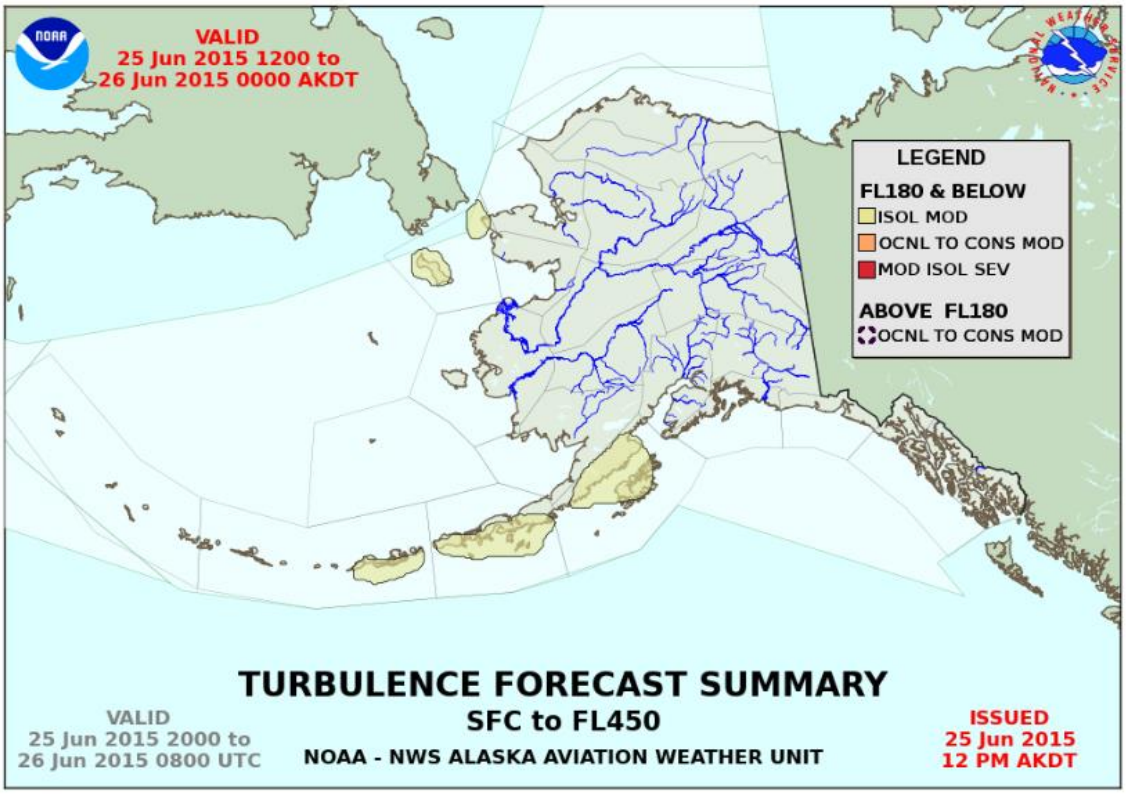


Figure 44 - NWS AAWU Turbulence forecast to 45,000 feet

12.0 Alaska Forecast Discussion

The NWS Juneau Forecast Office issued the Forecast Discussion describing the general weather conditions expected over the region. While not defined as an aviation weather product, it provides the general meteorological conditions influencing the area and provides insight into the forecast. The forecast discussion current at the time was as follows:

FXAK67 PAJK 251345
AFDAJK

SOUTHEAST ALASKA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE JUNEAU AK
545 AM AKDT THU JUN 25 2015

.SHORT TERM...A LARGE MULTI CENTER LOW OVER THE GULF OF ALASKA IS A SIGNIFICANT PLAYER IN THURSDAYS WEATHER. TWO OF THE SURFACE LOWS ARE ON THE WEST SIDE OF THE GULF WHILE THE THIRD IS MOVING NORTHWARD OVER THE EASTERN HALF OF THE GULF AND WEAKENING THROUGH TONIGHT. THIS FEATURE IS SPREADING RAIN NORTH ACROSS THE PANHANDLE. RAINFALL AMOUNTS FROM THE LOW ARE EXPECTED TO BE BETWEEN A HALF INCH AND AN INCH. THE RAIN SHOULD SPREAD TO THE NORTHERN PORTION OF THE PANHANDLE THROUGH LATE AFTERNOON AND EVENING.

BEHIND THE LOW AS IT MOVES NORTH TONIGHT A SURFACE RIDGE IS REBUILDING ALONG THE COASTLINE OF BRITISH COLUMBIA INTO THE SOUTHERN PANHANDLE. A FEW OF THE MODELS ARE SUGGESTING A QUICK BURST OF WIND DUE TO THE TIGHT GRADIENT. 20 TO 25 KT WINDS MOVING NORTH THROUGH INNER CHANNELS DURING THE AFTERNOON AND OVERNIGHT WORKING THEIR WAY TO JUST SOUTH OF LYNN CANAL BY SUNRISE FRIDAY.

RAIN WILL TAPER OFF SLIGHTLY ACROSS THE SOUTHERN PANHANDLE TONIGHT HOWEVER IT WILL CONTINUE ACROSS THE NORTHERN HALF TONIGHT.

.LONG TERM...WEAKENING LOW AND OCCLUDED FRONT WILL MOVE N OF THE AREA FRI MORNING. SFC RIDGE WILL BUILD IN BEHIND THE SYSTEM OVER SE AK AND THE FAR ERN GULF DURING FRI...THEN GENERALLY REMAIN THERE THRU THE WEEKEND. AFTER THAT...SYSTEM MOVEMENT BECOMES INCREASINGLY UNCERTAIN AS MODELS DIVERGE ON SMALLER SCALE DETAILS WITH SOME POSITIONAL DIFFERENCES ON LARGER SCALE FEATURES AS WELL. CURRENT FORECAST WAS REASONABLE FOR THE MOST PART...BUT DID MAKE A FEW TWEAKS HERE AND THERE. PREFERRED THE 00Z ECMWF HANDLING OF THE LOW AND FRONT FOR FRI MORNING...SO IT WAS USED TO ADJUST FORECAST FOR FRI.

PRECIP WITH LOW AND FRONT WILL GRADUALLY DIMINISH FROM THE S FRI...BUT ENOUGH ONSHORE FLOW SHOULD CONTINUE OVER THE N TO KEEP IT GOING THERE. WINDS WILL PICK UP AS LOW LEVEL RIDGING BUILDS N ACROSS THE AREA...BUT IT APPEARS THAT THE WINDS WILL PEAK A LITTLE LESS THAN PREVIOUSLY EXPECTED...WITH NRN LYNN CANAL EXPECTED TO PEAK AT 30 KT. THIS ONSHORE FLOW WILL REMAIN OVER THE N INTO THE WEEKEND...AND ALONG WITH MINOR SHORTWAVES ALOFT MOVING THRU THE AREA...WILL KEEP PRECIP THREAT GOING DURING THE WEEKEND IN MOST OF THE N. THE FAR S WILL HAVE LEAST PRECIP THREAT DUE TO SOME MID-LEVEL RIDGING TRYING TO BUILD INTO THAT AREA...BUT CORE OF THE RIDGE WILL REMAIN TO THEIR E SO CANNOT RULE OUT SOME LIGHT PRECIP FROM TIME TO TIME AS MINOR SHORTWAVES BRUSH PAST THEM.

FOR NEXT WEEK...WITH THE INCREASING UNCERTAINTY WITH WEATHER SYSTEMS POTENTIALLY AFFECTING THE AREA...FELT IT WAS BEST TO MAINTAIN CURRENT FORECAST. STILL LOOKS LIKE OVERALL BEST THREAT FOR PRECIP WILL BE OVER THE NW HALF OF THE AREA DUE TO ONSHORE FLOW. THIS THREAT MAY DIMINISH TOWARD LATE WEEK AS MODELS HINT THAT A

STRONGER UPPER RIDGE WILL TRY TO BUILD OVER THE GULF DURING THE LATTER PART OF THE WEEK...BUT MODELS HAVE NOT BEEN CONSISTENT ON THE LOCATION OF THE RIDGE AXIS OR THE SHARPNESS OF THE RIDGE ITSELF...SO CONFIDENCE IN TRYING TO DETERMINE ANY DRY PERIODS LATER ON IS LOWER THAN AVERAGE.

.AJK WATCHES/WARNINGS/ADVISORIES...
PUBLIC...NONE.
MARINE...SMALL CRAFT ADVISORY FOR PKZ036-052.
SMALL CRAFT ADVISORY DUE TO SEAS FOR PKZ041-051.

BEZENEK/RWT

13.0 Preflight Weather Briefing

There was no record of the pilot contacting the FAA Automated Flight Service Station (AFSS) or any Direct User Access Terminal System (DUATS) providers for any official weather briefing during the period. It is also unknown if he accessed any devise to review any of the FAA weather camera images or internet weather sources to familiarize himself before beginning the flight.

14.0 Topography of the Area

Topographical maps of the area with the accident site marked are included as figures 45-48, with the approximate flight track overlaid and spot elevations from the NOAA sectional map.

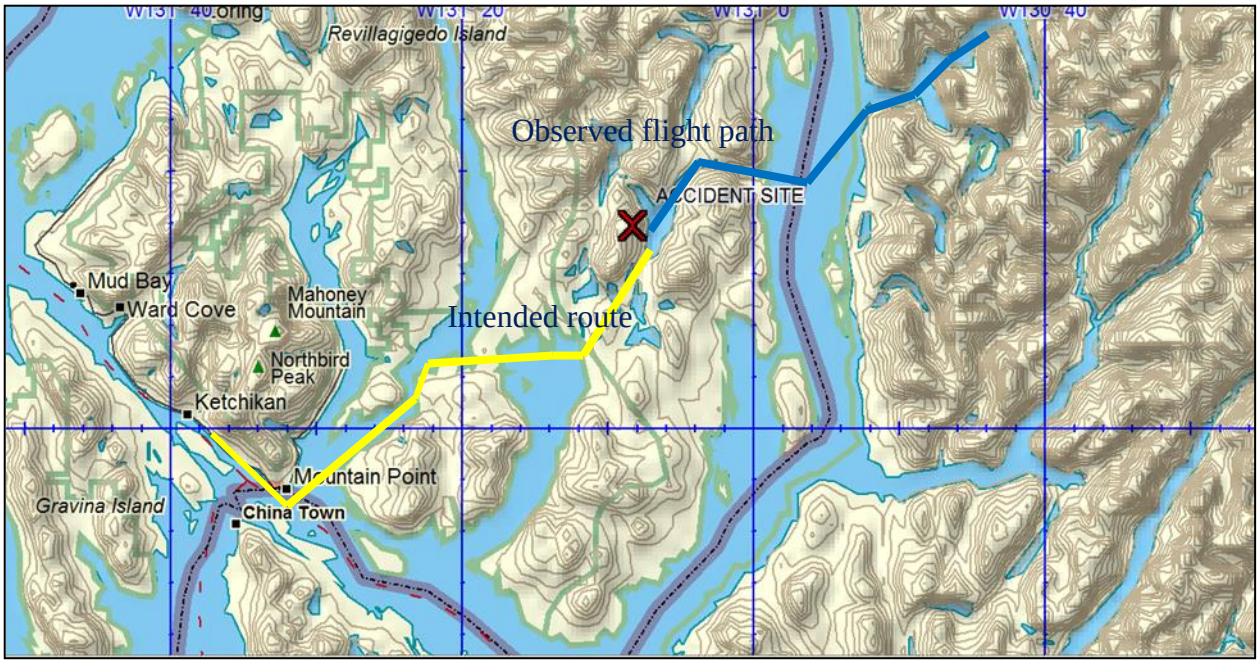


Figure 45 – Topographic map of the region

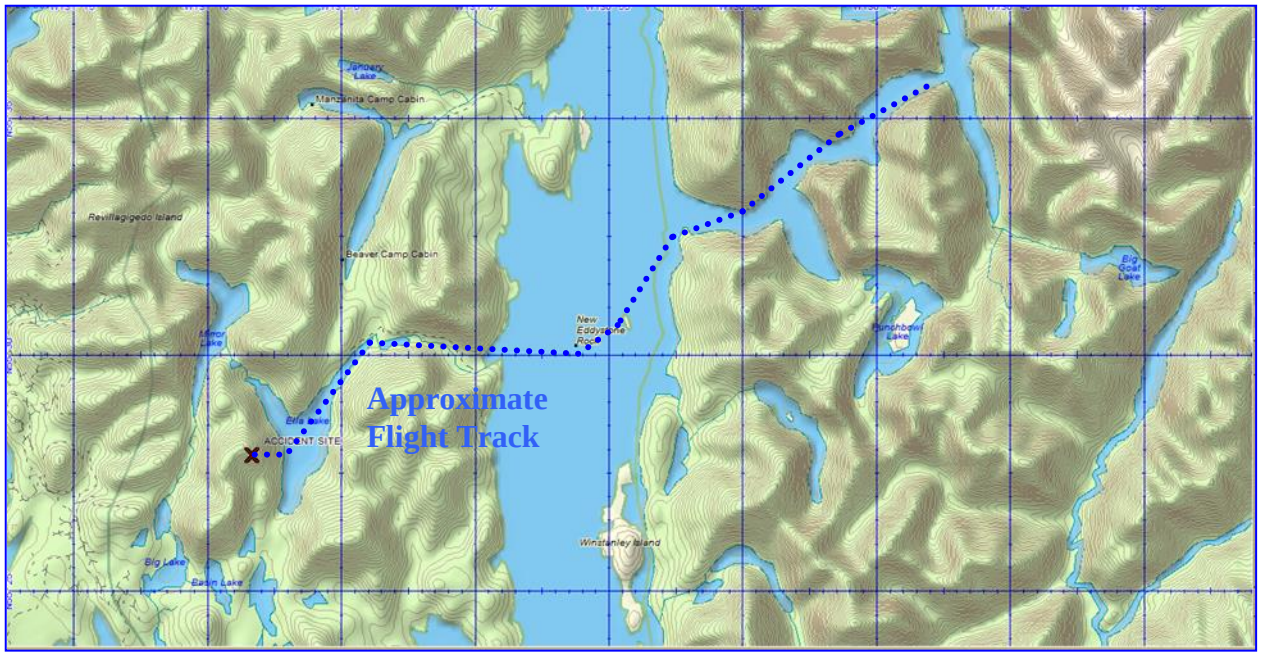


Figure 46 – Topographic map close-up from departure to accident site with flight track

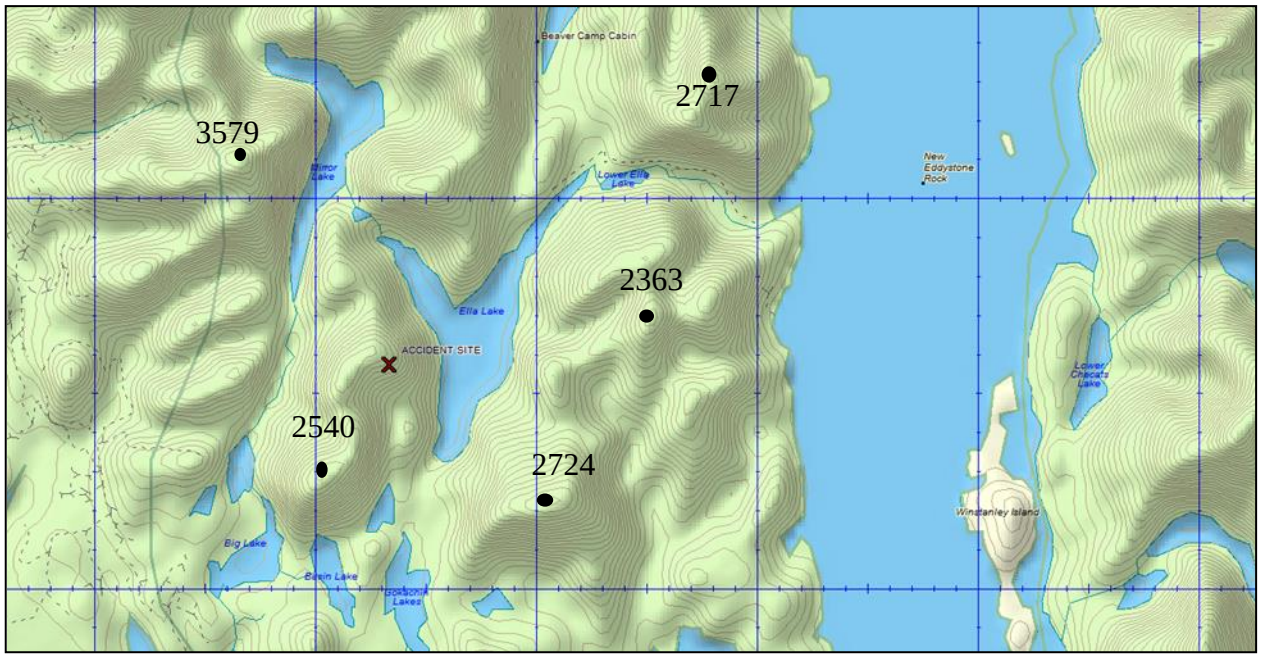


Figure 47 – Topographic map close up over the accident site with spot elevations

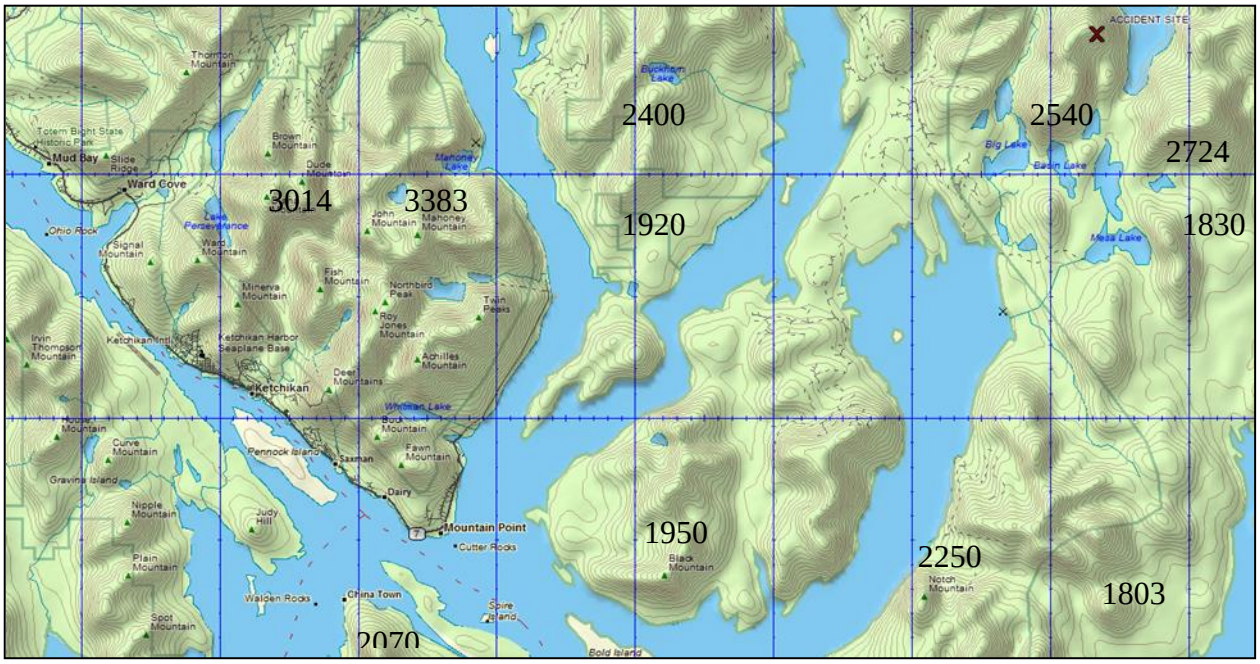


Figure 48 – Topographical map from accident site to Ketchikan with spot elevations

15.0 Astronomical Conditions

Data obtained from the United States Naval Observatory's website provided the following astronomical conditions for Ketchikan, Alaska, on June 25, 2015.

Beginning of civil twilight	0306 AKDT
Sunrise	0406 AKDT
Sun transit	1249 AKDT
Sunset	2132 AKDT
End of civil twilight	2232 AKDT

At the approximate time of the accident the Sun was 57.4° above the horizon at an azimuth of 165°.

Submitted by:

Donald Eick
NTSB Senior Meteorologist