# NATIONAL TRANSPORTATION SAFETY BOARD

**Office of Aviation Safety**
**Washington, D.C. 20594**

January 31, 2013

**Group Chairman's Factual Report**

# METEOROLOGY

**CEN13FA085**

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## A. ACCIDENT

| | |
|---|---|
| Location: | Greensburg, Indiana |
| Date: | December 2, 2012 |
| Time: | About 1819 eastern standard time (2318 UTC[1]) |
| Airplane: | Piper PA-46 Malibu; registration N92315 |

## B. METEOROLOGY GROUP

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## C. SUMMARY

On December 2, 2012, about 1819 eastern standard time (EST), a Piper PA-46-350P, N92315, collided with the terrain while performing the RNAV Runway 36 approach to the Greensburg Municipal Airport (I34), Greensburg, IN. The instrument rated private pilot and three passengers were fatally injured. The airplane was registered to an individual, and operated under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Instrument meteorological conditions (IMC) existed at the time of the accident, which was operated on an instrument flight rules flight plan. The flight originated at Destin-Fort Walton Beach Airport (KDSI), Destin, Florida, at 1416 central standard time.

Prior to the arrival of the accident airplane, a friend of the pilot flew the same flight in a similarly-equipped airplane. The friend arrived approximately 30 minutes prior to the accident airplane, and then stated that he performed the same approach to its termination point. The friend never broke out of the clouds, performed a missed approach and diverted to an alternate airport. At 1806:36, ATC cleared the accident pilot to perform the RNAV runway 36 approach. The last communication with the accident pilot was that the airplane was four miles from the no procedure turn initial approach fix, and that the accident pilot could change the airport advisory frequency. Weather at the time of the approach was reported as instrument flight rules (IFR) with ceilings estimated by witnesses at approximately 300 feet with fog and mist. A witness subsequently saw the airplane descend out of the clouds with no perceived pitch change or change in engine noise prior to impacting terrain. That witness contacted 911 at 1819 EST and informed them of the accident.

Approach minimums required 700 feet and 1 mile visibility for a straight-in approach and 800 feet and 1 mile visibility for the circling approach. An Eyewitness near the airport reported seeing a very low-flying airplane with landing lights on at the approximate time of the accident occurrence in a slight left bank, flying directly over his house 750 feet east of the approach end

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

of Runway 18. Other witnesses stated that the pilot-controlled runway lighting was not illuminated at the time of the accident. The runway lights were operationally checked following the accident and no anomalies were found.

## 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 National Climatic Data Center (NCDC) and from United Airlines. All times are eastern standard time (EST) based upon the 24 hour clock, local time is +5 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, both codes are intermittently used in this report.

## 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 Camp Springs, 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 00-45.

### 1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1900 EST on December 2, 2012 (0000Z December 3, 2012) is included as figure 1 with the approximate accident site by a red cross. The chart depicted a low pressure system over Canada with a cold front extending southwestward across Lake Eerie, into northern Ohio and Indiana, to central Illinois. A high pressure system at 1028-hectopascals (hPa) was located off the North Carolina coast with a high ridge extended west-southwest across the southeast. Over Indiana a weak pressure gradient existed with a general col or neutral point between the high and low pressure systems, with a general southerly winds flow of 5 knots or less over the region. Numerous station models across southern and central Illinois, Indiana, Ohio, Iowa, Minnesota, Michigan, into Pennsylvania reported visibility restricted in fog/mist, with overcast cloud conditions reported from Tennessee northward to the frontal area over Indiana. The station models closest to the accident site in southern Indiana indicated a temperature and dew point temperature of 57º Fahrenheit (F) with visibility restricted in mist.

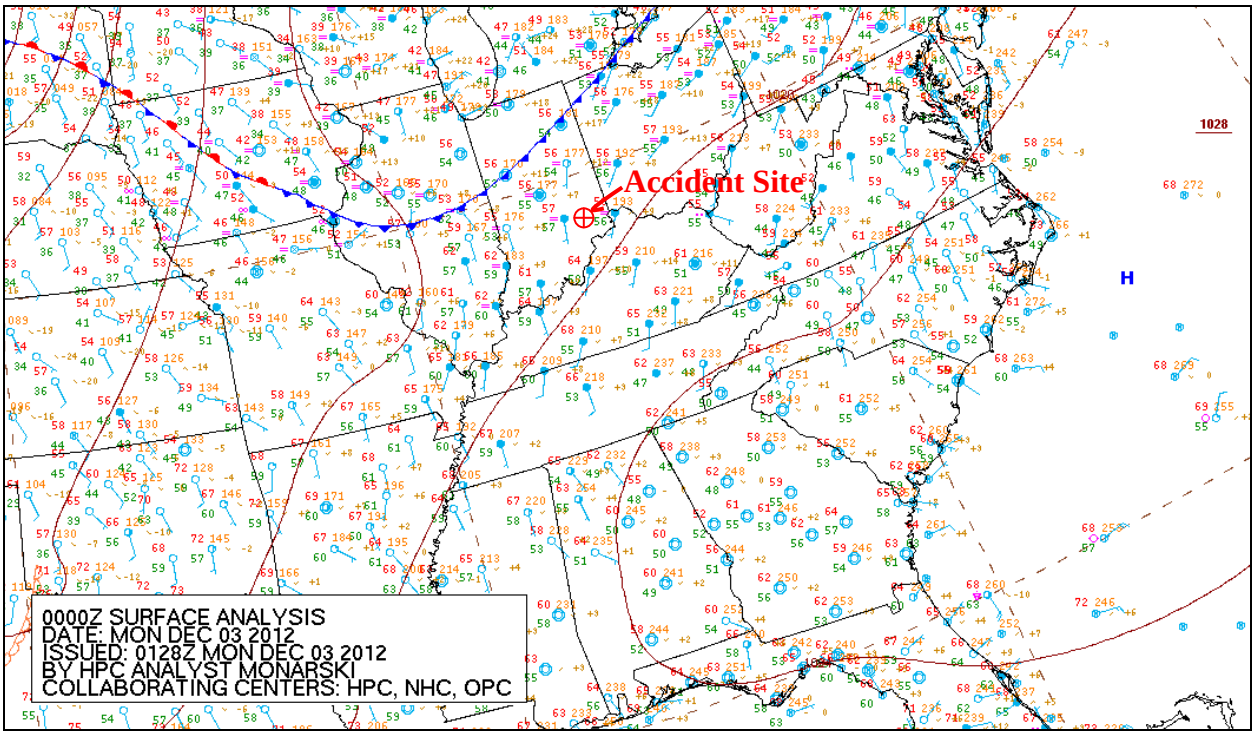


**Figure 1- NWS Surface Analysis Chart for 1900 EST**

Figure 2 is the next NWS Surface Analysis Chart issued at 2100 EST (0300Z on December 3, 2012). The chart depicted the previous cold frontal system becoming stationary across Indiana, Illinois, into Missouri. A col or neutral point in the pressure pattern existed over Indiana with a resultant weak pressure gradient. Numerous stations from Ohio, Indiana, Illinois, Iowa, Minnesota, and Michigan along and north of the front reported visibility restrictions in fog/mist.

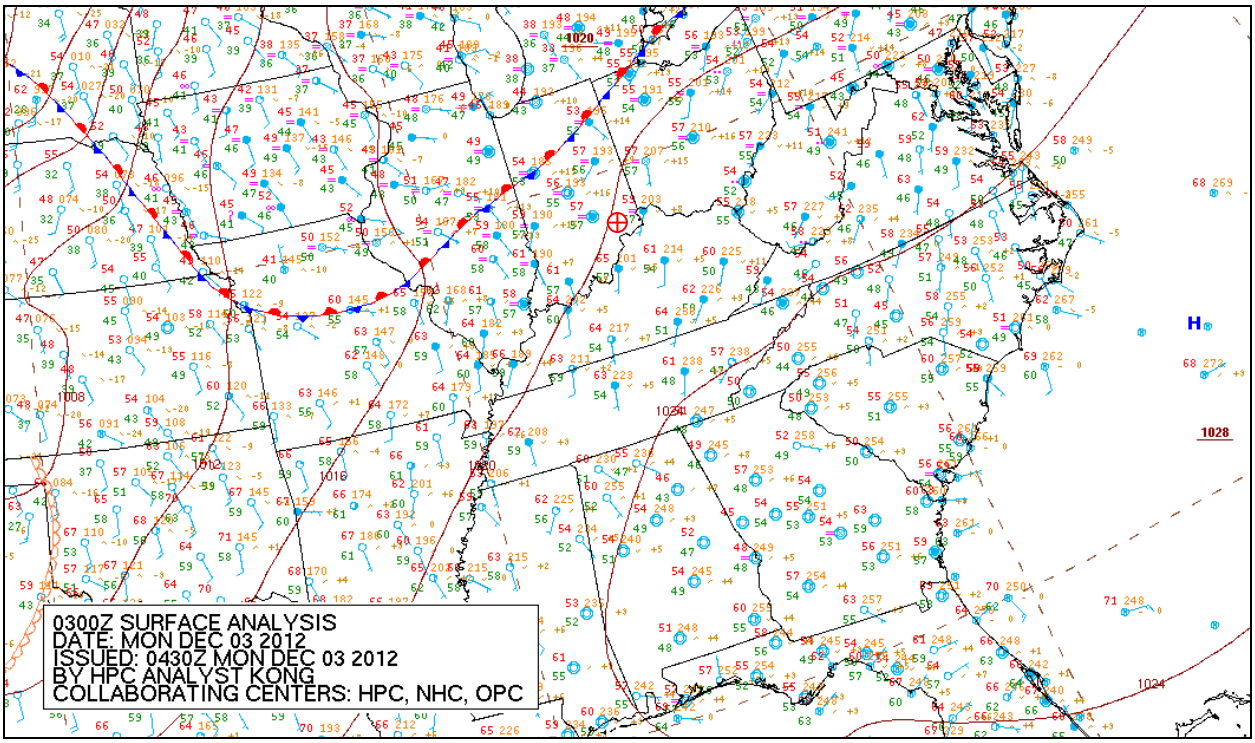


**Figure 2 - NWS Surface Analysis Chart for 2100 EST**

## 1.2 NWS Weather Depiction Chart

The NWS Weather Depiction Chart was documented to provide an estimate and extent of the weather conditions impacting the area. The chart is issued every 3 hours beginning and includes the frontal positions from the surface analysis chart issued an hour prior to the chart, along with the general flight categories. The chart is created based on the hourly weather observation from the primary synoptic stations across the country.

The Weather Depiction Chart issued for 1700 EST (2200Z) centered over the region is included as figure 3 with the approximate accident site marked. The chart depicted an area of instrument flight rule (IFR) conditions[2] extending along and ahead of the cold front over western New York and Pennsylvania, northern West Virginia, most of Ohio, and portions of southern Indiana by a shaded contour line. Surrounding that area was a large area of marginal visual flight rule (MVFR) conditions[3] that extended over most of Pennsylvania, West Virginia, Ohio, Indiana, northern and western Kentucky, southern Illinois, and western Tennessee by an unshaded contour. The station models reported the primary cause of the IFR or MVFR conditions due to visibility restricted in fog/mist, and due to light to moderate rain. The closest

[2] IFR conditions – are defined as ceiling or lowest layer of broken, overcast clouds, or the vertical visibility into a surface based obscuration of less than 1,000 feet agl and/or visibility less than 3 statute miles.

[3] MVFR conditions – are defined as a ceiling between 1,000 and 3,000 feet inclusive, and/or visibility 3 to 5 statute miles inclusive.

visual flight rule (VFR) conditions[4] depicted without a contour was over central Indiana north of the accident site.

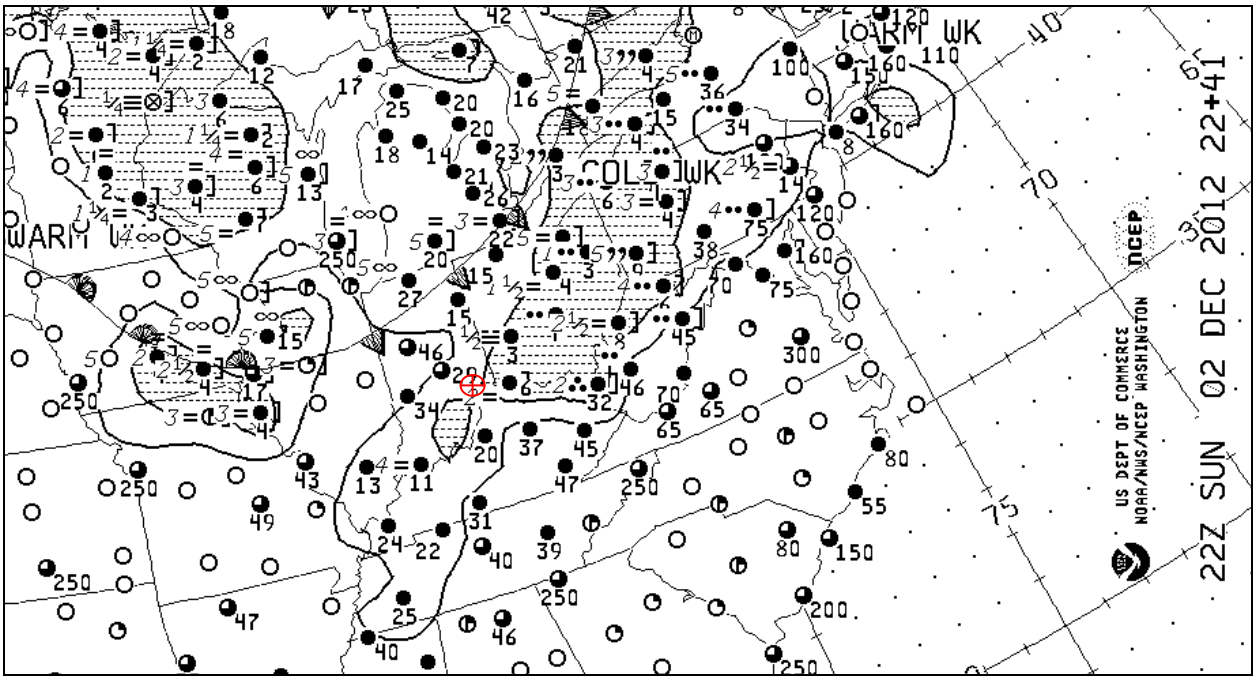


**Figure 3- NWS Weather Depiction Chart for 1700 EST**

## 1.3 Radar Summary Chart

The National Radar Summary Chart for 1820 EST (2320Z) is included as figure 3. The chart depicted scattered rain showers extending over Kentucky into southern Ohio, West Virginia and into the mid-Atlantic and New England states. No significant echoes were depicted over southern Indiana.

[4] VFR conditions – are defined as a ceiling greater than 3,000 feet and visibility greater than 5 statute miles.

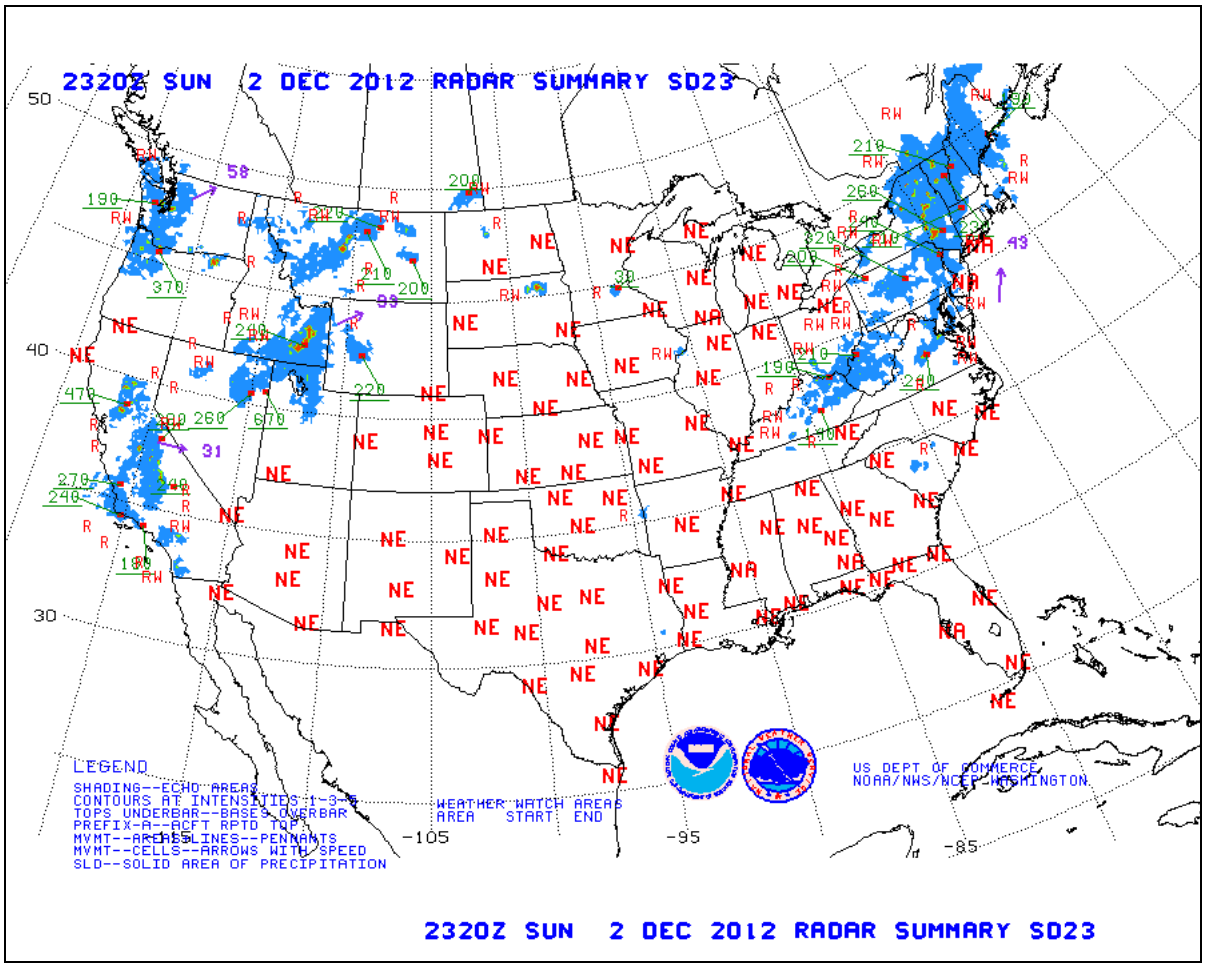


**Figure 4- National Radar Summary Chart for 1820 EST**

## 1.4 Regional Radar Mosaic

The regional radar mosaic for 1817 EST (2317Z) from the NWS is included as figure 4. The radar mosaic depicted a large area of scattered echoes extending over central Kentucky into West Virginia, southern Ohio, and Virginia. No meteorological echoes were depicted over Indiana or over the route of flight.

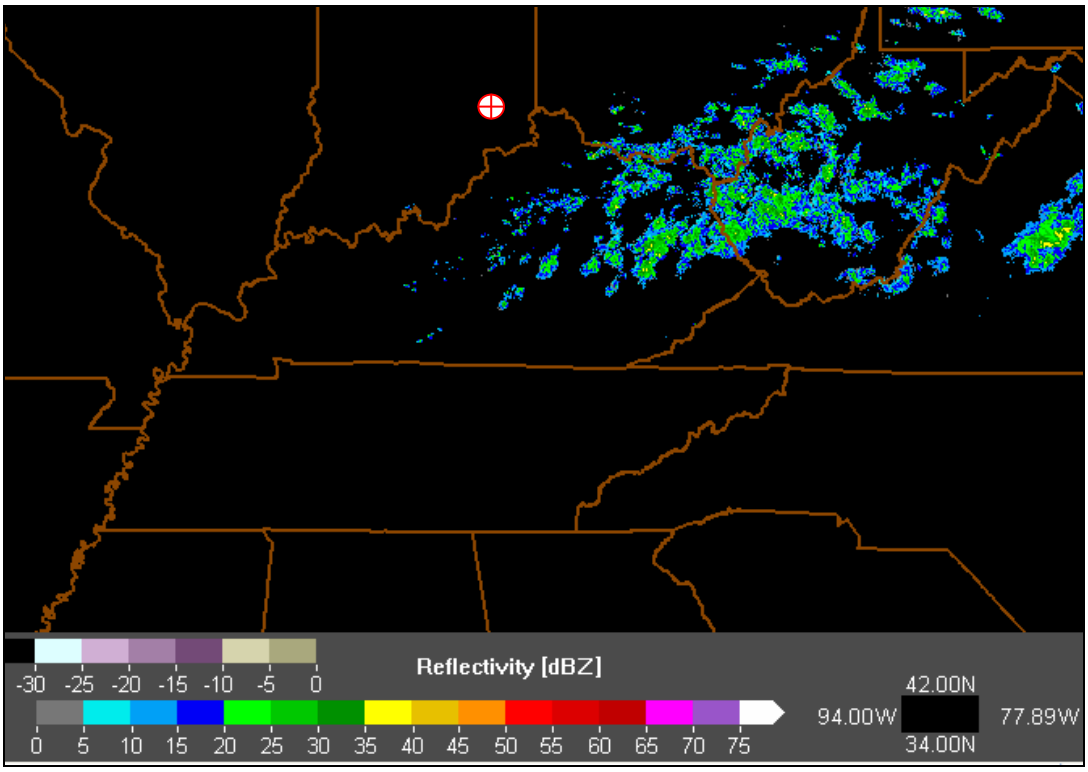


**Figure 5 - Regional Radar Mosaic for 1817 EST**

## 2.0 Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECIs) surrounding the period were documented for the departure and the closest airport to the accident site. The cloud heights are reported above ground level (agl).

## 2.1 Greensburg Municipal Airport (I34), Greensburg, Indiana

Greensburg Municipal Airport at an elevation of 912 feet does not have weather reporting capability and only had a lighted wind indicator according to the Airport Facility Directory (AFD). The airport listed a single asphalt runway 18/36 at 3,433 feet long and 40 feet wide. The airport also had a medium intensity runway lights and lists visual approach slope indicators (VASI) for both ends of the runway that are out of service. The closest weather reporting location to the accident site for aviation use such as for the local altimeter setting is from North Vernon Airport (KOVO) located 17 miles south, which has an Automated Weather Observation System (AWOS) but does not issue a formal METeorological Aerodrome Report (METAR) for dissemination.

A search of Mesowest sites across the Indiana indicated a remote weather station located in Greensburg (IN012) approximately 2 miles northeast of the airport. Although not intended for aviation use the system at 1810 EST reported a temperature of 53° F, a dew point 53° F, a relative humidity of 99 percent, and a wind from the southwest at 5 knots. Based on the temperature and dew point spread and high relative humidity saturated conditions were being

reported indicating fog, mist, or rain occurring at the time. The local weather radar however did not indicate any significant weather echoes over the area during the period, thus implying visibility restrictions in fog.

## 2.2 Columbus Municipal Airport (KBAK), Columbus, Indiana

The next closest official reporting location to the accident site that issued observations was from Columbus Municipal Airport (KBAK), Columbus, Indiana, located approximately 18 miles west of accident site at an elevation of 656 feet. The airport had an Automated Weather Observation System (AWOS) and reported the following conditions were reported at the approximate time of the accident:

Columbus weather observation at 1750 EST (2250Z), wind from 170° true at 6 knots, visibility 1 ½ miles in mist, ceiling overcast at 300 feet agl, temperature and dew point 14° Celsius (C), and altimeter 30.07 inches of mercury (Hg).

The raw observations surrounding the period were as follows with the general flight category indicated for reference:

| | |
|---|---|
| *MVFR* | *KBAK 021850Z 22010KT 10SM OVC014 15/14 A3005* |
| *MVFR* | *KBAK 021950Z 21008KT 7SM OVC012 15/14 A3005* |
| *MVFR* | *KBAK 022050Z 22006KT 5SM BR OVC010 15/14 A3007* |
| *MVFR* | *KBAK 022150Z 19005KT 3SM BR OVC010 15/14 A3007* |
| *LIFR* | *KBAK 022250Z 17006KT 1 1/2SM BR OVC003 14/14 A3007* |
| ***ACCIDENT 2319Z*** | |
| *LIFR* | *KBAK 022350Z 19006KT 2SM BR OVC003 14/14 A3009* |
| *LIFR* | *KBAK 030050Z 00000KT 1 1/2SM BR OVC003 14/14 A3010* |
| *IFR* | *KBAK 030150Z 00000KT 2 1/2SM BR OVC005 14/14 A3012* |
| *IFR* | *KBAK 030250Z 00000KT 2SM BR OVC007 14/14 A3013* |

The observations indicated that visibility began decreasing after 1350 EST with LIFR conditions[5] reported immediately prior to the accident at 1750 EST.

## 2.3 Shelbyville Municipal Airport (KGEZ), Shelbyville, Indiana

The next closest weather reporting location to the accident site was from Shelbyville Municipal Airport (KGEZ) located approximately 20 miles northwest at an elevation of 803 feet.

[5] LIFR conditions – is defined as a ceiling less than 500 feet and/or visibility less than ½ statute mile.

The airport had a federal owned and maintained Automated Surface Observation System (ASOS) and reported the following conditions:

Shelbyville weather observation at 1814 EST (2314Z), automated, wind from 170º at 6 knots, visibility 3 miles in mist, ceiling overcast at 800 feet agl, temperature 16º C, dew point 14º C, and altimeter 30.05 inches of Hg. Remarks: automated observation system, ceiling 400 feet variable 1,200 feet.

The raw observations surrounding the period were as follows:

| | |
|---|---|
| *MVFR* | *KGEZ 021853Z AUTO 21010KT 9SM OVC020 17/14 A3001 RMK AO2 SLP161 T01670139* |
| *MVFR* | *KGEZ 021936Z AUTO 21009KT 9SM OVC014 16/14 A3001 RMK AO2* |
| *MVFR* | *KGEZ 021953Z AUTO 21008KT 8SM OVC014 16/14 A3001 RMK AO2 SLP161 T01610139* |
| *MVFR* | *KGEZ 022053Z AUTO 21006KT 7SM OVC014 16/14 A3003 RMK AO2 SLP168 T01610139 53003* |
| *MVFR* | *KGEZ 022153Z AUTO 19007KT 6SM BR OVC014 16/14 A3005 RMK AO2 SLP172 T01560139* |
| *MVFR* | *KGEZ 022253Z AUTO 18007KT 4SM BR BKN010 OVC017 16/14 A3005 RMK AO2 CIG 007V012 SLP174 T01560139* |
| *IFR* | *KGEZ 022314Z AUTO 17006KT 3SM BR OVC008 16/14 A3005 RMK AO2 CIG 004V012* |
| ***ACCIDENT 2319Z*** | |
| *LIFR* | *KGEZ 022339Z AUTO 18009KT 3SM BR BKN004 OVC008 16/14 A3006 RMK AO2* |
| *LIFR* | *KGEZ 022349Z AUTO 18008KT 2 1/2SM BR BKN004 OVC008 16/14 A3006 RMK AO2 CIG 003V007* |
| *LIFR* | *KGEZ 022353Z AUTO 18008KT 2 1/2SM BR BKN004 OVC008 16/14 A3006 RMK AO2 SLP177 T01560144 10167 20150 52004* |
| *LIFR* | *KGEZ 030042Z AUTO 19008KT 1 1/2SM BR OVC002 15/14 A3007 RMK AO2* |
| *LIFR* | *KGEZ 030053Z AUTO 18006KT 1SM BR OVC002 15/14 A3007 RMK AO2 SLP182 T01500144* |
| *LIFR* | *KGEZ 030153Z AUTO 19003KT 3/4SM BR VV002 15/14 A3009 RMK AO2 SLP188* |
| *LIFR* | *KGEZ 030225Z AUTO 18004KT 1/4SM -RA FG VV002 15/14 A3010 RMK AO2 RAB22 P0000* |
| *LIFR* | *KGEZ 030234Z AUTO 19004KT 1/2SM FG VV002 15/14 A3010 RMK AO2 RAB22E31* |
| *LIFR* | *KGEZ 030253Z AUTO 18004KT 1/2SM FG VV002 15/14 A3010 RMK AO2 RAB22E31 SLP191 P0000 60000 T01500144 51009* |

The raw observations indicated IFR conditions due to a low ceilings and restricted visibility in mist was first reported at 1814 EST immediately prior to the accident and continued to deteriorate to LIFR conditions into the evening.

## 2.4 Indianapolis International Airport (KIND), Indianapolis, Indiana

Indianapolis International Airport (KIND) was located approximately 42 miles northwest of the accident site at an elevation of 797 feet. The airport had an ASOS and was augmented by NWS certified weather observers. The following conditions were reported at the approximate time of the accident:

Indianapolis weather observation at 1854 EST (2254Z), wind from 180º at 5 knots, visibility 8 miles, ceiling overcast at 1,400 feet, temperature 15º C, dew point 14º C, and altimeter 30.05 inches of Hg. Remarks: automated observation system, sea level pressure 1017.5-hPa, temperature 15.0º C, dew point 13.9º C.

The raw observations were as follows:

*MVFR* *KIND 021854Z 22010KT 10SM BKN018 OVC027 16/13 A3002 RMK AO2 SLP164 T01610133*

*MVFR* *KIND 021954Z 23010KT 10SM SCT016 OVC028 16/13 A3002 RMK AO2 SLP164*

*MVFR* *KIND 022054Z 22007KT 10SM BKN024 OVC035 16/14 A3004 RMK AO2 SLP172 T01610139 53004*

*MVFR* *KIND 022154Z 21007KT 9SM FEW017 BKN029 BKN038 15/13 A3004 RMK AO2 SLP172 T01500133*

*VFR* *KIND 022212Z 20006KT 7SM FEW029 SCT038 BKN050 14/13 A3004 RMK AO2*

*MVFR* *KIND 022233Z 19005KT 7SM BKN014 BKN024 BKN050 14/13 A3005 RMK AO2*

*MVFR* *KIND 022254Z 18005KT 8SM OVC014 15/14 A3005 RMK AO2 SLP175 T01500139*

***ACCIDENT 2319Z***

*MVFR* *KIND 022343Z 18007KT 7SM BKN015 OVC021 15/14 A3006 RMK AO2*

*MVFR* *KIND 022354Z 18008KT 7SM BKN017 OVC023 15/14 A3006 RMK AO2 SLP179 T01500139 10167 20139 53005*

*MVFR* *KIND 030022Z 19007KT 6SM BR SCT018 OVC025 15/14 A3007 RMK AO2*

*MVFR* *KIND 030024Z 19006KT 6SM BR SCT018 OVC025 15/14 A3007 RMK AO2*

*MVFR* *KIND 030044Z 19004KT 5SM BR FEW011 SCT025 OVC039 14/14 A3008 RMK AO2*

*MVFR* *KIND 030054Z 20003KT 5SM BR FEW011 BKN030 OVC039 14/14 A3008 RMK AO2 SLP185 T01440139*

*IFR* *KIND 030056Z 20004KT 5SM BR BKN009 BKN027 OVC039 14/14 A3008 RMK AO2*

*IFR* *KIND 030154Z 00000KT 5SM BR BKN008 OVC015 15/14 A3010 RMK AO2 SLP191 T01500139*

*IFR* *KIND 030254Z 18003KT 4SM -RA BR OVC008 14/14 A3010 RMK AO2 RAB48 SLP193 P0000 60000 T01440139 51015*

The raw observation indicated that IFR conditions were reported less than 2 hours after the accident at 1956 EST due to low ceilings and visibility restricted in light rain and mist.

## 2.5 Cincinnati/Northern Kentucky International Airport (KCVG), Covington, Kentucky

The next closest weather reporting location was from Cincinnati/Northern Kentucky International Airport (KCVG), located in Covington, Kentucky approximately 43 miles southeast of the accident site at an elevation of 896 feet. The airport had an augmented ASOS and reported the following conditions at the time of the accident:

Cincinnati weather observation at1802 EST, wind from 220º at 6 knots, tower visibility 1 ½ miles in mist, ceiling broken at 400 feet agl, overcast at 800 feet, temperature 14º C, dew point 13º C, altimeter 30.11 inches of Hg. Remarks: automated observation system, surface visibility 2 ½ miles.

Cincinnati special weather observation at1849 EST, wind from 210º at 5 knots, tower visibility 3/4 mile in mist, ceiling overcast at 600 feet, temperature 14º C, dew point 13º C, altimeter 30.11 inches of Hg. Remarks: automated observation system, surface visibility 2 ½ miles.

The raw observations were as follows:

*IFR* *KCVG 021852Z 21007KT 6SM BR BKN007 OVC010 14/12 A3008 RMK AO2 SLP181 T01390122=*

*IFR* *KCVG 021852Z 21007KT 6SM BR BKN007 OVC010 14/12 A3008 RMK AO2 SLP181 T01390122*

*IFR* *KCVG 021914Z 21008KT 2 1/2SM BR BKN007 OVC010 14/12 A3007 RMK AO2 SFC VIS 3*

*IFR* *KCVG 021928Z 22008KT 1 3/4SM BR BKN007 OVC010 14/13 A3008 RMK AO2 TWR VIS 2*

*IFR* *KCVG 021952Z 21011G15KT 1 3/4SM -RA BR OVC006 14/13 A3007 RMK AO2 TWR VIS 2 RAB52 SLP181 P0000 T01390128*

*IFR* *KCVG 021959Z 22009KT 2SM -RA BR OVC006 14/13 A3008 RMK AO2 P0000*

*IFR* *KCVG 022052Z 22008KT 2SM -DZ BR OVC006 14/13 A3008 RMK AO2 SFC VIS 2 1/2 RAE52DZB52 SLP183 P0001 60001 T01440133 55000=*

*IFR* *KCVG 022152Z 23008G15KT 2SM BR OVC006 14/13 A3010 RMK AO2 SFC VIS 3 DZE49 SLP187 P0000 T01440133*

*IFR* *KCVG 022227Z 23008KT 1 1/2SM BR OVC006 14/13 A3011 RMK AO2 SFC VIS 3*

*LIFR* *KCVG 022302Z 22006KT 1 1/2SM BR BKN004 OVC008 14/13 A3011 RMK AO2 SFC VIS 2 ½*

***ACCIDENT 2319Z***

*IFR* *KCVG 022349Z 21005KT 3/4SM BR OVC006 14/13 A3011 RMK AO2 SFC VIS 2 1/2*

| | |
|---|---|
| *IFR* | *KCVG 022352Z 21005KT 3/4SM BR OVC006 14/13 A3011 RMK AO2 SFC VIS 2 1/2 SLP193 60001 T01440133 10144 20133 51009* |
| *IFR* | *KCVG 030052Z 19004KT 1 3/4SM BR FEW003 OVC008 14/13 A3012 RMK AO2 SLP194 T01440133* |
| *IFR* | *KCVG 030125Z 20005KT 2SM BR OVC010 14/13 A3012 RMK AO2* |
| *IFR* | *KCVG 030152Z 20004KT 2 1/2SM BR OVC008 14/14 A3013 RMK AO2 SLP198 T01440139* |
| *IFR* | *KCVG 030252Z 21004KT 3SM BR BKN008 OVC013 15/14 A3014 RMK AO2 RAB08E51 SLP203 P0002 60002 T01500139 53008* |

## 3.0 Upper Air Data

The closest upper air sounding or rawinsonde observation (RAOB) in the same general air mass as the accident site was from the NWS Wilmington (KILN), Ohio, site number 72426, located approximately 80 miles east of the accident site at an elevation of 1,007 feet. The 1900 EST (0000Z on December 3, 2012) upper air sounding was plotted on a standard Skew-T log P diagram[6] utilizing RAOB[7] software is included as figure 5 from the surface to 500-hPa or 18,000 feet. The sounding depicted moist low-level environment with the relative humidity greater than 80 percent from the surface through 9,800 feet with dry air above. The lifted condensation level (LCL)[8] was identified at 167 feet agl, with a convective condensation level (CCL)[9] at 2,097 feet agl. The equilibrium level (EL)[10] or expected top of clouds was at 9,900 feet. The freezing level was identified at approximately 9,480 feet. The sounding also provided an index for fog formation; the fog stability index (FSI) of 34.6 and the fog threat index of 2.8 both indicated a moderate probability of radiation type fog. The fog point was indicated that fog was likely to form at a temperature of 12.8º C.

[6] 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.

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

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

[9] Convective Condensation Level (CCL) - The height to which a parcel of air, if heated sufficiently from below, will rise adiabatically until condensation starts. This is typically used to identify the base of cumuliform clouds, which are normally produced from surface heating and thermal convection.

[10] Equilibrium Level (EL) - On a sounding, the level above the level of free convection (LFC) at which the temperature of a rising air parcel again equals the temperature of the environment. The height of the EL is the height at which thunderstorm updrafts no longer accelerate upward. Thus, to a close approximation, it represents the height of expected (or ongoing) thunderstorm tops. However, strong updrafts will continue to rise past the EL before stopping, resulting in storm tops that are higher than the EL. This process sometimes can be seen visually as an overshooting tops or anvil dome. The EL typically is higher than the tropopause, and is a more accurate reference for storm tops.

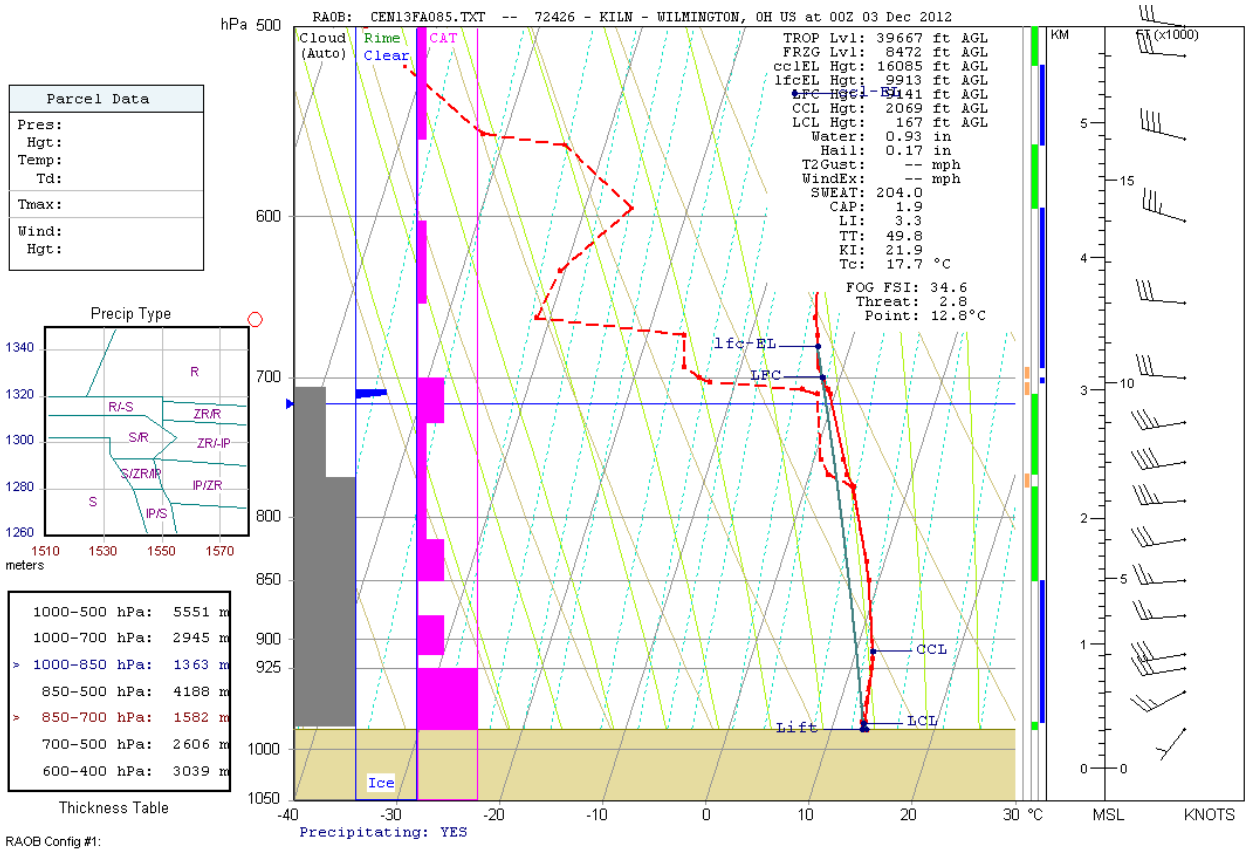


**Figure 6 - Wilmington 1900 EST sounding**

The sounding wind profile indicated a surface wind from. The mean 0 to 6 kilometer (18,000 feet) wind was identified from 274º at 31 knots. Some of the raw measurements and wind observations are provided on the following table from the sounding.

| Height (ft-MSL) | Pres (hPa) | T (C) | Td (C) | RH (%) | DD / FF (deg / kts) |
|---|---|---|---|---|---|
| 1007 | 981 | 13.4 | 13.0 | 97 | 215 / 7 |
| 1205 | 974 | 13.0 | 12.7 | 98 | |
| 2000 | 946 | | | | 240 / 24 |
| 2630 | 925 | 12.0 | 12.0 | 100 | 260 / 29 |
| 2899 | 916 | 11.8 | 11.8 | 100 | |
| 3000 | 913 | | | | 260 / 30 |
| 4000 | 880 | | | | 265 / 23 |
| 4948 | 850 | 9.0 | 9.0 | 100 | 265 / 25 |
| 5433 | 835 | 8.2 | 8.2 | 100 | |
| 6000 | 818 | | | | 260 / 32 |
| 7000 | 788 | | | | 265 / 36 |
| 7376 | 777 | 4.6 | 4.5 | 99 | |
| 7688 | 768 | 3.6 | 1.8 | 88 | |
| 8000 | 759 | | | | 260 / 39 |
| 8072 | 757 | 2.8 | 0.6 | 85 | |
| 9000 | 731 | | | | 260 / 36 |
| 9730 | 711 | -0.5 | -1.7 | 92 | |
| 9841 | 708 | -0.9 | -3.4 | 83 | |
| 10027 | 703 | -1.5 | -12.5 | 43 | |

## 4.0 Satellite Data

The Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained and displayed on the National Transportation Safety Board's Man-computer Interactive Data Access System (McIDAS) workstation. The infrared long wave imagery surrounding the time of the accident were reviewed surrounding and documented. 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 GOES-13 infrared image for 1815 EST (2315Z) at 4X magnification is included as figure 6 with Greensburg Airport indicated in red. The infrared image depicted an extensive area of low stratiform clouds over Indiana with a radiative cloud top temperature of 279º Kelvin (K) or 5.84º C, which corresponded to a cloud top near 7,000 feet based on the Wilmington sounding.

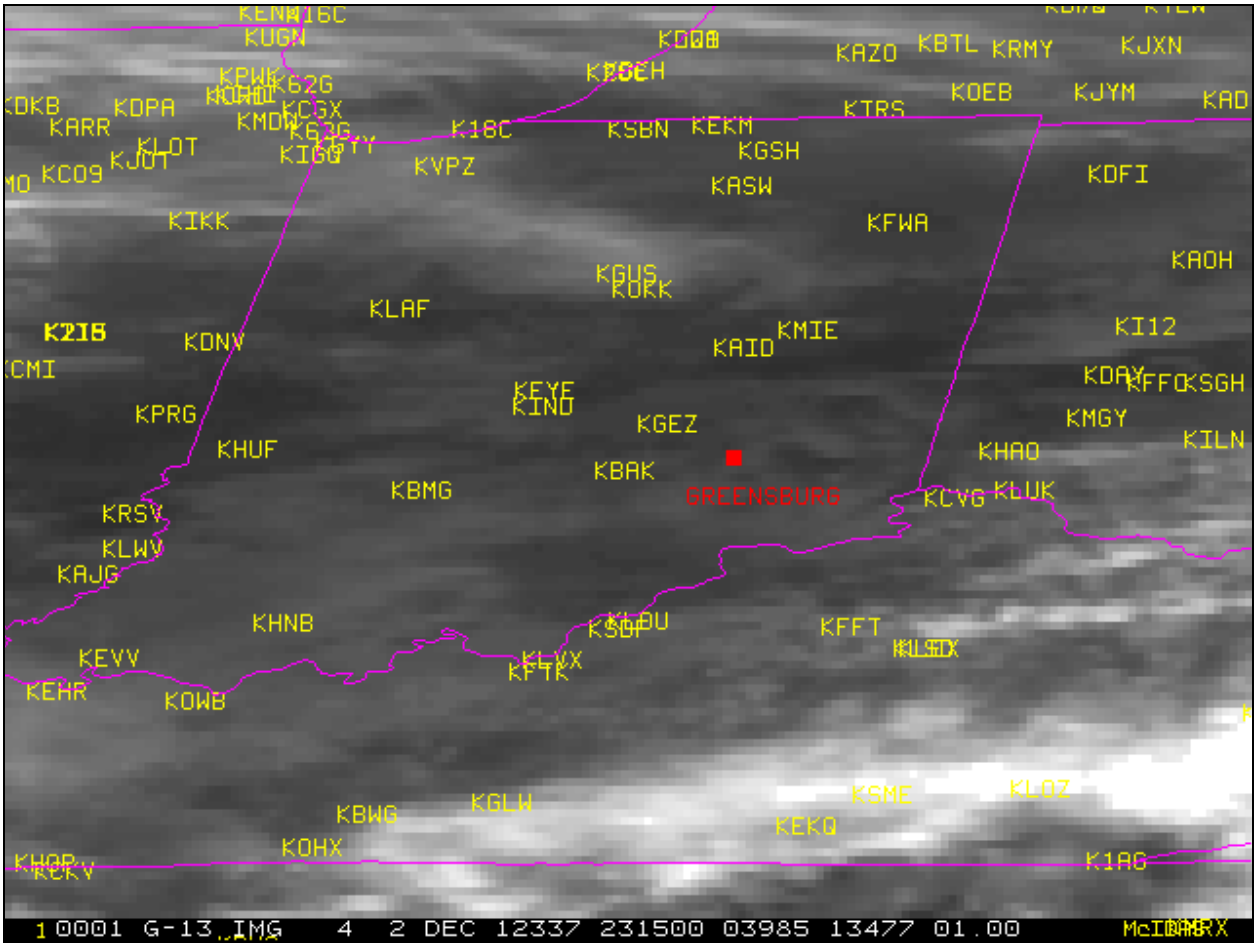


**Figure 7 - GOES-13 infrared image at 1815 EST**

## 5.0 Pilot Reports

The following pilot report (PIREP) was recorded over Indiana surrounding the period between 1600 and 2000 EST. The report was as follows:

Indianapolis (IND) routine pilot report (UA); Over – Indianapolis (IND); Time – 1605 EST (2105Z); Flight Level – unknown; Type aircraft – Embraer ERJ-145 regional jet (E145); Sky cover – overcast bases at 2,500 feet with tops at 7,000 feet; Remarks – during descent.

## 6.0 Area Forecast

The Area Forecast (FA) is a forecast of visual Flight Rules (VFR) clouds and weather conditions over an area as large as the size of several states. It must be used in conjunction with the AIRMET Sierra (IFR) bulletin for the same area in order to get a complete picture of the weather. The area forecast together with the AIRMET Sierra bulletin are used to determine forecast enroute weather and to interpolate conditions at airports which do not have a terminal forecast (TAF) issued. The NWS Aviation Weather Center (AWC) located in Kansas City, Missouri, issues the FA at regular intervals and issues specials reports as necessary usually in the form of an AIRMET. The Chicago (KCHI) regional forecast that was current at the time of the accident was issued at 1445 EST and valid through 0300 EST on December 3, 2012. The forecast was as follows:

*FAUS43 KKCI 021945 2012337 1930*
*FA3W*
*-CHIC FA 021945*
*SYNOPSIS AND VFR CLDS/WX*
*SYNOPSIS VALID UNTIL 031400*
*CLDS/WX VALID UNTIL 030800...OTLK VALID 030800-031400*
*ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY*
.
*SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.*
*TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.*
*NON MSL HGTS DENOTED BY AGL OR CIG.*
.
*SYNOPSIS...UPR LVL TROF ERN GREAT LAKES WILL CONT EWD THRU PD.*
*MID LVL IMPULSE OK/TX PNHDL WILL APCH ERN KS 06-08Z AND SRN*
*IA-NRN MO 12-14Z. OTRW..UPR LVL TROF WILL APCH NWRN PLAINS LATE*
*DURG OTLK. WLY FLOW THRUT. CDFNT SRN GREAT LAKES -NRN IL-SRN IA*
*WILL BECM WRM FNT 00-03Z AND APCH UPR MS VLY-NRN WI-SRN PTNS LM*
*MI DURG OTLK. CDFNT WRN PTNS ND SD 00-03Z WILL APCH ERN PTNS ND*
*SD-NRN NE 12-14Z. HI PRES WILL DMNT RMNDR.*
.
*IN*
*BKN-OVC015-025 TOPS 050. OCNL VIS 3-5SM BR. OTLK...IFR CIG BR.*

The forecast warned users to refer to the latest AIRMET Sierra series for IFR conditions and indicated that a cold front was moving through the southern Great Lakes region and was expected to become a warm front between 1900 and 2200 EST across the region. The forecast for Indiana was for broken to overcast clouds between 1,500 and 2,500 feet with tops near 5,000

feet, with occasional visibility 3 to 5 miles in mist. The outlook from 2300 through 0900 EST was for IFR conditions to prevail due to low ceilings and visibility in mist.

## 7.0 In-Flight Weather Advisories

The NWS issues in-flight weather advisories designated as Severe Weather Forecast Alerts (AWW's), Convective SIGMET's (WST's), SIGMET's (WS's), Center Weather Advisories (CWA's), and AIRMET's (WA's). In-flight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions, which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft. At the time of the accident the following AIRMET advisories were issued surrounding the period, there were no SIGMETs or any other hazardous weather advisories valid during the period:

AIRMETs

*WAUS43 KKCI 021733 AAA 2012337 1734*
*WA3S*
*-CHIS WA 021733 AMD*
*AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 022100*
*.*
*AIRMET IFR...ND SD NE KS MN IA MO WI LM LS MI LH IL IN...UPDT*
*FROM 30N INL TO YQT TO SSM TO YVV TO 50ESE ECK TO FWA TO 70SE*
*GRB TO 40WNW JOT TO 40ENE UIN TO 60SW MCI TO 30N OVR TO 50WNW*
*DBQ TO 60NE MOT TO 30N INL*
*CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 21Z THRU 03Z.*
*.*
*AIRMET MTN OBSCN...KY*
*FROM HNN TO HMV TO 30SSW LOZ TO HNN*
*MTNS OBSC BY CLDS/PCPN. CONDS DVLPG 18-21Z. CONDS CONTG BYD 21Z THRU 03Z.*

Figure 8 is the GOES-13 visible image at 1232 EST at with AIRMET Sierra update 5 plotted. The route of flight was expected to be under VFR conditions at the time.

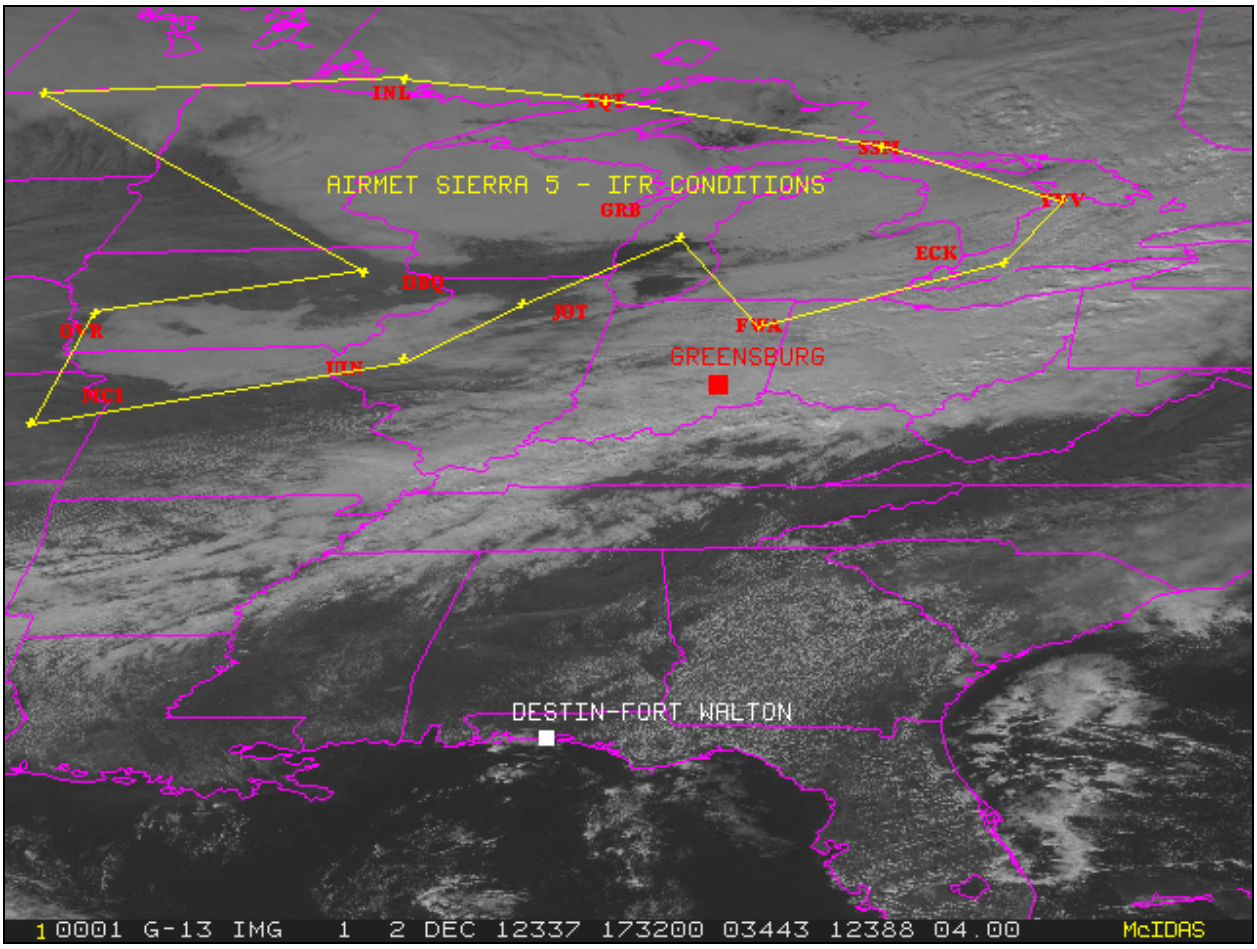


**Figure 8 - GOES-13 visible image at 1232 EST with AIRMET Sierra update 5**

Next scheduled update at 1545 EST:

*WAUS43 KKCI 022045* *2012337 2050*
*WA3S*
*-CHIS WA 022045*
*AIRMET SIERRA UPDT 6 FOR IFR AND MTN OBSCN VALID UNTIL 030300*
.
*AIRMET IFR...IA MO IL*
*FROM 40NE DSM TO 20W IOW TO 40N BDF TO 60SSW BDF TO 20ESE UIN TO*
*40SSW IRK TO 20ENE PWE TO 60SW FOD TO 40NE DSM*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 03Z THRU 09Z.*
.
*AIRMET IFR...ND MN IA WI LM LS MI LH*
*FROM 70NW INL TO YQT TO SSM TO YVV TO 30SE ECK TO DXO TO 30WSW*
*GIJ TO 20NNE DLL TO 50WNW DBQ TO 20SW GFK TO 90WSW YWG TO 70NW INL*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 03Z THRU 09Z.*
.
*AIRMET MTN OBSCN...KY*
*FROM HNN TO HMV TO 30SSW LOZ TO HNN*
*MTNS OBSC BY CLDS/PCPN. CONDS CONTG BYD 03Z ENDG 03-06Z.*
.

*OTLK VALID 0300-0900Z*
*AREA 1...IFR MN IA WI LM LS MI LH IN*
*BOUNDED BY 70ESE YWG-YQT-SSM-YVV-50SE ECK-20S DXO-FWA-20NNW TTH-*
*20NNW ORD-20W MCW-40NNE RWF-30W BRD-70ESE YWG*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG THRU 09Z.*
.
*AREA 2...IFR IA MO IL*
*BOUNDED BY 60ESE FSD-20W MCW-20NNW ORD-20NNW TTH-20ESE UIN-30ENE PWE-60ESE FSD*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG THRU 09Z.*
.
*AREA 3...MTN OBSCN KY*
*BOUNDED BY HNN-HMV-30SSW LOZ-HNN*
*MTNS OBSC BY CLDS/BR. CONDS DVLPG 03-06Z. CONDS CONTG THRU 09Z.*
....
*WAUS43 KKCI 022045 2012337 2031*
*WA3T*
*-CHIT WA 022045*
*AIRMET TANGO UPDT 3 FOR TURB AND LLWS VALID UNTIL 030300*
.
*AIRMET TURB...ND SD NE KS MN IA*
*FROM 70NNW ISN TO 80SE YWG TO 40S INL TO 40SSE RWF TO GLD TO*
*40ESE SNY TO 40ESE CYS TO 70NNW ISN*
*MOD TURB BLW 100. CONDS CONTG BYD 03Z THRU 09Z.*
.
*AIRMET TURB...SD NE MN IA MO WI LM MI IL IN*
*FROM 60NW RWF TO DXO TO FWA TO 40S OVR TO 40E ONL TO 60NW RWF*
*MOD TURB BTN FL280 AND FL400. CONDS CONTG BYD 03Z THRU 09Z.*
.
*LLWS POTENTIAL...ND SD MN*
*BOUNDED BY 70NE MOT-20NNE INL-40NW MSP-30S RWF-30SSW FSD-40NNE*
*ANW-20WSW BIS-70NE MOT*
*LLWS EXP. CONDS DVLPG 21-00Z. CONDS CONTG BYD 03Z THRU 09Z.*
.
*OTLK VALID 0300-0900Z*
*AREA 1...TURB ND SD NE KS MN IA WI LS*
*BOUNDED BY 70NW INL-YQT-20W FOD-GLD-40E SNY-50SSW BFF-50NNW ISN-70NW INL*
*MOD TURB BLW 100. CONDS CONTG THRU 09Z.*
.
*AREA 2...TURB SD NE MN IA MO WI LM MI LH IL IN*
*BOUNDED BY 30NNW EAU-20SE GRB-30SSW TVC-20NNW YVV-30SE ECK-FWA-*
*30N CVG-40NE UIN-40S OVR-40ENE ONL-50NW RWF-30NNW EAU*
*MOD TURB BTN FL280 AND FL400. CONDS CONTG THRU 09Z.*
.
*WAUS43 KKCI 022045 2012337 2048*
*WA3Z*
*-CHIZ WA 022045*
*AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 030300*
.
*AIRMET ICE...ND SD*
*FROM 70NNW ISN TO 70NE MOT TO BIS TO 20WNW DPR TO 70NW RAP TO 70NNW ISN*
*MOD ICE BTN 080 AND 170. CONDS DVLPG 21-00Z. CONDS CONTG BYD 03Z THRU 09Z.*
.
*OTLK VALID 0300-0900Z...ICE ND SD NE*
*BOUNDED BY 40S YWG-50WSW FAR-50ESE PIR-BFF-70SW RAP-50NNW ISN-40S YWG*
*MOD ICE BTN 080 AND FL200. CONDS CONTG THRU 09Z.*
.

*FRZLVL...RANGING FROM SFC-140 ACRS AREA*
*MULT FRZLVL 015-080 BOUNDED BY 90ESE YWG-YQT-SSM-YVV-20SE ASP-*
*20ESE TVC-40NW TVC-GRB-60S RHI-30W RHI-30NNE BJI-90ESE YWG*
*040 ALG 60WNW INL-20NNE DLH-50SSE SAW-70NW YVV*
*080 ALG 30SW ISN-40E ISN-30NE FAR-50SSW BRD-20ENE MSP-50SE GRB-60SSW YVV*
*120 ALG 40NNW BFF-50SE RAP-50SSE OBH-20N COU-50NE DYR-60WNW BNA*
*....*

Figure 9 is the GOES-13 visible image at 1545 EST at with AIRMET Sierra update 6 plotted.

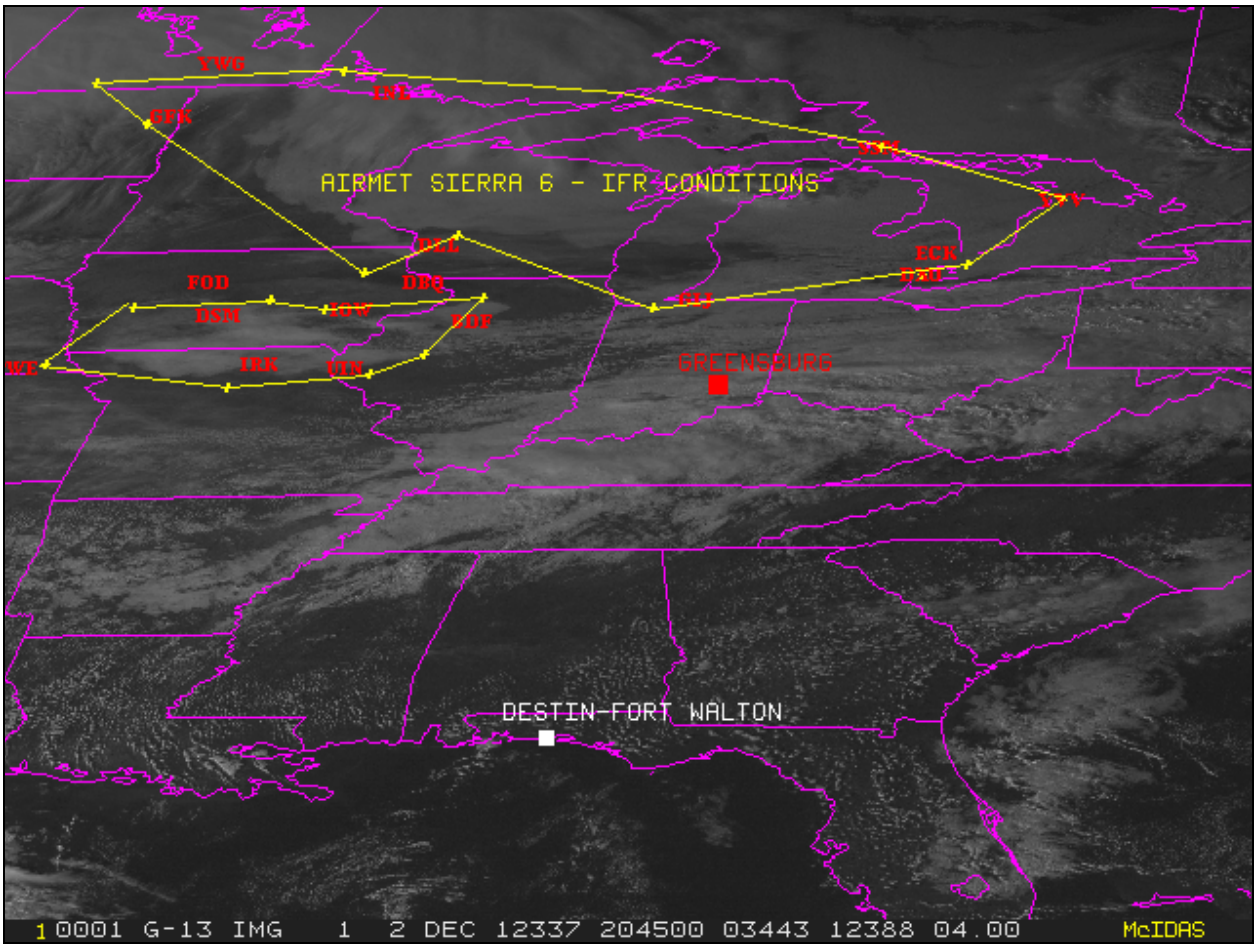


**Figure 9 - GOES-13 visible image at 1545 EST with AIRMET Sierra update 6**

Updates:

*WAUS43 KKCI 022315 AAA* *2012337 2316*
*WA3S*
*-CHIS WA 022315 AMD*
*AIRMET SIERRA UPDT 7 FOR IFR AND MTN OBSCN VALID UNTIL 030300*
*.*
*AIRMET IFR...IA MO IL*
*FROM 40NE DSM TO 20W IOW TO 40N BDF TO 60SSW BDF TO 20ESE UIN TO*
*40SSW IRK TO 20ENE PWE TO 60SW FOD TO 40NE DSM*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 03Z THRU 09Z.*
*.*

***AIRMET IFR...ND MN IA WI LM LS MI LH***
***FROM 70NW INL TO YQT TO SSM TO YVV TO 30SE ECK TO DXO TO 30WSW***
***GIJ TO 20NNE DLL TO 50WNW DBQ TO 20SW GFK TO 90WSW YWG TO 70NW INL***
***CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 03Z THRU 09Z.***
***.***
***AIRMET IFR...IN KY...UPDT***
***FROM 40WSW ROD TO CVG TO HNN TO 40E PXV TO 20S TTH TO 40WSW ROD***
***CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 03Z THRU 09Z.***
***...NEW AIRMET...***
***.***
*AIRMET MTN OBSCN...KY*
*FROM HNN TO HMV TO 30SSW LOZ TO HNN*
*MTNS OBSC BY CLDS/PCPN. CONDS CONTG BYD 03Z ENDG 03-06Z.*
*.*
*OTLK VALID 0300-0900Z*
*AREA 1...IFR MN IA WI LM LS MI LH IN*
*BOUNDED BY 70ESE YWG-YQT-SSM-YVV-50SE ECK-20S DXO-FWA-20NNW TTH-*
*20NNW ORD-20W MCW-40NNE RWF-30W BRD-70ESE YWG*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG THRU 09Z.*
*.*
*AREA 2...IFR IA MO IL*
*BOUNDED BY 60ESE FSD-20W MCW-20NNW ORD-20NNW TTH-20ESE UIN-30ENE PWE-60ESE FSD*
*CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG THRU 09Z.*
*.*
*AREA 3...MTN OBSCN KY*
*BOUNDED BY HNN-HMV-30SSW LOZ-HNN*
*MTNS OBSC BY CLDS/BR. CONDS DVLPG 03-06Z. CONDS CONTG THRU 09Z.*
*....*
*WAUS43 KKCI 022215 AAA 2012337 2216*
*WA3Z*
*-CHIZ WA 022215 AMD*
*AIRMET ZULU UPDT 4 FOR ICE AND FRZLVL VALID UNTIL 030300*
*.*
*AIRMET ICE...ND SD...UPDT*
*FROM 60N MOT TO 70NE MOT TO BIS TO 20WNW DPR TO 70NW RAP TO 70NNW*
*ISN TO 60N MOT*
*CANCEL AIRMET.*
*.*
*OTLK VALID 0300-0900Z...ICE ND SD...UPDT*
*BOUNDED BY 70SSW YWG-30ENE BIS-20S DPR-50W RAP-40NNW ISN-70SSW*
*YWG*
*MOD ICE BTN 080 AND FL200. CONDS DVLPG 03-06Z. CONDS CONTG THRU*
*09Z.*
*.*
*FRZLVL...RANGING FROM SFC-140 ACRS AREA*
*MULT FRZLVL 015-080 BOUNDED BY 90ESE YWG-YQT-SSM-YVV-20SE ASP-*
*20ESE TVC-40NW TVC-GRB-60S RHI-30W RHI-30NNE BJI-90ESE YWG*
*040 ALG 60WNW INL-20NNE DLH-50SSE SAW-70NW YVV*
*080 ALG 30SW ISN-40E ISN-30NE FAR-50SSW BRD-20ENE MSP-50SE*
*GRB-60SSW YVV*
*120 ALG 40NNW BFF-50SE RAP-50SSE OBH-20N COU-50NE DYR-60WNW*
*BNA*
*....*
*WAUS43 KKCI 022235 AAA 2012337 2236*
*WA3T*
*-CHIT WA 022235 AMD*

*AIRMET TANGO UPDT 4 FOR TURB AND LLWS VALID UNTIL 030300*
*.*
*AIRMET TURB...ND SD NE KS MN IA*
*FROM 70NNW ISN TO 80SE YWG TO 40S INL TO 40SSE RWF TO GLD TO*
*40ESE SNY TO 40ESE CYS TO 70NNW ISN*
*MOD TURB BLW 100. CONDS CONTG BYD 03Z THRU 09Z.*
*.*
*AIRMET TURB...SD NE MN IA WI LM MI LH IL IN...UPDT*
*FROM RHI TO 60S SAW TO YVV TO 30SE ECK TO FWA TO 20S BDF TO 50SE*
*OVR TO 50ESE OBH TO 40E ONL TO 30NNW RWF TO RHI*
*MOD TURB BTN FL280 AND FL400. CONDS CONTG BYD 03Z THRU 09Z.*
*.*
*LLWS POTENTIAL...ND SD MN*
*BOUNDED BY 70NE MOT-20NNE INL-40NW MSP-30S RWF-30SSW FSD-40NNE*
*ANW-20WSW BIS-70NE MOT*
*LLWS EXP. CONDS DVLPG 21-00Z. CONDS CONTG BYD 03Z THRU 09Z.*
*.*
*OTLK VALID 0300-0900Z...TURB ND SD NE KS MN IA WI LS*
*BOUNDED BY 70NW INL-YQT-20W FOD-GLD-40E SNY-50SSW BFF-50NNW ISN-70NW INL*
*MOD TURB BLW 100. CONDS CONTG THRU 09Z.*
*....*

Figure 10 is the GOES-13 infrared image at 1715 EST with AIRMET Sierra update 7 plotted on the image. A new AIRMET is depicted southern Indiana and northern Kentucky and extends over the accident site.

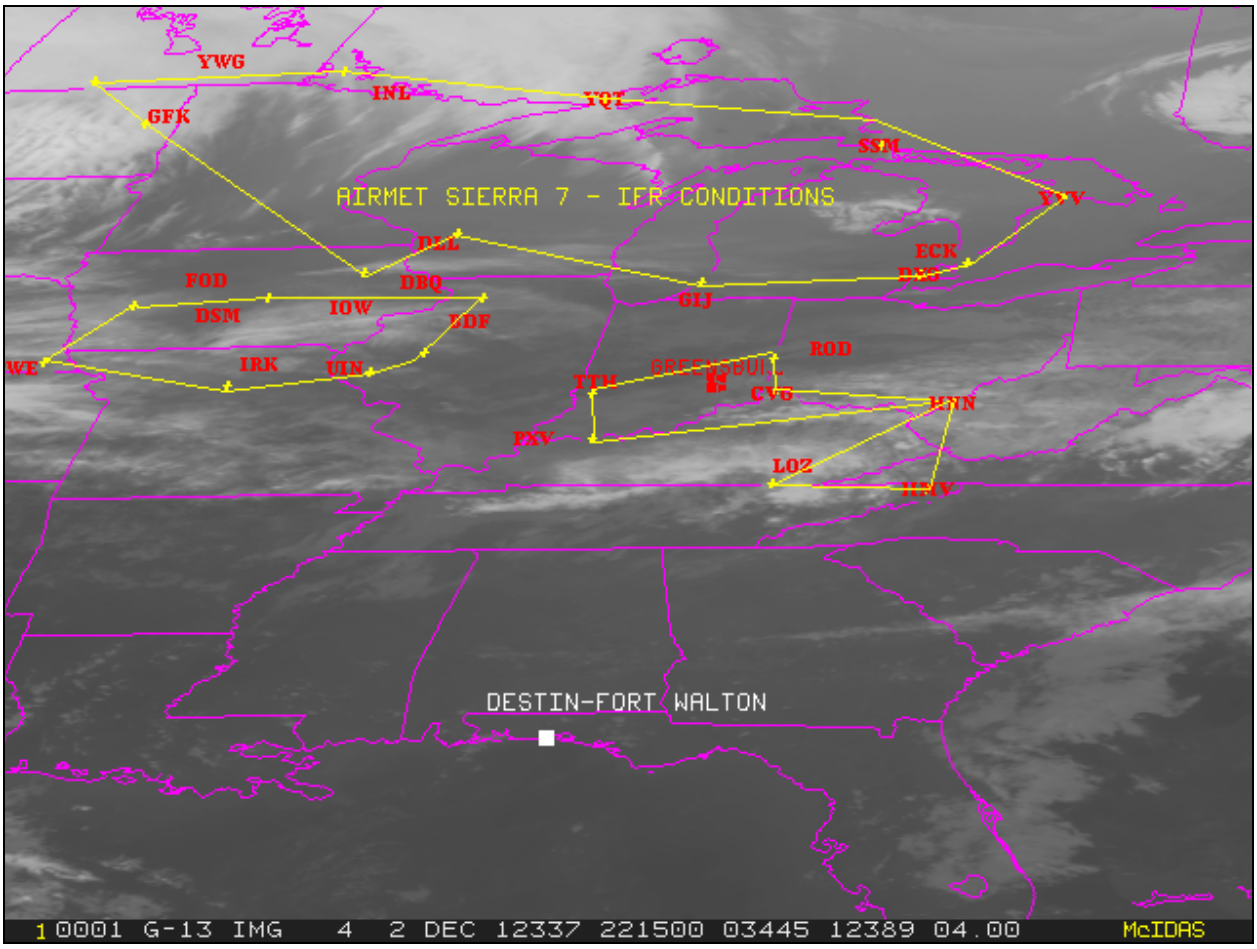


**Figure 10 - GOES-13 infrared image for 1715 EST with AIRMET Sierra update 7**

## 8.0 Terminal Aerodrome Forecast

The closest NWS Terminal Aerodrome Forecast (TAF) to the accident site was issued for Indianapolis International Airport (KIND) approximately 42 miles northwest of the accident site. While TAFs are only valid for a 5 mile radius around the airport center point, they provide a more time specific forecast of wind, visibility, weather, and sky condition than the Area Forecast. The forecast available at the time of the preflight briefing was issued at 1125 EST (1725Z) and expected MVFR conditions to prevail at the estimated time of arrival. The forecast was as follows:

Indianapolis forecast between 1600 and 1900 EST expected wind from 220º at 9 knots, visibility better than 6 miles, with ceiling overcast at 2,000 feet agl. After 1900 through 2300 EST ceilings were expecting to lower to 1,500 feet. MVFR conditions were expected to prevail during the period.

The forecast was amended while the flight was airborne at 1719 EST (2219Z) and expected VFR conditions to prevail through 1900 EST, with MVFR ceilings at 1,500 feet expected after

1900 EST. It was not until 1820 EST (2320Z) or the approximate time of the accident that the forecast included IFR conditions after 2300 EST due to mist and low ceilings.

*TAF KIND 021725Z 0218/0324 22012G18KT P6SM OVC020*
***FM022100 22009KT P6SM OVC020***
*FM030000 19005KT P6SM OVC015*
*FM031400 18012KT P6SM OVC015*
*FM031700 19015G22KT P6SM OVC020=*

***TAF AMD KIND 022219Z 0222/0324 21006KT P6SM SCT020 BKN035***
*FM030000 19005KT P6SM OVC015*
*FM031400 18012KT P6SM OVC015*
*FM031700 19015G22KT P6SM OVC020=*

***TAF KIND 022320Z 0300/0406 19005KT 6SM BR SCT008 OVC015***
*FM030400 19005KT 4SM BR OVC008*
*FM031500 20011KT 6SM BR OVC015*
*FM031900 19015G23KT P6SM SCT015 BKN200=*

The next closest TAF was issued for Cincinnati/Northern Kentucky International Airport (KCVG) located 43 miles southeast of the accident site. The forecasts issued during the period were as follows:

*TAF AMD KCVG 021858Z 0219/0324 20010KT P6SM VCSH OVC015*
*TEMPO 0219/0222 5SM -SHRA OVC007*
***FM022200 21008KT P6SM VCSH OVC015***
*FM030300 20005KT 4SM BR VCSH OVC012*
*TEMPO 0308/0312 2SM BR OVC008*
*FM031400 19010KT P6SM BKN025*
*FM031800 19010KT P6SM SCT035=*

*TAF AMD KCVG **021938Z 0220/0324 21008KT 5SM BR VCSH OVC012***
***TEMPO 0220/0224 2SM BR OVC007***
*FM030000 20005KT 4SM BR VCSH OVC012*
*TEMPO 0308/0312 2SM BR OVC008*
*FM031400 19010KT P6SM BKN025*
*FM031800 19010KT P6SM SCT035=*

*TAF AMD KCVG 022046Z 0221/0324 21008KT 2SM -RA BR VCSH OVC006*
***FM022300 20005KT 4SM BR VCSH OVC012***
*TEMPO 0308/0312 2SM BR OVC008*
*FM031400 19010KT P6SM BKN025*
*FM031800 19010KT P6SM SCT035=*

*TAF AMD KCVG **022208Z 0222/0324 21008KT 3SM BR VCSH OVC006***
***FM022300 20005KT 4SM BR VCSH OVC008***
*TEMPO 0308/0312 2SM BR OVC008*
*FM031400 19010KT P6SM BKN025*
*FM031800 19010KT P6SM SCT035=*

*TAF KCVG **022330Z 0300/0406 22008KT 3SM BR VCSH OVC006***
*FM030600 20006KT 5SM BR VCSH OVC012*
*TEMPO 0306/0310 3SM BR*
*FM031400 19009KT P6SM BKN020*

*FM031900 20010KT P6SM SCT025*
*FM032200 19007KT P6SM FEW030=*

## 9.0 Center Weather Service Unit Products

The Indianapolis Center Weather Service Unit (CWSU) issued a Meteorological Impact Statement at 1221 EST and indicated a threat of icing conditions and developing IFR conditions primarily due to lowering ceilings over southern Indiana during the afternoon and evening hours. The advisory was as follows:

*FAUS20 KZID 021721 2012337 1721*
*ZID MIS 02 VALID 021720-030230*
*...FOR ATC PLANNING PURPOSES ONLY..*
*IN ZID E OF A LN FM 15E BKW-30N LOZ-30SE CVG-35SW AIR OCNL MOD RIME/MX ICG IC/PRECIP...DMSHG TO ISOL MOD 19-00Z. IN ZID N OF A LN FM 35NW PXV-CVG-40E APE DVLPG AREA OF IFR CIGS. IN ZID S OF LN FM 45NE APE-30NW BWG OCNL MOD TB AOB 080 ENDG. ZID CWSU.=*

## 10.0 Astronomical Data

The United Stated Naval Observatory website provided the following astronomical data for Greensburg, Decatur County, Indiana for Sunday December 2, 2012:

| | |
|---|---|
| Beginning of civil twilight | 0714 EST |
| Sunrise | 0744 EST |
| Moonset | 1034 EST |
| Sunset | 1719 EST |
| End of civil twilight | 1749 EST |
| Accident | 1819 EST |
| Moonrise | 2106 EST |

At the time of the accident both the Sun and the Moon were more than 15º below the horizon and provided no illumination.

Submitted by:

Donald Eick
NTSB Senior Meteorologist