National Transportation Safety Board

Office of Aviation Safety

Washington, D.C. 20594-2000

November 30, 2011

METEOROLOGICAL FACTUAL REPORT

DCA11MA076

A. Accident

Location: Roswell, New Mexico
Date: April 2, 2011
Time: approximately 0934 mountain daylight time (1534 UTC[1])
Aircraft: Gulfstream GVI (G650), registration: N652GD

B. Meteorological Specialist

Paul Suffern
Meteorologist
National Transportation Safety Board
Operational Factors Division, AS-30
Washington, D.C. 20594-2000

C. Summary

On April 2, 2011, about 0934 mountain daylight time, an experimental Gulfstream Aerospace Corporation (GAC) GVI (G650)[2], registration N652GD, serial number 6002, crashed during takeoff from runway 21 at Roswell International Air Center Airport (ROW), Roswell, New Mexico. The flight was being operated by the manufacturer as part of its G650 developmental field performance flight test program. The two pilots and the two flight test engineers were fatally injured, and the airplane was substantially damaged. The flight was being conducted under 14 *Code of Federal Regulations* Part 91, and visual meteorological conditions prevailed at the time of the accident.

[1] UTC – is an abbreviation for Coordinated Universal Time.
[2] Gulfstream uses the Roman numeral designation "GVI" for aircraft certification purposes and the designation "G650" for marketing purposes. These designations mean the same aircraft model for purposes of this report and are used interchangeably.

D. Details of Investigation

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Climatic Data Center (NCDC). All times are mountain daylight time (MDT) on April 2, 2011, and are based upon the 24-hour clock, where local time is -6 hours from UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 33.30° N, longitude 104.53° W, at an elevation of 3,671 feet.

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 located in Camp Springs, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC-0045G CHG 1.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 0900 MDT is provided as figure 1, with the approximate location of the accident site marked. The chart depicted a high pressure system located across northwestern New Mexico and eastern Arizona with a central pressure of 1015-hectopascals (hPa), with the high pressure system to the northwest of the accident site. The station models near the accident site depicted generally southerly winds of 5-15 knots, with clear skies, temperatures in the mid 60's Fahrenheit (F), and dewpoint temperatures from 15° F to 30° F.

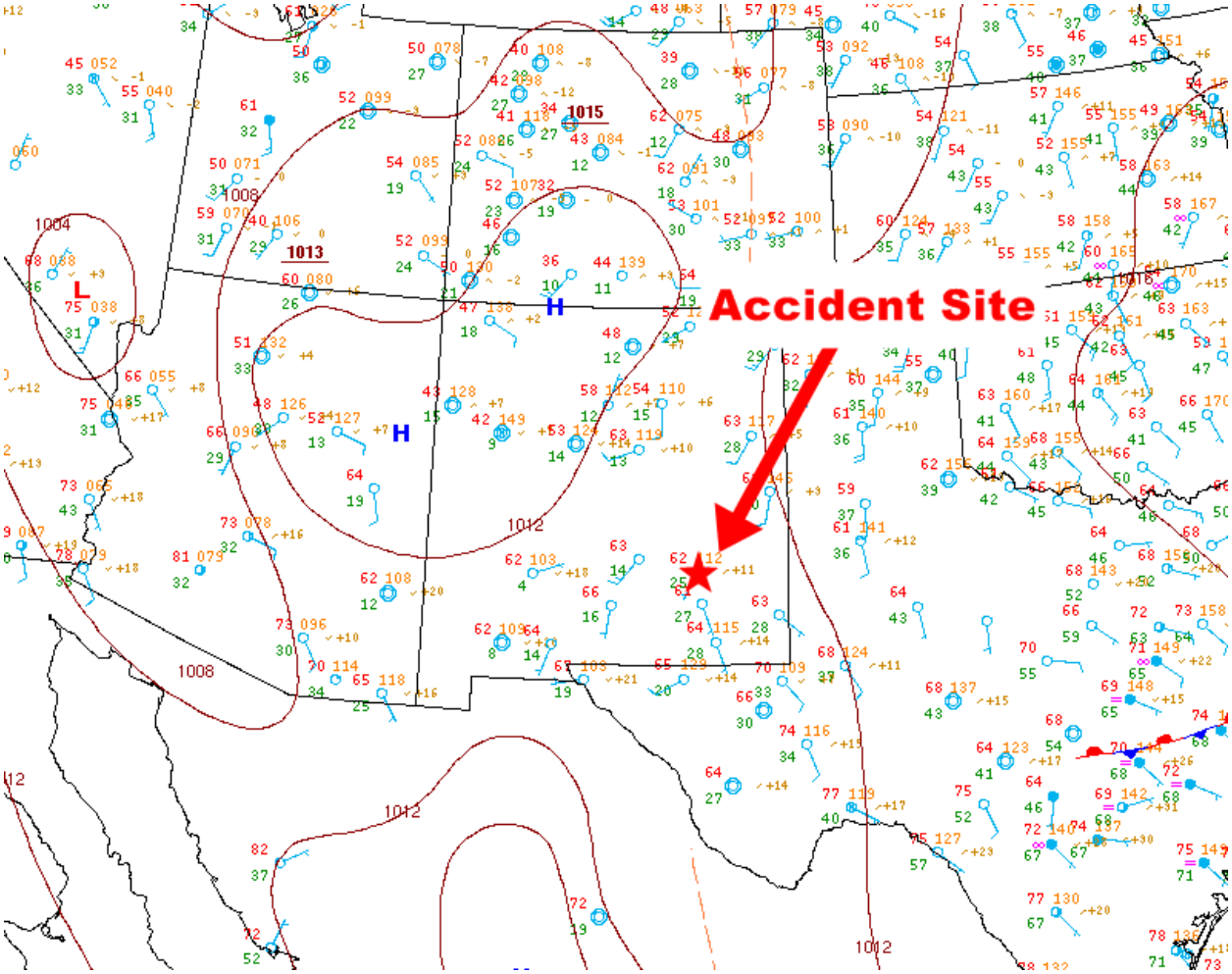


Figure 1 – NWS Surface Analysis Chart for 0900 MDT

1.2 Upper Air Charts

Storm Prediction Center Constant Pressure Charts for 0600 MDT are presented for 850-, 700-, 500-, and 300-hPa in figures 2 through 5. The 850-hPa chart depicted a mid-level trough[3] located east of the Rocky Mountains with a southerly low-level jet[4] of 20 to 30 knots from Texas northward into South Dakota. At 700- and 500-hPa the mid level flow is zonal[5] and an upper-level ridge[6] is located across the western United States at 300-hPa.

[3] Trough – An elongated area of relatively low atmospheric pressure or heights.
[4] Low Level Jet – A fast moving stream of air in the low levels of the atmosphere.
[5] Zonal wind flow – When the mid level winds are parallel or nearly parallel to the lines of latitude.
[6] Ridge – An elongated area of relatively high atmospheric pressure or heights.

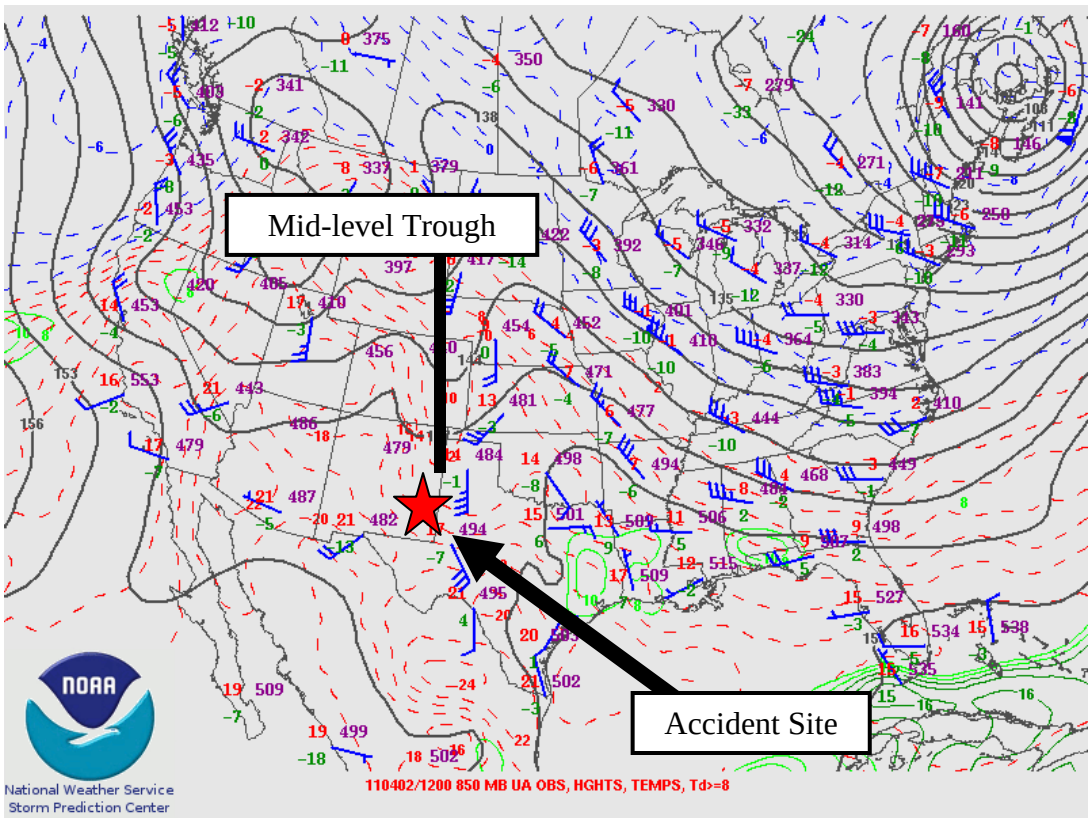


Figure 2 – 850-hPa Constant Pressure Chart for 0600 MDT

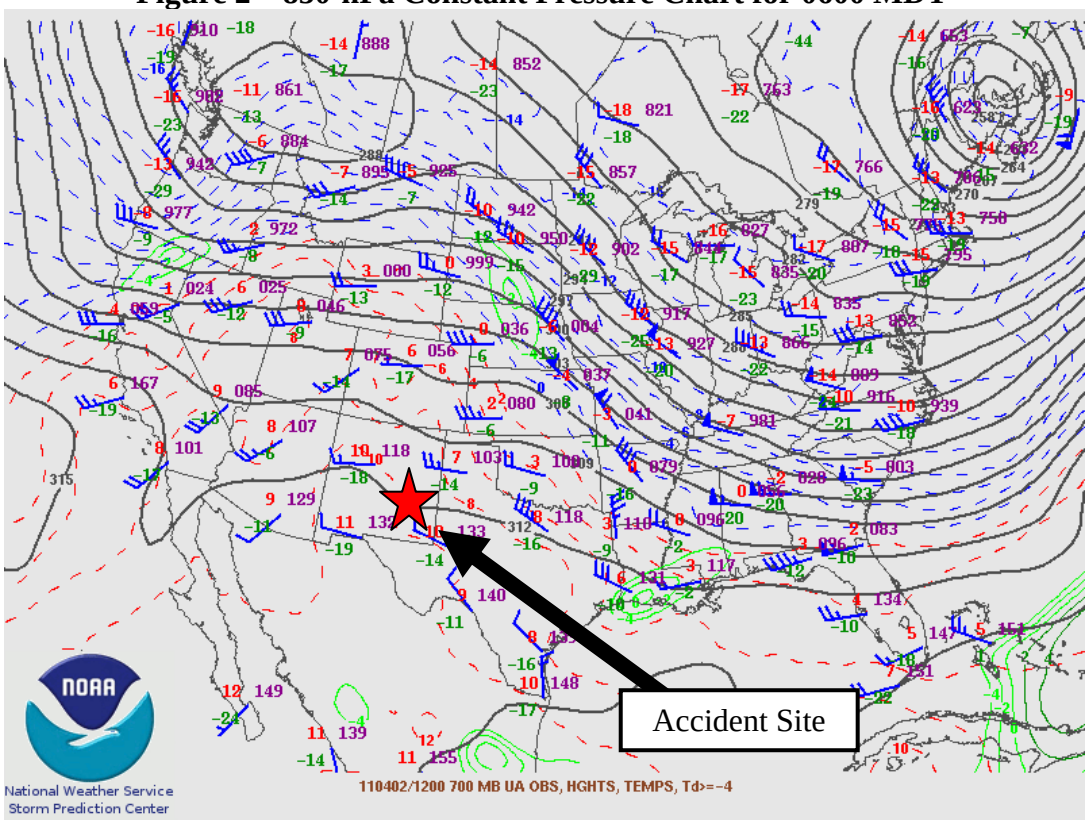


Figure 3 – 700-hPa Constant Pressure Chart for 0600 MDT

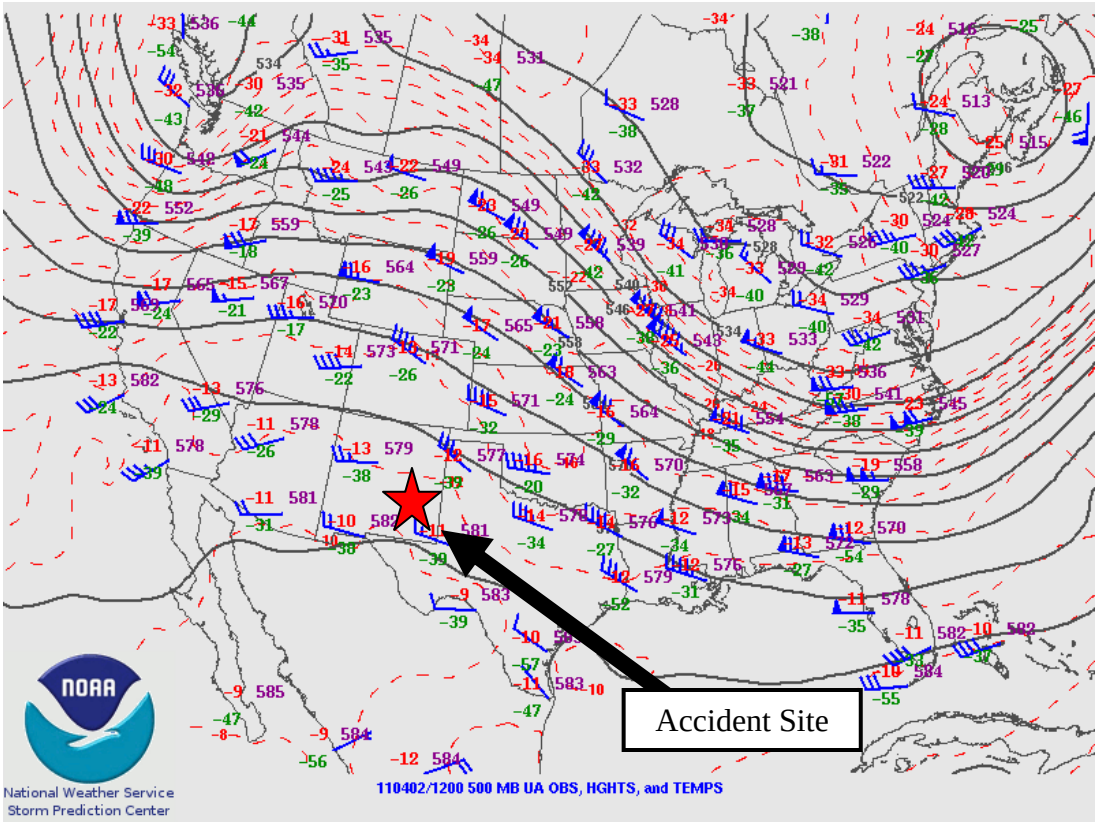


Figure 4 – 500-hPa Constant Pressure Chart for 0600 MDT

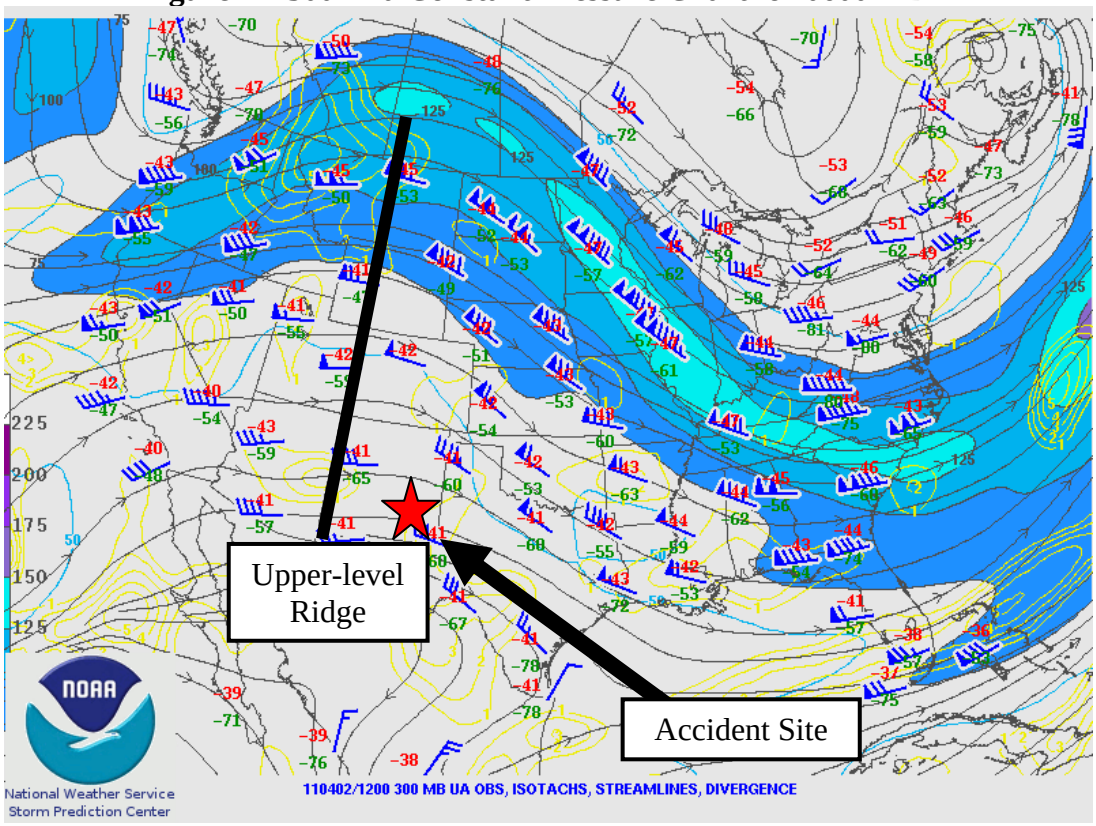


Figure 5 – 300-hPa Constant Pressure Chart for 0600 MDT

2.0 Radar Imagery

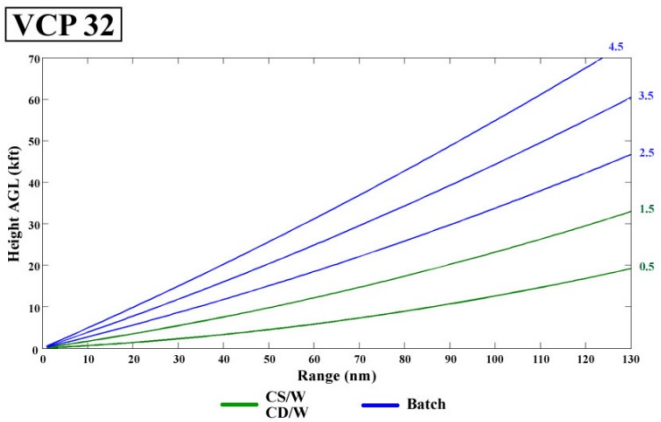
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D) was KHDX, located in Holloman Air Force Base, New Mexico, approximately 81 miles west-southwest of the accident site at an elevation of 4,222 feet. Level II archive radar data was obtained from the NCDC utilizing the Hierarchical Data Storage System (HDSS) and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy into a 0.95° beam width[7]. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

2.1 Volume Scan Strategy

The WSR-88D is a computer controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP). Products that require data from multiple elevation scans are not available until the end of the five to ten minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 14 elevation scans from 0.5° to 19.5° every five minutes. This particular scanning strategy is documented as volume coverage pattern 11 (VCP-11). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten minute period. During the period surrounding the accident, the KHDX WSR-88D radar was operating in the normal clear-air mode (Mode B, VCP-32). The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



VCP-32 Precipitation Mode Scan Strategy

[7] Beam width – A measure of the angular width of a radar beam.

2.2 Beam Height Calculation

Assuming standard refraction[8] of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width information of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	13,270 feet	9,280 feet	17,260 feet	7990 feet

Based on the radar height calculations, the 0.5° elevation scan depicts the conditions between 9,280 to 17,260 feet above msl over the accident site.

2.3 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.

[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 glazed ice.

[10] dBZ – A non-dimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

NWS VIP/DBZ CONVERSION TABLE

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

2.4 Base Reflectivity

Figure 6 presents the KHDX WSR-88D base reflectivity image for the 0.5° elevation scan initiated at 0932 MDT with a resolution of 1° X 250 meters. The image depicted no radar returns above the accident site.

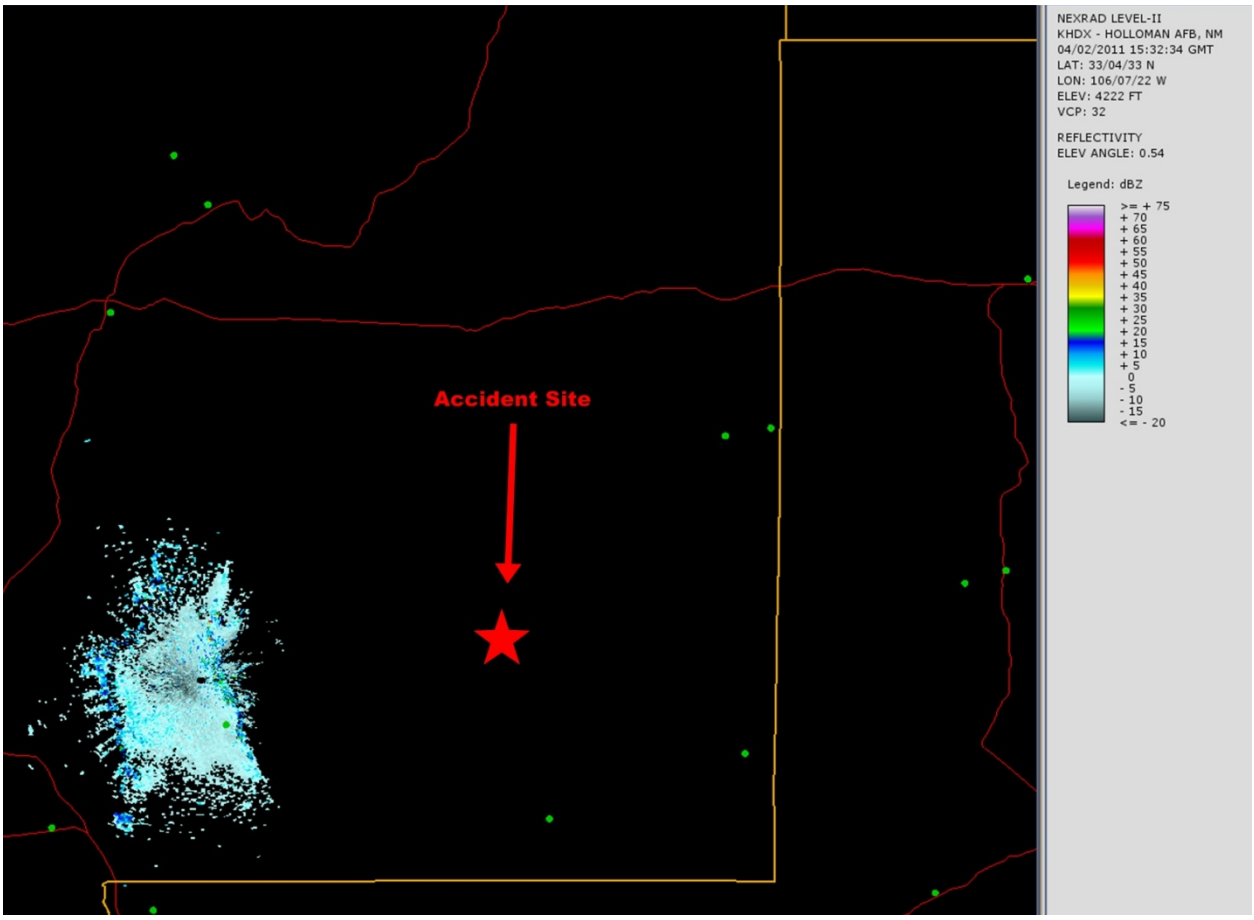


Figure 6 – KHDX WSR-88D 0.5° elevation scan for 0932 MDT

3.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language.

Roswell International Air Center Airport (KROW), located 3 miles south of the city of Roswell, New Mexico, had an Automated Surface Observing System (ASOS[11]) (figure 7). KROW had a 10° easterly magnetic variation[12] and its elevation was 3,671 feet. The following observations were taken and disseminated during the times surrounding the accident:

[11] ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.
[12] Magnetic variation – The angle (at a particular location) between magnetic north and true north.

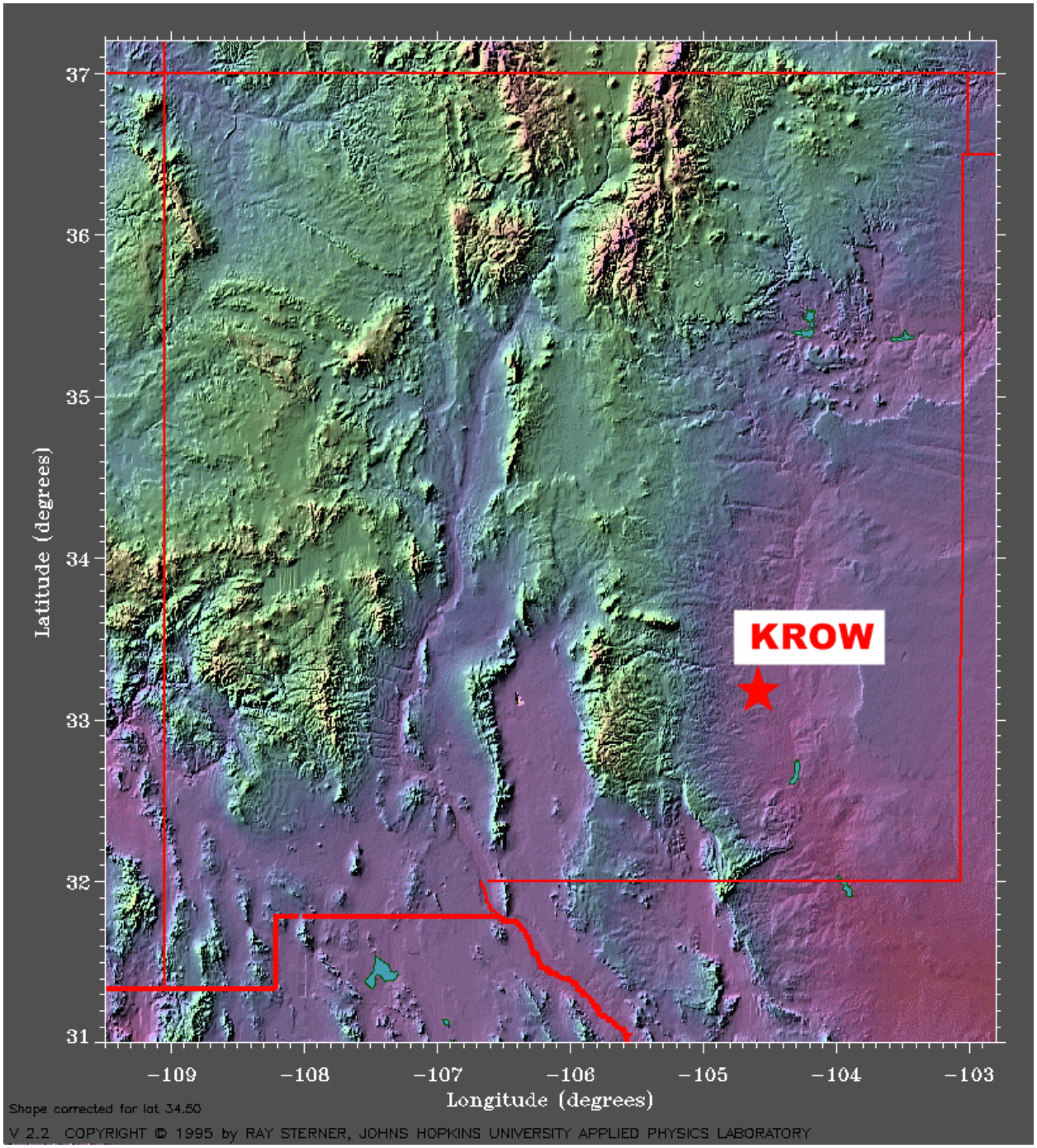


Figure 7 – Map of New Mexico with the location of KROW

[0751 MDT] KROW 021351Z 00000KT 10SM CLR 13/M04 A3000 RMK AO2 SLP115 T01331039

[0851 MDT] KROW 021451Z 21004KT 10SM CLR 17/M04 A3001 RMK AO2 SLP112 T01671039 51011[13]

Accident Time 0934 MDT

[0951 MDT] KROW 021551Z 16008KT 10SM CLR 20/M03 A3000 RMK AO2 SLP111 T02001033

[1000 MDT] KROW 021600Z 18009KT 10SM CLR 21/M03 A3000 RMK AO2

KROW weather at 0851 MDT, wind from 210° at 4 knots, visibility of 10 miles or greater, sky clear below 12,000 feet agl, temperature of 17° Celsius (C), dew point temperature of -4° C, and an altimeter setting of 30.01 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1011.2 hPa, temperature 16.7° C, dew point temperature -3.9° C, 3-hourly pressure increase of 1.1 hPa.

KROW weather at 0951 MDT, wind from 160° at 8 knots, visibility of 10 miles or greater, sky clear below 12,000 feet agl, temperature of 20° C, dew point temperature of -3° C, and an altimeter setting of 30.00 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1011.1 hPa, temperature 20.0° C, dew point temperature -3.3° C.

The density altitude[14] was calculated for 0851 MDT as 4,739 feet for KROW. The density altitude for 0951 MDT was 5,059 feet at KROW.

3.1 One-Minute Wind Observations

The one-minute KROW ASOS surface data was provided by the NWS for the times surrounding the accident. One-minute wind data was provided with two separate wind magnitudes and wind directions. The first wind data in the following chart is the two-minute average wind speed that was updated every five-seconds and reported once a minute. The second source of one-minute wind data is the five-second max wind average that was updated every five-seconds and reported once every minute. The wind directions are reported relative to true north. The following table provides the wind data in local time (MDT) as well as UTC time.

[13] Bold Text is text that is further highlighted in the narrative.
[14] Density altitude – The altitude in the International Standard Atmosphere at which the air density would be equal to the actual air density at the place of observation.

Station ID	Time(local)	Time(utc)	Dir of 2min avg wind	Speed of 2 min avg wind (knots)	Dir of max 5 sec avg wind	Speed of max 5 sec avg wind (knots)
23009KROW	ROW201104020900	1500	199	3	194	6
23009KROW	ROW201104020901	1501	197	4	184	6
23009KROW	ROW201104020902	1502	191	6	181	7
23009KROW	ROW201104020903	1503	184	7	182	8
23009KROW	ROW201104020904	1504	183	6	186	7
23009KROW	ROW201104020905	1505	179	7	173	9
23009KROW	ROW201104020906	1506	178	8	173	10
23009KROW	ROW201104020907	1507	173	7	165	8
23009KROW	ROW201104020908	1508	167	7	172	9
23009KROW	ROW201104020909	1509	166	7	165	8
23009KROW	ROW201104020910	1510	164	6	164	7
23009KROW	ROW201104020911	1511	163	6	163	8
23009KROW	ROW201104020912	1512	163	6	162	7
23009KROW	ROW201104020913	1513	170	6	178	7
23009KROW	ROW201104020914	1514	174	6	163	7
23009KROW	ROW201104020915	1515	164	6	158	8
23009KROW	ROW201104020916	1516	156	5	166	6
23009KROW	ROW201104020917	1517	157	5	162	6
23009KROW	ROW201104020918	1518	164	5	150	5
23009KROW	ROW201104020919	1519	170	5	185	8
23009KROW	ROW201104020920	1520	179	5	187	7
23009KROW	ROW201104020921	1521	188	6	187	7
23009KROW	ROW201104020922	1522	188	5	186	6
23009KROW	ROW201104020923	1523	193	5	205	7
23009KROW	ROW201104020924	1524	198	5	198	7
23009KROW	ROW201104020925	1525	193	6	196	8
23009KROW	ROW201104020926	1526	195	6	203	8
23009KROW	ROW201104020927	1527	194	6	202	8
23009KROW	ROW201104020928	1528	187	6	189	8
23009KROW	ROW201104020929	1529	186	6	206	8
23009KROW	ROW201104020930	1530	188	6	170	7
23009KROW	ROW201104020931	1531	185	6	177	7
23009KROW	ROW201104020932	1532	178	7	172	10
23009KROW	**ROW201104020933**	**1533**	**172**	**7**	**167**	**10**
23009KROW	**ROW201104020934**	**1534**	**170**	**8**	**166**	**10**
23009KROW	**ROW201104020935**	**1535**	**171**	**8**	**179**	**9**
23009KROW	ROW201104020936	1536	174	7	183	9
23009KROW	ROW201104020937	1537	173	6	176	8
23009KROW	ROW201104020938	1538	170	7	166	9

23009KROW	ROW201104020939	1539	172	8	173	11
23009KROW	ROW201104020940	1540	172	8	160	9
23009KROW	ROW201104020941	1541	177	7	190	8
23009KROW	ROW201104020942	1542	194	7	185	9
23009KROW	ROW201104020943	1543	204	6	216	7
23009KROW	ROW201104020944	1544	205	6	203	8
23009KROW	ROW201104020945	1545	207	7	218	8
23009KROW	ROW201104020946	1546	196	8	183	10
23009KROW	ROW201104020947	1547	178	8	173	9
23009KROW	ROW201104020948	1548	169	8	155	10
23009KROW	ROW201104020949	1549	162	9	168	13
23009KROW	ROW201104020950	1550	164	9	161	10
23009KROW	ROW201104020951	1551	163	8	165	11
23009KROW	ROW201104020952	1552	155	8	153	8
23009KROW	ROW201104020953	1553	155	7	158	8
23009KROW	ROW201104020954	1554	161	7	164	9

Table 1 – One minute KROW wind data for the time surrounding the accident

At 0933 MDT, KROW reported the two-minute average wind from 172° at 7 knots, and the five-second maximum average wind from 167° at 10 knots.

At 0934 MDT, KROW reported the two-minute average wind from 170° at 8 knots, and the five-second maximum average wind from 166° at 10 knots.

At 0935 MDT, KROW reported the two-minute average wind from 171° at 8 knots, and the five-second maximum average wind from 179° at 9 knots.

4.0 Upper Air Data

The closest upper air sounding to the accident site was from Dona Ana County Airport (EPZ), in Santa Teresa, New Mexico, site number 72364 with a station elevation of 4,104 feet and EPZ was located approximately 139 miles southwest of the accident site. The 0600 MDT sounding from EPZ was plotted on a standard Skew-T log P diagram[15], which is presented along with the derived stability parameters in figure 8 (with data from the surface to 600-hPa, or 14,000 feet). These data were analyzed utilizing the RAOB[16] software package. The sounding depicted a dry environment with the Lifted Condensation Level (LCL)[17] at 14,590 feet and a Convective Condensation Level (CCL)[18] of 24,711 feet. The freezing level was located at 14,361 feet. The tropopause height was identified at 39,469 feet. The precipitable water value was 0.17 inches.

[15] 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.

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

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

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

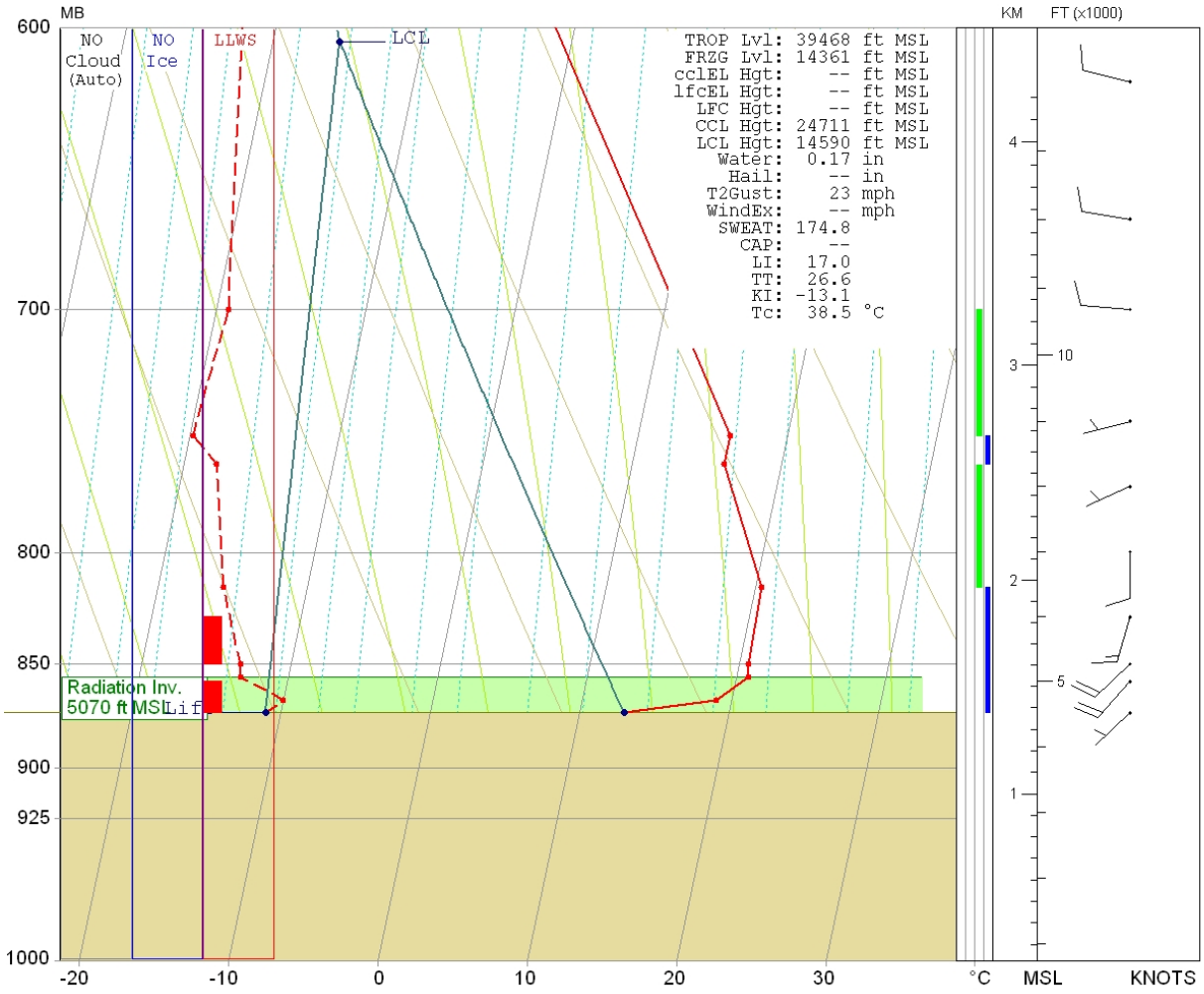


Figure 8 –EPZ 0600 MDT sounding

The sounding parameters indicated a dry and stable environment from the surface to approximately 6,500 feet. From 6,500 feet to 14,000 feet the vertical environment was dry and conditionally unstable. Such conditions are not considered supportive of any vertical cloud formation. From the surface to 5,070 feet, RAOB indicated an inversion due to radiational cooling.

The sounding wind profile indicated there was a surface wind from 225° at 7 knots and the wind remained out of the southwest while increasing in speed with height to 20 knots near 5,000 feet. From 5,000 feet to 14,000 feet the winds decreased and veered[19] to the west. RAOB indicated two layers between the surface and 7,000 feet that were conducive to low level wind shear (LLWS). RAOB didn't indicate any layers conducive for clouds or icing conditions below 14,000 feet.

[19] Veering wind – A wind that turns clockwise with height.

5.0 Satellite Data

Visible data from the Geostationary Operational Environmental Satellite number 11 (GOES-11) data was obtained from the NCDC and processed with the NTSB's Man-computer Interactive Data Access System (McIDAS) workstation. The visible imagery (GOES-11, band 1), at a wavelength of 0.65 microns (μm) was retrieved for the scene. Satellite imagery surrounding the time of the accident, from 0700 MDT through 1130 MDT at approximately 15-minute intervals, were reviewed and the closest image to the time of the accident is documented here.

Figure 9 presents the GOES-11 visible imagery from 0930 MDT at 2X magnification with the accident site highlighted with a red square. The 0.65 μm visible imagery shows no cloud cover over the accident site.

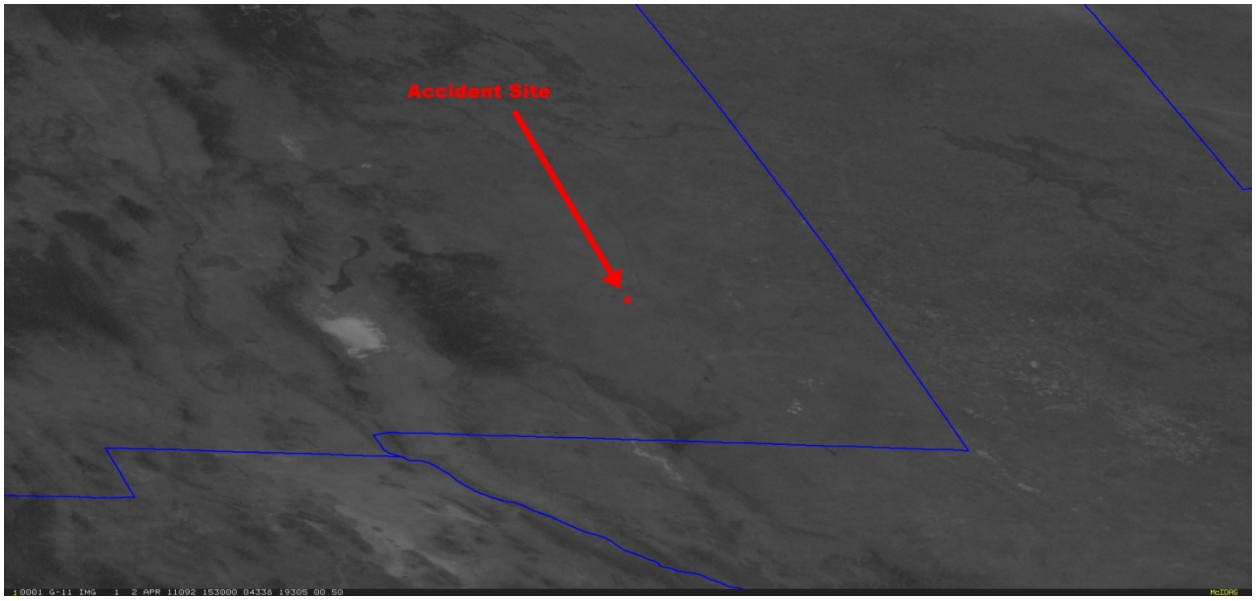


Figure 9 – GOES-11 visible image at 0930 MDT

6.0 Pilot Reports

No pilot reports (PIREPs) were filed near the accident site at the accident time.

7.0 AIRMET

No SIGMETs were active for New Mexico at the time of the accident.

AIRMETs active for the time of the accident for FL180 and below were reviewed and no AIRMETs were active for the accident site at the accident time. The only AIRMET active for New Mexico advised of moderate turbulence below FL180 for much of the Intermountain West (figure 10).

WAUS45 KKCI 021445
WA5T
_SLCT WA 021445
AIRMET TANGO UPDT 2 FOR TURB AND LLWS VALID UNTIL 022100
.
AIRMET TURB...ID MT WY NV UT WA OR CA AND CSTL WTRS
FROM 20WNW HUH TO 50NNW ISN TO 50NW RAP TO 20E PIH TO 50S FMG TO 30WNW SNS TO 130SW PYE TO 140WSW FOT TO 120WNW ONP TO 140W TOU TO 20WNW HUH
MOD TURB BTN FL240 AND FL410. CONDS CONTG BYD 21Z THRU 03Z.
.
AIRMET TURB...ID MT WY NV UT CO AZ NM WA OR CA
FROM 50NNW GGW TO 50E DDY TO 30WSW TBE TO 40SW BCE TO 40NE BVL TO 30SE LKV TO 80ESE YDC TO 50NNW GGW
MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.
.
LLWS POTENTIAL...ID MT WY UT
BOUNDED BY BIL-50ENE OCS-20S SLC-30ESE LKT-70SE HLN-BIL
LLWS EXP. CONDS CONTG BYD 21Z THRU 03Z.
.
OTLK VALID 2100-0300Z...TURB ID MT WY NV UT WA OR CA AND CSTL WTRS
BOUNDED BY 50N ISN-60NW RAP-20ENE BOY-20SE SLC-20SSW ILC-180SW SNS-140WSW FOT-120WNW ONP-150W TOU-40NE TOU-HUH-50N ISN
MOD TURB BTN FL240 AND FL410. CONDS CONTG THRU 03Z.
....

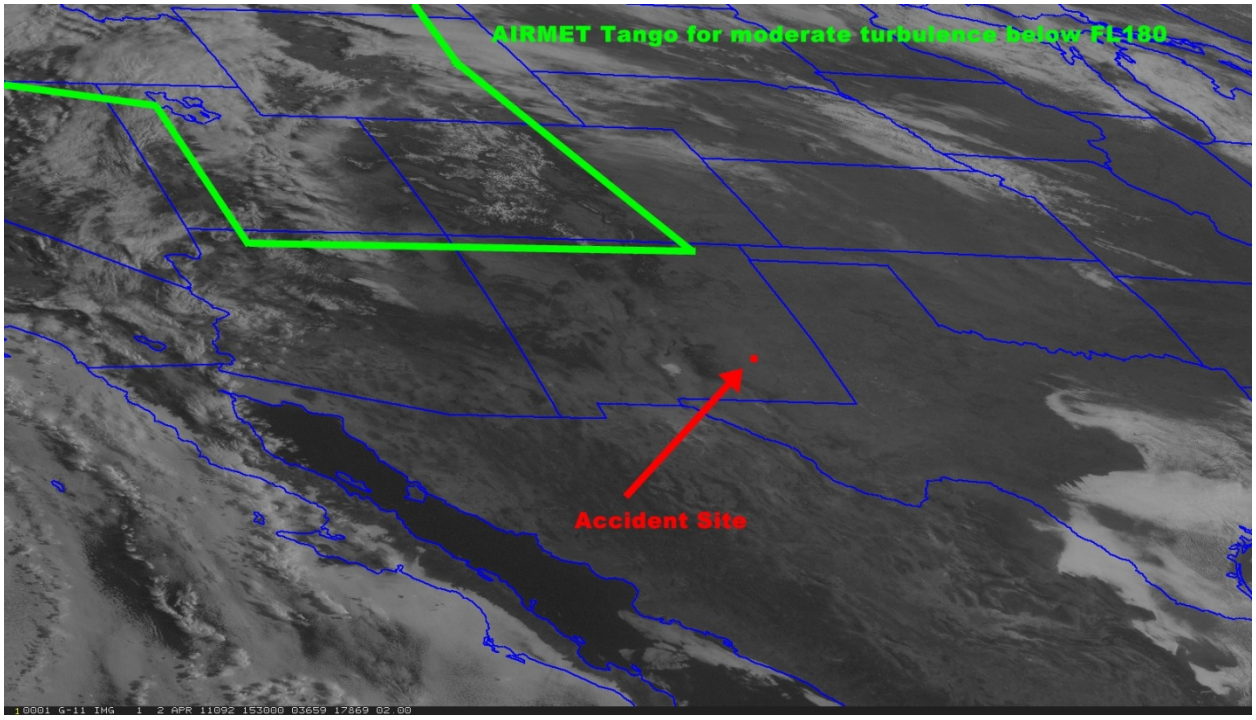


Figure 10 – AIRMET Tango valid at the time of the accident

8.0 Terminal Aerodrome Forecast

The NWS Terminal Aerodrome Forecast (TAF) for the accident location was issued at 0524 MDT and was valid for a 24-hour period beginning at 0600 MDT. The TAF forecast for KROW was as follows:

KROW 021124Z 0212/0312 **16008KT P6SM SKC**
FM021900 19016G26KT P6SM SCT250
FM030200 21012KT P6SM BKN250
FM030800 20006KT P6SM BKN250=

The forecast expected wind from 160° at 8 knots, visibility better than 6 miles, and clear skies at the time of the accident.

9.0 Area Forecast

The Area Forecast issued at 0645 MDT forecasted scattered cirrus clouds over New Mexico with southwest surface wind gusts of 25 knots after 1200 MDT:

FAUS45 KKCI 021045
FA5W
_SLCC FA 021045
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 030500
CLDS/WX VALID UNTIL 022300...OTLK VALID 022300-030500

ID MT WY NV UT CO AZ NM
.
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...ALF..HI PRES RDG OVR CNTRL MT-FOUR CORNERS BY 05Z RDG E OF FA. TROF OVR WRN WA-CNTRL CA WTRS WL MOV OVR CNTRL MT-NW NV BY 05Z. SFC..WRMFNT OVR NW MT-ERN. CDFNT OVR ERN WA-ERN OR-NRN CA WL MOV SEWD DURG PD OVR SRN WY-NERN UT-SRN NV.
.
ID
NRN...BKN040 LYRD FL250. VIS 5SM -RA. AFT 17Z SCT -SHRA. WND SW G30KT. AFT 21Z SCT -SHRASN/ISOL -TSSN. CB TOP FL270. OTLK...MVFR CIG SHRA TSSN.
CNTRL MTNS...BKN070 LYRD FL250. VIS 3-5SM -RA BR. AFT 17Z SCT -SHRASN. WND SW G25KT. AFT 21Z SCT -SHSN/ISOL -TSSN. CB TOP FL270. OTLK...MVFR CIG SHSN TSSN.
SWRN...BKN080 LYRD FL250. AFT 14Z BKN050 VIS 5SM -RA BR. AFT 17Z BKN070 SCT -SHRA. WND SW 20G30KT. 21Z SCT -SHRA/ISOL -TSRA. CB TOP FL270. OTLK...VFR SHRA TSRA.
SERN...BKN080 LYRD FL250. AFT 19Z BKN050 VIS 5SM -RA BR. WND SW 25G35KT. AFT 22Z BKN070 SCT -SHRA/ISOL -TSRA. CB TOP FL270. WND SW 25G35KT. OTLK...MVFR CIG SHRA TSRA WND.
.
MT
CONTDVD WWD...BKN050 LYRD FL250. VIS 5SM -RA BR. AFT 18Z SCT -SHRASN. WND SW G25KT. AFT 21Z SCT -SHRASN/ISOL -TSSN. CB TOP FL270. OTLK...MVFR CIG SHRA TSSN.
SWRN MTNS...BKN080 LYRD FL250. AFT 17Z BKN050 ISOL -SHRASN BR. 21Z BKN060 SCT -SHSN/ISOL -TSRA. CB TOP FL270. OTLK...MVFR CIG SHRA TSRA.
ERN SLOPES OF CONTDVD...SCT050 BKN CI. AFT 13Z BKN050 LYRD FL250. VIS 3-5SM -RA BR. AFT 18Z SCT -SHRASN. WND SW G25KT. 21Z SCT -SHRASN/ISOL -TSSN. CB TOP FL270. OTLK...MVFR CIG SHRA TSSN.
CNTRL...
NRN 2/3...SCT050 BKN CI. AFT 16Z BKN050 LYRD FL250. VIS 5SM -RA BR. AFT 18Z SCT -SHRA. 21Z SCT -SHRA/ISOL -TSRASN. CB TOP FL270. OTLK...MVFR CIG SHRA TSSN.
SRN 1/3...SCT150 BKN CI. 18Z WND SW G25KT. 22Z BKN070 LYRD FL250. ISOL -SHRA/-TSRA. CB TOP FL270. OTLK...VFR SHRA TSRA.
ERN...
NRN HLF...BKN040 LYRD FL250. VIS 5SM SCT -SHRA BR. 18Z BKN080. 22Z SCT -SHRASN/ISOL -TSRA. CB TOP FL270. OTLK...MVFR CIG SHRA TSRA.
SRN HLF...SCT150 BKN CI. 19Z WND SW G25KT. 21Z BKN070 LYRD FL250.

ISOL -SHRA/-TSRA. CB TOP FL270. OTLK...VFR SHRA TSRA.
.
WY
PLAINS...SCT150 BKN CI. BECMG 1417 WND SW G25KT. BECMG 2023 BKN070 LYRD FL250. ISOL -SHRA/-TSRA. CB TOP FL270. OTLK...VFR SHRA TSRA.
MTNS E OF CONTDVD...
NRN HLF...SCT150 BKN CI. BECMG 1417 WND SW 20G30KT. BECMG 2023 BKN070 LYRD FL250. ISOL -SHRA/-TSRA. CB TOP FL270. OTLK...VFR SHRA TSRA.
SRN HLF...SCT150 BKN CI. WND SW 20G30KT. BECMG 1417 WND SW 25G40KT. BECMG 2023 BKN070 LYRD FL250. ISOL -SHRA/-TSRA. CB TOP FL270. WND SW 30G45KT. OTLK...VFR SHRA TSRA WND.
MTNS W OF CONTDVD...BKN120 LYRD FL250. BECMG 2023 BKN090 SCT -SHRASN/ISOL -TSRASN. CB TOP FL270. WND SW G25KT. OTLK...MVFR CIG SHRASN TSRA WND.
.
NV
NWRN...SCT080 BKN CI. BECMG 1619 BKN100 LYRD FL250. VIS 5SM -RA BR. WND SW G25KT. BECMG 2023 BKN070 SCT -SHRA. WND NW 20G30KT. OTLK...MVFR CIG SHRA WND AFT 01Z VFR SHRA.
NERN...SCT080 BKN CI. BECMG 1619 WND SW G25KT. BECMG 2023 BKN080 SCT -SHRA/ISOL -TSRA. CB TOP FL270. WND SW 25G35KT. OTLK...MVFR CIG SHRA TSRA WND AFT 04Z VFR SHRA.
SRN...BKN CI. 19Z WND SW 20G30KT. 22Z SW 25G40KT. OTLK...VFR WND.
.
UT
NRN HLF...BKN CI. BECMG 2023 BKN070 SCT -SHRA/ISOL -TSRA. CB TOP FL270. WND SW G25KT. OTLK...MVFR CIG SHRA TSRA WND.
SRN HLF...SCT CI. 16Z WND SW G25KT. 20Z WND SW 25G35KT. OTLK...VFR WND.
.
CO
PLAINS...BKN CI. 18Z WND SW G25KT. OTLK...VFR WND.
MTNS E OF CONTDVD...SCT150 BKN CI. AFT 18Z WND SW G25KT. AFT 20Z WND SW 20G35KT. OTLK...VFR WND.
MTNS W OF CONTDVD...SCT CI. 16Z WND SW G25KT. 20Z WND SW 25G35KT. OTLK...VFR WND.
.
AZ
BKN CI. 18Z WND SW 20G30KT. OTLK...VFR WND.
.
NM
SCT CI. 18Z WND SW G25KT. OTLK...VFR WND.
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10.0 National Weather Service Discussion

The National Weather Service Office in Albuquerque issued the following Area Forecast Discussion at 0325 MDT discussing the increasing gusty surface winds in the afternoon hours throughout New Mexico:

FXUS65 KABQ 020925
AFDABQ
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
325 AM MDT SAT APR 2 2011
...RECORD TEMPERATURES EXPECTED AT MANY LOCALES TODAY...
...VERY STRONG WINDS/EXTREMELY CRITICAL FIRE WEATHER SUNDAY...
.DISCUSSION...SIGNIFICANT...HIGH-IMPACT WIND/FIRE WEATHER EVENT EXPECTED ACROSS THE AREA ON SUNDAY. WIND GUSTS EXCEEDING 60 MPH APPEAR LIKELY FOR MANY AREAS WITH 70+ MPH GUSTS FOR WIND-PRONE LOCATIONS ALONG/EAST OF THE CENTRAL MOUNTAIN CHAIN AND HIGHER TERRAIN OF WC/SW ZONES. WE WILL BE UPGRADING/EXPANDING PREVIOUS HIGH WIND WATCH TO WARNINGS...AND HOIST WIND ADVISORIES FOR THE NORTHWEST ZONES. THE EXTREMELY DRY...TINDER BOX CONDITIONS COUPLED WITH THESE HIGH WINDS WILL MAKE FOR A DANGEROUS/EXTREMELY CRITICAL FIRE WEATHER EVENT. MUCH COOLER AIR MASS OVERSPREADS THE AREA BY MONDAY WITH MAX TEMPS 25-40 DEGREES COOLER THAN THOSE EXPECTED TODAY. NEEDLESS TO SAY...BIG WEATHER CHANGE ON THE WAY.
STRONG RIDGE ALOFT CRESTS OVER THE AREA TODAY DOWNSTREAM OF A POTENT SHORTWAVE TROUGH THAT WILL PLOW INTO THE PACNW. MODELS NOT AS AGGRESSIVE IN DEFLATING THE RIDGE OVER OUR REGION DURING THE DAY...BUT IT WILL BEGIN TO FLATTEN CONSIDERABLY BY EARLY EVENING AS STRONG HEIGHT FALLS SPREAD E-SEWD FROM THE PACNW. WE STILL ANTICIPATE A BETTER DEVELOPED LEE SIDE SURFACE TROUGH AS COMPARED TO FRIDAY...BUT IT WILL NOT BE ESPECIALLY STRONG. AS A RESULT...AN UPTICK IN SURFACE WINDS FORECAST ESPECIALLY ON THE EASTERN PLAINS WHERE BREEZY/LOCALLY WINDY CONDITIONS EXPECTED. TODAY/S SCREAMING MESSAGE: RECORD TEMPERATURES THAT WILL LIKELY BE REACHED OR EXCEEDED OVER MOST OF THE FORECAST AREA. HIGH CLOUDINESS STREAMING NW TO SE ACROSS THE NORTHEAST PART OF FORECAST AREA WILL THIN AND MIGRATE EASTWARD THROUGH THE MORNING WITH PLENTY OF SUNSHINE EXPECTED TODAY.
FOR TONIGHT...RIDGE AXIS TRANSLATES EAST WITH MID-LEVEL FLOW QUICKLY BACKING TO SWLY AND STEADILY INCREASING AFTER MIDNIGHT. WILL HANG ONTO A VERY SMALL POP ACROSS THE SAN JUANS AND CHUSKAS FOR THE OVERNIGHT...BUT DAY SHIFT MAY NEED TO WHITTLE IT BACK EVEN FURTHER. VERY MILD TEMPS AND UNFORTUNATELY VERY POOR RH RECOVERIES AS WE TRANSITION INTO THE DAY SUNDAY. AS WE SURMISED YESTERDAY...A MODEL SOLUTION FAVORING A MORE PROGRESSIVE SHORTWAVE MIGRATION WAS

PREFERRED. BOTH THE NAM AND GFS HAVE NOW TRENDED TOWARD THAT SCENARIO...WHILE THE ECMWF INTERESTINGLY IS NOW THE SLOWER/DEEPER SOLUTION. REGARDLESS...A VERY IMPRESSIVE AND POTENT BAROCLINIC ZONE WILL ACCOMPANY THIS WAVE. 700 MB TEMPS WILL CRASH TO NEAR -10C ACROSS THE FAR NORTH BY DAYBREAK MONDAY...AND 500 MB TEMPS ALTHOUGH NOT AS COLD AS INDICATED YESTERDAY WILL STILL FALL INTO THE MINUS TEENS TO NEAR 20C. PERUSAL OF BUFKIT SOUNDINGS FOR AREA SITES SHOWING WINDS NEAR THE TOP OF THE MIXED LAYER SUNDAY PM PROGGED IN THE 60-75 KNOT RANGE. SO EVEN IF THE SUSTAINED WINDS DON/T HIT HIGH WIND CRITERIA /40 MPH/...WIDESPREAD WIND GUSTS OF 60+ MPH SEEM TO BE A LOCK AT THIS POINT. WE WOULD LIKE TO SEE THE DEEPENING SURFACE LOW A BIT FARTHER WEST...BUT GIVEN THE STRENGTH OF THE INCOMING PACIFIC COLD FRONT IT JUST LOOKS LIKE AN UGLY DAY OF WIND AND CLASSIC SET UP FOR HIGH WINDS. THE ONE AREA THAT WILL BE LEAST FAVORABLE IS OUR LOWER PECOS RIVER VALLEY BUT AREAS NORTH AND WEST OF ROSWELL SHOULD EASILY HIT HWW CRITERIA AS THE FRONT APPROACHES/MOVES THROUGH. OTHER CONCERN WILL BE ACROSS NORTHEAST ZONES SUNDAY NIGHT/MONDAY AM AS THE BACKDOOR NORTHERLY GRADIENT PEAKS. AREAS OF RAIN AND HIGHER ELEVATION SNOW WILL EXPAND IN COVERAGE IN COVERAGE ACROSS NC/NW ZONES DURING THE DAY SUNDAY AS PAC FRONT PRESSES EAST AND SOUTH. WOULD NOT BE SURPRISED TO SEE FRONTAL BAND PRECIP DEVELOP FARTHER SOUTH INTO CENTRAL/SW ZONES LATE IN THE DAY SUNDAY/SUNDAY EVENING BUT NOT LOOKING SIGNIFICANT. FOCUS FOR PRECIP SHIFTS INTO THE NORTHEAST QUARTER AFTER MIDDAY MONDAY. RIDGY PATTERN RETURNS FOR TUE...THEN MORE UNSETTLED WEATHER FOR THE MIDDLE PART OF NEXT WEEK. KJ
&&
.AVIATION...
VFR CONDITIONS EXPECTED THROUGH THE NEXT 24 HOURS. GUSTS AND GUST SPREADS WILL INCREASE THIS AFTERNOON DUE TO A VERY UNSTABLE ATMOSPHERE AND INCREASING WINDS ALOFT. THE MOST FAVORED AREAS FOR GUSTS GREATER THAN 35 KT WILL BE FOUND ACROSS THE FAR SOUTHWEST SUCH AS IMPACTING GUP AND ALSO TO THE LEE OF THE CENTRAL MOUNTAINS AND EASTERN PLAINS.
NEXT AVIATION DISCUSSION SCHEDULED FOR 21Z. CHJ
&&
.FIRE WEATHER...
SIGNIFICANT TO EXTREME WEATHER ON TAP FOR NORTHERN AND CENTRAL NEW MEXICO THIS WEEKEND. WATCHES AND WARNINGS WILL REMAIN AS IS EXCEPT TO UPGRADE ZONE 102 TO A RED FLAG WARNING ON SUNDAY...AS A GOOD PORTION OF THE UPPER RIO GRANDE VALLEY SHOULD SEE CRITICAL CONDITIONS SUNDAY AFTERNOON. RISING HUMIDITIES AND INCREASING CLOUD COVER STILL EXPECTED ACROSS THE NORTHWEST PLATEAU ON SUNDAY TO LIMIT FIRE WEATHER CONCERNS. MEANWHILE...EXTREME CONDITIONS EXPECTED ACROSS THE EASTERN PLAINS AND PORTIONS OF THE SOUTHERN RIO GRANDE VALLEY SUNDAY AFTERNOON.

TODAY WILL BE A VERY UNSTABLE...DRY AND WARM DAY. COULD EVEN SEE SOME SUPER HAINES FOR CENTRAL AND EASTERN PORTIONS THIS AFTERNOON. SUPER HAINES IS BASICALLY A TERM DUBBED FOR A REALLY UNSTABLE AND DRY ATMOSPHERE AND IS TIED TO VERY STEEP LAPSE RATES AND A SIGNIFICANT MID LEVEL DRY SLOT. THE MODELS ALSO INCREASE THE WINDS ALOFT AS THE UPPER RIDGE BEGINS TO BREAK DOWN. LATEST MODELS SHOW AN INCREASE IN THE 18000 FOOT AIR FLOW OVER THE AREA THUS EXPECTING HIGHER GUSTS SPREADS AND SOME PERIODIC HIGHER GUSTS. EXPECT BREEZY TO WINDY CONDITIONS BY MID TO LATER AFTERNOON ACROSS THE MAJORITY OF THE AREA. THESE WINDS WILL BE ERRATIC AT TIMES THUS CREATING THE HIGHER GUST SPREADS OR THE DIFFERENCE BETWEEN SUSTAINED AND PEAK GUSTS. THE CRITICAL FIRE WEATHER AREA REMAINS THE SAME AND WILL KEEP THE WARNING RUNNING FOR ZONES 105...103...104...108 AND 107. LOOKED HARD AT THE NORTHWEST PLATEAU OR ZONE 101 BUT MORE LIMITED AREA EXPECTED TO BE AFFECTED SO LEFT THE ZONE ALONE. ALSO LOOKED HARD AT THE LOWER RIO GRANDE VALLEY BUT AGAIN...WINDS WILL BE SOMEWHAT VARIABLE ON THE SUSTAINED SPEEDS. REGARDLESS...DUE TO THE SINGLE DIGIT HUMIDITIES ACROSS MOST OF THE AREA...FIRE DANGER WILL BE ENHANCED AREAWIDE. THE MID LEVEL DRY SLOT IS DEPICTED TO SHIFT EASTWARD SATURDAY NIGHT AND PROVIDE POOR HUMIDITY RECOVERIES ACROSS MUCH OF THE CENTRAL AND EASTERN PORTIONS OF THE FORECAST AREA. HUMIDITY VALUES SHOULD IMPROVE SOME FROM THIS MORNINGS READINGS ACROSS THE WEST...MAINLY NORTHWEST THIRD. EXPECT AN UNUSUALLY WARM OVERNIGHT AHEAD OF AN UPPER LEVEL TROUGH APPROACHES. HIGHER RIDGES...HIGHER ELEVATIONS AND AREAS ACROSS THE EASTERN PLAINS WILL SEE AN INCREASE IN WIND SPEEDS TONIGHT.

A CRITICAL TO EXTREME FIRE WEATHER DAY IS ON TAP FOR SOUTHERN AND EASTERN PORTIONS OF THE FORECAST AREA ON SUNDAY...SPECIFICALLY THE LOWER RIO GRANDE VALLEY AND EASTERN PLAINS WHERE HIGHER CLOUD COVER AHEAD OF THE TROUGH THINS SOME DURING THE DAY. THIS IS THE SAME AREA WHERE THE ATMOSPHERE WILL BE UNSTABLE AND HUMIDITY VALUES WILL BE THE LOWEST...MOST LIKELY SINGLE DIGITS. WINDS WILL ALSO BE DANGEROUSLY STRONG ACROSS THOSE SAME AREAS WITH GUSTS TO 70 MPH FOR A BRIEF PERIOD NOT OUT OF THE QUESTION. WINDS WILL BE FAIRLY STRONG ELSEWHERE AS WELL ALTHOUGH HUMIDITY VALUES WILL COME UP SOME ACROSS THE WEST AND NORTH...ESPECIALLY FAR NORTHWEST. THE ABQ METRO AREA WILL BE IN THE CRITICAL AREA WITH MINIMUM HUMIDITIES EXPECTED TO BE AROUND 10 PCT AND COMBINED WITH GUSTS UP TO 60 MPH. HAVE ADDED THE NORTH CENTRAL MOUNTAINS TO THE RED FLAG WARNING SUNDAY...MAIN FOCUS TO BE ON THE UPPER RIO GRANDE VALLEY.

IT IS BECOMING CLEARER THAT THE MAIN PACIFIC COLD FRONT WOULD RAPIDLY SWING ACROSS THE FORECAST AREA FROM NORTHWEST TO SOUTHEAST SUNDAY EVENING WHILE AT THE SAME TIME A VIGOROUS BACK DOOR PUNCHES IN FROM THE NORTH ACROSS THE EASTERN PLAINS. HUMIDITY VALUES WILL COME UP DUE TO THE COLD FRONTAL PASSAGES BUT THE TREND

UP WILL BE MUTED BY LOWERING DEWPOINTS MOST AREAS. THE EASTERN PLAINS...ESPECIALLY NORTHEAST PLAINS STAND TO SEE THE BEST HUMIDITY RECOVERIES DUE TO EXPECTED SHOWER ACTIVITY ALONG THE FRONT. NORTHERN AREAS WILL ALSO SEE PRECIPITATION ACTIVITY...MOST LIKELY IN THE FORM OF SOME SNOW ACCUMULATIONS LATER SUNDAY INTO SUNDAY NIGHT. THE MODELS ARE DEPICTING MORE OF A QUICK HITTING SYSTEM PASSAGE AS PRECIPITATION CLEARS OUT QUICKLY MONDAY AND MUCH LOWER DEWPOINTS FILTER IN BEHIND THE TROUGH. STILL KEEPING SOME GUSTY WINDS ACROSS MOST OF THE AREA BUT NOT NEARLY AS STRONG AS WHAT WILL BE OBSERVED ON SUNDAY. RIDGING IS STILL DEPICTED OVER THE STATE TUESDAY INTO WEDNESDAY. AS A RESULT...TEMPERATURES WILL INCREASE AND HUMIDITY VALUES WILL DROP AREAWIDE. CONFIDENCE BECOMES MUCH LESS FOR LATER WEDNESDAY THROUGH THE REST OF NEXT WEEK AS THE MODELS ARE HAVING A HARD TIME RESOLVING A WEAK BAJA LOW EJECTION MID TO LATE WEEK. THIS WOULD ALSO BE ASSOCIATED WITH ANOTHER INCOMING VIGOROUS PACIFIC TROUGH. DURING THIS PERIOD...INCREASING WINDS WILL BE POSSIBLE BUT THE HUMIDITY FORECAST IS SUSPECT DUE TO UNCERTAINTIES IN THEMODELS.
CHJ
&&

11.0 Weather Watches

No weather watches were active for New Mexico at the time of the accident.

12.0 Meteorological Impact Statements

No CWSU Center Weather Advisories or Meteorological Impact Statements were active for the area of the accident at the accident time.

13.0 Gulfstream Data Analysis of Event

Gulfstream provided an analysis of wind data during the accident flight and this is provided as attachment one. Gulfstream had a wind sensor located a few thousand feet east-southeast from the KROW ASOS (figure 11) and the data from this wind sensor, including calculated crosswind and headwind components for the accident flight, are provided within the analysis of attachment one. The Gulfstream wind sensor was located 8 feet agl with the KROW ASOS located the official 33 feet agl. The wind speed and direction data from the Gulfstream wind sensor are a three-second rolling average updated once a second. The wind data from this supplementary wind sensor was almost identical to the one-minute wind data from KROW provided in section 3.1.

Figure 11 – Location of KROW and Gulfstream additional wind sensor

14.0 Air Traffic Control Tower Wind Data

The Roswell Air Traffic Control Tower Local Control provided wind to the accident aircraft 3 minutes before the accident as wind from 170° at 9 knots.

15.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for KROW on April 2, 2011, indicated the following:

SUN	
Begin civil twilight	0620 MDT
Sunrise	0645 MDT
Sun transit	1302 MDT
Sunset	1919 MDT
End civil twilight	1944 MDT

Paul Suffern
NTSB Meteorologist