NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 30, 2014

Group Chairman's Weather Addendum 1

METEOROLOGY

ERA13FA088

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A. ACCIDENT

Location: 4 miles east-southeast of Parkton, North Carolina
Date: December 16, 2012
Time: approximately 1532 eastern standard time (2032 UTC[1])
Aircraft: Piper PA-28-160, registration: N5714W

B. METEOROLOGY GROUP

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C. SUMMARY

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

D. DETAILS OF THE 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 eastern standard time (EST) on December 16, 2012, and are based upon the 24-hour clock, where local time is -5 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident location was located at latitude 34.87° N, longitude 78.95° W, elevation: 162 feet.

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

E. FACTUAL INFORMATION

1.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D) was KRAX located near Raleigh/Durham, North Carolina, approximately 53 miles south-southwest of the accident site at an elevation of 348 feet. Level III archive radar data was obtained from the NCDC utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

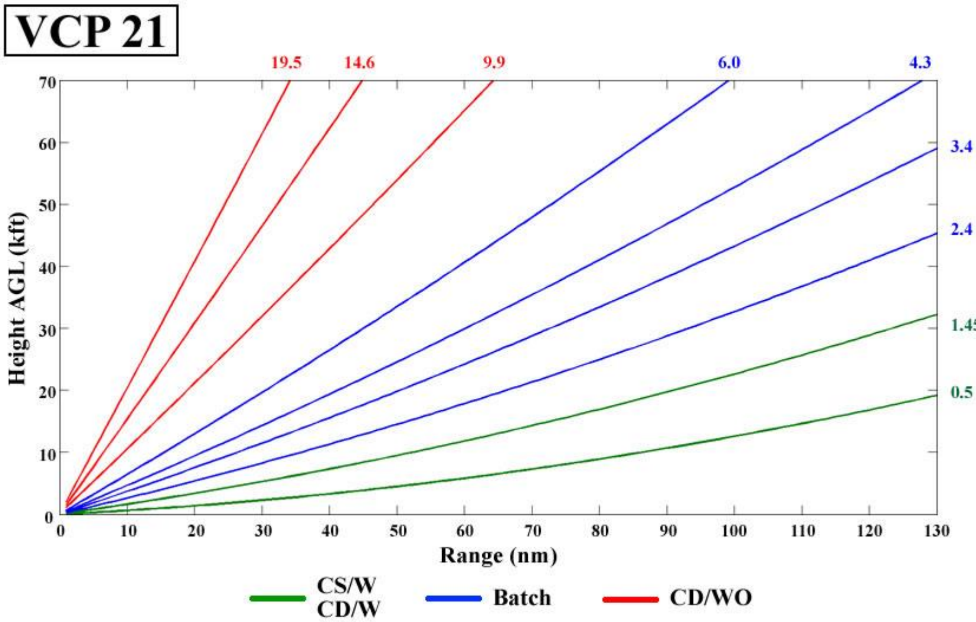
The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width[2]. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

1.1 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 9 elevation scans from 0.5° to 19.5° every six minutes. This particular scanning strategy is documented as volume coverage pattern 21 (VCP-21). 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 KRAX WSR-88D radar was operating in the normal precipitation mode (Mode A, VCP-21). 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.

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



VCP-21 Precipitation Mode Scan Strategy

1.2 Beam Height Calculation

Assuming standard refraction[3] of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width information[4] 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°	5,190 feet	2,570 feet	8,800 feet	5,230 feet

Based on the radar height calculations, the 0.5° elevation scan depicted the conditions between 2,570 feet and 8,800 feet msl over the accident site, and this antenna elevation is the closest to accident aircraft's altitude[5] before the accident descent.

[3] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.
[4] Beamwidth values are shown for legacy resolution products. Super resolution products would an effective beamwidth that would be approximately half these values.
[5] For more information see the ATC Factual Report.

1.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[6] 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[7]), 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 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

[6] 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.

[7] 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.

The Federal Aviation Administration (FAA) Advisory Circular AC 00-24B titled "Thunderstorms" dated January 2, 1983, also defines the echo intensity levels and potential weather phenomena associated with those levels. If the maximum VIP Level is 1 "weak" and 2 "moderate", then light to moderate turbulence is possible with lightning. VIP Level 3 is "strong" and severe turbulence is possible with lightning. VIP Level 4 is "very heavy" and severe turbulence is likely with lightning. VIP Level 5 is "intense" with severe turbulence, lightning, hail likely, and organized surface wind gusts. VIP Level 6 is "extreme" with severe turbulence, lightning, large hail, extensive surface wind gusts and turbulence.

1.4 Base Reflectivity

Figures 1 through 5 present the KRAX WSR-88D base reflectivity image for the 0.5° elevation scans initiated at 1504, 1510, 1516, 1522 and 1527 EST with a resolution of 1° X 1 km. The ATC flight track is also provided from 1516 to 1532 EST with the accident aircraft's location marked at the various times. The accident aircraft flew through 20 to 30 dBZ reflectivity values from 1516 EST to before 1522 EST, and given these values the accident aircraft likely encountered precipitation while located within a cloud layer (see Meteorological Factual Report and ATC Factual Report). Given the surface conditions, PIREPs, and upper air sounding data, between 1516 and 1522 EST the accident aircraft was likely located within instrument meteorological conditions and given a VIP level of 2, likely experienced up to moderate turbulence as well.[8]

[8] For additional support, including the surface, PIREPs, and upper air sounding information see the Meteorological Factual Report located within the NTSB docket for this accident.

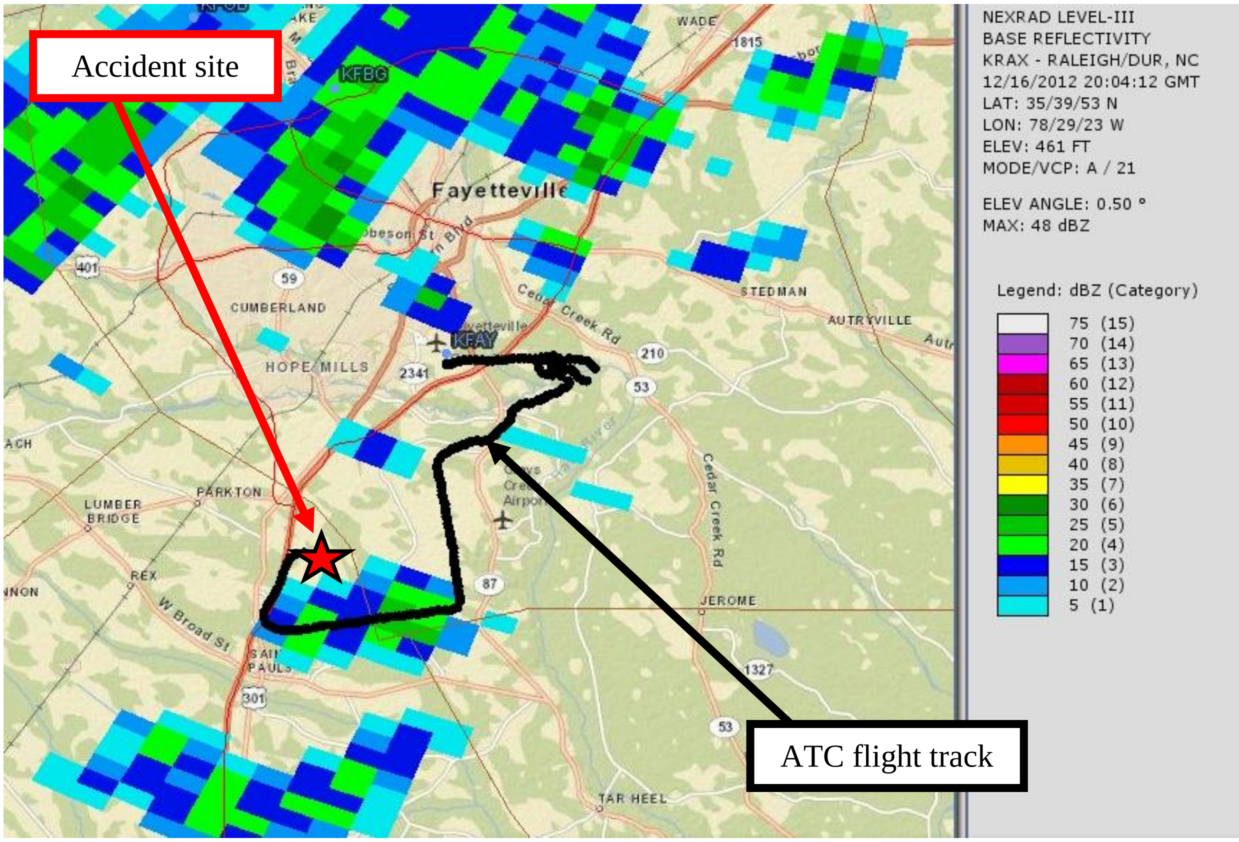


Figure 1 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1504 EST with the ATC flight track from 1516 to 1532 EST

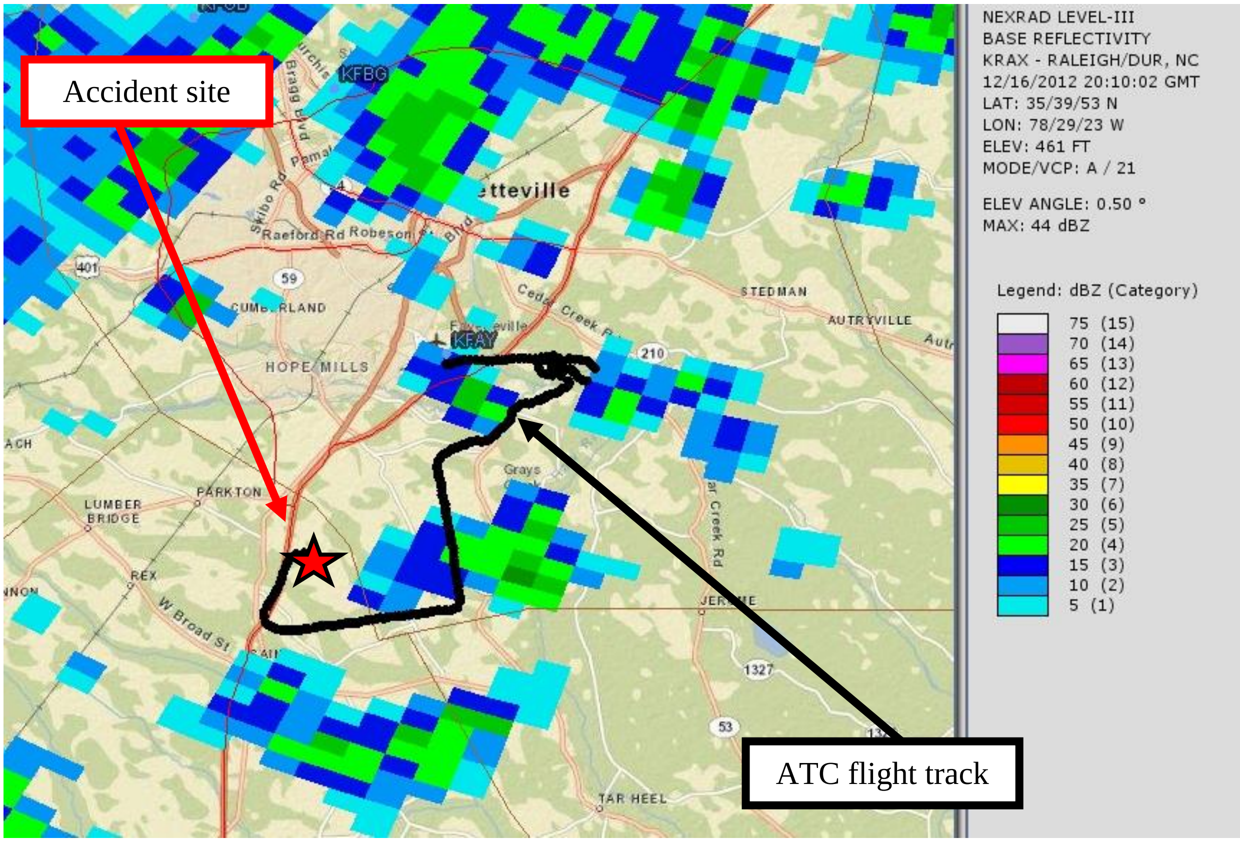


Figure 2 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1510 EST with the ATC flight track from 1516 to 1532 EST

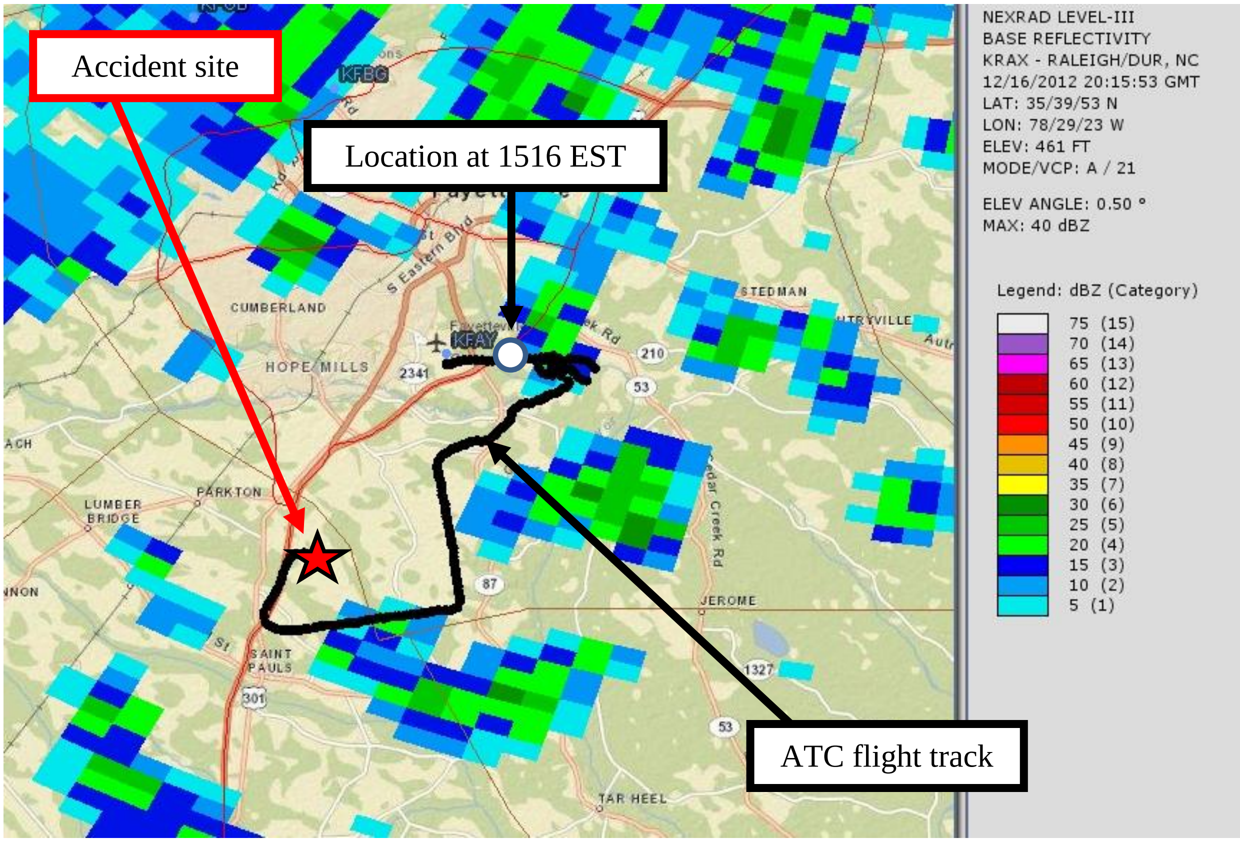


Figure 3 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1516 EST with the ATC flight track from 1516 to 1532 EST

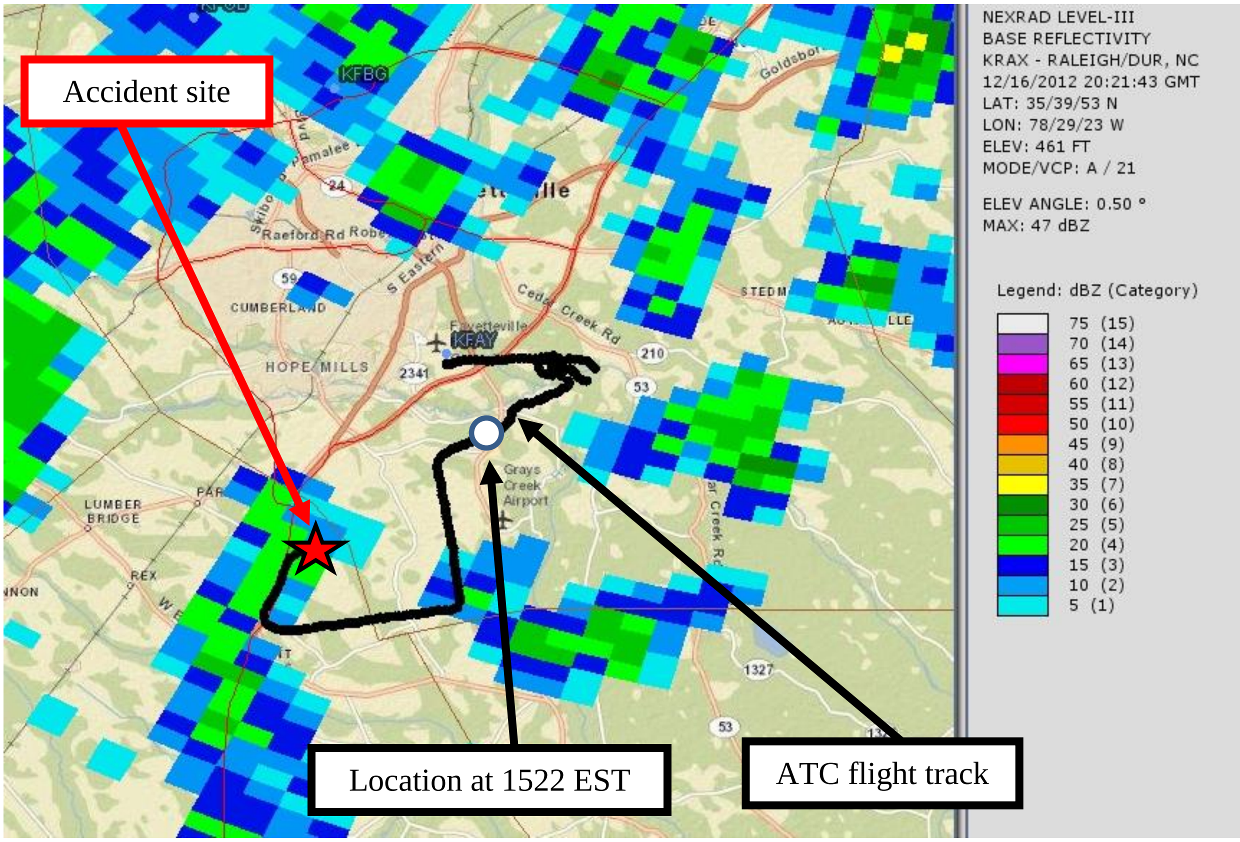


Figure 4 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1522 EST with the ATC flight track from 1516 to 1532 EST

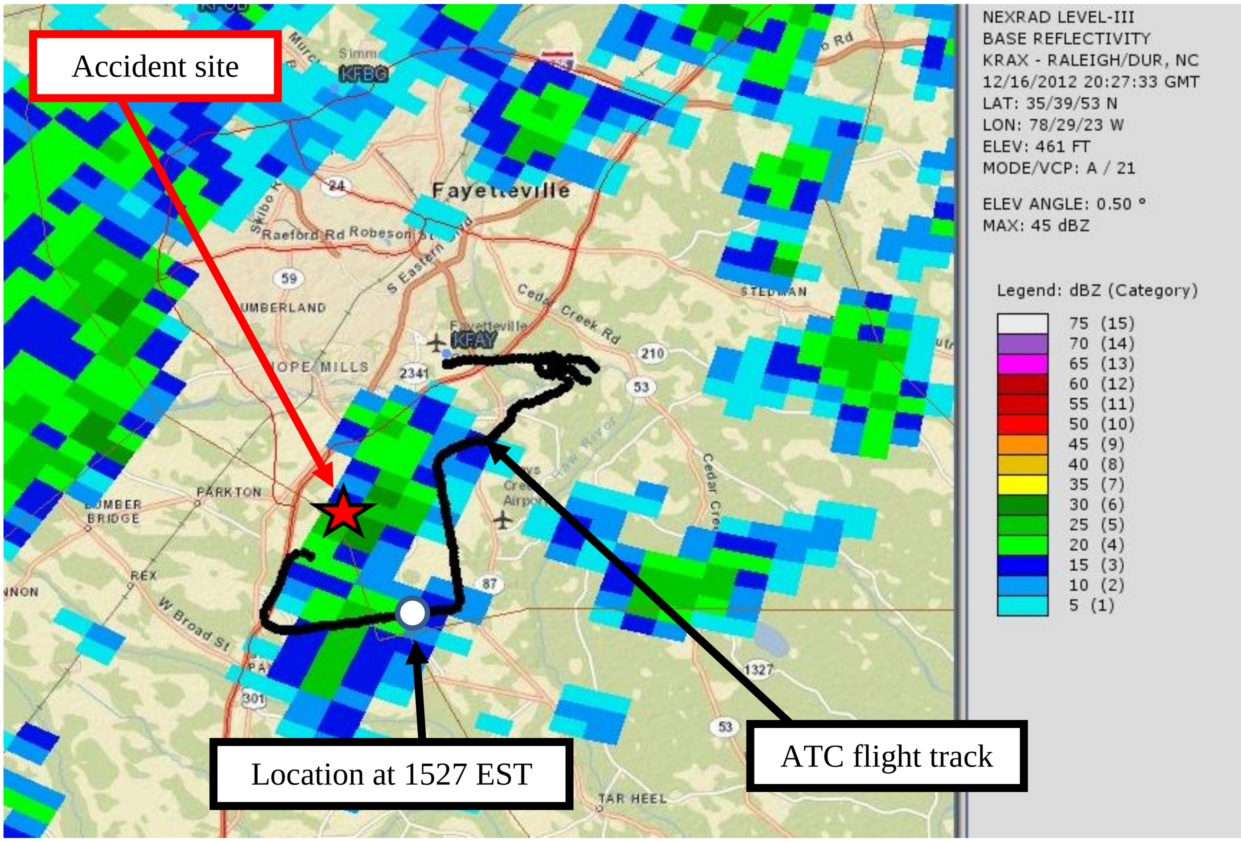


Figure 5 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1527 EST with the ATC flight track from 1516 to 1532 EST

F. LIST OF ATTACHMENTS

None

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