NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, D.C. 20594

February 7, 2002

Radar Data Impact Speed Study
American Airlines Flight 11
United Airlines Flight 175

by Daniel R. Bower, Ph.D.

A. SUBJECT AIRCRAFT

Location:	New York City, NY
Date:	September 11, 2001
Time:	08:47 AM Eastern Daylight Time
Flight:	American Airlines Flight 11
Aircraft:	Boeing 767
NTSB#:	DCA01MA060

Location:	New York City, NY
Date:	September 11, 2001
Time:	09:03 AM Eastern Daylight Time
Flight:	United Airlines Flight 175
Aircraft:	Boeing 767
NTSB#:	DCA01MA063

B. GROUP

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C. SUMMARY

This document describes calculations of performance parameters derived from the radar data for the final several minutes of American Airlines flight 11 and United Airlines flight 175 at impact with the north and south World Trade Center towers. Airport Surveillance Radar (ASR) from Newark International Airport (EWR) was used to determine the airspeed of the aircraft at impact.

D. Radar Data-based Performance Calculations

Aircraft performance data for the final portion of the flight, calculated using radar data, and aircraft data are presented in this section. The details of the radar data obtained in the investigation are in the report entitled Recorded Radar Data Study. The three dimensional radar data, weather data and the local magnetic variation were used to calculate performance parameters such as groundspeed, rate of climb, and aircraft heading. The winds were not utilized in determining the final speeds.

Calculation Results

Performance parameters computed for the last 1 minute, forty seconds of flight AA11 are shown in Figure 1. The calculated parameters include groundspeed, Mach number, and magnetic heading. Figure 2 shows the same parameters calculated for UA175 for the final 2 minutes, forty seconds.

As AA11 descended from 6000 to 5000 feet, the groundspeed remains near 290 knots. The aircraft further descends as it approaches southern Manhattan, and picks up speed as it approaches the World Trade Center. During the final 15 seconds of flight, the aircraft descends to 1000 feet altitude and impacts World Trade Center tower #1 at approximately 430 knots groundspeed.

For much of its final descent, UAL175 maintained a descent rate between 4000 feet per minute and 8000 feet per minute. During the descent from 12,000 feet to 6000 feet, the aircraft groundspeed remained between 500 - 520 knots. As the aircraft made its final descent to 1000 feet, it accelerated and impacted World Trade Center tower #2 at approximately 510 knots groundspeed.

The final 55 seconds of radar data from EWR are shown overlaid on a map of New York City in Figure 3. As shown on the plot, radar returns from the aircraft were received until immediately before impact with the south tower.

[redacted]

Daniel R. Bower
Senior Aerospace Engineer

Figure 1

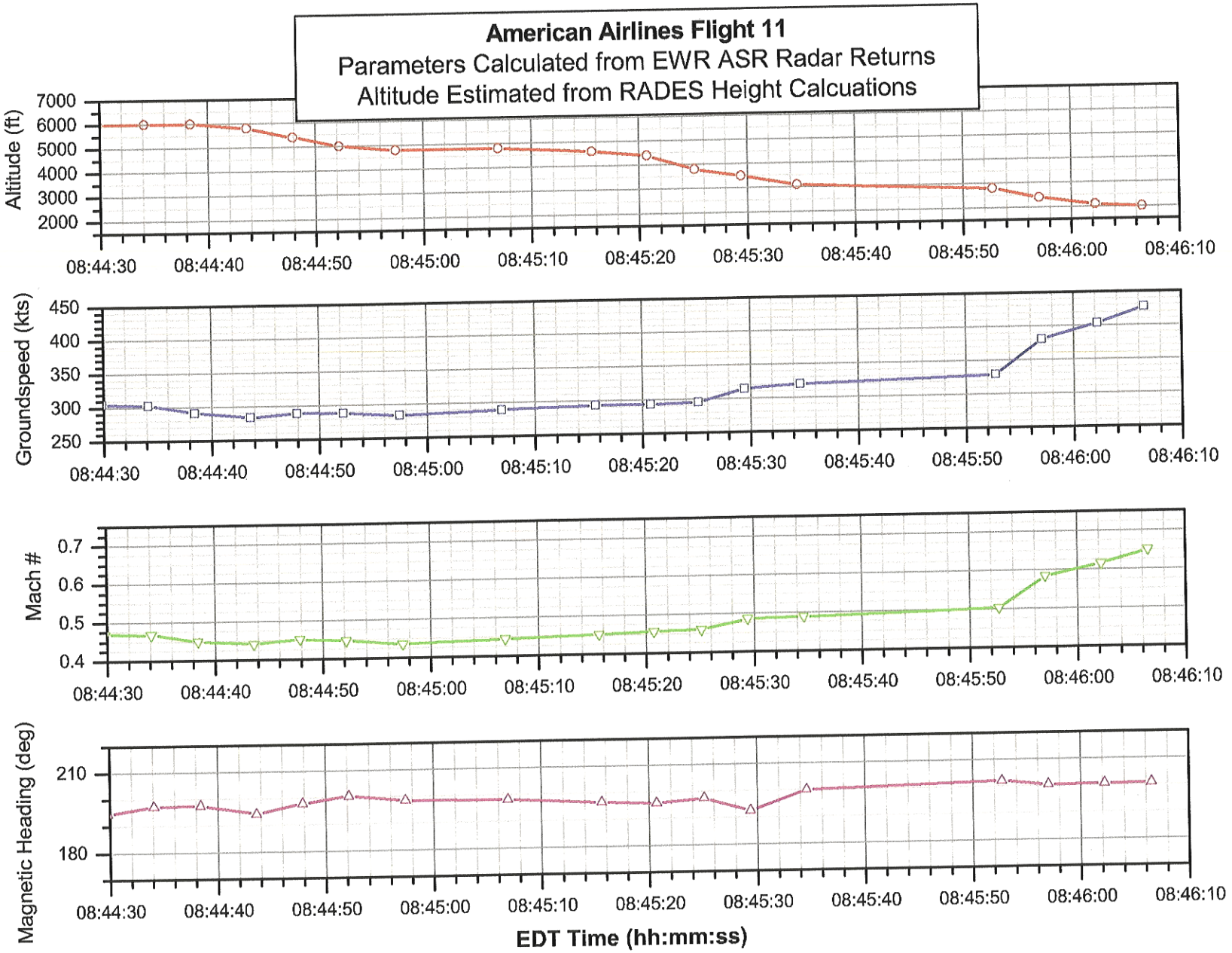

American Airlines Flight 11
Parameters Calculated from EWR ASR Radar Returns
Altitude Estimated from RADES Height Calcuations
Altitude (ft)
7000
6000
5000
4000
3000
2000
Groundspeed (kts)
450
400
350
300
250
Mach #
0.7
0.6
0.5
0.4
Magnetic Heading (deg)
210
180
08:44:30
08:44:40
08:44:50
08:45:00
08:45:10
08:45:20
08:45:30
08:45:40
08:45:50
08:46:00
08:46:10
EDT Time (hh:mm:ss)

Figure 2

United Airlines Flight 175

Parameters Calculated from EWR ASR Radar Returns

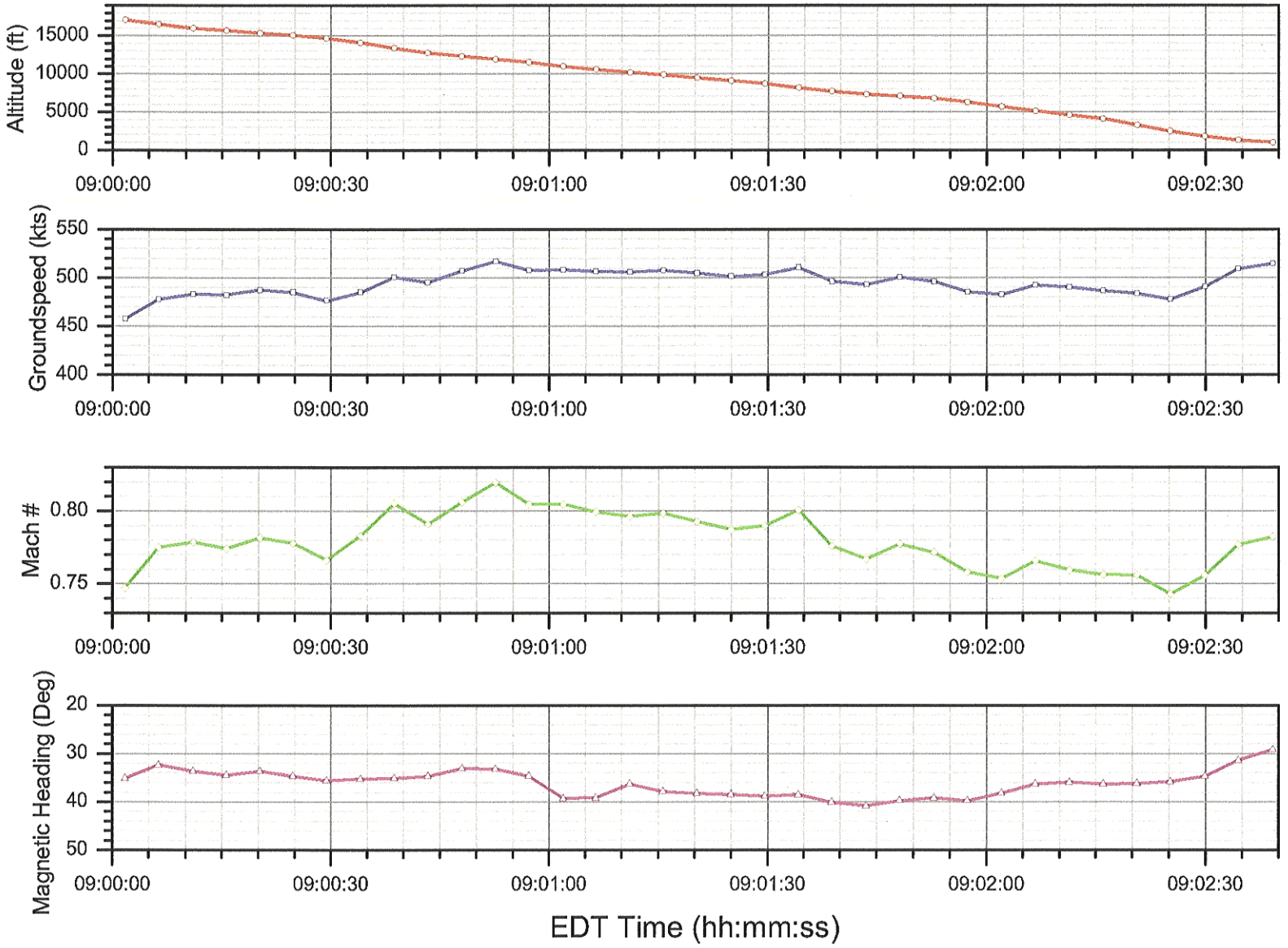
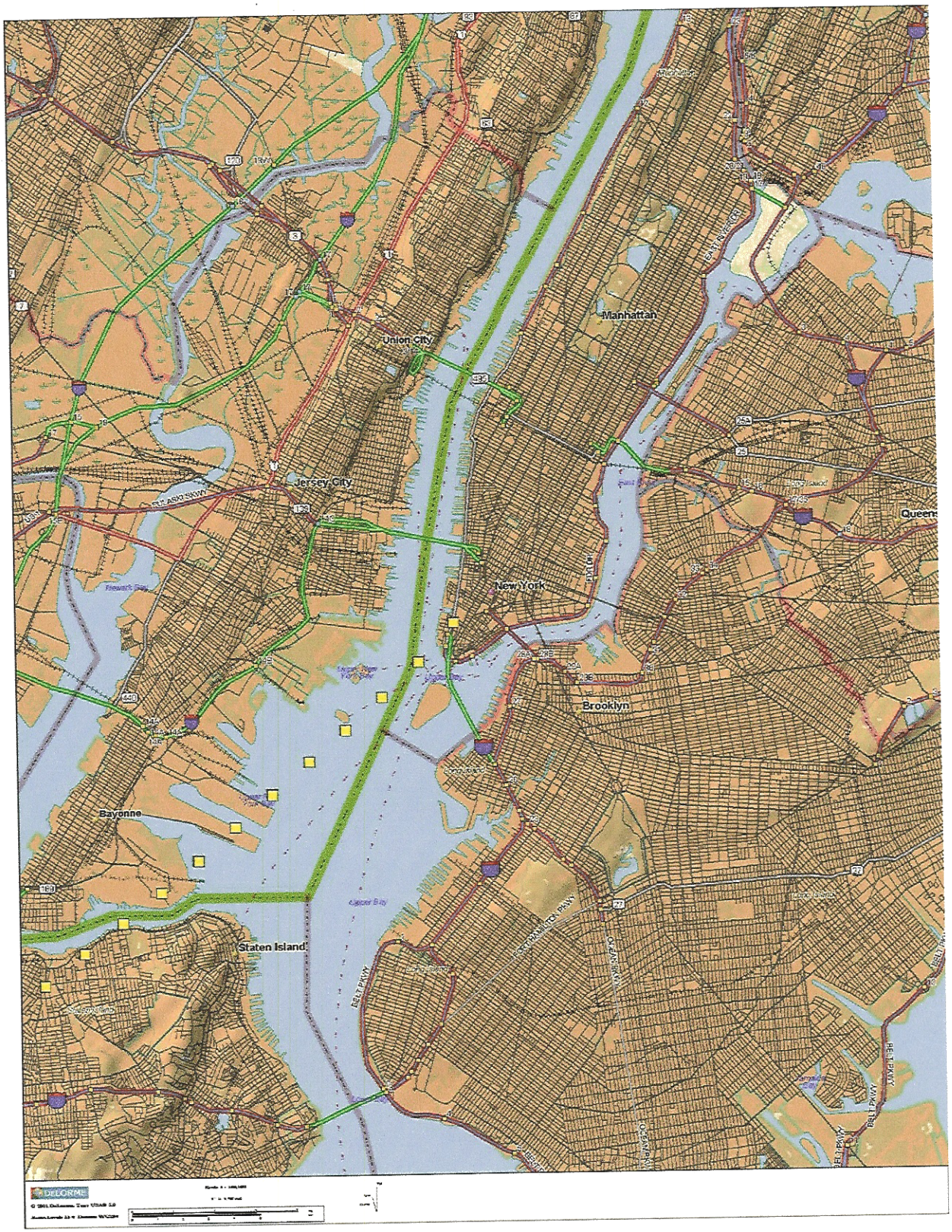


Figure 3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