

# NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

November 21, 2016

## Cockpit Display – Recorded Flight Data

Specialist's Factual Report

By Bill Tuccio, Ph.D.

### 1. EVENT SUMMARY

Location: Cheraw, South Carolina  
Date: March 24, 2016  
Aircraft: Harmon Rocket II  
Registration: N729PS  
Operator: Private  
NTSB Number: ERA16LA139

On March 24, 2016, about 0750 eastern daylight time (EDT), an experimental amateur-built Harmon Rocket II, N729PS, was substantially damaged when it impacted terrain near Cheraw, South Carolina. The airline transport pilot was fatally injured. The flight departed Cheraw Municipal Airport (CQW), Cheraw, South Carolina, about 0715. Visual meteorological conditions prevailed, and no flight plan was filed for the local personal flight, which was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91.

### 2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

### 3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic device:

Recorder Manufacturer/Model: **Garmin GDU 460**  
Recorder Serial Number: **350001073**

#### 3.1. Garmin GDU 460 Description

The Garmin GDU 460 is a line replaceable display unit featuring a 10.6-inch touchscreen display that is an integral part of the Garmin G3X, non-certified aircraft avionics system. The unit is capable of displaying electronic flight instruments, navigation, communication, weather, traffic, and engine information, depending on configuration.

If not disabled, the unit is capable of logging historical information at a variable rate of about 10 Hertz to internal non-volatile memory.<sup>1</sup> Historical logs may be copied to a standard SD card inserted into the slot provided on the front of the unit, starting the GDU 460 in

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<sup>1</sup> Non-volatile memory is semiconductor memory that does not require external power for data retention.

configuration mode, and selecting the touchscreen option “Copy to SD Card.”<sup>2</sup> Data is exported in engineering units, in a comma delimited value (CSV) format. Each record contains UTC date and time, as well as an integer number of milliseconds since the unit was last powered.

### 3.1.1. Garmin GDU 460 Recovery

The unit suffered minor damage in the event; however, power was applied and the unit started normally. Figure 1 shows the front of the unit with power applied during the download to an SD card, as well as the minor damage to the back of the unit.

Figure 1. Garmin GDU 460 – back and front.



### 3.1.2. Garmin GDU 460 Data Description

The recording contained 341,183 records across 4 power cycles and approximately 10 hours of data. The accident flight was the last recording on the unit, the duration was approximately 46 minutes, and data began recording about 1-minute and 20-seconds after the unit was powered on.

### 3.1.3. Garmin GDU 460 Engineering Units Conversions and Timing

The unit downloads in engineering units. Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board’s standard sign convention that climbing right turns are positive (CRT=+).<sup>3</sup>

APPENDIX A lists the parameters verified and provided in this report.

The unit recorded time in UTC. Four hours was subtracted to convert to EDT.

<sup>2</sup> See Garmin G3X Touch Install Manual, Garmin Part Number 190-01115-01 Rev. Z.

<sup>3</sup> CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

### 3.2. Plots and Corresponding Tabular Data

The following nine figures contain data recorded during the accident flight on March 24, 2016. The weather and lighting depicted in Google Earth are not necessarily representative of the weather and lighting conditions experienced during the accident flight.

Collectively, the figures 2 through 10 show the recording began at 0702 EDT and ended at 0748:30 EDT. There were various changes in altitude, pitch, and roll, with roll angles exceeding 90 degrees and pitch angles in excess of 30 degrees nose up at times.<sup>4</sup>

At about 0741 EDT, the aircraft approached the Marlboro County Jetport from the west, and then flew over the runway at an indicated airspeed of about 180 knots and an altitude of about 190 feet above mean sea level (MSL) (the airport elevation was charted as 147 feet MSL). After performing a 180 degree turn and overflying the runway again, the aircraft remained at altitudes below 1,000 feet MSL and overflowed a path coincident with the Great Pee Dee River (with a minimum altitude in the last 2 minutes of the recording of 169 feet MSL).

The last recorded data point at 0748:30 EDT was at 152 knots indicated airspeed and 174 feet MSL. Figure 7 shows a Google Earth/aviation Sectional chart overlay of the last recorded point surrounded by towers charted between 370 and 412 feet MSL, a railroad and highway bridge crossing the Great Pee Dee River, and power lines also crossing the river.

In the last five minutes of the recording, engine parameters were approximately invariant.

The corresponding tabular data used to create these nine overlays and plots are provided in electronic (\*.csv<sup>5</sup>) format as attachment 1 to this report.

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<sup>4</sup> Some overlays, such as figure 6, show a jagged flight path, which is the consequence of recorded GPS accuracy and/or precision.

<sup>5</sup> Comma Separated Value format.

Figure 2. Google Earth overlay of accident flight recording (satellite imagery).

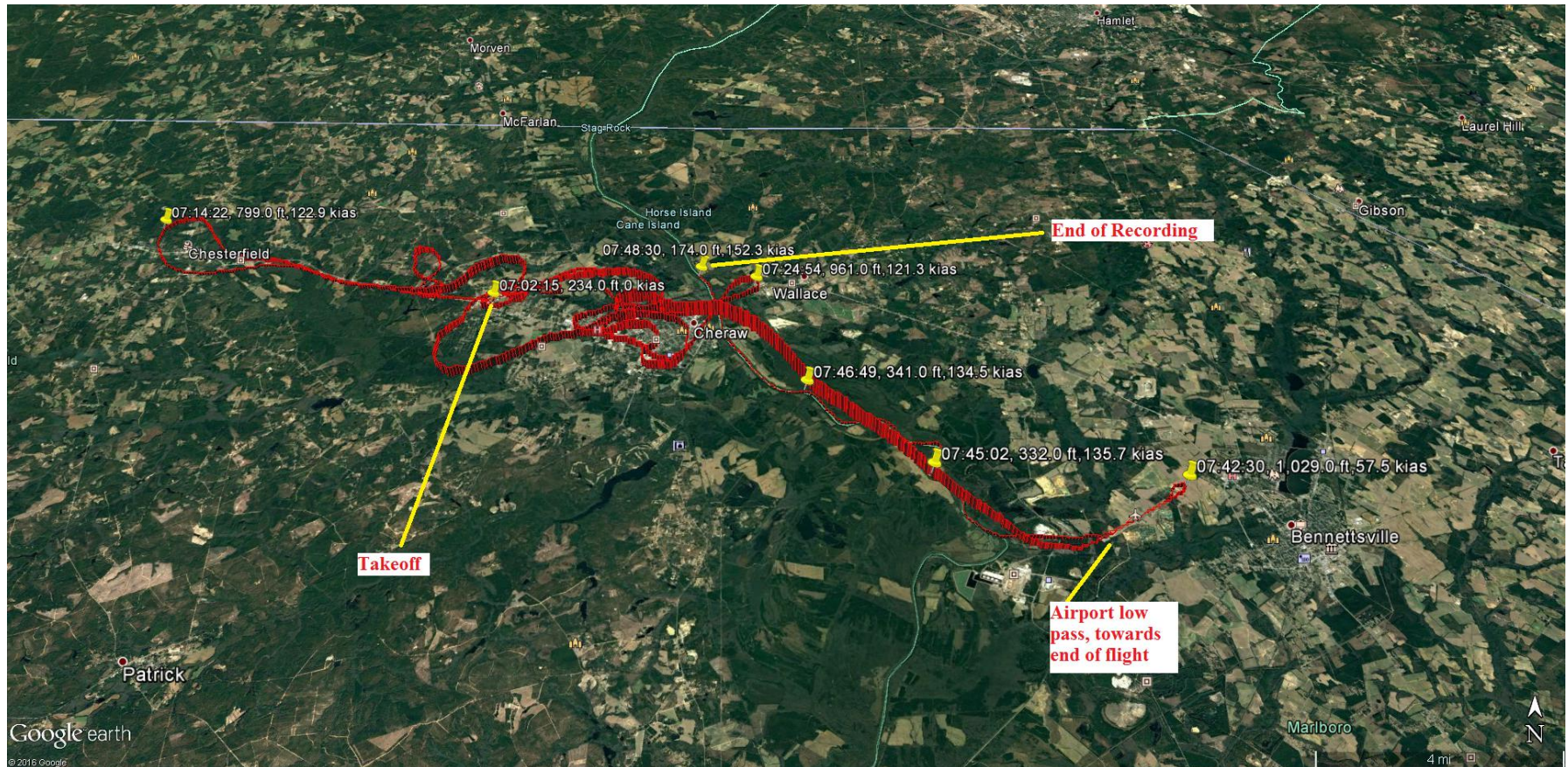


Figure 3. Google Earth overlay of accident flight recording (aviation Sectional Chart imagery).

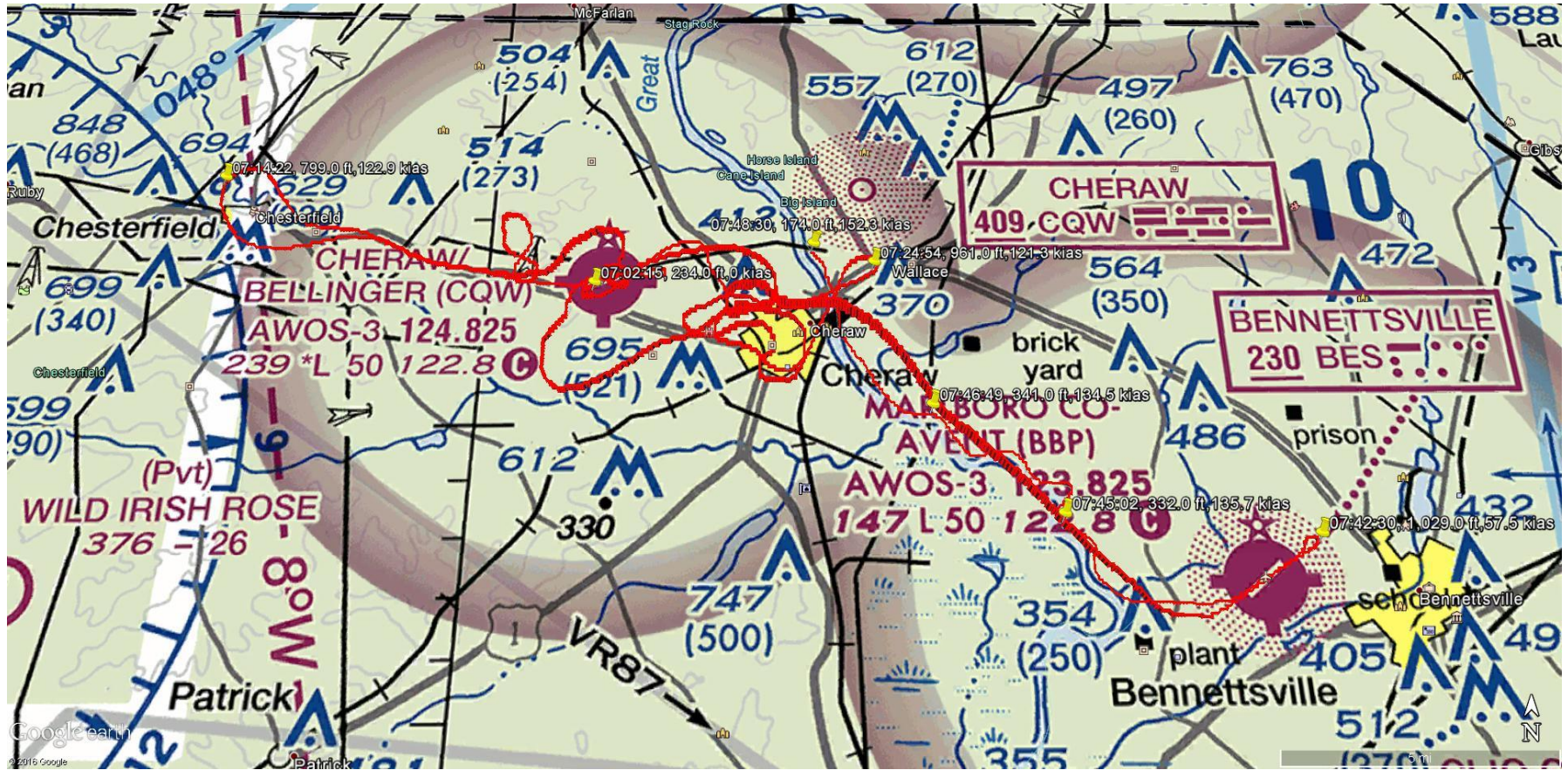


Figure 4. Google Earth overlay of start of accident flight recording (ground operations CQW).

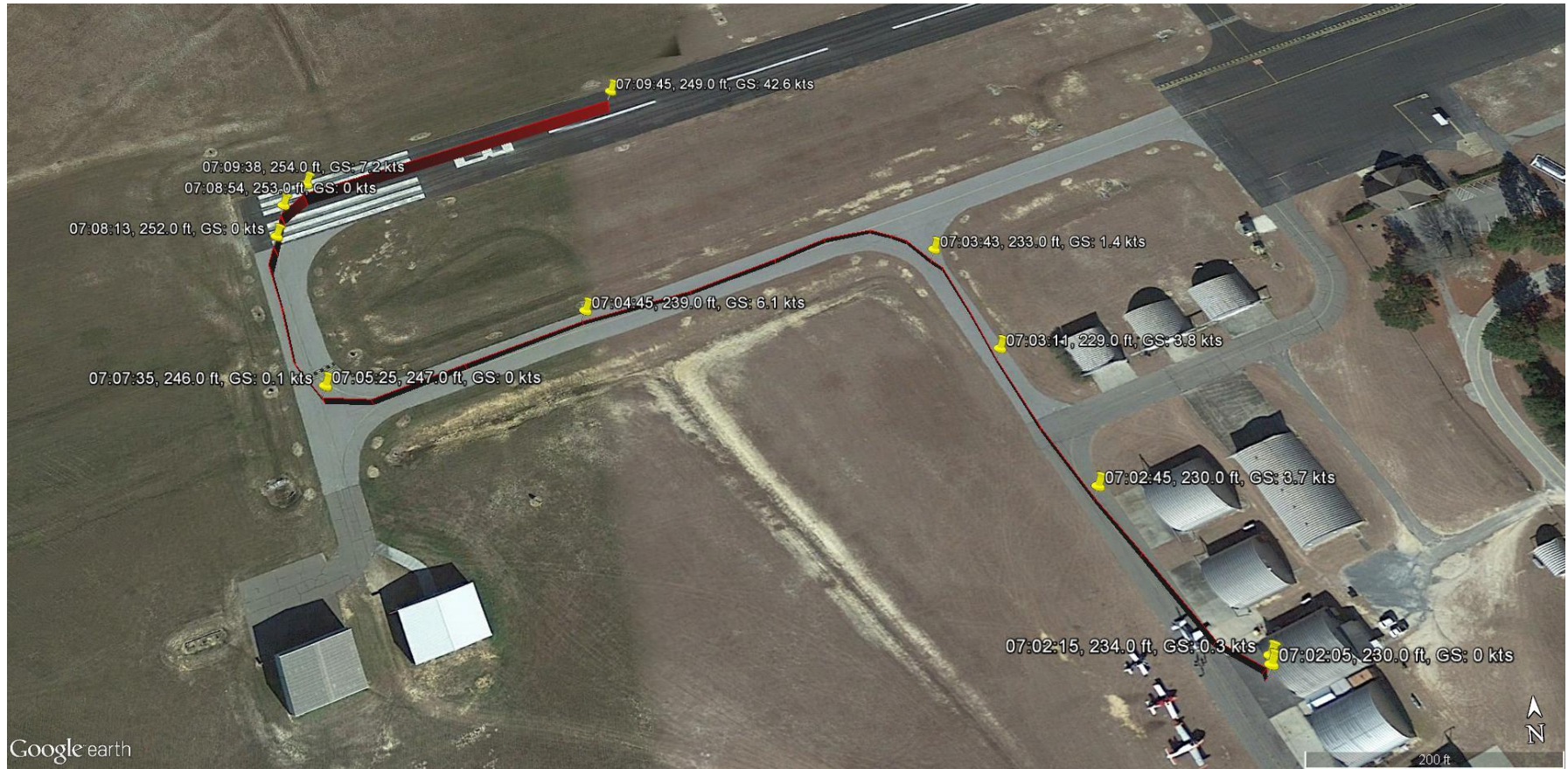


Figure 5. Google Earth overlay of end of accident flight recording (start of recording not shown for clarity).

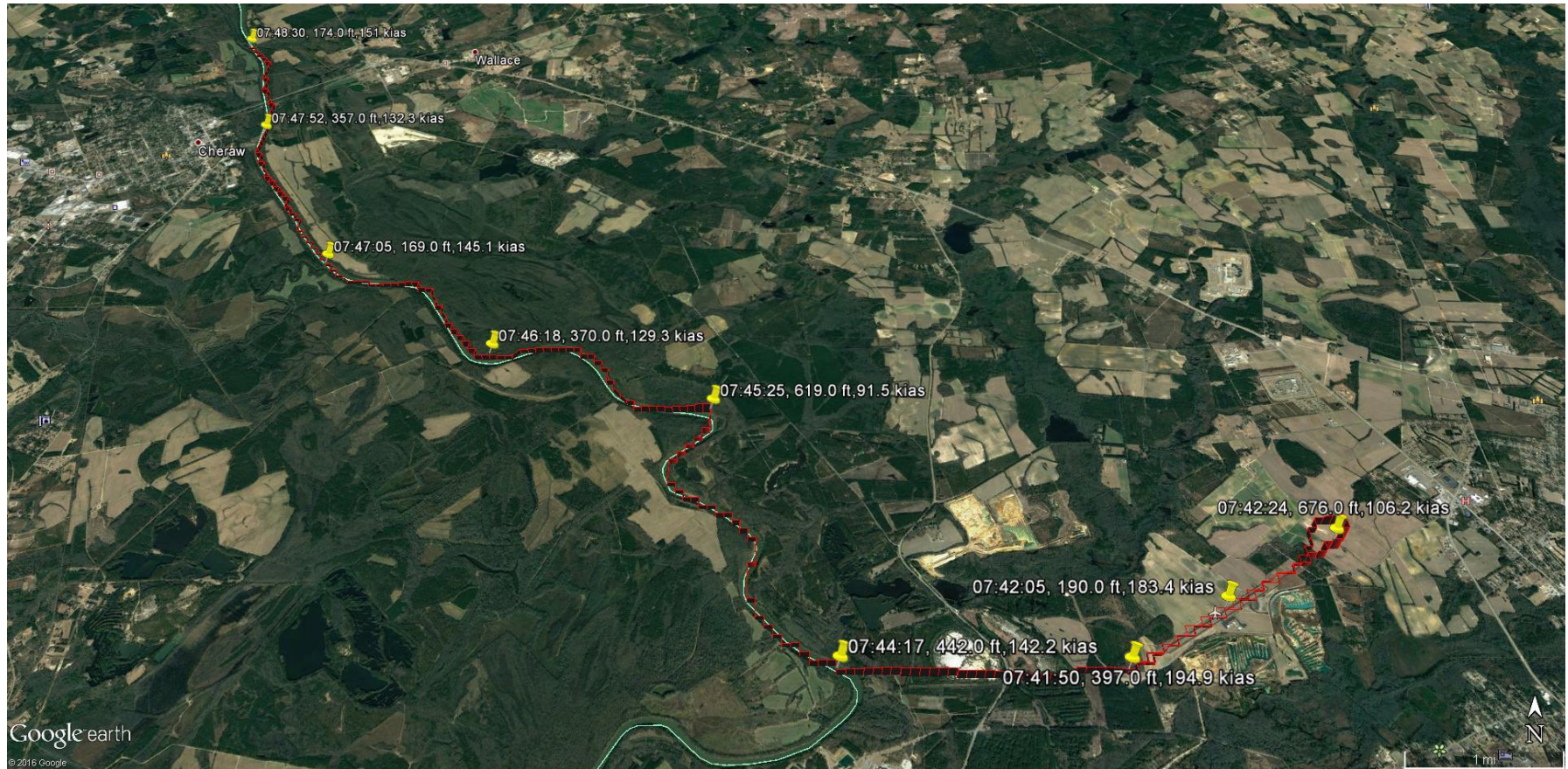


Figure 6. Google Earth overlay of end of accident flight recording.



Figure 7. Google Earth overlay of last recorded data point (sectional overlay).



Figure 8. Plot of accident flight recording.

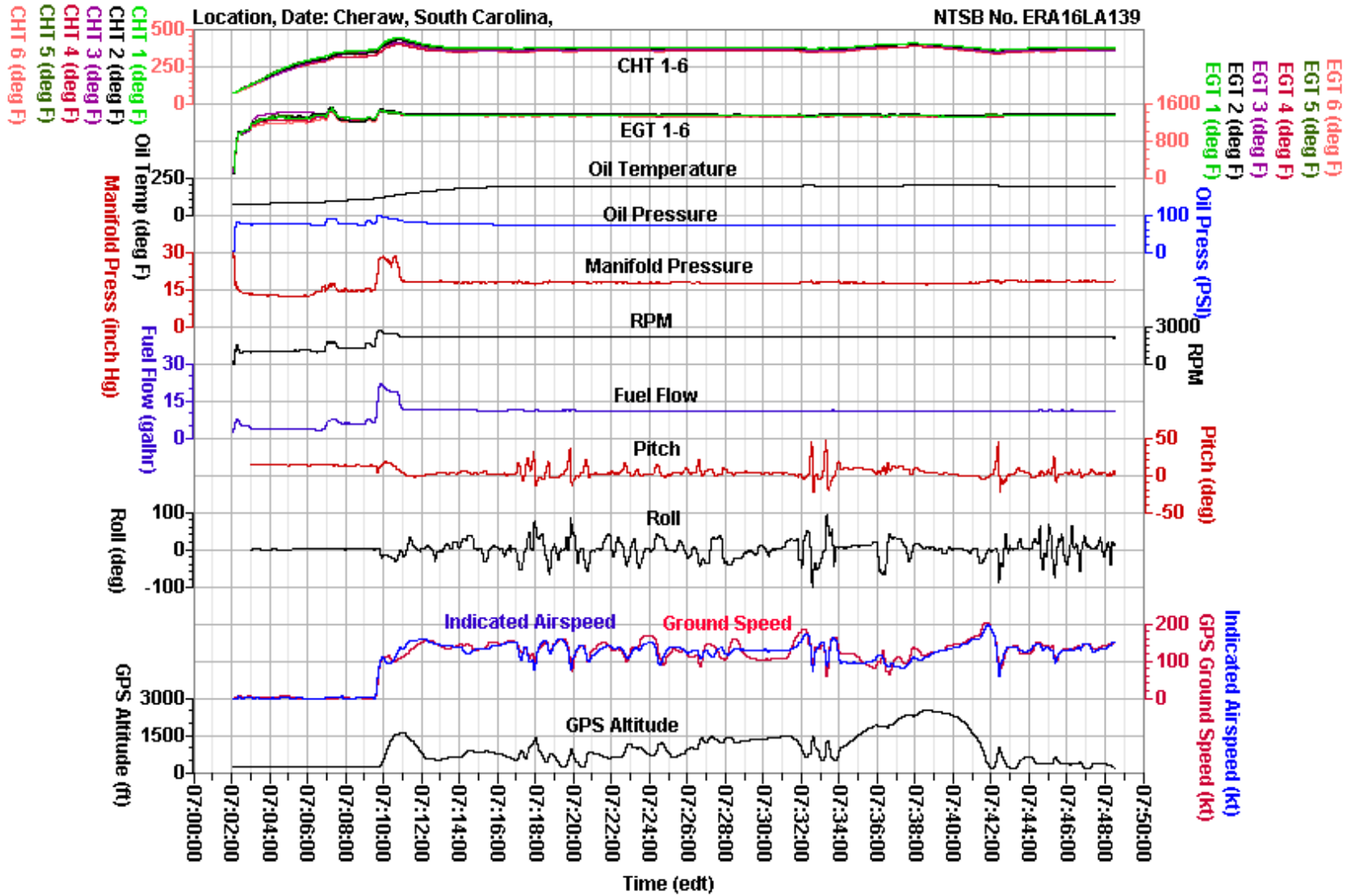


Figure 9. Plot of end of accident flight recording (last 8.5 minutes).

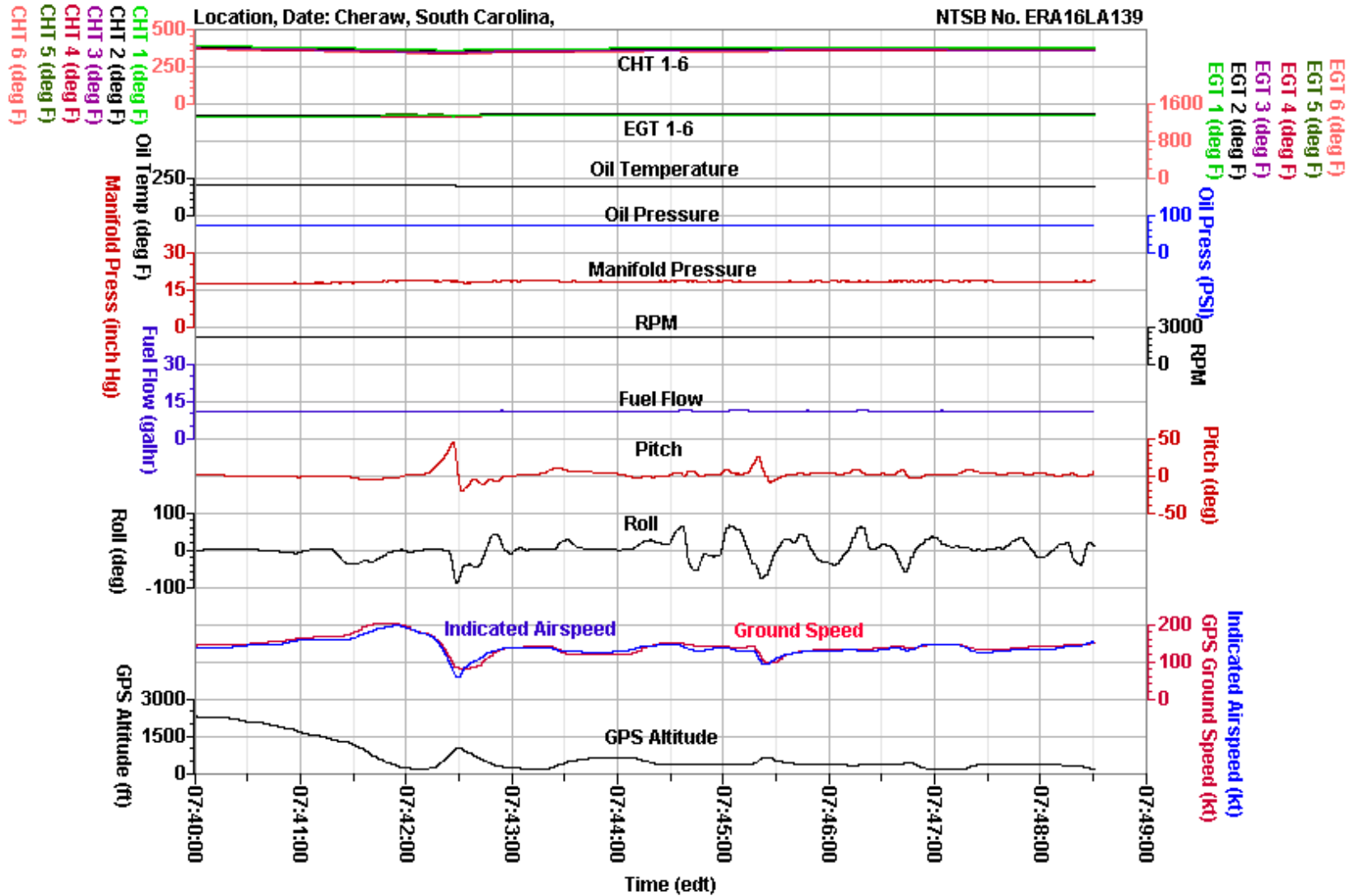
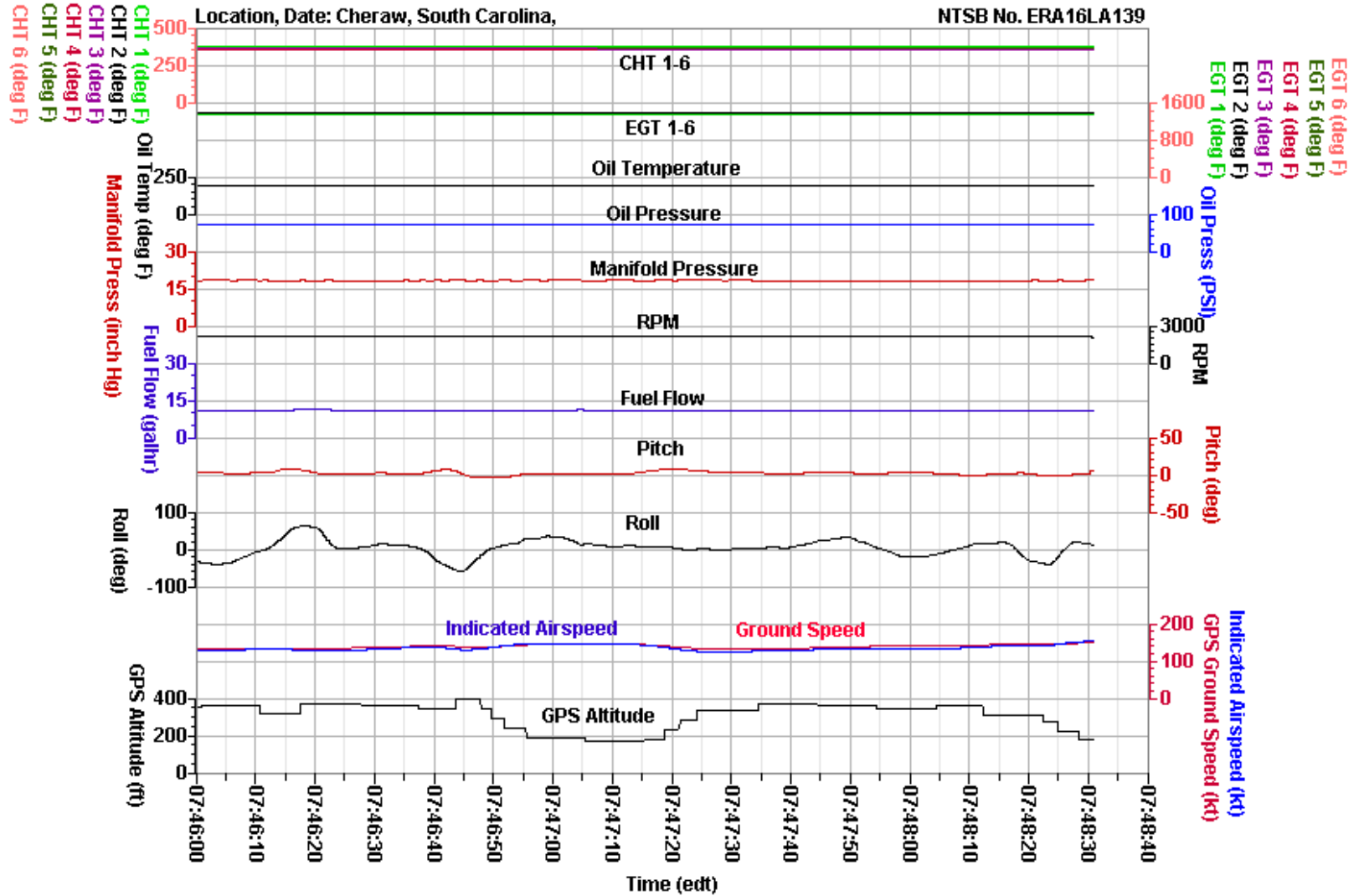


Figure 10. Plot of accident flight recording (last 2.5 minutes).



## APPENDIX A – Garmin GDU 460 Parameters

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report for Garmin GDU 460 parameters.

**Table A-1 - Verified and provided parameters.**

Parameter Name	Parameter Description
CHT # <sup>a</sup> (degF)	Cylinder Head Temperature (Cylinder #)
EGT # <sup>a</sup> (degF)	Exhaust Gas Temperature (Cylinder #)
Fuel Flow (gal/hr)	Fuel Flow
GPS Altitude <sup>b</sup> (ft)	GPS Altitude
GPS Ground Speed (kts)	GPS Ground Speed
Indicated Airspeed (kts)	Indicated Airspeed
Latitude (deg)	Latitude
Longitude (deg)	Longitude
Manifold Pressure (inHg)	Manifold Pressure
Oil Press (psi)	Oil Pressure
Oil Temp (degF)	Oil Temperature
Pitch (deg)	Pitch Angle
Roll (deg)	Roll Angle
RPM (rpm)	Propeller Revolutions Per Minute
Time (hh:mm:ss)	EDT Time
Power Timestamp (msec)	Time Since Device Powered

<sup>a</sup> # is a number from 1 to 6, representing the cylinder

<sup>b</sup>. FAA Advisory Circular AC 20-163, "Displaying Geometric Altitude Relative to Mean Sea Level" defines GPS Altitude as altitude relative to mean sea level, derived from geometric sources.

**Table A-2 - Unit abbreviations.**

Units Abbreviation	Description
deg	degrees
degF	degrees Fahrenheit
ft	feet
gal/hr	gallons per hour
hh	Hour
inHg	inches of Mercury
kts	knots
mm	second
msec	milliseconds
psi	pounds per square inch
rpm	revolutions per minute
ss	second