NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

February 2, 2015

Global Positioning System (GPS)

Specialist's Factual Report
By Christopher Babcock

1. EVENT SUMMARY

Location: McDade, Texas
Date: November 23, 2014
Aircraft: Aero Commander 500A
Registration: N14AV
Operator: Aerial Viewpoint Aerial Photography
NTSB Number: CEN15FA056

On November 23, 2014, about 0950 central standard time (CST), an Aero Commander 500A airplane, registration N14AV, impacted terrain near McDade, Texas. The airline transport pilot, the sole occupant, was fatally injured. The airplane was substantially damaged. The airplane was registered to and operated by Aerial Viewpoint Aerial Photography under the provisions of 14 *Code of Federal Regulations* Part 91 as a positioning flight. Visual meteorological conditions prevailed for the flight, which operated without a flight plan. The flight departed the David Wayne Hooks Memorial Airport, Houston, Texas, and was en route to the Austin Executive Airport, Austin, Texas. A hand-held GPS device was recovered and forwarded to the National Transportation Safety Board's (NTSB) Vehicle Recorder Laboratory for evaluation.

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Division received the following device:

      Recorder Manufacturer/Model: **Garmin GPSMAP 296**
      Recorder Serial Number: **67019980**

3.1. Garmin GPSMAP 296 Description

The Garmin GPSMAP 296 is a hand-held portable GPS unit equipped with a detachable antenna, a 256 color TFT LCD display, built in base map and an internal Jeppesen aviation database. The unit employs a parallel 12 channel receiver and can be operated using external power, or alternatively by using an internal Li-Ion rechargeable battery. The GPSMAP 296 is capable of storing date, route of flight, and flight time information for up to 50 individual flights in the form of a flight log. Flight logging begins when the GPS unit

senses a speed increase to greater than 30 knots together with an altitude gain of greater than 500 feet. The record is saved when the speed is sensed to decrease to below 30 knots, and a new log will be started if more than 10 minutes passes from this time.

A detailed tracklog, including latitude, longitude, date, time, and GPS altitude information, is stored within the unit whenever the receiver has a lock on the GPS signal. Position is updated within the tracklog as a function of time or distance moved, depending on how the unit has been configured. Once the current tracklog memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current tracklog can be saved to long-term memory and 15 saved tracklogs can be maintained in addition to the current tracklog. Tracklog storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory.[1] The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in serial port using the NMEA 0183 version 2.0 protocol.

3.2. Recorder Condition

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed light wear and negligible impact damage (Figures 1 and 2). The data was successfully recovered from the unit using the device's serial connection and manufacturer's recommended procedures.

Figure 1. Front of GPS device.

Figure 2. Rear of GPS device.

3.3. GPS Data Description

The data recovered included 23 individual track logs including the accident flight. Table 1 shows the data parameters provided by the GPS device. Groundspeed and track are derived and recorded by the device.

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[1] Non-volatile memory is semiconductor memory that does not require external power for data retention

Table 1. Parameters recovered from GPS.

Parameter Name	Parameter Description
Date	UTC Date
Time	UTC Time
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Altitude	Recorded GPS Altitude (ft)
Groundspeed	Derived Groundspeed (knots)
Track	Derived True Course (deg)

3.4.   Time Correlation

Timing was provided with each data point recovered from the GPS in UTC time. The date field for the accident flight was recorded as "4/9/1995," but the UTC time appears to coincide with the reported accident time. The departure airport was the same for the accident flight and the last recorded data point matched the location of the wreckage.

3.5.   GPS Plots and Corresponding Tabular Data

Figure 3 shows an overview of the taxi and takeoff roll of the accident flight. Figure 4 shows an overview of the accident flight. Figures 5 and 6 show the last several minutes of the accident flight. Weather and lighting conditions in the overlays are not representative of the conditions on the accident day.

The aircraft departed Hooks Memorial Airport to the south at 14:54 UTC and turned to the west. The aircraft climbed to approximately 6700 feet and cruised at 138 knots derived groundspeed. At 15:27 UTC, the aircraft began to descend and groundspeed decreased. The last recorded point was recorded at 15:44:35 UTC in the vicinity of McDade, TX, at a GPS altitude of 610 feet and groundspeed of 66 knots. Terrain elevation at that location was approximately 520 feet above mean sea level.

The corresponding tabular data used to create these plots are provided in electronic comma separated value (*.csv) format as attachment 1 to this report in the public docket for this accident.

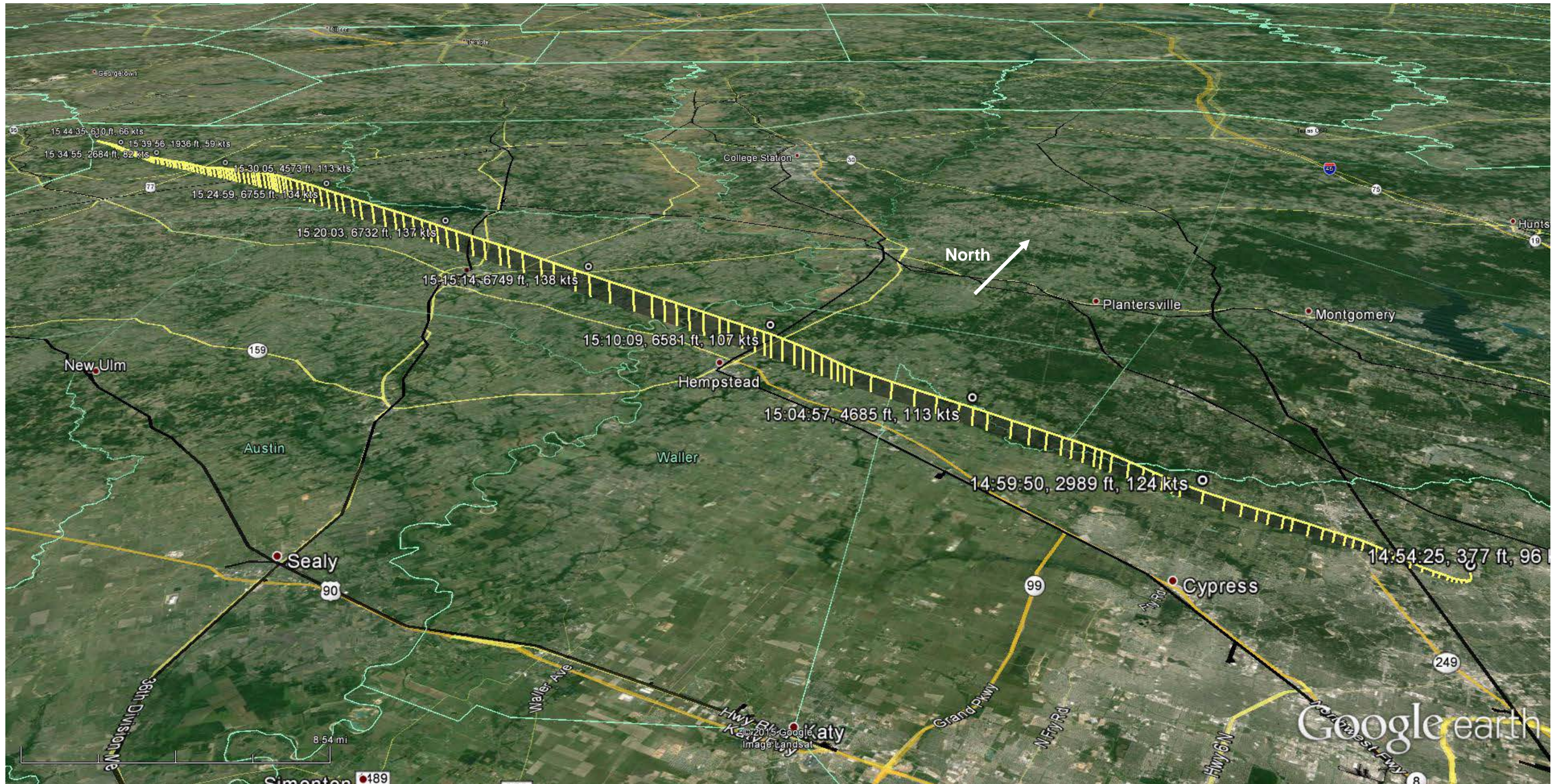**Figure 3.** Taxi and takeoff roll (UTC time).
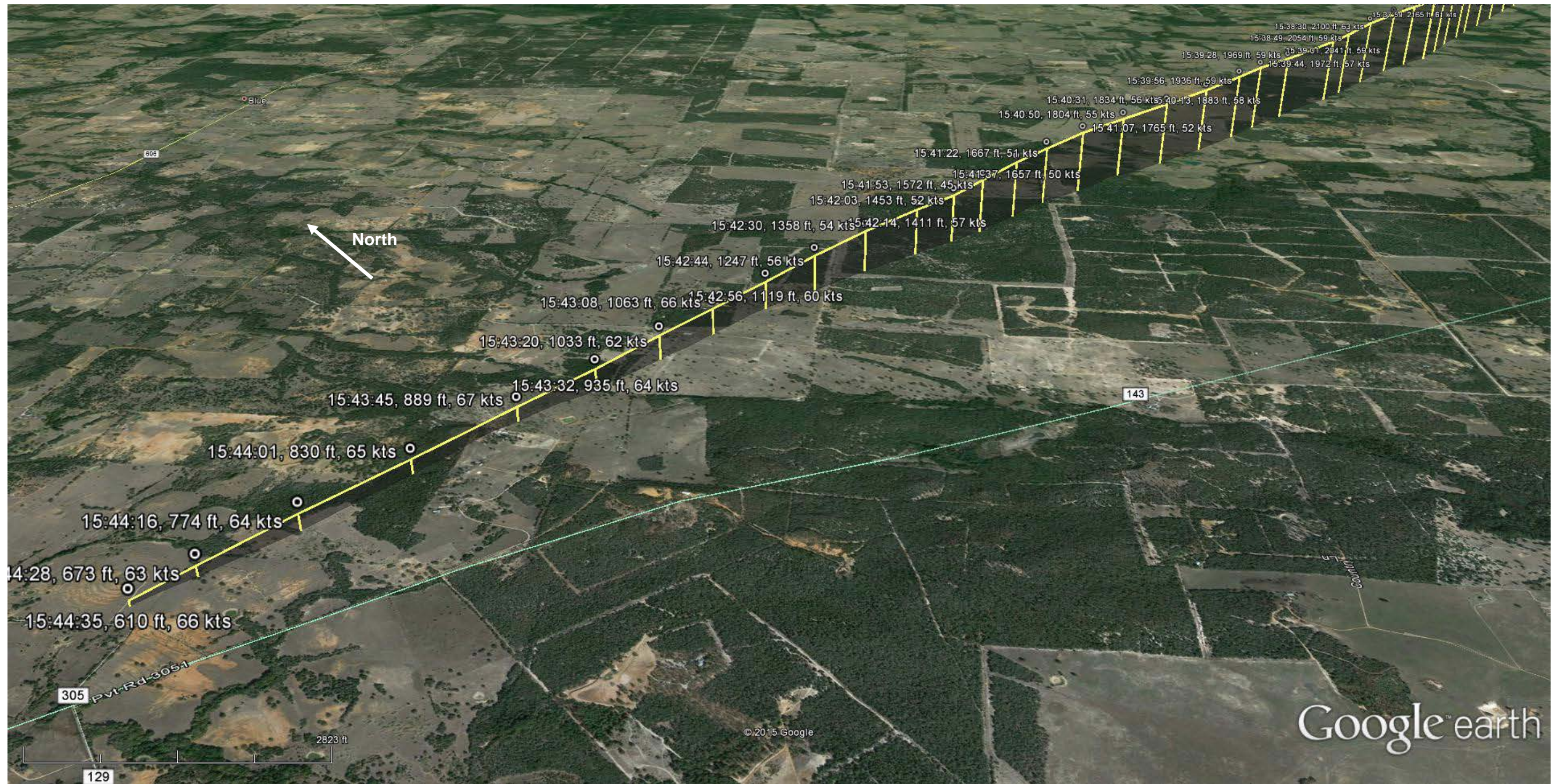
Figure 4. Overview of entire accident flight.

Figure 5. Final 6 minutes of accident flight (UTC time).

15:38:30, 2100 ft, 63 kts · 15:38:59, 2165 ft, 61 kts
15:38:49, 2054 ft, 59 kts
15:39:28, 1969 ft, 59 kts · 15:39:07, 2041 ft, 59 kts
15:39:44, 1972 ft, 57 kts
15:39:56, 1936 ft, 59 kts
15:40:31, 1834 ft, 56 kts · 15:40:13, 1883 ft, 58 kts
15:40:50, 1804 ft, 55 kts
15:41:07, 1765 ft, 52 kts
15:41:22, 1667 ft, 51 kts
15:41:37, 1657 ft, 50 kts
15:41:53, 1572 ft, 45 kts
15:42:03, 1453 ft, 52 kts
15:42:30, 1358 ft, 54 kts · 15:42:14, 1411 ft, 57 kts
15:42:44, 1247 ft, 56 kts
15:43:08, 1063 ft, 66 kts · 15:42:56, 1119 ft, 60 kts
15:43:20, 1033 ft, 62 kts
15:43:32, 935 ft, 64 kts
15:43:45, 889 ft, 67 kts
15:44:01, 830 ft, 65 kts
15:44:16, 774 ft, 64 kts
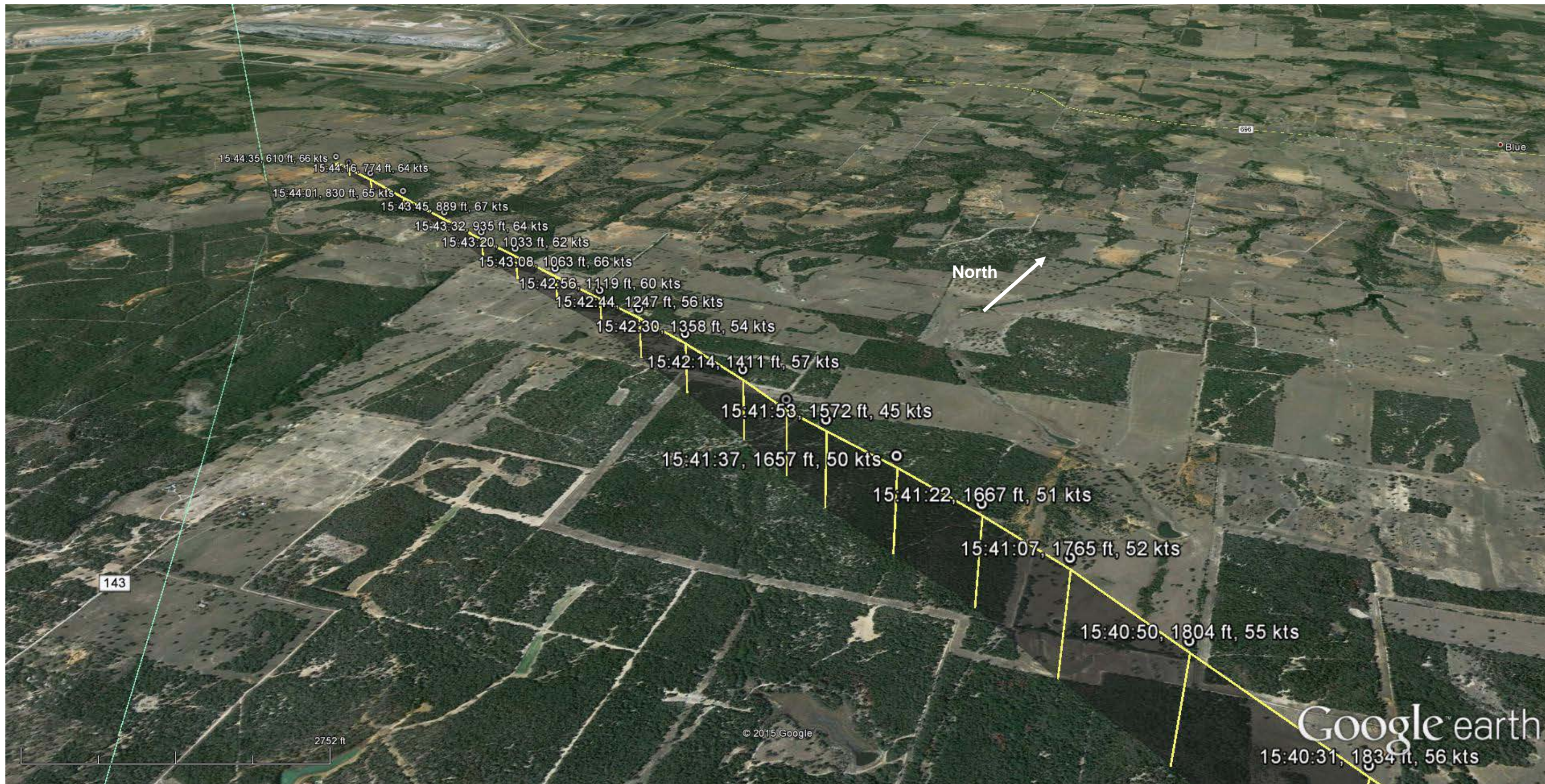44:28, 673 ft, 63 kts
15:44:35, 610 ft, 66 kts

North

Figure 6. Final four minutes of accident flight (UTC time).