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

November 24, 2017

Electronic Devices

Specialist's Factual Report
by Bill Tuccio, Ph.D.

1. EVENT

Location:	Harrisburg, Oregon
Date:	April 7, 2017
Aircraft:	Piper PA-46-310P
Registration:	N123SB
Operator:	Park City Aviation, LLC
NTSB Number:	WPR17FA085

On April 7, 2017, about 1046 Pacific daylight time (PDT), a Piper PA-46-310P, N123SB, was destroyed when it impacted terrain near Harrisburg, Oregon during an instrument approach to Mahlon Sweet Field Airport (EUG), Eugene, Oregon. The pilot and three passengers were fatally injured. The airplane was registered to and operated by Park City Aviation, LLC as a 14 *Code of Federal Regulations* Part 91 personal flight. Instrument meteorological conditions prevailed and an instrument flight rules plan had been filed for the cross-country flight that originated from Van Nuys Airport (VNY), Van Nuys, California at 0727.

2. DETAILS OF INVESTIGATION

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

Device 1:	Apple iPad Mini 3
Serial Number:	DLXNN8YLG5Y3
Device 2:	Garmin Aera 796
Serial Number:	2CY004791
Device 3:	Appareo Stratus 2S
Serial Number:	002367

2.1. Apple iPad Mini 3 Device Description

The Apple iPad Mini 3 is a portable computing device capable of wireless connectivity and running custom applications.

2.1.1. Apple iPad Mini Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the unit had sustained significant structural damage and environmental exposure, as shown in figure 1. In agreement with the Investigator-in-Charge (IIC), no effort was made to recover information from this device.

Figure 1. Apple iPad Mini 3, as received.

2.1.2. Apple iPad Mini 3 Data Recovery

No data was recovered.

2.2. Garmin Aera 796 Device Description

The Garmin Aera 796 is an electronic flight bag capable of displaying aviation information and recording track history. User interaction is accomplished using the touch screen.

2.2.1. Garmin Aera 796 Data Recovery

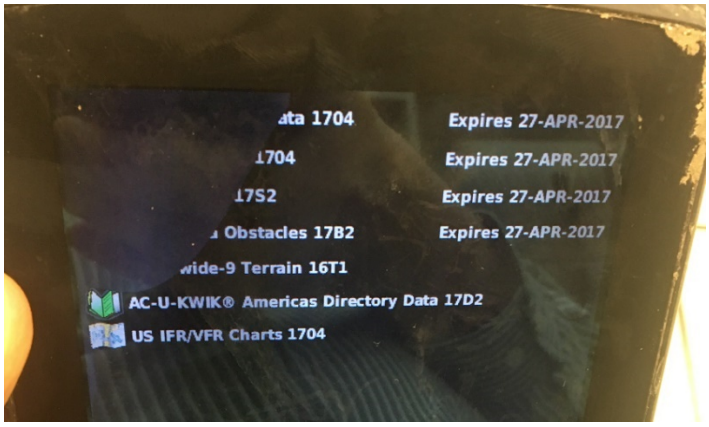
Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained minor damage, as shown in figure 2. The unit powered on, but due to damage to the screen, the user interface was inoperative. In agreement with the IIC, only the startup screen was documented.

Figure 2. Garmin Aera 796, as received.

2.2.2. Garmin Aera 796 Data Description

Figure 3 shows the database startup screen. Subscription aeronautical databases all had expiration dates of April 27, 2017.

Figure 3. Garmin Aera 796 database startup screen.



2.3. Appareo Stratus 2S Device Description

The Appareo Status 2S device is a self-contained battery powered unit that contains an internal AHRS,[1] GPS/WAAS receiver,[2] and ADS-B[3] receiver in one compact unit. The unit communicates wirelessly with compatible devices to display all the acquired information. In addition to communicating with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile flash memory[4] chip. Internal memory has the space to store over 13 hours of flight data that is sampled at approximately 5 data records per second (5 Hz).

2.3.1. Appareo Stratus 2S Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had not sustained any damage. The unit was powered on, wirelessly connected using the ForeFlight application running on an NTSB iPad, and the accident log was recovered.

[1] The Attitude Heading Reference System consists of a set of 3-axis gyroscope, accelerometers and heading reference sensors that enable the unit to compute pitch, roll, and yaw motions.
[2] The Wide Area Augmentation System (WAAS) is an air navigation aid to augment the Global Positioning System (GPS), by improving its accuracy, integrity, and availability.
[3] Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the national airspace system. The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GPS and transmit its position along with additional information about the aircraft to ground stations for use by air traffic control (ATC) and other ADS-B services. This information is transmitted at a rate of approximately once per second. Operators equipped with ADS-B realize additional benefits from ADS-B broadcast services: Traffic Information Service - Broadcast (TIS-B) (traffic information) and Flight Information Service - Broadcast (FIS-B) (weather information).
[4] Type of solid state memory that does not require electrical power to retain information.

2.3.2. Appareo Stratus 2S Data Description

Data recovered from the April 7, 2017, flight spanned from 14:07:17 UTC to 17:49:41 UTC. For this report, 7 hours was subtracted to convert UTC to PDT. The parameters listed in table 1 were recovered for this report.

Table 1: Appareo Stratus 2S Data Parameters

Parameter Name	Parameter Description
Time	Time (PDT) for recorded data point (seconds past midnight 4/7/2017, PDT)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
Altitude	Recorded GPS Altitude (feet)
Speed	Device recorded groundspeed (knots)
Course	Device recorded magnetic course (degrees)
Bank	Bank angle (degrees)
Pitch	Pitch angle (degrees)

3. Overlays, Plots, and Tabular Data

Figures 4 through 11 show overlays of recorded data created using Google Earth. Weather and lighting conditions in the overlays are not necessarily representative of the weather and lighting conditions at the time of the recording. Figures 12 and 13 show plots of the recorded data at different time intervals.

Collectively, these figures and attached tabular data show:

- The recording started at 07:07:17 PDT, at a parking area at VNY.
- By 07:12:13 PDT, the aircraft was taxiing to runway 16R at VNY.
- By 07:21:37 PDT, the aircraft began its takeoff on runway 16R at VNY.
- By 07:41 PDT, the aircraft was at a cruising altitude of about 14,200 feet,[5] on a generally direct route towards EUG.
- During level cruise, the recorded pitch attitude trended between 1 and 3 degrees nose down.
- By 10:19 PDT, the aircraft began a descent, consistent with an arrival in the EUG terminal area.
- By 10:43: 48 PDT, the aircraft passed east of EUG, descending through 3,573 feet GPS altitude, consistent with IIC supplied information that the aircraft was being vectored for an approach towards a southeast runway at EUG. At this time, the recorded pitch attitude was about 3.5 degrees nose down.
- Between 10:46:36 and 10:47:04 PDT, the aircraft turned left towards the west, at a steady altitude of about 1,870 feet GPS altitude; during this turn the groundspeed changed from 144 knots to 75 knots.

[5] Recorded altitude was GPS altitude and thus changed as the flight progressed, consistent with an IFR flight flying barometric altimeter altitudes across varying altimeter settings.

- At 10:47:41 PDT, the recorded pitch angle began to increase as the aircraft began to turn left at a GPS altitude of 1,923 feet.
- By 10:47:49 PDT, the recorded left bank angle was 42 degrees and the recorded pitch up angle was 13.6 degrees, as the aircraft's course turned through 205 degrees.
- At 10:47:56 PDT, the recorded left bank angle reached a local maximum of 95 degrees, with a recorded pitch attitude of 35 degrees nose down.
- By 10:47:59 PDT, the aircraft's course was towards the north, descending through 1,125 feet GPS altitude, with a recorded nose down pitch attitude of 30 degrees, and a recorded left bank angle of about 70 degrees.
- At about 10:48:01 PDT, the recorded bank angle passed through 0 degrees, rolling towards the right, as the recorded nose down pitch angle of 23 degrees began to decrease. At this time, the aircraft was travelling northbound and the aircraft was descending through 1,000 feet GPS altitude.
- The recorded right bank continued to increase until 10:48:06 PDT, to a maximum of 173 degrees and a recorded nose down pitch angle of 66 degrees, after which time the Stratus 2S began to record a left bank of 148 degrees
- At 10:48:12 PDT, the groundspeed decreased to 0, consistent with ground impact.
- The last recorded data was at 10:49:41 PDT, consistent with the Stratus 2S continuing to record after impact.

Tabular data used to generate figures 4 through 13 are included as attachment 1 in electronic comma-delimited (.CSV) format.

Figure 4. Overview of accident flight (satellite imagery).

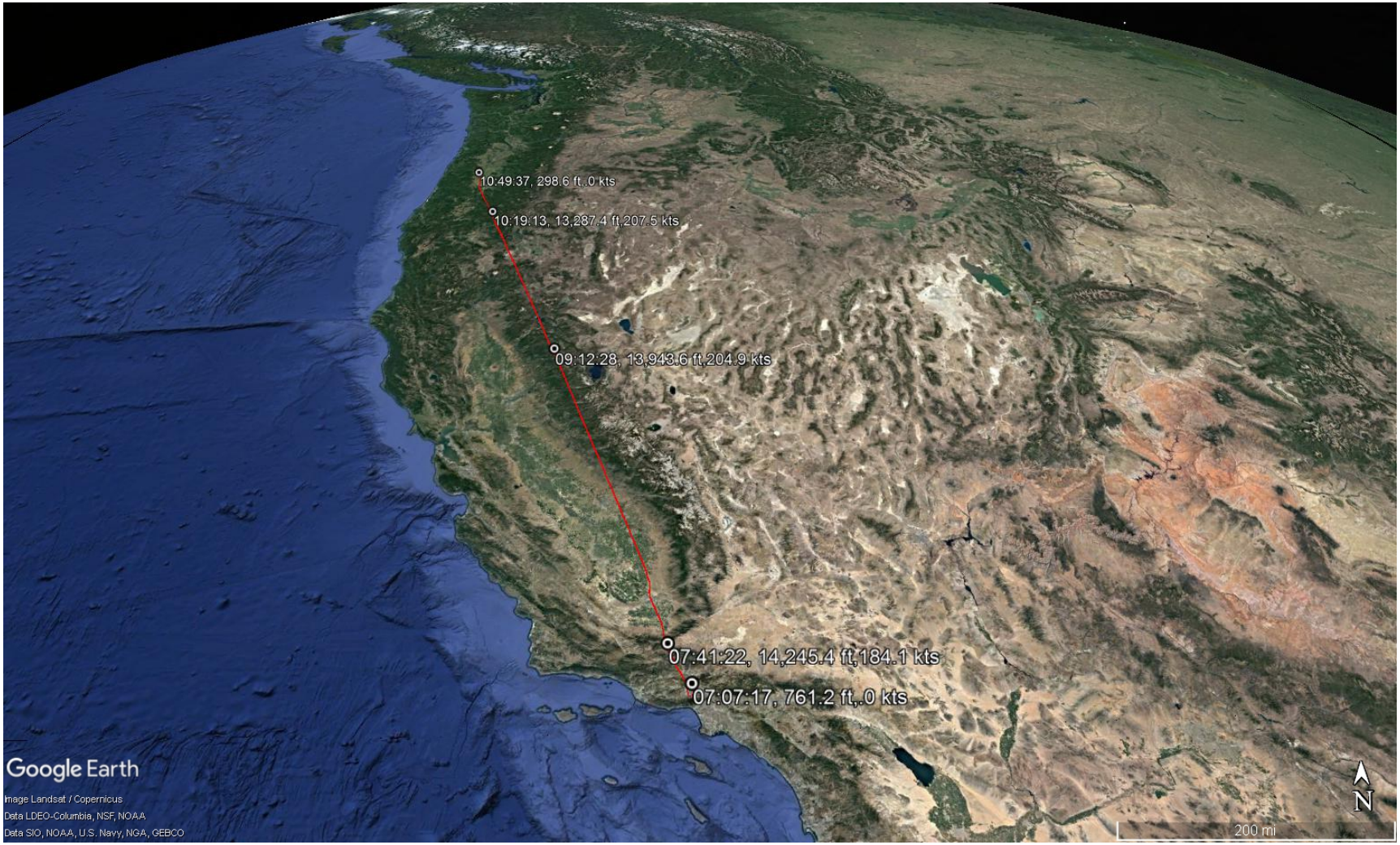


Figure 5. Overview of accident flight (IFR low altitude chart).

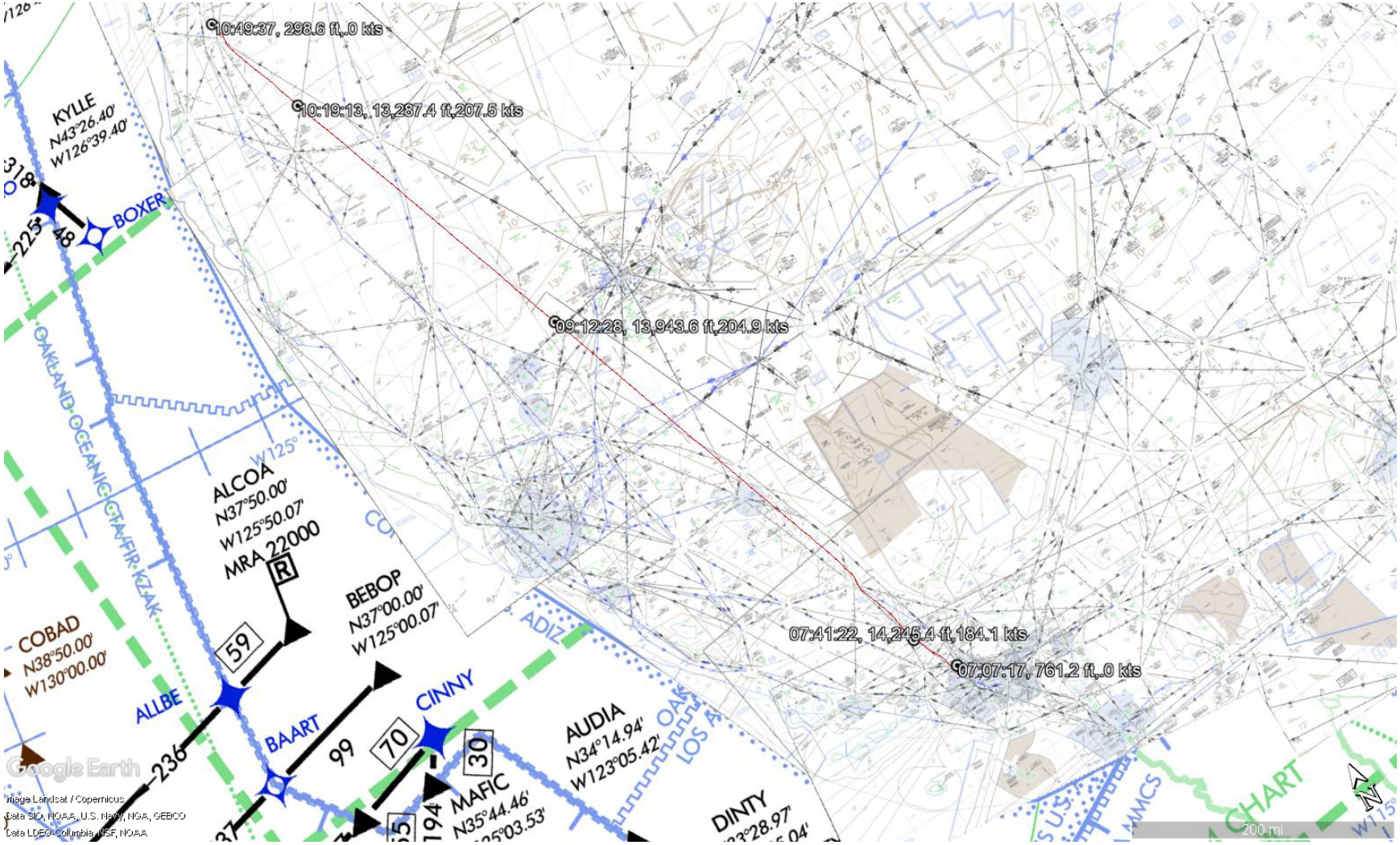


Figure 6. Start of recording.

Figure 7. Departure.

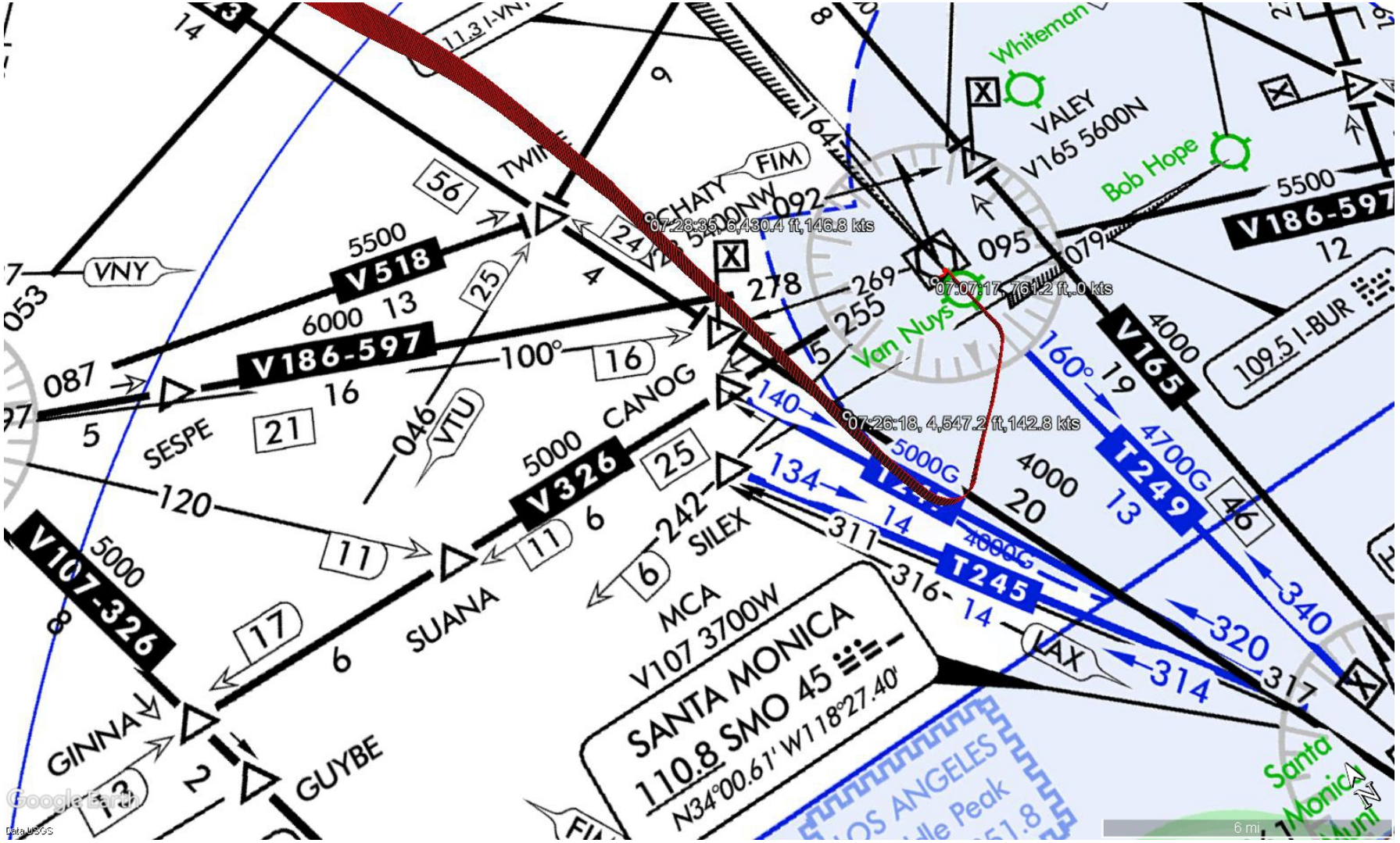


Figure 8. Enroute portion between Gorman VOR and Shafter VOR.

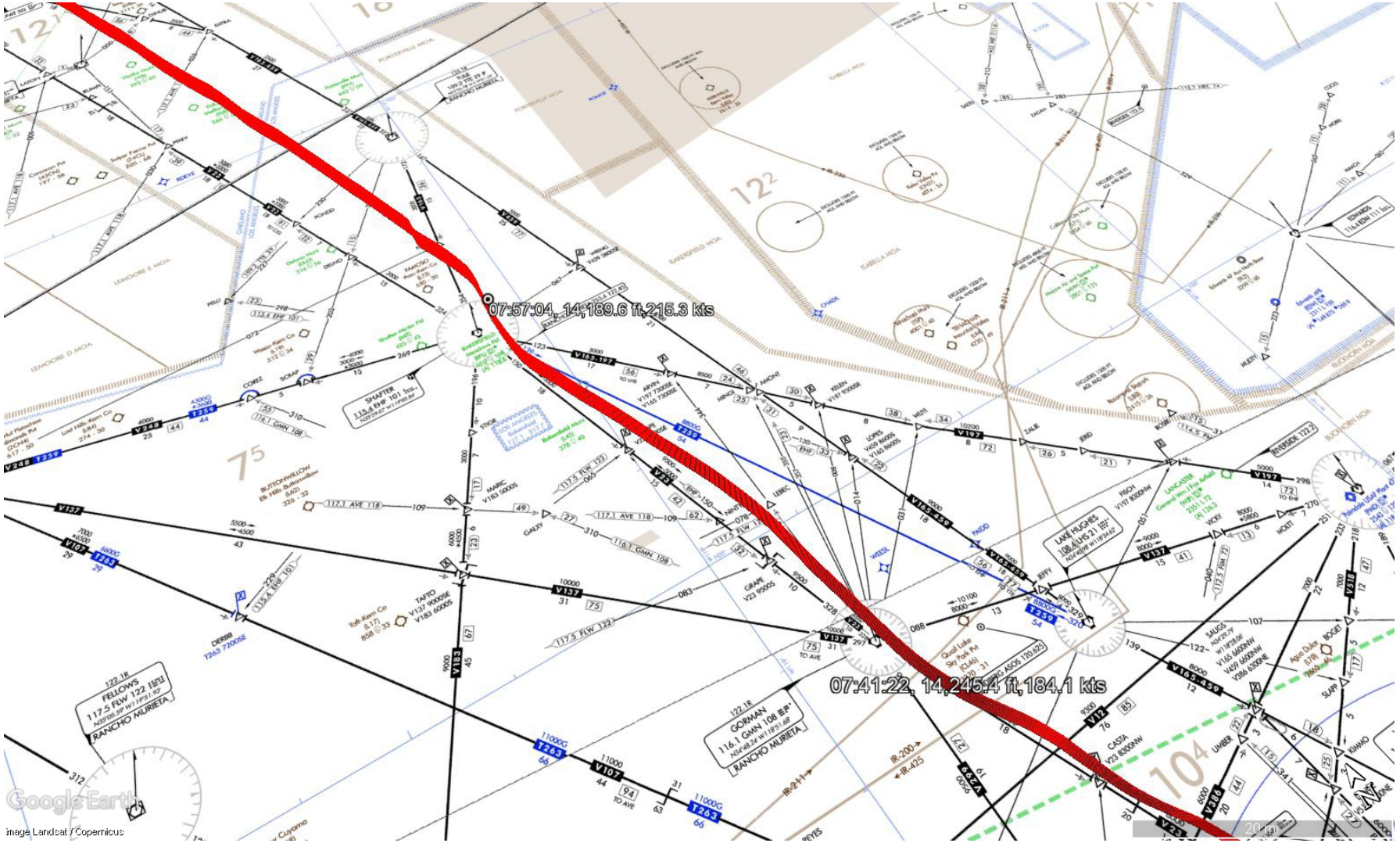


Figure 9. Terminal area to end of recording.

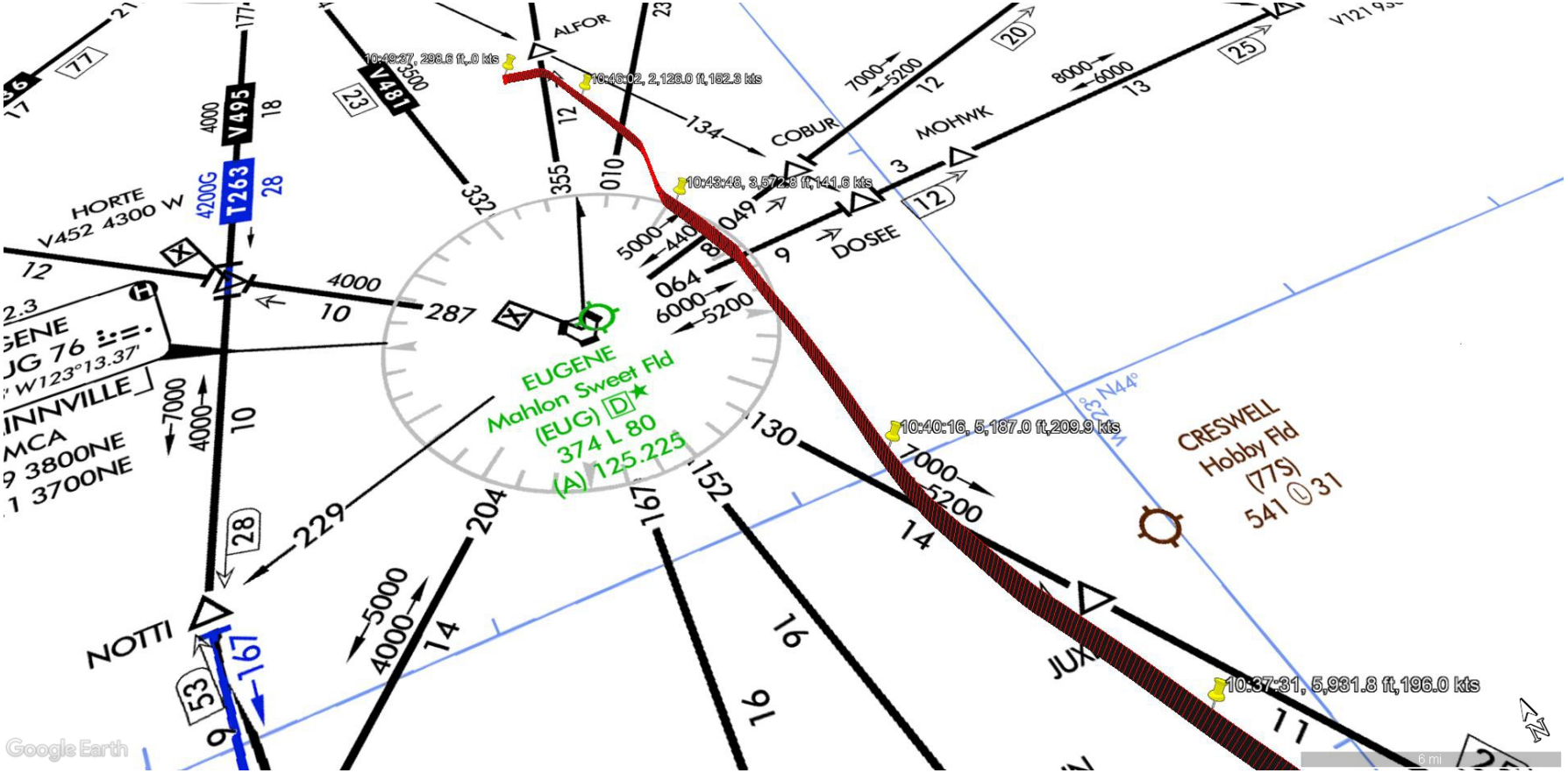


Figure 10. End of recording (overview, annotated).

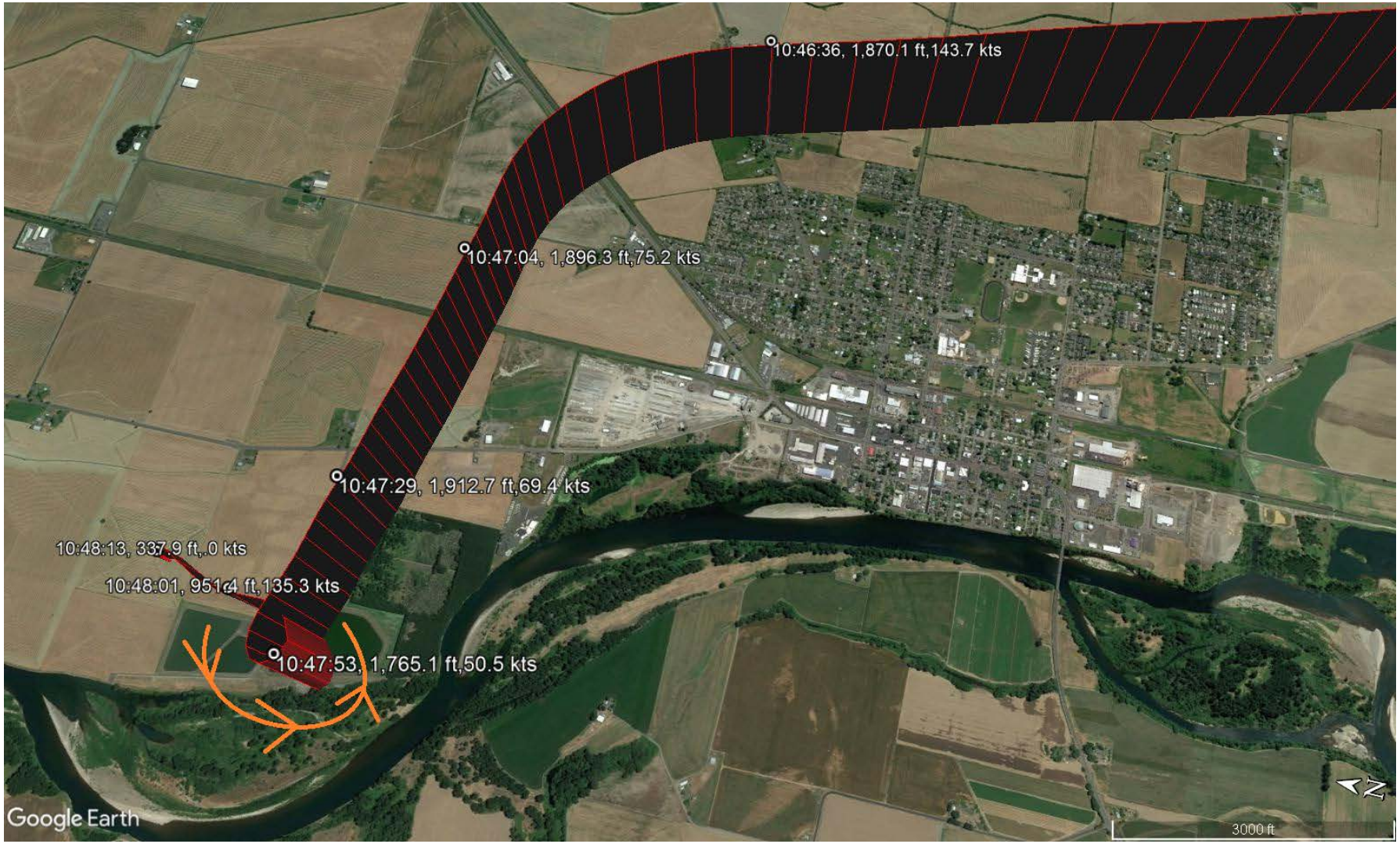


Figure 11. End of recording (detail view).

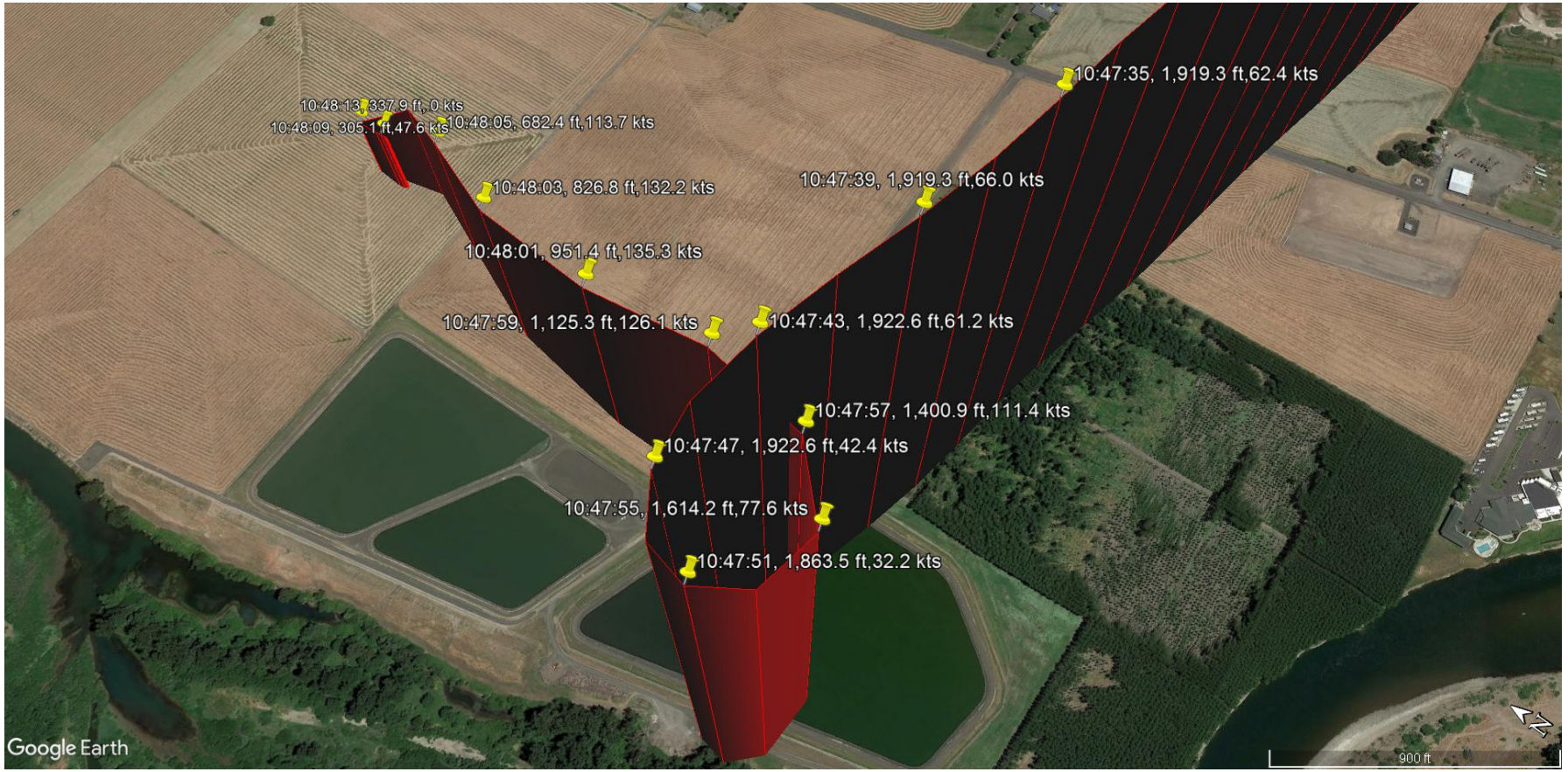


Figure 12. Plot of entire accident flight recording.

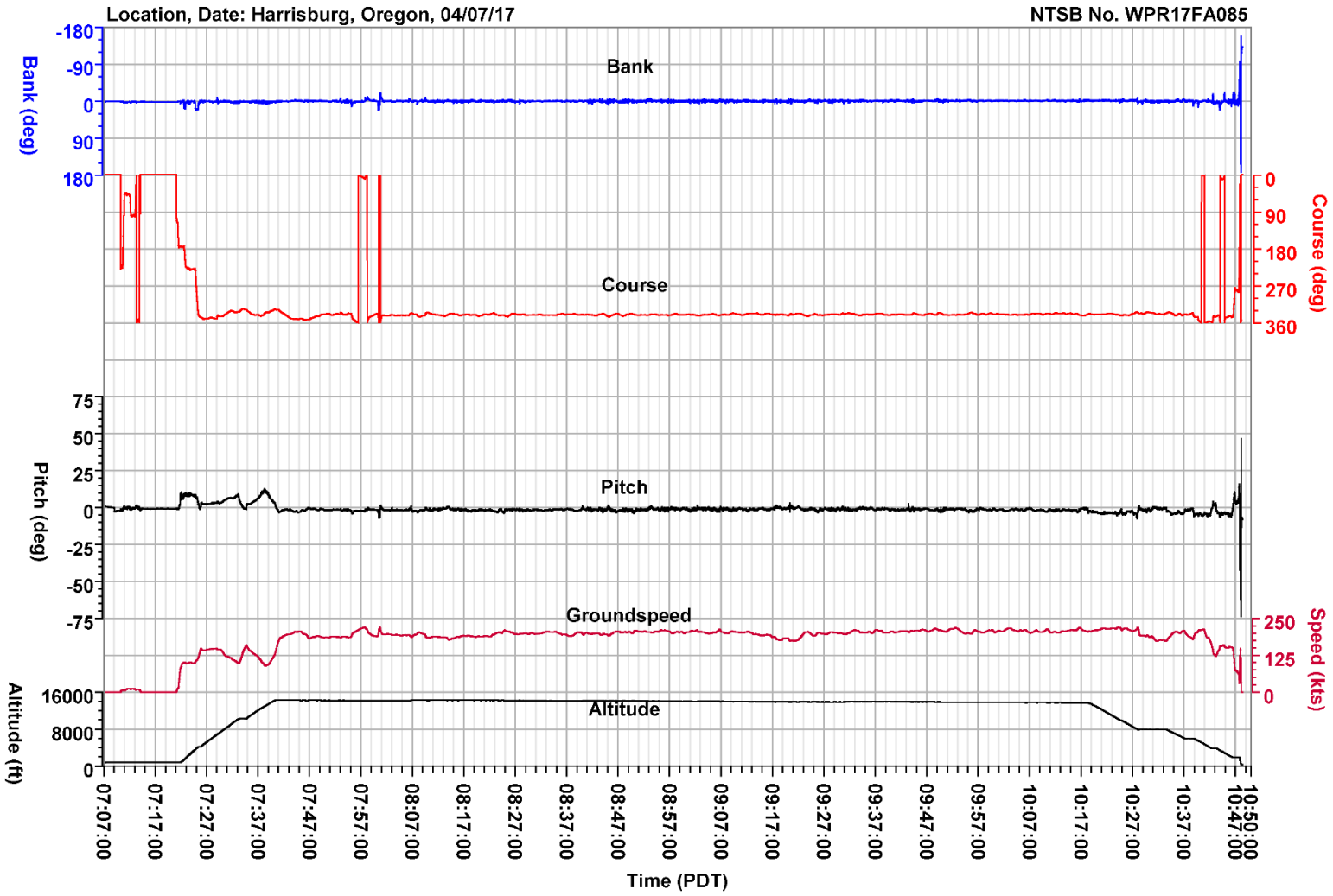


Figure 13. Plot of end of accident flight recording.