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

November 24, 2014

Electronic Devices

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

1. EVENT

Location:	Russell, Iowa
Date:	August 9, 2014
Aircraft:	Barger Van's Aircraft RV-7
Registration:	N92BF
Operator:	Private
NTSB Number:	CEN14LA424

On August 9, 2014, about 1310 central daylight time, an amateur-built Barger Van's RV-7A airplane, N92BF, was destroyed when it impacted terrain near Russell, Iowa. The pilot and passenger received fatal injuries. The aircraft was owned and operated by the pilot under the provisions of 14 *Code of Federal Regulations* Part 91 as personal flight. Marginal visual meteorological conditions existed in the immediate area of the accident site and the flight was operated on a visual flight rules flight plan. The flight originated from the Ottumwa Regional Airport (OTM), Ottumwa, Iowa at an unconfirmed time, and was bound for the Meadow Lake Airport, Colorado Springs, Colorado when the accident occurred.

2. DETAILS OF DEVICE INVESTIGATION

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

Devices with No Data Recovered

Device 1:	Artex SARLink
Device 1 Serial Number:	14571
Device 2:	Garmin Aera 560
Device 2 Serial Number:	3QV002241
Device 3:	Dynon D10A Electronic Flight Information System (EFIS)
Device 3 Serial Number:	Unknown

Device with Data Recovered

Device 4: Garmin GPSMAP 196
Device 4 Serial Number: 65405303

2.1. Devices with No Data Recovered

The Artex SARLink, shown in figure 1, is a satellite-based emergency locator beacon; in agreement with the Investigator-in-Charge (IIC), it was determined the device did not contain any pertinent information.

The Garmin Aera 560, shown in figure 2, is a GPS device capable of recording track history. Due to the extensive damage of the Garmin Aera 560 and the recoverability of pertinent information from the Garmin GPSMAP 196, it was determined the Garmin Aera 560 would not provide any additional information for the investigation.

The Dynon unit is shown in figure 3; the front of the display unit is on the left side of the photo and the back of the display unit is on the right side of photo. No other parts of the Dynon unit were recovered. Figure 4 shows a detailed view of the front and back of the printed circuit board shown in the right side of figure 3. Figure 4 includes an expanded view of the non-volatile memory[1] (NVM) chip (labelled "SST 39VF800A") that was recovered intact from the unit. A memory image of the NVM chip was made and the entire unit was sent to Dynon Avionics for attempted recovery.

Dynon reported the unit was a model D10A EFIS with a software version that did not support data recording. No further recovery efforts were made.

Figure 1. Artex SARLink device.

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

Figure 2. Garmin Aera 560.

Figure 3. Dynon unit.

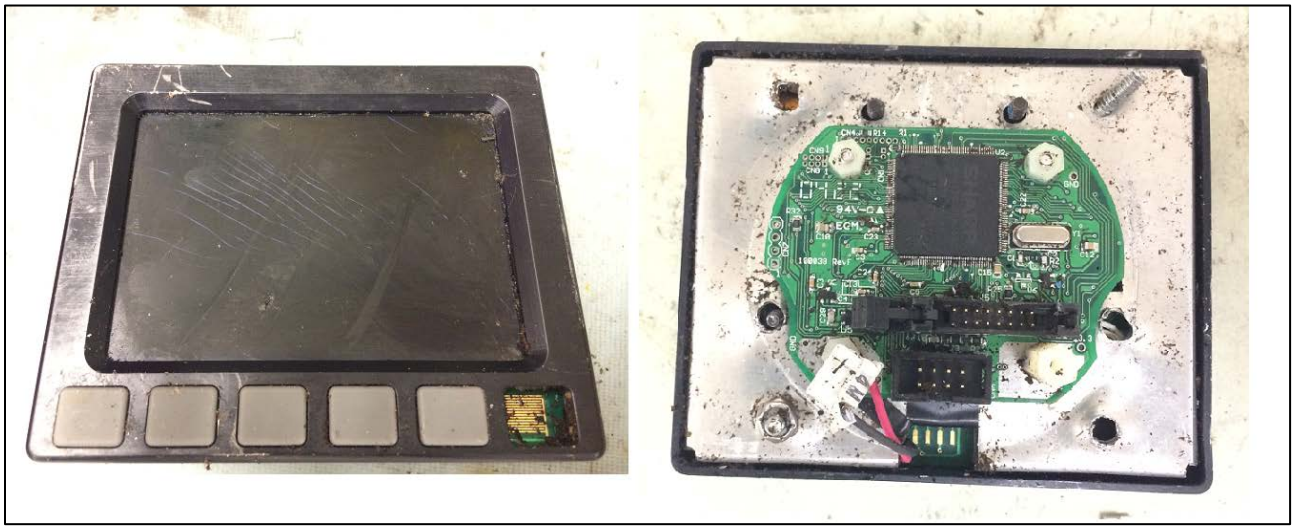
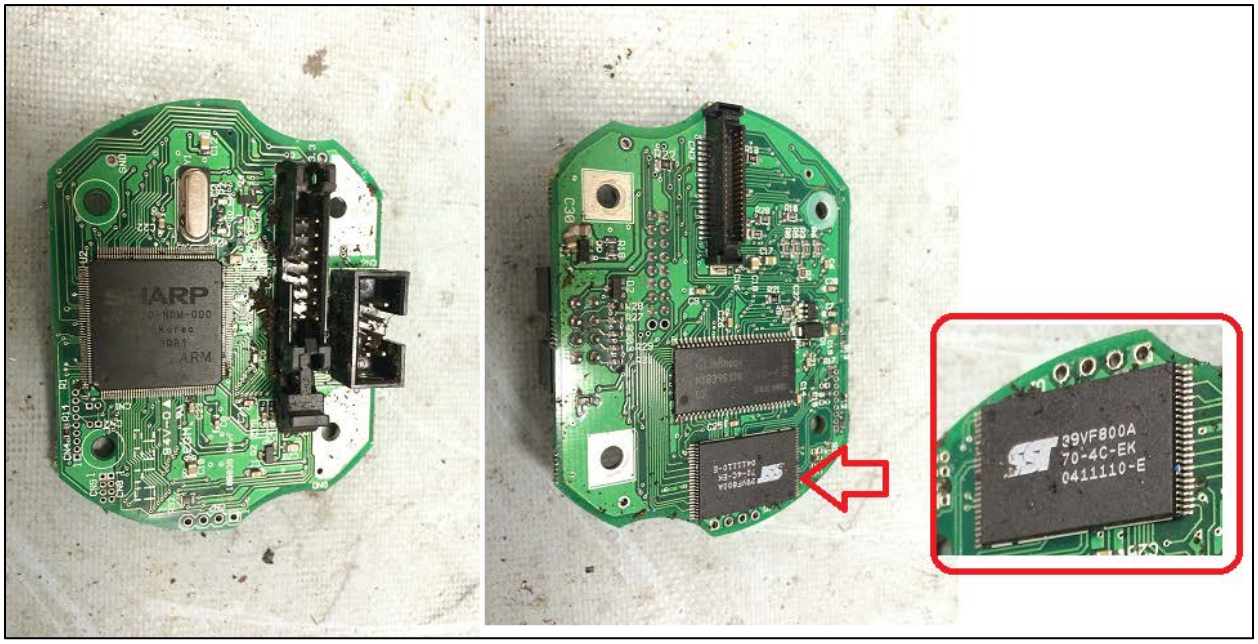


Figure 4. Dynon circuit board and NVM chip.



2.2. Device with Data Recovered: Garmin GPSMAP 196 Description

The Garmin GPSMAP 196 is a portable GPS unit equipped with a detachable antenna, and a 320 x 240 12-level grayscale LCD display. The unit is equipped with a built in base map and internal Jeppesen aviation database. The unit employs a parallel 12 channel WAAS-capable receiver and can be operated using external power, or alternatively by four standard AA-size batteries. The GPSMAP 196 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 of greater than 30 knots together with an altitude gain of greater than 500 feet. Recorded flight log data is saved when the speed is sensed to decrease to below 30 knots, and a new log is started if more than 10 minutes passes from this time. A detailed track log – including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Track log position is updated as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory and 15 saved track logs can be maintained in addition to the current track log. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information to a PC via a built-in serial port using the NMEA 0183 version 2.0

protocol. An internal button-battery is used to back-up power to the internal memory and real-time clock during those periods when main power is removed.

2.2.1. Garmin GPSMAP 196 Data Recovery

Upon arrival at the NTSB Vehicle Recorder Division an exterior examination revealed the unit had sustained significant impact damage, as shown in figure 3. An internal inspection revealed damage to components; however, the non-volatile, thin small outline package (TSOP) chip was intact, as shown in figure 4 (the TSOP chip is annotated in red). The accident unit's TSOP chip was removed and installed in an NTSB surrogate configured with a TSOP receptacle, as shown in figure 5. The surrogate was started and data downloaded normally using the manufacturer's software.

Figure 5. Garmin GPSMAP 196, as received.

Figure 6. Garmin GPSMAP 496 internal components, with TSOP chip annotated in red.

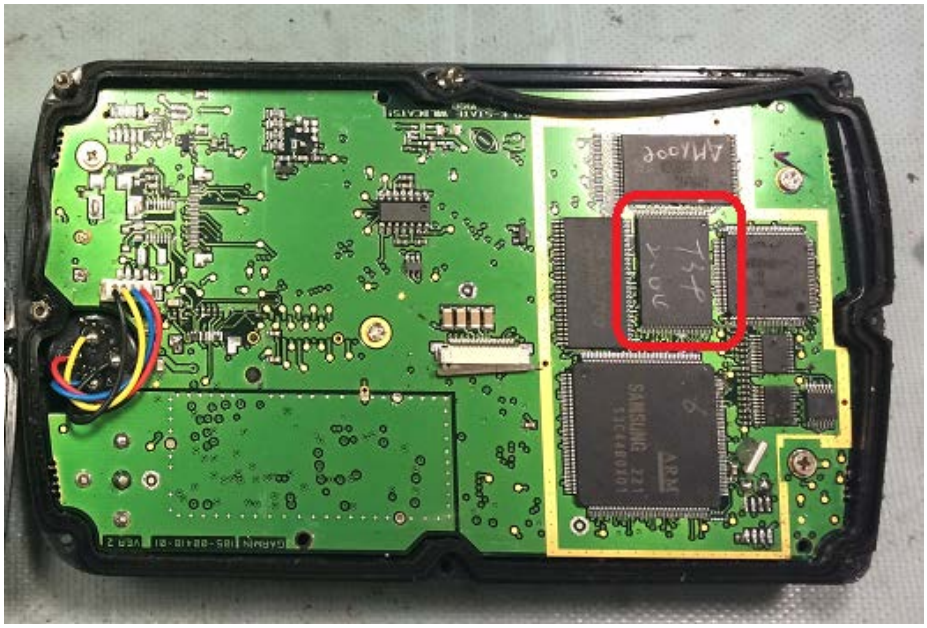
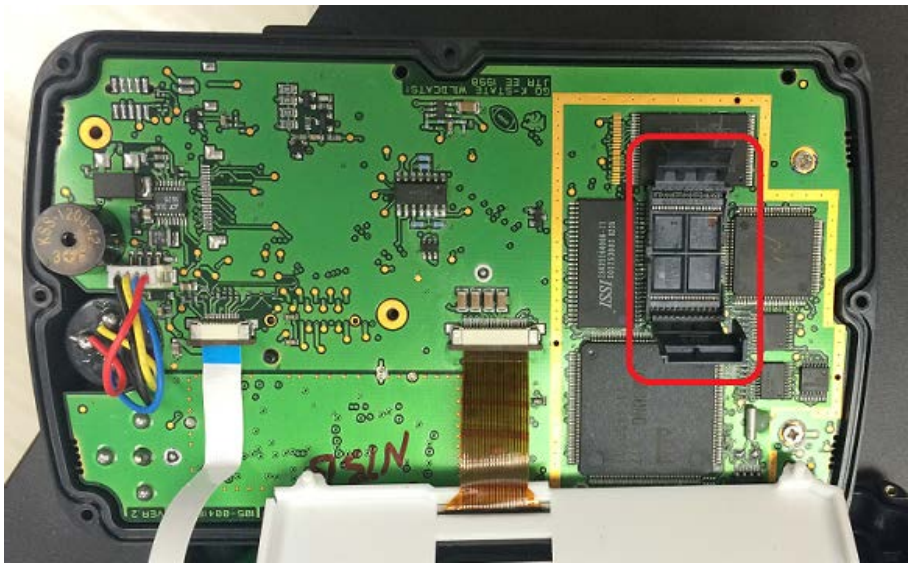


Figure 7. NTSB surrogate unit, with TSOP receptacle annotated.



2.2.2. Garmin GPSMAP 196 Data Description

The data extracted included 8 sessions from August 4, 2014 through August 9, 2014 (2,499 total data points). The accident flight was the last session, recorded starting at 17:42:18 UTC and ending at 18:09:07 UTC on August 9, 2014 (145 total data points).

3. GPS PARAMETERS PROVIDED

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived from the recorded parameters by Garmin MapSource (the manufacturer's download software).

Table 1: GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (UTC) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (feet, MSL[2])
Groundspeed	Average groundspeed (knots)
Track	Average true course (degrees)

4. OVERLAYS AND TABULAR DATA

All graphical overlays generated in this report were generated using Google Earth. Weather conditions depicted in the overlays do not necessarily represent weather conditions at the time of the accident.

Figures 8 and 9 provide an overview of the flight overlayed on satellite imagery and an aviation sectional chart, respectively. The recorded data began at 17:42:18 UTC at OTM. The aircraft departed and proceeded west/southwest at an initial altitude of about 4,500 feet. At about 18:04:51 UTC, the track of the aircraft became more westerly as the aircraft began to climb to a maximum recorded altitude of 7,769 feet. The aircraft then descended and increased speed until the end of the recording at 18:09:07 UTC.

Figure 10 shows the start of the recording at OTM. The recording began at 17:42:18 UTC on a ramp area. The aircraft taxied to runway 13 and took off about 17:49 UTC. After takeoff, the aircraft made a left turn and climbed to the northwest before proceeding southwest. After reaching an initial recorded altitude of 5,052 feet at 17:54:46 UTC, the aircraft descended to an average enroute altitude of 4,500 feet by 17:56 UTC. The average enroute groundspeed was about 150 knots.

Figure 11 shows the aircraft track turning right at about 18:04 UTC, to a more westerly track; this westerly track continued until about 18:06 UTC. Shortly after the aircraft turned westerly, it began a climb at a slower groundspeed, to a maximum recorded

[2] MSL means altitude above mean sea level

altitude at 18:08:15 UTC of 7,769 feet, when the groundspeed slowed to 75 knots. During this climb, the aircraft track turned left towards the southwest; however, the southwesterly track exhibited about three fluctuations in track to the left and right.

Figure 12 shows the descent from 7,769 feet, starting at 18:08:15 UTC until the end of the recording. After 18:08:15 UTC, the recorded track described a descending right turn of increasing groundspeed; reaching a maximum computed groundspeed of 208 knots by 18:08:57 UTC, as the aircraft was descending through 5,364 feet in excess of 3,000 feet per minute. The last recorded point was at 18:09:07 UTC when the aircraft was descending through 4,094 feet.

Tabular data used to generate figures 8 through 12 are included as attachment 1. These attachments are provided in electronic comma-delimited (.CSV) format.

Figure 8. Accident flight as recorded by Garmin 196 (satellite overlay).

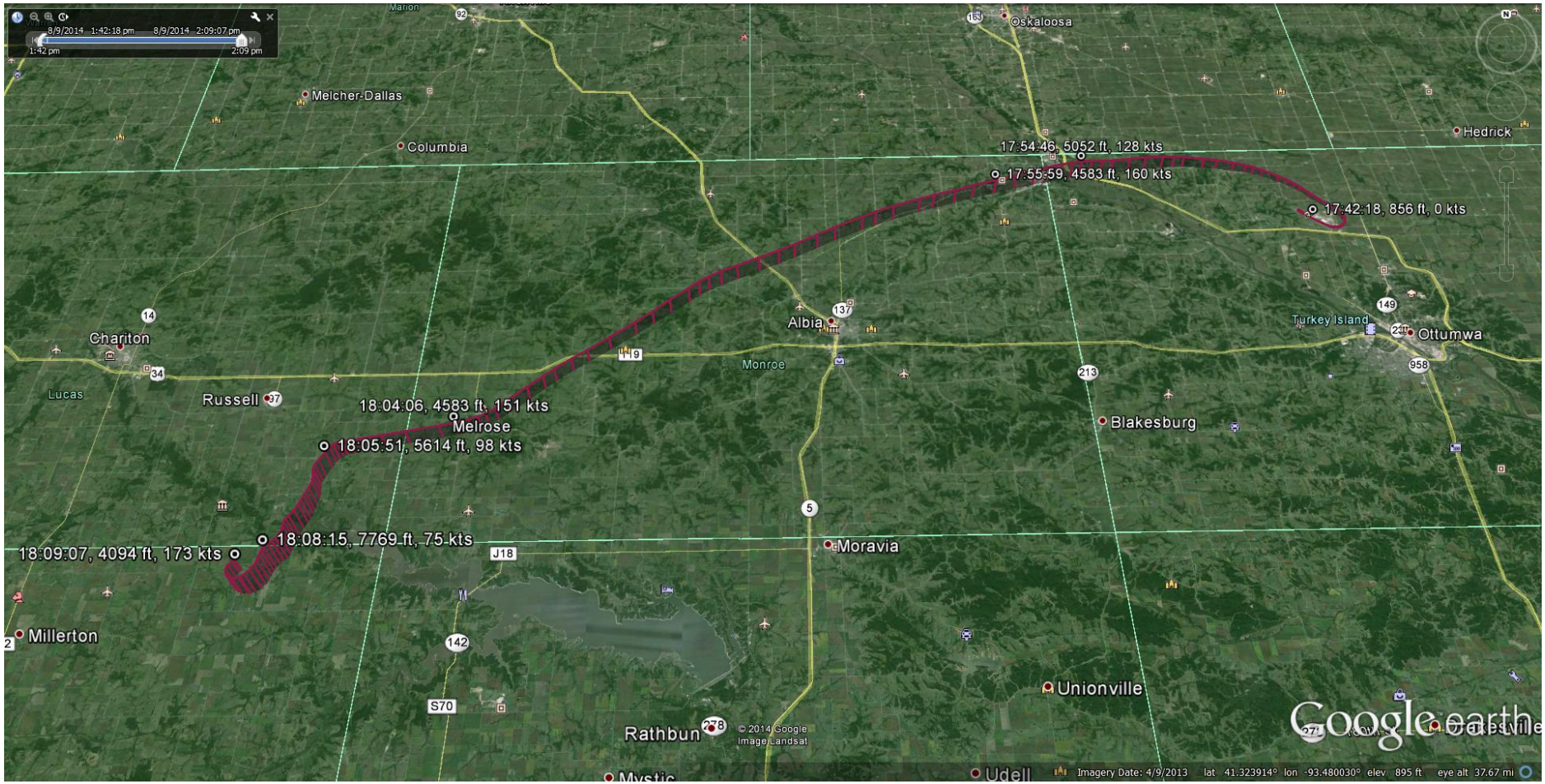


Figure 9. Accident flight as recorded by Garmin 196 (sectional chart overlay).

Figure 10. Accident flight – start of recording and departure from OTM.

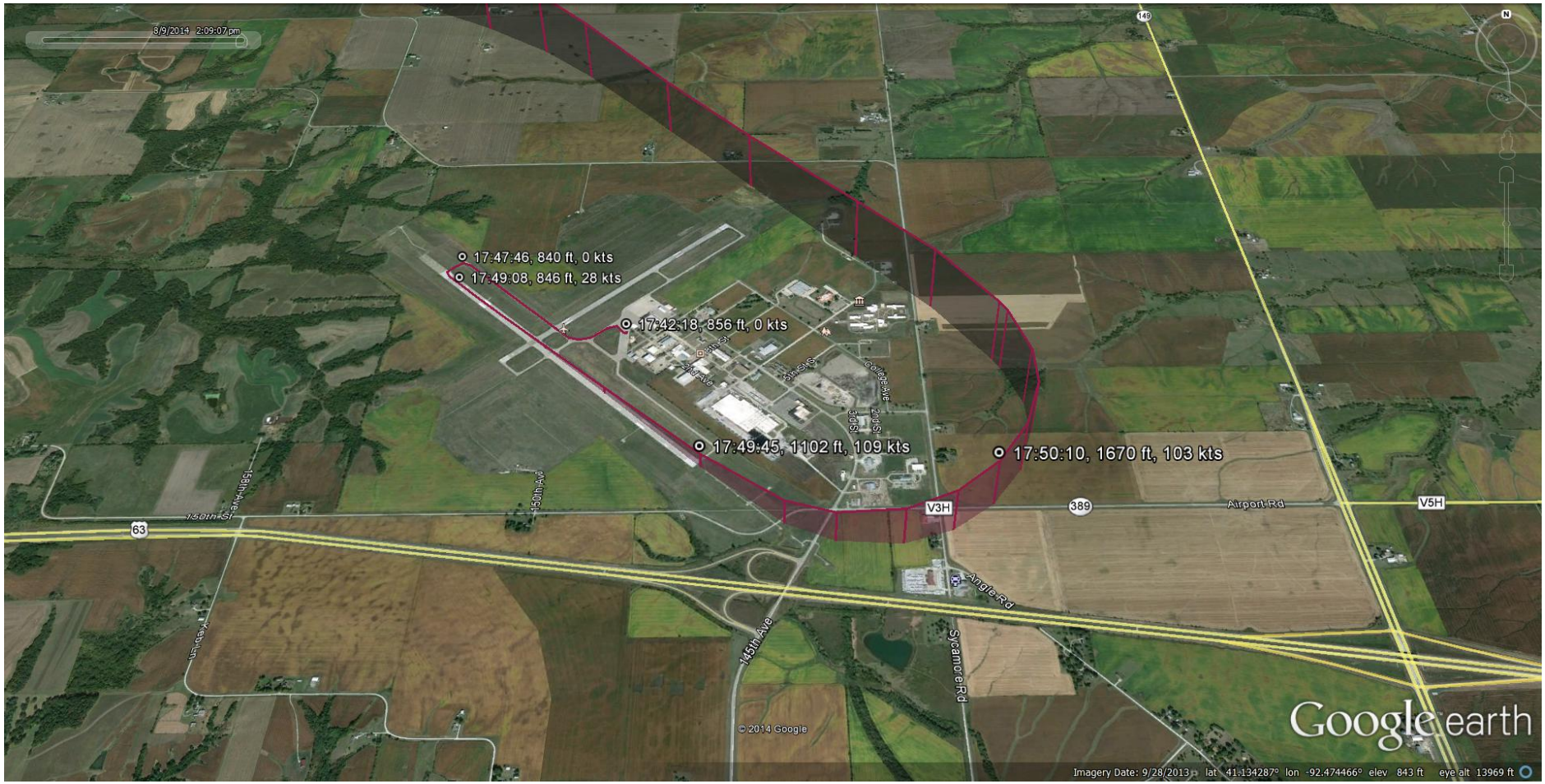


Figure 11. Accident flight – altitude and course changes until end of recording.

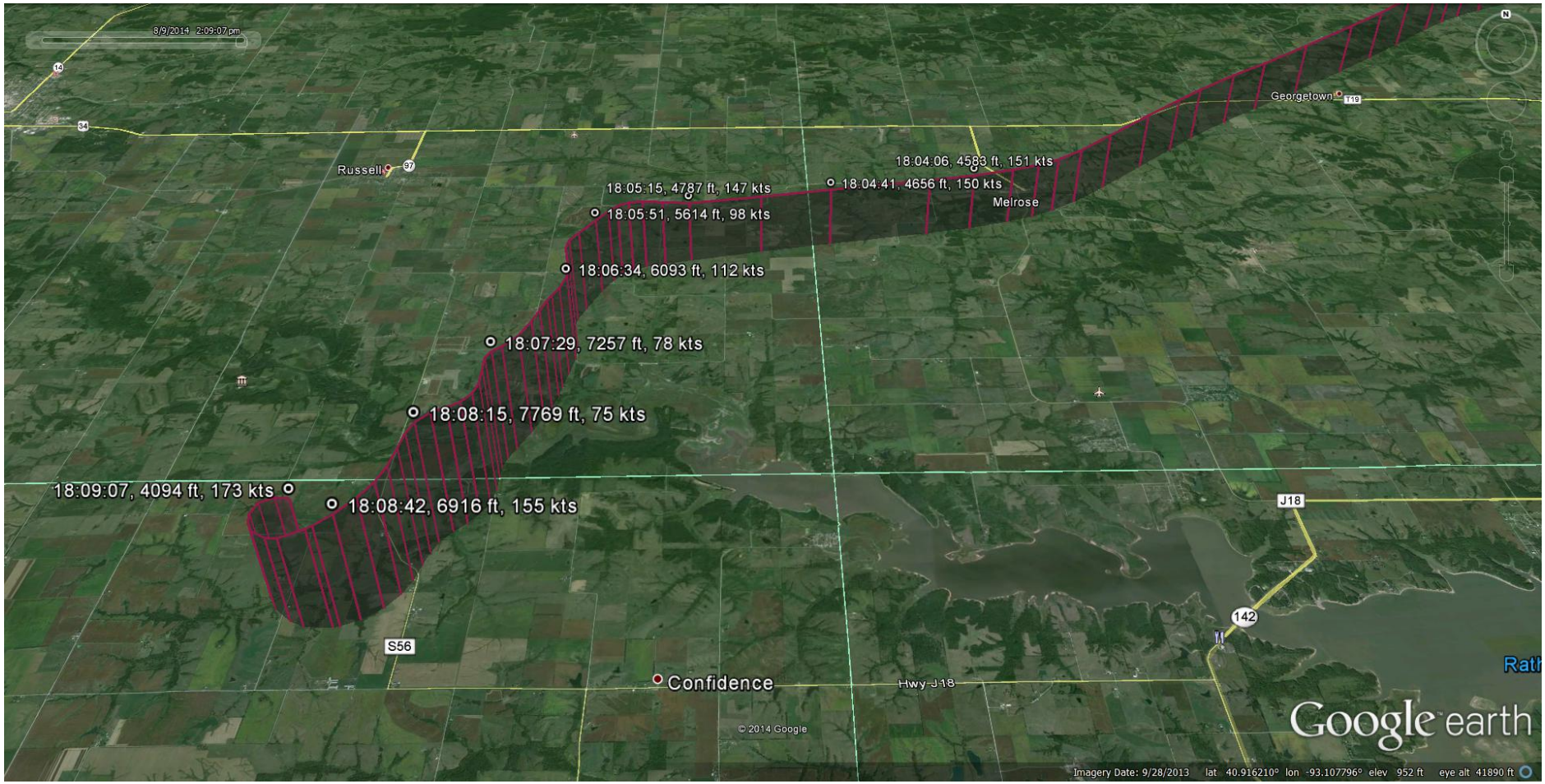


Figure 12. Accident flight – end of recording.