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

December 18, 2014

Electronic Devices

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

1. EVENT

Location:	Chicago, Illinois
Date:	November 18, 2014
Aircraft:	Aero Commander 500B
Registration:	N30MB
Operator:	Central Air Southwest
NTSB Number:	CEN15FA048

On November 18, 2014, about 0245 central standard time (CST), an Aero Commander model 500 B airplane, N30MB, impacted a residence while attempting to return after takeoff from the Chicago Midway International Airport (MDW), Chicago, Illinois. The pilot was fatally injured. The airplane was substantially damaged. The airplane was registered to and operated by Central Airlines, Inc., dba Central Air Southwest, under the provisions of 14 *Code of Federal Regulations* Part 135 as an on-demand cargo charter flight. Night visual meteorological conditions prevailed for the flight, which was operated on an instrument flight rules flight plan. The flight originated from MDW about 0238. The intended destination was the Ohio State University Airport (OSU), Columbus, Ohio.

2. DETAILS OF DEVICE INVESTIGATION

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

Device 1:	Apple iPhone 5C
Device 1 Serial Number:	F73LL5R0FFHK
Device 2:	Garmin GPSMAP 396
Device 2 Serial Number:	125000902

2.1. Apple iPhone 5C Device Description

The Apple iPhone is a touch-screen operated smartphone capable of voice calling, text messaging, email, photo/video recording, audio (music) playback, and numerous other specialized functions depending on configuration. The unit is capable of accessing

wireless networks using the IEEE 801.11n protocol (Wi-Fi) and other wireless devices supporting Bluetooth[1]. Specialized functions are supported by additional user-installed program applications (Apps). Application data is stored in non-volatile memory[2] and may include call logs, text messaging logs, image, video, and position location information. In addition, specialized application data may be stored in a proprietary file structure using numerous file formats including: binary, ASCII, HTML, SQL, etc. The amount and type of data stored varies based on the software version and configuration of the specific device.

2.1.1. Apple iPhone 5C Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had not sustained any damage, but was protected by a passcode. The Investigator-in-Charge supplied the proper passcode. The phone was examined by using a forensic download and by examining various screens.

2.1.2. Apple iPhone 5C Data Description

Information on the phone was used to build a partial 72-hour history of the pilot. Information indicative of user activity (as opposed to possible background activity) included: application screen shots, outbound phone calls, inbound phone calls of more than 10 seconds duration, internet (web) page displays, outbound text messages, user created documents, user photos, and joining Wi-Fi networks.

Appendix A, figure A-1 shows a 72-hour activity grid derived from the iPhone. User activity is shown in silver blocks; each block represents a 15-minute interval within the CDT hour. Tabular data used to generate figure A-1 are included as attachment 1 in electronic comma-delimited (.CSV) format.

2.2. Garmin GPSMAP 396 Device Description

The Garmin GPSMAP 396 is a battery-powered portable 12-channel GPS receiver with a 256-color TFT LCD display screen. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight information including NEXRAD radar, lightning, METARs, TAFs, and TFRs. The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 500 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed tracklog – 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. 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 the recording stops, depending on how the unit is configured. The current tracklog can be saved to

[1] A short-range, low bandwidth wireless protocol used in consumer electronics used mostly for low-overhead functions.
[2] Non-volatile memory is semiconductor memory that does not require external power for data retention.

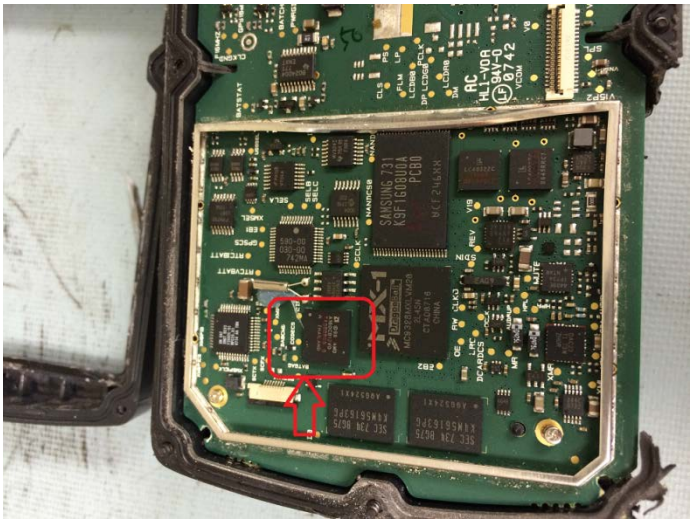
long-term memory and 15 saved tracklogs can be maintained in addition to the current tracklog. Tracklog storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in serial port using the NMEA 0183 version 2.0 protocol. The unit can also communicate with external devices such as a computer using a built in USB port. 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 396 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the device had sustained impact damage, as shown in figure 1. An internal inspection revealed damage to electronic components; however, the non-volatile memory chip was undamaged, as shown in figure 2. The chip was removed, downloaded, and decoded.

Figure 1. Garmin GPSMAP 396 as received.

Figure 2. Garmin GPSMAP 396 internal, with non-volatile memory annotated.



2.2.2. Garmin GPSMAP 396 Data Description

The data extracted included 57 sessions (15,880 data points) from November 4, 2014 through November 18, 2014. The accident flight was the last flight recorded, starting at 2:33:36 CST and ending at 2:42:07 CST on November 18, 2014[3].

2.2.3. Garmin GPSMAP 396 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. Date and Time were recorded as UTC by the device; 6 hours was subtracted from all UTC values to convert to CST for this report.

Table 1: GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (EDT) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (feet, MSL[4])
Groundspeed	Average groundspeed between current and previous data point (knots)
Track	Average true course between current and previous data point (degrees)

[3] The GPS recorded these times in UTC and they were converted to CDT for this report.
[4] MSL means altitude above mean sea level

2.2.4. Garmin GPSMAP 396 Overlays and Corresponding Tabular Data

Figures 3 through 8 were generated using data extracted from the Garmin GPSMAP 396 and overlaid using Google Earth. The weather and lighting depicted in Google Earth are not necessarily representative of the weather and lighting conditions experienced by the accident flight.

Figure 3 shows an overview of the accident flight. The recording began at 2:33:36 CDT on a ramp area at MDW. By 02:39:16 CDT, the aircraft began the takeoff roll. By the time the aircraft had crossed the intersection of runway 4R, the track had turned to the left. By 2:40:33 CDT, the aircraft track turned left and then followed a path similar to a left downwind for a northwest runway at an altitude of about 950 feet. The recording ended at 2:42:07 CDT, as the aircraft track was in a descending left turn.

Figure 4 shows the start of the recording and back taxi on runway 31C; arrows annotate the ground track direction. The ground track at the end of runway 31C is consistent with a counter-clockwise turn to align with the takeoff direction, with the last annotated point at 2:38:19 CST.

Figure 5 shows the start of the takeoff roll, with the first annotated point at 2:38:19 CST. By 2:39:03 CST the computed groundspeed was still at 2 knots. By the next recorded point, 2:39:16 CST, the computed groundspeed had increased to 12 knots and continued to increase thereafter.

Figure 6 shows the later part of the takeoff roll and initial climb. By 2:39:35 CST, the ground track started to deviate to the left. By 2:39:53 CDT, when the aircraft was at a recorded altitude of 716 feet (about 100 feet above ground level), the ground track had deviated to the left, nearly aligned with runway 31L.

Figure 7 shows detailed track points for the initial climb. Figure 8 shows all track points for the end of the recording.

Tabular data used to generate figures 3 through 8 are included as attachment 2 in electronic comma-delimited (.CSV) format.

Figure 3. Accident flight, as recorded by Garmin 396.

Figure 4. Accident flight start of recording, taxi, and back taxi, as recorded by Garmin 396.

Figure 5. Start of takeoff roll, as recorded by Garmin 396.

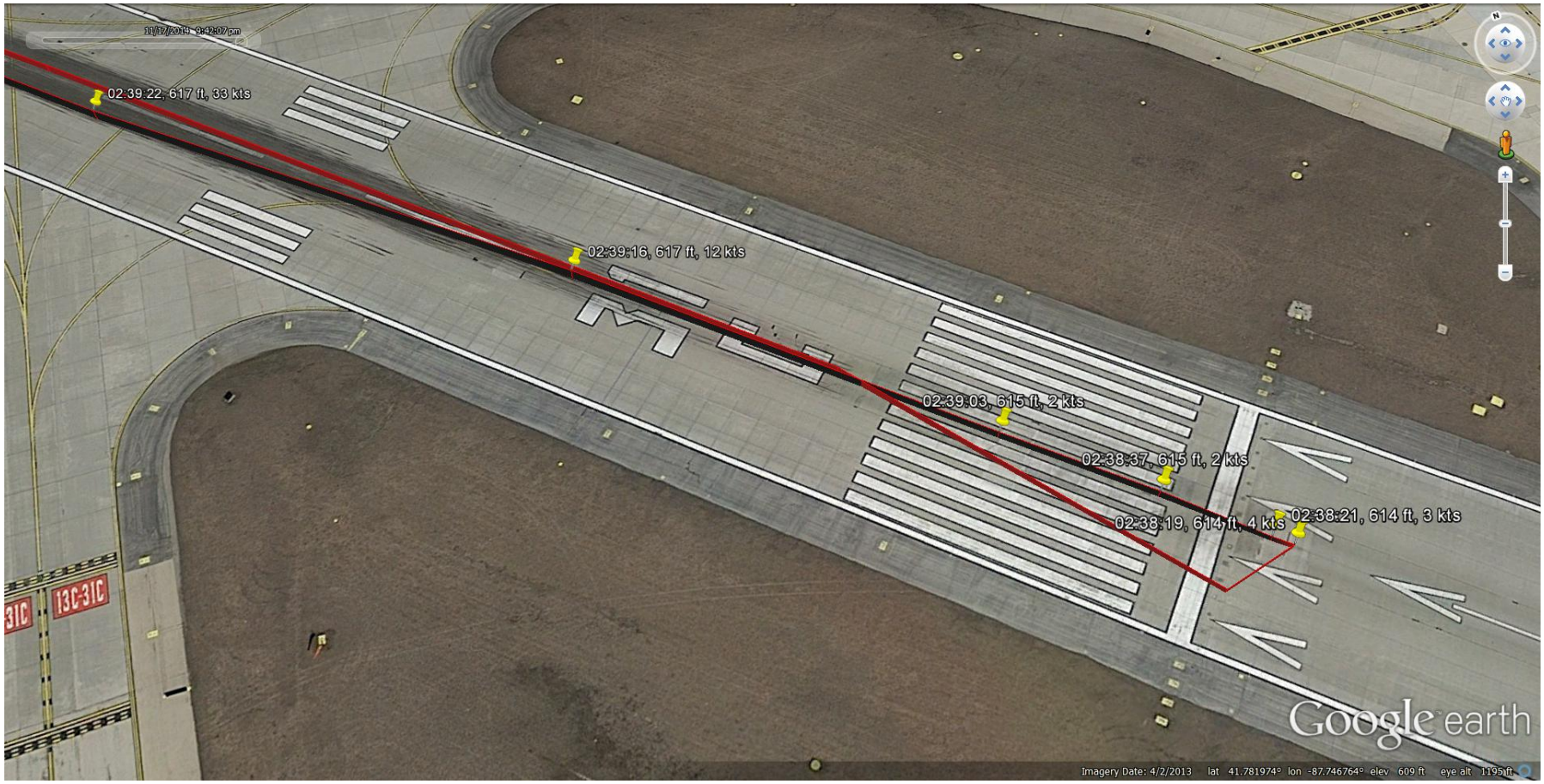


Figure 6. Takeoff roll and initial climb, as recorded by Garmin 396.

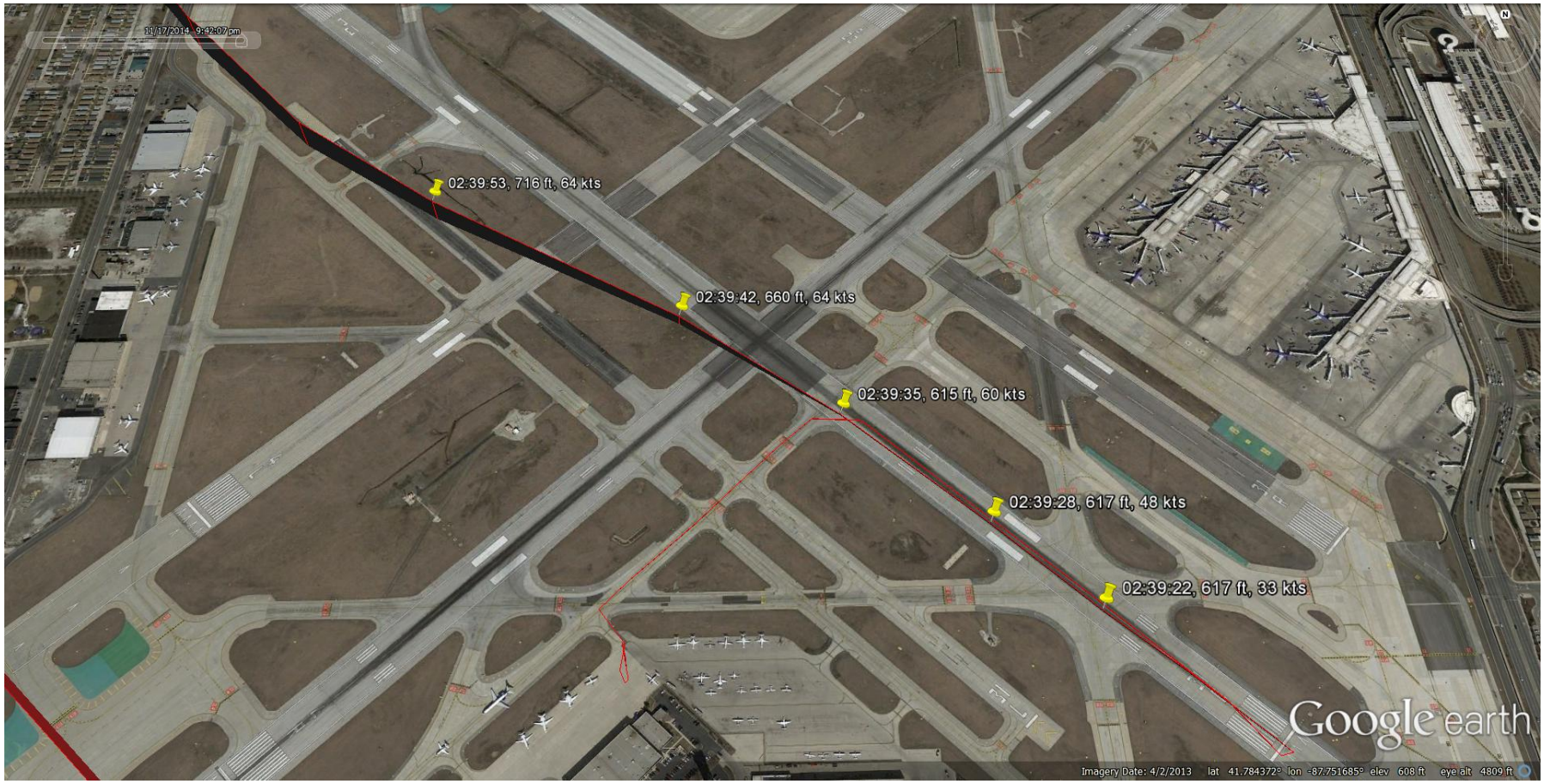


Figure 7.Initial climb, as recorded by Garmin 396.

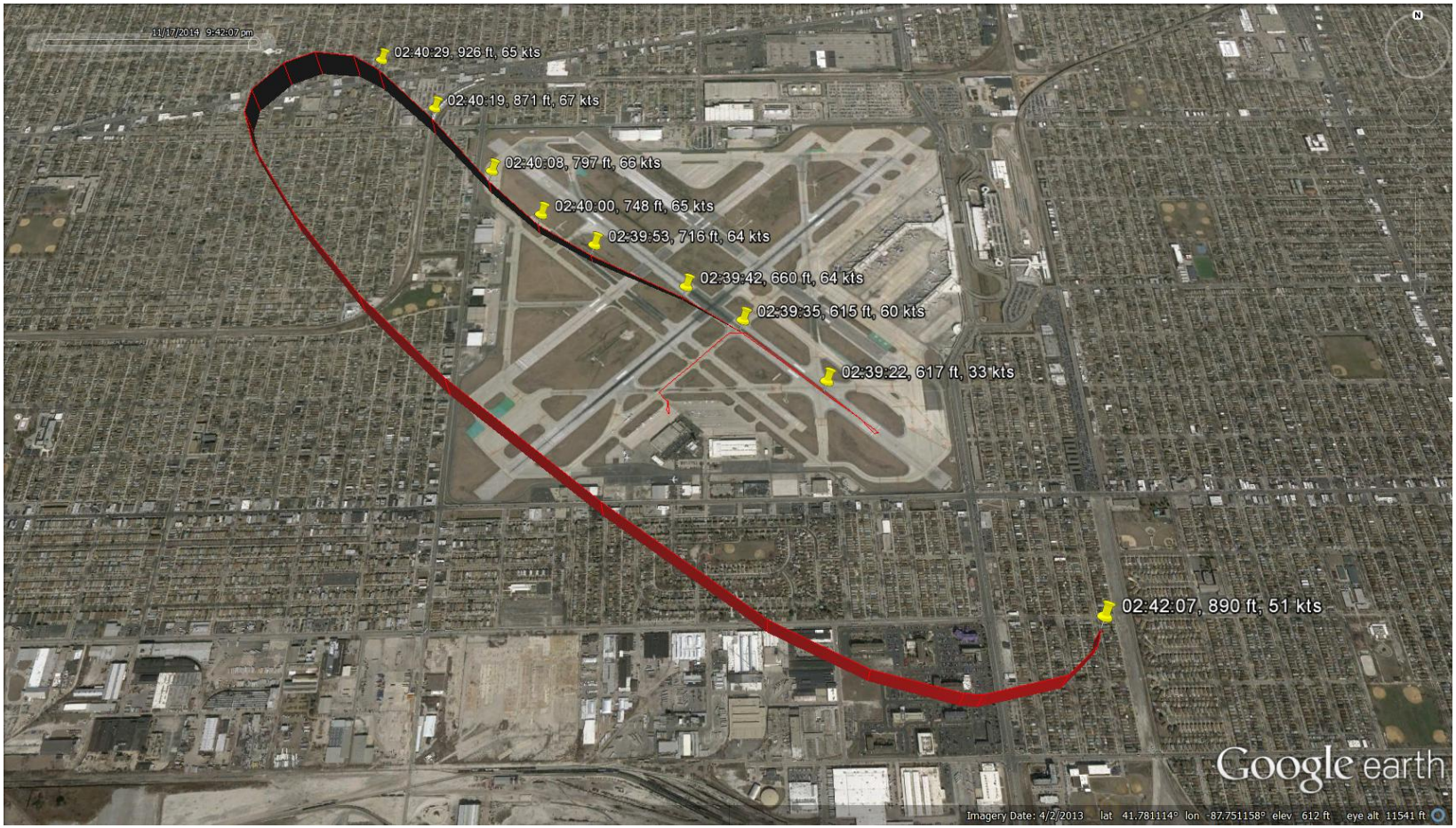
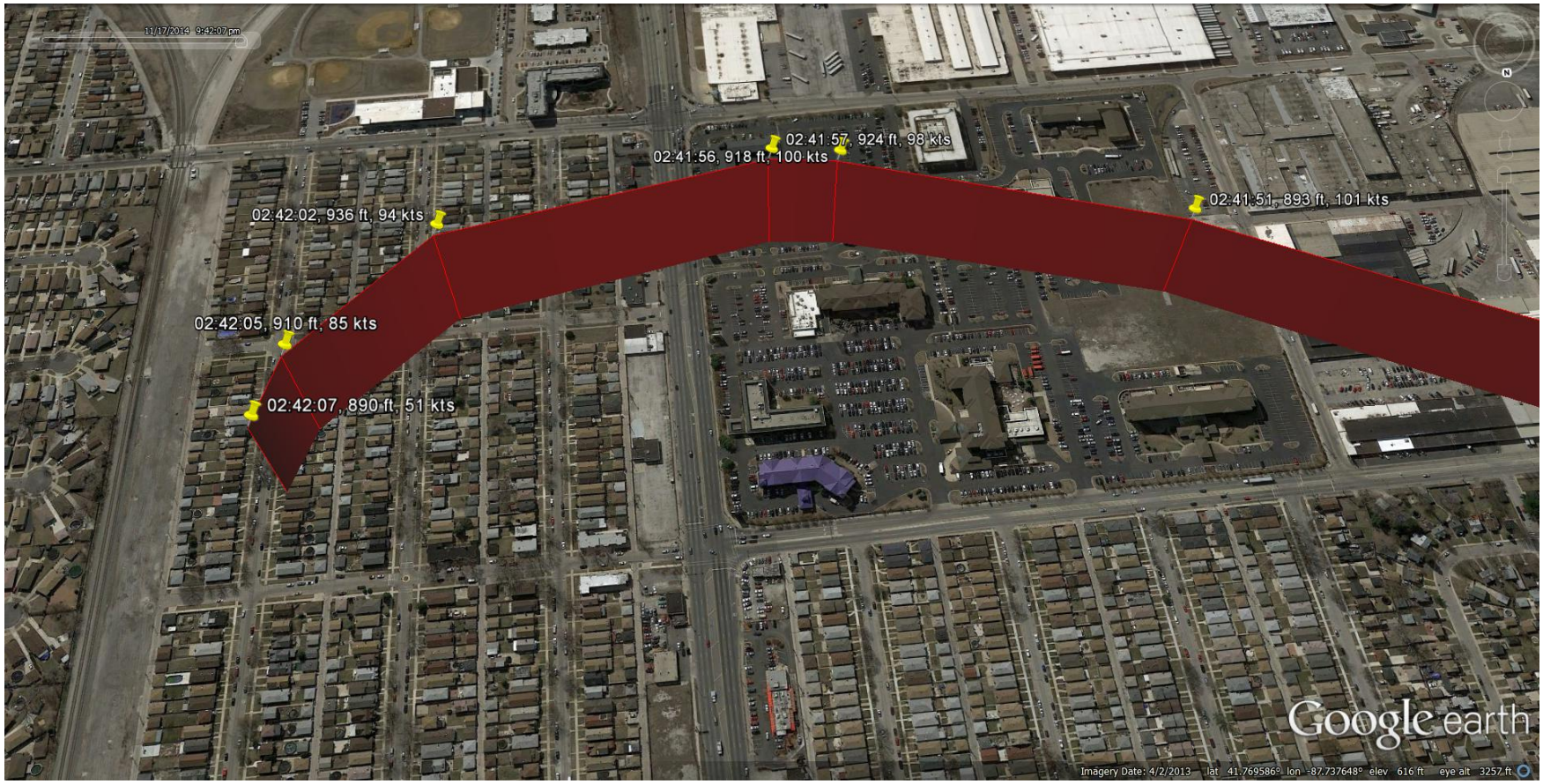


Figure 8. End of recording, as recorded by Garmin 396.



Appendix A

Figure A-1. Pilot partial 72-hour history, as derived from iPhone 5C.