

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

October 24, 2016

Cockpit Displays – Recorded Flight Data

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

1. EVENT SUMMARY

Location: Juneau, Alaska
Date: July 17, 2015
Aircraft: Cessna 207A
Registration: N62AK
Operator: Sea Port Airlines, Inc., dba Wings of Alaska
NTSB Number: ANC15FA049

On July 17, 2015, about 1318 Alaska daylight time (AKDT), a Cessna 207A airplane, N62AK, sustained substantial damage following an in-flight collision with tree-covered terrain about 18 miles west of Juneau, Alaska. The flight was being operated as Flight 202 by Sea Port Airlines, Inc., doing business as (dba) Wings of Alaska, as a visual flight rules (VFR) scheduled commuter flight under the provisions of 14 *Code of Federal Regulations* Part 135. The commercial pilot sustained fatal injuries, and four passengers sustained serious injuries. Visual meteorological conditions were reported at the Juneau International Airport at the time of departure. Flight 202 departed the Juneau Airport at about 1308, for a scheduled 20 minute flight to Hoonah, Alaska. A company flight plan was on file and company flight following procedures were in effect.

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 devices:

Recorder Manufacturer/Model: **Chelton Integrated Display Unit (IDU)**
Recorder Serial Number: **35860**

Recorder Manufacturer/Model: **Chelton IDU**
Recorder Serial Number: **36336**

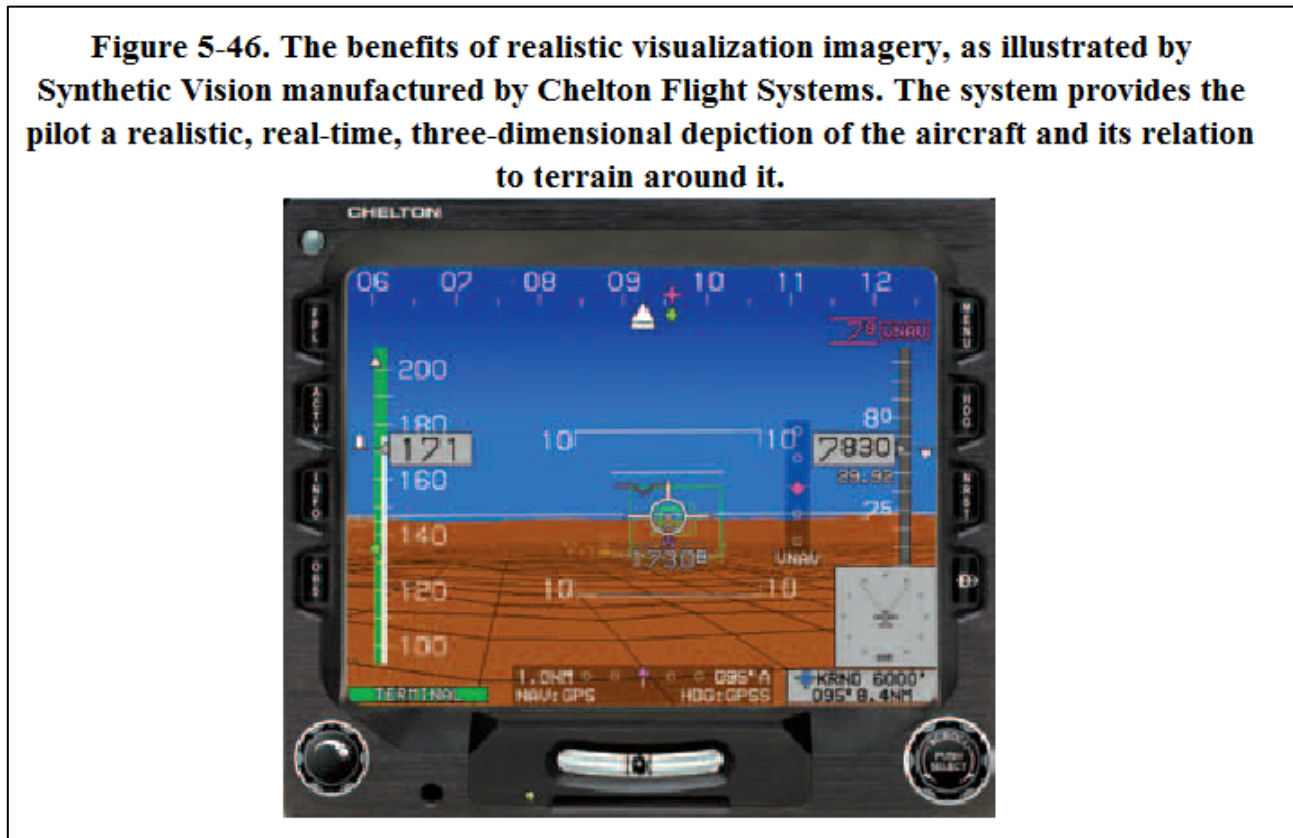
3.1. Chelton IDU

The IDU units are identical part numbers and are configured to operate as primary flight displays (PFD) or multi-function displays (MFD). Using external sensors, including solid state Air Data and Attitude Heading Reference System (ADAHRS), the PFD displays aircraft parameter data including altitude, airspeed, attitude, vertical speed, and heading.

The MFD displays navigational information by way of a moving map. Additionally, the units in this accident included a terrain awareness and warning system (TAWS) that may provide aural and color-coded warnings of terrain depending on pilot selections. As part of the TAWS system, the PFD is capable of providing a profile view of terrain ahead of the aircraft (“synthetic vision”). The FAA’s Instrument Flying Handbook (FAA-H-8083-15B) uses the Chelton IDU to explain the concept of synthetic vision, stating,

“Synthetic vision provides a realistic depiction of the aircraft in relation to terrain and flightpath. Systems such as those produced by Chelton Flight Systems, Universal Flight Systems, and others provide for depictions of terrain and course. Figure 5-46 [figure 1 in this report] is an example of the Chelton Flight System providing both 5-dimensional situational awareness and a synthetic highway in the sky, representing the desired flightpath. Synthetic vision is used as a PFD, but provides guidance in a more normal, outside reference format.” (Chapter 5)

Figure 1. Chelton display as depicted in the FAA Instrument Flying Handbook.



Each IDU contains two internally mounted flash memory devices (PCMCIA format) capable of logging flight data. Figure 2 shows a screen capture from the Chelton Installation Manual¹ of data parameters potentially recorded by each IDU once per second; the actual parameters recorded varies depending upon installation. The recording logic retains up to five hours of data from each of the last five flights. The recording begins after the pilot acknowledges the installed database dates by pressing a button on the IDU bezel and after internal diagnostics verify primary sensors are available. Additionally, every five

¹ Chelton Flight Systems EFIS-SV Installation Guide, 64-000038 Revision C.

seconds the IDU snapshots two binary files: (a) external parameters received by the IDU in an “ac.dat” file and (b) internal menu parameters indicating how the system was being operated in the “settings.dat” file.

The units installed in this aircraft conformed to Technical Standard Orders (TSOs), including TSOs: C2d, C4c, C6d, C8d, C10b, C113, and C146a.

Figure 2. Potential parameters recorded by each IDU.

First Line (Flight)	Second Line (Engine #1)	Third Line (Engine #2)
Latitude (°)	RPM	RPM
Longitude (°)	Fuel Flow (GPH)	Fuel Flow (GPH)
MSL Altitude (ft)	Aux. 1	Aux. 1
Pitch Angle (°)	Left Fuel (Gal.)	--
Bank Angle (°)	Right Fuel (Gal.)	--
Heading (° Mag.)	Fuel Pressure (PSI)	Fuel Pressure (PSI)
Track (° Mag.)	Aux. 5	Aux. 5
IAS (kts)	Oil Temperature (°F)	Oil Temperature (°F)
TAS (kts)	Oil Pressure (PSI)	Oil Pressure (PSI)
Ground Speed (kts)	Volts	Volts
VSI (fpm)	EGT #1 (°F)	EGT #1 (°F)
Glidepath (°)	CHT #1 (°F)	CHT #1 (°F)
G-force	EGT #2 (°F)	EGT #2 (°F)
Wind Speed (kts)	CHT #2 (°F)	CHT #2 (°F)
Wind Direction (° Mag.)	EGT #3 (°F)	EGT #3 (°F)
OAT (°F)	CHT #3 (°F)	CHT #3 (°F)
Density Altitude (ft)	EGT #4 (°F)	EGT #4 (°F)
Fuel Totalizer Qty. (Gal.)	CHT #4 (°F)	CHT #4 (°F)
--	EGT #5 (°F)	EGT #5 (°F)
--	CHT #5 (°F)	CHT #5 (°F)
--	EGT #6 (°F)	EGT #6 (°F)
--	CHT #6 (°F)	CHT #6 (°F)
--	Aux. Temp. 1 (°F)	Aux. Temp. #1 (°F)
--	Aux. Temp. 2 (°F)	Aux. Temp. #2 (°F)
--	Induction Temperature (°F)	Induction Temperature (°F)

3.1.1. Chelton IDU Data Recovery

Both IDUs sustained minor impact damage. Each unit contained two PCMCIA cards, which were removed from the unit. One card from each unit contained the flight log, “ac.dat,” and “settings.dat” files. These files were copied off the card using a PCMCIA card reader.

3.1.2. IDU Data Description

Each IDU flight log recording contained records of five power cycles corresponding to the last five flights. Data from both IDUs were compared and confirmed to contain the same data; as such, only the data from IDU serial number 35860 are used in this report.

3.1.3. IDU Engineering Units Conversions

The IDU records information in engineering units; therefore, no conversions were necessary. Where applicable, changes may have been made to ensure the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).²

Appendix A lists the IDU parameters verified and provided in this report.

3.1.4. IDU Settings Data

With assistance from the manufacturer, the ac.dat and settings.dat files were decoded. Values pertinent to this investigation from IDU serial number 35860 include:³

- TAWS was set to the inhibit position;
- Altimeter setting was 30.24 inHg;
- Above Ground Level (AGL) altitude used by TAWS: 112 feet; and
- Altitude indicated on the IDU was 1,223 feet.

3.2. Time Correlation

Each IDU record contains GPS date and time recorded in UTC. The data was converted to AKDT by subtracting 8 hours.

3.3. Plots and Corresponding Tabular Data

The following eight figures contain data recordings from July 17, 2015. Google Earth was used to overlay the data on satellite imagery. The weather, season, and lighting conditions in Google Earth are not representative of the conditions at the time of the accident.

Figure 3 shows an overlay of all recorded flights. The first recorded flight (Log 4) was from Juneau starting at 0522:36 AKDT. The last recorded flight (Log 0) was the accident flight from Juneau to Honnah. Table 1 summarizes each flight.

Table 1. Summary of five recorded flights.

Log	Start AKDT	End AKDT	Direction
4	0522:36	0553:44	From Juneau
3	0608:05	0649:55	To Juneau
2	1057:26	1019:57	From Juneau
1	1132:41	1150:06	To Juneau
0	1306:05	1318:08	From Juneau

Figures 4 and 5 show the prior flight from Juneau to Hoonah and the accident flight; figure 4 is presented over satellite imagery, and figure 5 over an aviation sectional. The accident flight was flown farther north than the prior recorded flight to Hoonah.

² 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 According to the manufacturer, the IDU software version did not record the status of the synthetic vision display on either IDU (i.e., if color-coded warnings were displayed on the PFD or MFD).

Figure 6 shows an overlay of the entire accident flight, and figures 7 and 8 show the start of recording and end of recording, respectively. The recording began at 1306:05 AKDT and the flight departed at about 1308:24 AKDT, making a right turn shortly after takeoff towards the west. The flight crossed Lynn Channel and the recording ended at 1318:08 AKDT on the west side of Lynn Channel.

Figures 9 and 10 show plots of recorded parametric data. After takeoff, the flight initially climbed to about 1,153 feet mean sea level (MSL).⁴ In cruise flight, the fuel flow was about 16 gallons per hour (gph) at an indicated airspeed of about 118 knots. At about 1313:54 AKDT, the aircraft began a left turn towards a magnetic heading of about 235 degrees.

At about 1315:22 AKDT, the aircraft began to descend and the indicated airspeed increased slightly, while fuel flow remained relatively constant. At about 1317:33 AKDT, at an indicated altitude of about 763 feet MSL, the pitch began to increase from 3 degrees nose down to 20 degrees nose up by 1317:47 AKDT, while the fuel flow remained relatively constant, the indicated airspeed decreased through 103 knots, and the altitude increased. The indicated airspeed slowed to 76 knots at 1317:52 AKDT, as the pitch attitude was decreasing towards 2 degrees nose down. At 1317:59 AKDT, the pitch attitude began to increase (nose up) again, as the indicated airspeed decreased. At 1318:01 AKDT, the pitch attitude was 20 degrees nose up and the indicated airspeed was 62 knots. Thereafter, the indicated airspeed continued to decrease until the end of the recording at 1318:08 AKDT.

The corresponding tabular data used to create these overlays and plots are provided in electronic (*.csv⁵) format as attachment 1 to this report.

⁴ Recorded altitudes were indicated altitude as displayed on the IDU.

⁵ Comma Separated Value format.

Figure 3. Annotated overlay of all recorded flights.

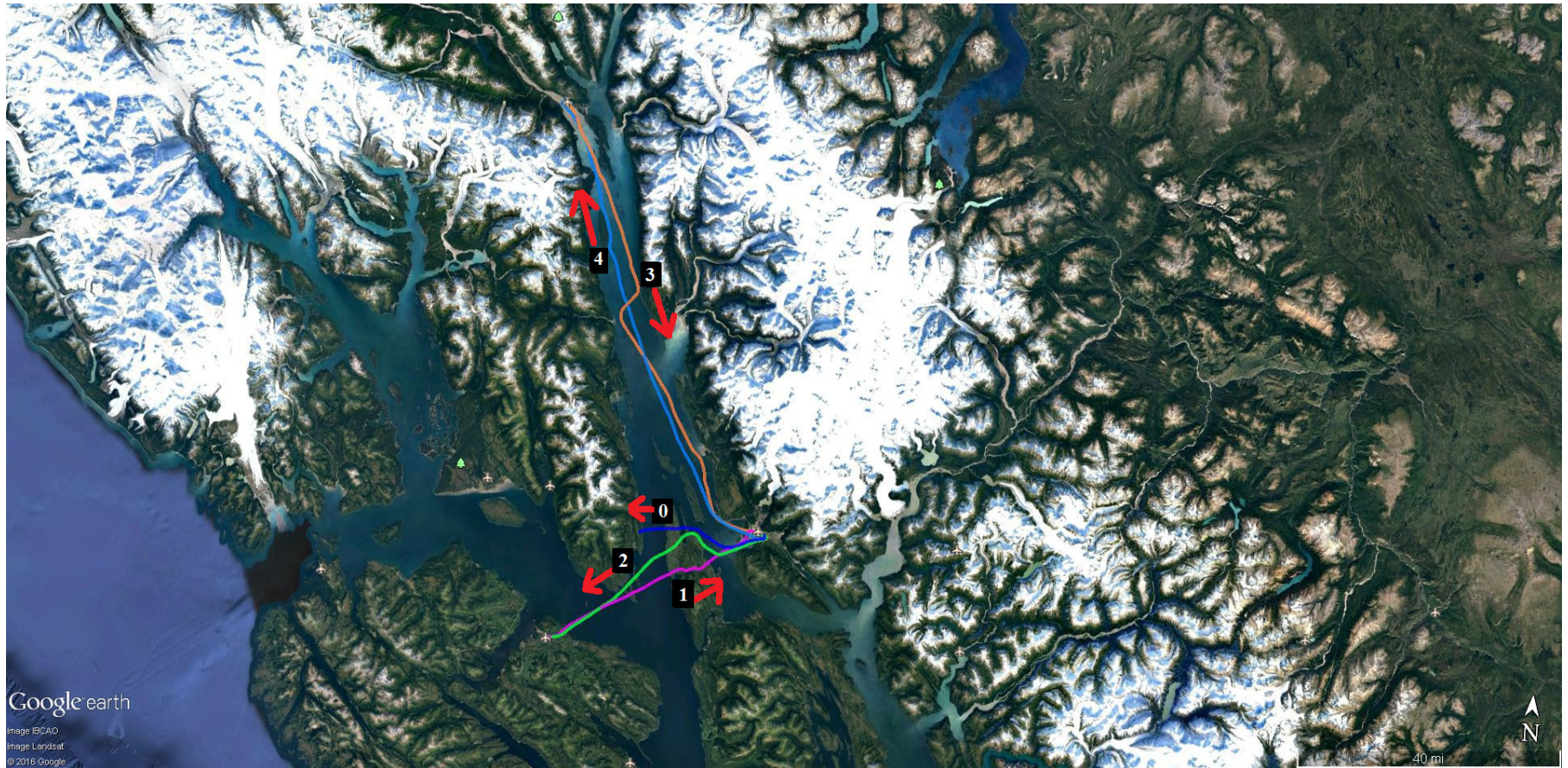


Figure 4. Overlay of accident flight and prior recorded flight to Honnah (satellite imagery overlay).

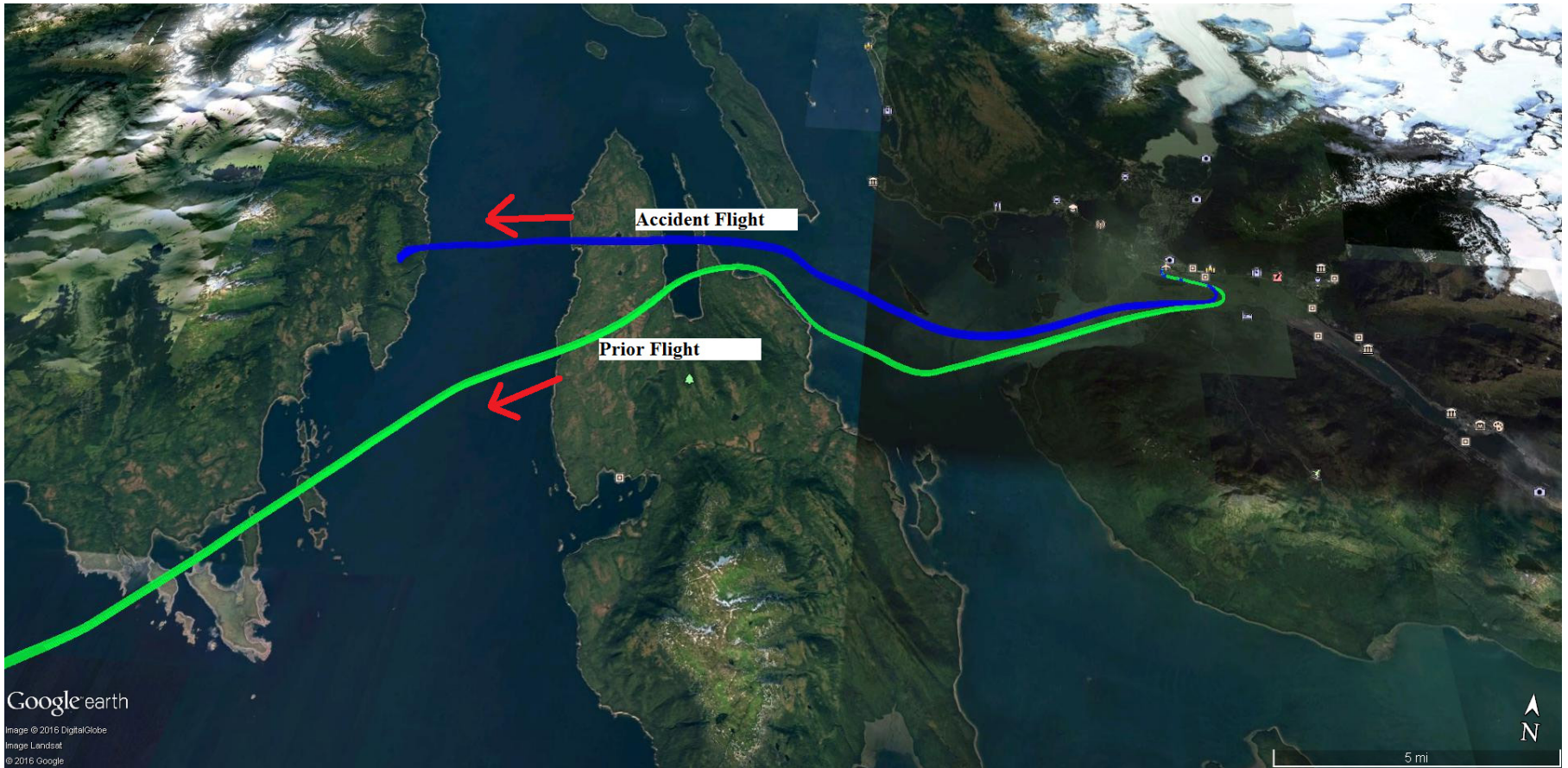


Figure 6. Overlay of accident flight recording.

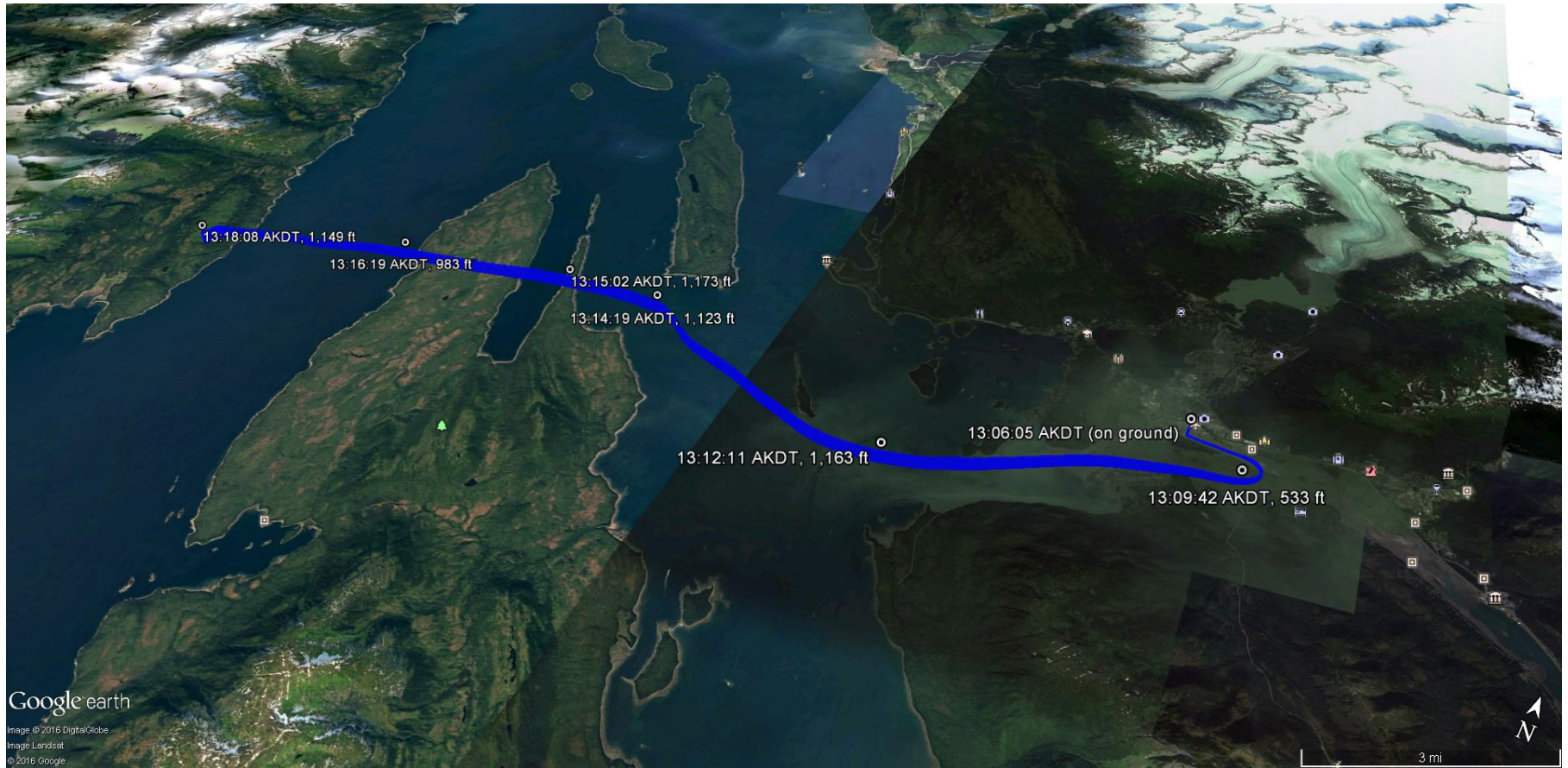


Figure 7. Overlay of start of accident flight recording.

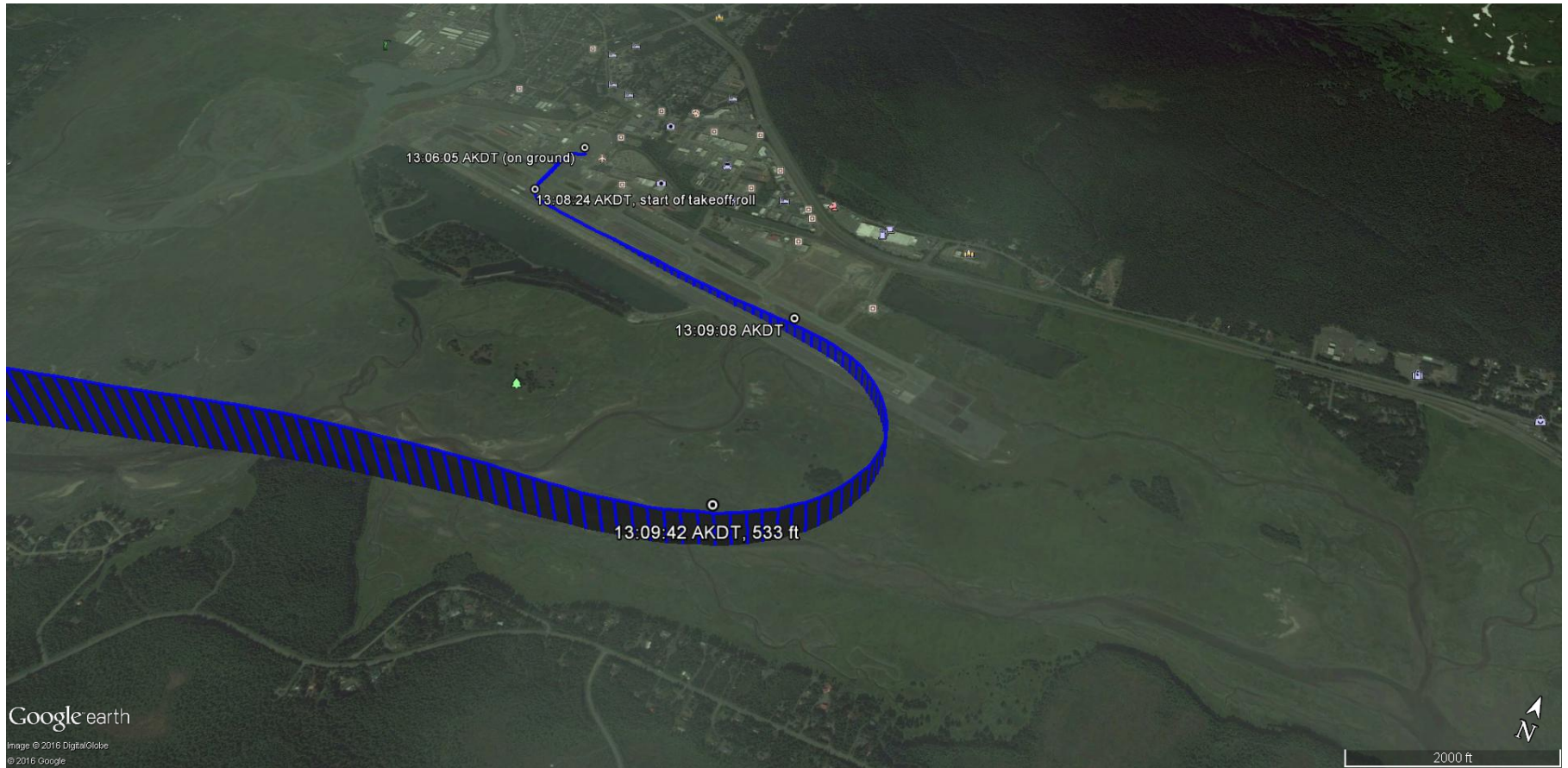


Figure 8. Overlay of end of accident flight recording.



Figure 9. Plot of entire accident flight recording.

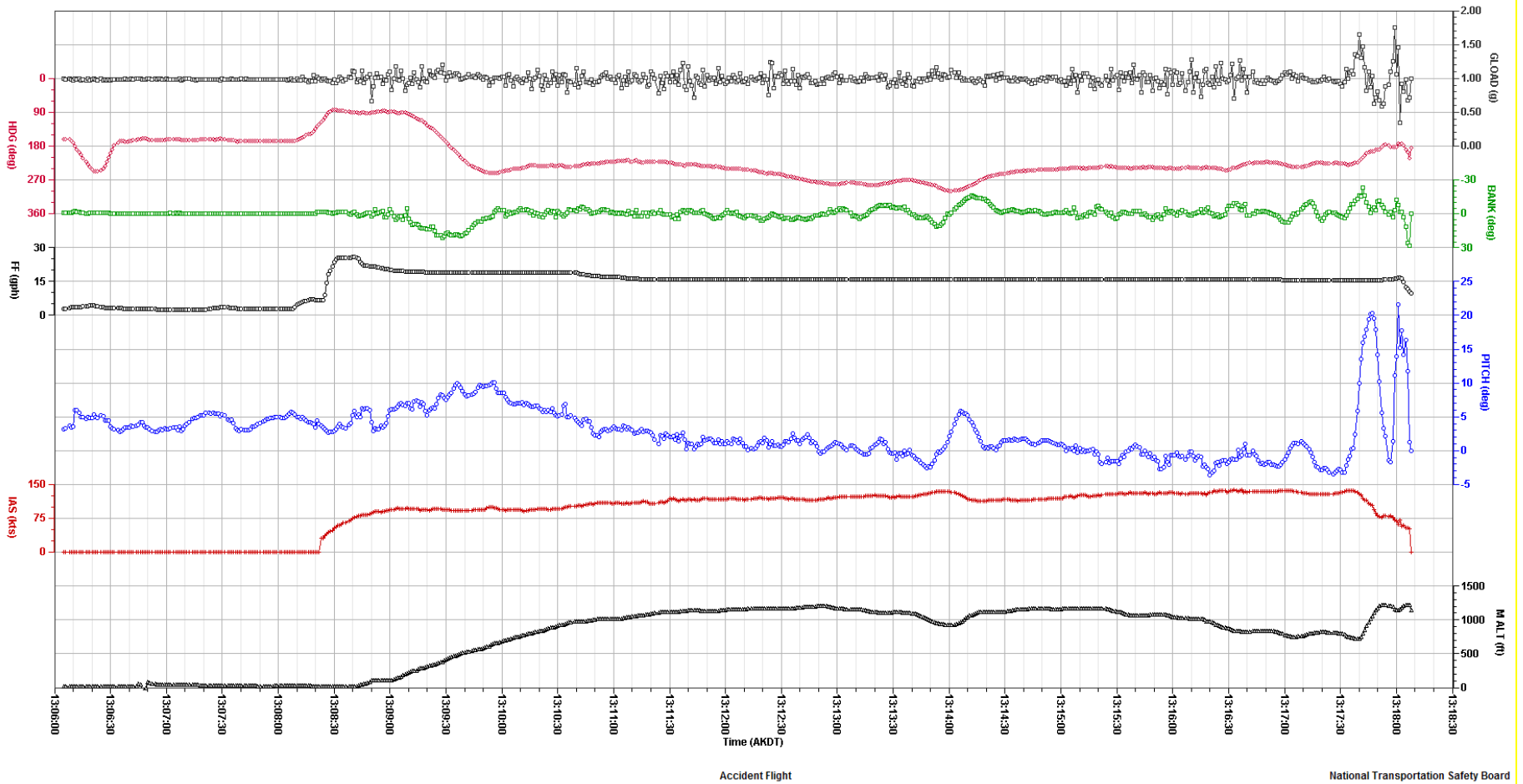
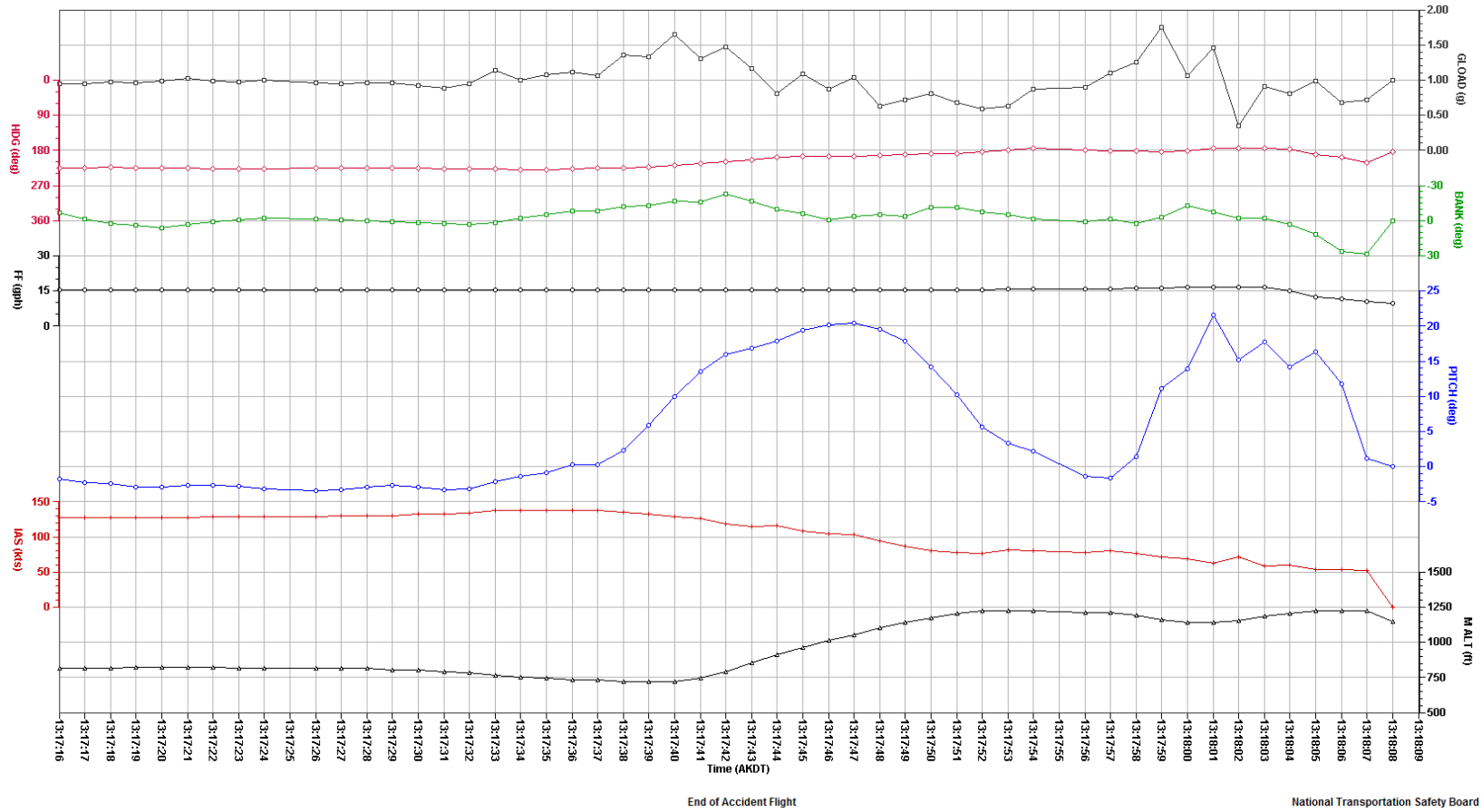


Figure 10. Plot of end of accident flight recording.



APPENDIX A - IDU Parameters

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

Table A-1 - Verified and provided parameters.

Parameter Name	Parameter Description
bank (deg)	Roll Angle
ff (gph)	Fuel Flow
gload (g)	Vertical Acceleration
hdg (deg)	Magnetic Heading
ias (kts)	Indicated Airspeed
lat (deg)	Latitude
Log	Log Number (see Table 1)
long (deg)	Longitude
m alt (ft)	Indicated Altitude
pitch (deg)	Pitch Angle
time (hh:mm:ss)	AKDT Time

The IDU records altitude as shown on the IDU, which is based on the altimeter setting set by the pilot.

Table A-2 - Unit abbreviations.

Units Abbreviation	Description
deg	degrees
fpm	feet per minute
ft	feet
gph	gallons per hour
kts	knots