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

November 3, 2011

17 - GPS Factual Report

by Bill Tuccio

A. EVENT

Location:	Dixie, Georgia
Date:	October 8, 2011
Aircraft:	Luscombe 8A
Registration:	N41907
Operator:	Private
NTSB Number:	ERA12FA017

B. GROUP - No Group

C. SUMMARY

On October 8, 2011, about 1450 eastern daylight time, a Luscombe 8A, N41907, incurred substantial damage when it impacted trees following a total loss of engine power near Dixie, Georgia. The pilot received serious injuries and the passenger was killed. Visual meteorological conditions prevailed at the time and no flight plan was filed for the Title 14 Code of Federal Regulations, Part 91, personal flight. The flight originated from the Thomasville Regional Airport (TVI), Thomasville, Georgia, earlier that day, about 1420.

D. DETAILS OF INVESTIGATION

On October 26, 2011, the NTSB Vehicle Recorder Laboratory received the following device(s):

GPS Manufacturer/Model:	Lowrance AIRMAP 1000
Serial Number:	101929039

Lowrance AIRMAP 1000 Description

The Lowrance AIRMAP 1000 is a WASS[1]-capable, battery operated hand-portable 12-channel mapping GPS unit equipped with a 320 x 320 pixel 16-level grayscale LCD display, soft key controls, and support for custom maps. The unit has the capability of performing E-6B[2] calculations. It contains a slot for a multi-media card (MMC) or Secure Digital (SD) FLASH[3] memory card. This card may be used to transfer and store custom map, waypoint[4], route[5], and trail[6] data to and from a desktop PC to the GPS unit. A serial interface using NMEA 0183[7] communication protocols is mounted in the back of the GPS unit, but the internal operating software does not support the download of saved data via this serial port.

The Lowrance AIRMAP 1000 can store up to 100 routes composed of up to 100 waypoints each. The unit can also store trail data composed of up to 10,000 latitude-longitude points per trail. Up to 100 individual trails may be named and saved by the user. Once the limit has been reached for recording continuously updated trail data trail, older latitude/longitude points are overwritten with new data on a first-in, first-out basis. The AIRMAP 1000 may be programmed to update trail data in one of three ways: automatically, by time, or by distance traveled. The default 'automatic' mode only updates trail data when the GPS unit senses that position has changed by at least 0.1 miles, or that direction has changed by 2° or more. Updating by time may be set to record a new latitude / longitude point every 1 to 9,999 seconds. Updating by distance may be set to record a new latitude/longitude point whenever the distance traveled from the last update exceed anywhere from 0.01 miles to 9.99 miles. All recorded data is stored internally in non-volatile memory[8], and may be copied to a MMC or SD card inserted in a card slot in the battery compartment. The data is stored in a Lowrance proprietary *.usr file format. This card may be read using a standard desktop PC running the Microsoft Windows operating system.

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[1] Wide Area Augmentation System. WAAS is based on a network of approximately 25 ground reference stations that covers a very large service area. Signals from GPS satellites are received by wide area ground reference stations (WRSs). Each of these precisely surveyed reference stations receive GPS signals and determine if any errors exist. Each WRS in the network relays the data to the wide area master station (WMS) where correction information is computed. The WMS calculates correction algorithms and assesses the integrity of the system. A correction message is prepared and uplinked to a geosynchronous satellite via a ground uplink system (GUS). The message is then broadcast from the satellite on the same frequency as GPS (L1, 1575.42MHz) to receivers on board aircraft (or hand-held receivers) which are within the broadcast coverage area of the WAAS. WAAS-capable receivers are capable of basic GPS accuracy to approximately 7 meters vertically and horizontally.

[2] E-6B is refers to mechanical and electronic tools assisting common flight related computations.

[3] FLASH Memory is a form of re-writeable, non-volatile memory that can retain data without external power - provided that the chip is not heated beyond the data retention temperature limit as stated in the datasheet

[4] Geographical point specified by a set of latitude and longitude data along with descriptive information.

[5] An ordered list of waypoints.

[6] Linked list of latitude and longitude data representing the position of the aircraft as a function of time.

[7] NMEA, National Marine Electronics Association. NMEA Standard 0183 is an ASCII-based serial communication protocol.

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

GPS Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had not sustained any damage (figure 1 and 2). Power was applied to the accident unit and the display briefly displayed startup information; however the display was thereafter inoperative. An operative unit was used to guide the input of keystrokes without the benefit of the screen. Recorded waypoint, route, and tracklog data was successfully transferred to the unit's SD card as a *.usr file. The *.usr file was subsequently decoded using NTSB developed software.

Figure 1. Front of Lowrance Airmap 1000.

Figure 2. Back of Lowrance Airmap 1000.

GPS Data Description

The data extracted included 2000 trail data points consisting only of latitude and longitude data, recorded in chronological order. The trail data contained no date/time stamp making groundspeed calculation impossible. GPS altitude was similarly not recorded. Since the trail update mode was set to 'automatic' while recording this trail data, no assumptions can be made concerning the relative timing of the recorded lat/lon points.

GPS Parameters Provided

Table 1 describes data parameters provided by the GPS device. Latitude and Longitude are recorded by the device. Data point number was added during data extraction and represents the ordinal position of the recorded trail point.

Table 1: GPS Data Parameters

Parameter Name	Parameter Description
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
Point ID	Ordinal position of position in file (integer)

OVERLAYS AND TABULAR DATA

Figure 2 is a graphical overlay generated using Google Earth for the accident flight. The flight departed the Thomasville Regional Airport (TVI) and flew south. Point #1497 is the southernmost point recorded by the GPS on this flight. This point was about 8.2 nm from the Jefferson Landing Airport (74FL). The straight line distance from point #1497 to the crash site was about 4.5 nm. The straight line distance from TVI to point #1497 was about 13.6 nm.

Figure 3 is a graphical overlay generated using Google Earth depicting the departure from TVI. Points #1410 through approximately #1427 depict the taxi portion prior to take-off.

Figure 4 is a graphical overlay generated using Google Earth depicting the crash location. The southernmost point recorded after final approach was point #1561. However points #1562-1564 were recorded about 295 feet further north from point #1561. An additional 436 points were recorded (points #1565 through #2000) but are not shown; the points had a scattered pattern around the crash site.

Tabular data used to generate figures 2 through 4 are included as Attachment 1. This attachment is provided in electronic comma-delimited (.CSV) format.

Figure 3. Google Earth overlay of whole flight.

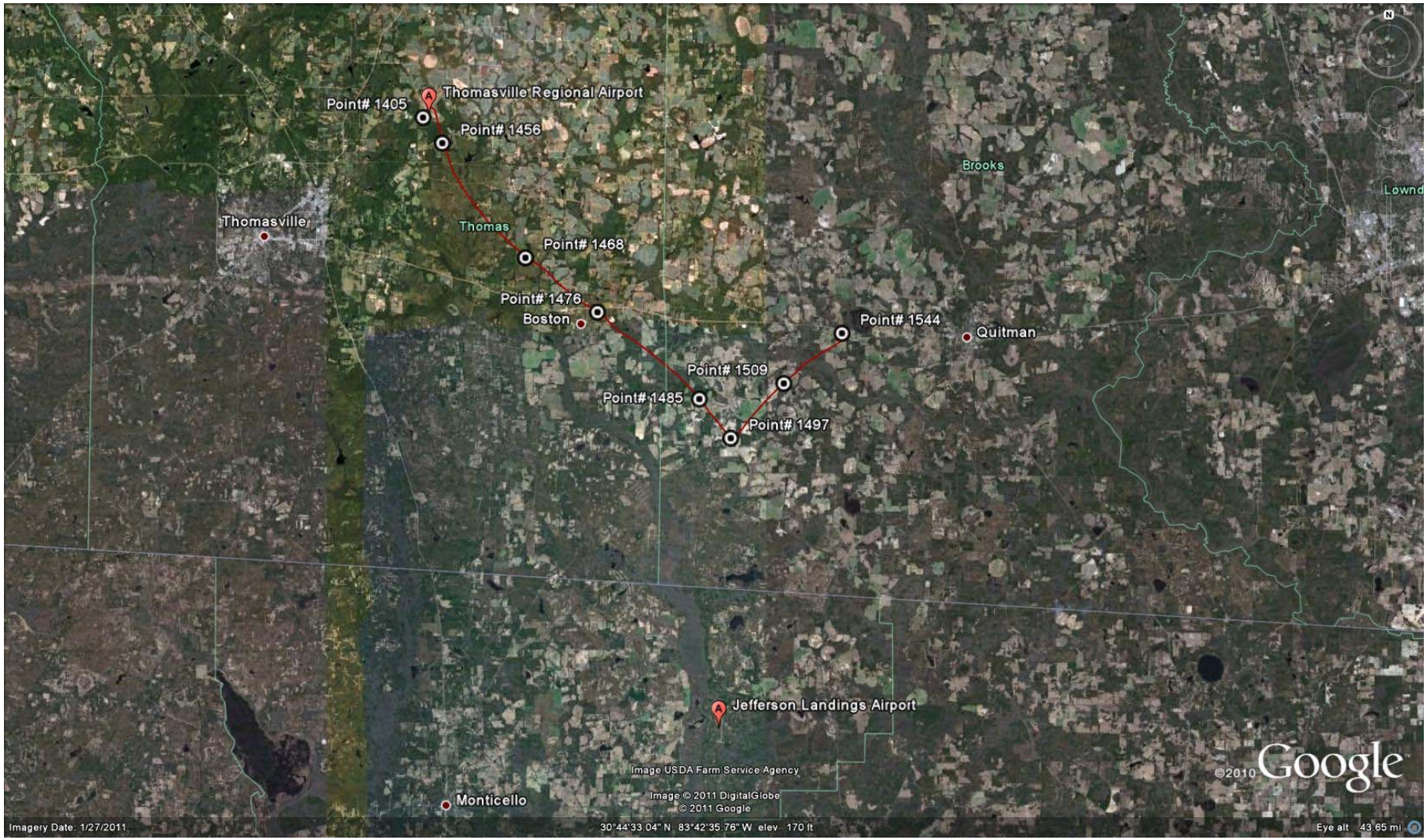

Figure 4. Google Earth overlay of take-off.

Figure 5. Google Earth overlay of crash location.