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

June 26, 2018

Global Positioning System

Specialist's Factual Report
by Alice Park

1. EVENT

Location:	Tyonek, Alaska
Date:	August 23, 2017
Aircraft:	Piper PA-18
Registration:	N1905A
Operator:	Private
NTSB Number:	ANC17FA049

On August 23, 2017, about 2245 Alaska daylight time, a tundra tire-equipped Piper PA-18 airplane, N1905A, originated from a remote airstrip in mountainous terrain near Telaquana Lake, located in the Lake Clark National Park and Preserve, was destroyed after impacting remote tree-covered terrain while en route to Merrill Field, Anchorage, Alaska about 31 mile northwest of Tyonek, Alaska. The pilot, the only occupant, died at the scene. The airplane was registered to and operated by the pilot as a 14 *Code of Federal Regulation* Part 91 visual flight rules personal flight. Dark night, visual meteorological conditions were reported at the Kenai Municipal Airport, Kenai, Alaska about 8 minutes after the accident time, and no flight plan was filed. The Kenai Municipal Airport is located about 44 miles southeast of the accident site.

2. DETAILS OF DEVICE INVESTIGATION

The National Transportation Safety Board Vehicle Recorder Division received the following Global Positioning System (GPS) device:

Device:	Garmin Aera 660
Device S/N:	4NN003877

2.1. Garmin Aera 660 Device Description

Garmin Aera 660 is a battery-powered portable multi-function display and GPS receiver with sunlight readable a 5-inch diagonal touchscreen operation display. The unit includes a built-in Jeppesen database and can receive XM satellite radio for flight information including NEXTRAD radar, lightning, METARs, TAFs, and TFRs. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and Safe Taxi Airport Diagrams are included for selected fields. The unit stores date, route-of-flight, and flight-time information for up to 50 flights. The unit has 23 different map ranges available, from 200 feet to 800 nm. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 250 feet and ends when groundspeed drops below 30 knots for 10 minutes or more. 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. Position is updated within the track log 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.[1] 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*[2] 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 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.

2.1.1. Garmin Aera 660 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit was severely damaged during the accident and would not power on (Figures 1 and 2). It was disassembled for further examination.

The Garmin Aera 660 stores recorded data on an eMMC[3] (SAMSUNG 031, KLMAG2GEND B031), FLASH[4] memory device mounted to the main printed circuit board (PCB) (see Figure 3 in red circle). It was removed from the PCB using a hot air re-work station. A raw-data binary readout of the device was obtained using a *Sireda eMMC*

[1] Changing track log setting can be done in the Main Menu. Track 'Distance' records after a specified distance has been traveled. 'Time' creates after a specified time elapsed Track log interval. Recording begins when the speed of the flight exceeds 30 knots and gains 250 feet of altitude. If the flight has landed and ground speed drops below 30 knots, the flight entry is saved, and a new entry is recorded when the flight departs the airport (by default).

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

[3] eMMC (embedded Multi-Media Controller) refers to a package consisting of both flash memory and a flash memory controller integrated on the same silicon die.

[4] FLASH memory is a form of re-writable, non-volatile memory that can retain data without external power.

Reader.[5] The recorded track log was identified and converted to engineering units using an in-house software program.

[5] This eMMC USB data recovery extractor recovers data and images using an external USB adapter to connect eMMC Chip Flash Memory to PCs and Notebook.

1. External view of the Garmin Area 660 - front (s/n 4NN003877).

Figure 2. External view of the Garmin Area 660 - back (s/n 4NN003877).

Figure 3. Internal view of the Garmin Aera 660 main Printed Circuit Board; front (Flash memory device circled in red)

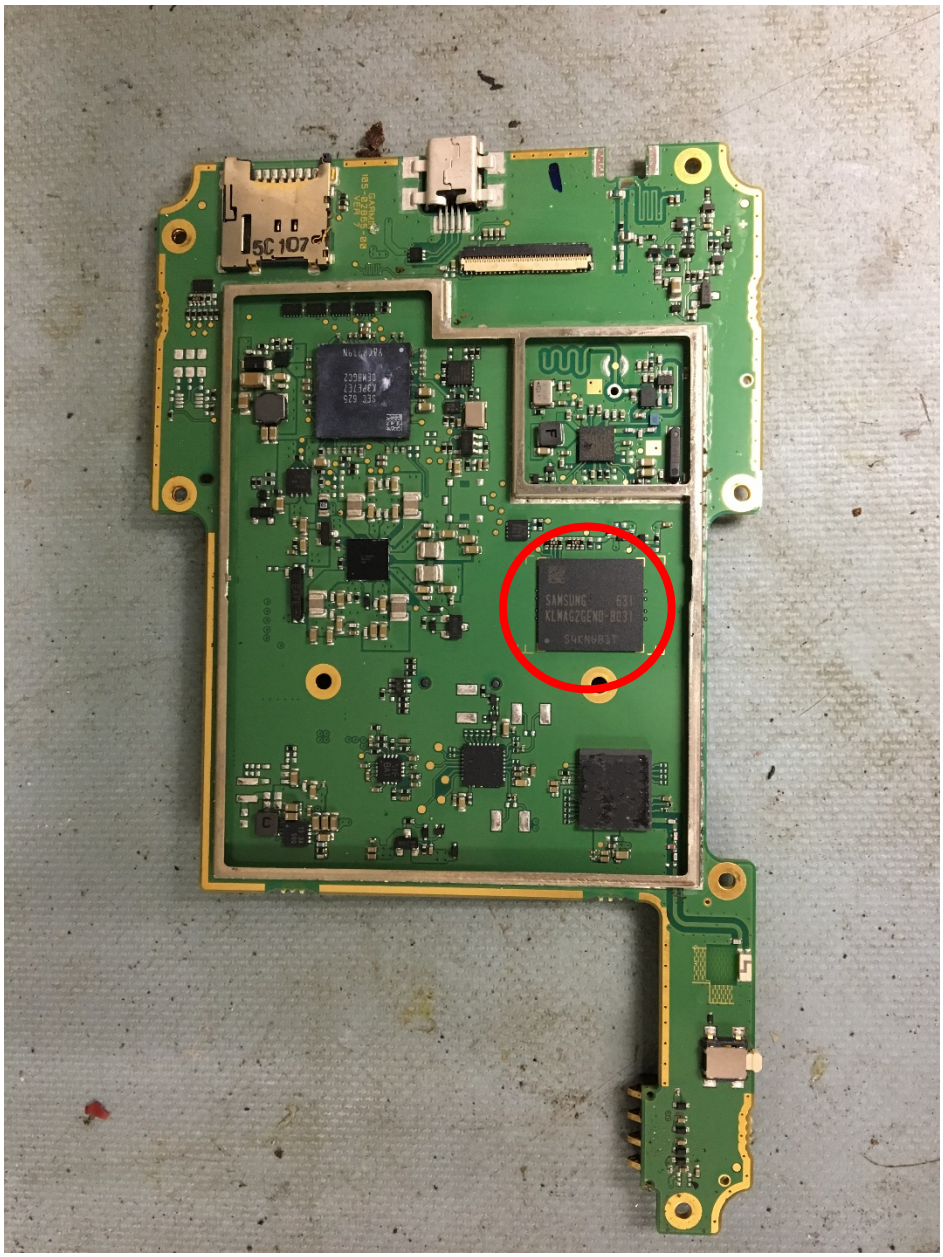
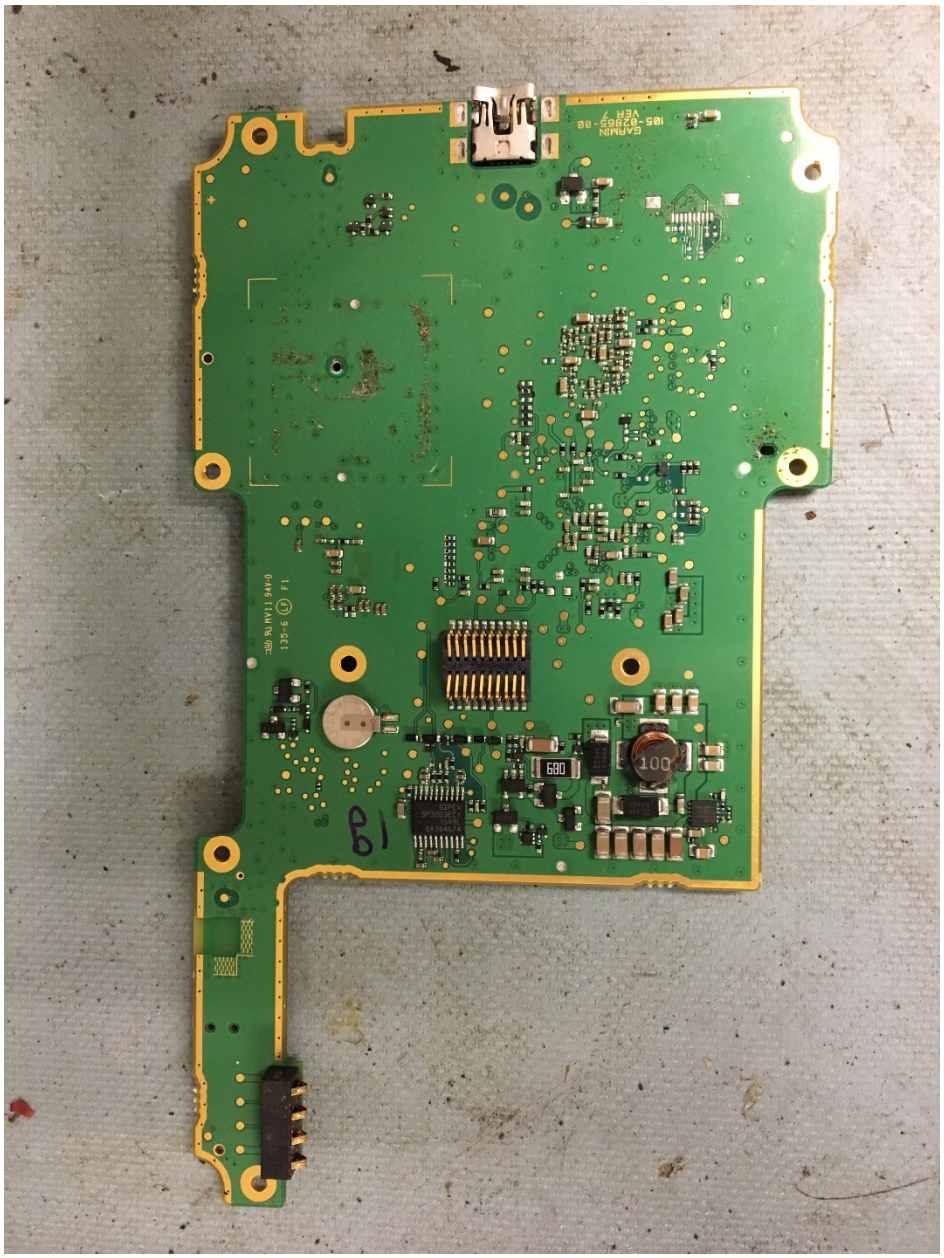


Figure 4. Internal view of the Garmin Aera 660 main Printed Circuit Board; back



2.1.2. Garmin Area 660 Data Description

Track log data dated from August 15, 2017 to August 24, 2017 was recovered directly from the device. And the track log of the accident flight was identified with the date of the accident.

3. GPS PARAMETERS PROVIDED

Table 1 describes the data parameters provided. Date, Time, Longitude, Latitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived by the download software using recorded information. Data from the accident flight recorded is provided in tabular format as Attachment 1 to this report.

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 (ft)
Groundspeed	Average groundspeed between current and following data point (knots)
Track	Average true course between current and following data point (degrees)

4. OVERLAYS AND TABULAR DATA

Graphical overlays in this report were generated using Google Earth Pro. Note that the weather and lighting conditions depicted in Google Earth imagery do not necessarily reflect the conditions present during the accident flight.

The most recently recorded track log began at 0554:20 Universal Time Coordinated (UTC) on August 24, 2017, departing near Telaquana Lake, located in the Lake Clark National Park and Preserve. The accident flight flew to east direction along the water way until the impact on terrain. The final position was recorded at 0641:03 UTC with an altitude about 549 feet. Figure 5 shows an overhead view of the entire flight. Figure 6 shows larger scale of the area, and Figure 7 presents the last segment of the flight with time and altitude of selected points.

Figure 5. Google Earth overlay of the entire flight of the accident flight

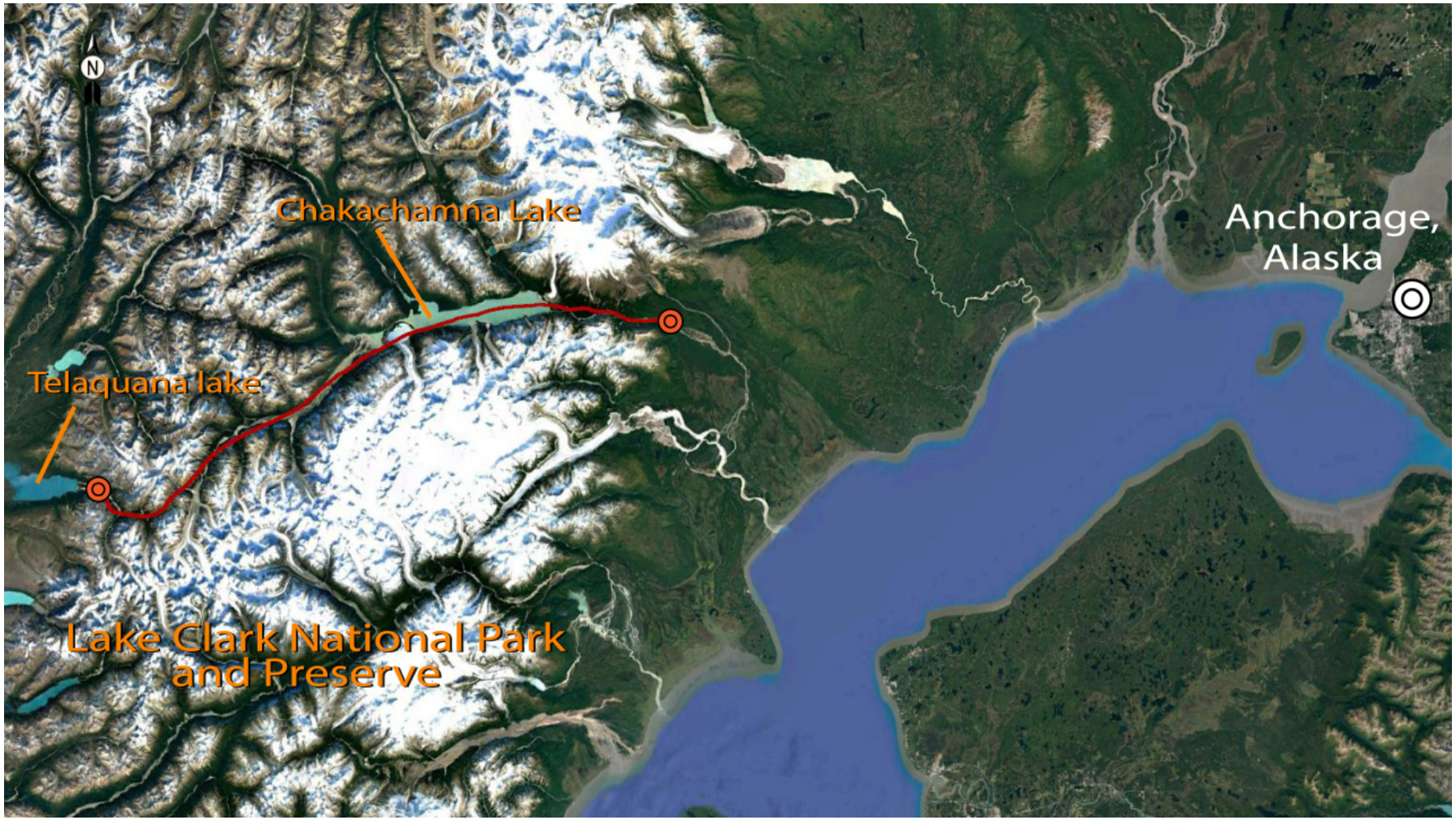


Figure 6. Google Earth overlay of the entire flight of the accident flight in medium scale

Figure 7. Google Earth overlay of the last segment of the accident flight with altitude and time of selected points in large scale