

National Transportation Safety Board

Office of Research and Engineering

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GLOBAL POSITIONING SYSTEM DEVICES

Specialist's Factual Report

December 6, 2023

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A. ACCIDENT

Location: Gaithersburg, Maryland
Date: November 27, 2022
Time: 1729 eastern standard time (EST)
2229 coordinated universal time (UTC)
Airplane: Mooney M20J, private operator, N201RF

B. GLOBAL POSITIONING SYSTEM DEVICES SPECIALIST

Specialist Charles Cates
Mechanical Engineer/Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A global positioning system (GPS) group was not convened. The NTSB Vehicle Recorder Division received the following GPS devices:

Recorder Manufacturer/Model: iFly 740b GPS
Recorder Serial Number: ZZBAA0005

Recorder Manufacturer/Model: Garmin GPSmap 496
Recorder Serial Number: 19710843

1.0 iFly 740b Device Description

The iFly GPS 740b is a portable uncertified 7" wide screen display aviation GPS. It is loaded with FAA Sectional Charts, Low Altitude Enroute Charts, Approach/Departure Plates, and Airport Diagrams.

Data can be recorded on an SD card installed in the device. According to the manufacturer, without an installed SD card no data is recorded by the internal memory of the device.

1.1 iFly 740b Data Recovery

The GPS was in good condition and log files were present on the SD card.



Figure 1. Photo of iFly 740b GPS, as received.

1.2 iFly 740b Recording Description

The data extracted included 18 flights from November 24, 2021 through November 27, 2022.¹ The accident flight was recorded, however the recording was incomplete and ended prior to the accident. For this reason, data efforts were focused on the Garmin GPS, which recorded data until the time of the accident.

2.0 Garmin GPSmap 496 Device Description

The Garmin GPSmap 496 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. 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. 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 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

¹ All dates and times are referenced to coordinated universal time (UTC).

unit has been configured. Once the current tracklog memory becomes full, new information overwrites the oldest information. The current tracklog can be saved to 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.



Figure 2. Photo of Garmin GPSmap 496 as received.

2.1 Garmin GPSmap 496 Data Recovery

The data extracted included 36 sessions from September 23, 2022, to November 27, 2022. The accident flight was the last one recorded by the device in session 36. It was 3 hours, 4 minutes, and 14 seconds in duration and the track covered a total of 269.76 miles.

2.2 Garmin GPSmap 496 Parameters Provided

Table 1 describes data parameters provided by the Garmin GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and distance are derived from the recorded parameters.

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)
Groundspeed	Average derived groundspeed (knots)
Distance	Total distance traveled (miles)

D. OVERLAYS AND TABULAR DATA

Data obtained from the Garmin GPSmap 496 was used to produce the following overlays and tabular data.

Figure 3 is a map overlay generated using Google Earth for the accident flight. Figure 4 is a map overlay showing the approach portion of the flight in a profile (overhead) view. Figure 5 is a map overlay showing the elevation profile of the flight with approach fixes at their published crossing heights. Figure 6 is a recreation of the approach plate elevation profile showing the aircraft's elevation profile throughout the approach. It should be noted that the weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The device was powered on and began recording at approximately 1926:35 UTC with the aircraft on the ramp at Westchester County Airport (KHPN). The aircraft began to taxi at about 1946:37 and began its takeoff roll on runway 16 at about 2000:50.

The aircraft climbed to about 8,000 ft and cruised there for about 1 hour and 5 minutes, beginning a descent towards Montgomery County Airpark (KGAI) at about 2120 UTC.

The aircraft crossed the RNAV RWY14 intermediate fix waypoint BEGKA at 2221:38 UTC at a GPS altitude of 2,877 ft. The published crossing altitude for BEGKA on the approach plate is listed as not lower than 3,000 ft.

The aircraft continued the approach and continued to descend below the published crossing altitudes. The aircraft crossed the final approach fix waypoint TIMBE at 2225:05 UTC. The aircraft was recorded at a GPS altitude of 1,618 ft, which is 582 ft below the published crossing altitude of not lower than 2,200 ft.

The aircraft then crossed the approach fix waypoint JOXOX at 2227:09 UTC at a GPS altitude of 863 ft. The crossing altitude for JOXOX is not lower than 1,280 ft.

The final point on the approach plate, the visual descent point (VDP), was 1.4 nautical miles from the runway 14 threshold. The aircraft crossed the VDP at 2227:57 UTC at a GPS altitude of 587 ft. The published decision altitude for the LPV approach was 789 ft.

The data ended shortly after at 2228:39 UTC. It showed the aircraft at a GPS altitude of 565 ft with no groundspeed. The field elevation is reported on the approach plate as 539 ft.

The corresponding tabular data used to create figures 3 to 6 are provided in electronic comma separated value (CSV) format as attachment 1 to this report.

Submitted by:

Charles Cates
Mechanical Engineer/Recorder Specialist

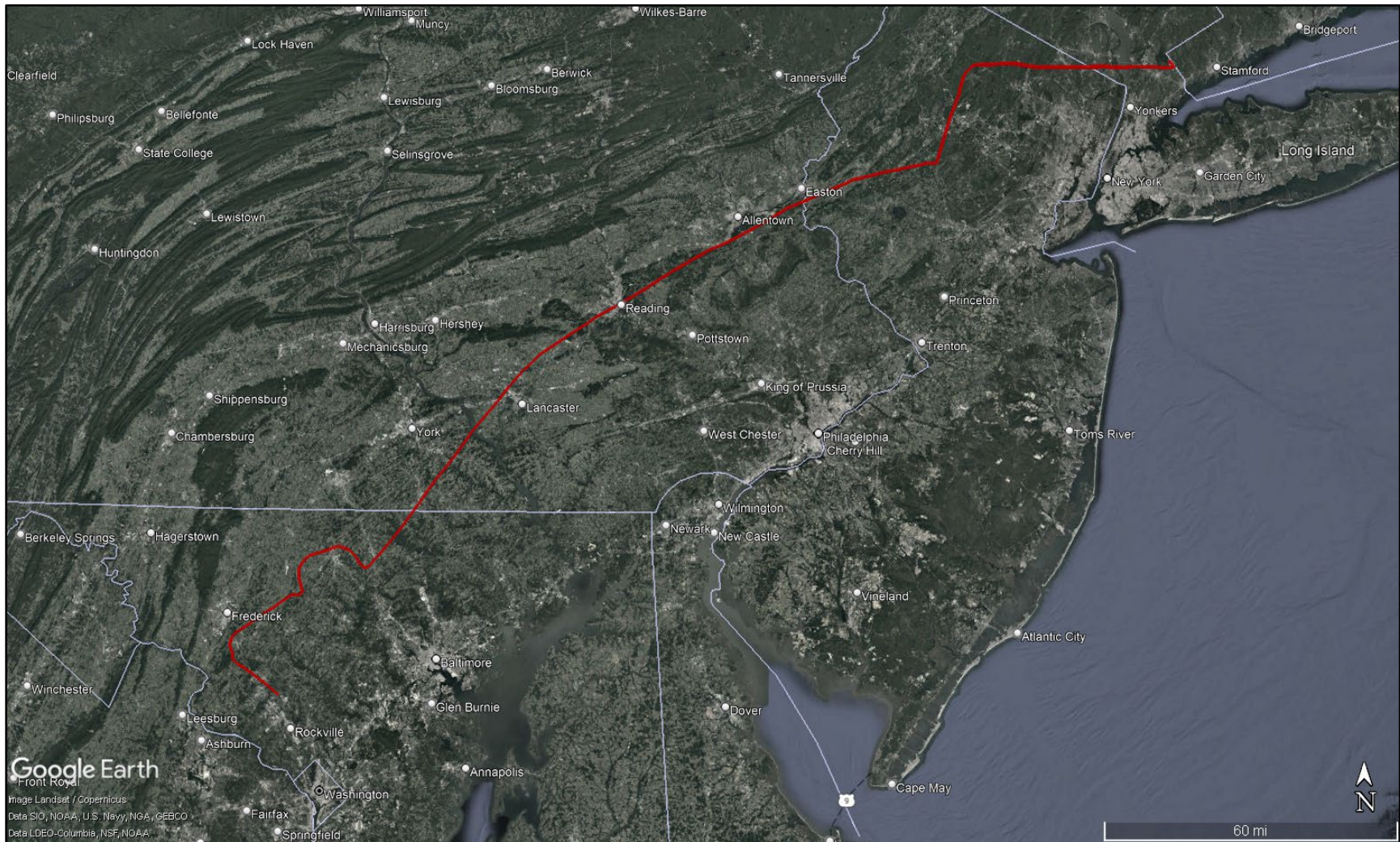


Figure 3. Map overlay of full accident flight.

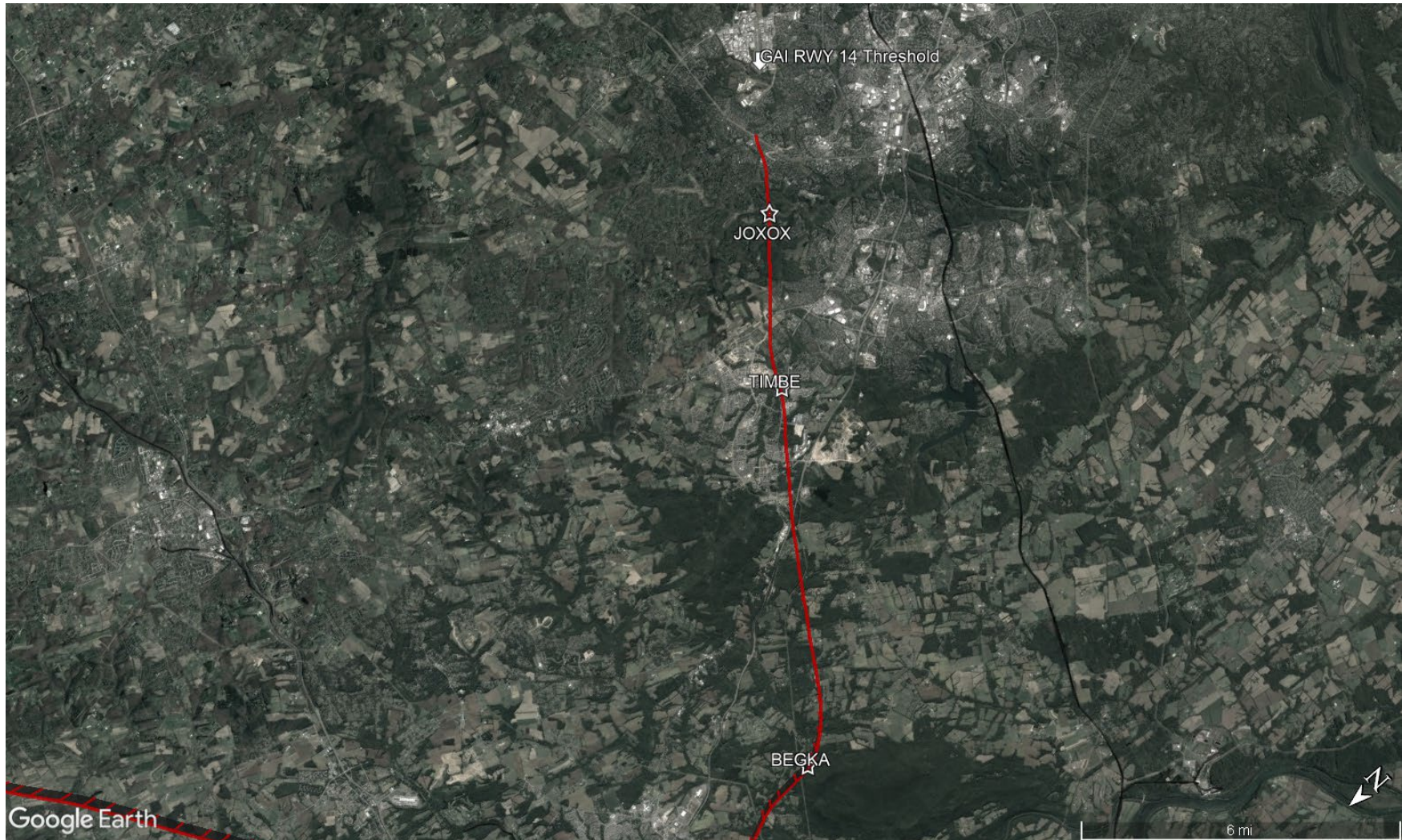


Figure 4. Google Earth overlay showing approach portion of the accident flight in an overhead view.

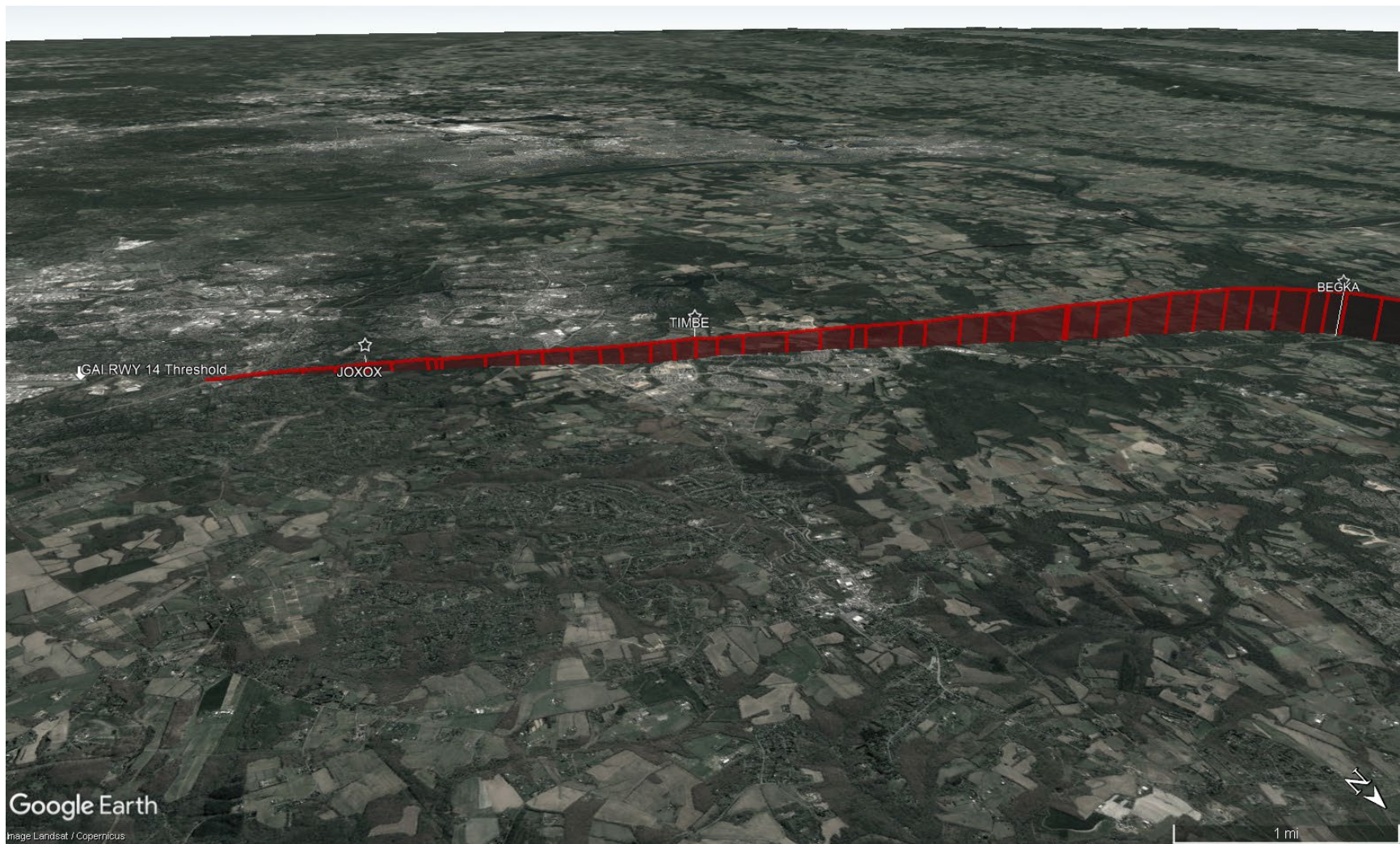


Figure 5. Google Earth overlay showing approach profile with approach fixes at their published heights.

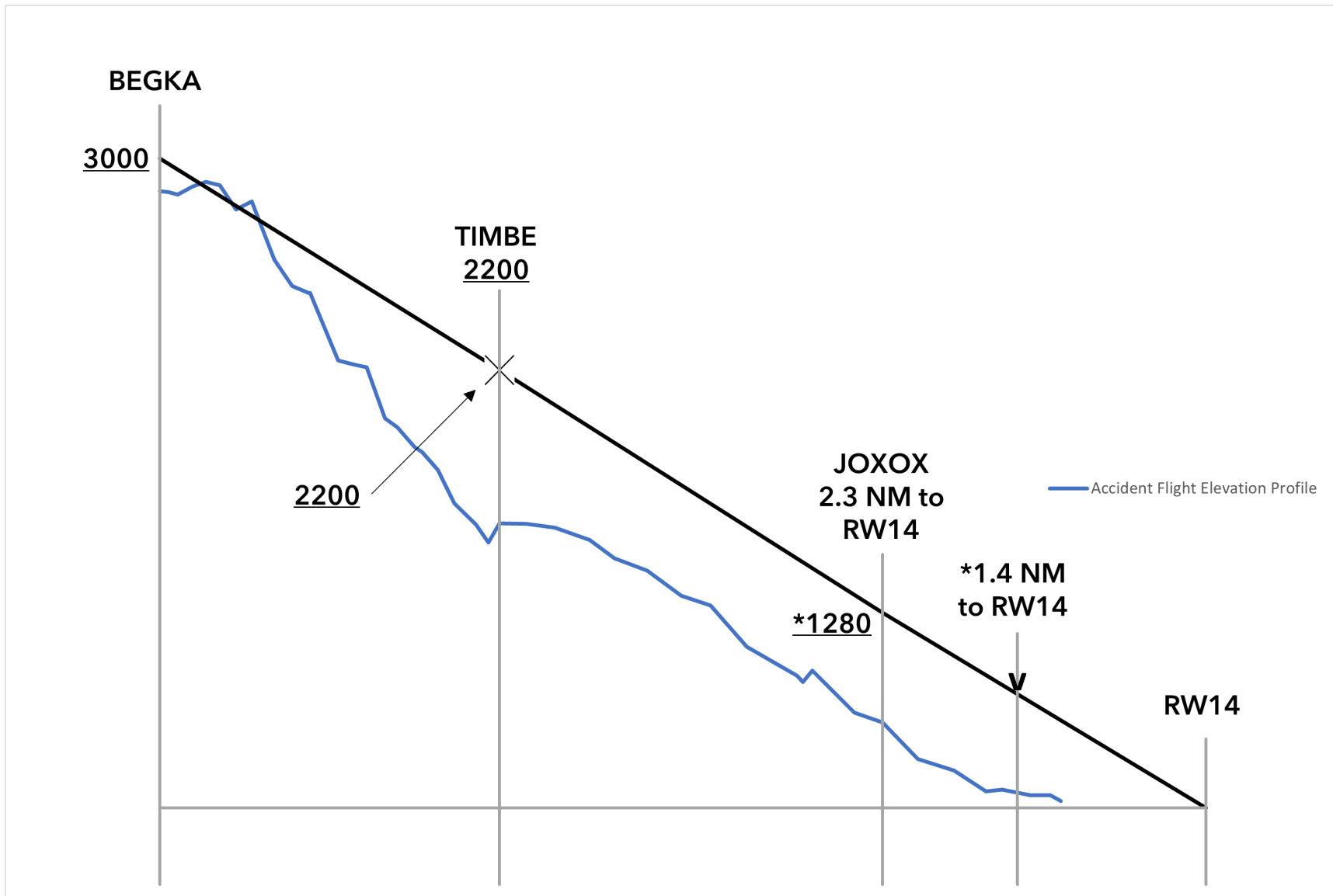


Figure 6. Recreation of KGAI RNAV RWY14 approach plate elevation profile.