

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

May 17, 2016

Flight Data Recorder

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

1. EVENT SUMMARY

Location: Seattle, Washington
Date: December 19, 2015
Aircraft: Boeing 737-900
Registration: N477AS
Operator: Alaska Airlines
NTSB Number: DCA16IA036

On December 19, 2015, about 0831 Pacific standard time (PST), a Boeing 737-900 airplane, N477AS, landed on taxiway "T" instead of the intended runway 16C, at the Seattle-Tacoma International Airport (SEA), Seattle, Washington. There were no injuries to the flight crew or passengers and the airplane was not damaged. The flight was conducted under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 as a regularly scheduled passenger flight from Chicago O'Hare International Airport, Chicago, Illinois. Visual meteorological conditions prevailed at the time of the incident.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened.

3. FDR Carriage Requirements

The event aircraft, N477AS, was manufactured in 2015 and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 88 parameters, as cited in 14 CFR Part 121.344.

4. DETAILS OF FDR INVESTIGATION

The National Transportation Safety Board's Vehicle Recorder Division received an electronic file containing the FDR data from the N477AS aircraft.

4.1. FDR Data File Description

The FDR data in the electronic file was configured such that 512 12-bit words of digital information were recorded every second. Each grouping of 512 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 512-word

intervals. Each data parameter (for example, pressure altitude, pitch angle, roll angle, and magnetic heading) has a specifically assigned word number within the subframe.

4.1.1. Recording and Aircraft Description

The FDR recording contained approximately 100 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The event flight was the last flight of the recording and its duration was approximately 4 hours and 15 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with the federal FDR carriage requirements.

The aircraft was equipped with Honeywell's Runway Awareness and Advisory System (RAAS); however, the system installed on N477AS did not have the taxiway landing alert enabled. RAAS is an extension of enhanced ground proximity warning systems (EGPWS) technology.

4.1.2. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the aircraft manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).¹

Table A-1 lists the FDR parameters verified and provided in this report. Additionally, table A-2 describes the unit abbreviations used in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, PST, was established by using the recorded Time UTC² hours, Time UTC Minutes, and Time UTC Seconds and then applying an additional 8 hours offset to change UTC to PST.

Accordingly, the time offset for the event flight data from SRN to local PST is the following: $PST = SRN - 334,482.0$. Therefore, for the rest of this report, all times are referenced as PST, not SRN.

4.3. FDR Overlays, Plots, and Corresponding Tabular Data

The following six figures contain FDR data recorded during the December 19, 2015 event. Overlays were made with Google Earth. Lighting and weather conditions in the overlays may not be representative of the conditions at the time of the event.

Figures 1 through 4 show overlays of the approach and landing track. At about 0824:50 PST, the aircraft turned towards the airport. At about 0829:09 PST, the aircraft made a slight course change and lined up with taxiway "T" at SEA.

¹ 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 = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

² UTC is an abbreviation for Coordinated Universal Time.

Figure 5 shows a plot of the entire flight; only two types of RAAS/EGPWS alerts were generated on the flight: (1) ground alerts related to approaching a runway and (2) a 500 foot alert. Figure 6 shows a close up of the approach.

These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

The corresponding tabular data used to create these six figures are provided in electronic comma separated value (*.csv) format as attachment 1 to this report.

Figure 1. Overlay of approach to SEA.

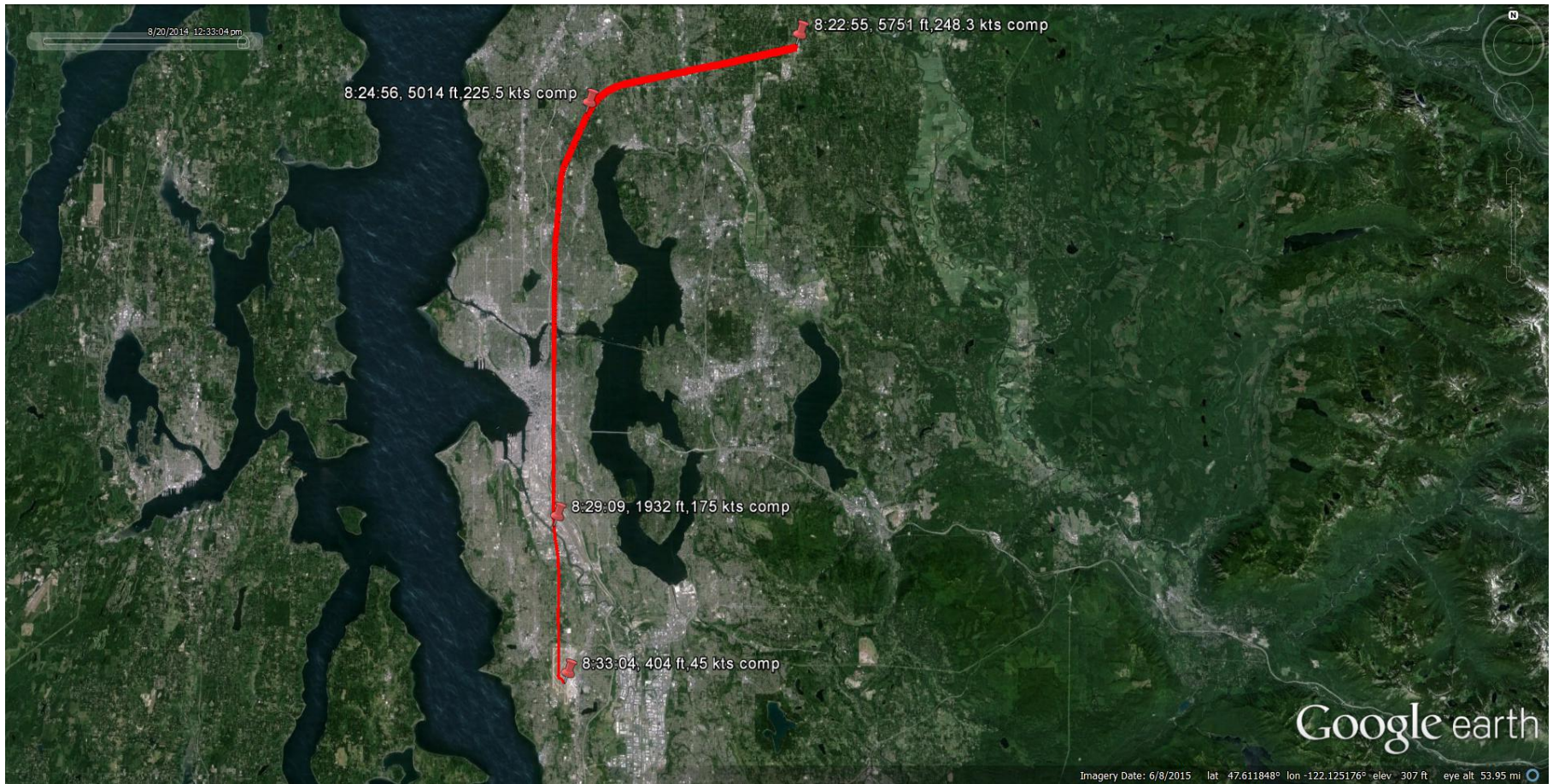


Figure 2. Overlay of final approach to SEA.

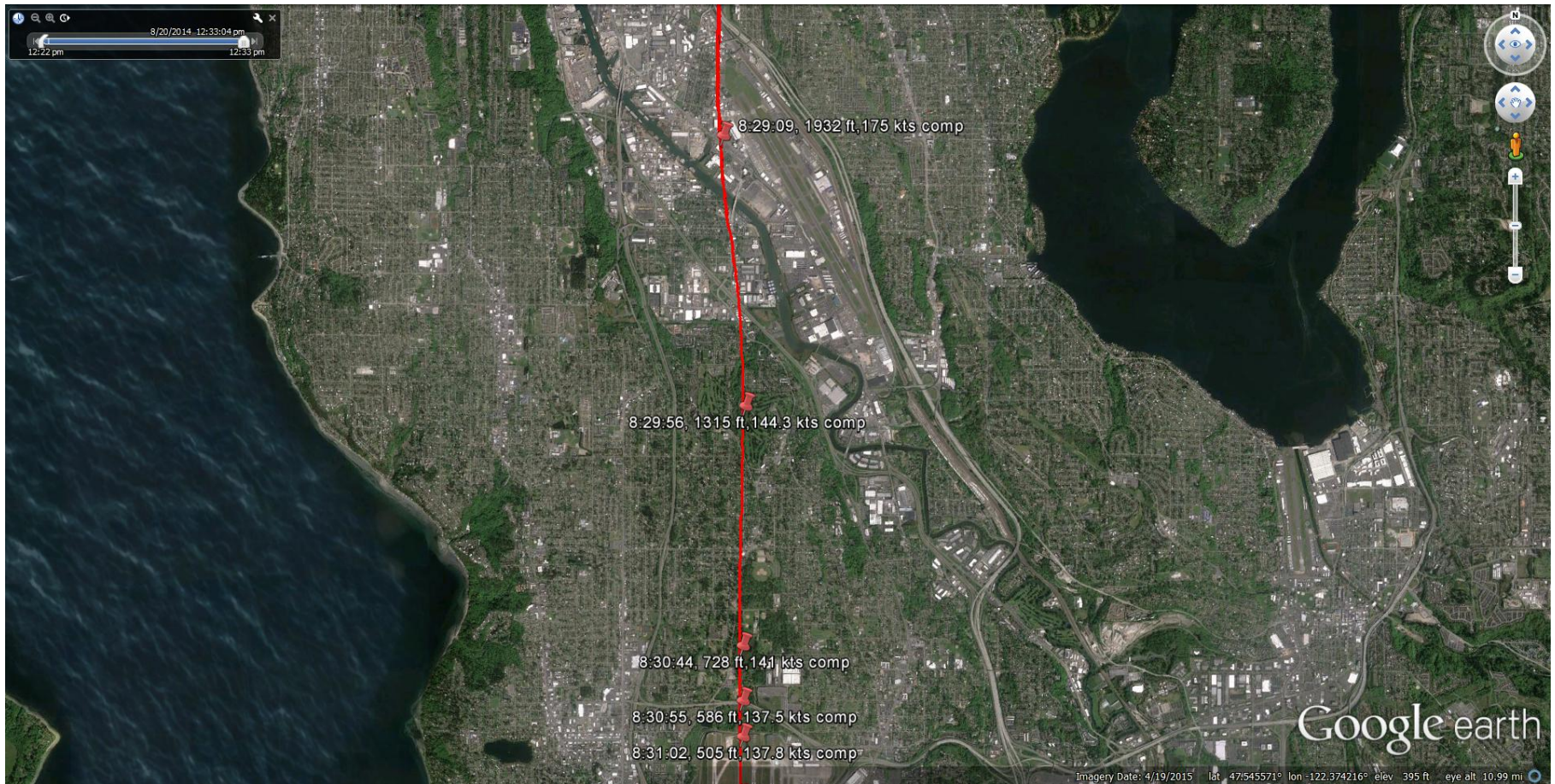


Figure 3. Overlay of final approach to SEA (top view).

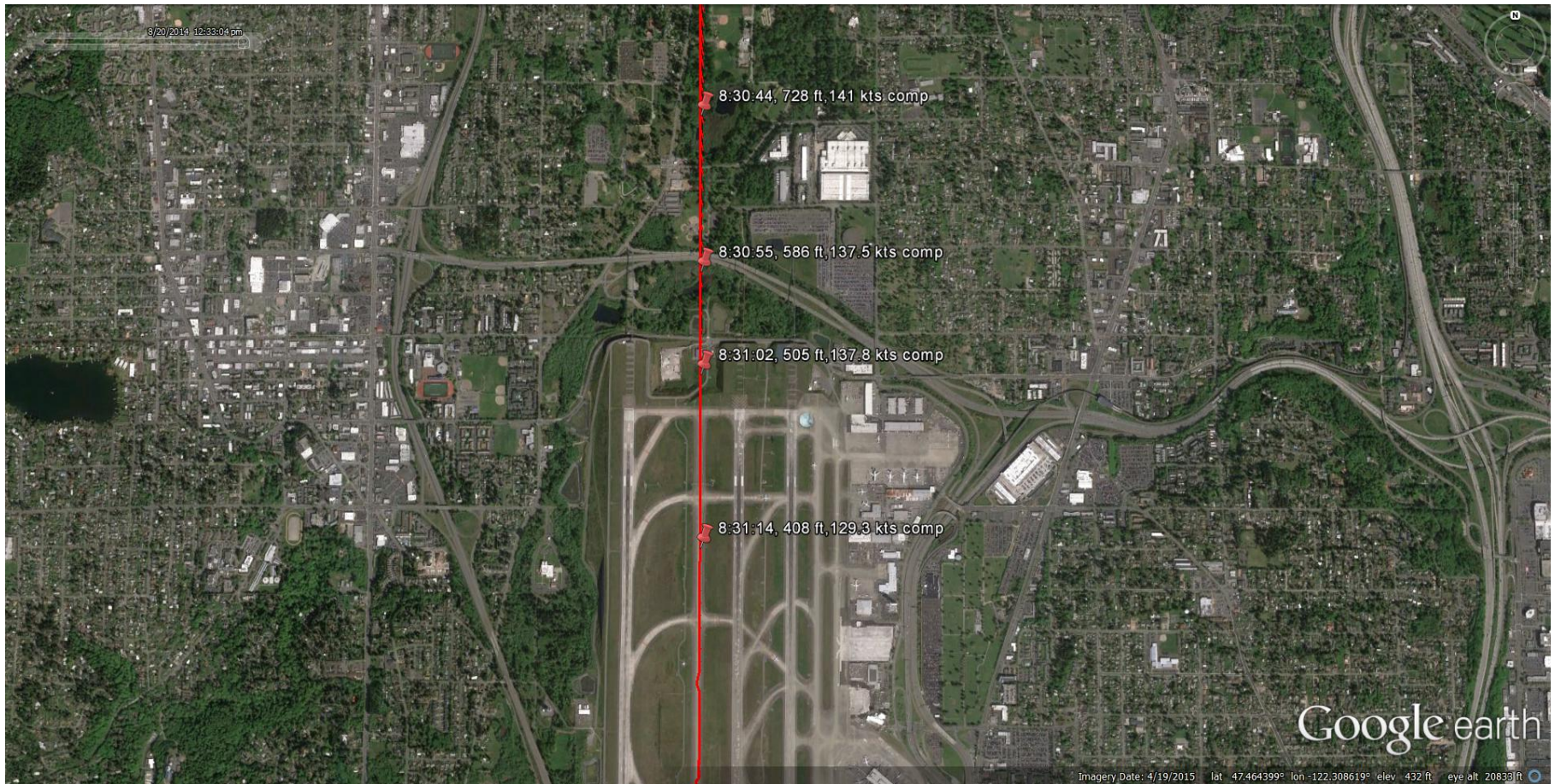


Figure 4. Taxiway diagram overlay of final approach to SEA.

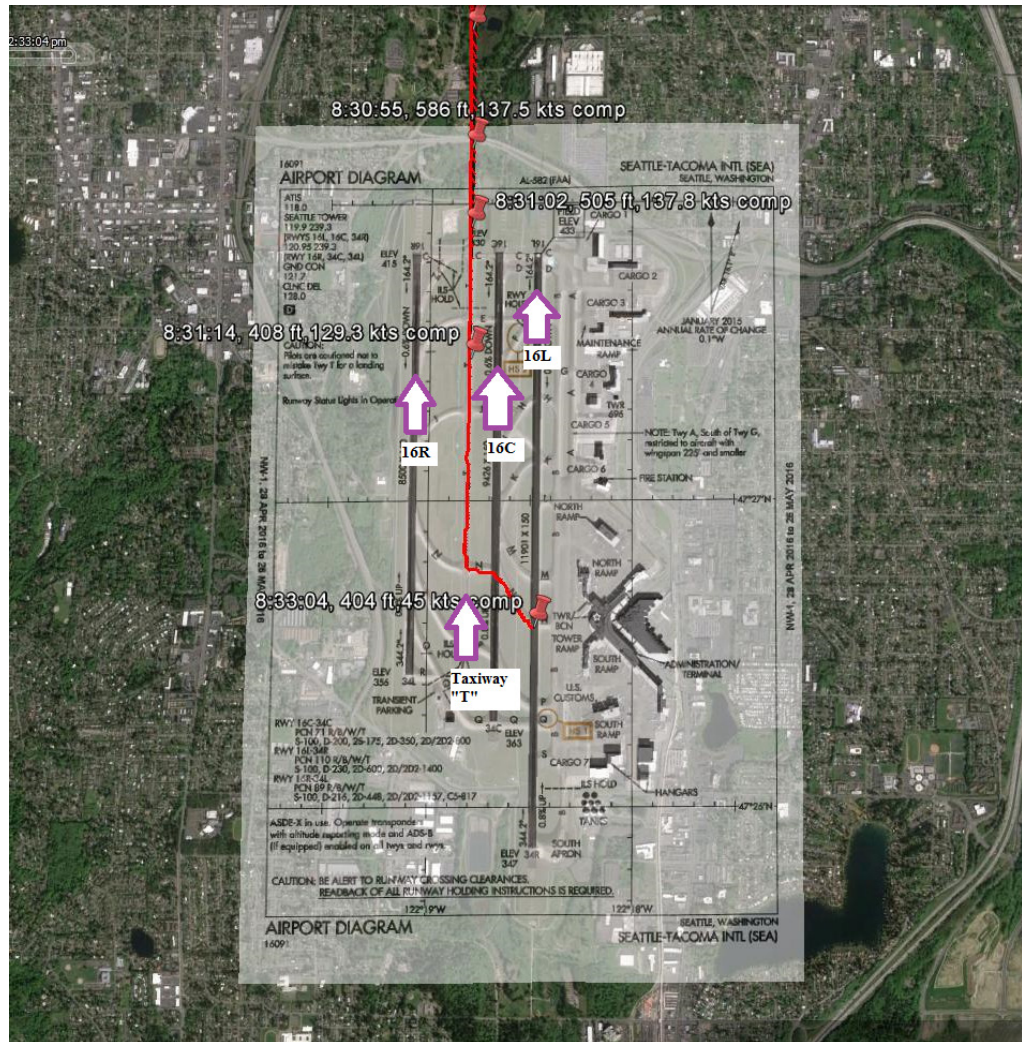


Figure 5. Plot of entire flight.

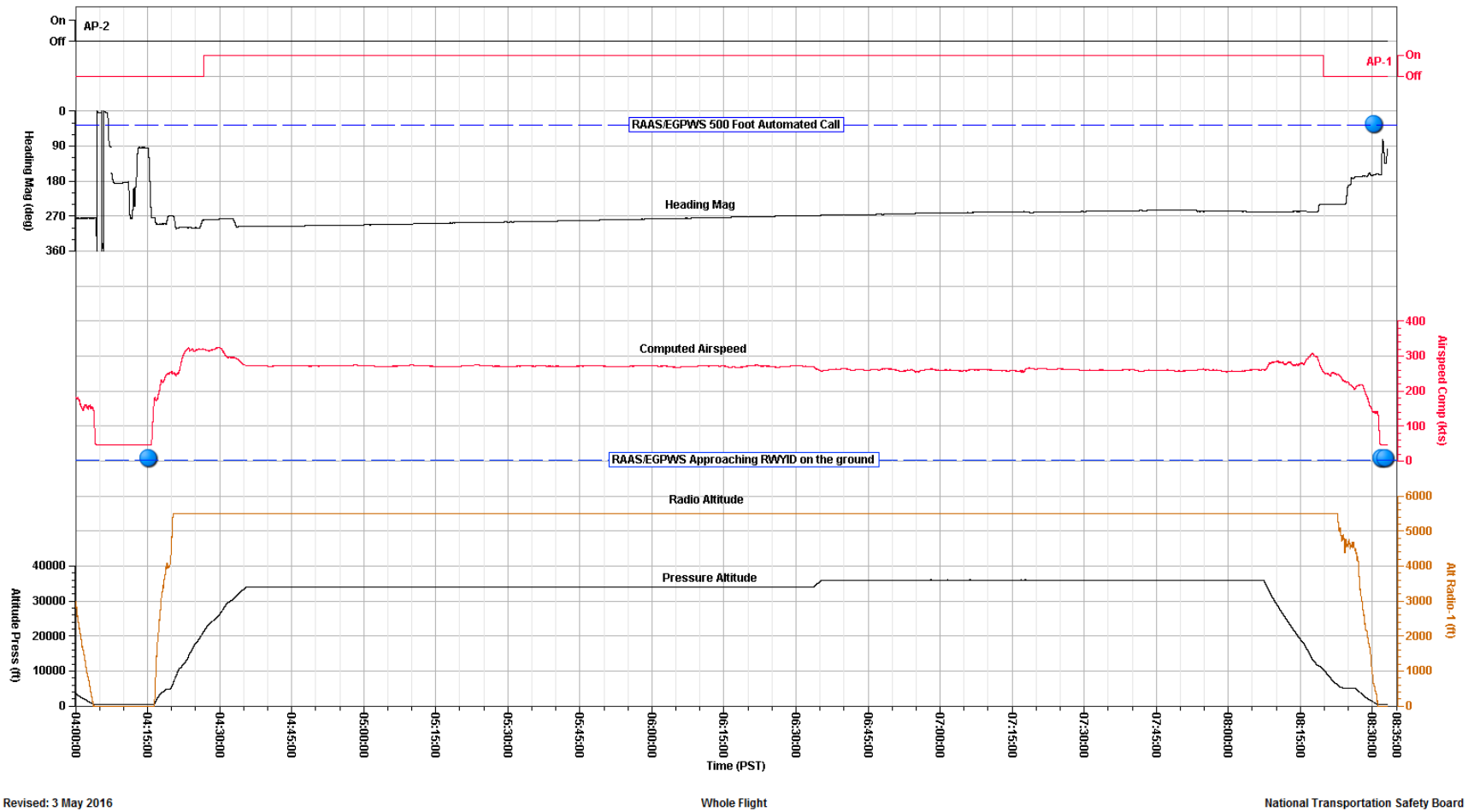
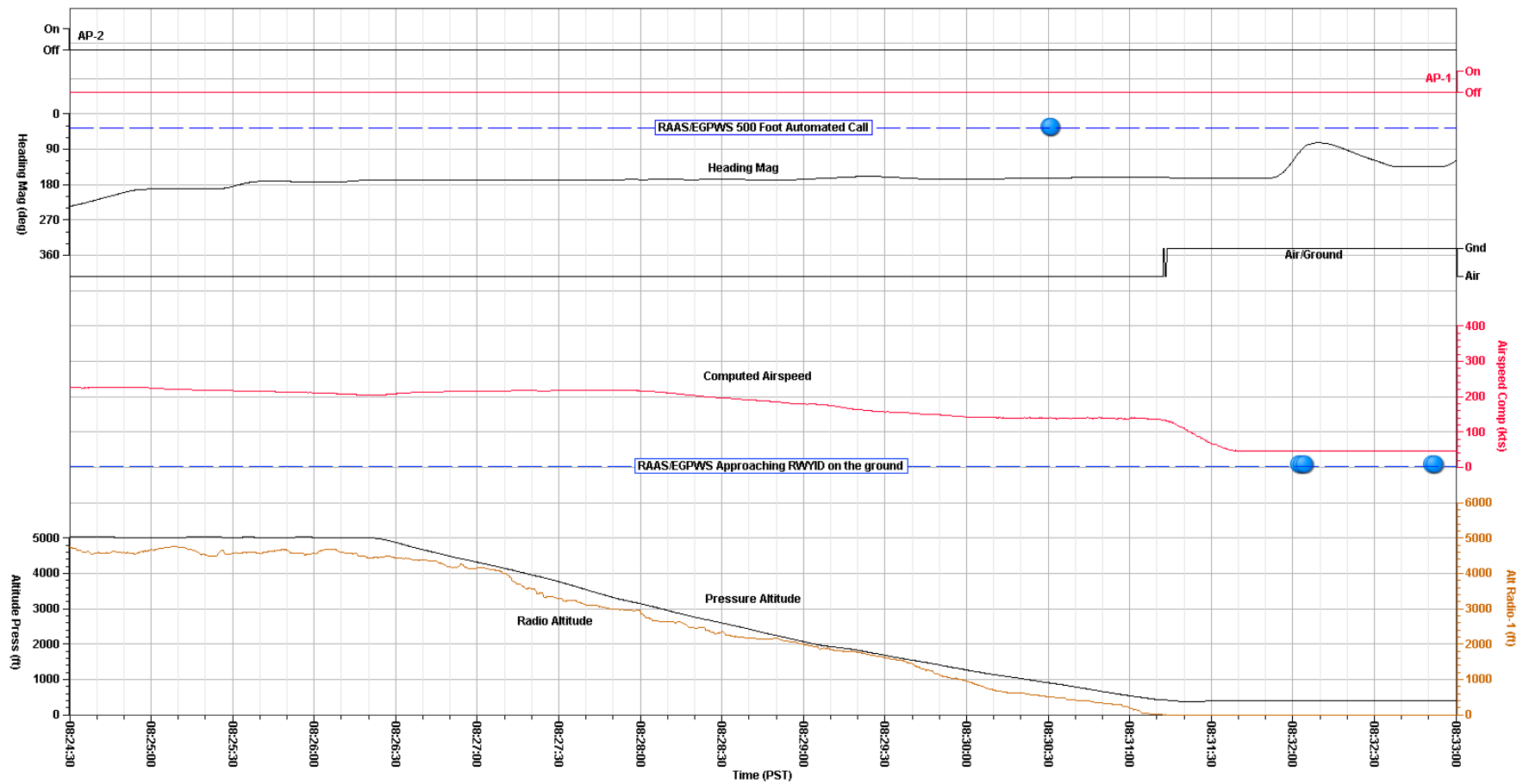


Figure 6. Plot of approach and landing.



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Approach and Landing

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APPENDIX A

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

Table A-1. Verified and provided FDR parameters.

Parameter Name	Parameter Description
1. Air/Ground (discrete)	Air or Ground State
2. Airspeed Comp (kts)	Computed Airspeed
3. Alt Radio-1 (ft)	Radio Altitude-1
4. Altitude Press (ft)	Pressure Altitude
5. AP-1 (discrete)	Autopilot-1
6. AP-2 (discrete)	Autopilot-2
7. Heading Mag (deg)	Magnetic Heading
8. RAAS (discrete)	RAAS Alert
9. Latitude_FMC (deg)	Latitude (from Flight Management Computer)
10. Longitude_FMC (deg)	Longitude (from Flight Management Computer)
11. UTC Hours (hrs)	UTC Hours
12. UTC Minutes (min)	UTC Minutes
13. UTC Seconds (sec)	UTC Seconds

NOTE: This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
kts	knots
discrete	discrete
ft	feet
hrs	hours
min	minutes
sec	seconds

NOTE: For parameters with a unit description of discrete, a discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.