National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594

DCA23FA149

FDR AND ADS-B STUDY

Aircraft Performance Study

By

Marie Moler

A. INCIDENT

Location: Austin, Texas
Date: February 4, 2023
Time: 06:40 central standard time (CST)
Airplane 1: Boeing 737-79P, N7827A
Airplane 2: Boeing 767-32LF, N297FE

B. SUMMARY

On February 4, 2023, at about 0640 central standard time (CST), Federal Express (FedEx) flight 1432 (FDX1432), a Boeing 767-32LF, and Southwest Airlines flight 708 (SWA708) a Boeing 737-79P were involved in a runway incursion with overflight that resulted in a loss of separation at the Austin-Bergstrom International Airport (AUS), Austin, Texas. There were no injuries reported to the 128 passengers and crew onboard the SWA airplane or to the 3 crew members onboard the FedEx airplane. SWA flight 708 was a regularly scheduled international passenger flight operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 from AUS to the Cancún International Airport (CUN), Cancún, Mexico. FedEx flight 1432 was a domestic cargo flight operating under the provisions of 14 CFR Part 121 from Memphis International Airport (MEM), Memphis, Tennessee to AUS.

C. PERFORMANCE STUDY

1.0 Aircraft

1.1 Boeing 737-79P

The Boeing 737-700 is a narrow-body jet aircraft. It is 110 ft 4 in (33.6 m) long and 41 ft 2 in (12.5 m) tall at the tail. Figure 1 is a photograph of the Southwest 737 passenger aircraft involved in the runway incursion, N7827A.

Figure 1. N7827A.

1.2 Boeing 767-32LF

The Boeing 767 is a wide-body jet aircraft. It is 180 ft 3 in (54.9 m) long and 52 ft (15.8 m) tall at the tail. Figure 2 is a photograph of the FedEx 767 cargo aircraft involved in the runway incursion, N297FE.

Figure 2. N297FE.

2.0 Weather

Weather was recorded at the airport by an automated airport weather station (ASOS) and augmented by tower personnel. Weather was recorded at 06:18 and

06:47. Visibility at 06:18 (night lighting conditions) was reported as 1/4 mile dropping to 1/8 of a mile at 06:47. Both recordings showed winds calm, runway 36R visual range 1,800 ft variable to 2,400 ft[1], freezing fog, vertical visibility 200 ft above ground level (agl), temperature 30°F (-1°C), dew point 30°F (-1°C), altimeter setting 30.43 inHg.

According to air traffic controllers in the tower during the period, they were above the fog at the tower level at about 300 ft agl and had unlimited visibility on top but were unable to see the surface due to the fog and the time of day.

3.0 Airport

The event occurred along runway 18L at AUS. Runway 18L is a concrete, grooved runway 150 ft wide and 9,000 ft long. The threshold for runway 18L is at 30°12'13.77"N, 97°39'28.43"W. Distances along the runway in this report were measured from this location. The elevation at the threshold is 491 ft, and the runway slopes down to 473 ft at the threshold to runway 36R. The runway's true heading is 179°. It has an instrument landing system (ILS).

4.0 Available Data

Both airplanes were equipped with Flight Data Recorders (FDRs) [1] and Cockpit Voice Recorders (CVRs) [2]. However, the incident was overwritten on both airplanes' two-hour CVRs. The FDR data for the incident was obtained from both airplanes. FDR data included airplane attitude, accelerations, altitude, airspeed, control inputs, control surfaces, engine parameters, avionic settings, and other parameters.

Communications between the two airplanes and the AUS air traffic control tower (ATCT) are included in the NTSB Air Traffic Control report [3].

The latitude and longitude parameters on the FDRs of both airplanes were not recorded to with enough precision to accurately determine the airplane's location. Therefore, Automatic Dependent Surveillance-Broadcast (ADS-B) data was used to determine the airplanes' locations. ADS-B broadcasts an airplane's Global Positioning System (GPS) position and other data to the ground where it is recorded. The GPS position has an accuracy of approximately 20 meters (65 ft) in both the horizontal and vertical dimensions.

The Federal Aviation Administration (FAA) provided ADS-B data from FAA owned and maintained ground stations, but this data did not include the SWA708

[1] Runway Visual Range (RVR) - is an estimate of the maximum distance at which the runway, or the specified lights or markers delineating it, can be seen from a position above a specific point on its centerline.

location until after the airplane had taken off. A SAAB ADS-B ground station was in the tower for demonstration purposes at the time of the event and the SAAB Aerobahn data was provided to the NTSB [4]. The Aerobahn data had a detailed record of the location of SWA708 on the ground and FDX1432 in the air.

All sources of data were resolved to the timing of the FAA ADS-B data by aligning the recorded pressure altitudes. This timing was also used to align the times of the ATCT communications with the crews. The SWA708 FDR timing was the same as the FAA time, but the FDX1432 FDR timing had to be shifted 2.5 seconds for the altitudes to match. The Aerobahn data did not record the time that position recordings were applicable, just the received time. For the Aerobahn altitude records to match the FAA altitude data, 0.5 s was subtracted from the SWA708 record and 1 s from the FDX 1432 record.

5.0 Airplane Separation Calculations

The airplanes' locations are reflective of the location of the GPS antenna. The altitudes have been corrected such that when the airplanes are on the ground, the altitude reflects the height of the radio altimeter[2].

On the B-767, the radio altimeter is on the belly of the airplane approximately 20 feet aft of the nose. The GPS antenna is on the top of the airplane, approximately 44 feet aft of the nose. On the B-737, the radio altimeter is on the belly of the airplane approximately 20 feet aft of the nose. The GPS antenna is on the top of the airplane, approximately 33 feet aft of the nose.

Two sets of separation calculations were made for this report. The first set simply took the recorded GPS location and radio altimeter altitude as a single point at each time and calculated the distance between each point. The air separation was the difference between the airplane's relative altitudes, the ground distance was the difference between the GPS locations, and the total separation was the total distance between these two points. These distances are shown in Figure 3 as the purple dotted lines.

The second set of calculations considered the geometry of the airplanes. The top of the B-737's tail sits over 37 feet above the radio altimeter and 73 feet aft of the GPS antenna. The pitch angle of the B-767 affected how much lower the empennage was compared to the radio altimeter altitude. Landing gear height for the B-767 were not considered for this calculation. The air separation was the distance between the lowest part of the B-767 and the top of the tail of the B-737. The ground distance was between the nose of the B-767 and the tail of the B-737. The total separation was

[2] The radio altimeter on the B-767 recorded a radio altitude of –7 ft when on the ground which was corrected to 9.5 ft above ground. The B-737 radio altitude was -5 ft when on the ground which was corrected to 3.5 ft above ground.

calculated as $\sqrt{(air\ separation)^2 + (ground\ separation)^2}$. These distances are shown in Figure 3 as the green dotted lines.

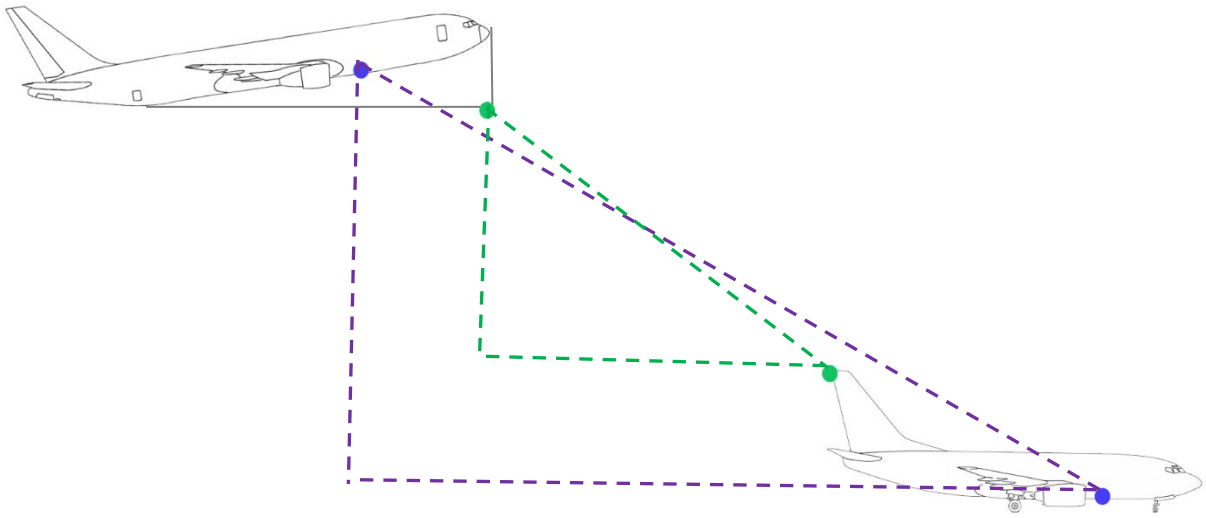


Figure 3. Airplane separation calculations. The purple lines show the distances between the radio altimeters of each airplane. The green lines show the distances between the low forward dimension of the B-767 and the tail of B-737.

However, it should be noted that some of the distances considered in this section are smaller than the GPS uncertainty discussed in Available Data. Therefore, calculated separation distances are best estimates, but the uncertainties should be considered when trying to draw strong conclusions.

6.0 Flight Path and ATC Communications

The time of interest for the incident began when FDX1432 was on approach to runway 18L. FDX1432 contacted the AUS ATCT at 06:34:02 to report they were established on the CAT III ILS approach for runway 18L [chart in appendix]. The controller informed them the runway visual range (RVR) values were 1,400 ft at touchdown, 600 ft at midpoint, and 1,800 ft for rollout. FDX1432 was cleared to land and the crew acknowledged. Landing gear were lowered at 06:36:55.

At 06:38:47, SWA708 was on taxiway bravo about 550 ft before the hold short line for runway 18L[3]. SWA708 notified the controller "we're short of one eight left we're ready" (Figure 4). The controller cleared SWA708 for take-off and advised them of traffic on three-mile final (FDX 1432). At 06:39:13, SWA708 acknowledged the clearance (Figure 5) and advanced engines from about 37% to 46% for about 10

[3] The Appendix contains a table of the ATC communications and diagrams of the airplanes' locations for each ATC communication from 06:38:47 until 06:40:13. This portion of the report features selected diagrams.

seconds while taxiing (Figure 6). The airplane was 400 feet from runway 18L. FDX1432 was 3.3 miles from the runway threshold and traveling at 126 kts groundspeed. FDX1432 was 1 minute 15 seconds from crossing the runway threshold.

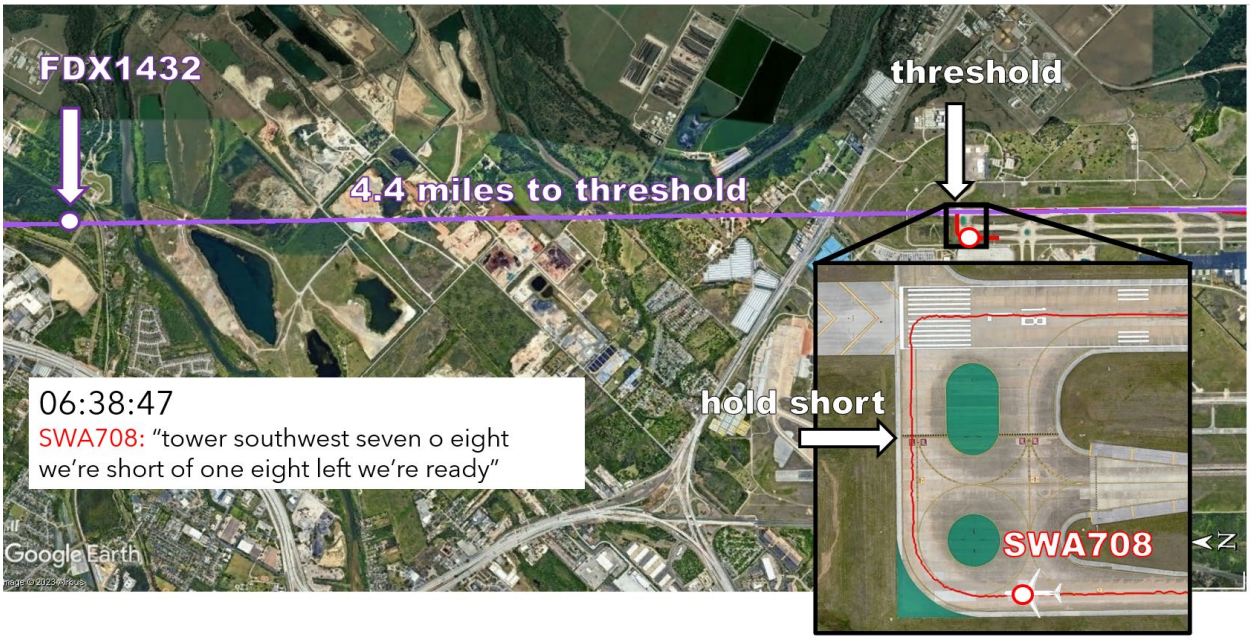


Figure 4. Airplane positions at 06:38:47 with ATC communication.

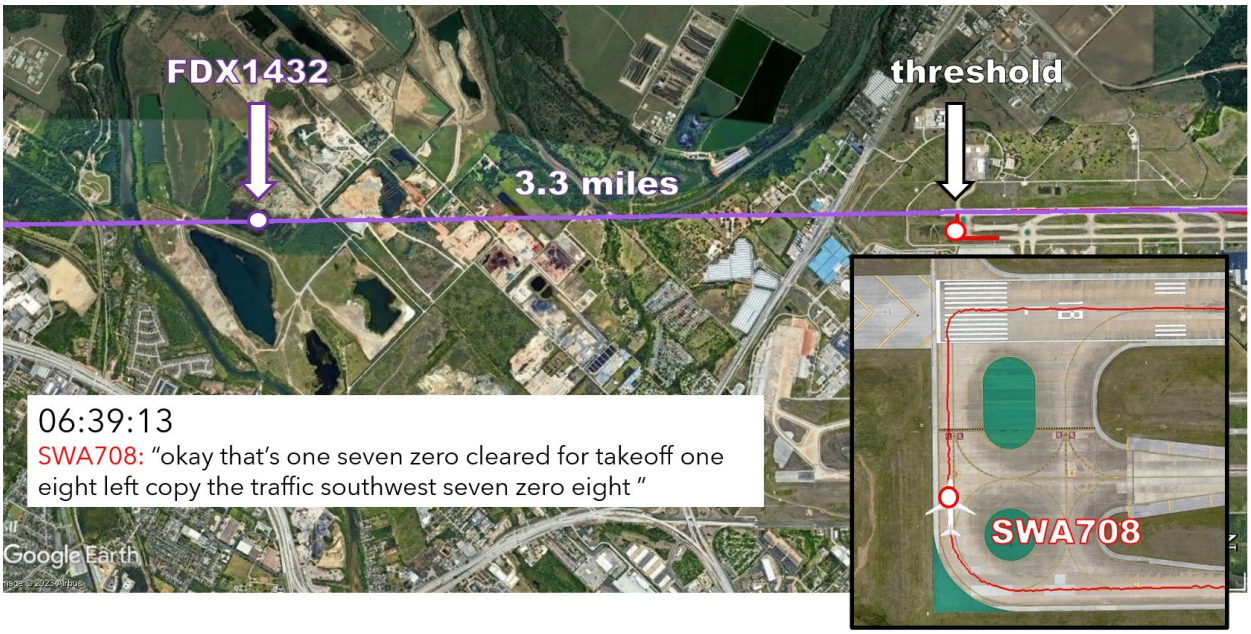


Figure 5. Airplane positions at 06:39:13 after SWA708 was cleared for take-off.

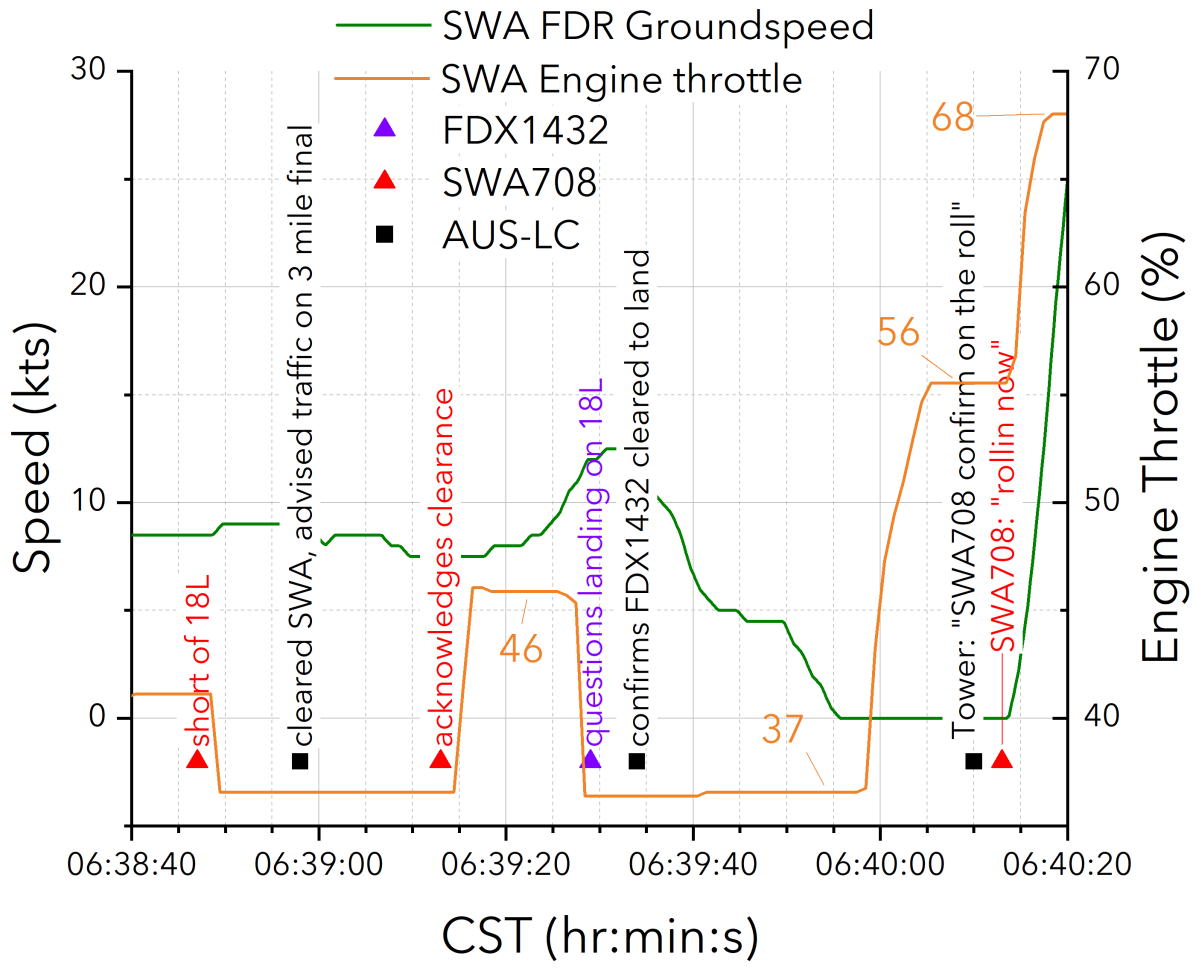


Figure 6. SWA708's FDR recorded groundspeed and engine throttle with selected ATC communications.

At 06:39:29, FDX1432, now 2.6 miles and 59 seconds from the threshold of runway 18L, questioned whether they were cleared to land on runway 18L. The controller confirmed they were cleared to land at 06:39:34 and advised that there was an airplane departing the runway ahead of them. At this time, SWA708 had just reached runway 18L.

At 06:39:44, FDX1432 was two miles from the runway threshold and SWA708 was on the active runway (Figure 7). FDX1432 was at an altitude of 880 ft and a groundspeed of 133 kts.

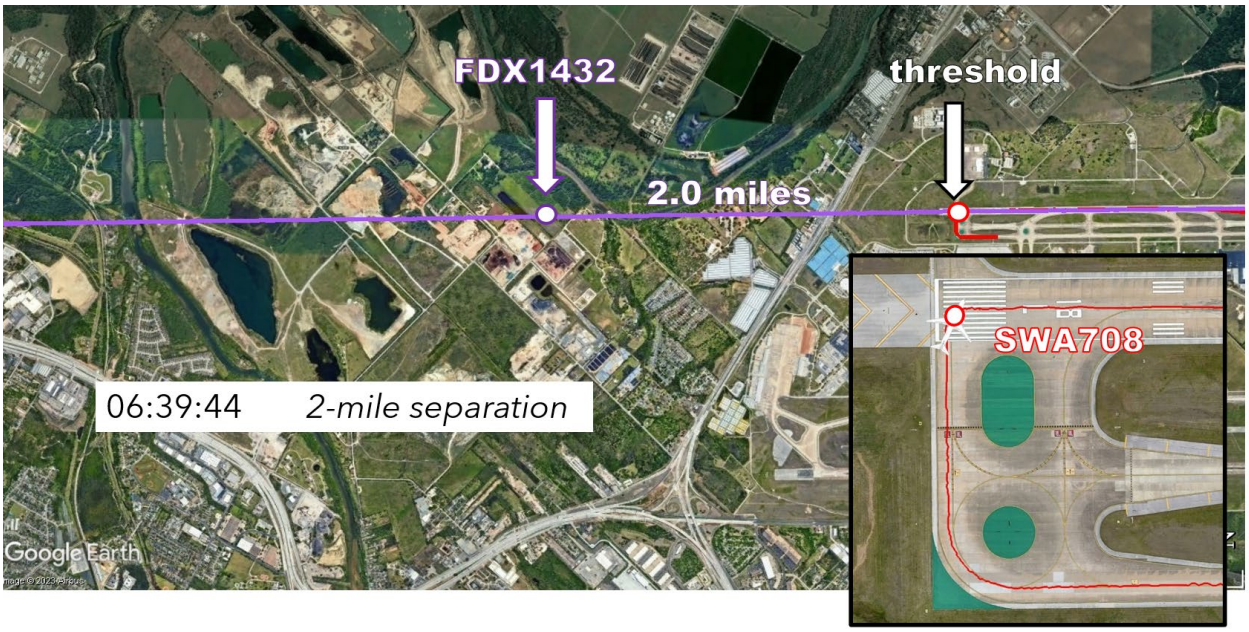


Figure 7. Airplane positions at 06:39:44.

SWA708 completed the turn onto the runway and stopped at 06:39:55 when FDX1432 was 33 seconds from the runway threshold and 8,000 ft from SWA708. SWA708's FDR groundspeed remained at zero for 19 seconds as engines were advanced from 37% to 56% (Figure 6). At 06:40:10, the controller asked if SWA708 was on the roll.

The crew responded affirmative and the airplane's groundspeed increased from zero at 06:40:14 as throttles advanced to 68%. FDX1432 was 3,400 ft from SWA708 (Figure 8) and at an altitude of 270 ft agl. It was traveling at 140 kts of groundspeed and was 14 seconds from the runway threshold.

Figure 8. Airplane positions at 06:40:14 as SWA708 begins take-off roll.

In interviews after the event, the FDX1432 crew reported seeing the shape of the Boeing 737 on the runway as they descended through the fog. As discussed in the Weather section, due to fog, vertical visibility was 200 ft agl and horizontal visibility was 1/4 mile decreasing to 1/8 of a mile. Figure 9 shows that at 06:40:25.25 the airplanes were within 1/4 mile of each other and FDX1432 was below 200 ft agl. It crossed the threshold to runway 18L at 06:40:28. At 06:40:29 the FDX1432 crew advanced the engines, initiating a go-around.

The airplanes shown in Figure 9 through Figure 11 are sized such that their length and height match the scale of the plot. However, due to the longer horizontal distances compared to the altitudes involved in these figures, the airplanes appear shortened compared to their heights. Figure 12 through Figure 14 have scales such that the horizontal and vertical dimensions are about equal and the drawing's aspect ratio is more consistent with the actual airplane. All airplane drawings are approximately positioned in relation to the airplanes' radio altimeters which are on the belly of the airplanes behind the nose. FDX1432's landing gear were down until 06:40:46 but are not shown in the figures as they were not considered in the separation calculations.

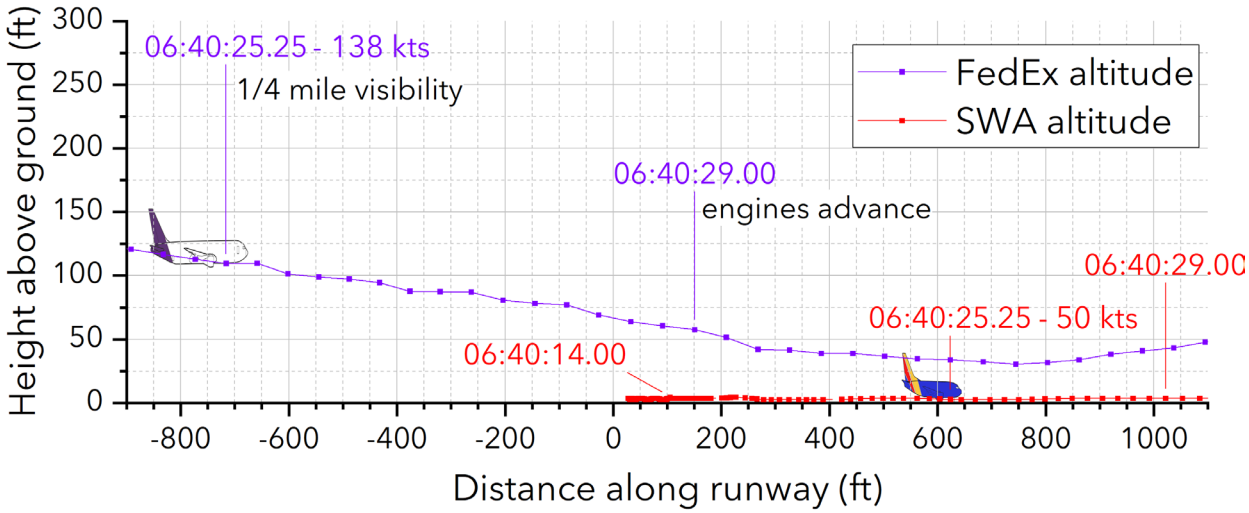


Figure 9. Airplane positions at 06:40:25.25, when the separation was ¼ mile, and 06:40:29 when the airplanes were 0.2 miles apart and the FDX1432 crew advanced the engines. Groundspeed is noted at 06:40:25.25. Horizontal and vertical scales are not the same. Airplane sizes are approximately to scale.

The FDX1432 FDR recorded the engines advanced and the control column was pulled back at 06:40:29 (Figure 10) when the airplane was 150 ft beyond the threshold, at a height of 70 ft, and a groundspeed of 138 kts. SWA had accelerated to 67 kts groundspeed and was 1,020 ft down the runway. At this time, the horizontal separation (the nose of FDX1432 to the tail of SWA708) was 870 ft and vertical separation (the lowest point of FDX1432 to the top of SWA708's tail) was 13 ft.

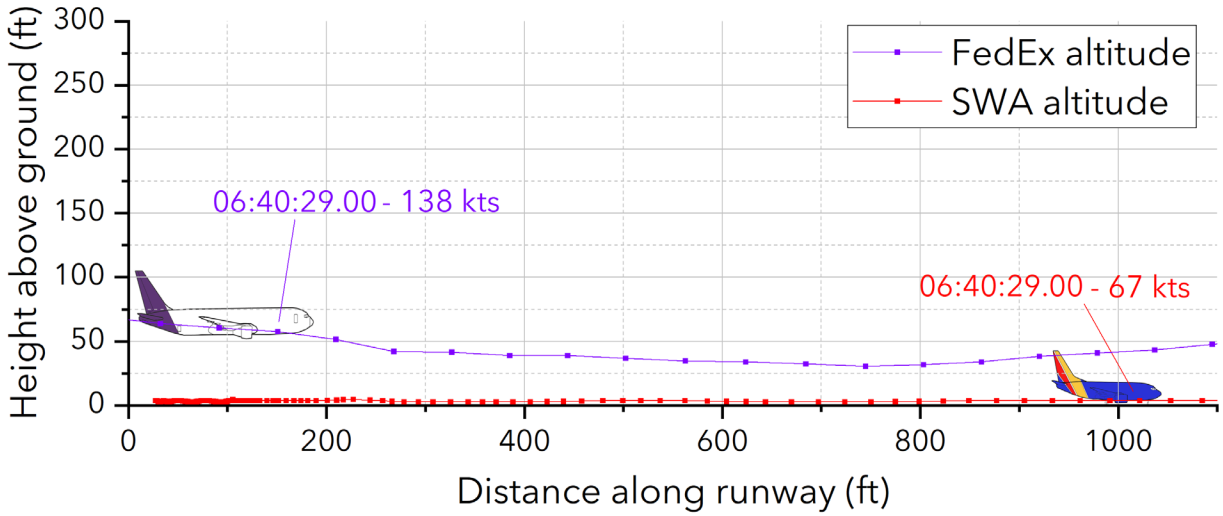


Figure 10. Airplane positions and groundspeed at 06:40:29 when FDX1432 advanced engine power for a go-around. Airplane sizes are approximately to scale.

FDX1432 continued to descend for 2.5 seconds as the airplane transitioned to climb. At 06:40:31, FDX1432 broadcasted "Southwest, abort". It reached a minimum corrected altitude of 31 ft at a point 750 ft down the runway (Figure 11). SWA708's

groundspeed was 78 kts and it was 1,350 ft along the runway. The horizontal separation was 480 ft and FDX1432 was lower than the top of SWA708's tail.

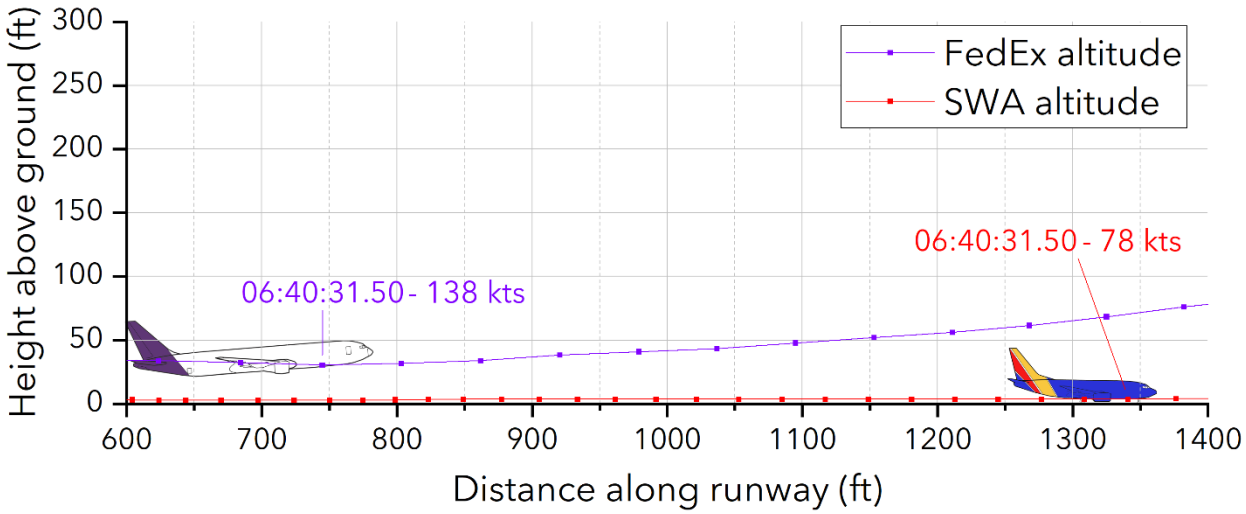


Figure 11. Airplane positions and groundspeed at 06:40:31.5 when FDX1432 was at its lowest altitude. Airplane sizes are approximately to scale.

At 06:40:34, FDX1432 broadcast "FedEx is on the go". FDX1432 was then 1,320 ft down runway 18L and climbing through 85 ft. SWA708 was 1,700 ft along the runway at a groundspeed of 88 kts and an indicated airspeed of 96 kts (Figure 12). Horizontal separation was 270 ft and the lowest point of FDX1432 was lower than the top of SWA708's tail.

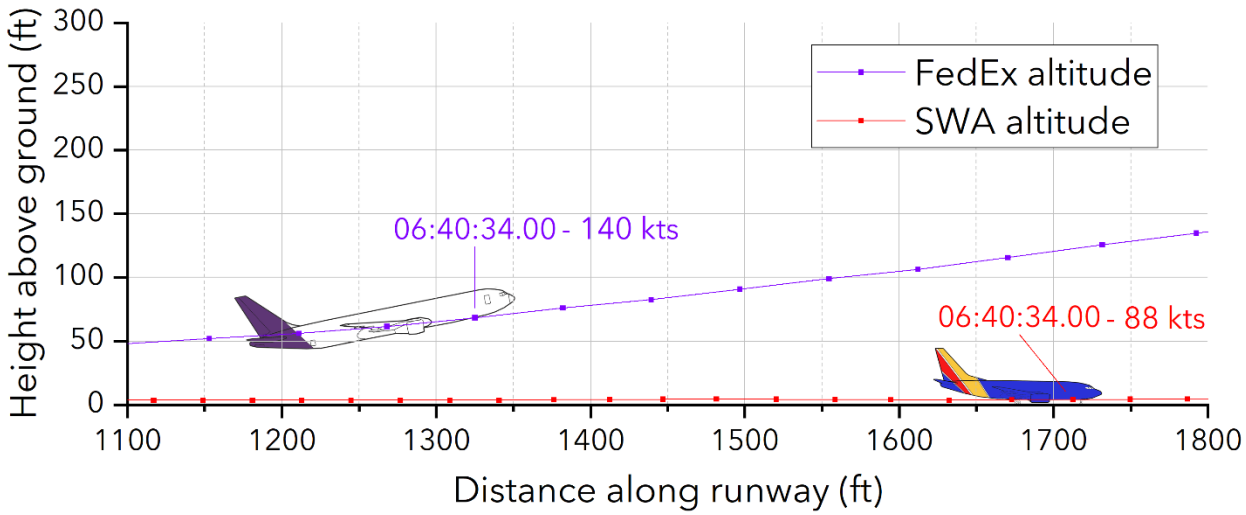


Figure 12. Airplane positions and groundspeed at 06:40:34. Airplane sizes are approximately to scale.

At 06:40:37 the airplanes reached their point of minimum separation for the event. FDX1432 was 2,020 ft down the runway and climbing through 190 ft. SWA708 was 2,200 ft down the runway at a groundspeed of 100 kts and an indicated airspeed of 107 kts (Figure 13). FDX1432 was climbing at a rate of 2,000 fpm (Figure 16).

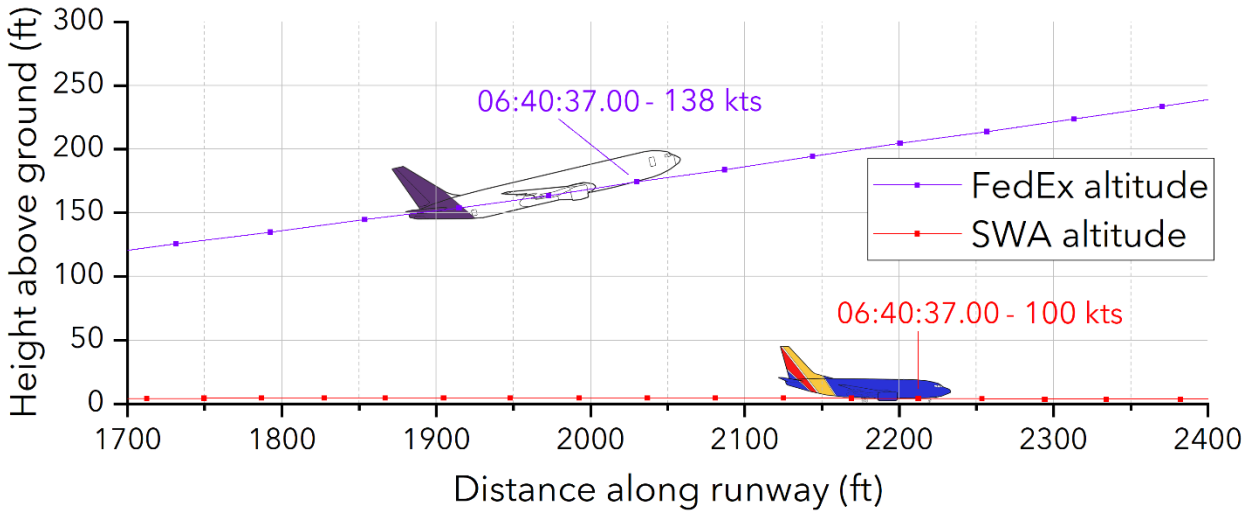


Figure 13. Airplane positions and groundspeed at 06:40:37 when the airplanes were at their closest point. Airplane sizes are approximately to scale.

Figure 14 shows a close up of the airplanes from Figure 13. The separation calculation between the lowest forward point of FDX1432 and the highest aft point of SWA708 was approximately 115 ft at 06:40:37. However, the absolute separation between the tail and the fuselage of the flying airplane was 150-170 ft, less than the length of the Boeing 767 airplane.

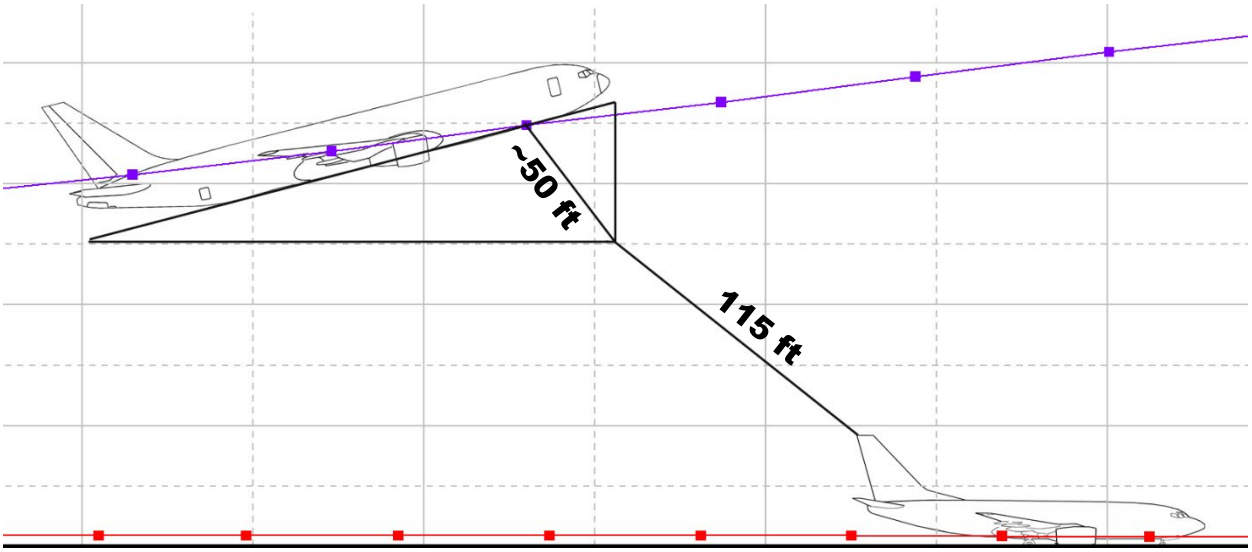


Figure 14. Airplane positions at 06:40:37 when the airplanes were at their closest point.

By 06:40:46, FDX1432's landing gear were up and stowed. At 06:40:47, SWA708 rotated at an indicated airspeed of 142 kts. The controller at 06:40:44 instructed SWA708 to turn right when able and the crew responded "negative". Main gear lifted off at 06:40:50 (Figure 15). SWA708 was 5,000 ft down runway 18L and FDX1432 was 500 ft above it. SWA708's groundspeed was now 7 kts faster than

FDX1432 and increasing. SWA708 received a traffic advisory from its Traffic Alert & Collision Avoidance System (TCAS) Computer at approximately this time [5]. In interviews, the SWA crew noted that after the TCAS alert they "shallowed" the climb (see Figure 16).

By 06:40:55, SWA708 was turning to the right of centerline. It was 6,300 ft down the runway at an altitude of 80 ft. FDX1432 was 6,200 ft down the runway at an altitude of 750 ft. Horizontal separation was 600 ft and vertical separation was 600 ft.

FDX1432 crossed the threshold of runway 36R at 06:41:07 at an altitude of 1,420 ft. The airplane was climbing at a rate of 3,400 fpm. SWA708, then at an altitude of 370 ft, was 500 ft past the threshold and 300 ft to the right. After an initial climb rate of 1,400 fpm, the SWA708's climb rate had slowed to 500 fpm. FDX1432 began a left climbing turn once past the threshold.

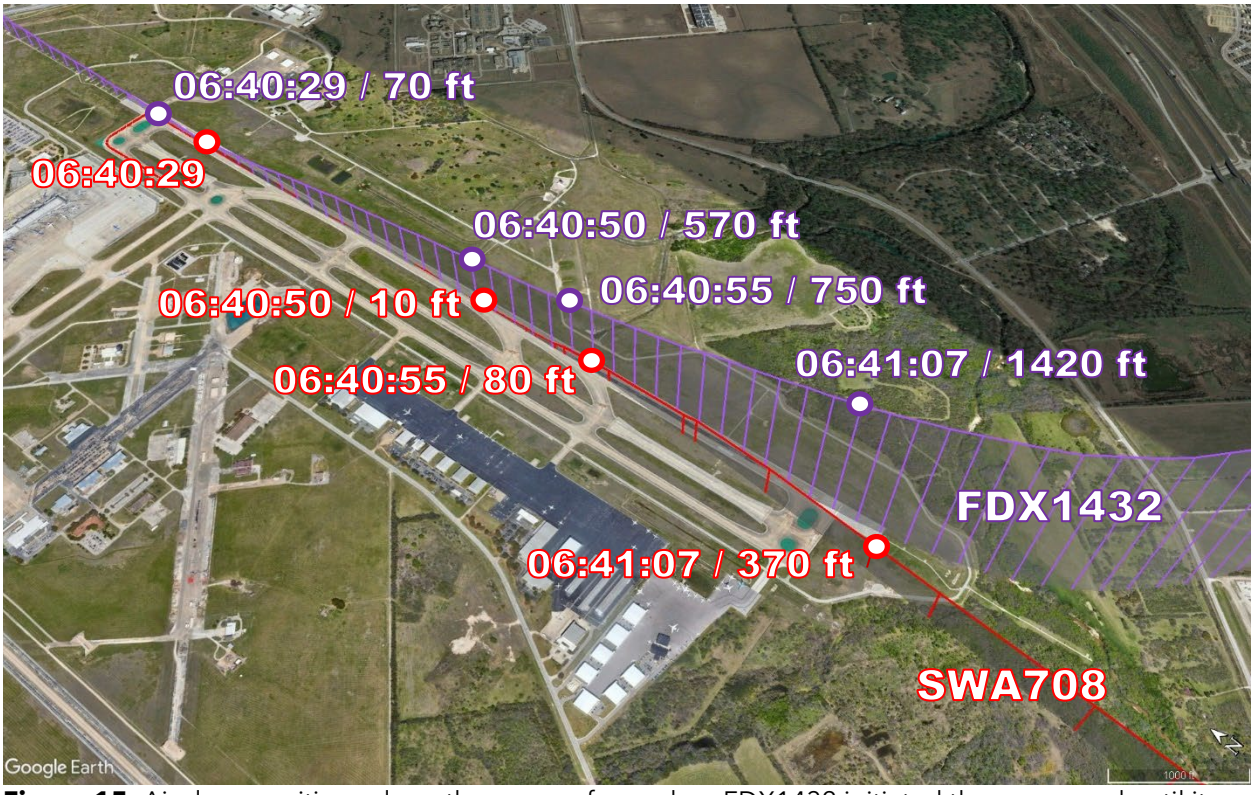


Figure 15. Airplane positions along the runway from when FDX1432 initiated the go-around until it crossed the threshold of runway 36R.

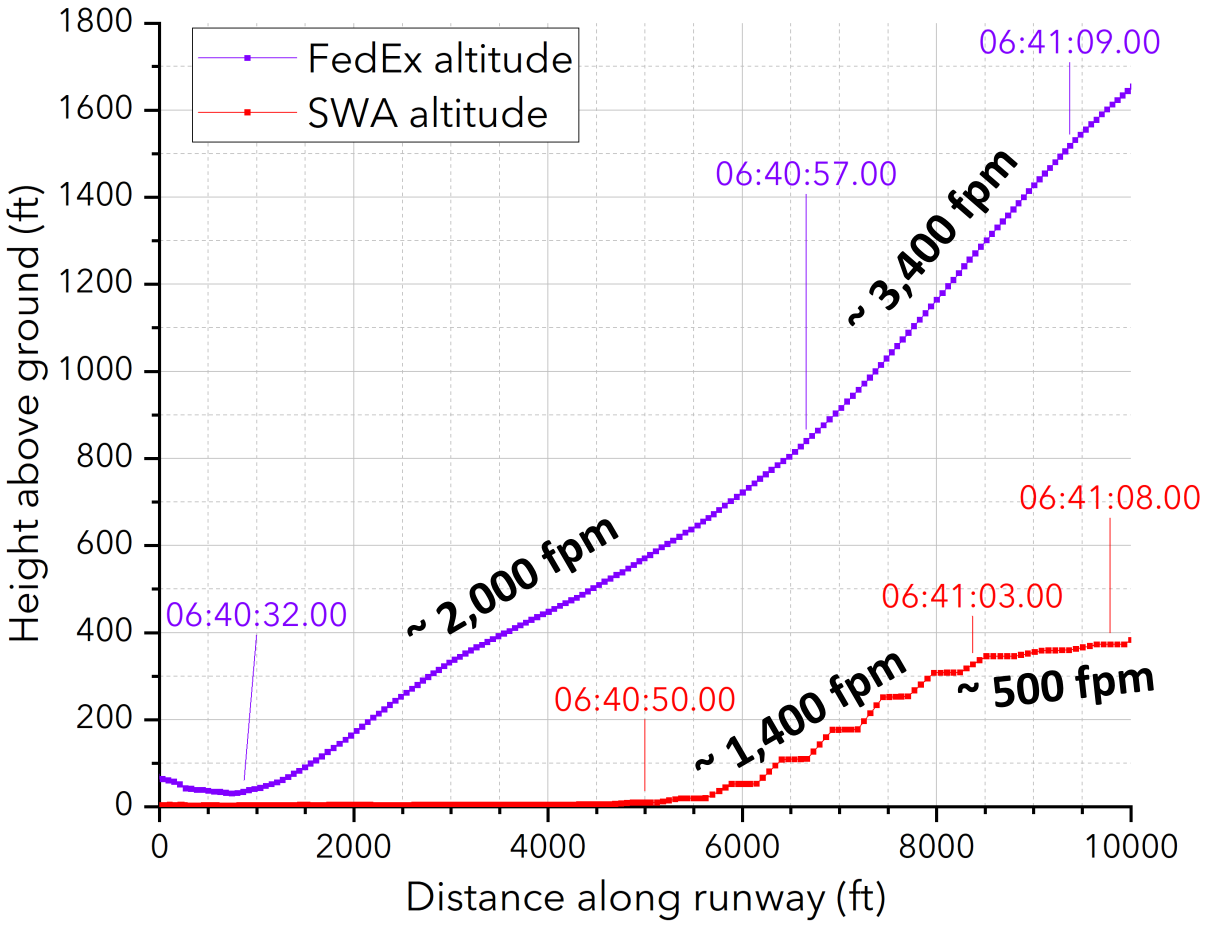


Figure 16. Airplane altitudes along the runway and rate of climb. The runway was 9,000 ft long.

FDX1432 completed a left turn, circled, and landed on runway 18L at 06:52. SWA708 completed its scheduled flight to Cancún, Mexico.

7.0 Traffic Alert and Collision Avoidance System

Both airplanes were equipped with Traffic Alert and Collision Avoidance System (TCAS) units [5]. The Honeywell TCAS unit on the Southwest airplane was downloaded and one traffic advisory (TA) was recorded for the incident. The time recorded on the TCAS was not accurate, but the TA occurred when SWA708's pressure altitude was 38 ft and FDX1432, the "intruder" aircraft, was 332 ft above and about 1 mile (recorded as 0.861 nautical miles in [5]) away. Using the FDR pressure altitudes for each airplane and the calculated separation, this is coincident with the airplanes' locations at 06:40:06.7. This TA would have occurred while SWA708 was stopped on runway 18L.

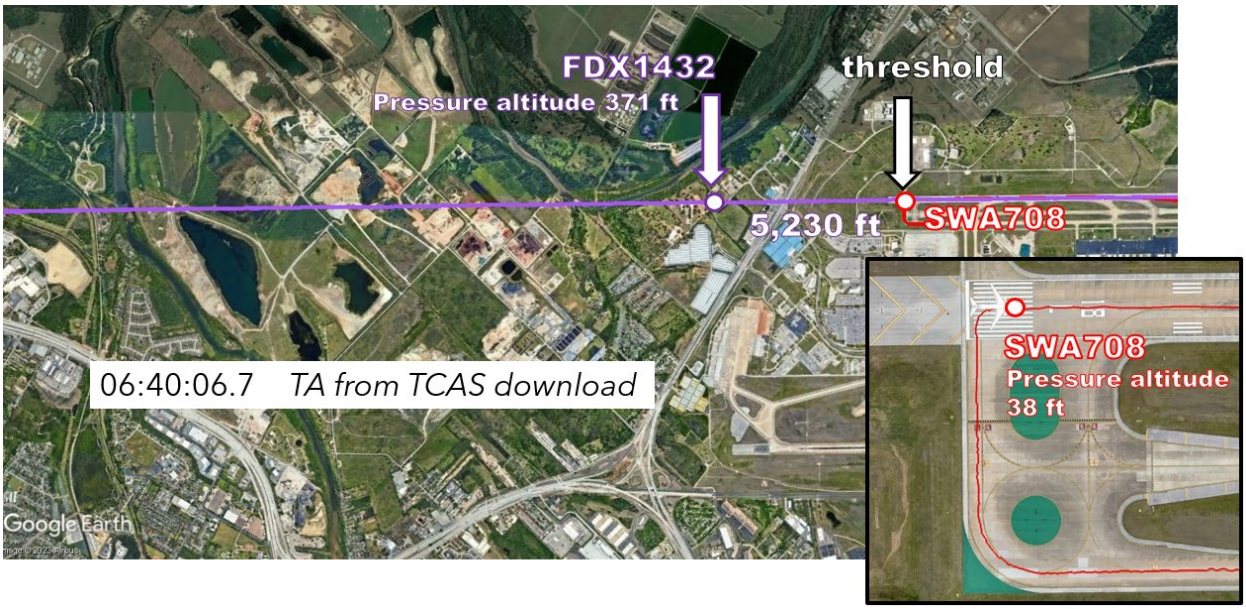


Figure 17. Locations of airplanes at 06:40:06.7 when the SWA708 TCAS recorded a TA.

Honeywell also completed a simulation of the Southwest TCAS system. The simulation predicted a TA without aural alert would have been issued at 06:40:01.75 when FDX1432 was 400 ft above and 6,400 ft away from SWA708. This was consistent with the FDR data and separation calculations. This TA would also have occurred while SWA708 was stopped on runway 18L, five seconds earlier than the recorded TA from the TCAS download.

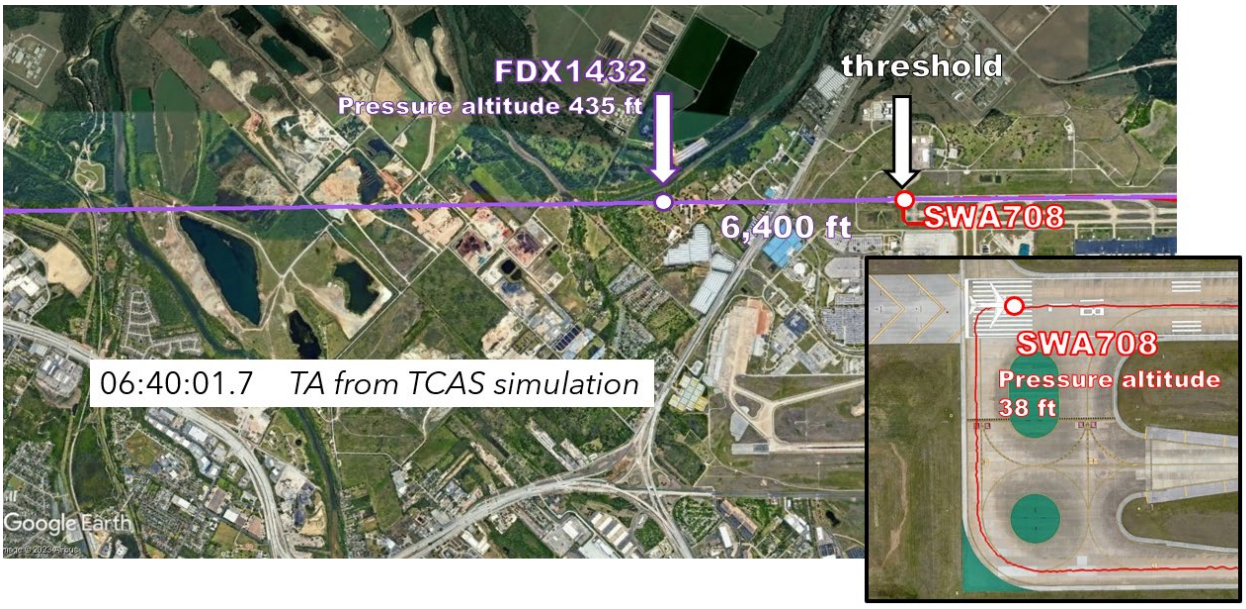


Figure 18. Locations of airplanes at 06:40:01.7 when the Honeywell simulation of the SWA708 TCAS recorded a TA.

The Aviation Communication and Surveillance Systems (ACSS, an L3 Harris & Thales Company) TCAS unit from the Federal Express airplane was also downloaded. No data was recorded from the event.

D. SUMMARY

SWA708 was cleared for take-off on runway 18L at 06:38:58, when FDX1432 was 3.9 miles from the runway threshold. SWA708 continued to taxi for another 57 seconds, coming to a stop on runway 18L at 06:39:55 when FDX1432 was 1.5 miles from the runway threshold. SWA708 was stopped for 19 seconds on the runway before beginning its roll at 06:40:14 when FDX1432 was 3,400 ft from the runway threshold.

FDX1432 crossed the runway threshold at 06:40:28 and advanced engines for a go-around at 06:40:29. The airplane reached its lowest radio altitude at 06:40:31.5 when it was 31 ft above the runway. At 06:40:37 the airplanes reached their point of minimum separation when the two airplanes were within 150-170 ft of one another. FDX1432 continued to climb as SWA708 continued to accelerate, increasing separation between the airplanes. SWA708 lifted off at 06:40:50. FDX1432 circled left and landed on runway 18L a few minutes later. SWA708 continued on its planned flight.

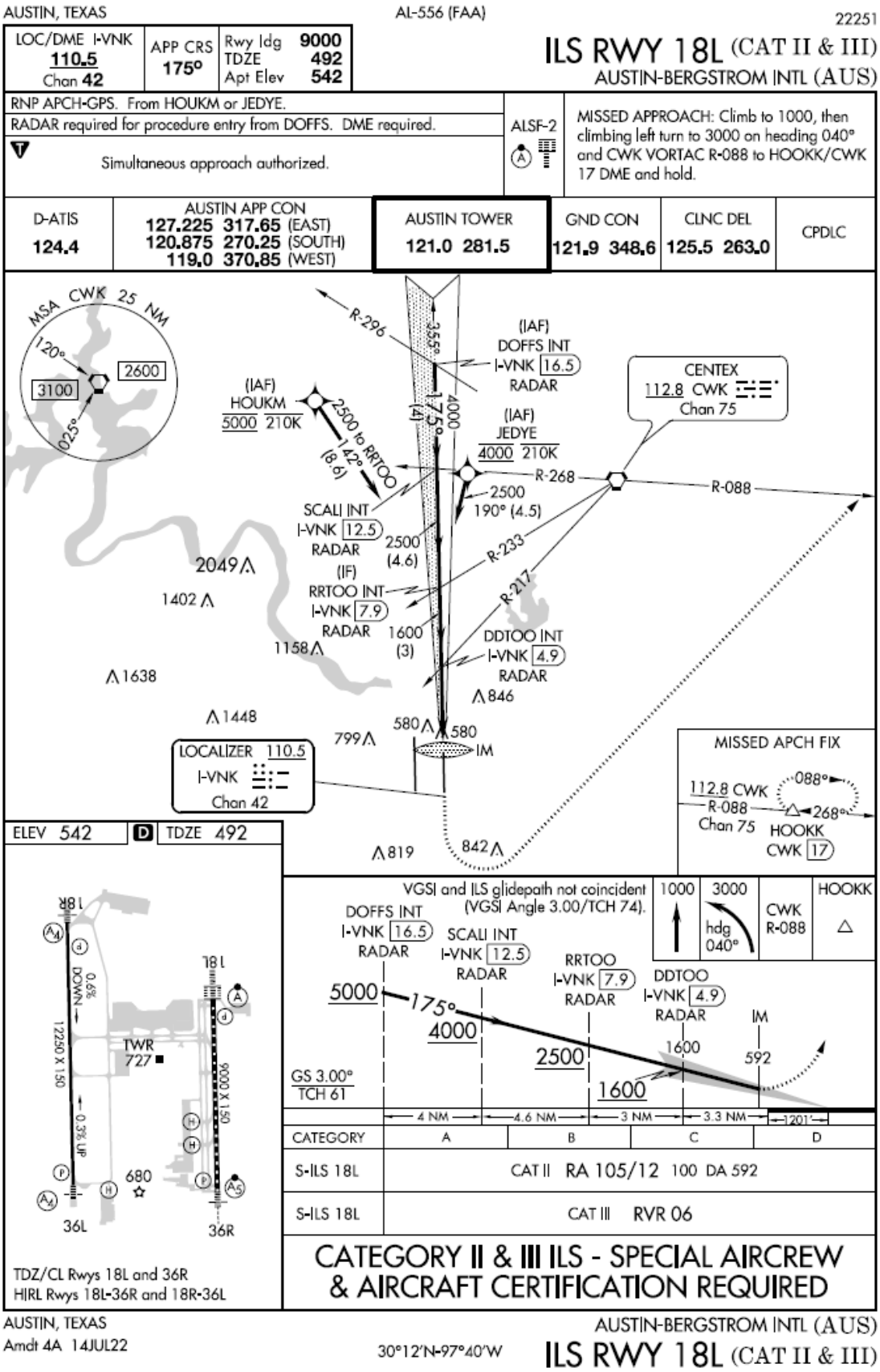
E. REFERENCES

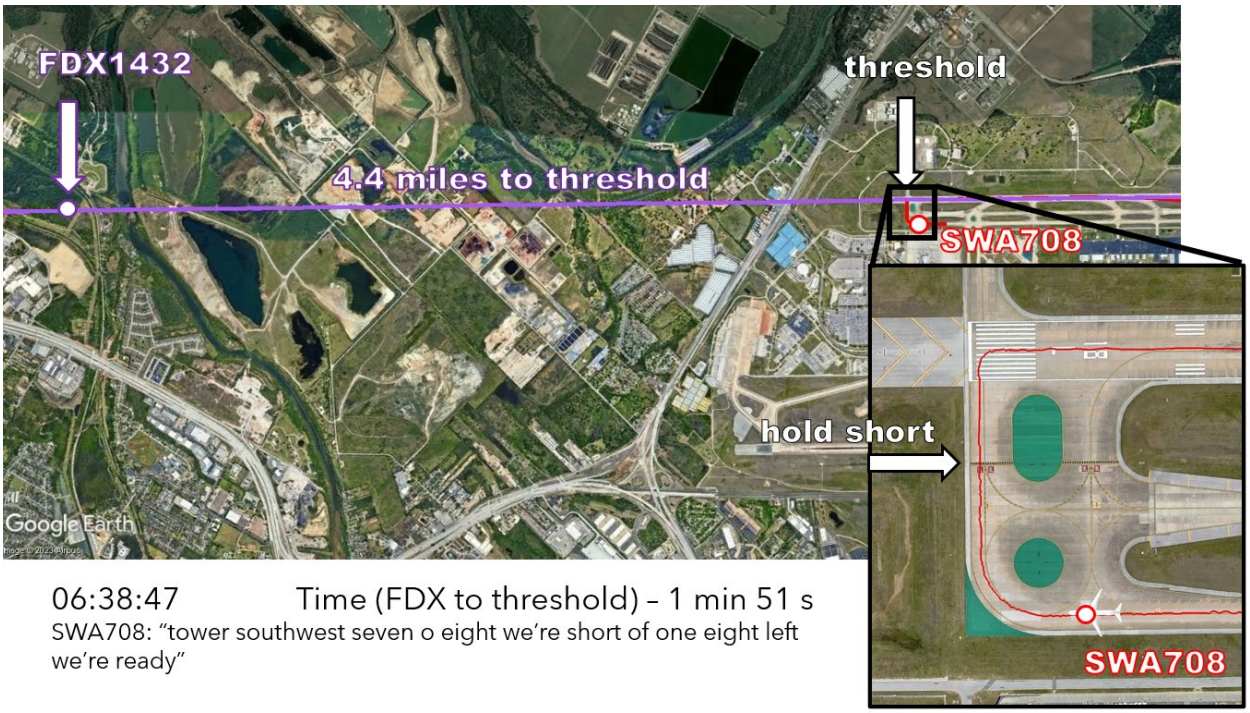
1. Flight Data Recorder Factual Report, DCA23LA149, National Transportation Safety Board, 2023.
2. Cockpit Voice Recorder Factual Report, DCA23LA149, National Transportation Safety Board, 2023.
3. Air Traffic Control Factual Report – Attachment 2, ATC Voice Transcription, DCA23LA149, National Transportation Safety Board, 2023.
4. Aerobahn ADS-B data, DCA23LA149, National Transportation Safety Board, 2023.
5. Systems Group Chairman's Factual Report, DCA23LA149, National Transportation Safety Board, 2023.

F. APPENDIX

Table 1. ATC communications and airplane locations.

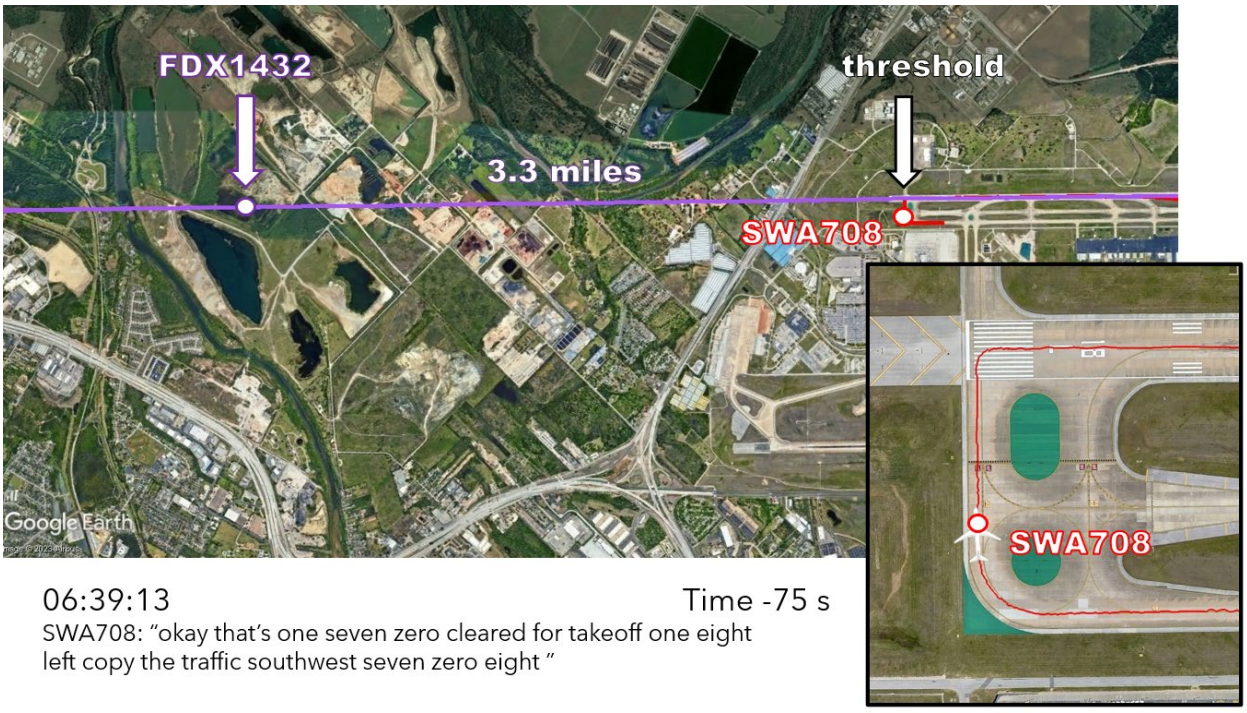
Time	ATC communication	FDX1432 location	SWA708 location
06:34:25	FDX1432: "cleared to land one eight left fedex 1432 heavy"		
06:38:47	SWA708: "tower southwest 708 we're short of one eight left we're ready"	4.4 miles from threshold	550 ft from hold short line, 850 ft from runway centerline
06:38:58	AUS-LC: "southwest 708 austin tower runway one eight left r-v-r one thousand two hundred midpoint six hundred rollout one thousand six hundred fly heading one seven zero runway one eight left cleared for takeoff traffic three mile final is a heavy seven sixty-seven"	3.9 miles from threshold	400 ft from hold short line, 700 ft from runway centerline
06:39:13	SWA708: "okay that's one seven zero cleared for takeoff one eight left copy the traffic southwest seven zero eight"	3.3 miles from threshold	180 ft from the hold short line,
06:39:26		2.7 miles from threshold	Hold short line
06:39:29	FDX1432: "tower confirm uh fedex 1432 heavy's cleared to land on the one eight left"	2.6 miles from threshold	230 ft from runway centerline
06:39:34	AUS-LC: "fedex 1432 heavy that is affirmative one eight left you are cleared to land traffic departing prior to your arrival's a seven thirty-seven"	2.4 miles from threshold	130 ft from runway centerline
06:39:40	FDX1432: "roger"	2.1 miles from threshold	On runway, turning onto runway heading
06:39:44		2 miles from threshold	On runway, 50 ft beyond threshold
06:39:55		1.5 miles (8,000 ft) from threshold	On runway, 100 ft beyond threshold SWA stops for deicing/engine run up
06:40:10	AUS-LC: "southwest 708 confirm on the roll"	0.82 miles (4,300 ft) from threshold	On runway, 100 ft beyond threshold
06:40:13	SWA708: "rolling now"	0.68 miles (3,600 ft) from threshold	On runway, 100 ft beyond threshold
06:40:14		0.64 miles (3,400 ft) from threshold	On runway, 100+ ft beyond threshold, moving
06:40:28		Crossed threshold	900 ft beyond threshold


AUSTIN, TEXAS
AL-556 (FAA)
22251
LOC/DME I-VNK 110.5 Chan 42
APP CRS 175°
Rwy Idg 9000
TDZE 492
Apt Elev 542
ILS RWY 18L (CAT II & III)
AUSTIN-BERGSTROM INTL (AUS)
RNP APCH-GPS. From HOUKM or JEDYE.
RADAR required for procedure entry from DOFFS. DME required.
Simultaneous approach authorized.
ALSF-2
MISSED APPROACH: Climb to 1000, then climbing left turn to 3000 on heading 040° and CWK VORTAC R-088 to HOOKK/CWK 17 DME and hold.
D-ATIS 124.4
AUSTIN APP CON 127.225 317.65 (EAST) 120.875 270.25 (SOUTH) 119.0 370.85 (WEST)
AUSTIN TOWER 121.0 281.5
GND CON 121.9 348.6
CLNC DEL 125.5 263.0
CPDLC
MSA CWK 25 NM
120°
2600
3100
025°
R-296
355°
(IAF) DOFFS INT I-VNK 16.5 RADAR
4000
(4)
175°
(IAF) HOUKM 5000 210K
2500 to RRTOO 142° (8.6)
(IAF) JEDYE 4000 210K
CENTEX 112.8 CWK Chan 75
R-268
R-088
2500 190° (4.5)
SCALI INT I-VNK 12.5 RADAR
2500 (4.6)
R-233
R-217
(IF) RRTOO INT I-VNK 7.9 RADAR
1600 (3)
DDTOO INT I-VNK 4.9 RADAR
2049
1402
1158
1638
1448
846
580
799
819
842
IM
LOCALIZER 110.5 I-VNK Chan 42
MISSED APCH FIX
112.8 CWK R-088 Chan 75
088°
268°
HOOKK CWK 17
ELEV 542
D
TDZE 492
18R
18L
0.6% DOWN
12250 X 150
TWR 727
9000 X 150
0.3% UP
680
36L
36R
TDZ/CL Rwys 18L and 36R
HIRL Rwys 18L-36R and 18R-36L
VGSI and ILS glidepath not coincident (VGSI Angle 3.00/TCH 74).
DOFFS INT I-VNK 16.5 RADAR
SCALI INT I-VNK 12.5 RADAR
RRTOO I-VNK 7.9 RADAR
DDTOO I-VNK 4.9 RADAR
IM
5000
175°
4000
2500
1600
592
GS 3.00°
TCH 61
1000
3000
hdg 040°
CWK R-088
HOOKK
4 NM
4.6 NM
3 NM
3.3 NM
1201'
CATEGORY A B C D
S-ILS 18L CAT II RA 105/12 100 DA 592
S-ILS 18L CAT III RVR 06
CATEGORY II & III ILS - SPECIAL AIRCREW & AIRCRAFT CERTIFICATION REQUIRED
AUSTIN, TEXAS
Amdt 4A 14JUL22
30°12'N-97°40'W
AUSTIN-BERGSTROM INTL (AUS)
ILS RWY 18L (CAT II & III)
SC-3, 18 MAY 2023 to 15 JUN 2023
SC-3, 18 MAY 2023 to 15 JUN 2023



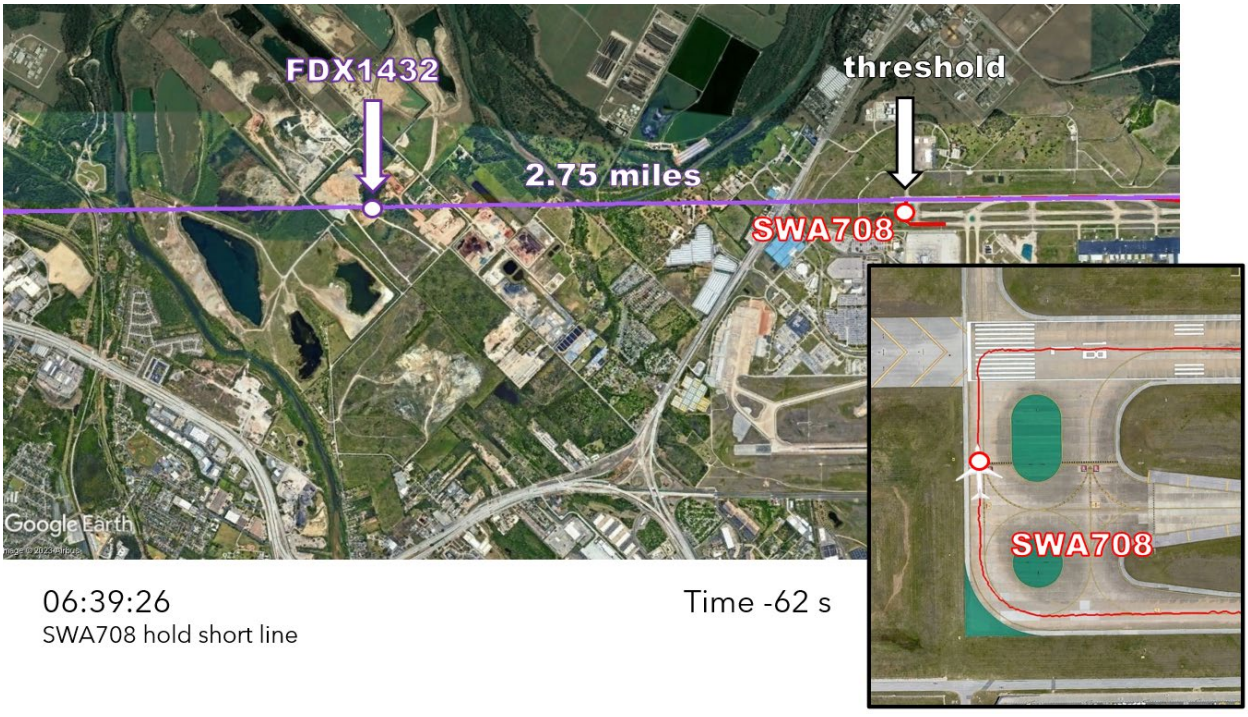
06:38:47 Time (FDX to threshold) – 1 min 51 s
SWA708: "tower southwest seven o eight we're short of one eight left we're ready"

06:38:58 Time -90s
AUS-LC: "southwest seven zero eight austin tower runway one eight left r-v-r one thousand two hundred midpoint six hundred rollout one thousand six hundred fly heading one seven zero runway one eight left cleared for takeoff traffic three-mile final is a heavy seven sixty-seven"



06:39:13 Time -75 s

SWA708: "okay that's one seven zero cleared for takeoff one eight left copy the traffic southwest seven zero eight "

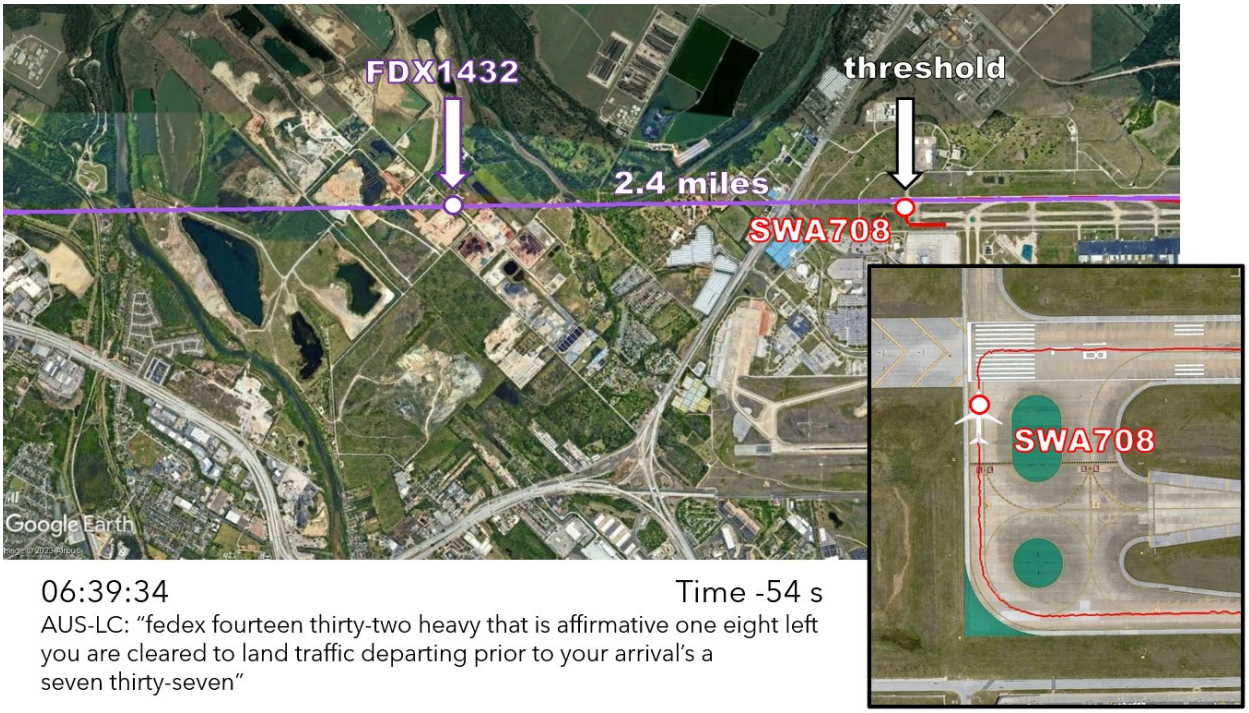


06:39:26 Time -62 s

SWA708 hold short line

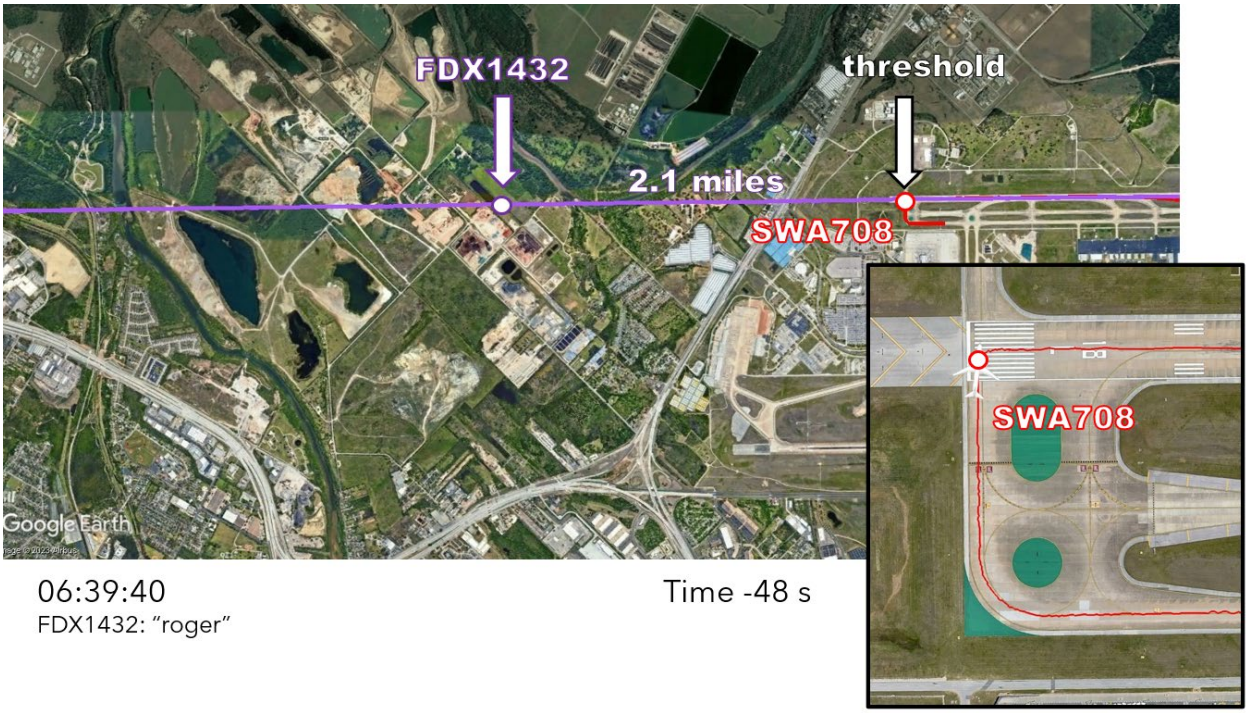
06:39:29 Time -59 s

FDX1432: "tower confirm uh fedex fourteen thirty-two heavy's cleared to land on the one eight left"

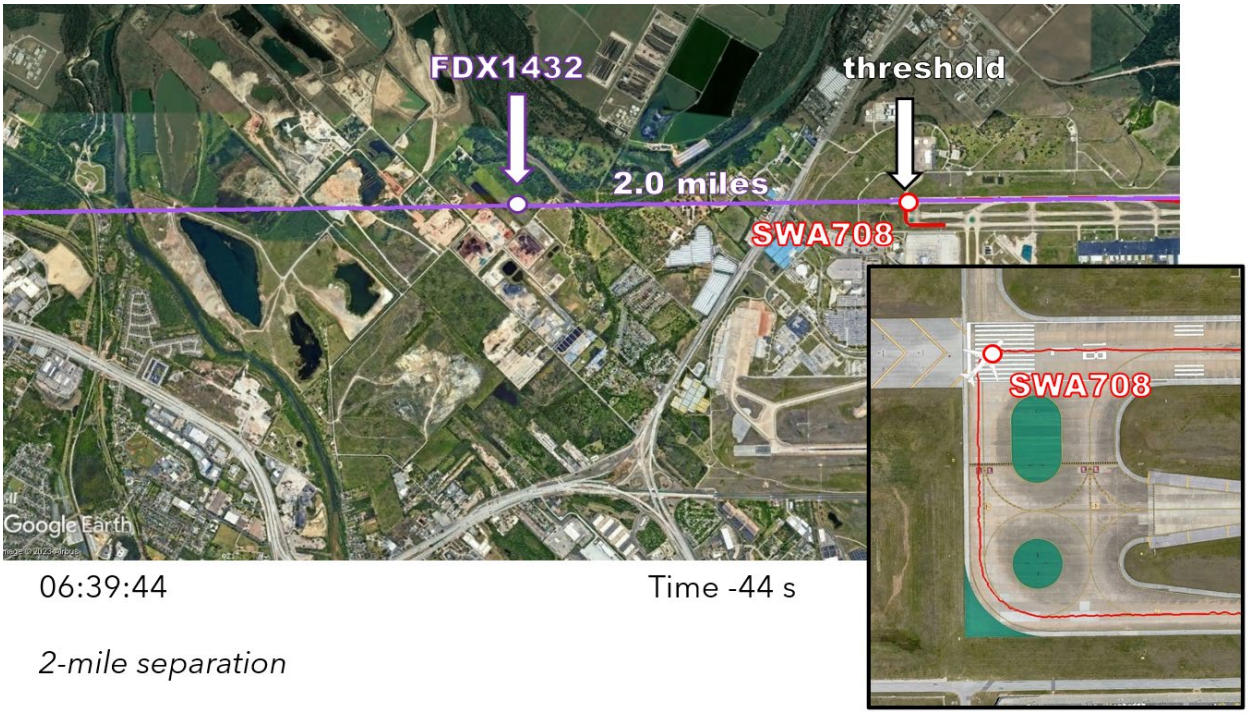


06:39:34 Time -54 s

AUS-LC: "fedex fourteen thirty-two heavy that is affirmative one eight left you are cleared to land traffic departing prior to your arrival's a seven thirty-seven"

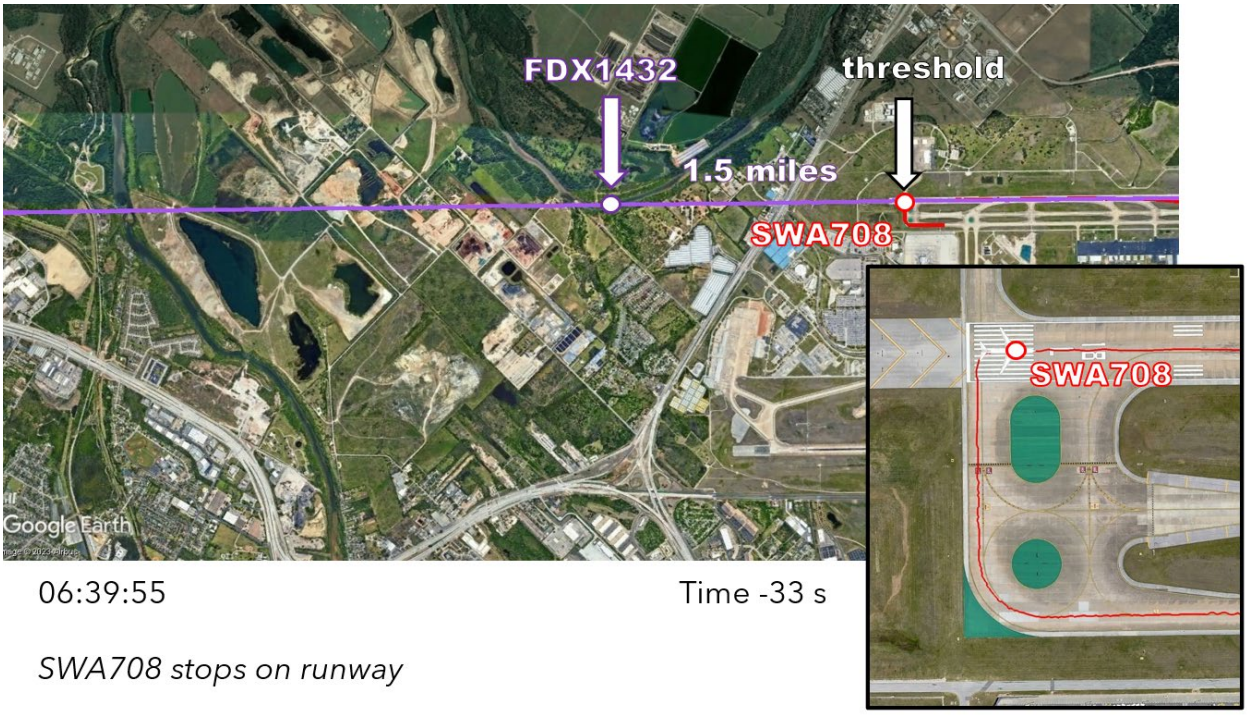


06:39:40 Time -48 s
FDX1432: "roger"



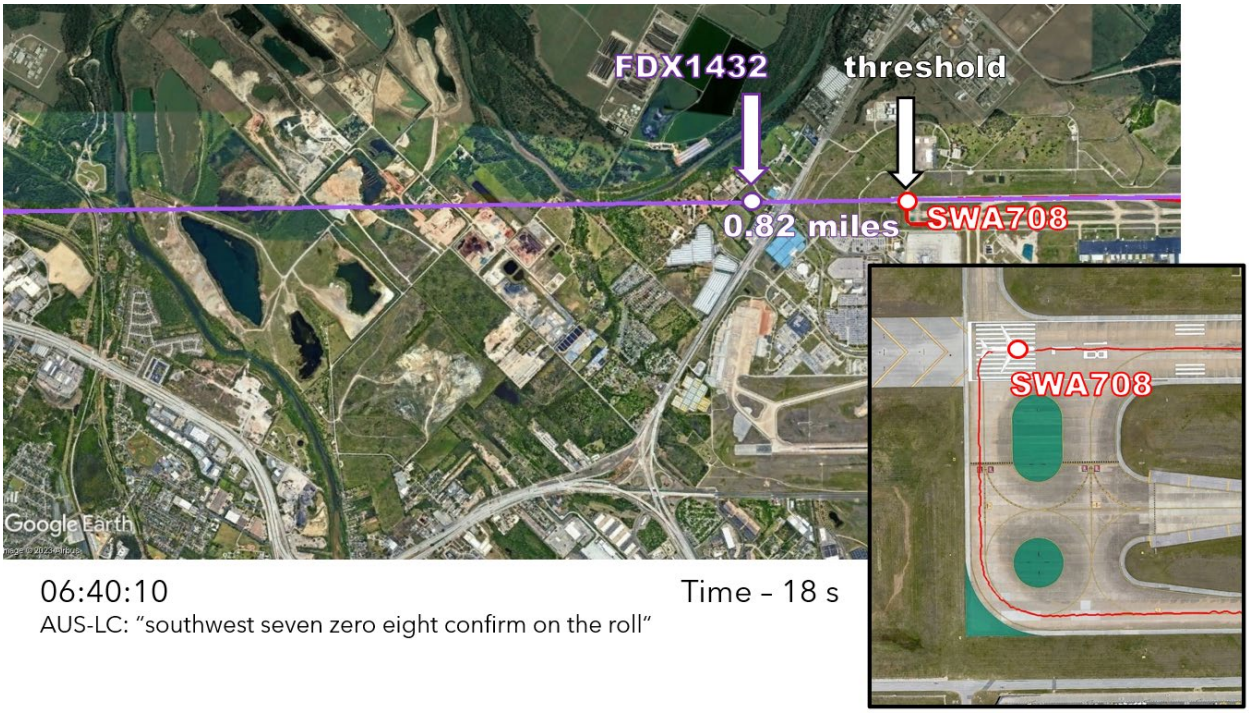
06:39:44 Time -44 s

2-mile separation



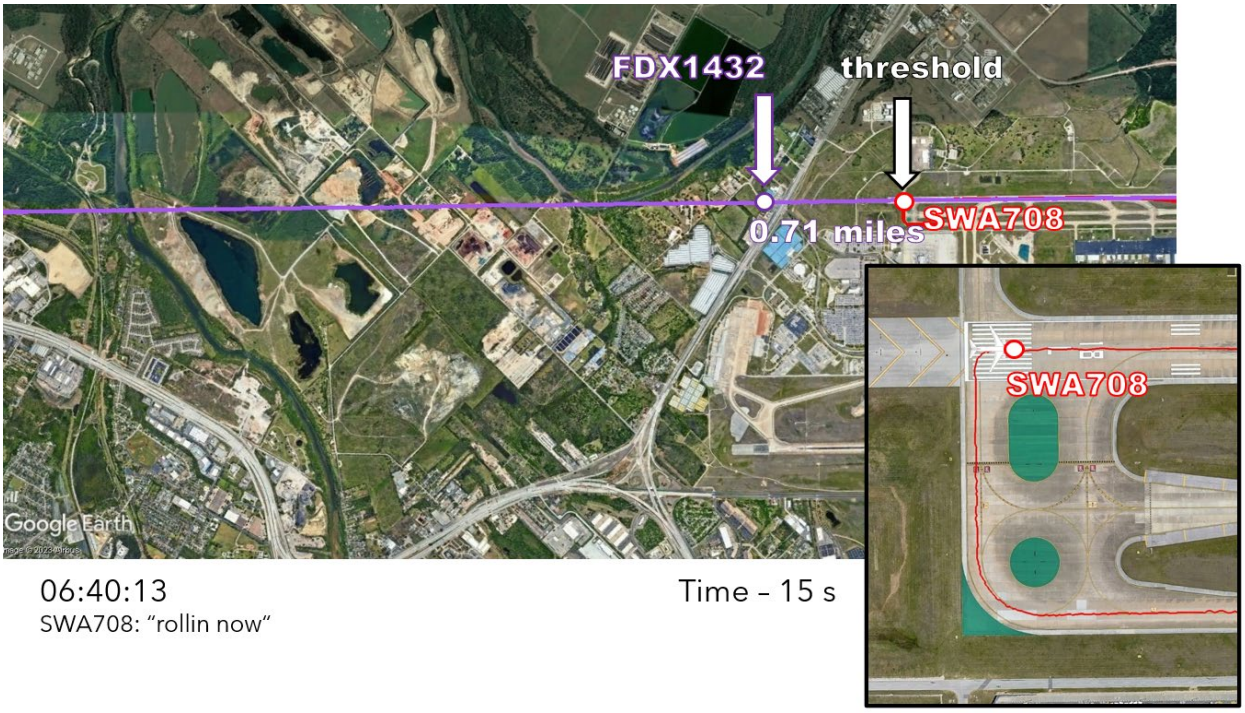
06:39:55 Time -33 s

SWA708 stops on runway



06:40:10 Time – 18 s

AUS-LC: "southwest seven zero eight confirm on the roll"



06:40:13
SWA708: "rollin now"

Time – 15 s