Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Boeing Company 737-3H4, N619SW

Fitzgerald River National Park, Western Australia on 6 February 2023

ATSB Transport Safety Report
Aviation Occurrence Investigation (Systemic)
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Addendum

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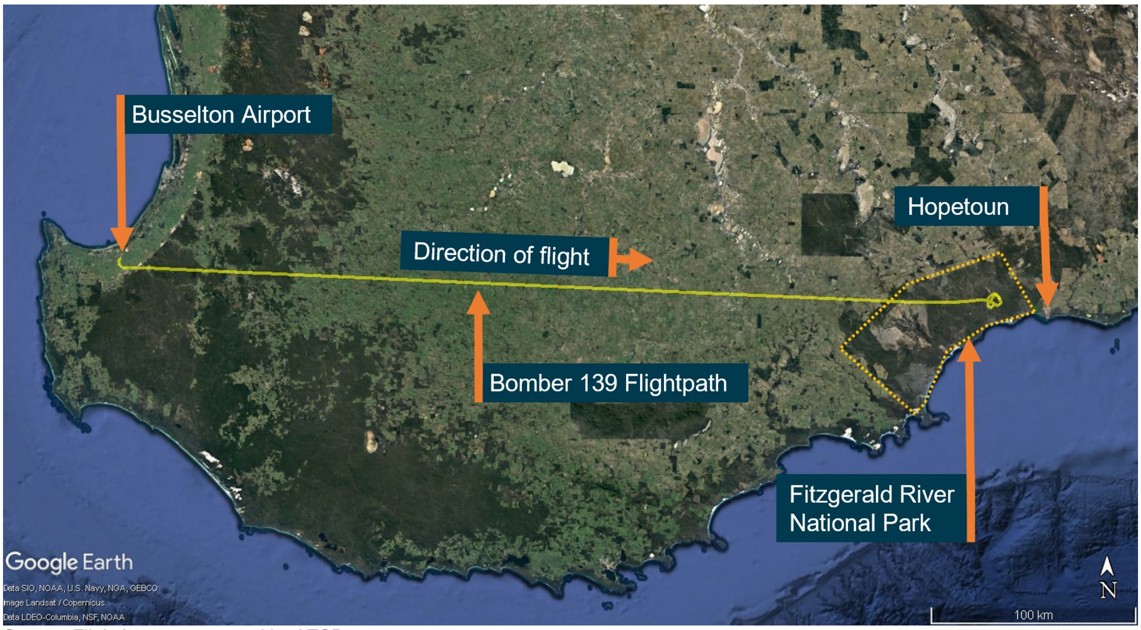
Preliminary report

This preliminary report details factual information established in the investigation's early evidence collection phase and has been prepared to provide timely information to the industry and public. Preliminary reports contain no analysis or findings, which will be detailed in the investigation's final report. The information contained in this preliminary report is released in accordance with section 25 of the *Transport Safety Investigation Act 2003*.

The occurrence

On 6 February 2023 at about 1532 local time, a Coulson Aviation Boeing 737-3H4 large air tanker (LAT), callsign Bomber 139 and registered N619SW, departed from Busselton Airport, Western Australia (WA) on a fire-fighting task to Fitzgerald River National Park, WA (Figure 1). There were 2 pilots on board, the aircraft captain in the left seat as the pilot flying and a co-pilot in the right seat as the pilot monitoring.[1]

Figure 1: Bomber 139 flightpath from Busselton to Fitzgerald River National Park



Source: FlightAware, annotated by ATSB

Earlier on the day, at 1015, and then again at 1215 and 1310, the WA Department of Biodiversity, Conservation and Attractions (DBCA) submitted aerial fire suppression requests to the State Operations Air Desk (SOAD). The request was for fixed-wing assets to the location of a fire 24 km west-north-west of Hopetoun, WA under the criteria of 'known high fuel loads and likelihood of excessive ROS [rate of spread] and/or extreme fire danger'. In response, the SOAD:

- identified the aerial assets available
- established a fire common traffic advisory frequency (F-CTAF)
- spoke to the pilots
- sent tasking messages at 1012, 1127, 1407 and 1505.

[1] Pilot Flying (PF) and Pilot Monitoring (PM): procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and the aircraft's flight path.

Bomber 139 was included in the 1127, 1407 and 1505 taskings. The SOAD LAT SARWATCH log[2] recorded Bomber 139 departing from Busselton on these taskings at 1208 and 1330, returning each time before departing on the accident flight at 1530.

At 1519 the bird-dog[3] responsibility for the LATs at the fireground transferred from bird-dog 125 (BD125) to BD123 (due to BD125 refuel requirements) with BD682 stationed above as the primary air attack aircraft.[4] Before BD125's departure, a familiarisation flight of the fire zone was conducted with BD123 to discuss the layout of the fire, tactics, retardant drops, and objectives for the drops. No hazards were discussed. The crew of Bomber 139 contacted BD123 when they were 15 minutes from the fireground. The crew of BD123 acknowledged and advised an altimeter QNH[5] setting of 1003 hPa. Bomber 139's crew acknowledged the altimeter setting and informed BD123 they would contact BD682 when they were 5 minutes from the fireground.

The pilot of BD682 subsequently cleared Bomber 139 to enter the F-CTAF not above an altitude of 2,500 ft and Bomber 139's crew notified them they would be working with BD123 on an altimeter setting of 1003. The crew of BD123 queried BD682 if the drop zone was clear and were advised that no ground personnel had been sighted and that they were not expected for about another hour. At this stage, Bomber 139's co-pilot advised the captain of their drop airspeeds, which included a target drop airspeed (V_{DROP}) of 133 kt (1.25 V_S[6]). When the crew of Bomber 139 reported BD123 in sight, they were asked if they wanted a 'show-me' run or to follow BD123 straight to the drop. Bomber 139's crew responded that they would follow them and go straight to the drop. The crew of BD123 then obtained confirmation that right-hand circuits would be acceptable due to visibility.

Bomber 139 was briefed by the bird-dog that the plan was to tag and extend the existing line of retardant while keeping the smoke off to the left side. Bomber 139's crew subsequently reported to BD123 that they were in position and the captain called for the pre-drop checklist from the co-pilot. The crew of Bomber 139 notified BD123 their target speed would be 135 kt for final and then set their flaps to flap-40 (full flap). Bomber 139's crew was then briefed on the drop by BD123, which included a straight exit, no hazards, a downslope, and target altitude initially of 500 ft descending to 400 ft. The co-pilot subsequently reported to the captain that the checklist was complete and BD123 reported turning onto final for the drop, which was on a heading of 155º.

Once on final, BD123's crew advised Bomber 139 to 'start at the road and keep all smoke to the left, 3, 2, 1, start, your target altitude is 500 descending to 400'. Bomber 139 descended to about 400 ft and completed a partial drop of three-quarters of their tank at about 70% N1[7] before the captain stopped the drop because their retardant line was starting to enter area that was burnt. The partial drop was reported to BD123, and another circuit commenced to tag and extend the line with the remaining retardant, with the captain remarking to the bird-dog '…and head down off the hill'.

The captain instructed the co-pilot to conduct the pre-drop checklist for the second drop. The co-pilot reported that 118 kt would be their drop airspeed and the captain requested BD123 slow to 120 kt for the next drop, which they acknowledged. BD123's crew then briefed Bomber 139 to 'tag and extend all existing retardant, it is start at the hill as it pushes down, target altitude 500

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2 SARWATCH log: record of movement times for managing aircraft search and rescue times.

3 The bird-dog is an intelligence-gathering aircraft, used to assess the fireground, determine the best flightpath and then lead the air tankers across the fireground and show them where to drop with a smoke generator. It is crewed by a bird-dog pilot and air attack supervisor.

4 The primary air attack aircraft maintains a strategic overview of the situation, which includes communications with ground personnel, objectives for the air tanker operation and aircraft separation protocols.

5 QNH: the altimeter barometric pressure subscale setting used to indicate the height above mean seal level.

6 V_S: The stall speed or the minimum steady flight speed for the aircraft configuration.

7 N_1: the rotational speed of the low pressure compressor in a turbine engine.

descending 400'. The co-pilot reported that flap-40 was set and the pre-drop checklist completed. The crew of BD123 then provided the following commentary, 'this is final, fully retardant drop out here in a second, standby, [pause], retardant's right at our 12 o'clock, [pause], 3, 2, 1, tag and extend existing retardant'.

During the second drop, Bomber 139 descended through 400 ft altitude (80 ft radio height) at about 110 kt computed airspeed[8] and 30% N1 (engines at high idle)[9] as the retardant line was extended downslope (Figure 2). The captain started to advance the throttle levers about 2 seconds before the aircraft's rate of descent peaked at about 1,800 ft/min and started to pitch the nose up.

The nose up pitch preceded the acceleration of the engines, resulting in a reversal of the rate of descent, but also a decay of the airspeed. The captain then announced 'fly airplane' followed immediately, at about 1614,[10] by the activation of the stick shaker[11] and an abrupt vertical acceleration associated with the aircraft impacting a ridgeline at an elevation of about 222 ft at 104 kt computed airspeed with the engines at 85-89% N1.

Figure 2: Accident retardant drop

Bulldozer fire tracks constructed after the accident.
Source: ATSB

The co-pilot did not announce any deviations during the drop and accident sequence and later reported their focus of attention was likely on the airspeed indicator and radio altimeter, monitoring for any adverse trends. After the impact with the ridgeline, the aircraft cleared a small line of foliage before impacting the ground a second time and then sliding to rest. In response to the collision, BD123's crew made an all-stations mayday[12] call.

After motion had ceased, the co-pilot started the evacuation checklist. Both pilots were unable to open the cabin door as it had buckled and the co-pilot was unable to open the right-side window.

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8 Computed airspeed is the airspeed recorded from the airplane air data inertial reference unit. This may differ slightly from the indicated airspeed on the analog instrument panel due to instrumentation errors.

9 HIGH IDLE: The high idle speed is set at a level above the low idle setting to assure rapid engine acceleration during go-around and to assure adequate anti-ice performance. In flight, only high idle speed is allowed.

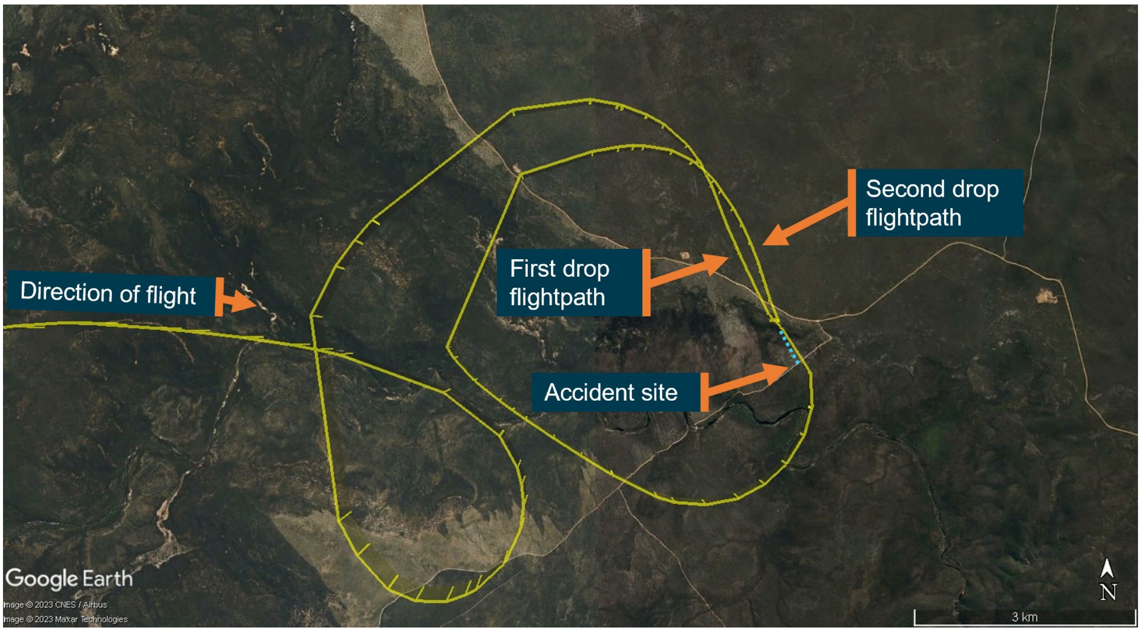
10 The clock input to the flight data recorder was the captain's clock, which was about 11.5 minutes ahead of actual time.

11 The flap-40 stick shaker activation threshold was 20° angle of attack.

12 MAYDAY: an internationally recognised radio call announcing a distress condition where an aircraft or its occupants are being threatened by serious and/or imminent danger and the flight crew require immediate assistance.

The captain observed out of the left side window that a post-impact fire had started and managed to open that window on their second attempt. Both pilots then exited out of the left window and moved clear of the wreckage and fire. They were subsequently rescued by a helicopter involved in the fire control activities after 2 single-engine air tankers had dropped retardant on the aircraft fire believing the crew were still inside. The crew suffered minor injuries and the aircraft was destroyed. Figure 3 depicts Bomber 139's recorded flightpath at Fitzgerald River National Park.

Figure 3: Bomber 139 recorded flightpath at Fitzgerald River National Park



Source: FlightAware, annotated by ATSB

Context

Aircraft information

The aircraft was a Boeing 737-3H4, serial number 28035, registration N619SW, issued with a certificate of airworthiness in the transport category[13] on 9 November 1995 and fitted with 2 CFM56-3 turbofan engines. It entered service with a United States airline on 12 November 1995 and accumulated 69,016 hours before transfer of ownership to Coulson Aviation on 8 August 2017. The latest certificate of registration was issued on 14 November 2017 and was valid until 30 November 2023.

On 10 November 2018, Coulson Aviation were issued with a supplemental type certificate (ST04050NY) for the installation of the Coulson Aerial Firefighter Tanker Modification to Boeing model 737-300 series aircraft, which limited passengers to persons related to firefighting mission-essential activities. The tanker modification was completed on 30 May 2022. At the time of the accident, the airframe had accumulated 69,187.6 hours.

Meteorological information

On the day of the accident there was a low-pressure trough crossing southern WA, resulting in thunderstorms and wind direction changes from the north-east to the south-east to the south-west. The graphical area forecast for the accident site included moderate turbulence from the surface to

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[13] Transport category: an airworthiness categorisation that applies to multi-engine aircraft primarily intended for regular public transport and/or cargo for hire or reward.

10,000 ft with thermals. A SIGMET[14] was issued at 1400 for frequent thunderstorms associated with the trough. While the north-western boundary of the SIGMET was close to the accident site, satellite and radar imagery indicated there were no thunderstorms in the vicinity of the accident site at the time of occurrence. The Hopetoun North weather station, located about 24 km east-north-east of the site, did not record any rainfall and the 10-minute weather data from the station is provided in Table 1.

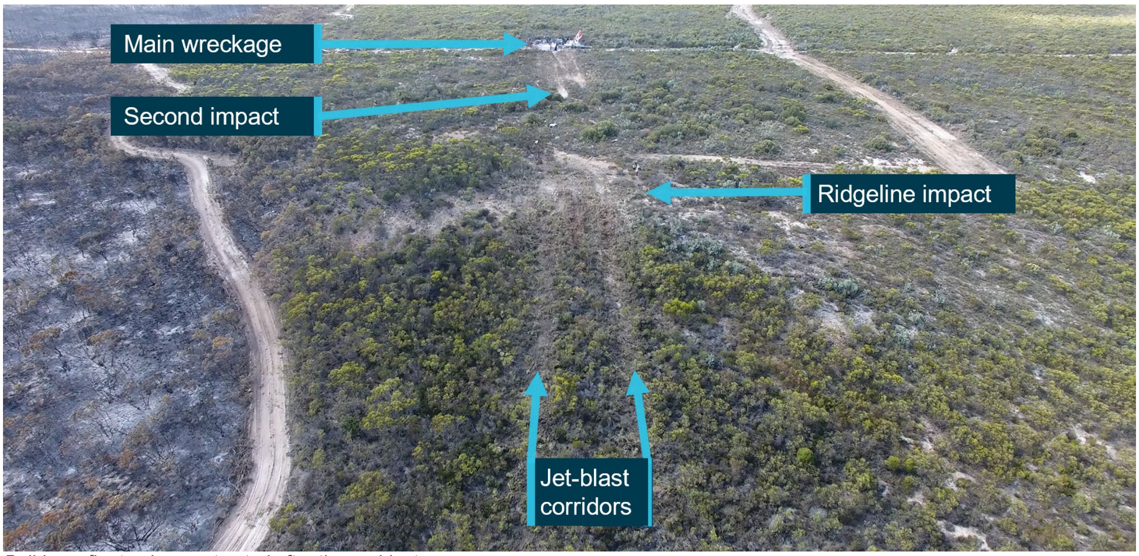
Table 1: Hopetoun North weather station recordings

Time (WST)	Air temp (ºC)	Dew point temp (ºC)	Average 10 min wind speed (kt)	Highest 10 min wind speed (kt)	Average 10 min wind direction	Rainfall in last 10 min (mm)
1550	23.4	18.7	14.8	20.4	ESE	0
1600	23.2	18.7	14.0	19.6	SE	0
1610	23.1	18.6	11.6	17.1	SE	0
1620	23.4	18.7	11.4	15.0	ESE	0
1630	23.1	18.8	11.5	14.4	SE	0
1640	23.1	19.0	9.9	15.0	SE	0

Wreckage and impact information

The aircraft's approach to the ridgeline left 2, distinct jet-blast lines evidenced by trees broken in the opposite direction of travel (Figure 4). Closer to the ridgeline trees were broken in the direction of travel, likely from contact with the aircraft's engines and airframe with evidence of retardant transfer from the airframe to the foliage just below the ridgeline. The length of the jet-blast lines were about 74 m and 62 m respectively for the left and right engines. After contacting the ridgeline, the aircraft became airborne for about 69 m, shedding engine, wing, and fuselage debris before impacting a second time in a slight nose down attitude on a heading of about 140º.

Figure 4: Jet-blast corridors and ridgeline impact



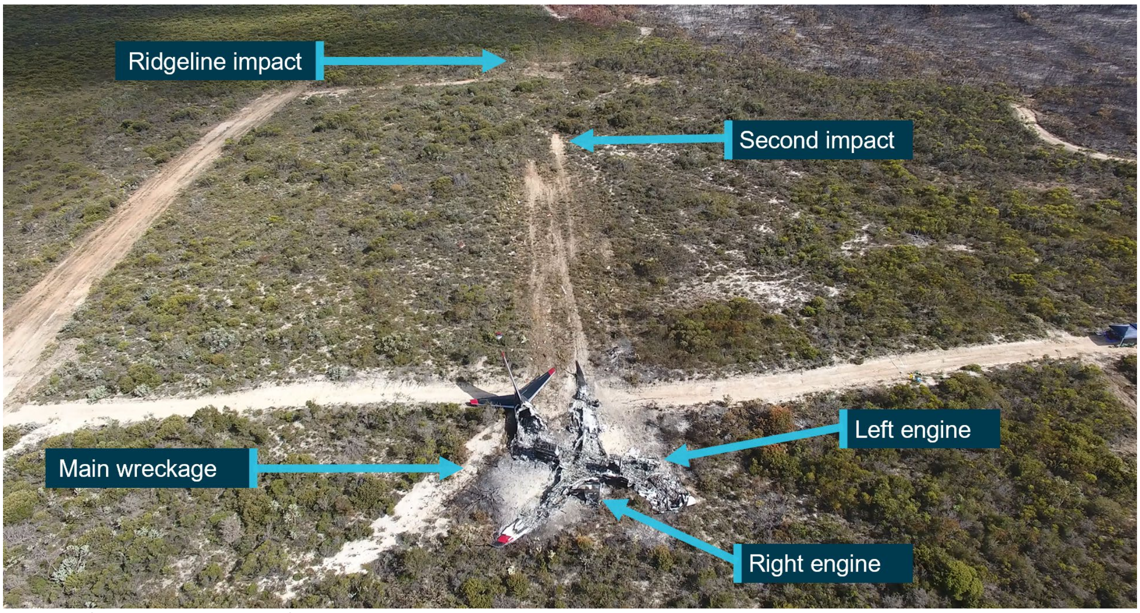
Bulldozer fire tracks constructed after the accident.
Source: ATSB

[14] Significant meteorological information (SIGMET): a weather advisory service that provides the location, extent, expected movement and change in intensity of potentially hazardous (significant) or extreme meteorological conditions that are dangerous to most aircraft, such as thunderstorms or severe turbulence.

The aircraft came to rest about 176 m from the ridgeline yawed left to the direction of travel onto a heading of about 080º. The fuselage had a main fracture near the tail and the left engine had separated from the left pylon and was resting adjacent to the forward fuselage (Figure 5). The left engine pylon exhibited a 70º upward bend, which was likely from the impact with the ridgeline, noting the left engine debris field started from the ridgeline and there was no evidence of left engine drag marks. The aircraft was consumed by fire, but there was no evidence of:

- fire trail[15] or fuel spill before the aircraft came to rest
- any debris separating from the aircraft before it impacted the ridgeline.

Figure 5: Second impact and main wreckage



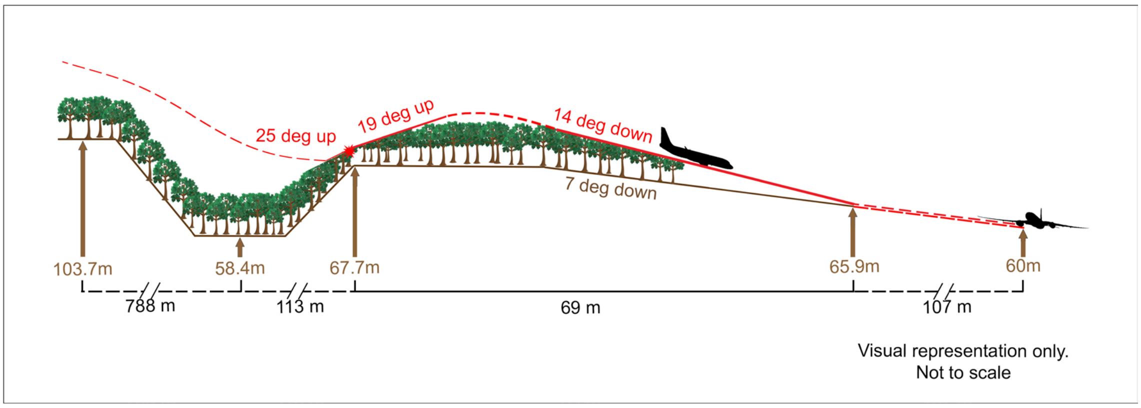
Bulldozer fire tracks constructed after the accident.
Source: ATSB

The flight data recorder (FDR) and cockpit voice recorder (CVR) were recovered on the first day of the site and wreckage inspection and retained by the ATSB for examination and download. Due to the extensive fire damage, only a limited inspection of the aircraft was achievable. This included establishing the positions of the leading-edge flaps, trailing-edge flaps, and horizontal stabiliser, with no anomalies found. The trailing-edge flap ballscrews were in the fully extended position, consistent with a flap-40 setting.

The left main landing gear was found adjacent to the aircraft and part of its support structure was in the debris field indicating it was torn from the aircraft prior to it coming to rest. The nose and right main landing gear were retracted in place. The extent of the fire damage precluded an inspection of the cockpit and flight instruments. Figure 6 depicts the horizontal distances and elevations (measured with a differential global positioning system), and the angles presented by the foliage damage associated with the accident sequence.

[15] Isolated burnt patches were evident in the wreckage trail where engine parts had separated.

Figure 6: Accident sequence distances and elevations



Source: ATSB

Recorders

The CVR (Honeywell SSCVR P/N 980-6022-001) and FDR (Honeywell SSFDR P/N 980-4700-001) were transported by a recorder specialist from the accident site to the ATSB's Canberra technical facility (Figure 7).

Figure 7: FDR and CVR as recovered and prior to disassembly

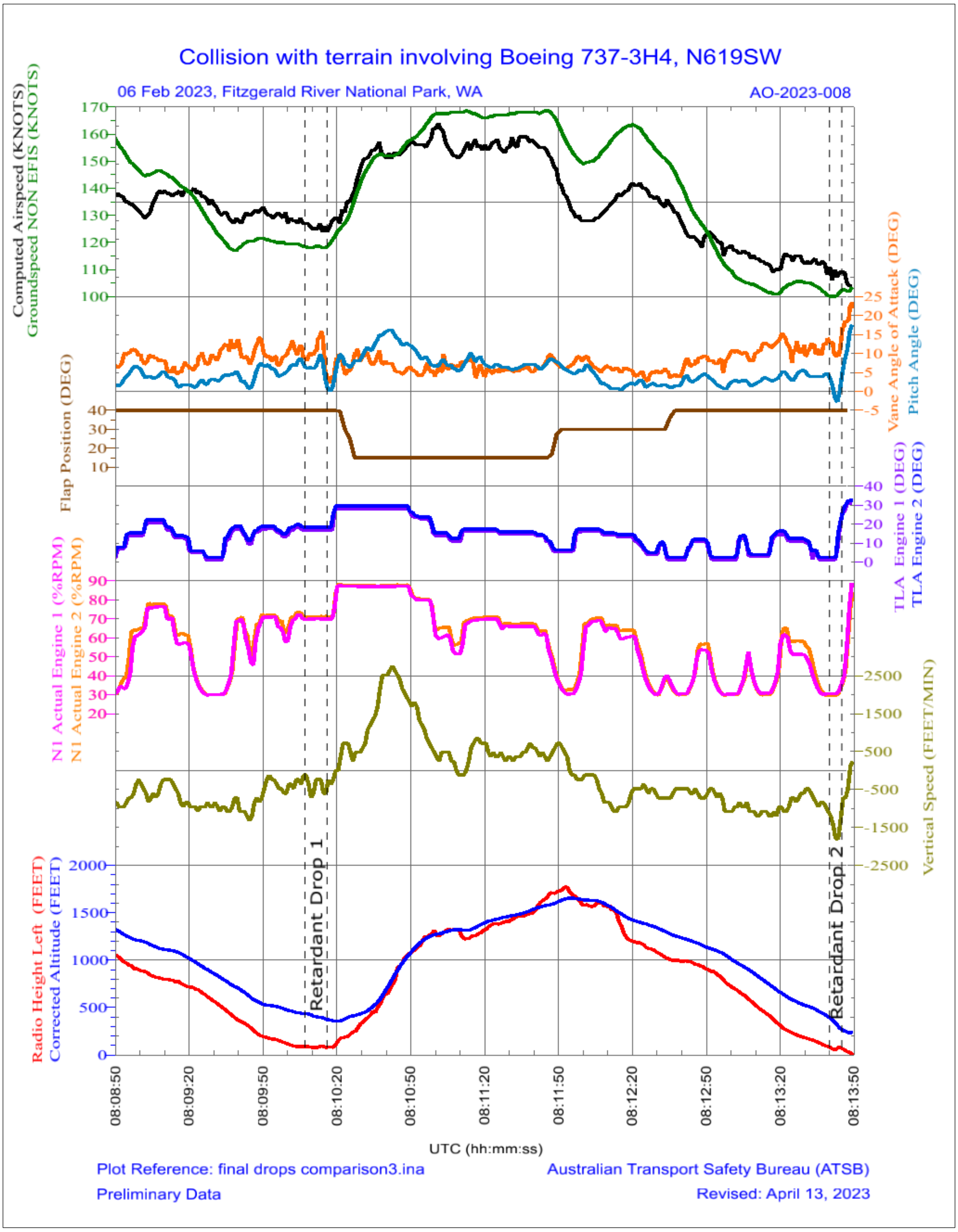
Source: ATSB

As a result of fire damage to the recorders the data recovery process required disassembly, inspection, and repair of the memory boards inside the crash survivable memory unit. The FDR memory board exhibited discoloration, melting and flow of the conformal coating with multiple controller pins desoldered.

The CVR exhibited discoloration of the heat indicator, several controller pins had separated from the memory board and multiple short-circuits were identified. Following repairs to both memory boards, successful downloads of data were achieved. The FDR provided 25.5 hours of flight data and the CVR 30 minutes of audio on 4 channels (pilot, co-pilot, public address, and cockpit area microphone). A preliminary flight data recorder plot with the first and second drops is shown at

Figure 8. The time parameter (UTC)[16] is an approximate calculation based on the aircraft's auxiliary telemetry unit (ATU) global positioning system recording of the retardant drops.

Figure 8: Flight data recorder plot with first and second retardant drop identified

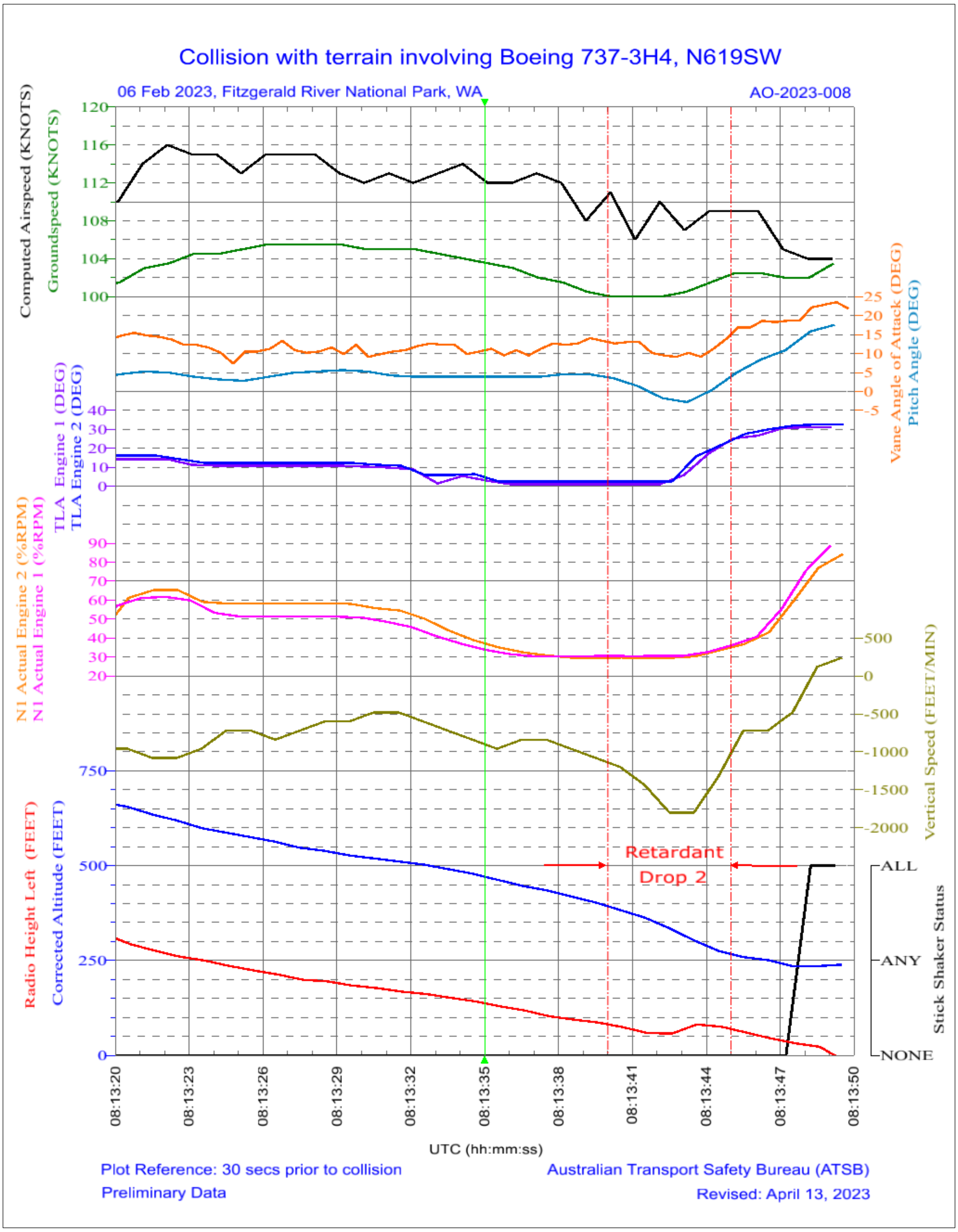


Source: ATSB

[16] Coordinated Universal Time (UTC): the time zone used for aviation. Local time zones around the world are expressed as positive or negative offsets from UTC.

During the final low-level retardant drop the throttle levers (TLA) were positioned at high idle (0°) while at a radio height above the ground of less than 100 ft. As the engine N1 speed decreased to about 30%, the rate of descent increased to 1,800 ft/min before the thrust levers were advanced while the aircraft continued to descend. About 2 seconds prior to impact, at a radio altitude of about 28 ft with the flaps at 40º, an increasing aircraft nose-up pitch attitude resulted in the vane angle of attack exceeding 20°, which triggered the stick shaker. The aircraft only attained a positive rate of climb just before impact with terrain. Figure 9 provides a plot of the final 30 seconds before the impact with the ridgeline with the approximate position of the accident retardant drop inserted.

Figure 9: Flight data recorder plot of final 30 seconds



Final 30 seconds of flight data showing corrected altitude, radio height, pitch angle, angle of attack (same scale), throttle lever angle, engine N1 speed, computed airspeed, groundspeed, vertical speed, stick shaker and approximate position of the retardant drop.
Source: ATSB

Safety action

Following the accident, Coulson Aviation issued operations bulletin 2023-01 advising their large air tanker pilots operating in Australia that their minimum retardant drop heights and V_{DROP} airspeeds had been increased from 150 ft above ground level and 1.25 V_S to 200 ft above ground level and 1.35 V_S. Their B-737 normal checklist was amended accordingly to reflect their new minimum V_{DROP} airspeeds.

Further investigation

To date, the ATSB has:

- completed the onsite wreckage examination
- interviewed the accident flight crew and bird-dog crew
- recovered the flight data recorder and cockpit voice recorder files
- collected documents and recorded data from Coulson Aviation
- collected records from the WA Department of Fire and Emergency Services (DFES)
- liaised with the United States National Transportation Safety Board (NTSB) and Boeing.

The investigation is continuing and will include validation of the recorded data and a review of the:

- communication procedures for bird-dog and large air tanker pilots
- operator's crew resource management procedures and practices
- standards and safety margins for the Boeing 737 Fireliner retardant drop.

Should a critical safety issue be identified during the course of the investigation, the ATSB will immediately notify relevant parties so appropriate and timely safety action can be taken.

A final report will be released at the conclusion of the investigation.

Acknowledgements

The ATSB acknowledges the support provided by the Hopetoun Police, WA Department of Fire and Emergency Services (DFES), WA Department of Biodiversity, Conservation and Attractions (DBCA), the United States National Transportation Safety Board (NTSB), Boeing, and Coulson Aviation for their assistance with the investigation.

General details

Occurrence details

Date and time:	6 February 2023 – 1614 Western Standard Time	
Occurrence class:	Accident	
Occurrence categories:	Collision with terrain	
Location:	17.24 NM 253 degrees from Ravensthorpe Aerodrome	
	Latitude: 33º 52.856' S	Longitude: 119º 52.681' E

Aircraft details

Manufacturer and model:	Boeing 737-3H4	
Registration:	N619SW	
Operator:	Coulson Flying Tankers	
Serial number:	28035	
Type of operation:	Part 138 Aerial work operations-Dispensing	
Activity:	General aviation / Recreational-Aerial work-Firefighting	
Departure:	Busselton Aerodrome	
Destination:	Busselton Aerodrome	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 2 (minor)	Passengers – 0
Aircraft damage:	Destroyed	

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.