



Australian Government

Australian Transport Safety Bureau

In-flight break-up involving Cessna 210N, VH-TFT

237 km east-north-east of Katherine, Northern Territory on 24 December 2022



ATSB Transport Safety Report

Aviation Occurrence Investigation (Defined)

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Addendum

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Executive summary

What happened

On 24 December 2022, the pilot of a Cessna 210N aircraft, registered VH-TFT and operated by Katherine Aviation, was conducting a charter flight under the visual flight rules to transport a single passenger from Gove to Katherine, Northern Territory. The aircraft departed Gove at 0814 local time, with an estimated arrival time to Katherine Tindal Airport of 1024. When the aircraft did not arrive, and contact was unable to be made with the pilot, search and rescue activities were initiated by the authorities. At 1204 the following day a wreckage field was found near to the intended flight track at a remote location in East Arnhem, approximately 237 km east-north-east of Katherine. The pilot and passenger sustained fatal injuries.

What the ATSB found

Upon arrival overhead the Bulman region, the aircraft likely entered an area of strong convective activity from a rapidly developing thunderstorm, which probably resulted in exposure to a combination of severe turbulence and reduced visibility for the pilot.

It is probable that a combination of turbulence encountered from the thunderstorm, airspeed, and control inputs led to the excessive structural loading and in-flight separation of the right wing from the fuselage before the aircraft collided with terrain.

It could not be determined with certainty why the pilot flew in close proximity to the storm, however, it is possible that they were in the process of diverting or turning back when the break-up occurred and/or the severity of the storm was not apparent.

What has been done as a result

Shortly following this accident, Katherine Aviation advised that it had:

- provided tracking and communication devices for their pilots that enabled real-time satellite-based tracking and monitoring of their fleet. The devices allowed messages to be exchanged between the company and their pilots in the absence of a mobile telephone signal.
- presented the theory component of their wet season training material to their company pilots and updated their exposition with the requirement that all pilots were to complete the briefing program on an annual basis.
- developed flight assessment tools to provide their pilots with better decision-making capability when planning for operations during marginal weather.


Safety message

During the Northern Territory wet season, rapidly developing and frequent thunderstorms with associated severe turbulence present pilots with a challenging and hazardous operating environment. Identifying and maintaining adequate clearance from thunderstorms is critical to flight safety.

The United States Federal Aviation Administration recommends that thunderstorms be avoided by at least 20 NM. Weather radar and satellite imagery can assist planning and in-flight storm avoidance, provided their limitations are understood.

A careful study and understanding of the relevant Bureau of Meteorology (BoM) forecasts, including the graphical area forecasts (GAF), when flight planning will also assist in avoiding hazardous weather. As shown in the example below, GAFs detail the forecast prevailing weather and other weather phenomena over a broad area for a 6-hour period. The forecast is set out in a tabular format, with the first row detailing the forecast prevailing conditions and the subsequent rows forecasting the presence, and effect, of other weather phenomena.

Of note, this format does not mean that the prevailing (first row) conditions and subsequent rows will necessarily co-exist. Pilots should keep this in mind and the BoM advises that it is not always practical for GAFs to detail the specific timing and likely locations of weather phenomena.

Graphical Area Forecast SFC - 10000FT NT			
Issued at 2212231605Z - Valid 232300 to 240500Z		 The Bureau of Meteorology	
Weather Features valid at 232300Z			
AREA	SURFACE VIS AND WX	CLOUD, ICING AND TURB	FZLVL
B	>10KM NIL	BKN ST 1000/2000FT TL 03Z BKN CU/SC 2000/8000FT BKN AC/AS 8000/ABV10000FT	ABV 10000FT
	8000M SCT -RA (WDSR IN B1)	OVC AC/AS 8000/ABV10000FT	
	2000M SCT SHRA	OCNL TCU 2000/ABV10000FT BKN ST 0500/2000FT BKN CU 2000/ABV10000FT	
	0500M ISOL +TSRA	ISOL CB 2000/ABV10000FT BKN ST 0500/2000FT	
		MOD TURB BLW 10000FT IN B1	

Source: BoM

Contacting the duty BoM forecaster via the phone number on the relevant GAF is the best way for pilots to assess the viability of a planned route, particularly if the forecast is marginal and the weather is changing. The BoM's online [Knowledge Centre](#) for pilots can further assist understanding of the meteorological information that is necessary for safe operations in the wet season.

A range of other education resources are also available for pilots to understand the unique weather challenges of operating during the wet season, including the Civil Aviation Safety Authority's (CASA) annual [Flying in the wet season](#) seminars. CASA also has available online a range of educational resources for managing severe weather-related scenarios.

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The occurrence

On 24 December 2022, a pilot from Katherine Aviation was assigned to operate a Cessna 210N aircraft, registered VH-TFT, on a passenger transport flight from Gove Airport to Katherine Tindal Airport, Northern Territory under the visual flight rules¹ (Figure 1).

At about 0730 local time, a Katherine Aviation operations staff member called the pilot advising of a potential delay to the sole passenger's arrival for the scheduled 0800 departure. With the pilot in attendance, the aircraft was refuelled by the Gove Airport refueler at 0735. The passenger arrived at about 0800 and boarded the aircraft with the pilot.

The pilot's radio transmissions were recorded on the Gove common traffic advisory frequency (CTAF). The transmissions indicated that at 0812 the aircraft was taxied for engine run-up checks and the take-off roll commenced shortly after at 0814. A witness observed the aircraft depart from runway 31 at about this time. At 0818, a final transmission was recorded on the CTAF, in which the pilot advised that VH-TFT was passing an altitude of 1,700 ft on climb to 8,500 ft and tracking direct to Katherine. No further radio communications from the pilot were identified. At 0841, the operations staff member received a text message from the pilot advising their expected arrival time of 1024 at Katherine Tindal Airport.

At 1058, when the aircraft had not arrived as scheduled, the staff member called the pilot's mobile phone without answer and then sent a follow-up text message. When no response was received, they checked with another company pilot stationed at Gove, who confirmed that VH-TFT had not returned to Gove. Several station properties were then contacted along the expected route to check whether VH-TFT had been sighted. At around midday, search and rescue officials were contacted by Katherine Aviation advising that VH-TFT was overdue.

Search and rescue

A search and rescue response was commenced by the Australian Maritime Safety Authority's Joint Rescue Coordination Centre (JRCC), with an airborne search commencing at 1344. The JRCC requested mobile phone tracing records that enabled the search to be refined around the Bulman area (Figure 1). The JRCC advised there was no signal received from the aircraft's emergency locator transmitter to assist with locating the aircraft.

On 25 December 2022 at 1204, a debris field was sighted from a search aircraft in a remote area of medium-density bushland in East Arnhem. The accident location was 237 km east-north-east of Katherine, approximately 7 km north of the planned track and 18 km north of Bulman. At 1354 first responders arrived at the accident site and confirmed that both occupants were fatally injured and the aircraft was destroyed. There were no known witnesses to the accident.

¹ Visual flight rules (VFR): a set of regulations that permit a pilot to operate an aircraft only in weather conditions in which they have sufficient visibility to fly the aircraft while maintaining visual separation from terrain and other aircraft.

Figure 1: Satellite view showing the planned direct track, the location of the accident site and its proximity to Bulman



Source: Google Earth, annotated by the ATSB

Context

Pilot and passenger information

Pilot information

The pilot commenced their flight training in June 2021 and obtained a commercial pilot licence (aeroplane) on 24 January 2022. After further flight training, the pilot obtained a multi-engine aircraft instrument rating that was issued on 19 February 2022. The pilot had accrued 23.6 hours of instrument flying, the last of which was 1.9 hours during the conduct of the instrument rating assessment flight on 19 February 2022. No further instrument hours were recorded in the pilot's logbook. The pilot held a Class 1 aviation medical certificate, valid until 13 May 2023, with no restrictions and no declared medical conditions.

The pilot's first commercial flying role commenced in August 2022 with Katherine Aviation, based in Katherine, Northern Territory. On 11 August 2022 the pilot commenced line training through the operator's in-command-under-supervision (ICUS) program, operating Cessna 210 aircraft under the supervision of either a senior base pilot or the head of flying operations. During that period, the pilot flew to remote communities and station properties throughout the Big Rivers, Top End and East Arnhem regions,² including on 3 occasions to the airfield at Bulman. The operator's training records showed that the pilot undertook 14 ICUS flights totalling 53.1 hours, and passed their company line check on 20 September 2022. The pilot remained in Katherine and completed an additional 76.1 hours conducting passenger-carrying charter flights under the visual flight rules (VFR) to predominantly remote locations within the Northern Territory.

On 1 December 2022, the pilot relocated to the operator's base in Gove, East Arnhem and accrued a further 45.2 flight hours prior to the accident day.

The pilot's logbook and operator's records showed the pilot had a total flying experience of 364.3 hours, 180.8 of which were in Cessna 210 aircraft. In the 30 and 90 days prior to the accident, the pilot had flown 53.7 and 99.1 hours exclusively in Cessna 210 aircraft.

72-hour history

The operator provided the pilot's accommodation in Gove. Table 1 summarises the pilot's flight and duty times for the previous 3 days. The pilot did not fly on 21 or 22 December 2022. On 23 December 2022 they accrued 5.7 hours on a flight to Lake Evella, Groote Eylandt and Elcho Island.

Table 1: Summary of pilot's duty and flight times

Date	21 December 2022	22 December 2022	23 December 2022
Duty time	0 hours	0700 – 1300 (6 hours)	0730 – 1815 (10.8 hours)
Flight time	0 hours	0 hours	5.7 hours

The ATSB was unable to establish the pilot's sleep routine in the 3 days prior to the accident, as the pilot lived alone at their Gove accommodation. A company pilot reported that during those 3 days, they saw the pilot intermittently in the office at Gove Airport. They also socialised together as part of pre-Christmas celebrations during the evenings of 22 and 23 December 2022, with each event concluding between 2000 and 2030. No concerns were noted by the co-worker on the accident pilot's wellbeing during that period.

At 0615 on the morning of the accident, the pilot sent a text message to the Gove Airport refueller requesting that the aircraft be refuelled. Software login records showed that at 0659 the pilot had

² The Northern Territory is administered through 6 defined regional areas: 1. Darwin, Palmerston and Litchfield, 2. Top End, 3. East Arnhem, 4. Big Rivers, 5. Central Australia, and 6. Barkly.

commenced their pre-flight flight planning from the airport company office. At about 0735 the refueller met with the pilot while the aircraft was being refuelled. They commented that the pilot did not show any indications of fatigue.

Passenger information

The passenger was being transported to Katherine for a period of respite care over the Christmas and New Year period and was scheduled to return to Gove on 4 January 2023. Katherine Aviation advised that the flight on 24 December 2022 was the third attempt to depart Gove, with the 2 previous attempts being cancelled due to unsuitable weather.

Aircraft information

General overview

The aircraft was manufactured by the Cessna Aircraft Company as a model 210N in the United States in 1979 and was first registered in Australia in 1989. It had seating for 6 people including the pilot and had a high-cantilever wing with retractable tricycle landing gear. It was powered by a Teledyne Continental IO-520-L46B 6-cylinder engine operating a Hartzell variable-pitch, 3-blade propeller.

The wing construction comprised a forward spar, main spar, conventional formed sheet-metal ribs and aluminium skin. The inboard section of each wing, forward of the main spar, was sealed to form an integral fuel tank. The aircraft fuel tanks held a combined total capacity of 341 L, of which 337 L was useable. Both wings attached to the central wing spar carry-through structure, which was the primary structural design element for carrying lateral and bending flight loads.

Aircraft maintenance

The maintenance records showed that the aircraft had accrued about 15,100 total flight hours. The engine had been factory overhauled and fitted on 27 March 2022, subsequently accruing 273.5 hours. The propeller had accrued 1,201.8 hours since overhaul.

The aircraft was maintained in accordance with Schedule 5 requirements prescribed by the Civil Aviation Safety Authority (CASA). Schedule 5 is a generic maintenance program developed by CASA that is required to be completed every 100 flight hours or 12 months, whichever comes first.

The most recent scheduled maintenance was a 100-hourly inspection completed on 27 October 2022 at 15,004.9 hours total time in service. During that maintenance, the following detailed inspections for cracking of the wing were completed with no defects found:

- Federal Aviation Administration Airworthiness Directive (FAA AD) 2012-10-04 – *Inspection for cracking of the main spar lower cap*
- Cessna Special Inspection Document (SID) operation 33 – *Inspection of the wing lower spar cap*
- SID operation 35 – *Inspection of the carry through spar lower surface*
- SID operation 37 – *Inspection of the wing spar carry through attachment lugs.*

The maintenance release current at the time of the accident was issued in the night visual flight rules and charter categories. It was found in the aircraft wreckage with the daily inspection certified for the day of the accident. There were 3 minor defects listed on the maintenance release that had not been certified as rectified, however they were not considered to have influenced the development of the accident. The defects were:

- rear navigation light inoperative
- early peaking of exhaust gas temperature in the number-5 cylinder
- fuel gauge flickering.

The maintenance release indicated that VH-TFT was due for a 100-hourly inspection at 15,104.9 hours. As the aircraft had less than 5 hours remaining prior to commencement of the accident flight, Katherine Aviation operations personnel arranged with the pilot to exchange VH-TFT with another Cessna 210 for the return to Gove.

Meteorological information

Wet season

Although variable from year to year, weather in the Northern Territory can generally be divided into the dry season from May to September and the wet season from October to April. In the context of Northern Territory aviation operations, most of the hazardous weather occurs during the wet season. This is a period of unstable atmospheric conditions where tropical cyclones and active monsoon troughs may produce heavy rainfall for prolonged periods, squally winds, and thunderstorms.

Thunderstorms are a very frequent and widespread hazard during the wet season. They are common during the late afternoon and early evening, with a secondary peak in the early morning. They often spread out to form sheets of altostratus and cirrostratus clouds late in their life cycle, bringing steady overnight rain and low cloud persisting into the morning. As a thunderstorm is growing, updrafts in the core can reach over 100 kt. These updrafts can exist alongside downdrafts of similar strength as rain starts to fall out of the storm, resulting in potential for severe turbulence and loss of aircraft control if flying into such conditions (BoM, 2012).

General weather conditions

The Bureau of Meteorology (BoM) advised that, on the morning of 23 December 2022, tropical cyclone Ellie crossed the coastline west of Darwin and tracked south. Later that evening, Ellie was downgraded to a tropical low, however, heavy rain and strong to damaging winds were expected to impact large parts of the greater Northern Territory the next day.

Aerodrome forecasts for Gove and Katherine Tindal

The BoM produces aerodrome forecasts (TAFs) that state the expected meteorological conditions in the airspace within an 8 km radius of the aerodrome reference point. TAFs were available for both Gove and Katherine Tindal Airports for the proposed flight.

Gove Airport conditions after 0830 and until 1130 were predicted to be clear with visibility greater than 10 km, northerly winds at 10 kt, no cloud ceiling below 10,000 feet above ground level (AGL) and no other weather phenomena.

The prevailing weather conditions at Katherine Tindal Airport were forecast to be above the day VFR alternate minima for the entire validity period of the TAF. Notably, the prevailing cloud ceiling was predicted to improve after 0930. However, deteriorating conditions below the alternate minima were predicted for periods up to 1 hour during the expected arrival time of the aircraft. Specifically, thunderstorms, low visibility (1,000 m), strong winds up to 35 kt, and a cloud ceiling at 500 ft AGL were forecast. These conditions required the pilot to plan for at least 60-minutes holding fuel on arrival at Katherine Tindal, or to plan for an alternate destination aerodrome to land.

Graphical area forecast

The Graphical Area Forecast (GAF) provides information on weather, cloud, visibility, icing, turbulence and freezing level in a graphical layout with supporting text. They are produced for

10 areas across Australia and are broadly state-based (BoM, 2017). Cloud amount is given using the following descriptions (BoM 2018):

- few – 1 to 2 oktas³
- scattered – 3 to 4 oktas
- broken – 5 to 7 oktas
- overcast – 8 oktas.

For cumulonimbus and towering cumulus, cloud amount is described as:

- isolated – individual features which are forecast to affect up to 50% of an area
- occasional – well-separated features which are forecast to affect greater than 50% but not more than 75% of an area
- frequent – little or no separation between adjacent features forecast to affect greater than 75% of an area.

Embedded is added to these coverage quantifiers to indicate cumulonimbus or towering cumulus clouds are embedded in layers of other cloud and cannot be readily recognised, regardless of whether or not they are protruding from the layer.

Weather coverage is described as:

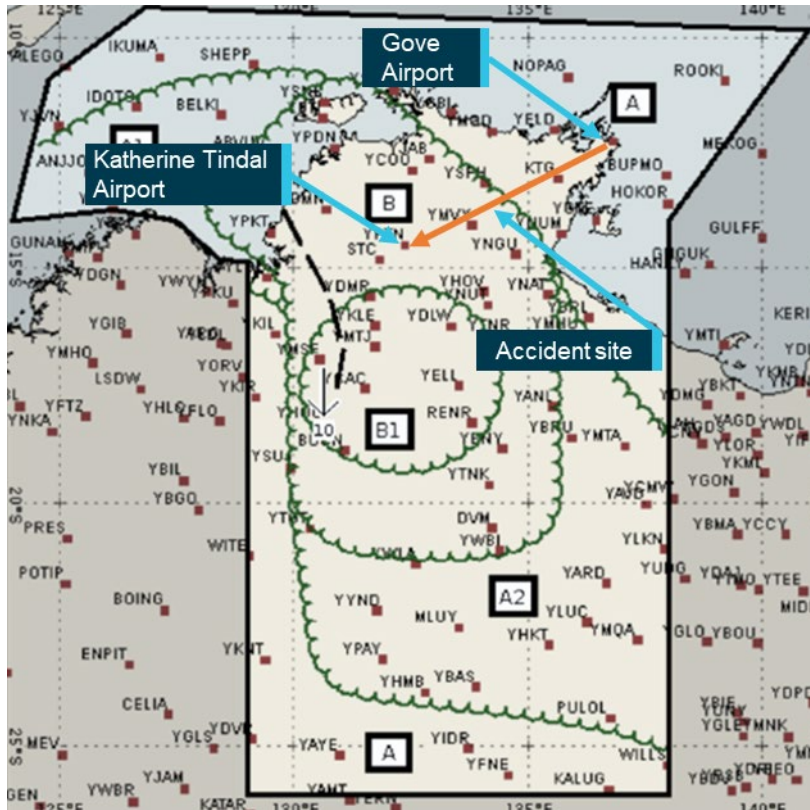
- isolated – individual features which are forecast to affect up to 50% of an area
- scattered – well-separated weather features which are forecast to affect greater than 50% but not more than 75% of an area
- widespread – features with little or no separation forecast to affect greater than 75% of an area.

When thunderstorms, cumulonimbus or towering cumulus are forecast, it implies severe icing and severe turbulence will be present. Forecast cumulus, stratocumulus and altocumulus imply moderate turbulence. All heights referred in the GAF are above mean sea level (AMSL) (BoM, 2017).

The GAF for the Northern Territory issued at 0135 on 24 December 2022, valid from 0830 to 1430, divided the territory into several areas (Figure 2). Gove was in area A, Katherine in area B and the accident occurred about 25–35 km into area B.

³ Cloud cover: cloud cover is reported using words that denote the extent of the cover – ‘few’ indicates that up to a quarter of the sky is covered, ‘scattered’ indicates that cloud is covering between a quarter and a half of the sky, ‘broken’ indicates that more than half to almost all the sky is covered, and ‘overcast’ indicates that all the sky is covered.

Figure 2: GAF for the Northern Territory with the track from Gove to Katherine Tindal Airport highlighted (upper image) and accompanying weather features (lower table)



Graphical Area Forecast SFC - 10000FT NT
 Issued at 2212231605Z - Valid 232300 to 240500Z
 Weather Features valid at 232300Z



AREA	SURFACE VIS AND WX	CLOUD, ICING AND TURB	FZLVL
A	>10KM NIL	BKN SC 1500/3000FT LAND IN A2 TL 03Z SCT CU/SC 3000/8000FT, BASES 5000FT S YBAS FM 03Z (BKN IN A2 TL 03Z) BKN AC/AS 8000/ABV10000FT IN A2	ABV 10000FT
	8000M SCT -RA IN A2	OVC AC/AS 8000/ABV10000FT	
	3000M ISOL SHRA (SCT IN A1 TL 01Z)	ISOL TCU 3000/ABV10000FT (OCNL IN A1 TL 01Z) SCT ST 1000/3000FT BKN CU 3000/ABV10000FT	
	1000M ISOL TSRA	ISOL CB 3000/ABV10000FT BKN ST 1000/3000FT	
		MOD TURB BLW 7000FT IN PO AND THERMALS S YBAS FM 00Z	
B	>10KM NIL	BKN ST 1000/2000FT TL 03Z BKN CU/SC 2000/8000FT BKN AC/AS 8000/ABV10000FT	ABV 10000FT
	8000M SCT -RA (WDSR IN B1)	OVC AC/AS 8000/ABV10000FT	
	2000M SCT SHRA	OCNL TCU 2000/ABV10000FT BKN ST 0500/2000FT BKN CU 2000/ABV10000FT	
	0500M ISOL +TSRA	ISOL CB 2000/ABV10000FT BKN ST 0500/2000FT	
		MOD TURB BLW 10000FT IN B1	

Source: Bureau of Meteorology, annotated by the ATSB

For the planned flight in area A, the GAF predicted visibility greater than 10 km when no other weather was present. Visibility was forecast to reduce in 2 weather phenomena, each with isolated coverage of up to 50% of area A. These were moderate showers of rain reducing visibility to 3,000 m, and thunderstorms with moderate rain reducing visibility to 1,000 m. Forecast clouds associated with these phenomena were:

- moderate rain – isolated towering cumulous clouds covering up to 50% of the area of reduced visibility with bases at 3,000 ft to above 10,000 ft, scattered stratus clouds covering 25–50% of the area with bases at 1,000 ft and cloud tops at 3,000 ft and broken cumulous clouds covering more than 50% of the area from 3,000 ft to above 10,000 ft.
- thunderstorms with moderate rain – broken stratus clouds covering more than 50% of the area from 1,000 ft to 3,000 ft, and isolated cumulonimbus clouds covering up to 50% of the area from 3,000 ft to above 10,000 ft.

In area B, broken cloud, covering more than 50% of the area was forecast from 1,000 ft to above 10,000 ft. Visibility was forecast to be greater than 10 km except in scattered light rain reducing visibility to 8,000 m in 50–75% of the area, scattered moderate showers of rain, reducing visibility to 2,000 m in 50–75% of the area, and isolated thunderstorms with heavy rain, reducing visibility to 500 m in up to 50% of the area. Clouds associated with these weather phenomena were forecast to be:

- light rain – overcast alto-cumulous and alto-stratus covering 100% of the area from 8,000 ft to above 10,000 ft.
- moderate showers of rain – occasional towering cumulus clouds covering 50–75% of the area from 2,000 ft and to above 10,000 ft. Broken stratus clouds from 500 ft to 2,000 ft and broken cumulus clouds from 2,000 ft to above 10,000 ft covering more than 50% of the area.
- thunderstorms of rain – isolated cumulonimbus clouds covering up to 50% of the area from 2,000 ft to above 10,000 ft, and broken stratus clouds covering more than 50% of the area from 500 ft to 2,000 ft.

Grid-point wind and temperature

Grid-point wind and temperature (GPWT)⁴ forecasts are issued by the BoM every 3 hours for low-level operations and display mean wind speed, direction and temperature for a range of altitudes. ATSB's review of the GPWT chart that was issued at 0330 (local) and valid at 0930 (local) showed a wind direction of 340° and speed of 18 kt at an altitude of 8,500 ft.⁵

En route weather

Analysis of satellite imagery⁶, conducted by the BoM, indicated that from 0900 convective cloud developed to the west of the accident site. The cloud developed into thunderstorms with the first observations of lightning recorded between 0940 and 0950. The satellite imagery in the vicinity of the accident site is shown in Figure 3 and the montage in Figure 4. The imagery shows the development of the weather system near the accident location from 0900 to 1000. The system persisted for several hours after 1000. The BoM estimated that the cloud tops in the vicinity of the accident site were between 38,000 ft and 46,000 ft AMSL.

⁴ Produced by the BoM, GPWT charts display the forecast wind speed, direction and temperature at specified heights above mean sea level, presented in a gridded format. <http://www.bom.gov.au/aviation/data/education/gridpoint.pdf>

⁵ The wind direction and speed at an altitude of 8,500 ft was calculated by interpolating the wind speed and direction that was provided in the GPWT at altitudes of 7,000 ft and 10,000 ft.

⁶ Satellite images were processed by the Bureau of Meteorology from the geostationary meteorological satellite Himawari-8 that was operated by the Japan Meteorological Agency.

The BoM further advised that the thunderstorms near the accident site may have resulted in severe turbulence,⁷ severe icing⁸ and wind shear with outflows of strong and gusty winds, not only in the immediate vicinity but also at some distance away from the storm. An automated weather station near Bulman recorded 12.4 mm of rainfall between 0930 and 1030 that morning. The development of the severe weather was consistent with the forecast for isolated thunderstorms in the Northern Territory GAF issued by the BoM at 0135.

The ATSB queried the BoM on whether the term embedded (EMBD) should have been added to the GAF considering the forecast for extensive cloud cover and isolated thunderstorms. The BoM advised that the term embedded indicates that a pilot may encounter cumulonimbus or towering cumulus clouds that they may not be able to readily recognise due to them being contained within other cloud layers.

In their analysis of the satellite imagery the BoM identified that the thunderstorms were not embedded due to discrete scattered to broken convective cloud rather than an overcast, poorly separated layer of cloud as would more likely occur in a rain band. The Bureau further advised that although the forecast prevailing conditions were for extensive cloud cover in area B, there was still a moderate to high likelihood that the convective clouds would have been visible to the pilot. This means that the top, or prevailing weather, row and subsequent weather rows may not necessarily co-exist. Put another way, conditions in area B at any location or point in time would be either the prevailing conditions or one of the subsequent rows in the forecast.

The forecast for area B covered a substantial portion of the Northern Territory, for a 6-hour period, with unstable atmospheric conditions. BoM advised that the predicted coverage was a worst case forecast for each weather row in area B, with conditions predicted to develop at different times and places throughout the period. For example, thunderstorms were predicted to cover up to 50% of area B at some point in time during the validity period of the forecast.

The BoM also advised that it was not practical to include additional detail of the specific timing and likely locations of weather phenomena in the GAF product in scenarios like those predicted for area B. To account for this, in cases where convective weather is forecast, pilots are encouraged to call the meteorologist who produced the GAF for details on the weather phenomena likely to be encountered for a specific route and time period.

A comparison of the overhead satellite imagery and the Katherine–Tindal weather radar is also shown at Figure 5 to Figure 7. After the flight had departed Gove, the data at 0830 that morning identified that while significant thermal activity had developed to the north-west of the planned route, the immediate area along the planned track near to Bulman was clear of rain. At 0930 to 1000, the weather radar identified light to moderate rain, along with increased convective activity, signalling the development of a thunderstorm. The BoM identified that limitations exist to the accuracy of weather radar information, particularly as distances increase from the radar head. As the flight progressed toward Bulman, it remains possible that the weather radar did not completely display the extent of the weather system to the pilot. Optimal coverage of weather radar information is described by the BoM:

Generally, the optimal coverage area extends to approximately 200km away from the radar. Beyond this distance some rainfall echoes may be displayed on the radar image, however these echoes will be from clouds higher up in the atmosphere and will not directly correspond with conditions experienced on the ground.

OzRunways and AvPlan were 2 electronic flight bag (EFB) applications authorised by Katherine Aviation. Each application can display rain radar information to assist pilots with weather-related

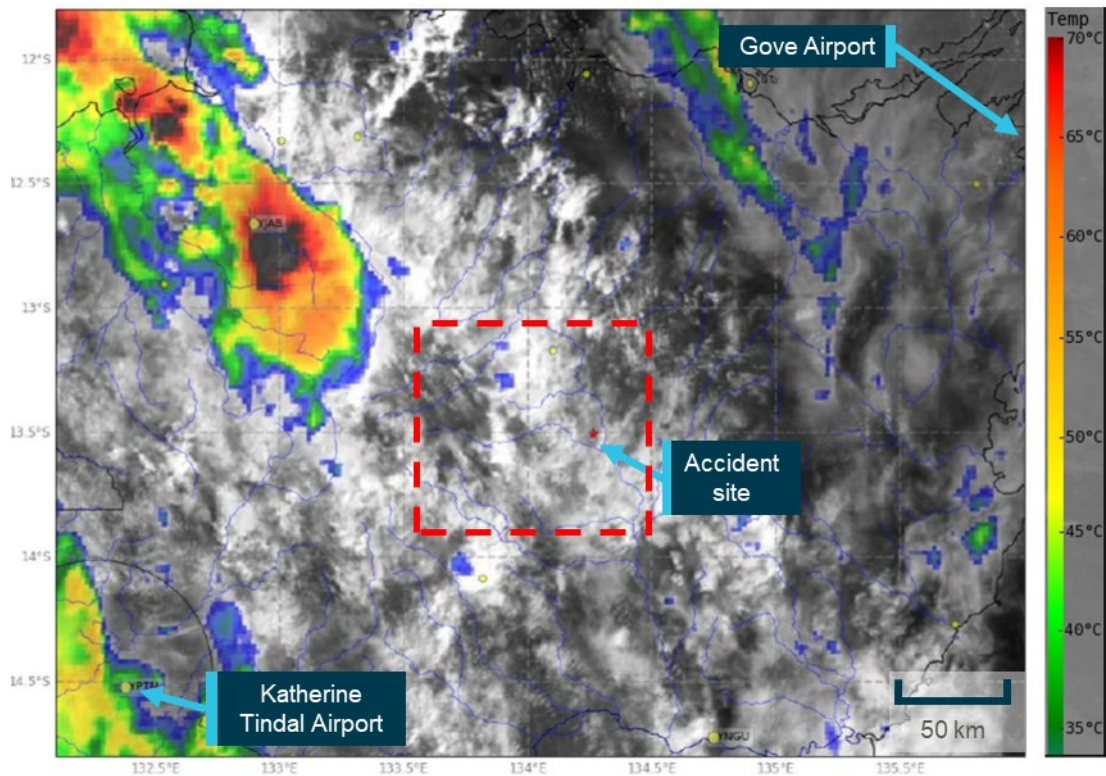
⁷ Turbulence intensity is specified according to the perceived effect upon aircraft and occupants. Severe turbulence produces large abrupt changes in attitude and/or altitude and momentary loss of control. Unsecured objects are tossed about and occupants violently forced against seatbelts. www.bom.gov.au/aviation/data/education/turbulence.pdf

⁸ Severe icing: the rate of accumulation is such that de-icing/anti-icing equipment fails to reduce or control the hazard to the aircraft, and thus an immediate diversion is necessary. www.bom.gov.au/aviation/data/education/icing.pdf

decision-making. The operator reported that it was expected that its pilots would access weather radar information in flight, however they identified that this was dependent on cellular data availability.

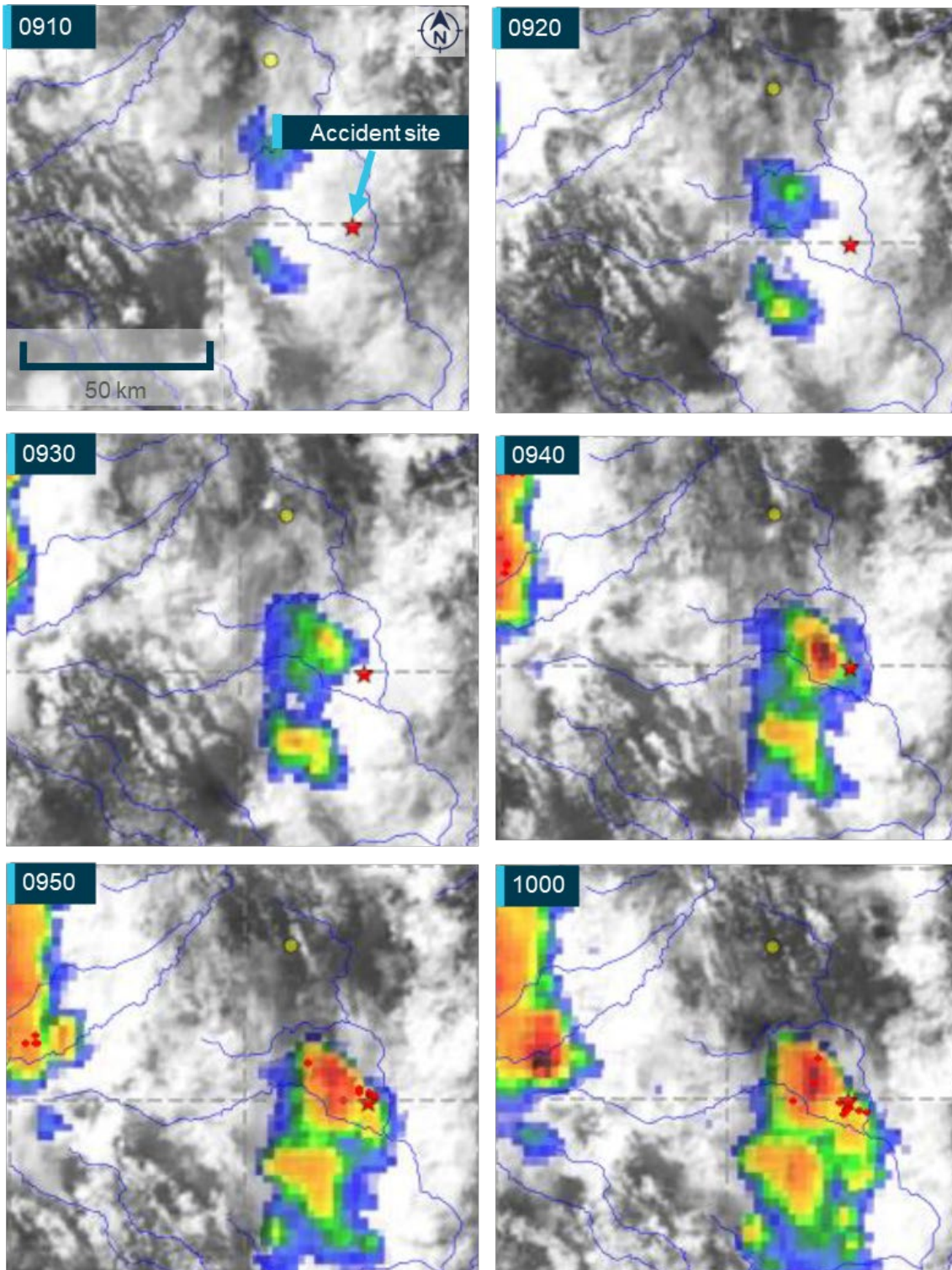
It was not possible to determine whether the pilot accessed the weather radar information prior to, or during the accident flight. Furthermore, the location of the accident site surrounding Bulman was beyond the optimal coverage range of the BoM radar. Therefore, as discussed above, even if this information was accessed by the pilot, the rain intensity detected by the BoM weather radar on approach to Bulman may not have accurately represented the conditions at the time.

Figure 3: Weather satellite imagery showing cloud and convective cloud activity relative to the accident site at 0900 on 24 December 2022



The white areas are scattered to broken clouds, and the colours provide an indication of the vertical development of the cloud with temperatures ranging between -35 to -70 °C. The colours provide an indication of the vertical development of the cloud and in general terms, the colder the cloud top temperature, the higher the top of the cloud.
 Source: Bureau of Meteorology, annotated by the ATSB

Figure 4: Montage of satellite imagery showing the rapid build-up of convective activity near the accident site from 0910 to 1000 on 24 December 2022



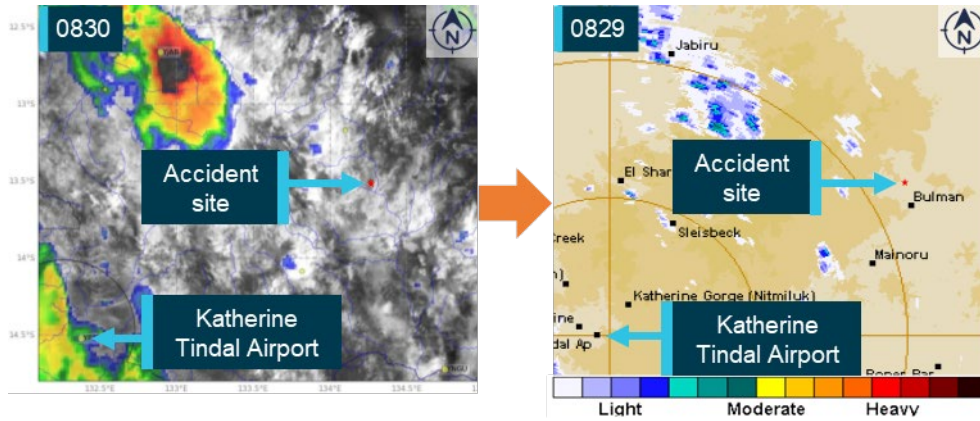
Red dots in the above images at 0940, 0950 and 1000 are recorded lightning strikes.

The accident site is represented by a red star.

The white areas are scattered to broken clouds, and the colours provide an indication of the vertical development of the cloud.

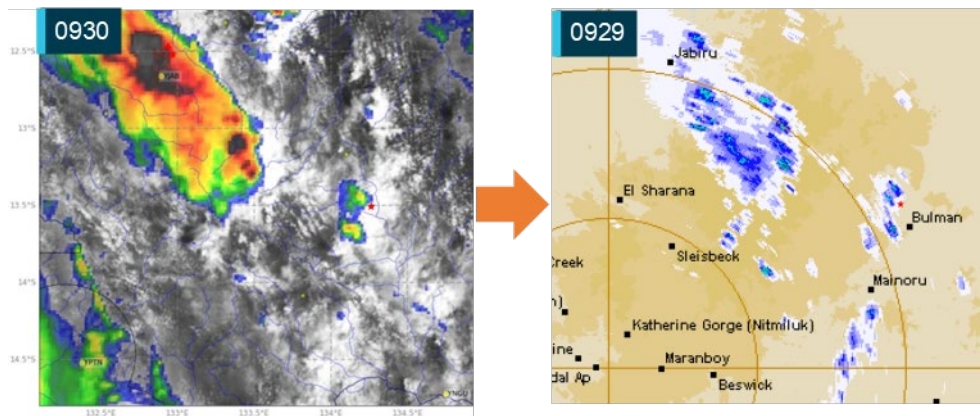
Source: Bureau of Meteorology, annotated by the ATSB

Figure 5: Broad area comparison of satellite/convective activity (left) and rain radar data (right) near to the accident site at 0830 on 24 December 2022



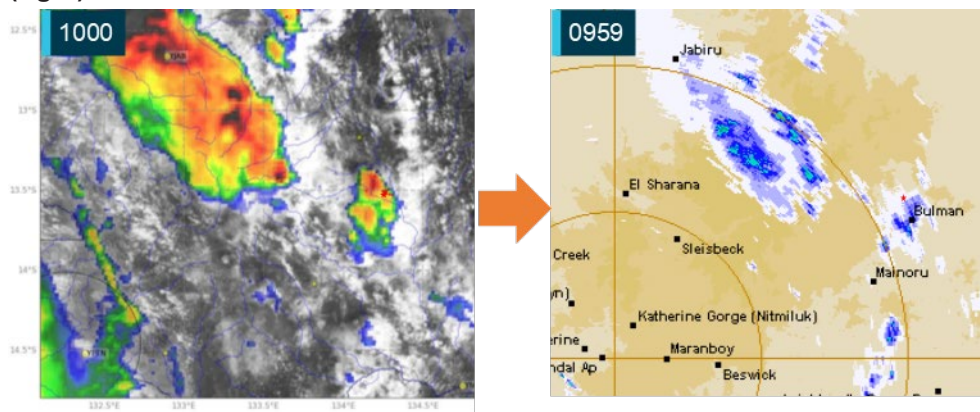
Source: Bureau of Meteorology, annotated by the ATSB

Figure 6: Broad area comparison of satellite/convective activity (left) and rain radar data (right) near to the accident site at 0930 on 24 December 2022



Source: Bureau of Meteorology, annotated by the ATSB

Figure 7: Broad area comparison of satellite/convective activity (left) and rain radar data (right) near to the accident site at 1000 on 24 December 2022



Source: Bureau of Meteorology, annotated by the ATSB

Operational information

Flight planning

The planned track between Gove and Katherine was over remote sections of the Northern Territory in class G non-controlled airspace and, closer to Katherine, RAAF Tindal controlled

airspace. Katherine Aviation required its pilots to produce an internal company flight plan using an electronic flight planning tool within one hour prior to departure. The planning tool was also used to access en route and destination weather data, through Airservices Australia's National Aeronautical Information Processing System (NAIPS).⁹ Login files identified that NAIPS was accessed by the pilot's personal and company accounts 3 times on the morning of the accident flight; at 0659, 0702 and 0712.

The NAIPS records showed that a GPWT forecast had been accessed during these periods, however, due to software limitations it could not be confirmed whether a GAF was accessed by the pilot.

A review of the pilot's previous flights identified that meteorological information, including the GAF, was used by the pilot for their flight planning. The operator indicated that their pilots were required to submit their flight documents to the senior base pilot at the conclusion of each flight. Documents included the flight plan, passenger information, fuel receipts and meteorological information. Although the loose-leaf flight plan printouts were not located at the accident site, based on previous work practice, the required weather forecasts, including the departure and destination TAFs, were probably accessed by the pilot on the morning of the accident flight.

It was a company requirement that a flight notification be lodged with Airservices prior to departure. This could be accomplished using the NAIPS website, the EFB software, or by telephone if internet access was not available. Airservices advised that a flight notification was not lodged for the accident flight.

During a telephone conversation at about 0730 on the morning of the accident flight, the pilot was reported to have stated to a Katherine Aviation operations staff member that the weather was 'a bit iffy'. The staff member further stated that pilots were encouraged by Katherine Aviation to remember that there was always the option to divert or return. The pilot had taken off and then turned back, due to unsuitable weather, on a flight a few days prior to the accident.

Requirements for flight under visual flight rules

Visual meteorological conditions are the minimum conditions in which a VFR flight is permitted. These conditions ensure pilots have sufficient visibility to control the aircraft and maintain visual separation from terrain and other aircraft.

The rules require that pilots operating below 10,000 ft have a minimum of 5,000 m flight visibility. Pilots also need to maintain 1,500 m horizontal and 1,000 ft vertical separation from cloud when above the higher of 3,000 ft AMSL or 1,000 ft AGL in non-controlled airspace. When operating at or below the higher of 3,000 ft AMSL or 1,000 ft AGL, the pilot must remain clear of cloud and in sight of the ground or water.

En route

The flight was expected to track directly from Gove to Katherine Tindal Airport. A loose-leaf form used by the operator for engine trend monitoring was located at the accident site. The document was damaged and incomplete, however it identified that the pilot had conducted trend monitoring when the aircraft was stabilised in cruise at 146 kt airspeed and at an altitude of 8,500 ft. Taking into account the climb performance of the aircraft, a forecast 18 kt wind speed at 340°, the cruise speed and a direct track to Katherine, the ATSB assessed that the aircraft would pass north of Bulman and over the accident site at about 0930.

⁹ The National Aeronautical Information Processing System (NAIPS) is a multi-function, computerised, aeronautical information system. It processes and stores meteorological and NOTAM information as well as enables the provision of briefing products and services to pilots and the Australian Air traffic Control platform. [About NAIPS \(airservicesaustralia.com\)](https://www.airservicesaustralia.com)

Operational staffing

Due to the approaching Christmas and New Year shutdown period, most Katherine Aviation staff were on leave, including the head of flying operations (HOFO) in Katherine and the senior base pilot at Gove. With only 2 flights scheduled for 24 December 2022, 2 staff remained on duty comprising of a senior pilot and an operations staff member, both in Katherine. The senior pilot had prepared another Cessna 210 aircraft for transfer back to Gove, while waiting for TFT to arrive.

Fuel

The aviation refueller at Gove reported receiving a text message from the pilot at about 0615, requesting full fuel (169 L) in the left wing tank and the right wing tank to be filled to the indicator tab (127 L), totalling 296 L. The fuel receipt showed that 211 L of Avgas 100 low lead fuel was uploaded to the aircraft between 0735 and 0745. Based on the Pilot's Operating Handbook (POH), 4 L was unusable, therefore there was 292 L usable fuel on board at startup, equating to 210 kg using a specific density of 0.72 for Avgas. Previous flight logs showed the pilot allowed 5 L (3.6 kg) for taxiing. This was consistent with the passenger/cargo manifest located at the accident site, which listed 207 kg fuel on board at take-off.

Weight and balance

The passenger/cargo manifest included a loading summary, which calculated the take-off weight including occupants, cargo and fuel for the aircraft to be 1,415 kg, which was less than the aircraft's maximum take-off and landing weight of 1,724 kg. The associated weight and balance assessment normally completed by the pilot was not located in the wreckage and the passenger's seating position was unknown.

Based on the weights listed in the manifest and the information provided in the POH, the ATSB assessed that the aircraft was in the mid-range of the aircraft's centre of gravity envelope, whether the passenger was seated in the front or centre row. Records from previous flights also showed that the pilot routinely switched between left and right tanks to maintain lateral balance. Therefore, the aircraft was almost certainly within the weight and balance limits throughout the flight.

Design limitations

The Cessna 210N is certified as a normal category aircraft. The airspeed and load limits defined in the Cessna 210N POH are defined in Table 2.

Table 2: Cessna 210N airspeed and load limitations

Never exceed airspeed (V_{NE})	200 kt (red line on the airspeed indicator)
Maximum structural cruising airspeed (V_{NO})	165 kt (green line on the airspeed indicator)
Manoeuvring airspeed (V_A)	125 kt at 1,724 kg 113 kt at 1,428 kg 101 kt at 1,134 kg
Maximum flight load factors (g)	+3.8 g to -1.52 g (flaps up) +2.0 g (flaps down)

Manoeuvring airspeed (V_A) is the maximum airspeed at which full control travel can be used without exceeding the design load factor. The manoeuvring speed decreases with aircraft weight. Factoring the take-off weight and TFT's fuel usage, the ATSB calculated that the manoeuvring airspeed at the time of the accident was about 111 kt.

The 4 forces acting on an aircraft in flight are lift, weight, thrust and drag. The ratio of lift force to the aircraft weight is the load factor. Load factors are defined in terms of g-loading, which is a measure of the forces acting on the aircraft structure to produce the accelerations involved in changing speed and direction in flight. In straight and level flight, lift force and aircraft weight are

balanced, so the load factor is 1 g. Aircraft structural limits are based on aircraft weight and the load factor, which can be affected by any one or combination of the following:

- full control movements above V_A which can occur while manoeuvring, as a result of disorientation, or during recovery from an unusual attitude.
- windshear, turbulence or gusts – severe turbulence is defined as variations in vertical acceleration greater than 1 g.

An aircraft must be operated within its flight envelope¹⁰ to prevent structural damage, or aerodynamic stall.¹¹ Exceeding the flight load limit below V_A results in a stall, whereas exceeding the flight load limit at a speed above V_A can produce structural damage.

Accident site and wreckage examination

Wreckage location

The ATSB initiated a field-based investigation following notification from the JRCC that the aircraft wreckage had been located. ATSB investigators attended the accident site on 29 and 30 December 2022. It was situated within the East Arnhem wilderness region with medium-density trees and largely flat terrain. The nearest aerodrome was located at Bulman, approximately 18 km south.

Site examination

The ATSB's onsite examination identified that the right wing and its detached wing tip were the first components in the wreckage trail. The wing tip and right wing were located 370 m and 300 m respectively from the primary point of ground impact, indicating they had separated from the aircraft during flight (Figure 8).

¹⁰ Flight envelope: the range of combinations of speed, altitude, angle of attack etc., within which an aircraft is aerodynamically stable.

¹¹ Aerodynamic stall: occurs when airflow separates from the wing's upper surface and becomes turbulent. A stall occurs at high angles of attack, typically 16° to 18°, and results in reduced lift.

Figure 8: Aerial view of the accident site showing the spread of wreckage



Source: ATSB

Severed tree branches and ground scars were consistent with the aircraft having a trajectory of approximately 35° down from horizontal immediately before colliding with terrain. Almost complete fragmentation of the aircraft structure had occurred on impact leading to aircraft components spreading over about 80 m from the primary ground contact point. The propellor, engine, left wing, carry-through structure, empennage, nose gear and cabin components were all identified in the wreckage trail.

The orientation of the wreckage trail was in a north-east direction, which was about 180° to the intended flight track to Katherine Tindal. The tail and empennage section had broken into several pieces and was partially reassembled to ensure that all the extremities and flight control mass balance weights were identified. Excluding the right wing and wing tip, all key components of the airframe were identified in the wreckage trail with no pre-impact defects identified. The left wing remained attached to the intact wing carry-through structure. The landing gear was assessed to be retracted at impact and the flaps were assessed to be in the retracted position.

Both wing tank filler caps remained fitted to their respective fill ports. There was no remnant smell of fuel in the wreckage when it was examined although there had been significant rain through the region prior to ATSB's examination of the wreckage. Additionally, yellowing of the small grasses and vegetation surrounding the accident site was consistent with chemical burning, likely from the release of fuel when the aircraft impacted terrain.

Separated right wing

Onsite examination of the right main wing spar identified that it had fractured diagonally, about 30–60 cm from the fuselage attachment points (Figure 9–Figure 11).

The right wing showed extensive permanent deformation and tearing of the internal structure with associated compression rippling to the upper skin. The damage was indicative of substantial upward bending forces applied to the wing prior to its failure and separation from the aircraft. The wing structure at the point of failure contained a permanent deflection of about 30° in the upward

direction. The internal main fuel tank had been ruptured during the break-up, with no residual fuel remaining.

The inboard end of the right wing spar remained attached to the fuselage carry-through structure. Examination of the fracture surfaces from the right wing spar presented evidence of ductile overstress. Wood fibres and soil were also embedded throughout the main spar surfaces. The onsite assessment did not identify any regions of fatigue cracking or other pre-existing damage that might have weakened the spar caps, straps, or web structure of the wing.

Black contact marks on the wing tip surfaces indicated that it had probably impacted the rubberised leading-edge protection on the tail during the break-up sequence.

The inboard end of the right wing spar and the corresponding fracture surfaces from the separated right wing were retained for further detailed examination at the ATSB technical facilities in Canberra.

Figure 9: The right wing as it was found approximately 300 m from the main wreckage



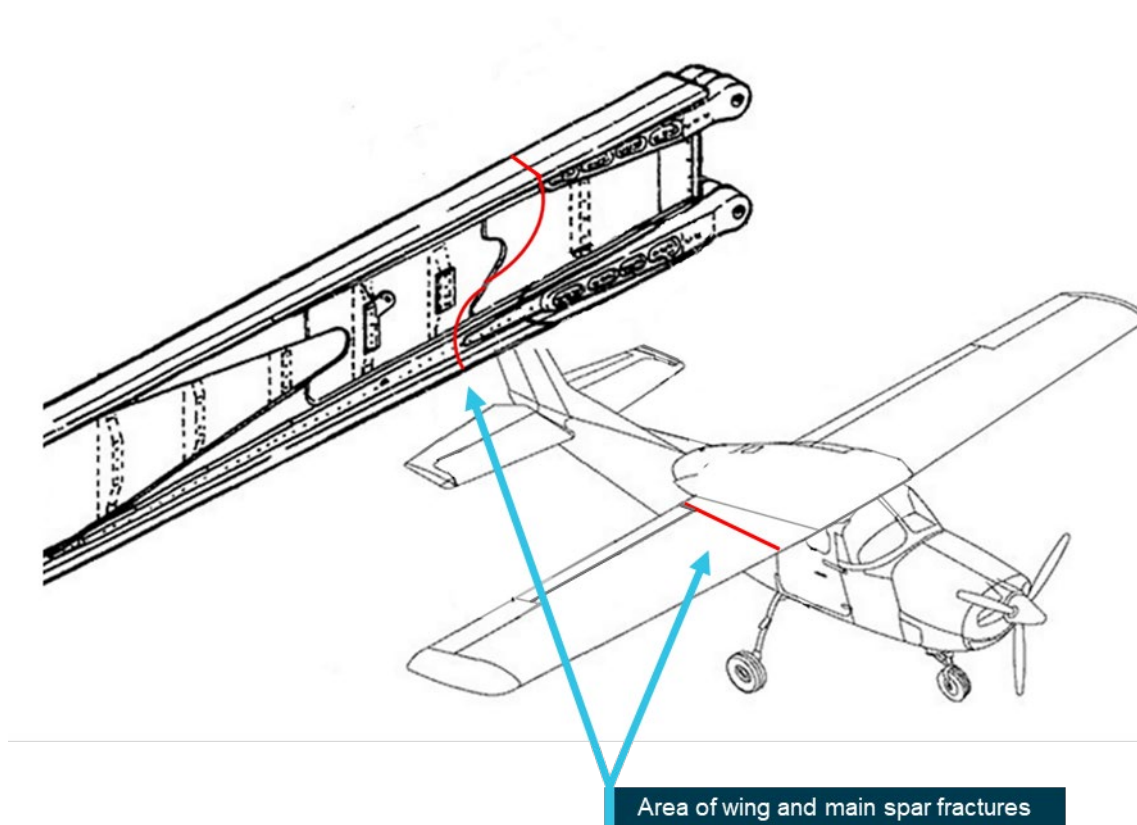
Source: ATSB

Figure 10: The right wing showed compression rippling of the upper skin surface and permanent deformation from exposure to upward bending



The wing was permanently deformed by about 30° in the upward direction at the point of failure.
Source: ATSB

Figure 11: Illustration of the Cessna 210 and the wing and main spar fracture location



Source: Textron – annotated by the ATSB

Engine

The engine had separated from the airframe and was found several metres from the initial impact point. The engine was examined externally for any type of pre-impact mechanical failure with none identified.

Exhaust system

Only small portions of the exhaust system from the engine were located at the accident site. The left side of the exhaust system containing the muffler section and heater shroud had been liberated from the engine and was not found at the accident site. It is possible they were obscured by debris or buried under the soil within the impact crater. The firewall area that housed the cabin heater inlet was destroyed and unable to be assessed for integrity.

The chief engineer for Katherine Aviation indicated they were unaware of any pre-existing issues with the exhaust system from VH-TFT and that it was inspected every 100 hours.

Propeller

The propeller hub had separated from the engine crankshaft due to overstress fracture under predominantly bending loads. One propeller blade had fractured from the hub at its base. All blades had sustained forward bending and rotational abrasion damage from passing through sand/soil. One of the blades displayed chord-wise twisting and compound bending. The damage signatures produced on collision with the terrain were consistent with an operating engine (Figure 12).

Figure 12: Propeller assembly after removal from the ground impact site



Source: ATSB

Emergency locator transmitter

The emergency locator transmitter (ELT) installed in the aircraft was an Artex 406 transmitter fitted to a fixed mounting bracket within the aft fuselage. It was required to be switched to the ARM position for flight so that the g-switch would provide impact-activation in the event of an accident.

The ELT from the aircraft was located within the wreckage trail. The switch was set to the armed position and the front panel light had illuminated, indicating that the inertial switch had activated on impact as designed. Although the unit was likely transmitting, the antenna had been severed, preventing the signal from propagating sufficiently to be received by overflying aircraft and/or satellites.¹²

Technical examination

A limited number of items from the accident site were retained as evidence for further review by the ATSB. They included operational documentation, electronic devices and physical components that were subsequently transported to the ATSB's technical facilities.

Electronic devices

It was a Katherine Aviation requirement for all pilots to use an electronic flight bag (EFB). The pilot used the OzRunways application on an iPad device. The ATSB's review of the pilot's OzRunways account identified a portion of a previous flight to Groote Eylandt on 23 December 2022. The account contained no flight data from the accident flight on 24 December 2022.

The ATSB's examination of the iPad and 2 mobile phones retrieved from the accident site was completed to establish if electronic data regarding the conduct of the flight could be recovered. Access to the severely damaged passenger's phone was achieved, however there was no data relating to the accident flight stored on that device. Data recovery from the pilot's phone and iPad was unsuccessful.

Flight instruments

Portions of 2 flight instruments were recovered from the accident site – a gyroscope from the artificial horizon and the front face of the vertical speed indicator.

Disassembly and examination of the gyroscope identified rotational scoring from contact with the rotor's housing. The scoring damage indicated that the aircraft's vacuum system and artificial horizon were likely operating.

Examination of the front face of the vertical speed indicator identified a defined witness mark that was consistent with the needle striking against the instrument face on ground impact. The witness mark showed a descent rate of 2,000 ft per minute. However, because the mark was at the limit of the instrument range, the descent rate of the aircraft may have been higher than indicated when it collided with terrain.

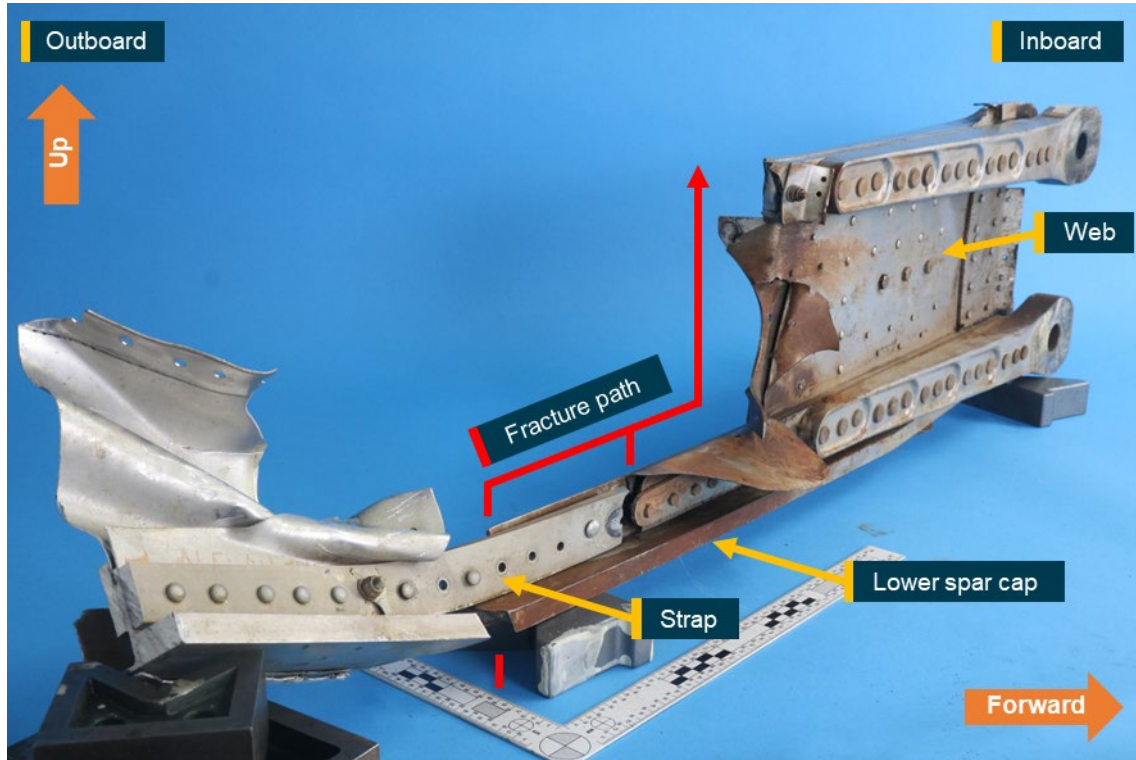
Right wing main spar

A red-brown product was adhered to much of the spar fracture surfaces and was likely a mixture of soil and impacted vegetation. Detailed examination of the main spar fragments identified features typical of ductile overstress. There was deformation and angular tearing throughout the spar cap, shear web and strap structure.

Overstress fracture in ductile materials (including the alloys comprising the wing component) occurs when the structure is loaded beyond its ultimate limit. Several rivets that had secured the straps to the spar cap had sheared during the break-up. The examination did not identify any evidence of pre-existing damage such as fatigue cracking, corrosion or other defects (Figure 13 and Figure 14).

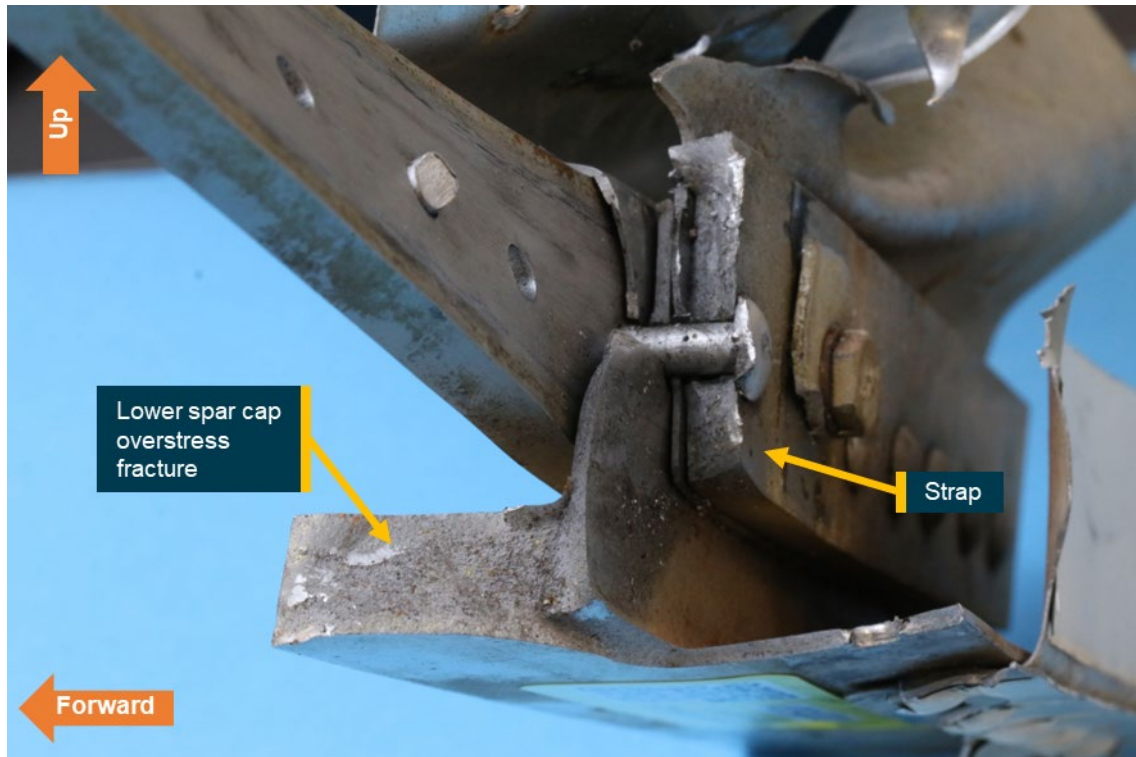
¹² The Cospas-Sarsat programme is a satellite-based search and rescue detection system that is used in Australia. <https://www.amsa.gov.au/safety-navigation/search-and-rescue/cospas-sarsat-search-and-rescue-satellite-system>

Figure 13: Fractured right wing main spar as received at the ATSB’s technical facilities



Source: ATSB

Figure 14: Close-up of the lower spar cap outboard fracture surfaces



Only ductile overstress features and associated deformation was present through the spar structure fracture surfaces.
Source: ATSB

Post-mortem and toxicology information

General

The pilot was described by co-workers and next of kin as active with a high level of health and fitness. They were a non-smoker.

Pilot results

A post-mortem examination conducted on the pilot found they sustained fatal injuries during the impact sequence. Toxicological analysis¹³ identified the presence of alcohol and carboxyhaemoglobin (COHb). However, due to chemical changes that occur post-mortem there was significant doubt over the validity of these results. That is, they were not reliable indications that the pilot was exposed to either alcohol or carbon monoxide prior to the accident.

Passenger results

A post-mortem autopsy examination was performed on the passenger, which found that they sustained fatal injuries during the impact sequence. Toxicology testing was not conducted.

Survivability

The accident was not survivable. Although a product of the accident dynamics, had an ELT signal been received by the search and rescue satellite system this would have resulted in earlier location of the accident site by the search authorities.

Organisational information

General

Katherine Aviation was established in 2006. It held an Air Operator's Certificate (AOC) and operated 15 Cessna 210, 6 Beechcraft Baron BE58, and 4 Cessna 172 aircraft. At the time of the accident it employed 20 pilots and was the registered operator of VH-TFT. It operated from 6 locations, with Katherine Tindal Airport being their main base, and Gove being one of 5 remote bases. The company conducted operations under Civil Aviation Safety Regulations (CASR) Part 135.¹⁴ It flew to communities and townships throughout the Northern Territory, and its services included general charter, patient transfer, freight and mail delivery, and scenic flights.

Katherine Aviation had a CASA-approved exposition that defined its procedures, activities, and conditions. It did not, and wasn't required to under the regulations, have a safety management system.

In December 2023, following sale of the business and its assets, Katherine Aviation ceased all charter operations and in January 2024 it cancelled its AOC, de-registering as an authorised aviation operator.

Key personnel

Katherine Aviation's key personnel were the chief executive officer (CEO), who was also the head of aircraft airworthiness and maintenance control (HAAMC), and a separate head of flying operations (HOFO). The HOFO commenced their aviation flying career with Katherine Aviation and after several years as a line pilot and performing other duties within the company, was appointed as the HOFO in May 2021. The HOFO role described in the company Exposition was to

¹³ Forensic Pathology Unit, Royal Darwin Hospital, NT Health.

¹⁴ Part 135 of the Civil Aviation Safety Regulations (CASR) covers the air transport rules for smaller aeroplanes and applies to operations in aeroplanes with: a maximum operational passenger seating capacity of 9 and a maximum take-off weight of 8,618 kg or less. [Part 135 of CASR Australian air transport operations - smaller aeroplanes | Civil Aviation Safety Authority \(casa.gov.au\)](https://www.casa.gov.au/part-135-of-casr-australian-air-transport-operations-smaller-aeroplanes)

manage and ensure the safety of flight operations. Duties also included the employment and induction of new pilots into the company, ground training and checking pilots to line.

Line pilots

The organisation's minimum requirements for pilots was a multi-engine instrument command rating with at least 5 flight hours operating a Cessna 210. Once located at a remote base, it was general practice that a senior base pilot provided supervision, mentoring and advice. Senior base pilots reported to the HOFO.

The HOFO and other company personnel stated that there was never any pressure applied to line pilots to complete a flight. They advised that the company supported the decision of a pilot if they elected to cancel a flight due to bad weather. The HOFO also advised it was an accepted, though not formalised practice, for pilots to depart and 'go have a look', when the forecast weather was unfavourable.

In-command-under-supervision training

Katherine Aviation required all pilots joining the company to complete line training as part of their induction. The training program was conducted in-command-under-supervision (ICUS) and provided assurance to the operator that, following a series of reviews, a pilot was proficient to conduct line operations. The HOFO reported that it typically took 25–60 ICUS flight hours before new pilots were checked to line. Elements from the ICUS program included:

- aircraft knowledge (aircraft speeds and limitations, pre-flight inspections)
- flight planning requirements
- flight component (taxi, climb, cruise, circuit and landing)
- weather management
- passenger briefings
- rules and procedures.

The operator advised that competency surrounding weather management and avoidance was assessed during ICUS flights. There was no formal weather examination during the training period, and pilots were expected to deviate, or descend early, to ensure the aircraft did not enter cloud.

Weather hazard management

On 13 October 2022, the operator held a safety meeting, which the pilot attended in preparation for the upcoming wet season. According to the meeting minutes, senior pilots discussed their personal accounts and experiences from flying during a wet season. The minutes from the meeting also identified that the HOFO had addressed the attending pilots, reiterating that:

'...no pressure to get the job done exists, and that pilots will be supported in their decision making.'

Katherine Aviation had created a specific internal training presentation on the hazards that exist in the Northern Territory during the wet season. That presentation was not delivered at the pilot safety meeting, however it was available for pilots to review on the internal computer network. The operator did not have a record of the accident pilot reviewing the presentation. The training presentation commenced with the following introductory statement:

This course is aimed at providing you with some specific information and guidance to help with decision making processes during the wet season. If you are new to flying in the NT then it is likely that you may not have experienced flying in a wet season. Wet season presents some extreme weather patterns that add to the complexities of planning and carrying out a flight. It is important that you are aware of some of these challenges and are suitably equipped to manage these situations whilst you are flying in the NT.

The presentation included advice on wet season weather phenomena, flight planning, flight into marginal visual meteorological conditions, guidance on the safe operation and control of an

aircraft when in turbulence and when to turn back. It also included a case study and lessons learned from a Cessna 210 in-flight break-up that occurred during the 2017 Northern Territory wet season (see the section titled *Related occurrences*).

Procedure for severe weather

The wet season training identified that it was likely for turbulence to be encountered when flying during a wet season. The presentation offered the following guidance:

- When encountering turbulence your priority is always to CONTROL THE AIRCRAFT
- Determine the intensity of the turbulence
- If the turbulence is of adequate intensity, begin to make corrective actions but do this slowly, (any abrupt changes to control inputs and power can increase G-loading on the aircraft)
- If descending – slowly revert to level flight to reduce airspeed
- Ensure you keep the wings level and do not “chase” attitude adjustments
- Slowly reduce power as appropriate to a minimum of 18 inches to reduce airspeed
- Allow the aircraft to decelerate to below the appropriate turbulent penetration speed for its weight (if applicable)
- If needed, ensure the aircraft is below gear extension speed and lower the gear
- Continue flight or descent in this configuration until you are clear of the turbulence
- DO NOT initiate quick roll manoeuvres or large turns. This may significantly increase G-loading on wings. G-loading limits are assessed on vertical movements of pressure and are not applied to twisting moments on wings. A twisting moment on the wing caused by rapid rolling movements (usually associated with someone attempting to “chase” an attitude) will apply further stresses to the aircraft. If a turn is required to attempt to manoeuvre away from a high turbulence area, ensure that it is made slowly and with minimum bank angle.
- CB’s and developed thunderstorms should be avoided by up to 10-15 nm or more. Some may need to be avoided by up to 40 nm or more!
- If you are diverting around a thunderstorm and it is turbulent then you are probably too close!

Additionally, section 2.19.3 of the operator’s exposition described procedures when encountering severe weather:

To minimise the risk of exceeding aircraft structural limitations due to thunderstorm turbulence, the pilot in command should:

- Ensure the aircraft does not take-off when thunderstorms are active within 10 nm of the aerodrome
- Avoid thunderstorms enroute by diverting by a minimum of 10 nm upwind or 20 nm downwind
- The pilot in command must either hold or divert to an alternate aerodrome if a thunderstorm is in 20 nm of the destination aerodrome.

Forecast and reported areas of turbulence should be avoided whenever possible. If turbulence is anticipated or encountered, the pilot in command should:

- ensure all persons, loose articles and cargo are secured
- maintain turbulence penetration speed or manoeuvring speed (V_A)
- maintain attitude control and accept altitude changes and speed variations whilst keeping the attitude within safe limits.

Decision making and perceived pilot pressure

The pilot was described by their co-workers and the HOF0 as professional and meticulous with their selection of speed and power settings when operating the Cessna 210 aircraft. They reported that the pilot exercised good en route decision-making during the ICUS program, particularly in the

avoidance of weather. A few days prior to the accident, the pilot turned back during a flight when en route weather conditions were unfavourable. In that instance, the pilot called the operations department and advised of the decision to cancel the flight. The decision not to push on was reflected by the company's stance on turnback and cancellation decisions during periods of adverse weather.

Perceived (or self-induced pressure) is specific to each pilot and may come from a range of sources. It may not be evident or easily identifiable by the pilot. Not every flight will result in potential for pilots to experience pressure; some pilots may not have experienced pressure due to the flights they have been involved in, and some pilots may not feel pressure in circumstances where other pilots do. In their research, Bearman (2014) reported that outback pilots are more likely to undertake risky behaviour to meet commercial imperatives and gain approval from their management. The desire for career progression by accumulating flight time was also an identified factor to influence risky behaviour for outback pilots.

On the day of the accident, conditions existed that may have led the pilot to experience a level of self-perceived pressure to proceed with the flight. These included:

- The aircraft was expected in Katherine for a 100-hourly scheduled maintenance. If the flight had returned to Gove, then it is likely that insufficient hours would remain on the aircraft's maintenance release to return to Katherine, potentially requiring a maintenance engineer to travel to Gove and complete the necessary maintenance.
- The flight was described in the booking as a patient transfer flight. This was the third time that Katherine Aviation had attempted to transfer the passenger for respite care. The previous flights earlier that week had been cancelled due to bad weather.
- The accident pilot was seeking to further their commercial flying career. The operator reported that the pilot was always keen to be assigned flight taskings to build flight time.

Balancing the potential for the above conditions, Katherine Aviation had no expectations for company pilots to depart or continue with a flight when confronted with adverse weather conditions. This expectation was outlined in the company Exposition and was supported by statements provided by operational personnel that pilots were accepted if they elected to cancel, divert or turn back. While it could be demonstrated that some aspects of self-perceived pressure were present, there was insufficient evidence available for the ATSB to determine the influence of each of these on the pilot's decision-making related to the accident flight.

Recorded data

Radar data

The Royal Australian Air Force (RAAF) provided air traffic control (ATC) recordings from Darwin and Tindal radar towers for the period of the accident flight. A review of the ATC data was completed and VH-TFT was not detected by the radar. In their analysis of the radar coverage, RAAF ATC confirmed that an aircraft operating at an altitude of 8,500 ft overhead the accident site would not have been detected by the Tindal radar system.

Telephone records

A single text message was sent from the pilot's phone to the operator at 0841, advising of the planned 1024 arrival time to Katherine. Mobile phone call charge records for the pilot and passenger's mobile phone devices were provided by a telecommunication network provider for the period 0900 to 1130. The data identified that from 0900 as the flight progressed, network connections were established with the cellular towers at Ramingining, Gapuwiyak, Alyangula, Numbulwar, and then to Bulman. The pilot's phone first came into the detectable range of the Bulman cellular tower at 0914 and the passenger's phone into range of the Bulman tower at 0915.

At 0929 both phones were again briefly detected on the Ramingining cellular tower, approximately 150 km north of the accident site. The provider advised that mobile networks were designed for

ground coverage. Connection to a network from within an aircraft while en route can be unpredictable and may be affected by variables such as climatic conditions, aircraft altitude and radio network traffic within the region. The Ramingining tower connection suggests that the aircraft may have been at a higher elevation and possibly closer to the planned cruise altitude of 8,500 ft, rather than at significantly lower altitudes.

At 1001 the passenger's phone signal ceased its connection with the Bulman tower, however the data identified that the pilot's phone remained connected to the cellular network. The passenger's phone was severely damaged during the accident sequence and had likely stopped operating upon impact with the terrain. In contrast, the pilot's phone remained relatively undamaged.

Recording devices on VH-TFT

The aircraft was not equipped with either a cockpit voice recorder or a flight data recorder, nor was it required to be. Further, there was no active flight tracking equipment fitted to the aircraft, which may have otherwise been used by the operator to track the aircraft and to assist search authorities to locate the occupants. There was no other device or system fitted to the aircraft that provided flight data.

Onboard recording devices have long been recognised as an invaluable tool for investigators in identifying the factors behind an occurrence and assisting with the identification of important safety issues. However, in many cases, investigations involving light aircraft are hampered by a lack of data about the circumstances that led to the occurrence. This contrasts with the investigation of occurrences involving larger transport aircraft that are required to be fitted with a flight data recorder and cockpit voice recorder.

Two recent ATSB investigations benefited greatly from the availability of recording devices. Although not crash protected, they greatly assisted in determining the contributing safety factors and enabling safety advice to be provided to the aviation industry:

- *VFR into IMC, loss of control and collision with terrain involving Airbus Helicopters EC130 T2, VH-XWD, near Mount Disappointment, Victoria, on 31 March 2022 ([AO-2022-016](#)).*
- *Loss of control and in-flight break-up involving Robinson R66, VH-KFT, near Hawks Nest, New South Wales, on 26 October 2023 ([AO-2023-051](#)).* Ongoing at the time of writing.

Related occurrences

A search of the ATSB occurrence database identified 5 other fatal accidents involving structural break-up for the Cessna 210 series aircraft in Australia (Table 3). Of these:

- One accident from 1976 (Cessna 210L) and one from 2017 (Cessna 210B) were attributed to significant aerodynamic loading, the source of which could not be established with certainty.
- The 2019 in-flight break-up and separation of the right wing from a Cessna 210M was identified to be from the fatigue cracking and fracture of the wing carry-through spar. Weather was not a factor to that accident.
- Exposure to severe weather was identified to be contributory for 2 accidents, one in 2011 (Cessna 210M) and the other in 2017 (Cessna 210L). These accidents and a serious incident from 2019 involving severe turbulence are briefly discussed below.

Table 3: Cessna 210 in-flight break-ups – Australia

Date	Investigation agency accident ID	Aircraft detail	General location	Detail
11 June 1976	Commonwealth of Australia Department of Transport AAIR 197600023	Cessna 210L	Cloncurry, Queensland	In-flight break-up
7 December 2011	ATSB AO-2011-160	Cessna 210M	Roma, Queensland	In-flight break-up
23 October 2017	ATSB AO-2017-102	Cessna 210L	Darwin, Northern Territory	In-flight break-up
24 October 2017	ATSB AO-2017-103	Cessna 210B	Albany, Western Australia	In-flight break-up
26 May 2019	ATSB AO-2019-026	Cessna 210M	Mt Isa, Queensland	In-flight break-up
25 November 2019	ATSB AO-2019-069	Cessna 210M	Darwin, Northern Territory	Severe turbulence

[ATSB investigation AO-2011-160](#)

On 7 December 2011, the owner-pilot of a Cessna 210M was conducting a private flight under visual flight rules from Roma to Dysart in Queensland. Thunderstorms with associated cloud, rain and severe turbulence were forecast for the area. About 30 minutes into the flight, the outer sections of the wings and parts of the tail separated. The aircraft collided with terrain, fatally injuring the pilot.

The ATSB established that the aircraft was structurally sound before the wing and tail sections separated. No aircraft system defects were identified. Ground-based weather radar showed thunderstorms in the vicinity of the accident site, and recorded engine data showed cruise power setting was maintained until recording ceased. Although the precise circumstances leading up to the accident were not known, a combination of aircraft airspeed with the effects of turbulence and/or control inputs generated stresses that exceeded the design limits of the aircraft structure.

[ATSB investigation AO-2017-102](#)

On 23 October 2017, a Cessna 210L with 2 pilots on board was conducting a charter flight from Darwin to Elcho Island, Northern Territory. When the flight was diverted to avoid adverse weather, the aircraft entered an area of strong convective activity and rapidly developing precipitating cells, which resulted in it experiencing severe turbulence and possibly reduced visibility for the pilots. While flying in these conditions, a combination of airspeed, turbulence and control inputs probably led to excessive loading on the aircraft's wings, which separated from the fuselage in-flight before it collided with terrain.

The ATSB found that the pilots had limited experience flying in the 'build-up' to the wet season in the Darwin area. Although pairing a supervisory pilot with a pilot new to the company was likely to reduce risk in other instances, in this case it did not adequately address the weather-related risks because neither pilot had experience flying in the region during the wet season.

[ATSB investigation AO-2019-069](#)

A serious incident was investigated by the ATSB following the report of passenger injuries and structural damage from exposure to severe turbulence during a charter flight.

On 25 November 2019, a Cessna 210M with four passengers was being flown from Darwin to Tindal, Northern Territory. Soon after departure, the pilot diverted 5 NM right of the planned track to avoid a large storm cell that was 5 NM left of track. Shortly after, the aircraft encountered sudden and sustained severe turbulence.

During the turbulence, the aircraft airspeed could not be controlled for several minutes through changing power settings, and for the most part the airspeed could not be held below 155 kt. For extended periods, the pilot had no control over bank angle, height, or heading. At one stage, the airspeed dropped below 140 kt, and the pilot lowered the landing gear in order to create drag and

slow the aircraft down. ATSB’s analysis of the radar data showed that the aircraft ground speed reached 210 kt, a maximum descent rate of 5,000 ft per minute.

International accidents

A search of the accident report databases held by both the Transportation Safety Board of Canada (TSB) and the United States National Transportation Safety Board (NTSB) identified several instances over a 25-year period where the Cessna 210-aircraft type has sustained structural failure during flight (Table 4). There were 8 fatal accidents identified and categorised as private operations and one other categorised as a charter operation. The accidents were further categorised to similarly themed primary and secondary contributing factors, these included: manoeuvring in excess of V_A, loss of control, spatial disorientation, continued flight into instrument meteorological conditions and severe weather.

Table 4: Cessna 210 in-flight break-ups – International

Date	Investigation agency accident ID	Aircraft detail	General location
21 Jan 1997	US NTSB CHI97FA056	Cessna 210N	Highland, Michigan
28 July 1997	Canada TSB A97Q0158	Cessna 210L	Milan, Quebec
18 June 2001	Canada TSB A010O165	Cessna 210L	Lake Lavieille, Ontario
4 December 2002	US NTSB FTW03FA057	Cessna 210L	Harrison, Arkansas
7 April 2005	US NTSB LAX05FA132	Cessna T210L	Tranquillity, California
12 August 2007	US NTSB MIA08FA027	Cessna T210N	Bloomfield, Kentucky
7 September 2010	US NTSB CEN10FA520	Cessna T210	Mountain Home, Arkansas
17 November 2014	US NTSB CEN14FA064	Cessna T210M	Cedaredge, Colorado
25 March 2017	US NTSB ERAFA17136	Cessna T210	Hayden, Alabama

Analysis

Introduction

On the morning of 24 December 2022, a Cessna 210N, registered VH-TFT, operated by Katherine Aviation, departed Gove Airport for a charter flight under the visual flight rules (VFR) to Katherine Tindal Airport. The flight departed with one pilot and one passenger on board. After the aircraft did not arrive and contact was unable to be made with the pilot, search and rescue activities were initiated by authorities. A distributed wreckage field was found the following day at a remote location in East Arnhem, approximately 237 km east-north-east of Katherine. Both occupants of the aircraft were fatally injured.

Examination of the accident site and recovered wreckage identified that the aircraft had sustained an in-flight break-up involving separation of the right wing. No pre-existing aircraft defects that had the potential to influence the accident were identified. The emergency locator transmitter fitted to the aircraft had activated from the accident sequence, however physical disruption between the unit and its antenna prevented an alert signal being received by the search authority.

The availability of flight data generally assists in the determination of contributing factors in accidents investigated by the ATSB. In this instance additional data may have provided time-referenced positional information, airspeed, altitude and heading. Notwithstanding, weather satellite information was gathered that identified the formation of a rapidly developing thunderstorm near to Bulman during the time period the aircraft likely transited the region. The following analysis will examine the flight into adverse weather, the accident time, development of the structural break-up, and aspects related to the operator's wet season training.

Time of the accident

The ATSB reviewed the aircraft performance, planned flight information and the available telecommunication records to determine a likely accident time. Based on the expected direct flight route conditions and aircraft speed, the aircraft should have arrived overhead the accident site at about 0930. However, the ATSB's review of the available telecommunication records identified that the passenger's mobile phone ceased its connection with the Bulman cellular tower at 1001 probably due to damage sustained during the accident sequence.

While there was insufficient information to ascertain the likely accident time more accurately than somewhere between about 0930–1000, possible reasons for the additional flight time to that planned included that the aircraft was slowed en route or diverted due to weather, including possibly being flown beyond Bulman and then turned back towards Gove.

Flight into adverse weather

This was the pilot's first commercial aviation role and was also their first period operating through a Northern Territory wet season. They had completed their line training with the operator in September 2022 during the dry season and after deployment from Katherine had flown for approximately 3 weeks from the operator's base in Gove. During that period, they had turned back previously due to unsuitable weather. This showed that the pilot had decision-making experience flying in convective weather.

The ATSB considered it likely that, while completing flight planning earlier that morning, the pilot had accessed the graphical area forecast (GAF) that described the predicted weather en route to Katherine. Supporting that was the pilot's previous flight planning records, where all the necessary information had been obtained and documentation completed. The pilot had mentioned in conversation to the Katherine Aviation operations staff member on the morning of the accident that the weather 'appeared to be a bit iffy', which also supported that the pilot had obtained and assessed the en route weather forecast.

Though most Katherine Aviation staff were away on leave that day, including the Gove senior base pilot and Head of Flying Operations, there were operational staff in place and on duty at the Katherine Aviation main base for consultation to assist with decision-making surrounding the conduct of the flight. Additionally, Bureau of Meteorology staff who had produced the forecast remained available as an informed source to provide weather advice.

The prevailing cloud coverage along the flight route near to Bulman were predicted in the GAF to cover between 5 and 7 oktas, with an effective ceiling of 1,000 ft above mean sea level (AMSL). There were no breaks predicted between subsequent cloud layers, with cloud tops predicted to be the same as each subsequent cloud base to above 10,000 ft AMSL. These forecast conditions were unsuitable for a flight under the VFR at an altitude of 8,500 ft. However, BoM analysis of satellite imagery identified that the forecast overcast conditions were not present in the Bulman region in the lead up to the accident.

Increasingly severe weather conditions were predicted to develop from the prevailing cloud coverage during the validity period of the GAF. Visibility was expected to be between 500 m and 2,000 m from rain showers, which was significantly below the required visual meteorological conditions. Towering cumulus and cumulonimbus clouds were also forecast to develop from cumulus cloud cells at different times and locations throughout area B during the forecast period.

A review of the available satellite imagery identified that the prevailing cloud coverage around the Bulman region rapidly formed into convective clouds as the aircraft approached the area. The thermal activity depicted in the satellite imagery within the Bulman area was accompanied by lightning strike detections at 0940, which confirmed that the towering cumulus and cumulonimbus clouds had further developed into a thunderstorm. This would have led to areas of moderate to heavy rain, with significantly reduced visibility as forecast in the GAF.

Depending on the proximity to these weather phenomena, it is also likely that the aircraft encountered severe turbulence associated with the convective action. Furthermore, because the satellite imagery confirmed that the prevailing overcast conditions did not exist in the Bulman region in the lead up to the accident, there was probably sufficient separation between the convective cloud formations associated with the developing thunderstorm to have been visible to the pilot. However, the severity of the conditions may not have been visually apparent.

The operator's procedures required a 20 NM downwind separation from thunderstorms and it was expected practice that a flight was to be diverted upon encountering such phenomena. If severe turbulence was encountered, pilots were to slow the aircraft and to avoid rapid manoeuvres. It was not possible to determine the pilot's precise actions during this final period of the accident flight. Had they been using the weather radar application on the iPad during the flight, it is possible that the extent of the developing storm near to Bulman was not evident due to the storm's significant distance from the weather radar head. This may have led to the pilot not perceiving the potential severity of the storm as they approached the Bulman region.

In summary, upon arrival into the Bulman region, the aircraft likely entered an area of strong convective activity from a rapidly developing thunderstorm which probably resulted in exposure to a combination of severe turbulence and reduced visibility for the pilot.

In-flight break-up

The position of the right wing and its control surfaces relative to the remainder of the aircraft at the accident site indicated that an in-flight break-up had occurred. All other control surfaces remained with the aircraft up until the collision with terrain. The main wing spar was critically important to carry the aerodynamic loads encountered during flight. Bending and shear loads were transmitted from the wing spar into the fuselage via the carry-through structure. Without any redundant load paths, aeroelastic upward bending and then fracture of the main spar led to the wing separation and an immediate loss of control. There was only evidence of overstress and associated deformation on the fracture surfaces, with no pre-existing defects or damage that might have otherwise reduced its overall structural integrity.

The single wing separation indicates that the aircraft was likely subject to asymmetric loading at the time of the in-flight break-up consistent with the aircraft being manoeuvred. The limited distance between the separated wing and the primary accident site also indicates that the break-up occurred at an altitude considerably lower than the initial cruise altitude. The direction of the wreckage trail was toward Gove. It was therefore possible that the aircraft had been, or was being, turned back to Gove prior to the break-up.

Had the aircraft entered an area of reduced visibility this would have likely created an increased risk of the pilot losing visual cues and experiencing spatial disorientation. The pilot's last recorded flight under instrument flight was about 10 months prior when they obtained their multi-engine endorsement. Though the pilot was rated for flight into instrument meteorological conditions, it was likely that the pilot's instrument flying proficiency had reduced during the intervening period.

Other previously investigated Cessna 210 accidents have identified structural failure and in-flight wing separation to be associated with conditions that were present near Bulman on the day of the accident. One serious incident from the Northern Territory during the 2019 wet season, also investigated by the ATSB, identified that upon coming within 5 NM of a developed thunderstorm, the pilot was unable to control the aircraft's attitude, airspeed and descent rate. Although the aircraft was able to be landed, the investigation determined that the structural limits of the airframe were likely approached during that flight.

Based on the available evidence, the ATSB concluded that the most likely explanation for the in-flight break-up of VH-TFT is that, while operating above the manoeuvring speed, the pilot applied a control input and/or the aircraft encountered severe turbulence that resulted in overloading and separation of the right wing.

Wet season training

New pilots employed by Katherine Aviation were given weather avoidance training during the ICUS period. Supporting that training, Katherine Aviation had specific information contained within its exposition for pilots to avoid thunderstorms as part of their operational requirements. Specifically, while en route pilots were to divert by a minimum of 10 NM upwind or 20 NM downwind of such weather systems. Pilots were to also slow the aircraft to the manoeuvring or turbulence penetration speed (V_A) when turbulence from these weather systems was encountered. Due to limited available information, the ATSB was unable to assess the degree those requirements were being applied by the accident pilot prior to the in-flight break-up of VH-TFT.

In addition to the formal operational requirements, Katherine Aviation had developed a training package that detailed the unique hazards of flying during the wet season. It described the procedures to help pilots mitigate the hazards when operating in that environment. The briefing contained specific advice on wet season weather phenomena that included: flight planning, flight into marginal visual meteorological conditions, safe operation and control of an aircraft when in turbulence, and advice on when to cancel the flight.

The pilot attended a company safety briefing prior to the commencement of the 2022 wet season, where elements of decision making were discussed, including first-hand accounts from senior pilots of their own wet season experiences.

Although the slide pack was not presented at the briefing it was made available for pilots to review after the meeting. Katherine Aviation did not require the training material to be reviewed by its pilots. The absence of a requirement for the training material to be reviewed may have been a lost opportunity for Katherine Aviation to ensure its pilots were further prepared to safely operate during the top end wet season.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the in-flight break-up involving a Cessna Aircraft Company 210N, registered VH-TFT, that occurred 237 km east-north-east of Katherine, Northern Territory on 24 October 2022. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- Upon arrival in the Bulman region, the aircraft likely entered an area of strong convective activity from a rapidly developing thunderstorm, which probably resulted in exposure to a combination of severe turbulence and reduced visibility.
- It is probable that a combination of turbulence from the thunderstorm, airspeed above the aircraft manoeuvring speed, and control inputs led to the excessive structural loading and in-flight separation of the right wing from the fuselage before the aircraft collided with terrain.

Safety actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the aviation industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions are provided separately on the ATSB website, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website as further information about safety action comes to hand

Safety action not associated with an identified safety issue

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Additional safety action by Katherine Aviation

Wet season training

On 11 February 2023, Katherine Aviation formally presented its wet season training material to its company pilots. In August 2023, the Katherine Aviation Exposition was updated with the requirement that all pilots were to complete the training on an annual basis.

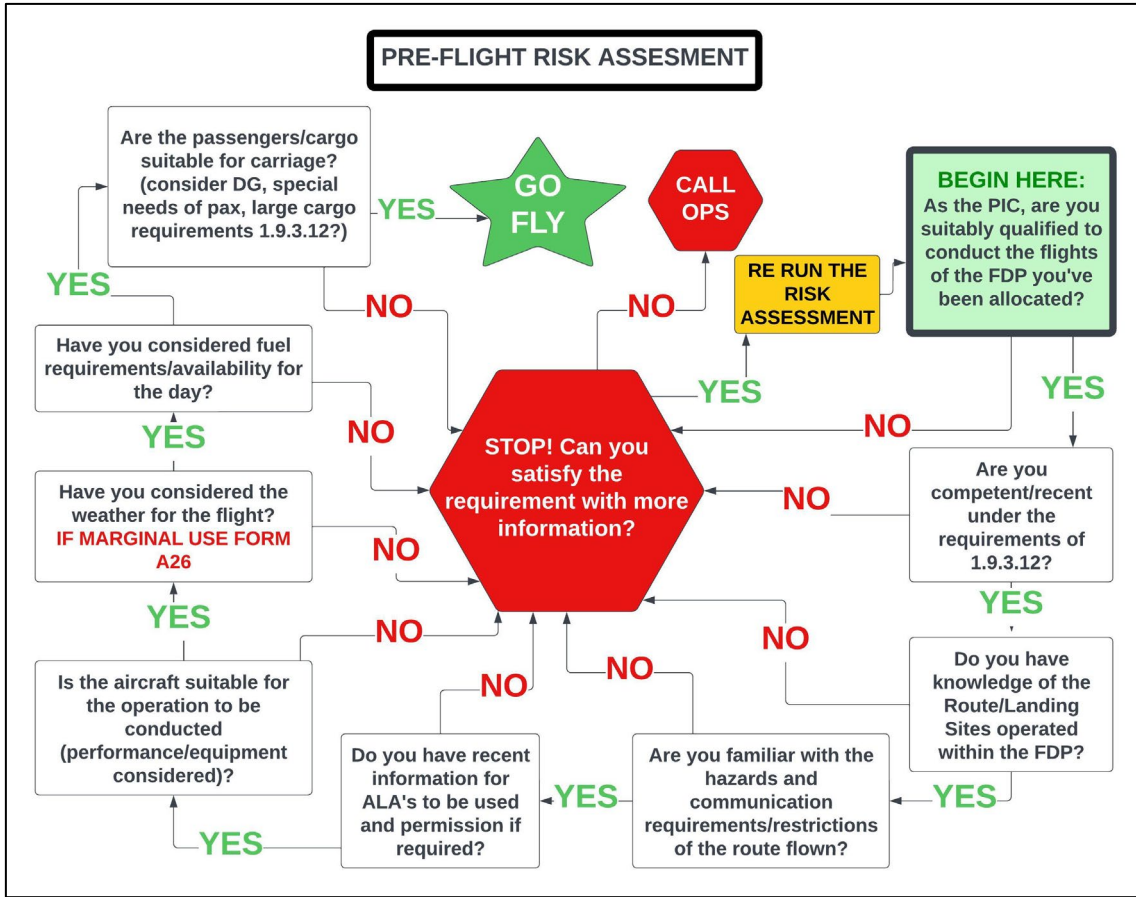
Flight monitoring

Katherine Aviation advised that, in January 2023, it commenced providing satellite tracking and communication devices for its pilots that enabled real-time satellite-based tracking and monitoring of its fleet. The devices allowed text messaging to be exchanged between the company and its pilots in the absence of a mobile telephone signal.

Operational control

Katherine Aviation advised that it had developed flight assessment tools that were required to be completed by its pilots prior to the conduct of any flights. The requirement to complete the assessments was identified in the August 2023 update to the Katherine Aviation Exposition. The tools were targeted to provide its pilots with better decision-making tools during planning for marginal weather.

A marginal weather decision-making chart was also developed to assist pilots assess the daily conditions. The requirement was communicated during a pilot safety meeting and the flowchart was displayed at all Katherine Aviation bases. Both charts are displayed below.



This decision making chart should be used at any time before departure if you believe that the in-flight conditions will be marginal for your proposed flight. Once you have answered YES to a question you may move on to the next box down.



General details

Occurrence details

Date and time:	24 December 2022 0930-1000 Central Standard Time	
Occurrence class:	Accident	
Occurrence categories:	Collision with terrain, In-flight break-up, Turbulence / Windshear / Microburst	
Location:	237 km east-north-east of Katherine, Northern Territory	
	Latitude: 13.5063° S	Longitude: 134.2622° E

Aircraft details

Manufacturer and model:	Cessna 210N	
Registration:	VH-TFT	
Operator:	Katherine Aviation	
Serial number:	21063448	
Type of operation:	Part 135 Australian air transport operations - Smaller aeroplanes	
Activity:	Commercial air transport-Non-scheduled-Passenger transport charters	
Departure:	Gove Airport, Northern Territory	
Destination:	Katherine Tindal Airport, Northern Territory	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – 1 (fatal)	Passengers – 1 (fatal)
Aircraft damage:	Destroyed	

Glossary

AD	Airworthiness Directive
AGL	Above ground level
AMSL	Above mean sea level
ATC	Air traffic control
BoM	Bureau of Meteorology
CB	Cumulonimbus
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations
CEO	Chief Executive Officer
CTAF	Common traffic advisory frequency
EFB	Electronic flight bag
ELT	Emergency locator transmitter
EMBD	Embedded
FAA	Federal Aviation Administration
GAF	Graphical area forecast
GPWT	Grid-point wind and temperature
HAAMC	Head of aircraft airworthiness and maintenance control
HOFO	Head of flying operations
ICUS	In-command-under-supervision
JRCC	Joint Rescue Coordination Centre
NAIPS	National Aeronautical Information Processing System
POH	Pilot's Operating Handbook
RAAF	Royal Australian Air Force
TAFs	Terminal area forecasts
VFR	Visual Flight Rules

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Katherine Aviation
- Civil Aviation Safety Authority
- Northern Territory Police Service
- Textron Aviation (Cessna)
- Airservices Australia
- Royal Australian Air Force
- Australian Maritime Safety Authority
- Northern Territory Health
- Bureau of Meteorology
- Champagne PC Services
- Telecommunication network provider
- OzRunways
- witnesses.

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Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- Katherine Aviation
- Bureau of Meteorology
- Civil Aviation Safety Authority

- Airservices Australia
- Australian Maritime Safety Authority.

A submission was received from the Bureau of Meteorology.

The submission was reviewed and, where considered appropriate, the text of the report was amended accordingly.

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.