Australian Government

Australian Transport Safety Bureau

Near collision involving Cessna 210, VH-SYT, and Cessna 206, VH-HPA

46 km south-west of Darwin Airport, Northern Territory, on 6 December 2017

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Addendum

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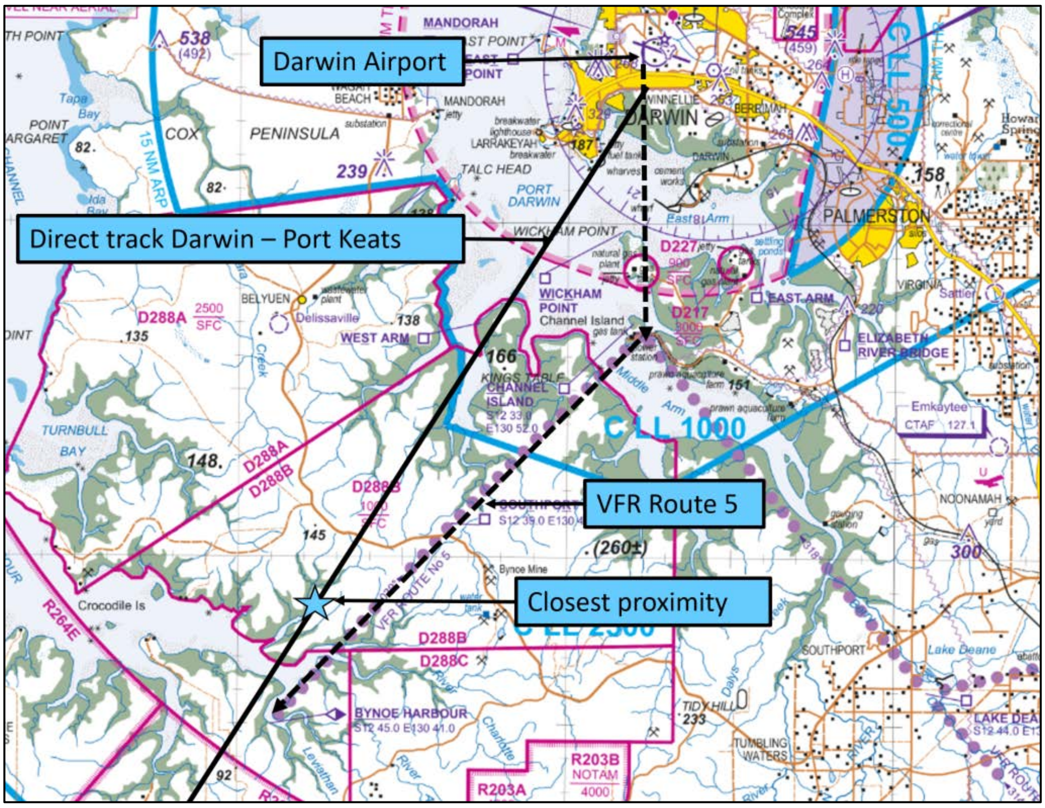
Near collision involving Cessna 210, VH-SYT, and Cessna 206, VH-HPA

What happened

On 6 December 2017, at about 0800 Central Standard Time,[1] a Cessna U206G (C206) aircraft, registered VH-HPA (HPA) and operated by Hardy Aviation, taxied at Darwin Airport, Northern Territory (NT). A Cessna 210L (C210) aircraft, registered VH-SYT (SYT) and operated by Chartair, taxied not far behind HPA.

The pilots of the aircraft were both operating charter flights to Port Keats, NT, under the visual flight rules (VFR),[2] and had planned to track at 8,500 ft. Their initial clearance, in accordance with the traffic management plan for Darwin, was to track via VFR route 5, which tracked south for 5 NM then south-west (Figure 1). Both aircraft were taxiing to depart from runway 18. Prior to take-off, the pilot of each aircraft was advised by air traffic control[3] that the other aircraft would also be tracking to Port Keats at 8,500 ft.

Figure 1: Extract of Darwin Visual Terminal Chart showing VFR Route 5 and direct track to Port Keats



Source: Airservices – annotated by ATSB

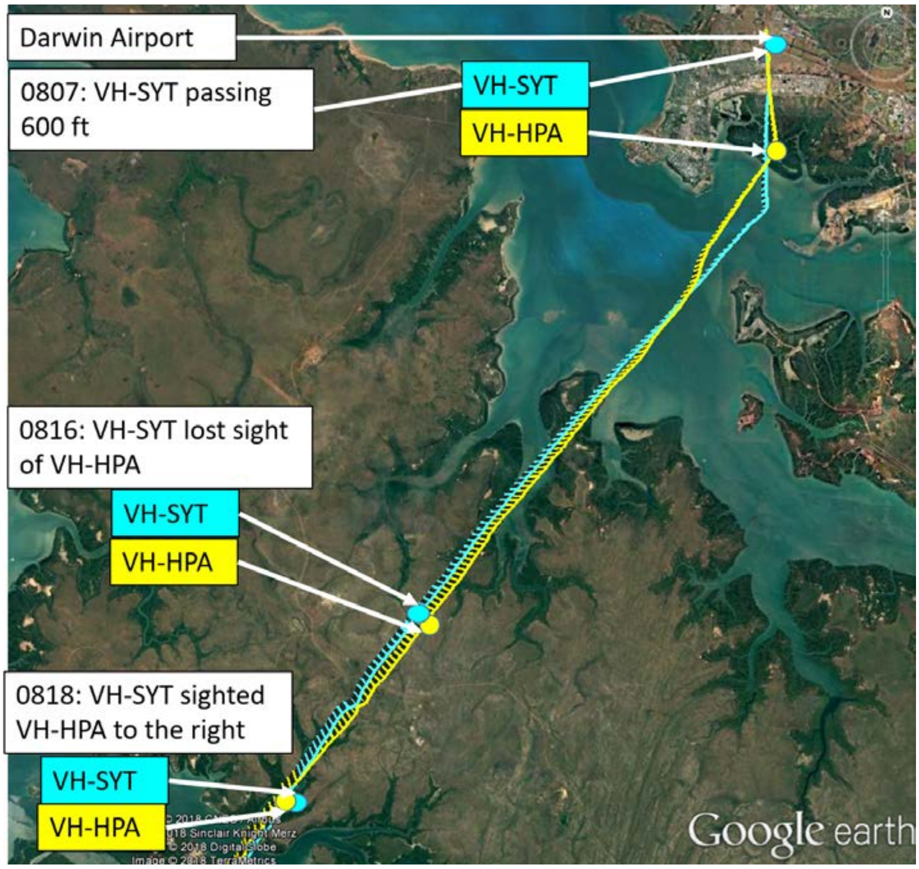
1 Central Standard Time (CST): Coordinated Universal Time (UTC) + 9.5 hours.
2 Visual flight rules (VFR): a set of regulations that permit a pilot to operate an aircraft only in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.
3 The Australian Defence Force provides the air traffic control services associated with Darwin Airport.

The pilot of HPA, with two passengers on board, observed SYT taxiing and saw only the pilot on board. He assumed, therefore, that SYT would probably be light and expected it would quickly overtake and out-climb HPA.

Shortly after take-off, the pilot of HPA contacted the Darwin approach controller and reported passing 800 ft on climb to 2,000 ft. The Australian Defence Air Traffic System (ADATS) controller's situation display indicated the aircraft's altitude as 700 ft at that time, based on the transmission from the aircraft's mode C transponder (see the section titled *Radar altitude*). The controller then cleared HPA to track direct to Port Keats at 8,500 ft.

The pilot of SYT was cleared for take-off about 1 minute after HPA. Once airborne, he immediately looked for, and sighted HPA. Just before 0808, the pilot of SYT contacted the approach controller and reported passing 600 ft on climb to 2,000 ft, with HPA in sight (Figure 2). By the end of that transmission, the controller's situation display radar altitude for SYT indicated 100 ft. The displayed level information differed from the pilot's reported altitude by more than the permitted tolerance of 200 ft (see the section titled *Radar altitude*) but there was no indication that the controller identified that discrepancy.

Figure 2: Google Earth image overlaid with aircraft tracks



Source: Google Earth and radar data – annotated by ATSB

In response to the transmission by the pilot of SYT, the controller advised that the preceding traffic (HPA) was now tracking direct to Port Keats at 8,500 ft, and then asked whether direct tracking was also being sought for SYT. The pilot of SYT responded 'affirm, when available'. The controller advised him to expect that clearance in 1 minute.

The approach controller reported that SYT was left on VFR route 5 for about 1 minute to segregate it from HPA, before being re-cleared to track direct to Port Keats at 8,500 ft. The pilot of SYT reported that the direct track to Port Keats put SYT on a similar track to HPA. Therefore, he kept HPA in sight, and manoeuvred to the right of its track, expecting to overtake it.

The pilot of HPA expected that SYT would be either just to the left (based on the VFR route's initial southerly track compared to the direct track to the south-west) or directly behind HPA. At 0812, the pilot of HPA requested (and received) a clearance to stop climb at 6,500 ft 'due to faster following traffic'. This transmission was intended to make the pilot of SYT aware that he knew SYT would be close behind, and for vertical separation between the two aircraft.

Three minutes later, the approach controller asked the pilot of SYT if he still had the preceding traffic in sight, and the pilot responded 'affirm'. The controller then advised him that HPA was now on climb to the amended level of 6,500 ft.

As SYT approached 5,500 ft, the pilot of SYT could see his aircraft was gaining on HPA, and assessed it would soon overtake HPA. Shortly after, HPA moved through the 10 o'clock position[4] of the pilot of SYT who then lost sight of it behind SYT's left wing.

At 0816, when about 15 NM south-west of Darwin Airport, the pilot of SYT reported to the approach controller that he was 'just coming up on HPA's 3 o'clock position and lost sight' of that aircraft. The controller advised that HPA was 'climbing through 6,200 [ft] at the moment, probably half a [nautical] mile to your left'. The pilot of SYT responded 'Sierra Yankee Tango', and did not sight HPA.

The controller then gave HPA traffic information: 'SYT is on your right 3 o'clock, half a [nautical] mile, climbing through 5,500 [ft]'. The pilot of HPA responded that he was 'looking'. The pilot of HPA looked to his right, but did not see SYT.

The radar data at that time indicated lateral separation between the aircraft was 0.27 NM (500 m), with SYT behind and slightly right of HPA and 800 ft below. About 30 seconds later, an ADATS conflict alert (CA)[5] activated on the controller's situation display (SYT indicated 5,600 ft and HPA 6,400 ft). When HPA reached 6,500 ft, the pilot levelled the aircraft off and completed the top of climb checks.

At 0817, the approach controller asked the pilot of SYT 'Do you have that traffic in sight or would you prefer a different level or tracking?' The pilot of SYT responded 'Negative, traffic not in sight… happy to maintain this track if HPA has us in sight'. The controller then asked the pilot of HPA if they had SYT in sight. The pilot of HPA responded 'Negative' and advised that HPA was now maintaining 6,500 ft.

The pilot of SYT reported that, at that time, he still thought the aircraft were half a nautical mile (900 m) apart and was expecting HPA to be out to his left. However, the radar data indicated that HPA was 800 ft vertically above, and 0.18 NM (333 m) laterally away from SYT.

At 0818 the CA activated again while neither pilot had the other aircraft in sight. The radar data at the time indicated that SYT was at 5,900 ft, HPA at 6,500 ft with a lateral separation of 0.13 NM (241 m).

The approach supervisor reported that, at that stage, there was still just over 500 ft vertically between the two aircraft and that he instructed the approach controller to maintain 500 ft separation between the aircraft.

In response to the direction from the supervisor, the controller asked the pilot of SYT if he would 'like to stop climb 6,000 [ft]?', to which he responded 'Negative, I'll continue on to 8,500 [ft], happy to take 3 [nautical] miles right of track if that puts us out of conflict'. The pilot of SYT reported that he was puzzled by the question because at that stage his altimeter was indicating an altitude of 6,300-6,400 ft. The radar data at the time showed SYT at 6,000 ft, HPA at 6,500 ft and 0.086 NM

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4 O'clock: the clock code is used to denote the direction of an aircraft or surface feature relative to the current heading of the observer's aircraft, expressed in terms of position on an analogue clock face. Twelve o'clock is ahead while an aircraft observed abeam to the left would be said to be at 9 o'clock.

5 The CA activated when aircraft were within about 1,000 ft and 3 NM of each other.

(160 m) lateral separation between the aircraft, which were then about 20 NM south-west of Darwin Airport.

The pilot of SYT commented that as soon as he made that request to deviate three nautical miles right of track, HPA came from the left top corner of his windshield across the nose to the bottom right in front of him and filled the windscreen. He estimated the two aircraft passed 3-4 m apart.

The pilot of HPA was looking out to his 3 o'clock position when the pilot of SYT was in the process of requesting the deviation right of track. SYT appeared in the pilot of HPA's 5 o'clock position and he reported being surprised by its close proximity. He and the passengers in HPA estimated the aircraft came within 5 m of each other.

The controller then cleared SYT to deviate up to three nautical miles right of track and advised that 'HPA by radar is on top of you 6,500 [ft]'.

Both pilots reported that by the time the approach controller cleared SYT to deviate right of track, the two aircraft had already passed each other and the separation between them was increasing. SYT was now to the left of HPA and the pilot of SYT had HPA in sight. The closest proximity according to the radar data was 100 ft vertically and 0.02 NM (37 m) laterally.

The approach controller reported that the CA activated again and SYT did not seem to be deviating to the right, just continuing to climb. The controller observed SYT passing 6,200 ft on the situation display and, as it was now less than 500 ft below HPA, they issued a safety alert. The approach supervisor reported also directing the controller to issue a safety alert at that time.

After the aircraft had already passed each other in close proximity, the pilot of SYT responded 'Say again'. The approach controller then responded 'Safety alert: HPA by radar is on top of you 6,500 [ft]. Deviate up to 3 [nautical] miles right of track and maintain 6,000 [ft] until clear'.[6]

The approach controller recalled assessing that SYT might be required to descend to the cleared altitude of 6,000 ft at the time the instruction was issued. In response to that transmission, the pilot of SYT advised that HPA was now to the right of their track, so SYT would stay to the left.

The two aircraft continued to Port Keats without further incident.

VFR aircraft in Class C airspace

In Class C airspace, VFR aircraft are provided with traffic information on other VFR aircraft and are not separated by air traffic control (ATC). The approach supervisor commented that there was no responsibility for ATC to provide separation between those two aircraft. However, they were entitled to a traffic service and a safety alert if the controllers assessed there was a problem.

Civil Aviation Regulation (CAR) 163 stated that 'The pilot in command of an aircraft must not fly the aircraft so close to another aircraft as to create a collision hazard.' In addition, CAR 163A states that 'the flight crew of an aircraft must… maintain vigilance so as to see, and avoid, other aircraft.'

The approach supervisor commented that they had an expectation that the pilots of the involved aircraft would have had an understanding of the relative performance of each other's aircraft and that they would maintain visual contact and be able to keep clear of each other.

While pilots of VFR aircraft are responsible for avoiding other VFR aircraft, according to MATS 2.2.1.1, the objectives of Air Traffic Services include to 'prevent collisions between aircraft.' The approach supervisor commented that when pilots of VFR aircraft lose sight of each other, the requirements of the safety alert come into place.

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6 ATC will issue a Safety Alert to aircraft, in all classes of airspace, when they become aware that an aircraft is in a situation that is considered to place it in unsafe proximity to: terrain; obstruction; active restricted or prohibited area; or other aircraft.

Darwin VFR aircraft operations

A large number of VFR aircraft operate charter flights to and from Darwin Airport. The controllers reported that VFR aircraft often tracked in close proximity to each other, although when there were more than two aircraft departing on the same track, ATC usually provided instructions to segregate them. In addition, ATC often separated VFR aircraft from instrument flight rules aircraft by issuing the pilots of the VFR aircraft with tracking instructions.

The controller commented that when multiple aircraft depart together bound for the same location, they are usually from the same operator, but in this incident they were not. He also commented that this might have contributed to the slower aircraft departing ahead of the faster one. If the two aircraft were from the same operator, the pilots may have sequenced themselves so the faster aircraft would depart first. The pilot of SYT said in future, taxiing out, he would contact the ground controller and ask if they could depart ahead of the slower aircraft. In addition, in a similar situation, as soon as possible, he would put his aircraft on a track 5 NM right of the other aircraft.

The approach controller commented that the C206 and C210 were very similarly performing aircraft, and their speeds can vary depending on how many people and how much cargo and fuel is on board, so the type of aircraft is not always a good indication of relative performance.

In accordance with Darwin's traffic management plan, all VFR traffic are cleared to depart via a published VFR route, except those going to the nearby islands. After departure most aircraft are cleared for direct tracking as soon as practicable. The VFR route 5 tracks 5 NM south of Darwin then south-west, and would have been within a couple of miles left of the direct track. The pilot of SYT had planned to track via VFR route 5 in accordance with their standard operating procedures.

The pilot of HPA was using an electronic flight bag[7] and tracked direct to Port Keats once cleared. The pilot of SYT reported maintaining a constant heading direct to Port Keats after receiving clearance to track direct, and that he 'was checking the heading continuously' and the two aircraft were 'paralleling until he lost sight of HPA'.

Conflict alert

In Class C airspace in Darwin, when aircraft operate within 3 NM horizontally and 1,000 ft vertically, a CA activates. In response, the controller usually announces to the other controllers and supervisor what separation standard is in place – whether it is 'traffic', or another standard such as '500 ft' vertical separation. The approach supervisor commented that it was normal for Darwin for the conflict alert to activate between VFR aircraft.

ATSB investigation AO-2011-011 identified a safety issue at Williamtown (Newcastle Airport), New South Wales associated with conflict alerting. The conflict alerting function had been disabled following a risk analysis and advice from safety specialists, due to numerous, unavoidable spurious alarms at Williamtown. During a trial period in which the alerts were activated, a Department of Defence investigation found that the alert function did not assist controllers in the identification or resolution of traffic conflicts and that false alerts may have resulted in controller desensitisation.

Limitations of see-and-avoid

The limitations of see-and-avoid practices are well known and documented. Civil Aviation Advisory Publication (CAAP) 166-2(1) *Pilots' responsibility for collision avoidance in the vicinity of non-controlled aerodromes using 'see-and-avoid'*[8] discusses see-and-avoid in non-controlled airspace, but much of the content is relevant to pilots of all VFR aircraft including in controlled airspace.

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7 Electronic flight bags can electronically store and retrieve documents required for flight operations, such as maps, charts, the Flight Crew Operations Manual, Minimum Equipment Lists and other control documents. See CASA CAAP 233-1.

8 Available from CASA's website: www.casa.gov.au

Alerted see-and-avoid, where the pilot is directed where to look to sight another aircraft, is much more effective than un-alerted. However, there are still a number of factors that affect a pilot's ability to sight another aircraft. In this incident, the pilot of SYT lost sight of HPA when it was above and diagonally to his left, as it was then obscured by SYT's left wing. Additionally, when the pilot advised ATC that he had lost sight of HPA, the controller responded that HPA was half a mile to his left, and then advised the pilot of HPA that SYT was half a nautical mile to his right in his 3 o'clock position. A review of the radar data identified that the relative positions of the aircraft differed from that advised by the controller.

Radar altitude

An aircraft's transponder operating in mode C transmits a signal that permits a secondary surveillance radar ground station to determine the distance and bearing to the aircraft as well as its altitude.

Aircraft altimeters and ATC situation display show barometric altitude below the transition altitude (10,000 ft in Australia). Aircraft mode C transponders sense and transmit static air pressure to ground-based surveillance equipment. That equipment converts the value into the corresponding pressure altitude and, if below the transition altitude, applies an input from a ground-based QNH to obtain the equivalent barometric altitude. The calculated altitude is displayed to controllers with a resolution of 100 ft.

MATS section 9.7.5.5 *Display tolerance* stated that 'when the displayed pressure altitude-derived level information differs from the pilot-reported or known altitude by more than 200 ft: a) advise pilot; b) request check of pressure setting; and c) confirm current level.'

When the pilot of HPA reported passing 800 ft, the displayed altitude was 700 ft and therefore within tolerance. However, when the pilot of SYT first contacted the approach controller and reported passing 600 ft, the aircraft's label on the situation display indicated 100 ft by the end of the pilot's transmission, which was outside the 200 ft tolerance. The 500 ft discrepancy between SYT's displayed radar altitude and actual aircraft altitude correlated with the recorded radar data from Airservices Australia while the aircraft was in cruise. There was no indication that the controller detected the discrepancy.

Because of this discrepancy, SYT was about 500 ft higher and therefore about 500 ft closer vertically to HPA than displayed. Allowing for this, the closest proximity between the aircraft around the time of the occurrence was within 100 ft, and this proximity occurred before the controller issued the safety alert. Given the radar is only displayed to the nearest 100 ft, this was consistent with the pilots of both aircraft reporting that the aircraft came within 3–5 m of each other at the same altitude and that they had passed before the safety alert was issued.

Safety analysis

Development of the occurrence

The pilots of the two aircraft were required to see and avoid each other. SYT was trailing, but faster than, HPA. That relative positioning reduced the opportunity for the pilot of HPA to identify the developing proximity event, as SYT was below HPA as the two aircraft converged. As SYT closed on HPA, the pilot of SYT lost visual contact as the wing structure visually obscured HPA. The pilot of SYT identified that his aircraft was about to overtake HPA, but did not manoeuvre to keep HPA in sight or request an alternative clearance. The pilot of SYT lost sight of HPA while the aircraft were about 500 m and 800 ft apart.

Although the pilot of SYT did not manoeuvre to maintain sight of HPA, he did advise ATC that he had lost visual contact with that aircraft. When requested, ATC will provide VFR flights in Class C airspace with a suggested course of action to avoid other VFR flights, but the pilot is still required to see and avoid other aircraft.

As neither pilot requested ATC to provide avoiding action, the controller did not issue alternative segregation instructions at that time and the two aircraft continued to converge. The controller did, however, provide traffic information to both pilots and offered alternative tracking.

The controller issued a safety alert and instructions when the vertical separation depicted on the situation display between the aircraft reduced to about 500 ft. However, due to a combination of radar accuracy/resolution and the altitude of SYT on the situation display not being within the required 200 ft tolerance, the aircraft were much closer than the indicated 500 ft. Consequently, the safety alert was issued after the near collision and so neither pilot had an appreciation of just how close the aircraft were until they re-sighted each other as they passed in close proximity.

Had the controller verified the initial altitude of SYT on first contact, they would have identified the discrepancy between the reported and displayed altitudes. The controller would then have had an accurate indication of the vertical distance between the two aircraft.

See-and-avoid limitations

Obstruction by the aircraft's wing is one of many factors identified by ATSB research that affect a pilot's ability to sight another aircraft. This occurrence therefore highlights the difficulties of the see-and-avoid principle, even when the pilot is given information about (or alerted to) the other aircraft's position. Airborne collision avoidance systems (ACAS) provide valuable information to alert pilots of other aircraft in their proximity and can direct the pilot to take avoiding action, thereby reducing the risk of collision.

Findings

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

- The approach controller did not verify the initial altitude of VH-SYT, which was outside the allowable 200 ft tolerance. That resulted in the two aircraft being significantly vertically closer than displayed and, in turn, the controller issuing a safety alert after the near collision had occurred.
- After the pilot of VH-SYT lost sight of VH-HPA, he advised air traffic control and took no further action to ensure segregation between the aircraft.

Safety message

Pilots and air traffic controllers have a joint responsibility to avoid collisions between aircraft. In controlled airspace, air traffic controllers are not required to provide pilots of aircraft operating under the VFR with separation from other VFR aircraft. While air traffic controllers can provide traffic information to pilots of VFR flights, see-and-avoid is the primary means of preventing collisions between VFR aircraft.

The limitations of see-and-avoid techniques are well known and are detailed in the ATSB publication *Limitations of the See-and-Avoid Principle*. When pilots are alerted to the location of another aircraft, this significantly improves their ability to sight the other aircraft. However, as detailed in the publication, many factors can affect a pilot's ability to sight another aircraft. The publication was written in 1991 and states that 'Because of its many limitations, the see-and-avoid concept should not be expected to fulfil a significant role in future air traffic systems.'

Both VH-SYT and VH-HPA were equipped with mode C transponders, but neither aircraft was equipped with any airborne collision avoidance system (ACAS) technology, nor were they required to be by regulation. Such a system provides information to increase a pilot's awareness of nearby aircraft and therefore reduces the risk of a mid-air collision.

Recent advancement of ACAS technologies has made them viable for general aviation aircraft and they should be considered. The ATSB report (AO-2016-015) into a near collision involving a Saab 340 aircraft and a glider in 2016 outlined a proposal by the industry body, Australian

Strategic Air Traffic Management Group, to the Civil Aviation Safety Authority (CASA). It recommended the adoption of standards for ADS-B technology to be fitted in general aviation aircraft to enable awareness of other aircraft traffic and thereby reduce the risk of mid-air collisions.

Following industry consultation, CASA is proposing to relax the equipment and installation standards for ADS-B fitment in VFR aircraft. The aim is to make it cheaper and easier for aircraft operating under VFR to purchase and use the technology.

General details

Occurrence details

Date and time:	6 December 2017 – 0818 CST	
Occurrence category:	Serious incident	
Primary occurrence type:	Near collision	
Location:	46 km SW of Darwin Airport, Northern Territory	
	Latitude: 12° 41.70' S	Longitude: 130° 33.62' E

Aircraft details: VH-SYT

Manufacturer and model:	Cessna Aircraft Company 210L	
Registration:	VH-SYT	
Operator:	Chartair	
Serial number:	21061052	
Type of operation:	Charter – Passenger	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – Nil	Passengers – Nil
Aircraft damage:	None	

Aircraft details: VH-HPA

Manufacturer and model:	Cessna Aircraft Company U206G	
Registration:	VH-HPA	
Operator:	Hardy Aviation	
Serial number:	U20605002	
Type of operation:	Charter – Passenger	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – Nil	Passengers – Nil
Aircraft damage:	None	

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and 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 that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

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

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine 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.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.