Australian Government
Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory Agency. The Bureau 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
- fostering safety awareness, knowledge and action.

The ATSB does not investigate for the purpose of apportioning blame or to provide a means for determining liability.

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

When the ATSB issues a safety recommendation, the person, organisation or agency must provide a written response within 90 days. That response must indicate whether the person, organisation or agency accepts the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

© Commonwealth of Australia 2012

In the interests of enhancing the value of the information contained in this publication you may download, print, reproduce and distribute this material acknowledging the Australian Transport Safety Bureau as the source. However, copyright in the material obtained from other agencies, private individuals or organisations, belongs to those agencies, individuals or organisations. Where you want to use their material you will need to contact them directly.

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608
Australia

1800 020 616

+61 2 6257 4150 from overseas

www.atsb.gov.au

Publication Date: 26 April 2012

ISBN 978-1-74251-256-3

Released in accordance with section 25 of the Transport Safety Investigation Act 2003

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2011-043
Final

Controlled flight into terrain, VH-LKI Moree Airport, New South Wales 30 March 2011

Abstract

On 30 March 2011, a Piper Saratoga PA-32R-301T aircraft, registered VH-LKI, with a pilot and five passengers on board was returning to Moree Airport from Brewarrina Airport, New South Wales under the night Visual Flight Rules (NVFR).

The aircraft flew overhead the airport at about 2000 Eastern Daylight-saving Time before the pilot conducted a left circuit for landing on runway 19. Witnesses observed the aircraft on a low approach path as it flew toward the runway during the final approach leg of the circuit. The aircraft contacted trees and collided with level terrain about 550 m short of the runway 19 threshold.

The pilot and three passengers were fatally injured. Two other passengers, who were seated toward the rear of the aircraft, were seriously injured. The aircraft was seriously damaged by the impact forces.

The investigation did not identify any organisational or systemic issues that might adversely affect the future safety of aviation operations. However, the pilot did not satisfy the recency requirements of his NVFR rating and the aircraft's take-off weight was in excess of the maximum allowable for the aircraft. In addition, the aircraft's centre of gravity was probably outside that specified in the aircraft flight manual, with the potential to significantly diminish the aircraft's in-flight performance and pitch stability.

This investigation highlights the importance of ensuring that all operational requirements are satisfied prior to exercising the privileges of any ratings or licences. In addition, the investigation reinforces the importance of pilots operating their aircraft within the published flight manual limitations.

FACTUAL INFORMATION

History of the flight

At about 0830 Eastern Daylight-saving Time[1] on 30 March 2011, the pilot of a Piper Saratoga PA-32R-301T aircraft, registered VH-LKI (LKI), with five passengers departed Moree Airport for Brewarrina Airport, New South Wales.

Recorded data from the aircraft's global positioning system (GPS)[2] unit indicated that the aircraft arrived at Brewarrina at about 0950 that day. It was reported that after arriving at Brewarrina, the pilot and passengers were driven around the local area to inspect cattle and a nearby property. Those activities concluded late that afternoon and the aircraft departed Brewarrina Airport at about 1815.

During the return flight to Moree, the pilot flew the aircraft over a number of landmarks to allow the passengers to inspect the associated properties. After completing the property inspections, the pilot continued to Moree.

1 Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

2 GPS is a space-based global navigation satellite system (GNSS) that generally provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.

A witness observed the aircraft flying overhead Moree Airport at about 2000 hours. The pilot indicated by radio that he intended to join the circuit on crosswind for a landing on runway 19. No further transmissions were recorded from the pilot.

A number of witnesses who were located along the aircraft's final approach path observed the aircraft flying lower than what they considered was the normal approach profile. The aircraft was seen to strike two trees within the boundary of a caravan park to the north of the airport. A short time later, it collided with terrain in an inverted, nose-down attitude about 30 m beyond the park boundary.

The aircraft was seriously damaged by the impact forces. The pilot and three passengers were fatally injured. Two other passengers, who were seated toward the rear of the aircraft, were seriously injured.

Personnel information

The pilot was issued a Private Pilot (Aeroplane) Licence (PPL(A)) in 1968 and held the appropriate licences and ratings for the flight. The pilot had a total aeronautical experience of about 1,010 flying hours.

The pilot obtained a Single Engine night Visual Flight Rules (NVFR) aeroplane rating in 1983 and was qualified to use NDB[3] and VOR[4] ground-based radio navigational aids for VFR navigation at night. Since attaining his night VFR rating, the pilot accrued a total of about 67 night flying hours, of which 47 hours were as pilot in command. Of those, 2.2 hours were conducted at night in LKI. One night flight of at least 1 hour's duration was flown by the pilot in the year prior to the accident.

The pilot completed an aeroplane flight review on 10 November 2010. That review, which was the last entry in the pilot's logbook, was conducted during daylight hours.

Although not reflected in the pilot's logbook, additional flights were undertaken by the pilot after the flight review. However, the recorded radio transmissions and witness reports indicated that it was unlikely that any of that flying was conducted after last light[5].

The recent experience requirements that applied to the flight included that:[6]

> -the pilot has, within the period of 90 days immediately before the day of the proposed flight, carried out at least 3 take-offs and 3 landings at night while flying an aeroplane as pilot in command
>
> -within the period of 1 year immediately before the day of the proposed flight has undertaken at least 1 flight of at least 1 hour duration while flying an aircraft at night as pilot in command, as pilot acting in command under supervision or in dual flying
>
> -in the case of an aeroplane grade of night V.F.R. rating — within the period of 6 months immediately before the day of the proposed flight, he or she has:
>
> (i) carried out at least 1 take-off and 1 landing at night while flying an aeroplane as pilot in command, as pilot acting in command under supervision, or in dual flying; or
>
> (ii) satisfactorily completed an aeroplane flight review or an aeroplane proficiency check that was conducted at least in part at night; or
>
> (iii) passed a flight test that was conducted at night for the purpose of the issue, or renewal, of an aeroplane pilot rating

The pilot held a current Class 2 medical certificate with restrictions that reading correction was available and that distance correction must be worn whilst using the privileges of the licence. The pilot was photographed wearing glasses after takeoff from Brewarrina, indicating that at the

3 A non-directional (radio) beacon (NDB) is a radio transmitter at a known location, used as a navigational aid. The signal transmitted does not include inherent directional information.

4 Very high frequency omnidirectional radio range (VOR). A ground-based navigation aid that emits a signal that can be received by appropriately-equipped aircraft and represented as the aircraft's bearing (called a 'radial') to or from that aid.

5 Last light is when the centre of the sun is at an angle of 6° below the horizon following sunset. At this time the horizon is clearly defined and the brightest stars are visible under clear atmospheric conditions. Last light can also be referred to as the end of evening civil twilight.

6 Civil Aviation Regulations (CAR) 1988 Division 5 Part 5.82 and Civil Aviation Orders (CAO) 40.2.2 Appendix 1 Subsection 5.

time of the accident, the pilot was probably wearing glasses for vision correction.

Aircraft information

General

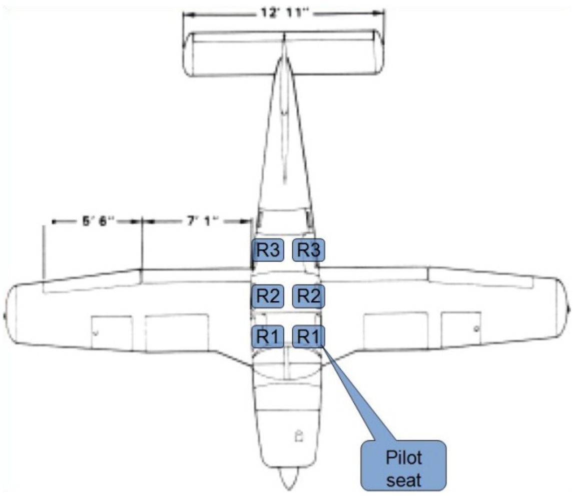
The aircraft, serial number 32R-8329020, was a single piston-engine, propeller-driven, low-wing aircraft with seating for a pilot and five passengers.

The aircraft, was manufactured in the United States in 1983. According to maintenance records, the aircraft had accumulated about 1,777 hours total time in service (TTIS) and was certified for private operations in accordance with the NVFR.

Weight and balance

The aircrafts rear four seats were configured in a 'club seating' arrangement, whereby the two second row seats (R2) were facing rearward and the two third row seats (R3) were facing forward (Figure 1).

Figure 1: Aircraft seating



The flight was initially planned to carry the pilot and two passengers. On the day prior to the accident, a passenger asked the pilot for permission to carry three more passengers on the flight. The pilot accepted the addition of the passengers and a small amount of baggage.

The pilot's family reported that flight planning calculations and mapping would normally be conducted as part of the pilot's pre-flight preparation.

Based on the known passenger weights and reports that the aircraft wing tanks were both full with fuel, the aircraft was estimated to be about 250 kg above the its maximum take-off weight (MTOW) when departing Moree. It was determined that, based on the day's flying activities and estimated fuel usage, the aircraft was still about 90 kg above the MTOW when the accident occurred. The centre of gravity (c.g.)[7] of the aircraft during both flight sectors would have been close to or beyond the aircraft's rearmost c.g. limit.

The effects of an aft c.g. on aircraft handling are well documented in many pilot training manuals. That includes the possibility for an out-of-limits aft c.g. to lead to aircraft pitch stability issues, in that the aircraft may become difficult to control.

Airworthiness and maintenance

The aircraft's maintenance records showed that it was maintained in accordance with the PA-32R-301T Piper maintenance schedule for the airframe and engine, and in accordance with Civil Aviation Safety Authority (CASA) Schedule 5 for instrument, electrical and radio inspections. The aircraft had a current Certificate of Registration and Certificate of Airworthiness. The current maintenance release showed that the last recorded daily inspection was on 30 March 2011.

In July 2009, an overhauled Textron Lycoming TIO540-S1AD engine and a new propeller were fitted to the aircraft. At the time of the accident, that engine/propeller installation had accumulated about 113 hours TTIS.

A 100-hourly periodic inspection was carried out in July 2010.

Fuel

The aircraft had two wing fuel tanks that had a total capacity of 405 L. The capacity of each wing tank was 192 L of useable fuel.

A surviving passenger recalled that on the morning of the accident, the pilot stated that he had fully fuelled each of the aircraft's wing fuel tanks. Information from the pilot's refuelling cards indicated that 219 L of fuel was purchased by the

7 The point through which the resultant force of gravity acts.

pilot using the refuelling card from the pilot's second, disused aeroplane.[8]

The investigation determined that the volume of fuel onboard the aircraft prior to departing Moree was sufficient to successfully complete the planned flights that day.

Figure 2: Approach into Moree Airport

On board navigation equipment

The aircraft was fitted with two Garmin 128 marine-type GPS units that provided aircraft tracking and groundspeed information. Flight data, including the day's flying, was retrieved from the GPS units' non-volatile memory.

The approximate flight times for the Moree to Brewarrina and Brewarrina to Moree sectors was 1 hr 23 min and 1 hr 43 min respectively. The last recorded data was of a position about 1 NM (2 km) short of the accident site. The absence of recorded tracking data in the last minutes of flight was consistent with previously-recorded approaches, including to Brewarrina Airport that day. Ground testing of the GPS unit could only replicate this phenomenon if the power supply to the GPS unit was turned off prior to reaching the destination.

The recorded GPS data showed that the pilot flew a normal left circuit pattern for runway 19 at Moree Airport (Figure 2). After turning toward the runway on the final leg of the approach, the aircraft converged toward the extended runway centreline from the left.

8 The pilot's logbook indicated that he had not flown that aircraft since the purchase of LKI.

The aircraft was also fitted with an altimeter and automatic direction finder (ADF)[9] that would have further assisted the pilot to confirm the aircraft's altitude and bearing to the airport during the approach. On examination, the aircraft's altimeter subscale was identified as being correctly set to a QNH[10] of 1017 hPa. That was consistent with the recorded meteorological information (see the section titled *Meteorological information)*.

Meteorological information

The Bureau of Meteorology recorded routine aerodrome reports (METAR)[11] for Moree Airport that included weather observations at about the time of the accident. That METAR indicated that the wind was from 170°T at 6 kts. At least 10 km of visibility was reported and the cloud was recorded as broken at 8,500ft above ground level (AGL). The QNH was 1017 hPa and there was no recorded rainfall.

On the day of the accident, the sun set at 1901 and the end of civil twilight[5,12] was at 1925. The moon was in the last quarter of its phase and its azimuth[13] at that time of the accident was 222°T with a vertical angle of about 40° below the horizon. This meant that the approach was conducted in darkness with no moonlight.

Communications

The aircraft was equipped with headsets for each occupant, which included the capability for two way communications between the passengers and pilot during flight. The surviving passengers reported that they could hear the aircraft's radios and that they spoke with the pilot at various times during the flight.

9 Airborne radio navigation aid that, when tuned to a ground-based non-directional (radio) beacon, could be used by qualified pilots to derive the aircraft's bearing from that beacon.

10 Altimeter barometric pressure subscale setting to provide altimeter indication of height above mean sea level in that area.

11 Routine aerodrome weather report issued at fixed times, hourly or half-hourly.

12 Determined from the Geoscience Australia web site www.ga.gov.au

13 The clockwise horizontal component of the sun's or moon's position from true north, measured in degrees.

The aircraft had two very high frequency (VHF) radio transceivers, each of which displayed two frequencies that were able to be independently tuned and selected. The selected frequency was known as the 'active' frequency and the other as the 'standby' frequency (displayed and tuned but having no effect unless selected as the active frequency).

Examination of the transceivers revealed that the active frequencies as preset by the pilot were the Moree common traffic advisory frequency (CTAF) of 126.7 MHz and pilot-activated lighting (PAL) frequency 119.6 MHz. Those frequencies were appropriate for the conduct of a night VFR approach into Moree Airport.

Airport information

Moree Airport is located about 4 km to the south-east of Moree Township and is at an elevation of 701 ft (213 m). The main runway, runway 01/19[14] was 1,613 m long with a sealed surface. The runway 19 lighting was part of the Moree PAL system and was suitable for night operations. The eastern airport perimeter was bordered by a well lit highway that crossed the final approach path for runway 19.

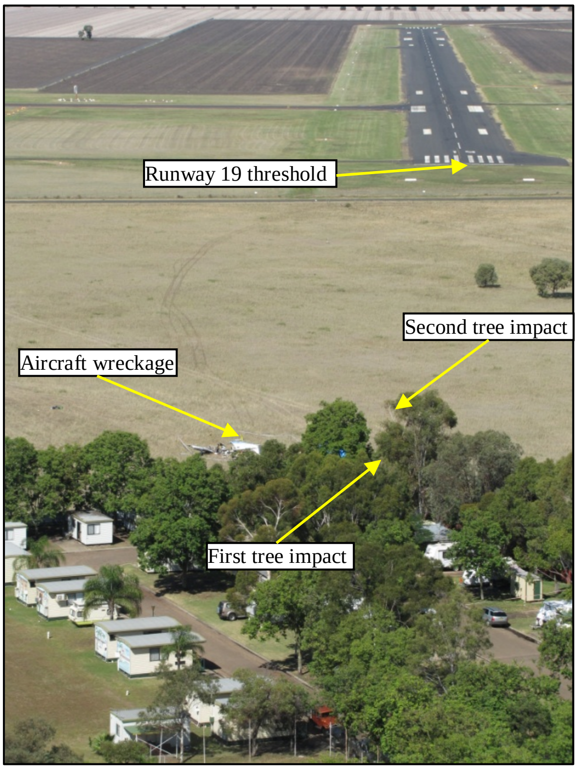
It was reported by the surviving passengers that the Moree Airport runway lighting was visible during the final approach that night.

Published instrument non-precision approaches were available for runways 01/19 at Moree Airport. Part of the certification for these approaches was to ensure that obstacles along the approach glidepath were identified and that unknown obstacles did not penetrate the protected areas for those approaches. The latest technical report for Moree Airport that was conducted prior to the accident confirmed that the two trees that were impacted by the aircraft did not infringe the approach glideslope protected area of 1.9°.

An aircraft with a 3° runway approach profile that was overhead the position of the first tree impact would have been about 33 m above ground level (AGL). The aircraft impacted the first tree at about 14 m AGL.

14 Runways are named by a number representing the magnetic heading of the runway.

Figure 3: Final approach path to runway 19



Wreckage examination

The aircraft impacted the first of two trees within the caravan park perimeter about 16 m to the left of the extended runway centreline before rolling left and impacting the ground in an inverted, steep nose-down attitude. The aircraft came to rest in a level, grassed paddock about 550 m from the threshold of runway 19. On-site examination of the wreckage found no pre-impact anomalies with the aircraft's flight control systems. That was consistent with their ability to operate normally at that time.

There was impact damage to the right wing with evidence of fuel leakage from the compromised right wing fuel tank. The left wing also sustained impact damage; however, the left wing fuel tank remained intact and contained a quantity of fuel that was sufficient to complete the flight.

An examination of the engine, associated engine components, propeller and aircraft instruments was conducted at an off-site facility. No abnormalities were identified in those items and components that would have prevented the aircraft from continued normal flight.

An examination of the propeller determined that it was rotating under engine power at the time of impact with the terrain. The amount of power could not be determined.

Medical and Pathological information

There was no evidence from the pilot's post-mortem and toxicology reports that the pilot's physiological condition might have contributed to the accident.

All four passengers who were seated toward the rear of the aircraft sustained significant injuries to the pelvic and abdominal areas.

Survival aspects

The survivable space encompassing the two front seats was significantly compromised. This was consistent with minimal chance of survival for the occupants of those seats. The two front seats had lap belt/shoulder harness-type restraints; however, it could not be confirmed if the shoulder harnesses were in use when the accident occurred.

The survivable space encompassing the rear two rows of seats appeared to have been mostly maintained. It was reported that the four passengers in those seat rows were wearing lap-type seat belts at the time of the accident.

Two passengers, who were seated in the second and third rows, survived the accident.

An examination of the on-site evidence and recorded data established the aircraft's approximate final trajectory and forward speed at ground impact. That information was compared with published survivability charts[15] to derive that the accident was not normally survivable and that as a minimum, serious injures would likely be sustained by the occupants as a result of the impact forces.

Lap belt only passenger restraints provide a lesser degree of support than would a combined lap belt/shoulder harness-type restraint, and a

15 National Transportation Safety Board, General Aviation Crashworthiness Project Phase Two – Impact Severity and Potential Injury Prevention in General Aviation Accidents, Safety Report NTSB/SR-85/01. Washington D.C.: NTSB, 1985.

number of previous safety reports[15,16] have highlighted the likely benefits of shoulder harnesses in improving passenger survivability. In one case, it was concluded that there could potentially be a 20% percent reduction in fatalities and an 88% reduction in serious injuries if shoulder harnesses were, when fitted, worn by passengers.

The extent to which the availability of more advanced seat belt restraints might have increased the survivability of the accident, particularly for the occupants in the rear of the aircraft, could not be determined.

Additional information

On-site hazards to emergency response personnel

In response to emergency calls, fire and rescue services attended the accident site to remove the surviving passengers from the aircraft wreckage. That necessitated emergency services personnel cutting through the floor surface of the inverted fuselage (Figure 4). It was reported that there was a smell of fuel in the vicinity of the aircraft and that it was difficult to see the wreckage because of the dark night and lack of lighting at that time. The roof section of the fuselage did not require cutting during the removal of the occupants as the aircraft was inverted. The aircraft's roof section contained the oxygen feed line to the cockpit from the pilot's oxygen bottle that was located in the rear of the aircraft. It is not uncommon for light aircraft to include an oxygen supply for use during higher altitude operations.

Guidance material for first response personnel[17] highlighted a number of dangers associated with approaching crashed aircraft and gave procedural information should that need arise. In that respect, caution should be given, but not limited to hazards associated with aircraft oxygen systems, any remaining fuel and the possibility of charged pressure vessels.

16 Available for download at http://www.atsb.gov.au/media/24441/aair200201846_001.pdf

17 Available for download at http://www.atsb.gov.au/publications/2010/civil-military.aspx

The oxygen bottle regulator that was fitted to the aircraft was in the ON position and indicated 1,100 psi of oxygen remaining.

Figure 4: Survivable space and pilot oxygen supply location

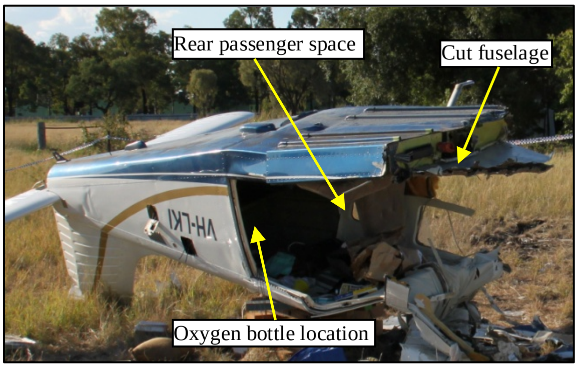


Figure 5: Rear fuselage area showing the oxygen bottle installation

Human factors

The factors that can affect a pilot's performance during night flight have been well researched. They include limitations in visual perception affecting the accuracy of night visual approaches and the possible errors that can result. A pilot flying a night visual approach may misinterpret or misjudge the vertical or horizontal position of an object, such as a runway, in relation to their aircraft.

Runways with limited visual cues, such as a remote runway void of surrounding lighting, have the potential to contribute to spatial disorientation and influence a pilot's ability to judge the aircraft's approach profile. These runways can lead to what is known as the 'black hole' illusion.[18] There are strategies and procedures used by pilots to minimise the risk posed by this illusion; however, research shows that these strategies may not be enough to overcome the compelling desire of the affected pilot to rely on their direct (yet incorrect) visual and vestibular senses. The black hole illusion is less likely if long straight-in approaches greater than 3 NM (6 km) are avoided.[19]

Other illusions are possible during night visual approaches where environmental conditions can limit the available visual cues. Factors such as a sloping or a narrower than normal runway may lead a pilot to fly a lower than desired glidepath in an attempt to make the runway 'fit' with the expected view of a normal width, level runway. During a day visual approach, pilots maintain a constant position of the runway in the windscreen and then use peripheral vision to judge height during the flare to land manoeuvre. At night, these visual cues will not be as strong, and if the runway dimensions are not standard, or the runway slopes in either direction, it may be more likely for the pilot to experience a visual illusion. It has been shown that pilots can often make low approaches 'under impoverished conditions such as those at night' and a study of landing approaches in a simulator demonstrated that as visual cues decrease, the accuracy of approach to landing performance becomes more variable.[20]

Proficient use of the aircraft's flight instruments is known to reduce the risk of errors precipitated by the effects of night visual illusions.[21] The use of instruments such as the altimeter, artificial horizon, and vertical speed indicator would allow a pilot to confirm that the aircraft is positioned appropriately for that phase of flight and therefore reduce the potential for a visual illusion.

Research suggests that pilots with low night VFR experience should seriously consider the option of rescheduling a flight if it would otherwise involve night VFR operations. If night VFR operations are conducted, then pilots need to consider the amount of celestial light that will be available, including information about the phase of the moon, and whether high level cloud will reduce the amount of light and increase the challenges of night operations.[22] In addition, it is recognised that as the time between recent practice and performance of a task increases, the performance can become more variable. That is, if recency in night VFR operations is not maintained, it is likely a pilot's performance would degrade from the required standard over time.

ANALYSIS

Flying safely at night requires pilots to rely on well developed skills that address the inherent issues that night flight poses. Altered visual cues, impaired perception, and illusions are some of the issues pilots must consider and address to successfully complete a cross-country night flight under the visual flight rules (VFR). Night recency requirements as determined by the Civil Aviation Safety Authority are a minimum standard that assist pilots to identify and address those issues. As such, pilots should ensure that they have a sufficient level of experience that at least meets these minimums to facilitate safe visual night flight operations.

This analysis will explore some of the factors that existed on the night of the accident and any effect they may have had on the flight.

Night perception and approach

Black hole illusions are typical at runways that lack visual lighting on approach to the runway. The illusion is created because there is a 'black hole' before the runway, which makes it hard for

18 The term 'black hole' is generally used to describe aerodromes isolated from sources of significant ground lighting. On a dark night, those aerodromes necessitate an approach to the runway over dark and generally unlit terrain and can contribute to the pilot experiencing various visual and other sensory illusions.

19 Flight Safety Foundation (1999). Darkness Increases the Risks of Flight. Human Factors and Aviation Medicine, 46(6).

20 Lintern, G. & Walker, M.B. (1992). Scene Content and Runway Breadth Effects on Simulated Landing Approaches. *The International Journal of Aviation Psychology*, 1(2), 117-132.

21 Flight Safety Australia (2006). *Night Fright*. Civil Aviation Safety Authority, March-April 2006, Canberra Australia.

22 Available for download at http://www.atsb.gov.au/media/29971/b20070063.pdf

pilots to judge their height above the ground. The approach to runway 19 at Moree is over a well lit part of the city, including the short final approach, which is over a caravan park and highway. In that case, it is unlikely the pilot experienced a black hole illusion during the approach.

Pilots rely on various visual cues to identify an aircraft's altitude and position relative to the runway during the approach and landing. Cues such as runway lights, available ground lighting, approach guidance lights, and aircraft instruments, combined with previous pilot experience are information sources that can assist a pilot in determining those parameters. In addition to the previously-mentioned lighting for this approach, the runway lighting, and other significant ground features such as the well illuminated highway were available as visual cues. These, in combination with the aircraft's altimeter and other flight instruments should, if correctly perceived, have provided a means to ensure that the aircraft was on the correct final approach glide path.

The pilot's total night flying hours were acquired over an 18-year period. This, in addition to the pilot's lack of night recency and time since the last night flying review, limited the opportunity for the pilot to maintain proficiency and increased the risk of the misperception of the available visual cues. A lack of recency would have resulted in his performance becoming more variable over time.

It is likely the pilot misinterpreted the available visual cues, or that his lack of familiarity with the presentation of these cues at night affected his ability to accurately assess them. As was shown in the research paper on night landing approaches, if visual cues are removed, pilots' performance during landing will often degrade. It is therefore probable that the decreased cues available to the pilot altered his perception of the approach, which was likely compounded by the pilot's limited recent night flying experience. The reduced cues and pilot's low night flying recency probably contributed to the pilot flying the aircraft too low on the approach to the runway. As the pilot did not detect that the aircraft was too low, no apparent corrective action was taken to address this issue.

Conduct of the flight

The pilot's limited recent night flying experience, and the decision to depart from Brewarrina at a time that would mean the arrival at Moree would be in darkness, increased the risk that the flight would not be completed safely. An arrival in daylight would have eliminated that risk.

The aircraft was loaded outside its design limits in weight, and probably the centre of gravity. In that case, the aircraft's handling characteristics, including the required power and aircraft configuration to achieve a desired aircraft profile, would have differed from the pilot's experience on previous flights that may have been flown within the aircraft's limits. This potentially would have required the pilot to be more focussed on flying the aircraft than normal, diverting attention away from maintaining the aircraft's flight profile.

It was not possible to determine if the pilot considered the weight and balance limitations in the aircraft flight manual before accepting the additional passengers. The aircraft's weight and balance charts clearly showed that with the five passengers and full fuel, the aircraft was outside the aircraft limits. The pilot had the option of limiting the number of passengers or reducing the fuel load to ensure that the aircraft was within its design limits.

When analysed, the data log from the aircraft's global positioning system (GPS) units showed that on a number of other flights, the last track point was recorded short of the final destination. It is unlikely, given the continuous operation and recording of the device during the day, that the GPS lost power during this phase of flight. It was therefore possible that, for a short time during the final approach segment, the pilot's attention was diverted to the task of selecting the GPS unit OFF. The investigation could not establish the extent to which that selection, if made, might have affected the pilot's ability to maintain a safe profile during the final approach segment for runway 19.

Conclusion

The investigation did not identify any organisational or systemic issues that might adversely affect the future safety of aviation operations. However, this accident highlights the importance of pilots ensuring that all operational requirements, including maintaining their aircraft within its design limits, are satisfied prior to flight.

FINDINGS

From the evidence available, the following findings are made with respect to the controlled flight into terrain that occurred near Moree Airport, New South Wales on 30 March 2011 involving Piper Saratoga PA-32R-301T, registered VH-LKI. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- Misinterpretation of the available visual cues for maintaining glidepath probably affected the pilot's ability to assess and correct the aircraft's low final approach altitude.
- The pilot continued the approach for Runway 19 despite being below the normal approach profile.
- The reduced number of visual cues, combined with the pilot's lack of night flying recency and low night flying experience, likely degraded the pilot's performance and resulted in increased safety risk to the flight.

Other safety factors

- A take-off weight in excess of the maximum allowable for the aircraft, and an aft centre of gravity outside that specified in the aircraft's flight manual had the potential to significantly diminish the aircraft's in-flight performance and pitch stability.

Other key findings

- The accident was not normally survivable.

SOURCES AND SUBMISSIONS

Sources of Information

The main sources of information during the investigation included the:

- Moree Avdata aerodrome recordings
- Bureau of Meteorology (BoM)
- Civil Aviation Safety Authority (CASA)
- surviving passengers and other witnesses.

References

Australian Transport Safety Bureau. (2007). *An overview of spatial disorientation as a factor in aviation accidents and incidents.* (Aviation research and analysis report B2007/0063). Canberra, ACT: Australian Transport Safety Bureau.

Australian Transport Safety Bureau (2002). *Piper PA-28-161, VH-IBK Socata TB-9, VH-JTV Bankstown Airport, NSW.* (Aviation safety investigation report 200201846). Canberra, ACT: Australian Transport Safety Bureau.

Flight Safety Australia (2006). *Night Fright*. Civil Aviation Safety Authority, March-April 2006, Canberra Australia.

Flight Safety Foundation (1999). Darkness Increases the Risks of Flight. *Human Factors and Aviation Medicine,* 46(6).

Lintern, G. & Walker, M.B. (1991). Scene Content and Runway Breadth Effects on Simulated Landing Approaches. *International Journal of Aviation Psychology,* 1(2), 117-132.

National Transportation Safety Board (1985). *General Aviation Crashworthiness Project Phase Two – Impact Severity and Potential Injury Prevention in General Aviation Accidents, Safety Report NTSB/SR-85/01.* Washington D.C.: NTSB.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act 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 maintenance organisation for the aircraft, the primary surviving aircraft occupant and CASA.

No submissions were received from those parties.