Australian Government
Australian Transport Safety Bureau

Wirestrike involving Cessna 172 VH-TKI

13 km NE of Bendigo, Victoria | 29 October 2012

Investigation

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Aviation Occurrence Investigation
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Safety summary

What happened

On 29 October 2012, a Cessna 172N, registered VH-TKI (TKI), was being operated on a visual flight rules (VFR) flight from Coldstream to a private aircraft landing area (ALA) at Bagshot, Victoria, with a pilot and two passengers on board.

A witness at the airfield stated that as TKI approached short final on the approach, the aircraft contacted a powerline located at the southern end of the airfield. The powerline significantly reduced the aircraft's forward speed, causing it to rotate about its nose and impact the airstrip in an almost inverted attitude. A post-impact, fuel-fed fire initiated at the wing roots almost immediately and witnesses assisted the aircraft occupants from the aircraft. However, the front-seat passenger was fatally injured, the pilot was seriously injured and the rear seat passenger sustained minor injuries.

What the ATSB found

Examination of the aircraft showed that its nose landing gear contacted the powerline. The powerline was located 8 m above ground level and about 140 m south of the displaced threshold of the landing strip.

The ATSB found that the pilot was aware of the powerline, but that his recollection was that they were closer to the tree line in the undershoot to the landing strip. In addition, a lack of adequate displaced threshold markings and the mown undershoot area led him to believe that the entire strip was useable for landing. This combined with the inherent difficulty of visually detecting wires and the distraction of another recently-landed aircraft on the airstrip to reduce the likelihood of the pilot detecting the wire.

No high visibility devices were attached to the powerlines, nor were they required to be under the current Australian Standards.

What's been done as a result

In response to this accident, the owner of the ALA has made significant changes to the runway markings, landing permission procedures affecting operations at the ALA and the available safety and firefighting equipment. In addition, markers have been erected near the powerline.

Safety message

Aeroplane landing area owners can help manage the risk of collisions with obstacles by assessing their airstrips against the guidance in Civil Aviation Advisory Publication (CAAP) 92-1(1) *Guidelines for Aeroplane Landing Areas*. Such risk assessments should explicitly consider the needs of first time users of the ALA.

Operational risk can also be reduced by pilots ensuring sufficient time to make appropriate decisions including, if in doubt, an early decision to go around. Pilots should also ensure that everyone in their aircraft is wearing seatbelts correctly, affording the best chance of survival in case of an accident.

Contents

The occurrence

On 29 October 2012, a Cessna Aircraft Company 172N, registered VH-TKI (TKI), was on a visual flight rules (VFR) maintenance positioning flight from Coldstream to an aircraft landing area (ALA) at Bagshot, Victoria. On board the aircraft were the pilot in command (PIC) and two passengers, who were also private pilots.

TKI arrived overhead the ALA at approximately 1254 Eastern Daylight-saving Time.[1] The PIC and passengers reported observing a Tecnam Eaglet (Tecnam) aircraft conduct a right circuit and landing from the south at the ALA. The pilot of TKI then overflew the airstrip and also carried out a right circuit in preparation for a landing from the south. The rear-seat passenger of TKI described a shortened circuit to land in the northerly direction. Figure 1 shows the estimated circuits of the two aircraft based on the recollections of the occupants of the Tecnam, an observer at the ALA and the rear-seat passenger in TKI.

The PIC of TKI could not recall conducting a right-hand circuit.

Figure 1: Overview of airstrip and flight paths

Source: Google Earth (modified by the ATSB)

The PIC and rear-seat passenger stated that, during the circuit and final approach, the occupants of TKI were concentrating on the position of the Tecnam, which was back-tracking along the airstrip to the parking bay. The rear-seat passenger reported that on final approach, while observing the Tecnam on the airstrip, he asked the PIC whether he was going to land or go-around.[2] The rear-seat passenger also said that the front-seat passenger made a comment along the lines of 'make sure you land on the other side of the ditch', referring to a small bump associated with a culvert in the undershoot[3] area shortly before the airstrip threshold. Neither of

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

2 A go-around is a manoeuvre whereby the pilot of an aircraft on final approach discontinues the approach and repositions for another landing attempt.

3 The word 'undershoot' is used in this report to describe an area, associated with a displaced threshold, which was intended by the ALA owner to be used for take-off but was not meant for landing.

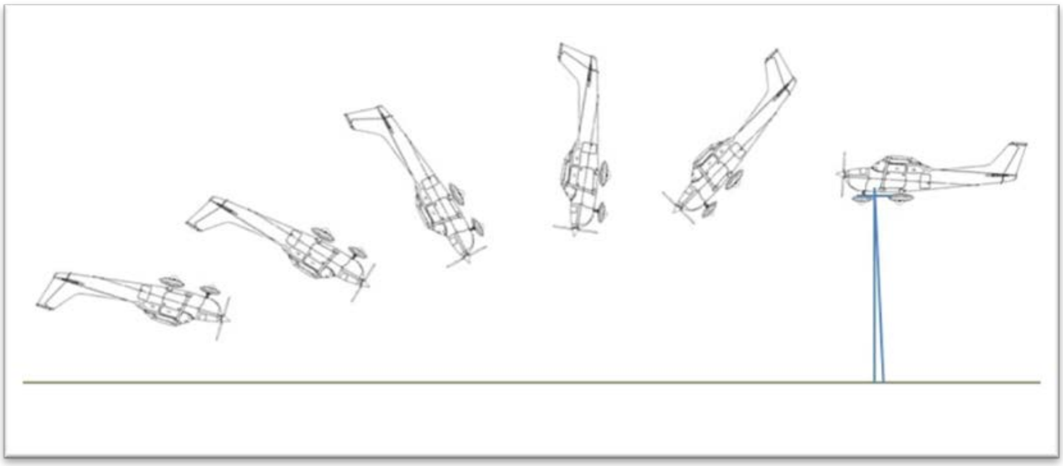
these communications was reported to have received a reply or other form of acknowledgement from the PIC.

The PIC recalled extending the flaps on short final and this was confirmed by the rear seat passenger, who saw the flaps moving towards the 30° position on short final. The PIC reported that, after he cleared the tree line located to the south of the airstrip, he adjusted the final glide path in order to 'dip down' and land short of the normal landing point. He indicated that this was to facilitate separation with the Tecnam, which was in the final stages of backtracking along the runway to the parking bay.

Soon after passing the tree line, the aircraft struck a powerline, which arrested the aircraft's forward speed. The aircraft rotated around the powerline and impacted the ground almost inverted.

The owner of the ALA was positioned close to the landing end of the strip and witnessed the accident. He described losing sight of TKI on final as it passed behind the trees along the side of the road. He stated that the engine note was 'normal' on final approach and that the aircraft reappeared from behind the trees before dropping slightly over the trees, contacting the powerline and rotating about the nose (Figure 2).

Figure 2: Depiction of the wirestrike sequence



The Tecnam pilots reported that they had just taxied into the parking bay (Figure 3), and shut their aircraft down when they heard a loud bang. The Tecnam pilots and the ALA owner arrived at the accident site within seconds and assisted the occupants to exit the aircraft.

By this time a fire had started around the area of the wing roots and in the forward cockpit. The right front-seat passenger was fatally injured, the PIC was seriously injured and the rear-seat passenger escaped with minor injuries. A post-impact, fuel-fed fire destroyed the aircraft.

Context

Personnel information

Pilot in command

The pilot in command (PIC) commenced flying training in 1985 and gained a restricted private pilot's licence in 1987. He attained an unrestricted private pilot's licence in 1991and held a valid Class 2 Medical Certificate. The PIC had attained 460.3 hours flying experience, of which 5 hours was within the previous month. Of the PIC's total flying time, 163.3 hours was in Cessna 172 aircraft.

Examination of the PIC's logbook identified that 2.6 hours of the 8.5 hours flown in the previous 90 days were logged as copilot.[4] This was reported to have included familiarisation in a Beech V35 Bonanza aircraft.

The PIC's activities in the preceding 72 hours were reported to be unremarkable. He stated that he was well rested prior to the flight with no outstanding medical or personal issues.

Passengers

The two passengers each held a private pilot licence with similar levels of experience to the PIC. The PIC reported that he was in control of the aircraft at the time of the accident and that the front-seat passenger did not manipulate the aircraft controls.

Aircraft information

The Cessna Aircraft Company 172N is a high-wing, four seater aircraft with a fixed tricycle undercarriage. It is powered by a four-cylinder, horizontally-opposed piston engine, driving a fixed pitch propeller. The aircraft, serial number 172-70881, was manufactured in the US in 1978 and had accumulated about 7,792 hours prior to the accident flight.

The aircraft was maintained in accordance with Civil Aviation Safety Authority (CASA) maintenance schedule (Civil Aviation Regulation (CAR) Schedule 5). The last periodic 100-hourly inspection was conducted on 1 November 2011 at 7,712.4 hours. The aircraft was being positioned at the maintenance facility for its next periodic inspection when the accident occurred. It was maintained to the day VFR standard, and had a current Certificate of Registration and Certificate of Airworthiness.

The pilot who flew the aircraft just before the accident flight reported that the aircraft was operating well with no known defects during that flight. The maintenance documentation was reviewed by the Australian Transport Safety Bureau (ATSB) with no anomalies identified that may have contributed to the accident.

Meteorological information

The ALA is located approximately 9 km north-east of Bendigo Airport, Victoria. The Bureau of Meteorology produced aerodrome forecasts (TAF)[5] and recorded weather observations for Bendigo Airport.

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4 The 2.6 hours of flight time logged as copilot was not valid flying experience. The flying was carried out in a single pilot aircraft and as such the pilot was not acting in the capacity of copilot.

5 Aerodrome Forecasts are a statement of meteorological conditions expected for a specific period of time, in the airspace within a radius of 5 NM (9 km) of the aerodrome.

The Bendigo TAF that was valid at the time that TKI arrived overhead the ALA forecast clear conditions, with a light north-westerly wind of less than 10 kt and visibility greater than 10 km. Witnesses at the ALA reported weather conditions, including wind strength, consistent with the Bendigo TAF. The Bendigo aerodrome observation for 1300 showed a north-westerly wind at 7 to 15 kt.

The position of the sun at the time of the wirestrike was determined via the Geoscience Australia website at www.ga.gov.au. That assessment found that the sun was in a relatively high position at the time, and the direction of the final approach meant that there was little potential for glare from the sun to affect the visibility of the powerlines. The PIC and the rear-seat passenger did not indicate that glare from the sun affected their forward vision on final approach.

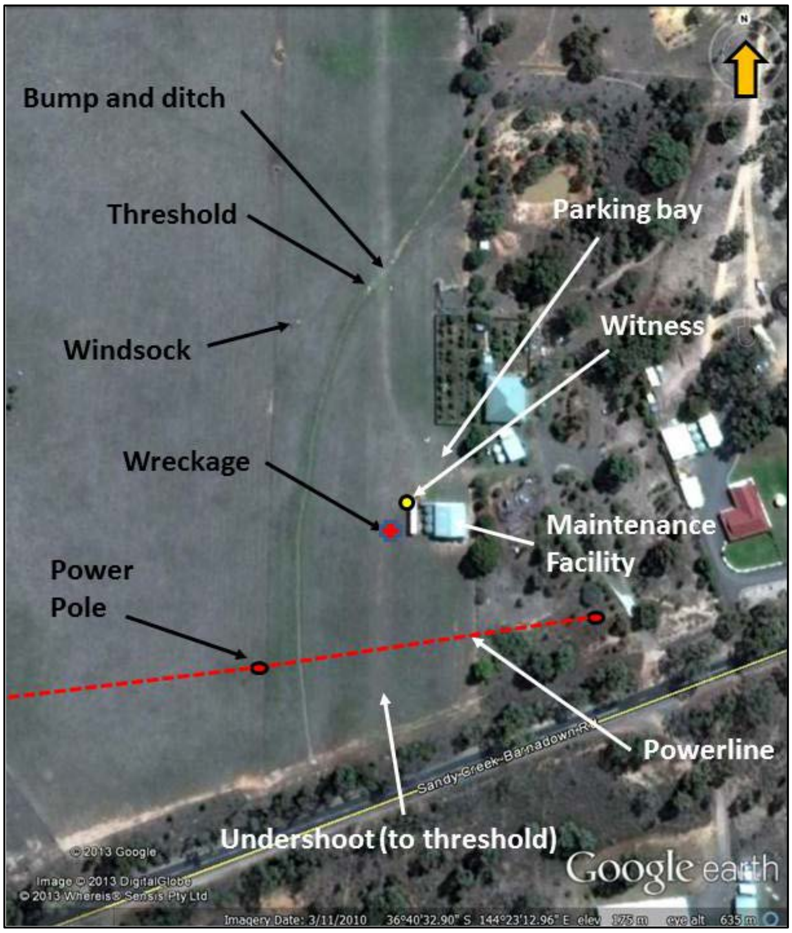
The weather conditions at the time were not considered to have affected the visibility of the powerlines or contributed to the accident.

Aircraft landing area information

The privately-owned, grass ALA was primarily used by aircraft undergoing maintenance at the property (Figure 3). The maintenance facility was operated by the ALA owner and was located at the southern end of the airstrip, adjacent to the parking bay.

The airstrip was oriented approximately north-south on a magnetic bearing of 355°, with a useable length from the permanently-displaced threshold to its northern end of about 900 m. Two threshold markers were located adjacent to the airstrip to indicate the threshold (Figures 3 and 4). These markers were the only markings on the airstrip, apart from one road verge-like post with a reflector that was abeam the threshold. The airstrip was otherwise defined by a 10 m wide mown area (Figure 4).

Figure 3: The ALA with witness location

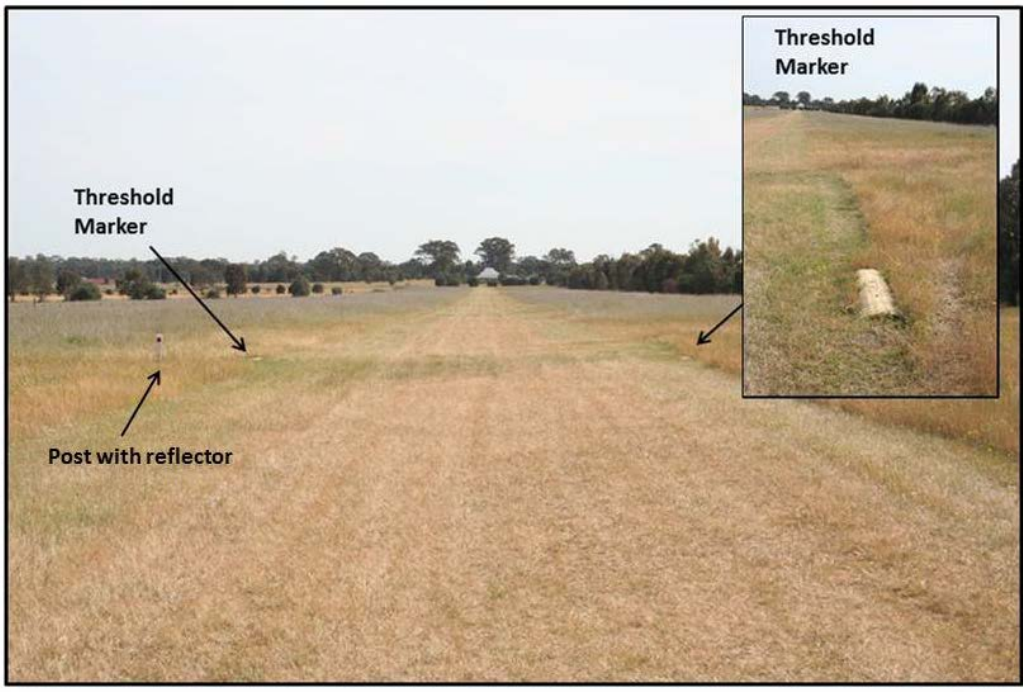


Source: Google Earth (modified by ATSB)

The owner of the ALA reported that the threshold was permanently displaced to the north due to the proximity of the maintenance facility, the position of the powerline and trees and the location of a culvert and associated bump in the surface of the airstrip. Although easily distinguished from directly above, the threshold markers were partially obscured by grass when viewed from the final approach perspective (Figure 4).

South of the threshold markers, the undershoot area was mown for a further 180 m back to the fence line, giving the undershoot the same appearance as the airstrip. This mown area provided extra take-off length to the north but was not intended to be used for landing from the south. A wind sock was located close to the threshold markers (Figure 3).

Figure 4: Threshold markings looking north



Source: ATSB

Operations into the ALA

ALA diagram and supporting documentation

The owner of the ALA supplied pilots with a hand drawn diagram of the ALA (Appendix A), depicting the location of hazards and operational procedures. The ALA diagram was not drawn to scale and showed the powerlines close and parallel to the road. A note on the diagram stated 'If landing from the south, touch down after [the] windsock to avoid trees, powerlines and [a] bump where pipes go under [the] runway'.

The ALA owner stated that he routinely provided advice to pilots who were about to use the ALA in regard to the location of the powerline and of the need to land at the threshold or beyond, and to avoid the trees and powerline when landing from the south. He stated that he provided this information to the front-seat passenger on the morning of the accident flight.

A 'hold harmless agreement' was also required to be read and signed by pilots wishing to land at the ALA. This document contained a detailed description of the airfield and hazards, procedures to be followed when using the ALA, and a statement relating to liability for damage and insurance. The ALA owner stated that the front-seat passenger had signed and returned a hold harmless agreement to the owner. He had no recollection of supplying the PIC with the hold harmless agreement and had no record of the PIC having returned a signed copy.

Both documents contained a mobile telephone number that was to be called by pilots prior to each arrival or departure. The PIC reported that he had previously seen a diagram of the airstrip but stated that he could not recall when he had seen it. He indicated that it looked different to the version supplied to the ATSB by the ALA owner.

Flight planning by the PIC

The PIC reported landing at the ALA on three previous occasions. He stated that he could not recall previously landing in the northerly direction. The PIC also indicated that he knew about the trees and powerlines at the southern end of the airstrip, although he stated that he thought the powerlines were further to the south, near the tree line. The PIC stated that he thought that if he cleared the tree line he would also clear the powerlines, and that he knew about the bump in the airstrip associated with the culvert.

In accordance with the required procedures, a telephone call was reported by the front-seat passenger to have been made to the ALA owner prior to departure from Coldstream. The ensuing discussion was reported to include the expected departure time from Coldstream, the estimated time of arrival at the ALA, the wind direction at the time and the need to land long due to trees and powerlines at the southern end of the airstrip.

The ALA owner believed that the front-seat passenger was the pilot who was going to fly the aircraft that day. The PIC stated that the front-seat passenger telephoned the owner of the ALA on his behalf, as he knew the owner of the ALA.

The PIC's recollection of the information passed to him by the front-seat passenger was that the trees at the southern end of the airstrip had recently been trimmed by the local council. In essence, the PIC was of the opinion that he had sufficient knowledge of the airstrip and associated hazards having landed there on three previous occasions.

The powerline

The powerline was a 22kV single-phase, overhead, high-voltage line. It consisted of two wire conductors of three-strand, galvanised steel.

The 125 m span crossed the airstrip undershoot area 47 m to the north of the tree line and 136 m south of the permanently displaced threshold, and was orientated from the south-west to the north-east at an angle of 75° to the airstrip centreline (Figure 3). The eastern power pole was situated amongst the garden and established trees associated with the dwellings. This pole was about 75 m east of the centreline of the airstrip. The western power pole was situated in an open paddock about 50 m west of the airstrip centreline.

The wire was calculated to be approximately 8 m above ground level at the point of contact. Wire marking indicators were not fitted to the powerlines. The requirements for marking powerlines are discussed in the section titled *Organisational and management information-wire marking standards*.

Wreckage and impact information

The aircraft wreckage

The aircraft came to rest inverted 27 m beyond the powerline, facing back along the flight path. The distance between the first ground impact mark and the wreckage was 12 m. All of the aircraft flight controls and extremities were accounted for on the accident site.

A post-impact, fuel-fed, fire consumed the entire fuselage (Figure 5). An inspection of the flight control systems found no pre-impact defects. Aileron and elevator trim settings could not be accurately assessed due to the distortion of the airframe. The flaps appeared to be extended just beyond the fully retracted position and measurement of the flap actuator thread section correlated with a flap position of about 2°. This may have indicated that the flap selector moved from the landing setting to the retracted position during the accident sequence before the loss of electrical power left the flaps in the 2° position.

Propeller rotational damage and ground strike marks indicated that the engine was operating at a low power setting at ground impact. This was consistent with a low power setting for landing.

Figure 5: Aircraft wreckage

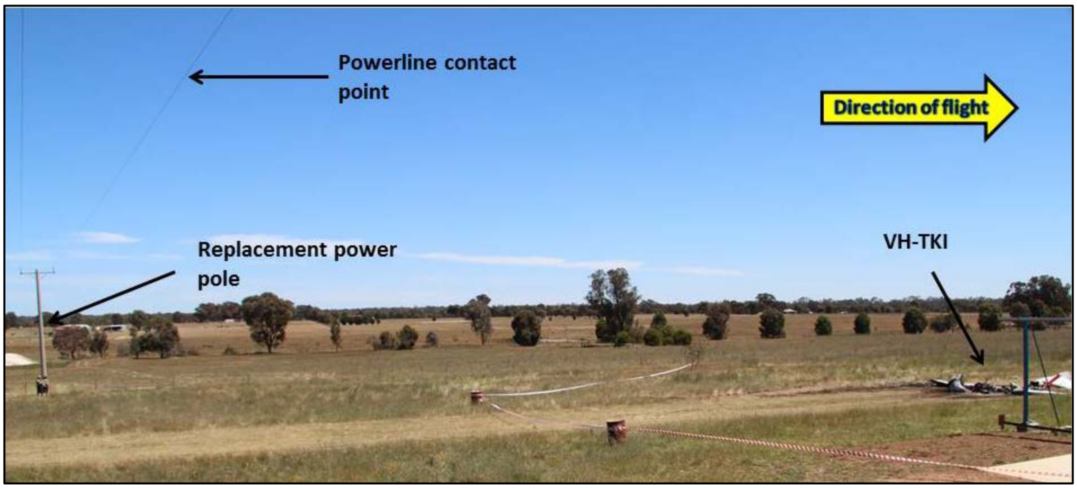
Source: ATSB

In summary, the inspection of the aircraft did not identify any pre-impact anomalies.

The wirestrike

Indentation marks on the powerline indicated that the aircraft struck the second wire of the two line, high-tension powerlines (Figure 6). The powerlines were strung about 8 m above ground level over the undershoot area, running at an angle of 75° to the airstrip centreline.

Figure 6: Powerlines and wreckage



Source: ATSB

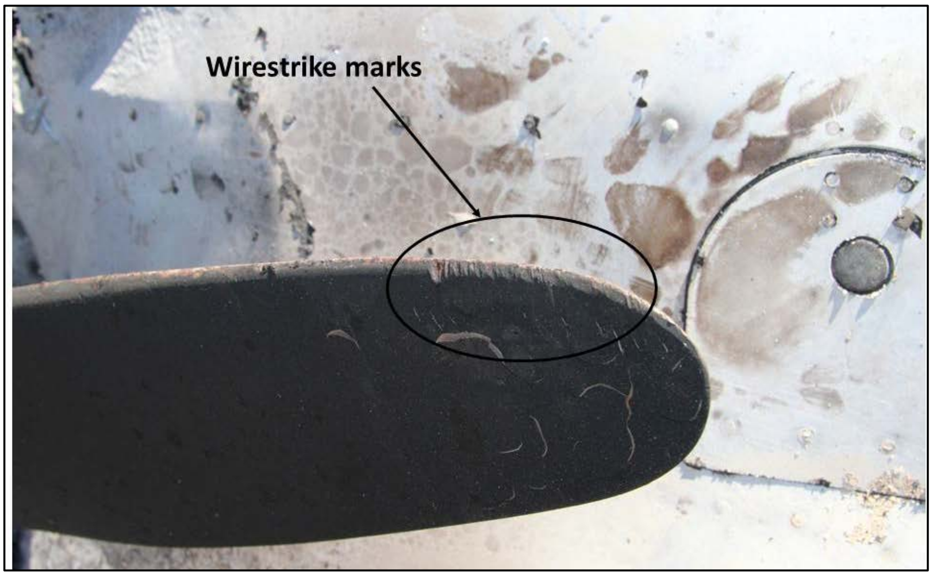
The powerline did not break when contacted by the aircraft; however, the power pole closest to the powerline contact point and east of the airstrip centreline fractured at its base (Figure 7). The fractured power pole was replaced before the ATSB arrived at the accident site to allow the restoration of electrical power to the local area. The replacement power pole was longer than the original and as a consequence, the powerline was reinstated approximately 1 m higher than the original position.

Figure 7: Broken power pole with the replacement pole in the background

Source: ATSB

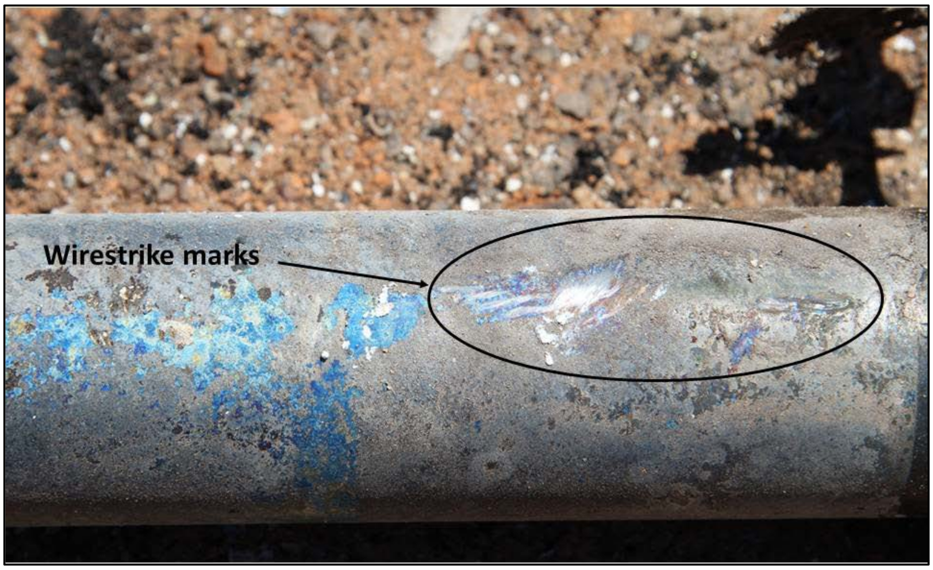
Wirestrike damage was evident in two locations on the aircraft wreckage. These were a wire indentation marking on one of the propeller blade tips (Figure 8), and scratch-type markings on the nose landing gear strut (Figure 9). The markings showed that the powerline made contact with the lower part of the aircraft.

Figure 8: Propeller blade tip with wirestrike damage



Source: ATSB

Figure 9: Nose gear strut with wirestrike damage



Source: ATSB

Survival aspects

In general, survival in the case of an aircraft accident is understood to depend on the:

- forces imparted on the aircraft occupants being within human tolerance
- occupants being restrained to prevent flail-type injuries
- liveable space inside the aircraft being maintained
- occupants having a means of escape.

The influence of each of these factors on the survivability of the accident is discussed in the following sections.

Impact forces

The distance between the initial terrain impact marks to the point where the aircraft came to rest was about 12 m. The initial impact point did not display a substantial amount of surface displacement. In combination these two factors indicated that the powerline significantly decreased the forward speed of the aircraft. This would have increased the chances of survival due to reduced ground impact deceleration forces being imparted on the aircraft's occupants.

Seatbelts

The condition of the aircraft's seatbelts could not be ascertained due to the extent of the post-impact fire. The two front seats were fitted with lap-sash type seatbelts, although the PIC reported that the front-seat passenger was only wearing the lap portion of the right-front seatbelt at the time. He stated that the passenger generally chose not to wear the sash portion of the belt because it made him feel uncomfortable. By not using the sash portion of the seatbelt, the passenger increased the risk of his upper body moving about (flail) and contacting the surrounding aircraft structure during an accident.

The United States (US) National Transportation Safety Board (NTSB) published research paper SR 85-01 titled *Impact Severity and Potential Injury Prevention in General Aviation Accidents.*[6] In terms of the potential benefits of shoulder harnesses, the research paper commented on the extent of any injuries in case of an accident as follows:

> There were five survivable accidents in which shoulder harnesses were worn by only one of two front-seat occupants. A comparison was made of the relative injuries of each occupant. It was found in each case that injury severity was less for the occupant who wore the shoulder harness.
>
> For example, in one accident each of two occupants sustained serious injuries, but the pilot, wearing a shoulder harness, sustained a broken leg and a slight concussion while the passenger without a shoulder harness sustained severe head injuries. The differences in the injuries in these comparisons were related to head and upper body injuries. Those persons who wore shoulder harnesses had markedly fewer head injuries.

The NTSB research also showed that if an aircraft occupant wore a shoulder harness, they increased their chances of survival by 20 per cent. Further, the chance of serious injury is decreased by 32 per cent.

Front-seat passenger and pilot in command

The front-seat passenger’s post-mortem examination showed that he sustained significant head and upper body trauma during the accident sequence. In contrast, the PIC’s injuries, although severe, did not involve head and upper body trauma. This was most likely due to the fact that the pilot was wearing the entire lap-sash seatbelt.

Rear-seat passenger

The rear-seat passenger reported that he was not wearing his seatbelt at the time of the accident. In contrast with the front-seat occupants, the rear-seat passenger did not have structural items, such as the instrument panel, or flight controls in his area of the cabin. In addition, his movement was confined by the front and rear seats. This might explain the ‘minor’ nature of the passenger’s injuries, despite his not wearing a seatbelt.

Liveable space

According to the surviving aircraft occupants, the liveable space was maintained within the cabin area. The extent of the damage from the post-impact fire prevented an examination of the cabin area.

Means of escape

The three people who first responded to the accident acted quickly to assist the two conscious aircraft occupants to exit the wreckage. Given the speed and intensity of the post-impact fire, it is unlikely that the PIC and rear-seat passenger would have survived without this assistance.

Emergency locator transmitter

There was no evidence that the aircraft was fitted with an emergency locator transmitter. However, the pilot reported that there was a portable 406 MHz personal locator beacon in the aircraft’s glove box. The glove box area was destroyed by the post-impact fire.

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6 Available at: http://libraryonline.erau.edu/online-full-text/ntsb/safety-reports/SR85-01.pdf

Organisational and management information

Use of aerodromes by pilots not engaged in regular public transport

Civil Aviation Regulation (CAR) 92 *Use of aerodromes* detailed the requirements affecting the use of aerodromes by pilots not engaged in regular public transport. CAR 92 stated that, with some exceptions that did not apply in this case:

> (1) A person must not land an aircraft on, or engage in conduct that causes an aircraft to take off from, a place that does not satisfy… [the requirement that]… the place… is suitable for use as an aerodrome for the purposes of the landing and taking-off of aircraft; and, having regard to all the circumstances of the proposed landing or take-off (including the prevailing weather conditions), the aircraft can land at, or take-off from, the place in safety.

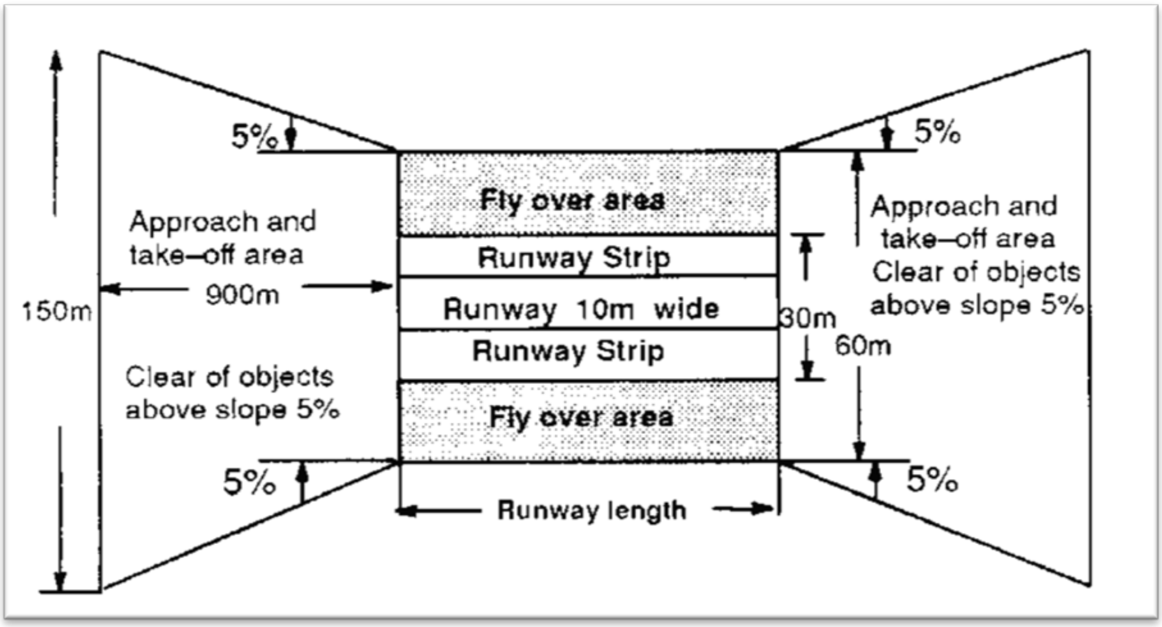
Responsibility for determining the suitability of an airstrip rested with a PIC.

Civil Aviation Advisory Publication (CAAP) 92-1(1) *Guidelines for aeroplane landing areas* provided guidance on how pilots might satisfy the requirements of CAR 92. This included outlining specific factors that should be taken into account to determine the suitability of an aircraft landing area (ALA), such as the recommended obstacle clearance standards and suggested landing area markings.

Obstacle clearance standards

Section 5 of the CAAP recommended minimum landing area physical characteristics. The recommended obstacle area for single-engine and centre-line thrust aeroplanes not exceeding 2,000 kg maximum take-off weight for day operations is depicted in Figure 10.

Figure 10: Recommended obstacle area



Source: CAAP 92-1(1)

The ATSB assessed the obstacle area to the south of the ALA in accordance with the guidelines in CAAP 92-1(1). This assessment found that the approach and take-off area to the south of the airstrip complied with the guidelines.

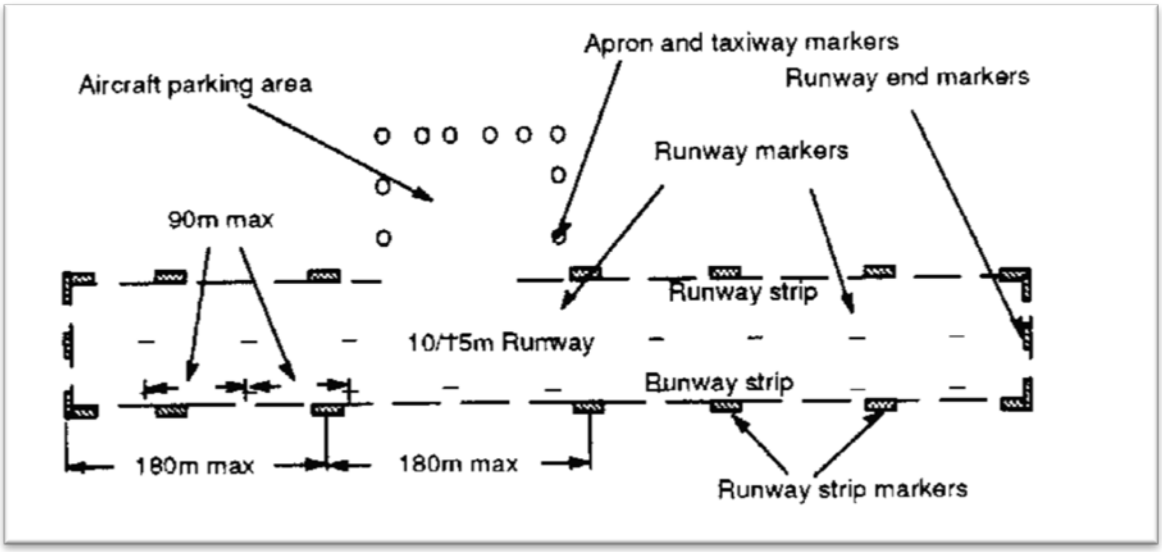
Landing area markings

Section 6 of CAAP 92-1(1) stated that:

> Where extended operations are expected to be conducted at a landing area, the owner/operator is encouraged to provide markings similar to those found at government and licensed aerodromes. If markings are provided, they should follow the colours and specifications set out in AIP AGA.[7]

A suggested suitable aerodrome layout as indicated in the CAAP is at Figure 11.

Figure 11: Typical ALA layout and marking



Source: CAAP 92-1(1)

The ATSB found that the ALA markings did not conform to the CAAP 92-1(1) guidelines. However, the requirements of the CAAP represented guidelines only; there was no mandatory requirement for the ALA to conform to this guidance material.

Wire-marking standards

The requirements for mapping and marking powerlines and their supporting structures were published in *Australian Standard AS 3891.1, 1991, Part 1, Permanent marking of overhead cables and their supporting structures* (AS 3891.1) and *AS 3891.2, 1992, Part 2, Marking of overhead cables for low level flying* (AS 3891.2).

AS 3891.1, Clause 3.2 described Authorised landing areas as:

> (a) Any landing or alighting place used by a licensed flying school as a base or satellite landing/alighting area;
> (b) any landing or alighting area used by regular public transport (RPT) flights; or
> (c) any landing or alighting place at which air charter, air work operators holding the current, appropriate Air Operators Certificate from the Civil Aviation Safety Authority are based.

AS3891.1 also stated that cables in proximity to authorized landing areas that penetrated the 20 per cent transitional slope or the 3.3 per cent approach and take-off slope shall be marked. This included on the cables and their supporting structures.

The ALA was not used as described in Clause 3.2 of AS 3891.1 and the powerlines did not penetrate the transitional slope as described. In addition, the powerlines were not in an area involved in planned low-flying operations as described in AS 3891.2. As such, the powerlines did not require marking in accordance with either Australian Standard.

7 Aeronautical Information Publication Australia Aerodromes, Air Routes and Ground Aids.

Wirestrike research

In September 2006, the ATSB reissued an aviation research paper titled *Wire-strike Accidents in General Aviation: Data Analysis 1994 to 2004.*[8] The research found that 119 wirestrike accidents and 98 wirestrike incidents were reported between 1994 and 2004and showed that the majority of wirestrike accidents were associated with aerial agriculture operations. However, 18 wirestrike accidents (15 per cent) involved private/business operations. Of these, 11 (61 per cent) occurred within the vicinity of the landing area.

In 82 or 63 per cent of the 119 wirestrike accidents, the pilot had prior knowledge of the wire. In other words, a significantly large proportion of pilots had prior knowledge of the wire before the wirestrike. Although the paper did not investigate the human factors involved in wirestrikes, it stated:

> Evidence that many pilots already knew of the existence and location of powerlines supports claims that distraction is one of the major causes of wire strikes during agriculture and other air-work. Other human factors that may be involved might include stress, fatigue, workload and visibility.

The ability of pilots to detect powerlines depends on the physical characteristics of the powerline, such as the spacing of power poles, the orientation of the wire, and the effect of weather conditions, especially visibility.

Depending on the environmental conditions, powerlines may not be contrasted against the surrounding environment. Often the wires will blend into the background vegetation and cannot be recognised. In addition, the wire itself can be beyond the resolving power of the eye: that is, the size of the wire and limitations of the eye can mean that it is actually impossible to see the wire. As such, pilots are taught to use additional cues to identify powerlines, such as the associated clearings or easements in trees or fields that can underlie the powerline, or the power poles and buildings to which the powerlines may connect.

The ability of a human to identify a power pole located in the periphery of the retina is also limited, because the eye's peripheral capability is designed to detect movement rather than the detail of an object.

The ATSB report titled *Avoidable Accidents No. 2 – Wirestrikes involving known wires: A manageable aerial agriculture hazard*[9] found that:

> Studies into 'inattentional blindness' have shown that we fail to perceive unexpected objects (even if they appear in the field of vision) if we are not paying attention to them (for example, focusing on another object or task). Without attention, there is no perception. Thus, you are unlikely to notice an approaching wire if you are not looking for it, even if you were previously aware of it. Add to this the inherent difficulty of visually spotting wires; the likelihood of hitting a wire is increased.

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8 Available at www.atsb.gov.au

9 Also available at www.atsb.gov.au

Safety analysis

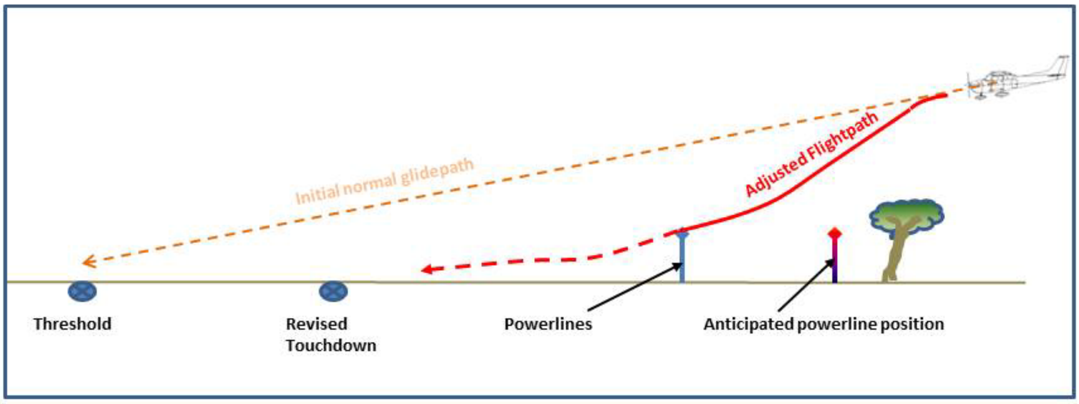
Introduction

There was no evidence that environmental factors or the performance of the aircraft and its systems contributed to the wirestrike. As such, this analysis will focus on the operation of the aircraft to the aircraft landing area (ALA) and influence of elevated pilot in command (PIC) workload and distraction risk at the time. Survivability aspects are also discussed.

In addition, the adjustment by the PIC of the final glide path to facilitate separation with the Tecnam aircraft increased the risk that the aircraft's flight path would intersect the powerline as depicted in Figure 12. In fact, this adjustment would have made little-to-no difference to the aircraft's separation from the Tecnam, and the possibility that PIC's decision-making at the time was influenced by the elevated workload is discussed in the section titled *Workload and distraction*.

Finally, the likelihood for more discernible threshold markings to have reduced the likelihood that the pilot would attempt a landing in the undershoot area is highlighted.

Figure 12: Depiction of the aircraft's flight path and the actual position of the powerline compared to the position as anticipated by the pilot



Source: ATSB

Aircraft operation

ALA markings

The airstrip was not marked in accordance Civil Aviation Advisory Publication (CAAP) 92-1(1) *Guidelines for aeroplane landing areas*, nor was it required to be. Indeed, the only markings on the airstrip were two threshold markers and a white road post marking the culvert. These markers were somewhat hidden by the grass that had grown around them, making them difficult to distinguish on final approach to land. As such, the only real delineation of the flight strip was the area of mown grass, which extended to the tree line about 180 m to the south of the permanently displaced threshold. This mown undershoot was difficult to distinguish from the airstrip proper and could give pilots the impression that it formed part of the useable airstrip.

Although the PIC stated he was aware of the displaced threshold he considered that it was safe to touchdown before this point. This belief was probably reinforced by the appearance of the airstrip and the lack of clearly visible threshold markings.

PIC hazard awareness

Although the PIC could not recall the specific details in the ALA diagram, he had flown into the ALA on three previous occasions and it is reasonable to expect that he had some firsthand knowledge of the ALA and its hazards. The PIC's recollection of the exact position of the hazards, in particular the powerline, was reflective of the pilot's planning for his previous departures to the south. That was, if he cleared the trees on climb out, then he would also clear the powerlines. However, the location of the powerline 47 m before the treeline on departure would suggest that this logic was incorrect. Indeed, application of this logic to a landing from the south increased the risk of a wirestrike on landing, as the powerline was now 47 m into the undershoot and upwind of the treeline. In the event, the PIC reported that he was not specifically considering the powerlines when he made the decision to adjust the aircraft's glide path and 'dip down' after passing the tree line.

Research shows that wire markings can enhance the powerline visibility. Given that the ALA continues to be used by unfamiliar users, such marking could be expected to enhance future powerline avoidance at the ALA. The ATSB could not categorically determine whether prior marking of the powerlines would have ensured their detection and avoidance in this case due to the reduced pilot visibility of the landing strip as a consequence of the right circuit, the reduced visibility of the displaced threshold during final approach, and the PIC's high workload and distraction. If the powerlines were marked, it is possible that one of the occupants of TKI would have been alerted to their presence during the circuit. The potential for the occupants' prior attention on the Tecnam to have impacted on that awareness was not quantified.

Workload and distraction

Workload refers to the interaction between an individual and the demands associated with the tasks that they are performing. It varies as a function of the number and complexity of the task demands, and the capacity of the individual to meet those demands. For the same situation, different individuals will experience different levels of workload depending on their experience, skills and techniques, as well as factors such as fatigue, drugs, or a medical condition. High workload can result in an individual's performance on some tasks degrading, tasks being performed with simpler or less comprehensive strategies, or tasks being shed completely. In some cases tasks can be shed efficiently by eliminating performance on lower priority tasks or they can be shed inefficiently by abandoning tasks that should be performed.[10]

There was no evidence that factors such as fatigue, drugs, or a medical condition affected the PIC's performance and decision-making. However, evidence of the high workload being experienced by the PIC during the join, approach and landing included:

- the relative complexity of the task of landing at an unfamiliar airstrip
- his relatively low flying experience, recent practice and subsequent skill level at this landing task
- the distraction of the Tecnam on the airstrip.

These factors are discussed in the following sections.

Complexity of the landing at an unfamiliar airstrip

A number of factors added to the complexity of the approach and landing task. In general, left circuits are the norm, as this affords the PIC, who occupies the left-front seat, better visibility of the runway and makes circuit planning and adjustments easier. This contrasts with the conduct of a right circuit, which can involve a higher workload for the pilot and less visibility of the runway

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[10] Wickens, CD & Hollands, JG 2000, *Engineering psychology and human performance*, 3rd edition, Prentice-Hall International, Upper Saddle River, NJ.

environment. The exact reason for the PIC choosing to fly a right circuit could not be ascertained, although the influence of the right circuit by the Tecnam pilot immediately prior to the arrival of TKI could not be discounted.

Compounding the PIC's workload was a level of unfamiliarity with the airstrip, as the PIC had not landed at this ALA from the south before. He stated that he was distracted by the Tecnam, which was his main concern during the approach. In the event, the unfamiliar approach direction combined with the distraction of the Tecnam to degrade the PIC's performance in some areas. This is demonstrated by the lack of recognition and feedback to questions and prompts from the passengers during the latter stages of the approach. In this respect, the front- and rear-seat passengers prompted the PIC about aspects of the approach, but neither received a reply or other form of recognition from the PIC.

Flying experience, recent practice and skill level

Although the PIC had been licenced since 1991, he had accumulated only about 200 hours in command in the following 21 years. While the PIC was current and qualified for the flight, he had limited experience of landing at ALA-type airstrips. Although his level of knowledge was good, his skill level for the task of landing at an unfamiliar, challenging ALA was considered low.

Distraction

Another well-known effect of high workload is attentional narrowing. In such cases, workload and time pressure lead to a reduction in the number of information sources an individual will access, and the frequency or amount of time these sources are checked.[11] In this accident, the PIC's decision-making and hazard detection appeared to be significantly affected by workload and the distraction of the preceding Tecnam to a point where he did not consider an elongated circuit to assure separation or, ultimately, consider a go-around. The PIC's expectation that he would land the aircraft, and preoccupation with the clearing ground traffic, reduced the likelihood of him remembering or detecting the powerline.

Survivability

Research has shown that the chances of surviving an aircraft accident are increased by wearing a shoulder harness. In this case, although the PIC was wearing the shoulder portion of his lap-sash type seatbelt, the front-seat passenger was not. A comparison of the injuries sustained by these two aircraft occupants showed significant differences, with the front-seat passenger sustaining significant head and upper torso trauma. In the absence of high deceleration forces, and given the maintenance of liveable space within the cabin before the onset of the post-impact fire, it is likely that the front-seat passenger would have survived the accident sequence had he been wearing the entire lap-sash seatbelt.

The rear-seat passenger reported that he was not wearing his seatbelt at the time of the accident, yet he survived. It is probable that this was due to the confined space, which would have reduced the time for this passenger to accelerate before striking any aircraft structure, the lack of hard objects in the rear of the aircraft, and the relatively low energy of the impact.

The three people who first responded to the accident acted quickly to assist the two conscious occupants from the burning wreckage. This greatly increased these occupants' chances of survival.

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[11] Staal, M. A. 2004, *Stress, cognition, and human performance: A literature review and conceptual framework.* NASA Technical Memorandum 2004-212824.

Summary

The lack of a well-defined and marked threshold gave the PIC the impression that the mown undershoot area formed part of the useable landing strip and contributed to the accident. This was compounded by the pilot's misunderstanding that, as in the case of departures to the south, by clearing the treeline he would clear the powerline. In fact, the powerline was located 47 m into the undershoot area.

Risks associated with operations to private airstrips can be mitigated by ALA owners assessing their airstrips against the guidance in CAAP 92-1(1) *Guidelines for aeroplane landing areas.* This includes means for marking obstacle clearances. Such risk assessments would benefit from giving consideration to first time users of the ALA.

This accident is a timely reminder to all pilots to give themselves time to make appropriate decisions and, if in doubt, make an early decision to go-around if at all unsure about the progress of the approach. In addition, the potential for enhancing passenger safety by pilots making sure that everyone in their aircraft is wearing their seatbelts correctly is highlighted.

Findings

From the evidence available, the following findings are made with respect to the wirestrike that occurred 13 km north-east of Bendigo, Victoria, on 29 October 2012 and involved Cessna 172, registration VH-TKI. They should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- The pilot in command of VH-TKI was distracted and experiencing a high workload, reducing his attention regarding hazards along the flight path during the final approach.
- The pilot in command modified the final approach, increasing the rate of descent on short final in order to land before the normal touchdown point, increasing the risk that the aircraft would contact the powerline.
- **The aircraft landing area did not have clearly defined threshold markings, making the mown undershoot area difficult to distinguish from the airstrip.[Safety issue]**
- The front-seat passenger was not wearing the sash portion of the lap-sash seatbelt, increasing the risk of his upper body contacting the surrounding aircraft structure during the impact sequence.

Other factors that increase risk

- The PIC was aware that there were powerlines at the southern end of the airstrip but his mental model placed the powerlines about 50 m further south, and closer to the trees, than their actual position.
- **The powerlines were not marked with high visibility devices, nor were they required to be so marked by the relevant Australian Standard. This reduced the likelihood of a pilot detecting the position of the wires. [Safety issue]**

Other findings

- The fast actions of the Tecnam pilots and the owner of the aircraft landing area to assist the surviving occupants to exit the burning aircraft contributed to the survivability of the accident.

Safety issues and actions

A safety issue has been identified during the investigation of this accident as detailed in the Findings section of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by an investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

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.

Airfield marking

Number:	AO-2012-142-SI-01
Issue owner:	Owner of the aircraft landing area (ALA)
Operation type:	Private Airfield-ALAs
Who it affects:	ALA owners

Safety issue description:

The aircraft landing area did not have clearly defined threshold markings making the mown undershoot area difficult to distinguish from the airstrip.

Current status of the safety issue:

Issue status: Adequately addressed

Justification: Threshold is marked and undershoot markings are in place.

Proactive safety action taken by: Owner of the aircraft landing area

The owner of the aircraft landing area (ALA) has advised that as a result of this accident, a number of steps have been taken to minimise the likelihood of further wirestrikes. These include making a number of changes to the existing procedures and documents and enhanced marking of the threshold and undershoot areas.

ATSB comment:

The ATSB is satisfied that the action taken by the owner of the ALA adequately addresses this safety issue.

Powerline marking

Number:	AO-2012-142-SI-02
Issue owner:	Owner of the ALA
Operation type:	Private Airfield-ALAs
Who it affects:	ALA owners

Safety issue description:

The powerlines were not marked with high visibility devices, nor were they required to be so marked by the relevant Australian Standard. This reduced the likelihood of a pilot detecting the position of the wires.

Current status of the safety issue:

Issue status:	Addressed
Justification:	The visibility of the poles has been enhanced and has been favourably reported by visiting pilots.

Proactive safety action taken by: ALA owner

The ALA owner has marked the powerline by installing two additional poles near the powerlines that are topped with high-visibility windsocks. The poles have a hinged base so they can be lowered for servicing. In addition, the owner of the ALA has re-written and issued updated versions of the ALA diagram and 'hold harmless agreements'. The depiction of the powerline on the new ALA diagram is more accurate and highlighted in red.

ATSB comment:

The ATSB is satisfied that the action taken by the owner of the ALA adequately addresses this safety issue.

Additional safety action

Although no organisational or systemic issues were identified in respect of the emergency and firefighting equipment at the ALA that might adversely impact the future safety of aviation operations, the owner of the ALA has purchased the following firefighting and rescue equipment:

- two sets of 9 L extinguishers, one each of dry powder foam and water that have been positioned in each end of the hangar
- one set of extinguishers in the airstrip midway cabinet
- two crash axes, one located in the hangar and the second in the midway cabinet
- a trailer-borne firefighting unit, which is attached to a ute and on standby
- small dry powder extinguishers, which are available in all vehicles
- a very high frequency radio to allow air-to-ground communications.

General details

Occurrence details

Date and time:	29 October 2012 – 1300 EST	
Occurrence category:	Accident	
Primary occurrence type:	Operations – Terrain Collision - Wirestrike	
Type of operation:	Private	
Location:	13 km NE of Bendigo, Victoria	
	Latitude: S 36° 40.57'	Longitude: E 144° 23.22'

PIC details

Licence details:	Private Pilot Licence (Aeroplane), issued 1991
Endorsements:	S/E AEROPLANES < 5700 KG MTOW
Medical Certificate:	Class 2 issued April 2012 (valid 12 months)
Aeronautical Experience:	460.3 hours
Last flight review:	Biennial Flight Review - August 2011

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 172N	
Registration:	VH-TKI	
Serial number:	172-70881	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – 1 (Serious)	Passengers – 1 (Fatal) 1 (Minor)
Damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- pilot in command (PIC) and rear-seat passenger
- Tecnam pilots
- owner of the aircraft landing area (ALA) and witness
- Civil Aviation Safety Authority (CASA)
- aircraft owner
- a number of flying instructors.

References

Staal, M. A. 2004, *Stress, cognition, and human performance: A literature review and conceptual framework.* NASA Technical Memorandum 2004-212824.

Wickens, CD & Hollands, JG 2000, *Engineering psychology and human performance*, 3rd edition, Prentice-Hall International, Upper Saddle River, NJ.

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.

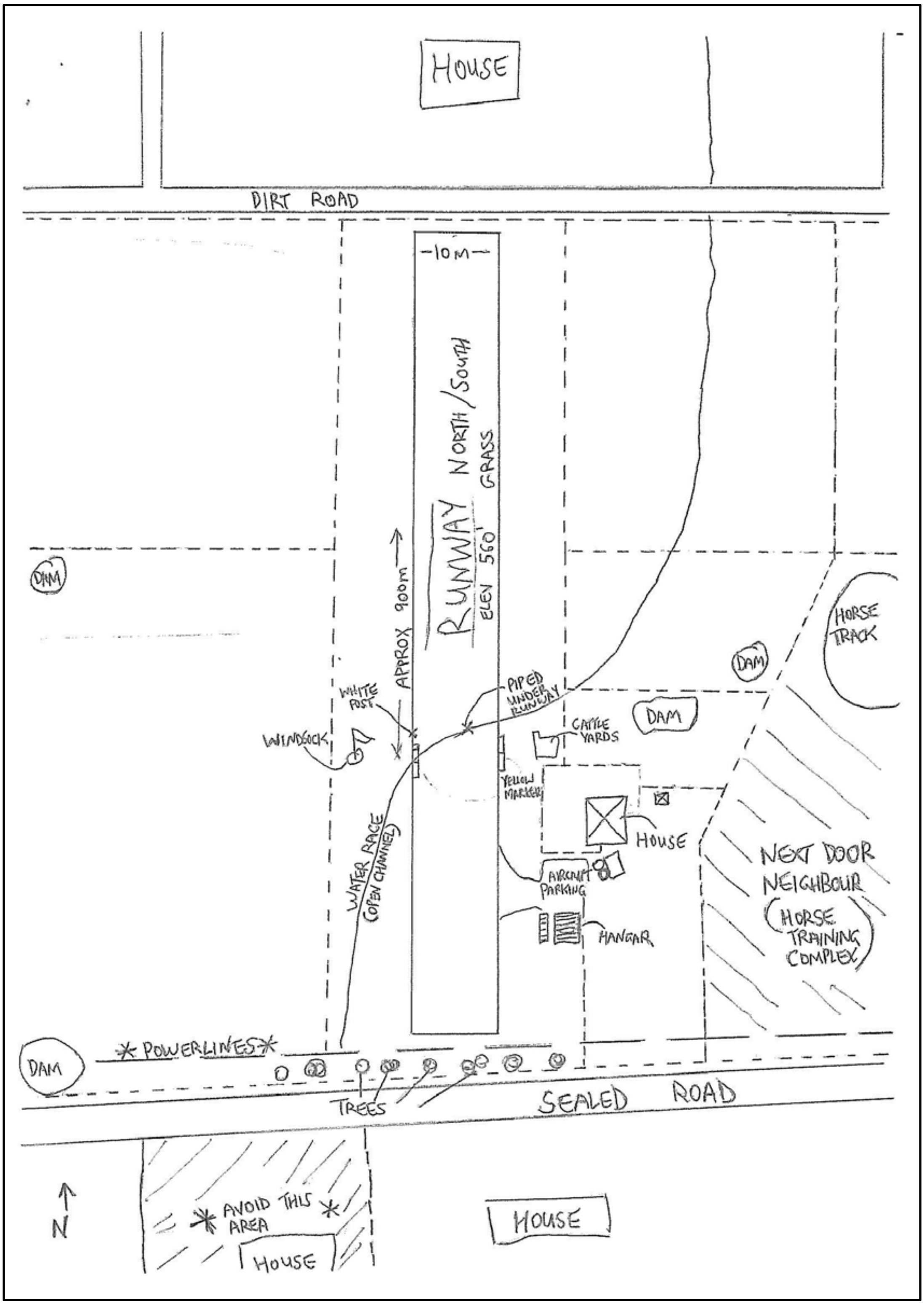
A draft of this report was provided to the PIC, the owner of the ALA, CASA, the aircraft owner and the rear-seat passenger.

Submissions were received from the PIC and the rear-seat passenger. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Appendices

Appendix A – Aircraft landing area owner's diagram as provided to pilots

Page 1



Page 2

[redacted]

1. RUNWAY IS APPROX NORTH/SOUTH, 900M LONG, 10M WIDE, GRASS WITH 560' ELEVATION.
2. PLEASE DO WIDE CIRCUITS WITH A LONG FINAL APPROACH SO AS NOT TO ANNOY NEIGHBOURS
3. DONT DO 'BEAT-UPS' ACROSS THE STRIP + ESPECIALLY NOT OVER THE HORSE TRAINERS COMPLEX NEXT DOOR TO HOUSE.
4. IF LANDING FROM SOUTH, TOUCH DOWN AFTER WINDSOCK TO AVOID TREES, POWERLINES + 'BUMP' WHERE PIPES GO UNDER RUNWAY.
5. WATER CHANNEL IS MARKED WITH A WHITE POST + YELLOW MARKERS.
6. DON'T TAXI OFF THE RUNWAY. TURN WITHIN THE WIDTH OF THE RUNWAY OR USE THE TURING NODES AT THE END.
7. NO RADIO REQUIRED, KEEP A GOOD LOOKOUT; CALL [redacted] FOR ANY EXTRA DETAILS.
8. WE ARE APPROX 5 MILE NORTH OF BENDIGO AIRPORT. BENDIGO FREQUENCY IS 119·3.

GPS – [redacted]

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (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; 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 fare-paying passenger operations.

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.

Purpose of safety investigations

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

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept 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.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
Wirestrike involving Cessna 172, VH-TKI
13 km NE of Bendigo, Victoria, 29 October 2012
AO-2012-142
Final – 7 November 2013