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- fostering safety awareness, knowledge and action.

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# Collision with water, VH-UFN

## Woolcunda Lake, New South Wales

### 21 June 2010

#### Abstract

On the morning of 21 June 2010 the owner/pilot of a Cessna Aircraft Company 172N, registered VH-UFN, departed from a private airstrip near Woolcunda Lake, New South Wales for a flight over the pilot's property. The aircraft did not return and was reported missing that afternoon. A search was initiated and, 2 days later, the aircraft was located in Woolcunda Lake.

The investigation identified that the aircraft impacted the lake in a left banking turn. Irrespective of the reason for being at low level, it is probable that the pilot misjudged the height of the aircraft above the lake's surface, or was distracted at a height from which the pilot was unable to recover before impacting the water.

Australian Transport Safety Bureau report AR-2009-041 *Avoidable Accidents No. 1: Low-level flying* addressed the dangers associated with low-level flight and in particular, the reduced time available to recover from any loss of control. This investigation provides a timely reminder of the effect on that risk of flight over expanses of flat, featureless terrain or water.

#### FACTUAL INFORMATION

##### History of the flight

At about 0915 Eastern Standard Time<sup>1</sup> on

21 June 2010, the owner/pilot of Cessna Aircraft Company 172N Skyhawk, registered VH-UFN (UFN), departed on a private flight from an airstrip on the pilot's property near Woolcunda Lake (the lake), New South Wales (NSW). The flight was to search for sheep that may have been missed from the previous day's muster in a paddock to the north of the airstrip. The pilot had planned to return around midday.

A witness reported hearing the aircraft operating in a paddock to the north of the property's homestead and, at about 1000, hearing the aircraft depart that paddock towards the south. When the aircraft did not return by midday, a local search was initiated. That search was unsuccessful and the aircraft was reported missing to authorities at about 1400.

Figure 1: Accident location—image courtesy of Google



1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

The aircraft was located in the southern part of the lake (Figure 1) at about 1030 on 23 June

2010. The aircraft was seriously damaged.<sup>2</sup> Shortly after, the fatally-injured pilot was located in the lake about 80 m north-west of the wreckage.

## Pilot information

The pilot was issued an Unrestricted Private Pilot Licence (Aeroplanes) in 1978 and, at the time of the accident, held a Private Pilot (Aeroplane) Licence. The pilot was endorsed on single-engine aeroplanes of less than 5,700 kg maximum take-off weight. He did not hold any other aircraft endorsements or permissions.

The pilot had accumulated 2,604 flight hours, of which 2,571 hours were in command. It was reported that, of those flight hours, the majority were flown in UFN. The pilot completed an aeroplane flight review on 3 October 2009.

Between December 2009 and June 2010, the aircraft was in Broken Hill, NSW undergoing an engine and propeller overhaul. The pilot did not log any flights during that period.

On 18 June 2010, the aircraft was delivered to the pilot's residence following the overhaul. The owner/pilot flew the delivery pilot back to the maintenance facility that day and then flew home. The pilot conducted two more flights in UFN before the accident flight, one on 19 June and the other on 20 June 2010.

The pilot held a valid Class 2 Medical Certificate with requirements that he wear distance correction spectacles when flying and have reading correction spectacles available. The pilot's spectacles were recovered from the wreckage.

There was no evidence of medical, fatigue or physiological issues that could have affected the pilot's performance on the day of the flight. Evidence indicated that the pilot had adequate rest and nourishment before the flight.

It was reported that the recent run-off into the lake, a rare occurrence, and the pilot's interest in aerial photography led to the pilot regularly visiting the lake when flying in that region.

## Aircraft information

### General information

The aircraft was manufactured in the United States (US) in 1978 and registered in Australia in 1979. The pilot acquired the aircraft in 1983. The aircraft's maintenance release was valid until 21 May 2011.

### Fuel

The aircraft was fully refuelled in Broken Hill before the delivery flight on 18 June 2010. The accident occurred 5.3 hours from that last known refuelling.

The pilot kept aviation fuel in drums in a shed at the homestead where the aircraft was hangared. Numerous empty drums were found stored to the rear of that shed. Three full and one almost empty drum were located inside the shed. A fuel sample was taken from the almost empty drum for testing by an approved laboratory. That test determined that the fuel met the standards required for fuel of that type.

As there were no records of any refuelling from the drum stock, it could not be confirmed whether the pilot refuelled the aircraft from that fuel stock in the period between the delivery flight and the mustering flight that day. An estimate of the aircraft's fuel state at the commencement of the mustering flight was made based on the premise that the aircraft was not refuelled from the drum stock after the last confirmed refuel at Broken Hill.

Using the known flight times for the subsequent flights, assumed flight profiles that were based on demonstrated pilot behaviour and fuel burns from the Pilot's Operating Handbook (POH), between zero and 40 L of fuel was estimated on board the aircraft at the commencement of the mustering flight. The range of possible fuel remaining related to a 20 % error margin applied to the projected fuel burn.

Given the ready availability of the drum stock at the homestead and the pilot's reported meticulous care of the aircraft, the investigation considered it unlikely that the pilot would not have refuelled from the drum stock after the last recorded refuelling in Broken Hill, and therefore departed with no more than 40 L on board for the mustering flight.

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<sup>2</sup> The *Transport Safety Regulations 2003* definition of 'serious damage' includes the destruction of the transport vehicle.

### *Aircraft weight and balance*

The investigation estimated that the aircraft was probably within its weight and centre of gravity limits for all possible fuel states during the flight.

### **Meteorological information**

The nearest available Bureau of Meteorology surface observation sites to the accident location were at Broken Hill and Mildura, Victoria. The aerodrome weather reports for Broken Hill and Mildura Airports from 1000 to 1800 that day indicated that the winds were light and trending from the south to south-east, that visibility was greater than 10 km and that any cloud was at or higher than 3,000 ft above ground level (AGL). The investigation concluded that the weather that day was not a factor.

Between 1000 and 1100 on 21 June 2010, the sun's elevation<sup>3</sup> at the lake was between 22° and 29° above the horizon. The investigation concluded that, at that elevation, the position of the sun was not a factor.

### **Wreckage information**

The wreckage was located in deep water towards the centreline of the lake. Initial inspection of the aircraft by police divers identified that, as a result of the impact with water, it had broken into three separate pieces as follows:

- Engine section (Figure 2). The engine was located in its mounts and affixed to the firewall. The firewall also formed the forward bulkhead of the cabin and had the aircraft's instrument panel still attached. The firewall had detached from the fuselage at the forward cabin pillars, but remained connected to the cabin by the control yoke flight control cables.
- Cabin section of the fuselage/wing (Figure 3). The cabin's forward bulkhead was detached from the cabin. The rudder pedals and associated nosewheel steering assembly remained attached to the cabin section of the fuselage. The forward and rear windshields were destroyed by the impact and pieces of the forward windshield were located in the

**Figure 2: The engine, propeller and firewall assembly and instrument panel**



**Figure 3: Cabin section of the fuselage/wing and tailplane sections**



**Figure 4: Left wing with flattened leading edge and rupture highlighted**



rear of the cabin. The pilot's cabin door was latched and jammed closed, while the passenger door was unlatched.

- Tailplane section (Figure 3). The tailplane and a section of the fuselage immediately aft of the cabin had detached, but also remained connected to the fuselage by flight control cables.

All structural components, except for the right wing aileron (which was not recovered) were contained in the wreckage. A small section of the right aileron and hinge remained attached to the wing. The damage associated with that section of the aileron was consistent with the aileron being

<sup>3</sup> The vertical angle to the sun from an ideal horizon, measured in degrees.

torn from the wing by impact forces.

Control cable continuity was established for all flight and engine controls.

During the recovery of the aircraft a fuel slick was evident on the surface of the lake. The wing fuel tanks were drained post recovery. They contained a significant amount of water; however, a small amount of fuel was recovered.

The leading edge of the left wingtip had been flattened and that wingtip's fairing torn from the wing (Figure 4). This type of damage was isolated to the left wing only.

The lower surfaces of both wings displayed significant water impact damage (hereafter referred to as hydraulic damage), which was particularly prevalent at the rear sections of each wing (Figure 5).

The forward section of the left wing structure just outboard of the wing strut had been ruptured during the impact sequence. The upper wing surface immediately adjacent to the rupture was scored, with evidence of paint transference consistent with the orange engine cowl (Figure 6).

The aircraft's nosewheel was detached from the wreckage and recovered with other flotsam on the lake shorefront to the north of the wreckage. The nosewheel mounting collar displayed evidence of over-stress failure in the longitudinal direction (Figure 7).

The aircraft's propeller showed evidence of rotation during the impact sequence. It could not be determined whether the propeller was producing thrust at that time.

The tailplane section exhibited a clean tear of the fuselage skin on the left side, with tearing and buckling on the right side (Figure 5).

Many of the aircraft's instrument panel switches and other controls may have been disrupted during the impact sequence. The key-activated ignition switch was in the BOTH position.<sup>4</sup> The key had been broken off during the accident sequence.

**Figure 5: Lower wing surfaces with the hydraulic buckling damage highlighted**



**Figure 6: Upper surface of the left wing, showing the ruptured section and adjacent scoring and paint transference**



**Figure 7: Nosewheel unit showing damage to the mounting collar**



A number of aircraft components were removed from the wreckage for later examination. This examination determined that, at the time of impact, the aircraft's flaps were retracted and that the fuel selector was in the BOTH position.<sup>5</sup>

The airspeed indicator was recovered intact and undamaged. It displayed a possible witness mark consistent with contact between the airspeed pointer and the instrument face as a result of impact forces. That contact mark was at 87 kts on

<sup>4</sup> Piston aircraft engines that are equipped with dual magneto ignition are usually run with both magnetos selected.

<sup>5</sup> The aircraft's fuel selector determined which of the aircraft's left or right fuel tanks supplied fuel to the aircraft's engine. The available selections were BOTH, LEFT, or RIGHT.

the airspeed scale.

The aircraft's engine was disassembled at an approved overhaul facility under the supervision of the Australian Transport Safety Bureau (ATSB). The engine exhibited characteristics of being recently overhauled. There was no evidence of mechanical failure of the aircraft's engine or associated systems.

There was no evidence of a birdstrike.

## Survival aspects

The pilot normally carried a portable emergency locator beacon (ELB) and a SPOT Satellite Messenger (SPOT).<sup>6</sup> The SPOT and ELB were recovered from the flotsam that washed up on the northern shore of the lake. Neither had been activated during or after the accident.

The separation of the aircraft's nose structure opened up the front of the cockpit and cabin area to the impact force of the water. Both front seats were forcibly detached from their mounting rails and driven rearward into the cabin area during the impact sequence.

The pilot's seatbelt buckle was not fastened.

## Additional information

### *Low flying*

Civil Aviation Regulation (CAR) 157 stated that the minimum height for flight of an aircraft over an unpopulated area was 500 ft AGL. There were a number of exceptions to that minima, including: due to the stress of weather; during takeoff or landing, and any associated manoeuvres; and where a specific permission had been received from the Civil Aviation Safety Authority (CASA) that permitted flight at a lower height. The pilot had not received such permission from CASA.

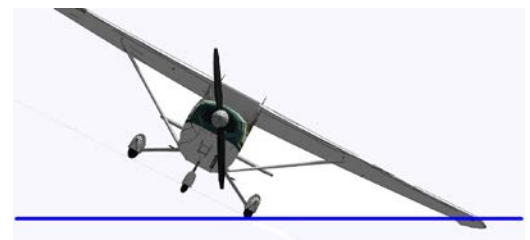
Before issuing a pilot with an approval for low flying, CASA required that pilot to undergo specific low-flying training. This training was designed to ensure that the pilot was proficient in handling an aircraft at low level as well as being aware of specific dangers associated with such operations.

Included in the low-flying training syllabus were items such as: the effect of false horizons; manoeuvring at varying speeds and angles of bank; and level, climbing and descending turns. A further danger with low flight was the very short time available for a pilot to recover from loss of control or an inadvertent descent, particularly when the low-level pilot's attention was distracted from handling the aircraft.

The property was traversed about 8 km to the east of the lake by powerlines that were 35 m (115 ft) in height. Numerous interviewees stated that the pilot was particularly concerned with the threat presented by these powerlines when flying in their vicinity. They implied that the pilot considered the height of the powerlines to be a personal lowest height when operating in their vicinity.

The delivery pilot stated that, on the return flight from the property to Broken Hill, the owner/pilot levelled out at about 300 ft AGL and departed via the lake before heading for Broken Hill. The flight to Broken Hill was reported to have been conducted predominantly at that height.

**Figure 8: Angle of bank required for a wingtip to contact a surface**



### *Aircraft geometry*

The angle of bank required for one of the aircraft's wingtips to contact a surface without any other part of the aircraft contacting that surface, was estimated to be a minimum of about 25° (Figure 8).

### *Aircraft emergency procedures*

The aircraft's POH contained guidance and checklist procedures for an engine failure and an emergency ditching. The following points from those procedures were relevant to the investigation:

- The target airspeed in the case of an engine failure or ditching was dependant on the

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<sup>6</sup> The SPOT system used the Globalstar satellite network to offer the capability of a one-way message transmission that could include an aircraft's location. The pilot did not subscribe to the SPOT location function.

aircraft's configuration at the time (with or without flap) and whether power was available. These target speeds varied between 55 kts and 65 kts.

- The *Emergency landing without engine power* checklist required the fuel selector valve and the ignition switch to be selected to OFF. For normal operations, both switches were required to be in the BOTH position.
- The *Ditching* checklist recommended ditching with flap selected, but provided guidance on ditching without flap. In either case, a level attitude was stipulated at touchdown. The aircraft's cabin doors were to be unlatched prior to ditching.

Table 1 contains data derived from the POH that details the aircraft's approximate gliding range from various heights. The data was based on an aircraft flown at the best glide speed<sup>7</sup> of 65 kts with the propeller windmilling, the flaps retracted and with zero wind.

**Table 1: Estimated gliding range**

Height AGL (ft)	Glide distance (m)
1,000	2,800
500	1,400
300	830
100	270

The nearest cleared landing field to the wreckage was at the southern tip of the lake, about 3.5 km from the wreckage.

#### *Glassy water and height perception*

The US Federal Aviation Administration (FAA) publication *Seaplane, Skiplane, and Float/Ski Equipped Helicopter Operations Handbook*<sup>8</sup> identified a particular danger associated with flight operations overhead bodies of water when the surface is glassy. The lack of surface features on a glassy surface leads to difficulty in depth

perception and a pilot accurately judging an aircraft's height above the surface. This is particularly the case if a pilot's attention is focused on the water surface and/or there are no other external cues that may assist with height determination, such as a shoreline. A smooth glassy surface may also reflect cloud or shore features, resulting in confusing illusions that further degrade height perception.

#### *Research and previous occurrences*

ATSB Aviation Research and Analysis Report AR-2009-041 *Avoidable Accidents No. 1: Low-level flying*<sup>9</sup> addressed the dangers expressly associated with low-level flight and in particular, the reduced time available to recover from a loss of control condition.

## ANALYSIS

The initial contact of the left wingtip with the water yawed the aircraft to the left, such that the subsequent impact was almost front on in a level or slightly nose-low attitude. That yaw and the aircraft's forward momentum combined to detach the aircraft's engine section from the fuselage, and resulted in the engine section impacting the left wing.

Two scenarios were considered that might explain the aircraft being so low that the wingtip contacted the surface of the water. Either the pilot ditched the aircraft in response to medical, mechanical or fuel related difficulties or, during intentional low-level flight, the wingtip contacted the surface of the lake.

### Pilot-initiated ditching

The post-mortem examination did not identify any medical condition that may have resulted in pilot incapacitation, or that would have necessitated an urgent landing. Further, it would be unlikely that the pilot would have ditched the aircraft for a medical emergency when there was a landing strip, with which the pilot was familiar, about 3.5 km away. The investigation discounted a medical event as a factor.

There was no evidence of a failure of the aircraft's engine or other systems that would have caused

<sup>7</sup> Best glide speed is the speed that provides the best glide ratio of distance travelled to height lost.

<sup>8</sup> FAA publication FAA-H-8083-23, available at [http://www.faa.gov/library/manuals/aircraft/seaplane\\_handbook/](http://www.faa.gov/library/manuals/aircraft/seaplane_handbook/)

<sup>9</sup> Available at <http://www.atsb.gov.au/publications/2010/avoidable-accidents-low-level-flying.aspx>.

the pilot to ditch the aircraft. While the right aileron was unable to be located, it probably detached from the wing as a result of the considerable hydraulic force applied to the rear of the wings during the impact sequence. The investigation concluded that aircraft/engine mechanical failure was not a factor.

Due to the unknown fuel state of the aircraft at commencement of the mustering flight, fuel starvation/exhaustion could not be positively excluded as a factor. However, the ready availability of the drum fuel stock and the pilot's reported meticulous care of the aircraft, suggested that he probably would have refuelled the aircraft prior to the mustering flight. That reduced the likelihood that fuel starvation/exhaustion was a factor.

A number of cockpit controls and the aircraft's configuration were inconsistent with the aircraft manufacturer's requirements for a ditching with or without engine power. In addition, the witness mark on the airspeed indicator at 87 kts indicated a speed well in excess of the recommended 55 to 65 kts ditching speed. Based on that excess speed, the aircraft's angle of bank of at least 25° on contact with the water and the cockpit controls and aircraft configuration, the investigation concluded that the ditching was not deliberate.

The location of the wreckage was about 250 m equidistant from the eastern and western shorelines. The aircraft's glide potential was such that, had it been at or above 100 ft above the surface of the lake when an event occurred that necessitated an immediate ditching, the pilot could have ditched adjacent to the shoreline.

The apparent lack of any initiating cause that would lead to a ditching, the inconsistency of the flight profile with a ditching, and the location of the wreckage, all weighed considerably towards a conclusion that the aircraft was probably not ditched deliberately.

### **Low flying**

Low-level flight over the lake that day could not be discounted. The return flight to Broken Hill below 500 ft above ground level (AGL) and the pilot's implied lower limit for operations that was based on the 35 m (115 ft) high powerline indicated that the pilot probably engaged in routine flight below that required under Civil Aviation Regulation 157, and possibly down to about 100 ft AGL, at least

while operating over his property.

Given the calm conditions on the day, it is probable that the lake's surface was glassy, which had the potential to adversely impact on the pilot's depth and height perception over the water. However, the numerous other visual cues available, such as dead trees and the shoreline, should have enabled visual height perception by the pilot, provided the pilot's focus was not concentrated on the lake's surface close to the aircraft. If the pilot's attention was focussed close to the aircraft, a shallow descent could have developed without the pilot being aware of any height loss until contact with the lake's surface was unavoidable. While the aircraft's attitude when the wing contacted the lake's surface adds weight to this scenario, there was insufficient evidence to rule an unintentional descent into the water in or out as a contributing factor.

Irrespective of the reason for being at low level, it is probable that the pilot misjudged the height of the aircraft above the lake's surface, or was distracted at a height from which the pilot was unable to recover the aircraft before impacting the water.

The investigation did not identify any organisational or systemic issues that might adversely affect the future safety of aviation operations. However, the accident does provide a timely reminder of the heightened risk associated with low-level operations, especially over expanses of flat, featureless terrain or water.

## **FINDINGS**

From the evidence available, the following findings are made with respect to the collision with water that occurred at Woolcunda Lake, New South Wales, on 21 June 2010 involving Cessna 172N registered VH-UFN, and should not be read as apportioning blame or liability to any particular organisation or individual.

### **Contributing safety factors**

- While flying at low height, the pilot either misjudged the height of the aircraft above the lake's surface or was distracted.

## SOURCES AND SUBMISSIONS

### Sources of Information

The sources of information during the investigation included the:

- Civil Aviation Safety Authority (CASA)
- Bureau of Meteorology
- Geoscience Australia
- United States Federal Aviation Administration
- New South Wales (NSW) Coroner
- NSW Police Service.

### 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 licensed aircraft maintenance engineer and CASA. There were no submissions from those parties.