Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation – AO-2007-009
Final

Collision with terrain
2 km west of Esperance Aerodrome, WA
26 May 2007
VH-FTT
Piper Aircraft Corp PA28RT-201

Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT

Aviation Occurrence Investigation
AO-2007-009

Final

Collision with terrain
2 km west of Esperance Aerodrome, WA
26 May 2007
VH-FTT
Piper Aircraft Corp PA-28RT-201

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

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office location: 15 Mort Street, Canberra City, Australian Capital Territory
Telephone: 1800 621 372; from overseas + 61 2 6274 6440
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117; from overseas + 61 2 6247 3117
E-mail: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

ISBN and formal report title: see 'Document retrieval information' on page iii.

DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN
AO-2007-009	17 October 2008	28	978-1-921490-74-3

Publication title

Collision with terrain - 2 km west of Esperance Aerodrome, WA - 26 May 2007 - VH-FTT, Piper Aircraft Corp PA28RT-201

Prepared by

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

Reference No.

INFRA-08279

Acknowledgements

Figures 1 and 3: WA Police.

Figure 2: Western Australian Land Information Authority (Landgate).

Abstract

On 26 May 2007 at about 1644 Western Standard Time, a Piper Aircraft Corp PA-28RT-201 aircraft, registered VH-FTT, departed Jandakot Airport for Esperance, WA. On board the private, visual flight rules (VFR) flight were the non-instrument-rated owner-pilot, and two passenger friends.

The flight arrived at Esperance about 1 hour and 40 minutes after last light, and in marginal weather conditions. The aircraft impacted the ground on what appeared to be a right base for runway 11. There were no survivors.

There was no evidence of any technical defect or other failure of the aeroplane, or of its associated systems, prior to the impact with terrain. That, and the normal operation of the approach and landing aids, and apparent activation of the aerodrome lighting, suggested that the most likely factors that contributed to the development of the occurrence related to the operation of the aircraft.

The investigation was unable to conclusively establish the reason for the impact with terrain. The investigation could not exclude the possibility of a sudden incapacitation of the pilot due to a cardiac condition. However, the weather conditions enroute to, and in the vicinity of Esperance were such that the pilot's decision to attempt the flight indicated a low appreciation, or an acceptance, of the associated risks. The attempted approach and landing under those conditions represented a significant level of risk for any flight attempted under the night VFR.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

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 enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, 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 proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

FACTUAL INFORMATION

History of the flight

On 25 May 2007 at about 1400 Western Standard Time[1], a Piper Aircraft Corp PA-28RT-201 aircraft, registered VH-FTT, arrived at Jandakot Airport from Esperance, WA. On board were the owner-pilot and two passenger friends. The flight reflected a number of regular such flights by the aircraft's occupants in connection with their shared interests and responsibilities.

Recorded radar data corroborated a number of witness statements and indicated that, at about 1644 the following day, the aircraft departed Jandakot on a private, visual flight rules (VFR) return flight to Esperance, with the same three persons on board. Just prior to departure, one of the passengers advised his family by telephone that they may have to make an in-flight diversion to Kalgoorlie due to weather. A review of the recorded radar data by Airservices Australia showed that the flight was last observed on radar at an unverified Mode C[2] altitude of 9,500 ft above mean sea level (AMSL), at about 387 km from Esperance. The radar system estimated the aircraft's time of arrival at Esperance as 1855.

Police reported, and telephone records and witnesses confirmed that, at 1836, one of the passengers telephoned his wife by mobile phone and advised that the flight was proceeding well, and that they expected to arrive in Esperance in about 20 minutes. The caller also said that there was a vehicle at the airport and that they would go to the other passenger's house after landing and, once there, the caller would ring again to arrange a lift home.

A hearing witness[3] who lived about 2 km north of the aerodrome reported that, just before 1900 that evening, he ventured outside his shed to turn off his lights and heard an aircraft approaching from the south-west. The witness stated that, shortly after, the sound of the aircraft changed as if it had hit something off the end of the runway.

The hearing witness went inside and telephoned a nearby friend, who was reported to have also heard the aircraft. The hearing witness returned outside and noticed that 'every light at the airstrip was on. It was lit up like a Christmas tree'.

When the aircraft passenger did not telephone his wife as expected, she attempted to contact each of the aircraft occupants by mobile phone. There was no answer.

The following morning, the aircraft occupants' families made a number of unsuccessful attempts to contact the aircraft occupants. A check of the airport confirmed that the aircraft failed to arrive. A friend of one of the families, who was

1 The 24 hour clock is used in this report to describe the local time of day, Western Standard Time (WST), as particular events occurred. Western Standard Time was Coordinated Universal Time (UTC) + 8 hours.

2 One of a number of pulse signals that can be transmitted by an aircraft's transponder equipment in response to its interrogation; for example, by ground-based secondary surveillance radar. Mode C includes the transmission of the altitude of the interrogated aircraft.

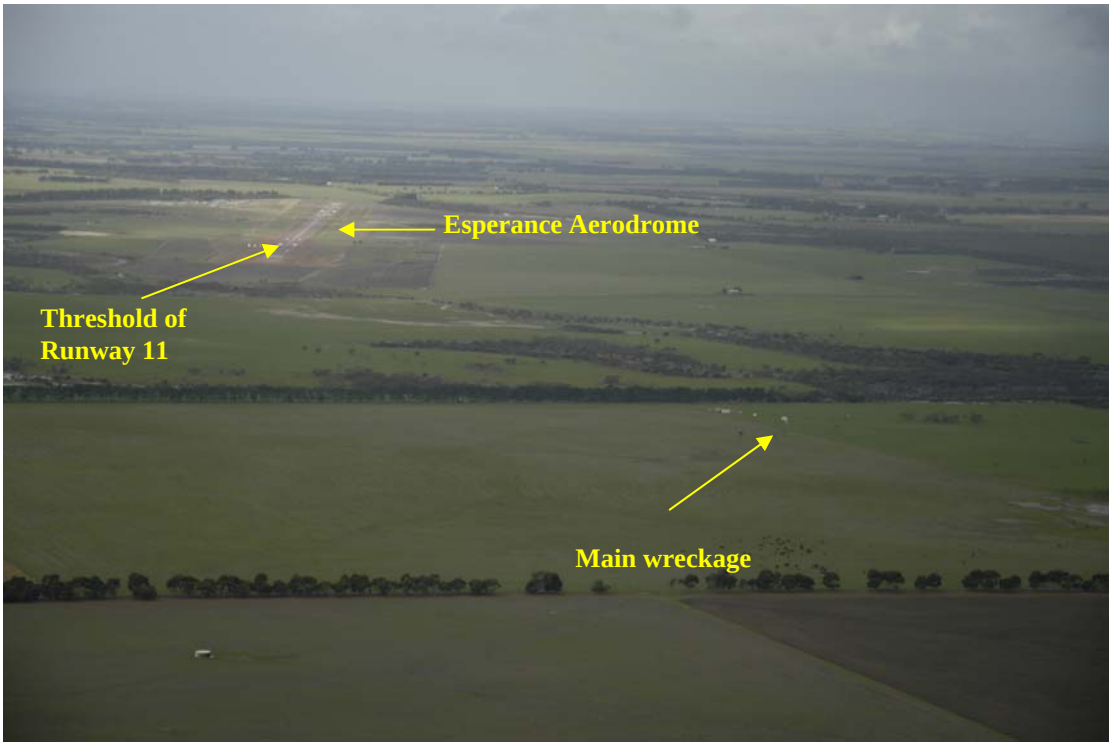
3 A witness that heard, but did not see and aircraft or incident.

also a pilot, contacted Australian Search and Rescue[4] (AusSAR) and raised the alarm. The pilot friend and another local pilot were tasked by AusSAR to commence a search for the aircraft and a SAR helicopter departed Perth for Esperance to join the search.

After an unsuccessful search, the local aircraft returned to Esperance. Shortly after, the Perth rescue helicopter located the aircraft wreckage about 2 km west of the aerodrome (Figure 1).

On arrival at the accident site, rescue personnel confirmed that there were no survivors. The aircraft was destroyed. There was no fire.

Figure 1: Main wreckage location in relation to Esperance Aerodrome



Personnel information

Qualifications and experience

The pilot held a Private Pilot (Aeroplane) Licence with constant speed propeller and retractable undercarriage endorsements. He held a current Class 2 medical certificate with a restriction that reading correction was to be worn while exercising the privileges of the licence.

An examination of the pilot's logbook showed that the pilot had accumulated a total of 1,676.6 flight hours, with more than 1,200 hours on type, 93.7 hours of night flight and 7.5 hours of instrument flight time. The last entry in the pilot's current

4 In general terms, AusSAR coordinates the Search and Rescue (SAR) response to aviation incidents across Australia.

logbook was the carry-over total from his previous logbook. The pilot had not recorded any instrument flight time in the last 14 years. The majority of the pilot's flight time was in the accident aircraft.

The pilot was issued with a night VFR (NVFR) rating[5] in December 1990, with endorsements that allowed the use of non-directional beacon (NDB) and very-high-frequency omni-directional radio range (VOR) navigation aids.[6] The pilot did not hold either a Command or Private instrument flight rules (IFR) rating.

The pilot's last recorded biennial flight review was conducted on 13 December 2005. There was no regulatory requirement for, or evidence of, the review of the pilot's night flying competence since he was issued with his NVFR rating in 1990.

When enacted, Civil Aviation Safety Regulation (CASR) Part 61 will introduce the requirement for the biennial review of pilots' night flying competence. The target commencement date for CASR Part 61 was unable to be determined.[7]

Flight management

Interviews were conducted with the pilot's wife, a number of passengers from previous flights conducted by the pilot, and with other pilots who had known and observed the accident pilot for many years. All had flown with the pilot, some on a number of occasions. Most described him as being methodical, confident in his ability and meticulous in all his endeavours (including in his flying), and as not being a risk taker. He was reported to have been very skilled manually and to have assisted in the maintenance of the aircraft.

The majority of passengers that were interviewed reported that they had experienced flight with the pilot in cloud or poor weather. That varied from momentary to 30 to 45 minute periods spent in those conditions, and was reported to have occurred in either the climb, in the cruise or in descent. While disconcerting for some, they trusted implicitly in the skill of the pilot. All of the passengers appeared to accept periods of flight in cloud or poor weather as common practice by the pilot. Those that could recall believed that the pilot evenly split his flight time between autopilot and manually-controlled flight. His wife recalled that he would usually hand fly the aircraft when in cloud.

Similar confidence in the pilot's abilities and flight management was expressed by the local pilots who knew the pilot.[8] None could recall the pilot having to divert from his intended destination, which they attributed to the pilot's thorough pre-flight planning.

---

5 Civil Aviation Regulations 1988 – Qualifications of Flight Crew, Part 5.01A.

6 Those endorsements permitted the pilot to navigate and to fix his aircraft's position by reference to those navigation aids. It did not permit their use in the conduct of instrument approach procedures.

7 As at 28 August 2008, the CASR Part Development Status indicated that the target 'Rule to commence' date for Part 61 was 'Dependent on OLDP [Office of Legislative Drafting and Publishing] Drafting'.

8 None of those pilots interviewed held a command instrument rating.

The local pilots observed that the pilot usually conducted a circuit rather than a straight-in approach on arrival at most airfields. Only one could recall the pilot carrying out a straight-in approach to land, and that was in fine and clear daytime conditions.

Of those interviewed, only one person expressed discomfort at the accident pilot's apparent regular operation in what were interpreted as non-VFR conditions.

Aircraft information

The aircraft was imported into Australia from the US and placed on the Australian register in June 1979. The owner-pilot had operated the aircraft since its acquisition in November 1990.

The Log Book Statement Form DA3191 that was affixed to the aircraft's airframe log book stipulated that the aircraft was maintained as a Class B[9] aircraft in accordance with Civil Aviation Advisory Publication (CAAP) 42B-1, in the VFR operational requirement category.

The aircraft was released to service after a 100-hourly maintenance inspection that was carried out at 4,032.2 airframe hours on 18 August 2006. The maintenance release issued at that time, and retrieved from the accident site, stated that the aircraft could be operated in the day and night VFR categories of operation. The aircraft had accrued an additional 72.4 hours prior to the takeoff from Jandakot for Esperance.

A number of people that had flown with the pilot reported that the low-wing monoplane aircraft was well looked after, that there were no noticeable problems with its operation, and that all of its equipment functioned correctly in flight.

The aircraft was not fitted with cockpit voice or flight data recorders, nor were they required by regulation.

Meteorological information

Forecast weather enroute Jandakot to Esperance

In order to facilitate the provision of aviation weather forecasts to pilots by the Bureau of Meteorology (BoM), Australia is sub-divided into a number of forecast areas. A direct flight from Jandakot to Esperance traverses forecast Areas 60 and 63, passing from Area 60 to Area 63 roughly north of Narrogin. Had any pre-flight planning been carried out by the pilot, the most recent BoM forecasts for those areas included the following predicted in-flight conditions:

- Area 60, issued at 1149 and valid from 1600 to 2359 on 26 May 2007:
  - isolated showers with areas of drizzle

9 An Australian aircraft that is not a Class A aircraft. A Class A aircraft means an Australian aircraft, other than a balloon, that is either or both certified as a transport category aircraft, or is or will be used for commercial purposes by the holder of an Air Operator's Certificate.

  - scattered[10] cumulus cloud, with a cloud base of 2,500 ft and cloud tops of 16000 ft; and broken stratocumulus cloud with a base of 3,000 ft and cloud tops of 6,000 ft (cloud base 4,000 ft inland)
  - visibility reducing to 3,000 m in drizzle and 4,000 m in showers
  - freezing level 9,500 ft and moderate icing in cloud above that altitude
  - moderate turbulence in any cumuliform cloud.
- Area 63, issued at 1202 and valid from 1300 to 2359 on 26 May 2008:
  - scattered showers and isolated areas of drizzle more than 111 km inland
  - scattered cumulus cloud, with a cloud base of 2,500 ft (3,500 ft inland) and cloud tops of 16,000 ft (contracting to south of Norseman after 2000); broken stratocumulus with a cloud base of 3,000 ft (4,000 ft inland) and cloud tops of 6,000 ft (becoming scattered inland after 2000); and broken altocumulus/altostratus above 8,000 ft
  - visibility reducing to 3,000 m in drizzle and 4,000 m in showers
  - freezing level 8,000 ft and moderate icing in cloud above that altitude
  - moderate turbulence in any cumuliform cloud.

Amended forecasts were issued by the BoM for Area 60 at 1633 and 1738, and at 1737 for Area 63. None of those amended forecasts changed the above-listed weather conditions as they affected the flight.

Weather conditions at Esperance

Forecast weather

The BoM aerodrome forecast for Esperance that was valid at the estimated time of arrival of the aircraft indicated the presence of light rain showers from 1400, with few clouds with a cloud base of 1,500 ft and broken cloud with a cloud base of 2,500 ft. Between 1400 and 2200, intermittent[11] (INTER) periods of low visibility (4,000M) and broken cloud with a cloud base of 1,000 ft were forecast.

---

10 An okta is the unit of measurement that is used to report the total sky area that is visible to the celestial horizon. One okta is equal to 1/8th of that visible sky area. The term okta is also used to forecast or report the amount of cloud in an area, along a route or at an airfield. The numbers of oktas of cloud are reported or forecast as follows: Few (FEW), meaning 1 to 2 oktas; Scattered (SCT), meaning 3 to 4 oktas; Broken (BKN), meaning 5 to 7 oktas, and Overcast (OVC), meaning 8 oktas.

11 INTER is used to indicate changes expected to occur frequently for periods of less than 30 minutes duration, the conditions fluctuating almost constantly, between the times specified in the forecast.

Actual weather

The Esperance METAR[12] that was issued by the BoM at 1900 recorded an actual wind at Esperance Aerodrome of 250 degrees at 9 kts, layers of broken cloud with cloud bases of 600 ft and 2,600 ft, and overcast cloud with a cloud base of 6,100 ft. Visibility was greater than 10 km, the temperature was 13.3° C and the dew point was 12.9° C. There was 0.2 mm of rain recorded since the previous METAR that was issued at 1830.

An examination of the dewpoint depression[13] by the BoM revealed that it decreased to, and remained less than 1° C between 1800 and 2000. That indicated a low cloud base at the aerodrome.

The actual weather conditions at the aerodrome were also available to the pilot on the Esperance Automatic Weather Information Service (AWIS) discreet radio frequency of 123.05 MHz, or by telephone.

Last light at Esperance on the day of the accident was at 1722.

Aerodrome weather reported by witnesses

The airport manager[14] advised that he left the aerodrome that night at about 1815. The manager commented that the weather conditions at that time included broken cloud with an estimated base of about 500 ft, and that light, steady rain necessitated the continual use of his car's windscreen wipers.

A farmer who lived about 2 km north of the aerodrome reported that the prevailing weather conditions that night included light, drizzling rain and south-westerly winds at 15 to 20 kts.

Flight management

A number of pilots that were involved in a group flying activity from Albany to Esperance and return on the day of the accident reported that they cancelled their planned flight due to the weather conditions. The group's organiser stated that the weather at Esperance was unsuitable for visual flight, and reported conditions that were consistent with those forecast.

A number of pilot friends indicated that the pilot routinely obtained weather information prior to his flights. However, there was no evidence that the pilot accessed the available weather information prior to the departure from Jandakot.

---

12 Routine recordings by automatic weather stations or observations by approved observers of the meteorological conditions at aerodromes.

13 The difference in temperature between the ambient temperature and the dewpoint. The dewpoint is that temperature at which, under ordinary conditions, condensation commences in a cooling mass of air.

14 The airport manager was also a trained BoM weather observer, with extensive experience in that field.

Communications and aids to navigation

Communications

The communications facilities and services that were available to assist the pilot during the flight included with Melbourne Air Traffic Services (ATS) and via the Esperance Common Traffic Advisory Frequency (CTAF).

Communication with ATS was through Melbourne Centre (ML CEN) and was possible enroute from Jandakot to Esperance on a number of frequencies. More specifically, communications with ML CEN was possible in the vicinity of, and on the ground at Esperance, on frequency 133.2 MHz. There was no record of any radio transmissions by the pilot on any of the ML CEN frequencies.

Operations at Esperance required the carriage and use of radio by pilots on the Esperance CTAF (Radio) (CTAF(R)) frequency of 126.7 MHz. Recorded information on that frequency showed that, at 1846:33, the pilot transmitted:

> All stations Esperance, this is Foxtrot Tango Tango [abbreviated, phonetic call sign of the aircraft], Piper Arrow, one five miles to the west inbound, going through 3,500 [ft] on descent.

There were no other recorded radio transmissions by the pilot on that frequency, or by other pilots that might have been able to provide an indication of the actual weather in the vicinity of the aerodrome.

Aids to navigation

The radio navigation and instrument approach and landing (IAL) aids at Esperance included Distance Measuring Equipment (DME), NDB and VOR navigation beacons. Supporting IAL approach plates were published for use by appropriately-qualified pilots. The pilot was not qualified for the conduct of instrument approaches in instrument meteorological conditions (IMC).

Aircraft

The aircraft was equipped with a Garmin 150 Global Positioning System[15] (GPS) receiver that the pilot was known to use. That receiver was certified to a Technical Standing Order[16] (TSO) that was not consistent with its use under the IFR. The use of GPS under the VFR is discussed at page 14.

Reports from a number of people that were familiar with the pilot's regular flights from Jandakot included that, in times of poor visibility, he flew to the threshold of a runway via GPS, before conducting a circuit to land. That was reported to normally entail the conduct of right circuits.

---

15 The Global Positioning System is a highly-accurate, worldwide navigation system that allows users to derive their location by interrogating a network of satellites.

16 Technical Standard Order – Establishes quality control for avionics and other equipment for use in aviation applications.

Aerodrome information

The main runway at Esperance was aligned east-south-east (runway 11) to west-north-west (runway 29). A crossing landing strip was aligned north-north-east (runway 03) to south-south-west (runway 21), and was of gravel construction.

Left circuits were required for all runways.

Aerodrome lighting

General

Runways 11 and 29 were each equipped with runway and taxiway lighting. In addition, precision approach path indicator (PAPI) and low intensity runway lighting (LIRL) systems were available for approaches to those runways. All of those lighting sources and systems were able to be activated by inbound pilots using discrete radio frequency 121.3 MHz.

The airport manager reported that he checked the radio activation of the runway and taxiway lighting from his vehicle on Sunday 27 May 2007. That check confirmed the lights' normal function.

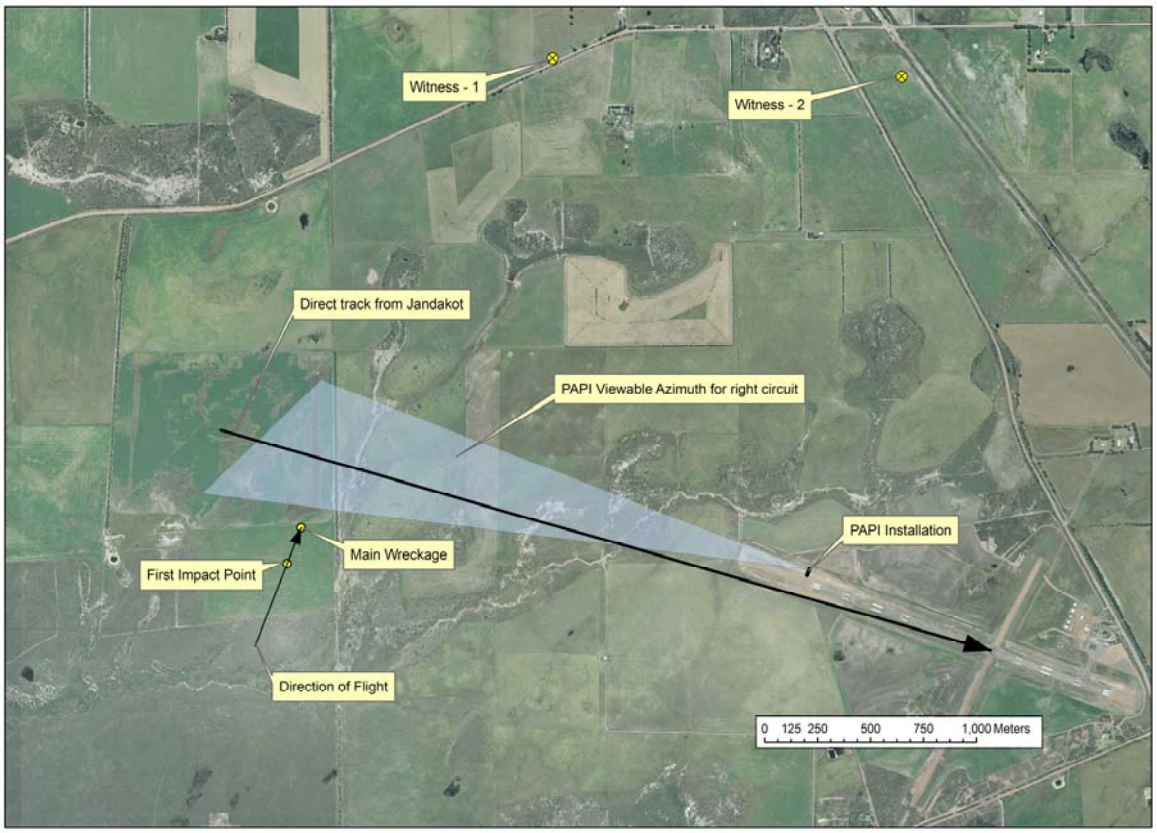
There was no facility to automatically record the activation by pilots of the aerodrome lighting systems.

Precision approach path indicators

The runways 11 and 29 PAPIs were located on the left side of each runway, and provided visual glide slope guidance to pilots during their approaches to land.

The horizontal splay or azimuth of the PAPIs was about 15 degrees either side of the relevant runway centreline. That placed the accident location outside the viewable azimuth for the runway 11 PAPI (Figure 2). In that case, the PAPI would not have been visible to the pilot immediately prior to, or from overhead the site of the accident.

Figure 2: Runway 11 PAPI azimuth and accident location[17]



The PAPI was last ground and flight checked on 12 February 2007 following its relocation after the lengthening of the runway. No abnormalities were documented as a result of either check.

Night operations at Esperance

The location of the aerodrome, 22 km from the lights of Esperance township, contributed to the development of dark night conditions for the pilot's approach to land. That was, the only illumination available was from the airport lighting facilities themselves, augmented by whatever celestial illumination was available. On the night of the accident, the available celestial illumination would have been reduced by the layers of broken and other cloud.

A number of commercial pilots who regularly operated to and from Esperance at night related that, due to its remoteness from the township, there were particular challenges as a result of the associated dark night conditions creating a 'black

17 This aerial photograph was taken before runway 11/29 was lengthened. The PAPI installation is shown in the correct position following that lengthening of the runway, and was its location at the time of the accident.

hole[18]' effect. One pilot stated that it was unlikely that the township lighting would assist a NVFR pilot to maintain an awareness of the horizon. The risk of a 'black hole' illusion is discussed further at page 16.

Wreckage and impact information

The accident site was located about 2 km west of the threshold of runway 11. The terrain was flat farm land, with a number of trees in the vicinity.

Wreckage examination

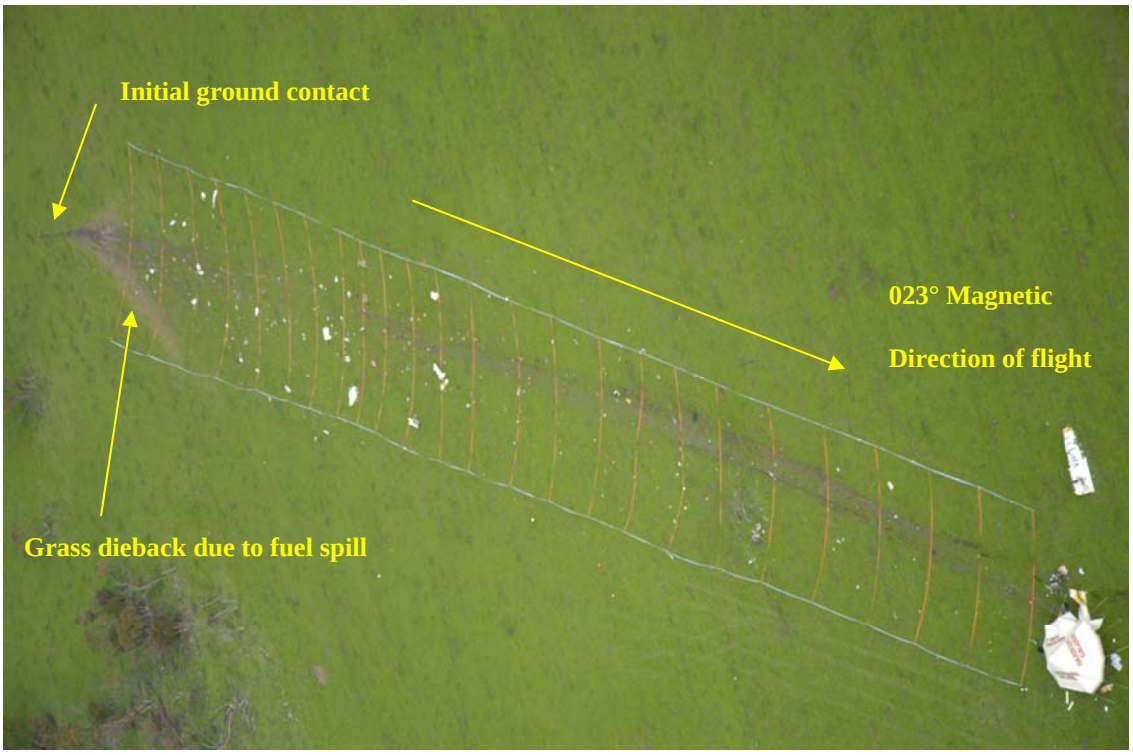
The aircraft impacted the terrain on a heading of 023 degrees magnetic in a right wing-low, nose-down attitude. The right wing separated from the fuselage and both wings' integral fuel tanks were ruptured during the initial impact. That was consistent with the evidence of fuel spillage early in the debris trail (Figure 3).

After the initial impact with terrain, the aircraft cart wheeled, before tumbling a number of times and breaking up. During that break-up, the horizontal stabiliser, left wing tip fairing, left aileron, engine cowl, flight instruments, undercarriage and a number of items of personal baggage detached or were thrown from the aircraft. The forces associated with the impact sequence and subsequent ground slide breached the cabin space.

The left wing and remnant fuselage came to rest approximately 166 m from the initial ground impact point. The engine was the final large piece of wreckage in the debris trail. The undercarriage was extended. The flap lever appeared to be in the first detent or stage of flap deployment but, due to the severe impact damage to the system, the position of the aircraft's flaps could not be verified.

18 The term 'black hole' is generally used to describe aerodromes that are 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 sensory and other illusions.

Figure 3: Aerial photograph of wreckage trail



All flight control cable runs were examined for continuity and were found to have been disrupted as a consequence of the impact sequence. No pre-existing defects were identified. The right aileron bellcrank was separated from its mounting within the wing structure. The nature of that separation could not be readily identified on-site and the bellcrank was recovered for technical examination.

The engine-driven vacuum pump assembly was destroyed by impact forces. The pump's nylon drive coupling was intact prior to its separation from the engine during the impact sequence.

The engine and propeller, and a number of gyroscopic and other flight instruments and aircraft items and components were recovered from the site for technical examination.

Examination of items and components recovered from the wreckage

Engine and propeller

The engine was disassembled and inspected at an authorised overhaul facility under the supervision of the Australian Transport Safety Bureau (ATSB). No anomalies were noted that would have prevented the normal operation of the engine.

Technical examination of the propeller showed that the aerofoil section of both propeller blades sustained moderate levels of deformation along the span. That damage was consistent with its occurrence during the impact sequence. There was

no evidence of any pre-existing defect or other anomaly that could have influenced the performance of the propeller assembly.

Metallurgical examination of the propeller blades revealed damage that was indicative of the aircraft striking the ground while under power, and with a significant yawing or sideways/slewing motion. The leading edge abrasion and axial twisting of the blade aerofoil sections were the principal indicators in that respect.

Exhaust system

A segment of exhaust header was removed from the engine for technical examination of the impact-related fracture surfaces. That examination showed evidence of 'deep straw' thermal tinting on the fracture surfaces. A colour comparison with an alloyed and unalloyed steel temperature chart showed that, at the time of the fracture, the exhaust system was operating at an estimated metal temperature of around 240 to 250° C. That was considered to be within the engine's normal operating range.

Aileron bellcrank

Metallurgical and microscopic examination of the right aileron bellcrank revealed that the damage to the component was consistent with the forces and loads sustained during the impact and break-up of the aircraft. There was no evidence of any pre-existing defect or cracking of the bellcrank, or indication of its abnormal operation.

Lighting

An examination of the instrument panel lighting loom and associated bulbs revealed filament stretch that was consistent with their being illuminated at the time of impact. That indicted that the aircraft's lighting system was functional at that time.

Instrument gyroscopes

A technical examination of the aircraft's electrical and vacuum-driven instrument gyroscopes found evidence of rotational scoring to those instruments' rotating and stationary component parts. That was consistent with their operation at the time of impact.

Global positioning system

Due to severe impact damage, no data was able to be downloaded from the aircraft's Garmin 150 GPS equipment.

Fuel

The impact damage to the aircraft's fuel tanks prevented the collection of a fuel sample from the aircraft for subsequent examination. However, the aircraft was refuelled prior to its departure from Jandakot and had completed almost 2.5 hours of apparently incident-free flight prior to the accident. That suggested that there had been no problem with the fuel onboard the aircraft.

In addition, there were no problems reported with the quality of the fuel from the Jandakot fuel supply by the pilots of other aircraft that refuelled from that source on the day of the accident.

Summary

The results of the on-site examination of the aircraft wreckage, and of the technical examination of the recovered items and components were consistent, and showed that the aircraft's engine, aircraft and electrical systems, and instruments were capable of normal operation prior to the impact with the ground. Further, the aircraft's electrical system was powered, and its instrument gyros were operating, at the time of impact.

Medical information

Post mortem examination revealed a 90% narrowing of the pilot's left anterior descending coronary artery. The examining pathologist advised that:

- the pilot succumbed to crash-related injuries
- there was no evidence to suggest that the pilot suffered any sudden illness or incapacity that may have affected his ability to control the aircraft.

A specialist cardiologist consulted by the family of the pilot during their review of the draft report considered that the results of the pilot's post mortem indicated 'a severe narrowing at the origin of the left anterior descending coronary artery.' The specialist suggested that that condition 'could have been responsible for sudden cardiac death due to ventricular arrhythmia without evidence of acute myocardial infarction.' When queried as to the likelihood for that to have occurred, the cardiologist described a cardiac event as being 'possible'.

The pilot's family advised that the family had a history of coronary heart disease.

Survival aspects

The destruction of the aircraft's cockpit and passenger cabin as a result of the impact forces rendered the accident non-survivable.

Organisational information

Civil Aviation Advisory Publication (CAAP) 5.13-2(0), titled *Night Visual Flight Rules Rating* advised that NVFR was not the same as night flight under the IFR, despite both requiring proficiency in instrument flying, and the use by pilots of radio navigation aids. The CAAP explained that the procedures differed because flight under the NVFR was based on the use of visual procedures in VMC.

Regulatory and other requirements affecting the flight

An examination of the regulatory and other requirements affecting flight under the night VFR, and of the in-flight weather conditions for such flight was undertaken during a number of ATSB investigations. Most recently, those examinations were

reported in ATSB investigation reports BO/200304282, BO/200505107 and AO-2007-014. The relevant regulatory and other requirements that affected the pilot's flight to Esperance included:

- **Visual meteorological conditions (VMC).** Whether by day or night, flight under the VFR requires specified minimum conditions of visibility and distance from cloud that are collectively known as VMC. The variables that can affect those specified conditions include the class of airspace in which a flight is undertaken, the height of that flight and the type of aircraft. The flight to Esperance at 9,500 ft required the following VMC criteria:
  - a minimum flight visibility of 5,000 m
  - the aircraft to be maintained 1,000 ft vertically and 1,500 m horizontally from any cloud.

  Flight below 3,000 ft AMSL or 1,000 ft above ground level (AGL), whichever was higher, required:
  - a flight visibility of 5,000 m
  - flight to be clear of cloud and insight of ground or water.
- **VFR flight on top of more than scattered cloud.** VFR flight was possible by the pilot on top of more than scattered cloud provided that:
  - VMC was able to be maintained during the entire flight, including in the climb out of Jandakot, the cruise, and in the descent into Esperance
  - the pilot was able to satisfy the navigation and position fixing requirements of the Aeronautical Information Publication (AIP) ENR 1.1 paragraph 19.2.1 sub-para b., or the other navigational requirements of sub-section 19.1.
  - prior to conducting the flight on top of more than scattered cloud, the pilot ensured that the current forecasts and observations (including those available once airborne) indicated that the conditions in the area of, and during the period of, the planned descent below the cloud layer(s) permitted his descent to be conducted in VMC
  - the position at which the pilot planned to descend below cloud enabled him to continue to Esperance and, if required, to an alternate aerodrome in VMC. A number of cautions were provided in the AIP, including that:

    > Pilots should not initiate VFR flight on top of more than SCT cloud when weather conditions are marginal. Before committing to operate VFR on top of more than SCT cloud, pilots should be confident that meteorological information used is reliable and current, and clearly indicates that the entire flight will be able to be conducted in VMC.
- **Use of GPS equipment.** AIP GEN 1.5 paragraph 8.5.4.1(a) allowed the use of GPS by the pilot 'to supplement map reading and other visual navigation techniques.' If the pilot did rely on his GPS during the flight to Esperance, that did not absolve him from the VFR navigation requirements of AIP ENR 1.1 paragraph 19.2.1.

Additional information

A number of ATSB investigation and other reports[19,20,21,22] and articles by a number of other agencies and bodies have cautioned pilots of the risks associated with flight under the NVFR, and of VFR flight in less than VMC conditions. In addition, an extensive resume of the hazards affecting flight under the NVFR is available in CAAP 5.13-2(0): *Night Visual Flight Rules Rating*. Some of those hazards are reviewed in the following paragraphs.

Pilot weather-related decision-making

The ATSB aviation and research analysis report B2005/0127, titled *General aviation pilot behaviours in the face of adverse weather* examined the decision-making behaviours amongst pilots that were involved in 491 accidents and incidents in Australia as a result of adverse weather. It was determined that there were three primary pilot decision-making behaviours:

- those that resulted in VFR flight into IMC, the risk of which increased as a flight progressed and represented the greatest threat to flight safety
- those in which pilots conducted a weather-related precautionary landing
- those in which the affected pilot made a decision to take significant weather-related avoidance action.

In general, the conduct by a pilot of a weather-related precautionary landing, or of significant action to avoid weather was undertaken before the mid-point of a flight. The risk of VFR flight into IMC by pilots that continued their flights in the face of adverse weather maximised during the final 20% of the flights' distances, and highlighted the danger of pilots pressing on in an attempt to reach their destination.

It was identified that 76% of the VFR into IMC accidents examined involved or resulted in a fatality(ies).

Spatial disorientation

A pilot relies on a number of sensory systems in order to establish or maintain orientation:

- The visual system, which receives its information from the eyes. If in receipt of visual cues, this system can normally be relied on to correct potentially conflicting signals from the other sensory systems. Should visual reference be interrupted or become misleading, such as in the case of a visual illusion, the

---

19 Most recently BO/200304282, BO/200505107 and AO-2007-014, available at www.atsb.gov.au.

20 ATSB Aviation Research and Analysis Report B2005/0127: *General aviation pilot behaviours in the face of adverse weather*, available at www.atsb.gov.au.

21 ATSB Aviation Research and Analysis Report B2006/0352: *CFIT: Australia in context 1996 to 2005*, available at www.atsb.gov.au.

22 ATSB Aviation Research and Analysis Report B2007/0063: *An overview of spatial disorientation as a factor in aviation accidents and incidents*, available at www.atsb.gov.au.

other sensory inputs can quickly become erroneous and, in the worst case, overpowering.

- The vestibular system, which obtains its information from the balance organs in the inner ear.
- The somatic or proprioceptive system, which uses the nerves in the skin, muscles and joints to sense gravity and other pressures on the body.

The vestibular and somatic (or proprioceptive) systems are each unable to distinguish between the force experienced as a result of gravity and accelerative forces experienced during flight. Reliance by a pilot on those systems in isolation can quickly result in that pilot's disorientation. A state of confusion results for the affected pilot, and can lead to incorrect control inputs and a loss of aircraft control.

The ATSB aviation and research analysis report B2007/0063, titled *An overview of spatial disorientation as a factor in aviation accidents and incidents* found that:

> when a pilot was unaware that he/she was spatially disorientated (Type I – unrecognised spatial disorientation), he/she continued to fly the aircraft as normal without corrective action.

and that:

> The pilot did not take any appropriate corrective action, since they did not perceive that there was in fact a problem. The fully functioning aircraft was then flown into the ground, with often fatal results.

'Black hole' illusion

The 'black hole' illusion is a particular visual illusion that can occur at aerodromes that have little or no ground lighting on the approach path or in the vicinity of the destination aerodrome. Such lighting would, if available, provide visual clues to the landing pilot. A lack of visual cues adversely affects the pilot's depth perception, and results in difficulty estimating height and distance.

When approaching to land in conditions that are conducive to the existence of a 'black hole' illusion, there can be a strong tendency by pilots to descend below their intended approach path, and to undershoot the intended runway. The lack of visual cues and associated risk of visual illusions as a result of 'black hole' conditions, requires pilots to carefully plan and execute their approach and landing to remotely-located aerodromes.

ANALYSIS

There was no evidence of any technical defect or other failure of the aeroplane, or of its associated systems, prior to the impact with terrain. That, the normal operation of the approach and landing aids, and apparent activation of the aerodrome lighting, suggested that the most likely factors that contributed to the development of the occurrence related to the operation of the aircraft. The following analysis will examine those factors.

Meteorological conditions affecting the flight

The latest meteorological forecasts prior to the pilot's departure from Jandakot suggested that the pilot may have been able to have remained in visual meteorological conditions (VMC) at 9,500 ft above mean sea level (AMSL) until approaching Narrogin. However, the forecast scattered cloud in the early part of the flight, with tops above the pilot's cruise altitude, would have been cause for concern.

In the latter stages of the flight, the forecast broken cloud with a cloud base below the pilot's cruising altitude represented a risk for the pilot's continuing flight in VMC. That risk was compounded by the forecast 8,000 ft freezing level affecting that portion of the flight, and by the possibility of moderate icing in any cloud above that altitude.

The investigation concluded that, based on the forecast weather conditions for Area 63, it would have been difficult for the pilot to have determined during any pre-flight planning that the entire cruise portion of the flight was possible in VMC.

The Bureau of Meteorology (BoM) forecast and observed cloud at Esperance was consistent with that reported by the airport manager and nearby farmer. Indeed the forecast broken cloud and 4,000 m visibility, and observed overcast at 6,100 ft indicated that conditions in the vicinity of Esperance were marginal, and that it was unlikely that the pilot would be able to maintain VMC during the descent and manoeuvring in the circuit area. That was corroborated by the decision by the organiser of the Albany group flying activity to cancel that group's planned flight to Esperance that day.

VFR flight on top of more than scattered cloud

The forecast enroute weather, and weather in the vicinity of Esperance, meant that the pilot must have committed to the night VFR (NVFR) flight in the knowledge that it required flight on top of more than scattered cloud. However, the forecast weather conditions, particularly those expected to affect the descent and approach to land at Esperance, showed the high risk nature of that decision.

On the basis that the pilot could not assure himself of maintaining VMC, particularly during the descent into Esperance, the investigation concluded that NVFR flight above more than scattered cloud was not possible. In that case, the pilot conducted at least portions of the flight in instrument meteorological conditions (IMC) for which he was not qualified, and for which the aircraft was not maintained. That elevated the risk that the non-instrument-rated pilot would, once

deprived of any visual references, or during the unapproved conduct of any instrument approach procedure, become disoriented, and lose control of the aircraft.

Approach and landing at Esperance

As previously indicated, the weather conditions in the vicinity of Esperance and in the circuit area were marginal, such that flight under the VFR was unlikely. The investigation considered the available approach and landing options, and the associated risks, as they affected the VFR pilot's arrival at Esperance.

The location of the accident site and orientation of the wreckage was consistent with the reported normal action by the pilot in bad weather to locate himself overhead the threshold via his onboard global positioning system (GPS) equipment, before carrying out a right circuit to land. That was, the pilot was probably on a right base to land runway 11 when the aircraft impacted the ground.

Given the forecast and observed weather conditions at Esperance, it was unlikely that the pilot established himself in the circuit area while maintaining VMC. However, the position of the aircraft on a probable right base for runway 11 suggested that, either the pilot had successfully carried out the approach or initial part of the circuit in 'visual' conditions, or that he had somehow re-established visual contact with the ground after a time in IMC. The investigation could not discount that the pilot may have inadvertently re-entered IMC on base to runway 11, become disoriented and lost control of the aircraft.

In any case, a decision by the pilot to conduct a right circuit to land on runway 11 meant that the pilot's view of the runway and other aerodrome lights would have been obscured by the aircraft's low right wing, by the passengers, and by the cabin roof in any right turn. That would have minimised the utility of those lights, particularly when turning onto base, and would have increased the risk of the pilot's view of the runway and aerodrome lights being interrupted. Any interruption to the pilot's view of those lights heightened the risk of the pilot becoming disoriented, applying incorrect control inputs, and losing control of the aircraft.

The remote location of the aerodrome and reported low cloud base would have combined to produce 'dark night' conditions for the pilot's approach and landing. In addition, the location of the accident outside the splay of the precision approach path indicator (PAPI) meant that the right base was carried out with little or no ground or approach lighting. That was, in conditions that were conducive to the existence of a 'black hole' illusion.

The likely 'black hole' illusion would have adversely affected the pilot's depth perception during the base turn, and resulted in the pilot experiencing difficulty estimating height and distance. In that case, there would have been a strong tendency for the pilot to descend below the intended approach path and, as a result, to undershoot the intended runway. That could explain the pilot's inadvertent descent and impact with terrain.

Medical information

The effect on the pilot of any stress associated with the descent in IMC and approach to land in marginal weather conditions could not be quantified. The

reported previous flights by the pilot in those sorts of conditions may have acted to normalise that behaviour, lessening any stress felt by the pilot.

The investigation was unable to quantify the cumulative effect of any stress experienced by the pilot and the pilot's cardiac condition to increase the risk of a cardiac event during the approach to land.

Summary

The investigation was unable to conclusively establish the reason for the impact with terrain. The investigation could not exclude the possibility of a sudden incapacitation of the pilot due to a cardiac condition. However, the weather conditions enroute to, and in the vicinity of Esperance were such that the pilot’s decision to attempt the flight indicated a low appreciation, or an acceptance, of the associated risks. The attempted approach and landing under those conditions represented a significant level of risk for any NVFR flight.

FINDINGS

From the evidence available, the following findings are made with respect to the collision with terrain involving VH-FTT and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factor

- The pilot committed to a night visual flight rules (NVFR) flight on top of more than scattered cloud, despite being unable to assure himself that visual meteorological conditions (VMC) were possible for the duration of the flight.

Other safety factors

- The pilot conducted at least portions of the flight in instrument meteorological (IMC) conditions, for which he was not qualified, and for which the aircraft was not maintained.
- The weather conditions in the vicinity of Esperance and in the circuit were marginal, making flight under the VFR unlikely.
- The decision by the pilot to conduct what appeared to be a right circuit would have minimised the utility of the available runway and other aerodrome lights, and elevated the risk of the pilot being affected by some form of visual illusion, or spatial disorientation.
- The remote location of the aerodrome and reported low cloud base combined to produce ‘dark night’ conditions for the approach and landing that were conducive to the existence of a ‘black hole’ illusion.
- The pilot’s decision to attempt the flight in the prevailing weather conditions indicated a low appreciation, or an acceptance, of the associated risks.
- There was a 90% narrowing of the pilot's left anterior descending coronary artery.

Other key finding

- The aircraft and relevant aerodrome facilities and lighting were capable of normal operation.
- It was not possible to exclude the possibility of a sudden incapacitation of the pilot due to a cardiac condition.

APPENDIX A: SOURCES AND SUBMISSIONS

Sources of information

- The sources of information during the investigation included:
- the Bureau of Meteorology
- Airservices Australia
- Esperance Aerodrome recorded radio transmissions
- Esperance Airport Manager
- Civil Aviation Safety Authority
- Office of the Coroner of Western Australia
- Western Australia Police
- Western Australian Land Information Authority (Landgate)
- hearing and other witnesses to the event
- family and friends of the aircraft occupants
- specialist cardiologist that was engaged by a family
- aircraft maintenance organisation
- telephone service provider
- aircraft manufacturer
- aircraft engine manufacturer
- US Federal Aviation Administration.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the Civil Aviation Safety Authority (CASA), Office of the Coroner of Western Australia and the families of the aircraft occupants.

Submissions were received from the family of the pilot. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.