



Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Cessna 182, VH-KKM

19 km WSW of Mount Hotham Airport, Victoria | 23 October 2013



Investigation

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Addendum

Page	Change	Date
6	First line of the paragraph under the heading <i>BoM</i> , delete Mount Hotham Airport.	17 April 2015

Safety summary

What happened

On 23 October 2013, the pilot of a Cessna 182Q aircraft, registered VH-KKM and operating under the visual flight rules, departed Moruya Airport, New South Wales on a private flight to Mangalore Airport, Victoria. The flight route encompassed the Alpine National Park, where the forecast and actual weather included extensive thick cloud and severe turbulence.

Shortly after passing Mount Hotham Airport, Victoria, the aircraft collided with terrain on the eastern side of Mount Blue Rag, at about 5,000 ft above mean sea level. The pilot sustained fatal injuries and the aircraft was destroyed.

VH-KKM



Source: Aircraft owner

What the ATSB found

The ATSB found that the visual flight rules-qualified pilot had minimal total and recent flying experience and departed Moruya with less than visual meteorological conditions forecast along the planned route. It was very likely that these conditions were encountered shortly after passing Mount Hotham Airport, while flying over the Alpine National Park. From the evidence available it was likely that the pilot encountered reduced visibility to the extent that terrain avoidance could not be assured, resulting in the aircraft colliding with terrain in controlled flight.

Safety message

This accident highlights the risks associated with operating under the visual flight rules in adverse weather, particularly when flying in a challenging environment such as in mountainous terrain.

Thorough pre-flight planning is essential for avoiding weather. It is not only important to obtain the relevant weather forecasts to develop a mental picture of the conditions that may be encountered, but also to assess this information and understand how it relates to the planned flight. In forecast marginal weather, this involves consideration of alternative options such as diverting or turning back and pilots assessing their skills and/or aircraft's suitability for the task in the conditions.

During flight, pilots must continuously assess the weather for conditions that may adversely affect the safety of the flight and be prepared to use an alternative course of action if conditions deteriorate. This can include seeking assistance, such as that available from air traffic control.

The ATSB is concerned about the frequency of accidents – many fatal – that involve pilots flying with reduced visual cues. This has been highlighted on the ATSB website www.atsb.gov.au as a SafetyWatch priority, along with a number of strategies to help manage the risk and links to relevant safety resources.

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The occurrence

On 23 October 2013, the pilot of a Cessna 182Q aircraft, registered VH-KKM (KKM), departed Moruya, New South Wales at about 0815 Eastern Daylight-saving Time,¹ for Mangalore, Victoria on a private flight under the visual flight rules (VFR).² The weather conditions for the departure were reported as being clear.

Prior to departing, the pilot downloaded the appropriate weather forecasts for the flight between 0511 and 0637, and was observed conducting a daily aircraft inspection. The pilot discussed their planned route over the mountains with another pilot at Moruya and at about 0744 submitted a flight plan to Airservices Australia, with a nominated SARTIME³ for his arrival at Mangalore of 1130. The flight plan indicated a track from Moruya Airport to Mangalore Airport via Mount Hotham Airport. Planned cruise was at 6,500 ft above mean sea level (AMSL) (Figure 1).⁴

Figure 1: Flight planned routes



Source: Google earth, modified by the ATSB

Recorded Airservices Australia surveillance data identified a radar return at 0826, about 8 NM (15 km) to the south-west of Moruya at 6,400 ft. The absence of other known aircraft in the area and correlation of this return with KKM's departure time, planned track and initial cruising altitude, meant that it was very likely that the radar return was from KKM. Subsequent recorded data showed that at about 0908, the aircraft was about 6 NM (11 km) south-south-west of Cooma and tracking towards Mount Hotham Airport at 7,300 ft. Due to limited radar coverage along the remainder of the aircraft's track, which was only available above 8,000 ft, no further radar returns from KKM were recorded.

At about 1015–1030, a witness at Mount Hotham Airport observed an aircraft, the description of which was consistent with the look of KKM, pass nearby. At about 1030, another witness located about 22 km west of Mount Hotham Airport heard an aircraft operating nearby (Figure 2).

At about 1330, the flight was reported overdue by the aircraft owner. The subsequent search and rescue response located the aircraft wreckage the next day in mountainous terrain,

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

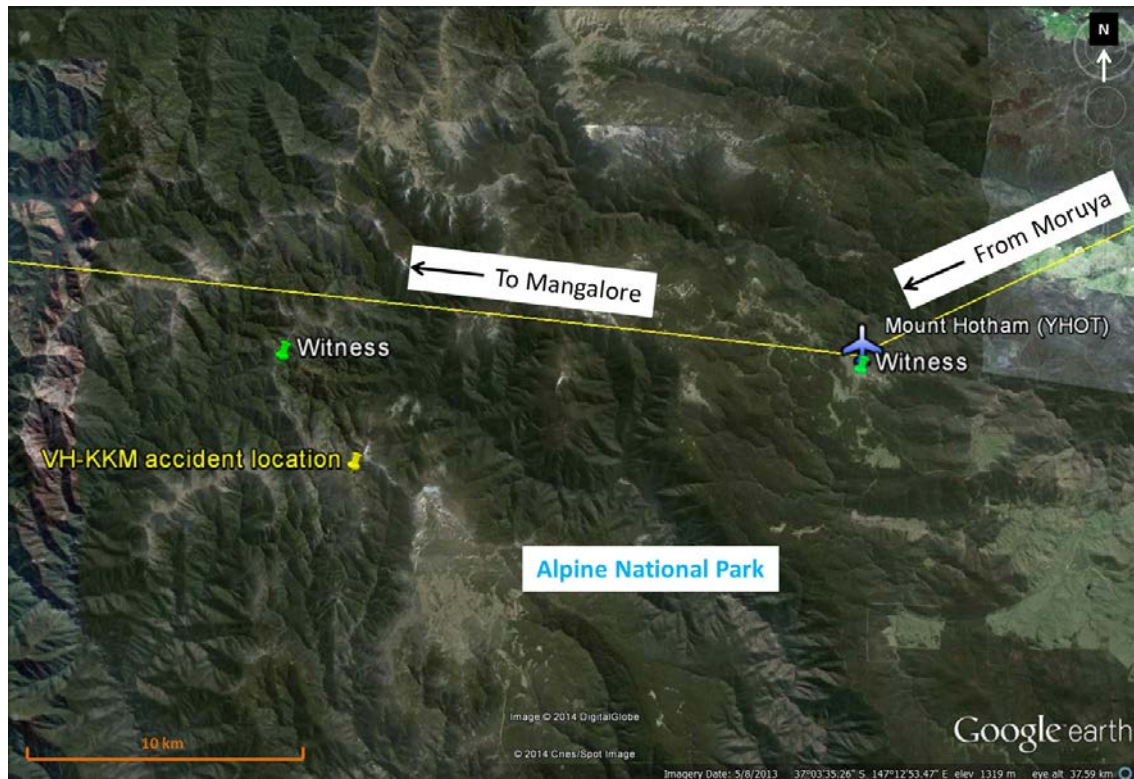
² Visual flight rules (VFR) are a set of regulations that allow a pilot to only operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

³ Time nominated by a pilot for the initiation of search and rescue action if a report from the pilot has not been received by the nominated unit.

⁴ The flight was conducted in Class G (non-controlled) airspace, in which VFR flights receive an on-request Flight Information Service.

19 km west-south-west of Mount Hotham Airport (Figure 2). The pilot sustained fatal injuries and the aircraft was destroyed.

Figure 2: Accident and witness locations



Source: Google earth, modified by the ATSB

Context

Pilot information

The pilot held a Private Pilot (Aeroplane) Licence that was issued on 13 September 2001. The pilot's logbook showed a total flying experience of 284 hours over the 12 years from that time. The last logbook entry was dated 19 March 2013, nearly 7 months before the accident. The pilot last completed an aeroplane flight review, which was carried out in KKM, on 13 October 2012. The pilot did not hold an instrument rating and had recorded a total of 4 hours of instrument time. The most recent instrument training recorded was on 11 November 2003.

A pilot at Moruya who conversed with the pilot of KKM on 22 and 23 October 2013 reported that he appeared healthy and happy. It was reported by family members and the aircraft owner that there was no apparent time pressure on the pilot to return to Mangalore.

Medical information

The pilot held a Class 2 Medical Certificate, valid until 1 June 2014. The certificate required the pilot to wear distance vision correction and a headset while flying and have vision correction available for reading. The ATSB was unable to determine whether distance vision correction spectacles or a headset were worn by the pilot at the time of the accident.

A post-mortem examination of the pilot did not identify any pre-existing medical conditions that may have contributed to the accident.

Aircraft information

The aircraft was not approved for operations under the instrument flight rules.⁵ However, it was equipped with vacuum-driven instrumentation to allow a suitably-qualified and experienced pilot to control the aircraft with reference to these instruments, such as in the case of inadvertent entry into instrument meteorological conditions (IMC).⁶

The aircraft was powered by a six-cylinder, normally-aspirated, horizontally-opposed and air-cooled engine. In such engines, fuel and air are mixed via carburettor before flowing to the cylinders for ignition.

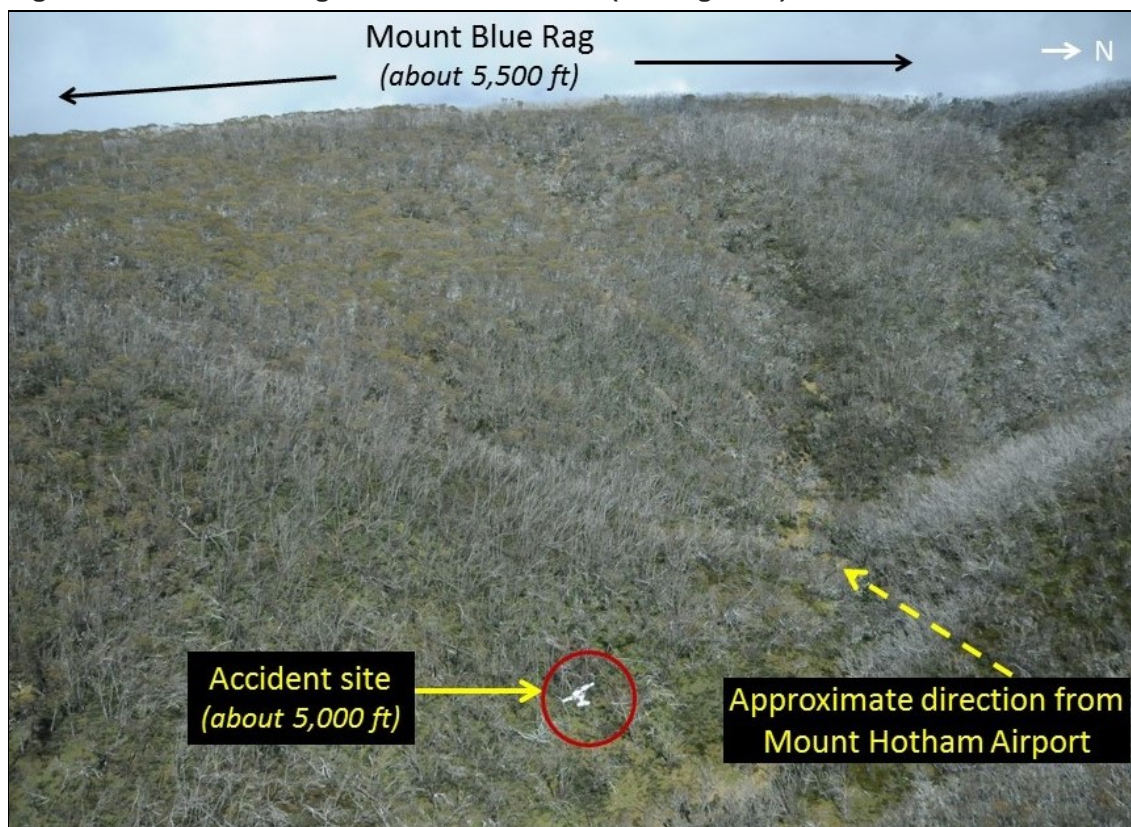
Wreckage and accident site information

The wreckage was located on the eastern side of Mount Blue Rag in the Alpine National Park at an elevation of about 5,000 ft (Figure 3). This was about 500 ft below the ridgeline.

⁵ Instrument flight rules (IFR) permit an aircraft to operate in instrument meteorological conditions (IMC), which have much lower weather minimums than visual flight rules. Procedures and training are significantly more complex as a pilot must demonstrate competency in IMC conditions, while controlling the aircraft solely by reference to instruments. IFR-capable aircraft have greater equipment and maintenance requirements.

⁶ IMC describes weather conditions that require pilots to fly primarily by reference to instruments, and therefore under instrument flight rules, rather than by outside visual references. Typically, this means flying in cloud or limited visibility.

Figure 3: Mount Blue Rag and the accident site (looking west)



Source: Victoria Police, modified by the ATSB

Examination of the wreckage found that the aircraft collided with rising terrain while travelling in a south-westerly direction, with the wings level and a nose-down attitude of about 6–10°, consistent with controlled flight into terrain (see the section titled *Controlled flight into terrain*). The impact severely compressed the wings and fuselage. The fuel tanks, located within the wings, ruptured at impact but there was no post-impact fire (Figure 4).

The engine, propeller and part of the forward fuselage were buried into the rising terrain, consistent with high forward velocity at impact. The engine and propeller were removed from the ground for examination. This examination established engine and engine control continuity, and that the propeller was producing significant thrust, consistent with normal engine operation at impact.

Continuity of the airframe and airframe flight controls was established.

Examination of the aircraft's vacuum-driven instruments established that they were functioning at impact. The aircraft's altimeter was 'captured' at an indication of 5,000 ft, which was consistent with the elevation of the accident site.

No defects were found with the aircraft or its systems that may have contributed to the accident.

Figure 4: Aircraft wreckage



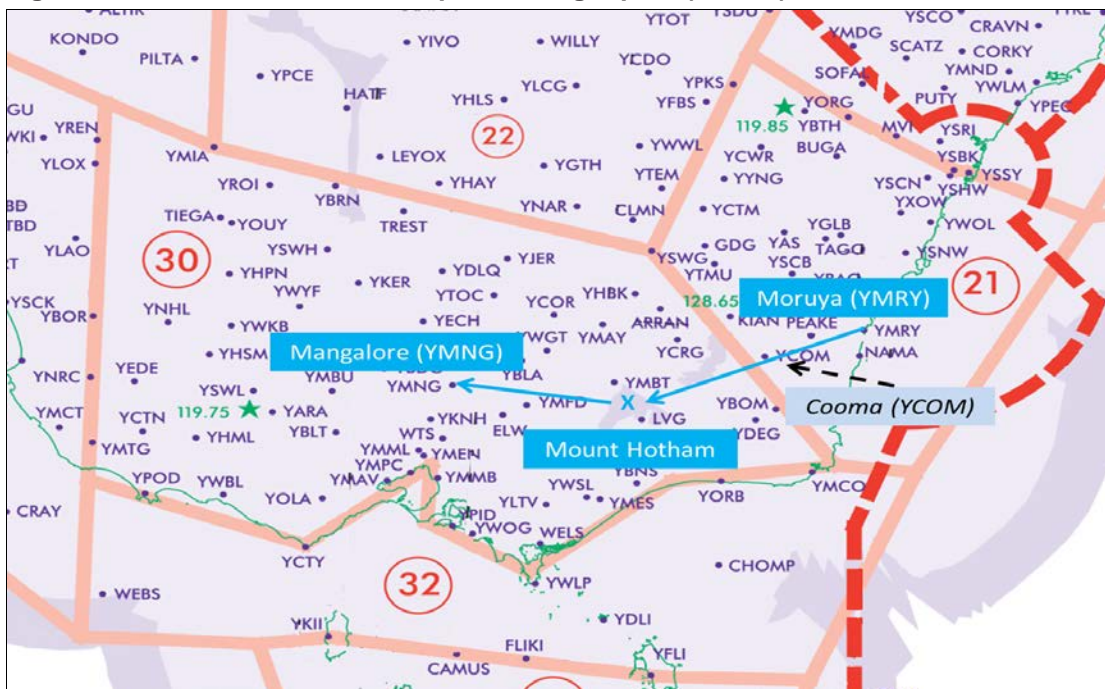
Source: ATSB

Meteorological information

Bureau of Meteorology forecasts

The Bureau of Meteorology (BoM) divides Australia into a number of forecast areas to facilitate the provision of aviation weather forecasts. The initial section of the flight was contained within Area 21, while the remainder of the flight, after passing Cooma, was located within Area 30 (Figure 5).

Figure 5: Areas 21 and 30 and the planned flight path (in blue)



Source: Airservices Australia, modified by the ATSB

Area 21

An amended Area 21 area forecast (ARFOR) was issued by the BoM at 0308 on 23 October 2013 and was valid to 1600 that day. The forecast included broken⁷ low cloud on the ranges and in precipitation and severe turbulence below 10,000 ft on, and in the lee of the mountain ranges.

Area 30/32

An amended Area 30/32 ARFOR was also issued by the BoM at 0307 on 23 October 2013 and was valid to 1600. The forecast weather in the vicinity of the flight-planned route at the estimated time KKM would have been in the area included broken cloud between 400 ft and 2,500 ft with tops to 8,000 ft and areas of broken cloud above 8,000 ft. Mist patches were forecast on the ranges (encompassing the Alpine National Park Region) tending to fog in the Gippsland area, with visibility reduced to 2,000 m in mist and 500 m in fog. Scattered showers and severe low-level turbulence were expected, and severe icing forecast above 9,000 ft.

Observations of the weather in the area

BoM

None of the nearby automatic weather stations (AWS)⁸, including at Mount Hotham, Omeo and Falls Creek were equipped with visibility sensors. However, the high relative humidity recordings by those stations indicated that there was a reasonable chance of isolated hill fog patches in the area.

Surface wind conditions in the area were generally from the north-west to the north-east at 15 to 20 kt, increasing up to 25 kt at the higher AWS elevations. Upper-level wind observations from Melbourne Airport, Victoria and Wagga Wagga Airport, New South Wales indicated the likely presence of severe turbulence below 10,000 ft. This was consistent with the observation of rotor clouds in that area (see the section *After-accident examination of the weather affecting the flight*).

Witness observations

At about 1015–1030, a witness at Mount Hotham Airport observed an aircraft matching the description of KKM pass near the airport. The witness reported that the aircraft appeared to be tracking towards 'stormy weather' and that there was cloud at the top of and down the mountain ranges towards Hotham Heights (about 18 km west-north-west of the airport). Furthermore, rain, fog and gusty winds conditions were observed in the Mount Hotham area but no ice was reported at the airport.

At about 1030, a witness who was camping about 5 km north-west of the accident site at an elevation of about 4,900 ft was seated inside their caravan when they heard an aircraft operating in the valley east of their position. The witness opened the door of their caravan and looked outside in an attempt to locate the aircraft. However, due to low cloud or thick fog, the witness was unable see beyond an estimated 50 m.

After-accident examination of the weather affecting the flight

An after-accident examination by the BoM of the Mean Sea Level pressure charts from about the time of the accident showed a trough associated with a low-pressure system moving slowly across Victoria and producing scattered showers and an extensive area of low cloud covering most parts of the state. Satellite images indicated an extensive area of thick, low-level cloud in the vicinity and

⁷ Cloud cover is normally reported using expressions that denote the extent of the cover. The expression few indicates that up to a quarter of the sky was covered, scattered indicates that cloud was covering between a quarter and a half of the sky. Broken indicates that more than half to almost all the sky was covered, while overcast means all the sky was covered.

⁸ An AWS is a meteorological station at which observations are made and transmitted automatically. It is designed to provide data to the Bureau's forecasting, warning and information services, and providing data for their climate database.

stratocumulus cloud in the lee of the ranges, indicating the existence of rotor clouds and rotor waves.

The aerological diagram for Melbourne Airport, Victoria at 1000 showed a saturated atmosphere favourable for the formation of cloud in any layer below 8,000 ft. As the cloud tops were generally higher than the freezing level of 8,000 ft, it was likely that moderate icing was also experienced above that altitude.

High resolution radar imagery showed isolated areas of light precipitation around the accident location at about 1030.

The BoM's examination concluded that the relevant forecasts issued were consistent with the likely weather conditions experienced at the time of the accident.

Estimation of the cloud base in the area

A conservative estimation of the cloud base in the area, based on the outside air temperature and dewpoint temperature⁹ obtained from the nearby AWSs, was undertaken by the ATSB. Table 1 is a summary of the derived cloud base for Mount Hotham Airport and Mount Hotham (about 20 km west-north-west of Mount Hotham Airport and in the vicinity of Hotham Heights).

Table 1: Estimation of cloud base

Location	Time	Cloud base above the ground	Cloud base (AMSL)
Mount Hotham Airport	1015	1,300 ft	5,600 ft
	1030	1,450 ft	5,700 ft
Mount Hotham	1000–1030	40 ft	6,100 ft

Carburettor icing

The atmospheric conditions recorded by the Mount Hotham Airport and Mount Hotham AWSs at the time of the accident were applied to a Civil Aviation Safety Authority *Carburettor icing probability* chart.¹⁰ Based on this chart, the likelihood of carburettor icing¹¹ at any power setting was 'serious'.

A reduction in power, such as in the case of carburettor icing, was inconsistent with the damage sustained by the propeller at impact (see the section titled *Wreckage and accident site information*). It was concluded that carburettor icing was not a factor.

Air traffic services information

In addition to the availability of a number of automated meteorological broadcast services for selected airports and aerodromes,¹² in-flight weather information is available via air traffic control (ATC)-initiated and on-request flight information service (FIS).¹³ FIS is designed to support a pilot's responsibility of obtaining information necessary to make operational decisions relating to the continuation or diversion of a flight.

⁹ Dewpoint is the temperature at which water vapour in the air starts to condense as the air cools. It is used among other things to monitor the risk of aircraft carburettor icing or likelihood of fog at an aerodrome.

¹⁰ Available from http://www.casa.gov.au/wcmswrl/assets/main/pilots/download/carburettor_icing_chart.pdf.

¹¹ Carburettor ice is formed when the normal process of vaporising fuel in a carburettor cools the carburettor throat so much that ice forms from the moisture in the airflow which can restrict the airflow and interfere with the operation of the engine.

¹² Including the automatic terminal information service, automatic en route information service, aerodrome weather information service and meteorological information for aircraft in flight.

¹³ FIS is a service provided by ATC for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

The Aeronautical Information Publication Australia (AIP) GEN 3.3 section 2 *FLIGHT INFORMATION SERVICE* stated that an ATC-initiated FIS included the provision of pertinent operational information such as meteorological conditions and the existence of non-routine meteorological products. These included but were not limited to amended ARFORs, an amended aerodrome forecast (TAF),¹⁴ a significant meteorological warning (SIGMET)¹⁵ and a special report of meteorological conditions at an aerodrome (SPECIs)¹⁶. The service was only provided to pilots receiving an ATC service, or to aircraft otherwise 'known' and in two-way communications with ATC. Consequently, visual flight rules (VFR) aircraft operating outside controlled airspace, even if a flight plan had been submitted, may not be necessarily 'known' to ATC. The AIP further stated that:

To ensure that accurate information is obtained in adequate time, pilots must take into consideration that ATC initiated FIS is limited to aircraft within one hours flight time of the condition or destination at time of receipt of the information by ATC. The only exception to this is SIGMET information, which shall cover a portion of the route up to two hours flying time ahead of the aircraft.

If there is a sudden change to a component of flight information that is not detailed in a current meteorological product or Notice to Airmen (NOTAM),¹⁷ and it has an immediate and detrimental effect on aircraft safety, this will be communicated by ATC as a 'hazard alert'. In the case of prolonged hazardous conditions, these broadcasts are repeated at stipulated intervals but normally cease after 1 hour or after an updated meteorological product or NOTAM is available for dissemination – whichever occurs first.

However, there is the possibility that an aircraft departs after ATC broadcasts the updated operational information, meaning that the pilot may not be aware of the changes. Pilot-initiated or on-request FIS is available from ATC for all aircraft in all classes of airspace, including those in uncontrolled airspace and perhaps previously unknown to ATC.

A review of Airservices Australia (Airservices) audio recordings of the applicable Melbourne Centre ATC frequency between 0730 and 1030 on 23 October 2013 found that numerous broadcasts were made by ATC advising pilots of the availability of updated weather information. However, while recordings of the Moruya common traffic advisory frequency¹⁸ indicated that the pilot of KKM broadcast a number of calls before departing Moruya, no radio broadcasts were recorded from the pilot on the Melbourne Centre frequency.

The radio frequency selections made by the pilot after departing Moruya could not be determined.

Pre-flight planning

Visual flight rules

Civil Aviation Regulation 172 stated that a VFR flight could only be conducted in visual meteorological conditions (VMC).¹⁹ The AIP ENR 1.2 Section 2.5 *Non-Controlled Airspace – Class G* stipulated that, for aircraft operating in this airspace below 10,000 ft, these conditions

¹⁴ 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.

¹⁵ A weather advisory service issued to warn of potentially hazardous (significant) or extreme meteorological conditions that are dangerous to most aircraft, such as thunderstorms or extreme turbulence.

¹⁶ A SPECI is a special report of meteorological conditions, issued when one or more elements meet specified criteria significant to aviation. SPECI is also used to identify reports of observations recorded 10 minutes following an improvement (in visibility, weather or cloud) to above SPECI conditions.

¹⁷ A NOTAM advises personnel concerned with flight operations of information concerning the establishment, condition or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to safe flight.

¹⁸ A common traffic advisory frequency is the frequency on which pilots operating at a non-controlled aerodrome should make positional radio broadcasts.

¹⁹ Visual meteorological conditions is an aviation flight category in which VFR flight is permitted—that is, conditions in which pilots have sufficient visibility to fly the aircraft maintaining visual separation from terrain and other aircraft.

included a minimum flight visibility of 5,000 m and a vertical and horizontal distance from cloud of 1,000 ft and 1,500 m respectively.

For flights at or below 3,000 ft or 1,000 ft above ground level (whichever is higher), this included a minimum flight visibility of 5,000 m and clear of cloud and the pilot remaining clear of cloud and in sight of the ground or water. Operations under these reduced conditions were required to carry a radio and use it on the appropriate frequency.

Route planning

A portion of the direct route from Moruya to Mount Hotham Airport and to Mangalore Airport passes over the Kosciuszko and Alpine National Parks. The Alpine National Park extends from central Gippsland, Victoria to the New South Wales border, where it adjoins Kosciuszko National Park. It is the largest national park in Victoria and contains 10 of the 11 highest mountains in the state. The topography is characterised by rugged mountainous terrain, with open forests and areas of grassland.

On the previous day, the pilot flew the aircraft from Mangalore Airport to Moruya Airport using a route further to the north. This avoided much of the mountainous terrain associated with the national parks (see Figure 1).

The nearest airport was Mount Hotham Airport, about 19 km to the east-north-east of the accident. Other potential landing areas in the area were the Mount Beauty aeroplane landing area (ALA) about 40 km to the north-north-east, Porepunkah ALA about 46 km to the west-north-west and Benambra ALA about 53 km to the north-east (Figure 6).

Figure 6: Nearest landing areas



Source: Google earth, modified by the ATSB

The landing areas were available for an unscheduled landing. There was no evidence that the pilot had or had not considered diverting to one of these aerodromes. However, the apparent route taken and location of the accident site suggests he did not initiate a diversion at any time.

Weather information

Airservices advised that the pilot had a National Aeronautical Information Processing System²⁰ user identification. Information provided by Airservices indicated that the pilot accessed this system on numerous occasions on 23 October 2013 using the software program 'OzRunways'.²¹ Table 2 is a summary of the weather information accessed by the pilot that day.

Table 2: Summary of NAIPS activity on 23 October 2013

<i>Time accessed</i>	<i>Type of information</i>	<i>Location/s</i>	<i>Time issued</i>	<i>Validity period</i>
0511	Area briefing	Area 30/32 ARFOR	0307	0310–1600
		Area 21 ARFOR	0308	0400–1600
		SIGMET (C04)	0212	0230–0630
		SIGMET (B05)	0323	0400–0800
0611	Location briefing	Moruya (TAF)	0509	0600–1900
0636	Location briefing	Moruya (TAF)	0509	0600–1900
		Mangalore (TAF)	0506	0600–1900
0637	Location briefing	Moruya (TAF)	0509	0600–1900
		Mangalore (TAF)	0506	0600–1900
		Mount Hotham (SPECI)	0630	Not applicable
0744	Flight plan submitted	Moruya Airport direct to Mount Hotham Airport and then direct to Mangalore Airport.		

Previous occurrences

Weather-related accidents in general aviation remain one of the most significant causes for concern in aviation safety. The ATSB research report titled *Accidents involving pilots in Instrument Meteorological Conditions*³¹ identified 72 occurrences between 2006 and 2010 where VFR pilots flew in IMC. Of these, about one in ten resulted in a fatal outcome. Previous ATSB investigations²² have also highlighted the risks associated with operating in adverse weather conditions.

ATSB investigation AO-2012-130

On 1 October 2012, a de Havilland DH-84 Dragon Mk 2 aircraft took off on a private flight from Monto to Caboolture, Queensland. The pilot was not qualified and the aircraft not equipped for instrument flight. About 2 hours after departure, the pilot contacted ATC and advised that the aircraft was in cloud. Over the next 50 minutes ATC provided assistance to the pilot but it was apparent that he was unable to navigate clear of the cloud. The aircraft wreckage was located on 3 October in high terrain; there were no survivors. The ATSB found that:

With no or limited visual references available in and near cloud, it would have been very difficult for the pilot to maintain control of the aircraft. After maintaining control in such conditions for about an hour, and being unable to navigate away from the mountain range, the pilot most likely became spatially disoriented and lost control of the aircraft before it impacted the ground.

²⁰ Able to be remotely accessed, a system that provides briefing and flight notification functions. This includes access to weather information.

²¹ OzRunways is a proprietary software program that allows pilots to access Airservices and Bureau of Meteorology information. OzRunways is approved by the Civil Aviation Safety Authority as a data provider under Civil Aviation Regulation 233(1)(h). See <http://www.ozrunways.com/>.

²² Available from the ATSB's website at www.atsb.gov.au.

ATSB investigation AO-2012-076

On 4 June 2012, a Cessna Aircraft Company 182Q aircraft departed Walgett in good weather conditions for a flight to Mudgee, New South Wales. The planned track would take the aircraft over the Warrumbungle Ranges. During the flight, the cloud base lowered and the aircraft was descended to about 1,000 ft above flat terrain, either close to, or in cloud. The aircraft subsequently collided with terrain about 100 ft below the top of a hill. At the time of the accident, the cloud base was about 100 ft below the accident site. The ATSB found that:

A diversion to a more conservative flight path that allowed for greater height between terrain and the cloud base would have provided more time and opportunity to manage further weather deterioration. This included any decision to divert to a different aerodrome with weather conditions more suitable for VFR flight.

Controlled flight into terrain

Controlled flight into terrain (CFIT) refers to the impact of an aircraft that is under the control of the pilot(s) with terrain, water or obstacles with no defect or unserviceability that would prevent the otherwise normal operation of the aircraft. In such cases, the pilot(s) have little or no awareness of the impending collision.

The aviation community has invested a considerable amount of time and resources in an attempt to reduce the risk of CFIT, particularly in the commercial sector. While these measures have substantially reduced these types of accidents, CFIT continues to occur.

ATSB Aviation Research and Analysis Report - B2006/0352 titled *CFIT: Australia in context 1996 to 2005*²³ identified that over half of the CFIT accidents recorded by the ATSB in that period involved private/business operations (ATSB 2007). Although CFIT in Australia was a rare event, when compared with the total number of accidents recorded in the 10-year period examined, if CFIT did occur, there was a high risk of fatal injuries to the aircraft occupants.

Other information relating to flying in mountainous terrain

A Civil Aviation Authority of New Zealand (2006) booklet titled *Mountain Flying*²⁴ discussed operations in mountainous terrain. The booklet described those operations as challenging, and cautioned that the weather conditions in that terrain can be severe and change rapidly. Specifically, a small change in the outside air temperature towards the dewpoint temperature can produce cloud almost instantaneously and an increase in wind strength can increase the intensity and extent of downdrafts and turbulence, often found in the lee of the mountain ranges.

The booklet further emphasised the need for a greater level of navigational accuracy when flying in the mountains. This, combined with poor weather conditions, can significantly increase pilot workload and result in a reduced mental capacity to make decisions and manage new tasks or problems. Therefore, weather is a very important consideration for pilots when operating in the mountains.

Operating under the VFR in adverse weather conditions

A study by Wiegmann and Goh (2000) suggested a number of possible factors that contribute to instances of VFR flight into adverse weather conditions. These included situation assessment (an inaccurate assessment by a pilot of the conditions), risk perception (a pilot may not appreciate the risks involved with continuing the flight) and motivational factors ('get-home-itis' or personal/social pressures to complete the flight). In particular, the study found that, during the conduct of a simulated cross-country flight, a significant proportion of participants overestimated the visibility and cloud base. That is, they perceived the conditions to be better than what they actually were.

²³ Available at atsb.gov.au.

²⁴ Available at http://www.caa.govt.nz/safety_info/GAPs/Mountain_Flying.pdf.

In its publication *Avoidable Accidents No. 4 - Accidents involving Visual Flight Rules pilots in Instrument Meteorological Conditions*²⁵, the ATSB (2011) found that many pilots will descend when confronted with deteriorating weather conditions. Being able to turn the aeroplane around and climb to a safe altitude, particularly in conditions of reduced visibility, requires proficiency in basic instrument flying and while these skills are obtained during training for Private and Commercial Pilot (Aeroplane) Licences, they diminish if not regularly used.

The publication further stated that if a pilot experiences marginal weather conditions and becomes disorientated or lost, they should seek whatever help is available, such as that of ATC. By declaring an emergency, ATC will initiate the In-flight Emergency Response Checklists²⁶ and provide assistance to the pilot.

ATSB SafetyWatch initiative

The ATSB's *SafetyWatch* highlights the broad safety concerns from ATSB investigation findings and occurrence data reported to the ATSB by industry. One of these concerns is *Flying with reduced visual cues* (see www.atsb.gov.au).

In the case of operations under the VFR it is crucial that pilots have sufficient visual reference to see and avoid obstacles. Visual reference can be reduced by cloud, darkness or atmospheric conditions such as rain, fog, smoke or haze. This may result in insufficient visibility to enable the pilot to see and avoid obstacles and result in flight into terrain.

Thorough pre-flight planning is crucial for avoiding adverse weather conditions. It is not only important to obtain the relevant weather forecasts to develop a mental picture of the conditions that may be encountered, but to also assess this information and understand its potential impact on the planned flight. In forecast marginal weather, this involves a thorough analysis of the forecasts and considering alternative options such as diverting or turning back.

For pilots with minimal experience, discussing weather forecast information with more experienced pilots before flight can be used to crosscheck their own interpretation of the conditions. In addition, the BoM includes a contact phone number at the end of all area forecasts that provides for pilots to query/discuss the applicable forecast.

Pilots should also conduct an honest self-assessment of their skills, taking into account total and recent experience, and their aircraft's capability to determine their combined suitability for the task given the weather conditions. In-flight, pilots must continuously assess the weather for conditions that may adversely affect the safety of the flight and be prepared for an alternative course of action if conditions deteriorate. This could include seeking assistance, such as that available from ATC.

²⁵ Available at www.atsb.gov.au.

²⁶ The In-flight Emergency Response checklists contain information and guidance for ATC in the case of an in-flight emergency. This includes VFR emergencies such as VFR in IMC and VFR on top of cloud.

Safety analysis

Introduction

The pilot had limited experience and recency and was not qualified or experienced in instrument flight. However, despite the weather forecast, which indicated unfavourable conditions for a visual flight rules (VFR) flight in the Alpine National Park area, the pilot elected to conduct the flight. It was not known if the pilot comprehended the unsuitability of the weather conditions for visual flight over the mountains or if he considered an alternative route.

This analysis examines the implications for the flight of the forecast weather conditions and the apparent decision by the pilot to continue the flight to Mangalore Airport. Diversion by the pilot to a close-by, suitable aerodrome in the otherwise serviceable aircraft would likely have mitigated the risk associated with continued VFR flight in limited visibility.

Adverse weather conditions

The relevant area forecast accessed by the pilot about 3 hours prior to departing Moruya indicated thick cloud from a base of 400 ft to more than 8,000 ft above mean sea level, severe turbulence and reduced visibility associated with showers, fog and mist. The forecast cloud base was well below the elevation of the accident site and consistent with the witness observations of the weather from slightly right of track in the Hotham Heights area and to the left of track at about the time of the accident.

In each case, the witnesses reported cloud below the height of the ranges and fog in the area. In particular, the witness who was about 5 km from the accident site reported a visibility of 50 m at that time. Given the proximity and similar elevation of this witness to the accident site, it was very likely that the pilot was operating in reduced visibility shortly before, and probably up until the accident.

Given the pilot's minimal flying experience since obtaining their pilot's licence, lack of recent instrument training and use of an aircraft that was not approved for flight under the instrument flight rules, it was unlikely that the pilot would have chosen to fly in adverse weather conditions. Rather, the pilot's conduct of the flight would suggest that they may not have fully appreciated the extent of the weather as indicated in the relevant forecasts, and/or its potential impact on the flight. Any lack of appreciation of the weather hazard affecting the flight diminished the usefulness of the Bureau of Meteorology forecasts that were accessed by the pilot in support of their flight planning. Post-accident analysis of the weather at the time of the accident by the Bureau of Meteorology confirmed the accuracy of those forecasts.

In the event, the route chosen by the pilot meant travelling over the Alpine National Park region, with mountainous terrain up to about 5,500 ft and in forecast strong west to north-westerly winds and severe turbulence. Visual navigation across such terrain in adverse weather conditions was likely to have exposed the pilot to rapidly changing in-flight visibility. Concurrently, there was a need for a greater level of navigational accuracy, which can significantly increase pilot workload and result in a reduced mental capacity to make decisions and manage new tasks or problems. Although it was not known whether the pilot considered an alternative route during the planning stage (such as a reversal of the track flown the previous day), the increased workload once affected by the conditions in the Alpine National Park region would have impacted on the pilot's ability to develop and enact a diversion to an alternate destination.

Pilot experience

Numerous studies have explored the relationship between a pilot's experience and weather-related decision making. Wiegmann, Goh & O'Hare (2001) noted that the loss of situation awareness (SA)²⁷ that results in a VFR pilot flying into adverse weather conditions occurs for a variety of reasons, but of most significance is a lack of experience with interpreting real-time weather by low-time or 'fair weather' pilots. Pilots continue a VFR flight into poor weather as they inaccurately identify the changes in, or severity of the weather conditions. Burian, Orasanu & Hitt (2000) highlighted that:

Some pilots, particularly those with less experience, may not trust what their eyes are telling them and proceed blindly on. Because of their relative inexperience, they may be unable to judge the severity of the conditions or to appreciate the implications of poor visibility for continuation of the flight.

However, due to the variable nature of the aviation environment, Wiggins & O'Hare (1995) also noted that:

...weather-related decision making is often considered a skill that cannot be prescribed during training. Rather it is expected to develop gradually through practical experience. However, in developing this type of experience, relatively inexperienced pilots may be exposed to hazardous situations with which they are ill-equipped to cope.

The study by Wiegmann and others further identified that previous experience influenced how long a pilot continued a flight into adverse weather conditions before diverting, with experienced pilots tending to divert earlier than less experienced pilots. Although total flight experience is significant for developing weather-related decision making skills, the study also found that the most relevant experience-based influence on a pilot's decision of when to divert was the number of flights conducted in the previous 30 and 90 days. This suggests that recency may be as important as total experience in some circumstances.

Furthermore, Groff & Price (2006) found that the risk of an accident in reduced visibility increased nearly five-fold for pilots that did not hold an instrument rating. Although the authors acknowledged that having the rating did not necessarily make a pilot immune to such accidents, to remain in visual meteorological conditions, many pilots will descend when confronted with deteriorating weather conditions. Being able to turn the aeroplane around and climb to a safe altitude, particularly in conditions of reduced visibility, requires proficiency in basic instrument flying skills. While these skills are obtained during training for Private and Commercial Pilot (Aeroplane) Licences, they diminish if not regularly used.²⁸

A study by the United States Federal Aviation Administration in 1983 examined private pilot flight skill retention 8, 16 and 24 months following the issue of a Private Pilot's Licence. The study found that:

Flight skills will degrade over time if not exercised sufficiently for the pilot to be able to retain or improve them. Thus, pilots who do not fly for extended periods of time, or who fail to practice certain critical tasks when they do fly, may be expected to make errors...Even if pilots fly regularly, their skill in executing flight tasks that are not performed frequently, such as emergency procedures, still may degrade.

The pilot of KKM did not hold an instrument rating and had attained about 284 hours in the 14-year period since commencing flying training. Of this experience, 4 hours of basic instrument flying training was carried out about 10–12 years previously and the pilot's last recorded flight was about 7 months prior to the accident. The pilot's minimal experience and recency, including in instrument flight, likely impacted on their ability to accurately interpret the forecast when planning the flight and the implications of the in-flight weather conditions, and to consider other options than continuing the flight in the reduced visibility conditions. Together with the increased workload

²⁷ Having an accurate understanding of what is happening around you and what is likely to happen in the near future.

²⁸ Australian Transport Safety Bureau (2011) <http://www.atsb.gov.au/publications/2011/avoidable-4-ar-2011-050.aspx>.

associated with the adverse weather conditions in the mountainous terrain, this likely explains the pilot's apparent decision to continue the flight beyond the last available landing area at Mount Hotham Airport.

Controlled flight into terrain

The lack of any defects with the aircraft or its systems at impact suggested that, in the absence of the adverse weather conditions continued safe flight ought to have been possible.

The loss of radar identification of the previously-radar-identified aircraft to the south-south-east of Cooma was consistent with the aircraft being below 8,000 ft from that time, or a distance of about 170 km along track before impacting terrain. Given the VFR pilot's likely intent to remain in visual conditions, the estimation of the cloud base in the area would suggest that the pilot descended to something below about 6,000 ft. Each of these derived not above altitudes was below the freezing level of 8,000 ft, indicating that the aircraft most likely did not encounter airframe icing or its controls become affected by icing.

The Bureau of Meteorology forecast and subsequent analysis of the weather conditions indicated that severe turbulence existed in the Alpine National Park region at the time of the accident. If the aircraft had encountered severe turbulence, this may have resulted in large, abrupt changes in altitude/attitude and the aircraft may have been temporarily out of control.²⁹ If the pilot had experienced a loss of altitude as a result of encountering turbulence, it would be expected that the pilot would attempt to climb and/or turn the aircraft to avoid any approaching terrain.

In respect of whether the pilot was attempting to climb the evidence was inconclusive. A pilot normally initiates a climb by raising the aircraft's nose to set the required climb speed and increasing power. Selecting wings level provides for the most efficient climb. In this instance the aircraft's wings were level and significant power was being delivered to the propeller at impact. In contrast, the aircraft impacted terrain in a 6–10° nose-down attitude with significant forward speed.

In the event, given the altitudes at which the aircraft was being flown and reported cloud and visibility in the area prior to the accident, and that the aircraft was at least 6° nose-down with wings level at the time of impact, it was probable that the pilot was either flying in low visibility and/or attempting to fly below cloud. As such, it was likely that the pilot either did not see the terrain before impact or that they saw the terrain but with insufficient time to manoeuvre.

The ATSB concluded that it was probable the accident was the result of controlled flight into terrain in reduced visibility conditions.

The ATSB is concerned about the frequency of accidents – many fatal – that involve pilots flying with reduced visual cues. This has been highlighted on the ATSB website at www.atsb.gov.au as a SafetyWatch priority, along with a number of strategies to help manage the risk and links to relevant safety resources.

²⁹ Civil Aviation Safety Authority. *Turbulence*. www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_91477.

Findings

From the evidence available, the following findings are made with respect to the collision with terrain involving Cessna Aircraft Company 182Q, registered VH-KKM, which occurred 19 km west of Mount Hotham Airport, Victoria on 23 October 2013. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- The pilot, who was qualified to operate only in visual meteorological conditions and had minimal total and instrument flying experience and recency, departed Moruya, New South Wales with a high risk of encountering adverse weather conditions, including reduced visibility and severe turbulence, in the Alpine National Park region, Victoria.
- It was likely that the pilot was operating in reduced visibility conditions where terrain avoidance could not be assured.
- The pilot's limited experience and recency likely impacted their ability to accurately interpret the forecast and in-flight weather conditions which, together with the increased workload associated with the difficult flying conditions, may have resulted in an attempt to continue flight to the intended destination rather than divert to other available airfields.
- It was likely that, due to the reduced visibility, the aircraft collided with unseen terrain under controlled flight.

General details

Occurrence details

Date and time:	23 October 2013 – 1030 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	19 km WSW of Mount Hotham Airport, Victoria	
	Latitude: 37° 5.296' S	Longitude: 147° 7.409' E

Pilot details

Licence details:	Private Pilot (Aeroplane) Licence, issued 13 September 2001
Endorsements:	Single-engine aeroplanes less than 5,700 kg maximum take-off weight, manual propeller pitch control; retract/undercarriage
Ratings:	Nil
Medical certificate:	Class 2, valid to 1 June 2014
Aeronautical experience:	About 284 hours
Last flight review:	13 October 2012

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 182Q	
Year of manufacture:	1978	
Registration:	VH-KKM	
Serial number:	18266240	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – 1 (Fatal)	Passengers – Nil
Damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- the Bureau of Meteorology
- Airservices Australia (Airservices)
- a number of witnesses
- Victoria Police.

References

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Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the 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 Civil Aviation Safety Authority, the Bureau of Meteorology, Airservices and the aircraft owner.

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

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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Notifications 1800 011 034

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Investigation

ATSB Transport Safety Report Aviation Occurrence Investigation

Collision with terrain involving Cessna 182, VH-KKM

19 km WSW of Mount Hotham Airport, Victoria, 23 October 2013

AO-2013-186

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