CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

CAA Safety Investigation Report
Controlled flight into terrain involving ZK-CMV
Cessna 185B Skywagon
Motatapu River North Branch near Wanaka
16 March 2015

ZK-CMV (Image source: nzcivair.blogspot.com)

CAA Final Report 15/1129
Report Date 16/07/2018

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Executive summary

The Civil Aviation Authority (CAA) was notified of the accident at 1343 hours on Monday 16 March 2015 by the Rescue Coordination Centre New Zealand. A pilot flying a helicopter along the Motatapu River North Branch near Wanaka, had spotted the wreckage of an aircraft. The police were notified and first responders were flown into the accident site where it was determined that all four occupants were deceased. The aircraft was identified as ZK-CMV, a Cessna 185B Skywagon.

The CAA safety investigation found that the aircraft had collided with terrain during a poor visibility reversal turn in the Motatapu River North Branch, 1.3 nautical miles from the saddle at the head of the valley. The impact forces involved during the accident were not survivable.

On board the aircraft were a husband and wife and their two children. Both the husband and wife were licensed pilots and experienced in mountain flying. The wife held a current B Category Instructor Rating with mountain flying and terrain awareness ratings. The safety investigation was unable to determine who was acting as pilot-in-command for the flight.

The forecast weather conditions, were not conducive for flight under Visual Flight Rules (VFR) for the intended route to be flown. There was no evidence to suggest that the pilots were subjected to any time pressure to reach the destination.

The CAA safety investigation determined that the actions and decision making by the pilots prior to and during the flight, including the breaching of CAA rules and not following recommended practices, contributed to the accident.

Private Pilot and Commercial Pilot training requirements were amended in 2009 with the addition of terrain awareness and mountain flying components to the training syllabus. This change was due to ongoing accident trends. A number of educational tools in relation to weather, terrain awareness and mountain flying educational media are available from the CAA for training purposes.

Factual information

History of the flight

The intended flight to visit friends, was to be conducted under VFR to The Branches Station farm airstrip, located approximately 22 nautical miles west of Wanaka Aerodrome. The route to be flown was familiar to the pilots. Tracking first from Wanaka Aerodrome toward Glendhu Bay, then following the Motatapu River valley system on to their destination. (Refer Figure 1).

The height at the valley head (saddle) of the Motatapu River North Branch, which the pilots needed to cross to reach the Polnoon Burn river valley and the Branches Station, rises to approximately 4100 feet above mean sea level (amsl).

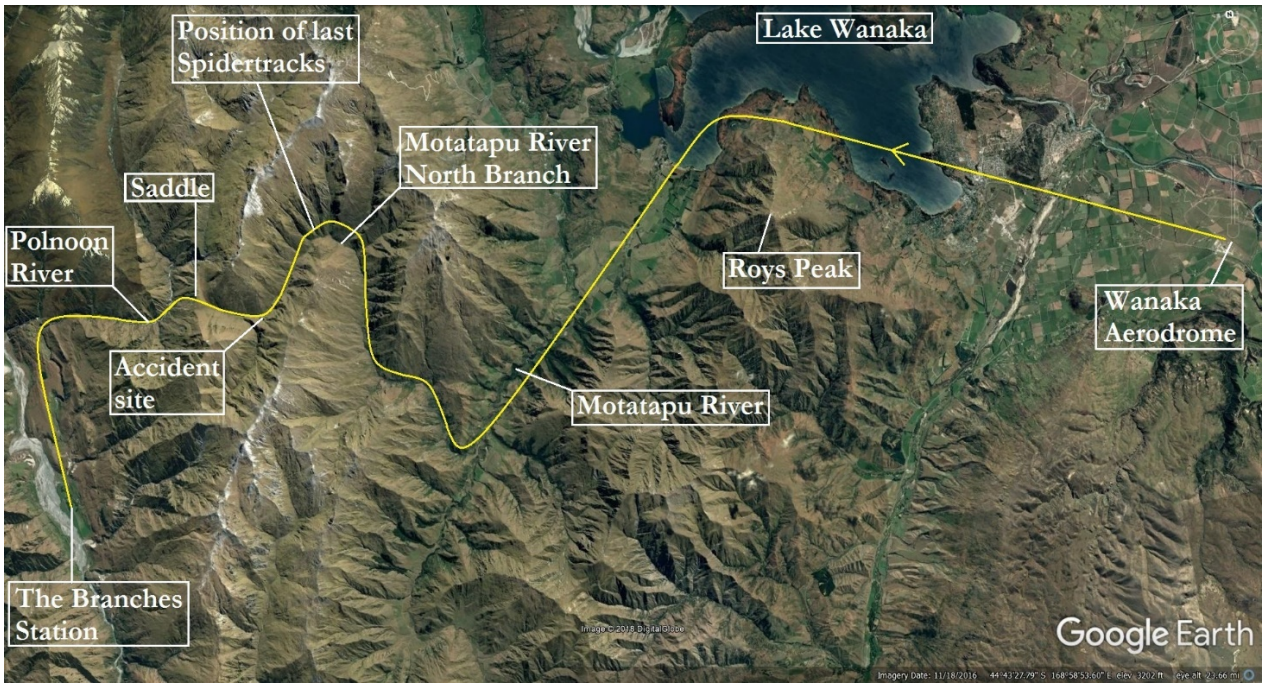


Figure 1: Intended route from Wanaka Aerodrome to The Branches Station

On the day of the accident, the pilots reportedly discussed the weather and their preferred route with their friends with whom they had been staying in Wanaka. However, they did not obtain a MetService weather briefing. According to their friends, both pilots had noted that Roys Peak which rises to 5177 feet amsl and its accompanying ridge above the Motatapu River, was immersed in cloud. (Refer Figure 2)

Figure 2: Roys Peak (left) on the morning of the accident. Cloud base is approximately 3400 feet amsl.

Radio transmissions, Spidertracks™ and the aircraft's Global Positioning System (GPS) recorded that the aircraft departed Wanaka Aerodrome at approximately 1111 hours and tracked west toward Wanaka township.

The GPS recorded the aircraft passing Roys Peak at approximately 3200 feet amsl. Shortly after entering the Motatapu River Valley North Branch and for unknown reasons, no further GPS data was recorded. At 1123:30 hours, the aircraft's Spidertracks™ system position report recorded the aircraft continuing its track along the north-western side of the valley at a height of 3852 feet amsl and a ground speed of 129 knots (This is consistent with the aircraft's normal cruise configuration). This was the last Spidertracks™ position report recorded prior to the accident occurring approximately 1.3 nautical miles from the saddle at the head of the Motatapu River North Branch valley.

At 1220 hours, a helicopter pilot transiting the valley system spotted the aircraft wreckage. Police and rescue authorities were then alerted. First responders to the site determined that the occupants had not survived the accident. Emergency Locator Transmitter (ELT) signals were not detected from the aircraft.

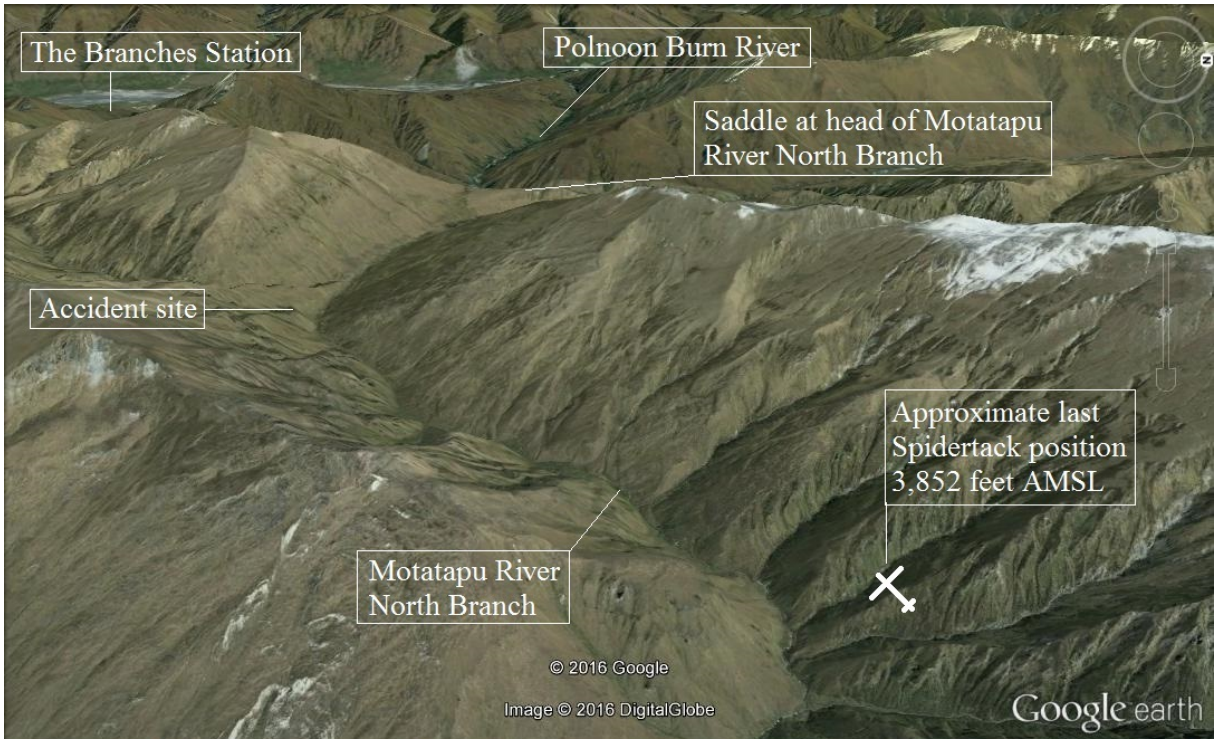


Figure 3: Overview of last two nautical miles of the flight.

Personal information

The husband held a Commercial Pilot Licence, a D Category Instructor Rating, was appropriately rated and held a current Class 2 medical certificate. His Class 1 medical certificate had expired. Therefore, he would have been exercising the privileges of a Private Pilot Licence. He had accrued approximately 4126 hours total flight time as recorded in his Pilot Logbook.

The wife held a Commercial Pilot Licence, a current B Category Instructor Rating and a current Class 1 medical certificate. In May 2011 she had completed a course in mountain flying, terrain and weather awareness ground and flight training and had demonstrated competence. One week prior to the accident, she had attended the CAA AvKiwi *Weather to Fly* seminar held in Christchurch.
She had accrued approximately 5584 hours total flight time as recorded in her Pilot Logbook.

The aircraft

ZK-CMV, a 1963 Cessna 185B Skywagon was first registered and issued with a Certificate of Airworthiness by the CAA in 1993. The family had co-owned the aircraft since 2009. The aircraft had accumulated approximately 10747 hours flight time and had been appropriately maintained. In 2005, the aircraft had been fitted with a Continental IO-550-D, 300 horsepower engine in accordance with the appropriate Supplemental Type Certificate. There were no defects recorded in the technical log or daily records.

It is estimated that the aircraft would have been within the allowable weight and balance limits during the flight.

Meteorological information

The first issue of the Clyde area forecast (CY ARFOR) which was appropriate for the route to be flown, provided weather information that indicated a general cloud base of 3000 feet amsl with visibility of 6000 metres in rain. An amended CY ARFOR, issued at 1019 hours forecast the same cloud conditions but the visibility was forecast to further reduce to 4000 metres in moderate rain or drizzle (Refer Appendix One).

The weather conditions encountered by the helicopter pilot who initially located the wreckage were indicative of those forecast. The pilot reported that there was low level cloud and reduced forward visibility in light drizzle which made flying conditions marginal. A photo taken approximately two hours after the accident shows weather conditions consistent with the forecast in the valley, but having improved from those encountered when the aircraft was first located. (Refer Figure 4).

Figure 4: Weather conditions observed at 1322 hours (approx. two hours after the accident occurred)

Wreckage and impact information

The aircraft initially struck a spur on the southern side of the Motatapu River North Branch valley at approximately 4050 feet amsl during a steep left descending turn. The aircraft then continued across a small gully and came to rest approximately 90 metres away from the initial impact point (Refer Figure 5).

First responders to the accident site found all occupants within the aircraft, the husband was seated in the front left seat while the wife was seated in the front right seat.

Due to the severing of the ELT antenna cable, ELT signals were not detected from the aircraft.

Examination of the aircraft at the accident site included inspection of the flight control systems for integrity. The aircraft's flaps were found extended 10 degrees consistent with the aircraft being configured to operate in reduced visibility.

Damage to the left elevator and both control columns indicate that a nose up elevator input was applied by the pilot(s) at the time the aircraft initially struck the spur. All damage to components of the flight control systems was attributed to impact overload failure.

The engine and propeller assembly were removed from the site and examined. The propeller assembly indicated that the engine was producing significant power when the aircraft struck the spur. No damage or defects were identified that would have prevented the engine from developing full power.

Figure 5. Overview of impact and wreckage sites (Photograph taken later the same day).

Medical and pathological information

Post-mortem examination of the occupants revealed the cause of death was due to very high energy impact injuries. The wife was found to have arm and hand injuries which could be consistent with holding the controls of the aircraft at the time of impact with the spur. The husband was found to have no such injuries.

Toxicological testing carried out on the pilots showed no evidence of any substances which may have impaired their decision making.

Analysis

The safety investigation found no evidence that the aircraft or its systems contributed to the accident. The safety investigation did identify two factors pertaining to the environment. The analysis commences with those factors before discussing available defences and the individual actions of the pilots.

The two elements pertaining to environmental aspects that formed part of the development of the accident are:

1) Poor weather conditions that were forecast and encountered en-route

2) Topographical features specific to the Motatapu River North Branch valley.

Weather conditions

Prior to the flight the pilots did not obtain the available meteorological forecasts for the area as required by CAA Rule Part 91.217, which states:

> *Before commencing a flight, a pilot-in-command of an aircraft must obtain and become familiar with all information concerning that flight including:*
> *(1) where practicable, the current meteorological information.*

Had the pilots done so, the actual weather conditions reported for Queenstown and Wanaka Aerodromes (overcast cloud layer with a cloud base of 3200 feet and 4000 feet above ground level respectively), would have provided important weather information to the pilots. The amended Clyde area forecast (CY ARFOR) issued at 1019 hours indicated a lower broken cloud base of 3000 feet amsl with visibility reducing to 4000 metres in moderate rain or drizzle. (Refer to Appendix One).

The flight was conducted in Class G airspace (general airspace) and the pilots were required to comply with CAA rule 91.301 *Meteorological Minima* which requires:

> *Aircraft operating above 3000 feet amsl or 1000 feet above terrain whichever is the higher must maintain a minimum distance from cloud of two kilometres horizontally and 1000 feet vertically. A minimum flight visibility of five kilometres is also required.*

The flight as planned should not have proceeded due to the en-route weather conditions existing at the time of the accident.

On encountering the combination of the low cloud base and rising terrain, a decision by the pilots to turn back early would have been prudent when the requirements of CAR 91.301 *Meteorological Minima* could no longer be met. However, for reasons undetermined, they continued with their original plan and significantly eroded their options for continued safe flight.

Research conducted by the Australian Transport Safety Bureau (ATSB) shows that although the dangers of flying VFR into Instrument Meteorological Conditions (IMC) are well known, pilots still fly into deteriorating weather. An ATSB research investigation report *General Aviation Pilot Behaviours in the Face of Adverse Weather*[1] concluded that:

> *'The chances of a VFR into IMC encounter increased as the flight progressed until they reached a maximum during the final 20 [percent] of the flight distance. This result highlights the dangers of pilots 'pressing on' to reach their destination.'*

Considering the aircraft's flight path, the destination had nearly been reached and therefore the pilots were nearing the maximum chance of a VFR into IMC encounter, as explored by the ATSB.

[1] Reference: ATSB (2005) General Aviation Pilot Behaviours in the Face of Adverse Weather. Aviation Research Investigation Report B2005/0127. Canberra, Australia: ATSB.

Poor weather conditions existing in mountainous terrain leave little margin for error for pilots operating VFR. Whilst the weather forecast was not obtained by the pilots, there was clear evidence that low cloud existed and was observed prior to the aircraft's departure. Reduced visibility in drizzle would likely have been encountered. The weather conditions placed considerable risk to the safety of the flight.

Local topography

The topographical features of the area surrounding the accident site were mountainous and narrow in the valley. To continue flying up the valley, the pilot would be required to alter the aircraft's heading to the right in order to cross the saddle at the head of the valley. At the lowest point the saddle was approximately 4100 feet amsl. However, it was apparent that instead, the pilots had attempted a reversal turn to the left due to their onward flight path being blocked by cloud.

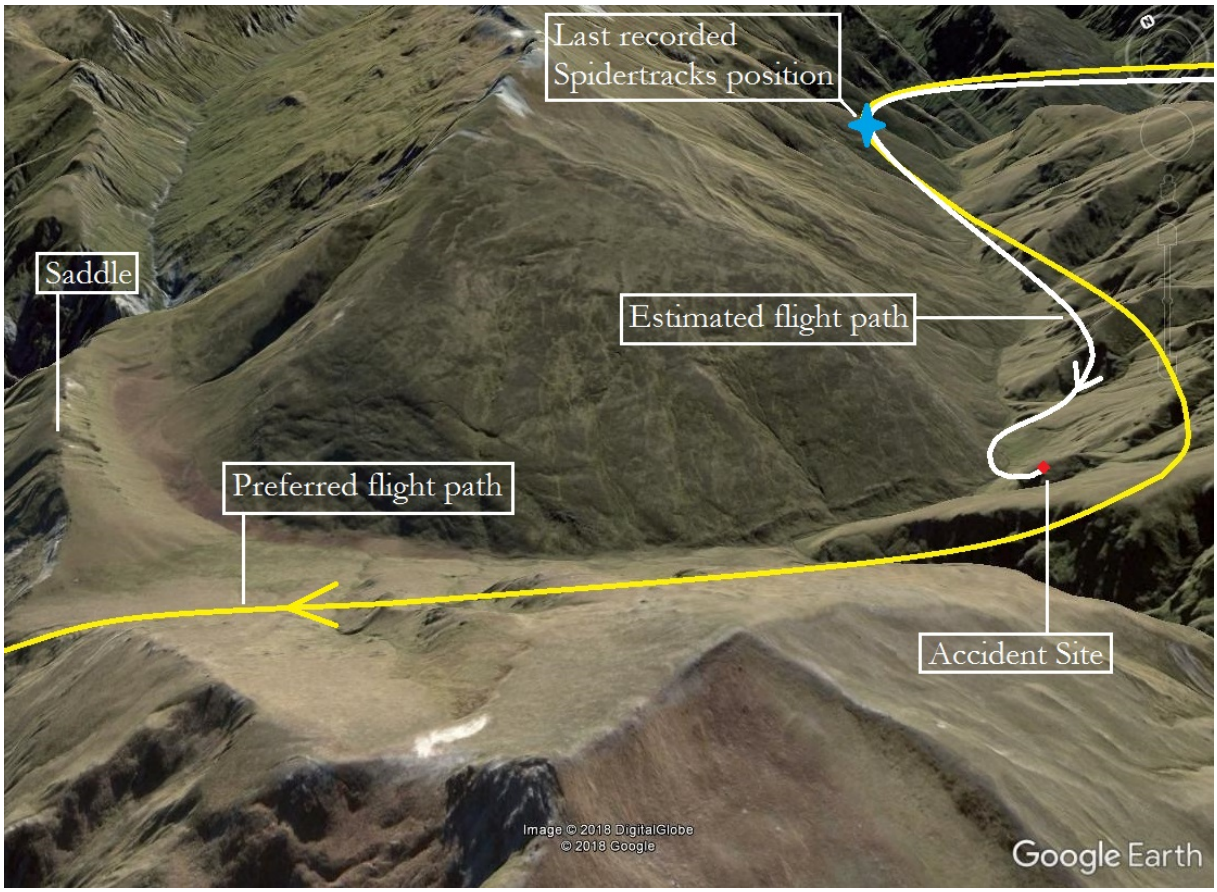


Figure 6: Preferred (optimal) flight path compared with estimated flight path (For illustrative purposes only).

As the aircraft continued flying toward the head of the valley, the flyable airspace between the terrain and the cloud base would have been reducing . The reducing flyable airspace placed an additional and immediate risk to the flight. The aircraft Spidertracks™ system recorded the aircraft tracking on the northern or right side of the valley. This factor would have exacerbated the situation.

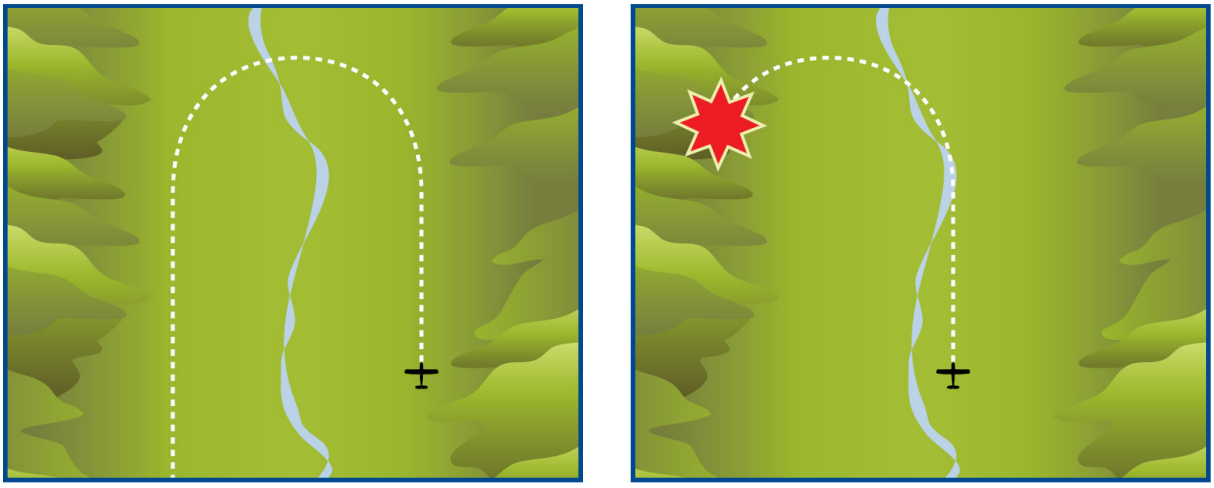
The valley has a right-hand bend with adjacent high terrain, that would have obscured the saddle from the pilots view for a longer period than if they had chosen to fly up the left side of the valley.

The safety investigation was unable to determine whether the two pilots were aware of the significance of this aspect.

The optimal positioning for the aircraft in the valley as it approached the right-hand bend would have been on the southern or left side of the valley as illustrated by the yellow line in Figure 6. This positioning then affords the pilots the greatest opportunity to observe the route ahead to the right and if required, turn away if it is impassable.

The fact that the pilots had attempted a left reversal turn would indicate that the aircraft was not positioned on the left side of the valley in the optimal position.

Figure 7 below, published in the CAA *Mountain Flying* GAP booklet, illustrates advice regarding the correct positioning of an aircraft operating in a valley to enable a safe reversal turn to be carried out.



Positioning to one side of the valley leaves maximum room to turn. Always use the maximum room available in case a 180-degree turn is required.

Positioning in the middle of the valley means a steeper turn is necessary and there may be insufficient room to turn back safely.

Figure 7: Example of aircraft positioning to enable a safe reversal turn

In order to comply with CAR 91.311 *Minimum heights for VFR flights* which requires a minimum of 500 feet above ground level for the area in which the aircraft was flying, the pilots would have required a minimum flight altitude of 4600 feet amsl when the aircraft crossed the saddle at the head of the valley. With the weather conditions existing at the time of the accident, this would not have been achievable.

The combination of the prevailing weather conditions and the nature of the alpine terrain probably made visual definition of the spur against the valley background extremely difficult for the pilots to distinguish. The pilot's vision through the aircraft's windscreen was probably reduced due to the effect of precipitation on the windscreen, further reducing visual definition of the terrain. From the damage noted to the aircraft's elevator and control columns, it is highly likely that one, if not both pilots observed the spur moments before the aircraft struck it.

Defences

There were a number of available defences applicable to the flight that were critically compromised:

1. Adherence to Civil Aviation Rules - rules set a common or consistent standard for aviation activities in the New Zealand aviation system.

2. Previous mountain flying training - both pilots were experienced in mountain flying, the wife being current in mountain flying training instruction.

3. Pre-flight weather briefing - a comprehensive weather briefing was available.

4. Inflight decision making - Do not continue toward rising terrain in poor weather. Make turn back decisions early. Maintain situational awareness by having a thorough knowledge specific to the topographical features for the route being flown.

Human factors - Individual decisions and actions

In most cases in general aviation, the individual decisions and actions would normally rest solely with the person who is acting as pilot-in-command. The husband and wife were both experienced pilots. The pilots were, in a sense, a team and had the same information and proceeded with the flight.

The safety investigation was unable to determine which pilot was acting as pilot-in-command for the flight to The Branches station. Although the husband was found to have been seated in the left (pilot's) seat, the wife was an active B Category flying instructor, and would have been competent to fly the aircraft from the right front seat should she be acting as pilot-in-command. The pathological evidence would tend to indicate that at the time of the accident, the wife was in control of the aircraft. However, there was no evidence available to the safety investigation to be able to determine at what stage in the flight she may have taken control.

The designated pilot-in-command, whether it be the husband or the wife, was ultimately responsible for the safety of the flight.

The pilots' actions did not comply with a number of CAA rule requirements and recommended practices:

- The CAA rule requirement of obtaining current available weather forecasts

- The CAA rule requirement of operating within the prescribed VFR meteorological minima in Class G airspace

- Poor decision making by continuing the flight into a degraded visual environment, to the extent that the decision to turn back was made too late at a point that left little or no margin for error.

Risk controls

Mountainous terrain makes up over half of New Zealand's topography. Pilots need to develop a special set of skills, knowledge and flying techniques to help them survive in this environment.

Pilots intending to fly VFR in mountainous terrain need to identify the risks involved. The biggest risk factors can be summed up in three categories:

- Pilot decision making
- Weather
- Terrain.

A strategy to reduce the risks is always to have a plan that includes comprehensive weather information and an optimal route.

Obtaining and interpreting all the available meteorological information is just one element that can help pilots draw a mental picture of forecast and existing weather conditions along an intended or alternate route, as well as at a destination or alternate aerodrome.

The plan should also thoroughly explore the route to be flown. The plan should include contingencies and escape routes. The required actions are to stick with the plan unless rapidly changing circumstances indicate a need to change the plan. Pilots should always have predetermined alternative plans and options available as part of their risk management strategies.

Good decision making processes start on the ground well before any flight. Objective evaluation of risks coupled with appropriate mitigation, will greatly reduce an instance of controlled flight into terrain.

Conclusions

- Both pilots were appropriately qualified for the flight
- The safety investigation was unable to determine which pilot was acting as pilot-in-command during the flight
- The aircraft had a valid Certificate of Airworthiness and had been maintained in accordance with relevant requirements
- No pre-accident aircraft defects or weight and balance anomalies were found
- The pilots did not obtain accurate weather information prior to the flight
- The actual weather conditions reflected the weather forecast for the area to be flown
- The weather conditions were below the required VFR meteorological minima for the route to be flown

- The pilots did not conform to a number of CAA rules and recommended best practices at the flight planning stage or during the flight
- The aircraft was flown toward rising terrain in poor weather conditions
- With the flight path over the saddle blocked by cloud, the pilots initiated a descending left reversal turn (valley escape manoeuvre)
- The aircraft was not in the optimal position in the valley when the left reversal turn was commenced
- During the reversal turn, the pilots were unable to maintain terrain clearance
- The aircraft's subsequent impact with the ground was not survivable.

Safety message

To afford the maximum amount of safety when flying in mountainous terrain, pilots must adhere to the Civil Aviation Rules, have preferably received training in terrain awareness and mountain flying techniques, and obtain a detailed weather briefing prior to flight. Always keeping an option available to make a turn back is of the utmost importance. Maintaining a high level of situational awareness when flying in mountainous terrain will enable a pilot to make a timely decision to discontinue the flight should weather conditions deteriorate.

The CAA GAP booklet *Mountain Flying* contains the following pertinent advice:

> *Escape Routes*
>
> *The golden rule of mountain flying is to **always have an escape route** regardless of whether you are flying a fixed wing aircraft or a helicopter.*
>
> *The aircraft must never be placed in a situation where there is insufficient room to turn back safely, or to recover from an encounter with turbulence or downdraught, or to make a successful forced landing in the event of an engine failure.*
>
> *Never enter a valley without being certain that there is an escape route available.*

Over recent years, a great deal of emphasis has been placed on the training and educating of pilots with regards to mountain flying and terrain awareness by the CAA and pilot training organisations. Unfortunately however, as in the case of this accident, occurrences still occur where pilots are caught out in mountainous terrain in poor weather conditions.

The CAA and Airways New Zealand have produced several educational tools for pilots to help them modify their behaviour, as follows:

- A Good Aviation Practice booklet (GAP) *Mountain Flying*. This booklet includes sections on valley flying, escape routes and is available free on the CAA website (search CAA website for the title). A DVD with the same title is also available from CAA by request (search website for 'CAA safety DVDs'),
- Two interactive website tools titled *Wx matters* and *Get the Mental Picture*. These are online programs designed to help pilots interpret information and make better decisions (search CAA website for AvKiwi); and,

- Airways New Zealand has developed a smartphone app called IFIS MOBILE. This app allows users to obtain MetService meteorological information and NOTAMS (notices to airmen) via a compatible smartphone.

About the CAA

New Zealand's legislative mandate to investigate an accident or incident are prescribed in the Transport Accident Investigation Commission Act 1990 (the TAIC Act) and Civil Aviation Act 1990 (the CA Act).

Following notification of an accident or incident, TAIC may conduct an investigation. CAA may also investigate subject to Section 72B(2)(d) of the CA Act which prescribes the following:

> **72B Functions of Authority**
>
> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990

The purpose of a CAA safety investigation is to determine the circumstances and identify contributory factors to an accident or incident with the purpose of minimising or reducing the risk, to an acceptable level, of a similar occurrence arising in the future. The safety investigation does not seek to ascribe responsibility to any person but to establish the contributory factors to the accident or incident, based on the balance of probability.

A CAA safety investigation seeks to provide the Director of Civil Aviation with the information required to assess which, if any, risk-based regulatory intervention tools may be required to attain CAA safety objectives.

Civil Aviation Authority of New Zealand

Level 15, Asteron Centre
55 Featherston Street
Wellington 6011
OR
PO Box 3555, Wellington 6140
NEW ZEALAND
Tel: +64-4-560 9400 Fax: +64-4-569 2024
www.caa.govt.nz

Appendix One

Note: issue times converted to NZDT

Meteorological Terminal Aerodrome Report (METAR)

METAR NZWF 161100NZDT AUTO 11019KT 20KM **OVC040**/// 10/05 Q1005
METAR NZQN 161100NZDT AUTO 17015KT 140V200 49KM **OVC032**/// 09/04 Q1006

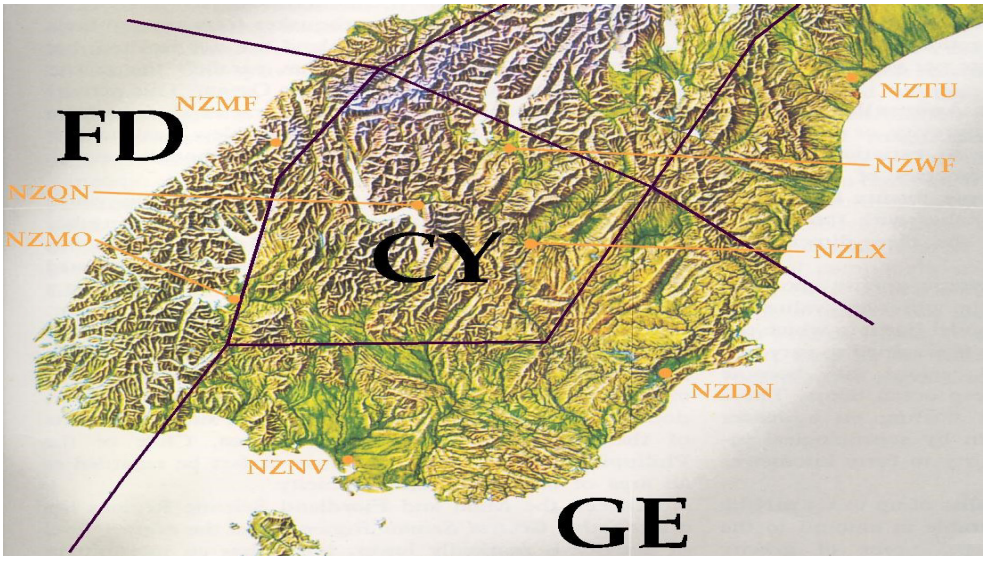
New Zealand Meteorological aviation forecast information

CY ARFOR Issued 16 March 2015, 05:09 NZDT.

ARFOR CY VALID 1600 TO 0100 UTC Valid 05:00 - 14:00 NZDT
3000 17005
5000 16010 PS03
7000 VRB05 ZERO
10000 33015 MS03
FZL 8500FT IN THE N SLOPING TO 6500FT IN THE S.
VIS 20KM REDUCING TO **6000M IN RA**.
CLD AREAS **BKN SC 3000** TOPS 7000.
AREAS BKN ASAC ABV 7000.
WX OCNL RA MAINLY SW OF NZQN.
ICE ISOL MOD ABV FZL.

CY ARFOR Issued 16 March 2015, 10:19 NZDT (Amended)

ARFOR CY VALID 2200 TO 1100 UTC Valid 11:00 - 00:00 NZDT
BECOMING EVENING
3000 16005
5000 16005 PS02
7000 VRB05 ZERO
10000 31010 MS03 25010
FZL 8500FT IN THE N SLOPING TO 6500FT IN THE S.
VIS 20KM REDUCING TO 10KM IN -RADZ AND **4000M IN RADZ**.
CLD AREAS **BKN SC 3000** TOPS 6500.
AREAS BKN ASAC ABV 6500.
WX PATCHY RADZ, EASING TO -RADZ AFTERNOON, CLEARING EVENING.
ICE OCNL MOD ABV FZL.



Local ARFOR sectors map