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

CAA OCCURRENCE 21/5661

BABY GREAT LAKES

ZK-ULM

DEPARTURE FROM CONTROLLED FLIGHT

BENMORE STATION, NEAR OMARAMA

25 OCTOBER 2021

ZK-ULM. Source: NZ Civil Aircraft website, David Paull

Foreword

New Zealand's legislative mandate to investigate an accident or incident is 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 inquiry. The Civil Aviation Authority (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, of 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 of 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 intervention tools may be required to attain CAA safety objectives.

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Glossary of abbreviations:

AGL	Above ground level
BFR	Biennial flight review
CAA	Civil Aviation Authority
CAR	Civil Aviation Rule(s)
E	East
ft	foot or feet
hp	horsepower
kg	kilogram(s)
m	metre(s)
MAUW	Maximum all-up weight
NZDT	New Zealand Daylight Time
NZTA	New Zealand Transport Agency
PPL (A or H)	Private Pilot Licence (Aeroplane)
RPM	Revolutions per minute
S	South
SME	Subject matter expert

Data summary

Aircraft type, serial number and registration:	Baby Great Lakes, s/n BLUL-01 ZK-ULM
Number and type of engines:	One, 102hp Simonini Victor 2 Plus
Year of manufacture:	2012
Date and time of accident:	25 October 2021, 1050[1] (approximately)
Location:	Benmore Station (near Omarama) Latitude[2]: S 44° 21’ 23” Longitude: E 170° 01’ 01”
Type of flight:	Private
Persons on board:	Crew: 1
Injuries:	Crew: 1 fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command’s licence	Private pilot licence (aeroplane)
Pilot’s age:	75
Pilot-in-command’s total flying experience:	10,641.7 hours 48.8 on type
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	KM Cook

[1] All times in this report are NZDT (UTC + 13 hours) or unless otherwise specified.

[2] World Geodetic System 1984 (WGS-84).

Executive summary

Baby Great Lakes Class 1 Microlight, ZK-ULM, was operated on a private flight that departed Omarama aerodrome (NZOA) on 25 October 2021 shortly after 1030.

The purpose of the flight was likely a local flight, possibly to test a makeshift elevator trim tab that the pilot had attached to the aircraft a couple of weeks earlier.

The aircraft departed from controlled flight and impacted terrain on farmland near Omarama around twenty minutes after departure. It is likely the aircraft entered an unintentional spin at an altitude that was too low for the pilot to recover.

Several human factors likely contributed to the spin entry and may have hindered the pilot's ability to recover from it. The most notable of these factors was a degenerative eyesight condition.

This accident is a reminder to all pilots that the deterioration of health conditions must be acknowledged by the pilot and notified to the appropriate authority. The CAA strongly recommends pilots self-assess and have 'honest conversations' with their medical assessors about conditions that may present a risk to flight safety.

The investigation also highlighted gaps in the CAA's ability to provide effective regulatory oversight of private pilot licencing medical requirements when pilots hold a New Zealand Transport Agency (NZTA) driver licence medical or use a recreational pilot medical declaration. Two recommendations have been made to the CAA to strengthen its capabilities in this area.

1. Factual information

1.1 History of the flight

1.1.1 On Monday, 25 October 2021, the pilot prepared ZK-ULM for a local flight from Omarama aerodrome.

1.1.2 Local pilots stated that the pilot attended the morning aerodrome briefing. The pilot told one of them he was going for a twenty or thirty-minute flight.

1.1.3 The weather on the day was described by local pilots as 'benign', with light winds and high cloud.

1.1.4 A witness observed the pilot take off on runway 09 at around 1030, conduct a 270-degree left turn climbing towards the south. The witness stated that the take-off and climb appeared normal.

1.1.5 Approximately twenty minutes later, two eyewitnesses, travelling together by car, saw the aircraft crash into a field on Benmore Station near the intersection of Lake Ohau Rd and State Highway 8. The eyewitnesses were approximately 100 metres from the intersection when the passenger (Witness 1) first saw the aircraft.

1.1.6 Witness 1 reported seeing the aircraft in what appeared to be level flight for one or two seconds and then watched it go into a steep descent with 'many turns'. She thought the aircraft was conducting aerobatics.

1.1.7 The second eyewitness (Witness 2), saw the aircraft after his attention was drawn to it by Witness 1.

1.1.8 Witness 2 recalled he initially saw the aircraft against a blue-sky background. The aircraft then descended against the backdrop of the ranges in a corkscrew motion. He believed from the time he saw it, the aircraft completed five or six turns prior to impacting the ground.

1.1.9 Witness 2 notified emergency services of the accident at 1050 then flagged down another driver (Witness 3), asking him to see if the pilot could be given assistance.

1.1.10 Witness 3 approached the wreckage, advising emergency services over the phone that he believed the pilot was deceased.

1.1.11 Emergency services arrived at the scene at 1103 and confirmed the pilot was deceased.

1.1.12 The accident occurred in daylight at approximately 1050, 7.9 nautical miles north-north-west of Omarama aerodrome at an elevation of 1646ft. Latitude S 44° 21' 23", longitude E 170° 01' 01".

Figure 1. Location of accident (Google Earth™)

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0

Table 1: Injuries to persons

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

Flying hours	*All types*	*Powered-aircraft*	*ZK-ULM*	*Glider*
Last 24 hours	0	0	0	0
Last 7 days	7.4	7.4	1.5	0
Last 30 days	16.5	16.5	2.2	0
Last 90 days	24.8	24.8	2.7	0
Total hours	10641.7	940.6	48.8	9701.1

Table 2: Pilot flight hours

1.5.1 The pilot held a microlight flight certificate,[3] a Private Pilot Licence Aeroplane (PPL A), a Commercial Pilot Licence Glider (CPL G), and glider instructor rating.

1.5.2 The pilot completed a glider Biennial Flight Review (BFR)[4] on 18 December 2019 and a PPL BFR on 19 May 2020.

1.5.3 The pilot's most recent microlight flight certificate expired in December 2019. The pilot held a current microlight medical declaration signed by a General Practitioner (GP) at the time of the accident, but records indicated that the pilot had not applied for an up-to-date microlight flight certificate.

1.5.4 The pilot did not hold a current CAA Class 2 medical certificate. Nor did he hold a current New Zealand Transport Agency (NZTA) DL-9 (Class 2 with P (passenger) endorsement)[5] at the time of the accident as this was not renewed by his GP.

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[3] The pilot's microlight documents were issued by the Sport Aviation Corp Limited (SAC) in accordance with Part 149 of the Civil Aviation Rules at the time. SAC has since been merged with the Recreational Aircraft Association of New Zealand (RAANZ), however, as the pilot operated under SAC, the report will reference SAC.

[4] The BFR is a flight test to ensure maintenance of the required pilot skillset. It is valid for two years from the date of issue subject to the pilot also holding a valid medical certificate.

[5] A DL-9 (Class 2 with P endorsement) is a medical certificate that is required to drive commercially within New Zealand.

1.5.5 At the time of the accident the pilot did not hold the appropriate pilot licence/microlight certificate and medical combination to conduct this flight. The pilot held an DL-9 Class 1 medical at the time of the accident, however, a Class 1 is not sufficient to validate a PPL or microlight certificate.

1.5.6 In addition to ZK-ULM, the pilot also owned ZK-XBO, a RANS S-7S Courier. ZK-XBO is a Class 2 microlight, able to carry one pilot and one passenger.

1.6 Aircraft information

1.6.1 The Baby Great Lakes, serial number BLUL-01, was an amateur-built, fully aerobatic, single-seat bi-plane. It had an open cockpit and tailwheel undercarriage configuration. The build was completed in 2012 and the aircraft was registered as ZK-ULM, a Class 1 microlight. The aircraft was powered by a 102hp Simonini Victor 2 Plus engine driving a two-bladed Thompson fixed-pitch wooden propeller.

1.6.2 The aircraft was of wood, metal, and fabric construction. It had a Maximum All-Up Weight (MAUW)[6] of 362kg.

1.6.3 An annual condition inspection was carried out on 11 November 2020 at 84.5 airframe hours and was valid at the time of the accident. No discrepancies or defects were noted in the aircraft logbook during the inspection. At the time of the accident, the aircraft had accrued approximately 110.1 airframe hours.

1.6.4 The aircraft was not fitted with a stall[7] warning system, nor was it required to be.

1.6.5 It was reported that shortly after purchasing the aircraft, the pilot conducted aerobatic manoeuvres that had overstressed the aircraft. The aircraft logbook indicates that the strut rod ends were bent. These were replaced and an annual condition inspection was carried out prior to the aircraft being returned to service on

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[6] This is the maximum weight at which the aircraft is permitted to fly.

[7] A stall is an aerodynamic condition where the relative angle between the wing and the airflow (angle of attack) increases beyond a certain point referred to as the critical angle, and lift begins to rapidly decrease. An aerodynamic stall is not to be confused with stalling the engine.

27 November 2018. The investigation did not find any evidence to suggest that this previous damage contributed to the accident.

1.6.6 In early 2021, the builder of the aircraft visited the pilot at Omarama. The pilot advised the builder that he no longer did loops in the aircraft and flew it just for fun. There was no reference in the pilot's logbook to conducting aerobatics. Friends reported that he had not recently discussed doing any aerobatics in the aircraft.

1.7 Meteorological information

1.7.1 The CAA's Chief Meteorological Officer was asked to summarise the weather conditions on the day of the accident.

1.7.2 Forecasts were for scattered cloud with a base of 4000-6000ft. This would see the top of the ranges between Twizel and Omarama in cloud. Satellite imagery indicated the presence of cloud, however, there were significant areas of clear skies in the region.

1.7.3 The observed winds at Pukaki, Tara Hills, Lindis Pass, and Kurow were all less than 7 knots. Winds at higher altitudes were forecast to be stronger north to north-westerlies, easing by mid-morning to around 10-15 knots between 3000ft and 7000ft.

1.7.4 The weather was described by local Omarama pilots as 'benign' with light winds. Statements by witnesses at the scene and police photos taken shortly after the accident support this.

1.7.5 Weather was not likely to have been a contributory factor in the accident.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 The aircraft was fitted with an ICOM IC-A5 model hand-held radio mounted under the instrument panel. Activation was by a push-to-talk switch.

1.9.2 Pilots transmit their position and intentions on the unattended radio frequency of 119.1 in and around Omarama aerodrome.

1.9.3 The Omarama aerodrome operator records the local frequency for the purposes of determining landing charges. The Omarama aerodrome operator advised that this recording equipment does not have sufficient range to capture transmissions from the location of the accident.

1.9.4 The investigation found no evidence to suggest that emergency radio transmissions were made by the pilot.

1.10 Aerodrome information

1.10.1 The flight originated from Omarama aerodrome (NZOA), which is an unattended aerodrome.[8] It is outside the range of air traffic control radar surveillance.

1.10.2 The accident occurred in the vicinity of Clearburn airstrip, which is located adjacent to the intersection of SH8 and Lake Ohau Rd. It is an unpublished airstrip located on farmland.

Figure 2. Location of Clearburn airstrip near accident site (Google Earth™).

[8] Unattended means no aerodrome air traffic control service is being provided.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 The aircraft impacted terrain in a steep nose-down attitude.

1.12.2 The wreckage signatures indicated high vertical forces with little forward horizontal energy.

1.12.3 Ground scars indicated that the aircraft was rotating at the time of impact.

1.12.4 The throttle was observed to be at a full-power setting. The RPM gauge needle was trapped at a reading of approximately 6500RPM.

1.12.5 The wooden propellor was substantially damaged. Some pieces of the propellor were located several metres away from the main wreckage.

Figure 3. Rear view of aircraft wreckage in-situ.

1.12.6 The trimmable horizontal stabiliser[9] was trimmed to a full nose-down position.

1.12.7 It was noted during the field investigation that a make-shift trim tab was attached to the elevator with tape.

Figure 4. Make-shift elevator trim tab.

1.12.8 Although flight control runs were disrupted as a result of the accident, pre-impact control integrity was established as far as possible.

1.12.9 No evidence was found of any structural, mechanical, or flight control system failure that may have contributed to the accident.

1.13 Medical and pathology information

1.13.1 The post-mortem examination determined the pilot died of high-energy impact injuries.

[9] A trimmable horizontal stabiliser is a fully-moving horizontal tail surface.

1.13.2 Toxicology results showed no presence of drugs or alcohol in the blood.

1.13.3 The pilot's GP records indicate that the pilot suffered from bilateral macular degeneration[10] with significant loss of visual acuity.

1.13.4 Recreational pilots operating on either a PPL or a microlight certificate must hold, at minimum, a current medical certificate as follows:

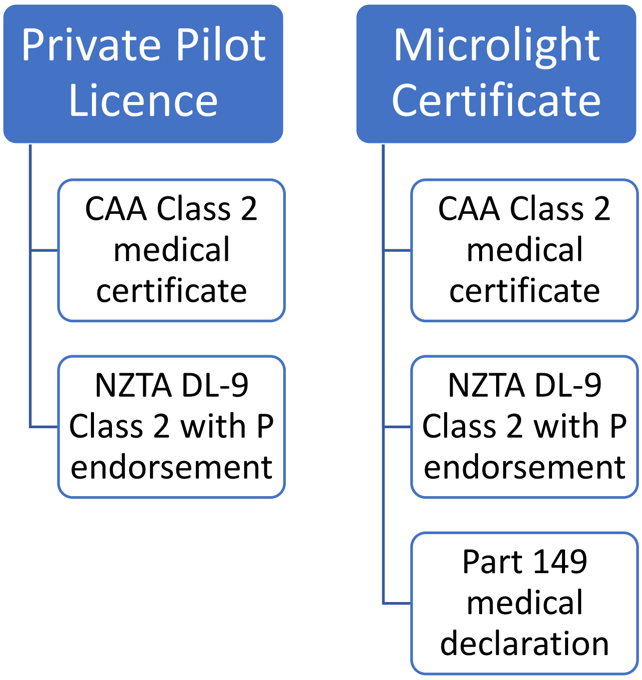

Figure 5. Medical certificate requirements for PPL and microlight certificate holders

1.13.5 As per CAA guidance, pilots operating on a DL-9 are only required to provide pages 1 and 4 of the DL-9 form to the CAA. Most of the medical information is contained within pages 2 and 3.

1.13.6 The pilot previously held a CAA Class 2 medical certificate that expired on 6 March 2016. The pilot was then declined a renewal of this medical certificate in April 2016 because of the impaired vision.

1.13.7 The CAA expert conducting the Accredited Medical Conclusion at the time wrote:

[10] Macular degeneration is a long-term disease resulting in vision loss in the centre of a person's field of vision.

"The experts note the presence of wet macular degeneration in the right eye and multiple injections to control the condition. They note that the applicant has substandard vision in that eye. They also note that there is reported 'increasing distortion in the left eye' as well as a background of severe colour vision deficiency. They note reduced peripheral visual fields and minor central visual fields impairment. Finally, the condition is progressive, and one cannot ascertain stability during the period of certification. While some of the deficiencies, considered in isolation, can be compensated for, their combination is likely to affect flight safety in the expert's opinion."

1.13.8 As part of the investigation, a CAA subject matter expert (SME) reviewed the pilot's medical notes. The SME stated that the pilot's eye condition would likely have caused difficulty seeing instruments and other aircraft in the air.

1.13.9 The pilot was issued with a NZTA DL-9 (Class 2 with P endorsement) medical certificate in January 2018. This DL-9 certificate expired in January 2020.[11] There was no renewal of the DL9 Class 2 beyond this date. A DL9 Class 1 medical certificate was issued in April 2021, which was not sufficient to validate either a PPL or microlight flight certificate.

1.13.10 The Sport Aviation Corporation (SAC) microlight medical declaration signed by both the pilot and his GP on 13 April 2021[12] contained the following clause of note:

"I also declare that I do not suffer from any medical condition or disability, either mental or physical including any visual defect or chronic ear, sinus or respiratory disease, or take any medication which would be likely to affect my ability to fly a Microlight safely."

1.13.11 As part of the investigation the CAA obtained an independent assessment of the pilot's medical notes provided by his GP. Key points from that assessment were:

[11] The DL9 medical certificate is valid for five years for drivers under the age of 40 and for two years for drivers 40 years of age and older.

[12] Validity period is two years for pilots over the age of 40.

"[The pilot's] reduced visual acuity probably would not have reduced the ability for him to see the horizon… however… straight lines, for example the horizon, may no longer appear straight, and worse, the alignment would change with gaze. It would also make reading instruments more challenging, depending on the extent of distortion."

"*The distorted central vision, in combination with an atypical vestibular input, could have made it more difficult to orientate himself, especially in a highly stressful situation where it may be difficult to rely on a learned behaviour."*

"The 6 April 2021 letter from [the] ophthalmologist, states his visual acuity was …below the driving standard, even before considering any regions of vision loss or distortions within the visual field….it is possible that he would have been able to make the 6/12 binocularly one week later at the GP visit on 13 April 2021, but I would assume this would have been borderline, and have taken considerable time and effort."[13]

"With such an extensive history of progressive AMD,[14] *it is very likely that [the pilot's] vision would have further deteriorated between the GP appointment in April and the accident in October, and it is unfortunate that it was not assessed at the GP appointment on 19 October 2021.*[15] *Based on clinical experience, I would think it would be very unlikely that he would have met the driving standards for visual acuity, and possibly for visual fields, at this appointment or the time of the accident*."

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[13] The assessor stated that the GP notes included a comment saying, 'Has eyesight cert,' which is likely a reference to a DL12 form (eyesight certificate for a driver licence). These are issued by an optometrist or ophthalmologist and are valid for 60 days. It is therefore possible that the pilot's eyesight was not assessed directly by the GP at the GP appointment on 13/4/21.

[14] Age-related Macular Degeneration

[15] The CAA noted that the GP appointment on October 19 2021 was related to a shoulder injury. It appears this appointment was not intended for the purpose of obtaining further eyesight assessment.

1.13.12 A local pilot stated that he had spoken with the pilot the day before the accident. The pilot told him that he had not flown in the preceding few days due to having a 'heavy head cold, with blocked sinuses and ears'.

1.13.13 Another local pilot sat next to the pilot at the airfield briefing on the morning of the accident and chatted to him. This pilot, who is also a doctor, stated that the pilot appeared well.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 The pilot was secured by a 5-point harness and was wearing a helmet at the time of the accident.

1.15.2 An Emergency Locator Transmitter (ELT) was not fitted to the aircraft, nor was it required to be. The pilot was not carrying a Personal Locator Beacon (PLB).

1.15.3 Notwithstanding the above, the accident was not survivable due to the impact forces involved.

1.16 Tests and research

1.16.1 The engine was removed and inspected by an engineer under CAA supervision.

1.16.2 There was significant impact damage to the engine, however, the engineer concluded that the engine was most likely operating normally immediately prior to the aircraft impacting the ground.

1.16.3 The fuel tank ruptured during impact, therefore, the exact quantity of fuel contained in the tank at the time of the accident is unknown. Emergency services reported smelling fuel on arrival at the site and the pilot's clothing had some fuel soakage. This evidence suggested that fuel exhaustion was not likely to have been a factor in the accident.

1.16.4 The CAA used full-fuel and half-fuel scenarios to calculate the likely range of weight and balance figures at the time of the accident.

1.16.5 The centre of gravity (C of G)[16] was within the allowable limits and was noted to be near the aft limit at both full and half tank scenarios. It would have moved closer to the aft limit as fuel was burned.

1.16.6 With a full fuel tank the aircraft weight would have been 351.2kg, within MAUW of 362kg.

1.16.7 A friend of the pilot reported that, sometime prior to the accident, he had asked the pilot to sit in the aircraft while he had lifted the tail. The friend felt that the aircraft was very tail-heavy.

1.16.8 The friend noted that the pilot had added a make-shift trim tab (refer Fig 4, page 14) to the elevator about two weeks prior to the accident. The pilot had stated that he 'wanted more forward stick' while flying.

1.16.9 The Skybrary Aero website details information about the C of G and the effect that an aft C of G has on an aircraft.

Of note are the following statements:[17]

> "[The location of the C of G]… *is of primary importance to aircraft stability, which determines safety in flight."*
>
> *"The aircraft becomes less stable as the C of G is moved rearward."*
>
> *"An aircraft loaded to the rear limit of its permissible C of G range handles differently in turns and stall manoeuvres… than when it is loaded near the forward limit."*
>
> *"The recovery from a stall in any aircraft becomes progressively more difficult as its C of G moves aft. This is particularly important in spin recovery."*

[16] The centre of gravity (C of G) is the point of balance at which the total weight of the aircraft is assumed to be concentrated. The C of G must be located within specific limits for safe flight.

[17] Skybrary Aero (2022), Weight and Balance | SKYbrary Aviation Safety

1.16.10 An information pack for builders and pilots of the Baby Great lakes was obtained from the Aircraft Spruce & Specialty Co website.[18] The information pack contained the following statement of note:

> *"The heavier the pilot is, the further aft will be the C of G. This makes it trickier and increases the speed required for effective control and take-offs and landing. The Baby [Great Lakes] is extremely sensitive to weight."*

1.16.11 The information pack advised pilot-builders who were 'heavier' that the nose section of the fuselage should be lengthened to compensate for the additional pilot weight to the rear of the aircraft. The builder of ZK-ULM was around 60kg and therefore did not need to apply this advice when constructing the aircraft. The pilot was 90kg meaning that the C of G would always have been more aft for the pilot than it had been for the builder.

1.16.12 The CAA Good Aviation Practice (GAP) booklet *Spin[19] Avoidance and Recovery* contains the following statement of note:

> *"Spin characteristics vary depending on aircraft type, but even a given type of aircraft can have markedly changed spin characteristics depending on the aircraft weight, the aircraft centre of gravity, and how the controls (including engine power) are handled during the spin."*

1.16.13 An aircraft with an aft C of G is harder to recover from a spin because the flight controls are less effective. More control deflection will be required to overcome the forces acting on the aircraft in the spin.

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[18] Aircraft Spruce & Specialty Co hold the rights to the Baby Great Lakes design.

[19] A spin is an aerobatic maneuver that can be conducted intentionally, however, it can also result from handling errors in normal flight. When conducted intentionally the Civil Aviation Rules require that it be above 3000 ft above ground level (AGL).

1.16.14 The GAP booklet makes the following statement about spin recovery:

> *"To have a chance at recovery from the spin, the pilot must immediately recognise the spin, and its direction, know exactly what to do in the right order, and then execute the procedure correctly the first time."*

1.16.15 Standard spin recovery is summarised in Figure 6.[20]

PARES Spin Recovery		
P	POWER	off (close throttle)
	Identify you are in a spin and the direction of rotation	
A	AILERONS	neutral
R	RUDDER	full opposite to direction of spin… Pause
E	ELEVATOR	move stick or control column progressively and centrally forward until spin stops
	Perform steps sequentially – centralise when spinning stops	
S	Spin STOPS	rudder neutral and ease out of ensuing dive

Figure 6. PARES Spin Recovery for powered aircraft, *GAP Spin Avoidance and Recovery,* page 22. Source CAA.

1.16.16 In a powered aircraft the first recovery action is to reduce the power to idle (Fig 6). Spin recovery in a glider does not require the consideration of power, otherwise recovery techniques are the same as for powered aircraft.

[20] There is no universal spin-recovery technique that will work for all aircraft. PARES is the most widely used and is detailed in this report to demonstrate the usual recovery technique.

1.16.17 The GAP booklet also states that unintentional spins are more likely to occur in low speed climbing turns, during a skidding turn onto final approach, and where false visual horizons occur such as in mountainous terrain.

1.16.18 The builder and test pilot of ZK-ULM both described the aircraft as 'easy to fly' and a 'good aerobatic beginner's aircraft'. Both stated that the aircraft would quickly recover from a spin when correct inputs were made.

1.16.19 Although the builder and test pilot stated the aircraft was easy to fly, the builder advised the investigation that the last time he spun the aircraft he scared himself. He stated that during an intentional spin with the usual recovery inputs, the aircraft kept spinning. After three or four spins, he was feeling nervous about the situation as he felt he was executing the recovery correctly. He then realised the stick was 'slightly off centre with a touch of right aileron'. A small adjustment to the stick recovered the aircraft from the spin. He advised the CAA that with the stick slightly off-centre, full rudder input had no effect on stopping the spin.

1.16.20 A well-known human factor that can affect pilots in emergency situations is the 'startle effect'. Skybrary defines startle effect as:

> *"An uncontrollable, automatic reflex that is elicited by exposure to a sudden, intense event that violates a pilot's expectations."*[21]

1.16.21 Skybrary also highlights the effects and consequences for a pilot who may be experiencing startle effect:

1. Slower information processing.
2. Serious impairment, or complete inability to evaluate and take appropriate action due to intense physiological response.
3. Basic motor response disruption for up to three seconds.
4. Performance of complex motor tasks impacted for up to ten seconds.

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[21] Startle Effect | SKYbrary Aviation Safety

5. May incur brief period of disorientation and confusion.

1.16.22 Skybrary lists 'aircraft upset', which includes stall and spin, as one of the potential situations where the startle reflex and response may occur.

1.16.23 Spatial disorientation is a critical risk during a spin. Skybrary Aero defines spatial disorientation as:

> *"The inability of a pilot to correctly interpret aircraft attitude, altitude, or airspeed in relation to the Earth or other points of reference."*[22]

1.16.24 The GAP booklet describes in detail how disorientation occurs during a spin. Orientation is a function of three sensory mechanisms: visual (the eyes), vestibular (the ears), and proprioceptive (the 'seat of the pants').[23]

Of note are the following statements:

> *"… the eyes, through the interpretation of instruments and outside references are important to orientation."*

> *"After about five turns, the eye becomes out of synch with the aeroplane rotation. Vision will blur and the speed of rotation appears to increase. Now the pilot has difficulty in determining the number of turns in the spin, its direction, and the effectiveness of any actions taken to exit the spin."*

> *"Disorientation occurs when there is a conflict between the visual and vestibular sensations – your eyes tell you one thing, but your inner ear says something else."*

1.16.25 According to the American Psychological Association, it is common for aging individuals to take longer to complete mental tasks. Gradual decline in cognitive function is a normal part of the aging process.[24]

[22] Spatial Disorientation | SKYbrary Aviation Safety

[23] Good Aviation Practice (GAP) – *Spin Avoidance and Recovery – Disorientation* - Revised 2014

[24] American Psychological Association, APA Dictionary of Psychology

1.16.26 Skills that are not practiced regularly can be subject to skill fade. Skybrary Aero defines skill fade as:

"The decay of ability or adeptness over a period of non-use." [25]

1.16.27 Skill fade is quite dependent on the level of experience, overall competence and the skill involved. Easier skills to learn are usually not significantly affected by skill fade, however, complicated or less predictable tasks or activities are more prone to skill fade. Unless these more complex skills are used regularly, the process becomes unfamiliar and the skill is more difficult to execute.

1.16.28 A pilot who flies different types of aircraft can be at risk of 'negative habit transfer'. In the aviation context this is the transfer of habits or responses from one aircraft type, where they are appropriate, to another aircraft type, where they are not appropriate. This creates a potential threat to safe aircraft operation.[26]

1.17 Organisational and management information

1.17.1 Not applicable.

1.18 Additional information

1.18.1 Not applicable.

1.19 Useful or effective investigation techniques

Altitude calculations

1.19.1 Based on statements provided by the witnesses, the CAA was able to calculate a likely altitude range that the aircraft was operating within when it entered the spin. Using the angles between the aircraft positions as indicated by the witnesses and the location of the witnesses at the time, the calculations indicated a range between 300-700ft Above Ground Level (AGL).

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[25] Skill Fade | SKYbrary Aviation Safety

[26] Negative transfer: a threat to flying safety - PubMed (nih.gov)

2 Analysis

2.1 It is likely that the purpose of the flight was a local flight, possibly to test the handling characteristics of the aircraft with the recently added makeshift elevator trim tab.

2.2 Based on witness statements and CAA calculations, the aircraft was likely to have been operating at a height at, or below, 700ft AGL when it entered a spin. Eyewitnesses who saw the aircraft in the spin estimated 5-6 rotations prior to impact. The CAA therefore considers it likely that the aircraft was at or near the upper calculated range of around 700ft AGL.

2.3 Intentional aerobatics must be conducted above 3000ft AGL unless approved. It was, therefore, unlikely that the pilot would have been conducting intentional aerobatics.

2.4 The absence of recorded data or witnesses prior to the spin limited the ability of the investigation to determine how the aircraft departed controlled flight. It is considered likely that the aircraft entered a spin unintentionally following a stall when the airspeed reduced below the aircraft stall speed.

2.5 The GAP booklet on spinning highlights that unintentional spins are more of a risk when in slow speed climbing and descending turns. They may also occur in mountainous terrain where false visual horizons can occur.

2.6 The investigation was unable to determine with certainty what phase of flight the aircraft was in prior to entering the stall/spin, however, it is likely the aircraft was in a climb or descent at the time. This is based on:

- The heightened risk of stall/spin scenarios in a climb or slow speed descent
- The calculated likely altitude of the aircraft (around 700ft) being an altitude associated with circuit climb and descent procedures
- The proximity of the accident site to Clearburn airstrip, and the accident site being directly below a logical circuit leg, and

- It is possible that he was testing the make-shift elevator trim-tab to determine its effectiveness either using the airstrip or operating in the vicinity of it.

2.7 The weight of the pilot (90kg) meant that the aircraft was always operated near the aft C of G limit. Unintentional stalls and spins are more of a risk with an aft C of G. The risk of stalling and spinning was therefore higher for this pilot in this aircraft when in low-speed climb and descent phases of flight, particularly during turns.

2.8 It is likely the pilot's degraded eyesight, coupled with his age, contributed to the entry to the stall/spin. This was due to the pilot taking longer to recognise and react to a developing situation and an inability to clearly perceive the horizon or see the airspeed indicator. If the pilot had not fully recovered from his recent head cold, residual effects may have exacerbated this.

2.9 Expert opinion was sought on the potential effect of the makeshift elevator trim tab on the stall characteristics of the aircraft. It was determined that due to the nose-down control force exerted by the trim tab, a stall would have been *less* likely than without the trim tab.

2.10 The SME also provided opinion on the potential effect of the makeshift trim-tab on the pilot's ability to successfully recover from the stall and spin. While the trim tab would have created additional nose-down force, it would also likely have reduced the amount of forward pitch control travel available to unstall the wing, meaning stall and spin recovery may have been more difficult.

2.11 SME opinion indicated that recovery from a spin at around 700ft would be extremely challenging for any pilot and in many cases, not possible. To achieve a recovery from this altitude, the pilot would need to implement immediate and correct recovery actions on entry to the spin. The investigation therefore considers that the low altitude at the time of spin entry was the predominant factor that prevented the pilot from successfully recovering from the spin.

2.12 Evidence at the site[27] suggested that the pilot did not apply the correct spin recovery techniques. One, or a combination, of the following factors likely prevented the pilot from immediately implementing the correct actions:

- Startle effect. An unintentional spin at around 700ft AGL likely caused the pilot to experience a significant level of startle. This would have impaired his cognitive processes to such an extent that recovery actions were either delayed, carried out incorrectly, or were not carried out at all.
- Impaired eyesight. Eyesight degeneration and possibly an impaired vestibular system due to a recent head-cold may have caused the pilot to experience spatial disorientation more rapidly than a pilot in full health. This may have prevented him from applying the appropriate recovery inputs.
- Age-related cognitive decline. The pilot was 75 years old and possibly had slower recognition and reaction times.
- Skill fade relating to aerobatic manoeuvres. There was no recent evidence in the pilot's logbook, or in reported conversations with friends, that he routinely conducted aerobatics in the aircraft. Therefore, it is likely the pilot had little or no recent aerobatic experience at the time of the accident. While the pilot was experienced at manoeuvres such as spinning, skill fade can occur when these manoeuvres are not practiced regularly. The pilot may not have responded quickly or effectively to the stall/spin because of skill fade.
- 'Negative transfer' (habits). The throttle position, high RPM setting, and damage to the propeller suggests that the aircraft impacted the ground while under power. It is likely that the pilot did not reduce the power on entry to the spin, which is a critical action in the event of a spin. The pilot had significant spin experience in gliders where power was not a

[27] Throttle position, trapped RPM gauge at high setting, and evidence that propellor impacted the ground while under power.

consideration. It is possible that the pilot reverted to their more dominant experience of glider spinning and did not remember to reduce the power to idle on first entry to the spin.

2.13 Additional factors that would make a successful recovery less likely were:

- Aft centre of gravity. Greater control deflection is required with an aft C of G to overcome the forces in the spin.
- Aileron not completely centred. While it was unable to be determined if this occurred, the aircraft builder related having difficulty recovering from a spin with the control stick not perfectly centred. The pilot may have encountered the same problem, but without the altitude available to trouble-shoot and identify the issue.

2.14 The pilot held several licencing and medical documents, however, none were of the appropriate combination to legally exercise the privileges of either a PPL (A) or microlight flight certificate.

2.15 A PPL must hold, at minimum, a current CAA Class 2 medical, or an NZTA DL-9 (Class 2 with P endorsement) medical certificate. A microlight pilot must hold, at minimum, a current NZTA DL-9 (Class 2 with P endorsement) medical certificate or a Part 149 medical declaration signed by a GP (refer Fig. 5, page 15).

2.16 While the pilot had completed a PPL (A) BFR he did not hold the appropriate medical certificate. He did hold an NZTA DL-9 (Class 1), however, this was not sufficient to validate the PPL (A).

2.17 The pilot had a current SAC microlight medical declaration, however, there was no accompanying microlight flight certificate either on record or in his possession at the time of the accident[28].

[28] Under SAC rules (now merged with Recreational Aircraft Association of NZ), a microlight flight certificate is not a lifetime licence.

2.18 The pilot had not held an appropriate licence and medical certificate combination since 10 January 2020 when his DL-9 (Class 2 with P endorsement) expired. The pilot's logbook recorded 231 flights in both ZK-XBO and ZK-ULM in the period between 10 January 2020 and the accident on 25 October 2021.

2.19 The pilot had completed the microlight medical declaration in 2021 with his GP. This medical form contained a declaration that the pilot did not suffer from a visual impairment that would affect his ability to fly the aircraft safely. The pilot and his GP signed this declaration.

2.20 An independent medical assessment obtained by the CAA indicated that the pilot's eyesight would likely have been 'borderline' at this GP visit with probable ongoing deterioration by the time of the accident. It is not known if the probability of further deterioration was adequately considered by either the pilot or the GP when signing this medical declaration.

2.21 The CAA had declined the pilot for a CAA Class 2 medical certificate in April 2016 citing 'risk to flight safety'. The pilot then obtained a DL9 (Class 2 with P endorsement). This allowed the pilot to exercise almost all the same privileges as he would be able to exercise using a CAA Class 2 medical certificate.

2.22 The safety investigation determined that there is limited capability within the CAA information system to identify pilots who have been declined a CAA medical on the grounds of risk to flight safety but are operating on a lower medical standard.

2.23 Additionally, the current CAA guidance does not require a DL9 holder to provide the full medical assessment completed by the GP. Of the four pages of information, only pages 1 and 4 are required to be sent to the CAA. This limited information hinders the CAA's ability to detect pilots who may pose a risk to flight safety.

2.24 If such a situation was identified, the Director can override the use of the DL-9 certificate in the interests of safety.

3. Conclusions

3.1 The aircraft departed from controlled flight and entered a spin from which it did not recover.

3.2 Based on the evidence available, the investigation concluded that the pilot likely entered an unintentional spin when the airspeed reduced below the aircraft's stall speed during a climb or descent.

3.3 The low altitude at the time of spin entry was the predominant factor that reduced the likelihood of a successful recovery.

3.4 It is likely that the pilot did not apply the correct recovery techniques on entry to the spin, further reducing the likelihood of a successful recovery in the height available.

3.5 It is unlikely that the makeshift trim tab contributed to the stall and spin entry. However, it may have hindered the pilot's ability to recover from the stall and spin.

3.6 The aft C of G possibly contributed to the entry to the stall and spin and may have affected the pilot's ability to recover.

3.7 It is likely that the pilot's eyesight impairment, combined with the additional human factors identified, contributed to his inability to recognise the approach to the stall and implement correct recovery actions.

3.8 The pilot had not held a valid pilot licence or certificate and medical combination since January 2020 and was, therefore, operating in breach of Civil Aviation Rules.

3.9 It is probable that the pilot was not medically fit to fly the aircraft safely at the time of the accident due to the deterioration of his eyesight.

3.10 Although the pilot held a current microlight medical declaration signed by a GP, it is likely that the pilot's eyesight was marginal at the time this was issued. The GP may not have considered the probability of further deterioration of the pilot's eyesight beyond that date.

3.11 The CAA Medical Team had declined the pilot for a CAA Class 2 medical certificate in April 2016 citing a 'risk to flight safety'.

3.12 The Director has the capability to override the use of the DL-9 medical certificate in an aviation setting in the interests of flight safety, if such a situation is identified.

3.13 There is currently limited capability within the CAA information system to identify pilots that have been declined a CAA medical on the grounds of risk to flight safety from operating on a lower medical standard.

3.14 Current CAA guidance around the provision of DL-9 medical certificate information to the CAA limits the ability of the Director to provide effective regulatory oversight of some private pilot licencing.

4. Safety actions/recommendations

4.1 The CAA is producing a special-issue Vector covering common themes identified during investigations of fatal air accidents, including medical, maintenance, and weather-related issues.

4.2 The CAA has raised Safety Action (Action ID 24A221) for the CAA to consider a business system improvement that will more effectively support the identification of pilots that have been declined a CAA medical certificate and are operating on a lower medical standard.

4.3 An Issues Assessment has been raised for the CAA to review the requirements for the provision of DL9 information and to assess the appropriateness of the current DL9 medical certificate limitations (Action ID 24A222).

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