CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 03/3531

CESSNA 172N SKYHAWK

ZK-EOA

2KM EAST OF LAKE LUNA, OTAGO

5 DECEMBER 2003

Glossary of abbreviations used in this report:

AMSL	Above mean sea level
ARA	Annual Review of Airworthiness
ATC	Air traffic control
ATS	Air traffic service
ATIS	Automatic terminal information service
CAA	Civil Aviation Authority
CAR	Civil Aviation Rule(s)
CFI	Chief Flying Instructor
CPL(A)	Commercial Pilot Licence (Aeroplane)
E	east
ELT	Emergency Locator Transmitter
ETA	estimated time of arrival
ft	foot or feet
hp	horsepower
hPa	hectoPascals
kg	kilogram(s)
km	kilometre(s)
KT	knot(s)
m	metre(s)
M	magnetic
METAR	Met Report
NZDT	New Zealand Daylight Time
PPL(A)	Private Pilot Licence (Aeroplane)
RNZAF	Royal New Zealand Air Force
S	south
SARTIME	Search and Rescue notification time
SIGMET	Significant weather information
SPECI	Special weather report
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
WGS-84	World Geodetic System (1984)

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Aircraft type, serial number and registration:	Cessna 172N Skyhawk, 17271497, ZK-EOA
Number and type of engines:	1 Lycoming O-320-H2AD 160hp
Year of manufacture:	1978
Date and time:	5 December 2003, 1630 hours[1] (approx)
Location:	2 km east of Lake Luna, Otago Latitude[2]: S 44° 58.133' Longitude: E 168° 30.266'
Type of flight:	Mountain flying training
Persons on board:	Crew: 2
Injuries:	Crew: 1 fatal, 1 serious
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence	Commercial Pilot Licence (Aeroplane)
Pilot-in-command's age	28 years
Pilot-in-command's total flying experience:	1236 hours 773 on type
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr T McCready

[1] All times in this report are NZDT (UTC + 13 hours)

[2] WGS-84) co-ordinates.

Synopsis

The National Rescue Coordination Centre was notified on the late afternoon of Friday 5 December 2003 that the aircraft had not returned to Queenstown after a mountain flying training flight. A local search was initiated and the wreckage of the aircraft was found in steep and mountainous terrain in the Twenty Five Mile Creek watershed, some 2 km east of Lake Luna, Otago, at about 1935 hours. The pilot under instruction, although seriously injured, survived, but the instructor received fatal injuries in the accident.

1. Factual information

1.1 History of the flight

1.1.1 The accident flight was part of a structured mountain flying training course conducted by the Wakatipu Aero Club based at Queenstown Airport. The course is intended to provide pilots with practical training in a mountain flying environment, and is used by commercial pilots to upgrade their flying standards if they have trained in other areas of New Zealand that cannot provide that standard of mountain training. The course has the support of many local tourist operators who require the training as a pre-requisite when pilots apply for job vacancies. The crew on this flight consisted of a commercial pilot under instruction who had just begun his course, and a mountain flying qualified B category flying instructor.

1.1.2 The instructor completed an Aero Club in-house VFR flight plan for a mountain flying training exercise. The route to be flown was from Queenstown via visual reporting points Moonlight, Lake Luna, Glenorchy, Oxburn, Flood burn, Skippers Saddle, returning to Queenstown. The instructor nominated a SARTIME of 1730 hours on the in-house flight plan.

1.1.3 The flight departed Queenstown airport at 1532 hours. The instructor advised ATC of an ETA back at Queenstown of 1652 hours.

1.1.4 At 1718 hours Queenstown ATS attempted to contact the aircraft as the aircraft was overdue on its nominated ETA.

1.1.5 At 1720 hours ATS contacted the Aero Club which was not expecting the aircraft back until 1730 hours. A search was commenced at 1759 hours.

1.1.6 The wreckage was located at approximately 1935 hours. The location was past the turning point into the Lake Luna valley route normally flown by the Wakatipu Aero Club and was further up a narrowing valley with rising terrain.

1.1.7 The accident occurred in daylight, at approximately 1630 hours, at Twenty Five Mile Creek, at an elevation of 2888 feet. Grid reference 260-E2155490 N5572638, latitude S 44° 58.133' longitude E 168° 30.266'.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	1	0	0
Serious	1	0	0
Minor/None	0	0	0

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 A stand of Beech trees was damaged by the impact.

1.5 Personnel information

1.5.1 The instructor, aged 28, first obtained his PPL(A) in 1993. He obtained a CPL(A) in February 1996 and held a Class 1 medical certificate valid to 26 December 2004. His logbook was endorsed with a type rating for the Cessna 172, a certificate of completion of 18 hours of mountain flying training at the Aero Club dated 23 December 2001, and a B Category Instructor Rating obtained on 14 July 2003.

1.5.2 He had flown 1236 hours in total, including 80 hours gliding; and 773 hours on Cessna 172 aircraft. Additionally, he had accrued 326 hours mountain flying, including training and instruction, all on the Cessna 172 type.

1.5.3 In January 2002, the instructor had commenced his training for local employment at the Aero Club as well as his C Category instructor rating, which he achieved on 17 June 2002. Upon completion of the local training and instructor requirements, he was employed by the Aero Club.

1.5.4 The commercial pilot undergoing mountain flying training held a CPL(A) which had been issued on 4 November 2003, and a Class 1 medical certificate valid to 5 November 2004. His logbook was endorsed with a Cessna 172 type rating issued on 31 October 2003.

1.5.5 He had logged 244.5 flying hours. During the week prior to the accident flight, he had flown three previous mountain flying training dual exercises, one of which was with the instructor involved in this accident. One of these flights had included the Queenstown, Moonlight, Lake Luna route.

1.6 Aircraft information

1.6.1 Cessna 172N Skyhawk ZK-EOA, serial number 172 71497 was manufactured in the United States of America in 1979 and was first registered in New Zealand in January 1985. It was registered in the name of the most recent owners in September 1989.

1.6.2 The aircraft had an Annual Review of Airworthiness and 100 hour maintenance check on 21 October 2003 which included replacement of the rudder cables and a re-rig of the rudder and aileron systems. It had a 50 hour check on 25 November 2003.

1.6.3 The aircraft had a standard non-terminating Certificate of Airworthiness issued on 30 May 1990.

1.6.4 The engine (serial number L 19134-39A) had run 2958.50 hours since new, and 442.9 hours since last overhaul.

1.6.5 The McCauley 1C160/DTM propeller, serial number 734391 had run 1185 hours since overhaul on 27 July 1999. It was last inspected on 25 November 2003.

1.6.6 The weight and centre of gravity for the flight were within normal limits.

1.7 Meteorological information

1.7.1 A strengthening north westerly flow covered the South Island ahead of a cold front approaching from the west. The cold front was forecast to reach the Queenstown area around midnight on December 5. Ahead of the front in the strong northwesterlies, severe turbulence about and east of the South Island ranges was forecast with numerous SIGMETs. There was also severe icing forecast in lee wave cloud east of the South Island main ranges with numerous SIGMETs issued.

1.7.2 SIGMET is information issued by a meteorological office concerning the occurrence, or expected occurrence, of specified en-route weather phenomena that may affect the safety of aircraft operations.

1.7.3 Winds above Queenstown at the time of the accident have been estimated by MetService as:

1000ft	340/20KT
3000ft	330/35KT
5000ft	320/50KT
7000ft	310/53KT
10000ft	310/55KT

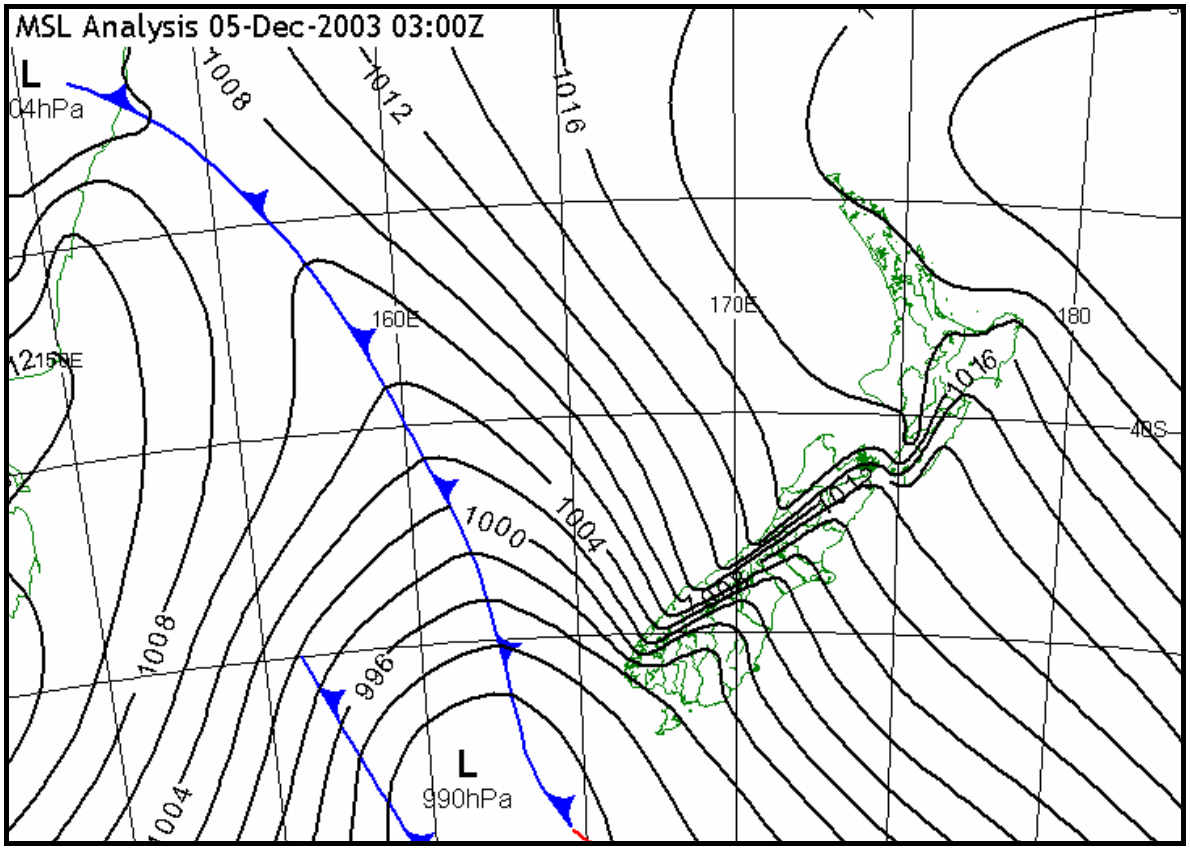

Figure 1: MSL analysis chart issued at 1600 NZDT

1.7.4 The 1500 hours Queenstown ATIS gave a surface wind of 280/13 gusting 21KT with direction varying between 210 and 300 degrees. The visibility was 70 km and there was scattered cloud at 7000 feet. The two thousand foot wind was forecast as 260/35KT.

1.7.5 The 1540 hours Queenstown ATIS gave a surface wind of 280/10 gusting 15KT with direction varying between 210 and 300 degrees. Wind shear was reported on final approach for runway 23. The visibility was 70 km and there was scattered cloud at 7000 feet. The two thousand foot wind was forecast at 260/35KT.

1.7.6 Between 1430 and 1630 hours, an off-duty police officer, who was very familiar with the area, was goat hunting in the same general area about 13 km northwest of the accident site. The officer described a very strong gusting northwesterly wind sufficient to break small branches off trees. Using the Beaufort Scale, which is a recognised scale of wind speed based on descriptive terms of wind strength, rather than measurement by instrument, this equates to a fresh gale with wind speeds between 34 and 40KT.

1.7.7 The officer reported that at 1630 hours (which was about the time of the accident), a rain squall came through the area and the gusts accompanying it were severe enough to make walking difficult. Visibility reduced in the squall which quickly passed through the area.

1.7.8 The officer returned to Mt. Gilbert hut at 1730 hours and reported that the wind gusts were severe enough to cause concern for the windows of the hut to be blown in. The strength of the gusts would have been sufficient to blow a person over. Using the Beaufort Scale, this equates to a strong gale with wind speeds between 41 and 47KT.

1.7.9 Another off-duty policeman on a boating trip on Lake Wakatipu commented that the wind and weather conditions were very unusual and unpredictable. On the trip he was caught unawares by the sudden change in wind strength and direction late in the afternoon after moving out of a sheltered area and then having to cross the more exposed open area of the lake on the return trip home.

1.7.10 A long-time resident of Queenstown commented than in over 25 years he had never seen such unusual and rapid changes in wind speed and direction late that afternoon.

1.7.11 The day had started with good flying conditions, as noted in a description given by the Aero Club Chief Flying Instructor, but turbulence had increased by the afternoon. The CFI flew to Wanaka in conditions that he described as moderate to severe turbulence and returned to Queenstown by 1500 hours. He commented that the conditions warranted not allowing the carriage of paying passengers due to the turbulence, but that the conditions were suitable for training of pilots as it exposed them to realistic weather encountered in the mountains, and allowed them to experience flight management to minimise discomfort to passengers and maximise safety for the conditions.

1.7.12 The Aero Club is equipped with a personal computer which is linked to the Airways New Zealand Internet Flight Information System (IFIS). Examination of Airways IFIS computer records showed that the Aero Club accessed all relevant meteorological information, including SIGMETs, prior to the accident flight departing.

1.7.13 It was not possible to determine if the instructor himself was aware of the weather information obtained from the IFIS, but colleagues stated that he was always meticulous about checking the weather prior to flight. A later interview with the instructors parents revealed that he had more than a passing interest in weather conditions - often taking photographs of cloud formations and changing weather. It is likely that he was well aware of the conditions.

1.7.14 The Queenstown Basin area can have very localized weather conditions due to many factors including the upper winds flowing across the mountain tops and leaving areas sheltered in the mountains with relatively benign wind conditions.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 The instructor communicated with Queenstown Tower. All transmissions were normal.

1.9.2 During the departure sequence, an incoming Boeing 737 aircraft reported wind shear on final approach to runway 23.

1.9.3 The last call made from the instructor to Queenstown ATS was “clear at Moonlight three thousand”.

1.10 Aerodrome information

1.10.1 Not applicable.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 The aircraft first struck the uprising ground near the top of a steep gully in an open tussock area on a heading of 340 degrees M, while in a slight bank to the left, in a slightly nose down attitude. The terrain after the initial impact point sloped down approximately 30 degrees. The aircraft was in the confines of a valley system and was midway through a turn away from rising ground that was further up the valley.

1.12.2 Several pieces of wheel spat fibreglass and windshield Perspex were located forward and downwind from the initial impact point due to a strong tailwind.

1.12.3 At initial impact, the nose-wheel assembly broke away, and remained in the open tussock area while the aircraft continued down into the gully and trees. The windshield shattered at this point and the main wheels broke away from the aircraft coming to rest some 80 m away.

1.12.4 After this impact the aircraft flew or bounced down into the gully, colliding with a Beech tree and slewing towards the right. The aircraft came to rest amongst a stand of Beech trees on a 50 degree downward slope facing west approximately 160m from the initial impact point, and 15 m from collision with the first Beech tree.

1.12.5 Upon entering the gully, the left wing collided with a Beech tree and, along with the left hand side of the cockpit, was completely separated from the aircraft. The engine and engine firewall, windshield remnants and instrument panel, were separated from the aircraft continuing down into the steep gully and coming to rest almost 7 m from the main wreckage. The propeller was severely damaged and was still attached to the engine.

1.12.6 The rear fuselage, empennage, and right wing remained attached to the fuselage wreckage.

1.12.7 The cockpit area was opened up by the impact, but the occupiable space in the cockpit area was uncompromised.

1.12.8 Due to the difficult terrain and possibility of evidence being destroyed during the recovery of the airframe wreckage by helicopter, an extensive on-site engineering investigation was carried out.

1.12.9 All extremities and control surfaces were accounted for at the site and pre-impact control integrity was established.

1.12.10 The throttle was in the fully forward position; the fuel mixture was rich, the carburettor heat was off, the magnetos were on "BOTH", and the master switch was on.

1.12.9 All engine components were accounted for. The engine was disassembled after the wreckage was recovered to an engineering facility. Magneto timing and testing was also conducted and no defects were found.

1.12.10 It was not possible to measure the available fuel on board, but fuel was clearly visible in the right wing which was resting on an angle of 70 degrees wing down. Fuel was confirmed to be present at the carburettor.

1.12.11 One propeller blade had been fractured by impact, and the other blade had static forward bending and across chord scratching.

1.13 Medical and pathological information

1.13.1 Post-mortem examination showed that the instructor died of a head injury.

1.13.2 Toxicology tests revealed nothing of significance.

1.13.3 The survivor sustained serious injuries in the accident and has only limited recollections of the accident flight.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 The pilot under instruction was thrown out of the aircraft when his seat belt webbing failed on impact due to the belts being cut by the disintegrating floor. His survivability was probably due to the sequence of the left side of the aircraft opening up due to the initial tree strike with the left wing, which weakened the airframe and released the engine and instrument panel from the fuselage. This created an open space at the front of the aircraft so that when the seat belt failed he had nothing to hit. He was found approximately three hours after the accident.

1.15.2 The instructor remained in his seat with his harness intact. A head injury sustained by impact with the right upper door frame of the cockpit was not survivable. His injuries are probably due to the aircraft slewing to the right side.

1.15.3 The aircraft was equipped with an emergency locator transmitter (Artex ELT-200), but this did not activate due to damage to the antenna resulting from the impact.

1.15.4 Heavy rain and strong northwest winds hampered the search and rescue mission.

1.15.5 The search and rescue helicopter pilot was aware of the planned route of the aircraft, which had been entered on the in-house flight plan. Although the aircraft had deviated from this route, the wreckage was located visually by the helicopter crew. The aircraft had come to rest in dense bush and was very difficult to see. The helicopter pilot had decided to search that section of the valley due to his prior knowledge of an accident in that area in 1981.

1.15.6 The aircraft was equipped with a comprehensive survival kit. The survivor was too badly injured to reach or use this.

1.16 Tests and research

1.16.1 Research into previous accidents revealed that on 19 September 1981 a Cessna 172 with four persons on board crashed in similar weather conditions while attempting to follow the same route, and the accident sites were close to each other. In this case the instructor survived, and later outlined how he had noted that the student pilot had missed the turn off across Lake Luna and that the instructor had allowed him to continue flying further up the valley waiting for the student to recognise his navigational error. Their accident occurred while turning out of the valley and encountering sink in the lee of the range. Details of this accident are contained in Office of Air Accidents Report No 81-077 for ZKDWT.

1.17 Organisational and management information

1.17.1 The Wakatipu Aero Club conducts a flying training programme with a requirement of 50 hours local time i.e. within the Wanaka, Milford, Te Anau, Queenstown area including 10 hours specialised Milford training, 10 hours specialised mountain flying training, 10 hours route check and 10 hours type rating. That time includes both dual and solo requirements. On successful completion a pilot is able to become operational as a commercial pilot with Wakatipu Aero Club. It is a standard also recognised by the other local scenic flight operators. This is in addition to the CAA Commercial Pilot Licence minimum experience requirement of 200 hours.

1.17.2 The Manager and Chief Pilot of the Wakatipu Aero Club stated that flying in pre-frontal weather conditions is an important component of mountain flying training.

1.18 Additional information

1.18.1 The CAA Good Aviation Practice (GAP) booklet relating to Mountain Flying warns pilots about up-draughts, downdraughts, turbulence, mountain waves, and rotors. These phenomena all become increasingly hazardous with increasing wind strength.

1.18.2 The GAP booklet recommends that pilots do not conduct mountain flying when upper winds are forecast over 25 KT.

1.18.3 The GAP booklet also recommends that pilots do not proceed in doubtful weather and cautions pilots about dangerous turbulence associated with high winds. It also provides guidance to pilots regarding turning in valleys, and escape routes.

1.18.4 The aircraft wreckage was located at 2888 ft AMSL on the lee side of a mountain range. The range is orientated north-east to south west and reaches an elevation of 4,800 feet AMSL in that area.

1.18.5 The wind direction was northwesterly and the wind speed was estimated to be between 35 and 50KT.

1.18.6 An interview with the surviving pilot revealed that he had limited memory of the accident flight, but he did recall that while conducting circuits at the Glenorchy Airfield he had noted the very high ground speed while travelling downwind and the steep approach which was required on finals due to the high head wind component. He also recalled the deteriorating weather when he had looked up the Dart Valley. His next memory was of reaching the area of the turn inland at the Twenty Five Mile Creek and of the two pilots discussing their options of going inland or continuing to follow the lake back to Queenstown. He does not recall the reason that the inland route was chosen.

Figure 2: The aircraft flew along this valley in high wind and turbulent conditions towards this point where the photograph is taken from, but should have turned into the valley system at the right of the photograph and continued over Lake Luna.

1.19 Useful or effective investigation techniques

1.19.1 Utilising mapping software a 3 dimensional "fly through" was created of the valley. This provided a possible simulation of the flight and showed that after missing the Lake Luna turn off, a more inviting wider area in which to execute a turn out of the valley existed near the accident site, but this wider area also had rising terrain associated with it.

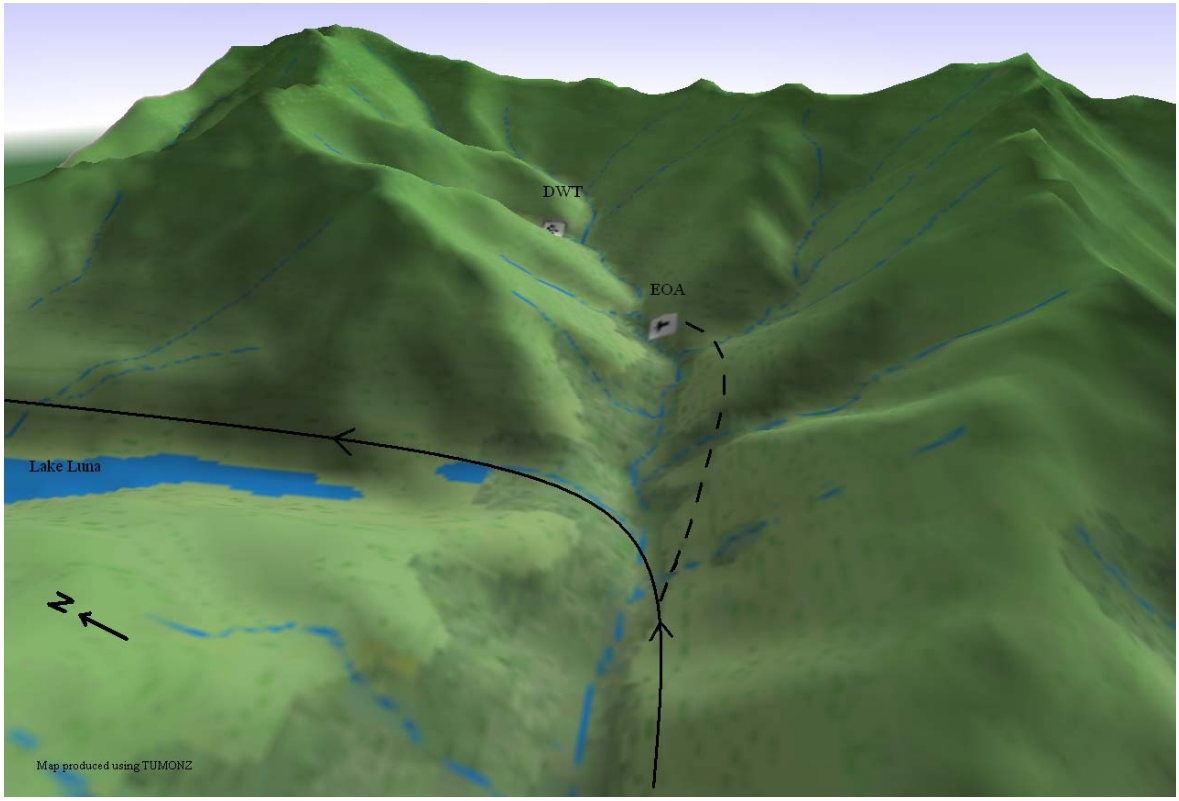

Figure 3: Solid line indicates intended flight path. Dashed line indicates continued flight path past the Lake Luna turn off. First white square is ZK-EOA accident site. Second white square indicates previous ZK-DWT (1981) accident site.

2. Analysis

2.1 An exhaustive engineering investigation both on-site and at an engine maintenance facility did not disclose any pre-accident defect with the aircraft that may have led to the accident. As far as could be ascertained, the aircraft was serviceable and operating normally up to the moment of impact.

2.2 The wind was blowing at or near right angles to the terrain where the aircraft was found. Downdraughts and turbulence will generally be found on the lee side of mountain ranges and will increase in severity and extent with increase in wind strength. Under these conditions, mountain wave and rotor conditions can prevail.

2.3 Rotors cause severe turbulence and downdraughts. The wind behind the rotor will be in the reverse direction to the general flow. Downdraughts can exceed 5000 feet per minute.

2.4 The wreckage trail indicated that the aircraft was in a left turn prior to impact, heading northwest towards the mountain range. This would be into an area of possible downdraught or rotor activity. The distribution of the light wreckage further along the valley from the initial impact point indicated that the aircraft had commenced turning with a strong tailwind component.

2.5 The condition of the nose-wheel assembly indicated that the initial impact of the aircraft on the ridge was with a high vertical component due to no bending of the nose wheel oleo normally associated with a forward flight impact, as the assembly was torn from the aircraft engine firewall vertically with shearing of the attachment hardware. This would probably indicate that the aircraft encountered significant sink in the lee of the mountain range.

2.6 The aircraft witness marks at the initial impact indicated a relatively low angle of bank compared with what would normally be expected during a turn in a confined valley, so this would also suggest that the aircraft encountered sink. With options running out, one of the pilots (most likely the instructor) may have attempted to level the wings to unload the aircraft angle of bank in the moments prior to impact.

2.7 The General Aviation forecast, Area Forecast, Aerodrome Forecasts for Milford Sound and Queenstown, METARs, SPECIs and SIGMETs were issued at the correct times and were accessed by the Aero Club and were also available through ATC.

2.8 The aircraft wreckage was found away from the normal mountain flying training route, in an area not normally flown by the Aero Club. This may have been due to a navigational error on the part of the student who was unfamiliar with mountain flying, which may have been allowed to continue by the instructor who was very familiar with the area. A similar accident occurred under these circumstances in 1981 near this location. Another scenario could be that the turn into Lake Luna was not executed due to poor localised weather conditions and that the option of continuing up the valley in order to find a sufficient area to conduct a turn was used. The significant sink that would have been encountered in the lee of the range may not have been anticipated when this option was taken.

3. Conclusions

3.1 The instructor pilot was appropriately licensed, experienced, and fit to carry out the flight.

3.2 The aeroplane had a current Airworthiness Certificate and had been maintained in accordance with current requirements.

3.3 No pre-accident defect was found.

3.4 Weather conditions were such that the likelihood of severe turbulence, downdraughts, and rotors were probable in the accident area.

3.5 No conclusive reason could be found for the aircraft to have been in the accident area, which was not on the normal training flight route. However, it can be concluded that the aircraft had continued past the 90 degree turning point on the route across Lake Luna.

3.6 The aircraft probably encountered sink from the turbulence from the mountain range. This involves a high vertical descent rate as indicated by the nose-wheel assembly impact and possible levelling of the wings prior to impact.

3.7 Most aspects of flying are about risk management. Any one of the elements in this accident scenario is not necessarily dangerous in itself; however, taken in combination and at the critical point of the Lake Luna turn off, the pilots, having found themselves unexpectedly further up a narrow valley at relatively low altitude with rising terrain and severe winds and turbulence to contend with, had limited remaining options available to them.

4. Safety actions

4.1 Wakatipu Aero Club officers have undertaken reviews of this accident at management, instructor and committee levels and are further emphasizing decision making in their mountain flying training. This accident report will be part of that process.

4.2 A series of DVDs on aviation decision making are currently being produced as an AIRCARE project co-sponsored by the CAA, the Accident Compensation Corporation, and the Aviation Industry Association. The first title of 14,000 copies has already been distributed with the second of 17,000 copies due for release shortly.

4.3 Wakatipu Aero Club committee members have trialled and are still investigating the feasibility of mountain flying training pilots wearing helmets during the low level phases of their training. This is current practice in the RNZAF and voluntary practice by many professional agricultural pilots.

4.4 Wakatipu Aero Club officers intend encouraging the use of personally worn Personal Locater Beacons (PLBs) during mountain flying training as a back-up to the mandatory aircraft fitted ELTs.

Report written by:

(signed)

Tom McCready
Safety Investigator
20 Sep 2005

Authorised by:

(signed)

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