Report 98-001

Cessna 172P

ZK-EWH

collision with terrain

16 nm east-north-east of Te Anau

9 January 1998

Abstract

On the morning of Friday, 9 January 1998, the pilot flew Cessna 172 ZK-EWH from Queenstown to Te Anau. The aircraft took off for the return flight, with two passengers, at about 0830 hours but did not arrive at Queenstown.

Emergency location transmitter signals led to the discovery of the wreckage of ZK-EWH later in the morning. The aircraft had struck a beech-forested slope in a steeply banked attitude at an elevation of about 3300 feet, some 200 feet below a saddle between two tussock covered peaks. The pilot and passengers were killed.

A cold unstable south-westerly flow, including vigorous cumulonimbus activity and snow showers, was affecting the area at the time of the accident.

The remoteness of the site, and the absence of witness or survivor information, precluded the finding of a conclusive reason for the accident. The available evidence suggested, however, that as the result of severely reduced visibility due to heavy rain, snow, or low cloud, the pilot inadvertently approached the forested slope, and during an attempted evasive manoeuvre the aircraft collided with the trees.

Contents

Transport Accident Investigation Commission

Aircraft Accident Report 98-001

Aircraft type, serial number and registration:	Cessna 172P, 17275356 ZK-EWH
Number and type of engines:	One Lycoming O-320-D2J
Year of manufacture:	1981
Date and time:	9 January 1998, approximately 0845 hours[1]
Location:	16 nm east north-east of Te Anau Headwaters of the Wood Burn Latitude: 45° 21.5'S Longitude: 168° 02.2'E
Type of flight:	Air transport
Persons on board:	Crew: 1 Passengers: 2
Injuries:	Crew: 1 fatal Passengers: 2 fatal
Nature of damage:	Substantial
Pilot-in-Command's licence:	Commercial Pilot Licence (Aeroplane)
Pilot-in-Command's age:	32
Pilot-in-Command's total flying experience:	1292 hours 204 on type
Investigator-in-Charge:	D G Graham

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

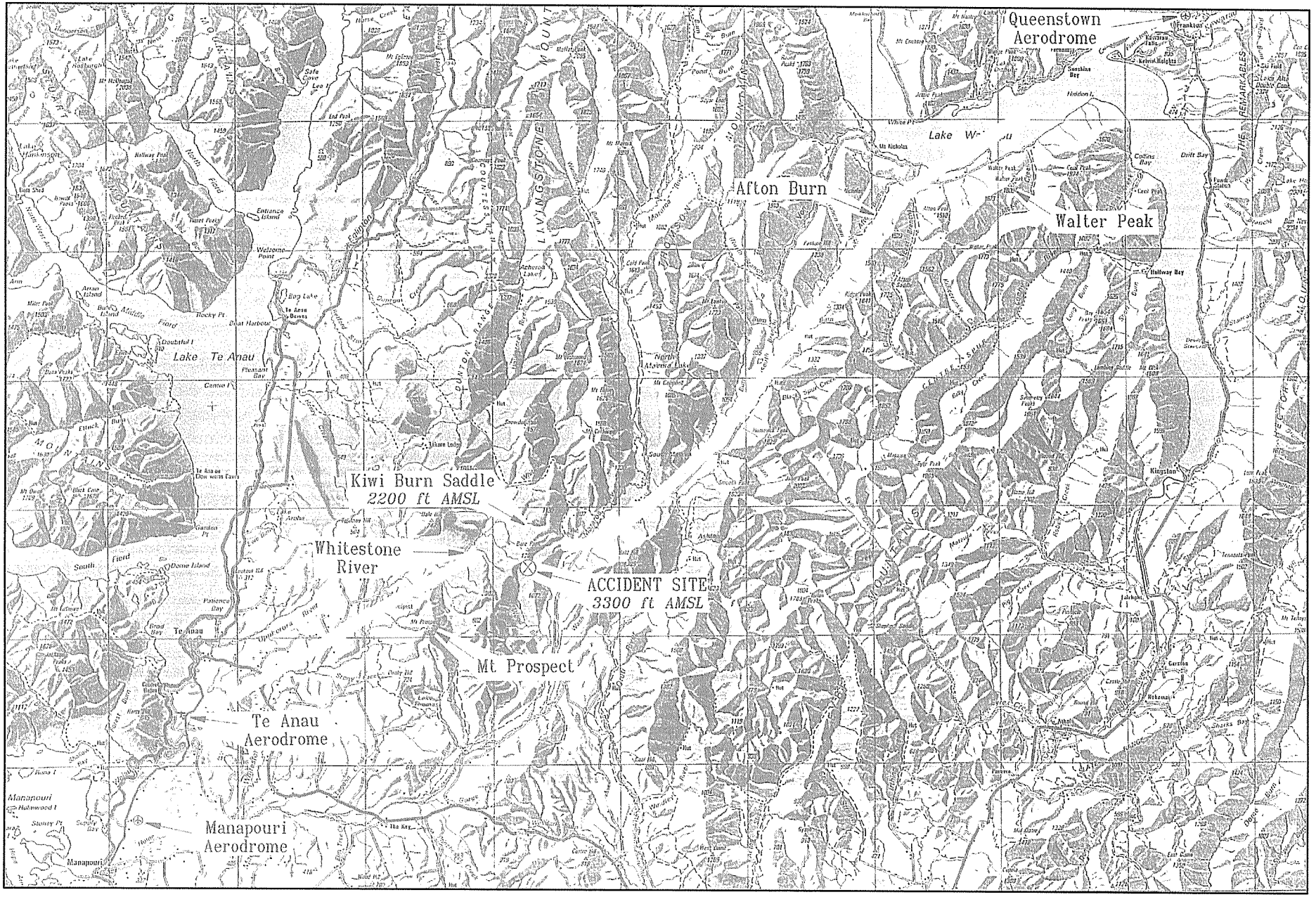


Figure 1
Normal route between Te Anau and Queenstown

1. Factual Information

1.1 History of the flight

1.1.1 The itinerary of a couple, who arrived in New Zealand from Tokyo on 4 January 1998, and were due to fly back to Japan from Auckland on 10 January 1998, included flying from Te Anau to Queenstown on the morning of 9 January 1998. The couple had onward bookings that day for Christchurch and Auckland. Their flight to Christchurch (ANZ 5036) was scheduled to depart from Queenstown at 0945 hours.

1.1.2 Arrangements for their travel from Te Anau to Queenstown on a Waterwings Airways (Te Anau) Limited (Waterwings) aircraft had been confirmed the previous day. Planned departure time was 0830 hours. The couple were picked up from their hotel in Te Anau by a local tour operator at approximately 0805 hours on 9 January 1998, and driven to the local airstrip some 6 km south of Te Anau to await the arrival of the Waterwings aircraft.

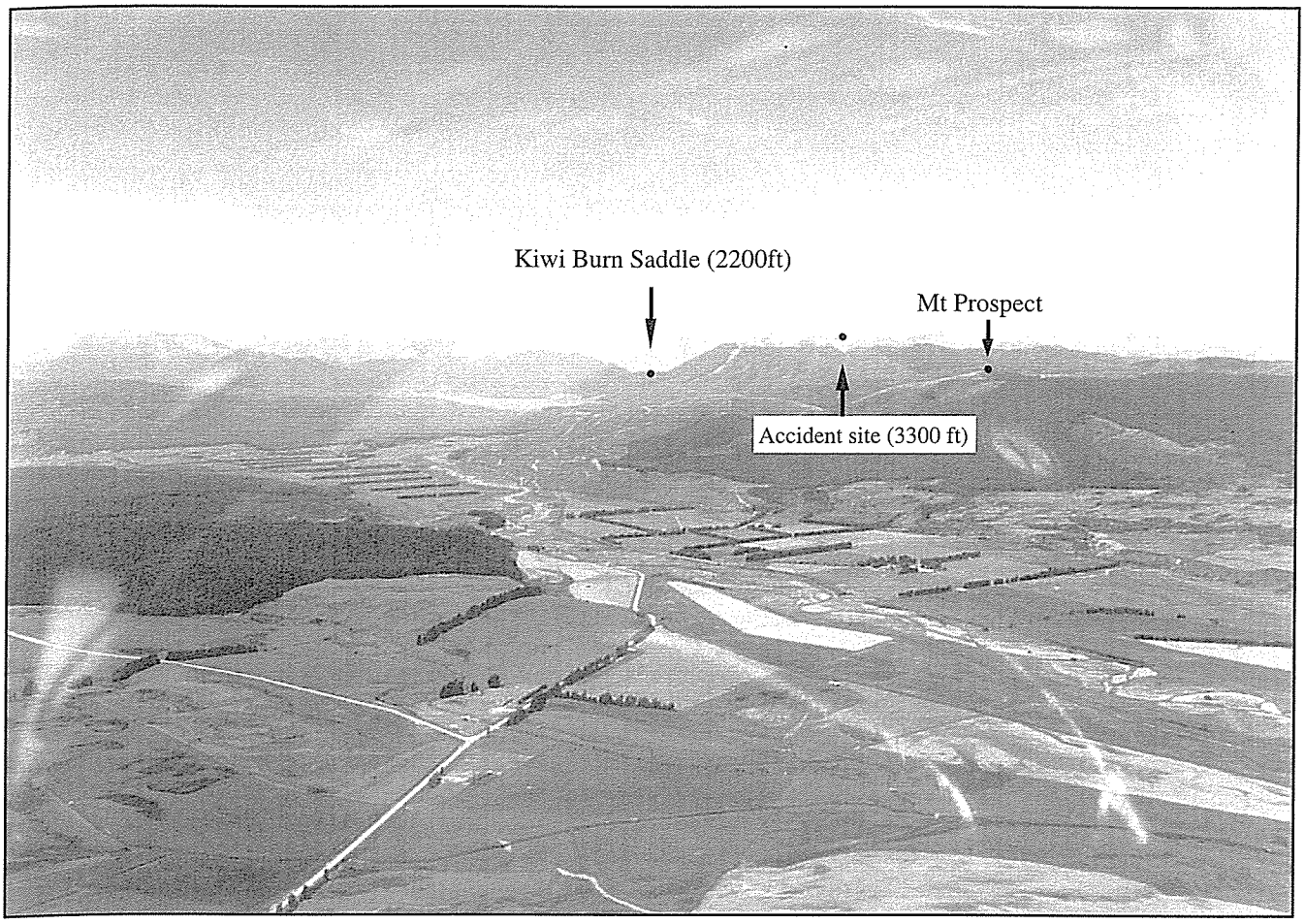
1.1.3 The Waterwings fleet included two Cessna 172 aircraft capable of carrying up to three passengers each, and several Cessna 207 aircraft which had a greater seating capacity. These aircraft were normally based at Queenstown. Waterwings also operated a Cessna 206 floatplane from Te Anau. In the circumstances, one of the Cessna 172 aircraft, ZK-EWH, was to be used for the morning flight from Queenstown to Te Anau and return.

1.1.4 The pilot rostered to fly ZK-EWH commenced duty routinely with other pilots at the Waterwings operations office at Queenstown Aerodrome. Flight preparation included discussion of the Te Anau and Milford Sound weather situation, and perusal of the current aviation meteorological reports received at the office by facsimile at 0700 hours. The pilot was later observed carrying out a pre-flight inspection on ZK-EWH, in accordance with the normal company procedure.

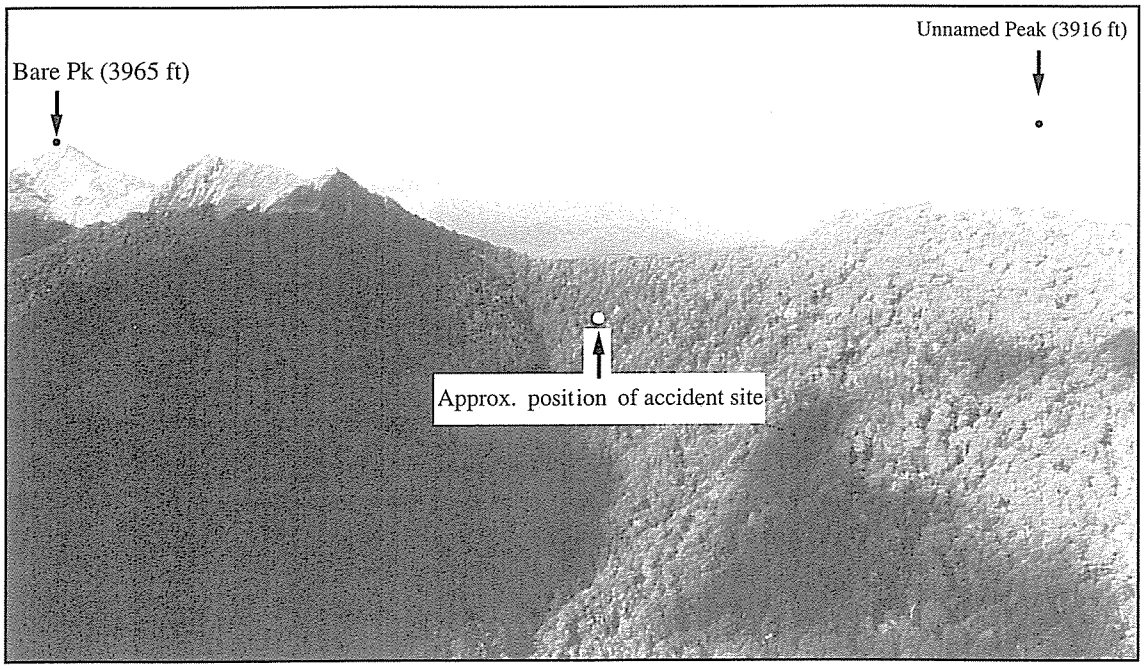
1.1.5 At approximately 0744 hours the pilot, who was the sole occupant of ZK-EWH, called Queenstown Ground, advised taxiing and departure details, and was subsequently cleared by Queenstown Tower for take-off for Te Anau at 0747 hours. He had requested a 23 Walter Peak Departure, and had read back the departure clearance correctly, including the current local QNH setting of 1011 hPa. He duly reported clear of the Queenstown Control Zone at approximately 0752 hours. Queenstown Air Traffic Control (ATC) had no further contact with ZK-EWH.

1.1.6 The standard flight time for the Waterwings Cessna 172 aircraft between Queenstown and Te Anau is 36 minutes. The height to which the pilot climbed ZK-EWH and then cruised, and the precise route he followed during the outbound flight is not known. However, shortly before 0810 hours he was heard to make a routine position report, "Kiwi Burn three thousand feet" (see Figure 1). This led to a brief communications exchange between the pilot of ZK-EWH and the pilot of a Nomad aircraft which had earlier flown from Queenstown to Manapouri and was approaching the Mount Prospect area on the return flight as ZK-EWH passed over the Kiwi Burn. (See Communications para 1.9.1.)

1.1.7 ZK-EWH landed at the Te Anau Airstrip shortly before 0820 hours. The tour operator and passengers had arrived some minutes earlier and watched the aircraft make a smooth touch-down on the grass airstrip. The pilot taxiied near to the Fiordland Aero Club hangar and shut the engine down. He got out of the aircraft and opened the baggage door at the left rear of the cabin. The tour operator placed the passengers' two bags into the rear compartment and closed the door.



View to north-east showing Whitestone River in foreground



Close-up of accident site

Figure 2
Accident area

1.1.8 After greeting the passengers briefly, the pilot explained that he had to use the telephone. This was to file an abbreviated flight plan with Milford Flight Service for the return flight. (See Communications para 1.9.3.) He went over to the hangar and returned a couple of minutes later. The tour operator drew his attention to the baggage compartment door of the aircraft which did not appear to have latched properly. The pilot opened the door and shut it again, ensuring it was satisfactorily closed.

1.1.9 The tour operator, who had known the pilot over a period of some two years through similar contacts, stated that he seemed to be his normal self, and did not appear to be in a hurry. The tour operator gave him an envelope from the Waterwings office, and passed on a message regarding assisting the passengers to the Air New Zealand check-in counter on arrival in Queenstown. The time spent with the pilot was very short. The pilot did not talk to the tour operator about the flight from Queenstown to Te Anau, or mention any concerns as to the aircraft, the weather, or time constraints in relation to maintaining the passengers' flight connections.

1.1.10 The pilot did not brief the passengers in the tour operator's presence. He boarded the passengers from the right side of the aircraft. The female passenger occupied the front right seat, adjacent to the pilot, and the male passenger was seated on the right of the rear bench-type seat, immediately behind her. The tour operator, who returned to his vehicle while the passengers were boarding ZK-EWH, waited at the airstrip until the aircraft departed. The take-off, at about 0830 hours, was normal. Although the weather was cloudy towards the east, the aircraft appeared to the tour operator to be heading into clear sky.

1.1.11 A Te Anau based pilot heard the pilot of ZK-EWH make a routine departure call on 119.1 mHz when leaving the Te Anau area on his return flight. The call was unremarkable, conveying the information "Echo Whisky Hotel, abeam Mt Prospect, [departing] for Queenstown". This was the last known communication from the aircraft.

1.1.12 The aircraft failed to arrive at Queenstown at 0900 hours, the estimated time of arrival (ETA) provided by the pilot to Milford Flight Service. Queenstown ATC attempted unsuccessfully to make radio telephone (RTF) contact with ZK-EWH on the appropriate local frequencies and an 'incerfa'[2] was declared at approximately 0944 hours. The Rescue Co-ordination Centre (RCC) in Wellington was activated. Concern was felt for the safety of the flight as the weather had deteriorated at Queenstown with the passage of cumulonimbus clouds (CBs) producing rain and snow showers.

1.1.13 The Waterwings floatplane took off from Te Anau at approximately 0950 hours to commence an initial search. After confirming that ZK-EWH was not at the Te Anau Airstrip, the floatplane pilot flew north-east, tracking towards Queenstown along the route most likely to have been followed by the pilot of ZK-EWH. Preparations began for a fixed wing aircraft and a helicopter to search from Queenstown towards Te Anau.

1.1.14 The floatplane pilot reported at about 1015 hours that he was receiving emergency location transmitter (ELT) signals in the vicinity of Mount Prospect, some 10 nm east of Te Anau. The weather was very poor and the pilot had to turn back from attempts to reach the Kiwi Burn Saddle area, due to low cloud, rain, and snow showers. In view of the location of the ELT transmissions a Te Anau based helicopter was tasked to commence a low level search in the area (see Figure 2).

[2] An uncertainty phase concerning the whereabouts of an aircraft, normally initiated when the aircraft is more than 30 minutes overdue.

1.1.15 LUT[3] messages indicating an approximate origin for the ELT signals were received by the RCC at 1024 hours. The Te Anau based helicopter, equipped with a winch, departed at 1043 hours carrying Police personnel and a doctor. At approximately 1140 hours the helicopter crew reported locating the wreckage of ZK-EWH. The doctor, who was winched onto the site, confirmed that none of the aircraft occupants had survived the accident.

1.1.16 The available evidence suggested that the accident occurred in daylight at about 0845 hours on 9 January 1998. The accident site was on a steep beech-forested slope at the headwaters of the Wood Burn, some 16 nm east-north-east of Te Anau, at an elevation of approximately 3300 feet above mean sea level (amsl). Grid reference 228257 NZMS 260 series D 43 Te Anau. Latitude 45°21.5'S Longitude 168°02.2'E.

1.2 Injuries to persons

1.2.1 The pilot and the two passengers received fatal injuries as a result of ground impact.

1.3 Damage to aircraft

1.3.1 The aircraft sustained substantial damage.

1.4 Other damage

1.4.1 The rotating propeller severed a branch into short lengths as the aircraft penetrated the forest canopy and a number of other branches were broken, tree trunks scraped and scored, and foliage disturbed as the aircraft descended to the ground.

1.5 Personnel information

1.5.1 The pilot-in-command (32 years old) had graduated from Lincoln University in 1988 with a Bachelor of Science degree. In November 1988 he undertook a trial flight, and during 1989 accumulated 5.5 hours of flight training at Ardmore.

1.5.2 In July 1990 he commenced a formal course of aviation training at Massey University, leading to a Diploma in Aviation. As a part of this training he obtained a Private Pilot Licence (Aeroplane) in June 1991, and a Commercial Pilot Licence (Aeroplane) in February 1992. He was issued with an Instrument Rating (single engine), endorsed for non directional beacon, VHF Omnidirectional radio range, distance measuring equipment (NDB/VOR/DME), in May 1992. While at Massey University he passed the Air Transport Pilot Licence theory examinations.

1.5.3 The pilot carried out some flying at Ardmore from October 1992 to January 1993, operating a Cessna 206 aircraft. He then moved to Queenstown and obtained a short term non-flying position as a bookings and desk person with Waterwings. During this period he gained some experience of company operations while flying as a passenger over various routes. He was also employed on a part-time basis in tourist related activity with other Queenstown based companies, including coach driving and four wheel drive tours.

[3] Local User Terminal, in this context referring to the facility in the RCC at Wellington enabling ELT transmissions intercepted by satellite to provide an approximate position.

1.5.4 By February 1994 the pilot had a total flying experience of 244 hours. At this time he began flying with the Wakatipu Aero Club, obtaining dual and solo experience in the surrounding area and completing a Glider Tow Rating and aerobatic training in the Champion Citabria. He first flew the Cessna 172 aircraft in March 1994, and flew this type regularly in subsequent training and check flights and scenic flying with the Aero Club.

1.5.5 The pilot was employed by Glenorchy Air Services Limited from September 1994 to November 1996. His flying was on a seasonal basis, comprising mainly flights from Queenstown to Milford and return, and between Queenstown and Dunedin. The majority of flying was in Piper PA32 aircraft but occasional flights were carried out in the Cessna 185.

1.5.6 In December 1996 the pilot obtained a position flying with Waterwings and was rostered for Milford and Te Anau duties. He frequently flew between Queenstown and the Te Anau area and Queenstown and Milford, operating either the four seat Cessna 172 or the larger Cessna 207 over these routes depending on the passenger load requirements.

1.5.7 The pilot's most recent Regulation 76 and 77 check was conducted on 19 December 1997 in a Cessna 207 aircraft. The check, which the pilot completed satisfactorily, included a flight from Queenstown to Te Anau.

1.5.8 At the time of the accident the pilot's total flying experience amounted to 1292 hours. He had flown 1156 hours as pilot-in-command, and 136 hours dual. The pilot's recorded instrument flying experience was 6 hours actual and 27 hours simulated.

1.5.9 His total flying time on Cessna 172 aircraft was approximately 208 hours. He had flown Cessna 172P ZK-EWH for a total of about 82 hours.

1.5.10 The pilot's logbook indicated that he had flown between Queenstown and Te Anau, Manapouri, or Te Anau Downs on approximately 236 occasions since commencing pilot duties with Waterwings in December 1996, and at least 6 times prior to that date. The recorded flight times suggested that all these flights would have involved flying via the Von Valley and Kiwi Burn Saddle, the standard direct route.

1.5.11 During the 90 days preceding the accident, the pilot had flown a total of 129 hours, of which 37 hours were in Cessna 172 aircraft and about 26 hours in ZK-EWH. In this period he had flown between Queenstown and Te Anau some 67 times.

1.5.12 In the seven days prior to the accident the pilot had flown 16.6 hours, of which 1.7 hours were in ZK-EWH. The most recent occasion on which he had flown between Queenstown and Te Anau was on 7 January 1998, two days before the accident.

1.5.13 The pilot had been rostered off duty on the day before the accident. He had, however, driven to Skippers Canyon and return during the afternoon in connection with his part-time driving duties for a bungy jump operator.

1.5.14 The pilot was regarded by his current and previous employers, and by his peers, as a trustworthy, reliable individual with a friendly helpful disposition.

1.6 Aircraft information

1.6.1 The Cessna 172 is an all metal, single engine, high wing, light aircraft of conventional design fitted with a fixed tricycle undercarriage. The cabin layout comprises pilot and front passenger seating, a centre double passenger seat, and a baggage area at the rear of the cabin.

1.6.2 The aircraft type has been well proven over many years and is widely used for private flying, flight training, and air transport operations where loadings are limited to three passengers or less. The aircraft is predictable and generally docile in handling when loaded and operated in accordance with the limitations specified by the manufacturer.

1.6.3 ZK-EWH, a Cessna 172P, was fitted with an electrically powered actuator to lower the flaps. A selector mounted on the instrument panel could be positioned to provide a flap setting of 10°, 20°, or 30° (maximum), or intermediate settings as desired. (Early Cessna 172 aircraft had manually operated flaps, and other 172 models had a maximum flap extension of 40°.)

1.6.4 The Cessna 172P Pilot's Operating Handbook does not contain specific instructions for a "bad weather" configuration for the aircraft. However, the use of 20° flap and an airspeed of 75 knots is recommended by many New Zealand flying training organisations as appropriate in conditions of significantly reduced visibility or flight at low level. (The Pilot's Operating Handbook suggests a 20° flap setting and an airspeed of 60 knots for a field inspection prior to making a precautionary landing with engine power.)

1.6.5 The aircraft records showed that ZK-EWH had been maintained in accordance with approved maintenance schedules. Total aircraft time in service, as at the occurrence of the accident, was calculated to be approximately 3912 hours. No pilot report, or other information, was received to suggest any difficulty in the operation of ZK-EWH in relation to the airframe, engine, or the overall performance of the aircraft. The technical log recovered from the aircraft contained no reference to any defect or malfunction having occurred since the most recent maintenance inspection.

1.6.6 The aircraft was fitted with a 160 horse power Lycoming O-320-D2J engine, serial number L-11825-39A. Logbook records indicated that at the time of the accident the engine had accumulated a total time since new of 3912 hours, and a total time since overhaul of 1913 hours. The aircraft was fitted with a McCauley fixed pitch metal propeller, serial number B/F101. The total time on the propeller was not recorded.

1.6.7 ZK-EWH was equipped with a fuel tank in each wing. Each tank had a capacity of approximately 81 litres. The aircraft had last been refuelled at the end of flying on 5 January 1998 when 50 litres of Avgas 100 aviation fuel was added, bringing the quantity on board to a total of more than 100 litres.

1.6.8 The total fuel quantity remaining at the time the accident occurred was probably some 70 litres giving an endurance of about two hours. The all-up weight of the aircraft was estimated as about 975 kg (2150 pounds). The passengers' baggage recovered from the accident site weighed a total of 14 kg. The maximum authorised all-up weight of the aircraft was 1090 kg (2400 pounds).

1.6.9 The position of the centre of gravity (CG) at the time of the accident was estimated to have been about 44 inches aft of datum (AOD). The permitted range for the CG at the likely all-up weight of the aircraft was 37 inches to 47.3 inches AOD.

1.7 Meteorological information

1.7.1 In an aftercast of the weather situation existing at the time of the accident the Meteorological Service of New Zealand Ltd (Met Service) provided information summarised as follows:

> On the morning of 9 January 1998, a strong cold unstable south-westerly airstream covered the southern half of South Island in the wake of a cold front which moved through the area the previous evening. Within the south-west flow, an area of enhanced convective cloud containing active cumulonimbus (CB) cells moved onto the south of South Island from the waters south of New Zealand. At the approximate time of the accident the CB cells were closely spaced over South Island from Queenstown southward. The CB cells were well developed as the airmass was very unstable.
>
> It is most likely that this area of active cloud was affecting the site at the time of the accident. The convection would have been vigorous and may have had hail and lightning associated with it. Invercargill Aerodrome reported hail at 0700 hours. Lightning counts were recorded at the automatic weather station (AWS) at Dunedin Airport at 0700 hours and 0900 hours on the 9th. Lumsden AWS also recorded lightning counts up to 1300 hours on the 9th. The exact time lightning occurred at Lumsden is not known due to a communications problem but lightning counts would have been probable at Lumsden during the morning of 9 January. These reports were consistent with the radiosonde soundings from Invercargill at midday and the previous midnight which demonstrated the very unstable (convective) nature of the airmass.
>
> Invercargill Aerodrome reported cloud bases of 3000 feet at the time. Queenstown Aerodrome reported bases around 6000 feet for the most part, but reported 7000 m visibility in rain and snow showers (mixed) with broken cloud at 1200 feet and 2000 feet, for one report at 1100 hours. Also significant was the mixed precipitation at Queenstown (elevation ~1200 feet). The radiosonde ascent from Invercargill suggests that snow to approximately 2000 feet was likely with mixed rain and snow possible below this level.
>
> The low level winds recorded at Invercargill between 0500 hours and 0600 hours were 240/35 knots at 2000 feet, 240/40 knots at 3000 feet, 240/45 knots at 5000 feet and 240/50 knots at 7000 feet. The combination of strong winds and convective instability including strong updraughts and downdraughts associated with CB and orographic effects would have made conditions very turbulent.
>
> Based on the above information the weather in the vicinity of the accident site was likely to have been characterised by:
>
> Frequent showers, sometimes heavy with hail and thunder. Visibility reduced significantly, in showers of rain and snow, probably to around 3000 to 4000 m but may have been as low as 500 m in snow showers. Cloud: scattered embedded CB with bases 4000 to 6000 feet amsl lowering to 2500 feet amsl at times in showers. Areas broken cumulus/stratocumulus (CUSC) 4000 feet, tops 8000 to 10000 feet. Snow down to about 2000 feet. Frequent moderate but occasional severe turbulence below 10000 feet. Severe ice in CB above the freezing level which was about 3000 feet.

1.7.2 The Te Anau based floatplane pilot reported that in looking toward the north-east at about 0900 hours on 9 January, he had observed a dark cell of snow showers in the region of the Kiwi Burn Saddle. Subsequently, when he approached the Kiwi Burn Saddle area while conducting the initial aerial search for ZK-EWH, it was snowing very heavily. He was flying at about 1800 feet and estimated the snow was falling to approximately 1500 feet. The snow showers were "extremely heavy". He was unable to get through the Kiwi Burn Saddle and continued the search on the eastern side of Mount Prospect. Conditions were marginal with a cloud base of about 2000 feet obscuring the adjacent hills, and snow lowering to 1500 feet. Due to the reduced visibility and cloud the pilot was obliged to turn back from his attempt to follow the increasing strength of the ELT signals up the valley of the Wood Burn.

1.7.3 The crew of the helicopter which located the wreckage of ZK-EWH reported encountering "atrocious" conditions involving "sub-zero temperatures, snow, and low cloud". The aircraft wreckage and the surrounding beech forest was covered with a layer of snow. The snow cover extended more than 500 feet below the accident site.

1.7.4 The tour operator who took the passengers to the Te Anau Airstrip stated, "the weather when ZK-EWH landed was good. It was cold but it wasn't windy or raining."

1.7.5 The pilot of a Nomad aircraft who had flown from Queenstown and landed at Manapouri Aerodrome just before 0800 hours reported that Lake Manapouri was in view, but beyond there were snow showers. It was evident that the weather was changing rapidly in the southerly conditions, and snow was to be expected. As a result the pilot minimised the time spent on the ground at Manapouri, and departed at 0805 hours. The return flight to Queenstown at 3500 feet was relatively smooth. The cloud base at that time was some 4500 to 5000 feet. The pilot indicated that there was southerly, wind blown, cloud in the Von Valley. Cloud which had been observed in the Mararoa Valley on the outward flight had moved across to the Mavora Lakes in the southerly windflow. It was rough on Lake Wakatipu and wind strength had increased.

1.7.6 The General Aviation Weather Report (GAWX) for South Island, issued by Met Service at 0514 hours on Friday 9 January 1998 valid for the period 0500 hours to 1800 hours contained the following information: (relevant portions reproduced only, and some abbreviations expanded for clarity)

Situation
Unstable and strengthening south/south-westerly flow

Forecast weather
Southland Otago South Fiordland: Areas broken CUSC 4000 tops 8000, isolated embedded CB 3000 tops FL 250 giving "Heavy showers rain small hail and/or snow pellets".

Visibility
30 km reducing to 4000 m in "Heavy showers rain small hail and/or snow pellets".

Ice
Moderate/severe in CB. Otherwise nil significant.

Turbulence
Frequent moderate turbulence about the ranges, severe as per Sigmet.
(Sigmet #8, valid from 0700 hours to 1100 hours, contained the following information: Isolated severe turbulence forecast below FL120 about the South Island ranges. Intensity no change).

Freezing Level
8000 feet north sloping to 3000 feet south.

Wind forecast
Forecast winds at 1300 NZDT (Wind: True/Speed: Knots)

NZNV (Invercargill)	3000	5000	7000	9000
	230/30	225/35	220/40	215/45

Comment
Winds gradually strengthening about the east coast.

Aerodrome forecasts (TAFs) valid from 0200 hours to 1900 hours

NZMF (Milford Sound) Wind 130/08 knots Visibility 30 km Cloud SCT (3 to 4 oktas) 7000 feet 2000 feet wind 240/20 knots

NZQN (Queenstown) Wind 220/15 knots gusting 25 knots Visibility 30 km Light Showers Rain
Cloud BKN (5-7 oktas) 5000 feet Temporarily 1300 hours to 1900 hours Visibility 7000m Moderate Showers Rain Cloud SCT 3000 feet CB 2000 feet wind 200/25 knots

TAF (amended) for NZNV valid from 0500 hours to 1900 hours
Wind 250/25 knots gusting 40 knots Visibility 30 km light showers rain Cloud BKN 4000 feet
Temporarily 0500 hours to 1900 hours Visibility 5000 m Moderate showers rain small hail and/or snow pellets BKN 2500 feet CB becoming 1600 hours to 1900 hours Wind 260/15 knots gusting 25 knots 2000 feet wind 240/35 knots becoming 1600 hours to 1900 hours 240/25 knots.

Aerodrome reports (METARs) as at 0800 hours

NZMF Wind 150/03 knots Visibility 60 km Cloud SCT 7500 feet Temp 5° C Dew point 4° C QNH 1013 hPa.

NZQN Wind 210/14 knots gusting to 29 knots (varying between 150 and 260) Visibility 50 km BKN cloud base 6500 feet Temperature 7° C Dew point -2° C QNH 1011 hPa.
Remarks: Showers rain to south-west.

1.7.7 Waterwings Operations Manual contained information relating to scheduled VFR operations between Te Anau and Queenstown. Section 2.4.2 of the Operations Manual indicated that (in the case of a flight originating from Te Anau) contact was to be made with the Queenstown pilot at 0730 hours for a weather report, and again at 0800 hours. If the weather was unsuitable, alternate ground transport would be used departing at 0830 hours for Queenstown. Possible turbulence in the Oreti and Von Valleys would be considered in addition to other factors in deciding the suitability of weather.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 ZK-EWH was equipped with a Cessna RT385A communications receiver. Normal RTF communication on the appropriate frequencies had taken place between the pilot and Queenstown ATC (Ground and Tower) at the time of his departure from Queenstown. Towards the conclusion of his outward flight the pilot of ZK-EWH spoke on 119.1 mHz with the pilot of a Nomad aircraft which was en-route from Manapouri to Queenstown. The pilot of ZK-EWH reported his position inbound for Te Anau as "Kiwi Burn three thousand feet". His transmission prompted the Nomad pilot, flying in the opposing direction at 3500 feet, to look for the aircraft. Having visually identified ZK-EWH, the Nomad pilot altered heading to remain well clear, and in turn advised position, altitude and intentions.

1.9.2 In addition to their position reports, the two pilots exchanged brief greetings. No discussion took place concerning the actual or impending weather, nor did the pilot of ZK-EWH comment upon, or allude to, any actual or anticipated flight difficulty or delay. The Nomad pilot reported that the pilot's voice sounded normal.

1.9.3 After landing at Te Anau, the pilot of ZK-EWH used the telephone at the Fiordland Aero Club to contact Milford Sound Flight Service. He submitted brief details for his return flight from Te Anau to Queenstown. The call was logged at 0820 hours and the information, which the Milford Sound Flight Service Officer duly transmitted to Queenstown Tower, comprised a standard flight plan for the route including departure at 0830 hours with three persons on board, and an ETA at Queenstown of 0900 hours.

1.9.4 The last reported communication from ZK-EWH was the pilot's routine departure call on 119.1 mHz indicating that he had reached the Mt Prospect area and was continuing toward Queenstown.

1.10 Aerodrome information

1.10.1 At the time of the accident to ZK-EWH, a current Notice to Airmen (NOTAM) advised that the Te Anau Airstrip was closed. This was to enable re-grassing to take effect, particularly on the shoulders and southern half of the airstrip. The closure was indicated by a white cross located at the side of the airstrip.

1.10.2 Although the airstrip remained technically closed in accordance with the NOTAM, local operations were able to take place using the serviceable northern part of the airstrip which was largely unaffected by the re-grassing programme. This portion of the airstrip was used by the pilot of ZK-EWH for his landing and take-off.

1.10.3 Passenger convenience was likely to have been the major factor prompting the pilot to use the Te Anau Airstrip in preference to Manapouri. The use of the airstrip was not considered relevant to the accident circumstances but demonstrated the pilot's willingness to be helpful whenever practicable.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 The accident site was on the southern side of a 3500 feet amsl, bush covered, saddle between Bare Peak 3965 feet and a similar, but un-named, ridge rising to 3916 feet, about 16 nm east-north-east of Te Anau. The site was on the Te Anau side of the saddle some 200 feet below the ridge-line, at an elevation of about 3300 feet amsl, above the headwaters of a tributary of the Wood Burn, one of many streams draining the extensive beech covered slopes of the Snowdon Forest.

1.12.2 The wreckage of ZK-EWH was not readily visible as the aircraft was lying at the base of closely spaced beech trees some 50 to 60 feet high, growing on a 45° to 50° slope. A narrow entry swath, with damage to the forest canopy confined to a width probably less than half the wingspan, suggested that the aircraft was banked steeply to the right when initial tree contact occurred.

1.12.3 ZK-EWH had come to rest rolled onto its right side on a heading of 110° M. Impact forces had almost completely severed the right wing and strut from the aircraft. The left wing and strut remained attached to the primary structure but the wing was slewed forward. Both wing leading edges had sustained severe compressive damage as a result of the descent of the aircraft through the forest growth. The propeller and engine were semi-buried in the forest floor.

1.12.4 Five pieces of an upper branch, about 65 mm in diameter, cleanly cut by the propeller into approximately equal lengths, were found 16 m downslope from the tail of the aircraft. Calculation using the averaged length of the severed pieces, and a power setting of 2400 rpm, indicated a probable speed at impact of 105 knots. This calculated speed was consistent with the expected performance of the aircraft in the clean (flaps "UP") configuration.

1.12.5 All components of ZK-EWH were accounted for on site. Structural damage was consistent with the descent of the aircraft through the trees and subsequent severe ground impact. Significant compression damage had occurred to the lower fuselage. The two front seats, and rear bench seat, had been dislodged from their tracks due to the distortion which had occurred to the cabin floor.

1.12.6 The attachments for the pilot's and front seat passenger's lap and fixed diagonal belts were intact, as were the attachments for the lap belt provided for the rear passenger who had been seated on the right side. The pilot's control yoke had fractured completely from the control column as a result of impact forces. The right control yoke and column assembly was intact.

1.12.7 The disruption which had occurred to the forward area of the cabin rendered the "as found" positions of the throttle and mixture controls unreliable. The following observations and readings were, however, considered representative of conditions immediately prior to the accident:

- Carburettor heat control pulled fully out (Full "ON")
- Elevator trim setting approximately neutral
- Altimeter QNH setting 1014 hPa

  (This setting indicated that the pilot had altered the subscale of the altimeter from the previous setting of 1011 hPa to reflect a revised QNH provided by Milford FSS)
- Battery and alternator switches "ON"
- Magnetos selected to "BOTH"
- Landing light switch "ON"
- Navigation lights switch "ON"
- Anti-collision beacon switch "ON".

1.12.8 Damage to each wing, and the angle at which the aircraft wreckage was lying was such that no significant quantity of fuel remained in either the right or left wing tank. However, both tank caps were securely fastened, and residual wetness and a smell of fuel suggested that fuel had been contained in each tank at the time of the accident. The fuel tank selector was found positioned to "BOTH".

1.12.9 The wreckage of ZK-EWH was lifted by helicopter from the accident site and transported to a suitable location where further inspection could be carried out. The wreckage was later transferred by road to another location where final inspection of the engine and airframe took place. The integrity of the primary control systems was established as far as practicable given the extent of disruption which had occurred. Cable failures were consistent with overload due to impact forces. There was no evidence to suggest "foreign object" jamming or any other pre-accident restriction of control movement.

1.12.10 Examination of the flap actuator showed that, at the time of the accident, the wing flaps were in the fully "UP" position. The filament of the landing light bulb exhibited severe stretch, consistent with the "ON" selection of the landing light switch.

1.12.11 The progressive severing of an upper branch by the propeller suggested the engine was delivering substantial power when the aircraft first struck the trees. The engine air intake assembly had sustained impact damage but the induction system was not obstructed. Uncontaminated fuel was present in the main fuel line to the carburettor. The inlet fuel filter was clear and disassembly of the carburettor revealed no internal anomaly or defect. The gascolator filter was clean and the drain shut-off closed.

1.12.12 Inspection of the engine disclosed no evidence of pre-impact malfunction. The crankshaft rotated freely and valve action was normal. Accessory drives were intact and magneto timing correct. The spark plugs were in normal condition. The main oil filter and the oil within the engine were free from contamination. Scrape marks indicated significant alternator rotation at the time of initial impact.

1.12.13 The documentation recovered from the aircraft, while including a load sheet pad, did not include any entry for the flight from Te Anau to Queenstown, which the pilot would normally complete, showing details of the passengers being carried and their baggage, the fuel on board, the aircraft empty weight and crew weight, and a resulting calculated take-off weight.

1.12.14 No topographical map of the area was found on board ZK-EWH, nor any notepad or navigational log form which might have been used by the pilot to record the progress of the flight.

1.13 Medical and pathological information

1.13.1 Post-mortem and toxicological examination did not reveal any medical condition which was likely to have affected the ability of the pilot to control the aircraft.

1.13.2 The pilot's most recent medical examination had taken place on 21 March 1997. He held a Class 1 medical certificate which was valid until 12 April 1998. Periodic medical surveillance did not indicate any medical problem relevant to the accident.

1.13.3 There was no medical or pathological evidence of pilot incapacitation or impairment. Damage to the pilot's control yoke suggested that the pilot was holding the controls at the time of impact.

1.13.4 The tour operator who met the aircraft on arrival at the Te Anau Airstrip considered the pilot to have been in normal health and spirits prior to the accident flight.

1.14 Fire

1.14.1 No fire occurred.

1.15 Survival aspects

1.15.1 The front seat occupants, who had upper torso harness restraints, suffered fatal head injuries. The rear seat occupant who was wearing a lap belt sustained severe impact trauma to the chest.

1.15.2 The ELT functioned as intended, enabling the aircraft wreckage to be located within three hours of the occurrence of the accident, despite the adverse weather, snow cover, and the masking effect of the forest canopy.

1.15.3 The low temperatures due to the unseasonable conditions and the elevation of the accident site were likely to have reduced the opportunity for survival of any severely injured occupant of the aircraft.

1.16 Tests and research

1.16.1 The altimeter from ZK-EWH was removed from the aircraft and tested against a calibrated master gauge over a range from 0 to 5000 feet. The altimeter performed consistently throughout the test range, under-reading actual altitude at each test point. The QNH setting mechanism, however, had received damage. Examination of the altimeter at an approved instrument overhaul facility indicated this was a result of the impact.

1.16.2 A photograph of the cockpit of ZK-EWH taken by the rear passenger prior to the aircraft's take-off from Te Anau included a portion of the instrument panel. This showed the altimeter, set to a QNH of 1014 hPa, indicating approximately 740 feet amsl. Published aerodrome elevation was 786 feet. The difference in reading, as observed, was consistent with the results of the tests conducted on the altimeter after the accident.

1.16.3 The aircraft was fitted with an acoustic type stall warning indicator. This unit functioned satisfactorily when tested after the accident.

1.17 Additional information

1.17.1 Operations under Visual Flight Rules

Uncontrolled Airspace

Civil Aviation Rules (CAR) Part 91 requires VFR flights in uncontrolled airspace to be conducted so that the aircraft is flown in conditions of visibility and distance from cloud equal to, or greater than, the following:

a) When operating above 3000 feet amsl, or 1000 feet above the terrain, whichever is the higher.

Distance from cloud: 1 nm horizontally, 1000 feet vertically
Flight visibility: 5 km

b) When operating at or below 3000 feet amsl, or 1000 feet above the terrain, which ever is the higher.

Distance from cloud: clear of clouds and in sight of the surface
Flight visibility: 5 km

1.17.2 The Waterwings Operations Manual contained the following information: (relevant sections reproduced only)

Part One: Section One
1.1 Policy

1.1.2.2 It is the responsibility of the Pilot-in-Command to ensure that all the operations are conducted in accordance with the guidelines laid down in this Manual and the publications listed..... (The listed publications included among others Civil Aviation Regulations, NZAIP Planning Manual and Visual Flight Guide and the Company Operations Specifications).

1.1.2.3 No flight crew member shall operate in any capacity on the Company's Air Transport Operations unless he is conversant with the contents of this Manual.

Part One: Section Two
1.2 Flight Planning

1.2.1 VFR General Instructions

1.2.1.1 Visual Flight Rules
For the purpose of this Operations Manual VFR means "flight in continual reference to the ground or water" (i.e. not above 4/8 cloud) and includes special VFR where applicable, except that where the aircraft is equipped, crewed and fuelled to IFR standards, VFR may be carried out above more than 4/8 cloud.

1.2.2 Terrain Clearance
The terrain clearance minima shall be not less than that required by Regulation .....i.e. 1000 feet above the highest point of the terrain or any obstacle thereon over cities, towns, or populous areas and 500 feet above the highest point of the terrain or any obstacle thereon over any other area.

Part One: Section Three
1.3 Weather Minima

1.3.1 VFR Flight
Flight shall not commence unless current meteorological reports indicate that the conditions en-route are at or above:
a. Ceiling 1000 feet
b. Visibility 5000 metres

Part Two: Section One
2.1 Policy

2.1.2 The order of priority for the conduct of flight operations shall be:
a. Safety
b. Passenger comfort
c. Company goodwill

2.1.3 Safety

2.1.3.1 Safety can be assured by strict compliance with:
a. Operating Limitations, Procedures and Techniques specified in Operating Manuals.
b. Civil Aviation Regulations and Company Orders.
c. Intelligent flight planning
d. Liberal amount of common sense

2.1.3.2 The pilot-in-command is responsible for the safety of the aircraft in flight, the persons and cargo carried, and the safety and conduct of the crew, and briefing of passengers.

2.1.4 Passengers

2.1.4.1 Passenger's comfort and passenger well being cannot be over-emphasised.

Part Two Section Five
2.5.1 Company communications

2.5.1.1 It will be the responsibility of the pilot-in-command to keep Waterwings Airways Ltd informed of any changes of plan or delays as soon as possible. If away from Queenstown or Te Anau a collect call will be made to Waterwings Airways Ltd unless HF or VHF R/T communication can be established.

2.5.2 Icing

2.5.2.1 In flight icing can occur flying VFR in freezing rain or in wet snow. Flight should not be continued in these conditions anytime forward visibility becomes impaired.

Part Two Section Seven
2.7.1. Operations

2.7.1.1 The following documents and publications shall be carried on every public air transport flight.
.....
f. Appropriate charts
g. Load sheet
.....
i. Met forecast and Reports (when available)
j. Passenger manifest
.....

Part Four
4.1 Flight plan routes

4.1.1 1. Queenstown - Te Anau
a. Lake Wakatipu, Von valley, Kiwi Burn Saddle, Whitestone River. Minimum altitude 2500 ft. Time 25 mins.

b. Lumsden - Jollies Pass- Kingston
2500 ft

1.17.3 A copy of NZMS 242 Sheet 14 TE ANAU was normally carried on board each Waterwings aircraft. This was a 1 to 250 000 "terrain" map which included the area over which ZK-EWH was flying at the time of the accident. The reason for the absence of the map from the documentation in the aircraft was not determined.

1.17.4 The meteorological forecast and reports applicable to each days flying were displayed on a clipboard at the Waterwings operations office at Queenstown Aerodrome, available for pilot reference prior to carrying out any flight.

2. Analysis

2.1 Examination of ZK-EWH disclosed no evidence of defect or malfunction in the airframe, engine, instrumentation or systems of the aircraft that might have contributed to the accident.

2.2 The routine departure call from ZK-EWH, on reaching Mount Prospect, indicated that no event had occurred, or difficulty presented itself, up to that point, which might have prompted the pilot to return to Te Anau, or divert significantly from his stated intention of proceeding to Queenstown.

2.3 With two passengers on board, and a modest amount of baggage, the aircraft was well within its loading and balance limitations. Nevertheless, a requirement existed for a load sheet/passenger manifest to be completed for the return flight, and a copy left at Te Anau with a suitable person or in a standard location.

2.4 The total quantity of fuel remaining at the time of departure from Te Anau cannot be known with certainty but was likely to have been sufficient for at least two hours flying, ample to allow for the flight to Queenstown, statutory reserves, and any unforeseen contingency such as an extended diversion due to weather.

2.5 The pilot's on-time arrival at Te Anau, and the lack of any reported comment from him at any stage concerning the flight, suggested that he had flown from Queenstown that morning without difficulty, either in relation to the serviceability of the aircraft, or the weather conditions encountered en-route.

2.6 The pilot's recorded flying experience, particularly within the last 12 months, indicated that he had flown the route between Queenstown and Te Anau on numerous occasions. It was also evident that he was familiar with operating the Cessna 172 aircraft type over the route, and was current specifically in terms of operating Cessna 172P ZK-EWH from Queenstown to Te Anau and return.

2.7 The pilot had been rostered "off-duty" on the day before the accident. There was no evidence to suggest that on the morning of 9 January 1998 he was other than in good health, adequately rested, and capable of competently handling ZK-EWH under all normal circumstances.

2.8 The dominant aspect of the circumstances surrounding the return flight by ZK-EWH from Te Anau to Queenstown was the rapid and extreme deterioration in the weather en-route. Reports from the crew members of the floatplane and helicopter involved in the subsequent search indicated the severity of conditions along the probable track of ZK-EWH toward the Kiwi Burn Saddle, and in the area where the wreckage of the aircraft was eventually located.

2.9 Low temperatures, heavy snow showers lowering to 1500 feet, and a 2000 foot cloudbase contrasted dramatically with the reasonable, but deteriorating, conditions experienced earlier in the day by the pilot of a Nomad aircraft flying between Manapouri and Queenstown.

2.10 In the absence of definitive evidence to suggest any other cause, the probability was high that the accident to ZK-EWH related directly to the adverse weather.

2.11 Previous accidents, involving aircraft operating VFR in hilly or mountainous terrain have shown that despite pilot experience and familiarity with a flight route, or local area, considerable potential exists for a collision with terrain if flight is continued in conditions where visibility is reduced, or restricted significantly, due to low cloud, rain or snow showers.

2.12 In such conditions, normal landmarks and prominent features relied upon for accurate navigation may be completely obscured, indistinct, or otherwise unrecognisable, and anticipated ground features may be mistakenly identified, resulting in loss of positional awareness and consequent error or confusion concerning an appropriate heading and altitude to be maintained. Even a temporary obscuring of forward visibility due to snow flurries, or heavy rain, may be critical to the safety of the flight.

2.13 In addition, without adequate visual reference to maintain a desired track, the changes in wind strength and direction associated with active CBs producing heavy rain and snow showers, may result in significant unperceived drift and unexpected increase or decrease in groundspeed. A hazardous situation is likely to develop if the aircraft is flying at an altitude insufficient to provide adequate vertical clearance from all surrounding terrain.

2.14 The altitude at which the pilot of ZK-EWH was operating during the return flight to Queenstown is not known. The elevation of the accident site, however, confirmed that the aircraft was at, or above, 3300 feet amsl prior to the collision with the beech-forested slope.

2.15 The saddle above the accident site had an elevation of approximately 3500 feet amsl. Whether the closeness of the accident site to the elevation of the saddle held significance as to the cruising altitude of the aircraft immediately before the accident, could not be determined. In normal VFR conditions 3500 feet was an appropriate and commonly selected altitude when flying the standard route from Te Anau to Queenstown via the Kiwi Burn Saddle.

2.16 The apparent in-flight selection by the pilot of the landing light and navigation lights "ON", and the carburettor heat control fully out to provide the maximum available protection against carburettor icing, although not individually conclusive, together supported the likelihood that reduced visibility, and conditions of outside temperature and visible moisture conducive to carburettor icing, had been encountered before the accident.

2.17 The flaps "UP" configuration, and calculated ground speed of about 105 knots at the time of contact with the trees, suggested, however, that the circumstances of the flight and the conditions encountered immediately prior to the accident had not led the pilot to employ a bad weather technique, typically involving, in the Cessna 172, selection of 20° flap and an airspeed of about 75 knots.

2.18 The use of an appropriate "bad weather" configuration in conditions of markedly reduced visibility, or situations where operation of the aircraft has become confined to a limited area by low cloud or surrounding higher terrain has the advantage of providing a greater safety margin for manoeuvring, enabling turns to be conducted within a smaller radius, and increasing the time available for effective evasive action should an obstacle be perceived ahead.

2.19 The location of the accident to ZK-EWH on the Te Anau side of the beech-forested slope, the narrow entry swath through the trees, the nature of the damage to the aircraft and the attitude in which it had come to rest, suggested that the pilot had attempted an evasive manoeuvre, entered from cruising flight, involving an extreme angle of bank to the right. In such a manoeuvre, essentially a maximum rate turn to avoid suddenly perceived terrain, there would have been considerable potential for the aircraft to be over-banked, or for inadvertent "slip" to develop resulting in a rapid, and probably undetected, loss of height as the turn was made.

2.20 In the circumstances involving the accident to ZK-EWH, if the aircraft was already close to the forested slope, the risk of colliding with the trees during an evasive manoeuvre of this nature was great.

2.21 While the above scenario was consistent with the available evidence, in the absence of external witness or survivor information concerning the final flight path of the aircraft or events immediately preceding the occurrence, no conclusive reason could be advanced to account for the accident.

2.22 The meteorological aftercast summarising the conditions likely to have existed as a result of the cold unstable south-westerly flow and the vigorous CB activity included, in addition to significantly reduced visibility in rain or snow showers, the possibility of lightning, hail, moderate and occasionally severe turbulence, and severe icing above the freezing level of about 3000 feet. Whether any of these potential hazards contributed to the accident, individually or in combination, could not be determined.

The pilot's decision making

2.23 There was no indication of any hesitation by the pilot in commencing the return flight. His actions at the Te Anau Airstrip were apparently unhurried, but at the same time purposeful, leading to an on-time departure at 0830 hours, and an ETA at Queenstown which would allow adequate time for his passengers to transfer to their next flight.

2.24 However, once it became evident en-route that the weather had deteriorated to the extent that conditions might present a barrier to the progress of the aircraft, the pilot would have had to consider the alternatives open to him. The options could be summarised broadly as follows:

- An immediate return to Te Anau to await an improvement in conditions before making a further attempt to fly to Queenstown, or alternatively arranging for his passengers to travel by road. The pilot would have been aware that the significant delay incurred in either case would have a flow-on effect, disrupting the passengers' already relatively tight schedule for their pre-booked travel.

- Adopting a major change in heading and flight route, to the north or to the south, in an attempt to overtake, or bypass, the worsening conditions. The pilot would have had to take into consideration the necessity to traverse high rugged terrain if a more northerly route was followed, and the probability in the prevailing south-westerly flow that an extended diversion to the south might yield little improvement. In either case the additional flying time was likely to have jeopardised the opportunity for the passengers to connect with their onward flight.

- Continuing to maintain a general heading towards Queenstown, and accepting some reduction in visibility in rain or snow showers, with the expectation that the most severe weather would be localised and could be negotiated safely. In the circumstances this option may have appeared to the pilot to be the best option of the choices available, particularly if within the widespread CB activity there were occasional breaks, or areas of less intense precipitation, suggesting that a route could be found through the weather system.

2.25 The "semi-scheduled" nature of the flight, timed specifically to enable the passengers' airline connection to be met, would have undoubtedly exerted some pressure, perceived or not, on the pilot to maintain the schedule.

2.26 Other factors likely to have influenced the pilot in a decision to persevere towards Queenstown on the return flight included:

- His familiarity with the route.
- The re-assurance from the successful flight through the Von Valley and over the Kiwi Burn Saddle less than an hour earlier.
- His knowledge of the relatively short flying time (approximately 15 minutes) normally required between Mount Prospect and Lake Wakatipu and the corresponding likelihood that exposure to the most severe weather would probably involve a brief period only.
- His confidence in the serviceability of ZK-EWH, and the performance capability of the aircraft given the light load.
- His probable awareness that the deterioration in the weather was likely to last for several hours, encouraging an attempt to complete the round trip before conditions precluded all VFR flying.
- His known helpful disposition and natural desire to avoid disrupting the passengers' travel arrangements.

2.27 The pilot's experience level in bad weather flying, and in basic decision making if, or when, faced with conditions marginal for VFR operations was not determined.

2.28 His background experience was largely in tourist scenic flying. Such flying, by its nature, limits the extent of poor weather operations which are likely to be carried out. However, the pilot had operated regularly between Queenstown and Milford and in particular between Queenstown and Te Anau on a "semi-scheduled" basis under VFR, and could be expected to have been exposed to marginal weather conditions on a number of occasions.

2.29 The possibility existed, nevertheless, that the severity of conditions encountered by the pilot was greater than he had experienced previously, and the rapidity of the deterioration in the weather took him by surprise.

Limitations of VFR air transport

2.30 VFR operations in general, including VFR air transport, place many demands upon a pilot-in-command, not least the necessity, in poor or marginal weather for decisions to be made in flight which may include turning back, diverting, or landing at other than the intended destination.

2.31 If a VFR air transport operation involves scheduled or "semi-scheduled" flights, the commitment inherent in providing the service is likely to create added pressure to complete a flight, and increase the difficulty of making any decision which could introduce a significant delay.

2.32 VFR minimum flight visibility and clearance from cloud requirements are defined in CAR Part 91, and these, or higher minima, will be specified in the company Operations Manual[4]. However, the pilot-in-command of a scheduled or "semi-scheduled" VFR air transport flight may be particularly vulnerable to "pressing on", especially if experience in the local operating environment has enabled the pilot, on other occasions, to successfully negotiate conditions marginal for VFR.

CRM considerations

2.33 The principles of crew resource management (CRM) are now well established in terms of air transport operations involving two or more crew members on the flight deck, engineering personnel, and cabin staff.

2.34 In a single pilot environment, the benefit of CRM is clearly not available directly, to assist the in-flight decision making of the pilot-in-command. However, CRM can be applied usefully in a wider sense.

2.35 In the case of a single pilot VFR air transport operation encountering marginal conditions an example of such CRM could include deliberate reference by the pilot to personal minima in regard to ceiling and visibility, decided upon at some earlier stage and adjusted as appropriate to reflect increasing experience.

2.36 At the same time, a conscious review could be made of any relevant instructions or procedures established by the operator in the event of poor weather being encountered, as well as adherence to the VFR minima as required by the Civil Aviation Rules (or the operator's minima, if higher).

2.37 An RTF call (VHF or HF) to base, if practicable, would also be of significant value in such situations, not only in enabling the pilot-in-command to advise position and present weather, but also, by the opportunity to verbalise alternatives and proposed actions, assist the pilot-in-command to avoid insidious, unrecognised, pressure to limit his or her options to one particular course of action or to "press on" in unsuitable conditions.

3. Findings

Findings and any safety recommendations are listed in order of development and not in order of priority.

3.1 The pilot held a valid Commercial Pilot Licence (Aeroplane) and had flown successfully for several years on scenic and charter flights in the mountainous areas surrounding Queenstown, Te Anau and Milford.

3.2 The aircraft had been maintained in accordance with approved schedules and was operating within the maintenance period and airframe hours specified in the current Technical Log.

3.3 The absence of reported defect or malfunction concerning the operation of ZK-EWH, evident continuation of the flight beyond the Mount Prospect area in the general direction of Queenstown, and the elevation at which the wreckage was located, indicated that the aircraft had performed to the satisfaction of the pilot at least until shortly before the accident.

3.4 The all-up weight and centre of gravity of the aircraft were within limits.

[4] See additional information, paragraphs 1.17.1 and 1.17.2

3.5 The pilot's numerous VFR flights between Queenstown and Te Anau, including many in the Cessna 172 aircraft type, were likely to have increased his confidence that, in all but the most severe weather conditions, he would be able to negotiate the route successfully.

3.6 The absence, on board ZK-EWH, of a navigational log form, flight notes, or a topographical chart relating to the route being flown, suggested that the pilot was relying upon his visual familiarity with the route and its geographical features for the conduct of the flight.

3.7 Weather conditions during the flight by ZK-EWH from Queenstown to Te Anau, and initially on departure from Te Anau, were suitable for VFR flight.

3.8 A rapid deterioration in the weather, including the development of vigorous CB activity, involving rain and snow showers, was likely to have produced localised areas in the region surrounding the accident site which were unsuitable for VFR flight.

3.9 The position of the accident site, in relation to the normal route via the Kiwi Burn Saddle, suggested that the pilot may have been unable, due to reduced or restricted visibility, to monitor the track of the aircraft accurately.

3.10 As a probable consequence of the weather deterioration, and due to misidentified ground features, undetected drift, or an attempt by the pilot to find an alternative route, the aircraft was flown to the south of the normal track.

3.11 The possibility existed, in the prevailing weather conditions, that a route which appeared initially feasible may have become unsuitable for VFR flight with unusual rapidity, and afforded little or no opportunity for the pilot to maintain flight in VMC.

3.12 The circumstances indicated that the pilot was unaware the aircraft was approaching rising terrain until shortly before the accident.

3.13 The probable speed of the aircraft and proximity to the forested slope would have allowed little time for the pilot to carry out an effective evasive manoeuvre.

3.14 The severity of impact, involving large longitudinal and vertical deceleration forces, rendered the accident unsurvivable.

3.15 The circumstantial evidence in this accident, including the probable short time-frame in which events occurred, suggested that in conditions of severely reduced visibility the pilot inadvertently approached the forested slope and during an attempted evasive manoeuvre the aircraft collided with the trees.

4. Safety Recommendations

4.1 On 12 August 1998 the Commission recommended that the Director of Civil Aviation:

4.1.1 arranges for appropriate publication of the circumstances surrounding this accident for safety educational purposes to alert pilots to the pressures inherent in scheduled and "semi-scheduled" VFR Air Transport flights relevant to enroute decision making, (071/98); and

4.1.2 in relation to the weather conditions in the area at the time of this accident, emphasises compliance with applicable VFR minima regarding flight visibility and clearance from cloud. (086/98)

4.2 On 12 August 1998 the Commission recommended that the Managing Director of Waterwings Airways (Te Anau) Limited:

4.2.1 remind pilots conducting VFR Air Transport flights of the company requirements to carry adequate charts, route guides and other appropriate aids to navigation, and to complete load sheets when required, (072/98); and

4.2.2 re-emphasise to pilots involved in single pilot VFR Air Transport that in the event of adverse weather or abnormal circumstances being encountered, management assistance and support from suitably qualified and experienced company personnel may be obtained by discussion prior to flight, or by RTF contact during flight. (073/98)

4.3 On 14 August 1998 the Managing Director of Waterwings Airways responded as follows:

4.3.1 The safety recommendations you stated have been adopted.

I have today, personally written to all of my pilots bringing their attention to these points.

Furthermore I have arranged a discussion group with all of my staff to ensure they clearly understood the importance of these procedures.

Approved for publication 5 August 1998

Hon. W P Jeffries
Chief Commissioner

Glossary of aviation abbreviations

AD	Airworthiness Directive
ADF	automatic direction-finding equipment
agl	above ground level
AI	attitude indicator
AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
amsl	above mean sea level
AOD	aft of datum
ARINC	Aeronautical Radio Incorporated
ASI	airspeed indicator
ATA	actual time of arrival
ATC	Air Traffic Control
ATD	actual time of departure
ATPL (A *or* H)	Airline Transport Pilot Licence (Aeroplane *or* Helicopter)
ATT	attitude
AUTO	automatic
AUW	all-up weight
BITE	built-in test equipment
BSCU	brake system control unit
C	Centre
°C	degrees Celsius
CAA	Civil Aviation Authority
CASO	Civil Aviation Safety Order
CDI	course deviation indicator
CFI	Chief Flying Instructor
CMC	central maintenance computer
C of A	Certificate of Airworthiness
C of G (*or* CG)	centre of gravity
CPL (A *or* H)	Commercial Pilot Licence (Aeroplane *or* Helicopter)
DC	direct current
DME	distance measuring equipment
E	east
EICAS	engine indication and crew alerting system
EIU	electronic interface unit
ELT	emergency location transmitter
ERC	Enroute Chart
ETA	estimated time of arrival
ETD	estimated time of departure
°F	degrees Fahrenheit
FAA	Federal Aviation Administration (United States)
FL	flight level
ft	foot/feet
g	acceleration due to gravity
GPS	Global Positioning System

LAME	Licensed Aircraft Maintenance Engineer
LF	low frequency
LLZ	localiser
Ltd	Limited
m	metre(s)
M	Mach number (e.g. M1.2)
°M	degrees Magnetic
MAP	manifold absolute pressure (measured in inches of mercury)
MAUW	maximum all-up weight
METAR	aviation routine weather report (in aeronautical meteorological code)
MF	medium frequency (300 to 3000 kHz)
MHz	megahertz
mm	millimetre(s)
N	north
NDB	non-directional radio beacon
nm	nautical mile
NOTAM	A notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
NTSB	National Transportation Safety Board (United States)
NZDT	New Zealand Daylight Time (UTC + 13 hours)
NZGA	New Zealand Gliding Association
NZMS	New Zealand Mapping Service map series number
NZST	New Zealand Standard Time (UTC + 12 hours)
OGE	out of ground effect
okta	eighth of sky cloud cover (e.g. 4 oktas = 4/8 of cloud cover)
PAR	precision approach radar
PIC	pilot-in-command
PPL (A *or* H)	Private Pilot Licence (Aeroplane *or* Helicopter)
psi	pounds per square inch
QFE	an altimeter subscale setting to obtain height above an aerodrome
QNH	an altimeter subscale setting to obtain elevation above mean sea level
RCC	Rescue co-ordination centre
RNZAC	Royal New Zealand Aero Club
RNZAF	Royal New Zealand Air Force
rpm	revolutions per minute
RTF	radio telephone or radio telephony
S	south
SAR	Search and Rescue
SSR	secondary surveillance radar
°T	degrees true
TACAN	Tactical air navigation aid
TAF	aerodrome forecast
TAS	true airspeed

UHF	ultra high frequency
UTC	Coordinated Universal Time
VASIS	visual approach slope indicator system
VFG	Visual Flight Guide
VFR	visual flight rules
VHF	very high frequency
VMC	visual meteorological conditions
VOR	VHF omnidirectional radio range
VORTAC	VOR and TACAN combined
VTC	Visual Terminal Chart
W	west