ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-CWIK
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2004 (Serial no: 8018)
Date & Time (UTC):	12 May 2012 at 1013 hrs
Location:	100 ft below summit of Ben More, Stirlingshire, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence (Microlights)
Commander's Age:	63 years
Commander's Flying Experience:	826 hours (of which 1 was on type) Last 90 days - 12 hours Last 28 days - 6 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was being flown by an experienced microlight pilot accompanied by the owner, who was a passenger, occupying the rear seat. They were transiting from Perth to Glenforsa, on the Isle of Mull, at about 6,000 ft, above scattered cloud. Approximately 2 nm east of Ben More mountain, in Stirlingshire, the aircraft descended in good visibility, remaining clear of the cloud. The descent and flight up to one second before impact was recorded on a video camera attached to the aircraft. The aircraft levelled off below the cloud base and approximately 100 ft above the summit of the mountain. It continued towards the mountain and encountered severe turbulence in the lee of the summit. This appeared to cause the pilot to lose control of the aircraft, which impacted the south side of the summit, fatally injuring both occupants.

History of the flight

A group of friends had agreed to fly from Perth Airport to Glenforsa, an airfield on the Isle of Mull, using four weight-shift microlight aircraft. The owner of G-CWIK had purchased the aircraft in October 2011 and was taking flying lessons in it. On the day of the accident the pilot and the owner (his passenger) arrived between 0700 and 0730 hrs and prepared their aircraft. G-CWIK had been refuelled the day before the accident and at about 0800 hrs the group met to discuss the flight. They would not be flying in formation, or as an organised stream,

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but would make their way independently, meeting at Glenforsa for lunch.

According to the ATC movements log, the group of aircraft departed to the west, between 0917 and 0927 hrs with G-CWIK departing at 0920 hrs. The pilots described the weather at Perth when they departed as having good visibility, with scattered clouds at about 4,000 ft. One of the pilots later reported that he initially climbed to 4,000 ft, where he estimated, from his GPS groundspeed and his indicated airspeed, a headwind component of about 15-20 mph with moderate levels of turbulence. Due to the turbulence, he climbed to between 6,000 and 7,000 ft, where the flying conditions were smoother. G-CWIK was last seen by one of the other aircraft at about 6,000 ft to the northeast of Ben More, where it was seen to descend.

A GoPro Hero video camera, attached to G-CWIK and facing forward in the direction of flight, was later used by the investigation to reconstruct the later stages of flight. The final camera recording commenced 3 minutes and 21 seconds before impact and showed the aircraft descending above a small patch of stratus cloud, with the snow-capped summit of Ben More (elevation 3,850 ft amsl) clearly visible through a gap. The local terrain was visible in sunshine with the slow-moving shadows of the scattered cloud. There was no smoke or other visual means to indicate the direction and strength of the wind, and no snow 'spindrift'[1] was being blown from the summit. The aircraft manoeuvred to the right and left avoiding entering cloud and then passed clear of the edge of a cloud, heading towards the top of the mountain. The aircraft levelled off and engine speed increased just below the cloud base, which was about 300 ft higher than the summit. The recording shows that the aircraft descended slightly, to about the same height as the summit and heading directly towards it, as if to pass over the top. The flight path appeared stable until about 300 m before the summit, when the aircraft began rolling from side to side, with some pitching motion. The engine speed increased significantly and the aircraft banked rapidly left and right and then pitched rapidly nose-down before impacting the mountain side.

A witness on top of Ben More saw the last moments of the aircraft's flight but did not see or hear the impact. He described the wind at the summit as "very strong" and that when he removed an item of clothing from his rucksack it was nearly "ripped" out of his hand by the wind. He did not realise that the aircraft had crashed; the noise of the wind had probably masked the sound of the impact. Shortly after this he met two other hill walkers and they came across the wreckage some time later. They reported the accident to the police, who mobilised the Search and Rescue response. Both occupants had been fatally injured.

Aircraft description

The Pegasus Quik is a tandem two-seat weight-shift microlight, powered by a Rotax 912 ULS piston engine driving a Warp Drive three-bladed propeller (Figure 1).

Figure 1

Accident aircraft G-CWIK

Footnote

[1] Spindrift is the movement of the surface snow particles due to the effect of the wind.

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G-CWIK was fitted with the optional electric pitch trim system and the GoPro Hero video camera was mounted on the forward strut. The Permit to Fly had been renewed on 3 May 2012 and the airframe and engine had accumulated 438 hours. The wing, which had been replaced in July 2010 following an accident, had accumulated 62 hours.

Accident site and wreckage examination

The aircraft had struck Ben More mountain on its south-eastern side 100 ft below the summit (Figure 2). The accident site was consistent with the aircraft having hit a small rock in a steep nose-down attitude with some left bank. The nosewheel and parts of the nose structure were embedded in the ground by the rock and the main aircraft wreckage was lying inverted 8 m away from the rock in the direction of 225°(M). The fuel tank had split and was empty but there was a distinct smell of fuel at the accident site. All three propeller blades had failed near the root.

The wreckage was recovered from the mountain by helicopter on 16 May 2012 and then transported to the AAIB's facility in Farnborough for more detailed examination. All the failures within the airframe and wing structure could be explained as a result of impact forces. The pylon had failed aft due to buckling loads which permitted the propeller to strike the wing. The aft end of the keel and the aft end of the fin tube had been deformed as a result of propeller strikes indicating significant energy in the propeller. All failures within the rigging were due to overload resulting from impact forces or propeller strikes. The electric motor for the pitch trim system was found set to 'six turns'. According to the aircraft manufacturer this trim setting, with two occupants, would result in an approximate trimmed airspeed of 60 to 65 mph.

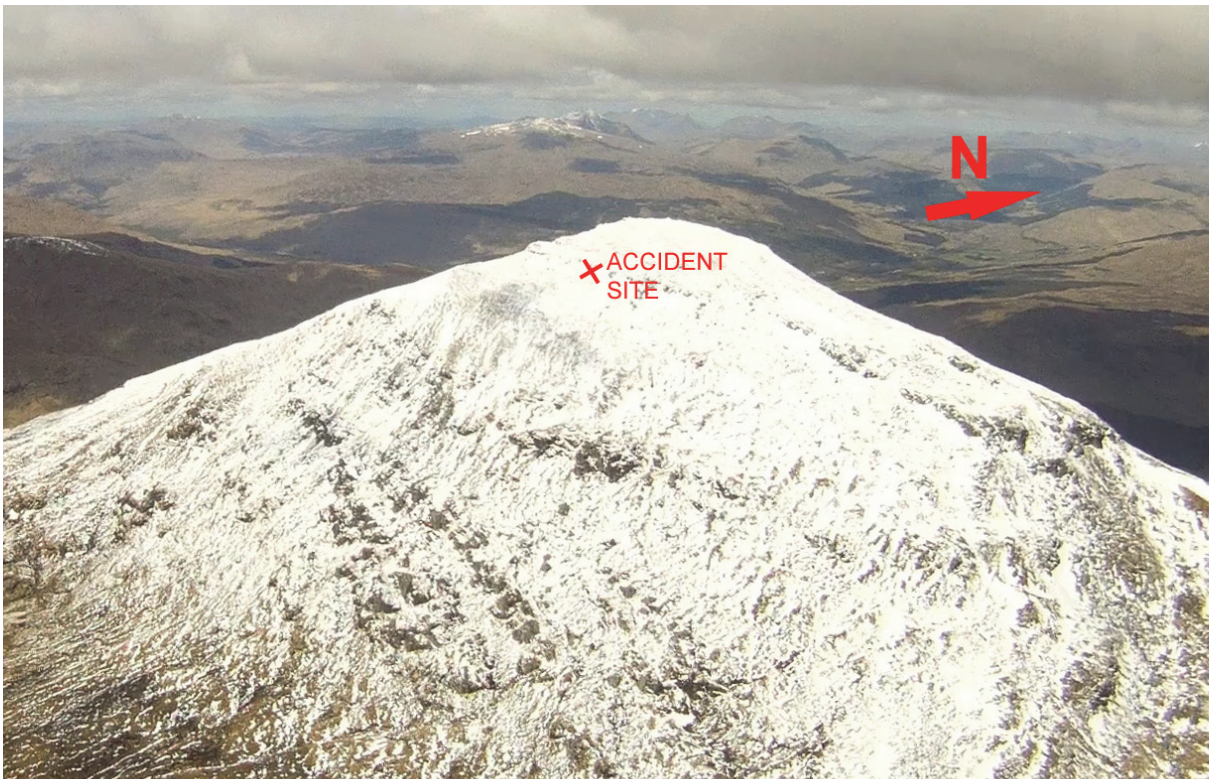

Figure 2

Accident site location, 100 ft below summit of Ben More (image extracted from video camera fitted to G-CWIK)

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The lap straps from both seats had failed in overload. However, the harnesses on UK microlights are only required to restrain occupants in the case of 9.0g forward loading and 4.5g upward loading – the impact loads in this accident would have been considerably higher.

Recorded data

Devices from the aircraft

A number of electronic devices were recovered from the accident site, including a GPS eTrex Legend C and a GPS-enabled iPad. However, the only relevant recordings that were recoverable were from the memory card of the GoPro Hero video camera.

Two video files were recovered from the video camera, both taken in the air during the accident flight. The first covered a period of one minute and four seconds while approximately 25 km east-south-east of the accident site. The second video file had not been completed properly, indicative of a loss of power, and required forensic techniques to make it playable. This video was three minutes and 21 seconds long and ended with the aircraft in a steep nose-down attitude, visually estimated to be 10 to 20 ft above the ground, within 20 m of where the main wreckage was found.

The video images provided good evidence of the weather conditions and flight path, shown in Figures 3 and 4 and described in the 'History of the flight' section of this report. The Figure 3 images at '6 seconds' and '5 seconds' indicate a roll rate of about 55°/sec and subsequent images showed a nose-down pitch.

Analysis of the recorded audio showed clear engine-related signatures. The engine speed varied for the bulk of the recording and towards the end increased in increments until reaching the maximum continuous speed of 5,500 rpm, 40 seconds before the end of the recording. This was maintained for 9 seconds before increasing to the redline speed of 5,800 rpm. 10 seconds before the end of the recording the engine speed increased to approximately 6,090 rpm. 3.6 seconds from the end of the recording, the audio signatures stopped, returned and then disappeared once more, coincident with moments of more extreme attitude apparent from the video images.

Radar

Radar return recordings from Kincardine and Lowther Hill radar heads were provided by the national provider of air traffic services, NATS. The aircraft was not using an ATC transponder so could only be tracked using primary radar. Microlight aircraft do not present a strong primary radar target and intervening terrain between the aircraft and the radar heads caused further problems in reconstructing the flight, resulting in parts of the flight path not being detected by radar and the other parts being subject to large errors. The last recorded radar return relating to the accident aircraft was 2.2 km east-north-east of the accident site.

The radar data included sporadic coverage of the other microlight aircraft in the area, showing them generally flying several kilometres apart, following different paths. This concurred with GPS tracks recovered from other microlight aircraft involved in the journey.

A secondary radar track from a helicopter in the area at the time was also reviewed. The helicopter flew from the south-east, between Ben More and the adjacent peak, below the height of the peaks, and then to the north-west (Figure 4). Photographs and video taken from this helicopter at about the time of the accident were reviewed but did not capture the accident aircraft.

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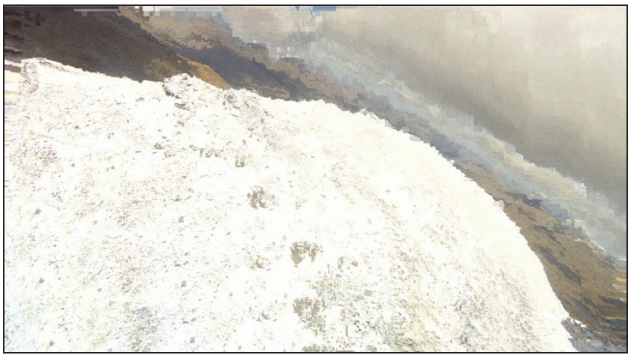
Start of video

Video at ~1 minute

Video at ~2 minutes 40 seconds

Video at ~3 minutes



6 seconds to final frame

5 seconds to final frame

Figure 3

Snapshots extracted from the recovered video, showing the approach to Ben More

Combined data

The final section of the radar track of the accident aircraft was consistent with the position of the aircraft established by analysis of the video. The correlation was used to derive the approximate timings for the video (Figure 4).

The paths and timings of the helicopter and the microlight indicate that the microlight impact was

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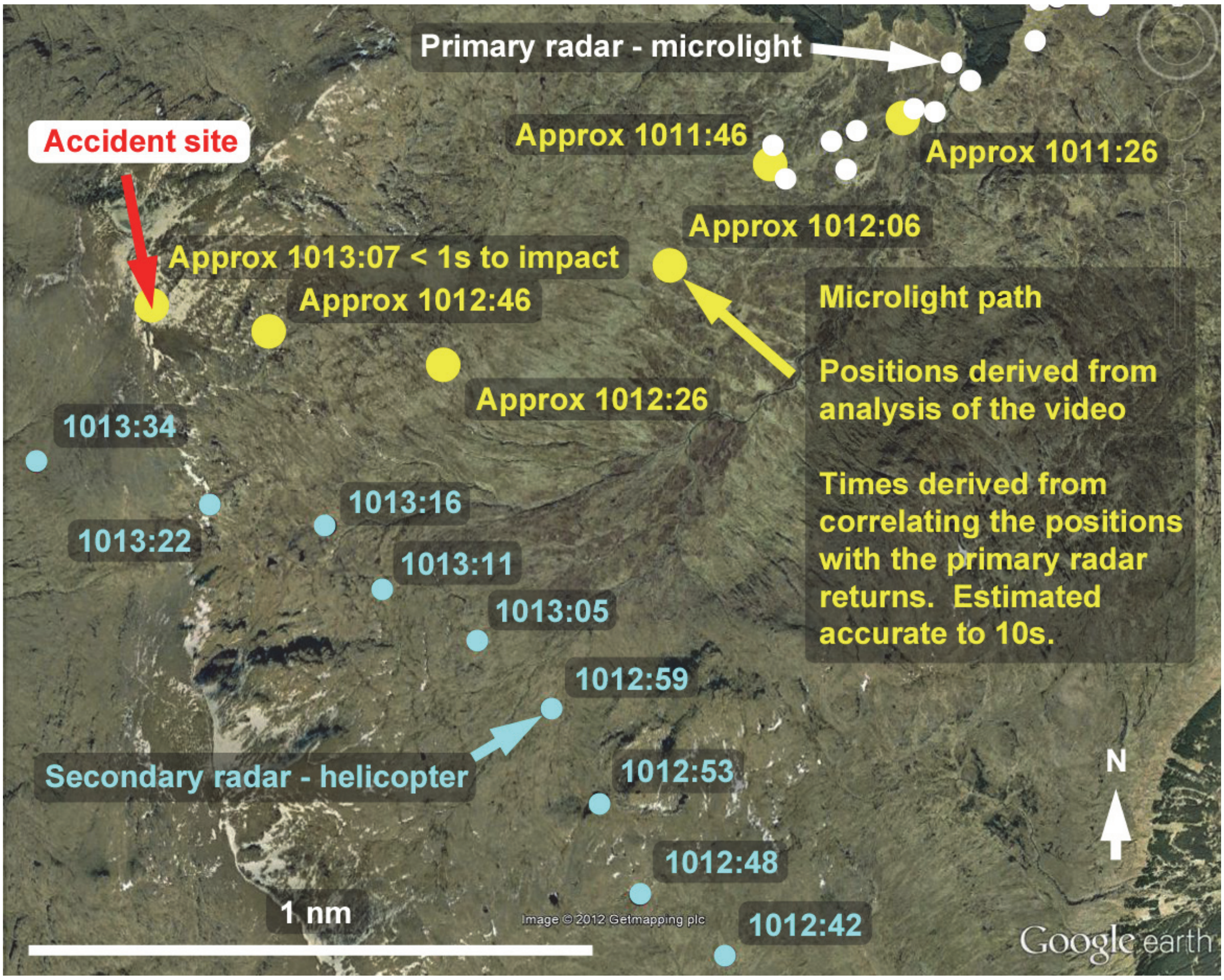

Figure 4

Flight paths and timings of the microlight and helicopter

between 0.4 nm and 1.1 nm ahead of the helicopter. This established that the helicopter was not a factor in the accident.

Meteorological information

On the day of the accident a large high pressure system was established to the west of the UK, extending its influence over Scotland. Over Scotland, the surface wind observations valid at 1100 hrs UTC show westerly winds of 10-15 kt with a 2,000 ft gradient wind of 310° at 25-28 kt. At Glen Ogle, near the crash site, the surface wind between 1000 and 1200 UTC was westerly 16-19 kt with gusts of 24-26 kt.

The movement of the cloud shadows near the summit of Ben More was recorded on the video and analysis indicated a wind of 306°T at 32 kt, at about 4,000 ft. The visibility was approximately 40 km with the generally scattered cloudbase between 3,500 and 5,000 ft. The sea level temperature was about 12°C.

Medical and pathological information

A post-mortem examination of both occupants revealed that they had died of severe multiple injuries, consistent with having been caused when the aircraft struck the ground. The crash forces were outside the range of human tolerance and therefore the impact was not

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survivable. There was no evidence of any pre-existing condition that may have contributed to the accident and toxicology showed no evidence of drugs or alcohol in either occupant.

Mountain flying guidance

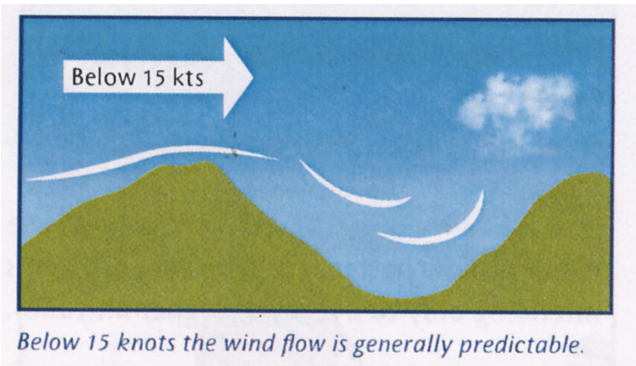
There are a number of documents available on the internet covering mountain flying. An example is the Civil Aviation Authority of New Zealand '*Good Aviation Practice (GAP), Mountain Flying*' publication (www.caa.govt.nz/safety_info/good_aviation_practice.htm). It contains valuable information and clearly describes the potential hazards associated with flying in mountainous terrain. The illustrations below are reproduced from this document. Wind strength increases as it passes over a mountain feature, due to the Venturi effect of the mountain. As a result, wind strength on the summit of a mountain will be significantly greater than the ambient wind speed away from the summit at the same height.

This fact is illustrated in Figure 5, with wind speeds for illustrative purposes only.

The strength of the ambient wind will govern the degree of turbulence created. A gentle wind will simply flow over the terrain following the contours but as the strength increases the wind will curl over and around features, forming up and down drafts as well as vortices, the severity of which will increase with the strength of the wind. This effect is shown in Figure 6.

Figure 5

The Venturi effect of the mountain increasing the wind speed at the summit



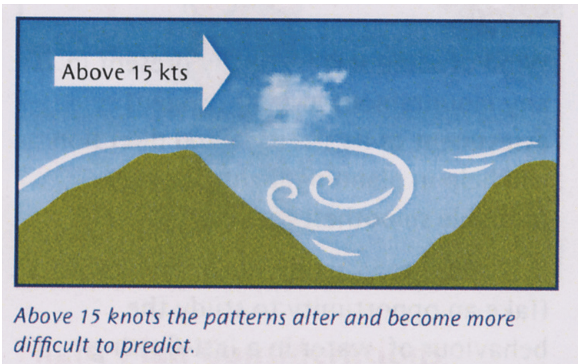


Figure 6

The creation of hazardous turbulence in the lee of high ground related to wind strength

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Analysis

The wreckage examination did not reveal any evidence of a technical fault or pre-impact structural failure. The engine was not examined in detail as audio evidence from the video camera, and the damage to the propeller blades, indicated that the engine was producing power at impact.

The video retrieved from the GoPro camera recorded the flight path as stable up to a point about 300 m from the summit of Ben More. At this point the aircraft started to roll rapidly from left to right and pitched nose-down. The increase in engine power up to the redline speed of 5,800 rpm and then, in the last 10 seconds before the end of the recording, to approximately 6,090 rpm, suggests the pilot was trying to arrest his rate of descent and climb out of the turbulence. The aircraft's motion and final flight path is consistent with the effect of turbulent air in the lee of a summit, which creates downdrafts, rotors and vortices.

The evidence of the hill walker on the summit of Ben More, regarding the direction and strength of the wind, indicated that the aircraft's track was downwind of the summit with a wind speed of 30 to 35 kt. This is supported by the recorded video data showing the clouds indicating a wind of 306° at 32 kt near the summit. The pilot of G-CWIK would have known that the winds were westerly from his takeoff at Perth but it is not known how he was conducting his en route navigation and whether that would have given him an appreciation of the wind speed and direction at Ben More. Further, the video recording shows that there was no compelling visual evidence of the wind speed and direction at the summit, such as snow 'spindrift'. It is likely that, in this case, a lack of awareness of the wind conditions, and of the likelihood and severity of turbulence downwind of high ground, were factors in this accident.

In summary, the severity of the turbulence created by the wind, close to the summit of Ben More, was such that it exceeded the safe conditions for flight in the microlight aircraft. This resulted in a loss of control, which led to the impact close to the summit of the mountain.

Safety Recommendation

The UK CAA produces a series of Safety Sense Leaflets covering a wide range of aviation activities but this does not currently include a leaflet covering mountain flying. The following Safety Recommendation is made:

Safety Recommendation 2012-037

It is recommended that the Civil Aviation Authority produce a Safety Sense Leaflet, or other guidance material, covering the activity of mountain flying for the UK general aviation community.

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