Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A08Q0110

LOSS OF VISUAL REFERENCES – COLLISION WITH WATER

EUROCOPTER EC 120B (HELICOPTER) C-GHNI
LAC À L'ÉPAULE, QUEBEC
19 JUNE 2008

Canada

Aviation Investigation Report

Loss of Visual References – Collision with Water

Eurocopter EC 120B (Helicopter) C-GHNI
Lac à l'Épaule, Quebec
19 June 2008

Report Number A08Q0110

Summary

At approximately 0907 eastern daylight time, the Eurocopter EC 120B helicopter (registration C-GHNI, serial number 1131) departed Lac des Neiges, Quebec, on a private visual flight rules flight to Québec/Jean Lesage International Airport, located 42 nautical miles (nm) to the south. Approximately 15 minutes after takeoff, the weather deteriorated and the pilot chose to land at Lac à l'Épaule, 28 nm north of his destination. While overflying the lake at low altitude to verify the chosen landing spot, the pilot turned on the demist hot air to clear the front windshield of condensation. The windshield immediately misted-up; the helicopter lost altitude and struck the surface of the water. The pilot and passenger sustained minor injuries and evacuated the aircraft successfully. The pilot helped the passenger towards the shore. They were assisted by two fishermen in a small boat and were then transported to hospital by ambulance. The passenger subsequently died. The helicopter, which sank approximately 500 feet from shore in 25 feet of water, was substantially damaged.

Ce rapport est également disponible en français.

Other Factual Information

History of the Flight

The pilot and passenger were invited to join a fishing excursion at an outfitter camp located at Lac des Neiges. The EC 120B departed Québec/Jean Lesage International Airport (CYQB) on 16 June 2008 and landed at Lac des Neiges as planned. The helicopter remained on the ground in the rain for the following two days.

The EC 120B was inspected and prepared for the return flight to CYQB on the morning of 19 June 2008. At approximately 0907 [1], the helicopter took off under visual flight rules (VFR) with the pilot and passenger on board. The pilot was seated in the right front seat and the passenger in the left front seat; the EC 120B is certified to be flown from either front seat. Weather at the time of departure was considered to be marginal visual meteorological conditions (VMC). The pilot estimated the visibility to be approximately 10 statute miles (sm) and the ceiling to be 300 to 600 feet above ground level (agl) with no precipitation. The pilot did not check the forecasted weather conditions for the planned route prior to departure. There was no internet service at the outfitter camp, but there was a telephone which could have been used to obtain a weather briefing.

Rain showers commenced and slowly intensified as the pilot flew through a valley en route towards Lac à l'Épaule. Lac à l'Épaule is situated on the southeast edge of the Jacques Cartier National Park. While overflying the lake, the pilot noticed two cottage locations on the east shore; one location on the north end and one on the south end. The pilot continued flying towards the southwest through a valley past Lac à l'Épaule. At this point, rain showers continued to intensify and cloud layers restricted passage through the valley. The pilot chose to return to Lac à l'Épaule and land at one of the previously observed cottage locations to wait until weather conditions improved.

The pilot did not find a safe landing area at the cottage located at the south end of the lake and proceeded towards the cottage at the north end of the lake (see Appendix A - Lac à l'Épaule). While transiting northbound over the lake at approximately 100 feet agl, condensation started to accumulate on the front windshield as the pilot reduced speed. Visibility outside the aircraft was restricted by heavy rain showers. The pilot activated the demist hot air to clear the inside of the windshield, but instead the windshield and the front side windows immediately fogged up, completely restricting his outside visibility. The helicopter descended from approximately 100 feet agl and struck the water surface at an estimated speed of between 20 to 30 knots. Position information extracted from the global positioning system (GPS) appears in Appendix A.

Both occupants were wearing their seatbelts and shoulder harnesses, and sustained minor injuries. They evacuated the helicopter and climbed on top of it while it sank. The pilot provided the passenger with a seat cushion to use as a flotation device and helped him towards the shore. While swimming, the pilot and passenger were assisted by two fishermen in a boat.

---

1 All times are eastern daylight time (Coordinated Universal Time minus four hours).

The boat was too unstable to attempt to lift both men into the boat. The pilot held on to the boat while holding the passenger until they reached the shore. Once ashore, it was discovered that the passenger had lost consciousness, and ambulances were called to transport the two injured persons to hospital. While the passenger initially survived, he subsequently died of cardiac arrhythmia due to exposure to the cold water and intense stress. The occurrence happened during daylight hours at approximately 0925.

The terrain between Lac des Neiges and Lac à l'Épaule is mountainous and elevations in the area range between 2275 feet and 3775 feet above sea level (asl). Lac à l'Épaule is oriented north-south and is approximately 6000 feet long and 3000 feet wide at it widest point. The two cottage locations on the east shore are accessible by road.

Aircraft Damage

Three days after the occurrence, the wreckage was salvaged and transported to a hangar where TSB investigators were able to examine it. The windshield panels on both the left and right side were shattered and the left sliding door had popped off on impact. The instrument and avionics panel was bent slightly towards the inside of the cabin. There was no deformation to any of the seats or seat structures. The four point seatbelt/shoulder harnesses and reels remained intact and likely restricted forward upper body movement on impact, limiting injuries to the occupants. Deformation of the cabin was minimal.

The emergency locator transmitter (ELT), a Pointer model 4000-10, serial number 408850, was found intact but had been immediately submerged in water after impact. The master switch was reported to have been in the AUTO position when recovered but the unit did not activate, most likely due to insufficient impact forces in line with the acceleration switch. The ELT was tested and found to function as designed.

Weather Information

The graphic area forecast (GFA) weather charts showed a low pressure system moving eastwardly across Quebec and affecting the region in which the occurrence flight took place. The GFA predicted the following weather: visibility 3 sm to greater than 6 sm in light rain, showers, and fog, altocumulus castellanus clouds at 18 000 feet asl, and patchy ceilings at 700 feet agl (see Appendix B – Graphic Area Forecast).

CYQB is the closest aviation weather reporting station to the accident site location. The Aviation Routine Weather Report (METAR) for CYQB at 0900 was as follows:

> Wind 100°T at 6 knots, visibility 6 sm in light rain and fog, scattered cloud at 900 feet agl, broken cloud at 1900 feet agl, overcast cloud at 2800 feet agl, temperature 14°C, dew point 13°C, altimeter setting 29.84 inches of mercury.

The terminal aerodrome forecast (TAF) for CYQB valid on 19 June 2008 from 0812 was as follows:

> Wind 070°T at 5 knots, visibility 6 sm in light rain and fog, broken cloud at 800 feet agl, overcast cloud at 2000 feet agl. Temporarily between 0800 and 1000, visibility greater than 6 sm, no significant weather, scattered clouds at 800 feet agl, overcast cloud at 2000 feet agl. From 1000, winds 080°T at 8 knots, visibility greater than 6 sm, few clouds at 800 feet agl, broken cloud at 2000 feet agl, temporarily between 1000 and 1200, broken cloud at 3000 feet agl.

The Villeroy radar weather station, located southwest of Québec, reported heavier rain showers in the mountainous area of the Jacques Cartier National Park and less precipitation south and north of the park during the period the flight took place (see Appendix C – Villeroy Radar Weather Station).

The helicopter was owned by the pilot and was operated for private use. In such a case, the *Canadian Aviation Regulations* (CARs) [2] state that "no person shall operate an aircraft in VFR flight within uncontrolled airspace unless the aircraft is operated clear of cloud with visual reference to the surface. Where the aircraft is a helicopter and is operated at less than 1000 feet agl during the day, flight visibility should not be less than one mile."

Personal Information

The pilot obtained a Canadian private helicopter licence in May 2002. His helicopter training was conducted on the Bell 206 helicopter and he was endorsed on the EC 120 in August 2003. The pilot's category 3 aviation medical certificate was valid at the time of the occurrence. He had completed approximately 1296 hours of flying time on the EC 120B since purchasing it in 2003. The pilot also held a private fixed-wing licence obtained in 1992 and was endorsed on floats. He had approximately 3434 hours total time on fixed-wing aircraft and 1663 hours total time on helicopters.

Aircraft Information

The helicopter was maintained by an approved maintenance organization (AMO) in accordance with existing regulations and an approved maintenance and inspection program. All mandatory airworthiness directives and required maintenance had been completed. Maintenance records indicate the EC 120B had flown 30 hours since the last annual/100-hour inspection. No anomalies were reported. The helicopter's weight and centre of gravity were within prescribed limits at the time of the occurrence. The pilot did not report any technical difficulties with the helicopter prior to colliding with the water. The aircraft was not certified or equipped to fly in instrument meteorological conditions (IMC) and this was not required by the regulations.

---

2 CAR 602.115

Figure 1 shows the cabin ventilation, heating, and demisting system on the EC 120B. Outside air flows in through the front air intake and is diverted into the right-hand forward cowling compartment by the ventilation scoop. The air is then directed by a blower fan to the distribution system via a hole in the cabin ceiling. The cabin air distribution system comprises a duct fitted underneath the cabin ceiling and positioned on the aircraft centreline. This duct is divided into two arms. If the fan blower is selected to the open position (ON), only outside fresh air is drawn inside the cabin. If demisting is needed to clear the helicopter windshield and windows, the pilot adjusts the gate valve control knob, located on the cabin ceiling between the two front seats. The outside air crosses the hot air tapped from the engine centrifugal compressor outlet (P2) venturi nozzle where it is mixed with P2 air [3]. To obtain optimum air flow towards the front windshield, the pilot must close the louvers supplying air to the rear cabin. Examination of the helicopter after the occurrence showed that the P2 gate valve control knob and the louvers were in the appropriate positions for maximum airflow to the front as indicated in the EC 120B flight manual instructions. If the windshield becomes misted-up, the EC 120B is equipped with a bad weather window that can, if time permits, be opened by pilots in flight and used to see outside from the side of the aircraft.

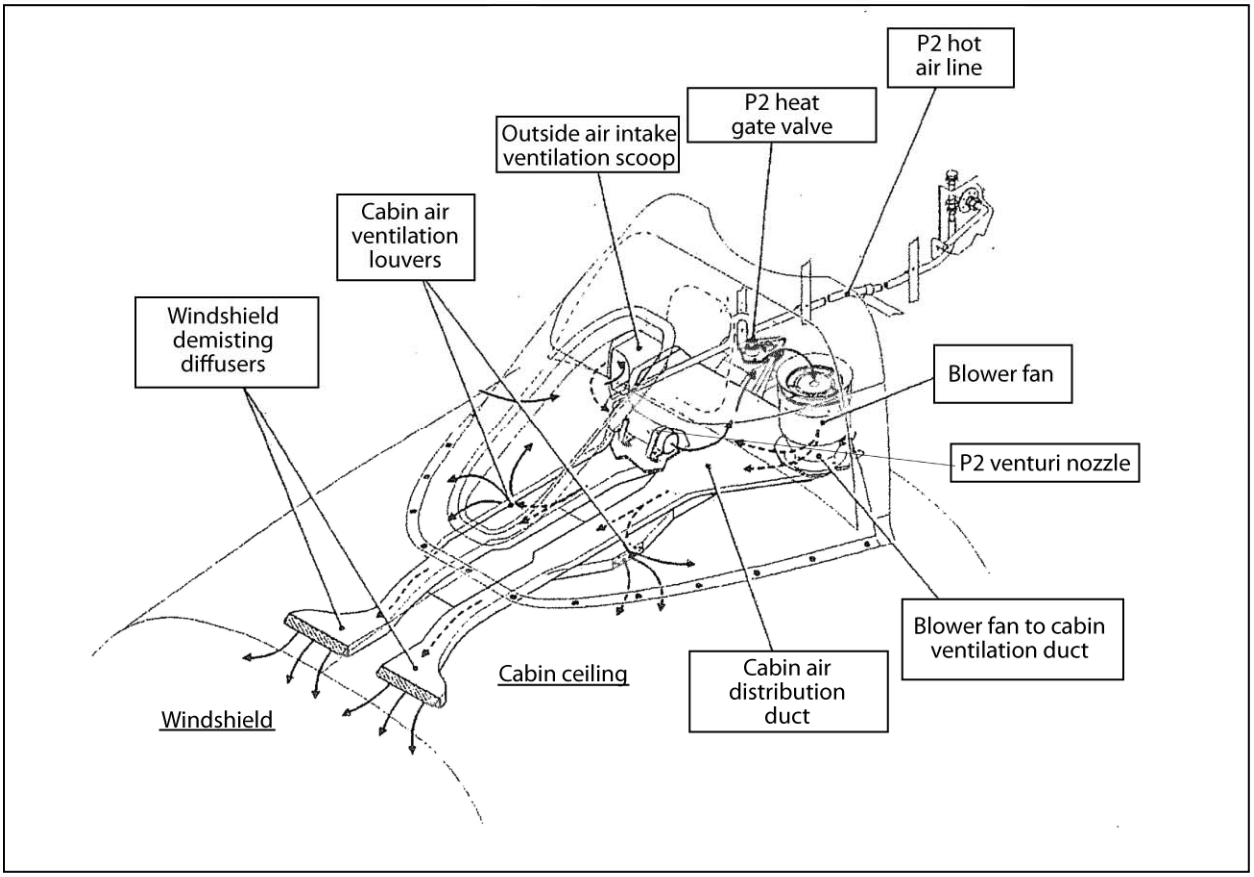


Figure 1. Cabin ventilation, heating, and demisting system.

[3] The P2 air is 351°C at the P2 chamber. It is cooled to less than 93°C in the mixing body before it exits through the ducting onto the windscreen.

The moisture content of the air is the amount of water vapour in the air at a given time. The higher the temperature in a given space, the higher the amount of water vapour it can contain. When the maximum level of water vapour in the air is attained, it is considered to be saturated. If saturated air is cooled, it will contain more water vapour than it can hold. The excess water vapour changes from a gas into visible water droplets, and fog or clouds form. The process whereby water vapour turns into water droplets is known as condensation. The degree of saturation is expressed by the term relative humidity. The phenomenon of windshield misting is generally known to pilots, and condensation can occur on any type of aircraft.

The aircraft had been parked for two days during damp, rainy conditions. The pilot had departed Lac des Neiges with the fan blower ON but did not feel it necessary to select demist hot air for the cabin because both occupants were comfortable. The final portion of the flight took place in moderate to heavy rain showers; the outside air was therefore saturated. The outside temperature for the time of the occurrence was approximately 8°C at 3000 feet asl. The cold rain falling from higher altitudes cooled the windshield, which would have been relatively colder compared to the inside temperature of the helicopter cabin.

The damp, rainy day would have allowed enough moisture to permeate from the rugs, seats, occupants, and their clothing that the humidity level in the aircraft cabin would most likely have been close to 100 per cent, causing condensation to accumulate slowly on the windshield. When the pilot selected demist hot air to clear the front windshield of condensation prior to landing, the entire windshield and front side windows immediately fogged up.

As with most lightweight helicopters, the EC 120B is not equipped with windshield wipers. However, this option is available if desired by the owner. At higher airspeeds, precipitation will flow off the windshield more easily because of the increased airflow. The occurrence helicopter was travelling at low airspeed on approach to land. The heavy precipitation encountered during this phase of the flight would have accumulated on the windshield, further restricting the pilot's visibility.

Flight Operations

In a three dimensional environment, pilots use vision, hearing, touch, and body senses to establish their position in relation to the ground. Sight is the body's most reliable input source, but the organs of the inner ear also play an important role in spatial orientation. Due to its design, the inner ear can mislead pilots as to their position in space. Pilots must use their eyes to validate information received from the inner ear. If changes in attitude, speed, or altitude are executed gradually, the inner ear will not sense the changes immediately and will not cue the brain to these changes. When flying with reference to outside visual cues, the pilot relies on these cues to sense changes in altitude, heading, speed, and rates of change in any axis. Changes in all three axes of flight can go undetected if visual cues are lost, possibly leading to a loss of control of the aircraft.

CAR 602.62(1) states that "no person shall...operate an aircraft over water beyond a point where the aircraft could reach shore in the event of an engine failure, unless a life preserver, individual flotation device, or personal flotation device is carried for each person on board." Because the flight was not planned to overfly water beyond a gliding distance to shore, no flotation devices

were carried on board. Operating a single-engine helicopter at low altitude over water is not unusual for certain aerial applications, but if there is a loss of power or a loss of control, there will be little time or altitude available for the pilot to execute a recovery. It is common practice for flight crews to follow low-lying terrain such as lakes, rivers, roads, and railways when flying in conditions of low visibility and low cloud. The occurrence helicopter was flown over Lac à l'Épaule to check for a feasible landing area. The helicopter was 100 feet above water on approach to land, and would not have been able to glide the 500 feet to get to the closest shore in the event of an engine failure. However, in the case of low visibility, approaching over the water allowed for a shallower approach and kept the helicopter clear of any obstacles.

The occurrence flight took place on a relatively cool day at low operating elevations. Therefore, as per the EC 120B flight manual [4], the pilot was not restricted in the use of demist on approach and landing. The use of demist under these circumstances would not have affected the helicopter performance. The flight manual does not caution pilots as to the consequence of selecting the demist under certain climatic conditions, especially during critical phases of flight. Although the demist will effectively clear the windshield, under certain conditions it may cause the windshield to fog up, temporarily restricting outside visibility.

A search of the TSB database did not reveal any relevant occurrences similar to this accident. The build-up of condensation on a windshield does not constitute a reportable incident; therefore, statistics on this type of occurrence do not necessarily reflect how frequently this may occur. Several EC 120B operators were contacted to see if they had experienced any similar windshield misting events while on final approach to land. Most reported events happened while the helicopter was on the ground, during which misting of the windshield often occurred when passengers embarked with wet clothing, thereby increasing the humidity level of the cabin. The pilot must then wait for the demist to clear the windshield before taking off.

The following TSB Engineering Laboratory report was completed:

LP 094/2008 – ELT & GPS Examination

This report is available from the Transportation Safety Board of Canada upon request.

---

[4] The Eurocopter EC 120B flight manual prohibits the flight crew from using demist with P2 heat when engine maximum continuous performance ratings for Ng and T4 are exceeded. In real terms, the engine Ng and T4 maximum continuous rating will be exceeded normally at high altitude or during high-temperature operations.

Analysis

Weather conditions for the planned route were not checked prior to departing Lac des Neiges. Although the forecast was for mainly VFR weather, low patchy ceilings and precipitation were forecasted for the area. The flight was to take place in a mountainous area where the cloud level would likely, at times, restrict free passage in some areas, especially over the elevated terrain. The pilot encountered unexpected conditions of reduced visibility in moderate to heavy rain showers in the vicinity of Lac à l'Épaule that forced him to find a safe landing spot to wait for the weather to improve.

The pilot chose to execute the approach over the water. This allowed for a shallower approach and kept the helicopter away from any obstacles that might have been difficult to detect. It is not unusual to fly over a river or lake in conditions of low visibility. However, in the event of an unforeseen problem (such as an engine failure), the helicopter may not be within gliding distance from shore, thereby posing a risk to the aircraft and its occupants. Even if there was no place to land along the shoreline, if the helicopter had been flown closer to it, the risk associated with swimming long distances in cold water would have been reduced.

When the pilot selected demist hot air to clear the windshield, the warm air from the ceiling ventilation ducting was instantly cooled when it hit the relatively cooler windshield. This rapid cooling caused the air to condense and fogged the windshield and front side windows. The immediate fogging of the windshield and front side windows, combined with the heavy precipitation, restricted the pilot's ability to maintain outside visual references. He did not have time to open the bad weather window, which could have given him some outside visibility. Without any outside visual cues, the pilot did not perceive that the helicopter was descending from 100 feet agl; it struck the surface of the water at low airspeed.

Warm air can hold more moisture than cold air. Therefore, with time, the warm air entering the cabin via the ceiling diffusers would have allowed the temperature of the windshield to rise to a point where the water vapour contained in the warm air from the ducting would not transform into water droplets. At this point, the windshield would then start to clear. Therefore, had the demist been selected while flying at a higher altitude, it is likely that the fogged windshield would have cleared in enough time for the pilot to notice and to correct the descent prior to striking the water surface.

No documentation cautions EC 120 flight crews about the risk associated with the selection of demist during certain critical phases of flight, which can, under certain weather conditions, cause a temporary loss of outside visibility and a loss of control of the aircraft.

Findings as to Causes and Contributing Factors

1. Weather conditions for the planned route were not checked prior to departing Lac des Neiges. The pilot encountered unexpected conditions of reduced visibility in moderate to heavy rain showers and low ceiling conditions which forced him to land.

2. The windshield fogged up immediately after the pilot had selected demist hot air. This, combined with the heavy precipitation encountered, restricted the pilot's ability to maintain outside visual references.

3. With the loss of visual references, the pilot did not perceive that the helicopter was descending from 100 feet above ground level (agl) and the helicopter struck the water. He did not have time to open the bad weather window, which could have given him some outside visibility.

Findings as to Risk

1. The approach for landing took place beyond gliding distance from the shore, which put the aircraft and its occupants at risk in the event of an unforeseen problem.

2. No documentation cautions EC 120B flight crews on the risk associated with activating the demist during certain critical phases of flight and under certain weather conditions; activating the demist system can cause a temporary loss of outside visibility.

Other Finding

1. Selection of the demist while flying at a higher altitude would likely have allowed the windshield to clear sufficiently in time for the pilot to notice and correct any undesired change in the aircraft's flight parameters.

Safety Action

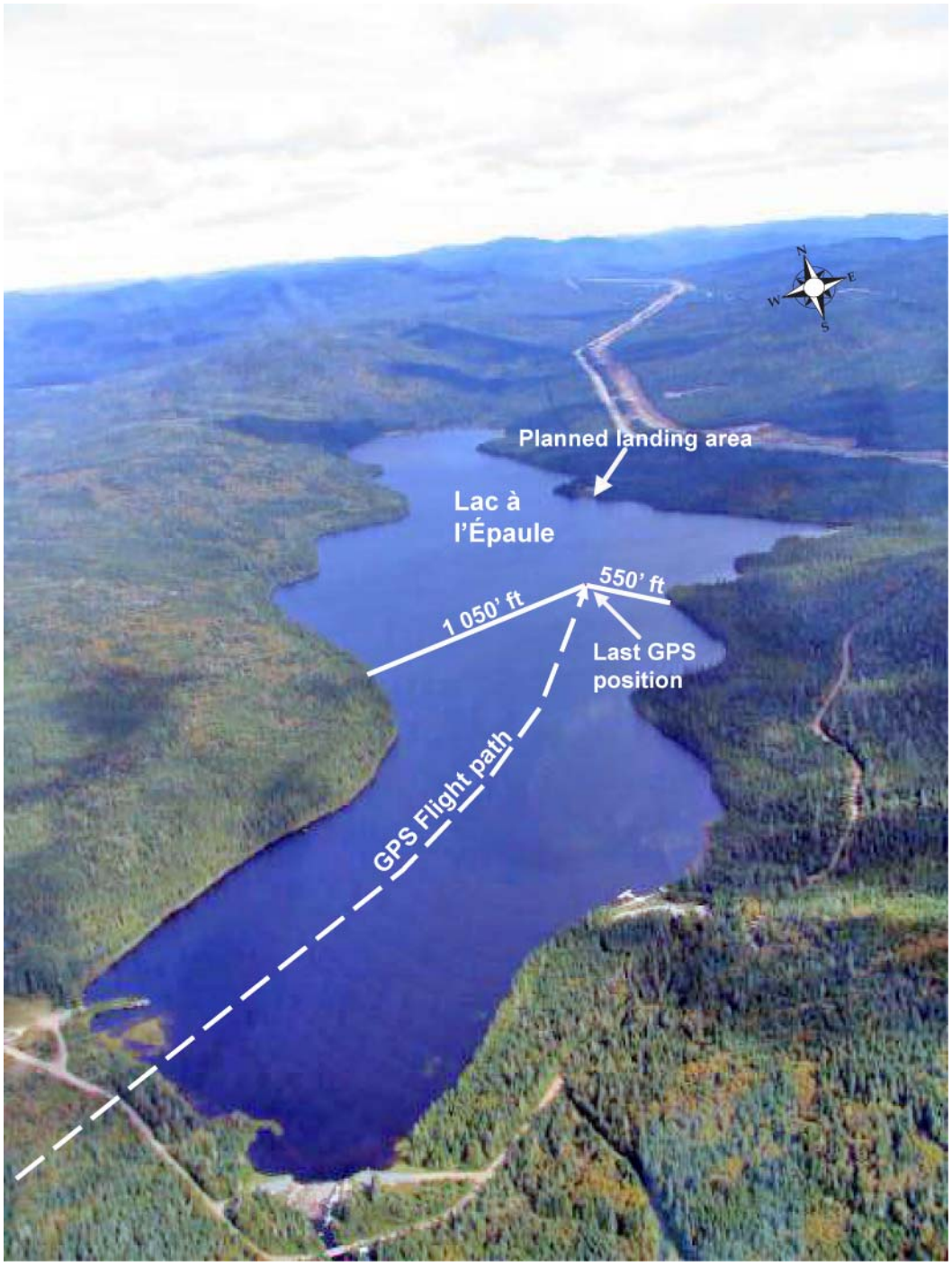
Action taken

Eurocopter has developed an Information Notice on the use of the demist system that will be issued on 15 July 2009. This notice will alert all Eurocopter helicopter crews of windshield flash fogging that can occur in certain weather conditions when the demist system is activated, which could, subsequently, reduce visibility and temporarily create a loss of visual references. This notice will remind crews of the importance of using the bad weather window in such circumstances to ensure visual contact with outside references.

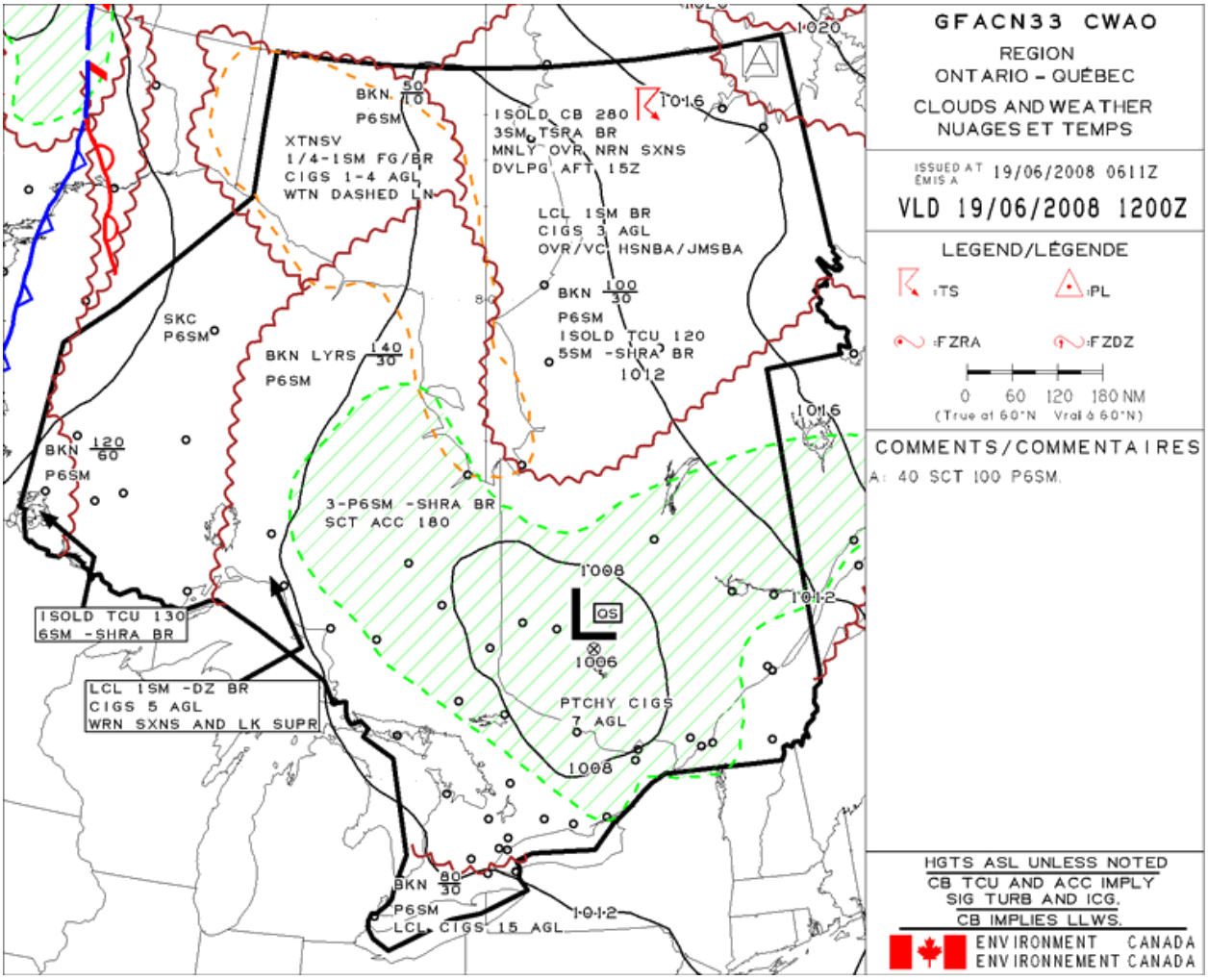
This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 13 May 2009.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – Lac à l'Épaule



Appendix B – Graphic Area Forecast



Appendix C – Villeroy Radar Weather Station (southwest of Québec)