Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT A15O0188

Collision with terrain

Cessna 182H, C-GKNZ
Parry Sound Area Municipal Airport, Ontario
09 November 2015

Canada

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Summary

On 09 November 2015, a privately registered Cessna 182H (registration C-GKNZ, serial number 182-56161) with 1 pilot and 1 passenger on board, departed from the Parry Sound Area Municipal Airport, Ontario, at 1917 Eastern Standard Time under night visual flight rules for a flight to Tillsonburg Airport, Ontario. Once airborne, the aircraft immediately started a right climbing turn for approximately 90° of heading, and then continued its turn for an additional 180° while descending before colliding with the terrain. The aircraft clipped trees in a nose-down attitude with a significant angle of bank to the right before striking the ground on a rocky downward slope. The 2 occupants were fatally injured and a post-impact fire destroyed most of the aircraft. The aircraft was equipped with an emergency locator transmitter, but it was not activated by impact forces. The accident occurred during the hours of darkness.

Le présent rapport est également disponible en français.

Factual information

History of the flight

On 09 November 2015, the pilot and his wife were returning home in a Cessna 182H (registration C-GKNZ) after a weekend at their cottage near Parry Sound, Ontario

During the previous summer, the couple had often commuted to their cottage using this aircraft, which was equipped with straight floats[1] at the time. Two weeks before the accident, the floats had been removed and the aircraft reconfigured as a landplane. When the aircraft was in this configuration, the Parry Sound Area Municipal Airport (CNK4), Ontario, was used for the commuting flights.

On this day, the aircraft departed CNK4 at 1917 Eastern Standard Time under night visual flight rules for a flight to Tillsonburg Airport, Ontario. The pilot did not file a flight plan prior to the flight, and there is no record of him requesting a weather briefing from NAV CANADA.

Data recovered from an onboard portable global positioning system (GPS) showed the aircraft taxied on Runway 35 before it took off from Runway 17. The aircraft became airborne just prior to the mid-point of the runway, at 1925:15.[2]

As soon as the aircraft became airborne, it started a climbing right turn for approximately 90° of the heading. At 1926:02, the aircraft began to descend while continuing the right turn for an additional 180°. At 1926:05, the GPS stopped recording, and shortly afterward the aircraft collided with the terrain (Figure 1). The aircraft clipped trees in a nose-down attitude with a significant angle of bank to the right before striking the ground on a rocky downward slope.

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1 Straight floats are not equipped with wheels and are intended for takeoff or landing on water surfaces only.

2 All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

Figure 1. Flight path using recovered GPS data (Source: Google Earth, with TSB annotations)

Severe impact forces and a post-impact fire destroyed the aircraft. The remaining wreckage, which was not consumed by the fire, was examined; however, this examination did not identify any pre-impact failure or system malfunctions, which would have contributed to this accident.

Weather

The closest available weather reporting service to CNK4 is the automated weather observing system at Muskoka Airport, Ontario, located approximately 39 statute miles (sm) to the southeast. The 1900 aerodrome routine meteorological report (METAR) reported winds at 120° true (T) at a speed of 2 knots, temperature and dew point of –5 °C, and a visibility of 9 sm. This METAR was consistent with weather conditions observed at CNK4 at that time.

Visual cues in the vicinity of the departure airport

The accident took place in visual meteorological conditions (VMC) with clear skies. Since evening civil twilight[3] had ended at 1727,[4] the flight was initiated during the hours of darkness.

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3 Relative to the standard meridians of the time zones, the period of time that begins at sunset and ends at the time specified by the Institute of National Measurement Standards of the National

In the vicinity of CNK4, pilots can use airport lighting, cultural lighting, and ambient illumination as visual cues during night operations.

The airport lighting at CNK4 consists of runway threshold lights, runway end lights, and medium-intensity runway edge lights. The airport beacon and all runway lights are controlled by a Type J aircraft radio control of aerodrome lighting (ARCAL) system.[5]

CNK4 is an uncontrolled airport without air traffic services. Transmissions made on the aerodrome frequency are not recorded; however, the investigation determined the airport lights were likely activated before the pilot initiated the takeoff.

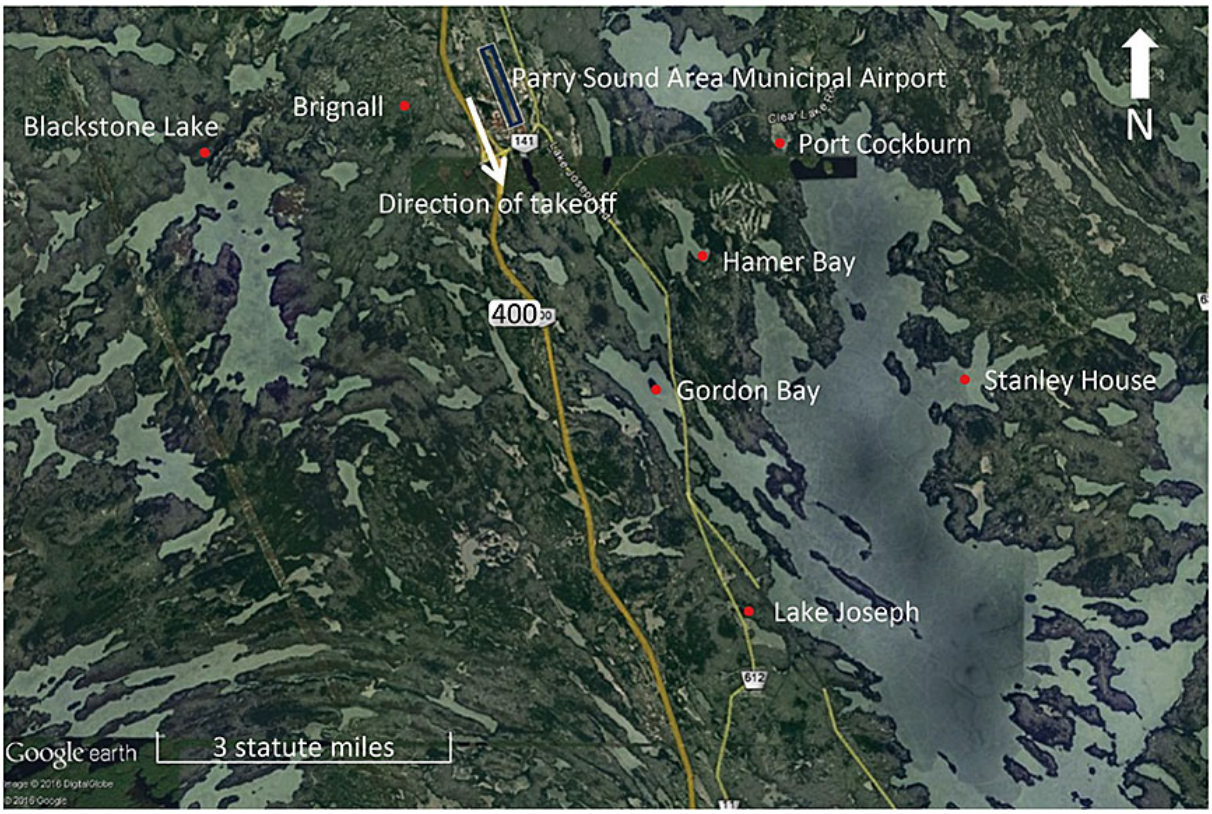
The pilot could expect some cultural lighting (e.g., cottages, traffic on Highway 400) to the south of the airport, but the availability of cultural lighting was limited to the west of Highway 400, which is the direction the aircraft turned after takeoff (Figure 2)

Research Council of Canada. **Note**: Evening civil twilight ends in the evening when the centre of the sun's disc is 6 degrees below the horizon. (Source: Transport Canada, Advisory Circular (AC) No. 100-001, *Glossary for Pilots and Air Traffic Services Personnel*, 05 June 2016).

4 Calculated using the National Research Council of Canada sunrise/sunset calculator http://www.nrc-cnrc.gc.ca/eng/services/sunrise/advanced.html (last accessed on 23 June 2017).

5 Type J aircraft radio control of aerodrome lighting (ARCAL) systems require pilots to key the microphone 5 times within 5 seconds to operate all aerodrome lighting for a duration of approximately 15 minutes.

Figure 2. Departure airport and surrounding area (Source: Google Earth, with TSB annotations)



There would have been limited ambient illumination available from the waning crescent moon, with less than 4% of the moon's visible disc illuminated.[6] The new moon took place on 11 November 2015, 2 days after the occurrence. Other pilots operating in the vicinity of CNK4 that evening reported that there was no discernable horizon when looking to the west.

Pilot training and experience

The pilot completed his private pilot's licence in late 2013, and he completed a night rating approximately 18 months before the accident. His Category 3 aviation medical certificate was valid at the time of the occurrence. The investigation determined that there was nothing to indicate that the pilot's performance was degraded by physiological factors.

The pilot purchased the occurrence aircraft in the summer of 2015 and had operated it on floats until converting it to wheels 2 weeks before the accident.

The pilot's logbook was destroyed in the occurrence; however, the recent completion of his private pilot licence training, combined with the flight hours logged in the aircraft airframe

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6 U.S. Naval Observatory, Astronomical Applications Department, "Complete Sun and Moon Data for One Day," at http://aa.usno.navy.mil/data/docs/RS_OneDay.php (last accessed on 23 June 2017).

logbook suggest that his total flying experience would have been less than 220 hours. The investigation could not determine the pilot's total night flying or instrument flying experience, but because regulations prohibit takeoff and landing on water at night, the pilot would not have used the occurrence aeroplane for night flying while it was on floats. In addition, the pilot was not instrument rated, and it is not known if he had undergone any recent instrument flying training.

Aircraft information

The Cessna 182H (registration C-GKNZ, serial number 182-56161) was manufactured in 1965. Records indicate that it was certified, equipped, and maintained in accordance with existing regulations.

The accident aircraft had had several supplemental type certificate (STC) modifications since its date of manufacture, including installation of the following:

- SA03-36 Seaplanes West Inc. float kit
- SA93-136 Air Research Technology Inc. wing extensions
- SA4303WE Stene Aviation's Sportsman leading edge cuff
- SA00834SE Micro AeroDynamics Inc. vortex generator kit.

Following the incorporation of STC SA03-36 (Seaplanes West Inc. float kit), the accident aircraft was certified for operation as a landplane or as a floatplane. Two independent aircraft weight and balance report amendments, identified as number 4 (landplane) and number 4A (floatplane), were available. An entry in the aircraft technical log dated 15 October 2015 shows the aircraft configuration changed to landplane, but there was no entry to indicate that the new weight and balance amendment to be used was now number 4.

It could not be determined during the investigation if the pilot calculated the aircraft take-off weight and centre of gravity location prior to the accident flight. The TSB calculated the weight and balance after the occurrence using estimated baggage weights, standard passenger weights, and maximum fuel quantity. It was concluded that the aircraft was within its allowable centre of gravity range and maximum take-off weight limit.

Emergency locater transmitter

The aircraft was equipped with an Artex Aircraft Supplies 406-megahertz (MHz) emergency locator transmitter (ELT) (model ME406, serial number 15982). The ELT was installed so that the device's longitudinal axis was aligned with the aircraft's longitudinal axis. When TSB investigators recovered the ELT from the wreckage, the outside case was significantly burnt and partially melted from the post-impact fire. The ELT did not activate during the crash sequence.

The ELT was equipped with a 2-position control switch, labelled ON and ARM; the switch was found in the ARM position. In this position, automatic activation will occur when impact forces are sufficient to activate an acceleration switch located inside the ELT casing. Manual activation occurs by selecting the control switch to the ON position.

In this occurrence, the impact forces were severe, and the aircraft was destroyed. An impact of this nature will generally cause the internal acceleration switch to activate the ELT. However, this model of ELT has a single-axis acceleration switch, which is installed in line with the ELT's longitudinal axis. If the impact forces are adequate for activation but are insufficient along this one axis, activation may not occur.

The ELT was removed from the wreckage and sent to the TSB Engineering Laboratory for further examination, where it was determined that the ELT was capable of functioning as designed. The following was observed:

- The internal components of the ELT were not damaged.
- The batteries were at full capacity (sufficient voltage was present to power the unit for activation).
- The required transmission characteristics for 121.5 MHz, and 406 MHz frequencies were met.
- The activation parameters for the internal acceleration switch were met.

Numerous TSB investigations[7] have identified that single-axis acceleration switches may not activate the ELT under certain conditions and, as a result, risk delaying search and rescue response.

Multiple supplemental type certificates

Individual STCs are approved by regulators after testing on an otherwise unmodified aircraft. Consequently, most STCs issued by Transport Canada (TC) include a compatibility statement which states, in part: "Conditions: […] Prior to incorporating this modification, the installer shall establish that the interrelationship between this change and any other modification(s) incorporated will not adversely affect the airworthiness of the modified product."

The Federal Aviation Administration recently released Advisory Circular (AC) 20-188, "*Compatibility of Changes to Type Design Installed on Aircraft*." This document "provides engineering guidance to installers on determining the compatibility of the installation of approved changes to type design where previously approved changes to type design are installed on aircraft."[8]

The combined aerodynamic effects of installing multiple STCs onto a single aircraft are unknown and are not typically tested by the STC holder. In TSB report A13P0278, involving

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7 Including TSB aviation investigation reports A10C0123, A10C0060, A09W0021, A08O0233, and A07O0190.

8 Federal Aviation Administration (FAA), Advisory Circular (AC) 20-188: Compatibility of Changes to Type Design Installed on Aircraft, at https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_20-188.pdf (last accessed on 23 June 2017).

a seaplane that departed from controlled flight and collided with terrain, the TSB raised a safety concern about the evaluation of multiple STCs, stating in part:

> Most light aircraft in Canada, including those being commercially operated, are maintained by smaller approved maintenance organizations (AMO) with limited capability for aerodynamic testing or engineering evaluations. As a result, the certification for compatibility and interaction between STCs is often made after only limited evaluation. Consequently, the Board is concerned that, if multiple STCs are installed without adequate guidance on how to evaluate and document the effects on aircraft handling, pilots may lose control of the aircraft due to unknown aircraft performance.[9]

However, the investigation did not find any indication that compatibility of the modifications affected the occurrence flight.

Spatial disorientation

The *Transport Canada Aeronautical Information Manual* (TC AIM) describes the potential for disorientation. It refers to vision as the strongest orienting sense and stresses that when in whiteout or cloud, this sense is not available, which increases the likelihood of disorientation. It says,

> For example, once a turn has been entered and is being maintained at a steady rate, the sensation of turning will disappear. Upon recovering from the turn, pilots may feel as though they are turning in the opposite direction and erroneously re-enter the turn, even causing the aircraft to enter into a spin.[10]

While the conditions mentioned are whiteout and cloud, a similar lack of external visual cues and resultant disorientation can occur in areas of darkness.

Night flying involves numerous risks owing to poor visual cues, especially on takeoff and landing. Few or no visual references at night can lead to various illusions that cause spatial disorientation because of the lack of discernible horizon. Night flying in, out of, or over featureless terrain such as bodies of water or wooded terrain —called black hole conditions—is particularly difficult.

Night flying

Rating and recency requirements

Canadian Aviation Regulations (CARs) Standard 421.42 sets out the requirements to endorse an individual with a private pilot licence with a night rating. The required experience is 10

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9 TSB Aviation Investigation Report A13P0278.

10 Transport Canada, *Transport Canada Aeronautical Information Manual* (TC AIM), AIR 3.7 (31 March 2016).

hours of night flying (5 hours dual and 5 hours solo) and 10 hours of dual instrument time. The applicant must also successfully complete a qualifying flight with a TC inspector or qualified flight instructor and demonstrate the level of skill specified in the *Flight Instructor Guide – Aeroplane* (TP 975).

For the holder of a night rating, CAR 401.05 establishes the recency requirements to exercise the privileges of flight crew licences and ratings. With respect to visual flight rules (VFR) flight at night, the only limitation specified is that, if passengers are carried, the pilot must have completed 5 takeoffs and landings at night within the previous 6 months. It could not be determined if the pilot met this requirement. There is no requirement to practise or maintain instrument flying proficiency to fly VFR at night.

Training

The *Flight Instructor Guide – Aeroplane* includes a chapter on night flying. With respect to takeoff, the guide emphasizes that, "[d]ifferent visual references during the take-off [*sic*], and the lack of references during the initial climb, impose special demands on the pilot when taking off at night."[11]

The guide lists the following essential background knowledge that instructors are expected to provide during training for a night rating:

- Explain that instrument references may be required after take-off [*sic*].
- Explain the importance of maintaining a positive rate of climb after take-off [*sic*].
- Explain illusion of linear acceleration (pitch-up illusion) and black hole illusions.
- Explain that no turns should be made below a safe altitude.[12]

Visual reference to the surface

The principle behind VFR flight is that the pilot uses visual cues (e.g., visual horizon, ground references) outside the aircraft to determine the aircraft's attitude. Therefore, some basic requirements must be met when conducting VFR flight—day or night.

According to CARs 602.114 and 602.115, the aircraft must be "operated with visual reference to the surface,"[13] regardless of whether it is operated in controlled or uncontrolled airspace. The CARs define surface as, "any ground or water, including the frozen surface thereof."[14] However, the CARs do not define "visual reference to the surface," which has been widely interpreted by the industry as meaning visual meteorological conditions.

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11 Transport Canada, TP 975, *Flight Instructor Guide – Aeroplane* (2004), p. 176.

12 Ibid., pp. 176–177.

13 *Canadian Aviation Regulations*, sections 602.114 and 602.115.

14 *Ibid.*, subsection 101.01(1).

Therefore, a flight conducted over an area away from cultural lighting and where there is inadequate ambient illumination to clearly discern a horizon would not meet the requirements for operation under VFR (i.e., to continue flight solely by reference to the surface). Instead, such flights would require pilots to rely on their flight instruments to ensure safe operation of the aircraft.

In a recent TSB report, involving a helicopter that crashed while departing VFR at night from a remote airport with limited lighting,[15] the TSB raised the issue of a lack of clarity in the definition of what "flight with visual reference to the surface" means in practice. It recommended that:

> Transport Canada amend the regulations to clearly define the visual references (including lighting considerations and/or alternate means) required to reduce the risks associated with night visual flight rules flight.
>
> **TSB Recommendation A16-08**

In September 2016, Transport Canada responded to TSB Recommendation A16-08 as follows:

> Transport Canada agrees with this recommendation.
>
> TC will address this recommendation in two steps; first with safety promotion and education activities as early as fall 2016; and secondly, by initiating a regulatory amendment project in 2017 including consultation with our key stakeholders. Safety promotion and education will leverage TC's recently published Advisory Circular No. 603-001 — *Use of Night Vision Imaging Systems*.

The Board's assessment of Transport Canada's response in December 2016 was the following:

> In its response, TC indicated that it will take a two-fold approach to address this recommendation to reduce the risks associated with night visual flight rules flights. In the short term, TC will conduct safety promotion/education activities, which will be followed in 2017 by a regulatory amendment project. The Board is pleased that TC is taking action to address this safety deficiency.
>
> However, until specific details about the proposed regulatory changes are fully known, the TSB cannot evaluate if these actions will fully address the safety deficiency associated with visual flight rules flights.
>
> Therefore, the response to Recommendation A16-08 is assessed as **Satisfactory Intent**.

Guidance for pilots and instructors

The TC AIM provides the following guidance to pilots with respect to flight operations at night:

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15 TSB Aviation Investigation Report A13H0001.

> There are many risks associated with operating aircraft in dark-night conditions where maintaining orientation, navigation and weather avoidance may become extremely difficult. Take-off and landing may be particularly dangerous for both VFR and IFR pilots.
>
> A variety of illusions may result at night because of a lack of outside visual cues. Your best defense, if you do not hold an instrument rating, is to receive some instrument training, and to be aware of the illusions and their counter measures.[16]

Awareness campaigns

Transport Canada

Following a number of night VFR accidents in the late 1990s, TC conducted a campaign to raise awareness of the hazards associated with night VFR flying. The campaign included posters (TP13717), articles in the *Aviation Safety Letter* (ASL), and a PowerPoint presentation about tools to prevent night VFR accidents, which was presented at its Civil Aviation Safety Seminars (CASS).

National Transportation Safety Board

The National Transportation Safety Board in the United States issued a Safety Alert in March 2003 that stated in part,

> Remember that, when flying at night, even visual weather conditions can be challenging. Remote areas with limited ground lighting provide limited visual references cues for pilots, which can be disorienting or render rising terrain visually imperceptible. When planning a night VFR flight, use topographic references to familiarize yourself with surrounding terrain. Consider following instrument procedures if you are instrument rated or avoiding areas with limited ground lighting (such as remote or mountainous areas) if you are not.[17]

Australian Transport Safety Bureau

The Australian Transport Safety Bureau analyzed 20 years of night flying accidents and issued a report in December 2013 entitled *Avoidable Accidents No. 7: Visual flight at night accidents: What you can't see can still hurt you*, which identified some of the threats to safe VFR flight in darkness, including the following:

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16 Transport Canada, *Transport Canada Aeronautical Information Manual* (TC AIM), AIR 2.16 (31 March 2016).

17 National Transportation Safety Board (NTSB), NTSB Safety Alert SA-020: Reduced Visual References Require Vigilance: Preparation and proficiency may help prevent accidents, at https://www.ntsb.gov/safety/safety-alerts/Documents/SA_020.pdf (last accessed on 07 July 2017).

> What can be seen outside an aircraft at night varies greatly between the almost day-like conditions of flying over a city under a full moon to the complete darkness of remote areas without any moon or significant ground lighting. Safe flight relies on pilots applying the correct flying skills using the combination of information from flight instruments and from outside the aircraft. […]
>
> A pilot who is qualified to fly visually at night should have the extra skills and equipment to control the aircraft by using flight instruments and by using more detailed flight procedures. Safe night visual flight requires the application, use and integration of all the information sources correctly. Compared with day visual flight, there is more to night visual flight than meets the eye. […]
>
> Night flying is more difficult than flying in the day. Ensure you are both current and proficient with disciplined instrument flight. Know your own personal limitations in terms of flying with minimal or no visual references. Only fly in environments that do not exceed your capabilities.
>
> Before committing to departing on a visual flight at night or close to last light, ensure your aircraft is appropriately equipped and consider all obtainable operational information, including the availability of celestial and terrestrial lighting.
>
> Some nights and some terrain are darker than others. Excellent visibility conditions can still result in no visible horizon or contrast between sky and ground. Inadvertently flying into instrument meteorological conditions (IMC) is also harder to avoid at night. […]
>
> Remain aware of illusions that can lead to spatial disorientation—they can affect anyone. Know how to avoid and recover from illusions by relying on instrument flight.[18]

TSB Engineering Laboratory reports

The TSB completed the following laboratory reports in support of this investigation:

- LP258/2015 – Instruments Examination
- LP259/2015 – ELT & Spot Tracking Download
- LP260/2015 – GPS Analysis

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18 Australian Transport Safety Bureau (ATSB), AR-2012-122, Avoidable Accidents No. 7: Visual flight at night accidents: What you can't see can still hurt you (17 December 2013), pp. 1–2.

Analysis

There were no indications that an aircraft system malfunction contributed to this accident. This analysis focuses on the operational factors that contributed to the accident and on the current regulatory environment.

Departure assessment

Night departures from aerodromes with limited cultural and ambient lighting sources present several hazards to pilots, especially to those without an instrument rating or current night flight experience.

While dark-night departures and associated illusions are covered as briefing points during training for a night rating, there is no practical requirement to have a pilot actually experience these conditions as part of his or her training. Without practical experience, a relatively inexperienced pilot would have difficulty in adequately assessing the risks associated with departures from aerodromes at night in areas with little or no illumination . If training for a night rating does not provide practical experience in areas with limited ambient or cultural lighting, there is a risk that pilots will not adequately assess or appreciate the hazards of flight in these areas.

Taking into account that no night-flying time can be logged while operating on floats, and that the pilot had flown his aircraft on floats until 2 weeks before the accident, it is likely that he had gained little night-flying experience since obtaining a night rating 18 months prior to the accident.

In light of his limited night flying experience, and because the weather in the area at the time of departure was visual meteorological conditions (VMC), it is highly likely that the occurrence pilot felt that the conditions satisfied the requirements for a night visual flight rules (VFR) flight, even though it is unlikely that visual reference to the surface could have been maintained. Given the pilot's total flight time, training, and limited night flying experience, it is likely that he did not adequately assess the hazards associated with a night VFR departure from an aerodrome with limited ambient and cultural lighting.

Loss of control

After takeoff, the airport lighting would have dropped from the pilot's field of view, first below the aircraft and then behind it. At that time, the pilot would have needed to rely on ambient illumination or cultural lighting to provide sufficient outside visual references to control the aircraft, or he would have had to transition to cockpit flight instruments.

Once the airport lighting was lost from view, there would have been few visual cues available outside the aircraft. There were not many lit ground features on the flight path, particularly to the west of the airport in the direction of the turn, and limited ambient illumination would have been available from the waning crescent moon. After takeoff, visual

references would have been greatly reduced, and the pilot would have found himself in a black hole situation.

It is not known whether the turn after takeoff was intentional or inadvertent, but it is clear that the increasing angle of bank and subsequent descent were either not detected or not corrected in time to prevent the collision with the ground. The pilot, who was probably not proficient at flying with reference to the instruments, may have become spatially disoriented after losing visual reference to the surface off the departure end of the runway and lost control of the aircraft.

Night visual flight rules regulations

The *Canadian Aviation Regulations* (CARs) require the pilot to maintain visual reference to the surface for night VFR flight, but do not define "visual reference to the surface." This terminology has been widely interpreted by the industry to mean VMC, which is based on visibility and distance from cloud.

As TSB Recommendation A16-08 indicates, if the CARs do not clearly define what is meant by visual reference to the surface, night flights may be conducted with inadequate visual references, which increases the risk of controlled-flight-into-terrain and loss-of-control accidents.

Instrument flight proficiency while flying night visual flight rules

The risks associated with night VFR are well documented, and some awareness campaigns highlight the importance of instrument flying proficiency when conducting night VFR operations. In Canada, one of the training topics Transport Canada's *Flight Instructor Guide – Aeroplane* lists for a night rating is reference to flight instruments after takeoff. However, there is currently no regulatory requirement for VFR pilots to maintain proficiency in instrument flight once they have completed their private pilot's licence and night rating.

The limited exposure to instrument flying that a private pilot receives during their night rating training is not intended to—and does not—adequately prepare him or her for night operations requiring sole reference to instruments—even in VMC.

If pilots who conduct night VFR operations are not required to maintain instrument flying proficiency, there is increased risk of controlled-flight-into-terrain and loss-of-control accidents when those pilots encounter conditions of limited cultural and ambient lighting.

Emergency locator transmitter

Examination of the emergency locator transmitter (ELT) revealed that it was capable of functioning as designed, and the impact forces were such that the ELT should have activated. However, it is probable that the force component along the axis of sensitivity was insufficient to trigger the single-axis acceleration switch and activate the ELT.

As identified in previous TSB aviation investigation reports, if an ELT is equipped with only a single-axis acceleration switch, and the force of impact is not aligned with the longitudinal axis of the unit, there is a risk that the ELT will not activate.

Findings

Findings as to causes and contributing factors

1. Given the pilot's total flight time, training, and limited night flying experience, it is likely that he did not adequately assess the hazards associated with a night visual flight rules departure from an aerodrome with limited ambient and cultural lighting.

2. The pilot, who was probably not proficient at flying with reference to the instruments, may have become spatially disoriented after losing visual reference to the surface off the departure end of the runway and lost control of the aircraft.

Findings as to risk

1. If the *Canadian Aviation Regulations* do not clearly define what is meant by visual reference to the surface, night flights may be conducted with inadequate visual references, which increases the risk of controlled-flight-into-terrain and loss-of-control accidents.

2. If training for a night rating does not provide practical experience in areas with limited ambient or cultural lighting, there is a risk that pilots will not adequately assess or appreciate the hazards of flight in these areas.

3. If pilots who conduct night visual flight rules operations are not required to maintain instrument flying proficiency, there is increased risk of controlled-flight-into-terrain and loss-of-control accidents when those pilots encounter conditions of limited cultural and ambient lighting.

4. If an emergency locator transmitter is equipped with only a single-axis acceleration switch, and the force of impact is not aligned with the longitudinal axis of the unit, there is a risk that the transmitter will not activate.

Safety action

The Board is not aware of any safety action taken following this occurrence.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 27 June 2017. It was officially released on 12 July 2017.

Visit the Transportation Safety Board's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.