Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A22Q0122

LOSS OF CONTROL AND COLLISION WITH WATER

True North Airways Inc.
de Havilland DHC-3 Otter, C-FDDX
Pluto Lake, Quebec
12 October 2022

Canada

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 3 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

On 12 October 2022, the True North Airways Inc. de Havilland DHC-3 Otter aircraft on floats (registration C-FDDX, serial number 165) was conducting a visual flight rules flight, with 1 pilot on board, from Mistissini Water Aerodrome (CSE6), Quebec, to Pluto Lake, Quebec, where it would deliver cargo and pick up passengers. At approximately 0929 Eastern Daylight Time, while manoeuvring for landing on Pluto Lake, the aircraft collided with the surface of the water. The pilot sustained serious injuries. The passengers, who had been waiting near the lake for the aircraft's arrival, transported the pilot to a nearby cabin from where he was later taken to hospital by a search and rescue helicopter. The emergency locator transmitter activated. There was significant damage to the aircraft.

1.0 FACTUAL INFORMATION

1.1 History of the flight

On the morning of 12 October 2022, the pilot of the True North Airways Inc. (True North Airways) de Havilland DHC-3 Otter aircraft on floats arrived at the dock of the Mistissini Water Aerodrome (CSE6), Quebec, to begin preparing for the day's flights at approximately 0730.[1]

Shortly after arriving at the dock, the pilot was informed that he would be conducting a charter flight to Pluto Lake, Quebec, located approximately 135 nautical miles (NM) to the northeast. The pilot was scheduled to fly out of CSE6 alone, with only cargo on board, and at the destination, he was to drop the cargo off, pick up 3 passengers, and take them back to CSE6.

The pilot prepared for the flight and reviewed weather data. There was no weather station at Pluto Lake, so the pilot checked the weather at the nearest reporting stations along the route of flight and reviewed the graphic area forecast issued by NAV CANADA. He also used a non-aviation web-based application to check the weather before departure. The pilot expected clear-sky conditions, with the dissipation of any morning fog by the time that he would reach the destination. The scheduled flight time for the flight to Pluto Lake was approximately 1 hour and 30 minutes. After completing the flight planning, the pilot, with the help of the ground crew, loaded the aircraft with drums of gasoline, propane tanks, and lumber. Then the aircraft was fuelled, and at about 0804, the pilot departed for Pluto Lake on a visual flight rules (VFR) flight under clear-sky conditions (Figure 1).

1 All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours).

Figure 1. Route of flight (Source: Google Earth, with TSB annotations)

About 4 NM southwest of the destination, the pilot noticed that there was a low layer of cloud in the vicinity of the intended landing area. He therefore initiated a descent to bring the aircraft below the clouds and keep the ground in sight.

Once below the layer of cloud, the pilot encountered reduced visibility of about 1 statute mile (SM) in fog. The pilot kept the aircraft below 500 feet above ground level (AGL) while he attempted to locate the passengers who were waiting for the aircraft on a beach. The reduced visibility made locating the passengers more difficult. This, combined with the fact that the passengers were not at the waiting area that had been provided to the pilot during his pre-flight preparation, resulted in the pilot not seeing the passengers on the first pass over this location. The pilot made a left-hand turn to fly back over the area and located the passengers. This area of the lake was further south than the usual landing location used during the pilot's previous flights. Because the winds were from the south, the pilot crossed over the narrow lake where the aircraft would be landing and initiated another left-hand turn to fly downwind (north). The pilot slowed the aircraft for landing and began to lower the flaps.

While the aircraft was established on the downwind leg, the pilot focused his attention outside to try to keep the desired landing area in sight without losing it in the fog. This led to a tighter circuit than usual. As the aircraft was flying on the downwind portion of the circuit, the aircraft's speed continued to slow. While making the turn to land, the pilot felt the aircraft begin to sink and noticed that the airspeed indicator was slowing through 65 mph. Recognizing that the aircraft was entering a stall, the pilot applied power in an attempt to recover; however, at about 0929, the aircraft struck the surface of the water approximately 2000 feet from the beach where the passengers had been waiting to be picked up.

Shortly after the aircraft had impacted the water, the pilot egressed the aircraft onto the aircraft's left float, which had partially detached from the aircraft during the impact, and climbed on top of the wing. After realizing that the aircraft had begun to sink, he began swimming to the nearest shore. The pilot quickly realized that the clothing he was wearing was making it very difficult to stay afloat, so he reached for the inflation handle on his personal flotation device (PFD) but was unable to inflate the device. He then removed the PFD and the jacket he was wearing and continued swimming to shore.

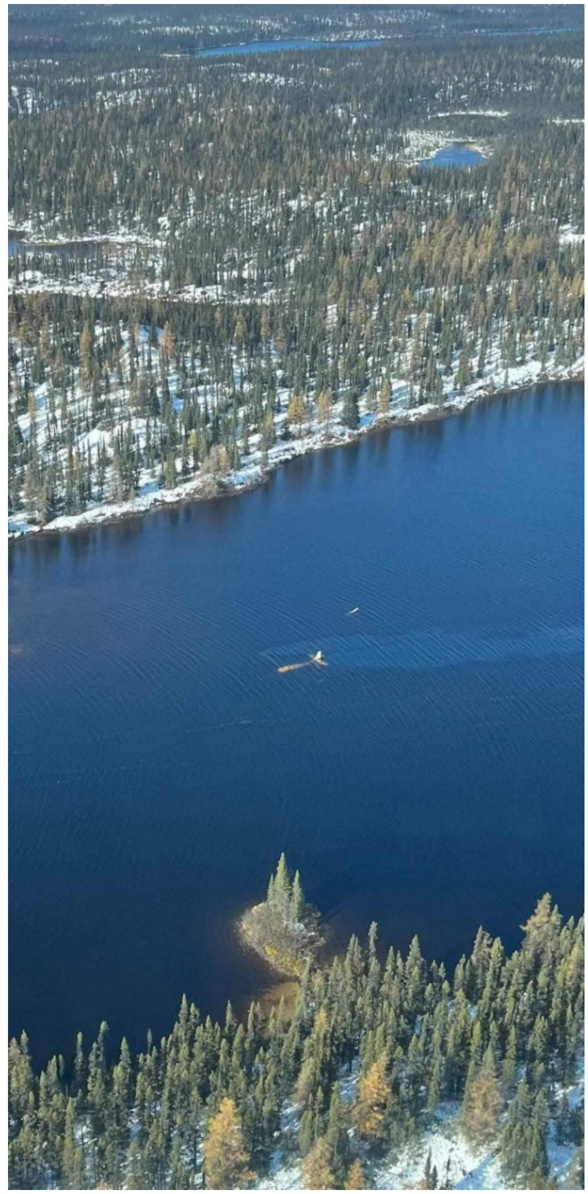
In the meantime, 1 of the passengers walked around the point of the beach to the open area of the lake and was able to see the floatplane beginning to sink in the middle of the lake, approximately 300 feet from shore. When the passenger returned to the waiting area, 1 of the other passengers accompanied him in their boat and headed toward the sinking aircraft.

It took only a few minutes for the 2 passengers to arrive at the aircraft. At this point, the aircraft was almost fully submerged, with only the tail sticking out above the surface of the water (Figure 2).

The passengers located the pilot on the shore of the lake, headed there to pick him up, and brought him to a nearby cabin. The pilot used the passenger's satellite phone to inform his company of the accident.

The Joint Rescue Coordination Centre (JRCC) in Trenton, Ontario, received an emergency locator transmitter (ELT) signal for the aircraft and attempted to contact the operator.[2] Two Canadian Armed Forces search and rescue (SAR) aircraft were dispatched to the area. When the 1st aircraft arrived at approximately 1213, low ceilings and low visibility were present in the area, and the crew were not able to locate the aircraft or cabin. About 20 minutes later, they located the cabin, and SAR technicians parachuted into the location and tended to the pilot's injuries. At about 1400, the pilot and SAR technicians were extracted by the 2nd SAR aircraft, a helicopter, and the pilot was transported to hospital.

Figure 2. Occurrence aircraft after the collision with water (Source: Department of National Defence search and rescue aircraft, with permission)



1.2 Injuries to persons

The pilot was the only person on board the occurrence flight. He sustained injuries to his head and back.

Table 1 outlines the degree of injuries received.

Table 1. Injuries to persons

Degree of injury	Crew	Passengers	Persons not on board the aircraft	Total by injury
Fatal	0	–	–	0
Serious	1	–	–	1
Minor	0	–	–	0
Total injured	1	–	–	1

2 See Section 1.15.3 *Emergency locator transmitter registration* in this report.

1.3 Damage to aircraft

There was significant damage to the aircraft. There was no post-impact fire.

1.4 Other damage

An unknown amount of Jet A fuel was released into Pluto Lake.

1.5 Personnel information

Table 2. Personnel information

Pilot licence	Commercial pilot licence – aeroplane
Medical expiry date	01 October 2023
Total flying hours	1938.9
Flight hours on type	Approximately 600
Flight hours in the 24 hours before the occurrence	8.4
Flight hours in the 7 days before the occurrence	24.5
Flight hours in the 90 days before the occurrence	224.1
Flight hours on type in the 90 days before the occurrence	103.5
Hours on duty before the occurrence	2.1
Hours off duty before the work period	12.7

The pilot held the appropriate licence and ratings for the flight in accordance with existing regulations. He held a Canadian commercial pilot licence – aeroplane, which was endorsed with a seaplane rating, and had a valid Category 1 medical certificate.

The pilot was hired by True North Airways in March 2021 and received initial training on the DHC-3 Otter in August 2021. His last pilot competency check for the DHC-3 Otter was conducted in July 2022. He also completed a water egress training course in April 2022 and received dangerous goods training in July 2022.

The pilot had been based out of CSE6 for several rotations, as well as the 5 days before the occurrence, and had previously flown to Pluto Lake.

Based on a review of the pilot's work and rest schedule, there was no indication that the pilot's performance was degraded by fatigue.

1.6 Aircraft information

1.6.1 General

The occurrence aircraft was manufactured in 1956 by de Havilland Aircraft of Canada Ltd. The aircraft underwent a turbine conversion in 2004 and was equipped with a turboprop engine. In 2006, Viking Air Ltd. acquired ownership of the type certificate for the DHC-3 Otter. The occurrence aircraft was purchased by True North Airways in January 2021 and operated on either skis, wheels, or floats, according to seasonal requirements.

At the time of the occurrence, several modifications had been installed on the aircraft in accordance with their respective supplemental type certificates (STCs), including but not limited to the following:

- STC SA03-50: DHC-3 9000 Pounds Aircraft Gross Weight Increase Modification
- STC SA89-32 (Federal Aviation Administration [FAA] STC 3777NM): Installation of Pratt & Whitney PT6A-34, -135 or -135A Turbine Engine
- STC SA94-114 (SA00287NY): Installation of Baron STOL [short takeoff and landing] Systems STOL Kit

Table 3. Aircraft information

Manufacturer	de Havilland Aircraft of Canada Ltd.*
Type, model, and registration	DHC-3 Otter, C-FDDX
Year of manufacture	1956
Serial number	165
Certificate of airworthiness issue date	26 August 2004
Total airframe time	17 489.5 hours
Engine type (number of engines)	Pratt & Whitney Canada PT6A-34 (1)
Propeller type (number of propellers)	Hartzell HC-B3TN-3DY (1)
Maximum allowable take-off weight	9000 lb
Recommended fuel type(s)	Jet A, Jet A-1, Jet B
Fuel type used	Jet A

* Viking Air Ltd. currently holds the type certificate for the aircraft type.

The aircraft's weight and centre of gravity were within the prescribed limits, and there was no indication that a component or system malfunction played a role in this occurrence.

The damage to the engine and propeller indicated that power was being produced during the impact sequence.

1.6.2 Stall speeds and warning system

Viking Air Ltd.'s *Airplane Flight Supplement for the de Havilland DHC-3 Otter Seaplane*, which is associated with STC SA03-50 (which provides approval for the increase in the aircraft's weight to 9000 pounds), contains a section on performance that presents the stall speeds for the occurrence aircraft. This section contains a graph showing stalling speeds for various weights, flap settings, and bank angles.[3] Based on the calculated aircraft weight of 8200 pounds, the TSB used this graph to interpolate stalls speeds at different bank angles and flap settings (Table 4).

[3] Viking Air Ltd., Report No. 030692, *Airplane Flight Supplement for the de Havilland DHC-3 Otter Seaplane*, Revision D (inserted 09 September 2006, approved 01 February 2007), section 5.2.1: Stalling Speeds, Figure 5-1, p. 5-4.

Table 4. Approximate stall speeds (calibrated airspeed) in miles per hour for the DHC-3 Otter at different flap and bank angles (Source: TSB table based on Viking Air Ltd., Report No. 030692, Airplane Flight Supplement for the de Havilland DHC-3 Otter Seaplane, Revision D [inserted 09 September 2006, approved 01 February 2007], section 5.2.1: Stalling Speeds, Figure 5-1, p. 5-4)

Flap setting	Bank angle		
	0°	30°	45°
Cruise	73*	78	86
Takeoff	60	65	72
Landing	57	61	68

These approximate stall speeds are based on an aircraft with forward centre of gravity, propeller at maximum rpm, and throttle idle.

The investigation could not confirm the position of the occurrence aircraft's flaps or its bank angle at the time of the stall (see Section 1.12 *Wreckage and impact information* for more details).

The occurrence aircraft was equipped with a stall warning light, located in the top left quadrant of the instrument panel, above the airspeed indicator (Figure 3). It was not equipped with any auditory stall warning system. The pilot did not recall seeing the light on before the collision with the water.

1.7 Meteorological information

The automatic aerodrome routine meteorological report (METAR AUTO) issued at 0800 for Chibougamau/Chapais Airport (CYMT), Quebec, located approximately 45 NM southwest of CSE6, indicated the following:

- Winds from 160° true, at 7 knots
- Visibility of 9 SM
- Clear sky
- Temperature 5 °C, dew point 4 °C
- Altimeter setting 29.92 inches of mercury (inHg)

Similar conditions were present at CSE6.

Figure 3. Stall warning light (Source: McLarens Aviation Limited, with permission)

The nearest reporting station to the occurrence site, approximately 130 NM to the northwest, at La Grande IV Airport (CYAH), Quebec, provides both a METAR and an aerodrome forecast (TAF). The TAF for CYAH,[4] issued at 0640 and valid from 0700 to 1700, indicated the following conditions after 0900:

- Winds from 210° true at 10 knots, gusting to 20 knots
- Visibility greater than 6 SM
- Scattered cloud based at 12,000 feet AGL

4 The TAF for CYAH is based on automated observations.

The forecast for the route indicated on the graphic area forecast (GFA), issued at 0730 and valid at 0800 was:

- Few clouds between 3000 and 6000 feet above sea level
- Visibility greater than 6 SM

After the accident, the TSB requested a meteorological assessment, conducted by Environment and Climate Change Canada (ECCC), of the weather conditions affecting Pluto Lake at the time of the occurrence. The assessment determined that, at the time of the occurrence, Pluto Lake was situated within the warm sector of a slow-moving warm front. The ECCC assessment states:

> […] the crash site was exposed to fairly steady conditions overnight. Light, southerly/southwesterly winds were pushing into the warm sector all night, and relative humidity in the air mass remained high, under a mainly clear sky. Conditions such as these are ideal for radiative fog development.[5]

The ECCC assessment concluded by stating that

> […] as the aircraft descended nearing [Pluto Lake] it would have experienced light low-level wind shear (-20kt/1000ft), before encountering the very low level stratus and fog (1500ft deep) over the lake. It is most likely that ceilings and visibility under this cloud were as low as 1/2SM […]. While conditions may have marginally improved after sunrise, given the similar extent of the cloud by [1030], it is unlikely that ceilings or visibility improved significantly by the moment of the accident.[6]

1.8 Aids to navigation

Not applicable.

1.9 Communications

There were no known communication difficulties.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder, nor was either required by regulation.

The aircraft was, however, equipped with a SPOT satellite tracking device. For unknown reasons, the unit stopped functioning almost halfway through the flight, and no additional position data could be obtained from this device.

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5 Environment and Climate Change Canada, *Meteorological Assessment October 12, 2022 – Lake Pluto, Quebec* (09 January 2022 [*sic*]), p. 7.

6 Ibid., p. 22.

The pilot also had a satellite communication device. The time of the last point recorded was at about 0912, more than 17 minutes before the occurrence.

1.12 Wreckage and impact information

Following the collision with the surface of the water and the pilot's egress, the aircraft settled upright on the bottom of the lake with only the vertical stabilizer out of the water.

Hydrodynamic impact damage on the occurrence aircraft shows that it impacted the surface of the lake while in a left bank and slight nose-low attitude. During the impact sequence, the left forward wing spar became detached from the fuselage and was canted rearward; the aft spar remained attached to the fuselage. The aft inboard section and respective flap contacted the cabin and compromised the cabin structure. The left float was significantly damaged and remained partially attached to the fuselage. The right float was completely detached. The engine, cowlings, and engine mount were displaced from the original position, but all remained attached.

The exact position of the flaps at impact could not be determined. The flaps are hydraulically actuated via an up/down selector and a flap pump handle, which can be in any given position once the desired flap angle is reached. Witness marks between the flaps and fuselage were not sufficient to provide reliable position information. The flap position indicator pointer did not provide a reliable indication of flap position due to impact damage to the fuselage.

The TSB laboratory analyzed the aircraft attitude indicator for witness marks. None were present, and therefore, it was not possible to pinpoint the exact attitude of the aircraft at impact.

1.13 Medical and pathological information

According to information gathered during the investigation, there was no indication that the pilot's performance was affected by medical or physiological factors.

1.14 Fire

There was no indication of fire either before or after the occurrence.

1.15 Survival aspects

1.15.1 Use of safety belts and restraints

The *Canadian Aviation Regulations* (CARs) contain several provisions requiring the use of safety belts, restraints and, if applicable, shoulder harnesses. Section 605.27 of the CARs stipulates the following regarding the use of safety belts by flight crew members:

> **(3)** The pilot-in-command shall ensure that at least one pilot is seated at the flight controls with safety belt, including any shoulder harness, fastened during flight time.[7]

The shoulder harness is an important part of an aircraft occupant's protection system, and wearing a shoulder harness is known to reduce the likelihood and severity of injuries. A major advantage of using a shoulder harness is that it minimizes body movements and ensures that the body does not strike the aircraft's structure during lateral and longitudinal impacts. Transport Canada (TC) states the following in its Advisory Circular (AC) 605-004:

> (1) A high percentage of pilot and passenger deaths and serious injuries have occurred in small aircraft accidents and have been attributed to the pilot's head making contact with the aircraft's control yoke, instrument panel or other parts of the flight deck structure, or the passenger's head making contact with the seat in front of them. This is due to the unrestrained upper body flailing around in the absence of a shoulder harness during the crash sequence.
>
> (2) Accident statistics provide substantial evidence that the use of a shoulder harness, in conjunction with a lap strap, can reduce serious injuries to the head, neck, and upper torso for occupants on board an aircraft, and has the potential to reduce fatalities of occupants in an otherwise survivable accident.[8]

The pilot's seat was equipped with a safety belt consisting of a lap strap and shoulder harness; however, the pilot was wearing only his lap strap during the occurrence flight. The shoulder harness on the occurrence aircraft was attached to the bulkhead and located above the pilot's seat. Due to the position and high attachment point of the harness, it had a tendency to rub against the pilot's neck, and he therefore found it uncomfortable. Additionally, the private aircraft that he flew regularly did not have any shoulder harnesses installed. As a result, it was a normal practice for the pilot not to wear the available shoulder harness while flying the occurrence aircraft.

1.15.2 Personal flotation device

Since 2020, regulations have required crew and passengers on commercial seaplanes carrying 9 passengers or fewer to wear an inflatable flotation device while these aircraft operate on or over water.[9]

The occurrence pilot was wearing an Onyx A/M-24 manual/automatic PFD. The red inflate handle was located on the right side of the PFD, which had been converted to the manual-only mode of deployment.[10] In manual-only mode, a "MANUAL ONLY" tag must hang outside

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[7] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subsection 605.27(3).

[8] Transport Canada, Advisory Circular (AC) 605-004: Use of Safety Belts and Shoulder Harnesses On Board Aircraft, Issue 3 (14 March 2022), section 3.0: Background.

[9] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 703.83.

[10] Chapter 551 of the *Airworthiness Manual* requires that the PFD be fitted with a manual-only inflator. (Source: Transport Canada, *Airworthiness Manual*, Chapter 551, Subchapter F, paragraph 551.403[c]).

the cover and beside the handle, according to the owner's manual.[11] Other PFDs recovered at the occurrence site had the "MANUAL ONLY" tag showing, so it is likely that the pilot's PFD also had this tag hanging outside the cover. However, this could not be confirmed by the investigation owing to the fact that the PFD was never recovered after the accident (Figure 4).

Figure 4. Example of an Onyx A/M-24 manual/automatic personal flotation device recovered from the occurrence aircraft. This is the same model as the one the occurrence pilot had. (Source: TSB)

When the pilot egressed the aircraft, he attempted to inflate the PFD once he was in the water and swimming to shore, but it did not inflate. The TSB conducted tests on an identical PFD at the TSB Engineering Laboratory in Ottawa, Ontario, and noticed that it was possible to mistake the "MANUAL ONLY" tag for the inflate handle.

The investigation could not determine whether the pilot pulled the inflate handle, the "MANUAL ONLY" tag, or another strap. Given that he was so close to shore, with the weight of waterlogged clothing weighing him down, the pilot did not spend much time attempting to inflate the PFD; rather, he chose to discard his heavy jacket, along with the accompanying PFD over it.

Finding: Other

For unknown reasons, the pilot encountered difficulty inflating his PFD, and because of his proximity to the shore, he removed it to make it easier to swim.

1.15.3 Emergency locator transmitter registration

The occurrence aircraft's 406 MHz ELT activated upon impact.

According to CARs subsection 605.38(4), an ELT capable of broadcasting on the 406 MHz frequency must be registered with the Canadian Beacon Registry.[12] When an emergency beacon signal is received,

> search and rescue authorities at [the Canadian Mission Control Centre] can retrieve information from a registration database. This includes beacon owner contact information, emergency contact information, and […] aircraft identifying

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11 Absolute Outdoor, Inc., Onyx, *Owners Manual for Model 3042C USCG Approved Type V Convertible (Manual/Auto) Inflatable PFD*, p. 9.

12 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, subsection 605.38(4).

> characteristics and equipment. Having this information allows search and rescue services to respond appropriately.[13]

According to the Canadian Beacon Registry, registering an ELT "will facilitate the task for search and rescue personnel in the event of a distress situation."[14]

When the JRCC receives an ELT signal, it immediately attempts to contact the ELT's owner using the information in the registration database to confirm whether the signal is in fact coming from an aircraft in distress or simply a false alarm. If the JRCC is unable to contact the owner, it starts consulting other resources (e.g., flight plans, air traffic services, web tracking) to confirm the validity and accuracy of the ELT signal.

When an event is unable to be confirmed, the decision whether or not to deploy resources, including but not limited to SAR services, will be made. However, the priority may change if another accident requiring SAR resources occurs and is confirmed.

True North Airways had not updated the information in the registry after acquiring the occurrence aircraft in January 2021.

The investigation obtained JRCC logs, which provided information related to the rescue response along with a timeline for the SAR operation. According to the logs, the ELT signal was first received by the JRCC at 0931, and it took the JRCC almost an hour to confirm with True North Airways that one of its aircraft had been involved in an occurrence. In this time, the JRCC made a number of calls to the previous owner of the occurrence aircraft, who was still listed in the Canadian Beacon Registry as its owner; identified the current operator as True North Airways; and, after a few unsuccessful attempts, established contact with this operator, which eventually confirmed the accident. The decision to deploy the SAR aircraft was not made until about 45 minutes after the time of the accident; however, given that the 1st SAR aircraft was coincidentally already airborne and heading in the direction of the occurrence aircraft, it reached the accident site sooner than if it had had to deploy from its base.

1.16 Tests and research

1.16.1 TSB laboratory reports

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

- LP118/2022 – ELT Analysis
- LP094/2022 – NVM Recovery – GPS and Satellite Communicators
- LP117/2022 – Instruments Analysis
- LP050/2023 – Shoulder Harness Analysis

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13 Canadian Beacon Registry, at cbr-rcb.ca/cbr/presentation/other_autre/index.php (last accessed on 18 October 2023).

14 Ibid.

1.17 Organizational and management information

1.17.1 General

True North Airways is a TC–approved commercial air operator that conducts flight operations under CARs subparts 702 (Aerial Work), 703 (Air Taxi Operations), and 604 (Private Operators). At the time of the occurrence, True North Airways also held a CARs Subpart 406 (Flight Training Units) operator certificate. It changed ownership in August 2020 and changed its name to True North Airways in January 2021. It is based in Azilda, Ontario.

At the time of the occurrence, True North Airways operated 8 aircraft: 2 Cessna 172Ks, 1 Cessna A185F, 3 DHC-2 Beavers, 1 Pilatus PC-12, and 1 DHC-3 Otter, which was the occurrence aircraft. The approval for operations under CARs subparts 702 and 703 is limited to day VFR operations only, for all aircraft except the Pilatus PC-12. Maintenance was performed on the occurrence aircraft by contracted TC–approved maintenance organizations.

Changes in management occurred in March 2022, when the company hired a new operations manager, who also became the chief pilot in August 2022.

The company did not have a safety management system for its CARs subparts 702 and 703 operations, nor was one required by regulation. Before the occurrence, the company had been involved in 3 accidents since January 2021; all were classified by the TSB as class 5[15] occurrences.[16]

In 2019, the TSB published the Air Transportation Safety Issue Investigation Report (SII) A15H0001.[17] The objective of this investigation was to improve safety by reducing the risks in air-taxi operations across Canada. The air-taxi sector continues to experience more accidents than any other in the commercial aviation industry.

1.17.2 Flight following

True North Airways utilizes a Type D operational control system under which operational control is delegated from the operations manager to the pilot-in-command of the flight.[18]

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15 A class 5 occurrence has little likelihood of identifying new safety lessons that will advance transportation safety. The investigation is limited to data gathering and the data are recorded for statistical reporting and future analysis.

16 TSB air occurrences A22O0067, A21O0141, and A21O0055.

17 TSB Air Transportation Safety Issue Investigation Report A15H0001, *Raising the bar on safety: Reducing the risks associated with air-taxi operations in Canada* (07 November 2019), at http://www.tsb.gc.ca/eng/rapports-reports/aviation/etudes-studies/a15h0001/a15h0001.html (last accessed on 18 October 2023).

18 Under a Type D operational control system, the pilot-in-command is responsible for all pre-flight duties, including weather assessments and risk analysis. Flights are self-dispatched and released by the pilot-in-command.

The responsibility for the day-to-day conduct of flight operations is retained by the systems operation manager, who reports to the operations manager.

According to True North Airways' company operations manual, the company has flight followers who monitor the progress of each flight from start to finish.[19] The pilot-in-command has the responsibility of carrying out the flight watch by "passing on to the flight followers messages concerning aircraft landings and departures from its point of origin, including any intermediate stops, and the final destination."[20]

The company used a satellite tracking device to follow aircraft movements. This tracking system provided an updated location every 10 minutes. However, during the occurrence flight, it stopped working approximately 35 minutes into the flight. The company did not notice that the system had stopped transmitting.

The occurrence aircraft had been chartered by a local Mistissini client and had been operating out of CSE6 for the duration of the summer. This client was itself an air operator that normally operated its own float-equipped DHC-3 Otter aircraft, but it was not able to do so that season. It therefore hired True North Airways.

Although the occurrence aircraft was not located at the True North Airways base in Ontario, it was the pilot's duty to provide his company's flight follower with flight information. While the aircraft was based in Mistissini, the pilot communicated mainly with the client's personnel, using either a satellite communication device, cellphone, or radio when within range, to provide estimates of arrival times and to communicate any logistical information (such as informing passengers of the aircraft's estimated time of arrival and letting dockhands know when to be back to unload the aircraft).

Upon being informed of the occurrence, True North Airways personnel had to contact the client in Mistissini for information because they did not know the aircraft's destination.

1.17.3 Dangerous goods

Dangerous goods can only be transported by air provided certain regulations and procedures are strictly followed. In Canada, the requirements for the carriage of dangerous goods are embodied in the *Transportation of Dangerous Goods Regulations*. In general terms, the procedures involved in the transportation of dangerous goods (TDG) are aimed at ensuring all links in the transportation chain know what dangerous goods they are transporting, how to properly load and handle them, and what to do if an incident or an accident occurs either in flight or on the ground.

In order to carry dangerous goods, an operator is required to have special authorization designated on its air operator certificate (AOC). The special authorization is issued by TC,

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19 True North Airways Inc., *Flight Operations Manual*, Issue 1 (11 May 2021), section 1.1.6: Flight Follower, paragraphs a. and e., pp. 9-10.

20 Ibid., section 1.1.7: Pilot-In-Command, paragraph f., p. 11.

and before it is issued, the operator must have TC–approved procedures and training for the carriage of dangerous goods included in its company operations manual.

When True North Airways changed ownership, the new owners continued to operate under the previous company's special authorization, which authorized dangerous goods to be carried on the Cessna 172 and 185, as well as on the DHC-2 Beaver. The new owners also continued to use the previous company's TDG manual and training program.

When True North Airways purchased the DHC-3 Otter, it made a request to TC that special authorization for the carriage of dangerous goods be added to the AOC for this aircraft. TC informed the company that before this special authorization could be issued, the TDG manual and training needed to be amended to include information for the DHC-3 Otter. In January 2022, the information had not been received, so the file was closed, and special authorization was not added to the AOC for the DHC-3 Otter. Since that time, the company acquired a new operations manager, and the absence of the necessary special authorization for the occurrence aircraft went unnoticed.

On the occurrence flight, the aircraft was carrying four 45-gallon drums of gasoline and two 30-pound propane tanks.

Finding: Other

The occurrence aircraft was carrying dangerous goods on board, even though the operator was not authorized to do so on its DHC-3 Otter aircraft.

1.18 Additional information

1.18.1 Aerodynamic stall

An aerodynamic stall occurs when a wing's angle of attack exceeds the critical angle at which the airflow begins to separate from the wing. When a wing stalls, the airflow breaks away from the upper surface, and the amount of lift generated is reduced to below that needed to support the aircraft.

The speed at which a stall occurs is related to the load factor of the manoeuvre being performed. The load factor is defined as the ratio of the aerodynamic load acting on the wings to the aircraft's gross weight, and it represents a measure of the stress (or load) on the structure of the aircraft. By convention, the load factor is expressed in *g*.[21]

In straight and level flight, lift is equal to weight, and the load factor is 1*g*. In a banked level turn, however, greater lift is required. It can be achieved, in part, by increasing the angle of attack (by pulling back on the stick/elevator control), which increases the load factor. As the load factor increases with bank angle, there is a corresponding increase in the speed at which the stall occurs.

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21 *g* is a unit of measurement of the force resulting from vertical acceleration due to gravity. An acceleration of 1*g* is 9.8 m/s^2.

Wind gusts impose momentary increases in load factor, and can be associated with wind shear.[22] A gust of wind, especially a vertical gust, can be strong enough to stall a wing.

As explained in *From the Ground Up*,

> [t]urbulence affects stall speed. An upward vertical gust causes an abrupt increase in angle of attack because of the change in direction of the air relative to the wing and could result in a stall if the airspeed of the airplane is at the same time relatively low.[23]

1.18.2 Visual flight rules flight into instrument meteorological conditions

The route of the occurrence flight was in uncontrolled airspace. According to the CARs,[24] for an airplane operating in VFR flight within uncontrolled airspace during the day at or above 1000 feet AGL, the visibility must be not less than 1 SM, and the airplane must maintain a distance of at least 500 feet vertically and 2000 feet horizontally from cloud. If operating at altitudes less than 1000 feet AGL, the visibility must be not less than 2 SM, and the airplane must remain clear of cloud.

The hazards associated with continuing VFR flight into instrument meteorological conditions (IMC) are well documented. TSB accident data show that continued VFR flight into adverse weather, or IMC, represents a significant threat to aviation safety. Aircraft operating under VFR that continue into IMC are at risk of controlled flight into terrain and loss of control accidents. The TSB examined its data to identify accidents involving pilots who were flying under VFR and proceeded into IMC. From 2001 to 2021, 93 accidents and 113 fatalities were identified.

1.18.3 Decision-making

Classical or normative decision-making models are focused on making rational, optimal decisions, such as buying a house, and are often characterized by slow, analytical evaluation of options and selection of the optimal choice. Pre-flight planning often uses these slower, more methodical decision-making approaches and prepares pilots in advance of a flight. Preparation during pre-flight can include considering the possibility of encountering poor visibility or weather changes, flying into IMC, or encountering mechanical or aeronautical issues with the aircraft during flight. It can also entail thinking about viable contingencies (e.g., planned alternate airports). Preparation in advance of a flight can reduce time-critical decision making.

Behavioural and naturalistic decision-making models, in comparison, are focused on how decisions are made in time-sensitive, dynamic, real-world settings. These models account for human cognitive limitations and are characterized by making decisions in routine,

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[22] Wind shear is a sudden change in wind speed or direction (e.g., a sudden decrease of the headwind component, or a change from a headwind to a tailwind) that can have an effect on aircraft performance.

[23] S. A. F. MacDonald, *From the Ground Up*, 29th Edition (Aviation Publishers Co., 2011), p. 30.

[24] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 602.115.

nonanalytical ways, comparing actions in terms of expected value or utility. Professionals in these contexts apply decision-making strategies depending on their experience, the task, and the operational context.[25] Decision making in flight often uses these faster, more situational decision-making approaches.

Decision making, in this way, "fuses two processes: the way decision makers size up the situation to recognize which course of action makes sense, and the way they evaluate that course of action by imagining it."[26] In these types of situations, decision makers recognize situations as familiar and take action. They understand the goals and priorities, as well as which cues are important, what comes next, and typical ways to respond in given situations. This type of decision making is efficient and performed quickly. However, it is susceptible to 3 categories of problems: inadequate experience in the decision maker, insufficient information in the unfolding situation, and a tendency on the decision maker's part to find a reason to dismiss a cue or piece of information.[27] Furthermore, stressors such as time pressure, noise, and ambiguity have been shown to reduce the information people can consider when making decisions.[28] To build expertise, real-world training and experience are important for this type of decision making.

1.18.4 Plan continuation

Plan continuation is the tendency of individuals to continue their original plan of action even when changing circumstances necessitate a new plan.[29,30,31] It means sticking with the original plan while a situation has actually changed and calls for a different plan. Once a plan is made and committed to, it becomes more difficult for cues or conditions in the environment to be recognized as indicating a need for change than it would be if a plan had not been made at all. For pilots to recognize and act on a reason to change their plan in a timely manner (e.g., to identify the need to divert an approach), conditions need to be perceived as sufficiently salient to require immediate action.

Most important in the continuation of plans (or in the abandonment of them for an alternative) are the contextual factors that surround people at the time. The order in which cues about the developing situation arrive and their relative influence are 2 key aspects.[32]

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[25] M.R. Lehto, F.F. Nah, and J.S. Yi, "Decision-making models, decision support, and problem solving," in: G. Salvendy (Ed.), *Handbook of Human Factors and Ergonomics*, 4th edition (John Wiley & Sons, 2012), p. 211.

[26] G. Klein, *Sources of Power: How People Make Decisions* (MIT Press, 1998), p. 24.

[27] Ibid., pp. 274-275.

[28] Ibid., pp. 275-276.

[29] B. Berman and R. K. Dismukes, "Pressing the approach" in *Aviation Safety World*, Volume 1, Issue 6 (December 2006), p. 28.

[30] S. Dekker, *Safety Differently: Human Factors for a New Era*, Second edition (CRC Press, 2015), p. 75.

[31] J. Orasanu and L. Martin, "Errors in Aviation Decision Making: A Factor in Accidents and Incidents", paper presented at HESSD 98, Working Conference on Human Error, Safety and Systems Development, Seattle, Washington (1998), p. 102.

[32] S. Dekker, *Safety Differently: Human Factors for a New Era*, Second edition (CRC Press, 2015), p. 75.

Situational cues and conditions often deteriorate gradually and ambiguously, not quickly and obviously. In the case of the former, “there are almost always strong initial cues that suggest that the situation is under control and can be continued without increased risk.”[33] This helps lock people into continuing with the plan. Often, the consequences of abandoning a plan are significant (e.g., diverting, missed approach), and people require strong evidence to change it.

Flying in deteriorating weather conditions or visibility can be a challenging situation because the cues that visibility is deteriorating can be incremental in a dynamic and changing environment. Deteriorating visibility reduces the visual references needed for flight. Studies suggest that pilots often underestimate the risk of a loss of control due to a lack of visual references, and that they have a high level of self-confidence in their ability to maintain aircraft control in adverse weather conditions.[34,35] Likewise, as goal achievement gets closer (e.g., getting closer to destination), research shows that there may be a natural tendency to downplay potential risk in favour of goal completion (i.e., reaching destination).[36] Human performance is goal-oriented, which is often a very positive aspect; however, the influence of this tendency in these situations is important to understand. Together, underestimating risks and being goal-oriented can contribute to a tendency for pilots to continue flight in deteriorating weather conditions, especially if these pilots assess that the reduced visibility is only temporary or that it will not become much worse, and if the consequences of choosing the alternative are serious (e.g., delaying the transport of passengers out of remote areas).

1.18.5 Attention and workload

Closely connected to the gradual change of situational conditions is the existence of an increasing workload that is often not recognized at the time. A narrowing of attention can occur when a person’s workload increases, and this can contribute to a tendency for plan continuation in that changes in the situation and cues are not detected as a person focuses attention on a primary task. This is a natural human coping strategy to manage increasing workload.[37,38,39] For example, as visibility deteriorates (e.g., conditions are changing), the

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33 Ibid., pp. 75-76.

34 M. W. Wiggins et al., “Characteristics of Pilots Who Report Deliberate versus Inadvertent Visual Flight into Instrument Meteorological Conditions,” in *Safety Science*, Vol. 50, Issue 3 (2012), pp. 472–477.

35 Federal Aviation Administration (FAA), DOT/FAA/AM-02/17, *Risk Perception and Risk Tolerance in Aircraft Pilots* (September 2002), p. 20-22.

36 J.M. Orasanu et al., “Errors in Aviation Decision Making: Bad Decisions or Bad Luck?,” paper presented at the Fourth Conference on Naturalistic Decision Making (May 1998), p. 8.

37 D. D. Woods, S. Dekker, R. Cook, et al., *Behind Human Error*, 2nd edition (Ashgate Publishing, 2010), p. 193.

38 J. Prinet and N. Sarter, Attentional Narrowing: A first step towards controlled studies of a threat to aviation safety, 18th International Symposium on Aviation Psychology (2015), pp. 189-194.

39 M.A. Vidulich and P.S. Tsang, “Mental Workload and Situation Awareness” in G. Salvendy (Ed.), *Handbook of Human Factors and Ergonomics*, 4th edition (John Wiley & Sons, 2012), p. 246.

attention and effort needed to concentrate and search outside an aircraft for external visual references increases. Attention is, at the same time, not given to other cues, especially those outside of the external field of view, such as displays of information, including airspeed and altitude indicators, and other cues inside the aircraft.

1.18.6 Visual and auditory warnings

Warnings are used as a method for hazard control. Some warnings simply alert while other warnings alert while also providing instructions to reduce or eliminate adverse consequences. Warnings can have different purposes. A stall warning light, for example, is a warning that is intended to provide information that communicates to a pilot an undesired aircraft state (e.g., conditions that a stall is imminent) enabling the pilot to take appropriate action for the developing situation.

As explained in the *Handbook of Human Factors and Ergonomics*,

> [f]or a warning to effectively communicate information and influence behavior, attention must be switched to it and then maintained long enough for the receiver to extract the necessary information.[40]

Auditory warnings, such as sounds, are often used for warnings needed in situations and environments in which the receiver is focused on visual information to complete the task. For example, an auditory warning would be effective during tasks that require the pilot to be focused and visually scanning external references outside the aircraft. A number of factors must be considered for the most effective warning design, whether auditory or visual, including, among others, size, colour, tone, placement, salience, and task context.[41]

Stall warnings in aircraft have a variety of designs that may incorporate some or all of the following:

- Lights
- Aural warning
- Stick shaker
- Stick pusher

According to the *Airworthiness Manual* section on stall characteristics, stall warning and spins,

> (a) The aeroplane must have controllable stall characteristics in straight flight, turning flight, and accelerated turning flight with a clear and distinctive stall warning that provides sufficient margin to prevent inadvertent stalling.[42]

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[40] M. Wogalter, K. Laughery, and C. Mayhorn, "Warnings and Hazard Communication" in G. Salvendy (Ed.), *Handbook of Human Factors and Ergonomics*, 4th edition (John Wiley & Sons, 2012), p. 875.

[41] Ibid., pp. 876, 889.

[42] Transport Canada, *Airworthiness Manual*, Chapter 523: Normal Category Aeroplanes, section 523.2150: Stall Characteristics, Stall Warning, and Spins.

In the occurrence aircraft, a stall warning light was installed on the aircraft panel, above the airspeed indicator.

2.0 ANALYSIS

An examination of the wreckage showed no indication that an aircraft system malfunction contributed to this occurrence. As a result, the analysis will focus on the circumstances of the occurrence flight and the existing pre-conditions leading up to the occurrence.

In particular, the analysis will explore factors that contributed to the aircraft departing controlled flight in reduced visibility; various survival aspects, such as the use of shoulder harnesses, stall warning systems, and emergency locator transmitter (ELT) registration; and company procedures for flight following.

2.1 Flight into reduced visibility

When the pilot was conducting his flight planning before the occurrence flight, the information available led him to assess that the destination weather would be suitable for visual flight rules (VFR) flight by the time that he arrived. This assessment was validated by the VFR conditions that the pilot observed for the majority of the flight, which lasted 1 hour and 25 minutes, further solidifying what he was expecting to see at destination based on his flight planning.

As the aircraft was approaching the remote passenger pick-up area on the destination lake, the aircraft encountered reduced visibilities, likely as low as ½ statute miles in an unexpected low layer of cloud, which was below the minimum required for VFR flight. In the reduced visibility conditions and at an altitude below 500 feet above ground level, the pilot continued the approach in instrument meteorological conditions to determine whether he could see the passengers and land, rather than diverting to an alternate lake and waiting for improved visibility.

When making decisions in such situations, pilots are continuously monitoring environmental cues, assessing conditions at the location, evaluating progress toward the goal or task, and acting upon this information. In this occurrence, several factors contributed to the pilot's decision to continue the flight into instrument meteorological conditions:

- the passengers waiting for transport from a remote location;
- the short remaining distance to the passenger pick-up point;
- the reduced, but not complete loss of, visibility in which the pilot could maintain visual reference with the shore of the lake; and
- the potential consequence of having to proceed to an alternate location and wait out the weather, effectively delaying the drop-off of passengers at their destination.

Together, these aspects contributed to the pilot's decision to continue the flight in reduced visibility, which fit the pattern of plan continuation.

Finding as to causes and contributing factors

Due to the visual cues of the landing area that were visible to the pilot, the close proximity of the landing site where passengers were waiting, and the natural tendency to continue a plan under changing conditions, the pilot continued the approach despite visibility in the local area being below the minimum required for VFR flight.

The low visibility below the clouds made it difficult for the pilot to locate the passengers on the ground. This was only made more difficult by the fact that the passengers were waiting in a different location from the one that had been given to the pilot during his pre-flight preparations and that both the location the pilot had been given and the beach where the passengers were waiting were further south than the landing location that the pilot was used to.

The pilot positioned the aircraft over the area where he believed the passengers would be waiting for him. During the 1st pass over the area, the pilot was not able to locate the passengers on the ground and circled back over the area for another look. During the left-hand turn back over the area, the pilot observed the passengers waiting on the beach below. The pilot lowered the flaps and began slowing the aircraft down in preparation for landing. The pilot's workload increased because he needed to keep his circuit tighter than usual so that he would not lose sight of the intended landing area in the reduced visibility. The reduced visibility also made fewer external visual cues available to the pilot to help him determine his speed. As the pilot focused more of his attention outside the aircraft, it continued to slow down. The approach and landing were made more difficult by the fact that the pilot had not landed on this particular section of the lake in the past.

Finding as to causes and contributing factors

Owing to the reduced visibility, the pilot's workload, while he was manoeuvring for landing, was high and his attention was focused predominantly outside the aircraft in order to keep the landing area in sight. As a result, a reduction in airspeed went unnoticed.

Flying a tighter circuit required the pilot to increase the bank angle during the turn in order to prevent the aircraft from flying through the intended centreline of his planned approach. An increased bank angle increases the load factor, resulting in an increase in the aircraft's stall speed.

According to the meteorological assessment conducted by Environment and Climate Change Canada, it is possible that an area of light low-level wind shear existed in the vicinity of Pluto Lake, Quebec, at the time of the occurrence. If the aircraft experienced a gust of wind, a further reduction in airspeed may have occurred, negatively affecting a wing that was already very close to the stall speed.

Finding as to causes and contributing factors

During the aircraft's turn from base to final, the increased wing loading, combined with the reduced airspeed, resulted in a stall at an altitude too low to permit recovery.

2.2 Use of shoulder harness

Statistics have shown that shoulder harnesses help mitigate injuries, namely upper-body injuries, during an accident.

During this occurrence, the pilot received head injuries upon impact with the water. The pilot had been flying the aircraft with only the lap strap portion of the safety belt fastened, despite the aircraft having shoulder harnesses installed. The attachment point of the shoulder harness on the occurrence aircraft was behind and above the pilot's shoulder, on the bulkhead. In this position, the harness tended to rub against the pilot's neck, leading him to find it uncomfortable. In addition, the pilot flew other aircraft, some of which had only lap strap installations. It was therefore common for him to fly without a shoulder harness secured.

Finding as to causes and contributing factors

The pilot was not wearing the shoulder harness while at the controls and operating the aircraft because he found it uncomfortable and other aircraft he flew were not equipped with one. As a result, during impact with the water, the pilot received serious injuries.

2.3 Stall warning systems

The *Airworthiness Manual* requires that airplanes have a clear and distinctive stall warning to prevent inadvertent stalling. Auditory warnings alert pilots to situations without the pilot having to be looking at or monitoring a specific light or instrument in the aircraft, whereas visual warnings must be seen to be recognized.

The occurrence aircraft had a stall warning light, which was installed on the instrument panel and designed to illuminate when the aircraft approached a stall condition. For the warning to be received by the pilot, the light needed to attract the pilot's attention to the inside of the aircraft, on the instrument panel, and the pilot needed to see and recognize this light.

During the take-off and landing phases of a flight, pilots deal with higher workload. Besides the monitoring of the instruments inside the aircraft, VFR pilots also constantly have to be looking outside the aircraft, a necessity that can also increase workload and divert attention away from the instrument panel, and thus, any visual warnings located on it.

Finding as to risk

If aircraft stall warning systems do not provide multiple types of alerts warning the pilot of an impending stall, there is an increased risk that a visual stall warning alone will not be salient enough and go undetected when the pilot's attention is focused outside the aircraft or during periods of high workload.

2.4 Registration of emergency locator transmitters

The aircraft's ELT activated upon impact. It began transmitting a distress signal to the Joint Rescue Coordination Centre, whose personnel then used the information linked to it in an attempt to contact the owner.

ELTs are required to be registered with the Canadian Beacon Registry. When the occurrence aircraft switched owners in January 2021 and was purchased by True North Airways Inc. (True North Airways), the ELT registration information in the registry had not been updated. Consequently, when the ELT activated, the Joint Rescue Coordination Centre did not have the correct contact information.

In a search and rescue operation, when time is critical and could determine the difference between life and death for passengers and crew, minimizing the time spent trying to reach a contact who can confirm that an accident has occurred is crucial. Although the out-of-date ELT registration information did not play a direct role in the outcome of this occurrence, it highlights a risk to aviation safety.

Finding as to risk

If aircraft operators do not ensure that their contact information on file with the Canadian Beacon Registry is accurate, there is a risk that search and rescue operations may be delayed.

2.5 Flight following

The DHC-3 Otter aircraft was being chartered by a local air operator operating out of the Mistissini Water Aerodrome (CSE6), Quebec, for the majority of the summer. True North Airways was conducting the scheduled work on the client company's behalf, and the pilot coordinated directly with dockhands and passengers located in Mistissini.

On the day of the occurrence, the pilot was passing along flight watch information to the client company for logistical reasons. The client was not passing this information along to True North Airways, nor had it been designated to do so. As a result, True North Airways flight followers were not advised of the information concerning the aircraft's departure from CSE6.

True North Airways used a satellite tracking device to monitor the progress of its company aircraft. On the occurrence flight, the tracking device had stopped working about 35 minutes into the scheduled 90-minute flight to Pluto Lake, and the company had not recognized that aircraft position reports were no longer being received. Without active monitoring of the flight by the operator, delays in the initiation of the search and rescue response could have resulted if the ELT had not activated.

Finding as to risk

If companies do not employ robust flight-following procedures, there is a risk that, after an accident, potentially life-saving search and rescue services will be delayed.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. Due to the visual cues of the landing area that were visible to the pilot, the close proximity of the landing site where passengers were waiting, and the natural tendency to continue a plan under changing conditions, the pilot continued the approach despite visibility in the local area being below the minimum required for visual flight rules flight.

2. Owing to the reduced visibility, the pilot's workload, while he was manoeuvring for landing, was high and his attention was focused predominantly outside the aircraft in order to keep the landing area in sight. As a result, a reduction in airspeed went unnoticed.

3. During the aircraft's turn from base to final, the increased wing loading, combined with the reduced airspeed, resulted in a stall at an altitude too low to permit recovery.

4. The pilot was not wearing the shoulder harness while at the controls and operating the aircraft because he found it uncomfortable and other aircraft he flew were not equipped with one. As a result, during impact with the water, the pilot received serious injuries.

3.2 Findings as to risk

These are conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences.

1. If aircraft stall warning systems do not provide multiple types of alerts warning the pilot of an impending stall, there is an increased risk that a visual stall warning alone will not be salient enough and go undetected when the pilot's attention is focused outside the aircraft or during periods of high workload.

2. If aircraft operators do not ensure that their contact information on file with the Canadian Beacon Registry is accurate, there is a risk that search and rescue operations may be delayed.

3. If companies do not employ robust flight-following procedures, there is a risk that, after an accident, potentially life-saving search and rescue services will be delayed.

3.3 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. The occurrence aircraft was carrying dangerous goods on board, even though the operator was not authorized to do so on its DHC-3 Otter aircraft.

2. For unknown reasons, the pilot encountered difficulty inflating his personal flotation device, and because of his proximity to the shore, he removed it to make it easier to swim.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 True North Airways Inc.

After the occurrence, True North Airways Inc. took the following actions:

- The company operations manual was amended to reflect the *Canadian Aviation Regulations* more accurately regarding visual flight rules weather limits.
- The fleet of DHC-2 Beaver, Cessna 172K, and Cessna A185F aircraft have been equipped with a flight-monitoring system that can track aircraft movements in near-real time and provide the option to replay flights.
- The company's manual on dangerous goods was rewritten and, at the time of report writing, was in the final process of being approved by Transport Canada.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 18 October 2023. It was officially released on 24 November 2023.