Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT A14O0217

COLLISION WITH TERRAIN

FLYBLOCKTIME INCORPORATED
CESSNA 150M, C-GJAO
WHITNEY, ONTARIO, 8 NM S
11 NOVEMBER 2014

Canada

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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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Whitney, Ontario, 8 nm S
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Summary

A Flyblocktime Incorporated Cessna 150M (registration C-GJAO, serial number 15077889) with 2 people on board departed from the Ottawa/Rockcliffe Airport, Ontario, at 1803 Eastern Standard Time under night visual flight rules for a flight to the Toronto/Buttonville Municipal Airport. At 2025, the pilot transmitted a mayday on the emergency frequency 121.5 MHz, indicating that he was lost and that the aircraft was low on fuel. This and subsequent transmissions were relayed to air traffic control by high-flying commercial aircraft. C-GJAO was below radar coverage, and air traffic control made numerous attempts to assist the aircraft in locating a suitable aerodrome. At 2127, the pilot made a final radio transmission, and the aircraft crashed shortly thereafter. The emergency locator transmitter activated on impact. Search-and-rescue personnel located the accident site in the south end of Algonquin Provincial Park at approximately 2340 but were unable to access the scene of the accident until 0300 because of inclement weather. Both of the aircraft's occupants were found fatally injured.

Le présent rapport est également disponible en français.

Factual information

History of the flight

On the day of the accident (11 November 2014), the pilot had planned a round-robin flight from Toronto/Buttonville Municipal Airport (CYKZ) to Trois-Rivières Airport (CYRQ) and return, with enroute stops at Peterborough Airport (CYPQ) and Ottawa/Rockcliffe Airport (CYRO). No flight plan or flight itinerary was filed, although one of these was required by regulation.[1] The Cessna 150M (C-GJAO) departed from CYKZ at around 0907[2] with the pilot and 1 passenger on board.

On the leg inbound to CYRO from CYPQ, the pilot flew through restricted airspace (CYR538) surrounding Rideau Hall in downtown Ottawa. The airspace violation occurred at 1144 during Remembrance Day ceremonies.

Following an uneventful flight from CYRO to CYRQ and return, C-GJAO again landed at CYRO at 1726, and the fuel tanks were filled in preparation for departure. At 1727, civil twilight ended and night began.

C-GJAO departed CYRO at 1803 for the final leg of the round-robin trip under night visual flight rules (VFR) toward CYKZ, the original departure point. On departure, the pilot did not contact air traffic control (ATC), nor was the aircraft in airspace where such contact was required.

At 2025, the pilot made a mayday call on an emergency frequency (121.5 MHz), stating that he was lost and that the aircraft was low on fuel. The call was received and acknowledged by the flight crew of a high-flying commercial aircraft, who relayed the information to ATC at the Toronto Area Control Centre (CZYZ).

Shortly after the mayday call, the pilot of C-GJAO reported that the aircraft was on the 170° radial of the VOR (very high frequency omnidirectional range) from Coehill (VIE) at 3600 feet.[3] Over the next several minutes, ATC attempted, working with a few different commercial aircraft via transmission relay, to establish direct controller–pilot communication (DCPC) with C-GJAO by having the occurrence pilot switch frequencies to frequencies with receivers and antennas located closer to C-GJAO’s reported location. Although DCPC was occasionally established, it was transient. As a result, ATC continued to communicate with the occurrence pilot mainly by relay through several different commercial aircraft for the remainder of the occurrence flight.

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1 *Canadian Aviation Regulations* (CARs) 602.73(2).

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

3 All altitudes are in feet above sea level (asl), unless otherwise noted.

Between 2032 and 2043, the pilot reported the aircraft as being on various radials from VIE, including 170°, 217°, 180°, and 320°. The aircraft heading was reported by the pilot as varying from 180° to 240° magnetic (M).

At 2041, ATC instructed the aircraft to climb in order to enter radar coverage, which would have made it possible for ATC to determine the aircraft's exact position. The pilot climbed as high as possible while remaining in visual meteorological conditions. At 2048, the aircraft reached a reported altitude of 5200 feet, but ATC was still unable to acquire the aircraft on radar.

At 2044, ATC asked the pilot how much fuel remained. The pilot reported that a quarter of the fuel in the aircraft's tanks was left. At 2051, with some assistance from ATC, the pilot reported that the aircraft was on the intersection of the 330° radial from VIE and the 220° radial from the Killaloe VOR (YXI). ATC asked the pilot how many minutes' fuel remained. The pilot responded that the aircraft's tanks were almost empty.

ATC determined from the pilot's reported position that the nearest airport equipped with runway lights was the Haliburton/Stanhope Municipal Airport (CND4), approximately 22 nautical miles (nm) to the northwest. Although CYPQ was in a better-lit urban area than CND4, it was 40 nm away from the pilot's reported position at that time then.

At 2059, to help the pilot navigate to CND4, ATC instructed the pilot to fly a heading of 350°M to intercept the 320° radial from VIE. The pilot acknowledged and informed ATC that a descent would be initiated in order to maintain VFR.

During the following 9 minutes, ATC requested several updates from C-GJAO as to the aircraft's position with reference to the VIE and YXI VORs. The positions reported by the pilot suggested that the aircraft was not making progress toward the 320° radial, but rather was moving further away from it, to the east.

At 2108, following a position report that established C-GJAO as being approximately 27 nm to the east of CND4, ATC instructed the pilot to fly a heading of 250°M.

At 2114, ATC asked the pilot whether his directional gyro[4] matched the standalone compass[5] heading. The pilot confirmed that it did, and that the aircraft was now level at 2500 feet. At 2116, the pilot reported that the VOR receiver was indicating that the aircraft was on the 360° radial from VIE, although the indicator flag was fluctuating between "FROM" and "OFF".

At 2124, the pilot reported on the 320° radial from VIE. As CND4 is located very close to this radial, ATC informed the pilot that the airport should be located nearby and suggested that the pilot circle around to look for it.

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4 The directional gyro is the aircraft's vacuum-driven heading indicator, which operates independently from the magnetic compass.

5 The standalone compass is a liquid-filled magnetic compass, which operates independently from all other aircraft systems and is periodically calibrated to ensure accuracy.

At 2127, the pilot reported that the aircraft was descending out of 2000 feet. When the commercial aircraft that was in direct contact with C-GJAO asked whether that was because the aircraft was out of fuel, the pilot responded in the affirmative. Although several attempts were made to contact C-GJAO following this transmission, there was no response.

Radio navigation and radar track

Pilots flying VFR at night between CYRO and CYKZ normally either fly directly, with the assistance of radio- or satellite-based navigation aids, or, more commonly, follow the well-lit major highways. The direct route is more expeditious; however, most of the route is over terrain that is sparsely settled and may be very dark at night. Although in-flight visibility may exceed the 3 nm minimum required by regulation,[6] the lack of ground lighting in this area means that there are few visual cues to identify landmarks, making visual navigation difficult. To assist with this navigation, pilots often use radio-based navigation equipment and fly the V300 very high frequency (VHF) airway, which begins as the 256° radial outbound from the Ottawa VOR.

The recorded radar track of the occurrence aircraft for the first 96 minutes following departure (Figure 1) indicates that, once clear of the lights of the Ottawa–Gatineau area, the pilot chose to follow the V300 airway. However, the track varied significantly in an area between the 256º and the 281° radials outbound from Ottawa/Macdonald-Cartier International Airport (YOW).

The recorded radar track ended at approximately 1939, when the aircraft moved out of range of the Ottawa-based radar. On the recording, the aircraft's cruise altitude varied between 2500 feet and 3900 feet. The final 98 minutes of the flight were not recorded on radar and, as a result, the aircraft's flight path during this period is uncertain.

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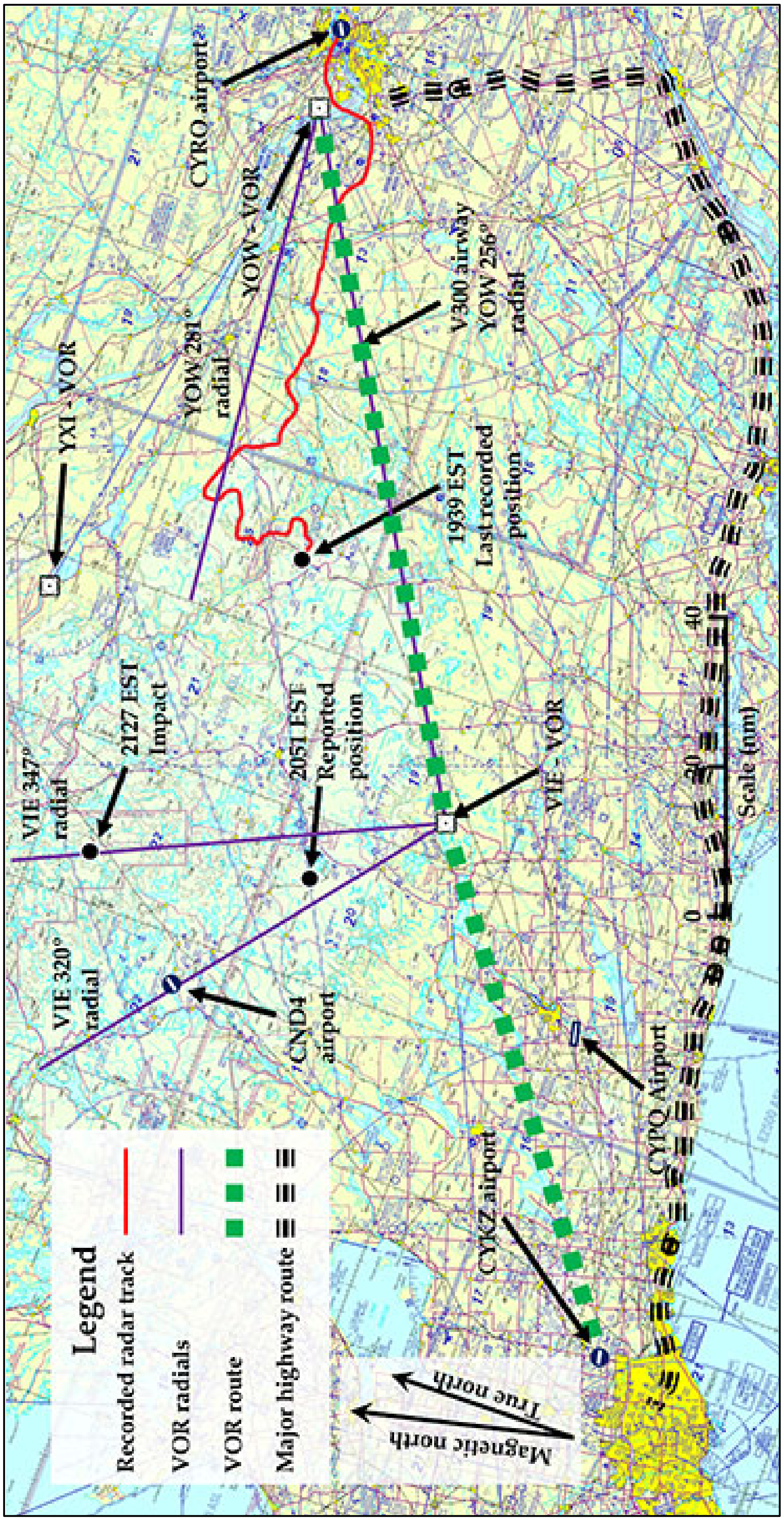
6 *Canadian Aviation Regulations* (CARs) 602.115 (b)(ii).

Figure 1. Depiction of the occurrence overlaid on a visual flight rules (VFR) navigation chart (Source: NAV CANADA, with TSB annotations)



Aircraft

C-GJAO was a Cessna 150M manufactured in 1976. Records indicate that it was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

The aircraft was equipped with the minimum equipment required[7] to legally operate under night VFR. Its only installed device for radio navigation was a TKM Avionics MX-300 receiver (serial number 2874) with an associated course deviation indicator (CDI). The aircraft was not equipped with an automatic direction finder or a global positioning system (GPS).

The aircraft had a Narco ELT 10 emergency locator transmitter (ELT), which activated on impact. The Narco ELT 10 transmits on 121.5 MHz. Since 2009, the Cospas-Sarsat search and rescue (SAR) satellite system scans for signals on the 406 MHz frequency only; as a result, it did not pick up the signal from C-GJAO.

VOR receiver

The occurrence aircraft's VOR receiver, which had only minor damage, was recovered following the accident and tested at the TSB Laboratory. The test determined that the unit generally functioned correctly once power was applied; however, an error of approximately 25° appeared 20 minutes into the test, once the unit's temperature had increased. The error was uniform in direction; that is, the radial that was displayed when the needle was centred on the CDI was always approximately 25° to the left of the radial that should have been displayed.

Further testing determined that the failure of an individual electronic component on the navigation converter section of the circuit board was causing the incorrect indications. The internal temperature that was required to cause the component failure gradually decreased as testing continued, as did the time from power-on to error indication. This rapid degradation indicated that the condition of the component was deteriorating quickly over time and with use. Based on the results of the testing, it was determined that the component had most likely begun to deteriorate just before or during the occurrence flight. Therefore, during the occurrence flight, the error may have been intermittent, alternating between no error and 25 degrees of error, rather than being consistent.

The attached CDI has a built-in ambiguity indicator, which displays either "TO", "FROM", or "OFF". The "OFF" indication is designed to be displayed when the unit is powered off or not receiving a usable signal. The indicator remained in the applicable "TO" or "FROM" position at all times during the testing, regardless of the state of the error.

There was no record of recent maintenance of the VOR receiver, nor is any periodic maintenance required by regulation. Maintenance or replacement is required only if a

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7 *Canadian Aviation Regulations* (CARs) 605.16.

malfunction or error outside of the device's tolerance range is reported. No such defects had been noted in the journey logbook, and pilots who had recently flown the aircraft indicated that they believed the unit to be functioning correctly.

Fuel calculation

The pilot filled the tanks to capacity at each enroute stop preceding the accident.

The *Cessna 150M Pilot's Operating Handbook* gives the estimated rate of fuel burn, depending on temperature, altitude, and power setting, of 4 to 6 U.S. gallons per hour. On the 3 legs preceding the accident, C-GJAO had burned, on average, approximately 5.4 gallons per hour (Table 1). Given the environmental conditions, this figure was consistent with the expected fuel burn at a cruise power setting of 75%, with the mixture leaned for maximum fuel efficiency. If the mixture had not been leaned, the fuel consumption would have been higher.

Table 1. Duration of flight and quantity of fuel burned

From	To	Time off	Time on	Air time	Distance (nm)	Fuel uploaded (U.S. gallons)	Fuel burned (U.S. gallons per hour)
CYKZ	CYPQ	9:07	9:43	0:36	49	7.2	11.98*
CYPQ	CYRO	10:11	11:51	1:40	137	8.3	4.95
CYRO	CYRQ	12:35	14:37	2:02	135	11.5	5.67
CYRQ	CYRO	15:15	17:25	2:10	135	12.0	5.54
CYRO	Accident	18:03	21:27**	3:24	n/a	n/a	n/a

* The amount of fuel on board and time spent doing run-up checks before departing from CYKZ is uncertain; therefore, this figure is unreliable.

** Time of last known transmission from C-GJAO

At a cruise power setting of 75%, the *Cessna 150M Pilot's Operating Handbook* describes an expected cruise speed of 102 knots true airspeed.

The aircraft was equipped with standard fuel tanks that have a combined capacity of 26 U.S. gallons, of which 3.5 gallons are unusable. The usable quantity of 22.5 gallons provides for slightly more than 4 hours of air time at the aforementioned cruise power setting. As fuel gauges can be unreliable, pilots are expected to calculate fuel endurance in terms of time remaining.

Weather

The pilot had planned the flight on the night before departure and had reviewed the weather forecast with the assistance of a friend who was a flight instructor. They assessed the forecast for the route as generally good, with the only concern being stronger winds for the return flight, which both pilots recognized would take place at night.

The pilot was aware of a warm front with associated frontal clouds and precipitation that was forecast between Muskoka and Petawawa, Ontario, but this area was a significant distance north of the planned route. A cold front was forecast to advance from the west later in the day, although at the time of the weather briefing it was not assessed as significant to the planned route of flight (Appendix A).

At TSB's request, a complete meteorological assessment was carried out by Environment Canada following the accident. The weather on the day of the accident was generally as forecast. The weather conditions during the first 90 minutes of the flight, from CYRO to CYKZ, were determined to be overcast ceilings, with clouds based at 5000 feet and topped at approximately 8000 feet above ground level (agl) and visibility greater than 6 statute miles (sm). The wind at the aircraft's cruise altitude during this period was approximately 170° true at 30 knots.

As the flight proceeded further west, both later and displaced further north than planned, the weather deteriorated because of the advancing cold front. The ceilings decreased to possibly as low as 1500 feet agl, with visibility reduced to as low as 3 sm in light rain. The wind increased in this area to 220°T at 40 to 45 knots.

The in-flight conditions further deteriorated in the 15 minutes directly before the accident. During this time, the ceilings decreased to as low as 500 feet agl, with visibility as low as 2 sm in rain showers (Appendix B).

At the time of the occurrence, ATC at CZYZ was aware of the weather system approaching from the west. However, as there are no nearby reporting stations, the controllers had no accurate information concerning cloud bases, wind, or precipitation.

With consideration of temperature, humidity, and precipitation, it was determined that in-flight airframe icing at the aircraft's altitude was not likely. However, the conditions would have been conducive to carburetor icing, which could not be ruled out.

Search and rescue

The Joint Rescue Coordination Centre based at Trenton was notified of the lost aircraft by ATC while CZYZ was still in contact with C-GJAO. When CZYZ lost contact with C-GJAO, it informed the centre, and 2 SAR aircraft were launched toward the aircraft's last reported location. The SAR aircraft arrived in the general vicinity at approximately 2312, and the first signal from the 121.5 MHz ELT was picked up around this time. At around 2340, SAR was able to narrow down the signal's position to an area in the south arm of Algonquin Park. Because of low ceilings and blowing snow in the area, the SAR helicopter was unable to get close to the suspected crash location and had to land at CND4 to wait for better conditions.

While the SAR aircraft operations were underway, a ground search was begun in coordination with the Ontario Provincial Police.

The aircraft accident site was eventually located at approximately 0300 by the SAR helicopter, and 2 SAR personnel were lowered to the crash site, which was in a wooded area.

The SAR personnel found the aircraft's 2 occupants lying outside of the main wreckage, fatally injured.

Wreckage

The aircraft wreckage was located in a wooded area near a stretch of high-tension power lines in the southern arm of Algonquin Park. There were rolling hills in the area, and the elevation of the impact site was approximately 1590 feet.

The initial impact point was a treetop approximately 250 feet east-southeast of the main wreckage, with subsequent tree strikes leading to the aircraft's final resting spot. The impact trail suggested a gradual descent on an approximate track of 310°M.

A tree was found approximately 30 feet before the aircraft's final resting spot, with a large slice out of it and paint markings consistent with the aircraft propeller approximately 20 feet above the base of the tree. The propeller also exhibited wave-like damage to the trailing edge of 1 blade, consistent with a strike while under significant power.

The aircraft structure was heavily damaged; however, the cockpit area, although resting upside-down and detached from the wing, was neither crushed nor collapsed.

The lap belts were found undone. The detachable shoulder straps were detached from the lap belts and were found at a distance from the seats, which suggested that they were not connected at the time of impact.

The 2 fatally injured persons were found outside of the wreckage nearby, with signs suggesting that they had removed themselves from the cockpit. Post-mortem examination determined that both individuals had died from internal injuries, likely following a very brief period of survival.

The surface temperature at the accident time and location was approximately 2 °C. The individuals were not dressed for cold weather survival, nor was any survival gear found in the aircraft.

Two smartphones were recovered intact and powered on. The pilot's phone had an aviation GPS application installed. The passenger's cell phone was also capable of GPS reception. Examination of both phones indicated that use of the GPS functions had not been attempted.

The VOR CDI was found set to 347º, a radial from the VIE VOR consistent with the crash location.

The fuel tanks were drained following aircraft recovery, and 6.2 U.S. gallons of fuel, divided evenly between the 2 tanks, was recovered. After the accident, the throttle and mixture were found in positions consistent with normal cruise power settings.

Flyblocktime Incorporated

Flyblocktime Incorporated is a non-profit flying club that leases aircraft to individuals for blocks of air time. At the time of the occurrence, the club owned 4 aircraft: 3 Piper Cherokees and 1 Cessna 150M (C-GJAO).

Pilot

Records indicate that the pilot was certified and qualified for the flight in accordance with existing regulations. The pilot held a valid private pilot licence obtained in January 2011 and endorsed with a night rating later that year, and a current Class 1 medical certificate.

He had begun flight training in 2009 with Island Air Flight School & Charters Inc. (Island Air), based at Billy Bishop Toronto City Airport (CYTZ). On 31 December 2012, the pilot passed the commercial pilot licence—aeroplane written examination on his third attempt. On 26 March 2014, he passed the commercial pilot flight test on his second attempt. This flight test included VOR navigation. In preparation for these examinations, Island Air provided training to the pilot and letters of recommendation to Transport Canada (TC).

At the time of the accident, the pilot had accumulated approximately 209 hours of flight time, including 29 flight hours at night. Although he had passed the applicable written and flight tests, the pilot still needed to accumulate some additional flight experience to obtain a commercial pilot licence. For its issuance, he needed to acquire an additional 15 hours as pilot-in-command, 3 hours of dual cross-country flight, and 8 hours of instrument flight. In addition to these time requirements, he needed to complete a 300 nm cross-country flight. He had leased C-GJAO with the intention of accumulating a portion of this required flight experience.

In the 30 days before the accident, the pilot had completed 8 hours of flight time at night, including more than 5 takeoffs or landings. As a result, he met the minimum regulatory currency requirements under CARs 401.05(2) for carrying passengers at night.

All of the night flying recorded in the pilot's logbook had taken place over well-lit portions of southern Ontario. The logbook recorded no flights, either day or night, along the accident route.

Before leasing C-GJAO, all of the pilot's flight experience was in Island Air aircraft. The school aircraft that the pilot flew were not equipped with GPS, and, as a result, the pilot had no experience with in-flight GPS operation. Although the commercial ground school likely included some GPS theory, the pilot's level of knowledge with regard to GPS could not be determined.

Before the pilot began leasing C-GJAO, an individual from Flyblocktime flew 2 flights with the pilot in October 2014 to ensure that the aircraft was operated safely. One of these flights was at night and included VOR tracking. The pilot initially made an error setting up the VOR, but later corrected the error himself. On learning that the pilot wished to do longer, cross-country flights, the Flyblocktime representative suggested that the pilot may want to consider leasing the club's Piper Cherokee, which included a GPS. As the pilot was unfamiliar with GPS operation, the pilot declined.

Flight training unit

Flight schools that offer training toward a commercial pilot licence must be legally authorized to do so by TC. In Ontario, in addition to this TC requirement, such schools must be registered with, and their programs approved by, the Superintendent of private career colleges, under the *Private Career Colleges Act*.

Island Air has authorization from TC, in the form of a valid Flight Training Unit Operator Certificate, to complete commercial pilot training. However, it does not have, nor has it ever held, authorization under the *Private Career Colleges Act*. Without this authorization, Island Air cannot legally offer or advertise commercial pilot training in Ontario.

TSB laboratory reports

The TSB completed the following laboratory report(s) in support of this investigation:

- LP264/2014 – VOR Receiver Examination
- LP262/2014 – Instruments Examination

Analysis

General

The pilot held the appropriate licence, rating, and medical certificate for the flight. Having recently completed both the written and flight tests required for issuance of a commercial pilot licence, the pilot had demonstrated the knowledge and ability required to safely plan and execute the day's flights.

The analysis will therefore focus on why the pilot was unable to navigate to destination, why air traffic control (ATC) assistance was unsuccessful, and why the impact with terrain resulted in fatal injuries.

Visual navigation

It was the pilot's first time flying to or from Ottawa, and he was therefore unfamiliar with the area and with the common visual flight rules (VFR) routes, especially those at night. In addition, the pilot's overall experience at night was very limited, as he had flown only over well-lit areas in southern Ontario.

Once clear of the lights of the greater Ottawa area, the aircraft was operated in darkness over an area with few ground lights and below an overcast cloud layer. Flying an aircraft in these conditions, without visual contact with the stars or moon, and with little reference to the ground, can be very difficult for pilots who are inexperienced in instrument flight.

In these unfamiliar conditions, with limited visual reference, the pilot had difficulty holding aircraft heading. This difficulty was evident in the significant and relatively rapid deviations in the recorded radar track as well as in the later report of unexplained heading variation between 180° and 240°.

The wind speed and direction at cruise altitude was very significant in relation to the aircraft airspeed and desired track. This relative strength and direction would require the pilot to hold a significant crab angle to achieve a desired track over the ground or to maintain a selected VOR (very high frequency omnidirectional range) radial.

The inability to spot visual landmarks because of the limited ground lighting along the selected route made visual navigation extremely difficult. Without this visual reference, the pilot would not have been able to monitor the aircraft's progress along the route or to cross-check landmarks against the radial indicated by the VOR receiver.

Radio navigation

After the aircraft departed from Ottawa/Rockcliffe Airport (CYRO) and was clear of the greater Ottawa area, the recorded track shows that it took a course that neither followed the major highways nor tracked the applicable outbound radial from the Ottawa VOR.

TSB examination of the aircraft's avionics discovered that a component within the aircraft's VOR receiver had deteriorated and was overheating, causing the component to fail. The component's failure was most likely intermittent at the time of the flight and caused the receiver to periodically indicate a radial-display error on the course deviation indicator (CDI) that was always 25° to the left of the radial that should have been displayed. Hence, when the component failed, if the CDI needle was centred on 256°, the aircraft was in fact on the 281° radial. During testing, the internal temperature required to cause the error became lower with testing and time from power-on, indicating that the component was deteriorating quickly over time and with use.

The recorded track outbound from Ottawa varied significantly from the 256° radial, which was likely being used to navigate the initial portion of the route. The deviations took place mainly in the area between the 256° and 281° radials. These deviations are consistent with what would have occurred if the pilot had attempted to track the 256° radial as it varied periodically between 0° and 25° of error.

Three minutes before the accident, the pilot centred the CDI and reported that the aircraft was on the 320° radial from VIE. When the CDI was recovered after the accident, it was found to be set to 347°. This final setting is consistent with the crash location, suggesting that the pilot centred the CDI on that radial shortly before impact. This 27° change of VOR indication in 3 minutes supports the conclusion that the error discovered during the laboratory examination was likely intermittent at the time of the accident.

The error did not cause the receiver to stop working or to display an "OFF" indication. As a result, there would have been no clear indication to the pilot that the unit had failed. The only way for the pilot to discover such an error would have been to cross-check the radial indicated by the VOR receiver against a visual landmark or against another navigation aid. Although this cross-check is required for instrument flight rules flight, no such check is required for VFR.

The pilot therefore had no reason to believe that the VOR receiver was functioning incorrectly. The serviceability of VFR radio navigation units is on-condition; that is, the units are serviced or repaired only if an anomaly is noticed and reported. Furthermore, pilots who had recently operated the aircraft had noted no anomalies or malfunctions. As a result, the pilot attempted to navigate by relying solely on aircraft heading and the VOR receiver. Difficulty holding heading, combined with the intermittent failure in the receiver, caused the pilot to become lost and disoriented.

Global positioning system

The pilot had little or no practical experience using an aviation global positioning system (GPS) installation, having not previously flown an aircraft equipped with such a system. Although the pilot had installed an aviation GPS application on his cell phone that would have been able to accurately pinpoint his position, there was no attempt to use the application before or after becoming lost.

Air traffic control assistance

The aircraft was not initially in contact with ATC following departure from CYRO, as the aircraft did not enter airspace requiring such contact.

Once in contact with the aircraft following the mayday call, ATC had difficulty determining the aircraft's position. Because they did not have radar coverage, the controllers had to rely on reports from the pilot regarding the aircraft's position relative to nearby VOR stations.

In the 60 minutes following the mayday call, the pilot reported being on various radials. A number of these radials were later determined to be inaccurate, which meant ATC had understood the aircraft to be in a position that differed significantly from its actual position. Several of these inaccuracies were likely due to the error in the VOR receiver.

In addition, several radials were misreported with regard to their orientation to or from the VOR station. These misreports may have been due to relative inexperience, stress, or disorientation on the part of the pilot.

At 2051, ATC obtained what it believed was an accurate position by requesting that the pilot report crossing radials from 2 separate VOR stations. Following this exchange, ATC asked the pilot how many minutes of fuel were remaining. The pilot was uncertain of the duration of fuel remaining and simply reported the fuel condition as nearly empty. As a result, ATC attempted to route the aircraft to the perceived nearest airport with runway lighting, rather than to one that was slightly more distant in a better lit, more heavily populated area. Had the pilot reported that there was likely more than 70 minutes of fuel remaining at that point, ATC may have considered other options.

Collision with terrain

The pilot's final radio exchange began with the pilot's report that the aircraft was descending, not with a report that the engine had stopped or with a mayday declaration. It was not until the commercial aircraft in contact with C-GJAO enquired about fuel that the pilot stated that the aircraft was out of fuel. It was determined from the damage to the propeller, the tree slice, and the fuel remaining in the tanks that it was unlikely that the engine had lost power.

The aircraft wreckage was recovered with 6.2 U.S. gallons of fuel on board, of which 2.7 gallons was usable. Based on that amount, the aircraft should have been able to continue at cruise for an additional 30 minutes.

Given that the aircraft engine was producing power at the time of impact, several possibilities were considered for the pilot's response regarding fuel exhaustion. One possibility is that engine hesitation occurred as a result of fuel cavitation or carburetor ice. As the aircraft had more than 30 minutes of fuel remaining, fuel cavitation was considered unlikely. Carburetor ice could not be ruled out, but the propeller damage and the tree strike were evidence of significant engine power; therefore, any power degradation from carburetor ice would have been minimal.

Another possibility is that the pilot's statement with regard to fuel status was intended generally. The pilot had reported the fuel condition to ATC 30 minutes previously as being almost empty. Given the duration of the flight after this statement and the pilot's increasing concern, he may have intended the statement to stress the point that the aircraft was almost out of fuel.

In the absence of signs suggesting a power loss, it was determined that the pilot entered a shallow descent under control while there was still significant power to the engine, possibly in an effort to maintain visual flight in deteriorating weather. As a result, the aircraft struck a heavily treed area.

Survivability

The 2 individuals on board were not wearing their shoulder harnesses and died as a result of injuries sustained during the impact. It could not be determined whether the injuries could have been prevented with the use of the harnesses. However, previous accidents have shown that if aircraft occupants do not wear the supplied restraint devices, there is an increased risk of serious or fatal injury in the event of an accident.

Had the occupants survived the impact with less serious injuries, they may not have been adequately equipped to survive in the prevailing conditions for the 6 hours it took for first responders to locate the aircraft. If aircraft are flown over sparsely settled geographic areas and are not equipped with appropriate survival equipment, there is an increased risk of injury or death due to exposure following an accident or unplanned landing.

The time it took for search-and-rescue (SAR) personnel to locate the aircraft was negatively affected by the fact that the emergency locator transmitter (ELT) on board C-GJAO did not transmit on the 406 MHz emergency frequency. As a result, its position could not be determined by the Cospas-Sarsat system. Instead, SAR aircraft had to first determine the general location of such an ELT and then use on-board equipment to home in on the signal. If aircraft are not equipped with 406 MHz ELTs, search and rescue may be delayed or be unable to locate them, decreasing the survivability of an accident.

Findings

Findings as to causes and contributing factors

1. The aircraft was being operated in darkness over an area with few ground lights and below a cloud layer. In these unfamiliar conditions, with limited visual reference, the pilot had difficulty holding aircraft heading.

2. A component within the aircraft's very high frequency omnidirectional range receiver had deteriorated and was overheating, causing the component to fail. The component failure was most likely intermittent at the time of the flight, causing the receiver to periodically indicate a 25° error on the attached course deviation indicator.

3. The pilot attempted to navigate by relying solely on aircraft heading and the very high frequency omnidirectional range receiver. Difficulty holding heading combined with the intermittent failure in the receiver caused the pilot to become lost and disoriented.

4. In the 60 minutes following the mayday call, the pilot reported being on various radials. A number of these radials were later determined to be inaccurate, which meant air traffic control had understood the aircraft to be in a position that differed significantly from its actual position. Several of these inaccuracies were likely due to the error in the very high frequency omnidirectional range receiver.

5. The pilot was uncertain of the amount of fuel remaining. As a result, air traffic control attempted to route the aircraft to the perceived nearest airport with runway lighting, rather than to one that was slightly more distant in a better lit, more heavily populated area.

6. While there was still significant power to the engine, the pilot entered a shallow descent under control, possibly in an effort to maintain visual flight in deteriorating weather. As a result, the aircraft struck a heavily treed area.

Findings as to risk

1. If aircraft occupants do not wear the supplied restraint devices, there is an increased risk of serious or fatal injury in the event of an accident.

2. If aircraft are flown over sparsely settled geographic areas and are not equipped with appropriate survival equipment, there is an increased risk of injury or death due to exposure following an accident or unplanned landing.

3. If aircraft are not equipped with 406 MHz emergency locator transmitters, search and rescue may be delayed or be unable to locate them, decreasing the survivability of an accident.

Other findings

1. Island Air offered training in Ontario toward the issuance of a commercial pilot licence without authorization to do so under the Ontario *Private Career Colleges Act*.

2. Five hours before the accident, the aircraft flew through restricted airspace surrounding Rideau Hall.

3. A global positioning system application capable of pinpointing the phone's location was installed on the pilot's cell phone, but the application was not used during the flight.

Safety action

Flyblocktime Incorporated

Following the accident, Flyblocktime issued a safety bulletin to associated pilots, reminding them of the company's requirement to obtain flight following on all cross-country flights at night and reminding them to file flight plans.

The company has also informed all pilots that they may not have an instructor supervise their actions without advising the company in writing and obtaining company approval.

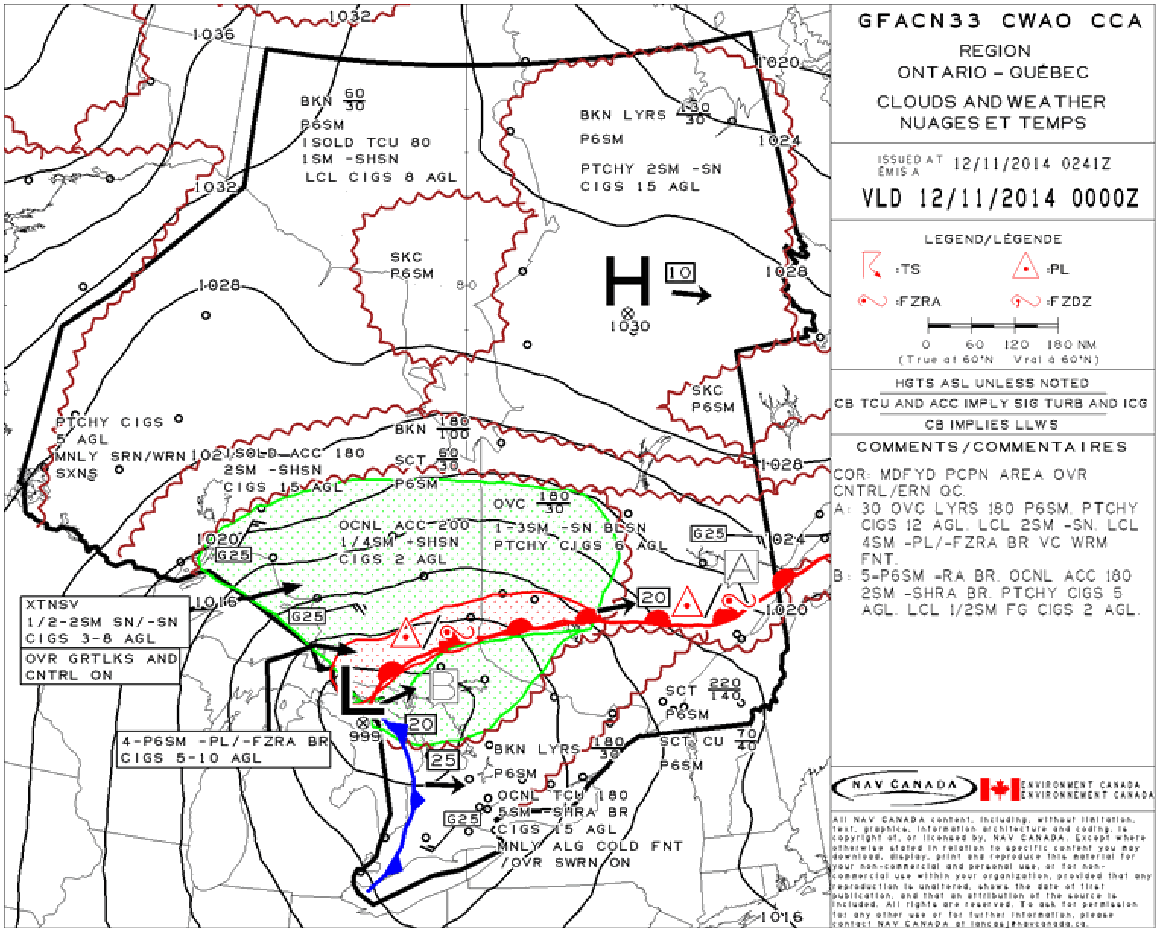
All pilots were asked to sign an agreement stating that they will not use the aircraft for training purposes.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 09 March 2016. It was officially released on 15 March 2016.

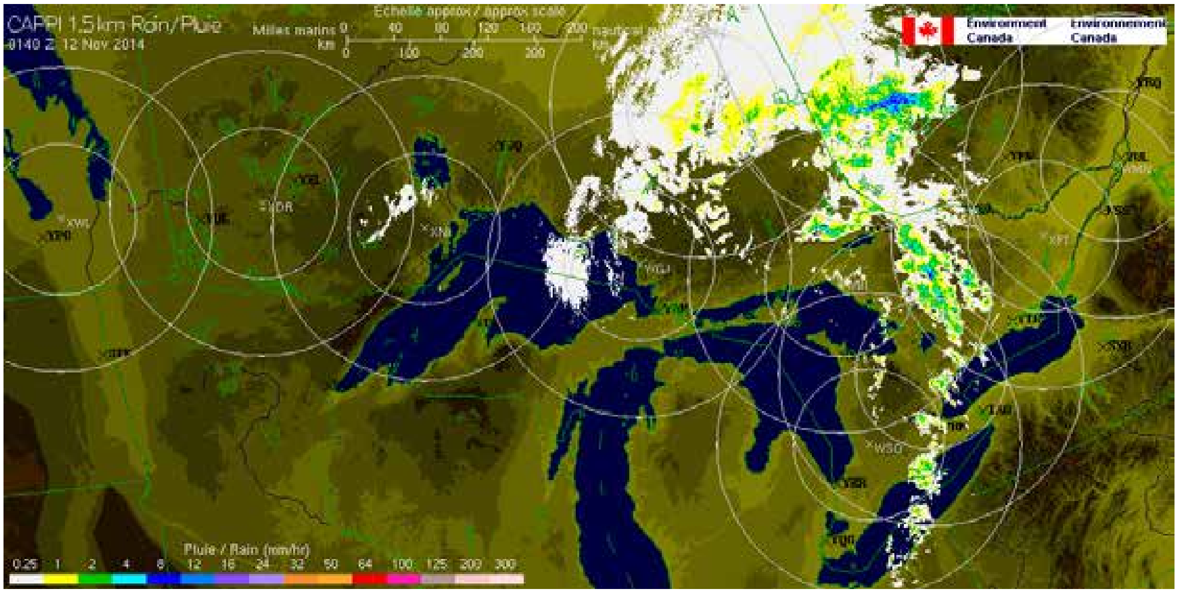
Visit the Transportation Safety Board's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken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

Appendices

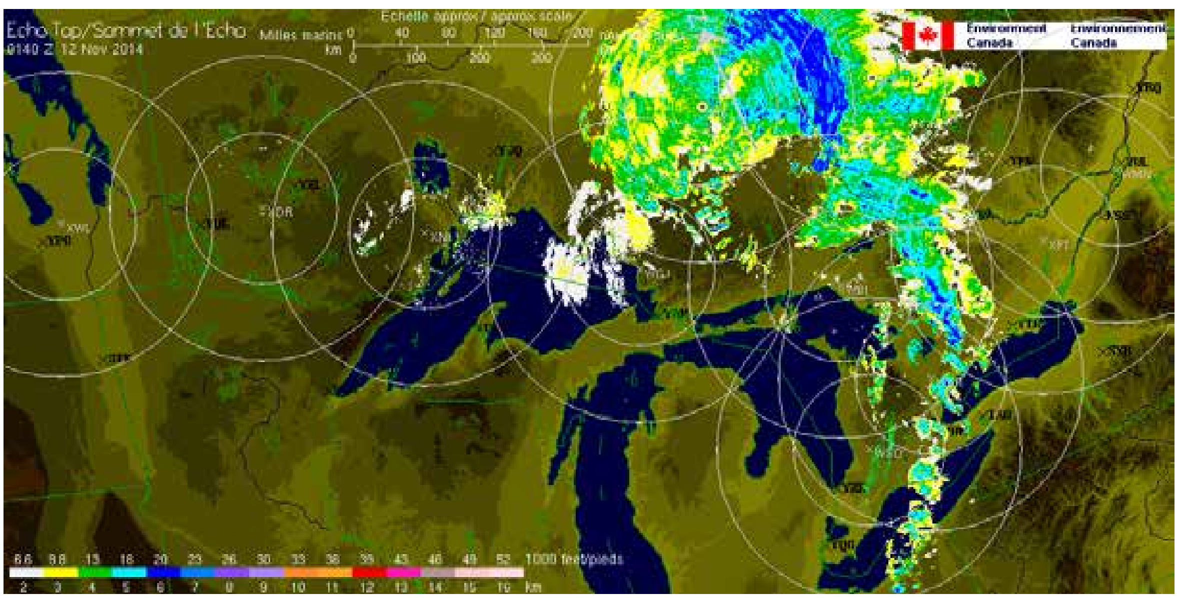
Appendix A – Graphic area forecast



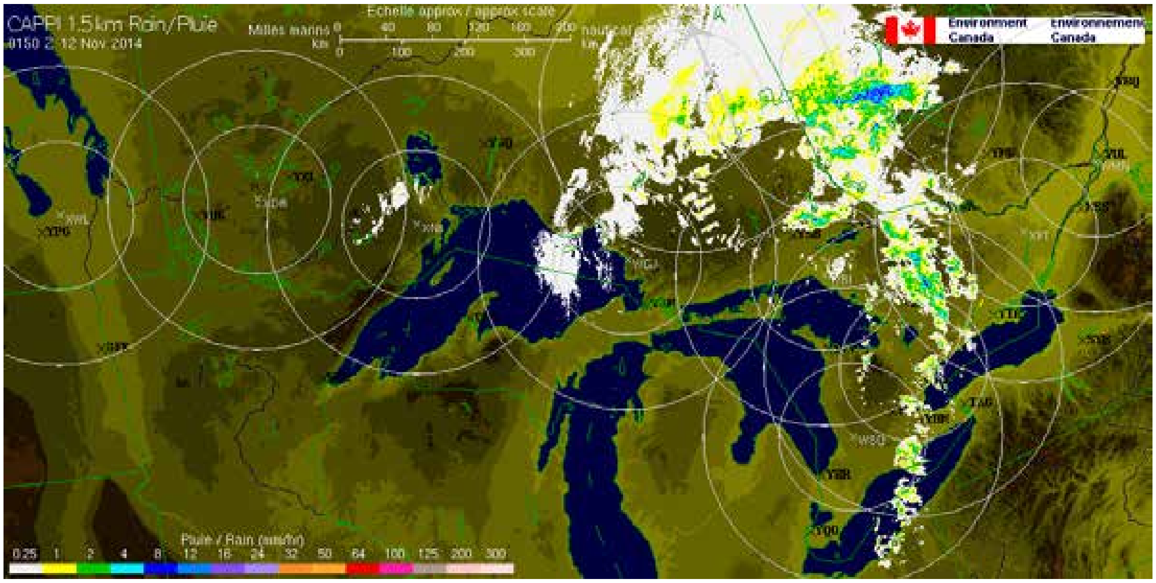
Appendix B – Weather radar imagery



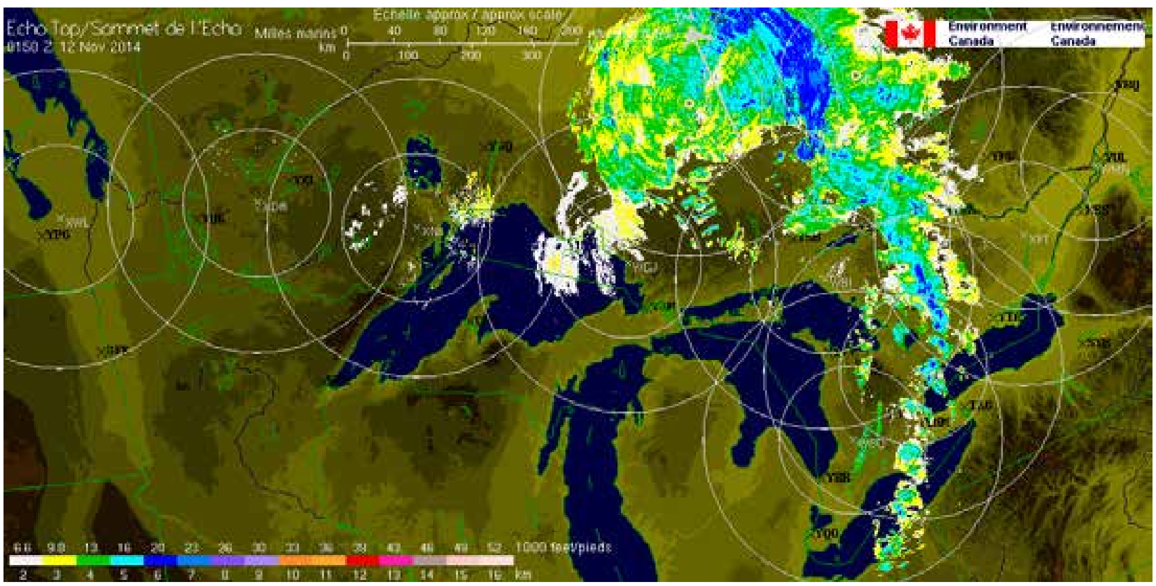
Constant altitude plan position indicator (CAPPI) at 1.5 km altitude, Rain valid at 0140Z 12 November 2014



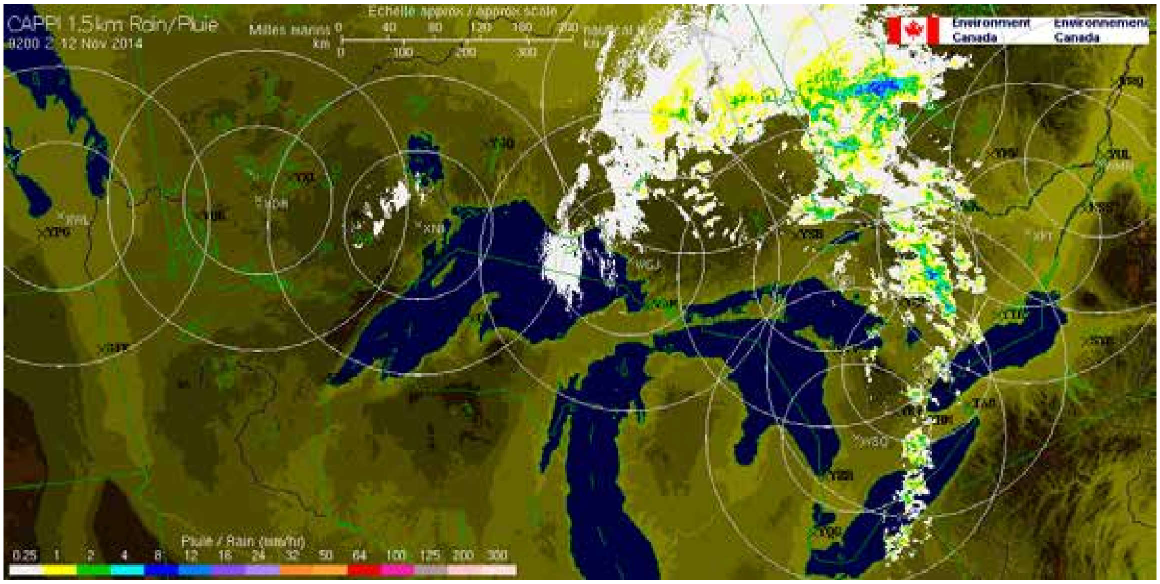
Echo top valid at 0140Z 12 November 2014



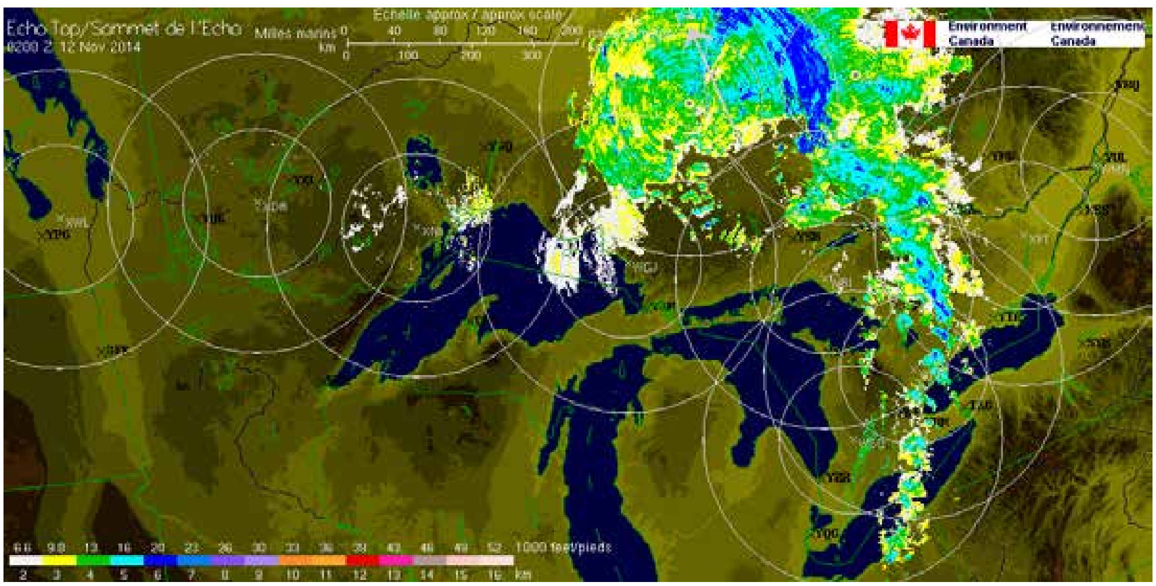
CAPPI at 1.5 km altitude, Rain valid at 0150Z 12 November 2014



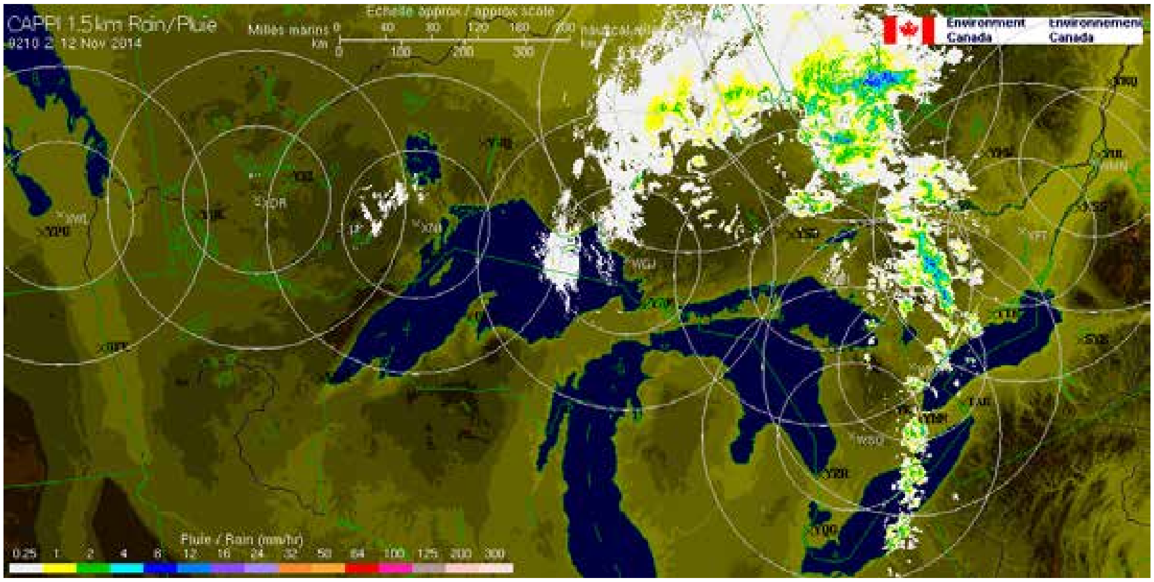
Echo top valid at 0150Z 12 November 2014



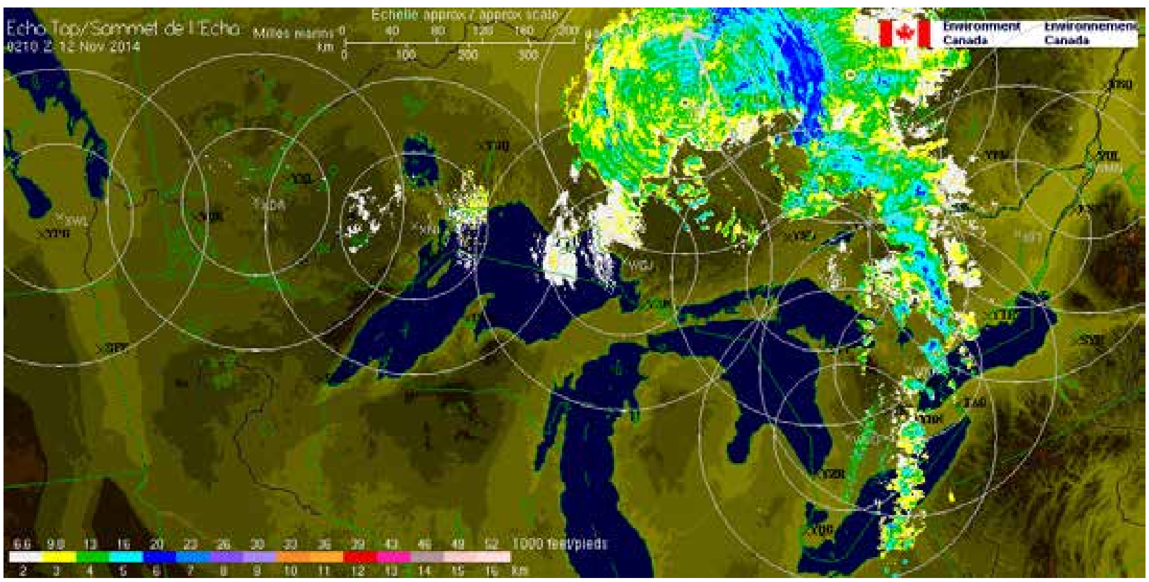
CAPPI at 1.5 km altitude, Rain valid at 0200Z 12 November 2014



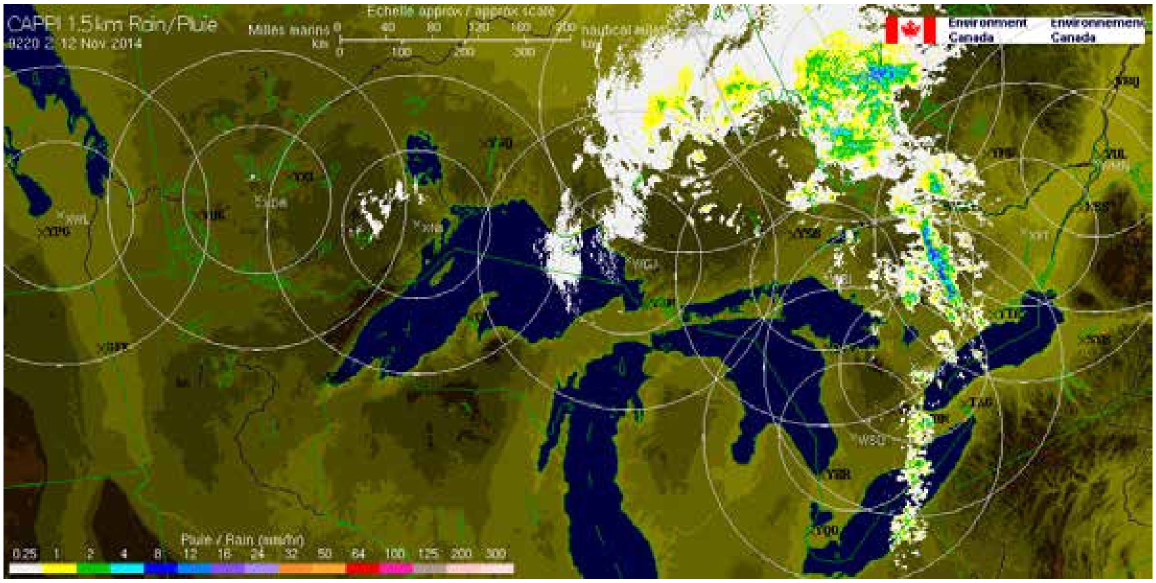
Echo top valid at 0200Z 12 November 2014



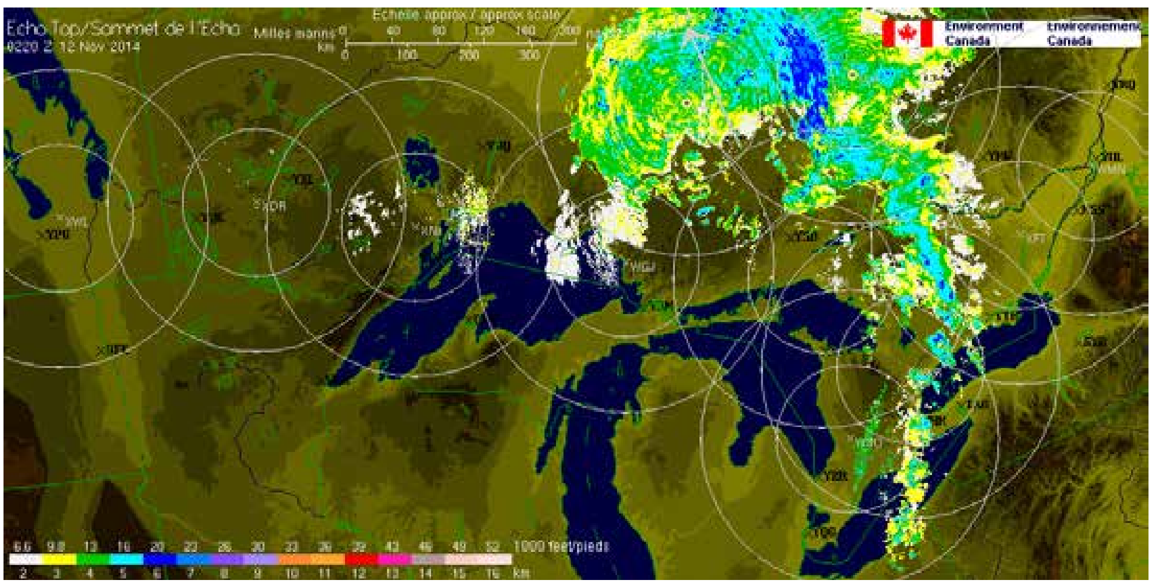
CAPPI at 1.5 km altitude, Rain valid at 0210Z 12 November 2014



Echo top valid at 0210Z 12 November 2014



CAPPI at 1.5 km altitude, Rain valid at 0220Z 12 November 2014



Echo top valid at 0220Z 12 November 2014