Transport Canada Transports Canada

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AVIATION SAFETY LETTER

In This Issue...

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Coming Into Force Dates for New Flight Crew Fatigue Management Rules

Design Eye Reference Point in Light Aircraft

Safe Egress Training During the Pandemic

TP 185E

Cover photo: Neil STOPFORTH

Canada

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Letters with comments and suggestions are invited. All correspondence should include the author's name, address and telephone number. The editor reserves the right to edit all published articles. The author's name and address will be withheld from publication upon request.

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TIPS AND TOOLS

Fit for flight? A primer on maintaining your AULA airworthiness, and successfully transferring ownership

Chris Horsten is the managing director of the Canadian Light Sport Aircraft Association*, an organization devoted to owners and pilots of AULA, LSA, and other similar aircraft. Chris is also the owner of Sport Aircraft Canada, a distributor of aircraft and avionics for the AULA and LSA markets. Chris can be reached at* *chris@sportaircraftcanada.com*

Claude Roy is a retired RCAF officer with over 35 years and over 6 000 hours of experience as a flight instructor. He also operated his own ultra-light flight school in the Ottawa area for 23 years (1997–2019)

Acronyms used in this article:

AULA—Advanced ultra-light aeroplane

BULA—Basic ultra-light aeroplane

CARs—*Canadian Aviation Regulations*

FFFF or **FFF Form**—Fit for Flight Form

POH—Pilot's operating handbook

TC—Transport Canada

An advanced ultra-light aeroplane (AULA) is defined as:

An "advanced ultra-light aeroplane" means an aeroplane that has a type design that is in compliance with the standards specified in the manual entitled Design Standards for Advanced Ultra-light Aeroplanes *(section 101.01, Subpart 1 of Part I of the* Canadian Aviation Regulations*.)*

The Light Aircraft Manufacturers Association of Canada (LAMAC) created the design standards, which have remained fundamentally unchanged since they were introduced in 1988. The rules are simple, flexible and provide for the owner to apply them in a reduced regulatory way that suits the category. This flexibility comes with great responsibility for the AULA owner and pilot.

Photo credit: Chris Horsten
AULA parts on a trailer

Each new AULA applicant requires a **manufacturer's prescribed maintenance program**. There is no standard for what that manual must contain, other than it should be adequate to allow the owner to keep their plane fit for flight (airworthy), and does not contain language that would describe it outside of the design standard parameters. As some aircraft might be registered in several categories, care must be taken to ensure that the manufacturer's maintenance and flight requirements are the final word, as there are many user groups and social media pages which might influence owners to deviate. Over the years, the complexity of AULAs has increased, along with the maintenance requirements. Owners may do well to seek professional help if they do not possess the skills necessary to properly maintain the aeroplane.

A pilot's operating handbook (POH) is not required. The manufacturer's responsibility is to make sure that through whatever means, all pertinent information is available to the pilot. This can be achieved by placards or a POH, or a combination of the two. However, almost all new AULAs are built to American Society for Testing and Materials (ASTM) standards, which include a POH, and also reflects the more sophisticated nature of many of the AULAs.

In this article, we're examining the **Fit for Flight Form** and what it means to a prospective buyer and the seller of an AULA. Unfortunately, most owners don't consider the FFF Form until it's time to sell. In fact, the *Ultra-light Aeroplane Transition Strategy* clearly states in section 3.6 Owner Responsibility:

> *The owner of an advanced ultra-light aeroplane shall maintain the aeroplane in a "**fit for flight**" condition by adhering to the* Manufacturer Specified Maintenance Program.

This statement sometimes causes confusion and results in a misinterpretation as to what "fit for flight" means, such as: If the wings are off and the aeroplane has not been flown in some time, is it fit for flight? What if the engine or prop is off? Can an FFF status be ascertained if the aeroplane is not completely assembled and ready for flight? If an older aeroplane has low hours, can the owner defer maintenance requirements on the basis that they aren't worn out yet? The absence of clear answers to specific questions often leaves owners wanting for clarity, or applying their own interpretation. When in doubt, owners and pilots are advised to contact their regional Transport Canada office. Organizations like the Canadian Light Sport Aircraft Association, whose focus is solely on AULA, LSA, and other aircraft built to ASTM standards, can also be helpful with related questions.

Alterations

When buying a used AULA, a good place for a buyer to start is with the documentation provided with the aeroplane. How did the owner document the maintenance requirements? Since there is no requirement for a log book, the buyer may have to establish a timeline and determine if all the mandatory actions, service bulletins, in addition to the regularly scheduled maintenance, have been completed. Some common additions which may not be approved include floats, skis, or ballistic recovery systems. Any changes to the original design as defined by its Type Definition require the manufacturer's written permission. These changes cannot alter the original Type Definition or result in the aeroplane being in conflict with the AULA design standards.

Some manufacturers may expect owners to seek a letter of authorization (LOA) for even small changes, while others may not. It is always in the owner's best interest to maintain a line of communication with the manufacturer and seek guidance before making any alterations. In addition to documenting changes, owners should keep copies even after the sale. If a change is considered minor, the manufacturer's response should be noted in the aircraft records along with the details of the change. Ultimately, it is the owner's responsibility to demonstrate that the aeroplane continues to conform. The FFF Form requires the vendor to certify that no modifications have been made without the manufacturer's written permission.

Unlike certified or amateur-built aircraft, AULAs do not need to file an Annual Airworthiness Information Report. It is the responsibility of the owner to document all the aircraft maintenance and deem the aeroplane airworthy. Some owners mistakenly believe they can play catch-up just prior to a sale. This is false, as the *Ultra-light Aeroplane Transition Strategy* clearly states that the aircraft must be maintained in an *ongoing* fit-for-flight status.

Repairs

Proper documentation includes recording damage history and the remedy to repair it. Sometimes an owner will make an unauthorized repair for economic reasons. Sometimes the owner may feel they are qualified to make a repair. In one case, a pilot who damaged his wingtip was in dispute with the manufacturer about the repair cost and expectations. He elected to hire some local "experts" to make a repair and did not document it in the log book. His actions not only disqualified it as an AULA, but exposed himself and those who did the work to a future liability.

When an owner decides to part with the aircraft, this is not the time to be asking, "Can I honestly sign off on the FFF Form?" Experience has shown that often the vendor or purchaser will refuse to sign the form. In some cases, a broker may refuse to participate in or witness the sale. This should be a red flag for any buyer. It becomes very troubling when a purchaser's strong desire to own the aircraft (a deal I can't pass up) will influence them into accepting an aeroplane that is not fit for flight, and therefore falsifying documents. Some obvious cases include: disassembled aircraft, removed engine, or having undocumented/unapproved modifications. Clearly, anything that does not permit the vendor from signing off that all required actions have been completed, and that the Type Definition has not been compromised, needs to be investigated further and rectified before the transaction takes place.

Although the form is quite simple and concise, there is a fear that it contains language that would create an unwanted liability to the vendor after the sale. In fact, signing the form does not increase the vendor's risk of being sued or of being found liable (that risk is already present as it is for any aircraft) inherent in any transaction. The owner's best defence is to follow the manufacturer's prescribed maintenance program and, if the owner has completed all actions expected of them to properly maintain the aeroplane, they will likely be able to provide documentation of the service history as stated in section 3.6 Owner Responsibility:

> *Section 3.6 Owner Responsibility: The owner of an advanced ultra-light aeroplane shall maintain appropriate records for the aeroplane which must include scheduled maintenance, mandatory action, modifications, and accident repairs.*

If, however, a vendor has little or no documentation, then the aircraft is suspect and the buyer should reject the sale.

What is the purpose of the FFF Form?

The FFF Form is TC's way of ensuring that the onus falls on the parties in the sale to ensure that the aeroplane continues to conform to the manufacturer's Type Definition, and that it has been properly maintained. TC has neither endorsed or approved any aspect of the aircraft and relies solely on the manufacturer's assertion that the aeroplane meets the design standard, and that the owner has completed the appropriate actions to maintain it. The end objective is to ensure that these passenger-carrying aircraft meet a standard that is worthy of that privilege.

There are many misconceptions about liability when it comes to signing off on the FFF Form. Here are some things that the form does and doesn't do:

What the FFF Form does:

- Records that the responsibility for all maintenance prior to the sale has been formally accepted by the seller.
- Records that the responsibility for all maintenance following the sale has been formally accepted by the buyer.
- Records that the buyer is satisfied with the condition of the aeroplane.
- Declares that no undocumented/unapproved modifications have been made.

What the FFF Form does not do:

- Relieve the purchaser from verifying the aircraft is airworthy or fit for flight.
- Guarantee the aircraft is airworthy.
- Create a liability to the vendor.
- Discharge the liability of the vendor for actions performed while they owned the aircraft, including maintenance, repairs, or alterations.

Below is a copy of the wording provided by Transport Canada, which must be on the form.

Fit for Flight Form Advanced Ultra-light Aeroplane

Registration: ________________________________

Serial Number: _______________________________

Make: _____________________________________

Model: ____________________________________

Manufacturer: ________________________________

I certify that the custody and control of the advanced Ultra-light Aeroplane described herein has been transferred to (name of new owner).

The aeroplane has been maintained in accordance with the Manufacturer Specified Maintenance Program, all mandatory actions have been completed, and no modifications have been made to the aeroplane without the written approval of the manufacturer.

Signature of Registered Owner/Date ____________________________________

I hereby accept the custody and control of the advanced Ultra-light Aeroplane described herein and have inspected the aeroplane and have found the aeroplane to be as described by the registered owner and is fit for flight.

Signature of New Owner/Date ____________________________________

The legal ramifications

By itself, the form does not contain a lot of ominous language that should prevent a diligent owner from signing off for a sale. The owner need only attest to having carried out the requirements of the maintenance program and not having modified the aeroplane without written permission.

This author is not aware of any cases where the adequacy of these statements has been tested either by Transport Canada as a result of an enforcement action, or in a court of law due to a litigation. There is an accepted risk associated with any activity such as flying, alpine skiing, or riding a skateboard. That understanding is undertaken by each person who participates. With an AULA, it’s a little different because the aeroplane can legally carry a non-aviation passenger. There is a duty of care to act in a way that provides for the safety of that passenger. Bending or breaking any of the rules or neglecting the guidance we have been given to ensure the safe operation of an AULA could be considered negligence in a civil case, and possibly warrant fines or sanctions from TC.

Best practices

As a best practice, I advise every owner to treat their AULA as if it was a commercial passenger-carrying plane. In other words, maintain the highest standard of maintenance and record keeping you practically can. When it comes to protecting your life, your passengers’ lives, and your investment, there is no substitute for a well maintained and documented aircraft. Keep a comprehensive log book just as you would for a certified aeroplane. The standard Canadian journey log used by all certified aircraft is perfect. Maintain a file with all receipts, annual or periodic inspection reports, and any other details that would help identify a negative trend.

Provide detailed descriptions of your maintenance, and date and sign off your work. Owners should always obtain clear evidence that changes or repairs were authorized by the manufacturer, so that it cannot be disowned at a later date. When it comes time to sell, you will have the benefit of negotiating for the full value of your plane based on a well-documented pedigree. If you are buying a used AULA, it would be a good idea to contact the manufacturer and ask for a list of all the service bulletins and mandatory actions to compare with what the vendor has declared. Once you have purchased the aeroplane, it’s also your responsibility to register with the manufacturer to enable them to continue supplying service bulletins and alerts. If you fail to advise the manufacturer, or if your aeroplane becomes orphaned, it could result in it becoming ineligible for AULA status.

If you’ve purchased a plane in the past which you think may have a questionable history, there is no time like the present to begin a comprehensive inspection and maintenance program that exceeds the manufacturer’s requirements to bring it up to spec. With some time and effort, you may be able to restore your aircraft’s integrity and its value, while relieving yourself of the worry of flying an unknown aircraft. If this is the case, it’s probably a good idea to contact the manufacturer to find out what’s been updated on the plane and go through it in detail, bringing each trouble area up to date. Don’t forget to document it!

Last words

The regulations contain consequences for deviating from the expected maintenance routine. When an aircraft fails to meet the requirements anymore, its certificate of registration is automatically cancelled and it is no longer flyable. The owner should inform TC so that it can be removed from the registry. If it meets the definition of a BULA, the owner can re-apply to register in that category. If it doesn’t meet the spec for a BULA, it must be permanently removed from the aircraft registry and is no longer flyable. Keep in mind that a pending modification or service item doesn’t mean the plane is disqualified, but the manufacturer might require the aircraft to be grounded until an update is completed. Some pilots believe that if the aircraft fails to meet the guidelines, they can continue operating it under BULA rules, but this is false. The regulations are clear on this: Transport Canada must be so advised, and the aircraft AULA registration is cancelled. Presuming you can convert to a BULA, you would still lose these two privileges: passenger carrying and 32 lb of useful load. Furthermore, aircraft registered BULA require their owners to wear a helmet. If we want to protect our privileges within the AULA community, we all need to do our part in keeping our aircraft properly maintained and operated safely. Doing so could save your life and the life of your passengers.

The following links are available on the Transport Canada website:

Ultra-light Aeroplane Transition Strategy

AULA Responsibilities—Overview

AULA Owner Responsibilities

AULA Manufacturer Responsibilities

Organizations whose focus includes ultra-light aircraft:

Canadian Light Sport Aircraft Association

Ultralight Pilot's Association of Canada △

ON THE RADAR

Open-water swimming

by Greg Maitinsky, founding member and marathon swimmer, GLOW Swimming

Pilots have a unique vantage point on the terrain below them. When flying over or using open bodies of water for take-off and landing, you might notice open-water swimming enthusiasts in lakes, rivers, and oceans.

We, the Open Water Swimming community, would like to introduce ourselves to you.

We usually swim close to shore and tend to stick together in pods for safety, just like dolphins do. We try to avoid high-traffic areas and often share our lane with kayaks, canoes, and small watercraft. Occasionally, we might even cross paths with taxiing floatplanes and flying boats.

Photo credit: Greg Maitinsky
Open-water swimmer

Swimmers in open water usually—but not always—pull fluorescent buoys/floats behind them for more visibility and for enhanced safety. However, our line of sight is limited and being submerged in water, we are very minimally tuned in to surrounding sound/audio clues. In addition, due to our relatively slower speeds, our collision avoidance capability is extraordinarily little when compared with watercraft.

We ask for your help to watch out for us in case we do cross paths. And if you are ever walking on shore and see a group of us, feel free to join! △

REGULATIONS AND YOU

Coming into force dates for new flight crew fatigue management rules

Stuart Doyle, Civil Aviation Safety Inspector, Commercial Flight Standards, Transport Canada

New prescriptive rules for flight crew fatigue management and regulations pertaining to fatigue risk management systems were published in the Canada Gazette, Part II, Volume 152, Number 25 on December 12, 2018. As part of the transitional process, the implementation dates for various subparts of CARs were phased in over a four-year period and table 1 shows the elements of the program and the dates they come into force.

Table 1

CARs Operating Rule	Prescriptive approach (Regulations)	Performance-based approach (FRMS)
Subpart 702 (Aerial Work)	New Division X 702.91 In force December 12, 2018	Optional – comes into force December 12, 2020
Subpart 703 (Air Taxi Operations)	New requirements come into force December 12, 2022	Optional – comes into force December 12, 2022
Subpart 704 (Commuter Operations)	New requirements come into force December 12, 2022	Optional – comes into force December 12, 2022
Subpart 705 (Airline Operations)	In force December 12, 2020	Optional – In force December 12, 2020
Medevac Flights	New Division IV (700.100)	Optional – coming-into-force date depends on operating rule

Although the new regulations are already in force for subparts 702 and 705, the remaining subparts (703 and 704) are still operating under the prescriptive rules that were in force on December 11, 2020. The new rules for 703 and 704 come into force on December 12, 2022.

This transitional provision is published in the Canada Gazette, Part II, Vol. 152, Number 25, at section 19.

The following advisory circulars (AC) are available and should be read in conjunction with the applicable regulations:

- AC 700-045 Exemption and Safety Case Process for Fatigue Risk Management Systems
- AC 700-046 Fatigue Risk Management System Requirements
- AC 700-047 Flight Crew Fatigue Management—Prescriptive Regulations

If you have any questions about the new flight crew fatigue management rules, please use the following mailbox: TC.FCFM-GFEC.TC@tc.gc.ca△

CASA 2021-02—Aluminum seat belt mounting bracket failures

Attention: OWNERS, OPERATORS AND MAINTAINERS OF CESSNA 120 AND 140 AEROPLANES

The purpose of this Civil Aviation Safety Alert (CASA) is to raise awareness of concerns with failures of aluminum seat belt mounting brackets addressed in the Federal Aviation Administration (FAA) Special Airworthiness Information Bulletin (SAIB) CE-15-13, and of the ongoing safety assessment undertaken by the FAA. △

New TC AIM Issue 2021-01

A new issue of the Transport Canada Aeronautical Information Manual (TC AIM) was published on March 25, 2021.

The TC AIM provides information on rules and procedures for aircraft operations that are of interest to pilots, including remotely piloted aircraft (RPA).

In the new 2021-1 issue, more information was added and the text was amended to clarify these sections of the *RPA* chapter: *2.0 micro RPA, 3.2.13.1 Types of altitude, 3.2.34 Transponders and Automatic Pressure-Altitude Reporting Equipment, 3.2.35 Operations at or in the Vicinity of an Aerodrome, Airport, or Heliport Information, 3.2.37 Incidents and Accidents and 3.4.5 Operations at or in the Vicinity of an Airport or Heliport—Established Procedure*.

The next edition of the TC AIM 2021-2 will be issued on October 07, 2021. △

The Civil Aviation Daily Occurrence Reporting System (CADORS)

Sherry Reid, Manager, Aviation Safety Research and Analysis, Transport Canada

Why CADORS?

Good safety information is key to the continuous improvement of aviation safety. As the main source of aviation occurrence information in Canada, the Civil Aviation Daily Occurrence Reporting System (CADORS) is an invaluable aviation safety tool.

Over the last five years, Transport Canada Civil Aviation (TCCA) has received an average of 16 750 aviation incident and accident reports annually—that is roughly 45 per day! CADORS collects and tracks the details of each occurrence and the information is used by stakeholders inside and outside TCCA to identify and monitor safety issues.

Launched in 1985, CADORS was created to provide timely information about civil aviation occurrences. It is also used to capture information that Air Traffic Services (ATS) operations certificate holders are required to report under *Canadian Aviation Regulations* (CARs), section 807.01.

There is a lot of value in collecting aviation occurrence information. Occurrence reporting and incident follow-up ensures that:

- TCCA has a record of civil aviation occurrences that is as accurate as possible and up to date;
- Civil aviation stakeholders are notified of occurrences;
- Underlying hazards in the aviation system are identified; and
- Occurrences are evaluated to identify the underlying factors that need to be addressed in order to eliminate or mitigate risks, thus maintaining aviation safety.

How is the information used?

The information gathered in CADORS is often used in the early identification of potential hazards and system deficiencies, and in the assessment of associated risks. CADORS data is further used by TCCA personnel and external stakeholders to follow up on specific events, develop safety communications, and develop reports and studies on potential safety issues.

Where does the information come from?

NAV CANADA provides about 80% of aviation occurrence information used to create a CADORS record. That information is provided in an aviation occurrence report (AOR). Other sources of information used to create a CADORS record may come from the Transportation Safety Board (TSB), Royal Canadian Mounted Police (RCMP), aircraft operators, and other government agencies.

NAV CANADA sends AORs to Transport Canada Aviation Operations (AVOPS) via e-mail. The CADORS application receives the individual AOR and adds it to the AOR list where Aviation Safety Research and Analysis (ASRA) staff enter the data into CADORS to create a record. ASRA retrieves missing information by consulting multiple sources. A quality assurance review is performed prior to the record being translated and

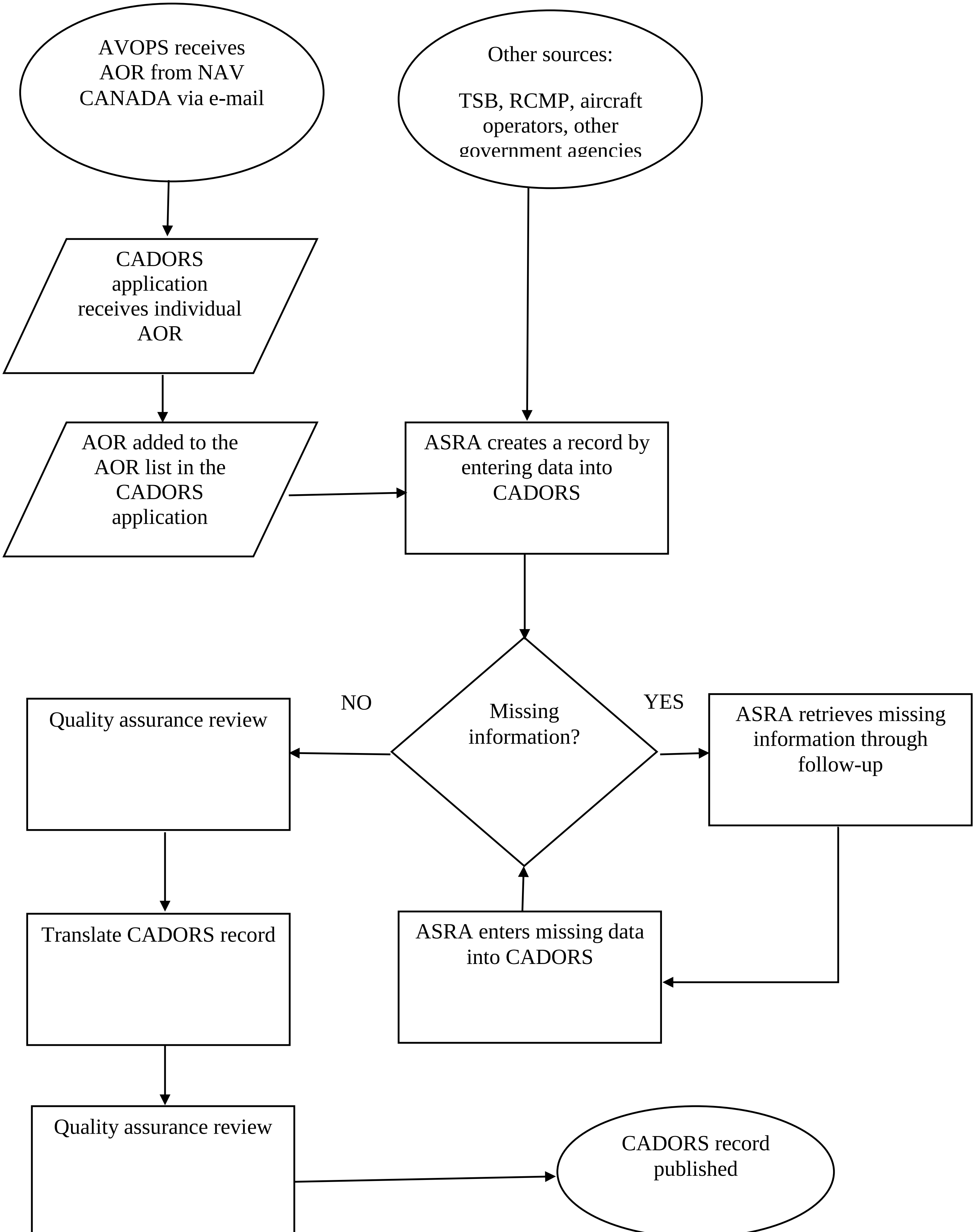

Figure 1: Creating and processing a CADORS record

finally published. The flowchart in Figure 1 outlines this process. Although CADORS data is considered preliminary, it is updated as required to include additional information or corrections.

ASRA is in the process of updating its CADORS manual to include current information on the criteria and reporting procedures for reporting an aviation occurrence as per section 807.01 of the CARs.

What does CADORS tell us? A snapshot of high-level event data

Regional analysis

Analyzing CADORS data helps us identify where aviation incidents and accidents are happening.

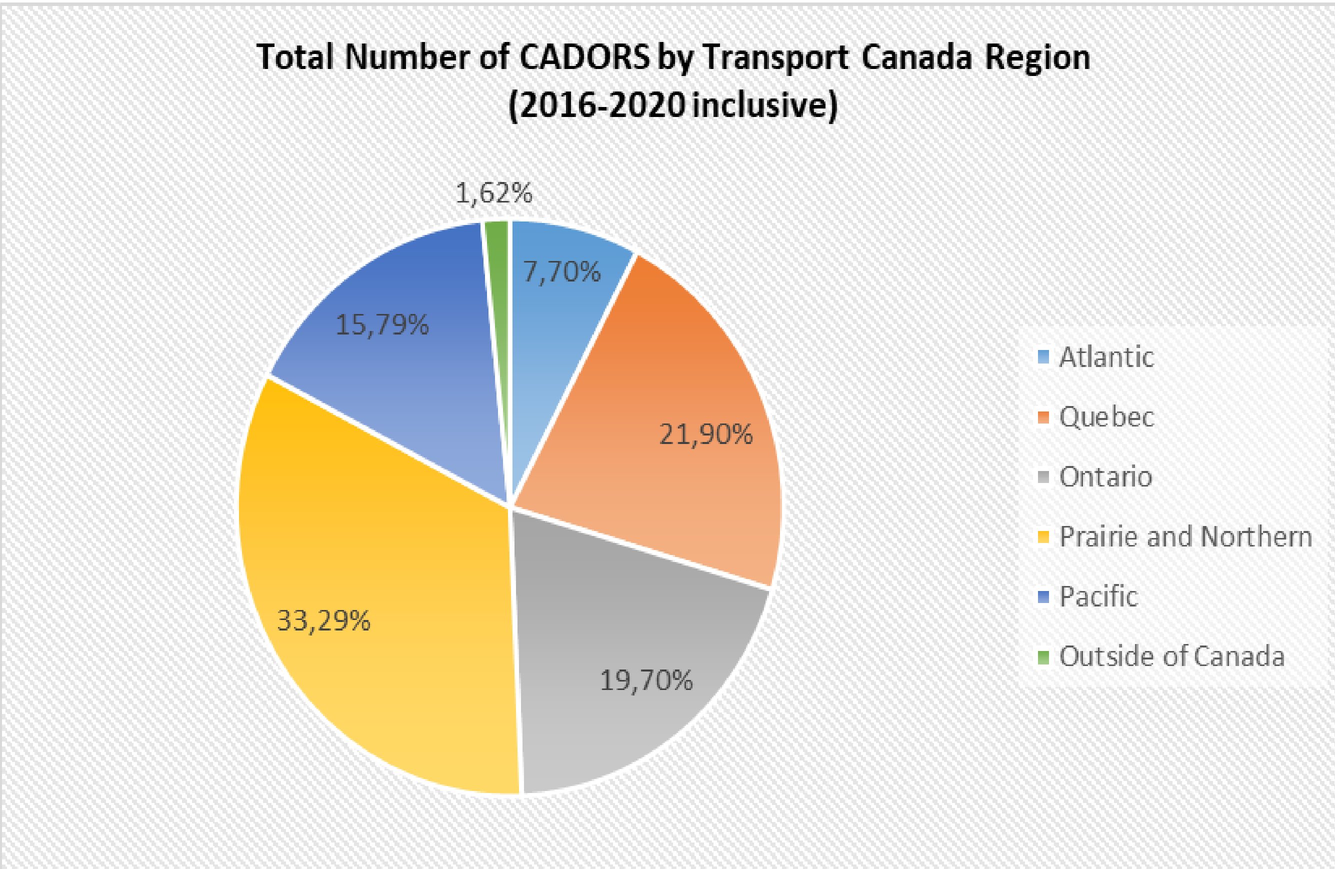

Figure 2: Total number of CADORS by Transport Canada region

Between 2016 and 2020, approximately one-third of aviation incidents and accidents reported in CADORS occurred in the Prairie and Northern Region (comprising Manitoba, Saskatchewan, Alberta, Nunavut, Northwest Territories and Yukon), while Quebec and Ontario Regions accounted for almost 55% of occurrences.

Event analysis

Analysts assign one or more events to each CADORS record based on the details of that occurrence. Events can describe something that happened to an aircraft (e.g. hard landing, diversion, navigation error, etc.) or something that happened within the aviation system (e.g. aerodrome, runway or taxiway shutdown, foreign object debris, etc.), and provide a short description of what happened during an occurrence.

Assigning an event or events to a record helps to categorize occurrences in CADORS and improves our ability to analyze data. Analyzing events allows us to perform immediate follow-up on more high-risk events while looking for trends and emerging risks through aggregate analysis.

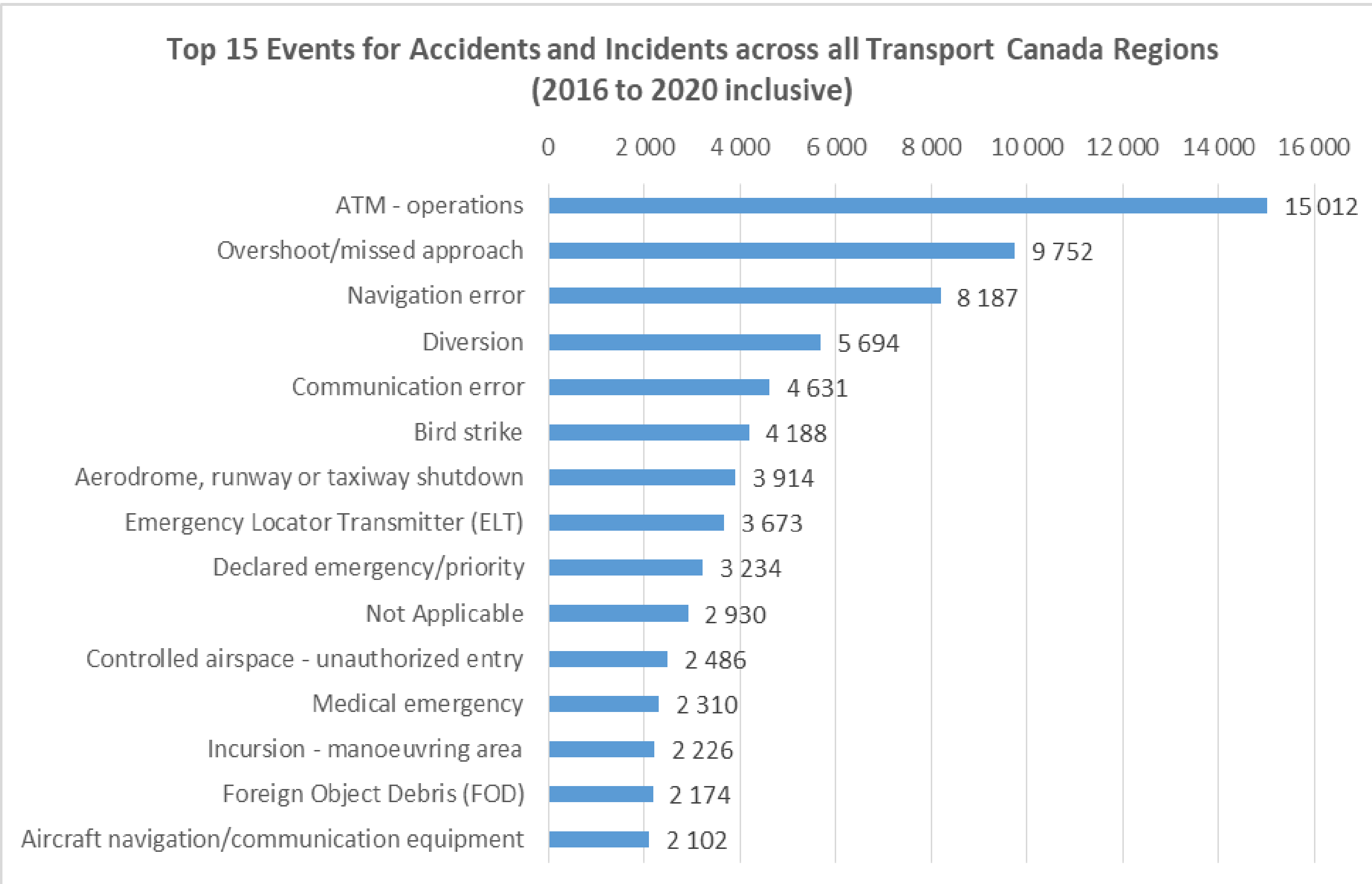

Figure 3: Top 15 events for accidents and incidents across all Transport Canada regions

The 15 most frequent events assigned to CADORS records over the last five years (2016 to 2020) accounted for 62% of all occurrences. Over that five-year period, "ATM—operations"[1] events accounted for 13% of occurrences, while 8% involved an overshoot or missed approach, 7% involved a navigation error, and 5% involved a diversion. The remaining events were each involved in less than 5% of occurrences.

Using CADORS data to analyze events provides an accurate view of what is happening and can lead to systemic improvements. For example:

- In 2018, TCCA implemented a Laser Attacks Strategy, including interim orders, to address the danger of hand-held laser attacks against aircraft. Since the implementation, the number of reported laser attacks has decreased significantly. Additionally, regulations replacing those interim orders came into force in June 2020. CADORS data on occurrences involving laser strike events are provided to relevant TCCA personnel on a monthly basis and helped identify the risk and track progress. The data provided evidence needed for analysis and hazard identification, and subsequently a regulatory amendment.
- The TSB has made several recommendations, calling on Transport Canada to improve the approach ban regulations in order to reduce the risks associated with approaches in low-visibility conditions. As part of its work to develop proposed amendments to the regulations in this area, CADORS data were used to identify where landings below aerodrome visibility had taken place. While additional follow-up is required to determine what these events tell us about the effectiveness of the current approach ban regulations, they provide helpful context to understand the bigger picture related to low-visibility operations.
- Finally, CADORS data has been used to support operational safety reviews on particular aircraft types such as the Robinson helicopter and the Embraer 505 series of aircraft.

Collecting data and analyzing events helps us to improve the system and identify minor risks before they become major. Reporting aviation occurrences helps keep CADORS data current, risk analysis relevant, and promotes data-driven decision-making.

Accessing CADORS data

Stakeholders and members of the public can subscribe to CADORS daily reports to receive aviation occurrence information at the national, regional, operator and/or aerodrome level. An individual can subscribe or modify their subscription from Transport Canada's CADORS Web site. CADORS daily reports are available in French and English.

For more information, you can contact the CADORS administrator at CADORS-SCREAQ@tc.gc.ca. △

[1] *"ATM—operations" events means that there was a temporary reduction in the level of service provided by air traffic management due to a late opening, early closing, hours extended, staff shortage or evacuation.*

INSTRUCTOR'S CORNER

Design eye reference point in light aircraft

by Michael Schuster, Chief Instructor, Aviation Solutions

Have you ever had a student who can't land? Take off straight? Or even taxi properly? There is a human factors element in aircraft design called the Design Eye Reference Point (DERP) which is frequently overlooked by flight instructors and general aviation pilots, which can have a remarkable impact on how well a pilot performs.

Let me start by saying that I recently rediscovered a handout on DERP that I received from the late Mike Spence, a TC inspector whom I had the privilege of doing both my Class 4 and Class 2 initial flight tests with. Some of the information in this article is drawn from his original work in 2003, for which I give him credit and thanks.

First, it's important to know that every aircraft has a DERP built in by aircraft engineers. In transport category aircraft, it's readily available information… the pilot adjusts his or her seat up/down and fore/aft until the alignment "balls" match. Ideally, the aircraft has adjustable rudder pedals that are now moved into position so that the pilot has full range of control.

When sitting in the correct DERP, the pilot has the best view of both the instruments and the outside world. According to the *SAE Dictionary of Aerospace Engineering*, the Design Eye Position is defined as "a point fixed in relation to the aircraft structure at which the midpoint of the pilot's eyes SHOULD be located." The *Aeronautical Information Manual* (Airmanship 4.12) goes on to highlight that the pilot should also be comfortable.

Photo credit: Michael Schuster
Example of a DERP

In light aircraft, there is indeed a DERP, but because of the small size of the aircraft, there are generally no clear mechanical indicators to align the pilot's eyes. However, a simple method can be used. Keep in mind that a good portion of the engine cowling should be visible to facilitate manoeuvres: approximately a 15-degree angle of view over the nose will accomplish this.[1]

Pilots should adjust their seat to where they think they should be sitting (and yes, this may involve cushions and phone books—there is still a purpose for printed yellow pages). Have someone else walk approximately 30 ft in front of the airplane. The pilot should be able to see the feet of that person. If not, the pilot needs to raise their seating position. If they happen to be sitting quite high, lower the pilot's seat, if possible.

I have done this many times, nearly always with great success in student performance. Flight instructors should consider investigating where a student's eyes sit at the beginning of any training in a new airplane type in order to give the student the best chance of success. Not only does it give the student the proper visibility to assist with flight manoeuvres and taxiing, but by having the instructor's and student's eyes at the SAME height (the correct DERP), instruction will also be more effective.

Finally, if a reasonable eye position cannot be achieved, it is highly recommended that another aircraft be selected more appropriate to the physical size of the pilot. Additionally, when determining the optimal position, pilots must be careful to ensure that all controls can be easily moved through their full range, no large head movements are necessary to scan outside or the instrument panel, and all warning lights remain visible.

A version of this article originally appeared on aviationsolutions.net. *Mike Schuster is an experienced Class 1 flight instructor who has taught at all levels, from ab initio to airline. He is the chief instructor at Aviation Solutions, which is an authorized Flight Instructor Refresher Course provider for rating renewal.* △

[1] Human Factors Considerations in the Design and Evaluation of Flight Deck Displays and Controls, FAA (Section 2.3)

ASL instructor's corner

The purpose of the ASL instructor's corner is for instructors to share past instructing/teaching experience with the ASL readership.

Submitted articles can be addressed to a variety of readers, instructors, student pilots, private pilots, and glider, ultra-light or commercial pilots. In fact, this issues's article is for any type of student that an instructor may encounter in the course of their career, whether it be for a licence or a rating. The most important thing is that, at the end of the article, a lesson has been learned.

Your submissions can be as basic as attitude and movement for private pilot training, to night rating, multi-IFR or seaplane rating, teaching tips for instructors. It can also be tips to increase aviation safety or to be better prepared for a flight.

It's up to you, as long as you have your instructor's hat on when you're writing your piece.

If you would like to submit an article or would like more information, please send an email to the following address: jim.mulligan@tc.gc.ca△

Safe egress training during the pandemic

by Bryan Webster, Aviation Egress Systems

Photo credit: Bryan Webster
Glassy water

Summer is in the air and with any hope the Covid pandemic we have all been subjected to is now at least under control or mostly in the rear-view mirror. Aviation is unfortunately still facing many challenges, which are being dealt with on a regular basis by both private and commercial operators as regulations change daily.

Aviation Egress Training was all but shut down in March 2020 due to pool facility and health protocols; thus, we elected to ride out the storm in a number of different ways.

Like many businesses negatively affected by the pandemic, we had few calls, so catching up on missed inquiries took a matter of minutes once we were back in the office. As fall weather set in at AES (Aviation Egress Systems) we had an opportunity not normally afforded to us regarding time, allowing for new ideas to formulate and turn into reality. With that being said, we have been working diligently on updating our Dry Egress Training as newer technologies pertaining to our original site (now five years old) required maintenance upgrades.

Fresh and up-to-date information is important to any online service and will be available shortly with exciting new graphics and technologies at www.egresstraining.ca.

This improvement also allows AES Dry Egress to be more acceptable to commercial seaplane pilots regarding their ground school when Egress Training mandated training takes place in less than a year on February 23, 2022. Once Covid rules relax, AES will be more available for Wet Egress Training across Canada, insuring all health regulations are complied with, including a specifically designed neoprene in-water mask.

Since 1998, AES has pioneered egress training with well over 6 000 students ready to deal with any water emergencies. Personally, I have witnessed numerous situations regarding student behaviours in our pool equipment at 63 locations, from Inuvik to Quebec and everywhere in between. From those observations, AES has been working diligently on a number of innovative seaplane safety products that will be announced once testing has been completed.

As well, Pitt Meadows B.C. Airport has teamed up with Airworthiness Resources, using their time wisely to design a Cessna 206 rear cargo door modification. For over 50 years, Cessna engineers, plus numerous other agencies, had attempted to solve the issue without success. Today, thanks to their dedication to safety, an STC'd door kit is available that allows for easy exit out the once near impassable configuration with flaps down. For further information, check out www.coastdogaviation.com.

With summer arriving shortly and all of those previously ice-covered lakes opening up, it's a great time to practise a few takeoffs and landings to become reacquainted with your aircraft. I suggest this to all pilots previous to loading up friends and family for their first flight since a winter of aviation inactivity.

If possible, practise a few of the many environmental seaplane challenges such as water conditions like rough, windy or calm. Glassy water, for example, is also well known to require a great deal of concentration and demands the utmost respect, requiring advanced skills—even the most experienced of pilots take it very seriously. In the event any pilots are not well prepared or taught how to handle this condition, the mirror-like illusion creates a sense of landing well above or below the actual surface. The consequences for error can be, and have been, in many seaplane accidents, catastrophic, proven by the well documented statistics over the years. It is highly suggested seaplane pilots who have not practised the proper method to set up for and land in this condition seek out an experienced individual before attempting it on their own.

For amphibious pilots, a colour-coded checklist with blue for water can be an important part of ensuring your landing gear is in the appropriate position for both landing and taking off. Landing with gear in the inappropriate position could be expensive on land or possibly life-threatening with wheels down in water.

Another common mistake for seaplane pilots is not realizing a missing float ball or plug may allow for rapid overloading of any float compartment with water during taxi or takeoff. A few have found out the hard way at night tied to a dock that wave action alone is capable of flooding unplugged compartments, which may cause the aircraft to submerge. Leaky floats within reason are one thing that may be dealt with until repairs are performed by pumping out excess water as required. Understand though, that in the event an aircraft float is damaged or unsealed and large amounts of water enter, for any floatation chamber weighing 10 pounds per gallon (or 4.5 litres), instability takes place. Once the aircraft gets airborne, there could be a sudden change in performance or worse, making it difficult to control. Float flying gives aviators the ability to enjoy wonderful far-off places where there is often little support in the event of an accident, so always remain proficient and ready for anything Mother Nature throws at you.

For commercial seaplane operators, be advised that new PFD (personal flotation devices) regulations will be in effect as of June 6, 2021. No doubt all affected companies have been made aware of the changes, although further information may be found on the TC Web site.

Pilots flying wheel-equipped aircraft departing from many of our airports located next to lakes or oceans should also at least consider their emergency ditching procedures in advance. The reason is low wing versus high; fixed gear or retractable configurations all have different procedures should a water landing be inevitable.

Remember, pilots have responsibilities to safeguard their passengers and equipment, which is why any training should be considered invaluable in the event an unforeseen situation arises.

With that being said, it may be time to review your POH in advance in order to remain up to date should you need to draw from those memory items.△

RECENTLY RELEASED TSB REPORTS

The following summaries are extracted from final reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified. Unless otherwise specified, all photos and illustrations were provided by the TSB. For the benefit of our readers, all the occurrence titles are hyperlinked to the full report on the TSB Web site. —Ed.

TSB Final Report A19Q0146—Collision with terrain

Background

At approximately 0830 on 22 August 2019, the pilot began his day with a pre-flight check of the float-equipped Cessna U206G aircraft. The pilot was scheduled to conduct sightseeing flights under visual flight rules (VFR) from and to the Lac-à-la-Tortue Water Aerodrome (CSU7), Quebec.

That morning, the floatplane was fuelled, with each of its two tanks filled to approximately 20 gallons. The pilot then conducted three sightseeing flights of approximately 20 minutes each. After these three flights, the pilot checked the remaining fuel level using a home-made dipstick. He noted 10 gallons in the left tank and 15 gallons in the right tank. Knowing that the floatplane used approximately 5 gallons per sightseeing flight, the amount of fuel noted by the pilot was enough for the three remaining sightseeing flights to be conducted in the afternoon, while keeping the mandatory minimum reserve required for 30 minutes of flight.

The pilot then conducted his first two afternoon flights. He took off in a northeasterly direction, following a departure path that provided a greater distance of the lake's surface than a takeoff fully into the wind (Figure 1). After flying his usual flight path, he returned and landed in a northwesterly direction, into the prevailing wind.

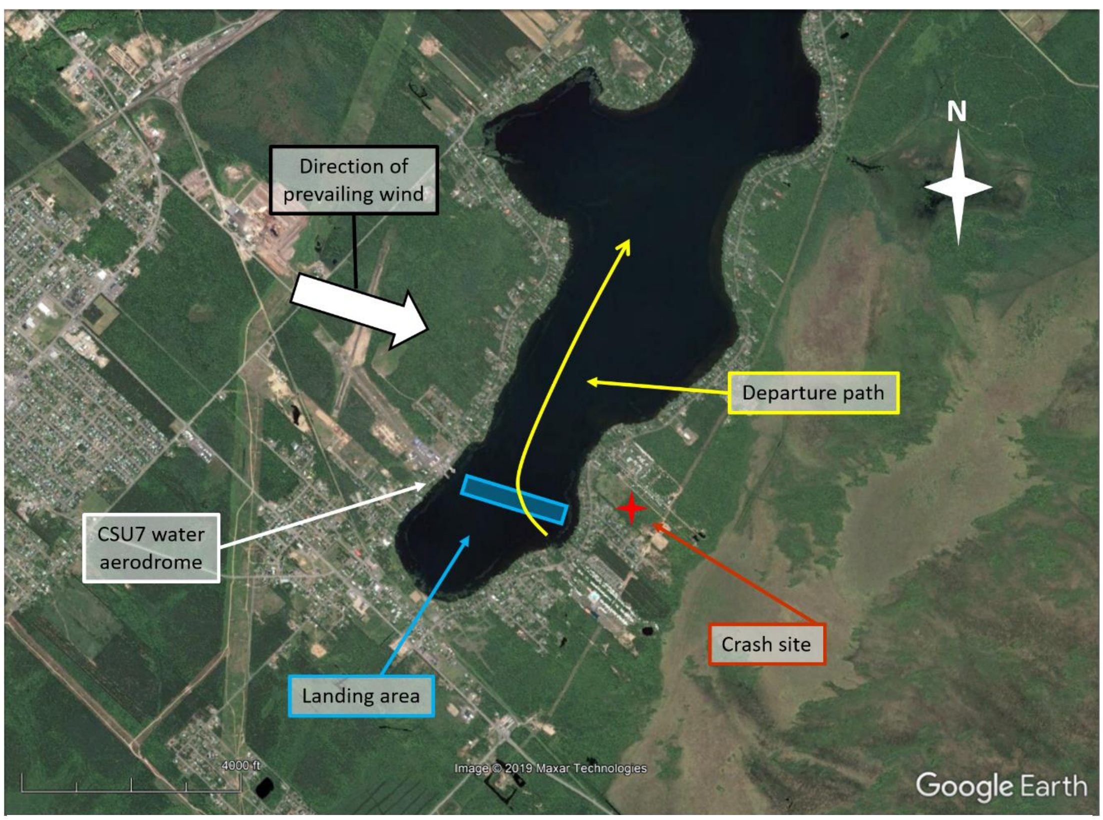

Figure 1. Map showing the departure path, the landing area, the direction of the prevailing wind and the crash site (Source: Google Earth, with TSB annotations)

History of the flight

At approximately 1450, the pilot took off for his third sightseeing flight that afternoon, using the same departure path as the previous two flights. The pilot and five passengers were on board. As the pilot was returning to CSU7, at approximately 3 nautical miles (NM) northwest of the water aerodrome, another aircraft was also heading to the water aerodrome. The occurrence pilot communicated to the other pilot that he would let him land first and that he would extend his own flight in order to maintain safe separation.

The flaps were set to 20° in preparation for landing, and at approximately 1507, as the pilot was turning northwest for the final approach, the engine stopped. The pilot steered the floatplane toward a wooded area to avoid a campground ahead. At the same time, he carried out the emergency procedure for an engine failure. He set the fuel selector to the left tank and turned on the auxiliary electric fuel pump. The engine restarted 5 seconds after it had stopped.

As per the emergency procedure, the pilot then turned off the auxiliary electric fuel pump. Six seconds later, the engine stopped again. As the floatplane was grazing the treetops, the pilot focused on flying the aircraft in order to avoid stalling in the trees. The pilot attempted to restart the engine by turning the auxiliary electric fuel pump back on, but was unsuccessful, and the floatplane struck the trees immediately afterward, 6 seconds after the second engine failure. The floatplane came to a stop in the woods approximately 1 000 ft from the lake. The pilot received minor injuries to the head, one passenger received minor injuries, and the other four passengers were not injured.

Once he saw that all of the passengers appeared to be unharmed, the pilot opened the main door on the aircraft's forward left side and broadcast a message on the radio to report an engine failure. A passenger attempted to open the rear-right-cabin double-cargo door, but the door was jammed because the flaps were down. The pilot secured the aircraft while the passengers exited using the main door. The pilot then exited the aircraft.

Pilot information

The pilot held a commercial pilot licence–aeroplane, with a seaplane rating and a valid Category 1 medical certificate. He was trained in accordance with the operator's approved training program.

The investigation did not find any indicators that the pilot's performance was degraded by fatigue or physiological factors.

Aircraft information

The occurrence floatplane was built in 1982 and was certified, equipped and maintained in accordance with existing regulations and approved procedures.

The floatplane had no known deficiencies, and it was being operated within its weight and centre-of-gravity limits.

Accident site and wreckage examination

The area surrounding the wreckage, approximately 1 000 ft southeast of the lake, was a woodland with large, deciduous trees. The first signs of an impact with trees could be found approximately 250 ft southeast of the wreckage (Figure 2).

Figure 2. Occurrence aircraft wreckage (Source: TSB)

A brief examination of the engine by investigators found no signs of a defect that could have caused the sudden engine failure. The propeller showed signs that are consistent with it still turning on impact.

The forward cargo door was partially open and jammed because the flaps were down. This issue, specific to the Cessna 206, was identified and analyzed during TSB investigation A18W0129 and resulted in Aviation Safety Advisory A18W0129-D1-A1. The rear cargo door of the occurrence aircraft was closed and the locking lever was in the stowed position. Investigators attempted to open the rear cargo door, but the top of the ladder was bent from the impact and was preventing the rear cargo door from being opened (Figure 3).

The cabin was not damaged. The shoulder harnesses for the front seats were found stored in their respective compartments. The fuel tank selector was in the "OFF" position, which was consistent with the pilot having secured the aircraft. A portable GPS (global positioning system) device was found on the accident site, but it did not have any data on the flight path.

The wings were damaged, but the two fuel tanks were intact, and there were no signs of a spill. The tanks and fuel lines were drained to check the amount of fuel remaining: the right tank contained 0.33 gallons, the left tank contained 3.58 gallons, and the fuel lines contained 0.29 gallons.

Fuel management

The fuel supply system includes two pumps: an engine-driven mechanical pump and an auxiliary electric pump, activated by a switch in the cockpit. An examination of the two pumps revealed no deficiencies; they were functioning properly.

Figure 3. Double cargo door of the occurrence aircraft after the accident (Source: TSB)

The floatplane had two fuel tanks, with a total capacity of 92 gallons. According to the manufacturer, the quantity of unusable fuel per tank is 2 gallons. The pilot uses two fuel gauges, one for each tank, to determine the amount of fuel left. The fuel tank selector valve has three positions (LEFT, OFF, RIGHT), which enables the pilot to select the left or the right tank to fuel the engine.

The fuel gauges were serviceable for the flight and met the aircraft certification basis criteria. However, it seems that the pilot did not rely on the information provided by the fuel gauges because it was not always accurate. The TSB has already investigated the well-known lack of precision of fuel gauges in aircraft with similar gauges, especially when the fuel quantity is below the one-quarter mark. As a result, operators of this type of aircraft have turned to making their own dipsticks to measure the quantity of fuel by inserting the stick all the way to the bottom of the tank through the filler cap.

These dipsticks are usually graduated by filling an empty tank in 5-gallon increments and marking the level of fuel in the tank on the dipstick each time. Some operators prefer that the first 5-gallon increment indicate only usable fuel, while others prefer that it indicate the actual quantity of fuel in the tank. To ensure that the fuel level markings are as accurate as possible, the floatplane must be empty and must be in its normal position on still water while graduating the stick. Once the dipstick is graduated, some operators will document the markings, for instance by reproducing them on a page in the aircraft's journey log.

Although using graduated dipsticks is common practice, the aircraft manufacturer does not provide any standards or recommendations on the subject. The investigation was unable to determine the origin of the occurrence floatplane's dipstick, or its marking procedure.

The dipstick used by the pilot was doubled, consisting of two sticks glued together at one end (Figure 4). The first stick, which was dark brown, had several notches at regular intervals, and three black pen markings indicating 10, 15, and 20 gallons. These markings were offset from the notches. The second stick, which was a lighter colour, had blue pen lines indicating 5, 10, 15, and 20 gallons, and was labelled "BON" [good] at the unmarked end (Figure 4). These markings were only visible by spreading the two sticks apart. The blue pen marks on the second stick closely matched the notches on the first stick. A comparison of the various markings revealed that the black pen marks appeared to indicate quantities approximately 2.5 gallons greater than the quantities indicated by the other markings.

There was no operating instruction regarding the use of a home-made dipstick, and the operator's training program did not cover this subject. The pilot of the occurrence aircraft was not trained to use the dipstick for this aircraft. He was relying on the black markings on the first stick without realizing that the second stick had another set of markings.

The TSB examined other dipsticks, including one used by another Cessna U206G operator whose aircraft was equipped with the same type of floats and fuel tanks. The black markings on the stick used by the occurrence pilot appeared to indicate quantities approximately 3.5 gallons greater than the quantities indicated by the other operator's stick.

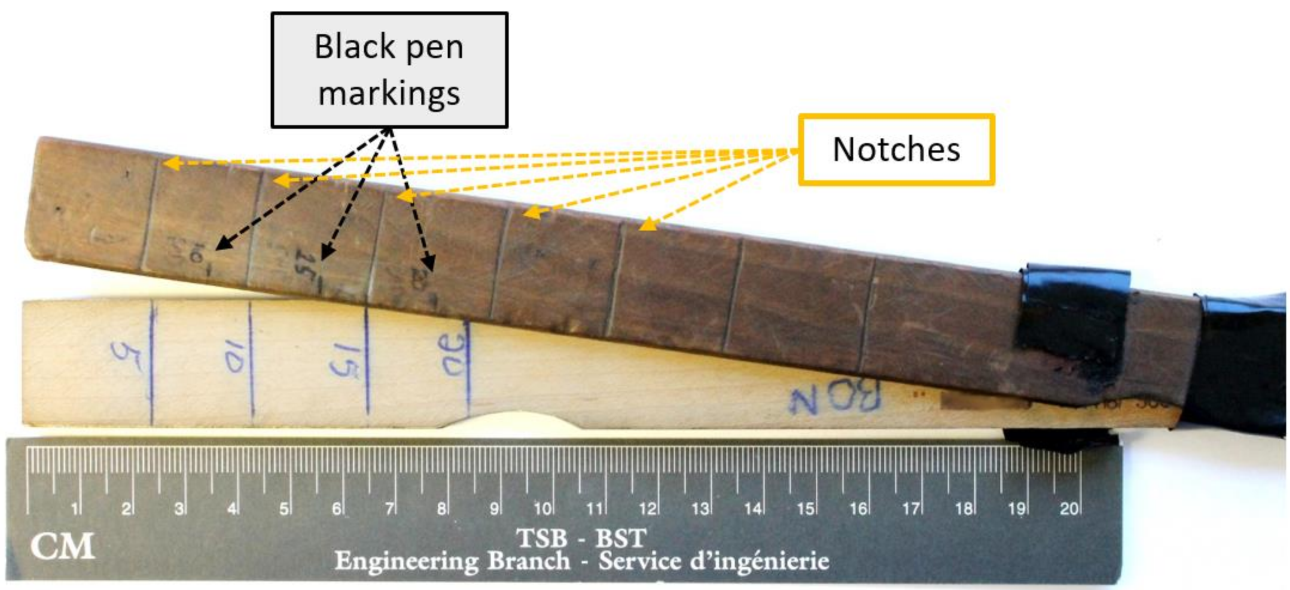

Figure 4. Graduated sticks used to measure the occurrence floatplane's fuel level (Source: TSB)

Based on the blue markings, each of the tanks would have contained approximately 17.5 gallons of fuel rather than 20 gallons after fuelling in the morning. When the fuel level was checked with the black markings after the third flight on the morning of the occurrence, there were supposedly 10 gallons remaining in the left tank and

15 gallons in the right tank. However, according to the blue markings, there were, in reality, 7.5 gallons remaining in the left tank and 12.5 gallons in the right tank.

Given that the first and third flights in the afternoon were conducted using fuel from the right tank, there should have been approximately 2.5 gallons remaining in the right tank by the end of the third flight. According to information gathered, the taxiing time to the takeoff area was longer than usual and the take-off paths were extended for the three afternoon flights. Furthermore, the last flight was extended on the return. These three elements resulted in more fuel being used than what was expected. The amount of fuel collected by the TSB at the accident site was 0.33 gallons on the right, which was below the minimum usable fuel level. That small amount of fuel led to the engine failure.

Safety belts

The pilot and the front seat passenger were not wearing the available shoulder harnesses. The pilot received minor injuries to the head.

Not wearing a shoulder harness is common practice on floatplanes because it is often reported that the shoulder harness impedes the pilot's movements. Also, it is often incorrectly reported that the regulations[1] do not specifically require its use. The TSB has previously investigated this inaccurate interpretation of the regulations regarding the use of shoulder harnesses and recently issued recommendation A19-01, in which it recommended that:

> *the Department of Transport amend the* Canadian Aviation Regulations *to remove any ambiguity associated with the definition of "safety belt."*
>
> ***TSB Recommendation A19-01***

Safety action taken

The company took the following action after the occurrence:

- The company checked the dipstick of its other Cessna 206. The fuel level indication was accurate for both tanks.
- A new procedure was introduced, making it mandatory to check the fuel level with a dipstick every time the aircraft is fuelled and after every two sightseeing flights.

Safety messages

Operators and pilots who use a home-made dipstick as a tool for measuring fuel should ensure that the markings are calibrated and documented based on parameters specific to their aircraft, including the quantity of unusable fuel in the tanks and the type of landing gear on the aircraft when calibrating.

It is important to wear shoulder harnesses when the aircraft is equipped with them. Their use reduces the risk of injury or death in the event of an accident.

1 Transport Canada, SOR/96-433, Canadian Aviation Regulations, sections 605.25 and 605.27.

TSB Final Report A08O0029—Controlled flight into terrain

Summary

The Sikorsky S-76A medivac helicopter departed Sudbury for Temagami, Ontario, to meet a land ambulance. At approximately 2202 eastern standard time, while on final approach to the Temagami Snake Lake Helipad in night visual meteorological conditions, the helicopter crashed in the forested area at the edge of the lake. The helicopter came to rest on its left side and was substantially damaged. Three of the four occupants received serious injuries and were transported to hospital.

Factual information

The closest reporting weather station was in North Bay, Ontario, approximately 50 nautical miles (NM) south of Temagami. The 2200 Aviation Routine Weather Report (METAR) for North Bay was as follows: wind 140° true (T) at 3 knots, visibility 12 statute miles (SM), light snow, scattered layer of cloud at 1 600 ft above ground level (AGL), broken layer at 3 000 ft AGL, temperature 6°C, dew point −7°C, altimeter 29.85 inches of mercury. The entire region was experiencing localized light to moderate snowfall on the evening of the occurrence and it was uncertain as to whether the flight would be able to land in Temagami.

The crew consisted of the captain, the first officer, and two paramedics.

The captain was the pilot flying (PF) and held a valid airline transport pilot license–helicopter. The captain was certified and qualified for the flight in accordance with existing regulations. Records indicate that he had received all of the company-required training, including night visual flight rules (VFR)/instrument flight rules (IFR) and controlled flight into terrain with specific training for black hole approaches (visual spatial disorientation). The captain had been to this location once in the past, on a day VFR flight.

The first officer was the pilot not flying (PNF) and held a valid commercial pilot license–helicopter. He was certified and qualified for the flight in accordance with existing regulations. The first officer was hired in July 2007 and had all the required training.

On the night of the occurrence, the helicopter departed Sudbury at approximately 2140 on a short flight to the Snake Lake Helipad in the town of Temagami, located approximately 60 NM to the northeast. The helicopter climbed to 2 500 ft and proceeded to Temagami. Throughout the initial portion of the flight, the visibility was found to be no less than 4 to 5 SM and improved as the flight progressed. The flight was uneventful and both pilots spent most of the time discussing procedures and coordinating the patient pick-up with dispatch. During the last 1.5 minutes of the approach, the PF was explaining to the PNF what he was doing, step by step, and what to watch out for during night approaches, including black hole illusions.

The Snake Lake Helipad is located on the northeast edge of town. According to the company, for the Sudbury/Moosonee district, the Snake Lake Helipad is at a field elevation of 997 ft above sea level (ASL) and has a 100-by-100-ft asphalt-surfaced pad with retro-reflective cones around the perimeter and with lead-in cones at 220° magnetic (M) from the pad. Four of the perimeter cones can be equipped with e-flares[1] to aid in visibility.

[1] Manually activated portable light emitting diode (LED) lights.

These must be requested by the flight crew and are placed and activated by ground EMS personnel. They were not requested on the night of the occurrence.

The directory cautions of the following hazards:

- Wires under, along east and north sides of the approach/departure sector.
- Large hills south, east, and north of the site.
- Tower west and fire tower south of the site.
- Ball park east of helipad.

Additionally, there is a single house located beside the ball park, which has typical outside-door entrance lights.

The approach to the helipad requires flying over the town and a small hill. The hill begins at approximately 2 430 ft horizontally from the helipad and rises to a maximum height of approximately 1 017 ft ASL, approximately 20 ft above the elevation of the helipad. It then gently slopes down to meet the lake shore 723 ft horizontally from the helipad, which is located on the opposite shore of the lake (see Figure 1—Temagami Topographic Map).

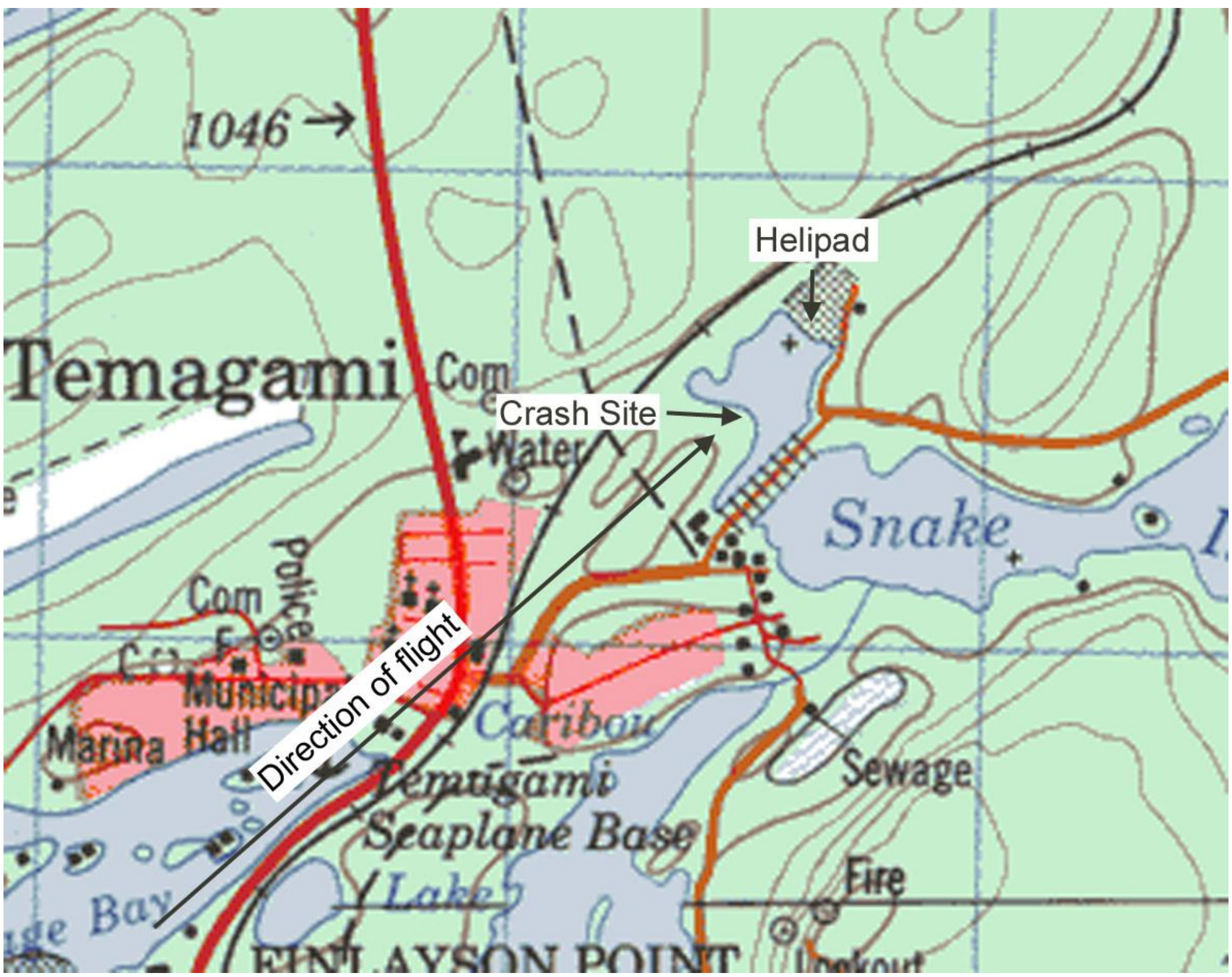

Figure 1. Temagami Topographic Map

The helicopter approached the helipad from the southwest on a heading of approximately 048° M and entered the trees near the edge of the lake approximately 814 ft horizontally from the helipad (see Figure 2—Snake Lake Helipad).

The trees on the approach averaged 40 ft in height. The helicopter impacted trees that were located on the downward slope of the hill, at approximately 70 ft horizontally from the shore where the height of the hill is approximately 10 ft higher than the helipad. As such, the average tree tops were approximately 50 ft higher than the helipad. The descent into the trees was near vertical with very little horizontal momentum and the nose of the helicopter came to rest approximately 15 ft from the shore. During the descent, a tree passed through the left

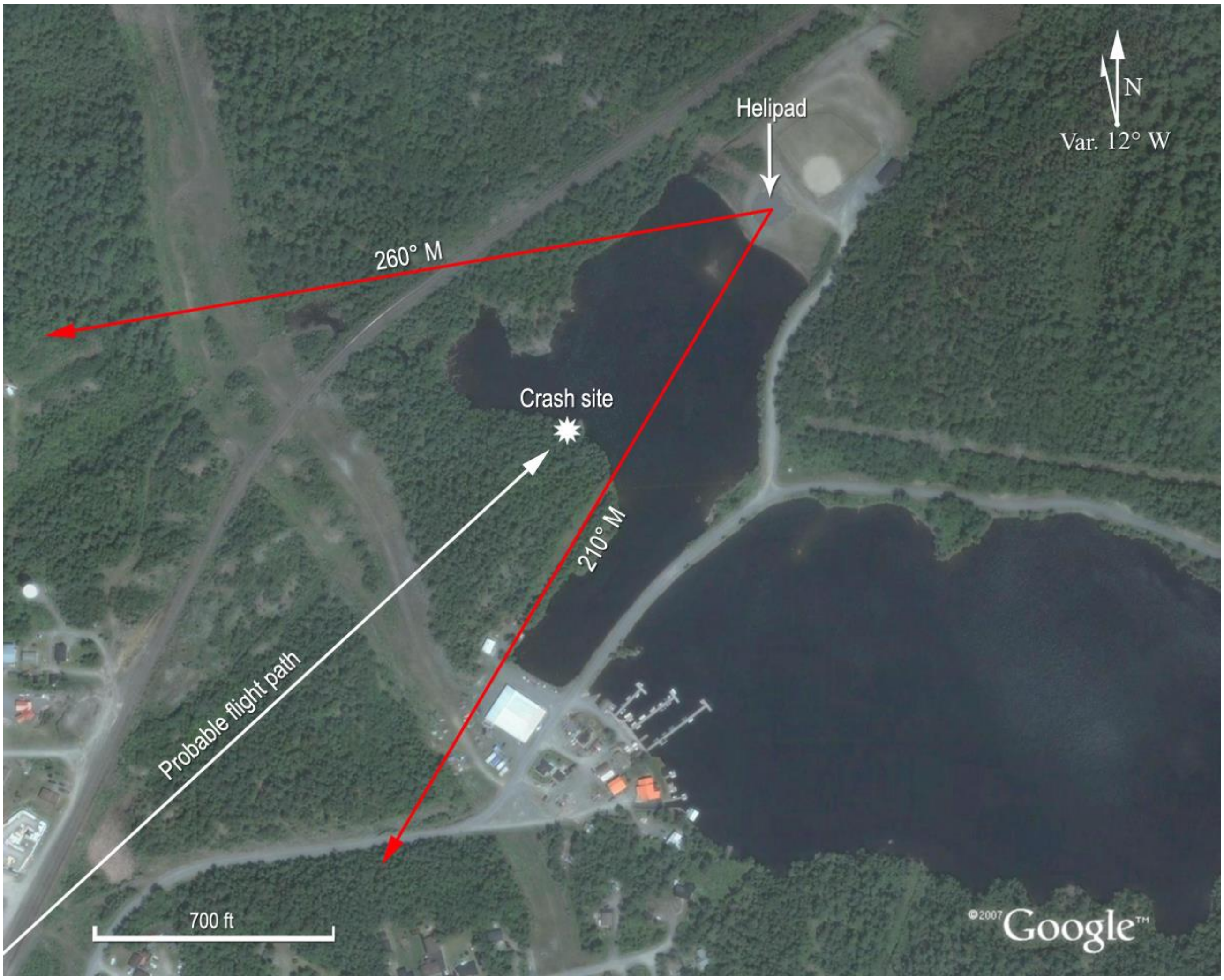

Figure 2. Snake Lake Helipad

landing gear bay, the main battery, and continued through the engine deck and exhaust collector of the right engine. There was evidence of heat and scorching on the tree consistent with the heat of a running engine, but no post-crash fire.

All switches in the cockpit were consistent with an in-flight condition and the helicopter search and landing light switches were in the ON position. The power levers were in flight mode; fire handles were in the normal mode. The fuel system is a two-tank system comprised of a left tank and a right tank; the normal in-flight position for the fuel levers is the direct position, with the left tank supplying the left engine and the right tank supplying the right engine.

The lap belt seat attachments for the paramedic seated in the starboard aft-facing seat failed in overload. Although the paramedic seats were equipped with four-point seat restraints, neither paramedic was wearing the shoulder harnesses.

The lap belt incorporates a standard clip-on style steel hook with a spring closure that clips on to an aluminum barrel nut, which is threaded onto the seat-back pivot bolts. The seat-back pivot bolt is designed to pass through the barrel nut to the end of the machined groove. The barrel nut failed where the bolt ended (see Figure 3). There was thinning of the material in the groove of the barrel nut due to wear from the stainless steel lap belt attachment.

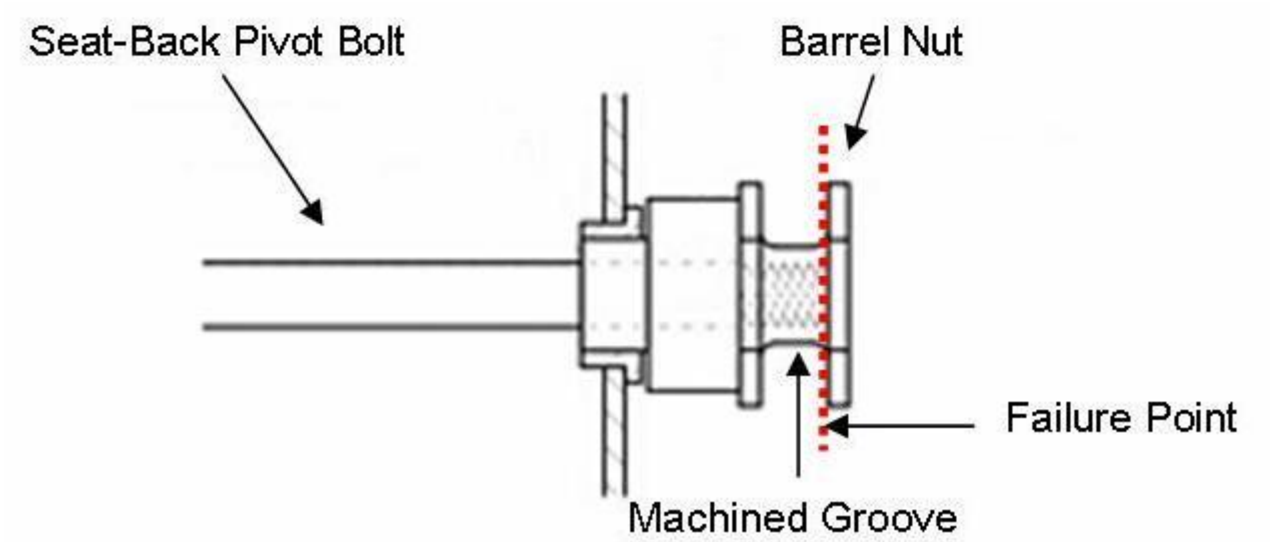

Figure 3. Lap belt attachment point

A detailed examination of the helicopter revealed no discrepancies that would have affected its flying characteristics.

The helicopter was equipped with an enhanced ground proximity warning system (EGPWS), dual Garmin GNS 530 global positioning system (GPS)/Navigation/Communication units, a Latitude Technologies SkyNode satellite tracking system, and a cockpit voice recorder (CVR). These components were removed and analyzed.

The EGPWS and Garmin units contained no valuable information. The Latitude Technologies SkyNode device is a combination GPS and satellite transmitter. The device operates by periodically sending a position fix (approximately every two minutes for this occurrence) to a satellite, which relays the information to a ground station, which, in turn, sends the data to a computer server operated by Latitude Technologies, where the data is stored. An operator can contact the server and review past flights or monitor active flights. It was noted that the SkyNode device had a non-volatile memory that would retain any untransmitted data. The examination of this showed that there was no unsent data. Therefore, there were no unsent coordinates. The transmitted data was retrieved, but the last recorded position was two miles from the helipad.

In addition to the voice and area microphone recordings, the CVR also recorded rotor RPM data. There were no operating abnormalities with the helicopter or engines prior to impact, and the helicopter was on the proper descent profile until it reached 500 ft AGL and 0.5 NM from the helipad, 21.5 seconds before impact. The PF perceived that the helicopter was too high and corrected accordingly. Simultaneously, the cockpit area microphone picked up the sound of the rotor RPM increasing slightly, then decreasing just prior to impact. The rotor RPM recording also confirmed an increase and decrease in rotor RPM just prior to impact. The PNF did not question the PF’s deviation from the proper descent profile, nor did he make any further speed or altitude calls after the deviation.

According to a study by the United States Air Force entitled “Running Head: BLACK HOLE ILLUSION,”[2] spatial disorientation (SD) is defined by Gillingham as: “an erroneous sense of one’s position and motion relative to the plane of the earth’s surface.”[3] The study also states:

Visual spatial disorientation (SD) is often cited as a contributor to aviation accidents. The black hole illusion (BHI), a specific type of featureless terrain illusion, is a leading type of visual SD experienced by pilots. A BHI environment refers not to the landing runway but the environment surrounding the runway and the lack of ecological cues for a pilot to proceed visually. The problem is that pilots, despite the lack of visual cues, confidently proceed with a visual approach. The featureless landing environment may induce a pilot into feeling steep (above the correct glide path) and over-estimate their perceived angle of descent (PAD) to the runway. Consequently, a pilot may initiate an unnecessary and aggressive descent resulting in an approach angle far too shallow (below the correct glide path to landing) to guarantee obstacle clearance.

Training at the company includes one hour in the simulator conducting night VFR operations. The flights are conducted to both runways and heliports where the heliports are all black holes, so black hole approach and

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[2] Randall W Gibb, *Visual Spatial Disorientation: Re-Visiting the Black Hole Illusion*, United States Air Force Industrial Engineering Department, Arizona State University

[3] K.K. Gillingham, The spatial disorientation problem in the United States Air Force, Journal of Vestibular Research, 1992; Volume 2, pages 297-306

departure techniques are required. The flights usually start with clear starry nights and then progress to overcast and reduced visibility conditions. The ceiling and visibility are increasingly reduced so that flight inadvertently goes IFR and the flight crews have to set up and complete an IFR approach to a local airport. The exercise is usually terminated after the IFR approach.

The company's *Operations Manual*, Part III—IFR/Night VFR, dictates the equipment requirements and procedures for performing a black hole approach. Section 1.16, Night Landing Site/Black Hole—Approach states:

> *1) Due to the wide variety of heliports and their locations, night landings are perhaps the most challenging of all approaches. Low (or no) illumination of the surrounding area makes reference to visual clues difficult. A structured procedure for the Night/Black Hole approach, with a heavy reliance on the aircraft instruments, is required. Preparation is needed long before commencing the final approach.*

The section goes on to state the following:

> *4) At heliports with only one ingress/egress, care must be taken not to readily accept a downwind approach. First, look for alternate landing sites. Failing that, limit downwind approaches to a tailwind component of 15 knots.*

1. The PNF's radar altimeter shall be set to 500 ft and the PF's radar altimeter shall be set to 150 ft.
2. Establish a descent from cruise altitude to arrive at a circuit height of 100 ft AGL and 80% of normal cruise indicated airspeed (IAS).
3. Helipads with only retro-reflective cones must be identified and illuminated before continuing the approach.
4. Structure the circuit to allow turning from base to final 1 NM back. Plan your descent to arrive at a point 0.5 NM back at 500 AGL at 50 knots indicated airspeed (KIAS).
5. The use of GPS is essential during the approach to determine the distance to the pad as well as determining the headwind/tailwind component.
6. Every possible searchlight/landing light combination should be used to illuminate the approach path and landing zone.
7. The PNF should monitor airspeed, vertical speed indicator (VSI), and radar altimeter.
8. Continue with a steady rate descent from 500 ft with a gradual airspeed reduction towards landing decision point (LDP).
9. Both pilots should confirm that they have good visual reference before further descent below 200 ft.
10. At LDP (100 ft and Vtoss [take-off safety speed for rotorcraft]), increase collective and decrease airspeed to arrive in a stabilized hover over the landing area.

The PF's radar altimeter was not set to 150 ft during the approach and there were no altitude or speed calls after 0.5 NM and 500 ft.

The company's standard operating procedures (SOPs), section 2.6.2, go on in greater detail to discuss the full procedures for the black hole hover landing. The landing profile section of this SOP calls for the following:

1. Establish an approach speed of 50 KIAS at 500 ft AGL. A stabilized final approach should commence with "wings level" at no less than one-half (1/2) NM back and at 500 ft. This will allow for a moderately steep approach angle of approximately 8° (16%).
2. Once through 500 ft AGL, adjust attitude with cyclic to slowly decelerate to a minimum of 35 KIAS. During this portion of the descent, the aircraft will be approx. 5° nose up. Torque should remain at +/-40% and should not exceed 55% (one engine inoperative limits). 750 ft per minute maximum rate of descent.
3. Do not aim for the helipad. Adjust the sight picture to aim for a point beyond the intended touchdown spot. This will allow for settling as the aircraft slows below translation.
4. In practice, the LDP is a variable depending on aircraft weight, wind, obstructions and helipad height. A normal LDP of 100 ft and 35 knots. However, this will not apply to situations where obstructions are in the intended overshoot path. Increase height of the LDP proportional to obstructions higher than the surface of the helipad. As an example, a 30-ft obstruction along an overshoot path will require a LDP of 130 ft. Adjust the LDP accordingly. Call "committed" when no longer able to overshoot.
5. After passing LDP, increase collective slightly and adjust attitude to slowly decelerate further. Torque should increase through 55% as the aircraft passes over the forward portion of the helipad. Adjust the flare to arrive over the touchdown zone at approximately 25–30 ft AGL while simultaneously increasing power to control rate of descent.
6. Continue to raise collective to terminate in a hover.

Analysis

There were no anomalies found with the helicopter that would have contributed to the accident. Therefore, this analysis focuses on the operation of the helicopter.

The Snake Lake Helipad is a classic black hole approach helipad. Temagami itself is a small community and the location of the helipad is on the northeast edge of town. The approach is flown over the town and past all the lights with a relatively featureless landscape forward. The only visible lights are those of the house beside the ball park. On the terrain along the approach path, a small hill begins to rise approximately 2 430 horizontal ft from the helipad. The maximum rise is approximately 20 ft, which then gently slopes back down to the lake surface 723 ft horizontally from the helipad. The mature trees along the flight path would further increase the obstacle height another 40 ft. However, the steep approach angle of 8° into the landing site would have provided for adequate clearance above the trees to land safely.

The black hole approach requires diligent monitoring of the helicopter's instruments. The flight crew followed most of the SOPs during the approach and appropriate calls were made. In this case, the PNF was monitoring the air speed, altitude and distance to the helipad. He relayed this information to the PF regularly. The PF, flying a visual approach, utilized the information from the PNF in addition to the visual cues for reference. However, the PF's radar altimeter was not set to 150 ft as called for by the operations manual. This would have provided an additional cue to the flight crew that the helicopter was approaching the ground too soon during the descent into the helipad. Meanwhile, the helicopter was on a stabilized approach with the proper 8° descent profile, as required by the operations manual and the SOP.

During the 1.5 minutes of the approach, the PF's attention was split between flying the approach and explaining why things were happening and what to watch for during a black hole approach. This likely distracted the pilots from the task at hand. In this case, the PF acknowledged a 0.5 NM and 500-ft call, an on-profile condition, but visually perceived that the helicopter was too high and, therefore, increased the rate of descent. This coincides with the increase in the rotor RPM—an indication that the collective is being lowered, decreasing the load on the rotor blades and increasing the descent rate. This was followed by a decrease in rotor RPM, as the collective was raised, increasing the load on the rotor blades and decreasing the descent rate just prior to impact. At no time did the PNF question the PF's deviation from the proper descent profile, nor did he make any further speed or altitude calls after the deviation.

Based on the available information, a descent from 500 ft to impact in less than 21.5 seconds equates to a descent rate of more than 1 400 ft per minute—well in excess of the recommended maximum descent rate of 750 ft per minute. The increased descent rate caused the helicopter to descend into the trees before either crew member realized what was happening.

The lap belt barrel nut attachment failed due to several factors. First, the barrel nut was weakened due to wear from the stainless-steel lap belt attachment. Second, the seat-back attachment bolt did not pass completely through the barrel nut, but instead passed only part of the way through to the end of the machined groove. This created a weak point on the assembly at the outside edge of the barrel nut. Under normal loads, such as forward and aft g-forces, this would not be an issue, because the main load would be over the machined groove and seat-back attachment bolts. However, with a side impact, the main loads are in a sideways direction on the end barrel nut. This placed an abnormal load on the end of the barrel nut, which caused it to fail at the weakest point.

Findings

Findings as to causes and contributing factors

1. The pilot flying (PF) was likely affected by visual spatial disorientation and perceived the approach height of the helicopter to be too high. While correcting for this misconception, the helicopter descended into trees 814 ft short of the helipad.
2. The pilots were likely distracted during the critical phase of the approach and did not identify that the helicopter had deviated from the intended approach profile and recommended descent rates.

Findings as to risk

1. The right rear aft-facing paramedic seat lap belt attachment barrel nut was worn in the groove where the seat belt attaches, weakening the barrel nut's structural integrity, thereby increasing the risk of failure.

2. The helicopter crashed on its side, placing an abnormal side load on the right rear aft facing paramedic seat lap belt attachment barrel nut, thereby causing it to fail.

Safety action

Following the occurrence, JCM Aerodesign Limited, the supplemental type certificate (STC) holder for the emergency medical services (EMS) interior utilized in the S-76, issued Service Bulletin No. SB-EMS76-1. This service bulletin identified the affected helicopters and called for the replacement of the existing barrel nut lap belt attachment with a steel shackle. All affected helicopters have complied with the service bulletin.

TSB Final Report A19O0103—Wheels-down water landing

History of the flight

At approximately 1225 on 04 August 2019, a privately owned and operated amphibious Cessna A185E aircraft departed for a daytime visual flight rules cross-country flight from Runway 30, a hard surface runway at the Orillia Rama Regional Airport (CNJ4), Ontario. The pilot, six family members, and a dog were on board the aircraft bound for a cabin located on the west shore of Upper Raft Lake, Ontario, approximately 48 nautical miles north of CNJ4. The pilot had originally planned to make two separate flights; however, because of a previously planned family engagement, he decided to fly a single flight in order to save time.

The cruise portion of the 34-minute flight was flown at an altitude of approximately 2 200 ft above sea level. At 1259, the aircraft touched down on the water of Upper Raft Lake with the wheels in the down position and flipped over, coming to rest in an inverted position. The passengers sustained minor injuries from the impact and managed to egress from the right side of the aircraft. The pilot, however, did not egress the aircraft and subsequently drowned. The dog also drowned.

The passengers, one adult and five children, climbed onto the aircraft's floats. They paddled the aircraft to the east shore, tied it to a rock, and waited on shore for assistance. The family was unable to call for assistance because their mobile telephones were in the aircraft. They spent the night on the shore near the aircraft. At approximately 0900 the following morning, another family member informed a seaplane operator at CNJ4 that the aircraft had not yet returned. The operator dispatched an aircraft and the seaplane was located at approximately 1000 in Upper Raft Lake. Subsequently, the pilot landed to assist the survivors.

The flight information centre in London, Ontario, and the Joint Rescue Coordination Centre in Trenton, Ontario, were then notified. Shortly after, the Joint Rescue Coordination Centre dispatched two aircraft to the site. The survivors were airlifted to hospital.

Pilot information

Records indicate that the pilot was certified and qualified for the flight in accordance with existing regulations.

Aircraft information

The occurrence aircraft was a single-engine, six-seat aeroplane manufactured by Cessna Aircraft Company in 1968.

The aircraft had been in a previous accident in 2013. It was completely rebuilt by the occurrence pilot, who was also a licenced aircraft maintenance engineer. During the rebuild, which was completed in February 2019, some modifications were installed, all in conformance with the supplemental type certificates approved for the type and model of the aircraft.

The aircraft had been flown approximately 23 hours since it had been rebuilt. In July 2019, after approximately 14 hours of air time since the aircraft had been rebuilt, Wipaire 3730 amphibious floats were installed. The floats incorporated a retractable landing-gear assembly that enabled the aircraft to land on runways or on water. The aircraft had then flown approximately nine hours before the accident.

Wreckage information

The aircraft touched down on the surface of the water with the wheels down, causing it to flip over; the aircraft came to rest inverted, the floats above the water keeping it afloat (Figure 1).

Figure 1. The occurrence aircraft found the day after the occurrence, tied to the shore (Source: friend of the pilot)

The aircraft was recovered from Upper Raft Lake five days after the occurrence. It had sustained substantial damage. All damage to the airframe was attributable to impact forces when the aircraft flipped over.

All of the control surfaces were accounted for; the flaps were found set to 30º. The aircraft's flight instruments were intact. A global positioning system (Garmin Aera 660) was removed from the aircraft and sent to the TSB Engineering Laboratory in Ottawa, Ontario, for analysis. The unit provided information pertaining to the occurrence flight, including the flight path.

All of the wheels were found fully extended and the landing-gear selector handle was found in the UP position. It could not be determined if the handle had been selected up by the pilot at some point, or if it had moved to the UP position as part of the impact and egress sequence.

Landing-gear system information

The landing gear system on the occurrence aircraft was powered by an electro-hydraulic power pack made up of an electrical pump and a hydraulic fluid reservoir mounted as a unit on the forward left-hand side of the engine firewall.

Normally, in this system, the landing gear selector assembly has a red PUMP ON light that illuminates to indicate that the electro-hydraulic power pack is operating when the landing gear is extending or retracting.

The pump shuts off automatically after the desired gear position is attained. A pressure switch cuts off the electrical power to the pump when hydraulic pressure builds up in the system after the wheels are fully extended or fully retracted.

A 40 A circuit breaker for the associated hydraulic pump is located on the front panel under the landing gear selector and protects the electrical circuit to the pump. If it trips at any time prior to or during the selection of the landing gear lever to the UP position, the landing gear is no longer powered and will not retract.

The circuit breaker was found protruding from its normal position, indicating that it had tripped. The investigation could not determine if the circuit breaker was tripped before, during, or after the occurrence flight.

The aircraft was equipped with an emergency hand pump that could be used to operate the landing gear manually in case of an electro-hydraulic power pack failure, or a general electrical failure of the gear system. However, nothing indicated that this backup system had been operated. The aircraft was also equipped with a bubble window on the pilot's side, and a curved mirror located on the underside of the left wing to enable the pilot to check the wheels' position visually.

The aircraft was equipped with eight independent landing-gear position annunciator lights (Figure 2). These lights are split into two groups: four blue lights for water landing and four green lights for hard-surface landing. Normally, each light, in each colour grouping, is associated with each of the four wheels of the landing gear: two lights for the nose gear at the top and two lights for the main gear below. When the landing gear is up, the blue lights illuminate; when the landing gear is down, the green lights illuminate.

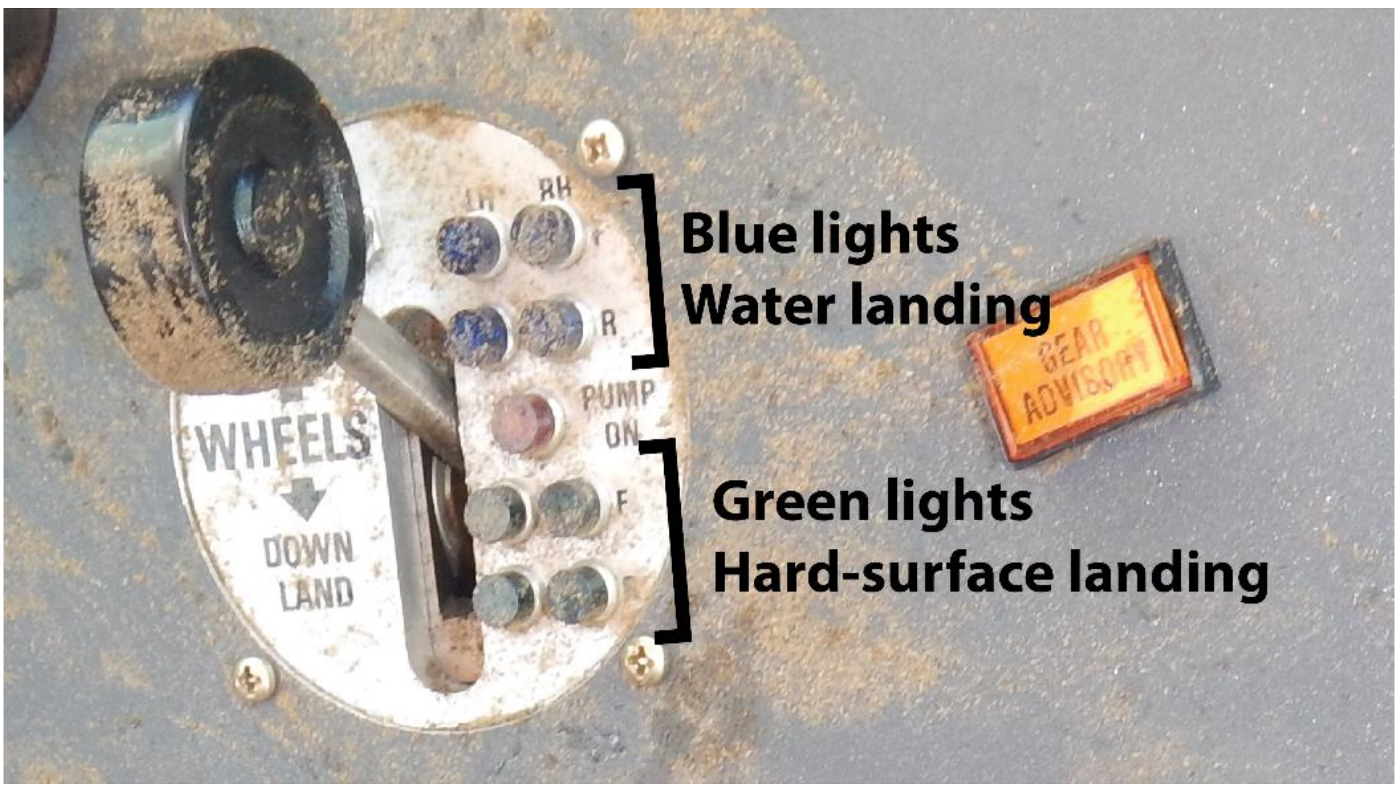

Figure 2. The aircraft's landing-gear position annunciator lights (Source: TSB)

The aircraft was equipped with an amphibious landing-gear position advisory system, which was meant to provide an aural warning as to the landing gear position when the aircraft decelerated through a specific airspeed. This system was examined to determine the threshold airspeed at which the advisory would activate and to confirm if the aural warnings were serviceable. It was determined that the threshold airspeed setting was set to activate the unit once the airspeed was reduced to 95 mph or below.

The electrical ground connection for the amphibious landing-gear position advisory system was broken. Following the prolonged water immersion of five days in the lake, the advisory system could not be repaired and remained defective, providing no aural advisory or warning light. The investigation could not determine if the unit was operational during the occurrence flight.

The hydraulic pump and motor were examined and appeared to have no deficiencies that would have affected normal operation. The landing-gear selector assembly was fully functional and leak-free.

Aircraft checklist information

It could not be determined whether the pilot used a checklist to operate the aircraft during normal operations, including to check if the gear was in the correct position for landing. No checklists or placards were found during the examination of the wreckage and the aircraft contents. However, because the aircraft was subjected to substantial impact forces and was inverted in water for some time, if there had been a checklist on board, it may have become separated from the wreckage.

Section 602.60 of the CARs requires that all power-driven aircraft be equipped with:

1. a checklist or placards that enable the aircraft to be operated in accordance with the limitations specified in the aircraft flight manual, aircraft operating manual, pilot operating handbook or any equivalent document provided by the manufacturer.

Furthermore, it states that:

> *A checklist or placards […] shall enable the aircraft to be operated in normal, abnormal and emergency conditions, and shall include […]*
>
> 4. a pre-landing check […]

Weight and balance information

The aircraft had a maximum gross take-off weight of 3 350 pounds and a basic empty weight of 2 389.5 pounds, which provided a useful-load capacity of 960.5 pounds for the pilot, passengers, baggage, and usable fuel.

Given that the fuel tanks were compromised during the impact sequence, an accurate weight and balance calculation of the occurrence flight could not be completed. To remain below maximum gross take-off weight, considering the weight of the aircraft, passengers, and baggage, it would have been possible to carry 25 gallons of fuel, enough for approximately 90 minutes of flight at a cruise power setting.

Survival aspects

The investigation revealed three different survival aspects: safety belts, life preservers, and egress training.

Safety belts

The aircraft was capable of carrying four people, including the pilot: there were four seats installed, and each was equipped with a restraint system.

Section 605.22 of the CARs stipulates that "no person shall operate an aircraft other than a balloon unless it is equipped with a seat and safety belt for each person on board the aircraft other than an infant."

Although there were only four seats on the aircraft, there were seven people on the occurrence flight: the pilot, one adult passenger, five children, and one dog. Three children occupied the two rear seats: one child used a seat and was wearing a safety belt; the other two children, who were sharing the second seat, did not wear the safety belt. Another child and the dog occupied the baggage area, which did not have any seats nor safety belts. The adult passenger was sitting in the front, next to the pilot, and was holding a child (not an infant). Both the pilot and the adult passenger only wore the lap strap; neither wore the available shoulder harnesses. The child on the passenger's lap was unrestrained.

Subsection 101.01(1) of the CARs defines a safety belt as "a personal restraint system consisting of **either** [emphasis added] a lap strap or a lap strap combined with a shoulder harness."

Life preservers

Although the six passengers were able to egress the aircraft, the aircraft was only equipped with five personal flotation devices. None of the passengers was wearing a personal flotation device, nor did they egress with one.

Subsection 602.62(1) of the CARs states that:

> *No person shall conduct a take-off or a landing on water in an aircraft or operate an aircraft over water beyond a point where the aircraft could reach shore in the event of an engine failure, unless a life preserver, individual flotation device or personal flotation device is carried for each person on board.*

Egress training

Neither the pilot nor the passengers had received underwater egress training, nor were they required to by regulation.

A TSB study of Canadian seaplane accidents determined that there were challenges for occupants to egress after the aircraft impacted the water. In order to increase survivability, egress training for pilots was deemed essential. In February 2019, proposed amendments to the CARs were published in the *Canada Gazette*, Part II. These amendments, which will come into force in February 2022, will make underwater egress training mandatory for all pilots of commercially operated seaplanes.

Safety messages

There were two adults and five children on board the aircraft, but only four seats and restraint systems. The two available shoulder harnesses were not used by the front-seat occupants. One child was held on an adult's lap and was unrestrained; another child was not sitting in a seat at all. Two children were sharing one seat and not wearing the available safety belt. It is important that each occupant has their own seat and uses the available restraint system to improve the odds of survival and egress from an aircraft involved in an accident.

The passengers in this occurrence were able to exit the aircraft after the impact. However, there were not enough personal flotation devices for everyone on board. It is important that aircraft have enough personal flotation devices on board for all occupants in case of an accident on water.

The pilot of the occurrence aircraft had not received underwater egress training. This training has been demonstrated to improve the chances of survival in seaplane accidents and should be considered by private seaplane operators.