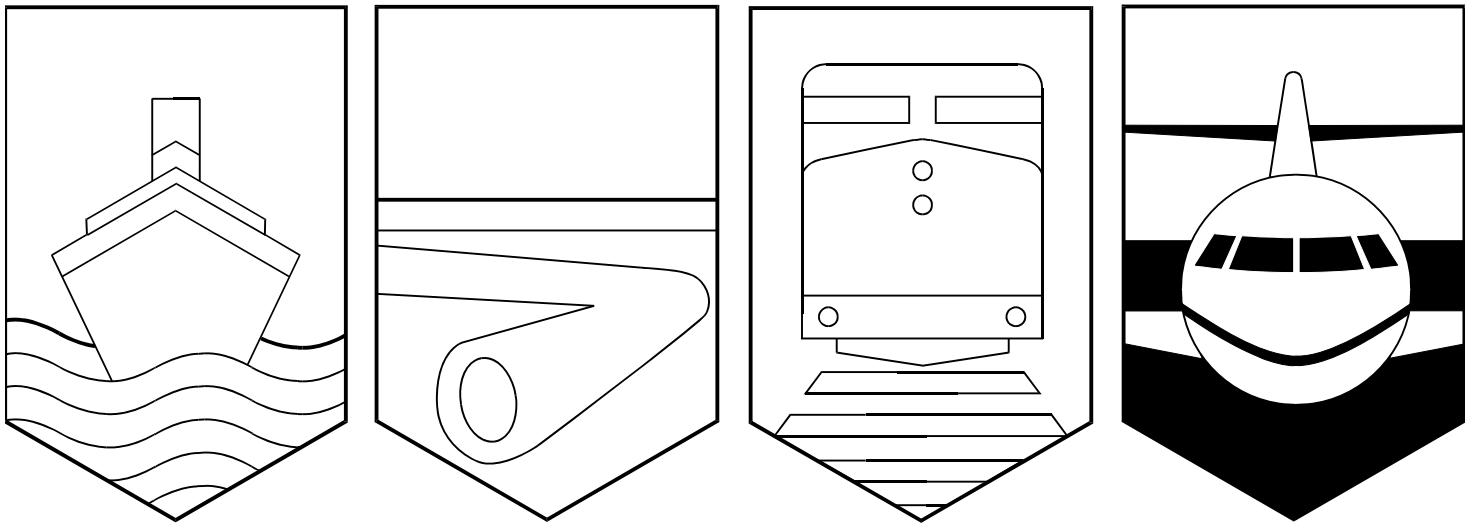
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



AVIATION OCCURRENCE REPORT

COLLISION WITH WATER

NORTHERN MOUNTAIN HELICOPTERS
BELL 205A-1 (HELICOPTER) C-GNMR
LEAF RAPIDS, MANITOBA
28 JUNE 1995

REPORT NUMBER A95C0139

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.

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Aviation Occurrence Report

Collision with Water

Northern Mountain Helicopters
Bell 205A-1 (Helicopter) C-GNMR
Leaf Rapids, Manitoba
28 June 1995

Report Number A95C0139

Synopsis

The helicopter was being operated on contract to the provincial Ministry of Natural Resources in support of forest fire suppression activities. The pilot departed Leaf Rapids, Manitoba, with seven passengers and their equipment on board, for a local flight to drop off a fire-fighting crew. The reported visibility was three-quarters of a mile in smoke as the flight began and the helicopter flew northward from the town. While crossing the Churchill River, the pilot encountered significantly reduced visibility and turned to the right to return for landing. The helicopter descended while in the turn, the main rotor blades struck the water, and the aircraft crashed into the river. The pilot and four of the passengers exited the aircraft and were rescued; however, three passengers were incapacitated by head injuries and drowned. The aircraft was destroyed.

The Board determined that, while turning the helicopter to avoid an area of reduced visibility, the pilot lost the visual cues required for flight. The helicopter descended while in the turn and struck the water before the pilot was able to regain adequate visual reference.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 History of the Flight

The Bell 205 A-1 helicopter was under contract to the provincial Ministry of Natural Resources (MNR)[1] in support of fire-fighting operations. The occurrence helicopter was one of six helicopters that were being operated out of a temporary heliport at a fire base that had been established on the golf course adjacent to the town of Leaf Rapids, Manitoba. The occurrence flight was the first flight of the day for the pilot, and the first flight to depart from the heliport that morning. The purpose of the flight was to transport six fire-fighters and their associated equipment to a location approximately seven and one-half miles[2] northeast of the town. In addition to the six fire-team members seated in the rear of the helicopter, a Natural Resources Officer (NRO), who was the Division Boss in charge of forest fire-fighting operations in the area, occupied the left front cockpit seat.

The visibility in the area of the heliport was reported to be three-quarters of a mile in smoke when the aircraft departed. The plan established between the pilot and the NRO prior to departure was to take off and try to reach their destination, but to turn around and return for landing should visibility be insufficient.

The pilot completed the take-off and initially headed north from the town, following a highway at an altitude of 75 to 100 feet above ground level (agl) and an airspeed of approximately 40 knots. A few minutes later, the helicopter began to cross a river valley where a road bridge spanned the wide river. Immediately after crossing the river's north shore, and while in the vicinity of the bridge, the pilot noted that the visibility was deteriorating and initiated a right turn to return to better conditions. The pilot lost visual reference while in the turn over the river. The pilot immediately checked the flight instruments and noted that the vertical speed indicator showed that the helicopter was descending at 200 feet per minute. The pilot attempted to stabilize and maintain control of the aircraft while trying to regain visual references; however, the main rotor struck the surface of the water. The helicopter crashed into the Churchill River (elevation 850 feet above sea level), at position 56º29.5'N, 099º58.5'W, at approximately 0935 central daylight saving time (CDT)[3], during the hours of daylight.

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1 See Glossary for all abbreviations and acronyms.

2 Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

3 All times are CDT (Coordinated Universal Time [UTC] minus five hours) unless otherwise stated.

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	3	-	3
Serious	1	-	-	1
Minor/None	-	4	-	4
Total	1	7	-	8

1.3 Damage to Aircraft

The helicopter was destroyed by the impact with the water.

1.4 Other Damage

Approximately 156 gallons of Jet B fuel was released from the helicopter into the Churchill River.

1.5 Personnel Information

	Pilot
Age	45
Pilot Licence	CPL
Medical Expiry Date	01 Sep 95
Total Flying Hours	4,250
Hours on Type	3,400
Hours Last 90 Days	130
Hours on Type Last 90 Days	130
Hours on Duty Prior to Occurrence	2.5
Hours Off Duty Prior to Work Period	9.5

The pilot completed his initial helicopter pilot training with the United States military, and received his pilot qualification in 1972. He received instrument flight training and had a limited amount of instrument flight experience during his subsequent military career with the Vietnamese Army. The pilot was issued a Canadian commercial pilot licence in 1980, having accumulated approximately 1,970 hours of flying experience. He did not have an instrument rating and did not maintain currency in instrument flight. The pilot was certified and qualified for the occurrence flight, in visual flight conditions, in accordance with existing regulations.

1.6 Aircraft Information

Manufacturer	Bell Helicopter Textron Inc.
Type and Model	205A-1
Year of Manufacture	1968
Serial Number	30015
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	6,341.6 hours
Engine Type (number of)	Textron Lycoming T53-13B(1)
Propeller/Rotor Type (number of)	Bell Helicopter Textron 204-011-250-001 (1)
Maximum Allowable Take-off Weight	9,500 pounds
Recommended Fuel Type(s)	Jet B
Fuel Type Used	Jet B

Records indicate that, at the time of the occurrence, the helicopter was equipped with basic instrumentation for flight in visual meteorological conditions (VMC) and was certified for flight in VMC in accordance with existing regulations. The helicopter was not certified or equipped for single-pilot flight in instrument meteorological conditions (IMC).

Post-occurrence calculations indicate that the aircraft weighed about 9,350 pounds when it departed on the occurrence flight. The maximum take-off weight for the aircraft is listed as 9,500 pounds. Both the lateral and longitudinal centres of gravity were determined to be within the acceptable limits.

1.7 Meteorological Information

The MNR fire team obtained public weather information from Environment Canada every morning and sought weather updates during the day. The information was passed along to fire management personnel, who then made it available to the pilots. Pilots could also access weather information directly by telephone through Transport Canada's 1-800-INFO-FSS service; however, it was not determined whether any pilots had done so. There were no aviation weather briefing facilities available locally, neither are there any Environment Canada weather observation personnel at Leaf Rapids.

The smoke from forest fires in the region created a wide area of partially obscured conditions with no clearly defined ceiling. At the time that the occurrence aircraft commenced its flight, the wind was reported to be light, and smoke reduced the visibility in the area of the heliport to approximately three-quarters of a mile. Witnesses reported that, immediately after the occurrence, visibility in the river valley near the occurrence site was approximately 200 yards. The sky was totally obscured by the smoke, and the water surface was observed to be flat and calm.

1.8 Aids to Navigation

A private, unmonitored non-directional beacon (NDB) is located approximately one mile east of the town, and the aircraft was equipped with a global positioning system. The occurrence flight was operated under visual flight rules (VFR) using visual ground references for navigation.

1.9 Communications

There was a trailer adjacent to the heliport set up with a radio communications system manned by a radio operator. Helicopter pilots were required to make departure and arrival advisories by radio to the radio operator, who recorded these aircraft movements in a written log. Shortly after take-off, the pilot made a routine departure advisory to the radio operator, who made an entry in the radio log.

1.10 Heliport Information

Six helicopters under contract to MNR were being operated out of a temporary heliport established at the fire base on the golf course adjacent to the town. One of the golf course fairways had been laid out with ground markings for landing pads. Each landing pad was equipped with portable refuelling and fire extinguishing equipment.

1.11 Flight Recorders

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

1.12 Wreckage and Impact Information

The helicopter was in a descending right turn when the main rotor blades struck the surface of the water and severed the tail boom. The main rotor mast sheared, and the main rotor separated from the aircraft. The forward section of the tail boom was torn from its fuselage mounts.

The fuselage initially contacted the water on the left side in a nose-down attitude. The fuselage tumbled after the initial impact, and struck the water again on the right rear of the fuselage. The fuselage broke behind the front landing gear attachment point and to the rear of the cockpit. The wreckage separated into four major sections: the rear tail boom and tail rotor, the forward tail boom, the main rotor assembly, and the fuselage. The helicopter wreckage came to rest in about 35 feet of water, approximately 100 feet from shore.

All damage to the aircraft was attributable to the contact with the water and the subsequent breakup. The engine was closely examined at a commercial overhaul facility and no evidence of any malfunction was found. There was no evidence found of any aircraft failure or system malfunction either prior to or during the flight.

1.13 Medical Information

There was no evidence to indicate that the pilot's performance was affected by physiological factors.

1.14 Fire

There was no evidence of aircraft fire either before or after the crash.

1.15 Survival Aspects

The helicopter was equipped with personal restraint systems and these restraint systems were being used in accordance with existing regulations. Both of the seats in the cockpit of the helicopter were equipped with four-point safety harnesses. The pilot used the available shoulder harness and lap belt. The NRO in the other cockpit seat used the lap belt only, although a shoulder harness was available. The seats in the passenger cabin were equipped with lap belts only. All the passengers used the lap belts. The pilot was wearing a protective helmet; however, none of the other occupants was wearing a helmet.

When the aircraft struck the water, the damage to the aircraft caused the doors and emergency exits to open. As the aircraft sank, occupants who were not incapacitated by the impact forces were able to release their safety harnesses and float to the surface. The passenger in the left front cockpit seat, and two of the passengers who were seated in the centre rear and right rear portions of the cabin, did not survive. These three passengers were found in their seats with their lap belt safety harnesses still done up. Post-mortem examinations indicated that each of them had suffered head injuries during the impact sequence, which resulted in their incapacitation; unable to release their safety harnesses, they subsequently drowned. There were no other life-threatening injuries found.

Studies have shown that approximately 70 per cent of all serious and fatal injuries in helicopter accidents occur primarily to the head, spine, torso, and neck. An analysis of helicopter crash dynamics

by Coltman (1985)[4] showed that, of the personnel who experienced a helicopter crash, only 9 per cent of those who were wearing a shoulder harness had severe injuries, compared with 34.3 per cent of those who wore only a lap belt.

Existing Canadian regulations require that helicopters engaged in specific or special purpose operations conform with more stringent provisions concerning the fitment and use of shoulder harnesses. For example, Air Navigation Order (ANO) Series II, No. 2, requires that all persons aboard a special purpose operation flight keep their lap belt and shoulder harness fastened at all times, except when a person is performing duties that relate to the special purpose operation or the operation of the aircraft and that require the person to remove the shoulder harness or lap belt or both. These "special purpose operations" generally involve greater risk to the passengers and crew and include such operations as helicopter external load operations. Passenger-carrying helicopter flights in support of forest fire-fighting operations, such as in this occurrence, are not considered a "special purpose operation".

1.16 Loss of Visual Reference

The flight was being conducted under visual flight rules (VFR), which demand that flights be conducted with continuous visual reference to the ground or water. ANO Series V, No. 3, specifies that, for a helicopter operating in uncontrolled airspace below 700 feet agl, the visibility must not be less than one-half mile, and the helicopter must be clear of cloud. Also, the helicopter must be operated at such a reduced airspeed as to give the pilot-in-command adequate opportunity to see other air traffic or obstructions in time to avoid a collision.

During VFR flying, pilots rely on cues from the natural horizon and the earth's surface to maintain the desired attitude of the aircraft. When these external visual cues become obscured by environmental conditions, such as smoke, a pilot can quickly become disoriented with respect to the position and attitude of the aircraft relative to the ground or water. Just after the occurrence, the water surface was observed to be flat and calm, creating a mirror-like effect that would have resulted in a virtually monochromatic visual environment devoid of an identifiable horizon.

On entry into IMC, a pilot must revert to flight instruments to determine and maintain proper aircraft attitude. For pilots who are not current in conducting instrument flight, success in overcoming the effects of spatial disorientation is rare[5]. Spatial disorientation can be so overpowering that, even for pilots who are "instrument rated, current, and proficient in helicopters, success at coping with inadvertent instrument flight is not guaranteed."[6] Part of the reason is that, once visual reference is lost, it can take as much as 35 seconds to re-establish full control of the aircraft by reference to instruments[7]; of that 35 seconds, at least 5 seconds are spent recognizing that a hazard exists, determining the necessary corrective action, and initiating a response.

1.17 Organizational and Management Information

1.17.1 Fire Team Structure

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4 J.W. Coltman, *Analysis of rotorcraft crash dynamics for development of improved crashworthiness design criteria.* DOT/FAA/CT-85/11. (U.S. FAA, 1985).

5 National Transportation Safety Board. *Safety study - Commercial emergency medical service helicopter operations.* (NTSB/SS-88/01). (Washington, DC: NTSB, 1988).

6 Ibid.

7 Federal Aviation Administration, *Spatial Disorientation*, FAA Advisory Circular 60-4A, 2/9/83.

Under normal conditions, smaller forest fires are brought under control using the local resources available within each Natural Resources specified district. When a forest fire expands to the extent that the fire-fighting is beyond the capability of the local resources, a project fire team is established and sent to the fire location. The project fire team, under the command of a Fire Boss, is tasked with setting up an organization to combat that fire. A six-member project fire team had been established and was operating on the forest fire when the accident occurred.

The two major components of the fire team are: 1) the suppression group, which is responsible for putting out the fire; and 2) the service group, which is responsible for providing the supplies and services required to support the fire-fighting effort (see Figure 1).

The suppression portion of the organization is headed by a Suppression Boss, who designates Division Bosses to manage subsections of the fire. The Division Bosses direct allocated people and resources (including helicopters) to put out the fire within their assigned area.

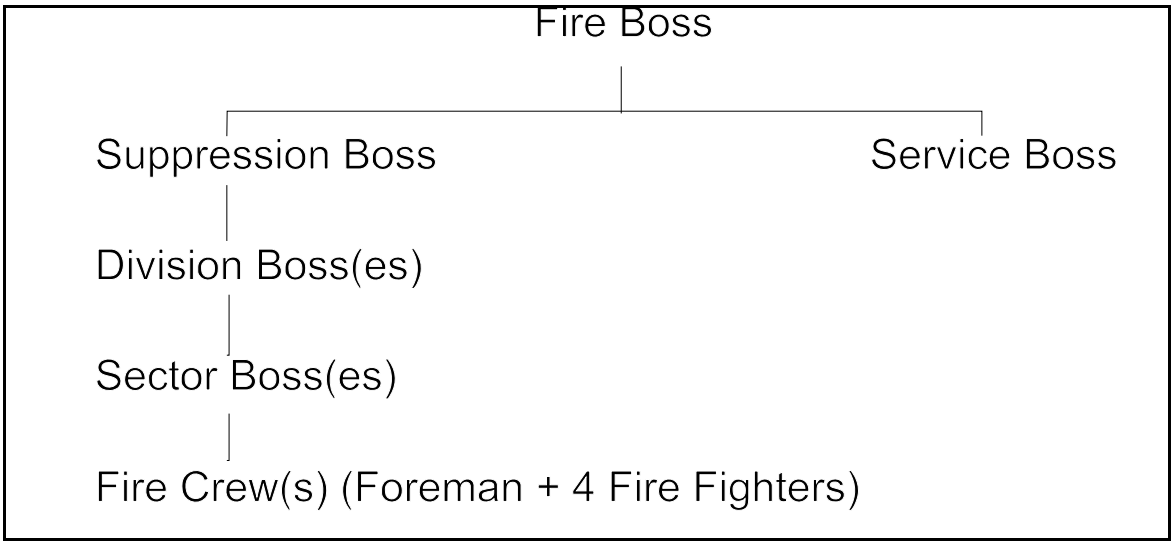

Figure 1 - Project Fire Team Structure

At the time of the occurrence, the suppression portion of the fire team was divided into two divisions, each responsible for areas of the fire either east or west of the main highway running north and south through the town. The NRO seated in the left front seat of the occurrence helicopter was the Division Boss for the eastern portion of the fire. To effectively monitor the successful execution of the suppression plan, Division Bosses reportedly spend approximately 50% of their time flying on helicopters in and around the fire.

1.17.2 Fire Team Safety-Related Positions

The MNR Fire Program office has published a Fireline Notebook[8] for use as a guideline by personnel appointed to work on fire teams. The notebook outlines an example of a large fire organization that includes several positions that are assigned duties relating to the safe and effective employment of aircraft used in the fire-fighting effort. Specifically, a Fire Safety Boss reporting directly to the Fire Boss is designated. The Fire Safety Boss is required to "inspect and make recommendations on all safety aspects of the fire operations." The duties of the Fire Safety Boss include several items listed under "Air Transportation Safety"; the book also states that "it [air transportation] has the potential to be the most hazardous part of the operation."

In the example, a Helicopter Officer position is also designated to report through the Transport Officer to the Service Boss. Pages 99 to 107 of the Fireline Notebook list the 80 items that make up the Helicopter Officer's Checklist. Thirty-four of the items are listed under the heading "Safety," and include requirements such as the need to check that tailgate safety sessions between the helicopter officer, ground crew, and pilots are conducted each shift (safety item no. 9), as well as the need to monitor whether seat-belts and shoulder harnesses are always being worn by pilots and passengers (safety item no. 27).

The Fireline Notebook notes that duties of various job positions may be combined when warranted. The criteria governing when these positions may or may not be filled are not defined. The fire team involved in this occurrence was described as a relatively small organization consisting of about 225 personnel and six helicopters. The positions of Fire Safety Boss and Helicopter Officer were not staffed on the fire team involved in the occurrence.

1.17.3 Management Structures

The Helicopter Flying Offer contract between Northern Mountain Helicopters and the Province of Manitoba indicates that the helicopter operator is to perform "Class 4 charter commercial air services." In outlining the standards for operation of charter flights, the document states that the helicopter operator "shall have exclusive control over its chartered helicopter, its contents and crew and ensure that each flight is conducted in a safe and efficient manner and in accordance with the Aeronautics Act, all applicable air regulations and air navigation orders."

The United States National Transportation Safety Board (NTSB), in a safety study (see footnote 5), acknowledged that, when two management structures are involved in an operation, they can have objectives that conflict and adversely affect safety. To ensure that the objectives of the two management structures do not conflict and become detrimental to safety, the NTSB believes that "effective and regular communication on safety issues between separate managements and the employees is mandatory."

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[8] Manitoba Natural Resources Fire Program, *Fireline Notebook,* Manitoba Government Publication MG-12027.

An important step in developing a safety philosophy within an organization is the implementation of risk management principles that allow for the identification of hazards, the evaluation of risk associated with those hazards, and the implementation of controls in the form of clearly defined managerial policies and enforced procedures. The NTSB study also recognizes that, in an operation involving two management structures, it is important for the contracting organization to become knowledgeable about safety issues in helicopter operations because personnel from the contracting organization often become the *de facto* management for the pilot.

In its discussion of minimum safety standards, the TSB safety study on VFR flight into adverse weather[9] noted the following:

> While examining commercial VFR-into-IMC accidents, it became clear that a number of major users of Canadian aviation charter services stipulate additional safety criteria when they contract air charter services. Major clients of Canadian charter services are demanding a higher standard of safety than the existing regulations and industry practices can provide. Oil companies, many air ambulance services, and a number of agencies and departments from various levels of government have adopted such practices.

[9] Transportation Safety Board of Canada, *Report of a Safety Study on VFR Flight Into Adverse Weather*, TSB Report No. 90-SP002, 1990.

2.0 Analysis

2.1 Introduction

The examination of the helicopter revealed no evidence of any aircraft failure or system malfunction either prior to or during the flight. The pilot was certified and qualified for the flight in accordance with existing regulations, and there was no evidence that the pilot's performance was affected by physiological factors. This analysis will focus on the pilot's loss of visual reference, and, although not directly related to the cause of the accident, the chances of survival of the helicopter occupants, and the on-site safety monitoring system.

2.2 Loss of Visual Reference

The flight was being conducted under visual flight rules, which require that the pilot maintain continuous visual reference with the ground or water. Because there were no aviation weather briefing facilities or weather observation personnel available at Leaf Rapids, pilots were required to assess local weather conditions themselves. At the commencement of the flight, the visibility of approximately three-quarters of a mile exceeded the minima required for VFR flight; however, as the helicopter was crossing the Churchill River, the smoke became more dense and the visibility deteriorated rapidly.

The helicopter was equipped with basic instrumentation for VFR flight and was not certificated or equipped for single-pilot flight in IMC. The pilot had received instrument flight training early in his flying career, but he did not have an instrument rating, nor had he maintained instrument flying currency during the 15 years preceding the occurrence. As a result, neither the pilot nor the aircraft was certified or equipped to continue the flight in IMC; the only option available to the pilot was to attempt to maintain VFR.

When the pilot decided that visibility conditions were no longer suitable to continue the flight, he elected to carry out a right turn over the river. During the turn, the pilot lost visual reference with the surface. After the accident, the visibility at the occurrence site was reportedly about 200 yards in smoke, the sky was obscured, and the water surface was observed to be flat and calm. This combination of conditions was conducive to spatial disorientation in VFR flight.

The pilot had to rely solely on his manual control of the helicopter and on his interpretation of the aircraft's basic flight instruments to maintain control of the helicopter until he regained external visual cues.

Upon losing visual reference, the pilot checked the flight instruments and noted that the vertical speed indicator showed that the helicopter was descending at 200 feet per minute. Descending at this rate from a height of about 75 feet, the helicopter would have taken only about 23 seconds to hit the water's surface. Since the pilot was not current in instrument flying, and the helicopter was not equipped for IFR flight, and there was a lack of identifiable outside visual references, the pilot had little chance of making a successful recovery.

2.3 Survivability

The analysis of helicopter crash dynamics by Coltman documented the significant reduction in severe injuries incurred in helicopter crashes when people wore shoulder harnesses. The MNR Fireline Notebook also recognizes the benefit of using shoulder harnesses, and assigns the Helicopter Officer to monitor their use by pilots and passengers as a safety-related checklist item. The fact that the pilot, who

was wearing both a shoulder harness and a protective helmet, survived the crash, while the other cockpit occupant did not, further highlights the increased level of protection provided by the additional safety gear.

Forest-fire operations involve risk levels higher than those encountered on routine transportation flights. While it could not be proven that the wearing of shoulder harnesses or helmets would have changed the outcome for those passengers who did not survive this occurrence, there is sufficient evidence to indicate that the use of shoulder harnesses and protective headgear improves chances of survival. Use of shoulder harnesses and protective headgear might have prevented the incapacitation of the casualties in this occurrence.

2.4 Safety Management

Transport Canada's regulations have been developed primarily to establish minimum safety standards for commercial and private air transport operations, and they do not specifically address the unique nature of forest-fire operations. Oil companies, many air ambulance services, and a number of agencies and departments from various levels of government have examined their flight operations requirements and determined the need to specify particular standards for the safety of their personnel, beyond the minimum standards required by Transport Canada regulation. These higher standards can be specified in the contract signed with the helicopter operator. The contract in effect at the time of the occurrence placed exclusive responsibility for safety standards with the helicopter operator, and only specified compliance with applicable regulations.

The NTSB study advocates the establishment of compatible management policies and procedures in situations where two management structures (in this occurrence, MNR and Northern Mountain Helicopters) are involved together in operations of an urgent nature. The intent is for all operational personnel from both organizations to be operating to the same standards and limits. The NTSB study highlights the *de facto* management role that on-scene personnel have with helicopter pilots. This role places an onus on fire management organizations to establish a safety philosophy that includes flight operations. To a great extent, a similar philosophy and policies were already embodied in the MNR Fireline Notebook; however, personnel were not assigned to safety-related positions on the fire team.

3.0 Conclusions

3.1 Findings

1. There was no evidence found of any aircraft failure or system malfunction either prior to or during the flight.

2. Records indicate that the aircraft was certified and equipped for flight in VMC conditions in accordance with existing regulations.

3. There was no evidence to indicate that the pilot's performance was affected by physiological factors.

4. The pilot was certified and qualified for the occurrence flight in accordance with existing regulations.

5. Although the pilot had instrument flight training early in his flying career, he did not have an instrument rating, nor had he maintained instrument flying currency during the 15 years preceding the occurrence, nor was he required to do so under existing regulations.

6. There were no aviation weather briefing facilities or weather observation personnel available at Leaf Rapids, and pilots were required to assess local weather conditions themselves.

7. The pilot lost the visual cues required for flight in visual meteorological conditions, and the helicopter struck the water before the pilot was able to regain adequate visual reference.

8. Three of the eight persons on board were incapacitated by head injuries caused by the crash. They were unable to release their safety harnesses, and drowned.

9. Studies indicate that the use of shoulder harnesses and protective headgear improves occupants' chances of survival in helicopter accidents; their use might have prevented the incapacitation of the casualties in this occurrence.

10. MNR fire-team management guidelines provided for the establishment of safety-related positions on the fire team, but these positions were not staffed.

3.2 Causes

While turning the helicopter to avoid an area of reduced visibility, the pilot lost the visual cues required for flight. The helicopter descended while in the turn and struck the water before the pilot was able to regain adequate visual reference.

4.0 Safety Action

4.1 Action Taken

4.1.1 Passenger Safety Equipment

The Manitoba Ministry of Natural Resources has issued an internal operational guideline, effective as of the 1996 fire season, pertaining to all fire-fighting-related flights. The guideline requires persons on board such flights to wear seat-belts, shoulder harnesses (where available), and helmets or hard hats secured with a chin strap, except when performing duties that require the removal of any or all of these items. In addition, in its future long term contracts with helicopter operators, the Ministry will require that approved shoulder harnesses be supplied at all normally occupied seat locations; this specification will be a preferred item for all casual hire rentals of helicopters.

4.1.2 Fire Team Safety-Related Positions

The Manitoba Ministry of Natural Resources has amended its operational guidelines to ensure that, on any overhead fire team mobilized to manage large fire outbreaks, the role of Fire Safety Officer is assigned to a specific and suitably trained individual. The Fire Safety Officer's responsibilities include complying with the items outlined in the Helicopter Officer Check List and ensuring that both pilots and other fire staff operate under the same standards and limits while on site.

4.1.3 Dissemination of Information

The Board believes that others involved in managing the safety of forest fire operations should be made aware of the safety issues identified during this investigation and of the subsequent action taken by Manitoba's Ministry of Natural Resources. As such, the final report of this occurrence investigation is being distributed to the authorities responsible for forest fire management in each of the provinces and territories.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 25 June 1996.

Appendix A - List of Supporting Reports

The following TSB Engineering Branch Report was completed:

LP 105/95 - Instruments Examination.

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

The following supporting report was completed by Standard Aero Engine Limited:

Standard Aero Investigation T53-13B Engine - 9 August 1995.

Appendix B - Glossary

agl	above ground level
ANO	Air Navigation Order
CDT	central daylight saving time
CPL	commercial pilot licence
FAA	Federal Aviation Administration
FSS	Flight Service Station
hr	hour(s)
IFR	instrument flight rules
IMC	instrument meteorological conditions
lb	pound(s)
MNR	Ministry of Natural Resources
NDB	non-directional beacon
NRO	Natural Resources Officer
NTSB	National Transportation Safety Board
TSB	Transportation Safety Board of Canada
UTC	coordinated universal time
VFR	visual flight rules
VMC	visual meteorological conditions
'	minute(s)
"	second(s)
º	degree(s)

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