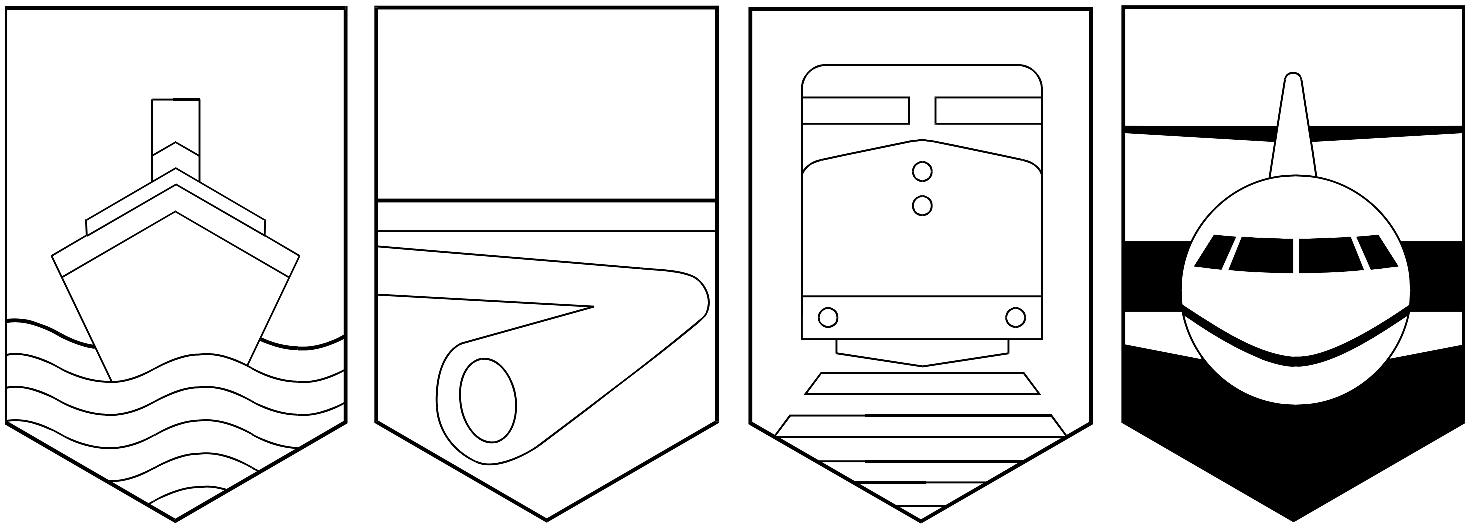
Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada



AVIATION OCCURRENCE REPORT

INSTRUMENT APPROACH - GROUND IMPACT

AIR SATELLITE
CESSNA 402B C-FFAS
HAVRE-SAINT-PIERRE, QUEBEC 1.5 nm E
23 NOVEMBER 1994

REPORT NUMBER A94Q0215

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

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Aviation Occurrence Report

Instrument Approach - Ground Impact

Air Satellite
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Synopsis

The pilot, sole occupant of the aircraft, took off from Lourdes-de-Blanc-Sablon, Quebec, on a flight to Havre-Saint-Pierre, Quebec. About 25 nautical miles from destination, the pilot commenced his descent to the airport. During the descent, the aircraft flew into snow showers. The pilot continued his instrument approach to the minimum descent altitude (MDA). A short time later, the aircraft touched the ground and crashed about 1.5 nautical miles from the runway threshold. The pilot sustained minor injuries; the aircraft sustained substantial damage.

The Board determined that the pilot continued the descent below the MDA without the required visual references.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 History of the Flight

The Air Satellite Cessna 402B, flight 638, took off from Lourdes-de-Blanc-Sablon, Quebec, on an instrument flight rules (IFR)[1] flight to Havre-Saint-Pierre, Quebec, with a load of mail.

At 6,000 feet above sea level (asl), meteorological conditions were visual (VMC). About 35 nautical miles (nm) from Havre-Saint-Pierre, the pilot began his descent. At 25 nm from the airport and at an altitude of 5,000 feet asl, the pilot contacted the Flight Service Station (FSS) specialist at Sept-Îles, Quebec, via the remote communications outlet (RCO). He requested weather information for Havre-Saint-Pierre Airport. The specialist gave him the latest weather report available for the Havre-Saint-Pierre FSS. The report had been issued three hours previously by Environment Canada. The meteorological sequence indicated VMC. The pilot could see the town of Havre-Saint-Pierre when he commenced his back course approach for runway 27.

During the descent, the aircraft flew into snow showers. The pilot contacted the company to check the weather at Havre-Saint-Pierre Airport, and he was told there was light snow. The pilot continued the approach to the MDA indicated on the Havre-Saint-Pierre approach chart, that is, 420 feet asl. There was moderate turbulence during the approach. The pilot tried to maintain control of the aircraft while operating the radio in an attempt to obtain more detailed weather information. One of the company pilots told him the snowfall was heavier. The aircraft then banked right. The pilot corrected, and, at the same time, the wheels touched the ground. The aircraft crashed and slid on its belly about 100 feet before coming to rest. The pilot sustained minor injuries; the aircraft sustained substantial damage.

The accident occurred about 1.5 nm from the threshold of Havre-Saint-Pierre runway 27 on marshy ground. The pilot remained in radio contact with overflying aircraft and said he would stay on board the aircraft until rescuers arrived. Search and rescue crews walked toward the crash site, but they were unable to find the aircraft because of the rough terrain and reduced visibility. Five hours later, a Search and Rescue helicopter located the aircraft with the aid of the direction finder. The weak signal from the emergency locator transmitter (ELT) was still readable and was received. The pilot was transported to hospital for first aid treatment.

The accident occurred during the hours of darkness, around 1714 eastern standard time (EST)[2], at latitude 50°16'N, longitude 63°36'W[3].

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1 See Glossary for all abbreviations and acronyms.

2 All times are EST (Coordinated Universal Time [UTC] minus five hours), unless otherwise stated.

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

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	1	-	-	1
Total	1	-	-	1

1.3 Damage to Aircraft

The aircraft sustained substantial damage to the landing gear, engines and propellers. Structural damage was quite substantial.

1.4 Other Damage

The aircraft uprooted a few bushes before coming to rest.

1.5 Pilot Information

	Pilot
Age	22
Pilot Licence	CPL
Medical Expiry Date	01 Sep 1995
Total Flying Hours	689

	Pilot
Hours on Type	29
Hours Last 90 Days	192
Hours on Type Last 90 Days	25
Hours on Duty Prior to Occurrence	8
Hours Off Duty Prior to Work Period	8

1.5.1 Pilot Experience and Qualifications

The pilot was certified and qualified for the flight in accordance with existing regulations. He had passed his pilot proficiency check (PPC) and instrument flight rating on the company Cessna 402B on 04 November 1994. He was a qualified pilot-in-command for that aircraft.

The company operations manual and Air Navigation Orders (ANO), Series VII, No. 3, Part IV, read in part as follows:

> Where the operation of an aeroplane has been authorized without a second-in-command [...], it shall be operated in compliance with the terms, conditions and limitations set out in Schedule C;

Schedule C, subsection 1(e) reads:

> No flight shall be terminated at an airport in weather conditions less than the alternate weather minima specified for that airport in the *Canada Air Pilot* or the operations specifications.

For Havre-Saint-Pierre Airport, the alternate minimum altitude is 1,600 feet asl with visibility three miles.

As pilot-in-command and sole pilot on board, the pilot was not authorized to descend below the alternate weather minima at the destination. The pilot was not fully aware of this limitation that applied to him as the sole pilot on board.

1.6 Aircraft Information

Manufacturer	Cessna Aircraft Company
Type	402B
Year of Manufacture	1975
Serial Number	402B0820

Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	7,012 hr
Engine Type (number of)	Continental TSIO 520 (2)
Propeller/Rotor Type (number of)	McCauley 3AF32C87 (2)
Maximum Allowable Take-off Weight	6,300 lb
Recommended Fuel Type(s)	100 LL
Fuel Type Used	100 LL

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The weight and centre of gravity were within the prescribed limits.

The two altimeters were checked immediately after the accident. They had been recently calibrated and the indicated error was under the maximum of 50 feet required for instrument flight. No deficiencies were found or reported by the pilot.

The aircraft was not equipped with either a radar altimeter or an altitude alert system. Existing regulations did not require these instruments on this type of aircraft.

1.7 Meteorological Information

When the pilot departed Lourdes-de-Blanc-Sablon for Havre-Saint-Pierre, both the current and forecast weather for his destination were VMC. Around 1705, while en route from Lourdes-de-Blanc-Sablon to Havre-Saint-Pierre, the pilot was flying at night in VMC.

At 25 miles from destination, the pilot contacted the FSS specialist at Sept-Îles via the RCO and was given the latest weather sequence for Havre-Saint-Pierre. This sequence had been transmitted at 1400 by the automated weather observation system (AWOS) station to the Environment Canada weather data centre at Dorval, which sent it to the Sept-Îles FSS specialist at 1414. The sequence indicated a layer of scattered cloud at 3,000 feet, visibility over nine miles, and winds from 290 degrees at 25 knots gusting to 35 knots.

No weather data was transmitted by the Environment Canada weather data centre between 1414 and 1735. At 1735, some 20 minutes after the accident, the AWOS did not report a ceiling but indicated a visibility of 0.7 miles in light snow.

The pilot had flown all day in VMC. En route for Havre-Saint-Pierre, he received a weather report indicating VMC.

1.7.1 AWOS Stations

The AWOS consists of a set of meteorological sensors, a data processing system, and a communications system. The sensors measure and report the air temperature, dew point, visibility, wind velocity, altimeter setting, cloud height and sky coverage, precipitation, and icing. All these data transmitted by the sensors are received, identified, and collated by a central controller, which then forwards them to a communications controller (CC) at the AWOS site. The data are then transmitted via telephone line to the Environment Canada computers at Dorval. AWOS data are fed through three computers before being entered in the central computer (CODCON), which converts the raw data (RA) into weather reports (SA, RS, SP). From the CODCON, the data are sent to another CMC (TANDEM computer), which transmits them to the ANIKOM (FSS, DEA, Météomédia, etc).

In the 1980s, Environment Canada deployed basic weather autostations (not designated to meet aviation requirements) at selected airports with light traffic, like Parent, Chévery, Port-Menier and Rivière-du-Loup. Transport Canada then gradually installed more advanced AWOS to augment or replace the aviation surface weather observation program at some FSSs. The Havre-Saint-Pierre AWOS came into service on 17 November 1994.

1.7.2 Havre-Saint-Pierre AWOS Station

On the day of the accident, the AWOS station sensors were functioning correctly, and the hourly and special observations were transmitted to the Environment Canada weather data centre at Dorval. However, a glitch in the CODCON central computer caused a delay in data transmission of about three hours--from 1414 to 1735.

Environment Canada had to replace the existing software because it was not efficient enough. A new computer, CODCON II, was subsequently installed, and data processing is now more efficient. In addition, Transport Canada's regional action plan anticipates the resumption of weather observations at Havre-Saint-Pierre pending improvement of the AWOS.

1.7.3 Altimeter Setting Requirements

Canada Air Pilot - East, in the section entitled Operating Minima - Landing, states the following:

> Before commencing an instrument approach procedure the pilot shall have set on the aircraft altimeter a current altimeter setting usable for the location where the approach is to be flown. The altimeter setting [...] is provided by the routine hourly weather report. These readings are considered current up to 90 minutes from the time of observation. CAUTION: Care should be exercised when using altimeter settings older than 60 minutes or when pressure has been reported as falling rapidly.

The pilot used the altimeter setting from the routine hourly weather report issued 180 minutes before the approach. The difference between the two altimeter settings was 0.02 inches of mercury, representing 20 feet.

1.8 Aids to Navigation

The back course localizer transmitter for runway 27 at Havre-Saint-Pierre Airport was functioning normally, and no anomalies were reported during the periodic check of the unit or by pilots who used it before or after the accident.

1.9 Communications

Communications between the aircraft and the Sept-Îles FSS via the RCO were normal. No deficiencies were reported either before or after the accident.

1.10 Aerodrome Information

Havre-Saint-Pierre Airport has one asphalt-surface runway 4,500 feet long by 100 feet wide. Two types of approach are used. There is a runway localizer (LOC) co-located with distance measuring equipment (DME) on runway 09, and a back course (BC) on runway 27. The published MDA for the LOC(BC)/DME approach to runway 27 that the pilot used is 420 feet asl.

1.11 Flight Recorders

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

1.12 Wreckage and Impact Information

The aircraft touched down about 1.5 miles from the runway 27 threshold. Aircraft attitude was horizontal and the landing gear was down at the time of impact. The elevation of the accident site is 124 feet asl.

1.13 Medical Information

There was no evidence that incapacitation or physiological or psychological factors affected the pilot's performance.

1.14 Fire

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

1.15 Survival Aspects

The pilot sustained minor injuries in the impact. He was wearing a four-point seat-belt; however, it could not be determined how the shoulder straps were tightened.

The pilot used the winter coat provided by the company to keep warm, and he stayed on board the aircraft until the rescuers arrived at the site. The ELT functioned normally, emitting a weak signal.

Search and rescue operations were initiated by local police and airport personnel. They were unable to find the aircraft, however, because of the rough terrain and the rivers that had to be crossed. In addition, visibility was reduced. A Search and Rescue helicopter located the aircraft using the direction finder. The ELT signal was still readable and was received.

1.16 Organization and Management Information

The company chief pilot was familiar with the company operations manual and aviation regulations (ANO Series VII, No. 3(4)). He knew the limitations that the pilot was required to comply with, and had explained to the pilot that he could fly alone in VMC, and in IMC when weather conditions were equal to or above the alternate weather minima specified in the *Canada Air Pilot*. The chief pilot had asked him to fly with a second pilot if meteorological conditions dictated instrument flight (IMC).

1.17 Additional Information

1.17.1 Instrument Flight Training

Training, completing checklists, and learning and routinely executing operating procedures all contribute to safe flying. When pilots learn to fly by their instruments, they learn the importance of preparing for the flight, the approach, and the missed approach.

Pilots must be mentally prepared to carry out their plan of action, taking into account limits and decisions to be made according to the options available, such as minimum descent altitude and the distance at which the missed approach must be executed. Several studies have shown that reaction times are much slower when the individual is not mentally prepared for a situation that arises.

1.17.2 Mental Model

Flying involves observing and reacting to indicators or events occurring inside and outside the aircraft. As the flight progresses, these indicators and events change and pilots must adapt their handling of the aircraft accordingly and make decisions to ensure continued safe flight.

From visual cues outside the aircraft and readings from the aircraft instruments, pilots form a mental model of their environment and the position of the aircraft in space. During the flight, information received by the pilot will confirm or alter the existing mental model.

1.17.3 Transition from VFR to IFR Flight

The transition from VFR flight to IFR flight is considered very difficult. Pilots must sometimes adjust very quickly to the differences in scale, format, and content of the information. They must be attentive to outside information as well as the information available inside the cockpit.

During a flight in IMC, the information required for the conduct of the flight comes from the flight instruments. This information must be integrated into a mental model of the position and altitude of the aircraft in space. This mental model must include the external characteristics that will be present on the transition from VFR to IFR flight.

On an instrument approach, confusion can arise in the pilot's mind when the actual conditions do not correspond to those of the mental model. The pilot will then look for external cues to confirm or update the mental model, sometimes at the expense of instrument scanning.

1.17.4 Workload

A pilot flying alone in IMC carries a workload that is already greater than it would be if two pilots were on board. Flying in turbulent or difficult conditions also increases the workload. On a flight with two crew members, the pilot at the controls usually handles the flying duties, and the other pilot operates the radio, confirms instrument readings, calls out minimum altitudes, and performs other tasks. Dividing up tasks in this manner enables the crew to evenly share the workload.

When the workload is greater, pilots sometimes scan the instruments more slowly or less attentively, and they may even concentrate on just one instrument. When there is no second pilot on board to check instrument readings, memory aids like radar altimeters or altitude alert systems can be used; these memory aids warn the pilot by activating a visual or audible alarm or both when the aircraft reaches the selected altitude.

1.17.5 Channelled Attention

Channelled attention occurs when a person focuses exclusively on a single stimulus to the exclusion of all others. This becomes a problem if the person does not perform a task or does not respond to a stimulus that carries a higher priority or is more urgent, and consequently does not notice, or does not have time to react to, cues that require immediate attention.

Pilots must scan their instruments quickly without focussing on any particular instrument. If they stare at an instrument for too long, they deprive themselves of important information in a continuously changing environment.

1.17.6 Landing Minima

Air Regulation 555 specifies that landings are governed by published decision heights/MDAs. The *Canada Air Pilot* states that pilots of aircraft on instrument approaches are prohibited from continuing the descent unless the required visual reference is established and maintained in order to complete a safe landing. The visual references required by the pilot in order to continue the approach to a safe landing should include at least one of the following references and should be visible and identifiable to the pilot:

(a) the runway or runway markings;
(b) the runway threshold or threshold markings;
(c) the touchdown zone or touchdown zone markings;
(d) the approach lights;
(e) the approach slope indicator system;
(f) the runway identification lights (RILS);
(g) the threshold and runway end lights;
(h) the touchdown zone lights;
(i) the parallel runway edge lights;
(j) the runway centre line lights.

None of the above visual references was established by the pilot during the approach before ground impact.

2.0 Analysis

2.1 Meteorological Conditions and AWOS Station

At the time of the accident, the AWOS station transmitted the data corresponding to the current meteorological conditions at Havre-Saint-Pierre. However, those data were not retransmitted to the pilot via the specialist at the Sept-Îles FSS. A glitch in the CODCON central computer at Dorval caused a delay of about three hours--from 1414 to 1735--in the transmission of the data for Havre-Saint-Pierre; the accident occurred during that period.

2.2 Pilot Preparation

The pilot commenced his descent about 25 nm from Havre-Saint-Pierre. He requested the latest meteorological sequence from the Sept-Îles FSS specialist. The sequence was sent to him, and it indicated VMC. The pilot used an altimeter setting that was over 90 minutes old, thereby introducing an error of about 20 feet into the altimeter. However, this error is negligible and is not considered a factor in the accident.

After seeing the lights of the town, the pilot, relying on the weather report he had received, proceeded with the instrument approach to runway 27. The pilot expected to encounter VMC during the approach, and he did not prepare for the possibility that he might have to execute a missed approach.

As it was dark, the pilot could not see the clouds and snow showers around the airport. During the instrument approach, the pilot did not notice that the IMC encountered were very different from the VMC he was expecting. The IMC encountered did not enable him to establish the required visual references during the approach.

2.3 Workload and Pilot Attention

The pilot's workload was increased because he had to fly an instrument approach as the sole occupant on board, in the dark, in moderate turbulence, and without having established the visual references he expected. His workload was further increased by the radio calls he made during the final approach to request the weather at the airport.

During the approach the pilot had to scan the instruments, try to establish the required visual references, and use the radio. As the pilot had to concentrate on all these tasks during the approach, the instruments, particularly the altimeter, were scanned less attentively. As he was no longer monitoring his vertical navigation effectively, the pilot allowed the aircraft to descend below the MDA until it struck the ground.

Aviation regulations and the *Canada Air Pilot* specify that the pilot was not authorized to descend below 1,600 feet asl unless he established and maintained the required visual references with the runway or runway markings. Not having established the required visual references, the pilot continued the approach in IMC until the aircraft struck the ground, although he could have executed a missed approach. Executing a missed approach would have allowed the pilot either to make another instrument approach in known IMC, or to proceed to the alternate airport if the conditions precluded him from landing at Havre-Saint-Pierre Airport.

3.0 Conclusions

3.1 Findings

1. The pilot was qualified for the flight.

2. The Havre-Saint-Pierre AWOS station transmitted the meteorological data that had been captured.

3. The Environment Canada CODCON computer at Dorval was unable to process or transmit data to users for a period of three hours, and the flight and accident occurred during that period.

4. The pilot was not prepared to execute an instrument approach in IMC.

5. The pilot was not prepared to execute a missed approach at a predetermined altitude in the event that he could not establish visual contact with the runway or its surroundings.

6. The pilot continued the descent below the MDA without having established and maintained the required visual references with the runway or runway markings.

7. On the final approach, the aircraft struck some trees and crashed on the extended centre line of runway 27, approximately 1.5 miles short of the runway threshold.

3.2 Causes

The pilot continued the descent below the MDA without the required visual references.

4.0 Safety Action

4.1 Action Taken

4.1.1 Automated Weather Observation Systems

Since the occurrence, Transport Canada has issued a class 1 Notice to Airmen (NOTAM) and has sent an Aviation Notice concerning deficiencies of the AWOS to all licensed pilots in Canada. Further, Transport Canada, in partnership with Environment Canada, has created a task force to rectify the deficiencies and validate improved AWOS performance. In the meantime, there is a temporary hold on the commissioning of future AWOS sites, and some existing sites are being manned by observers.

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 Hugh MacNeil, authorized the release of this report on 14 September 1995.

Appendix A - Glossary

ANO	Air Navigation Order
asl	above sea level
AWOS	automated weather observation system
BC	back course
CODCON	central computer
CPL	commercial pilot licence
DME	distance measuring equipment
ELT	emergency locator transmitter
EST	eastern standard time
FSS	Flight Service Station
hr	hour(s)
IFR	instrument flight rules
IMC	instrument meteorological conditions
lb	pound(s)
LOC	localizer
MDA	minimum descent altitude
nm	nautical miles
PPC	pilot proficiency check
RCO	remote communications outlet
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VFR	visual flight rules
VMC	visual meteorological conditions
°	degrees
'	minutes

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