Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05Q0024

LANDING BESIDE THE RUNWAY

SCOTT AVIATION
HAWKER SIDDELEY HS 125-600A N21SA
BROMONT AIRPORT, QUEBEC
21 FEBRUARY 2005

Canada

Aviation Investigation Report

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Hawker Siddeley HS 125-600A N21SA
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Report Number A05Q0024

Summary

The HS 125-600A, operated by Scott Aviation, registration number N21SA, serial number 256006, with two crew members and four passengers on board, took off from Montréal, Quebec, at 1756 eastern standard time, for a night instrument flight rules flight to Bromont, Quebec. Upon approaching Bromont, the co-pilot activated the lighting system and contacted the approach UNICOM (private advisory service). The flight crew was advised that the runway edge lights were out of order. However, the approach lights and the visual approach slope indicator did turn on. The flight crew executed the approach, and the aircraft touched down at 1818 eastern standard time, 300 feet to the left of Runway 05L and 1800 feet beyond the threshold. It continued on its course for a distance of approximately 1800 feet before coming to a stop in a ditch. The crew tried to stop the engines, but the left engine did not stop. The co-pilot entered the cabin to direct the evacuation. One of the passengers tried to open the emergency exit door, but was unsuccessful. All of the aircraft's occupants exited through the main entrance door. Both pilots and one passenger sustained serious injuries, and the three remaining passengers received minor injuries. The aircraft suffered major damage.

Ce rapport est également disponible en français.

Other Factual Information

The flight crew was certified and qualified for the flight in accordance with existing regulations. The pilot-in-command had been working for the company since July 2004. He had accumulated a total of 5000 flight hours, including 550 hours on the HS 125 as captain and 200 hours as co-pilot. At the time of the accident, he was sitting in the left seat and was acting as pilot flying (PF). The co-pilot had been working for the company since October 2004. He had flown approximately 1700 flight hours, including 100 hours as co-pilot on the HS 125. At the time of the accident, he was sitting in the right seat and was acting as pilot not flying (PNF).

The aircraft, a HS 125-600A, was operated by Scott Aviation, a business aircraft management company that operates 13 aircraft. The company's head office is at the DuPage Airport in Illinois, United States. The company holds operating certificate SVTA0235 issued by the Federal Aviation Administration (FAA). The flight was carried out in accordance with Part 135 of the *Federal Aviation Regulations* (FARs). The company also holds a Canadian foreign air operator certificate, number F-7262, issued by Transport Canada under Part VII, Subpart 1, of the *Canadian Aviation Regulations* (CARs). The general conditions of the Canadian foreign air operator certificate state that the company must conduct its aviation operations in accordance with International Civil Aviation Organization (ICAO) standards and CAR applicable provisions.

On the day of the accident, the flight crew reported for work at the DuPage Airport at approximately 1000 eastern standard time.[1] The aircraft flew to the Middle Georgia Regional Airport and to the Cobb County Airport–McCollum Field in Georgia, United States, before heading to Montréal, where it landed at 1542. These flights were completed without incident.

Before departure from Montréal, the captain filed an instrument flight plan with the Québec, Quebec, flight information centre (FIC). The FIC specialist asked the pilot whether he needed the notices to airmen (NOTAMs), and the pilot indicated that he did not need them. According to the company's standard operating procedures (SOP) manual, the captain is responsible to obtain the NOTAMs before departure. The co-pilot was not informed of the NOTAMs before departure. This was the first time the crew had ever flown to Bromont. According to the flight plan, the planned flight time was 15 minutes, and the fuel on board was sufficient for 1.5 hours of flight. The aircraft took off from Montréal at 1756. This was a night flight.

No weather observations are taken at the Bromont Airport. The 2300 UTC aviation routine weather report (METAR) from the Saint-Hubert Airport, Quebec, located 30 miles from Bromont, was as follows: winds 110 degrees True at 5 knots, visibility 1 mile in light snow flurries and cloud cover at 2000 feet. The investigation showed that similar conditions were prevailing at Bromont at the time of the accident. According to paragraph 135.213(b) of the FARs, when a flight is conducted under instrument flight rules, the weather observations

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[1] All times are eastern standard time (Coordinated Universal Time [UTC] minus five hours) unless otherwise stated.

produced and given to the pilots must be taken at the airport where the aircraft is heading, unless otherwise authorized by an operating specification issued by the FAA or by a designated person. However, there is no indication that the company had such a specification.

The flight crew performed the front course localizer (LOC) approach on Runway 05L. Runway 05L is a paved runway, 5000 feet long and 100 feet wide. It is equipped with "J" type aircraft radio control of aerodrome lighting (ARCAL), consisting of approach lights, low-intensity runway edge lights and a precision approach path indicator (PAPI). The PAPI is located at the left side of the runway, in accordance with Canadian civil aviation standards. The lighting comes on for approximately 15 minutes when the pilot presses the microphone button five times within five seconds.

Approximately nine minutes before the landing, the co-pilot activated the ARCAL and contacted the approach UNICOM (AU) at Bromont. The Bromont Airport dispatcher informed the crew that only the PAPI was operational. A NOTAM had been issued on 17 February 2005, indicating that the runway edge lights would be out of order until 2200 UTC, 22 February 2005. The PAPI and the approach lights lit up when the PNF activated the ARCAL, because their switches had been left on. There is no indication in the CARs or in the airport operating manual that the lights should have been turned off while the runway edge lights were out of order.

At approximately 1000 feet asl and five miles from the threshold, the flight crew had the approach lights and the PAPI in sight. It was not evident whether the PAPI was positioned on the right or the left side of the runway. The airport chart published by Jeppesen indicated "PAPI-L" (see Appendix A), and interpretation meant that the PAPI was on the left. In response to a query from the crew, the Bromont dispatcher indicated that the PAPI was on the right side of the runway. From his location facing the aircraft, the PAPI was to the dispatcher's right. The approach chart, also published by Jeppesen, showed the position of the PAPI by means of a pictograph, showing a drawing of the runway threshold and the approach lights with the word "PAPI" on the left side of the drawing (see Appendix B). Although that chart was referred to during the approach, there is no indication that the crew noticed the pictograph.

The approach was continued visually, keeping to the left of the PAPI. At approximately two miles from the runway threshold, the co-pilot noticed that the approach lights were at his right. He reported his observation to the captain, who paid little attention to it. The co-pilot concluded that these were the approach lights for Runway 05R, although Runway 05R was not equipped with runway lights. Less than two seconds before the crash, the co-pilot asked the captain whether he had the runway in sight. The captain did not reply and continued the descent until the aircraft touched down 300 feet to the left of Runway 05L, 1800 feet beyond the threshold. When the captain realized that he was not on the runway, he applied full power to execute a missed approach; however, the aircraft hit a ditch approximately four feet deep that was perpendicular to the flight path. The nose wheel and right landing gear collapsed. The aircraft came to a stop facing back the way it had come, after travelling a distance of 1800 feet during which it made a full turn followed by a 180-degree turn.

Once the aircraft had come to a stop, the flight crew attempted to shut down the engines (TFE 731-3-1H) by closing the two HP cock levers and the two LP cock levers. However, the left engine did not stop. The investigation showed that the left LP cock lever was blocked at the halfway point. This LP cock is located underneath the fuselage, in a spot that suffered some

damage that might have restricted the movement of the bellcrank that activates the LP cock. Since the supply of fuel to the engines can be cut off by means of the HP cock levers under normal operating conditions, it is possible that the mechanical links connecting the left HP cock lever also suffered damage, which prevented the fuel supply from being cut off. The engine finally stopped on its own, 38 minutes after the accident. The investigation did not reveal any irregularity in the aircraft that could have contributed to the accident.

The co-pilot went into the cabin to direct the evacuation. The passengers had difficulty hearing his evacuation orders because of the noise of the left engine, which was still running. The HS 125 is equipped with a main door located at the left front that can be used in case of evacuation, as well as the emergency exit located above the right wing. The emergency exit can be opened from the inside by pulling on a handle to unlock it, or from the outside by pushing a push-button. One of the passengers tried unsuccessfully to open the emergency door. As a result of the fuselage being bent out of shape, the door was jammed in its frame. After the accident, the investigators noted that, despite diligent efforts, it was impossible to push the outside push-button without using a cylindrical object. It was impossible to determine why the push-button was not working properly.

A cabinet that served as an armrest for the side seat was partially blocking the emergency exit (see Photo 1). The armrest/cabinet is connected to the seat by means of a rail along which it slides when it is necessary to remove it. According to Supplementary Type Certificate (STC) SA4147SW, a notice indicating that the armrest must be removed before each take-off and landing must be displayed when the armrest is in position. At the time of the accident, the armrest/cabinet was in position, and the notice stated that the cabinet should be pulled forward in order for the emergency exit to be used.

Photo 1. Armrest/cabinet

All the occupants left the aircraft through the main door, which proved difficult to open because the fuselage was bent out of shape. The door and its built-in stairway open downwards and could not be fully lowered because of the collapsed front landing gear. One of the passengers tripped over the doorway during the evacuation. Once they were outside the aircraft, the two pilots noticed that the passenger who was seated at the extreme rear of the aircraft had not exited the aircraft. He was unable to move due to his injuries. The crew helped him. Due to the horizontal position of the stairway, one of the passenger's feet got stuck twice while he was being evacuated. The company's General Operations Manual states that, among the duties to be performed during an evacuation, the crew must ensure that all the occupants have left the aircraft before leaving it themselves.

According to Section 135.117 of the FARs, the pilot-in-command must ensure, before each take-off, that the passengers have been given an oral briefing, which must include the following information, among others:

- how to use the seatbelts;
- the location of the main doors and emergency exits, and how to use them;
- the location of survival equipment;
- how to use the oxygen, under normal conditions and in an emergency; and
- the location of fire extinguishers and how to use them.

The same section states that a printed card must supplement the safety briefing. The ICAO standard concerning the safety briefing is comparable. The passengers did not receive any safety briefing before the departure from Montréal or before the previous take-offs made earlier that day. The passengers had not read the printed card.

All the passengers were wearing their lap safety belts. However, the two passengers seated on the side seat were not wearing the shoulder straps, which were found behind the back of the seat. Their method of use is so unusual that no one was able to figure it out. Moreover, instructions for their use were not provided in the information leaflet that was found on board.

The Bromont municipal police was notified of the accident at 1826, eight minutes after the crash. The first responders – the police and the fire department – arrived at the scene approximately four minutes later. At 1843, the first of five ambulances arrived at the scene. All the occupants were taken to hospital.

After the accident, the Bromont Airport navigation aids were subjected to an in-flight test, which showed that they met operating requirements and that the broadcast parameters were within technical tolerances. No operating irregularity of the navigation aids was reported on the day of the accident.

The Bromont Airport is operated by the Régie aéroportuaire régionale des Cantons de l'Est (Eastern Townships Regional Airport Board), which holds operating certificate 5151-1Q-401. The airport has one paved runway, 05L-23R, which is 5000 feet long, and one grass strip, 05R-23L, which is 3200 feet long and 320 feet wide. The grass strip is not equipped with runway lights and is closed in the winter. The airport is at an elevation of 374 feet asl.

The airport is staffed by one chief dispatcher, five dispatchers and one maintenance officer. The dispatchers look after radio communications, the parking of aircraft, runway safety, refuelling and the issuance of NOTAMs. The dispatcher on duty at the time of the accident held a restricted radio operator's certificate. The communications between the flight crew and the dispatcher were conducted via the AU. With respect to this occurrence, a NOTAM had been issued as required by regulations. Despite the absence of operating runway edge lights, the airport was not considered closed for nighttime use. The CARs do not require an airport operator to evaluate the impact of a reduced level of service provided at the airport and give no guidelines on how to evaluate such an impact.

According to the airport operations manual, snow-clearing operations begin when three centimetres of snow have accumulated. A runway surface condition report (RSCR) issued at 0844 that day (that is, nearly eight hours before the accident) indicated that 80 per cent of the surface was covered with hard snow, and 20 per cent was bare and dry. The RSCR did not specify the thickness of the snow cover. During the approach, the flight crew was notified that there was a little snow on the entire surface. However, no details on the thickness of the snow and no braking action report were provided to the flight crew. The Bromont Airport does not have any equipment for measuring the braking action and is not required to. The exact quantity of snow on the runway at the time of the accident could not be determined. However, when the investigators arrived at the scene a few hours after the accident, the runway was covered with between one and three centimetres of snow.

The weight of the aircraft at landing, as calculated by the crew, was 18 200 pounds. To determine the landing distance, the crew used a chart included in the normal checklist and determined it to be 4080 feet, by rounding the weight up to 19 000 pounds and the pressure altitude to 1000 feet. This distance is the product of the unfactored landing distance on a dry runway, multiplied by 1.67.

The landing performance diagrams from the flight manual mention three types of runway conditions for determining the unfactored landing distance – dry runway, wet runway and icy runway with a friction coefficient of 0.05. There is no diagram referring to a snow-covered runway. Based on the diagram corresponding to the aircraft's configuration at the time of landing, it was determined that the unfactored landing distance was 2520 feet on a dry runway, 3230 feet on a wet runway, and 9300 feet on a slippery runway with a friction coefficient of 0.05. These distances are based on a weight of 18 200 pounds and a pressure altitude of 454 feet. There is no indication that the flight crew looked at the diagram during the flight planning.

According to SOPs, the captain has the final authority and the responsibility to undertake or to cancel a flight. SOPs also indicate that, as soon as a crew member notices that another crew member is taking dangerous actions, or that his actions are contrary to company procedures or to regulations, he must notify the other crew member. When the co-pilot indicated that the approach lights were on the right, the captain did not question the validity of the information and continued with the approach.

According to ICAO international standards and recommended practices, a pilot-in-command must comply with the laws, regulations and procedures of the country in which the aircraft is flying. Subsection 602.40(1) of the CARs states that it is prohibited to take off or land at an aerodrome at night unless the aerodrome has lights in accordance with the requirements stated in Part III of the CARs. According to subsections 301.07(1) and (2), the aerodrome operator shall indicate each side of the runway along its length with a line of fixed white lights that is visible in all directions from an aircraft in flight at a distance of not less than two nautical miles, or else he must use white retro-reflective markers that are capable of reflecting aircraft lights and that are visible at a distance of not less than two nautical miles from an aircraft in flight that is aligned with the centreline of the runway. Neither of these requirements was met when the accident occurred. Landing was prohibited. The FARs runway light requirements for night landings are similar to those of the CARs. They indicate that the boundaries of the surface used for night take-offs or landings must be clearly indicated with side marker lamps or runway lights.

Analysis

According to the Canadian foreign air operator certificate, the flight crew was required to comply with ICAO standards and thus with the CAR applicable provisions. Although it is possible that the flight crew was not familiar with the Canadian regulations, they knew that it was against the American regulations to land at night without runway edge lights, and there was no reason to believe that the rules were different in Canada. The CARs prohibited night landings without runway edge lights, and this is a precaution to prevent such accidents.

Closing the runway for night use would have provided an additional precaution that would have helped prevent night landings without runway edge lights. Nevertheless, a series of decisions made by the flight crew contributed to the accident. Consequently, this analysis will focus on those decisions and how they circumvented the precautions put in place to reduce operating risks.

The coordination of a crew and the SOPs are the most easily available defence tools for dealing with threats, errors and undesirable conditions. In this occurrence, the crew was faced with two primary threats. The first was landing at night without runway edge lights, and the second was the wrong information about the position of the PAPI.

The airport was not closed for night use, despite the absence of runway edge lights. Nothing required it to be. The crew was therefore able to obtain authorization for a flight under instrument flight rules to this destination without being aware that the runway edge lights were out of order. If the crew members had known about the NOTAM before departure, they would have had additional information on which to base their flight decisions. The SOP manual gave the pilot-in-command the prerogative of postponing or cancelling the flight if he deemed that it was not safe to undertake it.

The decision to carry out the approach with the intention to land, after being advised that the runway edge lights were out of order, was illegal. The captain was able to activate some runway lighting components; therefore, it is possible that he was confident that he would eventually be able to perceive the runway. Since the snow-covered runway provided little contrast with the adjacent terrain, and the flight took place at night without runway edge lights, it was impossible to distinguish the runway from the surrounding terrain.

Even though he did not have the runway in sight, the captain continued the descent until the aircraft touched the ground, instead of executing a missed approach and returning to Montréal. The fuel on board and the weather conditions made it possible to do so. There is no indication that the crew was subjected to pressure from the company or from the passengers. It is well known that, in some circumstances, pilots put pressure on themselves out of a desire to complete the mission, especially when they have not been working long for the company, as was the case in this occurrence.

The crew members were not familiar with the Bromont Airport, as they had never been there before. However, the airport chart and the approach chart to which they referred provided all the information they needed. The positions of the PAPI and the approach lights were clearly indicated, and there was no reason to think that there were approach lights for Runway 05R.

Therefore, there is reason to believe that the crew members were not sufficiently familiar with the information shown on the approach chart, and that is why they asked the dispatcher about the position of the PAPI. Despite the fact that the crew members were misinformed about the position of the PAPI, they could have ensured that they were aligned with the runway by referring to the course deviation indicator (CDI) and the approach lights. Landing was prohibited in any event. Since neither pilot noticed the deviation on the CDI, it may be assumed that both pilots were focusing their attention outside, probably in an effort to locate the runway.

The crew members did not inquire about the runway conditions at Bromont before departing from Montréal. Even if they had done so, the most recent report reflected conditions approximately eight hours earlier and was not representative of the current conditions. The runway had not been cleared of snow in the hours preceding the accident because the surface was covered with less than three centimetres.

It was not until the final approach that the crew learned that the runway was snow-covered. Without even knowing how thick the snow cover on the runway was, the captain was determined to land there, even with a slight tailwind. Not knowing the actual condition of the runway surface, it would have been risky to land even if runway edge lights had been available. The landing distance calculated using the chart was not valid for a snow-covered runway. Even if the crew had used the landing performance diagram in the flight manual, the diagram made no reference to a snow-covered runway; therefore, it was impossible for the flight crew to ensure that the runway was long enough for a safe landing on a snow-covered surface.

The key to successful piloting is good flight planning, good airmanship and effective communication between crew members. Communications must be clear and concise. In this occurrence, planning was deficient, and the communications between the two pilots were indirect and subjective. The captain did not clearly indicate his intentions when he learned that the runway edge lights were out of order. He continued his approach without explaining what his action plan was. Nevertheless, the co-pilot did understand that the pilot was going to attempt to land. The co-pilot commented on the manoeuvre that the captain was about to undertake without stating clearly whether he agreed with it or not.

Since the captain did not have the runway in sight, it would have been prudent to conduct a go-around. When the co-pilot realized that neither he nor the captain had the runway in sight, he could have asked for a go-around or he could even have taken the controls and done it himself. It is well known that some co-pilots feel uncomfortable about questioning a captain's decision or about taking over the controls. Instead, they opt for an indirect or subjective comment, in hopes of getting their message across. It could not be determined why the co-pilot did not react or question the pilot more openly about his intentions. Various factors might explain this type of behaviour: the age difference, seniority, culture, respect for authority, overall experience, or experience with this type of aircraft. In this case, it is possible that the co-pilot's level of experience compared to the captain's may have had a bearing on the crew's interaction during the occurrence.

Contrary to regulations, the flight crew did not give a safety briefing to the passengers. Consequently, the passengers were not well prepared to assume their responsibilities in case of an emergency, which reduced their probability of survival. Due to the absence of a briefing, the two passengers seated on the side seat were unaware of the existence of shoulder straps, which

were hidden behind the seat. Since they were not wearing the shoulder straps, their protection in case of an accident was greatly reduced. Even if the passengers had read the printed card, it did not explain the complex method of attaching the straps.

The emergency exit could not be opened due to structural damage, which delayed the evacuation and could have had serious consequences. As well, the armrest next to the side seat was blocking the access to the emergency exit. The notice on the armrest was not compliant with the STC, which required that the armrest be removed before each take-off and landing. STCs are not normally provided to pilots, so the flight crew had no way of knowing about this requirement.

Poor flight planning, non-compliance with regulations and SOPs, and the lack of communications between the two pilots reveal a lack of airmanship on the part of the crew, which contributed to the accident.

Findings as to Causes and Contributing Factors

1. The flight crew attempted a night landing in the absence of runway edge lights. The aircraft touched down 300 feet to the left of Runway 05L and 1800 feet beyond the threshold.

2. The runway was not closed for night use despite the absence of runway edge lights. Nothing required it to be closed.

3. Poor flight planning, non-compliance with regulations and standard operating procedures (SOPs), and the lack of communications between the two pilots reveal a lack of airmanship on the part of the crew, which contributed to the accident.

Findings as to Risk

1. Because they had not been given a safety briefing, the passengers were not familiar with the use of the main door or the emergency exit, which could have delayed the evacuation, with serious consequences.

2. The armrest of the side seat had not been removed as required and was blocking access to the emergency exit, which could have delayed the evacuation, with serious consequences.

3. Because they had not been given a safety briefing, the passengers seated in the side seats did not know that they should have worn shoulder straps and did not wear them, so they were not properly protected.

4. The possibility of flying to an airport that does not meet the standards for night use gives pilots the opportunity to attempt to land there, which in itself increases the risk of an accident.

5. The landing performance diagrams and the chart used to determine the landing distance did not enable the flight crew to ensure that the runway was long enough for a safe landing on a snow-covered surface.

Safety Action Taken

On 19 July 2005, the TSB sent Safety Advisory A050012 (A05Q0024) to Transport Canada. The safety advisory states that, in this occurrence, the precautions embodied in the various civil aviation regulations did not prevent this night landing when the runway edge lights were unserviceable. Consequently, Transport Canada might wish to review the regulations with the goal of giving airport operators guidelines on how to evaluate the impact of a reduced level of service on airport use.

Pursuant to this safety advisory, Transport Canada determined that it would be very difficult to prepare guidelines that would cover all factors that are directly or indirectly associated with airport certification or operations. Moreover, Transport Canada believes that requiring aerodrome operators to evaluate the impact of a reduced level of service on aerodrome use would be a particularly complex task that could greatly increase the possibility of errors in assessment or interpretation. However, Transport Canada is examining the possibility of adding information on the level of runway certification to the *Canada Flight Supplement*, which would provide more information and details to pilots regarding any change to the certification status of a given runway.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 18 April 2006.

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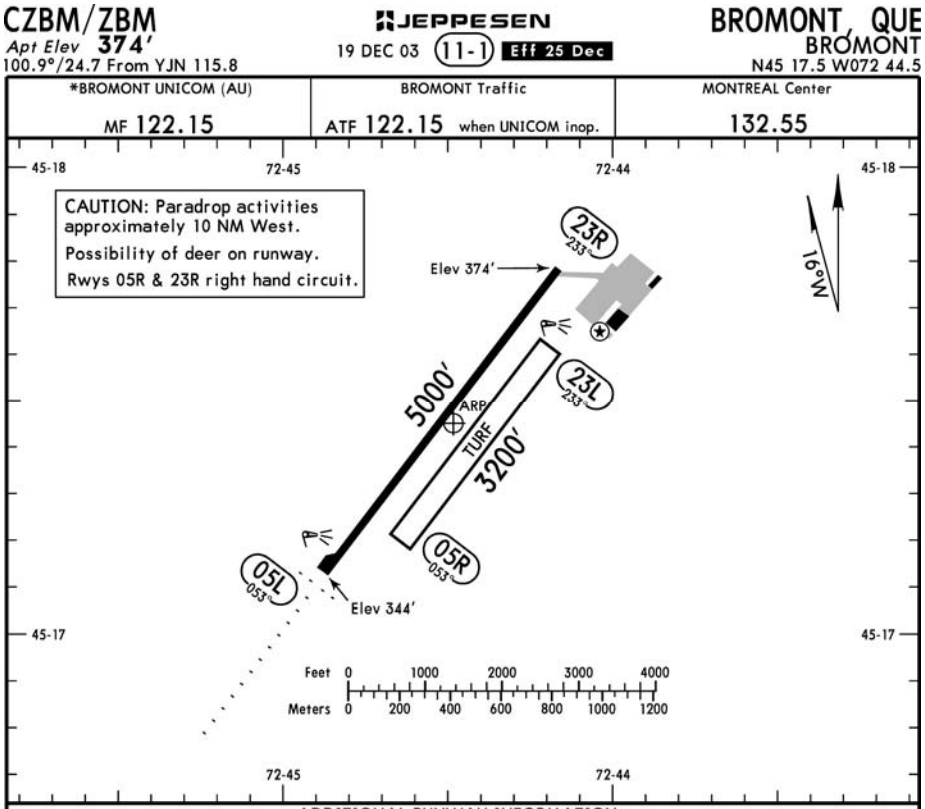
Appendix A – Aerodrome Map

(Reproduced with permission of Jeppesen Sanderson, Inc. Not to be used for navigation)



ADDITIONAL RUNWAY INFORMATION

RWY		USABLE LENGTHS — LANDING BEYOND — Threshold	Glide Slope	TAKE-OFF	WIDTH
05L	❶RL ❶❷ALS ❸PAPI-L (angle 3.0°)				100′
23R	❶RL ❸PAPI-L (angle 3.0°)				
05R					320′
23L					

❶ Activate on 122.15.
❷ Non-std; Yellow.
❸ For aircraft with eye-to-wheel height up to 25′.

TAKE-OFF & DEPARTURE PROCEDURE

Rwy 05L	Rwy 23R
Climb on 053° heading to 800′. Climbing left turn to 2000′ on 030° heading before proceeding on course. Remain clear of CY(R)-610 (600′ ASL 3.3 NM southwest of 05L threshold) and of CY(A)-621(H) (7000′ ASL 8 NM northwest of 23R threshold). DEPARTURE PROCEDURE EASTBOUND OR SOUTHBOUND: Climb on 053° heading to 800′. Climbing left turn to 2000′ on 030° heading. Climbing right turn direct ZBM NDB before proceeding on course. Before entering Class E airspace call Montreal Center. Expect to maintain 5000′ ASL or assigned altitude. Expect published hold southwest of ZBM NDB inbound track 054°, all turns left (max 175 kts).	Do not proceed east of rwy centerline before reaching 1800′ before proceeding on course. Remain clear of CY(R)-610 (600′ ASL 3.3 NM southwest of 05L threshold) and of CY(A)-621(H) (7000′ ASL 8 NM northwest of 23R threshold). DEPARTURE PROCEDURE EASTBOUND OR SOUTHBOUND: Climb on 234° track untill 1600′ via ZBM NDB. Climbing right turn direct ZBM NDB before proceeding on course. Before entering Class E airspace call Montreal Center. Expect to maintain 5000′ ASL or assigned altitude. Expect published hold southwest of ZBM NDB inbound track 054°, all turns left (max 175 kts).
A B C D ½	½

CHANGES: Take-off & Departure Procedure.

Appendix B – Approach Map

(Reproduced with permission of Jeppesen Sanderson, Inc. Not to be used for navigation)