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

AIR TRANSPORTATION SAFETY INVESTIGATION REPORT A22Q0025

RUNWAY OVERRUN

Skyservice Business Aviation Inc.
Honda Aircraft Company, LLC, HondaJet HA-420, C-FJJT
Montréal/St-Hubert Airport (CYHU), Quebec
07 March 2022

Canada

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Summary

On 07 March 2022, the HondaJet HA-420 aircraft (registration C-FJJT, serial number 42000205) operated by Skyservice Business Aviation Inc. was conducting a flight from Val-d'Or Airport, Quebec, to Montréal/St-Hubert Airport, Quebec, with 2 flight crew members and 4 passengers on board. After touching down on Runway 06L, the aircraft overran the runway and came to a stop approximately 700 feet beyond its end. There were no injuries. The aircraft was not damaged.

1.0 FACTUAL INFORMATION

1.1 History of the flight

At approximately 0500[1] on 07 March 2022, the 2 pilots who made up the flight crew for the HondaJet HA-420 aircraft (HondaJet) that was manufactured by the Honda Aircraft Company, LLC (Honda Aircraft) and operated by Skyservice Business Aviation Inc. (Skyservice), arrived at Toronto/Lester B. Pearson International Airport (CYYZ), Ontario, to begin their workday. They were scheduled to conduct a series of 4 flights:

- From CYYZ to Montréal/St-Hubert Airport (CYHU), Quebec
- From CYHU to Val-d'Or Airport (CYVO), Quebec
- From CYVO to CYHU
- From CYHU to CYYZ

The flight from CYYZ was scheduled to depart at 0600 and the last flight of the day was scheduled to arrive at CYYZ at 2100.

Ready earlier than scheduled, the flight crew began the series of flights at 0539. The first 2 flights were uneventful. The aircraft landed at CYVO at 0851. The flight crew then had a rest period of several hours at CYVO.

At 1821, the aircraft departed CYVO bound for CYHU with the 2 flight crew members and 4 passengers on board. The captain was in the left seat and was the pilot flying (PF). The first officer was in the right seat and was the pilot monitoring (PM).

Shortly before the descent to CYHU, the flight crew took note of the information provided by the automatic terminal information service (ATIS) and planned the area navigation (RNAV) approach for Runway 06L, which had an available length of 6696 feet. For the approach, the flight crew calculated the landing distance using the flight management system, based on the runway and weather conditions reported by ATIS. The calculated distance required for the landing was approximately 4900 feet. Calculations with the flaps set to the "take-off and approach" position (owing to the possibility of icing) gave a landing reference speed (V_{REF}) of 121 knots[2] and an approach speed of 126 knots.

At approximately 1909, the aircraft began the approach. When the aircraft was 1000 feet above the aerodrome elevation, its speed was approximately 135 knots and decreasing. The aircraft was configured for landing and was within the stabilized approach criteria established by the operator. Once the flight crew had the runway in sight, they continued the approach, and the aircraft maintained a speed of 125 to 130 knots from 200 to 50 feet above aerodrome elevation.

The aircraft crossed the displaced runway threshold at a height of 26 feet and a speed of 126 knots. The 2 engines were set to idle and, 6 seconds later, at 1913:38, the aircraft

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[1] All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

[2] All speeds are indicated airspeeds, unless otherwise stated.

landed approximately 1100 feet beyond the displaced threshold of Runway 06L at a speed of 122 knots. The speed brake was deployed immediately, and the PF began to brake, but did not feel the deceleration expected. At that point, approximately 5600 feet of runway remained. After the aircraft had travelled approximately 1100 feet, the on-board alerting system announced that 4000 feet of runway remained. The aircraft's ground speed was 106 knots, and the deceleration force was approximately 0.07*g* at the time. From that point, deceleration did not improve significantly over the remainder of the paved surface. After briefly discussing the minimal deceleration with the PF, the PM applied the brakes on his side, but with no effect. At that time, with approximately 3500 feet of runway remaining, deceleration still had not improved, and ground speed was 96 knots.

After a landing roll of 38 seconds on the runway, the PF realized that a runway overrun was imminent, given that only 200 feet of runway remained and the speed was still relatively high (ground speed of 55 knots). To reduce the risk of damage and injuries, the PF made a slight turn to the left to avoid Runway 24R's approach lights and shut down both engines. The aircraft overran the runway at a speed of 60 knots (ground speed of 54 knots) and came to a stop in wet snow approximately 700 feet beyond the end of the runway (Figure 1). The captain immediately informed CYHU tower of the runway overrun.

Figure 1. Aircraft at rest after the runway overrun (Source: Third party, with permission)

1.2 Injuries to persons

There were no injuries.

1.3 Damage to aircraft

The aircraft was not damaged.

1.4 Other damage

A runway end light was damaged.

1.5 Personnel information

The flight crew held the appropriate licences and ratings for the flight in accordance with existing regulations.

The captain and first officer had been employed by Skyservice since April 2021. They completed their initial type training and their pilot proficiency checks in May 2021.

The flight crew had been on duty for approximately 5 hours on the morning of 07 March and then had a rest period of at least 4 hours, which enabled them to extend their maximum flight duty time by 2 hours.[3,4] At the time of the occurrence, the flight crew had been on duty for 14.5 hours.

Based on a review of the flight crew's work and rest schedule, there is no indication that the captain's or first officer's performance was degraded by fatigue or other physiological factors.

Table 1. Personnel information

	Captain	First officer
Pilot licence	Airline transport pilot licence (ATPL)	Commercial pilot licence (CPL)
Medical expiry date	01 March 2023	01 May 2022
Total flying hours	10 493	2230
Flight hours on type	302	317
Flight hours in the 24 hours before the occurrence	2.2	2.2
Flight hours in the 7 days before the occurrence	9.4	7.1
Flight hours in the 30 days before the occurrence	42.7	30.6
Flight hours in the 90 days before the occurrence	145	94
Flight hours on type in the 90 days before the occurrence	145	94
Hours on duty before the occurrence	14.5	14.5
Hours off duty before the work period	33.5	33.5

1.6 Aircraft information

Table 2. Aircraft information

Manufacturer	Honda Aircraft Company, LLC
Type, model, and registration	HondaJet HA-420, C-FJJT
Year of manufacture	2020

3 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 700.16.

4 Although this section was repealed in 2018, it remained applicable until December 2022, pursuant to a transitional provision in *Canada Gazette*, Part II (Volume 152, Number 25, 07 December 2018).

Serial number	42000205
Certificate of airworthiness issue date	06 August 2021
Total airframe time	435.4 hours
Engine type (number of engines)	Honda HF120-H1A (2)
Maximum allowable take-off weight	10 700 lb
Recommended fuel types	Jet A, Jet A-1
Fuel type used	Jet A

According to the aircraft's journey log, the aircraft had been maintained in accordance with existing regulations and approved procedures. The aircraft's weight and centre of gravity were within the manufacturer's prescribed limits. After the occurrence, the braking system was inspected and no deficiencies were found. This inspection included:

- testing that no air was in the braking system;
- checking the hydraulic brake pressure;
- bleeding the left and right brake hydraulic system; and
- checking the brake pedal forces on all 4 pedals.

An examination of the tires did not reveal any signs of damage or reverted rubber. The tread depth was measured along the entire circumference of the tires, and it varied between 6.7 and 7.8 mm.[5] Tire wear did not exceed the limit set by the manufacturer.

1.6.1 Remaining runway length

In addition to the various visual cues available to estimate the remaining runway length, the pilots also had available to them the aircraft's integrated avionics system with display and alerting functions, that informs them when the remaining runway length is 4000, 3000, 1000 and 500 feet.[6] In this occurrence, the system functioned properly while the aircraft was rolling on the runway.

1.6.2 Braking system

1.6.2.1 General

The HondaJet has 2 main landing gears and a nosewheel. The Pilot's Operating Manual states:

> Each main landing gear is equipped with a multiple-disc brake that uses four rotating steel discs and three stationary steel discs. […]
>
> Brake application is initiated by applying a force to the top of the rudder pedals, which supplies a control pressure at the master cylinders. The amount of braking force is proportional to the force applied to the rudder pedals.

5 The tread depth of a new tire is 8.13 mm.

6 Garmin Ltd., 190-01490-02, *Garmin G3000 Integrated Avionics System Cockpit Reference Guide, HondaJet HA-420 System Software Version 1792.24 or later* (Revision C, 2021), p. 210.

> Antiskid protection is available when the aircraft wheel speed is above approximately 10 knots and below approximately 165 kts (190 mph). Wheel skid, as measured by the wheel-speed transducer, is signaled to the control unit which outputs a signal to the power brake/antiskid control valve to release both brake pressures at the same time. The automatic antiskid function resumes its standby mode after any wheel skid stops or brake pedal pressure is decreased below the wheel skid threshold level. Power brakes will still be available if the antiskid system fails.
>
> Touchdown protection prevents brake application until wheel spin-up occurs. After weight-on-wheels has been true for three seconds, power braking is enabled with or without a wheel speed signal.
>
> Locked wheel crossover protection starts if either wheel slows significantly below the speed of the other when aircraft speed is above 25 kts. When the sensed speed of either main landing gear wheel slows to 30% or less when compared to the other wheel speed, a full brake release occurs which removes the locked wheel condition.[7]

1.6.2.2 Antiskid system control logic

The HondaJet is equipped with a digital MARK IV antiskid system developed by Crane Aerospace & Electronics (Crane). This system includes a single servo valve that provides the same pressure to both wheel brakes on each main landing gear at the same time. If a skid is detected on only 1 wheel, it will modulate the brake pressure on both wheels at the same time, as if both wheels needed correction. An antiskid system with paired wheel control has the advantage of reducing the directional control issue, especially during heavy braking. However, this system reduces braking efficiency and stopping performance compared to one that controls each wheel independently.

The antiskid system constantly attempts to optimize the wheel slip rate, targeting a rate that corresponds with optimal braking. To achieve this rate, the system must have a precise measurement of the aircraft’s reference speed (i.e., ground speed) and wheel rotation speed.

The MARK IV system is based entirely on the wheel rotation speed from both wheel-speed transducers (1 on each wheel of each main landing gear). If there is a fault with the wheel-speed transducers, the performance of the antiskid system might not be as designed. It should be noted that the aircraft’s reference speed is not detected directly by the wheel-speed transducers. It is estimated using algorithms based on wheel-speed transducer signals.

1.7 Meteorological information

Before departure from CYVO, the flight crew obtained the aerodrome forecast (TAF) for CYHU, which had been issued at 1519 on 07 March 2022. The TAF forecast the following conditions as of 1900:

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7 Honda Aircraft Company, *HondaJet Model HA-420 Pilot’s Operating Manual* (31 August 2018), pp. 1-139 and 1-140.

- Winds from 010° true (T) at 10 knots
- Visibility of ¾ statute mile (SM) in light snow and mist
- Overcast ceiling at 400 feet above ground level (AGL)

According to the TAF, between 1900 and 2300, prevailing visibility would temporarily be 1½ SM in light snow, with an overcast cloud layer at 800 feet AGL. Between 1900 and 2100, there was a 40% probability that visibility would be ½ SM in snow and ice pellets.

During the flight, the flight crew received the updated ATIS Foxtrot weather report issued at 1900, which included the following information:

- Winds from 040° magnetic at 10 knots
- Visibility of 1¾ SM in light rain and unknown precipitation
- Overcast ceiling at 400 feet AGL
- Temperature 0 °C, dew point −0 °C
- Altimeter setting 29.42 inches of mercury (inHg)

Also, a runway surface condition report for Runway 06L gave runway condition code (RWYCC) 5/5/5 on a 100% wet runway.[8]

Data for the aerodrome routine meteorological reports (METAR) for CYHU are collected by an automated weather observation system (AWOS). METARs and aerodrome special meteorological reports (SPECI) that use data from an automated system contain the qualifier AUTO.

AWOSs have certain limitations and cannot report precipitation other than rain or snow (e.g., hail, snow grains, snow pellets, and ice crystals) or different forms of precipitation falling at the same time (reported as "Unknown precipitation – UP").

The observations in the METARs for CYHU issued between 1800 and 1918 are summarized in Table 3.

Table 3. Summary of aerodrome routine meteorological reports (METAR) issued from 1800 to 1918 for Montréal/St-Hubert Airport

Time issued	Wind (direction / speed)	Visibility / precipitation	Ceiling (AGL)	Temperature (°C)	Dew point (°C)	Altimeter setting (inHg)
1800	020°T/10 kt	1¾ SM / light rain, light unknown precipitation and mist	Overcast at 400 feet	0	−0	29.42

[8] Runway condition code 5/5/5 indicates that "braking deceleration is normal for the wheel braking applied AND directional control is normal." Pilot braking action is assessed as good. (Source: Transport Canada, Advisory Circular No. 300-019: Global Reporting Format [GRF] for Runway Surface Conditions [Issue 02: 21 February 2021], Section 6.4: Runway condition code (RWYCC), at tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-300-019#toc6_4 [last accessed on 02 January 2025]).

1816	030°T/10 kt	2½ SM / light rain and mist	Overcast at 400 feet	0	−0	29.38
1822	030°T/11 kt	3 SM / light rain and mist	Overcast at 400 feet	0	−0	29.38
1854	010°T/9 kt	3 SM / light snow and light unknown precipitation	Overcast at 400 feet	0	−0	29.40
1900	010°T/11 kt	3 SM / light snow and a remark that 2 mm of precipitation had fallen in the past hour	Overcast at 400 feet	0	−0	29.38
1912	010°T/9 kt	3 SM / light snow and light unknown precipitation	Overcast at 400 feet	0	−0	29.37
1918	350°T/5 kt	4 SM / light unknown precipitation and mist	Overcast at 400 feet	0	−0	29.38

1.7.1 Runway conditions

The airport operator is responsible for making aircraft movement surface condition reports available. These reports detail the surface conditions for all movement areas at an airport, including runways, taxiways and aprons. Information on the contents and publication of these reports can be found in Transport Canada (TC) Advisory Circular 300-019.[9]

At 1704, a runway surface condition report for Runway 06L indicated good braking action compatible with operations on a wet runway. The RWYCC was 5/5/5, with a 100% wet runway. This information had been issued in a NOTAM and was in one of the NOTAMs reviewed by the captain before departing from CYVO. The ATIS Foxtrot report also contained this same information.

A runway inspection carried out at approximately 1855 reported a RWYCC of 5/5/5 with the presence of a contaminant: ⅛ inch of slush.[10] The goal of the runway inspection was to check the runway condition and plan the work to be carried out in the evening. Given that the RWYCC had not changed, the NOTAM did not need to be updated.[11]

Although conditions did not require them, friction measurements[12] were still taken for each third of the runway length during the inspection at 1855. Given the reported RWYCC,

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9 Transport Canada, Advisory Circular No. 300-019: Global Reporting Format (GRF) for Runway Surface Conditions (Issue 02: 21 February 2021), at tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-300-019 (last accessed on 02 January 2025).

10 Only a trace of slush was visible. Because the choice of description in the runway condition report was either no slush or ⅛ inch of slush, the observer chose ⅛ inch of slush.

11 Ibid., Section 13: Requirements to issue an AMSCR.

12 Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, section 302.416.

Canadian Runway Friction Index measurements were approximately the measurements to be expected (Table 4).

Table 4. Canadian Runway Friction Index measurements taken during the inspection of Runway 06L at 1855

Runway 06L	1st friction measurement	2nd friction measurement	3rd friction measurement	Average
1st third	0.45	0.40	0.46	0.43
2nd third	0.45	0.53	0.41	0.46
3rd third	0.40	0.47	0.48	0.45

1.8 Aids to navigation

The occurrence aircraft conducted the RNAV (GNSS [global navigation satellite system]) RWY 06L[13] instrument approach at CYHU to the localizer performance with vertical guidance (LPV) decision altitude of 339 feet above sea level (251 feet above aerodrome elevation).

1.9 Communications

Not applicable.

1.10 Aerodrome information

At the time of the occurrence, the non-profit organization Développement Aéroport Saint-Hubert de Longueuil was responsible for the management, operation, and development of CYHU. As an airport certificate holder, the organization had implemented a safety management system approved by TC.

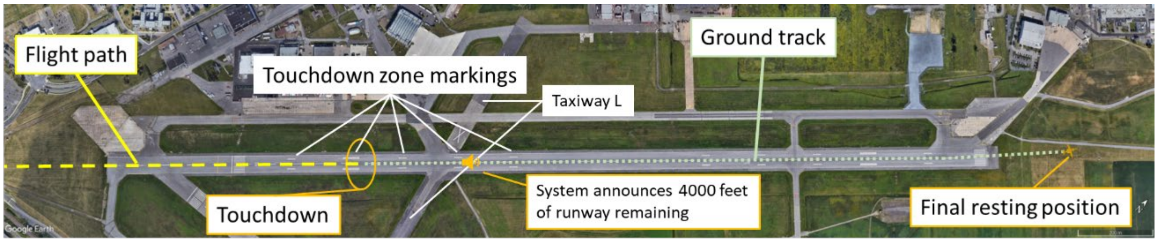
CYHU has 3 paved runways:

- Runway 10/28, which is 2420 feet long and 150 feet wide
- Runway 06R/24L, which is 3922 feet long and 100 feet wide
- Runway 06L/24R, which is 7801 feet long and 150 feet wide

The threshold of Runway 06L is displaced by 1105 feet, leaving a landing distance available (LDA) of 6696 feet. The touchdown zone is indicated by pairs of white rectangles, on either side of the runway centreline, at 492, 984, 1476, 1968, and 2460 feet (150, 300, 450, 600, and 750 m) from the runway threshold (Figure 2).

[13] NAV CANADA, *Canada Air Pilot* (CAP), CAP 5: Quebec (effective 27 January 2022 to 24 March 2022), p. CYHU-IAP-3A.

Figure 2. Image showing the touchdown zone markings as well as the aircraft's flight path (dashed line), the touchdown point, the location of the announcement of 4000 feet of runway remaining, the aircraft's ground track (dotted line), and its final resting position (Source: Google Earth, with TSB annotations)



Runway 06L has a runway end safety area (RESA) that extends for 260 m (853 feet); this exceeds TC standards[14] that require a RESA of 150 m (492 feet).

In the runway data for CYHU in the *Canada Flight Supplement*, it states that hydroplaning may occur on Runway 06L/24R (especially at the intersection with Taxiway L) during heavy precipitation.[15]

1.10.1 Runway surface texture

The frictional forces between the tire and the runway surface are influenced, in part, by the texture of the runway. Surface texture is characterized by micro-texture and macro-texture.

Micro-texture refers to the "sharpness" of the individual asperities that make up the topography of the surface. Micro-texture can be characterized by observing how "polished" the surface is. If the asperities of the exposed aggregate (on an asphalt runway) are smooth and polished from extended years of use, the micro-texture will be characterized as poor.

Macro-texture is the average depth/height between the peaks and valleys of the surface asperities. Macro-texture plays an important role in providing pathways through which liquid can exit the tire footprint as the tire moves through it. Insufficient macro-texture will significantly degrade braking performance on a runway contaminated by liquids (such as rain).

On 04 May 2022, 2 TSB engineers performed surface texture tests and recorded general observations of CYHU's Runway 06L. The micro-texture was observed to be good. There was no appreciable polishing of the asperities, and the sharpness was perceptible when touched. Tests were conducted at 8 equidistant stations along the length of the runway. At each station, macro-texture measurements were taken 3 m right and left of the centreline. The resulting average macro-texture depth was 0.68 mm, which is the number the TSB used to calculate the braking performance (see section 1.16.2 *Deceleration calculations*).

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14 Transport Canada, TP 312, *Aerodrome Standards and Recommended Practices*, 5th edition (effective 15 January 2020).

15 NAV CANADA, *Canada Flight Supplement* (CFS), effective 27 January 2022 to 24 March 2022, Aerodrome/facility directory – Montréal/St-Hubert QC, RWY DATA heading, RCR field, p. B699.

1.11 Flight recorders

The aircraft had a solid-state cockpit voice and flight data recorder (CVFDR).[16] The CVFDR was sent to the TSB Engineering Laboratory in Ottawa, Ontario, and the data were successfully downloaded.

The flight data recorder (FDR) had recorded and stored data for more than 129 flight hours, which included the occurrence flight.

The cockpit voice recorder (CVR) had recorded and stored 2 hours of audio data (voices, radiocommunications, alarms, and noise in the cockpit), which included part of the previous flight, the ground preparation at CYVO before departure of the occurrence flight, the occurrence flight, and the events up to 11 minutes after the occurrence.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

There was no indication that the flight crew's performance was affected by medical or physiological factors.

1.14 Fire

There was no indication of fire either before or after the occurrence.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

1.16.1 TSB laboratory reports

The TSB completed the following laboratory reports in support of this investigation:

- LP027/2022 – FDR and Braking Performance Analysis
- LP028/2022 – CVR Audio Recovery

1.16.2 Deceleration calculations

1.16.2.1 Braking performance

The TSB performed calculations to compare the aircraft's typical deceleration with the deceleration of the occurrence flight. To do this, the TSB took test data from the HondaJet's

[16] A cockpit voice and flight data recorder (CVFDR) is a cockpit voice recorder (CVR) combined with a flight data recorder (FDR).

certification and calculated the deceleration for various types of runway contaminants in the weather conditions that prevailed at the time of the occurrence.

To evaluate the braking performance, fundamental braking principles were used to model the occurrence aircraft's expected performance under several different scenarios. The methods for applying these fundamental principles were taken from the Engineering Sciences Data Unit's (ESDU) literature.[17,18,19,20] The ESDU model accounts for all significant forces that contribute to slowing an aircraft, including the following:

- Rolling resistance: the force arising from the flexing of the tire. This resistance arises in all runway surface conditions (dry, wet, or contaminated);
- Contaminant drag (liquid or snow): the force that is generated by the displacement and/or compression of contaminants on the tire's path;
- Braking: the force resulting from braking action alone;
- Aerodynamic drag of the aircraft's wing-body: the force dependent on the flap and spoiler configuration; and
- Propulsive forces (thrust): an aircraft that does not have reverse thrust, such as the occurrence aircraft, continues to produce forward propulsive forces, even at idle.

The CVFDR recorded sufficient data for TSB engineers to accurately estimate the drag and thrust. It also recorded the longitudinal acceleration. Finally, the mass of the aircraft at landing was known. Given all these data, TSB engineers were able to deduce the actual total wheel forces for the occurrence landing.

Using all the major forces that contribute to the aircraft's deceleration, the ESDU model for predicting braking performance was used to estimate the ground-speed profile of the aircraft under 5 hypothetical runway-condition scenarios:

1. Dry
2. Wet – 3 mm of water contaminant (Figure 3)
3. Slush – 10 mm of slush contaminant (Figure 4)[21]

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17 Engineering Sciences Data Unit, ESDU 10015, *Model for performance of a single aircraft tyre rolling or braking on dry and precipitated contaminated runways* (February 2013, revisions A and B: July 2015).

18 Engineering Sciences Data Unit, ESDU 05011, *Summary of the model for performance of an aircraft tyre rolling or braking on dry or precipitate contaminated runways* (May 2005, Revision D: July 2015).

19 Engineering Sciences Data Unit, ESDU 10003, *Worked example for tyre in linear motion on a contaminated runway surface* (May 2013, revisions A and B: September 2015).

20 Engineering Sciences Data Unit, ESDU 15003, *Planing of rib-tread aircraft tyres* (June 2015, Revision A: July 2016).

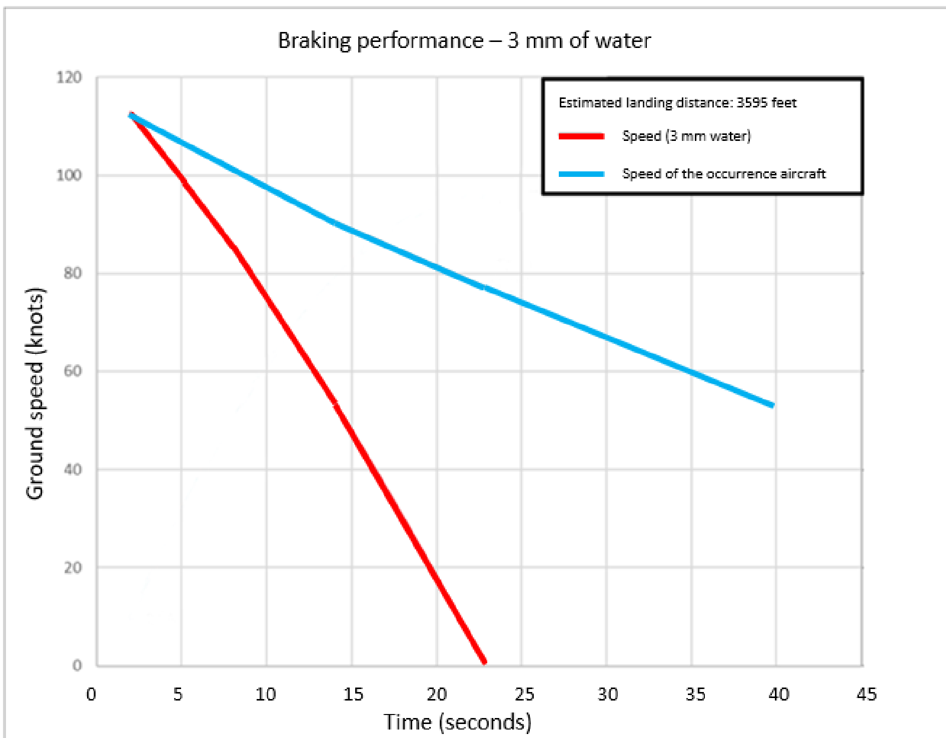
21 Slush means "partially melted snow or ice, with a high water content, from which water readily flows. (Slush will spatter if stepped on forcefully, and water will drain from slush when a handful is picked up.)" (Source: Transport Canada, Advisory Circular No. 300-019: Global Reporting Format (GRF) for Runway Surface Conditions [Issue 02: 21 February 2021], Section 2.3: Definitions and abbreviations, at tc.canada.ca/en/aviation/reference-centre/advisory-circulars/advisory-circular-ac-no-300-019#toc2_3 [last accessed on 03 January 2025]).

4. Snow – 10 mm of wet snow contaminant (Figure 5)[22]
5. Ice – 100% surface ice contaminant (Figure 6)

The dry runway scenario was included to validate the model used with the manufacturer's certification data. The results for a dry runway suggest that ESDU model predictions can be relied on with a high level of confidence for the defined scenarios.

The other scenarios were runway conditions that may have been present based on weather conditions.

Figure 3. Graph showing the predicted braking performance of a HondaJet on a runway contaminated with 3 mm of water, and the braking performance of the occurrence aircraft – Scenario 2 (Source: TSB)



This scenario is representative of the runway conditions reported shortly before the occurrence.

22 Wet snow means "snow that will stick together when compressed but will not readily allow water to flow from it if squeezed. (Wet snow contains enough water to be able to make a well-compacted, solid snowball, but water will not squeeze out.)" (Source: Ibid.)

Figure 4. Graph showing the predicted braking performance of a HondaJet on a runway contaminated with 10 mm of slush, and the braking performance of the occurrence aircraft – Scenario 3 (Source: TSB)

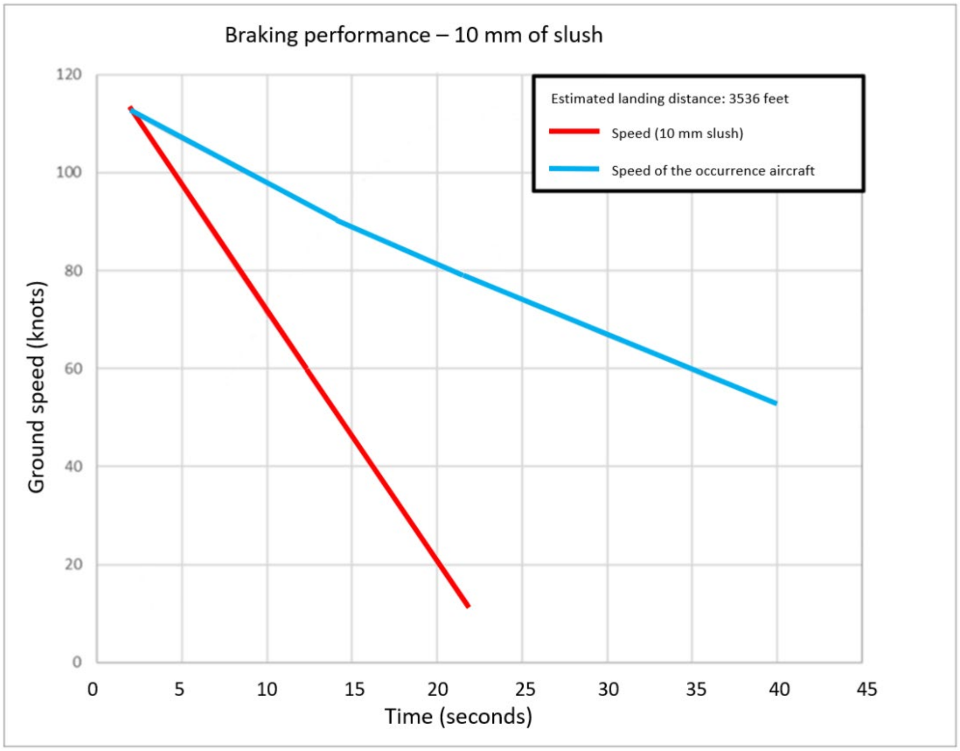
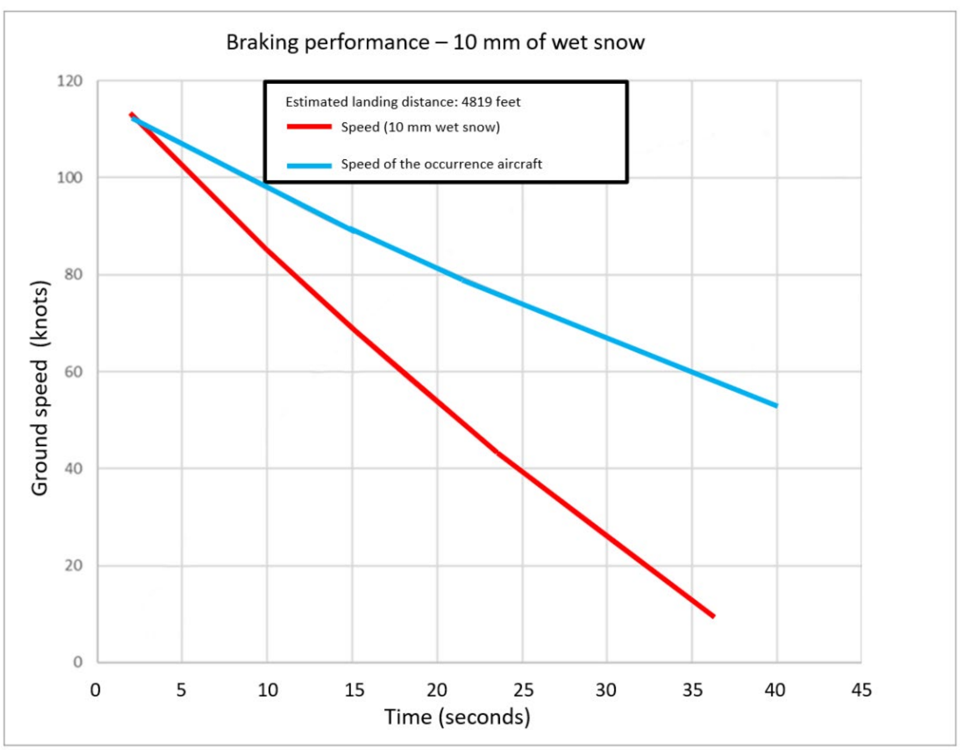
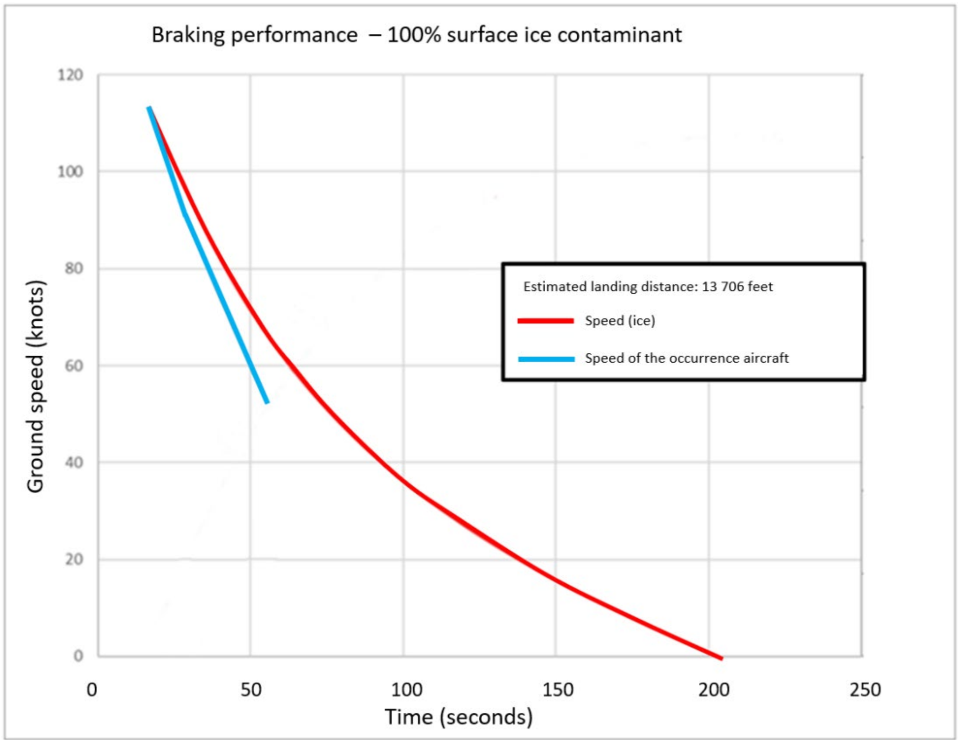


Figure 5. Graph showing the predicted braking performance of a HondaJet on a runway contaminated with 10 mm of wet snow, and the braking performance of the occurrence aircraft – Scenario 4 (Source: TSB)



In scenarios 2, 3, and 4, there is a large disparity when comparing the simulated results to the actual speed profile of the occurrence aircraft. Therefore, it is unlikely that the conditions depicted in these scenarios are representative of the actual conditions during the occurrence.

Figure 6. Graph showing the predicted braking performance of a HondaJet on a runway contaminated with 100% surface ice, and the braking performance of the occurrence aircraft – Scenario 5 (Source: TSB)



There is a higher degree of correlation between the simulated results of scenario 5 and the actual speed profile of the occurrence landing than with the results of the other scenarios.

1.16.2.2 Changes in runway surface conditions

After the runway overrun, when airport personnel arrived at the aircraft, there was some slush on the taxiways and the runway, but the surfaces were not slippery. At approximately 2130, Runway 06L/24R, which had been closed following the runway overrun, was reopened once the aircraft had been towed away and the runway was cleared. Given the ongoing weather conditions, runway maintenance personnel continued to clear the runway. They reported that it was not until sometime between 2330 and midnight that ice seemed to begin to form on the runway surface. Maintenance personnel then began removing the ice and drying the runway.

Environment and Climate Change Canada assessed the runway conditions using the Model of the Environment and Temperature of Roads (METRo).[23] Using observations from a road weather information station and a weather forecast, it is possible, using METRo, to predict road conditions that are of particular concern, such as freezing rain, snow accumulation, and ground freezing or thawing.

The following information was used to determine runway conditions at the time of the occurrence:

- CYHU weather observations
- Observations from the ministère des Transports et de la Mobilité durable [Quebec Department of Transport and Sustainable Mobility] road weather information system stations closest to the airport
- Characteristics of Runway 06L/24R at CYHU

The assessment concluded that at the time of the incident, water from melting snow could not have frozen and formed ice. Also, ice could only have formed after 2300 at the earliest.

1.16.3 Simulations

1.16.3.1 Wheel-speed transducer failure simulations

To better understand the characteristics of the HondaJet antiskid system, the Crane HIL (hardware-in-the-loop) simulator was used to observe the system's response to specific hypothetical failures. The simulations were carried out at Crane's engineering facilities in Burbank, California, United States, with 2 TSB investigators present.

In total, 17 simulation scenarios were carried out. The system functioned as designed for all of the scenarios except one. In this instance, the hypothetical failure consisted of an intermittent loss of output signal (approximately once per wheel rotation) from 1 of the 2 wheel-speed transducers. This failure resulted in a constant, weak brake pressure, similar to what would be expected during locked wheel protection. Such a failure would not last long enough to be detected as a system fault and would not be recorded in the central maintenance computer.

It was noted that this deceleration was comparable to the deceleration of the occurrence flight, as deduced from FDR data.

1.16.3.2 Vibration and water infiltration tests

Crane also conducted vibration tests to monitor and record the wheel-speed transducer output signal when it is exposed to vibrations and various weather conditions. Both of the occurrence aircraft's wheel-speed transducers, as well as 2 others from a different aircraft, were used for these tests.

[23] Model of the Environment and Temperature of Roads (METRo) is software that predicts temperature along a road. It was created in 1999 and distributed by Environment and Climate Change Canada under a general public licence. Further information on METRo is available at framagit.org/metroprojects/metro/-/wikis/home (last accessed on 03 January 2025).

Five-minute tests were performed with rotational speeds of 333, 833, 1667, and 2500 rpm (corresponding to aircraft speeds of approximately 15, 38, 76, and 115 knots, respectively) and with different types of vibrations. During these tests, the wheel-speed transducer output signals were recorded every minute, with 100 000 samples per second for 2 seconds. For each sample, the maximum and minimum voltages were recorded, along with the variation frequency.

Crane also conducted water infiltration tests using the same parameters. Before beginning the tests, the wheel-speed transducers were sprayed with water for 5 minutes, then semi-submerged in water for at least 2 hours.

No anomalies were detected.

1.17 Organizational and management information

1.17.1 Operator

Based in Dorval, Quebec, Skyservice is an air operator that provides aircraft management and other services. At the time of the occurrence, the company was operating 56 aircraft, based at several locations throughout Canada, pursuant to subparts 604 (Private Operators), 703 (Air Taxi Operations), and 704 (Commuter Operations) of the *Canadian Aviation Regulations* (CARs). The occurrence flight was conducted under Subpart 704.

1.17.1.1 Stabilized approach criteria

According to section 5.14 in Skyservice's standard operating procedures (SOPs), under normal circumstances an aircraft flying in instrument meteorological conditions must be on a stabilized approach by the "stabilized approach gate," i.e., 1000 feet above aerodrome elevation.

A stabilized approach configuration is defined as follows:

> (a) [aircraft] established on the localizer/inbound track with no deviations (+/- one dot, +/- 5° of desired track);
>
> (b) [aircraft] established on the glide path (if applicable) with no deviations (+/- one dot), **or** no more than 300' above the FAF/FAWP [final approach fix/final approach waypoint] Minimum Altitude if flying a step-down approach;
>
> (c) during a circling approach, [the aircraft's] wings should be level on final when the aircraft reaches 300' AAE [above aerodrome elevation];
>
> (d) no abnormal airspeed (within -5 KIAS and +15 KIAS of V_{app} [approach speed]); and
>
> (e) no abnormal rate of descent (maximum descent rate of 1,000 FPM unless higher rate has been briefed) […].[24]

[24] Skyservice Business Aviation Inc., *Aircraft Standard Operating Procedures*, Revision 1 (07 June 2021), Section 5: Normal Flight Procedures – Arrival, paragraph 5.14: Stabilized Approach, p. 5-8.

1.17.1.2 Aircraft landing performance

As part of the certification process, the manufacturer determined the landing distance required for the aircraft to come to a full stop (unfactored landing distance). Given the nature of the certification test procedures, the stopping distances obtained do not take into account all of the variations that might be encountered under actual operating conditions.[25] To address that, the International Civil Aviation Organization recommends taking into account variations in the approach and the landing technique, and to include a safety margin of at least 15% when calculating the landing distance.[26]

On 31 August 2006, the Federal Aviation Administration (FAA) of the United States issued Safety Alert 06012[27] in which it recommended that turbojet airplane operators develop procedures for flight crews to assess landing performance. Using these procedures, flight crews should base their decisions on the various actual conditions at the time of arrival rather than the presumed conditions at the time the flight is dispatched. Therefore, they should consider the weather conditions, the runway surface conditions, the airplane's weight, and the braking system used. Once the landing distance under actual conditions is determined, they should add an additional safety margin of at least 15%.

Honda Aircraft included a safety margin of 15% in the landing distances published in the aircraft flight manual (AFM)[28] to account for operational factors such as crosswinds and the landing technique.

1.17.1.3 Regulatory requirements

According to paragraph 704.49(1)(a) of the CARs, which stipulates the dispatch limitations for landings at destination and alternate aerodromes,

> no person shall dispatch or conduct a take-off in an aeroplane unless
>
> (a) in the case of a turbo-jet-powered aeroplane, the weight of the aeroplane on landing at the destination aerodrome and at the alternate aerodrome will allow a full-stop landing within 60% of the landing distance available (LDA); […][29]

Also, subsection 704.50(1) of the CARs requires that the LDA at the destination airport be "at least 115 per cent of the landing distance required pursuant to

[25] Variations in a pilot's braking application, execution of the flare, and application of deceleration methods, and variations in touchdown speeds due to turbulence or crosswinds.

[26] International Civil Aviation Organization (ICAO), Document 10064, *Aeroplane Performance Manual*, First Edition (2020), Chapter 5, section 5.4.7.

[27] Federal Aviation Administration (FAA), Safety Alert for Operators (SAFO) 06012, Landing Performance Assessments at Time of Arrival (Turbojets) (31 August 2006). This SAFO was cancelled, and information was incorporated into the FAA Advisory Circular (AC) 91-79B, Aircraft Landing Performance and Runway Excursion Mitigation (28 August 2023).

[28] Honda Aircraft Company, *Model HA-420 Airplane Flight Manual* (14 December 2018), p. 5-144.

[29] Transport Canada, SOR/96-433, *Canadian Aviation Regulations*, paragraph 704.49(1)(a).

paragraph 704.49(1)(a)”[30] when, based on weather forecasts, the runway may be wet at the estimated time of arrival.

There is an exception to the provisions in subsection 704.50(1) of the CARs if the AFM includes specific information about landing distances on wet runways. In that case, the LDA may be less than what is required in subsection 704.50(1) of the CARs, provided that it is not less than what is required in subsection 704.49(1) of the CARs and, therefore, paragraph 704.49(1)(a).[31]

The manufacturer of the occurrence aircraft had published landing distances on wet runways. However, those distances were published in an AFM supplement for European operators, and they were not used by Skyservice. Also, these distances were not less than the distance required by subsection 704.50(1) of the CARs.

To determine if these requirements are being met, the factored landing distance must be calculated. For dry runways, the dry runway unfactored landing distance is multiplied by 1.67. To obtain the wet runway factored landing distance, the result is then multiplied by 1.15. Therefore, the wet runway factored landing distance can be calculated by multiplying the dry runway unfactored landing distance by 1.92. These distances are then compared to the stated runway length available (i.e., the LDA).

The occurrence flight crew used this type of calculation with a landing distance calculated based on the aircraft configuration and weather conditions at the destination. The dry runway unfactored landing distance calculated for the occurrence flight was 3280 feet, and the wet runway factored landing distance was 6298 feet (3280 x 1.92), thereby meeting CARs requirements.

1.17.1.4 Landing performance calculations

Skyservice’s SOPs for preparing for an approach refer to the AFM, which describes the procedure to be followed.

The flight crew must confirm landing data by determining the aircraft’s landing weight and planned landing configuration based on icing conditions. After obtaining information about the aerodrome and weather conditions using the flight management system, the flight crew calculates V_{REF}, which enables them to confirm the landing distance.

To calculate the landing distance using the flight management system, the flight crew selects the planned runway and enters the weather data and runway surface conditions (dry or wet). The flight crew can then select the landing configuration for icing conditions, if necessary, and lastly, increase the landing distance by adding a percentage based on actual conditions, an approach speed faster than the calculated V_{REF}, and/or an abnormal situation.

For the purposes of this investigation, calculations were performed using the aircraft flight management system for the occurrence flight. By selecting Runway 06L wet, with the flap

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30 Ibid., subsection 704.50(1).

31 Ibid., subsection 704.50(2).

configuration in the "take-off and approach" position, and the weather conditions present at the time of landing, the landing distance calculated was 4903 feet, well below the LDA of 6696 feet.

Calculations performed by the flight management system are based on AFM data and extrapolated using the selected parameters. When a wet runway surface is selected, the system takes the distance indicated in the AFM for a dry runway, and increases it by 30%, as recommended in the AFM for a contaminated runway. Then, the system increases this result by 15% to account for operational factors such as crosswinds and the landing technique.[32]

1.18 Additional information

1.18.1 Studies and references on runway overruns

Runway overruns are an international concern. They have been studied by various agencies, organizations, and manufacturers to determine their causes as well as the factors that could mitigate their risk of occurring.

To provide ways for pilots and air operators "to identify, understand, and manage the risk associated with runway overruns during the landing phase of flight,"[33] the FAA published Advisory Circular (AC) 91-79B in 2023. The AC stated the following list of ''hazards'' that increase the risk of a runway overrun:

- Unstabilized approach;
- Excess airspeed;
- Excessive height over the runway threshold;
- Landing beyond the intended touchdown point;
- High airport elevation;
- Airplane landing weight;
- Downhill runway slope;
- Delayed use of deceleration devices/Maximum braking; and
- Effect of a tailwind on landing distance.[34]

One study, led by the Flight Safety Foundation, analyzed runway overrun data gathered over 14 years and divided hazards into 4 major factors: aircraft performance, flight crew techniques and decision making, weather conditions, and aircraft systems.[35]

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[32] Honda Aircraft Company, *Model HA-420 Airplane Flight Manual* (14 December 2018), Section 5: Performance.

[33] Federal Aviation Administration (FAA), Advisory Circular (AC) 91-79B: *Aircraft Landing Performance and Runway Excursion Mitigation* (issued 28 August 2023), Section 1.1: Purpose of this advisory circular (AC), p. 1-1.

[34] Ibid., Chapter 5: Runway overrun hazards, pp. 5-1 to 5-3.

[35] Flight Safety Foundation, *Reducing the Risk of Runway Excursions: Report of the Runway Safety Initiative* (May 2009), pp. 157 to 160.

1.18.1.1 Landing technique used in the aircraft flight manual

To determine the aircraft performance indicated in the HondaJet AFM, the manufacturer based its calculations on a touchdown speed equal to 95% of V_{REF}, with the aircraft being at V_{REF} when it is 50 feet above the runway threshold, and with power then being reduced to a minimum. In this occurrence, V_{REF} was 121 knots, which would have led to a touchdown speed of about 115 knots. Calculations performed for the purposes of this investigation showed that the aircraft's speed was 130 knots when it was 50 feet above the runway elevation, 126 knots when it was above the displaced threshold, and 122 knots at touchdown.

Speeds above V_{REF} increase the landing distance. In this occurrence, it was determined that the excess airspeed would have increased the landing distance by approximately 390 feet.

1.18.2 Hydroplaning

Hydroplaning occurs when a layer of water forms between the aircraft tires and the runway surface, leading to a loss of traction. This prevents the aircraft from responding to control inputs such as steering or braking.

According to the *Transport Canada Aeronautical Information Manual*:

> Under these conditions, the tire traction drops to almost negligible values, and in some cases, the wheel will stop rotating entirely. The tires will provide no braking capability and will not contribute to the directional control of the aircraft. The resultant increase in stopping distance is impossible to predict accurately, but it has been estimated to increase as much as 700 percent.[36,37]

In general, there are 3 different types of hydroplaning, described as follows:

Dynamic hydroplaning occurs at high speed. In this condition, the tire is completely raised off the runway surface by the water layer, thus impeding braking action.

Viscous hydroplaning occurs at a relatively lower speed than dynamic hydroplaning on a wet runway. The friction between the tire and runway is reduced, but not to a level that impedes the wheel rotation.

Reverted rubber hydroplaning occurs when a locked wheel skids along the runway surface, generating sufficient heat to change water into steam and revert (melt) the tire rubber to its original uncured state. Only this type of hydroplaning produces a clear mark on the tire tread that resembles a burn (a patch of reverted rubber) and possibly steam-cleaned marks on the runway when sufficient heat is generated by friction between the tire and the runway to change the water into steam.

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36 Transport Canada, TP 14371, *Transport Canada Aeronautical Information Manual* (TC AIM), AIR – Airmanship (07 October 2021), Section 1.6.6: Wet Runways.

37 This phenomenon corresponds to dynamic hydroplaning.

1.18.2.1 Dynamic hydroplaning speed

During dynamic hydroplaning, the tire lifts off the pavement and rides on a layer of water like a water ski. Because the conditions required to initiate and sustain it are extreme, the phenomenon is rarely encountered. However, when dynamic hydroplaning occurs, it causes such a substantial loss of friction between the tire and the runway surface that wheel spin-up may not occur and braking forces would be negligible.

Rudimentary methods for estimating the minimum speed for dynamic hydroplaning have existed for decades. For instance, the most common equation, $V=9\sqrt{P}$, where V is the minimum hydroplaning speed and P is the gauge pressure of the tire in pounds per square inch. It has been shown that this method often underestimates the minimum speed required for dynamic hydroplaning. If this equation is applied to the HondaJet aircraft, using the normal pressure of the main landing gear tires (212 lb/in^2), a hydroplaning speed of approximately 131 knots is obtained.

In 2016, ESDU published a detailed model for predicting the minimum speeds for dynamic hydroplaning. The model estimates speeds for 2 sub-categories of dynamic hydroplaning:

- Partial hydroplaning – initial and intermittent onset of dynamic hydroplaning
- Full hydroplaning – fully developed and sustained dynamic hydroplaning

The model takes into account the following variables:

- Tire width
- Tire diameter
- Contaminant depth
- Runway drainage (proportional to macro-texture depth)
- Contaminant density
- Tire gauge pressure
- Atmospheric pressure

In this occurrence, given the characteristics of the aircraft's tires, and an assumed contaminant depth of 3 mm, the predicted partial and full hydroplaning speeds were estimated to be 133 and 179 knots, respectively. The landing was conducted below these hydroplaning speeds, and the tires showed no signs of reverted rubber.

1.18.3 TSB Watchlist

The TSB Watchlist identifies the key safety issues that need to be addressed to make Canada's transportation system even safer.

Runway overruns are a Watchlist issue. As this occurrence demonstrates, when a runway overrun occurs during landing, it is important that the aircraft have an adequate safety area beyond the end of the runway to reduce adverse consequences.

Every year in Canada there are millions of movements without incident on airport runways, and yet aircraft occasionally go past the end of the runway during landing or a rejected takeoff. Between 01 January 2005 and 30 June 2022, there was an average of 9.3 runway overruns per year at Canadian aerodromes. Of these, 6.7 occurred during landing. The TSB investigated 24 of these occurrences during this period and issued 6 recommendations. Three recommendations are still active,[38] 2 are closed[39] and 1 is dormant.[40] The recommendations are available on the TSB's website.[41]

ACTION REQUIRED

Runway overruns will remain on the TSB Watchlist until

- TC demonstrates that the residual risk at airports with runways that are not required to comply with the International Civil Aviation Organization's 150 m standard is as low as reasonably practicable; and
- TC requires operators of airports with runways longer than 1800 m that have a RESA shorter than the International Civil Aviation Organization's recommended length of 300 m to conduct formal runway-specific risk assessments and to take action to mitigate the risks of overruns to the public, property, and the environment.

Despite the actions taken to date, the number of runway overruns in Canada has remained constant since 2005 and demands a concerted effort to be reduced.

38 TSB recommendations A20-02, A20-01, and A07-05.

39 TSB recommendations A07-03 and A07-06.

40 TSB Recommendation A07-01.

41 The recommendations can be found at https://www.tsb.gc.ca/eng/recommandations-recommendations/aviation/index.html (last accessed on 07 January 2025).

2.0 ANALYSIS

The occurrence aircraft was maintained in accordance with regulations, and no deficiencies were found that would have prevented normal operation of the aircraft. The flight crew members held the appropriate licences and ratings in accordance with regulations.

To better understand why the runway overrun occurred, the analysis will focus on the underlying conditions and factors that may have caused or contributed to the runway overrun, as well as the aircraft's braking capacity.

2.1 Factors contributing to runway overruns

Further to studies on runway overruns, the Flight Safety Foundation and the Federal Aviation Administration of the United States identified a number of factors contributing to runway overruns.

The Flight Safety Foundation determined that runway overruns were usually caused by at least 1 of the following factors: aircraft performance, flight crew techniques and decision making, weather conditions, and aircraft systems.

This investigation focused on these factors to determine whether any of them were present during the occurrence.

2.1.1 Aircraft performance

The investigation began by examining aircraft performance calculations. The captain had performed landing distance calculations before departure in accordance with regulatory requirements, i.e., the wet runway factored landing distance was calculated by multiplying the dry runway unfactored landing distance by 1.92. In order to conduct the flight, the result of this calculation had to be less than the landing distance available (LDA), which was 6696 feet. In this case, the calculated wet runway factored landing distance was 6298 feet, which was less than the LDA (6696 feet). Once airborne, the flight crew performed landing distance calculations using the Garmin G3000 system integrated into the aircraft's avionics. The investigation determined that by selecting the aircraft configuration, the winds, and the runway conditions noted in the weather observations, the calculated landing distance was 4903 feet. This distance includes a 15% increase for operational factors, and a 30% increase for a contaminated runway, as recommended by the manufacturer in the aircraft flight manual (AFM).

According to calculations based on performance data in the AFM, an LDA of 6696 feet was sufficient to conduct the planned landing.

2.1.2 Flight crew techniques and decision making

According to Skyservice Business Aviation Inc. procedures, stabilized approach criteria must be met before the aircraft reaches a height of 1000 feet above the aerodrome elevation, otherwise the crew must conduct a go-around.

The investigation determined that the approach conducted met the stabilized approach criteria established by the operator.

Once the flight crew had the runway in sight, they continued the approach, and the aircraft maintained a speed of 125 to 130 knots from 200 to 50 feet above aerodrome elevation. When it flew over the displaced runway threshold at a height of 26 feet and with a speed of 126 knots, the 2 engines were set to idle. The aircraft touched down 6 seconds later at a speed of 122 knots, 1100 feet beyond the displaced runway threshold, and in the middle of the touchdown zone. Given the aircraft's configuration, the targeted landing reference speed (V_{REF}) at 50 feet was 121 knots, with a touchdown speed equal to 95% of V_{REF}, that is, 115 knots.

A high approach and landing speed is one of the factors that can lead to a runway overrun. The investigation determined that the speed in excess of V_{REF} at the time of the occurrence extended the landing distance by approximately 390 feet.

It should be noted that the 15% increase for operational factors, stipulated in the AFM for calculating landing distances, serves in part to compensate for variations in piloting techniques, such as a higher-than-normal landing speed. This additional distance was included in the 15% increase (492 feet) used to account for operational factors when calculating the landing distance.

2.1.3 Weather conditions

The investigation examined weather conditions, particularly runway contamination. At the time of landing, rain had just turned to snow. According to observations taken approximately 15 minutes before landing, a small amount of snow was beginning to be visible on the ground, forming a thin layer of slush.

At 1855, the Canadian Runway Friction Index for each one-third section of Runway 06L at Montréal/St-Hubert Airport (CYHU), Quebec, was 0.43/0.46/0.45. These figures matched the conditions reported earlier in NOTAMs and in the automatic terminal information service report, i.e., runway condition code 5/5/5. Slush on a runway during landing has the same effect as water, which means that there is a risk of hydroplaning. Runway 06L at CYHU was subject to conditions conducive to hydroplaning during heavy precipitation.

In the hour before the occurrence, only light precipitation had fallen. The occurrence aircraft's landing speed was below the tire hydroplaning speed, deceleration was not representative of hydroplaning, and the tires showed no signs of hydroplaning.

Given that the weather conditions were changing, the investigation examined the possibility that runway surface conditions were also changing. The occurrence aircraft's deceleration was calculated for different types of runway contamination and compared to the typical deceleration for the aircraft. The occurrence flight's deceleration during landing was comparable to that of a HondaJet HA-420 aircraft landing on a runway that was 100% contaminated by ice.

The investigation then examined the possibility of ice on the runway. According to runway maintenance personnel at the airport, the runway did not appear to be icy when they arrived at the aircraft. It was not until late in the evening, after 2330, that maintenance personnel noticed ice beginning to form on the surface of the runways. An analysis by Environment and Climate Change Canada confirmed that there was no ice on the runway at the time of the occurrence and that ice could only have formed after 2300.

Finding: Other

Based on witness statements gathered, the weather conditions at the time of the occurrence, and the analysis carried out by Environment and Climate Change Canada, the investigation concluded that there was no ice on the surface of the runway at the time of the occurrence.

2.1.4 Aircraft systems

There were no braking system failures detected by the aircraft's onboard systems during the occurrence landing, and post-occurrence maintenance activities did not reveal any malfunction or defects with the braking system.

2.2 Braking capacity

Several risk factors can lead to a runway overrun. An analysis of these factors during the investigation did not reveal why the aircraft overran the runway at a speed of 60 knots. The braking system's capacity was then analyzed.

2.2.1 Recorded flight data and technical simulations

Simulations carried out by Crane Aerospace & Electronics (Crane), the braking system manufacturer, using data available from the flight data recorder, helped to eliminate several scenarios that could have led to the runway overrun. The scenario with deceleration data that compared best to the data from the occurrence flight was one in which there was an intermittent loss of the output signal (approximately once per wheel rotation) from 1 of the 2 wheel-speed transducers.

In this scenario, the fault would not have been detected and reported as a failure. However, the system would have interpreted the loss of signal as an intermittent locked wheel condition and would have then released the pressure from both brakes until the condition was no longer present. With an intermittent signal loss at each wheel rotation, the system would have been constantly releasing and reapplying brake pressure in multiple small imperceptible bursts, thereby decreasing deceleration to a minimum.

The occurrence aircraft's wheel-speed transducers were sent to Crane to test whether these parts would produce the same failure as this scenario under certain environmental conditions. The vibration and water infiltration tests performed by Crane did not detect similar failures.

Finding as to causes and contributing factors

After conducting a stabilized approach, the aircraft touched down in the touchdown zone on the wet runway at an appropriate speed and the flight crew applied the brakes; however, the ground deceleration that followed was significantly less than expected for the runway conditions and the aircraft overran the runway at a speed of 60 knots. The reason for the reduced deceleration could not be determined.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are conditions, acts or safety deficiencies that were found to have caused or contributed to this occurrence.

1. After conducting a stabilized approach, the aircraft touched down in the touchdown zone on the wet runway at an appropriate speed and the flight crew applied the brakes; however, the ground deceleration that followed was significantly less than expected for the runway conditions and the aircraft overran the runway at a speed of 60 knots. The reason for the reduced deceleration could not be determined.

3.2 Other findings

These items could enhance safety, resolve an issue of controversy, or provide a data point for future safety studies.

1. Based on witness statements gathered, the weather conditions at the time of the occurrence, and the analysis carried out by Environment and Climate Change Canada, the investigation concluded that there was no ice on the surface of the runway at the time of the occurrence.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Skyservice Business Aviation Inc.

Following the occurrence, Skyservice Business Aviation Inc. took the following safety actions for its HondaJet HA-420 aircraft operations:

- No operations (departures or arrivals) are permitted when runway surface conditions are below runway condition code 5/5/5.
- All flights to destinations where the runway might be wet or contaminated upon landing must be approved in advance by the chief pilot.
- Flight crews must only choose aerodromes that are capable of accommodating the aircraft when the runway landing distance available is equal to, or greater than, twice the wet runway unfactored landing distance.
- Given the landing distances available at certain airports, pre-approval has been provided for the following: Toronto/Lester B. Pearson International Airport (CYYZ), Ontario; Montréal/Pierre Elliott Trudeau International Airport (CYUL), Quebec; and Windsor Airport (CYQG), Ontario.

4.1.2 Honda Aircraft Company Inc.

Honda Aircraft Company Inc. took the following safety actions:

- In October 2022, it published a service letter on the factors that can affect landing distances on wet and contaminated runways. The letter contains a recommendation regarding the use of data from the aircraft flight manual (AFM) supplement for landing performance on wet and contaminated runways, as well as a recommendation to enter the AFM supplement's data into the Garmin G3000 system.
- A communications campaign was launched focused on HondaJet HA-420 aircraft operators, recommending the use of the AFM supplement for landing performance on wet and contaminated runways, and recommending data entry in the Garmin G3000 system.
- In July 2023 and September 2023, the company revised the AFM supplement to include the HondaJet Elite S and Elite II models.
- Revisions were made to the *Wet and Contaminated Runway Performance AFM Supplement* with data computed using an improved wet runway model, based on the methodology contained in the *Code of Federal Regulations*, Title 14, subsection 25.109(c). The scheduled publication in 2025 of this revised supplement will be the "final corrective action."

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 15 January 2025. It was officially released on 28 January 2025.

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