

MARINE INVESTIGATION REPORT

M98C0026

ACCIDENT ABOARD VESSEL

PASSENGER JET BOAT "SAUTE MOUTONS 6"

NIAGARA RIVER GORGE

10 JUNE 1998

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The passenger jet boat "SAUTE MOUTONS 6" left the port of Niagara-on-the-Lake for a routine whitewater excursion on the Niagara River. The excursion was without incident until the final run from the Niagara Gorge whirlpool at Devil's Hole. While negotiating the series of rapids, three passengers were injured. The "SAUTE MOUTONS 6" then diverted to Queenston wharf and two of the injured passengers were evacuated on stretchers and transported to the local hospital by ambulance. It was later determined that the injuries sustained by the three passengers were similar in nature, each being associated with the vertebrae and back of the victims.

Ce rapport est également disponible en français.

Other Factual Information

	"SAUTE MOUTONS 6"
Port of Registry	St. Catharines, Ontario
Flag	Canada
Registry/Licence Number	815419
Type	Passenger – Water Jet
Gross Tons ¹	7
Length	12 m
Draught	Forward: 0.735 m Aft: 0.573 m
Built	1996, Kingston, Ontario
Propulsion	Diesel; three turbocharged 450 horsepower
Number of Crew	3
Number of Passengers	48
Registered Owner	Niagara Gorge Jet Boating Ltd.

Description of the Vessel and its Operation

The "SAUTE MOUTONS 6" is purpose-built for navigation through rapids and similar whitewater. It is of robust construction, with high strength aluminum sections serving to withstand the severe accelerations and stresses to which the vessel is exposed. It is essentially box shaped, with a flat bottom, and has a shallow rise forward.

The vessel's high power, combined with the water jet configuration permits speeds of 50 knots in calm conditions. The "SAUTE MOUTONS 6" is highly manoeuvrable and can perform a unique "spin around" manoeuvre on its own axis, at high speed.

Seven rows of foam-cushioned benches make up the passenger seating area. This area is sheltered between moulded, compartmentalized buoyancy tanks, which also form part of the outer hull, sides and bottom. Immediately in front of each row of seating is a horizontal support bar at arm's reach, grasped by the passengers to help them stay seated during the whitewater ride.

There is a windshield forward, which rises approximately 0.7 m above the foredeck. Its primary purpose is to shield passengers from large volumes of water coming over the bow section of the vessel. The passengers are

¹ Units of measurement in this report conform to International Maritime Organization (IMO) standards or, where there is no such standard, are expressed in the International System (SI) of units.

nonetheless exposed to water coming over the top and around the sides of the windshield. However, the passengers expect the wet ride, as promotional brochures and a video viewed before the excursion illustrate this effect.

The water accumulating in the passenger area can rise briefly to waist level before exiting through one-way water evacuation ports located aft, on the port and starboard sides. There are no other freeing ports. The steering and engine control station is located aft and is protected from spray by a partial enclosure with a windshield that allows the operator clear visibility in all directions. There is no central aisle. Crew members at the steering station are able to walk forward on top of the 0.8 m wide, side buoyancy tanks.

Safety Precautions

A mandatory pre-departure safety briefing (of approximately 10 to 15 minutes), includes a safety lecture and makes reference to posted signs highlighting the inherent risk of the activity (see photos). Although informational brochures about the trip were available, there is conflicting information as to whether these were distributed, prior to the occurrence. While it is not mandatory, prior to departure passengers can view a video outlining the trip upon which they are about to embark. Every passenger must wear the approved small vessel life-jacket provided, and optional rain gear is available. The pre-boarding briefing also includes instruction and a demonstration of the importance of using the support bar. The operator repeats this instruction to the passengers immediately before traversing the rapids.

Before boarding the "SAUTE MOUTONS 6", each passenger must fill out and sign a waiver, called a "participation agreement." The company attaches a greater risk to individuals who may be suffering from back, neck, or other ailments, and the operator encourages such people to inform the staff of their medical situation. The final decision to allow or disallow a passenger's participation in the excursion is taken by the vessel's operator.

Children under the age of six are not allowed to take the trip. When seniors, and persons who identify themselves as having medical problems are allowed to board, they are usually directed to sit in the after two rows of seats. This is very close to the pivot point of the vessel and there is less movement at this position than elsewhere on the vessel.

The passengers do not have restraining seat belts, as quick evacuation would be of prime importance if the vessel were to capsize. Once seated, the passengers are instructed to keep their backs straight and bodies immobile by pushing with their arms and hands against the support bar immediately in front of them with their elbows locked. In the event that a large wave breaks over the bow, the passengers are instructed not to lower their heads towards the support bar but to tuck their chins in against their chests. Other instructions include the request that passengers raise their arms when prompted by the operator. A "no show" is taken to mean that all is not well with the passenger.

A Typical Excursion

A typical excursion departs Niagara-on-the-Lake at slow speed and, once clear of nearby marinas, gradually builds up to maximum speed. Upstream from Queenston, the vessel begins to ascend mild rapids, the waves of which become significantly larger near the American Power Dam Generating Station. A short distance further,

the rapids again increase in size, primarily due to the extreme current of more than 20 knots and the presence of underwater rocks. The height of the waves from trough to crest is approximately 3 to 4 m under normal conditions, and the distance between the crests can sometimes be less than the length of the "SAUTE MOUTONS 6".

Near an area of high turbulence called "Devil's Hole," the operator indicates to the passengers that they will be making a practice run with the current, starting at the whirlpool and passing into Devil's Hole. This practice run is meant to familiarize the passengers with the vessel's movement and minimize any anxiety. The passengers are asked to raise their arms as described above. The final run proceeds from the whirlpool, over the rapids, into Devil's Hole and then over the remaining rapids before returning to Niagara-on-the-Lake. Each trip is videotaped so that passengers can purchase a copy as a memento of their tour. The round trip from Niagara-on-the-Lake normally takes about 60 minutes.

The Occurrence

For the excursion on the morning of June 10, the majority of the passengers were fellow workers from a local hotel in Niagara Falls. They had taken a similar trip the previous year and were enthusiastic about taking it again. They proceeded to do a practice run. Reportedly, in comparison to the trip they had taken a year before, the vessel was now manoeuvred in such a manner that caused it to "zig zag". Immediately after this run, a tall passenger forward found that she could not keep herself properly seated, with elbows locked while pressing/holding the bar with her hands. She reported this to a crew member. The trip was uneventful until the final run from the Niagara Gorge whirlpool near Devils' Hole. At this point the vessel's bow dipped down and rapidly climbed over the crest of a large wave, the third of a series, and dropped into a deep trough.

While proceeding over this wave, three passengers sitting in the forward section on the starboard side were subjected to severe accelerations. The video tape shows all the passengers in a "cowering" posture just prior to the occurrence and simultaneously coming down hard on their seats. When the bow became immersed in the next wave, the fourth in a series, two of these passengers were in the first row and one in the second row. The vessel rapidly accelerated upward and the foam-cushioned seating collided with the downward-moving pelvic regions of these passengers. The three passengers indicated that they were pushing against the support bar at this time. All three passengers experienced great pain in the lower back area, upon impact with the seat. This happened in an instant and in the next fraction of a second the passengers seated in the first row were struck on the chest by a large volume of water that rendered them breathless.

Because of their pain, none of the injured passengers was able to signal their plight to staff members. Their extreme discomfort was only recognized after the vessel traversed the remaining set of rapids, at which point the operator asked all the passengers to raise their arms. All but the three injured passengers did so. At this time, the operator declared a medical emergency and immediately notified home base by very high frequency (VHF) radio. The "SAUTE MOUTONS 6" was then diverted to Queenston. One injured passenger, assisted by others, walked to the ambulance. The two other injured passengers were immobilized in the upright position and carried off in stretchers and taken by ambulance to Greater Niagara Regional Hospital where it was determined that two had suffered compression fractures of their vertebrae. As of November 1999, two of the injured passengers remained under the care of a medical specialist.

Company staff aboard the "SAUTE MOUTONS 6" reported that, at the time of the occurrence, the vessel was being operated at the normal speed, in relation to the round trip completion time. One of the injured indicated that the speed of the vessel in the rapids appeared to be faster than on a trip taken previously. Water flow, currents and wave heights were not unusual. The vessel was not ahead of schedule. The operator, however, adjusts engine revolutions per minute (rpm) almost continuously, to deal with the conditions encountered, and engine response is instantaneous. The speed of the vessel at the instant of the occurrence could not be determined.

There is an apprenticeship training program that allows a certificated trainee to become proficient in handling a jet boat, and the trainee's progress is monitored by the master of the vessel and company staff. A trained operator must, by the use of power and steering, quickly adjust the speed and the vessel's heading according to the variations in the form of the waves on the water's surface. The operator must also be vigilant of passenger and deck crew movements and take appropriate action in an emergency.

The master of the "SAUTE MOUTONS 6" was properly certificated and had been operating this vessel for the last year and a half.

Paying customers expect thrills associated with whitewater rides of this nature. The majority of the passengers knew each other, had taken the trip on a previous occasion, and were enthusiastic about this one.

This was the first time that an occurrence of this nature involving a jet boat whitewater excursion had been reported since the carrier began operations seven years before the occurrence.

Analysis

At the time of the occurrence, when the bow section of the jet boat "SAUTE MOUTONS 6" was immersed in the fourth large wave at Devil's Hole, the rate of upward acceleration of the bow was directly related to the speed of the vessel. The acceleration was further increased by the upward velocity of the water within the wave, which was caused by a current of over 20 knots.

Because of the short distance between the wave crests, the stern section remained high due to the lift from the previous crest, and the vessel experienced a pivoting action. All the forces acting on the hull section forward, in conjunction with the pivoting action, combined to make the bow "snap" upward rather than move smoothly and symmetrically upward upon hitting the next wave. In addition, there was a rapid deceleration of the vessel. This caused the passengers on the starboard side forward, who appeared to be more subject to the accelerations and decelerations, to move rapidly ahead and up. As no other passenger suffered similar injury, it can be deduced that either the accelerations experienced in this part of the boat were greater than in other areas, or the force the three injured passengers exerted against the bar to stabilize themselves against the accelerations was insufficient to remain immobile in their seats.

The tour videotape appeared to show that one of the injured passengers, had attempted to stand. However, as all three passengers suffered similar injuries, it is more likely that she was propelled to an upward position during

the injury sequence. Given that this passenger was taller than the others around her, the perception that she was standing was most likely due to the aft camera angle.

The injuries received by the passengers when they fell back into the padded seating may have been due in some measure to the degree of protection offered by the cushioning.

Because video records of this and other trips were scrutinised and there appeared to be little difference in wave height or direction or in the vessel's approach, the variable which may have caused the vessel to react in the way that it did was the vessel's speed.

Other factors in the occurrence were the handling characteristics of the boat and the ability of the operator. Engine power is instantly translated into vessel movement—movement of the controls results in an instantaneous response. Over-application of power or steering can result in a sudden, unwanted movement of the vessel. Decisions by the operator as to throttle setting and direction must be resolved in fractions of a second while negotiating the whitewater. Had the circumstances permitted the speed of the vessel to be lower, the resulting “snap” action forward, which propelled the passengers from their seats, would most likely have been less violent. The scheduled tour was on time; there was no indication that the vessel had been proceeding at a higher-than-normal speed over the whole trip.

The “raising of arms” at intermittent times during the trip is used to signal the well-being of passengers, but this system may have serious drawbacks. Because the vessel continues to pitch and gyrate over the waves, the time intervals between “raising arms” may be too great for an injured passenger to promptly signal that something is wrong. Immediately after the event that injured the passengers, the “SAUTE MOUTONS 6” continued to run through the whitewater at the same speed. It was only when the passengers were requested to “raise arms” a short time later, that the operator knew that all was not well.

Findings

1. Except for momentary requirements for increased rpm; which may have suddenly increased the speed at the time of the occurrence, the engines of the “SAUTE MOUTONS 6” were, over the time period allotted to complete the trip, operated at a normal speed.
2. Three passengers in the forward section of the seating area were injured when they were propelled out of their seats by the movement of the “SAUTE MOUTONS 6”.
3. The injured passengers did not, or could not, stabilize themselves with sufficient force to prevent being propelled out of their seats.
4. The injured passengers were not able to instantly signal their distress to the operator or crew.
5. There was a lapse of time between when the passengers sustained their injuries and when they were identified by the crew as having been injured. During this time the vessel continued to pitch and gyrate over the whitewater.
6. The foam within the seat bench was not capable of sufficiently cushioning the impact sustained by each of the injured passengers.

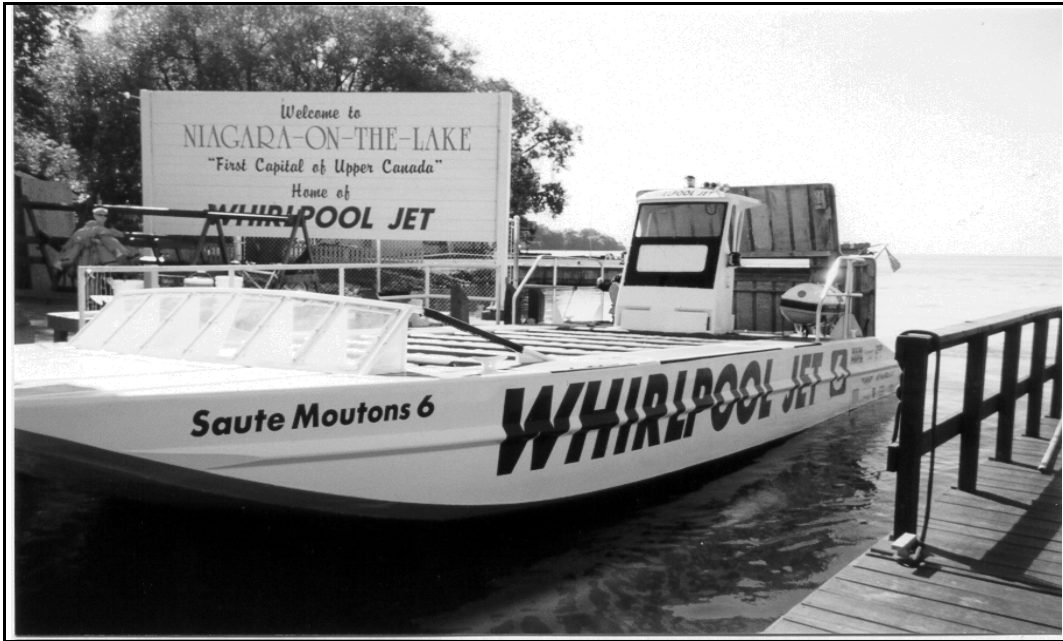
Causes and Contributing Factors

The rapid accelerations and decelerations experienced by the vessel and passengers caused the pelvic regions of the three passengers to forcefully strike the seat bench of the vessel, causing vertebrae and back injuries. The possibility that these passengers may not have braced themselves in their seats as instructed may have contributed to their injuries. The cushioning ability of the seat appears to have been inadequate for the movements of the “SAUTE MOUTONS 6” at the time of the occurrence and was a contributing factor.

Safety Action

At the time of the occurrence, the vessel's owners were studying various ways of improving the cushioning of the passenger seats and the degree to which injuries could be mitigated by improvements in seat design and cushioning. This study includes the possibility of using liquid filled satchels in the shape of cushions. Since the occurrence a more substantial foam padding has since been fitted to the passenger seats.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 15 November 2000.



Appendix A - Photographs





