

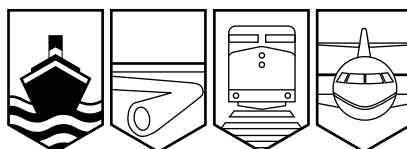
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

MARINE INVESTIGATION REPORT

M99W0137



CAPSIZING WITH LOSS OF LIFE

THE INFLATABLE RIVER RAFT "FLIP"
SULPHUR RIVER, GRANDE CACHE, ALBERTA
12 JULY 1999

Canada

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.

Marine Investigation Report

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Summary

A group of 10 paying passengers set out, in two rafts, on a river-rafting day trip down the Sulphur River near Grande Cache, Alberta. One raft was operated by a guide, the other by the trip leader, who was also the tour operator. There were five passengers per raft.

At an abrupt descent in the Sulphur River known as the *ledge*, one of the rafts capsized, throwing its occupants into the water. One of the passengers, who apparently struck his head on an obstruction, was later found downstream, unconscious, floating face down in the water. Despite the continuous administration of cardiopulmonary resuscitation (CPR) from the time of his discovery onward, he was pronounced dead on arrival at the hospital in Grande Cache.

Ce rapport est également disponible en français.

Other Factual Information

"FLIP"	
Registry/Licence Number	n/a
Porte of Registry	n/a
Flag	n/a
Type	"ZEBEC" River Raft "450 S/B"
Gross Tons	n/a
Length	4.50 m ¹
Draught	n/a
Built	1996
Propulsion	oars/paddles
Number of Crew	1
Number of Passengers	5
Registered Owner	Dan's Rafting & Tours

The Rafts

The "ZEBEC" River Raft "450 S/B" is an inflatable, self-bailing river raft manufactured in South Korea by Woosung I.B. Co. Ltd. It is 4.5 metres (m) long with an extreme breadth of 2.1 m, constructed of polymer material. The perimeter of the raft is entirely bounded by a flotation tube about 0.5 m in diameter, subdivided into four buoyancy compartments of approximately equal volume. Along each side are three equally spaced handles affixed to the exterior. The perimeter buoyancy tube angles upward at both bow and stern to increase freeboard (to about 0.7 m).



Photo 1
The "FLIP"

¹ Units of measurement in this report are expressed in the International System of units.

The perimeter of the raft floor is penetrated by a series of grommet-reinforced holes. These provide the self-bailing capability of the raft. The central portion of the floor is constructed of a double thickness of material; when inflated, it serves as an additional buoyancy chamber. Three cylindrical buoyancy compartments (about 0.33 m in diameter), spaced equally athwartships across the midlength of the raft, are secured at their ends by laces to the inside of the perimeter buoyancy tubes.

At the stern of the raft, resting on top of the perimeter buoyancy tube and secured to the raft by web straps, is a rectangular frame fabricated from 25-millimetre (mm) galvanized steel pipe to the specifications of the operator. Bolted to the aftermost part of this frame, on the centreline of the raft, is a plywood seat for the person controlling the raft. This frame also incorporates thole pins on both the port and starboard sides,² to which are clipped the steering oars used by the operator of the raft.

The passengers are seated atop the athwartships buoyancy tubes; they wedge their feet under floor-mounted web straps or the athwartships buoyancy tubes in order to stabilize themselves within the raft while paddling.

A lifeline is becketed around the uppermost surface of the perimeter buoyancy tube. For carrying the raft, there are moulded plastic handles, three per side, outboard on the port and starboard perimeter buoyancy tubes. Lines of approximately 5 m are fitted to the bow and stern on each raft. For identification purposes, the name of each raft is marked across the bow in 200 mm lettering.

On 12 July 1999 both rafts were configured as described. Each of the two forward buoyancy tubes had a passenger port and starboard, and the third (aftermost) tube, a single passenger to port with some additional gear stowed to starboard. Included in the additional gear were materials for repairing the rafts, a hand-operated air pump and first-aid items.

River Rafting

Commercial river rafting is a form of adventure tourism operated by a loosely organized industry in Canada. Statistics on matters such as vessel activities, movements, client population and fleet size are not readily available. However, it is estimated that the industry caters to upwards of 140,000 passengers per year, and is growing.

In western Canada, river rafting as a commercial enterprise dates from 1972, when expeditions were run on the Chilcote and Fraser Rivers. The 1980s saw the emergence of oar- and paddle-powered rafting on small-volume, fast flowing rivers, where passengers could actively participate.

² A thole pin is an upright steel pin on a rowing frame that serves as a fulcrum or pivot for the oar.

The Tour Operation

This whitewater rafting and tour business was established in 1990 by the current owner/operator, in Hinton, Alberta. For the most part, he is the sole employee and, as such, serves as trip leader.³ Since 1994 the business had been based in Grande Cache, rafting on rivers in and around Willmore Wilderness Park. The operator estimates that he has made approximately 2,700 rafting trips, roughly 80 of them on the Sulphur River in 1999 prior to July 12. The operator reported having gained river-rafting experience, since 1979, in the Yukon Territory, British Columbia and Alberta.

The guide, in charge of the second raft, had been employed by the operator on a part-time basis for four years and had 12 to 14 years' rafting experience. He had worked as a guide the four days prior to July 12. On July 11, commencing at 1100 mountain daylight time,⁴ the guide and the trip leader had conducted a guided tour down the Sheep River. They each reported sleeping from approximately 2400 on July 11 until 0900 on July 12. This work/sleep pattern was reported to be similar to that followed by them on the four days prior to the occurrence.

Promotional material that the business makes available includes the description "Certified guides, 21 years experience. All needed safety equipment is provided. Wet suits P.F.D. Helmets and safety discussion before rafting will be given by guides."

History of the Voyage

Approximately six weeks before the occurrence, a representative of the passengers telephoned the trip leader to arrange the outing. Factoring in the number in the group, their lack of river-rafting experience together with their expectations, the Sulphur River trip was selected as the most appropriate among the alternatives available. The tour operator's brochure describes this trip as class 3. Various versions of the International Scale of River Difficulty describe class 3 as either "Medium" or "Difficult" (see Appendix A). The brochure does not mention specific hazards.

At 1030 on July 12, the 10 passengers gathered at the operator's base of operations in Grande Cache. (Although the day was seasonably warm and sunny, with light winds, there had been significant snow accumulation at lower elevations due to late snows in the area. A result of this was that the rivers in the region were running at levels higher than normal.) Here they met the trip leader and guide, viewed the rafts "FLIP" and "FLOP" and the equipment to be used, and completed waiver forms. All of this was accomplished in advance of the wetsuits, personal flotation devices (PFDs) or helmets being distributed and fitted to the passengers.

While the trip leader took final payment and arranged for supplies, the guide gave the passengers a demonstration of what they could expect while river rafting: the excitement, risks

³ The terms "trip leader" and "guide" are common industry terms; a trip leader is in charge of a trip, a guide is in charge of a river raft.

⁴ All times are mountain daylight time (coordinated universal time minus six hours).

and dangers. The guide outlined the standard procedure during a run, safety precautions, the function and wearing of wetsuits, PFDs and helmets, as well as procedures to be followed should a person be thrown overboard: to not fight the current and thereby conserve energy.

Before the group departed for the put-in point on the Sulphur River, three kilometres (km) away, a quantity of wetsuits and PFDs deemed sufficient for the group was stowed in the rafts. None of these articles was individually fitted. No sailing plan or passenger count was filed, either with search and rescue resources or with anyone else, prior to departure from Grande Cache at approximately 1115.

A taxi and a pickup truck transported the passengers and rafts as close to the put-in point as the road permitted. Between the vehicle drop-off point and the river's edge, the group, together with their equipment, was required to descend a steep embankment approximately 75 m long, with an average incline of 40 degrees below the horizontal. It was the practice of the operator to send the rafts down a section of the embankment that, through use, had been worn free of vegetation; the raft would slide down the slope and come to rest in the undergrowth above the water's edge. The personnel would then follow a zigzag path to the bottom of the same slope.

On this occasion, whilst the "FLOP" successfully negotiated the track down the slope, the "FLIP" upset part way along the track and tumbled to the bottom. At the bottom, the trip leader inspected the raft and discovered that the steering frame had been bent on the starboard side. Having noted this, the trip leader declared that the raft was serviceable and that the outing would proceed.

By approximately 1140, all gear and personnel were assembled on the bank of the Sulphur River. At this time, the wetsuits and PFDs were broken out and distributed; it was then discovered that the equipment available was insufficient to equip each member of the group with properly fitting wetsuits and PFDs. The wetsuit normally worn by the trip leader was given to a passenger, and both the trip leader and guide went without wetsuits. PFDs were available but, while a range of sizes was provided, many of them were too small to fit as designed. When one passenger was unable to fasten the buckles of his PFD, a length of velcro was used to keep the vest snug against his body.

At the water's edge, the trip leader gave the passengers a demonstration of what to expect and how to react. This included positioning, paddling instruction and commands. When a passenger asked about helmets he was told that for the section of the river on which they would be rafting, the wearing of helmets was an option rather than a requirement, and passengers were not encouraged to wear them. Consequently neither the trip leader, nor the guide, nor any of the passengers wore a helmet. Fitting of helmets was not demonstrated; the limited supply of available helmets remained in the "FLIP".

At approximately 1215, with five passengers in each raft, the group began its descent of the Sulphur River. By custom, the trip leader took the lead in the "FLIP", while the guide followed in the "FLOP". The river was quite gentle at this point. The two rafts had been on the river about five minutes when the trip leader elected to beach the "FLIP" for maintenance, which included "topping up" the buoyancy chambers with additional air. After paddling, it had become apparent that the bent steering frame compromised the manoeuvrability of the "FLIP".

The passengers were utilized to straighten the frame by pulling on each side of it. After several attempts, the trip leader declared that the frame was sufficiently straightened and that the trip could continue. At approximately 1225, passage was resumed.

All passengers had paddles. However, the drill was for them to paddle only on instruction from the trip leader, who controlled the raft by means of oars. During the next half hour, the trip leader several times brought the raft close to dangers along the river: boulders, logs and the sometimes-bluff banks at the river's edge. Some passengers felt that the trip leader waited longer than necessary before veering the raft clear of these hazards. One passenger's concern was that people might strike their heads against overhanging hazards. In response to these concerns, the trip leader subsequently maintained a greater distance from these hazards.

Approximately 5 km from the put-in point is an overfall, or drop,⁵ approximately 90 centimetres high, referred to as the *ledge*. With minor variations, it continues unbroken across the river from bank to bank (see photograph 2). The rafts are designed with increased freeboard at each end, and the generally accepted approach for turbulent waters, such as the *ledge*, is head-on.

In the minutes before reaching the *ledge*, the trip leader spoke to the passengers about the river and about his experiences. While he was engaged in conversation with one of the passengers, the raft approached the *ledge*. The trip leader reportedly instructed all of his passengers to paddle; however, his instruction was not universally understood—passengers on the port side of the raft paddling only for a moment before stopping. The raft was swept broadside over the *ledge*, whereupon it capsized. The estimated time was 1245. Only one passenger can recall hearing a warning and paddling instruction in the moments prior to the accident.

The "FLIP" went over the *ledge* with its starboard side leading; it rolled to starboard and then to port, and then capsized. All occupants were spilled out of the raft and into the water. Of the six occupants, two surfaced beneath the upturned raft while the remainder found themselves adjacent to it. The two passengers beneath the raft, by their own efforts, swam clear; one upstream, the other downstream. The raft was undamaged.



PHOTOGRAPH OF A RAFT APPROACHING THE "LEDGE"

Photo 2

A raft approaching the *ledge*

⁵ A drop is an "abrupt descent in a river, a pitch." —*British Columbia River Rafting Guide Certification Manual*

Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	1	-	1
Missing	-	-	-	-
Serious	-	-	-	-
Minor/None	1	4	-	5
Total	1	5	-	6

For moments after capsizing, the “FLIP” remained stationary, caught in the reversal at the base of the *ledge*.⁶ Once everyone was clear from beneath the capsized raft, the six occupants were distributed about the “FLIP”. Three of the passengers were downstream of the raft. One of these three passengers lost his glasses and, with his vision limited, made his way to the left bank. The passenger furthest from the raft was seen to be floating downstream with the current; he was face up and wearing his PFD but showed no movement. The trip leader reported that at first he had managed to grasp this person’s PFD to try to assist him. At that time he noticed signs of blood at the base of the victim’s skull. The trip leader reported that he then lost his grip and the victim floated downstream with the current. The remaining downstream passenger also lost his grip on the raft and was carried with the current away from the *ledge*.

The trip leader and the two passengers remaining with the overturned raft were able to extract it from the reversal and, clinging to it, proceed downstream an estimated 300 m, at which point they were able to stop the raft and right it. Despite wearing PFDs and wetsuits, the passengers reported that, upon being immersed, they noticed that the water was cold. The temperature of the water was below 10 degrees Celsius.

When the trip leader observed the blood on the victim’s head he concluded that the victim was unable to assist himself but he did not share this information with the others in the water. The trip leader reassured his two passengers that the most difficult part of the river was now behind them. After righting the raft, the trip leader and the two passengers with him continued downstream in search of the two passengers last seen floating in the river. Shortly afterward, one of the two was sighted running downstream through the water along the left bank. The raft was manoeuvred close enough for this person to be pulled aboard. As the raft travelled downstream, the people in the raft recovered paddles that had been lost when the raft upset. The buckled PFD worn by the victim was recovered later that day by another rafting party which included both the trip leader and guide.

⁶ A reversal is “a depression in the water and accompanying boils formed downstream of an obstruction when water flows over it. A reversal may hold persons and objects for long periods of time.” —*British Columbia River Rafting Guide Certification Manual*

Minutes later, the victim was seen floating face down in the water. As the raft passed by, one passenger jumped from the raft and was able to pull the victim to shore. The raft was manoeuvred to shore a short distance further downstream. When the passengers and trip leader ran upstream to the victim, they found that their fellow passenger had begun CPR. The location was approximately 2.5 km downstream of the *ledge*, and the time, approximately 1300.

While awaiting the "FLOP", the survivors administered CPR to the victim, who was unconscious and bleeding from a wound on the back of his head.

The "FLOP" had been far enough astern of the "FLIP" that her occupants were unaware of the capsizing, she negotiated the *ledge* without mishap. The occupants were alerted to trouble upon seeing the passenger from the "FLIP" who had waded ashore after losing his glasses. The "FLOP" was carried about 200 m downstream from the *ledge* before they were able to put it ashore to retrieve that passenger. Due to the rough terrain, it took the guide an estimated 15 minutes before he was able to return to the raft with the passenger and proceed to the aid of the "FLIP".

As neither raft carried any communication equipment, communication between the rafts (or from a raft to shore) was not possible.

At approximately 1320, the "FLOP" came into view of the trip leader and passengers of the "FLIP" who, on the bank of the river, continued to administer CPR to the victim. As the "FLOP" passed by, the guide informed the trip leader that he had picked up the passenger from the shore. All personnel were now accounted for. The guide, in turn, was made aware of the gravity of the situation. It was agreed that they would utilize an alternate take-out 3 km downstream, the closest road access, and seek assistance; the "FLIP" would follow.

The trip leader, with the victim and three remaining passengers, borne by the "FLIP", joined the "FLOP" and her crew at the alternate take-out at approximately 1345. In the meantime, the guide had searched for a method of transporting the victim to hospital or a means of alerting assistance. A vehicle and driver were located. The trip leader travelled in the vehicle directly to the Royal Canadian Mounted Police (RCMP) station in Grande Cache, arriving there at 1410.

The Grande Cache RCMP detachment and other emergency services are located in the same building. An ambulance and two RCMP vehicles were dispatched without delay. One of the RCMP units, a 4x4 GMC Suburban, was used to transport the victim up the rough, steep grade between the beach and gravel road leading to town for transfer to the waiting ambulance. The victim was pronounced dead on arrival at the Grande Cache hospital.

A subsequent autopsy determined drowning to be the cause of death.

Regulations and Standards

Federal

The *Small Vessel Regulations* do not require river rafts such as the "FLIP" to be registered or licensed, although certain provisions may apply. In 1978, pursuant to the *Canada Shipping Act*,

Transport Canada established the *Boating Restriction Regulations*. The *River Rafting Standards* (TP8643) were promulgated in 1987. These standards set out minimum requirements for the safe operation of commercial river raft operations. The standards address, *inter alia*, construction, equipment, capacity, safety equipment and qualifications of trip leaders and guides.

The *Boating Restriction Regulations* require the provinces to list the waters to which certain provisions will apply. Six provinces, including Alberta, have listed their waters for particular provisions. The *River Rafting Standards* are applicable to the waters listed in Schedule VI.I of the *Boating Restriction Regulations* (white waters for which a permit is required to operate a commercial river raft). The Province of British Columbia is the only province which has chosen to list its waters under Schedule VI.I .

The *River Rafting Standards* do not apply in Alberta and therefore do not apply to this operation.

The Canadian Rivers Council

The Canadian Rivers Council (CRC), with twenty member outfitters, represents rafting operations primarily in Ontario and Quebec. Over time the Council has developed its own, voluntary safety regulations and a system to administer and regulate its membership.

British Columbia

In British Columbia, during a seven-week period in 1987, four separate river-rafting accidents resulted in 12 fatalities. In 1988 the Government of British Columbia produced the *Report of the Advisory Committee on Commercial River Rafting in British Columbia*. The Report explains that, when the *River Rafting Standards* were adopted, the industry, through its voluntary membership in the River Outfitters Association of British Columbia (R.O.A.B.C.), attempted to ensure that its membership conformed to the guidelines. The Report states:

However, the R.O.A.B.C. was unable to police the industry because (1) they lacked a method of enforcement, (2) the industry was small and highly competitive, so negative judgements about an operation are seen as an aggressive business tactic, and (3) only a portion of industry was represented in the voluntary membership because of the wide geographical location of members and the resultant difficulty in attending meetings.... Had the industry been able to police itself, government enforcement would not be required.

In response, the Government of British Columbia developed the *Commercial River Rafting Safety Act and Regulations*, administered through its Ministry of Environment, Lands and Parks by the Registrar of Commercial River Rafting.

Alberta

Alberta does not have regulations specific to whitewater rafting. There are, however, two self-regulating associations; the Jasper National Park Professional River Outfitters Association (JNPPROA), which is for outfitters operating within Jasper National Park, and the Professional

River Outfitters Association of Alberta (PROAOA). Both associations, within their respective mandates, promote safe river rafting. The percentage of operators within these associations is low; however, PROAOA is making efforts to increase its membership. Each organization has developed standards similar to those of the CRC.

The owner of “FLIP” was not a member of the CRC or of either Alberta association and did not self-regulate to any of the standards set by and available from these organizations.

Analysis

Safety Standards

Canadian river raft operators are not required to comply with a uniform set of safety standards. British Columbia alone has legislated operational requirements for river raft operations. In the other provinces and territories, industry associations have worked to encourage outfitters to voluntarily adopt some form of self-regulation. These efforts have had some effect in Ontario and Quebec. In other areas of the country, like Alberta, there is no form of regulation or self-regulation in place—operators essentially apply the safety precautions they deem necessary for their operations.

The *River Rafting Standards* issued by Transport Canada under the *Boating Restriction Regulations* provide a minimal but reasonable set of safety standards for river rafting operations. Because restrictions under the *Boating Restriction Regulations* require provinces to seek and/or agree to the application of a restriction, they are not uniformly applied across Canada. They do not apply in Alberta.

The lack of uniform safety standards in the river-rafting industry presents a risk to the increasing segment of the population engaged in this type of adventure tourism. The analysis of this occurrence will focus on the risk of injury or death due to not being adequately trained and the risk associated with passengers not being equipped with necessary safety equipment. The analysis will further examine how these risks may have been reduced had the operator been required to meet the minimum requirements of the *River Rafting Standards*.

Training

Included in Transport Canada’s *River Rafting Standards* are minimum equipment specifications and training requirements. Each of these topics is covered, in greater depth, in both the B.C. *Commercial River Rafting Safety Act and Regulations* and the safety regulations developed by the Canadian Rivers Council. In this instance, although both the trip leader and guide had years of river-rafting experience, they were essentially self-taught and had not received any formal river-rafting instruction. Consequently, neither had “trip leader” or “guide” certification as defined by the *River Rafting Standards*, nor were they required to. The business was not a member of any river-rafting association and did not use the guidance of any of the available industry standards. No independent body had assessed the level of difficulty of the rivers on which the company operated. There was no mechanism in place to audit standards.

Equipment

Lifejackets and Personal Flotation Devices

The *River Rafting Standards* stipulate that either the “standard lifejacket”, meeting the standard set by the Canadian General Standards Board, or the “small vessel lifejacket”, (as defined in the *Small Vessel Regulations*) providing it meets the buoyancy requirements of the “standard lifejacket”, is to be used. The “standard lifejacket” is bulky and hampers physical activity but is designed to turn an unconscious person face up and to keep the person’s head out of the water.

None of the PFDs provided by the trip leader for the use of his passengers were designed to meet the requirements for a “standard lifejacket” in either performance or flotation. In particular, a PFD is not designed to turn an unconscious person in the water face up.



Photo 3

Personal flotation device worn by the victim

The PFD worn by the victim displayed signs of age and rough service. The PFD manufacturer’s information tag sewn on this PFD had, through use, become completely unreadable. The information tag of the PFD had been printed with the caution: “This device may lose buoyancy over a period of time and become no longer serviceable.” Other PFDs in the inventory of the trip leader were in a similar condition, some with torn fabric or missing buckles.

In this occurrence, the PFD was seen to have supported the victim face up when he was thrown from the raft when it capsized. The victim, who was later determined to have suffered a head wound, did not appear to be conscious. When he was recovered, however, he was no longer wearing the PFD. The PFD was recovered and was found to have remained buckled, indicating that it had slipped off the victim, who was most probably unconscious.

Helmets

Section 32 of the *River Rafting Standards* states: “Protective headgear, of the correct size, and meeting the requirement of CSA Standard CAN3-Z262.1-M83 or equivalent,⁷ shall be worn by each person on a raft in waters where risk of head injury may exist.” Of the eight helmets the trip leader produced for inspection after the accident, none had the identifying marks of the CSA or an equivalent organization. Although the standards developed by the Canadian Rivers Council stipulate that approved helmets must be worn within 250 m of a rapid, no one on board

⁷ This is the CSA International (formerly Canadian Standards Association) standard for ice hockey helmets.

the “FLIP” wore protective head gear. On the day of the accident, the number of helmets on the rafts was insufficient for all the participants; helmets were not assigned or distributed between both rafts; the wearing of helmets was not encouraged and neither the trip leader nor the guide wore one. Passengers were exposed to the risk of head injury when the raft capsized and the victim, who suffered a head wound, may have been rendered unconscious because he was not wearing a helmet.

Damage to the Raft’s Steering Frame

The steering frame of the river raft “FLIP” was damaged when the raft upset while travelling down an embankment toward the launching point on the shore of the river. This damage affected the raft’s steering to the extent that the raft’s descent of the river was interrupted and the help of the passengers was enlisted to pull the bent steering frame into a position deemed satisfactory to the trip leader. It is not known if the bent steering frame was a factor in the subsequent loss of control of the raft at the *ledge*.

Findings as to Cause and Contributing Factors

1. As the raft “FLIP” approached an abrupt descent in the river, known as the *ledge*, the attention of the operator was distracted by communication with a passenger.
2. The “FLIP” capsized after passing over the *ledge*.
3. The PFDs used by the passengers were not of a design to turn an unconscious person face up in the water, were not fitted to individuals prior to departure from the operational base and, consequently, some did not fit their wearers.
4. The PFD worn by the victim remained fastened but floated free from him after the capsizing.
5. Helmets were not available in sufficient quantities; none of the occupants of the “FLIP” was wearing a protective helmet.
6. One of the passengers, who may have struck his head on an obstruction as a result of the capsizing, appeared to have lost consciousness. This was a contributory factor in his death by drowning.

Findings as to Risk

1. There was no effective means of communication between the rafts or from a raft to a base unit because neither raft carried any communication equipment.
2. Although the water temperature was below 10 degrees Celsius, neither the trip leader nor the guide was wearing a wet suit and, as such, both were susceptible to hypothermia when immersed.

3. No sailing plan or passenger count was filed with search and rescue, or other resources, prior to departure.
4. Small passenger vessels of not more than 5 tons, and carrying not more than 12 passengers, are exempt from annual inspections.
5. At present, in Canada, mandatory training and operator licensing are not required for passenger vessels of 5 tons or less.
6. The *River Rafting Standards*, intended to provide a *minimum* standard of protection for the fare-paying public, are not applicable across the country.

Other Findings

1. The following, "rescue" raft, the "FLOP", was a distance away from the "FLIP", and her occupants did not observe the accident.
2. The PFDs worn by the occupants were below the standard stipulated by the *River Rafting Standards*, and some had torn fabric or missing buckles.

Safety Action

As a result of this accident, the TSB apprised, via TSB Marine Safety Information letter MSI 06/00, the Government of the Province of Alberta of the safety shortcomings in commercial river-rafting operations with respect to, *inter alia*, the use and carriage of safety equipment, the knowledge and training of operators, and the inadequacy in safety standards applicable to such commercial operations.

In addition, the owner/operator of this commercial river-rafting company was issued a deficiency notice under the *Canada Shipping Act* by Transport Canada, Marine Safety (TCMS). His commercial river-rafting operation was suspended until it met with the requirements of the *River Rafting Standards* to the satisfaction of TCMS.

In the spring of 2000 the company was re-inspected by TCMS. At that time the operation was found to be in compliance with the *River Rafting Standards*.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 14 February 2001.

Appendix A—International Scale of River Difficulty

Note: There are slight variations in the International Scale of River Difficulty in use in various jurisdictions.

Flat water.

- I *Easy.* Waves small; passages clear; no serious obstacles.
- II *Medium.* Rapids of moderate difficulty with passages clear. Requires experience plus fair outfit and boat.
- III *Difficult.* Waves numerous, high, irregular; rocks; eddies; rapids with passages clear though narrow, requiring expertise in manoeuvring; scouting usually needed. Requires good operator and boat.
- IV *Very difficult.* Long rapids; waves powerful, irregular; dangerous rocks; boiling eddies; passages difficult to scout; scouting mandatory first time; powerful and precise manoeuvring required. Demands expert boatman and excellent boat and outfit.
- V *Extremely difficult.* Exceedingly difficult, long and violent rapids, following each other almost without interruption; riverbed extremely obstructed; big drops; violent current; very steep gradient; close study essential but often difficult. Requires best person, boat, and outfit suited to the situation. All possible precautions must be taken.
- VI (or U) *Unrunnable.*