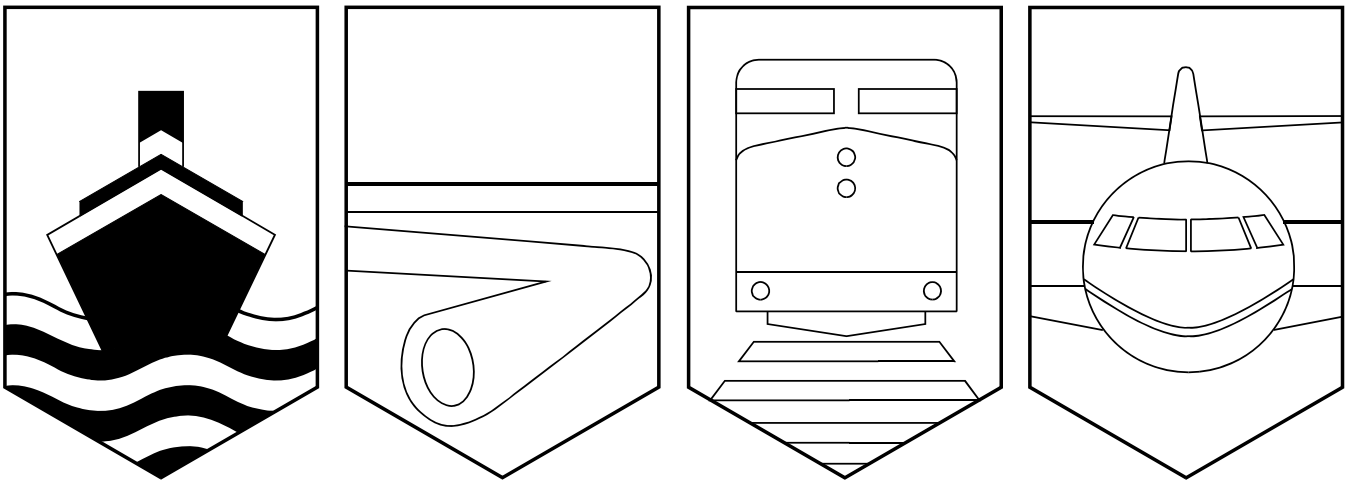
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



# MARINE OCCURRENCE REPORT

## CAPSIZING

## OF THE CABLE FERRY "SIMCOE ISLANDER" IN BOAT CHANNEL, WHILE CROSSING FROM WOLFE ISLAND TO SIMCOE ISLAND, ONTARIO 12 SEPTEMBER 1995

## REPORT NUMBER M95C0052

Canada

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# Marine Occurrence Report

# Capsizing

# of the Cable Ferry "SIMCOE ISLANDER" in Boat Channel, while crossing from Wolfe Island to Simcoe Island, Ontario 12 September 1995

# Report Number M95C0052

## *Synopsis*

On the morning of 12 September 1995, the "SIMCOE ISLANDER" suddenly capsized while transporting a road vehicle loaded with large limestone rocks. The accident occurred in fair weather conditions when the cable ferry was approximately halfway across Boat Channel, proceeding from Wolfe Island to Simcoe Island. In the capsizing, the ferry operator fell overboard and the truck driver was carried to the channel bottom inside the cab of the discharged vehicle. Both persons surfaced and reboarded the overturned ferry, and were subsequently taken to Simcoe Island by a small pleasure craft.

The Board determined that the cable ferry "SIMCOE ISLANDER", which was heeled slightly to starboard and trimmed by the stern on departure, capsized because longitudinal and transverse stability were lost when the vehicle loaded on deck shifted. The initial backward movement of the truck was induced by the ferry motion and poor frictional contact between the vehicle's worn tires and the sloping wet surface of the wooden deck sheathing, and was not arrested because of ineffective rear wheel chocking and the absence of any other securing arrangement.

Ce rapport est également disponible en français.

# *Table of Contents*

# 5.0 Appendices

# 1.0 Factual Information

## 1.1 Particulars of the Vessel

| "SIMCOE ISLANDER" | |
|---|---|
| Official Number | 319334 |
| Port of Registry | Kingston, Ont.[1] |
| Flag | Canadian |
| Type | Steel cable ferry |
| Gross Tons[2] | 24 |
| Length | 14.63 m |
| Breadth | 5.49 m |
| Depth | 1.14 m |
| Crew | 1 Operator |
| Passengers | 12 (maximum),<br>1 (at time of occurrence) |
| Built | 1964, Kingston, Ont. |
| Propulsion | 53 BHP (40 kW) diesel engine with hydraulically driven cable drive |
| Owners | Corporation of the Township of Wolfe Island,<br>Wolfe Island, Ont. |

### 1.1.1 Description of the Vessel

The "SIMCOE ISLANDER" is a self-propelled cable ferry of all-welded steel construction. She was fitted with diesel-engine-driven hydraulically powered propulsion gear, friction-drive wheels, fairleads, and 19 mm-diameter wire cable, which, together with the enclosed control shelter for the operator, are located on the starboard side of the main deck. The hull is of simple barge form with symmetrical raked ends, and is sub-divided into 12 watertight compartments by two longitudinal and three transverse bulkheads.

Hydraulically controlled loading/unloading ramps are centrally located at each end of the ferry. The

[1] See Glossary for all abbreviations, acronyms, and definitions.

[2] 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.

main deck is fitted with wooden sheathing, laid fore and aft on each side of the centre line in way of the vehicle wheel lanes, as shown on the "Outline General Arrangement Plan" (see Appendix A, Figure No. 1, and Appendix C, Photograph No. 1).

The ferry guide cable is submerged and spans Boat Channel between Wolfe Island and Simcoe Island. The channel is approximately 480 m wide and 7 m deep at its midpoint. The ferry crossing normally takes between four and five minutes to complete. (See Appendix B for sketch of the area.)

## *1.2 History of the Voyage*

At about 1035[3], 12 September 1995, the cable ferry "SIMCOE ISLANDER", after loading a large truck carrying some eight long tons (hereinafter referred to as tons) of limestone boulders, began crossing from Wolfe Island to Simcoe Island. The weather conditions were relatively light, with a 15 kph south-westerly wind, slight swell, and a 30 cm chop acting on her port side.

In preparation for departure, the truck driver drove onto the deck of the ferry, positioned the vehicle as directed by the ferry operator, turned off the ignition key leaving a low forward gear engaged, and applied the parking brake. The truck was parked symmetrically about the fore-and-aft centre line of the main deck, and the forward end of the truck's cargo box was abreast the forward end of the operator's shelter.

After he had raised and secured the after loading ramp and ensured that the ferry was floating free of the shore, the operator placed wooden chocks behind the rear wheels of the vehicle. He then returned to the control shelter and applied forward hydraulic power to the guide cable.

When under way, the ferry was heeled slightly to starboard due to the weight and hauling action of the guide cable, and also because of an accumulation of flood water in a leaking starboard side underdeck compartment. The ferry was equipped with a portable gasoline-driven bilge pump which had last been used to pump clear the same compartment shortly before loading the same vehicle about one and a half hours earlier that morning. The pump had not been employed during intervening crossings when the ferry was lightly loaded with either one or two automobiles, and was not in use during this second heavily loaded crossing.

[3] All times are EDT (Coordinated Universal Time (UTC) minus four hours) unless otherwise stated.

The ferry was also trimmed by the stern, partly due to the slight squat induced by the ferry's forward speed, but mainly because of the trimming effect of the heavy truck, the centre of gravity of which was aft of midships. The after freeboard of approximately 30 cm observed on departure by the operator was similar to that on previous heavily loaded crossings, during which spray and water were routinely shipped on the after end of the main deck in similar weather conditions.

The truck driver remained seated in the vehicle cab with both door windows open. As the ferry proceeded toward Simcoe Island, the operator left the control shelter to collect the fare, and remained standing on the port side of the deck, slightly forward of the truck.

At about 1037, approximately halfway across the channel, both persons suddenly became aware that the truck had started moving toward the after end of the ferry. Neither the operator nor the truck driver felt any bump or other untoward movement of the vehicle, its load of rocks, or the ferry, nor did they notice whether any of the truck wheels were turning or sliding. The driver immediately applied the hydraulic foot brake; however, the backward movement of the truck continued to accelerate, and the momentum caused the ferry to trim markedly by the stern and to ship water on the after end of the main deck. As the truck continued toward the stern, the after half of the main deck became completely submerged and the ferry suddenly capsized, discharging the vehicle to starboard.

The ferry operator fell outboard to port, while the truck driver was carried to the bottom of the channel inside the cab of the discharged vehicle. The operator quickly swam to and reboarded the overturned vessel. The operator subsequently located the truck driver, who had escaped from the submerged cab and had cleared the guide cable and starboard side rails on his way to the surface, and he assisted him on board.

The sound of the capsizing drew the attention of nearby fishermen, who quickly went to the overturned ferry and transferred the survivors to Simcoe Island in their outboard-powered boat.

The ferry operator and truck driver were startled by the rapidity with which the capsizing had occurred, and both subsequently estimated that the elapsed time between first becoming aware of the backward movement of the truck and being in the water was no more than five seconds.

At about 1050, the ferry operator phoned the Wolfe Island municipal office and reported the occurrence. At 1055, the town clerk informed the Transport Canada (TC), Marine District Office at Kingston, which in turn informed Rescue Co-ordination Centre (RCC) Trenton, thereby initiating official Search and Rescue (SAR) response. TC Marine[4] also initiated pollution control response.

The capsized ferry was hauled to Wolfe Island and subsequently righted at 1825, 13 September. The vehicle was recovered and hauled to Simcoe Island on 15 September.

## *1.3 Injuries to Persons*

The ferry operator and truck driver were not physically injured during the capsizing and did not seek medical attention, nor did they subsequently report any ill effects as a result of their immersion. Neither wore any personal flotation device, and the truck driver was a non-swimmer.

## *1.4 Damage*

### *1.4.1 Damage to the Vessel*

Post-casualty examination of the righted ferry showed that the safety rails and control shelter were damaged during the righting operation. However, apart from extensive water immersion damage to the machinery and to the electrical and communications equipment, there was only superficial structural damage directly related to the capsizing.

Pressure testing showed that the gaskets of several flush-fitting bolted access plates in the main deck were not watertight, and that some bilge/flood water found in otherwise intact underdeck compartments had entered while the deck was immersed and the ferry inverted.

### *1.4.2 Damage to the Environment*

The ferry diesel fuel and hydraulic oil tanks' total capacities are 191 L and 168 L respectively, and at the time of the occurrence, each tank was approximately 75 per cent full. The truck is reported to have had some 200 L of gasoline fuel in its tank. Most of these oils escaped immediately after the capsizing and quickly dissipated in the atmosphere. The remaining oil slick was contained by pollution containment booms deployed by the Canadian Coast Guard (CCG) around the ferry and vehicle as they were being recovered and/or righted. The small quantity of spilled oil remaining was subsequently recovered from within the containment boom with oil absorbent material, for removal and controlled disposal.

## *1.5 Vessel and Crew Certification*

The vessel was in possession of a valid Ship Inspection Certificate (SIC) 24 approved for Minor Waters

[4] Formerly the Canadian Coast Guard.

Class II Operation with 12 Passengers.

Because of the location and restricted nature of the ferry operation, there is no mandatory requirement for operator certification; however, all of the operators hold valid "Temporary Engineer" certificates, which are renewed annually by TC Marine. The operator in charge of the ferry at the time of the occurrence has held this qualification for 13 years.

The TC publication entitled *Stability, Subdivision, and Load Line Standards* (TP7301) includes minimum stability standards that have to be met by vessels of different size and type for regulatory approval. However, since the ferry was constructed before 01 June 1977, and as she is certificated to carry no more than 12 passengers, none of the standards apply to the "SIMCOE ISLANDER". There is no record of the preparation or submission of any detailed as-built stability information.

## *1.6 Weather Information*

The weather at the time of the occurrence was clear, with a local south-westerly wind of approximately 15 kph, causing a slight swell and a chop of about 30 cm which, at the time of the occurrence, acted on the port side of the ferry. The reported wind and sea conditions were markedly less than those in which service is usually curtailed; however, during an earlier crossing on the morning of the occurrence, when the ferry was loaded and under way with the same vehicle on board carrying a similar load, the wind and wave action had been such that spray and water were shipped on the after end of the main deck.

## *1.7 Life-saving Equipment*

At the time of the occurrence, the life-saving appliances on board the ferry were in accordance with the approved requirements listed on the current CCG SIC 24. The appliances comprised a 2-person emergency boat, one 12-person buoyant apparatus, 13 adult and 2 children's approved lifejackets, and 2 lifebuoys with attached heaving lines.

All of the life-saving appliances were recovered after the capsizing; however, because of the rapidity of the capsizing, none was used, and only the lifebuoys floated free.

Post-casualty examination revealed that:

- the emergency boat and buoyant apparatus were not fitted with retro-reflective tapes;
- the buoyant apparatus was not painted with a high visibility colour; and
- the buoyant apparatus was lashed to the shipside with a securely knotted rope with no quick-release mechanism.

## *1.8 Ferry Operational History and Loading Practices*

The ferry has been in regular service since 1964 without any major incident. The ferry is crewed by one operator, and continuous daily service is maintained with one stand-by and three regular personnel. A work shift system ensures that individual working periods do not exceed 7.75 hours on weekdays and

10.5 hours on weekends, when traffic is less frequent.

The ferry routinely carries full loads of either three automobiles and 12 passengers, or one heavy truck. Vehicles are loaded and positioned as directed by the operators. Reportedly, the operators always fit chocks of 10 cm by 10 cm hardwood, some 40 cm long, behind the rear wheels of the heavy trucks.

When heavy trucks are being loaded, the shoreward end of the ferry often grounds as the vehicle passes over the ferry ramp, causing significant damage and abrasion to the bottom shell plating, and also increased resistance when leaving the dock. In order to ensure better handling during the crossing and also reduce the grounding effect on arrival on the other side of the channel, heavier vehicles are routinely located so as to ensure that the ferry is trimmed slightly by the stern. However, the reduction in freeboard at the after end due to such trim makes the ferry more susceptible to shipping and retaining water on the after end of the main deck.

Spray and water are regularly shipped and retained on deck in relatively moderate weather conditions, particularly when the ferry is carrying heavy road vehicles. Reportedly, this service is curtailed when the combined swell and waves due to south-westerly winds approach or exceed some 75 cm in height. Because freeboard and trim are less affected when the ferry is loaded with lighter and more evenly distributed automobiles, that service is often maintained in slightly more severe weather conditions.

No formal loading or stability information is provided for the guidance of the operators, nor is any maximum load limitation notice on display at the ferry landings.

Other than the daily record of fares collection, no formal record or log of operating procedures is maintained, and the level of bilge water in any of the underdeck compartments is not routinely monitored.

The transport of heavy loads of limestone rocks from Wolfe Island has recently increased due to the construction of a new breakwater on Simcoe Island. There is no public highway scale on Wolfe Island, nor is there a means to weigh the rock at the quarry, so the weight of rocks on each vehicle is not precisely known. Consequently, to determine the weight of the truck and its load, the ferry operators rely on visual comparison of the volume and configuration of each truckload with those previously carried, and on the driver's estimate of the load. The decision to sail is based upon this approximation and the prevailing weather conditions.

The vehicle involved in the occurrence made several crossings the previous day with another driver and reportedly similar loads, until the ferry operator curtailed service in the late afternoon due to a pronounced south-westerly swell exceeding 75 cm in height. The truck driver at the time of the capsizing was making his first unaccompanied crossing after vehicle familiarization and one introductory trip with the other driver earlier that morning.

## *1.9 Vehicle Condition at the Time of the Occurrence*

The vehicle is a 1978 International Loadstar 1800 three-axle truck with a tare weight of 7,020 kg and a rated gross weight of 22,800 kg. At the time of the occurrence, the truck was reportedly loaded with 8 tons (8,130 kg) of limestone boulders, for a total laden weight of some 15 tons (15,150 kg). The cargo box of the truck was approximately 4.1 m long, 2.4 m wide, and 0.9 m high, and the tailgate was removed to facilitate dumping the boulders, which were loaded toward its forward end and protruded about 0.5 m above its sides.

A diver's examination of the submerged vehicle during the recovery operation confirmed that the ignition key was in place and the ignition turned off, a low forward gear was engaged, and the parking brake, which mechanically locks the main drive shaft, was fully applied.

After the vehicle was recovered from the channel bottom on 15 September, examination showed only slight structural damage. The hydraulic pressure hose to the front right wheel brake was found to be severed. However, this damage reportedly occurred during the recovery operation, at which time the hose was temporarily sealed with a vice-grip wrench to prevent further loss of hydraulic fluid from the braking system.

A provincial Ministry of Transportation inspection on 27 September showed that 7 of the vehicle's 10 tires were in a worn but regulatory satisfactory condition, and that the treads of the two right rear outside tires were worn down below regulatory minimum standards. Furthermore, the tread of one of the left rear outside tires was damaged, exposing internal reinforcement wires over an area about 20 cm long by 6 cm wide. The abraded and rusty surfaces of the exposed wires were consistent with this damage having been incurred some time before the immersion of the vehicle in this occurrence. (See Appendix C, Photographs No. 2 to No. 4.)

## *1.10 Ferry Condition at the Time of the Occurrence*

There have been several modifications and additions to the ferry during her 31 years of service, and their accumulated extra weight has reduced the mean freeboard. The principal modifications include the replacement of the drive system with diesel-engine-driven

hydraulic hauling gear and fairleads; the installation of larger loading ramps, lifting posts and counter weights; the fitting of additional compensatory trimming ballast; the provision of additional life-saving appliances and anchoring equipment, etc.; and the welding of chafing and reinforcement steel doubling plates to the bottom shell plating.

Post-casualty inspection of the ferry showed that the No. 1 starboard side underdeck compartment was flooded because of grounding and abrasion damage to the bottom shell plating. This previously incurred damage was unrepaired at the time of the capsizing, and a portable gasoline-engine-driven pump had reportedly been in use for several weeks to intermittently pump the damaged compartment free of flood water.

Examination of the wooden deck sheathing surface showed that diesel and hydraulic oil that had inadvertently spilled during routine refuelling and servicing, together with that dripped by previously loaded vehicles, etc., had been absorbed in areas adjacent to the propulsion engine, hydraulic drive, and loading ramp operating systems on the starboard side of the main deck. Consequently, the frictional characteristics of the sheathing surface were not uniform, and some areas were more adversely affected than others--particularly when wet with rain, spray, or shipped water.

## *1.11 Ferry Trim and Stability*

In view of the reported capsizing sequence, post-casualty stability examination focused on establishing the departure loading condition and the detrimental effects on trim and stability of the shipping of water on the main deck and the sudden backward movement of the vehicle. The post-casualty calculations are based on "static" conditions; however, the momentum of the moving vehicle would have caused dynamic changes of trim and main deck immersion significantly greater than those indicated.

TC Marine records of construction plans and hydrostatic data approved when the ferry was built in 1964 indicate a lightship mean draught of 1'5" (0.43 m), and a deck load of 12.95 tons at a maximum mean draught of 2'1" (0.635 m). The data do not indicate whether the lightship draught shown was a preliminary design draught or if it was verified after construction was completed. However, as the vessel was re-powered and several other modifications and additions are known to have been carried out during the past 31 years of service, the original lightship weight has increased. Consequently, the post-casualty calculations of trim and stability characteristics were based on hydrostatics and lightship details generated from hull measurements and a draught survey carried out before the ferry returned to service on 27 September 1995. They indicated a current lightship mean draught of 1' 7 1/2" (0.495 m).

A post-casualty analysis/examination[5] of the vessel's trim and stability at the time of the accident showed the following:

[5] The stability report is available upon request.

- On departure, the ferry had relatively high initial stability, with a transverse metacentric height (GMt) of 2.46 m, and a mean draught of 0.736 m.

- The restraint of the hauling cable and the flood water known to have accumulated in the damaged No. 1 starboard side compartment caused the ferry to be heeled some two degrees to starboard, and the fore-and-aft location of the vehicle caused the ferry to trim 0.184 m by the stern.

- The combined effects of the aft trim and starboard heel were such that the static freeboard at the after end of the main deck centre line was 0.31 m, and 0.222 m at the after starboard corner.

- The after freeboard was reduced further by the slight settling of the stern when the ferry was under way, and the prevailing 30 cm-high waves caused water to be regularly shipped on the after end of the main deck, particularly on the lower starboard side.

- When the moving vehicle reached the after end of the main deck, the "static" trim increased to 0.711 m, and the after end centre-line freeboard was reduced to zero. The initial heel to starboard resulted in the after end starboard corner being immersed 0.095 m. However, due to the wave action and the dynamic trimming effects of the moving vehicle, the effective immersion of the after end of the main deck was actually greater.

- With the vehicle 30 cm off-centre, the "static" angle of heel would be such that the starboard after corner of the main deck would be submerged some 20 cm.

# 2.0 Analysis

## 2.1 Cause of Ferry Capsizing

Because the ferry's lightship weight and draught have increased since the ferry was built, her effective freeboard is reduced. Although the ferry's initial transverse stability is relatively high, the range of positive stability is dependent upon the retention of adequate freeboard. Consequently, symmetrical athwartships and fore-and-aft distribution of vehicles is essential in preventing premature immersion of the main deck edge. In this instance, the trim associated with the positioning of the truck, in conjunction with the restraint on the hauling cable and the accumulation of flood water in the No. 1 starboard side compartment, resulted in some two-degree starboard heel and a reduction in the after freeboard on the starboard side. In the prevailing 30 cm-high waves, this condition permitted water to be shipped regularly on the after end of the main deck.

As the moving truck gained backward momentum, the initial heel and trim would have tended to slew the truck slightly to starboard. With the vehicle only some 30 cm off-centre, the starboard after corner of the main deck would be submerged some 20 cm. With the added effect of the 30 cm-high waves, almost 50 per cent of the aftermost main deck area would be suddenly inundated. (See Appendix A, Figure No. 2.)

The submersion of the after end of the main deck caused the centre of flotation of the remaining intact waterplane to suddenly move forward of midships and greatly increase the dynamic trimming effect of the moving vehicle. Consequently, as the ferry was settling rapidly by the stern, the dynamic trimming and slewing effects of the moving truck overcame the remaining longitudinal and transverse righting ability of the ferry, and the restraint of the hauling cable caused the ferry to capsize to starboard.

## 2.2 Vehicle Loading and Securing

The truck was loaded on the centre line under the direction of the ferry operator, and was positioned such that the ferry was trimmed by the stern on departure. Fore-and-aft movement was restricted by fitting wooden chocks behind the rear wheels only--no other means of securing was employed or provided.

The frictional contact between the truck and the wooden deck sheathing was reduced because of the truck's worn tires and of the wet and oily condition of the wood surface. In the absence of any arrangement to secure the vehicle to the deck, the lack of traction, in conjunction with the slight motion of the ferry, would have permitted the tires to slide on the sloping wet wood surface.

Because the vehicle's ability to roll backward was mechanically limited and because the nature of the initial movement of the vehicle's wheels (rolling or sliding) was not noticed by either the ferry operator or the truck driver, it could not be determined whether the vehicle rode over, pushed back, or pushed aside the small wooden chocks fitted behind its rear wheels. In any event, the wooden chocks proved ineffective.

## *2.3 Ferry Operation and Operating Practices*

Owners' records included no documentation related to ferry stability, lightship weight or freeboard revisions due to machinery or structural changes, nor any formal operating or maximum deck loading instructions for the guidance of the operators. Consequently, the operating practices adopted--including deck load limitations and the decision of when to curtail ferry service because of adverse weather--were based on the accumulated on-the-job experience of the operators.

# 3.0 Conclusions

## 3.1 Findings

1. The owners did not provide the operators with formal instructions or guidance regarding maximum deck loading or vessel trim and stability.

2. A public notice showing the maximum deck load was not displayed at either of the ferry landing areas.

3. There are no public highway weigh scales on Wolfe Island, nor is there any other suitable facility at the quarry.

4. The determination of the laden weight of the vehicles carrying rocks between Wolfe Island and Simcoe Island is based on the driver's estimates and the ferry operator's observations.

5. Shell plating damage causing flooding in a starboard side underdeck compartment was not reported to TC Marine, and remained unrepaired for several weeks before the occurrence.

6. The cumulative effect of machinery and structural changes and additions since the ferry was built was an increased lightship weight and draught.

7. The inherent effect of the hauling cable and the accumulation of flood water in the damaged compartment caused a slight list to starboard.

8. The routinely adopted fore-and-aft location of trucks loaded on deck caused a significant trim by the stern, reduced the after freeboard, and made the ferry vulnerable to shipping water on the after end of the main deck.

9. The frictional contact between the truck and the wooden deck sheathing was reduced because of the worn and damaged condition of the truck's tires, and of the wet and oily condition of the wood surface.

10. The chocking arrangement adopted was ineffective in preventing the initial backward movement of the truck on the sloping wet surface of the wooden deck sheathing.

11. The backward movement of the truck caused an increase in aft trim and immersion of the after end of the main deck, such that the ferry's longitudinal and transverse stability characteristics were suddenly markedly reduced.

12. Due to the ferry's starboard list, the truck slewed slightly off the centre line as it moved backward, and this dynamic heeling effect overcame the ferry's remaining reserve stability.

13. Trimming ballast located on the port side of the main deck to counter the weight and heeling effect of the starboard side machinery installation was unsecured.

14. The bilges of the underdeck compartments were not routinely monitored.

15. The buoyant life-saving apparatus was not fitted with a quick-release mechanism.

16. The emergency boat and the buoyant apparatus were not fitted with retro-reflective tapes, nor were they painted with high visibility colour.

17. The suddenness and rapidity of the capsizing precluded the ferry operator and the truck driver from donning lifejackets.

## *3.2 Causes*

The cable ferry "SIMCOE ISLANDER", which was heeled slightly to starboard and trimmed by the stern on departure, capsized because longitudinal and transverse stability were lost when the vehicle loaded on deck shifted. The initial backward movement of the truck was induced by the ferry motion and poor frictional contact between the vehicle's worn tires and the sloping wet surface of the wooden deck sheathing, and was not arrested because of ineffective rear wheel chocking and the absence of any other securing arrangement.

# 4.0 Safety Action

## 4.1 Action Taken

### 4.1.1 Ferry Operation

Following this occurrence, the Transportation Safety Board of Canada (TSB) and Transport Canada (TC) apprised the owners of safety deficiencies concerning the operation of the ferry. In addition, TC imposed specific requirements with respect to vessel operation prior to re-certification.

Subsequently, the owners took several corrective measures, inter alia, restricting the maximum deck load, installing fittings to prevent the movement of the vehicles on deck, and establishing procedures to record daily sounding of underdeck compartments. Furthermore, the buoyant apparatus was fitted with a quick-release mechanism, and manhole covers were modified to make them watertight. A Ship Inspection Certificate (SIC) 24 was re-issued by TC in September 1995 with a notation restricting the maximum deck load to 13 tons pending submission of appropriate trim and stability data by the owners.

In addition, TC issued a notice to other ferry owners reminding them of their responsibility to ensure that vessels are loaded and ballasted to maintain adequate stability, and to promptly report structural damage affecting the seaworthiness of their vessels to TC.

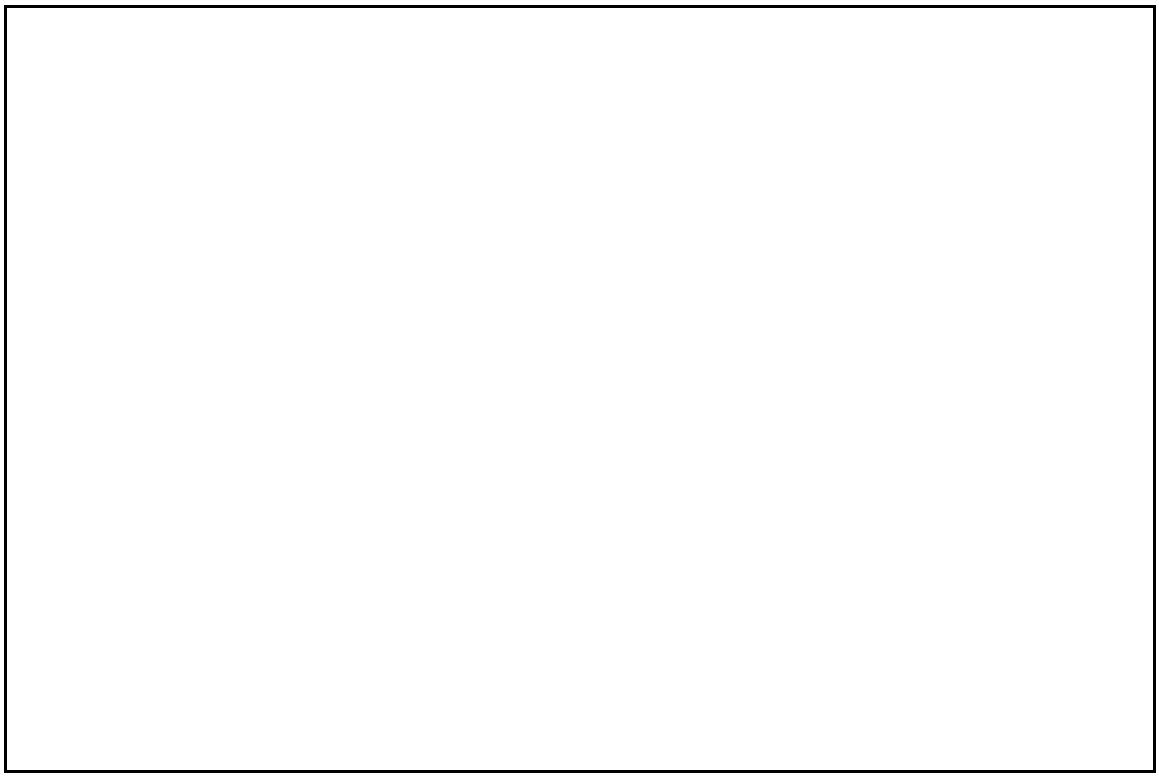
*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, Benoît Bouchard, and members Maurice Harquail and W.A. Tadros, authorized the release of this report on 18 September 1996.*

## *Appendix A - Figure No. 1 - Outline General Arrangement Plan*

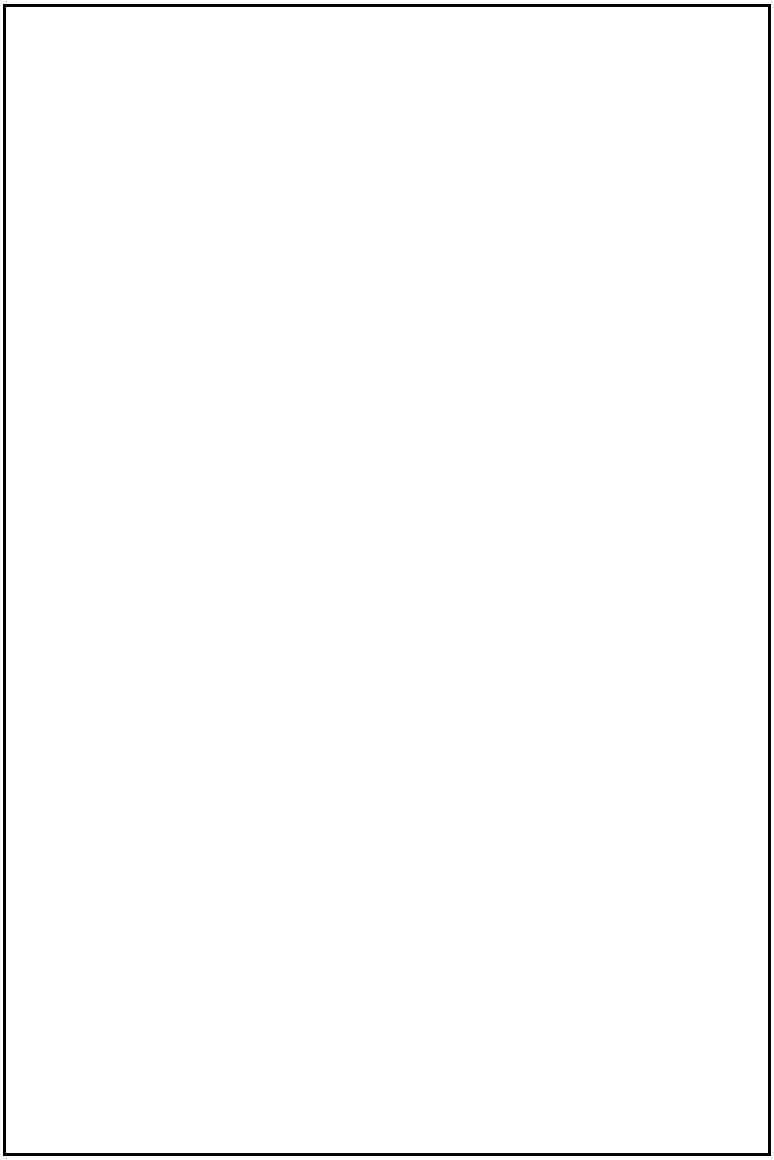
*Figure No. 2 - Sketch Depicting Main Deck Immersion, "Static" and with 30 cm Waves, after Shift of Vehicle*

# *Appendix B - Sketch of the Occurrence Area*

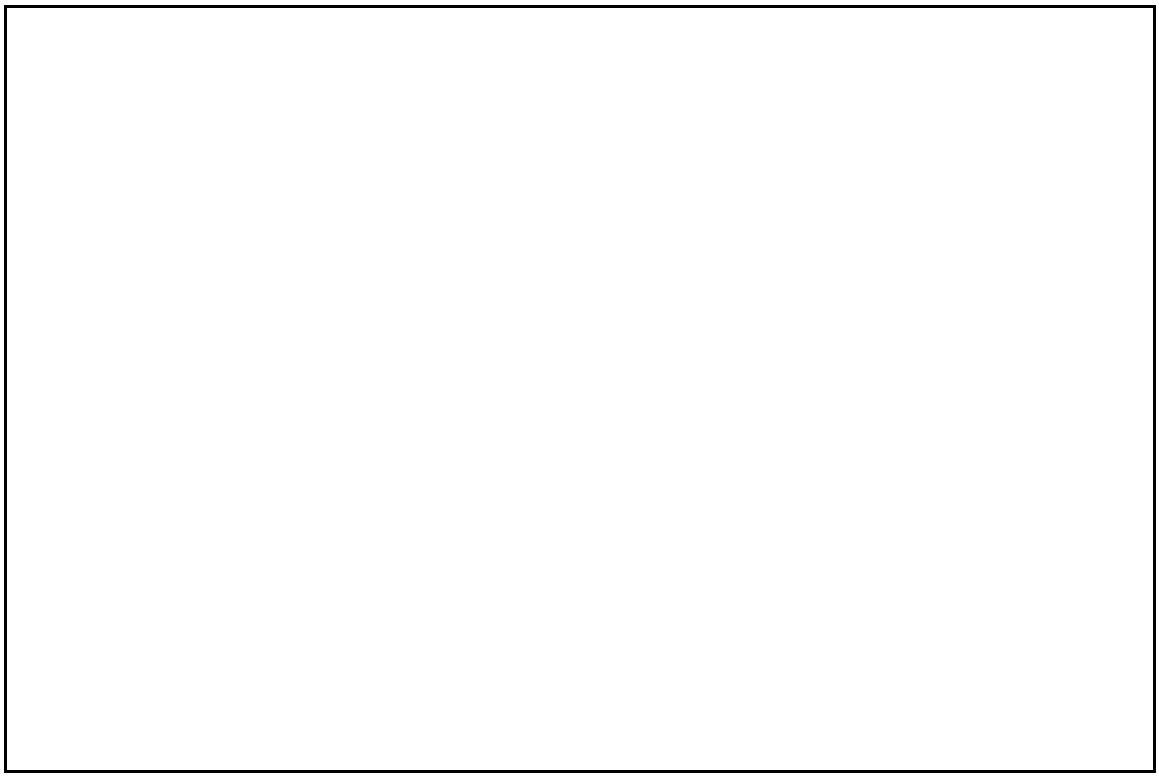
# *Appendix C - Photographs*



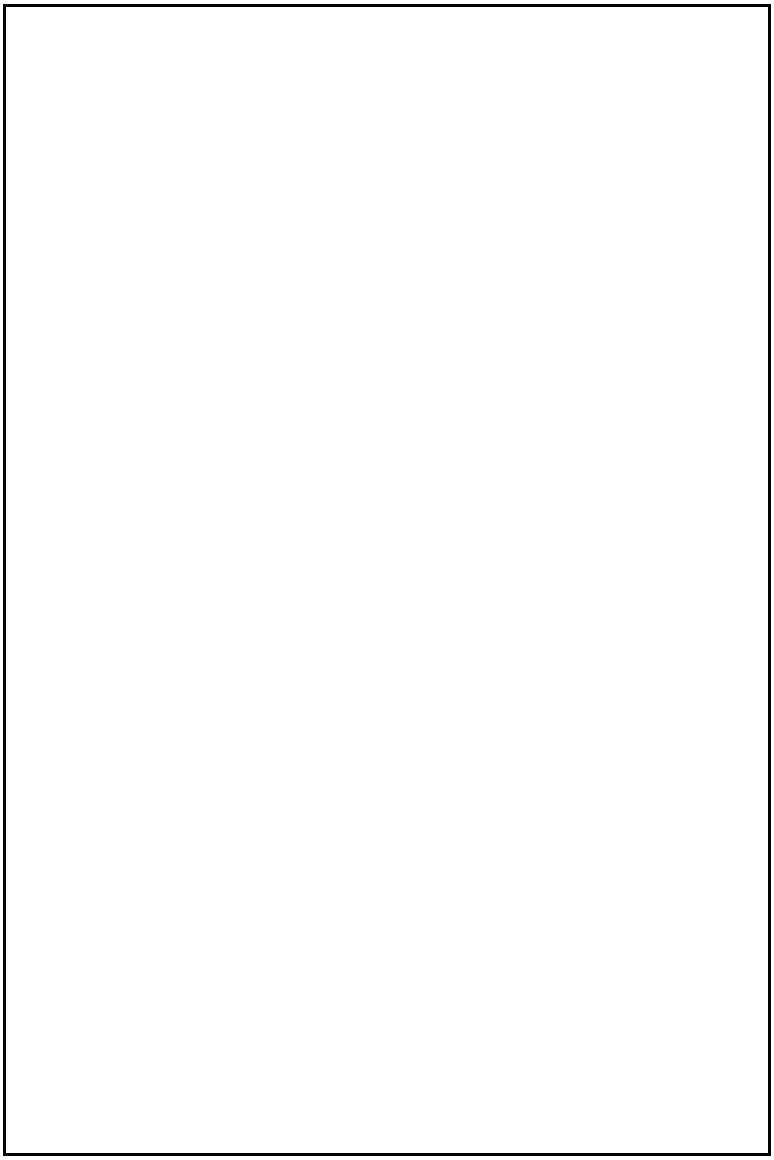
Photograph No. 1 The "SIMCOE ISLANDER" ready for loading.



Photograph No. 2 Recovered vehicle, rear view.



Photograph No. 3 Recovered vehicle, side view.



Photograph No. 4 Recovered vehicle, rear tire damage.

# *Appendix D - Glossary*

| | |
|---|---|
| B | ballast |
| B.A. | buoyant apparatus |
| BHP | brake horsepower |
| B/L | base line |
| (C) | centre |
| CCG | Canadian Coast Guard |
| centre of gravity | The point through which a vessel's weight is deemed to act downward. |
| ℄ | centre line |
| cm | centimetre |
| EDT | eastern daylight time |
| flooding | The ingress of water into a hull by way of openings below the sea surface. |
| GMt | Transverse metacentric height, which is indicative of the vessel's initial transverse stability. |
| IMO | International Maritime Organization |
| kg | kilogram |
| kph | kilometre per hour |
| kW | kilowatt |
| L | litre |
| length O.A. | length overall |
| list | The static inclination of a vessel from the vertical. |
| L.O.D. | length on deck |
| L.W.L. | load waterline |
| m | metre |
| M.E. | main engine |
| mm | millimetre |
| Ont. | Ontario |
| (P) | port |
| RCC | Rescue Co-ordination Centre |
| reserve buoyancy | Enclosed hull or superstructure volumes which, when immersed, provide buoyancy which is included in the computation of a vessel's intact stability. |
| S | sand |
| (S) | starboard |
| SAR | Search and Rescue |
| SI | International System (of units) |
| SIC | Ship Inspection Certificate |
| TC | Transport Canada |
| trim | Difference between the vessel's designed level trim draughts. |
| ton | long ton (1,016 kg) |
| TSB | Transportation Safety Board of Canada |
| UTC | Coordinated Universal Time |
| watertight | Structure designed to prevent the passage and withstand the pressure of water |

| | |
|---|---|
| | from either side. |
| W/H | wheel-house |
| W.L. | waterline |
| W.T.B. | watertight bulkhead |
| ° | degree |
| ' | foot |
| " | inch |