



Office of Transport Safety Investigations

## MARINE SAFETY INVESTIGATION REPORT

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**COLLISION BETWEEN SYDNEY FERRIES' HARBOURCAT  
*PAM BURRIDGE* and MOTOR LAUNCH *MERINDA***

**SYDNEY HARBOUR**

**28 MARCH 2007**



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and  
MOTOR LAUNCH *MERINDA*

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28 MARCH 2007

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# THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

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The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of accidents and incidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the *Transport Administration Act 1988*, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the causes and contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that caused or contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

OTSI's investigations are conducted under powers conferred by the *Rail Safety Act 2002* and the *Passenger Transport Act 1990*. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises and examine and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect a "Just Culture" approach to the investigative process by balancing the presentation of potentially judgemental material in a manner that properly explains what happened, and why, in a fair and unbiased manner.

Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI's website at [www.otsi.nsw.gov.au](http://www.otsi.nsw.gov.au)

OTSI cannot compel any party to implement its recommendations and its investigative responsibilities do not extend to overseeing the implementation of recommendations it makes in its investigation reports. However, OTSI takes a close interest in the extent to which its recommendations have been accepted and acted upon. In addition, a mechanism exists through which OTSI is provided with formal advice by the Independent Transport Safety and Reliability Regulator (ITSRR) in relation to the status of actions taken by those parties to whom its recommendations are directed.

## TERMS OF REFERENCE

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The Instrument of Appointment and Terms of Reference for the investigation into the circumstances of the collision between Sydney Ferries' *Pam Burrridge* and the motor launch *Merinda* on the evening of Wednesday 28 March 2007, prescribed that the purpose of the investigation was to:

- establish what caused the *Pam Burrridge* and *Merinda* to come into collision and identify any matters, in addition to those described below, which may have been contributory causative factors of this accident;
- determine whether the ferry and the launch were being operated appropriately at the time of the accident;
- determine whether mechanical functions and/or design features contributed to cause the accident;
- identify whether there were any policy, organisational and/or administrative matters which relate to safety management which had a bearing on the circumstances of the accident;
- ascertain whether this type of accident had been, or should have been, anticipated and the effectiveness of any strategies that were in place to manage the related risks;
- assess the effectiveness of the emergency actions in response to the accident;
- make safety recommendations, the implementation of which would prevent, or at the very least, minimise the potential for recurrence of this type of accident, and
- propose any course of action in relation to other matters arising from the investigation that would enhance the safety of ferry and boating operations more generally within Sydney Harbour.

## FOREWORD

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The lines of inquiry that have been followed to address the Terms of Reference for this investigation have been informed by a number of rules and regulations that are referred to throughout this report. The following extracts are derived from the rules and regulations which are relevant to the circumstances of the collision between Sydney Ferries' HarbourCat *Pam Burrridge* and the motor cruiser *Merinda* on Sydney Harbour on the night of Wednesday 28 March 2007.

### **International Regulations for Preventing Collisions at Sea, 1972 and Navigation (Collision) Regulations 1983 (NSW) Schedule 1**

#### **Rule 5 Look-out**

*Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.*

#### **Rule 6 Safe Speed**

*Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.*

*In determining a safe speed the following factors shall be among those taken into account:*

- (a) *By all vessels:*
  - (i) *the state of visibility;*
  - (ii) *the traffic density.....;*
  - (iii) *the manoeuvrability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;*
  - (iv) *at night, the presence of background light such as from shore lights or from back scatter of her own lights;*
- (b) *Additionally, by vessels with operational radar:*
  - (i) *the characteristics, efficiency and limitations of the radar equipment;*
  - (iii) *the effect on radar detection of the sea state, weather and other sources of interference;*



- (iv) *the possibility that small vessels ..... may not be detected by radar at an adequate range.*

## **Rule 7 Risk of Collision**

- (a) *Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.*

## **Rule 15 Crossing Situation**

*When two power driven vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way and shall, if the circumstances of the case admit, avoid crossing ahead of the other vessel.*

## **Rule 20 Lights and Shapes - Application**

- (b) *The Rules concerning lights shall be complied with from sunset to sunrise.....*

## **Rule 21 Lights and Shapes - Definitions**

- (a) *“Masthead light” means a white light placed over the fore and aft centreline of the vessel showing an unbroken light over an arc of the horizon of 225 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on either side of the vessel.*
- (b) *“Sidelights” means a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of the horizon of 112.5 degrees and so fixed as to show the light from right ahead to 22.5 degrees abaft the beam on its respective side. In a vessel of less than 20 metres in length the sidelights may be combined in one lantern carried on the fore and aft centreline of the vessel.*
- (c) *“Stern light” means a white light placed as nearly as practicable at the stern showing an unbroken light over an arc of the horizon of 135 degrees and so fixed as to show the light 67.5 degrees from right aft on each side of the vessel.*
- (d) *“Towing light” means a yellow light having the same characteristics as the “stern light” defined in paragraph (c).*
- (e) *“All-round light” means a light showing an unbroken light over an arc of the horizon of 360 degrees.*
- (f) *“Flashing light” means a light flashing at regular intervals at a frequency of 120 flashes or more per minute.*

## **Rule 22 Visibility of Lights**

*The lights prescribed in these Rules shall have an intensity ..... so as to be visible at the following minimum ranges:*

- (b) *In vessels of 12 metres or more in length but less than 50 metres in length:*
  - *a masthead light, 5 miles; except that where the length of the vessel is less than 20 metres, 3 miles;*
  - *a sidelight, 2 miles;*
  - *a stern light, 2 miles;*
  - *a towing light, 2 miles;*
  - *a white, red, green or yellow all-round light, 2 miles.*
  
- (c) *In vessels of less than 12 metres in length:*
  - *a masthead light, 2 miles;*
  - *a sidelight, 1 mile;*
  - *a stern light, 2 miles;*
  - *a towing light, 2 miles*
  - *a white, red, green or yellow all-round light, 2 miles.*

## **Rule 23 Power-driven Vessels Underway**

- (a) *A power-driven vessel underway shall exhibit:*
  - (i) *a masthead light forward;*
  - (iii) *sidelights;*
  - (iv) *a stern light.*
  
- (c)
  - (i) *A power-driven vessel of less than 12 metres in length may in lieu of the lights prescribed in paragraph (a) of this Rule exhibit an all-round white light, and sidelights.*
  - (ii) *A power-driven vessel of less than 7 metres in length whose maximum speed does not exceed 7 knots may in lieu of the lights described in paragraph (a) of this Rule exhibit an all-round white light and shall, if practicable, also exhibit sidelights.*

## **Rule 25 Sailing Vessels Underway and Vessels Under Oars**

- (a) *A sailing vessel underway shall exhibit:*
  - (i) *sidelights;*
  - (ii) *a stern light.*

- (b) *In a sailing vessel of less than 20 metres in length the lights prescribed in paragraph (a) of this Rule may be combined in a lantern carried at or near the top of the mast where it can best be seen.*
- (d) (i) *A sailing vessel of 7 metres in length shall, if practicable, exhibit the lights prescribed in paragraphs (a) or (b) of this Rule, but if she does not, she shall have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision.*

**Maritime Authority of NSW**  
**Code of Conduct for Vessels Operating in Sydney Cove, 2005**

**Clause 3      Definition of Sydney Cove and the “Limit Line”**

*The 8-knot speed limit Gazetted as the **Port of Sydney (Sydney Cove) Area** under the **Maritime Service Act 1935** applicable to the navigable waters lying southwards of a line extending from the Eastern extremity of Dawes Point to the Western extremity of Bennelong Point.*

**Clause 12.2    North / South Rule**

*Vessels departing Sydney Cove to a place West of Sydney Cove must be navigated on a Northerly course until the vessel is at least abeam of the Diamond Shape marking the centre of the Harbour Bridge before the vessel’s course is altered to Port.*

**Clause 14.1    Speed**

*Vessels must not be operated in excess of the Sydney Cove 8-knot speed limit.*

In addition to giving particular consideration to the above regulations, OTSI coordinated a re-enactment of the circumstances of the accident using a vessel of the same make and design as, and of a similar vintage to, *Merinda* and the *Pam Burridge* itself. The purpose of the re-enactment was to explore issues associated with visibility. The re-enactment, which is described in Part 2 of the report, could only approximate the circumstances of the collision and it had no bearing on OTSI’s determination of its location.

## EXECUTIVE SUMMARY

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### Preliminary Facts

At approximately 7:00pm on Wednesday 28 March 2007, a group of 12 people including members of three families, an overseas visitor from Belgium and a number of their friends, many of whom had a common interest in the sport of ice skating, embarked at Drummoyne on the motor cruiser *Merinda* for an evening cruise which was to take in Darling Harbour and subsequently, the Woolloomooloo area of Sydney Harbour.

The *Merinda*, a 9.15 metre timber “Island Gypsy” motor cruiser which was designed for recreational use, consisted of a Main Saloon with a Driving Station, a Fly-Bridge with a Driving Station, a Forward Deck, a Trunk Cabin with two bunks and a small After Deck. It was part-owned by one of the members of the party onboard who is referred to as the Co-owner throughout this report. The Co-owner’s step-son was also aboard and for the majority of the journey operated the vessel as the Helmsman from the Driving Station in the Main Saloon. He was supervised by the Co-owner who also assisted him by acting as a look-out.

Having cruised to a point in the vicinity of the Opera House, the *Merinda* turned and headed for Darling Harbour. As it proceeded through Darling Harbour to berth at Cockle Bay, CCTV footage confirms that its Main Saloon, Mast, Stern and Starboard navigation lights were illuminated. It berthed at Cockle Bay at approximately 8:20pm.

The passengers had dinner onboard the *Merinda* while it was berthed at Cockle Bay, and afterwards, several of them took a short walk in the immediate area. Having re-embarked its passengers, the *Merinda* departed Darling Harbour for Woolloomooloo at about 10:30pm. CCTV footage shows the *Merinda* passing Northbound under the Pyrmont Bridge with light emanating from the Main Saloon, but no illumination from its Mast or Port navigation lights.

Meanwhile, Sydney Ferries' HarbourCat *Pam Burrridge* departed Meadowbank at 10:29pm on its last service run for the day and proceeded to Circular Quay, with no passengers aboard, where it dropped off its cashier at No. 5 Wharf West. CCTV footage shows the *Pam Burrridge* departing the Wharf at 10:47pm with its main cabin, masthead, side navigation, stern and all-round flashing lights illuminated. Subsequently, the footage shows the ferry proceeding on a Northerly course out of Sydney Cove and then turning Westwards towards the Harbour Bridge.

Because the *Pam Burrridge* was not fitted with any kind of data recording device, the point at which the Master commenced turning Westwards cannot be established precisely. Nevertheless, the Master estimated that he commenced his turn about half way between the centre of the Harbour Bridge and the Southern shoreline, and not when he was abeam of the Diamond Shape marking the centre of the Bridge as required by the NSW Maritime Authority's *Code of Conduct for Vessels Operating in Sydney Cove*.

## The Collision

Again, because neither the *Pam Burrridge* nor the *Merinda* were fitted with data recording devices, it is not possible to plot the precise tracks of their respective courses, but the fact that the two vessels were proceeding on courses that would ultimately converge is tragically realised at a point which has been calculated with considerable accuracy some 96 metres East of the Harbour Bridge and 180 metres out from the shoreline of Dawes Point.

As the vessels approached this convergence point at a closing speed of approximately 25 knots<sup>1</sup>, the *Merinda* was heading East with two of its three Main Saloon lights illuminated but with no illumination from its Mast or Side navigation lights. The Helmsman was operating the *Merinda* from the Driving Station in the Main Saloon and the Co-owner was standing beside him assisting as a look-out. Of the other passengers, two were asleep in the Trunk Cabin, three were seated in the Main Saloon and the other five were in the area of the After Deck.

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<sup>1</sup> Calculated on the basis of estimations provided by both the Master of the *Pam Burrridge* and the Co-owner of the *Merinda* that they were proceeding at about 20 – 22 knots and 5 knots respectively.

Onboard the *Pam Burrridge*, the Master was alone in the wheelhouse while the General Purpose Hand was in the passenger cabin preparing the area for the following day's services. The direction in which the ferry was tracking after it turned Westward placed it on an approach course to the *Merinda* from her Starboard side at an angle of approximately 30°.

The Master of the *Pam Burrridge* asserts that he first saw the *Merinda* on his bow at a range of approximately 20 metres and that his instinctive reaction was to turn hard to Port and to "throttle off", but that it was too late for these actions to have any effect in preventing the collision.

At approximately 10:50pm, the Starboard pontoon (hull) of the *Pam Burrridge* collided with the Starboard side of *Merinda* at a point about midway along its length and continued through the cruiser, tearing through the hull, machinery space and decking and dislodging the transom. *Merinda's* Fly Bridge was all but lifted away as a result of the collision.

As a result of the collision, *Merinda* was effectively cut in two and its occupants were either thrown into the water or left standing on, or clinging to, the wreckage of the launch. Air trapped below deck in the Trunk Cabin kept the wreckage of *Merinda* afloat until it was secured to one of the vessels that responded to the scene.

After the collision, *Pam Burrridge* continued on the same heading for a short distance before it stopped and then returned to the vicinity of the collision. During this manoeuvre, the Master contacted Harbour Control by radio and advised that he had been involved in a collision with another vessel and that there were people in the water as a consequence.

Two other ferries, *Fishburn* and *Golden Grove*, diverted to the scene of the accident to render assistance. A vessel belonging to Sydney Ports Corporation which was on stand-by to respond to environmental incidents in the Harbour and a vessel operated by a contractor working for the Navy, also responded to the scene to provide assistance.

As a result of the collision, four passengers on board *Merinda* were fatally injured and the remaining eight required hospitalisation. Three of these surviving eight passengers were seriously injured.

## Findings

In determining the factors which caused and contributed to the circumstances that brought the *Pam Burridge* and the *Merinda* into collision, the investigation found that there were a number of factors, including human error, vessel visibility and environmental conditions, which ultimately combined at one fatal culminating point to bring about this tragic accident.

However, the most critical question which has been the focus of all the lines of inquiry that have been investigated has been:

***Why did the Master of the Pam Burridge and the Helmsman and Co-owner of the Merinda not see each others' vessels in time to take action to avoid collision?***

The factors that bear most significantly on the answer to that question have to do with the following considerations:

- a. ***To what extent did the general conditions of visibility on the Harbour in the vicinity of Sydney Cove and the Bridge affect the ability of vessel operators to see other vessels?***

While the effects of shadowing, light reflection and scatter on the water can make the detection of vessels in the vicinity of the Harbour Bridge quite difficult at night, the prevailing conditions of visibility on the night of 28 March 2007 were not unusual and should not have presented a problem for vessels whose operators were maintaining a proper look-out.

- b. ***Should Merinda, which was not exhibiting its navigation lights, have been seen as it was operated under and East of the Harbour Bridge by vessels coming out of Sydney Cove?***

Waterborne observations and the results of the re-enactment conducted by OTSI reveal that notwithstanding the maintenance of a proper look-out, a vessel of *Merinda's* type not exhibiting the required configuration of

navigation lights would have been extremely difficult to detect from vessels coming out of Sydney Cove, irrespective of the state of its cabin lighting.

- c. ***Within those prevailing conditions of visibility, to what extent should Pam Burrridge, which was exhibiting the required navigation lights, have been visible to other vessels that were keeping a proper lookout as it was operated out of Sydney Cove?***

Waterborne observations and the results of the re-enactment conducted by OTSI reveal that the HarbourCat can be detected at long range.

- d. ***To what extent did Pam Burrridge's course, after departing Sydney Cove and turning West to pass under the Bridge, contribute to causing the collision?***

While it is a fact that *Pam Burrridge's* course did not conform fully with the requirements of the *Code of Conduct for Vessels Operating in Sydney Cove*, the course itself did not cause the collision because there was a clear line of sight between the two vessels and this extended over a distance which would have allowed either vessel to have altered course before the vessels came into close proximity, provided, of course, that both vessels were exhibiting the prescribed configuration of navigation lights and were maintaining a proper lookout.

- e. ***To what extent did speed play a part in causing the collision?***

*Pam Burrridge* was not constrained by any speed restriction after it crossed the "limit line" (see page viii), but the Master was obliged to proceed at a "safe speed". Although the Master's decision to operate at approximately 22 knots reflected a limited appreciation of what constituted a "safe speed" in the area of the Harbour Bridge, the speed itself did not cause the collision since, even at that speed, he would have had sufficient time to have detected *Merinda*, had it been exhibiting the required configuration of navigation lights, and to have changed course in the event that it became necessary to do so. Equally, the re-enactment conducted by OTSI revealed that, even at speed, *Pam Burrridge* could have been seen at a



considerable distance, provided a proper look-out was being maintained on *Merinda*, and that the ferry could have been avoided.

**f. *Was a proper look-out maintained onboard Pam Burridge?***

The Master maintains that he kept a proper look-out and there is no technological or other means of establishing otherwise. OTSI's re-enactment established that in the absence of navigation lights, the illumination of cabin lights on a vessel like the *Merinda* was insufficient to have allowed the vessel to be seen from the ferry at anything other than very close range.

**g. *Was a proper look-out maintained onboard Merinda?***

The Helmsman and the Co-owner maintain that they kept a proper look-out and there is no technological means of establishing otherwise. They maintain that they did not see *Pam Burridge* as it approached on their Starboard bow. Four witnesses who were involved in the emergency response have indicated that the Helmsman made comments, while in a highly distressed state, which indicated that he may have seen *Pam Burridge*, albeit for a limited period of time, before the collision. The Helmsman has no recollection of the statements attributed to him. These conflicting accounts could not be reconciled.

Equally difficult to reconcile is how *Pam Burridge*, given its size and the fact that its navigation lights were exhibited, was not seen if a proper look-out was being maintained onboard *Merinda*.

It is acknowledged, however, that the ability of the Helmsman and the Co-owner to maintain a proper look-out might have been restricted by the supporting pillars in their vessel's main saloon, but these should not have completely obscured *Pam Burridge* during the latter stages of its exit from Sydney Cove and for the entire period thereafter up until the collision.

The conclusion to be drawn from the analysis of these prime factors, together with all the material evidence gathered in the course of the investigation, is that

the primary causes and factors which contributed to this tragic accident can be attributed to the following conditions and circumstances:

**a. Causation**

- i. Because the *Merinda* was not exhibiting the navigation lights it was required to, it did not become visible to the Master of the *Pam Burridge* until it was too late for him to take effective collision-avoidance action.
- ii. Because a proper look-out was not maintained onboard *Merinda*, *Pam Burridge's* approach was either not detected, or was detected in insufficient time for the Helmsman to give way to, or avoid, the ferry.

**b. Contributory Factors**

- i. The position and dimensions of supporting pillars that formed part of *Merinda's* Main Saloon windscreen, windows and superstructure would have restricted the Helmsman's and Co-owner's field of view as they looked-out towards the direction from which *Pam Burridge* approached.
- ii. The course taken by *Pam Burridge* to proceed West out of Sydney Cove did not conform with the requirements of the *Code of Conduct for Vessels Operating in Sydney Cove* and altered the angle at which the two vessels converged, but the course itself had no effect on the Master's ability to detect the presence of properly illuminated vessels, or its visibility to those maintaining a proper lookout from any other vessel in the vicinity.
- iii. Lighting conditions on the water at night in the vicinity of the Harbour Bridge can vary significantly in a matter of metres and may have further detracted from the ability of the Helmsman and the Master to detect each other's vessels.

**c. Anticipation and Management of Risk**

- i. Neither the Helmsman nor the Master were subject to any speed restriction on their respective tracks away from and towards the

Harbour Bridge and *Merinda* and *Pam Burrridge* were being operated at approximately 4-6 knots and 20-22 knots<sup>2</sup> as they converged. However, the Helmsman and the Master were under an obligation to maintain a proper lookout for other vessels and to operate at a safe speed, i.e., “one at which the vessel can be stopped in time to avoid any danger which arises suddenly”.<sup>3</sup>

- ii. The Helmsman’s decision to operate *Merinda* at night from the Driving Station within the Main Saloon, rather than from the Fly-Bridge where he would have enjoyed an unrestricted field of view, is indicative of a limited understanding of the risks associated with operating a small motor vessel on Sydney Harbour at night. It also reflects on the Co-owner’s lack of appreciation for those same risks.
- iii. In operating *Pam Burrridge* at approximately 20-22 knots at night, the Master did not fully take into account the requirement to operate at a safe speed in the unique conditions that prevail in the vicinity of the Harbour Bridge.
- iv. There is a higher risk of collision in the immediate area of the Harbour Bridge than in other parts of the Harbour because of the following factors:
  - (1) the relative narrowness of the channel under the Harbour Bridge;
  - (2) the convergence of traffic travelling either East or West in the main channel with that entering or exiting Walsh Bay and Sydney Cove;
  - (3) the juxtaposition of commercial and recreational vessels, and
  - (4) the variability of lighting conditions at this location by night.

NSW Maritime’s *Code of Conduct for Vessels Operating in Sydney Cove*<sup>4</sup> is intended to manage some of the known risks in this area,

<sup>2</sup> These estimates of speed are based on evidence provided by the Helmsman and Master when interviewed by OTSI.

<sup>3</sup> These requirements are specified in Rules 5 and 6 of the *Navigation (Collision) Regulations 1983 – Schedule 1*, although the amplifying definition is derived from a section entitled “Water Traffic Rules” in NSW Maritime’s *Boating Handbook*.

<sup>4</sup> This Code was revised in January 2005. In essence, it restricts other than commercial operators from operating in Sydney Cove and identifies limits on the speeds and routes at/over which vessels may be operated on entering or exiting the Cove.

but the *Code* is either not fully understood, or is not being observed, by some masters employed by a number of operators who have agreed to operate in accordance with the *Code*, including Sydney Ferries. In addition, one of the key control measures, the 8 knot 'limit line', is depicted inaccurately within the *Code*.

- v. NSW Maritime's strategy for managing the risk of boating accidents is overly reliant on the operators of all vessels being aware of navigation rules and collision regulations, especially so in the absence of a requirement for all persons operating a vessel to hold a boating license.

#### **d. Effectiveness of the Emergency Response**

- i. Although the situation on the water was confused, in that those responding to the scene of the accident had no way of knowing how many people had been onboard *Merinda*, the emergency response was timely and conducted in a highly effective manner.
- ii. Given the circumstances, *Pam Burridge's* Master displayed considerable presence of mind and good seamanship in the way he manoeuvred his vessel as he returned to the scene of the collision, ensuring that those in the water were not placed at further risk. The seamanship of the masters operating *Fishburn*, *Golden Grove* and Sydney Ports' response vessel, in acting to secure *Merinda* and *Pam Burridge*, was also highly effective.
- iii. The passengers onboard *Fishburn* and *Golden Grove* appreciated, and benefited from, being advised of the accident and the need for their vessels to be diverted.
- iv. The actions of the uninjured, or relatively less injured, persons from *Merinda*, particularly the Helmsman who was already in the water, together with the actions of the GPH and Engineer from *Fishburn* who entered the water without hesitation, to assist those who, by virtue of their age or injuries, were unable to assist themselves, were selfless and directly responsible for preventing further loss of

life. Crew members from Sydney Ferries' vessels at the scene including *Pam Burridge's* Master, from Sydney Ports' response vessel and a veterinarian and veterinary nurse, who were passengers on the *Golden Grove*, administered CPR and acted to stem the bleeding of the most seriously injured. Their actions, and those subsequently taken by Ambulance officers at Dawes Point, were also highly significant.

**e. Other Matters that would enhance the Safety of Ferry/Boating Operations**

The following matters did not have a bearing on the collision between *Pam Burridge* and *Merinda* but are identified as having the potential to cause or contribute to other instances of collision on the water, and especially between sunset and sunrise, within NSW.

- i. The current provision which allows an unlicensed person to operate a motor vessel in NSW, regardless of its size and the number of passengers onboard, provided they do so at below 10 knots, needs to be reviewed.
- ii. Qualifying for a recreational boating licence in NSW needs to be contingent upon satisfying a knowledge test and demonstrating a satisfactory level of proficiency in basic boating competencies.
- iii. The current provision which allows vessels less than 7 metres in length and with a maximum speed of 7 knots to be operated with a single white light needs to be reviewed.
- iv. NSW Maritime needs an increased presence on the Harbour, by day and night, to enforce compliance with its requirements for safe boating and ferry operations.
- v. A range of stakeholders have concerns about Sydney Ports' plan to relocate the Harbour Master and the Harbour Control function to Port Botany. Some of the concerns might be redressed were Sydney Ports to provide stakeholders with greater visibility of the risk assessments that have been/or are being done in anticipation of the relocation, and of new aids, technologies or systems that are likely to be employed as a consequence.

## Recommendations

In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the organisations specified below:

**a. NSW Maritime Authority**

- i. Increase its presence within Port Jackson, by day and night, to ensure greater compliance with its requirements for safe boating and ferry operations, including those rules pertaining to the exhibiting of lights between sunset and sunrise.
- ii. Amend the *Code of Conduct for Vessels Operating in Sydney Cove* to more accurately depict the 8 knot 'limit line' and to incorporate a requirement that vessels that are bound by clause 12.2 of the North-South Rule must pass to the Starboard side of the Diamond Shape marking the centre of the Harbour Bridge as they pass under the bridge.
- iii. Ensure that all operators permitted to operate out of Sydney Cove understand and comply with the requirements of the North-South Rule implicitly.
- iv. Require that all vessels that are manually powered exhibit an all-round white light when operating between sunset and sunrise in NSW.
- v. Remove the provision that allows motor vessels of less than seven metres in length, and that are not capable of exceeding 7 knots, to exhibit a minimum of a single all-round white light and require all vessels under 12 metres in length, irrespective of their maximum speed, to be operated with a minimum of side navigation lights and an all-round white light when operating between sunset and sunrise in NSW.
- vi. Remove the provision that allows sailing vessels less than seven metres in length to be operated between sunset and sunrise in NSW with a minimum of white light and require such vessels to display a minimum of side navigation lights and a stern light.

- vii. Amend the requirements for obtaining a recreational boating licence in NSW to incorporate some form of practical assessment of basic boating competencies.
- viii. Remove, or further qualify, the provision that allows unlicensed persons to operate a vessel in NSW, provided they do so at less than 10 knots, to ensure that vessels capable of carrying a significant number of passengers or attaining high speeds are not operated by other than a person holding a boating licence.
- ix. Examine the feasibility of permitting only licensed persons to operate a vessel between sunset and sunrise in NSW.

**b. Sydney Ferries Corporation**

- i. Ensure all of its masters understand the North-South Rule as specified in the *Code of Conduct for Vessels Operating in Sydney Cove* and comply with it implicitly.
- ii. Impress upon its masters the need to comply with safe operating requirements at all times, in order to minimise risk to passengers, crew and other boat users, particularly as it affects their credibility as master mariners and the public's confidence in Sydney Ferries Corporation as a safe provider of passenger services.
- iii. Enhance its capacity in the near term to identify and manage instances where ferries are not being operated in accordance with the required rules and regulations, and/or its own safe operating requirements, by fitting real time tracking devices on all its vessels.
- iv. Notwithstanding that timetabling was not at issue in this accident, complete the review of its schedule of services and adjust that schedule, if necessary, to ensure that masters are not placed under any form of pressure to exceed speed restrictions in order to comply with its timetables.
- v. Expedite the fitment of data loggers across its fleet.

**c. Sydney Ports Corporation**

Provide stakeholders with visibility of the risk assessments that have been, or are being, done in anticipation of the relocation of its Harbour Control function to Port Botany, and of new aids, technologies or systems that are likely to be employed as a consequence.

**d. Australian Maritime Officers' Union**

Impress on those of its members who are employed as masters on passenger vessels operating on Sydney Harbour, of the need to comply with safe operating requirements at all times, in order to minimise risk to passengers, crew and other boat users, and to enhance public confidence in the safety of waterborne passenger services.



## PART 1 FACTUAL INFORMATION

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### Accident Synopsis

- 1.1 At approximately 10:50pm on Wednesday 28 March 2007, Sydney Ferries' *Pam Burrige* and a privately owned motor launch, *Merinda*, collided on Sydney Harbour at a point approximately 96 metres East of the Sydney Harbour Bridge and 180 metres from the shoreline of Dawes Point. At the time of the collision, *Pam Burrige* (*Photo 1*) was heading in a Westerly direction towards the Harbour Bridge. It had completed its last passenger service of the day and was en route to Sydney Ferries' shipyard at Balmain.
- 1.2 *Merinda* (*Photo 2*), had 12 persons onboard and was travelling in an Easterly direction, away from the Harbour Bridge, at the time of the collision.



**Photo 1: *Pam Burrige***



**Photo 2: *Merinda*, at the time of an earlier sale in 1996**

- 1.3 As a result of the collision, four passengers on board *Merinda* were fatally injured and the remaining eight required hospitalisation. Three of the surviving eight passengers were seriously injured. There were no passengers on board *Pam Burrridge* at the time of the collision and neither of its two crew members was injured.

## **Accident Narrative**

### **Before the Collision**

- 1.4 *Merinda* commenced cruising from Drummoyne at approximately 7:00pm. Onboard were members of three families and a number of their friends, including an overseas visitor from Belgium, with many of these people having a common interest in the sport of ice skating. *Merinda* was owned in partnership and one of the partners was on board. This partner (hereafter referred as the Co-owner) operated the vessel for a limited period of time during the outing. However for the majority of the outing, and at the time of the collision, the Co-owner's 22 year old step-son was at the helm.

- 1.5 After an uneventful transit to a point in the vicinity of the Opera House, *Merinda* turned, headed for Darling Harbour and subsequently berthed at Cockle Bay at approximately 8:20pm. CCTV footage shows *Merinda* entering Darling Harbour and passing under the Pyrmont Bridge en route to Cockle Bay with its main saloon, mast, stern and Starboard navigation lighting illuminated.<sup>5</sup>
- 1.6 While berthed, the passengers consumed a pre-prepared dinner onboard. Later, several of the passengers took the opportunity to take a short walk in the immediate area.<sup>6</sup> Some time around 10:30pm,<sup>7</sup> *Merinda* departed Darling Harbour for Woolloomooloo. CCTV footage shows *Merinda* passing under the Pyrmont Bridge after exiting Cockle Bay with two of its three main saloon lights illuminated, but with its mast, stern and Port navigation lights extinguished.
- 1.7 After what the Master and the GPH described as a routine day's operation, the *Pam Burrridge* completed its last passenger service run to Meadowbank at 10:29pm and returned to Circular Quay to drop off its cashier.<sup>8</sup> CCTV footage shows the ferry departing Circular Quay from No. 5 West Wharf at 10:47pm with its masthead light, side navigation lights, stern light, an all-round flashing light and its passenger cabin lights illuminated. Subsequently, it shows the ferry tracking Northwards out of Sydney Cove and then turning Westwards towards the Harbour Bridge.

## The Collision

- 1.8 The tracks and speeds of both vessels placed them on a collision course, with the *Pam Burrridge* approaching *Merinda* from her Starboard side at an angle of approximately 30°. When interviewed, the Master of *Pam*

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<sup>5</sup> *Merinda's* orientation in this footage meant that it was not possible to observe whether its Port navigation light was illuminated. However, later examination indicated that the related circuit and globe were operable at this time and it is therefore highly probable that the Port light was also illuminated at the time this image was captured.

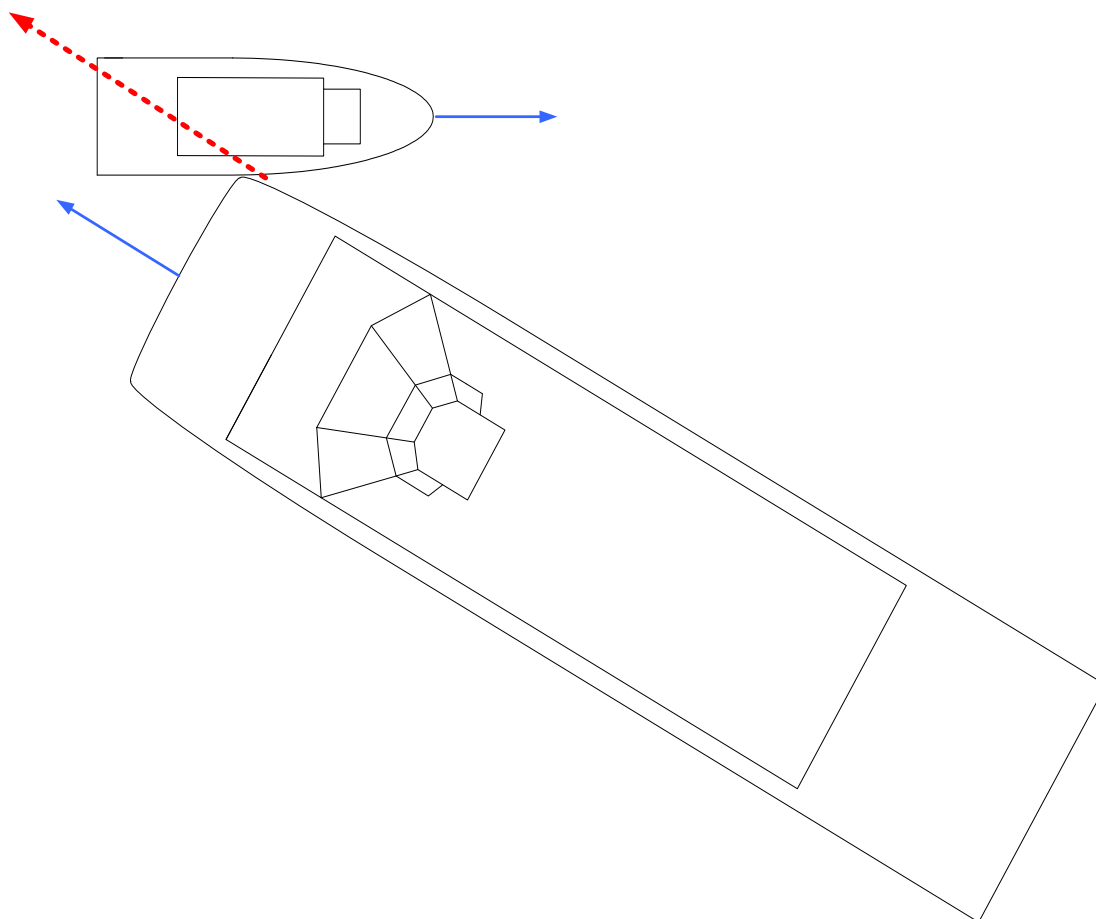
<sup>6</sup> The sequence of events described in the commentary in paragraphs 1.4-1.6, less that which is indicated as having been derived from CCTV, was compiled from written statements provided by three persons onboard *Merinda*.

<sup>7</sup> In the written statements referred to above, there is a reference to the departure time being "sometime after 9:30pm" but CCTV footage taken from three cameras in different locations in Darling Harbour show *Merinda* heading North shortly after 10:30pm.

<sup>8</sup> The Master and GPH were interviewed, separately, on 11 April 2007.

*Burrige* advised that he first saw *Merinda* on his bow at a range of approximately 20 metres and that his immediate reaction was to turn hard to Port and to “throttle off” but that it was too late to avoid the collision.<sup>9</sup>

- 1.9 *Merinda’s* Helmsman advised OTSI that he did not see *Pam Burrige* at all and, upon hearing a series of loud bangs, thought that he had hit either a submerged or a floating object.
- 1.10 The starboard pontoon (hull) of *Pam Burrige* collided with the starboard side of *Merinda* around the midway point and continued through *Merinda*, tearing through the hull, machinery space and decking, and dislodging the transom. *Merinda’s* fly bridge was all but lifted away as a result of the collision. *Diagram 1* shows the angle at which the vessels collided.



**Diagram 1: Angle and point of impact of the collision**

<sup>9</sup> When interviewed on 11 April 2007, the Master was able to provide only a limited account of the circumstances of the accident and indicated that there was nothing he could have done to avoid the collision. The actions taken by the Master to avoid the collision were described by the Master at a second interview on 25 November 2007.



- 1.11 *Photo 3* shows the extent of the damage to *Merinda*. *Photo 4* depicts an area of *Merinda's* deck over which *Pam Burrige* passed and further indicates the angle of the collision. The specific location of this area of deck is indicated by the yellow arrow in *Photo 3*.



**Photo 3: Depicting the extent of damage to *Merinda***



**Photo 4: An area of *Merinda's* deck across which *Pam Burrige* passed**

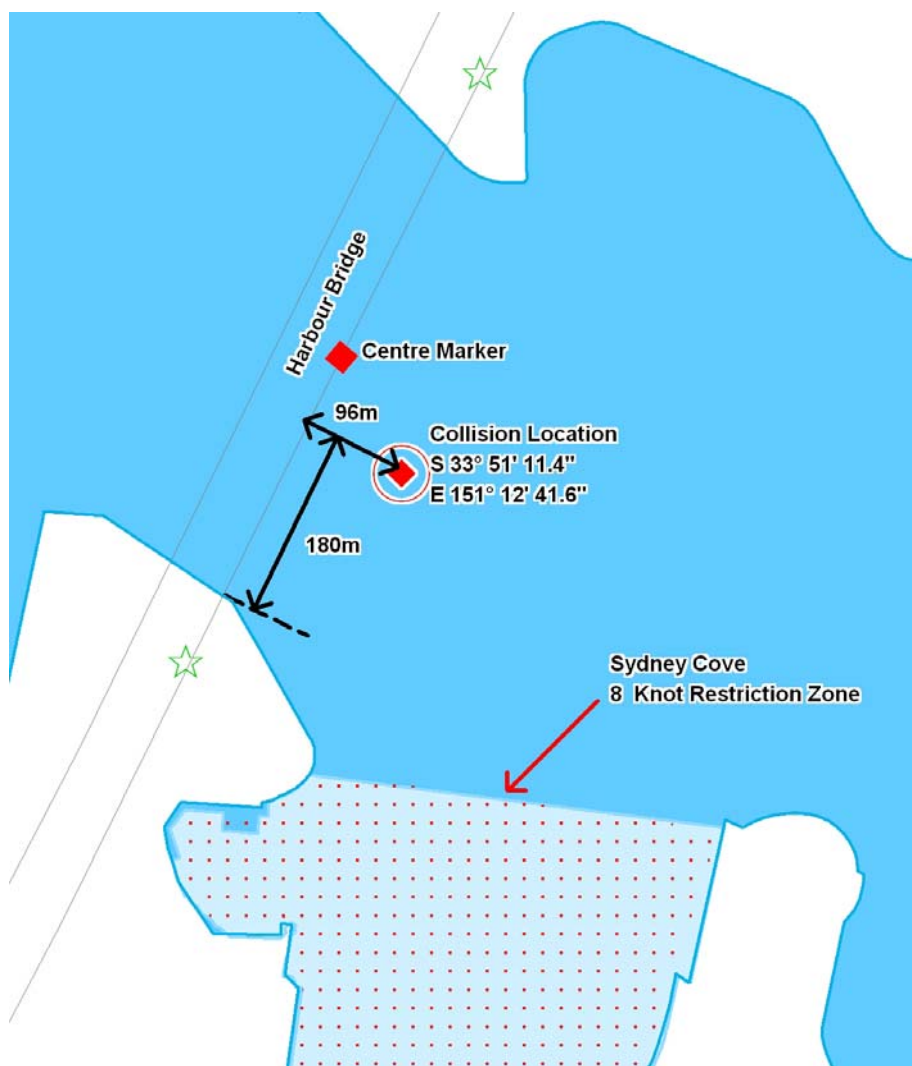
## After the Collision

- 1.12 As a result of the collision, *Merinda* was effectively cut in two and its occupants were either thrown into the water or left standing on, or clinging to, the wreckage of the launch. Air trapped below deck in its trunk cabin kept the wreckage of *Merinda* afloat until it was secured to one of the vessels that responded to the scene.
- 1.13 CCTV footage taken from Circular Quay shows that after the collision, *Pam Burridge* continued on the same heading for a short distance before it stopped and then returned to the vicinity of the collision. During this manoeuvre, the Master contacted Harbour Control by radio and advised that he had been involved in a collision with another vessel and that there were people in the water as a consequence.
- 1.14 Two other Sydney Ferries, *Fishburn* and *Golden Grove*, diverted to the scene of the accident to render assistance. A vessel belonging to Sydney Ports Corporation which was on stand-by to respond to environmental incidents in the Harbour, and a vessel operated by a contractor working for the Navy, also responded to the scene. During the subsequent rescue and recovery operation, which is described in detail in Part 2 of this report, a number of people distinguished themselves by virtue of their professionalism and/or selflessness.
- 1.15 All but one of *Merinda*'s passengers were recovered to Dawes Point where the survivors were treated by ambulance officers before being conveyed to one of two hospitals, and the search for the missing passenger, a 14 year old female, was commenced. This search involved multiple agencies utilising helicopters, vessels, divers and sonar equipment but after 90 hours without results, was scaled down. In the early afternoon of 2 April 2007, the body of the missing person was sighted on the surface of the water, in the vicinity of the collision site, by a security guard on the Harbour Bridge and was recovered by the Water Police.

## Location of the Collision

- 1.16 It was not possible to draw on information from either *Pam Burridge* or the *Merinda* to determine the exact course taken by both vessels, the exact

speed at which they were operated, or the exact location of the collision as neither vessel was fitted with a data logger.<sup>10</sup> Additionally, the actual collision was not captured on radar and although *Pam Burrige* was fitted with a Global Positioning System (GPS), it displayed, rather than recorded, information. Nevertheless, analysis of CCTV footage supplied by the RTA, together with radar records supplied by Harbour Control allowed OTSI to calculate that the collision occurred approximately 96 metres East of the Sydney Harbour Bridge and on a perpendicular to the Bridge 180 metres from the shoreline of Dawes Point, as depicted in *Diagram 2*.



**Diagram 2: Collision Point, Latitude: S 33° 51' 11.4\", Longitude: E 151° 12' 41.6\"**

<sup>10</sup> Sydney Ferries has advised that as at 12 February 2008, 16 of its 31 vessels have been fitted with data loggers but that because its fleet replacement strategy did not include the retention of its two Lady class vessels, these vessels would be not fitted with data loggers. It further advised that data loggers would be fitted to the remaining 13 vessels by the end of 2008.

- 1.17 The CCTV footage used to calculate the location of the collision was taken by RTA security cameras. One of the cameras, located on the North-East pylon of the Harbour Bridge, showed the wreckage of the *Merinda* to be located on a line from the camera, tangent to the Overseas Passenger Terminal as indicated in *Photo 22* on page 83. This photo also shows the location of rescue vessels in relation to the wreckage. A second camera, located on the centre walkway at the top of the arch of the Bridge, showed the location of the wreckage and rescue vessels relative to the Bridge's centre and allowed this to be quantified by scaling against the known length of the rescue vessel *Fishburn*. The intersection of these two reference lines fixed the location of the wreckage. Further elaboration on the location of the collision is provided in Part 2 of this report and in Appendix 1.

## Vessel Information

- 1.18 *Pam BurrIDGE* was manufactured in 1998 and like its sister vessel, *Anne Sargeant*, it measures 27.1m in length, 7.2 metres in width and displaces approximately 35 tonnes. It is designed to carry a maximum of 150 passengers and when it is not otherwise restricted by speed limits, traffic and environmental factors, operates at a cruising speed of approximately 22 knots.
- 1.19 *Merinda* was designated an 'Island Gypsy' by its builders, Kong and Halverson. Built in November 1977, it measured 9.15 metres in length and 3.5 metres across the beam. As can be seen in *Photo 2*, it had a fly-bridge, a main saloon, a trunk cabin and a small rear deck. The vessel was designed for recreational use and was rated by the previous regulator, the NSW Waterways Authority, as being suitable for the carriage of a maximum of 10 adult persons. *Merinda* was powered by a 115 horsepower diesel engine and would have had a maximum cruising speed of approximately 9 knots. It had been acquired by the current owners in 2002.



## Crew and Passenger Information

- 1.20 *Pam Burrridge* was crewed by a Master and a GPH and there were no passengers onboard.
- 1.21 The Master joined Sydney Ferries as a GPH in May 1989 and gained the necessary qualifications to operate a ferry and was appointed as a master in November 2001. He was first assessed as competent to operate a HarbourCat on 15 November 2001 and re-certified on the vessel type in September 2003 and March 2005. The Master's Class 4 licence is valid until 30 May 2011.
- 1.22 As indicated, *Merinda* had 12 people on board at the time of the collision. The Co-owner held a boating license but was not at the controls of the vessel at the time of the collision. The Helmsman did not hold a boating licence, nor was he required to do so.<sup>11</sup>

## Injuries

- 1.23 Four of *Merinda's* occupants died as a result of the accident. The eight survivors were conveyed to hospital where it was confirmed that three had suffered serious injuries.
- 1.24 *Pam Burrridge's* crew members were not injured.

## Medical and Toxicological Information

- 1.25 Both of *Pam Burrridge's* crew members returned negative readings following testing for the presence of drugs and alcohol. *Merinda's* Helmsman and the Co-owner were similarly tested and also returned negative results.<sup>12</sup>

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<sup>11</sup> NSW boating regulations permit the operation of a recreational motor vessel, other than a jet ski, by an unlicensed person provided the vessel is being operated at less than 10 knots.

<sup>12</sup> The results of the tests were provided to OTSI by the NSW Water Police.

## Meteorological Information

- 1.26 The weather observations recorded by the Bureau of Meteorology at Fort Dennison on 28 March 2007 indicate that there was as a 4 knot NNE wind at 10:30pm which had reduced to 1 knot at 11:00pm. The tidal recording closest in time to the accident was 0.79 metres at 10:48pm.<sup>13</sup> At 10:45pm, the Moon was at 77% at an angle of 25.3° on a bearing of 323.4° true.
- 1.27 On the night of the accident, Sydney Observatory conducted viewings from 8:15pm to 10:15 pm and described the night as “clear”.

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<sup>13</sup> The Bureau records the tide at Fort Denison in six minute intervals. The reading at 10:48pm, of 0.79 metres, was 0.05 metres higher than predicted and low tide, of 0.72 metres, which occurred at 11:48pm.

## PART 2 ANALYSIS

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- 2.1 This Part of the Report examines all of the supporting material and corroborating evidence acquired during the course of the investigation and describes the analysis which has established why *Pam Burridge* and *Merinda* collided on the night of 28 March 2007.
- 2.2 To understand the circumstances that prevailed immediately prior to the vessels colliding, it was necessary to construct, as closely as possible, a re-enactment of the sequence of events which culminated in the fatal collision. That re-enactment was conducted on the night of 24 July 2007 and is described later in this Part, together with the results which were derived from it and their utilisation in informing the investigation.

### Seaworthiness and Loading of the Vessels

- 2.3 **Pam Burridge**. The Master of *Pam Burridge* advised that he had not encountered any problems with the vessel on the day of the accident. The ferry's maintenance records dating back to 2005 were examined and revealed that there were 31 outstanding maintenance issues. Many of these issues pertained to cosmetic matters and none of them were considered to be significant in the context of the investigation.
- 2.4 OTSI investigators inspected *Pam Burridge* over several days, commencing at first light on 29 March 2007 and particular attention was paid to the condition of its navigation lights. When switched on, all of the navigation lights, except the Starboard light, illuminated. Further examination established that this light was being supplied with almost full battery voltage of 24v. When its globe was examined, the filament was intact and a slight movement of the globe in its socket resulted in it illuminating. This indicated that the problem was that of a poor connection with the electrical contacts in the light socket. It is probable that the contact was interrupted by the force of the collision with *Merinda*. This conclusion is supported by video evidence of *Pam Burridge* only minutes before the collision which shows its Starboard light to be illuminated. On

the basis of its checks, OTSI determined that there were no grounds to conclude that *Pam Burrridge* was other than seaworthy on the night of 28 March 2007.

- 2.5 **Merinda**. The Helmsman of the *Merinda* advised OTSI that he was not aware of any defects on the vessel and that there had been no mechanical or electrical problems throughout the evening.



Photo 5: *Merinda*'s circuit and control switches, showing the "NAV. LT." Circuit Breaker in the OFF position

- 2.6 When the wreckage of *Merinda* was inspected by OTSI investigators, the condition of that part of the vessel that had suffered least from the collision indicated that the vessel had been in relatively good condition. Examination of the control panel revealed that two switches were taped over (see *Photo 5*) and one of the owners of the vessel advised that this was to ensure that no-one inadvertently switched off the bilge pumps. It was also noted that while the running light switch was in the 'ON' position, the navigation light circuit breaker switch was in the 'OFF' position. The potential significance of the condition of the circuit breaker switch is addressed later in the report. On the basis of the advice provided to OTSI and its own examination, OTSI determined that there were no grounds to conclude that *Merinda* was other than seaworthy when it commenced its cruise on the night of 28 March 2007.
- 2.7 **Loading.** *Pam Burrridge* is licensed to carry 150 passengers but was not carrying any passengers at the time of the accident. *Merinda* was operated with 10 adult persons, a teenager (aged 14) and a five year old onboard. Notwithstanding that this exceeded the number recommended on its capacity plate, OTSI does not consider that *Merinda's* load had a bearing on the circumstances of the accident.<sup>14</sup>

## Obligations of the Master and Helmsman

- 2.8 As previously identified, the Helmsman did not hold a recreational boating licence, but the Co-owner did. However, because control of a vessel can be exercised by other than the person at the helm, and often is on large commercial and military vessels, OTSI had to give consideration as to who was actually in control of *Merinda* at the time of the accident before it could consider whether or not that person fulfilled their obligations. In the light of comments made by the Co-owner in his written statement, attesting to the competence and experience of the Helmsman, and responses provided by the Helmsman when interviewed, OTSI considers the Helmsman and not

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<sup>14</sup> The capacity plate provides guidance only. The capacity is determined by taking into account a vessel's length, beam and whether it has a fly-bridge. The compliance plate affixed to *Merinda* identified that, for the purposes of calculation, children under the age of 1 are not considered to be passengers and those under the age of 12 are classified as half of an adult.

the Co-owner to have been in control of *Merinda* at the time of the collision.

- 2.9 Both the Helmsman and the Master were required to observe a number of fundamental obligations as they operated their vessels on the night of 28 March 2007. Amongst other responsibilities, they were required to ensure that they were not under the influence of illicit substances and that their blood alcohol content (BAC) was below the prescribed limits<sup>15</sup>. Both the Helmsman and the Master returned negative results following testing for the presence of drugs and alcohol. On the basis of their statements, and an examination of the Master's work roster, fatigue was also discounted as a factor which was likely to have contributed to the cause of the accident. The Helmsman and the Master were required to ensure that their vessels were seaworthy when they were placed into service and, as indicated, OTSI considers that they were. Importantly, both the Helmsman and the Master were also obliged to operate their vessels in a safe manner.

## Safe Operation of Vessels

- 2.10 The safe operation of both vessels required the Helmsman and the Master to have maintained a proper look-out for other vessels; to have travelled at a safe speed; to have observed relevant navigation and operating rules; and to have ensured that their vessel's navigation lights were illuminated.
- 2.11 **Maintenance of a 'Look-out'**. The purpose of maintaining a look-out is to ensure situational awareness, thereby detecting the presence of other vessels and objects and avoiding conditions of proximity which might culminate in a collision. While the person operating a vessel may be assisted to maintain a look-out, he/she retains responsibility for ensuring that this critical function is properly discharged. At the time of the accident, the Master was not being assisted in this regard as the GPH was on the passenger deck undertaking a number of tasks in preparation for the next day's operations.

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<sup>15</sup> As a transport safety worker, the Master's BAC was required to be below 0.02 grams which equates to below 20 milligrams of alcohol in 100 millilitres of blood, whereas the Helmsman, who was not a transport safety worker, was required to be below 0.05.

- 2.12 *Merinda's* co-owner indicated that he supervised the Helmsman during the evening and, in the process, assisted him to look-out. He specifically confirmed that he was next to the Helmsman as *Merinda* was passing under the Harbour Bridge and at the time of the collision. When asked whether he was covering a specific arc of responsibility, by agreement with the Helmsman, or looking-out more generally, the Co-owner indicated that he was not covering a specific arc of responsibility. In response to being asked whether there were any matters that might have limited his view to the Starboard, the Co-owner indicated that the presence of the Helmsman, a supporting pillar and the adjacent door frame and curtains that were drawn and secured in the same area would have impacted on his view in this direction.<sup>16</sup>
- 2.13 The Helmsman and the Co-owner indicated in their written statements, and when interviewed separately, that they did not see *Pam Burrridge* until after the collision. They estimated the collision to have occurred approximately 30-40 metres East of the Harbour Bridge.
- 2.14 Two witnesses, seated in positions 3 and 4 as indicated in *Diagram 5* on page 55, indicated that they did see what proved to be *Pam Burrridge* before the collision, albeit seemingly only momentarily.<sup>17</sup> Their recollection of seeing *Pam Burrridge* is elaborated upon in paragraph 2.26. At a second interview, the Helmsman was asked whether, upon reflection, he too may have seen *Pam Burrridge*, even if only fleetingly. He reiterated that he did not see the ferry.<sup>18</sup>
- 2.15 Two persons aboard a Sydney Ports' response vessel that responded to the accident indicated, separately, that the Helmsman made his way onto their vessel after assisting others. They described the Helmsman as becoming very distressed when he saw the state of other persons recovered onto the same vessel and as saying "the ferry just kept coming"

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<sup>16</sup> This information, and that subsequently described as being provided by the Co-owner at interview, was provided on 10 November 2007.

<sup>17</sup> One of these two witnesses provided the related information in a written statement, provided to OTSI on 21 May 2007, and the other during an interview on 30 November 2007.

<sup>18</sup> This information was provided during the second interview with the Helmsman, on 10 November 2007.

and that “it didn’t even blow its horn”.<sup>19</sup> OTSI asked the Helmsman, during the second interview, if he could recall making a statement to this effect and he indicated that he could not. OTSI also asked the Co-owner, who was also recovered onto the same vessel, whether he could recall the Helmsman making such a statement and he indicated that he could not.

2.16 Two Ambulance officers advised OTSI that a young man who had been involved in the accident and recovered to Dawes Point, indicated, while in a very distressed state, that he was responsible for those who had perished.<sup>20</sup> Asked if he could recall making such a statement when interviewed for the second time, the Helmsman replied that he could not. When the Co-owner was asked, separately, if he could recall the Helmsman making such a statement, he indicated that he could not. The Co-owner did acknowledge, however, that over the ensuing months, the Helmsman had struggled to overcome the trauma associated with the collision and felt a strong sense of responsibility for what had happened. He added however, that he considered that any person who had been at the helm at the time would feel similarly under the circumstances, and that this was not akin to actually being responsible for the accident. OTSI considered these sentiments to be understandable.

2.17 Maintenance of a Safe Speed. The Master indicated that he was operating *Pam Burrridge* at approximately 20-22 knots prior to the collision. In his written statement, the Helmsman stated that *Merinda* had been operated at below 4 knots within Darling Harbour, but that he had increased the vessel’s speed slightly after exiting Darling Harbour. The Co-owner thought that *Merinda* was travelling at approximately 5 knots as it passed under the Sydney Harbour Bridge. Although they were not bound by a speed restriction as they approached each other, the Helmsman and the Master remained under a fundamental obligation to travel at a safe

<sup>19</sup> One of these crew members provided this information during an interview conducted by telephone on 8 May 2007. In the light of other, later, indications that *Pam Burrridge* had been seen before the collision, OTSI interviewed the crew member again, on 30 November 2007, during which time he repeated the statement attributed to the Helmsman. The other crew member was interviewed, separately, on the same day.

<sup>20</sup> This information was provided during an interview conducted on 4 May 2007 and OTSI considers the “young man” to have been the Helmsman.



speed.<sup>21</sup> NSW Maritime's *Boating Handbook* defines a safe speed as being "one at which the vessel can be stopped in time to avoid any danger which arises suddenly". The term is therefore a relative one because it requires a master or helmsman to take into account a range of variables such as visibility, navigation hazards, wind, waves, current, vessel manoeuvrability and the presence of other vessels.<sup>22</sup>

- 2.18 Both the Helmsman and the Master described the operating conditions on Sydney Harbour on the evening of 28 March 2007 as being clear and visibility as being good. However, the Master observed that the moon was on the Western side of the Harbour Bridge and that there was significant shadowing underneath and to the East of the Bridge. Notwithstanding, he did not consider that these conditions required him to exercise any additional level of caution at the time.
- 2.19 Navigation and Operating Rules. On his departure from Circular Quay, *Pam Burrridge's* Master was obliged by the *Code of Conduct for Vessels Operating in Sydney Cove* (hereafter referred to as the *Code*) to operate his vessel at a speed of below 8 knots until he was level with the 'limit line'<sup>23</sup>, an imaginary line between the Eastern and Western extremities of Dawes and Bennelong Points respectively. Thereafter, he was permitted to accelerate to whatever he considered to be a safe speed. However, after clearing the limit line, the Master was also bound under the 'North-South' Rule specified in the *Code* to continue to proceed on a Northerly course and not to commence to turn towards the Harbour Bridge until his vessel was "abeam" of, or in other words, level with, a red diamond symbol indicating the centre of the Bridge.
- 2.20 *Merinda's* Helmsman described travelling quite close to the shoreline as he exited Darling Harbour but then moving a little further out into the channel because of the backwash from the seawall, and increasing speed slightly as he did so. He estimated that he was approximately 60 metres from the

<sup>21</sup> NSW Maritime imposed a speed restriction in this area, on 1 August 2007, in response to a recommendation made by OTSI in its report into a collision between a ferry and a dinghy on 5 January 2007.

<sup>22</sup> These, and other variables, are identified in Rule 6 of the *Navigation (Collision) Regulations 1983 – Schedule 1*.

<sup>23</sup> This speed limit has been officially 'gazetted' in accordance with Section 13SA of the *NSW Maritime Services Act 1935*.

Southern shoreline as he passed under the Bridge<sup>24</sup>, heading for a point midway between the Opera House and Fort Denison.

- 2.21 *Pam Burridge's* Master said he first saw *Merinda* on his bow at a distance of approximately 20 metres and that his immediate reaction was to initiate a hard turn to Port and to throttle off. At a closing speed of approximately 25 knots<sup>25</sup>, or some 12.9 metres/second, the time from the Master's sighting of the *Merinda* to the moment of collision would have been approximately 1.6 seconds.
- 2.22 Had the Helmsman and the Master detected the presence of each other's vessel before the collision was imminent, the Helmsman would have been obliged to give way because *Pam Burridge* was on *Merinda's* Starboard side.<sup>26</sup> However, this 'right of way' is not absolute because those operating vessels are also required to be prepared to take whatever action is deemed necessary to avoid a collision.
- 2.23 Performance trials conducted on 24 July 2007 before the re-enactment of the accident, established that given the vessels' relative speeds, a sighting distance of 20 metres did not provide the Master with sufficient time to manoeuvre *Pam Burridge* in such a way that it would have completely avoided the collision with *Merinda*. Had the Helmsman seen *Pam Burridge* at the same time, he would also have had insufficient time to have avoided the ferry.
- 2.24 Vessel Tracks and Location of the Collision. Throughout the course of its investigation, OTSI identified four people who claimed to have witnessed the collision. They were: the Master of *Pam Burridge*; two of *Merinda's* passengers, seated in positions 3 and 4 as indicated in *Diagram 5* on page 55, and a witness ashore on the South-Eastern side of the Harbour Bridge. A further witness, also ashore on the South-Eastern side of the Harbour Bridge, heard the collision and saw its immediate aftermath.

<sup>24</sup> The Co-owner thought it was approximately 50 metres from the shore but as has been explained in Part 2, and for reasons that are presented later in this Report, *Merinda* was in fact considerably further from the Southern shoreline.

<sup>25</sup> This speed represents the vector sum of the approximate speeds of both vessels.

<sup>26</sup> This requirement is specified in Rule 15 of the *Navigation (Collision) Regulations 1983 – Schedule 1*.

- 2.25 When asked about his speed and course, the Master described operating *Pam Burridge* on a Northerly course at less than 8 knots until he reached the limit line, at which he commenced to apply full throttle, and shortly after, turning towards the Harbour Bridge. When asked whether he was relying on any navigation aids at this time, the Master indicated that he had his radar on but that it was of limited use at the time, because of interference caused by the Harbour Bridge. He also indicated that after turning, he headed for a navigation marker, the red diamond, at the centre of the Harbour Bridge. In response to questioning about where he commenced his Westward turn, relative to the Southern shore and the centre of the Harbour Bridge, the Master indicated that it was about “half-way”. As described by the Master, the course taken by the *Pam Burridge* out of Sydney Cove and towards the Harbour Bridge did not conform to all of the requirements of the ‘North-South’ Rule. This matter is addressed in greater detail on pages 50 - 52 and 60 - 61.
- 2.26 The witness seated in position 3 on the *Merinda*, as indicated in *Diagram 5*, advised that she was looking at the person in position 5 “when at the same instant I saw something green like a nose coming towards me through the windows”. This witness described what proved to be *Pam Burridge* passing behind the passenger seated in position 5 and in front of her, and indicated that she did not see any lights or hear a horn on/from the object that struck *Merinda*. However, she recalled the object seeming to veer away from her after it struck and then pass through *Merinda*. She further recalled water entering *Merinda* very quickly. Another witness, seated in position 4, stated that she had just finished a conversation with the witness in position 3, when she saw a pale grey shape “well out” from them through the door on the Starboard side. This door is depicted in *Photo 2* (on page 2), albeit in the closed position. She described this shape then becoming white and finally, when it was upon them, white and green. When asked what she meant by “well out”, the witness could not estimate the distance at which she first saw the vessel and described herself as only having time to turn her head to the right and take a breath in order to speak before the collision occurred, after which she was

immediately under the water. She further stated that she did not see any lights on what proved to be *Pam Burrridge*. When this witness was asked whether she had any sense of where the accident may have occurred, she indicated that once she surfaced and was clear of *Merinda* she remembered seeing the red diamond above her.

2.27 A security guard, positioned at ground level in the vicinity of the South-Eastern pylon of the Harbour Bridge at the time of the accident, was interviewed by OTSI<sup>27</sup> and in the process he provided a copy of a statement he made, as recorded by the Police, on 6 April 2007. The key pieces of information contained in this statement were that:

- a. he had observed both vessels for about a minute before the accident and that he both saw and heard the collision;
- b. *Merinda* appeared as a “small white boat” which he first saw about “four metres off the centre of the Bridge on the eastern side”;
- c. *Merinda* appeared to be stationary<sup>28</sup> and the only light he saw on the vessel was a small red light, “which was not very bright”, on the “top of the boat”;
- d. *Pam Burrridge* appeared as being a “white and green rivercat” which was travelling “very fast, faster than normal” from the South-East;
- e. *Pam Burrridge*, which had a blinking orange “hazard light” on, did not appear to slow down or change course immediately prior to the collision;
- f. *Merinda* started to sink very quickly after it was hit and rolled to one side as it did so;
- g. *Pam Burrridge* slowed down “about two seconds” after the crash and returned to the scene of the accident; and
- h. he estimated the accident happened about “100 metres away”.

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<sup>27</sup> This interview occurred on 12 December 2007.

<sup>28</sup> When interviewed by OTSI, this witness stated that he was now uncertain about whether *Merinda* was stationary or moving slowly.

- 2.28 When shown a chart which included the area of the Harbour Bridge, and asked if he could provide an indication of *Pam Burrridge's* course, and in particular where it might have turned towards the Bridge, the Security Guard had difficulty in doing so. Asked whether *Pam Burrridge* might have turned sharply and close to the Southern shoreline or made a gradual turn further out, the Guard indicated without hesitation that *Pam Burrridge* did not make a sharp turn close to the shoreline.
- 2.29 The additional witness who was ashore, described hearing the collision and then seeing a vessel sinking at a point which was East of the Harbour Bridge and in her estimation approximately 200 metres from where she was standing at the railing of the Dawes Point footpath.
- 2.30 In the absence of data loggers and CCTV onboard *Pam Burrridge* and *Merinda*, OTSI examined CCTV footage and radar records in great detail. These records were useful in determining the location of the accident but did not allow the exact course and speed of each vessel to be determined.
- 2.31 CCTV images taken from cameras No.3 and No.4 at Circular Quay do not show any clear images of *Merinda*, but do show *Pam Burrridge's* movement into and out from Sydney Cove and its turn towards the Harbour Bridge. However, because of the position of these cameras and the resolution of the related footage, these images are not sufficiently clear to be used to determine, with any precision, the speed of the *Pam Burrridge*, either within or beyond Sydney Cove; the point at which it changed from a Northerly to a Westerly heading, or the location of the collision.<sup>29</sup> What can be discerned with decreasing levels of clarity is:
- a. *Pam Burrridge* departing No. 5 West Wharf at 10:47:40pm and heading in a Northerly direction, with its navigation lights exhibited ;
  - b. *Pam Burrridge* commencing to turn towards the Bridge at 10:49:19<sup>30</sup>;

<sup>29</sup> These images were recorded from cameras that were essentially behind *Pam Burrridge* as it headed out of Sydney Cove. At the point at which *Pam Burrridge* crossed the limit line, it was approximately 600 metres away from these cameras. In the absence of cameras focused into the Cove from along its Eastern and Western boundaries, for example, in the vicinity of the Opera House and the International Passenger Terminal, there was no means of accurately determining the time at which *Pam Burrridge* passed specific points, and therefore of confirming its speed.

<sup>30</sup> The related images were not sufficiently distinct in the CCTV footage to be converted into clear still pictures that could be reproduced in this report.

- c. a shadow, first apparent at 10:49:44pm, moving in an Easterly direction then merging with *Pam Burrridge* at 10:49:46pm, which OTSI considers to be the movement of *Merinda*, and subsequently the collision<sup>31</sup>;
- d. a number of flashes of light around the time and location of the accident, which OTSI does not consider to be associated with the collision;<sup>32</sup> and
- e. *Pam Burrridge* ceasing to move in a Westerly direction and commencing to move in an Easterly direction at 10:50:19pm, consistent with its return to the scene of the accident.

2.32 Footage taken from a CCTV camera at Dawes Point moments before the collision shows *Merinda* immediately East of the Bridge but does not show *Pam Burrridge*. Nor does this camera capture the moment of the collision. However, footage from an RTA camera on the Harbour Bridge does show the wreckage of *Merinda*, other vessels coming to its assistance and the subsequent rescue and recovery effort.

2.33 All of the radar tracks recorded by Harbour Control leading up to the time of the accident were reviewed. They revealed that:

- a. *Merinda's* movements were not captured on radar;
- b. *Pam Burrridge's* movement from No. 5 Wharf and the subsequent collision were not captured on radar, and
- c. the rescue and recovery effort was centred on the Eastern side of the Harbour Bridge and to the South of its centre.

2.34 The radar records that were examined showed a vessel approaching the Harbour Bridge from a considerable distance to the West at 25.4 knots at approximately 10:45pm. Because the Bridge effectively acts as a radar shield, this track disappears when the vessel passes under the Bridge, but reappears for a short distance after the vessel emerges on the Eastern

<sup>31</sup> The related images were not sufficiently distinct in the CCTV footage to be converted into an image that could be reproduced in this report.

<sup>32</sup> OTSI is uncertain as to the source of these light flashes. There was no explosion or fire as a result of the collision and they precede the collision. It is likely that the lights emanated from a source in the Milsons Point/North Sydney/Kirribilli area.

side of the Bridge and begins to move into Sydney Cove. The radar track ceases shortly thereafter because Harbour Control's radars do not provide coverage into Sydney Cove. The timings, speed and track recorded by the radar establish that this vessel was most likely to have been *Pam Burrridge* on what was its final run into Circular Quay to drop off its cashier.

- 2.35 Although there is no radar coverage of *Pam Burrridge's* departure from Circular Quay, there are a series of recorded tracks that coincide in time with the convergence of vessels towards the wreckage of *Merinda*. This provided further confirmation of the location of the accident as previously described.
- 2.36 OTSI considered the possibility that the location where the response effort was focused, and which was able to be fixed by radar, might have been some distance from the scene of the collision. A number of propositions to this effect were put to OTSI by some of the Directly Involved Parties, with Sydney Ferries contending that the accident occurred closer to the Bridge and further North and some of the parties on *Merinda* contending that the accident occurred closer to the Southern shoreline than the location determined by OTSI. Either of these propositions would have required that *Merinda* shifted position significantly after the collision, by virtue of the current; its own momentum; the force of the collision; its engine, until such time as it ceased to function; or because it was entangled with and dragged by *Pam Burrridge*. OTSI discounted these possibilities because:
- a. The first response vessel was alongside *Merinda* in less than a minute and the state of the tide and the vessel's largely submerged state make it improbable that the portion of the vessel that remained intact would have drifted to such an extent in this short period of elapsed time.
  - b. *Pam Burrridge* passed over and through *Merinda*. *Merinda* would therefore have initially been pushed downwards. Statements by those onboard indicated that the ingress of water into that section of the vessel remaining intact was sudden. Given such a circumstance, *Merinda's* engine is likely to have been 'drowned' very quickly.

- c. There was nothing in the statements of those who were involved to indicate that *Merinda* became entangled or was dragged or displaced over a considerable distance.
- d. The security guard who witnessed the collision was asked whether he had observed *Merinda* continuing to move after the collision and advised that it did not and that the vessel sank very quickly.

2.37 **Illumination.** In NSW, all vessels over seven metres in length are required to exhibit navigation lights when operating between sunset and sunrise. Vessels that are less than seven metres in length and which are not capable of travelling at more than seven knots, may carry a single all-round white light in lieu. Vessels greater than 12 metres and less than 50 metres, as is *Pam Burridge*, must exhibit:

- a. a masthead light forward which is visible at 5 nautical miles;
- b. side lights (Red and Green on the Port and Starboard sides respectively) which are visible at two nautical miles,<sup>33</sup> and
- c. a stern light which is visible at two nautical miles.

2.38 Vessels less than 12 metres in length, as was *Merinda*, are required to exhibit:

- a. a masthead light forward which is visible at a distance of 2 nautical miles;
- b. side lights (Red and Green on the Port and Starboard sides respectively) which are visible at 1 nautical mile;
- c. a stern light which is visible at 2 nautical miles, or
- d. alternatively, an all-round white light which is visible at 2 nautical miles, and side lights.

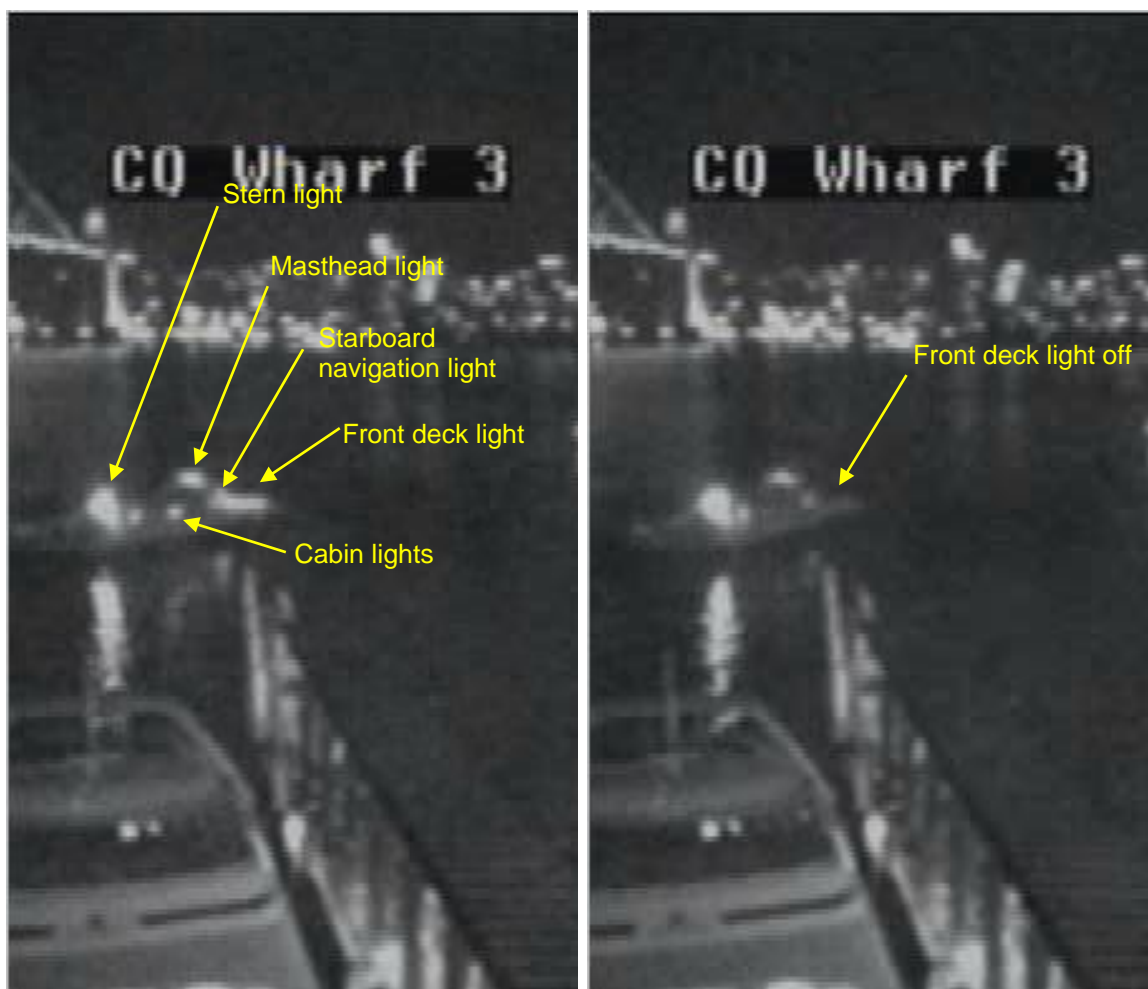
2.39 The CCTV footage of *Pam Burridge* departing No. 5 West Wharf at Circular Quay shows its deck lights being turned off, and the masthead light, side navigation lights, an all-round flashing light and a stern light to be illuminated. It also shows the vessel's passenger cabin lights to be

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<sup>33</sup> These distances are expressed in nautical miles to be consistent with internationally agreed standards.



illuminated and, in accordance with prescribed operating instructions, the overhead lighting in the wheelhouse to be extinguished.<sup>34</sup> Photos 6 and 7, below, were obtained from this footage. These lights, less the Starboard navigation light which could not be seen, were also apparent when the vessel returned to the scene of the collision.



**Photo 6: *PB* departing from Circular Quay**

**Photo 7: *PB* departing from Circular Quay**

2.40 The witness who heard the collision while at Dawes Point indicated that she saw *Pam Burrridge* moving past Dawes Point “quite fast” and that it was well illuminated. As indicated previously, this witness described hearing a loud noise and then looking out into the Harbour where she saw a small vessel in the process of sinking, with some people in the water and others clinging to the front of the vessel which remained above the water.

<sup>34</sup> The Vessel Operating Manual (VOM) requires overhead lighting in the wheelhouse to be extinguished during night operations in order to prevent the reflection of internal light onto the windscreen.

This witness further recalled the small vessel as initially having a light on inside and the light then being extinguished as the vessel sank further. The witness was quite certain about this latter matter and described the illumination from the interior light as being 'diffused' or similar to that which might be seen if a light bulb was viewed through a sheet. However she was uncertain whether there were any other lights illuminated on the sinking vessel.

- 2.41 When questioned specifically about *Merinda's* lights, the security guard stated that the only light he could recall seeing was a small red light on top of the vessel, which he thought might have been on some form of "stick or pole". OTSI is uncertain as to what this light might have been, or indeed whether *Merinda* was the source of the light, but given the orientation of the vessel relative to the guard, it could not have been the Port navigation light.
- 2.42 Crew members from the *Golden Grove* and *Fishburn* recalled seeing *Pam Burridge* well illuminated as they approached the scene of the accident. They did not recall seeing any of *Merinda's* lights but emphasised that they were unable to see the *Merinda*, or what was left of it, at all, until they closed on the scene.
- 2.43 A passenger onboard the *Fishburn* advised that he did not "register" whether any lighting was apparent on the *Merinda* as his ferry approached the scene of the accident and explained that in the circumstances of a sinking vessel and casualties in the water, the state of the vessel's illumination was not a consideration for him.
- 2.44 Another passenger onboard the *Golden Grove* recalled that "the ferry's lights were on" but that "there were no lights on what was left of the other vessel (*Merinda*)".
- 2.45 In his written statement, *Merinda's* Helmsman described turning on his cabin and navigation lights at Drummoyne and doing so again before departing Cockle Bay and, having done so, physically checking the navigation lights on both occasions. In his written statement, the Co-owner stated that he:

- a. witnessed the Helmsman checking the navigation lights at Drummoyne;
- b. noticed the navigation lights were on as he untied the berthing lines at Drummoyne;
- c. turned the navigation lights off after *Merinda* berthed at Cockle Bay, and
- d. again noticed the navigation lights were on while he released the berthing lines immediately prior to *Merinda*'s departure from Cockle Bay.

2.46 CCTV footage shows *Merinda* entering and exiting Darling Harbour and later East of the Harbour Bridge prior to the collision. It showed the *Merinda*:

- a. passing underneath the Pyrmont Bridge, en route to Cockle Bay at 8:18pm, with its main saloon, mast, stern and Starboard navigation lighting illuminated (*Photo 8* on page 28);<sup>35</sup>
- b. passing underneath the Pyrmont Bridge, after exiting Cockle Bay, with its main saloon light illuminated but with its mast, stern and Port navigation lights extinguished (*Photo 9* on page 28), and
- c. immediately East of the Harbour Bridge moments before the collision (*Photo 10* consisting of four frames, on page 29 ).

2.47 It is important to note when viewing *Photos 8-10*, and any others taken at night appearing in this report, that camera lenses are less capable than the human eye in discerning and capturing images. That said, the four frames in *Photo 10* do illustrate the extent to which visibility of *Merinda* in the area immediately East of the Harbour Bridge, as viewed from the South, could change in a very short period of time.

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<sup>35</sup> *Photo 8* shows the *Merinda*'s saloon, mast and Starboard side lights illuminated. The CCTV footage from which *Photo 8* was taken also shows the stern light illuminated.



**Photo 8:** *Merinda* passing Sydney Aquarium en route to Cockle Bay.



**Photo 9:** *Merinda*, after departing Cockle Bay, in Walsh Bay en route to Woolloomooloo



**Photo 10: Set of four frames indicating *Merinda* (circled) immediately East of the Bridge moments before the collision**

- 2.48 When *Merinda's* controls and instrumentation were examined on the morning of 29 March 2007, it was found that a pull-out switch labelled 'RUNNING' was in the 'ON' position and a like switch labelled 'ANCHOR' was in the 'OFF' position (see *Photo 5* on page 12 ). It was also noted that a circuit breaker labelled 'NAV. LT.' was both physically and electrically in the 'OFF' position. If this was the case before the collision, it would explain why *Merinda's* navigation lights were shown not to be illuminated on the CCTV footage taken of the vessel after it departed Cockle Bay.
- 2.49 There are three possible reasons why this circuit breaker might have been in the 'OFF' position before the collision:
- a. that it was used as the means to switch the navigation lights off when *Merinda* arrived at Cockle Bay but was not returned to the 'ON' position when the vessel departed;

- b. that the navigation lights were switched on as *Merinda* departed Cockle Bay but that the related circuit breaker switch was inadvertently switched to 'OFF', perhaps in lieu of the blower switch, shortly thereafter, or
  - c. that the navigation lights were switched on, but that there was some form of electrical malfunction that caused the circuit breaker to 'trip' in the short period of time between the vessel's departure from Cockle Bay and passing under the Pyrmont Bridge.
- 2.50 The Helmsman is adamant that he both switched the navigation lights on and checked that they were working before he departed Cockle Bay. In a written statement, the Co-owner asserts that he observed the Helmsman carry out the actions as described.
- 2.51 Another explanation for the 'OFF' position of the 'NAV. LT.' circuit breaker is that it might have been tripped as a result of the collision. The light bulb filaments from *Merinda*'s navigation lights were examined the day after the collision, but none of the typical indicators that would suggest the globes had been 'lit' at the time of the collision, such as filament distortion or broken bulb glass melted to a filament, were present. All of the filaments on these lights were intact. An examination of the cabling leading to each light also showed that the related electrical circuit was complete.
- 2.52 The three main saloon interior light globes were also examined. The filaments in two of the globes were broken and there were indications of filament balling and arcing at the terminal posts consistent with the breakages occurring while the globes were lit, i.e., these globes failed as the result of an impact.
- 2.53 In view of the extent of damage to wiring throughout *Merinda*'s frame and engine room, and the fact that there were no other circuit breaker switches in the 'OFF' position, the condition of the 'NAV. LT.' circuit breaker in the 'OFF' position is a matter of particular significance, and is indicative of either electrical malfunction or human intervention, rather than interruption as a consequence of the collision.

- 2.54 Several days after the collision, unattributed reports in the media suggested that, prior to the collision, another vessel operator had advised Harbour Control that he had sighted a vessel in the vicinity of the Harbour Bridge that was not exhibiting its navigation lights. The reports implied that this message had not been passed on to Sydney Ferries and/or that Sydney Ferries had not responded in some way to this warning.
- 2.55 Harbour Control's voice tapes and duty logs and Sydney Ferries' duty logs were examined and there was no record of a report of a vessel operating without its navigation lights being illuminated on the night prior to the collision. However, at 10:52pm, i.e., two minutes after the collision, such a message was recorded on Harbour Control's voice logs. This call was initiated by a charter boat operator. This operator was subsequently interviewed by OTSI<sup>36</sup> and he stated that he had been operating his vessel approximately 200 metres West of the Bridge on the Southern side of the channel, en route to Balmain at some time after 10:30pm<sup>37</sup> when he noticed a "clipper style" launch about "30 feet" in length on his Port side. He described the vessel as having its cabin lighting, but not its navigation lights, illuminated. The charter boat operator described the launch as heading North-East towards the Harbour Bridge. He also advised that as he reached for his radio's microphone to advise Harbour Control of this occurrence, he became concerned about the presence of a fast-moving water taxi approaching him. Distracted by the need to take action to avoid the water taxi, and with the other vessel now well to his rear, the charter boat operator "lost sight" of his intention to report the "unlit" vessel to Harbour Control.
- 2.56 The charter boat operator first became aware of the collision when he heard a transmission between the Master of *Fishburn* and Harbour Control on his VHF radio. However, because this transmission contained references to a collision between a ferry and a "fishing trawler", he did not associate the "clipper style" launch he had seen without navigation lights with the collision.

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<sup>36</sup> This interview occurred on 10 April 2007.

<sup>37</sup> The charter boat operator indicated that he had disembarked passengers at the Hyatt Wharf at "approximately 10:30pm".

- 2.57 Thinking that the launch he had seen might still be in the area, the charter boat operator alerted Harbour Control to the presence of a vessel without navigation lights. This communication occurred after the collision and was intended to warn other vessels to avoid the possibility of yet another collision. Having subsequently seen photographs of *Merinda* in the press, the charter boat operator considers it was identical to the vessel that was the subject of his belated report to Harbour Control.
- 2.58 On the basis of the CCTV footage, evidence from the wreckage of the *Merinda* and the interview with the charter boat operator, it is conclusive that at the time of the collision, two of the *Merinda*'s internal cabin lights were illuminated but that its masthead and side navigation lights were not. The condition of the navigation lights is attributable to either:
- the use of the navigation lights' circuit breaker to switch off the vessel's external lights on arrival at Cockle Bay and it not being returned to the 'ON' position as *Merinda* departed Cockle Bay;
  - the navigation lights being inadvertently switched off between Cockle Bay and Pyrmont Bridge, or
  - the circuit breaker being 'tripped' somewhere between Cockle Bay and Pyrmont Bridge.

## Human Factors

- 2.59 The Helmsman and the Master both maintain they kept a proper look-out. In the absence of any independent means of corroboration, such as inwards-facing CCTV cameras on the vessels, OTSI must accept that both were engaged in the process of looking out as their vessels converged. In view of the fact that at the time of the collision *Merinda* was not correctly illuminated and that the Master of *Pam Burrridge* did not fully comply with the North-South Rule, OTSI examined those matters that might have affected the judgement and/or actions of the Master and the Helmsman.
- 2.60 **Master of Pam Burrridge.** When interviewed, the Master indicated that there was nothing distracting him as he departed Circular Quay; that he was unsure of whether there was music playing within the wheelhouse but



if there was, it would have been muted; that he had not made or been required to respond to any radio calls at the time, and he was not using his mobile phone.<sup>38</sup>

- 2.61 He stated that he had commenced work well rested and his day had been relatively uneventful. A check of the Master's roster over the preceding 17 days established that he had worked 12 days, four of which were on overtime. On six of those 12 days he had worked a normal 12 hour shift. The shortest of the other six shifts was seven and a half hours. At no stage did the Master work in excess of 12 hours or more than four consecutive days.
- 2.62 The Master advised that he did not have any domestic problems; did not have any health issues; was not taking any form of medication and that he enjoyed good health. A check of Sydney Ferries' records established that the Master had last been medically assessed, for work purposes, on 30 January 2006 and that there were no restrictions or qualifications arising from that assessment.<sup>39</sup>
- 2.63 When questioned about light emanating and reflecting from North of the Bridge, i.e., from Luna Park, the foreshore and North Sydney's buildings, and whether such light presented any special difficulties, the Master indicated that because he was aware of, and used to, the presence of different light patterns, he did not find that such lighting presented any particular difficulties. He observed that the area immediately under the Bridge could be extremely dark, depending on the phase and position of the moon and cloud cover, and that it was extremely dark under the Bridge on the night of the accident.
- 2.64 **Helmsman of *Merinda*.** In a written statement and at interview, the Helmsman indicated that he had operated *Merinda* on the Harbour on many occasions over a period of about five years, by both day and night, but always in the company of the Co-owner. He indicated that he had

<sup>38</sup> Police checks confirmed that the Master, Helmsman and the Co-owner did not make or receive calls prior to, at the time of, or immediately after the collision.

<sup>39</sup> The effect is that the Master is not required to undergo another medical assessment for work purposes until he is next required to revalidate his Master's Certificate of Competency which falls on 30 May 2011.

returned from overseas two days before the accident but had experienced plenty of rest during those two days. He also indicated that he was not troubled by any business or domestic issues. He described himself as being especially cautious on the day of the accident because he had not operated the vessel for a “few months”.

2.65 In examining reasons why the Helmsman might not have seen the *Pam Burridge*, consideration was given to whether he may have been blinded by the headlights of vehicles travelling North along Hickson Road in the vicinity of Dawes Point Reserve and Dawes Point Park. This possibility was discounted when CCTV footage showed that the only vehicular movement on Hickson Road at the time of the collision was in a Southerly direction.<sup>40</sup>

2.66 **Cognitive Demand.** The overall level of cognitive demand that was experienced by both the Helmsman and the Master immediately prior to the collision was examined. The Helmsman was operating a vessel, with which he was reasonably familiar, with 11 passengers who appeared to have been interacting in a subdued manner. He was proceeding at low speed and on a straight heading fixed on a point midway between the Opera House and Fort Denison. The lighting conditions ahead of the Helmsman would have been somewhat variable given the proximity of the Opera House and to his Starboard, Circular Quay. (see *Photos 11 and 13*<sup>41</sup>).

2.67 *Pam Burridge*’s Master was operating a larger vessel, with which he was completely familiar, from a position approximately two metres higher than that of the Helmsman and was alone in the wheelhouse as he did so. The Master was operating at, or about, *Pam Burridge*’s normal cruising speed and was also turning towards a fixed point on the Harbour Bridge. He would have been confronted by less even lighting conditions. *Photo 12* depicts lighting conditions that approximate to those that the Master would have experienced before the collision.

<sup>40</sup> CCTV footage shows that the flow of traffic was being dictated by a portable set of traffic lights close to Dawes Point and that there was no North facing/moving vehicular traffic immediately prior to the collision.

<sup>41</sup> *Photo 11* was taken from Dawes Point and the perspective is therefore slightly different to that which would have been seen by the Helmsman. The bright horizontal yellow line in front of the Opera House is emanating from a passing ferry. *Photo 12* was also taken from Dawes Point, so it too provides an approximation only. Nonetheless, the two photographs do illustrate that the lighting to the North was less even than that to the East.



**Photo 11: Lighting conditions looking Eastwards**



**Photo 12: Lighting conditions looking Northwards and showing the Red Diamond on the Harbour Bridge**

- 2.68 Considering that the *Pam Burridge* departed No. 5 West Wharf within seconds of having entered it, it is possible that the Master's vision may not have adjusted fully to the difference between the bright view that confronted him at the Wharf and the relative darkness that prevailed as he departed Sydney Cove.<sup>42</sup> The relative brightness of Circular Quay is shown in *Photo 13*, although it is important to note that the large vessel which can be seen in the right of this photograph was not berthed at Circular Quay when *Pam Burridge* came into Circular Quay to drop-off the Cashier.



**Photo 13: View of Circular Quay, looking Southwards**

- 2.69 In terms of the conditions in which he was operating, it would be possible to conclude that the Helmsman had a lower level of cognitive demand upon him than the Master, but such a conclusion does not take into account his relative lack of experience or the impact of the presence of the other passengers. It is also difficult to quantify the extent to which the Master's familiarity with what he was doing might have impacted on his decisions and actions. The only reasonable conclusion that could be arrived at in relation to the cognitive demands that the Helmsman and

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<sup>42</sup> CCTV footage taken on the night of the accident shows *Pam Burridge* coming alongside No. 5 West Wharf, the cashier stepping off the vessel and the ferry departing immediately thereafter, i.e., there was less elapsed time at the wharf than for a normal berthing.

Master experienced is that the factors that might have competed for their attention, as they transited under and towards the Bridge respectively, are likely to have been different in their significance and bearing on their decision-making actions.

## Re-enactment of Events Leading up to the Collision

- 2.70 In order to understand why the Master of *Pam Burridge* claims only to have seen *Merinda* at a distance of approximately 20 metres and why *Merinda's* Helmsman claims not to have seen *Pam Burridge* until after the collision, OTSI coordinated and conducted a re-enactment of events leading up to the collision. This re-enactment could not have occurred without the assistance of NSW Maritime, the Water Police, Sydney Ports and in particular Harbour Control, and was dependent upon the provision and operation of *Pam Burridge*, or its sister vessel, by Sydney Ferries and a privately owned Island Gypsy of the same vintage and design as *Merinda*.
- 2.71 In the lead up to the re-enactment, Sydney Ferries advised OTSI that its legal counsel would be onboard *Pam Burridge* during the re-enactment. OTSI indicated that this was acceptable to it but advised that similar access would have to be extended to those acting on behalf of those who had been onboard *Merinda* if such access was requested. This access was subsequently requested and agreed to by Sydney Ferries, but late on the afternoon of the re-enactment, indeed while the two vessels were in the final stages of preparation, it withdrew its approval. In the face of such late notice, there was little OTSI could do to have this decision reversed; it was not in a position to compel the Corporation to reverse its decision, nor could OTSI refuse to allow the Corporation's legal counsel onboard its own ferry. Given the number of agencies and the amount of coordination involved to that point, OTSI was not prepared to cancel the re-enactment. It is important to note that notwithstanding this late, and in OTSI's view regrettable, decision, there were no persons from either Sydney Ferries or the *Merinda* onboard the Island Gypsy throughout the re-enactment and that the only person connected with Sydney Ferries who was allowed

access to *Pam Burridge's* wheelhouse was the master who was operating the vessel and a designated liaison officer.<sup>43</sup>

2.72 The re-enactment was held on 24 July 2007 at approximately the same time of night, in the same location and under similar lunar and tidal conditions as prevailed on the night of 28 March 2007. Prior to the re-enactment, the *Island Gypsy* was retro-fitted with the navigation lights from *Merinda* and the acceleration, deceleration and turning characteristics of both vessels were also tested. The following results were significant:

- a. *Pam Burridge* was:
  - i. able to accelerate from 8 knots to 25 knots over a straight line distance of about 140 metres in a time of 22 seconds;
  - ii. able to decelerate from 23 knots to an emergency stop in 130 metres;
  - iii. while travelling at 23 knots, able to make a Starboard turn through 180° with a turning radius of 70 metres, and
  - iv. nine metres wide of its original course 30 metres into its Starboard turn.
- b. The *Island Gypsy* was able to decelerate from 5 knots to an emergency stop within 20 metres and turn 90° to the Starboard within the same distance.

2.73 The first phase of the re-enactment focused on *Merinda's* movement into and out of Walsh and Cockle Bays. As previously indicated in *Photo 9*, *Merinda's* masthead, stern and Port side lights were not illuminated as the vessel travelled within Walsh Bay towards the Harbour Bridge. *Photo 14*, which replicates *Photo 9*, and *Photo 15* provide a comparison between the appearance of *Merinda* and the *Island Gypsy* as they passed the same CCTV camera within Walsh Bay at approximately the same time on 28 March 2007 and 24 July 2007 respectively. The fact that the *Island*

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<sup>43</sup> OTSI had foreshadowed to both Sydney Ferries and the *Merinda* parties with whom it had contact, that they would not be permitted onboard the *Island Gypsy*. OTSI also indicated that *Pam Burridge's* wheelhouse would be 'out of bounds'. Sydney Ferries' legal counsel therefore observed the re-enactment from *Pam Burridge's* passenger deck area.



Gypsy's Port side navigation light appears white, as opposed to its actual red, in *Photo 15* is a consequence of the limitations of the CCTV recording, the relative angle of the vessel to that of the camera when the image was captured and the preponderance of other light sources in the immediate vicinity. The significant issue is that *Merinda's* navigation lights are clearly not exhibited.



**Photo 14: *Merinda* departing Walsh Bay, 28 March 2007**

**Photo 15: *Island Gypsy* departing Walsh Bay, 24 July 2007**

- 2.74 The second phase of the re-enactment involved the *Island Gypsy* and *Pam Burridge* in a series of scenarios in the vicinity of the Harbour Bridge. In each serial, *Pam Burridge* was operated in a Northerly direction out of Wharf No. 5, at both 8 and 15 knots before it crossed the limit line, after which full throttle was applied. Its master was then instructed to turn Westwards, towards the Bridge, when he was either abeam of the red diamond or at an earlier point approximate to that where the Master indicated he had commenced his turn. Initially, the *Island Gypsy* remained in a holding position in the vicinity of the Harbour Bridge but it was subsequently operated in an Easterly direction at the same time as *Pam*

*Burridge* was underway. Two of the *Island Gypsy's* cabin lights were illuminated throughout these serials, but its navigation lights varied between being illuminated and extinguished. During the final stages of what had to be a carefully controlled series of manoeuvres, *Pam Burridge* and the *Island Gypsy* were brought in very close proximity at a point and under the conditions at/in which OTSI believes the collision to have occurred.

2.75 The re-enactment and the testing before it, established that:

- a. *Pam Burridge's* navigation lights, and particularly its overhead flashing light, are readily discernable, as is its superstructure which measures approximately 17 metres in length, when the vessel is illuminated at night. However, the vessel's hull is not readily visible which means that approximately the front third of the vessel is hard to discern unless there is some form of additional illumination.



**Photo 16:** *Pam Burridge's* wheelhouse, showing supporting pillars

- b. *Pam Burridge's* wheelhouse elevates the Master's eye height approximately 4 metres above water level. This, in conjunction with the placement of the supporting pillars (see *Photo 16*) provides a



good field of view, albeit one which provides a ‘top-down’ perspective of smaller vessels.

- c. When the overhead lighting is extinguished in the wheelhouse, as it was on the night of the accident, *Pam Burrridge*’s controls are readily apparent and there is no reflected light from the vessel’s instrumentation, radar or any other source of onboard illumination to distract a master.
- d. The *Island Gypsy*’s navigation lights, which were retro-fitted after having been removed from *Merinda*, were visible from *Pam Burrridge* when illuminated, as can be seen in part in *Photo 17*.<sup>44</sup> These lights were even more apparent when the *Island Gypsy* was moving because they contrasted more clearly with the stationary lights on the Northern side of the Harbour’s foreshore.



**Photo 17: Island Gypsy’s Starboard and mast lights as seen from *Pam Burrridge***

- e. With two of the three main saloon lights on the *Island Gypsy* illuminated, there was sufficient illumination for those in the cabin to read and write.
- f. Once the *Island Gypsy*’s navigation lights were extinguished, and even with the benefit of knowing the vessel’s approximate location,

<sup>44</sup> The Port and stern lights cannot be seen because of the vessel’s orientation.

the illumination from the two saloon lights was insufficient to make the vessel apparent from the wheelhouse of *Pam Burridge* at other than very close range (see *Photo 18*).



**Photo 18: Island Gypsy, with navigation lights extinguished, as viewed from *Pam Burridge***

- g. With the forward-most of its main saloon lighting extinguished, as was the case with *Merinda* at the time of the accident, the Island Gypsy's controls are readily apparent to a helmsman operating from the driving station within the saloon and there is no source of light from elsewhere on the vessel to affect or distract his/her views ahead, or to the Port and Starboard. The illumination provided by the two rear saloon lights might impact on a helmsman's view astern.
- h. *Pam Burridge's* 17 metre long superstructure and its navigation lights were clearly visible to the Island Gypsy's helmsman from the fly-bridge, but significantly less so from within the saloon.
- i. Vision within the Island Gypsy's saloon, which was identical in design to *Merinda's*, is significantly affected by the position and dimension of the cabin's supporting pillars which are depicted in *Photos 19 and 20*.

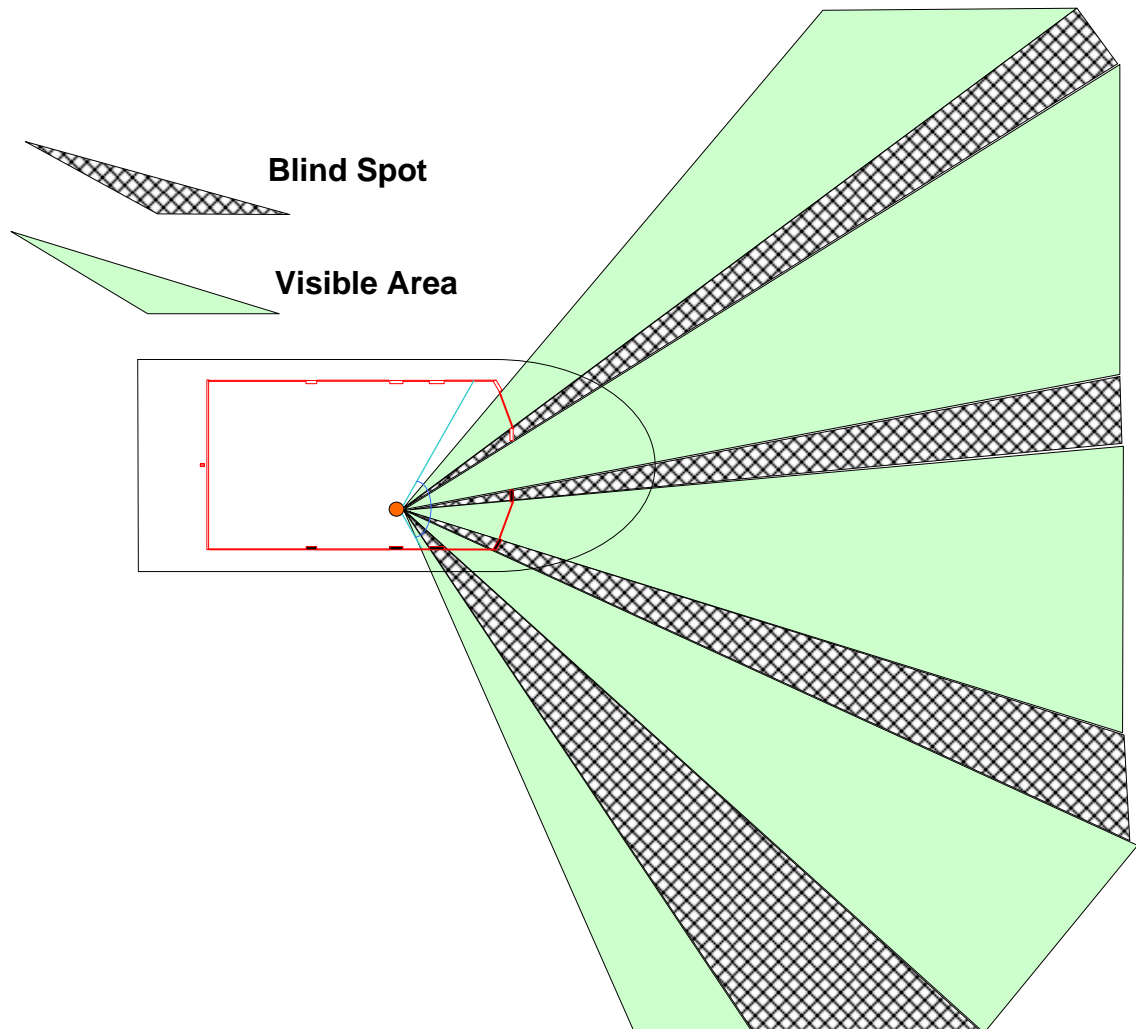


**Photo 19: Forward view from the saloon of the Island Gypsy**



**Photo 20: Front view of the Island Gypsy showing the width and position of the supporting pillars and the relatively small side window**

2.76 *Diagram 3*, a scaled representation which takes into account the height of the Helmsman and the position from which he was controlling *Merinda*, illustrates the extent to which the main saloon's design can restrict visibility if a helmsman remains in a relatively static position.



**Diagram 3: Indication of the effect of the Island Gypsy pillar design on visibility**

2.77 The eight frames in *Photo 21*, appearing on page 45, were obtained from video footage taken during the re-enactment. The frames depict a period of *Pam Burrridge's* movement out of Circular Quay as filmed from within the saloon of the *Island Gypsy* from the same driving position as the Helmsman would have operated on *Merinda*. The consecutive frames are separated by approximately two seconds in time and the significance of each frame, as viewed from left to right and top to bottom, is described on page 46 following the *Photos*:



**Photo 21: Series of eight frames showing *Pam Burrige* moving out of Sydney Cove, as viewed from within the *Island Gypsy*'s saloon**

- a. in frames 1 and 2, *Pam Burrridge*'s mast head light, cabin lights and Port navigation light (indicated by the yellow arrow) are visible;
- b. in frame 3, *Pam Burrridge* is disappearing from view behind the cabin pillar on the left;
- c. in frame 4, *Pam Burrridge* has disappeared from view;
- d. in frames 5-7, *Pam Burrridge* commences to re-appear and its masthead light, cabin lights and Port navigation light are visible, and
- e. in frame 8, *Pam Burrridge*'s masthead light, cabin lights and Port navigation light are visible, as is the vessel's bow.

## Conclusions Drawn from the Performance Trials and Re-enactment

2.78 Before presenting its conclusions, OTSI believes it is important to emphasise that the re-enactment was not intended, for obvious reasons, to be an exact replication of the collision. While every effort was made to make the activity as authentic as possible, the following accommodations had to be made:

- a. The *Island Gypsy* was operated from the driving station on the fly-bridge at the insistence of its owner because he felt that it was safer to operate the vessel at night from this position. OTSI shared his view. In addition, the driving station area in the main saloon was too small to accommodate a helmsman, two investigators and photographer with tripod-mounted equipment. Operating from the fly-bridge also allowed the camera to be positioned in the same location as *Merinda*'s Helmsman, rather than trying to film around or over a helmsman.
- b. The *Island Gypsy*'s white hull was lighter than *Merinda*'s which was off-white.
- c. The *Island Gypsy* was fitted with larger navigation lights than the *Merinda*; hence OTSI's decision to retro-fit *Merinda*'s navigation lights to it. In re-rigging *Merinda*'s navigation lights to the *Island Gypsy*, every effort was made to ensure the integrity of the



associated wiring and circuits. New globes of the same voltage and power rating were fitted to the original holders and, after being connected to a new wiring loom, the original lenses and covers were re-fitted to the lights. The wiring loom to connect the lights was constructed of new 15amp rated automotive cable. Every connection in the loom was soldered to prevent voltage drop and insulated to prevent any short circuits. A toggle switch and fuse were incorporated into the circuit, protecting the Island Gypsy's electrical system and allowing its own navigation lights to be used in transit to and from the scene of the re-enactment. The loom was connected via heavy duty clamps straight to one of the Island Gypsy's 12v batteries which were operating at full voltage. Notwithstanding these efforts, OTSI had no way of establishing whether *Merinda's* batteries and wiring were in a like condition.

- d. *Merinda* and the Island Gypsy had three interior main saloon lights positioned identically and in both cases the rectangular light recesses were covered by semi-opaque acrylic diffusers. However, the three original bulb type fittings on the Island Gypsy had been replaced with three 12 volt, 8 watt miniature fluorescent tubes. OTSI gave consideration to retrofitting *Merinda's* three 12 volt, 25 watt GLS series light bulbs but only one of these remained intact after the collision and OTSI was unable to source like, or in-lieu, bulbs in the time the vessel was available to it.
- e. During its review of the CCTV footage of *Merinda* entering and exiting Cockle Bay, OTSI noted that there were only faint indications of light emanating from the main saloon. The limited extent to which the cabin lights cast external illumination was also noted by a witness who observed *Merinda* immediately after the collision. She described the lighting emanating from the cabin as being diffused. During Phase 1 of the re-enactment, at Cockle Bay, OTSI considered the lighting to be brighter than indicated in the CCTV footage taken of *Merinda* and that described by the witness at Dawes Point. A single sheet of white A4 paper was therefore taped

over the two rearmost of the cabin light fittings to soften the cabin lights and this remained in place for the remainder of this and the subsequent phase.<sup>45</sup> It is important to note, that even with the lighting softened, there was sufficient visibility within the cabin to read and write without difficulty.

- f. OTSI relied on information provided by the Helmsman and the Master in their statements, CCTV footage and radar recordings in relation to vessel tracks and speeds, in order to approximate the courses of both vessels.
- g. OTSI relied on high resolution cameras operated by members of the NSW Police Forensic Imaging Section to record the re-enactment, while recognising that such camera lenses are less capable than the human eye in discerning and capturing images. In *Pam Burrridge's* wheelhouse, because it was necessary for the operating master to be at the control station, it was not possible for the camera to be placed in exactly the same position as the Master on the night of 28 March 2007. Therefore, the cameraman had to operate from a position immediately left and slightly to the rear of the operating master. OTSI's Investigator in Charge (IIC) was able to position himself closer and, in essence, looked over the shoulder of the master, who was significantly shorter, for much of the re-enactment.

2.79 It is significant that the owner of the *Island Gypsy* elected to control his vessel from the fly-bridge during the re-enactment. He advised OTSI that he always operated his vessel from this position when he was on the Harbour at night because it provided a much better position from which to look out for other vessels. It is also significant that later models of the *Island Gypsy* have cabin pillars which provide for substantially improved visibility for a helmsman operating from the driving station within the main saloon.

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<sup>45</sup> The Helmsman indicated that he had extinguished the forward-most cabin light so that he could see his controls more readily and this is borne out in *Photo 14*.



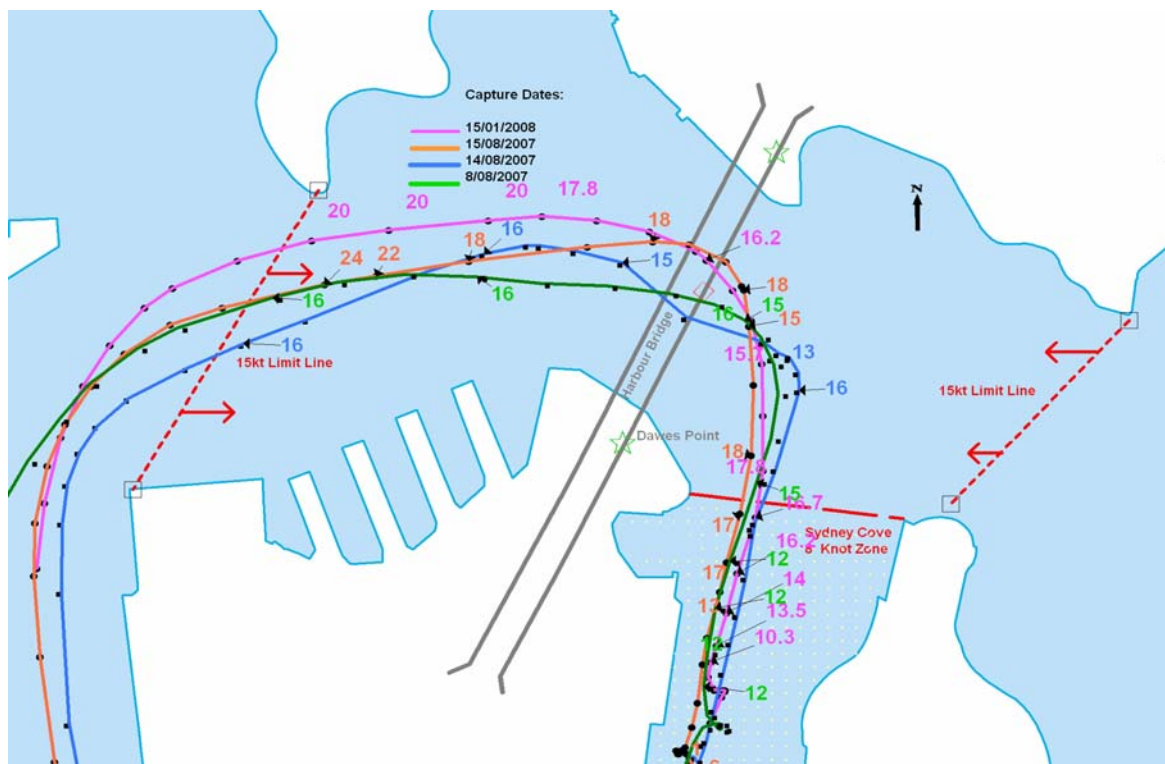
2.80 Notwithstanding the important ‘qualifications’ identified in paragraph 2.78, OTSI is satisfied that the following conclusions can be drawn from the re-enactment:

- a. It was not necessary for *Pam Burridge* to have been operated at above 8 knots within Sydney Cove for it to have reached a speed of 20-22 knots in the vicinity where the collision occurred.
- b. At a range of 20 metres, and given the speed at which the two vessels converged, the Master could not have avoided *Merinda*.
- c. Although *Pam Burridge*’s Master did not fully comply with the North-South Rule, the track taken by him did not amount to a ‘blind turn’ and his vessel should have been readily visible to a helmsman operating a vessel in an Easterly direction, in the vicinity of the Bridge, provided he/she maintained a proper look-out and enjoyed an unrestricted field of view from where they were operating.
- d. *Merinda*’s Helmsman did not enjoy an unrestricted field of view from within the saloon, but would have if he had operated the vessel from the fly -bridge.
- e. *Merinda* would have been readily visible from the wheelhouse of *Pam Burridge* if *Merinda*’s external navigation lighting had been illuminated. However, in the absence of those lights, the cabin lights alone are unlikely to have emitted sufficient external illumination to make the vessel readily apparent to *Pam Burridge*’s Master as the vessels converged.
- f. Lighting conditions on the Harbour in the vicinity of the Bridge are variable and change in a matter of metres, and particularly so for a vessel departing Sydney Cove and turning towards the Bridge, and could affect a master’s or a helmsman’s ability to see other vessels, lit or otherwise.
- g. There were different levels of cognitive demand on the *Merinda*’s Helmsman and *Pam Burridge*’s Master as their vessels approached each other on converging courses, and each set of respective demands could have detracted from their situational awareness.

## Compliance with the North-South Rule

- 2.81 During the re-enactment it became apparent to OTSI that at a HarbourCat's normal operating speed of 20-22 knots, it is quite difficult to turn when abeam of the red diamond unless a master is intent on passing well to the North of the marker, or he/she lengthens the turn by first swinging out to the North-East. This difficulty is obviated of course if a master slows down to make the turn. The master operating the HarbourCat during the re-enactment observed that a more normal approach, during other than peak periods, was to commence the turn before reaching the red diamond because this "smoothed" the turn. The master demonstrated such a manoeuvre and the turn was indeed smoother. However, it was also apparent that such a manoeuvre also reduces the safety margin that was intended when the North-South Rule was established.
- 2.82 In order to determine the extent to which the North-South Rule was being complied with, OTSI monitored 19 movements by Sydney Ferries' vessels, out of Sydney Cove and under the Bridge during the period 06:50am and 09:04am on 3 August 2007. Six of the movements saw ferries commencing to turn towards the Bridge on, or shortly after, crossing the limit line and passing to the South of the red diamond. Another seven movements also involved the commencement of a turn towards the Bridge shortly after crossing the limit line, but these ferries passed under the red diamond. Four ferries travelled from Circular Quay to Luna Park wharf in a direct line passing under the Bridge North of the red diamond. Only two ferries passed under the Bridge North of the red diamond on a Westwards track and one of these only because it was required to alter its course to pass to the rear of a large ship being assisted by tugs, i.e., only two of 15 Westbound ferries observed the North-South Rule.
- 2.83 Using a GPS, OTSI recorded three HarbourCat runs, at random, out of Circular Quay under the Harbour Bridge. The green trace in *Diagram 4* on page 51, was recorded on 8 August 2007 and indicates that the master operated his/her vessel in excess of the speed limit within Sydney Cove, conformed with the speed limit after crossing the limit line, turned slightly

earlier than before he/she should have and virtually passed underneath the red diamond. The blue track, recorded on 14 August 2007, shows that the master accelerated slightly before reaching the limit line, turned before his/her vessel was abeam of the red diamond and crossed to the South rather than the North of the channel, but otherwise operated at an appropriate speed. The red trace, recorded on 15 August 2007, indicates that the master operated in excess of the speed limit virtually from the time he/she left Circular Quay and was travelling at twice the permissible speed as he/she approached the limit line, commenced to turn well before the red diamond, but did pass to the North of the channel.



**Diagram 4: HarbourCat tracks and speeds recorded on 8, 14 and 15 August 2007 and 15 January 2008**

2.84 OTSI repeated the above exercise on 15 January 2008. The purple track indicates that the master exceeded the 8 knot limit within the Cove and the 15 knot limit within the immediate vicinity of the Bridge and commenced to turn toward the Bridge before he was abeam of the red diamond. However

in this instance, the master did pass well to the North of the red diamond. These observations and those in paragraph 2.83 appear to confirm the advice offered by the master who operated *Pam Burridge* during the re-enactment, i.e., that the practice of 'smoothing' the turn may have become a standard, albeit noncompliant, practice. However, Sydney Ferries' masters are not alone in this regard as OTSI witnessed other operators on the same days also turning before they were abeam of the red diamond. These GPS recordings provide further evidence of the fact that some masters are not complying with speed restrictions within Sydney Cove and Walsh Bay.

## Anticipation and Management of Risk

- 2.85 **Helmsman's Decisions and Actions.** Two important factors in the anticipation and management of risk are knowledge and experience. The Helmsman indicated that he was aware that the area immediately East of the Bridge on the Southern side of the Harbour required additional caution, because of ferry and other commercial vessels coming into and out from Sydney Cove, and the Co-owner of *Merinda* described the Helmsman as being both competent and sensible in his operation of the vessel. OTSI asked a number of questions of the Helmsman to establish his level of familiarity with *Merinda's* controls, instrumentation and electrical system and he was able to readily identify the purpose of 11 of the 14 gauges and switches on the control panel. When asked to describe basic operating procedures onboard *Merinda*, the Helmsman did so without difficulty.
- 2.86 OTSI asked both the Helmsman and the Co-owner whether they were familiar with operating *Merinda* from the fly-bridge and they indicated that they were. When asked why they might operate from the saloon rather than the fly-bridge, the Helmsman indicated that while the fly-bridge provided a better field of view, it could be uncomfortable during wet or windy conditions. The Co-owner indicated that he preferred to operate from the fly-bridge when there was a lot of traffic because of the improved field of view. However, it was his opinion that it was more difficult to judge

distances and speed from the fly-bridge and for this reason he preferred to operate from within the cabin when there was less traffic.

- 2.87 When questioned about navigational matters, the Helmsman indicated that he had not heard of the Collision Regulations. However, he was able to provide logical responses when presented with a number of scenarios involving two vessels approaching on converging courses. In his written statement, the Helmsman stated that he thought vessels were restricted to a maximum operating speed of 4 knots inside Circular Quay.
- 2.88 On the basis of the responses provided during two interviews and his written statement, OTSI formed the view the Helmsman was sufficiently familiar with *Merinda* to operate the vessel and that he was not unaware of basic navigational requirements. However, on the basis of his decision to operate *Merinda* at night from the saloon which restricted his field of view, rather than the fly-bridge which did not, OTSI considers that the Helmsman might not have fully comprehended the risks associated with operating *Merinda* where, and how, he did on the evening of 28 March 2007.
- 2.89 **Master's Decisions and Actions.** The Master did not lack knowledge or experience and was aware that other vessels can be hard to detect in the area of the Bridge because of shadowing and uneven lighting. He was also aware of the fact that the Bridge effectively 'masks' other radar signatures that might otherwise appear on his vessel's radar monitor. Further, the Master would have known of the all too frequent occurrence of vessels operating within Port Jackson with poor or no illumination. Finally, the Master was aware of the North-South Rule and his description of the point at which he commenced to turn towards the Bridge indicates that he did not fully comply with it. Accordingly, OTSI considers that in operating *Pam Burrridge* at the speed he did, where and when he did, the Master did not fully anticipate, and therefore did not properly manage, risks that were known to him. When confronted with the almost certain prospect of a collision, the Master's immediate and instinctive reaction was to turn to Port, which was away from *Merinda*'s path. However, the proximity of the vessels when the Master saw the *Merinda* was such that contact between the vessels could not be avoided.

- 2.90 **Regulator.** OTSI further considers that, for reasons that are elaborated under the heading of *Other Safety Matters* in this report, there is an inappropriate level of risk being assumed by NSW Maritime within the current regulations and requirements governing the operation of recreational vessels in NSW.

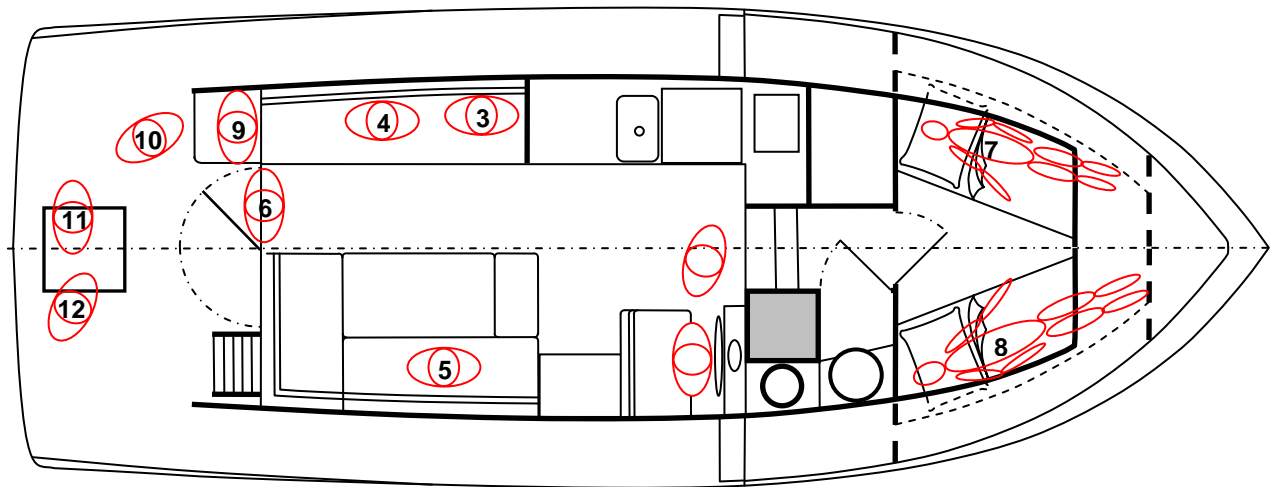
## Adequacy of the Emergency Response

- 2.91 Immediately after the collision, *Pam Burridge's* Master alerted Harbour Control to the accident and this call was monitored by the Masters of *Fishburn* and the *Golden Grove*, as well as the crew of Sydney Ports' response vessel. These vessels immediately commenced to move towards the accident scene. En route, the passengers aboard *Golden Grove* and *Fishburn* were advised that their vessels were being diverted and the reason for the diversion. The Master, although shaken, had sufficient presence of mind to exercise a high level of caution to ensure that he did not endanger those in the water as he manoeuvred *Pam Burridge* into a position where it could be of assistance to them.
- 2.92 One of the passengers onboard *Merinda*, who was below deck asleep (in position 8, as indicated in Diagram 5<sup>46</sup> on page 55) described being awoken by a loud thump, and thinking that the vessel had run aground. He was immediately aware that *Merinda* was starting to sink and recalled grabbing hold of a five year old passenger who was also asleep in the same area (in position 7) and then "floating out of a window". The Helmsman (in position 1) recalled pushing "two or three" elderly female passengers (believed to have been in positions 3 and 4) out of the cabin while the vessel was sinking. He then saw a person (who was believed to have been in position 6) floating face down in the cabin and swam to that person, to discover it was his mother. He freed his mother from the cabin and kept her afloat until he was assisted by another person he did not

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<sup>46</sup> This diagram was produced from another provided to OTSI by a solicitor representing a number of the survivors onboard *Merinda*.

recognise.<sup>47</sup> This person proved to be the GPH from *Fishburn*. Together, they assisted the unconscious woman onto *Pam Burridge* after which they re-entered the water. The Helmsman then discovered, in succession, a female and two males who were not conscious and assisted in their recovery (these persons were believed to have been in positions 10, 11 and 12). He also recalled returning to the wreckage of *Merinda* to try to unlock a cabin window, which he was unable to do, in an attempt to locate a missing 14 year old female (who had been in position 5).



**Diagram 5: Plan of *Merinda*'s deck and below, showing reported positions of passengers**

2.93 As the Helmsman attempted to assist the first unconscious person he came in contact with, he was joined by the GPH from *Fishburn*. The GPH recalled he and *Fishburn*'s Engineer donning life jackets before they entered the water to assist those in distress. Media reports indicated that a passenger on *Fishburn* may have done likewise, but OTSI was unable to confirm these reports. The GPH's first contact was with an elderly female who was clutching onto debris. He assisted her into a lifebuoy ring and placed this person onto her back before recovering her to *Pam Burridge*. He then re-entered the water and moved towards a male person, the Helmsman, who was assisting an unconscious female. The GPH and the Helmsman recovered the unconscious woman onto *Pam Burridge*. The

<sup>47</sup> The actions attributed to the Helmsman in paragraphs 2.92 and 2.93 are described in his written statement to both OTSI and the Water Police. The written statement was provided to OTSI by the Helmsman's legal counsel.

GPH again re-entered the water and came across another female passenger clinging to debris. At the same time, he noticed a body nearby, floating immediately below the surface of the water. The GPH pulled the body to the surface, whilst the Engineer assisted the female who was clinging to the debris. The GPH and the Engineer assisted their respective victims to the *Fishburn*. Having done so, the GPH commenced to deliver CPR to the unconscious male. Unfortunately, this person had a major head injury and could not be revived.

- 2.94 In the early stages of the emergency response, Sydney Ports' response vessel arrived, shortly after the *Fishburn*, and positioned itself to the North of what was left of *Merinda*. Lines were passed from the Sydney Ports' vessel to two of *Merinda*'s passengers who were standing on a submerged part of the vessel. The lines were used to secure *Merinda* to the Sydney Ports' vessel. The *Golden Grove* arrived while this was in progress and positioned itself to the South of *Pam Burridge* and secured both vessels to each other. In this way, *Pam Burridge*'s Master was relieved of the requirement to hold his vessel's position and was able to focus on the rescue effort. These were important and highly effective acts of seamanship.
- 2.95 In all, 11 of the 12 people who had been on *Merinda* were recovered from the water, although three (who were believed to have been in positions 10, 11 and 12) were deceased. Two of the eight people who were recovered alive had serious injuries that were very apparent; one had lost a foot and had head injuries and the other had both legs broken. A visiting couple from New Zealand, one of whom was a veterinarian and the other a veterinary nurse, responded to a call by the master of *Golden Grove* over the PA system asking passengers with medical experience to assist in the treatment of those being recovered. The couple were transferred to *Pam Burridge* where they treated four people. Their efforts to stem the bleeding of the female whose foot had been severed were particularly significant in the context of her subsequent survival.
- 2.96 The master of *Golden Grove* subsequently relocated his vessel, with *Pam Burridge* lashed to it, to Ives Wharf at Dawes Point where Ambulance and



Police officers were in attendance. Security Guards from the Sydney Harbour Bridge assisted in keeping onlookers at arms length while Ambulance officers determined which persons were in most urgent need of medical attention. While this process was underway, the Police commenced to collect basic information, such as the names and contact details of those involved. Those associated with the accident not requiring evacuation to a hospital, i.e., the crew and passengers from the three ferries, were subsequently transferred to Balmain where they were interviewed by the Police.

- 2.97 OTSI questioned all of the crew members from *Pam Burridge*, *Golden Grove* and *Fishburn* and a number of passengers on the latter two ferries about, amongst other things, the emergency response. It also questioned the Helmsman and three other survivors from *Merinda*,<sup>48</sup> persons aboard the Sydney Ports' and the Defence contractor's vessels and two Ambulance officers who attended to the survivors ashore at Dawes Point, in relation to the same matter. None of these persons were in any way critical of the emergency response. The majority of those interviewed alluded to the situation on the water as being confused because there was no quick way of establishing how many people were in the water and their condition. However, they also spoke in positive terms about the way in which those executing the rescue and recovery effort discharged their functions.
- 2.98 OTSI considers the rescue and recovery effort to have been highly effective. It notes that in the latter half of 2006, Sydney Ferries devoted additional attention to emergency drills and response and that there were clear indications of improved communication and coordination within Sydney Ferries in the aftermath of the collision. The seamanship of the three masters after the accident, and that of the master of Sydney Ports' response vessel, was also good. While the situation on the water was confused, the actions of those involved were not. Of particular significance

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<sup>48</sup> In addition, OTSI was provided with written statements by the Helmsman, Co-owner and another survivor. OTSI was not provided with any form of testimony by two of the adult-aged survivors, one of whom resides overseas and returned home after being released from hospital and another who suffered serious head injuries and has no recollection of the accident.

were the selfless actions of the uninjured, or relatively uninjured, passengers from *Merinda*, particularly the Helmsman, and the GPH and Engineer from *Fishburn* who without hesitation entered the water to assist those who, by virtue of their age or injuries, were unable to assist themselves.

## Other Safety Matters

- 2.99 In the weeks following this accident, it was perhaps inevitable that media commentary would draw comparisons between this accident and another involving a ferry and a dinghy near the Harbour Bridge, on 5 January 2007. While not all of this commentary was well-informed, it is a fact that both accidents involved a collision between a vessel operated by Sydney Ferries which was travelling near, or at, top speed and a recreational vessel, in the vicinity of the Harbour Bridge. However, neither of these accidents can be attributed to a single error or omission, or indeed the actions of a single party.
- 2.100 Contemporary accident theory contends that accidents are nearly always associated with a chain of events. In the 'chain', single events may be relatively insignificant but in combination, these events take on increased significance. This is sometimes referred to as the "Swiss Cheese" model of accident causation.<sup>49</sup> Contemporary accident theory also contends that limitations in individual or team actions are often underpinned by organisational or 'systemic' limitations which may have existed, and been exacerbated, over time. Such theory further contends that because humans are fallible, systems should be designed to incorporate defences which 'trap' or contain the consequences of error. OTSI believes that additional 'defences' are required on the water in NSW.
- 2.101 **Limitations in the 'Rules' – The Need for Speed Restrictions.** OTSI's investigation report into the collision between a ferry and a dinghy West of the Harbour Bridge on 5 January 2007, which was published after the accident involving *Pam Burrridge* and *Merinda* occurred, identified speed as

<sup>49</sup> This term and model was coined by James Reason in "Managing the Risks of Organisational Accidents" (Ashgate Publishing Limited, 1997)

a contributing factor. OTSI recommended, amongst other things, that NSW Maritime give consideration to the imposition of a maximum operating speed limit on the approaches to, and under, the Harbour Bridge. A speed limit of 15 knots, between Bennelong and Kirribilli Points to the East of the Bridge and Millers and Blues Points to the West, came into effect on 1 August 2007.

#### 2.102 **Limitations in the 'Rules' – The Need for Improved Knowledge.**

Operators of recreational vessels are not required to have any form of boating licence unless they operate a vessel, other than a personal water craft<sup>50</sup>, in excess of 10 knots. In the absence of a requirement for all persons operating a recreational vessel to pass a boating knowledge test, there can be no assurance that those operating recreational vessels understand the 'rules of the road'. While operating a vessel at reduced speed provides some form of safety margin, it does not guarantee that those doing so will be able to interpret navigation markers; that they will position their vessel properly in the absence of markers, or that they understand the rules governing 'right of way'. In the absence of such knowledge, there is also the reduced prospect of such operators comprehending the difficulties that their actions might present to others, and especially to the operators of commercial vessels. In good daylight conditions, the experience of the licensed operator and commonsense on the part of the unlicensed operator will generally be sufficient to avoid a collision. However, this margin is significantly reduced at night where it becomes much more difficult to judge distances and speed and to see other vessels. In such circumstances, matters such as the selection of an appropriate speed and route and the ability to interpret navigation markers and lights becomes highly significant to the safe operation of a vessel. For this reason, OTSI considers that it is not appropriate for any type of vessel, including rowing boats, kayaks, dragon boats, and dinghies (be they powered or otherwise) to be operated at night in NSW by a person who does not hold a boating license.

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<sup>50</sup> Such vessels, more commonly known as jet skis, can only be operated by persons holding a boating licence.

2.103 **Limitations in the 'Rules' – The Need for Revised Boating Licensing Requirements.**

In addition to requiring persons who wish to operate vessels by night to hold a boating licence, OTSI considers that there is an anomaly in the current regulations which requires that persons only need a boating licence if they are operating a vessel in excess of 10 knots, other than a jet ski, under power. As the regulation currently stands, a large recreational vessel capable of taking numerous passengers and/or of attaining high speeds can be operated by someone who does not have a boating licence, provided that person operates the vessel at below 10 knots. OTSI questions the wisdom of allowing any person who does not have a boating licence to operate a large vessel, even at low speeds, because such vessels are more difficult to manoeuvre and often have an array of controls and sophisticated instrumentation. It also questions the wisdom of allowing an unlicensed person to operate a vessel with a significant number of passengers onboard, even at low speeds. OTSI considers that this rule needs to be amended by requiring that vessels of a certain size and/or engine capacity only be operated, by night and day, by persons holding a boating licence.

2.104 OTSI notes that under current arrangements, a boating licence can be issued to anyone over the age of 16 after satisfactory completion of a boating knowledge test and attendance at a boating course. It is not mandatory for practical activities to be included in the boating course and applicants can watch a DVD in lieu of attending a course. OTSI considers that there should also be some form of practical boating test which might require, for instance, an applicant to demonstrate their ability to get their vessel underway, to bring their vessel alongside a berth or onto a mooring, to anchor their vessel and to apply the basic 'rules of the road'.

2.105 **Limitations in the 'Rules' – The Need to Review the Code of Conduct for Vessels Operating in Sydney Cove.** As indicated in paragraph 2.82, the North-South Rule is either not fully understood or is deliberately not being complied with by some masters. NSW Maritime advised OTSI that the intention behind the rule was to get vessels coming out of Sydney Cove with the intention of travelling Westwards, to a point where they were

likely to be clear of vessels moving Eastwards, under and beyond the Harbour Bridge, before they commenced their turn. The commencement of a turn when abeam the red diamond was also intended to result in those vessels ending-up on the Northern side of the channel at the completion of their turn. However, the *Code* does not articulate these intentions; in light of recent events and current practices, OTSI considers that it would be more useful if it did. In addition, there is an anomaly within the *Code* which also needs to be addressed and that is that the limit line, as depicted on the last page of the *Code*, is not consistent with its position as defined within the accompanying Glossary and as gazetted within the *Maritime Services Act 1935*.

2.106 Limitations in Enforcement of the Rules. Three agencies share responsibility for ensuring those operating vessels on Sydney Harbour do so safely. The Harbour Master and his fellow officers in the Navigation Services Section within Sydney Ports ensure that commercial shipping enters and exits the Harbour under controlled arrangements; NSW Maritime's Boating Service Officers (BSOs) patrol the Harbour to monitor compliance with safety requirements on the water, to detect dangerous and/or irresponsible behaviour and to inspect moorings, and the Water Police are tasked to detect and prevent criminal offences/activities on the water.<sup>51</sup>

2.107 In its investigation report into the collision on 5 January 2007, OTSI intimated that it had reservations about the capacity available within NSW Maritime and the Water Police to respond to events on the Harbour outside normal working hours.<sup>52</sup> These reservations arose in the context of comments made by professional mariners about the number of instances of vessels being operated on the Harbour at night without proper lighting, or in some instances without any lighting, and the fact that those that do so are rarely apprehended. The concerns were reiterated during the course of OTSI's investigation into the collision involving *Pam BurrIDGE* and

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<sup>51</sup> The Water Police also have the authority to act to enforce compliance with boating regulations.

<sup>52</sup> This report, dated 18 June 2007, can be found at [www.otsi.nsw.gov.au](http://www.otsi.nsw.gov.au). OTSI's concerns are intimated in paragraphs 3.20 and 3.21

*Merinda*<sup>53</sup> and would appear to be legitimate given that Sydney Ferries was able to provide evidence of reports by its masters of 57 such occurrences in Port Jackson during the period 1 April – 31 October 2007. On closer examination, it became apparent that in 33 instances, notwithstanding that the vessels might have been difficult to see, the operators were not in breach of any boating regulation because their vessel's type was such that they were only required to exhibit a single white light in the event that they considered they were at risk. In OTSI's view, this highlights a fundamental weakness in the existing rules pertaining to the illumination of vessels between sunset and sunrise. OTSI was also concerned by the view, expressed to it on a number of occasions, that there was little point in reporting instances because the BSOs only work "9 to 5" and the "Water Police aren't interested in such matters".

2.108 OTSI reviewed Harbour Controls' records and established that it does respond to reports it receives of vessels operating without proper navigation lighting, or being totally unlit, by broadcasting a warning message on Channel 13<sup>54</sup> and immediately providing NSW Maritime and the Water Police with the related details by facsimile. However, NSW Maritime's BSOs operate at night by exception. While OTSI considers the assertion that the Water Police are not interested in such reports as unreasonable, it is reasonable to classify these matters as being of less significance than criminal matters. It is also reasonable to contend that such matters are seen as less significant in view of the Water Police's increasing commitment to security operations in recent times.

2.109 OTSI considers that NSW Maritime should have the primary responsibility for responding to reports of vessels operating without navigation lights. When OTSI questioned NSW Maritime about the view that it does not respond to such sightings, it was advised that where the offending vessel can be identified, it follows up such reports. It was also advised that when

<sup>53</sup> Such views were expressed by Sydney Ferries' masters, Harbour pilots and representatives of the AMOU.

<sup>54</sup> This VHF channel is used by Harbour Control to monitor, and where necessary direct, the movement of trading vessels into and out of Sydney Harbour and Port Botany. However, all commercial operators are required to monitor this channel and many recreational operators elect to do so because it provides them with the opportunity to monitor events on these waters.

vessels could not be identified specifically, unless there happens to be a BSO in close proximity to the sighting, responding was akin to trying to find a “needle in a haystack”. The relevance of this remark became more apparent when OTSI was advised that of the 55 BSOs deployed throughout NSW, only five operate in the area encompassing Port Jackson, i.e., Middle Harbour, Sydney Harbour and the Parramatta River.

2.110 NSW Maritime has divided Port Jackson into five patrol zones: the Eastern Suburbs (Zone A), Middle Harbour (Zone B), the Northern side of the Parramatta River (Zone C), the Southern side of the Parramatta River (Zone D) and from the Harbour Bridge to Middle Head (Zone E). A BSO is allotted to each of these zones. Under the terms of their employment, BSOs are required to work weekends and receive time off in-lieu of any overtime worked.

2.111 OTSI examined the BSOs’ rosters for a six month period and noted that typically, with leave, RDOs and time-in-lieu requirements taken into account, at least one of the BSOs would be off-line at any given time. Notwithstanding the fact that personnel from NSW Maritime’s Safety Education and Compliance Team<sup>55</sup> are often used to supplement the BSO roster, it was readily apparent to OTSI why it might be perceived that BSOs do not operate at night. However, a close examination of the BSO’s rosters revealed that they are underpinned by an ‘intelligent’ consideration of recreational boating activity. For instance, manning is increased on the weekends and leave is generally not granted to BSOs over the peak holiday seasons. Shifts are commenced later in the day during the summer periods, to allow for night operations, and there is increased staffing to cover major events, such as New Year’s Eve, the start of the Sydney to Hobart yacht race and Australia Day. The lack of BSO ‘presence’ on the water is therefore related to their limited numbers, rather than rostering.

2.112 OTSI appreciates that there is generally more activity on the Harbour by day than there is by night. However, OTSI contends that the risk of a

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<sup>55</sup> This small team’s primary purpose is to liaise with community and sporting groups throughout NSW for the purpose of promoting safe boating and in particular the safe use of jet skis.

serious accident at night does not decrease in direct proportion to the decreased volume of traffic at this time because other factors, such as reduced visibility and limitations in knowledge assume greater significance. OTSI also considers that the extent to which those operating vessels will be prepared to report transgressions on the water is influenced by their perception that such reports will be acted upon.

- 2.113 Throughout the course of its investigation, a number of professional mariners expressed the view that there was little point introducing new speed restrictions unless they were going to be enforced and, in the absence of increased enforcement activity, especially at night, it would only be a matter of time before there would be another tragedy on the Harbour. OTSI does not share this view of 'inevitability', but it does consider that an increased enforcement presence is needed to discourage unsafe acts. While OTSI appreciates that it is not possible for the BSOs to be omnipresent, it believes that this important service needs to be staffed to a level that ensures that there is a BSO on patrol in each zone by day and night.
- 2.114 Sydney Ports' Relocation Plan. Throughout the course of its investigation a number of commercial masters and harbour pilots expressed concerns about Sydney Ports' plans to relocate its Harbour Control staff to Port Botany at, or about, the end of the first quarter of 2009. The AMOU also expressed like concerns in a written submission to OTSI.
- 2.115 Presently Sydney Ports, through Harbour Control, monitors the movement of trading vessels<sup>56</sup> in and out of Port Botany 'remotely', i.e., it tracks vessels electronically, through radar and CCTV, and directs them from the Control Tower at Millers Point. While it also uses these same systems to track vessels in and out of Sydney Harbour, the Control Tower at Millers Point provides an excellent vantage point from which vessel movements can be visually observed over a part of the busiest area of the Harbour, i.e., that immediately West of the Bridge. Those who voiced concerns to OTSI about the impending relocation of Harbour Control indicated that they

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<sup>56</sup> Such vessels include tankers, cruise ships, bulk carriers and container vessels.



placed great importance on this additional 'layer' of defence because the AIS (Automatic Identification System) only captures the movements of vessels that are fitted with transponders, and radars rely on line of sight and have difficulty in detecting vessels that are made of fibre-glass, timber or plastic and/or that have low profiles. The AMOU considers that because the shipping channel in Port Botany is straight, it, the swinging basin and Brotherson Dock can be electronically monitored relatively easily. It contends, however, that the main channel on Sydney Harbour has between three and five ninety degree bends, depending upon which berth is being used,<sup>57</sup> and that a number of these bends are considered 'blind' in that a ship approaching the bends cannot see the channel on the other side. The AMOU believes that this, combined with the general irregularity of the shape of the Harbour and the number of recreational and commercial operators on it, means that monitoring traffic on Sydney Harbour solely by 'remote' will be a much more difficult proposition.

2.116 Sydney Ports' plan to relocate Harbour Control to Port Botany is a consequence of a decision by the NSW Government to redirect much of the current volume of commercial shipping entering Sydney Harbour to either Port Botany or Port Kembla<sup>58</sup>. Sydney Ports contends that because its core business is in facilitating the movement of trading vessels and because the numbers of such vessels that will enter Port Jackson is reducing significantly, it is appropriate that it relocates the bulk of its operations to Port Botany. It also contends that its responsibilities do not extend to monitoring the movement of other than trading vessels, but acknowledges that if a recreational or commercial vessel is in, or is creating, a hazardous situation and NSW Maritime or the Water Police are not in a situation to respond, it does deploy its own vessels to investigate the situation and, if need be, to move the vessel on. It also contends that it will be in no less a position to discharge its responsibilities vis-à-vis Sydney Harbour upon relocation, because it already monitors this area by

<sup>57</sup> Sydney Ports contests the propositions that Port Botany is a straight channel and that there are 3-5 ninety degree bends on the Harbour, depending on which berth is being used. It advises that there are two such bends; being Millers and Peacock Points, and that one of these will disappear when East Darling Harbour is redeveloped.

<sup>58</sup> Sydney Ports estimates that by October 2008, 80% of vessels visiting ports in Sydney will visit Port Botany and 20% will come into Sydney Harbour.

'remote', and has advised OTSI that upon relocation, it will still have vessels and personnel at Moores Wharf at the Western end of Walsh Bay to respond to events on the Harbour. Finally, Sydney Ports has also advised that it has commissioned an independently facilitated risk assessment of the proposed changes to identify the aids that will assist it to fulfil its responsibilities once it has relocated; that it has consulted with Sydney Ferries, NSW Maritime and the RAN, and that it intends to consult the Commercial Vessel Association.

2.117 OTSI is not advocating a particular position on whether or not Sydney Ports should relocate its Harbour Control staff and appreciates that some of the arguments that have been put to it may have been underpinned by industrial concerns. However, it does consider it important that Sydney Ports continues to engage those who have safety concerns in relation to its proposed relocation because the sharing of information, and particularly that which relates to Sydney Ports' risk assessment and its consideration of the aids upon which it intends to rely, may go a long way to easing stakeholder concerns.

2.118 Sydney Ferries' Crew Culture. As indicated earlier in the report, a considerable number of people to whom OTSI spoke in the course of its investigation indicated that they believed that Sydney Ferries' vessels are operated at inappropriate speeds and Sydney Ferries' General Manager Operations expressed the same concerns in writing to all of the Corporation's masters on 5 May 2006. Some senior officers in NSW Maritime therefore expressed concern about OTSI's recommendation, in its investigation into the fatality occasioned by the collision between a Sydney Ferries' RiverCat and a dinghy on 5 January 2007, that the Orange Diamond scheme<sup>59</sup> be extended to all Sydney Ferries. They felt that the culture amongst Sydney Ferries' masters was such that any extension of privileges would simply encourage the masters to exercise less caution. NSW Maritime rejected OTSI's recommendation because it is concerned that while there is sufficient room for sailing vessels to give way to those

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<sup>59</sup> This scheme provides those of Sydney Ferries authorised to display an Orange Diamond symbol with priority over sailing vessels by day.

vessels that are currently allowed to exhibit the Orange Diamond, by virtue of the routes over which such ferries are operated and the speed at which they are operated, there may not be sufficient room on the routes travelled by vessels such as the RiverCats and HarbourCats.<sup>60</sup> OTSI appreciates NSW Maritime's concerns in this regard, and the concerns of some of its officers in relation to the speed at which some of Sydney Ferries' vessels are operated from time to time because these concerns are not without some foundation.

2.119 Previous OTSI investigations have identified organisational weaknesses within Sydney Ferries, i.e., weaknesses that have their roots in arrangements that have been, or have not been, put in place by its management. However, there are some matters in Sydney Ferries that cannot be addressed by management alone. It is universally accepted within the maritime industry that the master has the ultimate responsibility for the safe operation of his/her vessel. OTSI was struck, therefore, by the incongruity of masters expressing their concerns about the increasing level of risk associated with operations on the Harbour and the failure of some to adjust the operation of their vessels to accommodate known risks. This might be explained if OTSI had found evidence of actions being taken against masters for late running. However, OTSI found no such evidence; on the contrary, it found documented evidence in which management has expressed its concerns about speed, highlighted the need for additional caution when operating in degraded visibility conditions and stated quite clearly that safety must take precedence over on-time running. In making this point, OTSI is not claiming that all of Sydney Ferries' masters routinely operate at inappropriate speeds, but it is observing that the way in which some masters operate is impacting on safety on the Harbour and the reputation of their colleagues and the Corporation more generally.

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<sup>60</sup> At present, only the Freshwater, Lady and First Fleet class vessels are allowed to display this symbol. These vessels operate at slower speeds and generally in the more expansive waters East of the Harbour Bridge.

## Remedial Actions

- 2.120 On 2 April 2007, Sydney Ferries imposed a speed restriction of 15 knots on its vessels between Bennelong and Kirribilli Points to the East of the Bridge and Millers and Blues Points to the West. It also re-stated, for the benefit of its masters, the general requirement that vessels not be operated above 10 knots when passing within 30 metres of another vessel or a fixed object. This requirement becomes especially significant in the narrower confines of the upper sections of the Parramatta River where it becomes more difficult for vessels to give each other a wider berth. Sydney Ferries is also currently reviewing its service schedules to take into account the effect of longer transit times that will result from full compliance with the new speed restrictions in the vicinity of the Harbour Bridge and adherence to extant requirements when operating in a confined space or in close proximity to other vessels.
- 2.121 NSW Maritime imposed a speed restriction of 15 knots in the area between Bennelong and Kirribilli Points to the East of the Bridge and Millers and Blues Points to the West with effect 1 August 2007. NSW Maritime also advised Sydney Ferries that an exemption that had allowed its HarbourCats and RiverCats to travel in excess of an 8 knot restriction to the West of the Bridge between Millers Point and the Darling Street Wharf would be withdrawn as of 1 October 2007. However, this decision is being reviewed by NSW Maritime following a submission from Sydney Ferries and in the interim, Sydney Ferries' HarbourCats and RiverCats continue to be exempted from the related speed restriction.

## Summary

- 2.122 Both the Master and the Helmsman were adamant that they were maintaining a proper look-out and there was nothing to suggest that they were impaired or distracted at the time. The Master has acknowledged that he saw *Merinda* at very close range prior to the collision. The Helmsman has stated to OTSI that he did not see *Pam Burrridge* prior to the collision, but statements attributed to him by several witnesses cast some doubt in relation to this matter. OTSI has no way of positively

establishing what the Helmsman or the Master saw. However, if the Helmsman did see *Pam Burridge*, it is likely to have been peripherally and at very close range.

2.123 There is more conclusive evidence in relation to the following matters that had a causative bearing on the accident: *Merinda* was not displaying its navigation lights, thereby making the vessel considerably less visible to the Master of *Pam Burridge*, than it ought to have been, and *Merinda's* main saloon design would have limited the Helmsman's field of view in the direction from which *Pam Burridge* approached. The consequence of these factors was magnified to an extent by the track taken by the Master who commenced to turn towards the Harbour Bridge earlier than was permitted by the North-South Rule.

2.124 This tragedy might have been even worse were it not for the highly effective and timely emergency response that was mounted. Concrete actions are required to reduce the likelihood of a recurrence of such an accident; there is a need for NSW Maritime to review a number of the regulations, rules and requirements governing the operation of recreational vessels in NSW, particularly by night, and for it to increase its enforcement activity. There is also a need for it to enforce strict compliance with its *Code of Conduct for Vessels Operating in Sydney Cove*. Finally, there is a need for Sydney Ferries' and recreational vessels to be operated in all circumstances with greater caution.

## PART 3 FINDINGS

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- 3.1 In determining the factors which caused and contributed to the circumstances that brought the *Pam Burrridge* and the *Merinda* into collision, the investigation found that there were a number of factors, including human error, vessel visibility and environmental conditions, which ultimately combined at one fatal culminating point to bring about this tragic accident.

However, the most critical question which has been the focus of all the lines of inquiry that have been investigated has been:

***Why did the Master of the Pam Burrridge and the Helmsman and Co-owner of the Merinda not see each others' vessels in time to take action to avoid collision?***

The factors that bear most significantly on the answer to that question have to do with the following considerations:

- a. ***To what extent did the general conditions of visibility on the Harbour in the vicinity of Sydney Cove and the Bridge affect the ability of vessel operators to see other vessels?***

While the effects of shadowing, light reflection and scatter on the water can make the detection of vessels in the vicinity of the Harbour Bridge quite difficult at night, the prevailing conditions of visibility on the night of 28 March 2007 were not unusual and should not have presented a problem for vessels whose operators were maintaining a proper look-out.

- b. ***Should Merinda, which was not exhibiting its navigation lights, have been seen as it was operated under and East of the Harbour Bridge by vessels coming out of Sydney Cove?***

Waterborne observations and the results of the re-enactment conducted by OTSI reveal that notwithstanding the maintenance of a proper look-out, a vessel of *Merinda's* type not exhibiting the required configuration of navigation lights would have been

extremely difficult to detect from vessels coming out of Sydney Cove, irrespective of the state of its cabin lighting.

- c. ***Within those prevailing conditions of visibility, to what extent should Pam Burridge, which was exhibiting the required navigation lights, have been visible to other vessels that were keeping a proper look-out as it was operated out of Sydney Cove?***

Waterborne observations and the results of the re-enactment conducted by OTSI reveal that the HarbourCat can be detected at long range.

- d. ***To what extent did Pam Burridge's course, after departing Sydney Cove and turning West to pass under the Bridge, contribute to causing the collision?***

While it is a fact that *Pam Burridge's* course did not conform fully with the requirements of the *Code of Conduct for Vessels Operating in Sydney Cove*, the course itself did not cause the collision because there was a clear line of sight between the two vessels and this extended over a distance which would have allowed either vessel to have altered course before the vessels came into close proximity, provided, of course, that both vessels were exhibiting the prescribed configuration of navigation lights and were maintaining a proper lookout.

- e. ***To what extent did speed play a part in causing the collision?***

*Pam Burridge* was not constrained by any speed restriction after it crossed the limit line, but the Master was obliged to proceed at a "safe speed". Although the Master's decision to operate at approximately 22 knots reflected a limited appreciation of what constituted a "safe speed" in the area of the Harbour Bridge, the speed itself did not cause the collision since, even at that speed, he would have had sufficient time to have detected *Merinda*, had it been exhibiting the required configuration of navigation lights, and to have changed course in the event that it became necessary to do

so. Equally, the re-enactment conducted by OTSI revealed that, even at speed, *Pam Burrridge* could have been seen at a considerable distance, provided a proper look-out was being maintained on *Merinda*, and that the ferry could have been avoided.

**f. *Was a proper look-out maintained onboard Pam Burrridge?***

The Master maintains that he kept a proper look-out and there is no technological or other means of establishing otherwise. OTSI's re-enactment established that in the absence of navigation lights, the illumination of cabin lights on a vessel like the *Merinda* was insufficient to have allowed the vessel to be seen from the ferry at anything other than very close range.

**g. *Was a proper look-out maintained onboard Merinda?***

The Helmsman and the Co-owner maintain that they kept a proper look-out and there is no technological means of establishing otherwise. They maintain that they did not see *Pam Burrridge* as it approached on their Starboard bow. Four witnesses who were involved in the emergency response have indicated that the Helmsman made comments, while in a highly distressed state, which indicated that he may have seen *Pam Burrridge*, albeit for a limited period of time, before the collision. The Helmsman has no recollection of the statements attributed to him. These conflicting accounts could not be reconciled.

Equally difficult to reconcile is how *Pam Burrridge*, given its size and the fact that its navigation lights were exhibited, was not seen if a proper look-out was being maintained onboard *Merinda*.

It is acknowledged, however, that the ability of the Helmsman and the Co-owner to maintain a proper look-out might have been restricted by the supporting pillars in their vessel's main saloon, but these should not have completely obscured *Pam Burrridge* during the latter stages of its exit from Sydney Cove and for the entire period thereafter up until the collision.



The conclusion to be drawn from the analysis of these prime factors, together with all the material evidence gathered in the course of the investigation, is that the primary causes and factors which contributed to this tragic accident can be attributed to the following conditions and circumstances:

**a. Causation**

- i. Because the *Merinda* was not exhibiting the navigation lights it was required to, it did not become visible to the Master of the *Pam Burrridge* until it was too late for him to take effective collision-avoidance action.
- ii. Because a proper look-out was not maintained onboard *Merinda*, *Pam Burrridge*'s approach was either not detected, or was detected in insufficient time for the Helmsman to give way to, or avoid, the ferry.

**b. Contributory Factors**

- i. The position and dimensions of supporting pillars that formed part of *Merinda*'s Main Saloon windscreen, windows and superstructure would have restricted the Helmsman's and Co-owner's field of view as they looked-out towards the direction from which *Pam Burrridge* approached.
- ii. The course taken by *Pam Burrridge* to proceed West out of Sydney Cove did not conform with the requirements of the *Code of Conduct for Vessels Operating in Sydney Cove* and altered the angle at which the two vessels converged, but the course itself had no effect on the Master's ability to detect the presence of properly illuminated vessels, or its visibility to those maintaining a proper lookout from any other vessel in the vicinity.
- iii. Lighting conditions on the water at night in the vicinity of the Harbour Bridge can vary significantly in a matter of metres and may have further detracted from the ability of the Helmsman and the Master to detect each other's vessels.

**c. Anticipation and Management of Risk**

- i. Neither the Helmsman nor the Master were subject to any speed restriction on their respective tracks away from and towards the Harbour Bridge and *Merinda* and *Pam Burrridge* were being operated at approximately 4-6 knots and 20-22 knots<sup>61</sup> as they converged. However, the Helmsman and the Master were under an obligation to maintain a proper lookout for other vessels and to operate at a safe speed, i.e., “one at which the vessel can be stopped in time to avoid any danger which arises suddenly”.<sup>62</sup>
- ii. The Helmsman’s decision to operate *Merinda* at night from the Driving Station within the Main Saloon, rather than from the Fly-Bridge where he would have enjoyed an unrestricted field of view, is indicative of a limited understanding of the risks associated with operating a small motor vessel on Sydney Harbour at night. It also reflects on the Co-owner’s lack of appreciation for those same risks.
- iii. In operating *Pam Burrridge* at approximately 20-22 knots at night, the Master did not fully take into account the requirement to operate at a safe speed in the unique conditions that prevail in the vicinity of the Harbour Bridge.
- iv. There is a higher risk of collision in the immediate area of the Harbour Bridge than in other parts of the Harbour because of the following factors:
  - (1) the relative narrowness of the channel under the Harbour Bridge;
  - (2) the convergence of traffic travelling either East or West in the main channel with that entering or exiting Walsh Bay and Sydney Cove,

<sup>61</sup> These estimates of speed are based on evidence provided by the Helmsman and Master when interviewed by OTSI.

<sup>62</sup> These requirements are specified in Rules 5 and 6 of the *Navigation (Collision) Regulations 1983 – Schedule 1*, although the amplifying definition is derived from a section entitled “Water Traffic Rules” in NSW Maritime’s *Boating Handbook*.

- (3) the juxtaposition of commercial and recreational vessels, and
- (4) the variability of lighting conditions at this location by night.

NSW Maritime's *Code of Conduct for Vessels Operating in Sydney Cove*<sup>63</sup> is intended to manage some of the known risks in this area, but the *Code* is either not fully understood, or is not being observed, by some masters employed by a number of operators who have agreed to operate in accordance with the *Code*, including Sydney Ferries. In addition, one of the key control measures, the 8 knot 'limit line', is depicted inaccurately within the *Code*.

- v. NSW Maritime's strategy for managing the risk of boating accidents is overly reliant on the operators of all vessels being aware of navigation rules and collision regulations, especially so in the absence of a requirement for all persons operating a vessel to hold a boating license.

#### **d. Effectiveness of the Emergency Response**

- i. Although the situation on the water was confused, in that those responding to the scene of the accident had no way of knowing how many people had been onboard *Merinda*, the emergency response was timely and conducted in a highly effective manner.
- ii. Given the circumstances, *Pam Burridge*'s Master displayed considerable presence of mind and good seamanship in the way he manoeuvred his vessel as he returned to the scene of the collision, ensuring that those in the water were not placed at further risk. The seamanship of the masters operating *Fishburn*, *Golden Grove* and Sydney Ports' response vessel, in acting to secure *Merinda* and *Pam Burridge*, was also highly effective.

<sup>63</sup> This Code was revised in January 2005. In essence, it restricts other than commercial operators from operating in Sydney Cove and identifies limits on the speeds and routes at/over which vessels may be operated on entering or exiting the Cove.

- iii. The passengers onboard *Fishburn* and *Golden Grove* appreciated, and benefited from, being advised of the accident and the need for their vessels to be diverted.
- iv. The actions of the uninjured, or relatively less injured, persons from *Merinda*, particularly the Helmsman who was already in the water, together with the actions of the GPH and Engineer from *Fishburn* who entered the water without hesitation, to assist those who, by virtue of their age or injuries, were unable to assist themselves, were selfless and directly responsible for preventing further loss of life. Crew members from Sydney Ferries' vessels at the scene including *Pam Burrridge's* Master, from Sydney Ports' response vessel and a veterinarian and veterinary nurse, who were passengers on the *Golden Grove*, administered CPR and acted to stem the bleeding of the most seriously injured. Their actions, and those subsequently taken by Ambulance officers at Dawes Point, were also highly significant.

**e. Other Matters that would enhance the Safety of Ferry/Boating Operations**

The following matters did not have a bearing on the collision between *Pam Burrridge* and *Merinda* but are identified as having the potential to cause or contribute to other instances of collision on the water, and especially between sunset and sunrise, within NSW.

- i. The current provision which allows an unlicensed person to operate a motor vessel in NSW, regardless of its size and the number of passengers onboard, provided they do so at below 10 knots, needs to be reviewed.
- ii. Qualifying for a recreational boating licence in NSW needs to be contingent upon satisfying a knowledge test and demonstrating a satisfactory level of proficiency in basic boating competencies.

- iii. The current provision which allows vessels less than 7 metres in length and with a maximum speed of 7 knots to be operated with a single white light needs to be reviewed.
- iv. NSW Maritime needs an increased presence on the Harbour, by day and night, to enforce compliance with its requirements for safe boating and ferry operations.
- v. A range of stakeholders have concerns about Sydney Ports' plan to relocate the Harbour Master and the Harbour Control function to Port Botany. Some of the concerns might be redressed were Sydney Ports to provide stakeholders with greater visibility of the risk assessments that have been/or are being done in anticipation of the relocation, and of new aids, technologies or systems that are likely to be employed as a consequence.

## PART 4 RECOMMENDATIONS

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4.1 In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the organisations specified below:

**a. NSW Maritime Authority**

- i. Increase its presence within Port Jackson, by day and night, to ensure greater compliance with its requirements for safe boating and ferry operations, including those rules pertaining to the exhibiting of lights between sunset and sunrise.
- ii. Amend the *Code of Conduct for Vessels Operating in Sydney Cove* to more accurately depict the 8 knot 'limit line' and to incorporate a requirement that vessels that are bound by clause 12.2 of the North- South Rule must pass to the Starboard side of the Diamond Shape marking the centre of the Harbour Bridge as they pass under the bridge.
- iii. Ensure that all operators permitted to operate out of Sydney Cove understand and comply with the requirements of the North-South Rule implicitly.
- iv. Require that all vessels that are manually powered exhibit an all-round white light when operating between sunset and sunrise in NSW.
- v. Remove the provision that allows motor vessels of less than seven metres in length, and that are not capable of exceeding 7 knots, to exhibit a minimum of a single all-round white light and require all vessels under 12 metres in length, irrespective of their maximum speed, to be operated with a minimum of side navigation lights and an all-round white light when operating between sunset and sunrise in NSW.
- vi. Remove the provision that allows sailing vessels less than seven metres in length to be operated between sunset and sunrise in NSW with a minimum of white light and require

such vessels to display a minimum of side navigation lights and a stern light.

- vii. Amend the requirements for obtaining a recreational boating licence in NSW to incorporate some form of practical assessment of basic boating competencies.
- viii. Remove, or further qualify, the provision that allows unlicensed persons to operate a vessel in NSW, provided they do so at less than 10 knots, to ensure that vessels capable of carrying a significant number of passengers or attaining high speeds are not operated by other than a person holding a boating licence.
- ix. Examine the feasibility of permitting only licensed persons to operate a vessel between sunset and sunrise in NSW.

**b. Sydney Ferries Corporation**

- i. Ensure all of its masters understand the North-South Rule as specified in the *Code of Conduct for Vessels Operating in Sydney Cove* and comply with it implicitly.
- ii. Impress upon its masters the need to comply with safe operating requirements at all times, in order to minimise risk to passengers, crew and other boat users, particularly as it affects their credibility as master mariners and the public's confidence in Sydney Ferries Corporation as a safe provider of passenger services.
- iii. Enhance its capacity in the near term to identify and manage instances where ferries are not being operated in accordance with the required rules and regulations, and/or its own safe operating requirements, by fitting real time tracking devices on all its vessels.
- iv. Notwithstanding that timetabling was not at issue in this accident, complete the review of its schedule of services and adjust that schedule, if necessary, to ensure that masters are

not placed under any form of pressure to exceed speed restrictions in order to comply with its timetables.

- v. Expedite the fitment of data loggers across its fleet.

**c. Sydney Ports Corporation**

Provide stakeholders with visibility of the risk assessments that have been, or are being, done in anticipation of the relocation of its Harbour Control function to Port Botany, and of new aids, technologies or systems that are likely to be employed as a consequence.

**d. Australian Maritime Officers' Union**

Impress on those of its members who are employed as masters on passenger vessels operating on Sydney Harbour, of the need to comply with safe operating requirements at all times, in order to minimise risk to passengers, crew and other boat users, and to enhance public confidence in the safety of waterborne passenger services.



## Appendix 1: Determination of the Time and Location of the Collision

### Time of Collision

OTSI had difficulty determining the exact time of the collision. The Master's call to Harbour Control following the accident was logged at 10:50pm.

In reviewing CCTV footage, it became apparent that the four cameras from which the footage was derived, the locations of which are shown in *Image 1* on the next page, were not synchronised. Using the time indicated on camera 1 as reference and instances that are captured on a number of cameras, OTSI has been able to apply the corrections indicated in *Table 1*.

Camera	Operated by	Description	Correction
1	RTA	North-East pylon	0 (reference)
2	RTA	Centre of Bridge arch	0
3	SFC	Circular Quay Wharf 5	-59 minutes 41 seconds <sup>64</sup>
4	SFC	Circular Quay Wharf 2	+40 seconds

**Table 1: Time Corrections**

Applying these corrections, the time the collision as observed on cameras 3 and 4 is 10:49:46 pm.

### Collision Location

OTSI relied on a variety of sources to determine the location of the collision. They included:

- a. Examination of recordings derived from CCTV cameras on the Harbour Bridge and at Circular Quay, owned by the NSW Roads and Traffic Authority and Sydney Ferries respectively.
- b. Examination of radar records, from Sydney Ports Corporation, showing the movement of the ferry *Fishburn* towards the scene of the collision and the position at which it commenced to 'hold'.
- c. Witness statements.

<sup>64</sup> This camera had not been re-set at the end of Daylight Saving.



Image 1: CCTV camera locations

### RTA CCTV Recordings

The RTA provided CCTV recordings from five different locations in the vicinity of the Harbour Bridge. Of these five recordings, two provided valuable information regarding the location of the wreckage of the *Merinda* and identifiable rescue vessels within two minutes of the collision.

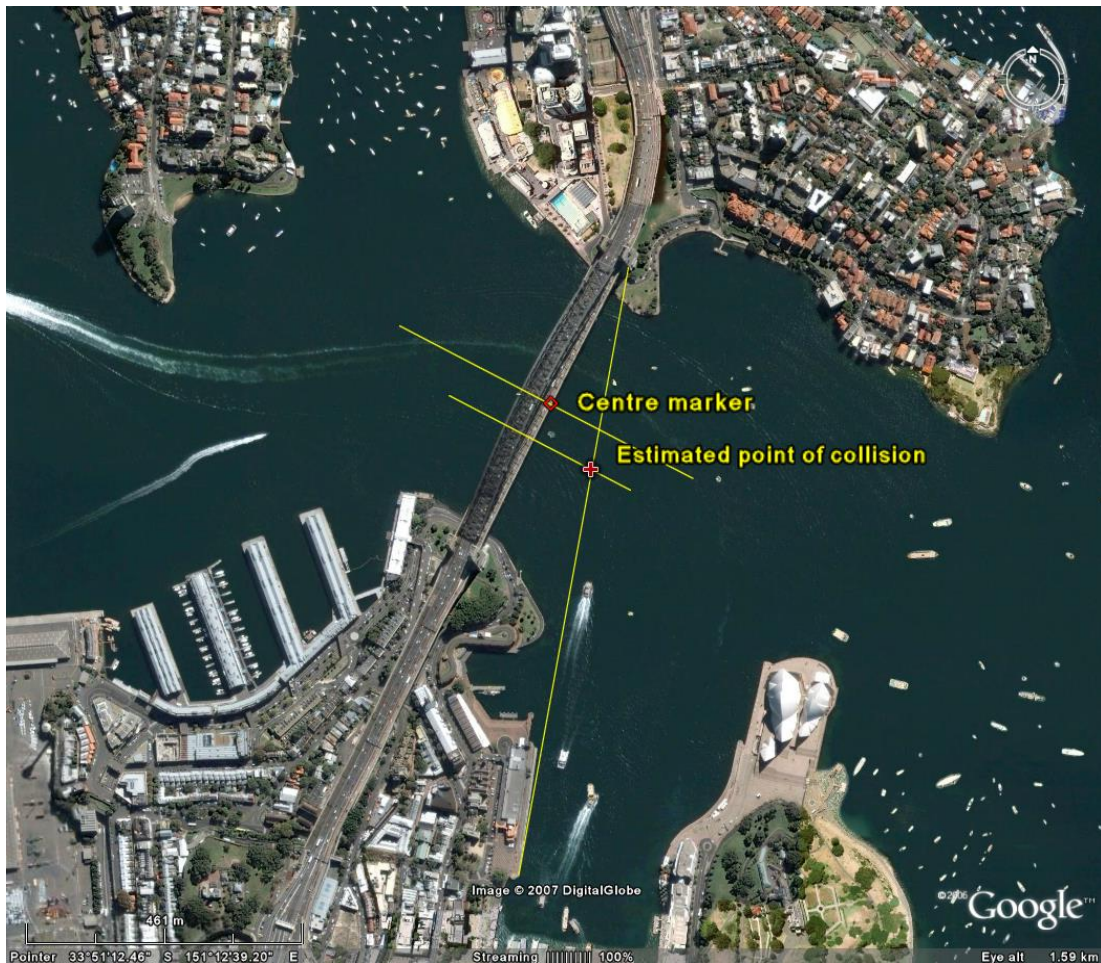
Camera 1 was re-oriented within a minute of the collision onto the wreckage of the *Merinda* and subsequently captured the response effort. A short, early sequence clearly shows in centre frame the bow of *Merinda* surfacing after having been submerged. Fortuitously, the South-Eastern corner of the Overseas Passenger Terminal is also in centre frame in the background, indicating that the bow of the *Merinda* surfaced on a line from the camera to the corner of the Overseas Passenger Terminal, as shown in *Photo 22*.



**Photo 22: Location of bow of *Merinda* as recorded by Camera 1**

Camera 2, mounted above the central walkway between the tops of the East and West arches of the Harbour Bridge and looking down and to the East, also shows the *Fishburn* arriving on scene after the collision. Although no other vessels can be seen and the wreckage of the *Merinda* cannot be discerned on this footage, a comparison of the images captured by this camera with those showing the position of the *Fishburn* at the same times from Camera 1, together with *Fishburn*'s known length, allows an estimation to be made of the distance from a perpendicular to the centre of the Bridge to the position where the bow of the *Merinda* surfaced. The intersection of the lines determined by these two CCTV records gives the location at which the *Merinda* surfaced after the collision, as shown in *Image 2*, as South 33°51'11.4", East 151°12'41.6".





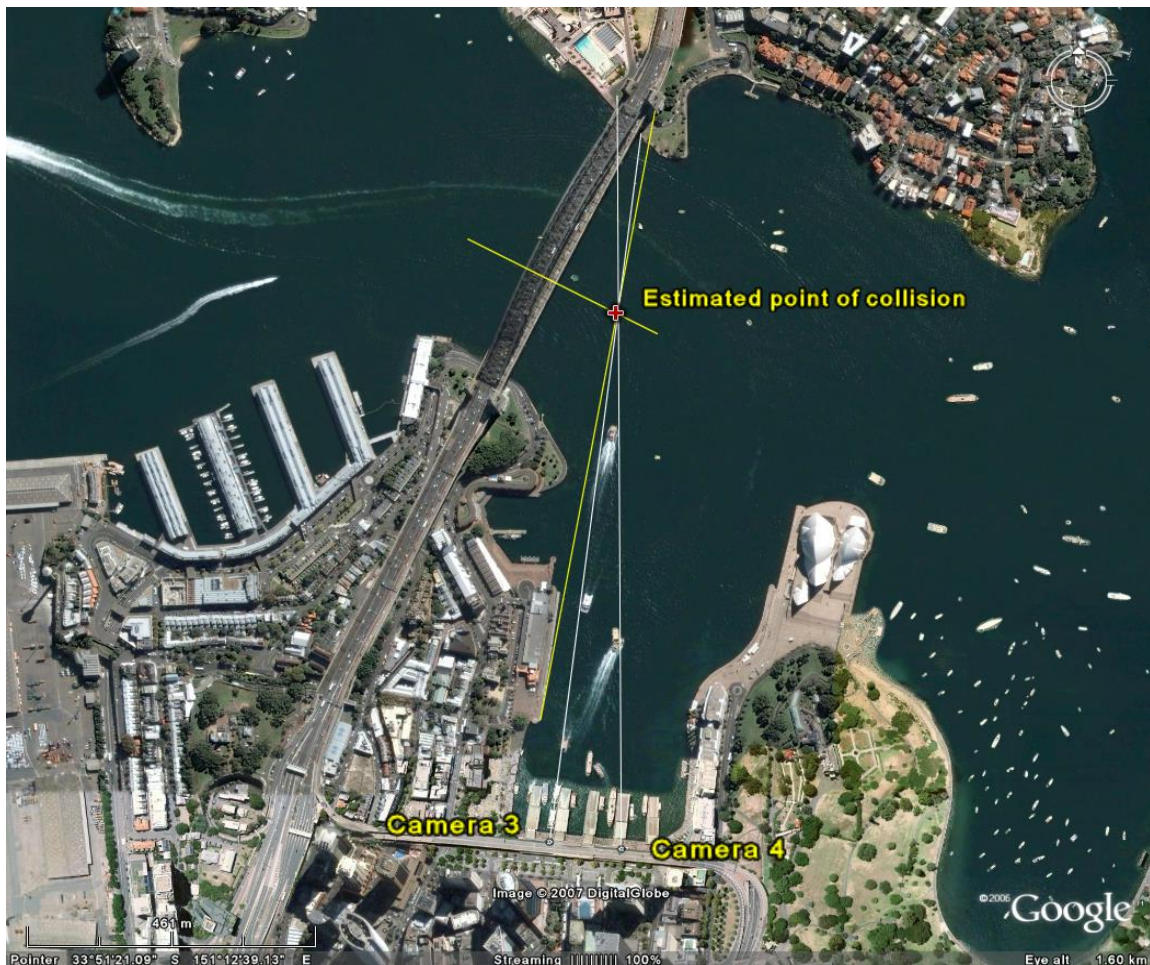
**Image 2: Indicating the estimated point of collision**

### **Sydney Ferries CCTV Recordings**

Sydney Ferries provided CCTV records from two cameras, Cameras 3 and 4, positioned above the Northern platform of the Circular Quay Railway Station. They showed *Pam Burridge*'s course leading up to, and after, the collision.

These images were of low resolution and were indistinct. However, with knowledge of the location at which the bow of the *Merinda* surfaced after the collision, and after very detailed examination of the relevant CCTV sequences, OTSI was able to discern both vessels in the moments immediately prior to the collision and *Pam Burridge* in the minutes after the collision. The lines of sight from Cameras 3 and 4 through the point where the paths of the two vessels merged were projected to the shoreline. Comparison with photographs taken in daylight from the CCTV camera positions allowed the positions at which the lines of sight intersected with identifiable locations on the shore to be determined. In

*Image 3*, these lines of sight are superimposed on an image showing the location determined from the RTA camera records as seen in *Image 2*. As can be seen, there is close agreement between the locations determined by these two independent methods, indicating that the wreckage of the *Merinda* surfaced very close to the location of the collision.



**Image 3: Lines of sight from Circular Quay cameras to area of the collision**

### Radar Records

Available radar records do not show the convergence of *Merinda* and *Pam Burridge* and this can be attributed to the materials used in the construction of both vessels and the obstruction caused by the Bridge. However, there is a trace which shows a vessel diverting from its North-Easterly course to the West and it subsequently stopping East, and South of the Centre of the Harbour Bridge. Given its course and the time of its arrival, this vessel was determined to be the *Fishburn*.

The estimated location at which *Fishburn* stopped, determined by taking bearings and distances from Milsons Point and the Opera House, was South 33°51'11.0", East 151°12'40.3" i.e., approximately 37 metres *North-West* of the site of the collision. This distance must be considered approximate because OTSI was not able to determine what part of *Fishburn* was captured on radar. Notwithstanding, the radar indication provides additional corroboration of the collision having occurred East of the Bridge and South its centre.

### **Witness Statements.**

OTSI identified four people who claimed to have witnessed the collision: the Master, two passengers onboard *Merinda* and a person ashore at Dawes Point. An additional witness, also ashore at Dawes Point, heard the collision and saw *Merinda* sinking. The Master and the two witnesses aboard *Merinda* indicated that they only saw each other's vessel momentarily. The person who witnessed the collision from Dawes Point, while standing underneath the Southern end of the Bridge near Hickson Road, was only able to provide a general indication of the location of the collision. The witness who heard the collision did so from a position slightly South-East of the witness who saw the collision and estimated the distance from the shore to the point where *Merinda* was sinking to be about 200 metres and East of the Bridge. While both of these indications should be considered very approximate, they are broadly consistent with the location of the collision as determined by OTSI using CCTV and radar recordings.

## Appendix 2: Sources and Submissions

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### Sources of Information

Bureau of Meteorology (NSW)

Crew members on Sydney Ferries' vessel *Pam Burridge*

Crew members and passengers onboard Sydney Ferries' vessel *Fishburn*

Crew members and passengers onboard Sydney Ferries' vessel *Golden Grove*

Helmsman, Co-owner and passengers onboard the motor launch *Merinda*

Officers of the Australian Maritime Officers' Union

Officers of the NSW Ambulance Service

Officers of the NSW Maritime Authority

Officers of the NSW Police, Marine Area Command

Officers of the NSW Roads and Traffic Authority

Officers of the Sydney Harbour Foreshore Authority

Officers of the Sydney Harbour Pilots Service

Officers of Sydney Ferries Corporation

Officers of Sydney Ports Corporation

Other witnesses who gave evidence on the basis of the provisions of Section 45C(3) of the *Transport Administration Act 1988 (NSW)* that they would not be identified by name in any material published by OTSI

### References

*International Regulations for Preventing Collisions at Sea, 1972*

*Marine Safety Act 1998 (NSW)*

*Maritime Services Act 1935 (NSW)*

*Navigation (Collision) Regulations 1983 (NSW)*

NSW Maritime Authority's *Boating Handbook*

NSW Maritime Authority's *Code of Conduct for Vessels Operating in Sydney Cove, 2005*

Office of Transport Safety Investigations' report into a collision involving Sydney Ferries' *Dawn Fraser* and a Dinghy, Registered No.AAP694N at Walsh Bay in Sydney on 5 January 2007

*Passenger Transport Act 1990 (NSW)*

Sydney Ferries Corporation's HarbourCat Class *Vessel Operating Manual*

Sydney Ferries Corporation's investigation report into the accident involving *Pam Burridge* and *Merinda* on 28 March 2007

*Transport Administration Act 1988 (NSW)*

*Water Traffic Regulations (NSW)*



## Submissions

Although he is not required to do so, the Chief investigator provided a briefing on the preliminary findings of the Draft Report to all Directly Involved Parties (DIPs). He subsequently forwarded a copy of the Draft Report to the DIPs to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Australian Maritime Officers' Union
- Independent Transport Safety and Reliability Regulator
- Legal Counsel representing Directly Involved Parties
- Master of *Pam Burrridge*
- NSW Police, Marine Area Command
- NSW Maritime Authority
- Survivors from *Merinda* and the Next of Kin of the deceased
- Sydney Ferries Corporation
- Sydney Ports Corporation

Submissions were received from the following Directly Involved Parties:

- Australian Maritime Officers' Union
- Co-owner of *Merinda*
- Legal Counsel representing the Master of *Pam Burrridge*
- Legal Counsel representing *Merinda*'s Helmsman, Co-owner and three other survivors
- Legal Counsel representing a *Merinda* survivor and the family of one of the deceased passengers
- NSW Police, Marine Area Command
- NSW Maritime Authority
- Parents of one of *Merinda*'s fatally injured passengers
- Sydney Ferries Corporation
- Sydney Ports Corporation

The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.