ACCIDENT REPORT

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

Report on the investigation of

the fatal person overboard from the motor cruiser

Diamond Emblem 1

at Great Yarmouth Yacht Station, River Bure, England

on 19 August 2020

VERY SERIOUS MARINE CASUALTY REPORT NO 5/2022 MAY 2022

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

Front cover image courtesy of Norfolk Constabulary

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AINA	-	Association of Inland Navigation Authorities
BSS	-	Boat Safety Scheme
CCTV	-	closed-circuit television
CE	-	Conformité Européene (European Conformity)
DoC	-	Declaration of Conformity
EC	-	European Commission
EEA	-	European Economic Area
Ferry Marina	-	The registered owner of *Diamond Emblem 1* (A J & J Cator t/a Ferry Marina)
HBC	-	The Code for the Design, Construction and Operation of Hire Boats, commonly referred to as the Hire Boat Code
ISO	-	International Organization for Standardization
kW	-	kilowatts
m	-	metre
mm	-	millimetre
MCA	-	The Maritime and Coastguard Agency
mph	-	miles per hour
NWSF	-	The National Water Safety Forum
QAB	-	Quality Accredited Boatyard Scheme
RA	-	Risk assessment
RCD	-	Recreational Craft Directive
RoSPA	-	Royal Society for the Prevention of Accidents
rpm	-	revolutions per minute
t/a	-	trading as

TIMES: all times used in this report are UTC+1 unless otherwise stated.

Image courtesy of Norfolk Constabulary

Diamond Emblem 1

SYNOPSIS

At 1318 on 19 August 2020, Laura Perry, a member of a family group on board the motor cruiser *Diamond Emblem 1*, fell overboard from the aft deck when the boat's stern made hard contact against the embankment wall opposite the Great Yarmouth Yacht Station. She became entangled in a length of rope and the propeller, suffering multiple injuries that resulted in her drowning.

It is likely that Laura would have been prevented from falling into the water if *Diamond Emblem 1* had been fitted with an adequate guardrail around its stern. The boat's driver at the upper helm control position was unable to control the motor cruiser at the time, most likely because the helm position changeover lever had been incorrectly set to the lower helm control position. Various contributing factors were identified relating to the technical features of the dual helm control system. *Diamond Emblem 1*'s conformance with the Recreational Craft Directive's essential safety requirements was incomplete in several respects and hazards inherent in the boat's design were not considered. The MAIB investigation also established that both the boat handover and the documentation provided to the family were insufficient to ensure that the hire party were competent to drive a boat with dual helm control.

In October 2020, anticipating the increased demand for local hire boats created by overseas travel restrictions imposed due to the COVID-19 pandemic, the Chief Inspector of Marine Accidents urgently recommended the Association of Inland Navigation Authorities to amend the proposed Code for the Design, Construction and Operation of Hire Boats (the Hire Boat Code) to strengthen the requirements for person overboard prevention, handover procedures and engine control systems (recommendation 2020/129). The recommendation was partially accepted.

This report makes a further recommendation to the Association of Inland Navigation Authorities to provide guidance and oversight to its members in complying with the requirements of the Hire Boat Code when adopted as mandatory by them in 2022.

The Broads Authority has been recommended to: make the British Marine and VisitEngland Quality Accredited Boatyard Scheme a requirement of its licensing provisions; review its licensing regime with respect to required boat documentation and following up on a change in hire boat company ownership; and retain records that demonstrate compliance with the Recreational Craft Directive's requirements for boats.

The owner of *Diamond Emblem 1* has been recommended to: align its handover procedures with the Hire Boat Code; ensure appropriate documentation is provided to hirers; assess and mitigate the risk of falling overboard from its boats; ensure that safety critical controls are easily identifiable on any boats that they operate; and eliminate the risk on boats with dual helm controls by providing control system interlocks and a means of identifying the active helm control position.

The Boat Safety Scheme has been recommended to conduct a review of the Boat Safety Scheme requirements for boats with multiple helm positions to have control system interlocks and a means of identifying the active helm.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF *DIAMOND EMBLEM 1* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Diamond Emblem 1*
Flag	Not applicable
Classification society	Not applicable
Broads registration number	518 S
Type	Recreational hire craft
Registered owner	A J & J Cator t/a Ferry Marina
Manager(s)	A J & J Cator t/a Ferry Marina
Construction	Glass reinforced plastic
Year of build	2010
Length overall	12.8m
Beam	3.66m
Gross tonnage	Not applicable
Minimum safe manning	Not applicable
VOYAGE PARTICULARS	
Port of departure	Stracey Arms, Norfolk Broads
Port of arrival	Great Yarmouth
Type of voyage	Not applicable
Manning	Not applicable
MARINE CASUALTY INFORMATION	
Date and time	19 August 2020 at 1318:01
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	Great Yarmouth Yacht Station
Place on board	Aft deck
Injuries/fatalities	One fatality
Damage/environmental impact	Damage to the hull of *Diamond Emblem 1*, with a hole at the bow below the rubbing band and also at the starboard aft corner. Damage to the stern of the motor cruiser *Challenger*.
Ship operation	On passage
Voyage segment	Not applicable
External & internal environment	Dry, light breeze, ebbing tide. Great Yarmouth Yacht Station predicted high water at 1049 and low water at 1729.
Persons on board	9

1.2 BACKGROUND

Diamond Emblem 1 **(Figure 1)** was a 12.8 metre (m) motor cruiser with a 3.66m beam, designed for use on inland waterways. The boat was hired out on a self-drive basis to holidaymakers on the Norfolk Broads by the hire boat operator A J & J Cator, trading as (t/a) Ferry Marina – hereafter referred to as Ferry Marina. It had a large internal accommodation area (cabin space) and open upper deck, forward deck, aft deck and side decks. Access to the cabin space was from the aft deck, via a door that opened outwards with its hinges on the starboard side, and a sliding door on the port side deck.

The cabin space **(Figure 2)** contained three double cabins, one twin cabin and a forward saloon area with wraparound seating, which could be converted into additional berths. It also included a small galley, toilets and shower rooms, and a lower helm control console, forward on the port side of the cabin space **(Figure 3a)**. The upper deck had seats and an upper helm control console, which was located on the starboard side around midships **(Figure 3b)**. The main means of access between the cabin space and the upper deck was via a set of steps on the port side of the aft deck. The side decks could be accessed via steps on the port and starboard sides of the aft deck; by the sliding door on the port side; or from the upper deck helm control position on the starboard side.

Image courtesy of Norfolk Constabulary

Figure 1: *Diamond Emblem 1*

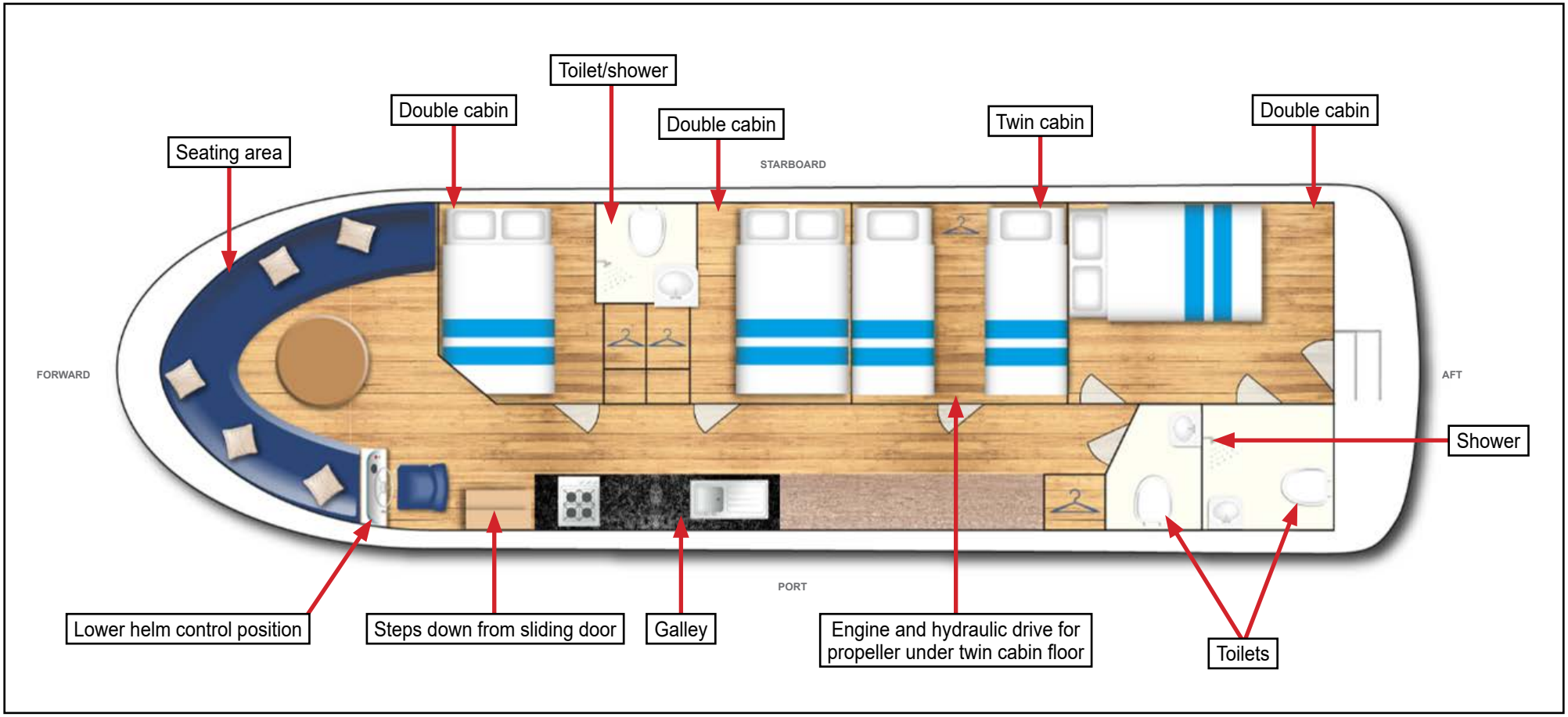

Figure 2: Layout of *Diamond Emblem 1*

Image 3a courtesy of Norfolk Constabulary

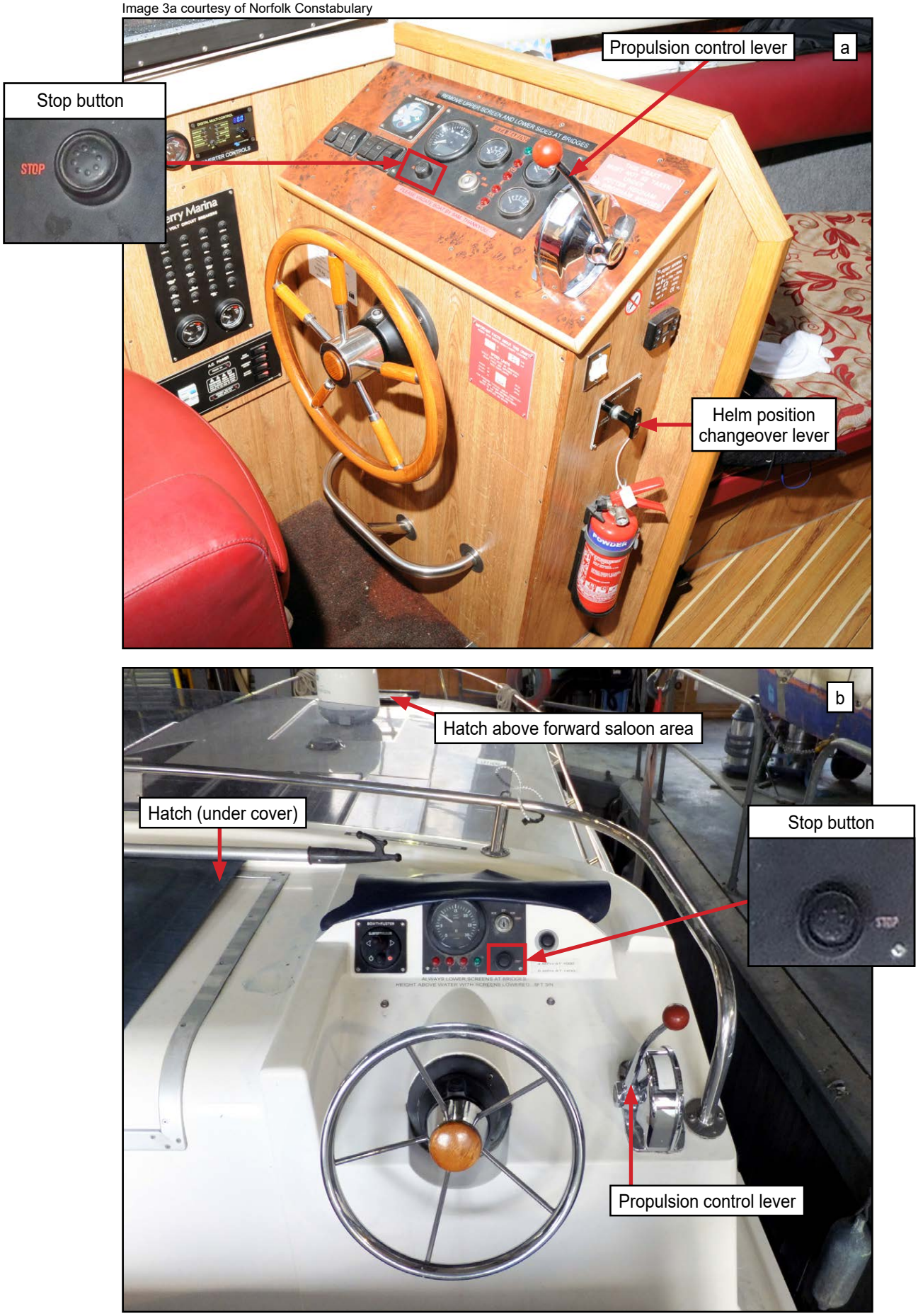

Figure 3: Lower helm control position (a) and upper helm control position (b)

Each helm control console had a steering wheel, dual-function[1] propulsion control lever, key operated engine start switch, engine stop button, and bow thruster control. A helm position changeover lever was located on the inboard side of the lower helm console **(Figures 3a** and **4)**; there was no similar changeover lever at the upper helm console.

Image courtesy of Norfolk Constabulary

Figure 4: Helm position changeover lever at lower helm control position

[1] The dual-function lever controlled the engine speed and propeller direction.

1.3 NARRATIVE

1.3.1 Events prior to the accident

At about 1418 on 17 August 2020, a family group of nine arrived at the Ferry Marina boat hire office at Horning, Norfolk. Their arrival was 18 minutes later than scheduled for a 5-day boating holiday on board the motor cruiser *Diamond Emblem 1*. The group consisted of: Laura Perry, her partner (the nominated skipper) and their three sons aged 16, 14 and 4; her mother and father; her sister (the driver) and her 16-year-old niece.

The group were met by a Ferry Marina instructor. Each of them was given a lifejacket and the nominated skipper went into the office to register the group. Both the nominated skipper and the driver received elements of the handover briefing on board *Diamond Emblem 1* while the group's luggage was being loaded onto the boat. During the handover, which took about 10 minutes, the instructor explained the boat's layout, equipment, and propulsion control and steering systems at the lower helm control position.

Following the handover, the instructor went ashore and the family group departed the marina on board *Diamond Emblem 1*. The family spent the afternoon and following day visiting different locations in the North Broads area **(Figure 5)**. On 18 August, the group spent the evening at the Stracey Arms Windpump, where they moored overnight.

At about 1100 on 19 August, *Diamond Emblem 1* left the Stracey Arms mooring and headed east down the River Bure toward Great Yarmouth, where the group planned to spend the afternoon visiting the town. About 30 minutes later, while *Diamond Emblem 1* was being driven from the upper helm control position, the engine stopped. The family thought that the nominated skipper's youngest son, who was 4 years old, may have pressed the engine stop button on the lower helm console. After several unsuccessful attempts to restart the engine, the nominated skipper decided to drop the boat's anchor and seek assistance. At 1145, the driver called Ferry Marina and asked for advice. One of the hire boat operator's engineers talked her through several potential solutions, but again the engine failed to start. The engineer told the driver that someone would be sent to help.

At about 1215, as the Ferry Marina staff were preparing to set off, someone managed to restart the engine from the lower helm control position. The driver called Ferry Marina and advised them that they were back underway. The Ferry Marina engineer asked her to call back when they reached Great Yarmouth.

For the next hour, the nominated skipper's eldest son, who was 16 years old, steered *Diamond Emblem 1* from the lower helm control position down the river, supervised by his father. About 5 minutes before the boat reached the moorings at Great Yarmouth Yacht Station, the driver on the upper deck shouted down to the cabin space and asked for the control to be passed to the upper helm control position. In response, the driver heard someone shout "OK, it's all yours". The driver at the upper helm put the propulsion control lever to an ahead position and began to steer along the river toward the yacht station. The lower helm control position was vacated following the request to switch control to the upper helm. At 1317, *Diamond Emblem 1* arrived at the yacht station travelling at a speed of about 4 to 6 knots. The driver sat at the upper helm control position and the nominated skipper was standing

Map courtesy of Broads Authority

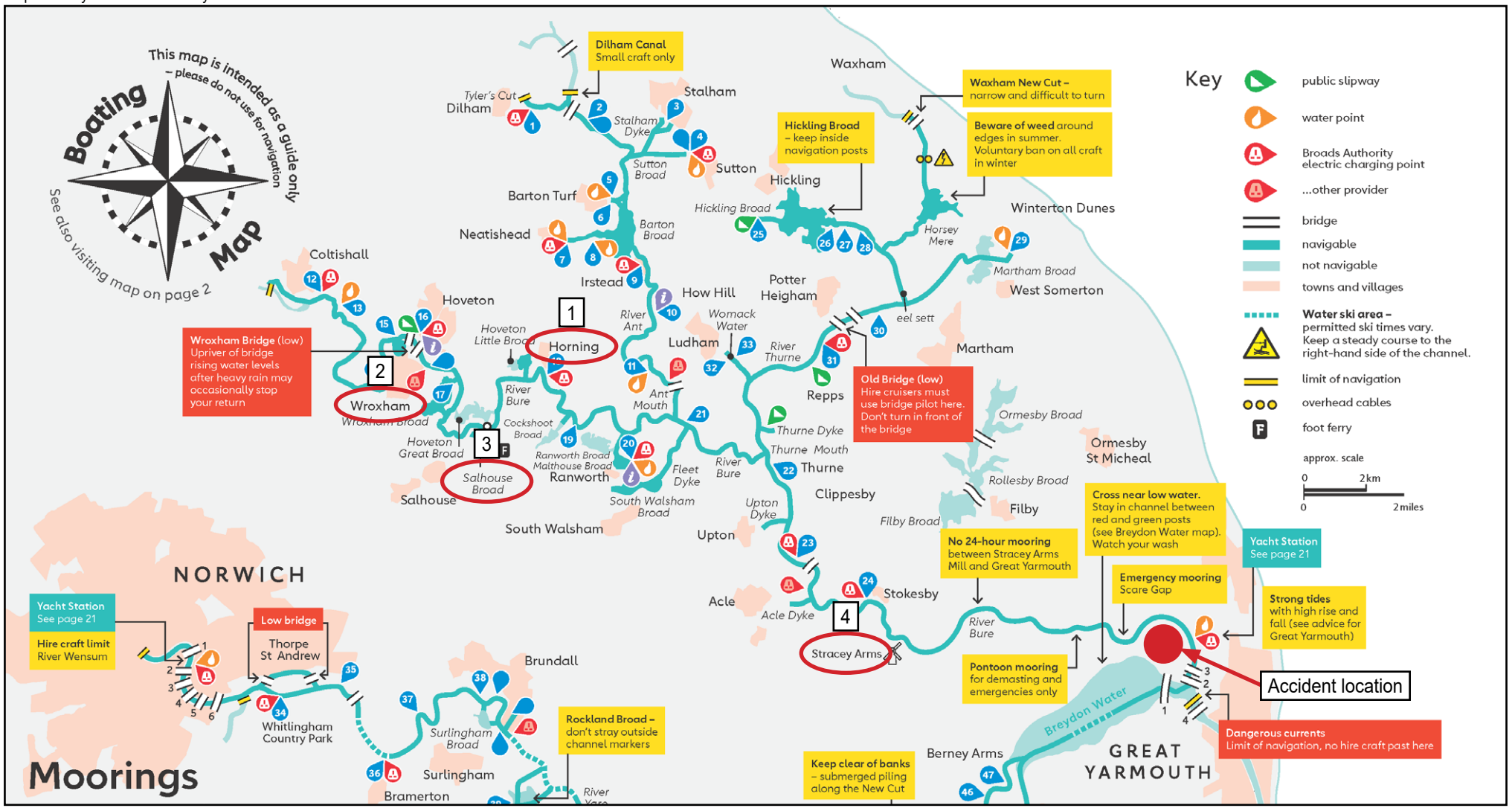

Figure 5: Norfolk Broads Boating Map, showing sites (circled) visited by the family during the trip starting on 17 August 2020

adjacent to her on the port side deck. Laura sat behind her sister on the upper deck, her mother was standing on the upper deck access steps looking forward and her father was in the cabin space with the children. As the motor cruiser passed the yacht station, the nominated skipper shouted down through the cabin space sliding door to ask for help on deck to moor the boat.

1.3.2 The accident

At 1317:19, a Broads Authority ranger shouted across from outside the yacht station to *Diamond Emblem 1* and asked, “Cruiser, are you going through the bridges?”. Laura replied, “No, we are going to moor up”. The ranger then told them there was no space at the moorings.

At about the same time, the driver tried to slow the boat by pulling the propulsion control lever into reverse and her father put his head up through the cabin space sliding door to see what was happening. Shortly after the exchange with the ranger, the driver began to turn *Diamond Emblem 1* to port. The driver then pulled the propulsion control lever to its full reverse position. As *Diamond Emblem 1*’s engine pitch increased, its speed toward the boats moored on the riverbank also increased. As they neared the moored boats, the nominated skipper walked swiftly to the forward deck and Laura’s father climbed back down into the cabin space **(Figure 6)**.

The driver put the propulsion control lever back to neutral and tried desperately to engage astern propulsion, but the lever would not move. In a last attempt to avoid a collision, the driver shouted down to the cabin space for someone to cut the engine.

At 1317:44, *Diamond Emblem 1* collided with the stern of the moored motor cruiser *Challenger* **(Figure 7)**. The force of the impact caused a wine glass to fall onto the cabin space floor and shatter and the youngest child cried out.

Almost immediately, the pitch of the engine increased and *Diamond Emblem 1* started to accelerate astern toward the embankment wall on the opposite side of the river. Laura, who was standing on the upper deck, walked aft and climbed down the steps, past her mother who was standing on them, to the aft deck. Simultaneously, her father began to pick up the broken glass from the cabin space floor below and comforted the distressed child.

At 1318:01, as Laura opened the aft deck door to the cabin space, *Diamond Emblem 1* made heavy contact with the embankment wall **(Figure 8a)**. At the same time, Laura was thrown violently backwards into the water, while holding a large piece of material that appeared to be the curtain that was hanging inside the doorway, and did not resurface. The impact with the wall also caused a length of mooring rope that had been loosely stowed on the boat’s port aft side deck to fall aft into the water **(Figure 8b)**.

In the cabin space, her father, who at some point during the commotion had tried to stop the boat by pulling the propulsion control lever back at the lower helm control position, heard the engine screech and pressed the engine stop button.

The rangers and members of the public on the embankment who witnessed the accident shouted across to *Diamond Emblem 1* that someone had fallen overboard. The adults on board quickly realised that Laura was missing and that she was trapped under the boat.

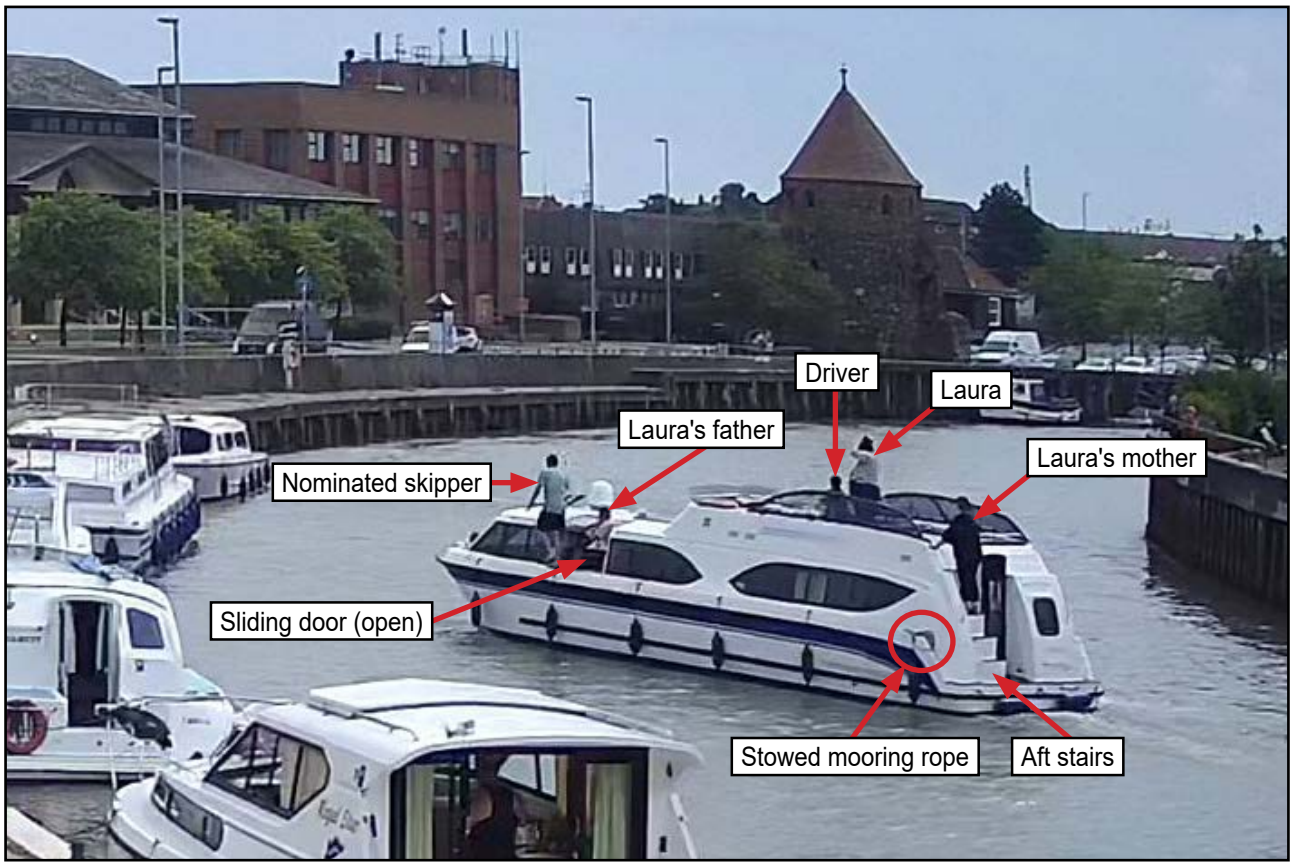

Figure 6: *Diamond Emblem 1* approaching the moored boat *Challenger* at 1317:38, showing the five adults

Figure 7: *Diamond Emblem 1* making contact with the moored boat *Challenger* at 1317:44

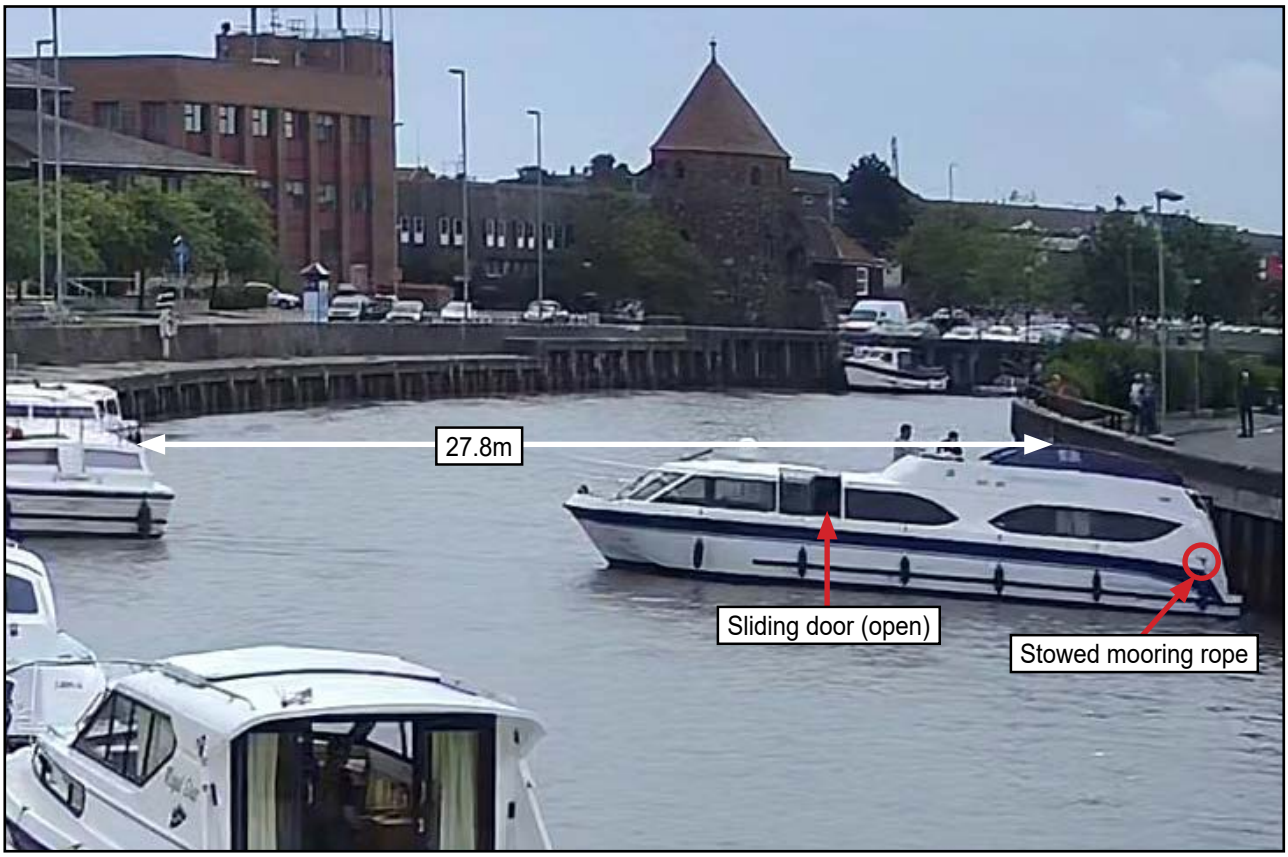

Figure 8a: *Diamond Emblem 1* making contact with the river embankment wall at 1318:01

Figure 8b: Mooring rope on port aft deck of *Diamond Emblem 1* falling into the water at 1318:01

The driver, and shortly afterwards the nominated skipper, entered the water and discovered that Laura was entangled and trapped against the boat's propeller and rudder. They tried to release her but were unsuccessful. The rangers alerted the emergency services and responders from the police, land and air ambulance services, the Royal National Lifeboat Institution and the fire service arrived on scene.

Despite the efforts of the emergency services, Laura could not be rescued and her body was later recovered by divers. The driver of the boat was subsequently breathalysed, with a negative result.

1.3.3 Postmortem

Laura's postmortem examination report stated the cause of death as multiple injuries and drowning, with the former caused by the propeller and entanglement in a rope.

Toxicological tests revealed no traces of alcohol or recreational drugs. However, the tests identified traces of a number of prescribed medications, including high levels of the opioid analgesic dihydrocodeine. Several of the medications stated dizziness as a common side effect and, in one instance, confusion. The toxicological report stated that:

> *The interaction between several drugs are complex, and the likelihood of significant side-effects or toxicity including effects on cognitive behaviour and motor function may be enhanced.*

The postmortem report further concluded that:

> *Given the circumstances of her death, and the autopsy findings, the relatively high concentration of dihydrocodeine found in her blood is unlikely to be significant.*

1.4 ENVIRONMENTAL CONDITIONS AT GREAT YARMOUTH YACHT STATION

Diamond Emblem 1 arrived at Great Yarmouth Yacht Station on 19 August, about 2.5 hours after high water. The tide was ebbing and low water was predicted to occur at 1729. There was a light breeze and the weather was fine and dry.

Great Yarmouth Yacht Station is about a 10-minute walk from the town centre and there are two fixed bridges between it and the entrance to Breydon Water **(Figure 9)**. Boats should always approach the moorings against a running river tide and the ideal time to arrive at the yacht station was at slack low water. This made it easier to manoeuvre onto the moorings and allowed boats to pass under the bridges and turnaround if required. Slack water began about 1 hour after low water and lasted about 2 hours.

The height of the river at the yacht station can vary from about 2m at low water to about 4m at high water. To help boat drivers assess whether there was enough headroom to pass safely under the bridges into Breydon Water, a river gauge was positioned on the bank opposite the yacht station. When *Diamond Emblem 1* passed the yacht station, the gauge was reading 2.6m.

Map courtesy of Google Earth

Figure 9: Location of *Diamond Emblem 1* at the time of the accident

A label positioned on the lower helm console stated that the height of *Diamond Emblem 1* with its upper deck windscreen and canopy lowered was 2.52m. *Diamond Emblem 1*'s windscreen and canopy side screens were in place and the driver was conscious that there was insufficient headroom under the bridges for the motor cruiser.

1.5 THE BOAT HIRERS

The skipper and the driver had been on several boating holidays in the past and both had previous experience driving boats. In 2018, the family (without the sisters' parents) hired Ferry Marina's motor cruiser *Azure Emblem* for a similar 7-day holiday on the Broads. *Azure Emblem* was 11.6m long and had a single helm control system.

During both the *Diamond Emblem 1* and *Azure Emblem* boat hire holidays, the elder children were given the opportunity to steer the motor cruisers under close supervision. The nominated skipper and main driver were the same for both trips and undertook all boat handling tasks and did most of the driving.

The nominated skipper's eldest son had driven the boat several times during the two days prior to the accident, but only from the upper helm control position and under supervision. He was aware of the helm position changeover lever but did not know how to switch controls between the helm control positions; this task was always done by either the nominated skipper or the driver. Laura and her parents had no experience of driving boats; she and her father did not take the helm of *Diamond Emblem 1* during the trip, but her mother did take a turn.

1.6 *DIAMOND EMBLEM 1*

1.6.1 Construction and layout

Diamond Emblem 1 was a Funnell 42 Sundeck motor cruiser built in 2010 at the Ferry Marina boatyard. The boat's design was agreed in line with the requirements of the owners of Ferry Marina at the time and provided by John R. Moxham Designs, a naval architecture company. It was constructed from glass reinforced plastic and the primary means of boarding was via the aft deck. The distance between the aft edge of the aft deck and the access door to the cabin space was 850 millimetres (mm). The distance between the edge and the bottom of the steps that led to the upper deck was 250mm **(Figure 10)**. A full-length curtain could be drawn across the aft door and ran along a curtain track mounted on the cabin ceiling just inside the doorway **(Figure 11)**. The curtain, which was stowed on the port side of the doorway when not being used to cover the door, was missing when the boat was inspected after the accident.

In addition to the aft deck door and sliding door on the port side, there was a hatch in the cabin space roof above the forward saloon area and a hatch adjacent to the upper helm control position that opened into one of the cabins below **(Figures 3b** and **10)**. When *Diamond Emblem 1* arrived at Great Yarmouth Yacht Station, the hatch adjacent to the upper helm control position was closed. However, the port side door and forward hatch were both open and communication between the upper deck and cabin space was achieved by shouting or relaying verbal messages through the side door and forward hatch. The horizontal and vertical separation between the helm positions was 4.5m and 1.5m respectively.

Image courtesy of Norfolk Constabulary

Figure 10: Aft deck and staircase between upper and lower decks on *Diamond Emblem 1*

1.6.2 Construction and design technical standard

Diamond Emblem 1 was designed, constructed and equipped to meet the requirements of the Recreational Craft Directive (RCD) 94/25/EC[2], as amended by Directive 2003/44/EC in 2003, for category D[3] conditions.

The RCD was introduced in 1998 by the European Commission (EC) to ensure a uniform level of safety in the design and manufacture of recreational craft with a hull length of between 2.5 and 24m throughout the European Economic Area (EEA). The Directive established the free movement of recreational craft within the single market and was first implemented in the UK by the Recreational Craft Regulations 1996, which were superseded by the Recreational Craft Regulations 2004 and 2017 respectively.

[2] In November 2013, Directive 94/25/EC was repealed and replaced with Directive 2013/53/EU, which was published on 28 December 2013.

[3] Designed for voyages on sheltered coastal waters, small bays, small lakes, rivers and canals when conditions up to, and including, wind force 4 and significant wave heights up to, and including, 0.3m may be experienced, with occasional waves of 0.5m maximum height, for example from passing vessels.

Figure 11: View of *Diamond Emblem 1* stern, showing handholds and (inset) ceiling-mounted curtain track inside aft doorway

1.6.3 Recreational Craft Directive essential requirements

A manufacturer is responsible for ensuring that a boat complies with the RCD by meeting essential requirements[4]. This is frequently demonstrated by compliance with harmonised standards, which provide a presumption of RCD compliance. The EC publication, the 'Blue Guide' on the implementation of EU products rules 2016 (2016/C 272/01), which was originally published in 2000, stressed that essential requirements were to be applied as a function of the inherent hazards in a product.

It was therefore incumbent upon manufacturers to conduct a risk analysis to identify all possible risks presented by a product, with the analysis to be included in the technical documentation:

> *In addition, the manufacturer needs to document the assessment of how he is addressing the risks identified to ensure that the product complies with the applicable essential requirements (for example, by applying harmonised standards).*

[4] A phase in the progression of EU legislation for goods was the 'New Approach' developed in 1985, which restricted the content of legislation to 'essential requirements' leaving the technical details to European harmonised standards.

1.6.4 Application of the Recreational Craft Directive

The RCD required a manufacturer to issue a written Declaration of Conformity (DoC) declaring that the essential requirements had been met, including references to the relevant harmonised standards or other technical specifications used. The manufacturer was also required to obtain a Conformité Européenne (CE) mark, which had to be placed on a builder's plate on the boat. The plate fitted to *Diamond Emblem 1* **(Figure 4)** stated that the boat had been designed for a recommended onboard capacity of ten persons, with a maximum recommended combined people and luggage load of 1150kg.

The RCD further required the manufacturer to provide technical documentation to enable understanding of the design, manufacture and operation of the boat in order to allow assessment of conformity with the requirements. An owner's manual, providing all the information necessary for the boat's safe use, including risk prevention and management, was also listed as one of the essential requirements.

1.6.5 Declaration of Conformity and technical documentation

The DoC prepared for the Funnell 42 Sundeck Ferry Emblem Fleet, of which *Diamond Emblem 1* was a part, listed the 23 essential requirements and a short explanation of how each of these had been met the under the heading *Documentation and Standards used to comply with essential safety requirements* **(Annex A)**. The technical manual provided further explanation of the pertinent design features that related to the essential requirements **(Annex B)**.

Examination of the DoC and technical file revealed the following:

- Incorrect standards were referenced for the essential requirements.
- Several technical file annexes referenced in the technical manual were missing from the technical file.
- Trial data was not included in the technical file.
- Records of test procedures and results were not included.
- There was no justification for the methods used and how the tests met the essential requirements.
- The DoC was neither signed nor dated as required.
- The technical file did not contain a risk analysis document.

The technical manual stated that the recommended maximum load of people the boat could carry was eight, corresponding to a maximum combined people and luggage weight of 920kg.

1.6.6 Owner's manual

As required by the RCD, an owner's manual **(Annex C)** had been prepared for *Diamond Emblem 1* and was attached to the technical manual. This 7-page document further summarised the boat's key attributes and reiterated the

recommended maximum loading figures stated in the technical manual. The owner's manual additionally highlighted dangers, warnings and cautions about the boat's safe operation and handling, which were categorised as:

> ***Danger*** *– Denotes that an extreme intrinsic hazard exists which would result in high probability of death or irreparable injury if proper precautions are not taken.*
>
> ***Warning*** *– Denotes that a hazard exists which can result in injury or death if proper precautions are not taken*
>
> ***Cautions*** *– Denotes a reminder of safety practices or directs attention to unsafe practices which could result in personal injury or damage to the craft or components or to the environment.*

The manual's information included:

- ***Caution*** *Care must be taken when moving around the deck as the deck has a step in it.*
- ***Caution*** *When using the lower helm position, visibility is obstructed to the rear, obtain a lookout as necessary or use the upper helm.*
- ***Caution*** *There are blind spots from the upper helm position with regard to small items such as canoes and dinghies. From and standing position with a 1m movement in any direction there will be up to a 2.8m blind spot astern and a 2.5m blind spot to the port side.*
- ***Warning*** *No one should sit on the roof at any time, or stand on the decks while in motion.*
- *Make sure you have selected the correct helm position, the handle will point to the selected position.* [sic]

The owner's manual contained no hazards considered to represent a **Danger**, nor was there explicit reference to the risk of falling overboard or the hazards associated with the use of the dual helm controls. Neither a copy of the technical manual nor owner's manual was available on board *Diamond Emblem 1* at the time of the accident.

1.6.7 Protection from falling overboard requirements

On essential requirement 2.3, *Protection from falling overboard and means of reboarding*, Annex 1 of the RCD stated that:

> *Depending on the design category, craft shall be designed to minimise the risks of falling overboard and to facilitate reboarding.*

The relevant harmonised standard was International Organization for Standardisation (ISO) 15085:2003 *Small craft – Man-overboard prevention and recovery*. The ISO standard specified the design, construction and strength requirements intended to minimise the risk of falling overboard, as well as the requirements to facilitate reboarding.

ISO 15085:2003 required working areas on deck to be made slip-resistant with a minimum width of 100mm for craft classed as design category D. Although guardrails were not required for category D boats, the standard required handholds to be provided at a maximum distance of 1.5m from each other and reboarding facilities to be available. Any part of the craft that could be gripped by hand to reduce the risk of falling overboard such as a seat edge, cleat, handle or steering wheel could be considered as handholds.

The DoC prepared for the Funnell 42 Sundeck Ferry Emblem fleet stated the following:

> *2.3 Protection from falling overboard Empirical test data*

The DoC made no reference to ISO 15085:2003, nor was there any clarification of the empirical test data used or referred to.

The technical manual's explanation for *Protection from falling overboard* stated:

> *There are handrails located all round the deck area, also a rail around the screen area on the front deck. There is a handrail on the aft steps up to the upper helm… There is a high toe rail all round the side decks to help prevent slipping.* [sic]

The main handrail for the steps leading from the aft deck to the upper deck was positioned on the outboard side of the steps **(Figures 10** and **11)**. There was a short vertical handrail at about head height level on the inboard side of the steps that could be used when passing through the aft deck door. There was also a horizontal handrail on the other side (starboard) of the door opening.

At the time of the accident, Laura's mother was standing on the aft staircase and holding onto the small handrail on the inboard side of the steps. The handrail on the starboard side of the door was out of reach when the door into the cabin space was open.

1.6.8 Propulsion and steering

Diamond Emblem 1's propulsion system comprised an unguarded four-blade fixed pitch propeller driven by a hydraulic motor, powered by a hydraulic pump. This was in turn driven by a 44.7kW (60 horsepower) diesel engine. The flow of hydraulic fluid to the motor was controlled by a directional spool valve with three positions: forward, neutral and reverse.

The steering system was powered by a single hydraulic cylinder that could be activated from either helm position. There was no interlock between the upper and lower helms and steering could be conducted at either helm control position regardless which position was active and had propulsion control.

Diamond Emblem 1 was fitted with a bow thruster driven by a 2kW electric motor. The bow thruster could be controlled from either helm position irrespective of the active position. The bow thruster was typically used to help manoeuvre the cruiser on and off a mooring and turn it around in the narrow waterways.

1.6.9 Dual helm propulsion control levers

Diamond Emblem 1 was equipped with MT-3 top mount single lever dual-function control units **(Figure 12a)** that were manufactured by Teleflex Marine[5] and widely used on board small motor boats and cruisers.

The hydraulic system could be taken out of gear (disengaged) by pulling the propulsion control lever out sideways by a distance of 4mm from its neutral position **(Figure 12b)**. The lever could then be pushed forward or pulled back. This allowed the engine speed to be increased during engine start-up providing time for the engine to warm up without the propeller turning. The function could be performed at either helm control position regardless of the helm position changeover lever's setting.

Image courtesy of Gael Force Marine Equipment (www.gaelforcemarine.co.uk)

Image courtesy of Norfolk Constabulary

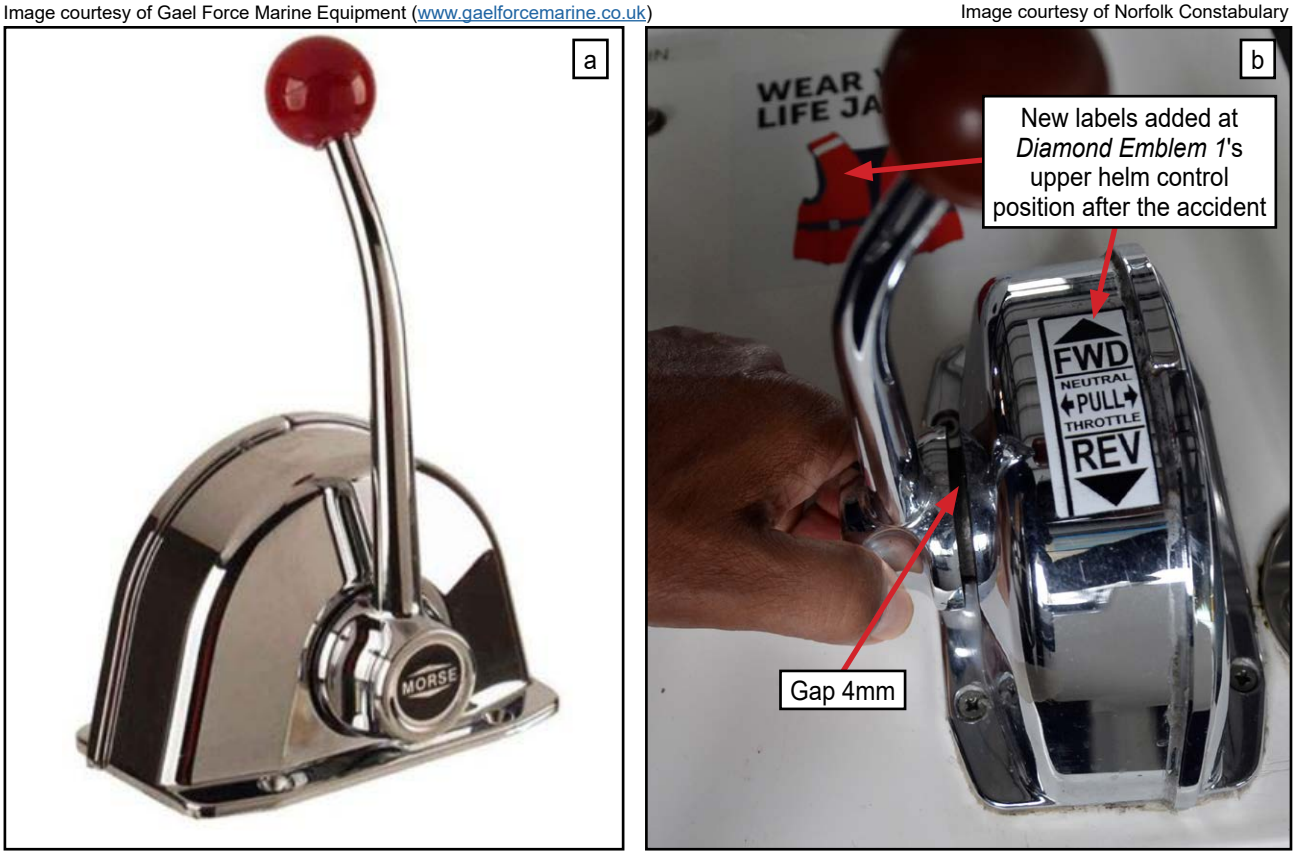

Figure 12: Teleflex MT-3 top mount single lever control (a) and lateral disengagement of propulsion control lever (b)

The control levers were connected to the engine propulsion and hydraulic system's directional control spool valve via Teleflex push/pull cables. Moving the propulsion control lever forward or back from its neutral detent first engaged the hydraulic directional control spool valve. This caused the propeller to rotate in the direction selected at its slowest speed. Moving the control lever further activated the engine's propulsion control. These sequential steps ensured that the hydraulic spool valve was first set to the boat's desired direction of motion of the boat (forward or reverse) before increasing the engine and therefore propeller speed **(Figures 13a** and **13b)**. Labels at the upper and lower helm control positions indicated that engine speeds of 1000 revolutions per minute (rpm) and 1400rpm corresponded to boat speeds of 4 miles per hour (mph) and 6mph respectively. An interlocking system ensured that the direction the hydraulic propulsion motor was turning could only be altered from the selected helm control position.

[5] Teleflex Marine was renamed Seastar Solutions in 2013.

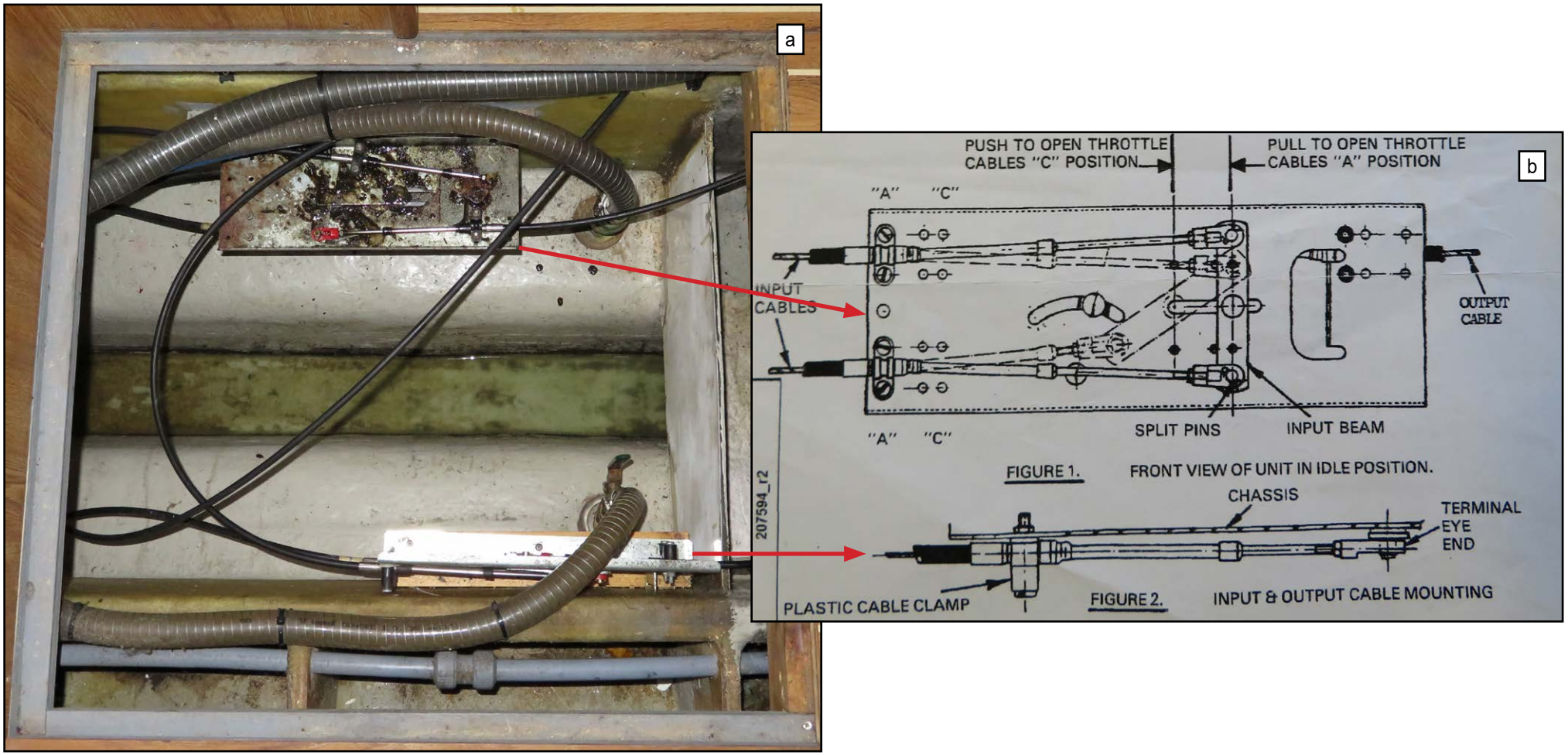

Figure 13: Teleflex control system for direction and propulsion (throttle) control (a) and Teleflex control system schematic drawing (b)

The propulsion control units were supplied with labels to indicate the forward, neutral and reverse positions. The labels on the control levers at both the upper and lower helms were almost completely faded and illegible **(Figure 14)**.

1.6.10 Helm position changeover

The transfer of propulsion control from one helm position to the other was achieved by pulling out the helm position changeover lever at the lower helm position **(Figure 4)**, turning it through 90° and pushing it back in. To do this, both the upper and lower propulsion control levers had to be in their neutral positions. When the changeover lever was in the vertical position (labelled *LOWER STEERING*), propulsion control was at the lower helm control position and when set in the horizontal position (labelled *UPPER STEERING*), control was at the upper helm control position.

Diamond Emblem 1's technical manual stated:

> *The main steering position is from the upper helm. This position gives clear all round vision in all directions, however, there are large blind spots at the waterline level … The lower helm does not give any visibility astern or to starboard aft sections. There is a warning notice in place for this at the helm position.*

There were no notices on the boat to indicate that the upper helm position was the main steering position. Neither was there any notice displaying the visibility limitations of the upper and lower helms.

1.7 POST-ACCIDENT PROPULSION CONTROL TESTS

On 21 August 2020, MAIB inspectors attended the Ferry Marina boatyard and inspected *Diamond Emblem 1*. During the inspection, the operation of engine controls, steering system and bow thruster were demonstrated and all functioned as expected. No mechanical or hydraulic system faults were identified.

On 25 September 2020, the MAIB carried out further tests on the engine control system and established that:

- The engine could be started with the propulsion control lever in gear, in either the ahead or reverse position.
- The engine could be started or stopped from either the upper or lower helm control position using the start key or stop buttons irrespective of which helm position was selected.
- The propulsion control lever at the helm control position that was not selected could not be moved without pulling the lever out from the neutral position.
- When the lower helm control position was active and the lower helm propulsion control lever set to the half ahead position, the upper helm propulsion control lever could be disengaged (pulled out) and set to reverse; pulling the upper helm propulsion control lever to the full reverse position caused the engine speed to increase.
- The upper helm propulsion control lever could be pulled out of gear using one hand and holding the top of the lever. The nominated skipper had probably done this the day before the accident while attempting to put the lever into

Image courtesy of Norfolk Constabulary

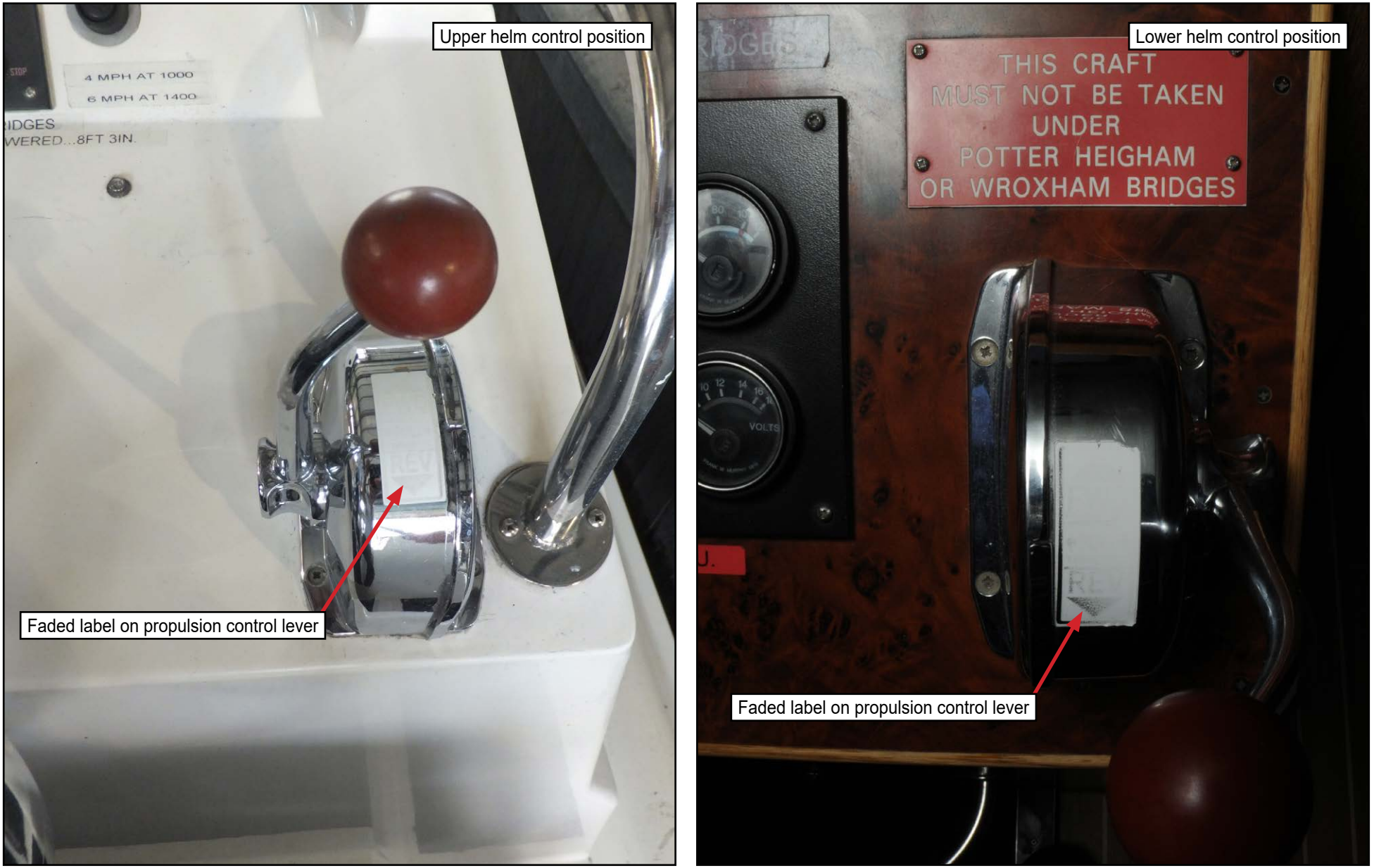

Figure 14: Faded propulsion control labelling at upper and lower helm control positions at time of *Diamond Emblem 1* accident

reverse. On that occasion, he quickly realised the propeller was not turning and re-engaged the hydraulic drive by returning the propulsion control lever to its neutral position.

1.7.1 Small craft helm control standards

ISO 25197:2020 *Small craft – Electrical/electronic control systems for steering, shift and throttle*, contained the technical standards for craft with more than one helm position. This ISO standard was first published in 2012. It included the following requirements for multiple helm systems:

- Each helm station shall give a visual indication when active;
- Each helm station shall, by visible and/or audible means, alert the operator when the system enters the fail-safe mode;
- Transfer of command from one station to another shall be completed at the helm station intended to be active;
- In the event of a command station malfunction in a multiple helm station system, system shall: switch to a fail-safe mode; not prevent transfer to, or operation from, other helm stations; and alert the operator audibly that the failed command station is not working;
- The information provided in the owner's manual shall include locations of helm stations, information regarding all visual indicators and audible alerts, and information on how to transfer command from one helm station to another.

1.8 THE HIRE BOAT OPERATOR

1.8.1 Overview

The hire boat operator, A J & J Cator trading as Ferry Marina (Ferry Marina), came under new ownership in November 2018. Its hire fleet comprised 42 holiday cruisers with sleeping accommodation, and eight day-cruisers. Fourteen of the holiday cruisers had dual helm control.

The fleet included ten Emblem Class motor cruisers, which were built between 2009 and 2017, with lengths ranging from 9.3m to 12.8m. *Diamond Emblem 1* and its sister vessel, *Diamond Emblem 2*, were Ferry Marina's largest holiday cruisers.

1.8.2 Risk register

Ferry Marina maintained a risk register that was dated January 2020 and developed in consultation with an external risk assessment (RA) company. The risk register included 49 separate items of risk, 42 of which covered activities by employees while on business premises and on board the hire boats. The other seven risks considered the onboard activities of its hire boat customers.

One of these seven risks related to falling overboard from a hire boat, with the hazards identified as drowning, hypothermia and waterborne diseases. The category of people particularly at risk of falling overboard from hire boats was

identified as inexperienced/novices and those less able, with a potential severity of *death* and an *improbable* likelihood. The control measures to mitigate the risk were listed as follows:

- *Each customer is issued a buoyancy aid – these are recorded on the hand over form.*
- *Man over board procedure is explained.*
- *Each customer is told the importance of wearing the lifejackets.*
- *Posters on lifejacket use are up in the office, details are also in the skipper's manual.* [sic]

The application of these control measures was considered to reduce the likelihood to *remote* with the hazards deemed to be *Adequately controlled*.

The risk associated with the activity 'Cleaning Boat Exteriors' included a control measure to mitigate the risk of falling overboard. It stated:

> *Boats all fitted with hand/guard rails and handholds.* [sic]

The risk of an injury caused by a turning propeller was not included in the risk register. There were also no identified risks relating to: the use of boats with dual helm controls; a loss of control resulting in a collision or allision; or a lack of visibility from the helm positions.

1.9 MOTOR CRUISER VIDEO TUTORIALS

Ferry Marina had produced video tutorials that explained the key features of its motor cruisers and the operation of onboard equipment and controls. The tutorials where available on its website and links were sent to its customers. The video link for *Diamond Emblem 1* was sent to the nominated skipper and he had watched it before travelling to Norfolk.

The duration of *Diamond Emblem 1*'s video tutorial was 6 minutes and 25 seconds. Most of the video focused on the boat's domestic and ancillary systems, such as the toilet, cooker and television. The instructor also explained the switches, buttons, gauges, and controls at the lower helm console. He demonstrated how to start the engine, how to transfer control between the lower and upper helm positions, and how to stop the engine.

The video did not show the upper helm control position console or provide any guidance on how to communicate between the two helm control positions. During the video, the instructor explained that the engine should always be started from the lower helm control position. No key was provided for the upper helm start switch on board *Diamond Emblem 1*.

To start the engine, the instructor pulled the propulsion control lever out of gear and placed it at its half ahead position. Once the engine was running, the instructor pulled the propulsion control lever back to its neutral position and allowed it to re-engage. When he first tried to demonstrate how to apply forward and reverse propulsion, he could not move the propulsion control lever forward or back. This was

because he had unintentionally left the helm position changeover lever in the upper helm control position. This omission was quickly rectified without any comment by the instructor and the demonstration of the controls completed.

1.10 MOTOR CRUISER HANDOVER PROCESS

1.10.1 Overview

Ferry Marina's hire boat handover process usually commenced in the front reception area of its office, where the customers were fitted with lifejackets before being taken to their boat by an instructor and shown around. The instructor's handover brief followed the same format as that provided in the video tutorial. The length of the demonstrations varied depending on the amount of previous experience the customers had of driving the operator's motor cruisers.

A Ferry Marina handover form was completed by its instructors and signed by the nominated skipper. The form included: check boxes for starting and stopping the engine; use of the bow thruster; explanation of upper and lower helms; tides; Broads Authority byelaws; man overboard and collision. Under the section Trial Run the handover form listed: turn in the river; use of reverse gear; and effects of wind and tide. The form contained the following statement:

> *I have been given instruction on all of the items listed and have been given an acceptable trial run, guidance on handling and mooring up. I am responsible for all persons on board… Any and all damage will be reported to Ferry Marina with full details of any third parties involved.*

In-water trials were not routinely conducted for previous customers or for those who had experience of driving cruisers on the Broads.

Due to the restrictions introduced during the COVID-19 pandemic, only one person at a time could be taken on board for the handover brief. Both the driver and nominated skipper received elements of the brief from the instructor while the luggage was being loaded onto the boat.

During the onboard demonstration, the Ferry Marina instructor showed the skipper and driver how to change over helm controls and explained that the boat should be driven from the upper helm control position when mooring and unmooring. He took them both briefly to the upper helm control position, but did not conduct a trial run.

The abbreviations BB/NB[6] were printed on the top left corner of the handover form; BB was circled because the nominated skipper had previous experience of driving river cruisers. The handover form was signed by the nominated skipper but not by the instructor, and none of its checkboxes were ticked as completed **(Figure 15)**.

1.10.2 Onboard documentation

Customers were provided with copies of two documents as part of the handover process:

- **Skippers' Manual**: This 25-page booklet provided generic safety-related information, including navigation hazards; procedures to follow in an

[6] Been Before/Not Been Before.

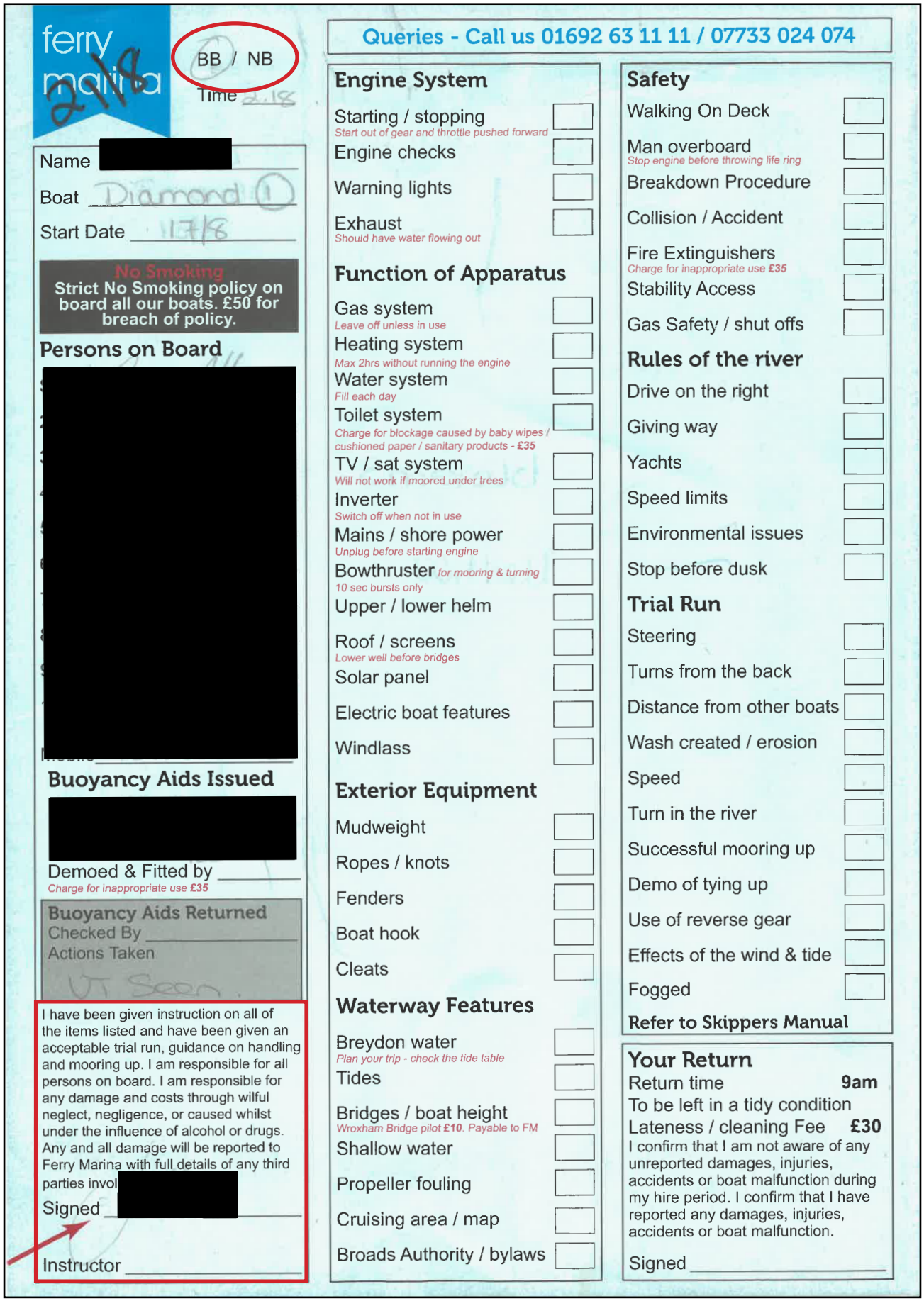

Figure 15: Incomplete handover sheet for the *Diamond Emblem 1* trip departing on 17 August 2020

emergency, which included details of the actions to be taken in the event of a person overboard **(Annex D)**; route planning; manoeuvring tips for driving, turning, and mooring; and guidance on the various geographical features of the Broads. The manual stated that a lifejacket should always be worn when on deck and, under the heading of Boat Safety:

- *Keep the ropes on board so they don't get tangled in the propeller*

- **Your Boat Information**: This 4-page document **(Annex E)** was specific to *Diamond Emblem 1* and stated a maximum of 12 people were to be on board. It provided procedures for various emergency scenarios, including a lack of reverse gear and running aground. Brief descriptions were provided of various onboard technical systems, supported by pictures. For the helm position, a photo of the changeover lever was provided along with the following instructions:

  - *Ensure both controls are out of gear before using the change over lever*

  - *If the change lever won't select, don't force it, try wriggling both gear sticks to ensure they are out of gear, then select again.* [sic]

1.11 THE HIRE BOAT CODE

1.11.1 Original Hire Boat Code

The Code for the Design, Construction and Operation of Hire Boats, commonly referred to as the Hire Boat Code (HBC), was published in 2009. It was developed jointly as a non-statutory code by the Maritime and Coastguard Agency (MCA), the Association of Inland Navigation Authorities (AINA) and the trade association British Marine Federation (currently known as British Marine). The HBC was written in two parts, *Power driven boats and Unpowered craft*.

Under the section Operational Standards of the HBC, detailed handover requirements were provided **(Annex F)** that included:

- Communication of pre-trip information to hire company customers.

- Demonstration of boat operation, including engine and steering controls.

- Provision of briefing material to boat hirers, including guidance on personal safety, detailed information on the functions of the boat and dealing with emergencies.

It stated:

> *In view of the importance of the handover process, hire operators are strongly recommended to periodically have their handover arrangements independently audited. Licensing authorities can reserve to right as part of licence conditions to carry out sample audits; having an independent audit available is likely to satisfy such a requirement.* [sic]

The HBC adopted an approach based on the foreseeable risks of hire boating activity and recognised that the responsibility to maintain adequate levels of safety should be shared by the navigation authorities, hire boat operators and hirers. The responsibilities listed for the hirer included nominating a skipper and ensuring that the skipper and any other members of the party nominated to drive or handle the boat attended the handover briefing. The HBC further stated that the hire

boat operator was to prevent the boat from departing if they concluded that the nominated persons had insufficient competence to handle the boat safely. At the time of the accident, the HBC did not contain a requirement to conduct trials during handover. It stated:

> *Throughout the handover process, the person giving the instruction should take account of any qualifications … or previous experience professed by the skipper(s), however this should only be recognised as an opportunity to accelerate the briefing, not dispense with it.*

The HBC also defined various technical and operational standards for boats, including that:

> *Handholds are any part of the boat that may be gripped by hand to reduce the risk of falling overboard. To be available around superstructure.*

It also indicated that weather decks and exterior tread surfaces were to be provided with effective slip-resistant surfaces/coatings.

1.11.2 Revised Hire Boat Code

In December 2019, a 12-week public consultation exercise was launched by AINA and British Marine that led to the issue of a revised version of the HBC in April 2021. The revised HBC included relevant changes to responsibilities, amendments to the technical standards and reiteration of the principles for safe hire boating. It also introduced new definitions and amended existing ones. The revised HBC was intended to be adopted as mandatory in 2022, where the licensing authorities had the power to do so. It included minor amendments to the handover process and stated that:

> *An in-water trial is an integral and important part of the handover process*

1.12 THE BOAT SAFETY SCHEME

1.12.1 Overview

The Boat Safety Scheme (BSS) was established in 1995 as a collaborative effort between British Waterways (now The Canal and River Trust) and the National Rivers Authority (now the Environment Agency). Its purpose was to harmonise existing construction and equipment standards for vessels operating in their waterways and to verify compliance by an independent 4-yearly boat examination.

Between 1997 and 2000, a requirement for the mandatory examination of boats was introduced. Subsequently, most inland navigation authorities adopted the BSS, making the 4-yearly examination a mandatory condition for licensing private and hire boats operating in their waterways.

In 2013, the UK's inland waterway navigation authorities invited boat hire operators and other interested parties to participate in a general review of hirer safety limited to self-drive, powered hire boats. The objective of the review was to strike an appropriate balance between the roles and responsibilities of the navigation authorities, hire operators and hirers in ensuring hirer safety. As a result, the BSS standards for hire boats, previously reviewed in 2002, were revised. A modified set of BSS requirements for hire boats was introduced in April 2017. The revisions included the introduction of six new requirements and the improvement or clarification of five existing requirements. These were stated to include the

alignment of the handrail/guardrail requirements with ISO 15085 and the provision of ‘handholds’ at designated crew areas. They also made 23 private boat advisory checks mandatory for hire boats.

The 2017 revisions included the introduction of a 12-page checklist titled *BSS Examination Record Form – Hire Boats* **(Annex G)**, which required completion during each 4-yearly examination.

Divided into ten sections, part 10.1 *Protection from falling overboard* included the following checks:

- *Are all designated external Crew Areas, companionway steps, and boarding planks provided with suitable slip-resistant surfaces?*
- *Are all designated external Crew Area decks provided with suitable handholds in good condition?*

In 2019, an interim review was conducted of the core BSS Examination Checking Procedures used for examining private boats, resulting in the issue of an updated version of the Examination Record Form in September 2021. This included several technical changes and a large number of editorial changes, but no changes to the wording of the above checks. The revised BSS Core Examination Checking Procedures (for Private Boats and Hire Boats) were issued for public consultation on 7 March 2022, with the updated version intended to formally come into effect in early June 2022.

1.12.2 BSS examination of *Diamond Emblem 1*

Diamond Emblem 1 was examined on 15 December 2017 by a BSS Examiner. The report was unsigned but confirmed that the boat met all applicable minimum safety standards and had an expiry date of 16 January 2022. The checks were performed with the aid of a laminated sheet, which was later erased. No permanent records were maintained despite the BSS requirement to keep such records for a period of 6 years. The BSS reported that the reusable laminated checklists were withdrawn in 2017 as they did not inherently provide the level of protection an examiner needs.

1.13 THE BROADS

1.13.1 Governance

The Broads is a network of 63 shallow lakes termed ‘broads’ that were formed by flooded peat works and joined by seven rivers in Norfolk and Suffolk. There are over 120 miles of navigable waterways and speed limits of between 3mph and 6mph are in place for the restricted areas. The speed limits are clearly indicated on riverbanks.

The Norfolk and Suffolk Broads Act 1988 established the Broads Authority, of which one of its three primary functions was to manage the Broads for the purposes of:

- Protecting the interests of navigation.

During the 1990s, several enforceable byelaws relating to navigational matters and vessel dimensions and registration were introduced within the Broads.

In 2006, the Broads Authority introduced the Broads Authority (Boat Safety Standards) Byelaws, which formalised the requirement to comply with the BSS within the Broads. In 2009, these byelaws were superseded by the provisions of

the Broads Authority Act 2009, which made compliance with the BSS examination a mandatory requirement. The 2009 Act also gave the Broads Authority further powers for the regulation and management of the navigation area and enabled it to introduce compulsory third-party insurance. The Act also transferred the powers of hire boat licensing from the local authorities to the Broads Authority, when it was able to apply section 94 of the Public Health Acts Amendment Act 1907.

At the time of the accident, twelve full-time rangers were employed by the Broads Authority to patrol five main areas of the Broads all year round. The full-time rangers were assisted by five seasonal rangers and volunteers during the peak summer period. The Broads Authority operated eight patrol launches and conducted regular public safety events such as 'Super Safety Days' and the 'Wear It' lifejacket campaign.

The Broads Authority's annual report for 2018-19 stated:

- *Our key means of ensuring safety is the Port Marine Safety Code, which requires harbour authorities to undergo a Formal Safety Assessment and to maintain a Safety Management System, to control the identified risks to a level as low as reasonably practicable. Our compliance with the code has been confirmed until March 2021.*

- *Safety standards on the waterways are high, although speeding, and people falling while getting on and off boats, are commonly reported problems.*

1.13.2 Licensing

The Broads Authority granted operator licences for hire boat companies under Section 94 of the Public Health Acts Amendment Act 1907 and Sections 12 and 40 of the Broads Authority Act 2009. Each licence enabled the operator to let for hire, or use for carrying passengers for hire, the vessels listed in a schedule. The Broads Authority also issued individual licences for each hire boat. The licences, both for the company and individual hire boats, had an annual validity running from 1 April to 31 March.

The Broads Authority Hire Boat Operator Licensing Conditions document **(Annex H)** set out conditions for granting licences. The first condition stated:

> *(a) Each Vessel is licensed to carry the number of persons indicated against the Vessel in the Schedule.*
>
> *(b) The number of persons that the Vessel is licensed to carry must be conspicuously displayed on the Vessel using a notice or notices provided by the Authority.*
>
> *(c) A Vessel must not carry any number of persons in excess of that permitted by this Licence.*

Diamond Emblem 1 was licensed to carry up to 12 people and the permitted combined maximum people and luggage weight stated on its Broads Authority boat licence sticker was 1176kg.

The Licensing Conditions document required that the authority was informed of any changes in the ownership or particulars of any vessel within 14 days of the change(s).

1.13.3 Broads Authority audits

The title of the Broads Authority's annual audit document **(Annex I)** indicated that these were conducted annually. However, the Broads Authority audited the hire boat companies operating in its area at 3-yearly intervals. Prior to the accident on *Diamond Emblem 1*, Ferry Marina was last audited in November 2017 and no adverse comments or observations were recorded in the audit report. No further verification that the vessels were being operated in accordance with the relevant requirements was conducted when Ferry Marina changed ownership in November 2018.

Audits were conducted in two parts: operator checks and vessel checks. The operator checks included comparison of handover procedures against best practice identified in the HBC. The vessel checks were carried out on a randomly selected vessel and included verification of: the vessel's compliance with the requirements of licensing; reboarding arrangements if the freeboard exceeded 1m; guarding of propeller shafts; and a record of onboard handovers.

DoCs older than 7 years were not retained by the Broads Authority, including the DoC for *Diamond Emblem 1*. At the time of the accident, the DoC for another Ferry Marina vessel, *Zircon Emblem*, built in 2017, was held by the Broads Authority but was unsigned.

1.14 TRADE BODIES AND ORGANISATIONS

1.14.1 Association of Inland Navigation Authorities

The AINA was formed in 1996 as a membership organisation for inland navigation authorities in the UK. AINA's membership included the Canal & River Trust, the Environment Agency and the Broads Authority in addition to local government authorities, private canal companies, internal drainage boards and a variety of public and charitable trusts. In 2021, its membership comprised one Welsh and 16 English navigation authorities.

1.14.2 British Marine

British Marine is a trade association for the UK leisure, superyacht and small commercial marine industry. At the time of the accident, it had over 1500 members that included boat builders, boatyards, and passenger boat owners. In 2018, the Quality Accredited Boatyard Scheme (QAB) became a condition for British Marine membership. This accreditation scheme was developed by British Marine in conjunction with VisitEngland, the official tourist board for England, and indicated that hire boat operators are committed to quality, with assessments every 3 years and random inspections during the 3-year cycle. The QAB Standard **(Annex J)** outlined the assessment criteria for a hire boat operator, including health and safety processes, handover procedures and the operator's website and brochure. It included a requirement for: a documented safety management system; a policy for the review of risk assessments; documented emergency procedures for likely incidents; a company Designated Person to be nominated; and details of the handover, such as its start and completion time, to be recorded.

At the time of the accident, there were 23 boat hire companies on the Broads offering onboard living accommodation. Of these companies, 19 were affiliated to the Broads Hire Boat Federation, which was also part of British Marine, and 15 of the 19 companies were hire boat operators. Only two of them were QAB accredited as the planned audits were not conducted due to COVID-19 restrictions. At the time of the accident, the QAB scheme was not a requirement of the Broads Authority's Hire Boat and Hire Operators licensing provisions.

Ferry Marina was not a member of British Marine. It had been a member under its previous ownership, but was never accredited to the QAB.

1.15 THE NATIONAL WATER SAFETY FORUM

The National Water Safety Forum (NWSF) is a voluntary network of diverse organisations with a shared interest in drowning prevention and water safety. It was established in 2004, following a government review into water safety.

The NWSF, hosted by the Royal Society for the Prevention of Accidents (RoSPA), was supported by core advisory groups focusing on various aspects of water safety, including inland waters, which was chaired by the Broads Authority at the time of the accident.

The NWSF publication, *Water Safety Principles*, recognised that:

> *…some participants over-estimate their skills and abilities to a large degree …* [sic]

and that:

> *…participants will have a range of abilities to recognise any given hazard. Some will over-estimate while others will under-estimate and sometimes fail to recognise a hazard exists.* [sic]

The NWSF encouraged the provision of training to improve competence. Both the original and revised versions of the HBC stated that the NWSF principles had been applied in their production.

1.16 PREVIOUS/SIMILAR ACCIDENTS

1.16.1 MAIB investigations

On 8 January 2006, the helmsman of *Olesea*, a hired narrow boat, was tipped over the guardrail around the stern and fell into the water when the boat struck the canal bank. The engine was stopped by a crew member who was standing on the canal bank and had to climb back onto the boat. The helmsman was entangled in the propeller and died from his injuries. The MAIB published a Safety Flyer[7] that disseminated the lesson that guardrails, where fitted, should be of sufficient height to prevent people falling overboard.

[7] https://www.gov.uk/maib-reports/person-overboard-from-narrowboat-olesea-with-loss-of-1-life

On 8 August 2020, a collision between *Rib Tickler* and a personal watercraft (MAIB report 3/2022[8]) caused one fatality and resulted in the Royal Yachting Association being recommended to address, in its *Personal Watercraft and Start Powerboating* handbooks, the issue of oversight of inexperienced and untrained helms.

1.16.2 Accidents in the Broads

In the 10 years preceding the accident on *Diamond Emblem 1*, five fatalities were reported as a result of people falling overboard, with two of the cases believed to involve alcohol consumption. A further four people suffered serious leg injuries, including one requiring a foot amputation after coming into contact with a propeller while in the water. A month after the accident on *Diamond Emblem 1*, there was a fatal accident on another hire boat when a passenger was hit by the boat's propeller. The party on board had been drinking alcohol and the passenger was pushed into the water by friends who were fooling around.

1.16.3 Other UK inland waterways accidents

Between 2015 and 2019, there were 11 fatal accidents involving people falling overboard from propelled boats. Two of these fatalities resulted from injuries sustained because of contact with the propeller.

[8] https://www.gov.uk/maib-reports/collision-between-rigid-inflatable-boat-rib-tickler-and-a-personal-watercraft-with-loss-of-1-life

SECTION 2 – ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory factors and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 OVERVIEW

Laura Perry died because she was thrown overboard by the force of *Diamond Emblem 1*'s heavy impact with the River Bure embankment wall opposite Great Yarmouth Yacht Station. Having fallen into the water, she then became entangled in a rope and trapped in way of the boat's propeller and rudder, causing multiple injuries and leading to her drowning. *Diamond Emblem 1* had struck the moored boat *Challenger* just before making contact with the embankment wall. Both impacts were because its driver was unable to control the motor cruiser at the time.

This section of the report describes the reasons why Laura was thrown overboard, and the circumstances that led to the driver's loss of control and *Diamond Emblem 1*'s two heavy impacts will be analysed. The underlying factors that led to the fatal accident and other safety issues, which did not directly contribute to the accident but were identified during the investigation, will also be explored.

2.3 FATAL FALL OVERBOARD

Diamond Emblem 1 was travelling astern toward the embankment wall when Laura climbed down the steps to the aft deck, which was the main access route from the upper deck. Her focus was almost certainly on maintaining her balance while descending the steps to go and assist her son, who had become distressed when the motor cruiser made contact with *Challenger*. It is highly unlikely that she recognised the risk of the boat striking the embankment wall, nor was any warning provided by the driver that this was about to happen; therefore she did not brace herself for an impact.

As Laura opened the door to enter the cabin space, *Diamond Emblem 1*'s stern hit the embankment wall. The force of the impact threw her backwards out of the doorway and over the boat's stern into the water.

As the boat's propeller was rotating astern, she was drawn into it and did not resurface, having become entangled in a length of mooring rope. The rope had been loosely stowed on the boat's port aft side deck and the boat's impact with the wall provided the impetus for it to fall aft into the water. The rope was also drawn into the propeller and would have hindered the initial rescue attempts to release Laura from it. The combination of becoming entangled in the mooring rope and the rotating propeller led to Laura sustaining multiple injuries and drowning.

The presence of the mooring rope on deck in preparation for tying the boat up alongside was reasonable. However, the Skippers' Manual for the boat that was provided to the hire group highlighted the importance of ensuring ropes did not go overboard and become entangled in the propeller. It is possible that Laura would have been recovered quicker and sustained less severe injuries if the mooring rope had been properly secured onto the vessel and not fallen overboard.

It is also likely that Laura would have been prevented from falling into the water if *Diamond Emblem 1* had been fitted with an adequate guardrail around the stern of the boat (see section 2.6.3).

Laura's postmortem report confirmed that she was not under the influence of alcohol or recreational drugs at the time of the accident. However, it did identify traces of various prescribed medications with possible side effects that can affect an individual's balance. Analysis of the accident's circumstances indicated that any such side effects would have been unlikely to have changed the outcome.

2.4 LOSS OF CONTROL OF *DIAMOND EMBLEM 1*

At the time of the accident, *Diamond Emblem 1* was being driven from its upper helm position. The driver had requested control from the lower helm position about 5 minutes prior to the planned mooring at Great Yarmouth Yacht Station. When the driver was told "OK, it's all yours", she put the upper helm propulsion control lever ahead and began to steer the boat down river. Everything on board appeared to be normal, with the skipper standing on the port side deck, while members of the family had been asked to come on deck to help moor the boat.

However, things went wrong very quickly when the driver attempted to slow the boat and turn it around after the Broads ranger informed the family group that there was no space at the moorings. Within just over 40 seconds, *Diamond Emblem 1*'s bow had struck the moored boat *Challenger* on one side of the river and its stern had hit the embankment wall on the other.

When the driver pulled the propulsion control lever to its full reverse position during the turn, the engine speed increased as expected but *Diamond Emblem 1* failed to slowdown. Instead, its speed ahead started to increase. Realising she had lost control, the driver then put the lever back to neutral and the engine speed reduced. However, the lever would not move and she was unable to pull it back into reverse. Despite this, the engine pitch increased again almost immediately after the impact with the moored boat. However, *Diamond Emblem 1* started to accelerate astern toward the other side of the river and made heavy contact with the river embankment wall due to a loss of control of the boat.

The investigation considered several scenarios that could have led to the loss of control; these included:

- propulsion control mechanical fault;
- hydraulic system failure;
- boat handling errors; and
- incorrect helm control setting.

Earlier on the day of the accident, the family group had experienced problems restarting the engine after the youngest child had unexpectedly pressed the engine stop button at the lower helm control position. The group managed to restart the engine unaided and got back underway. The machinery inspections and trials conducted after the accident did not identify any propulsion control or hydraulic system faults and it was therefore considered unlikely that the loss of control was the result of a mechanical or hydraulic system failure.

Diamond Emblem 1 had arrived at Great Yarmouth Yacht Station on an ebbing tide about 4 hours before low water, therefore increasing the boat's speed over the ground. Due to the lack of mooring space at the yacht station, the driver had to turn the vessel around because passing under the Yarmouth bridge was not an option due to the state of tide. However, the intervention by the ranger and the need to turn around before reaching the bridges should not have been a major concern to the driver or the nominated skipper. Furthermore, the driver had been handling *Diamond Emblem 1* for the previous two days; she had manoeuvred the boat on and off most of its moorings and also turned it around in the river. Given the driver's previous experience and the circumstances leading up to the accident, the loss of control was unlikely to have been the result of basic boat handling errors. There were no apparent distractions that could have affected her and she was not under the influence of alcohol at the time of the accident.

The most likely scenario was that the helm position changeover lever was set to the lower helm when the driver attempted to slow and turn *Diamond Emblem 1*; this was the position it was found in after the accident. For this to have been the case, propulsion control was either never passed to the upper helm when requested by the driver about 5 minutes before the boat's arrival, or control was taken by someone in the cabin space on the approach to the yacht station. This latter scenario could have been due to the control having been incorrectly passed to the upper helm.

The youngest child had pressed the stop button on the lower helm control position console while the boat was being driven from the upper deck earlier in the day. However, there was no evidence to indicate that anyone had accidentally or deliberately moved the helm control lever from the upper helm to lower helm position during the approach to the yacht station. Furthermore, for this to have happened, both propulsion control levers would have needed to have been placed in the neutral position. The upper helm propulsion control lever was not moved from its ahead position before the motor cruiser reached the yacht station, when it was placed momentarily in its neutral position.

The following sequence of events describes the most likely scenario that led to the initial collision with the moored boat *Challenger*:

1. When the driver requested control at the upper helm control position, the lower helm propulsion control lever was not returned to its neutral position and the helm position changeover lever was not turned to the upper helm control position.

2. The driver, thinking she had control, inadvertently pulled the upper helm propulsion control lever out laterally, and then pushed it forward into an ahead position. This was easy to do, and something the skipper had probably done earlier in the holiday.

3. The driver then steered the boat down river for about 5 minutes, unaware that she did not have control of the propeller direction.

4. When the driver first pulled the upper helm propulsion control lever into reverse it remained disengaged, and the propeller continued to rotate in the forward direction at a similar speed.

5. When the upper helm propulsion control lever was pulled to its full reverse position the engine revolutions, and therefore propeller speed, increased, and the motor cruiser began to increase speed rather than slow down.

6. When the driver returned the upper helm propulsion control lever to the neutral position it sprung back into gear. As the lower helm control position was selected as active, the upper helm propulsion control lever could not be moved forward or back.

7. When the driver realised they were about to collide with the moored boat, she shouted down to stop the engine.

The actions taken immediately after the driver's request to stop the engine and during the 17-second period between the initial impact with the boat and the heavy contact with the wall are unclear. However, analysis of the CCTV recordings, showing *Diamond Emblem 1*'s movement immediately after the initial collision, as well as witness accounts, support the following sequence of events:

1. The lower helm propulsion control lever was pulled to its full reverse position just before or at the same time as *Diamond Emblem 1* collided with the moored boat.

2. The propeller direction changed and the engine speed increased. This caused the motor cruiser to begin to move astern immediately after the first impact.

3. As Laura's father began to pick up the broken glass and comfort the distressed child, *Diamond Emblem 1* continued to accelerate astern and made heavy contact with the river embankment wall.

4. Laura's father, who was knocked backwards by the force of the impact with the embankment wall, realised that something was wrong with the engine and pressed the stop button at the lower helm control position.

The likely sequence of events described above happened over a short period of time. The driver and the nominated skipper were both confused, there was a lot of shouting going on both on board and ashore, and communication between the upper helm position and the cabin space was difficult. All of these factors contributed to the loss of control.

2.5 TRANSFER OF CONTROL BETWEEN HELM POSITIONS

When the driver asked for control to be passed to the upper helm control position, she heard a response from the cabin space that indicated to her that she had control. She then managed to put the lever in an ahead position and started to steer *Diamond Emblem 1* down river.

It is possible that either the nominated skipper's eldest son, who had been driving from the lower helm control position, or the nominated skipper, who was supervising him, misunderstood the request or the driver at the upper helm misinterpreted or misheard the response. This could have been exacerbated by the background engine noise, physical separation between the upper and lower helm control positions, and lack of a direct means of communication between the two positions.

The skipper's eldest son had driven *Diamond Emblem 1* several times during the first 2 days of the 5-day holiday. However, he had not driven the boat from the lower helm control position until the morning of the accident. Although he was aware of

the helm position changeover lever, he did not know the procedure for switching between the helm control positions, as this was a task that had always been performed by the nominated skipper or driver. It is therefore likely that the eldest son assumed that someone else had or would switch controls when he stopped steering and had then left the lower helm control position. Alternatively, someone in the cabin may have misinterpreted that the helm position changeover lever was set to the upper helm because it was pointing upwards, given the lever's counterintuitive orientation, and therefore reported that the control was with the upper helm position.

It is also possible that the eldest son or the nominated skipper understood the request from the driver on the upper deck but did not pull the lower helm propulsion control lever back far enough to put it into its neutral position. This would have been a simple mistake to make given the badly faded label on the control lever **(Figure 14)**. If this was the case, the propeller would have continued to rotate ahead and the engine rpm and boat's speed would have increased when the upper helm control lever was pushed forward. However, this is considered unlikely as the nominated skipper would have realised that the control lever was not in the neutral position when he could not turn the helm position changeover lever.

The unfortunate circumstances of this accident highlight the importance of an effective communication system when navigating a boat, particularly when control needs to be transferred between helm positions. In this case, the difficulties in communicating between the helm positions would have been exacerbated by their physical separation and the noisy environment. However, it is also possible that the failure to transfer control to the upper helm may have been due to insufficient knowledge of the helm control changeover process and a possible lack of supervision. Such issues are not uncommon in the maritime sector and the MAIB has investigated many collisions, contacts and groundings involving commercial vessels and professional seafarers that were attributed to procedural errors when switching between propulsion and steering control stations. It is essential that hirers of boats such as *Diamond Emblem 1* are provided with effective handovers and appropriate documentation. These should highlight the operational risks and recommended best practices to ensure hirers are properly prepared to safely operate the boat.

2.6 SAFE DESIGN

2.6.1 Dual helm control positions

Diamond Emblem 1 had two control positions for the helm. There was no positive indication of the active helm control position except for the changeover lever, which counterintuitively pointed vertically up for lower control and horizontally for upper control. The engine control was only partially interlocked, meaning it was possible to increase the engine power at either helm control position irrespective of which position was selected as active. The steering and bow thrusters also did not have any interlocks and could be operated independently of the helm control position that was active and in use. Prior to the arrival at the yacht station, the driver would have mistakenly assumed the active helm had been transferred to the upper helm control position. Had there been a clear visual indication, such as an indicator lamp on the upper helm control position panel, the driver would have almost certainly recognised that the control had not been transferred to the upper position. Furthermore, an

interlock to prevent propulsion being controlled from an inactive helm control position would have prevented the increase of engine power leading to the first heavy contact being made.

It is unfortunate that the guidance provided by ISO 25197 (see section 1.7.1), which was first published in 2012, did not exist in 2010, when *Diamond Emblem 1* was constructed. Even though this standard was aimed at electric or electronic controls, the requirements for a visual indication to be provided for the active helm and the transfer of the helm position to be completed at the position taking control were equally applicable to a mechanical control system:

Incorporating these features into *Diamond Emblem 1*'s control system would therefore have prevented the confusion that prevailed just before the accident.

A significant number of Broads cruisers have more than one helm position, many of which are hired by people inexperienced in boat handling, and often with children on board, thereby increasing the risk of an unintended helm intervention. Actions to ensure that vessels with multiple helm control positions, such as *Diamond Emblem 1*, cannot inadvertently be controlled by an inactive helm position would significantly reduce the likelihood of future accidents.

2.6.2 Ergonomics, signage and labelling

Several examples of unsatisfactory ergonomics and misleading or missing labels at both helm control positions were present on *Diamond Emblem 1*:

- Counterintuitive helm position changeover lever positions.
- Signage at the helm position changeover lever implied that the steering position was being changed instead of the propulsion control. As the vessel could be steered irrespective of which helm control position was in use, this had the potential to cause confusion.
- There was no indication that the main steering position was the upper helm control position due to the good all-round visibility provided and that the lower helm had no visibility aft.
- Despite the technical manual stating that a warning notice about the visibility issues was available at the helm control position, no such information was provided on *Diamond Emblem 1*, nor did the Skippers' Manual or Your Boat Information document highlight this.
- The driver would have been more likely to have used the engine stop button at the upper helm control position during the emergency if it had been bright red instead of black, and better labelled.
- The labels on both the upper and lower propulsion controls were significantly faded and did not aid the user's understanding of the propulsion control levers.

Accurate and unambiguous labels assist users to operate a vessel safely. Conversely, misleading, illegible and counterintuitive labels can lead to misunderstanding of critical functionality. Furthermore, it is disappointing that labels

warning about the visibility issues were not fitted as required by the technical manual. These conditions created an environment detrimental to the safe operation of the motor cruiser; this is particularly the case when boats are being handled by holidaymakers who are neither professional mariners nor trained in the boat's operation.

2.6.3 Fall prevention

Diamond Emblem 1 was constructed as an RCD category D boat. The associated DoC document for the vessel referred to empirical data instead of the harmonised standard ISO 15085:2003 as the means of complying with the essential safety requirement for *Prevention from falling overboard*. However, no such empirical data was available in the technical file. It was therefore unclear on what basis the boat had been deemed to meet this requirement, while the RCD conformity assessment was not supported by an analysis of the risks, as unambiguously stated in the EC publication, the 'Blue Guide'. Furthermore, Ferry Marina's generic risk register, as required by the HBC, did not consider the hazard of being injured by a turning propeller.

The 'Blue Guide' also made it clear that a harmonised standard, or equivalent, could be applied to meet the essential requirements to demonstrate compliance with the RCD. Although the ISO 15085:2003 requirements were not specifically referred to in the DoC, the boat builder's and hire boat operator's reliance on handholds as the primary means of fall protection was in accordance with the RCD requirements for boats operating in category D areas. *Diamond Emblem 1* was built with a guardrail around its forward deck, a raised toe rail along the side decks, and handrails and handholds located all around the deck, while the aft external staircase was fitted with a railing. These features were all designed to reduce the likelihood of someone falling overboard. The handrails and handholds provided individual active fall protection in that they required a person on deck to always maintain a grip on them.

Immediately before the accident, Laura was facing the stern of the boat as she climbed down from the upper deck to the aft deck and initially held onto the handrail on the outboard side of the steps. She was unable to use the small handhold on the inboard side of the steps as her mother, who was standing on the aft staircase, was holding onto it. Having descended the stairs, Laura opened the door into the cabin at the exact moment that the boat hit the wall. As the door opened outwards, the handrail on the starboard side of the door was out of reach. Therefore, with none of the handrails readily accessible to her, she appeared to grab hold of the curtain that was hanging inside the doorway, maybe in an attempt to arrest her fall. Unfortunately, the curtain detached from its fastenings on the cabin ceiling **(Figure 11)** and went overboard with Laura as she was thrown violently backwards into the water between the wall and the boat's stern. Had she been able to hold on to, or grab, a fixed handrail she might have been able to interrupt her fall.

Hire boats operating on the Broads and other inland waterways are often involved in collisions and heavy contacts. These collisions and contacts should not result in people being thrown overboard. However, it is not uncommon for people to fall or be knocked overboard when mooring, as evidenced by the available accident statistics. Every time a person falls into the water from a motorboat there is a risk of being struck by a rotating propeller, as highlighted by the MAIB's 2006 investigation into an accident involving a narrowboat. However, this hazard was not identified in Ferry Marina's risk register.

Diamond Emblem 1's narrow aft deck was in constant use by those on board and its unprotected edge was directly above the boat's propeller. Furthermore, the aft-facing external staircase, which acted as the main thoroughfare between decks, terminated just 250mm from the edge of the aft deck **(Figure 10)**. Nonetheless, this distance still exceeded the minimum working deck width of 100mm for a category D boat stipulated in ISO 15085:2003 and would have been deemed acceptable if this standard had been referred to when preparing the DoC. Despite this, each use of the staircase and aft deck exposed the vessel's occupants to the risk of falling overboard. Undoubtedly, the position of the staircase outside the accommodation was intended to maximise the boat's internal living space; however, this design principle also increased the risk of someone falling overboard from the narrow unprotected aft deck. This risk was mitigated by the need for the occupants to use the provided handholds. However, passive collective fall prevention, which protects everyone on board without needing them to take any action, was not considered while designing the vessel's aft area. Therefore, the risk of falling overboard while not using a handhold remained uncontrolled. Had guardrails, like those fitted around *Diamond Emblem 1*'s forward deck, been fitted to the aft deck at a sufficient height, it is unlikely that Laura would have gone overboard despite having been knocked off her feet when the boat hit the wall.

2.6.4 Recreational Craft Directive conformance

Diamond Emblem 1's conformance with the RCD's essential requirements was incomplete in several respects (see section 1.6.5). Furthermore, the hazards inherent in the design of the vessel were not considered during the RCD conformance checks. As vessels operating in category D waters do not require third party oversight for establishing compliance with construction standards, vessel owners and navigation authorities should ensure that the required paperwork is complete, accurate and verifiable. Large motor cruisers with sophisticated controls are becoming increasingly common and are often driven by members of the public who have limited or no proficiency in boat handling. It is therefore considered likely that accidents such as this will recur unless a thorough assessment and mitigation of all the inherent risks is undertaken.

2.6.5 Boat documentation

Diamond Emblem 1 had been provided with a fleet technical manual **(Annex B)** and owner's manual **(Annex C)** as part of the RCD's required documentation. Although the former provided details of the relevant design features relating to the RCD's essential requirements, the document was inconsistent and incomplete and did not demonstrate that the risks associated with operating the boat had been adequately considered or addressed.

The owner's manual contained a useful summary of the boat's key characteristics and systems and highlighted a number of warnings and cautions relating to the boat's safe operation. These included cautions to take care while moving around the deck and emphasising the limitations in visibility from both the upper and lower helm control positions. Furthermore, it included a reminder to ensure the selection of the correct helm control position. However, the manual was lacking in several respects. It provided only cursory information on the dual-function helm controls and did not identify the hazards associated with their use, including the need for an effective communication system between the helm control positions. A more thorough description of the helm control positions and the transfer of command between

them, as required by ISO 25197:2020, would have provided a greater understanding of their use and helped prevent the loss of control leading up to this accident. Crucially, the manual made no explicit reference to the danger of falling overboard from the stern into the water in the vicinity of an unguarded rotating propeller.

Despite its omissions, the availability of an onboard copy of the owner's manual, or a reproduction of its contents in the documentation given to the hire party, would have at least provided some additional support and guidance to the boat's operators. Both its absence on board, and the significant omissions from the manual, reflected a lack of appreciation of the risks associated with the boat's operation and the need to communicate these risks and their mitigations to hirers.

2.7 HIRE BOAT HANDOVER PROCEDURE

2.7.1 Handover on 17 August 2020

The family group hiring *Diamond Emblem 1* arrived at Ferry Marina's offices at the start of the boat trip 18 minutes later than their allocated time. Ferry Marina's COVID-19 social distancing restrictions meant that only one member of the hire party was supposed to be present at the onboard handover. However, both the nominated skipper and driver attended elements of the briefing while the luggage was being loaded onto the boat. The handover lasted approximately 10 minutes and, although it included a verbal explanation of the engine, steering and bow thruster controls, it took place at the lower helm control position only. The primary upper helm control position was pointed out briefly and without a demonstration. Furthermore, the functionality of the propulsion control lever to increase the fuel to the engine from either helm control position was not discussed. Significantly, an in-water trial was not conducted, even though the nominated skipper signed the handover form that stated an in-water trial had taken place; the form also confirmed that he had previous experience on river cruisers, which was the case. There was no evidence to suggest that the family group's late arrival affected the standard process for handing over the boat to them, other than the restricted onboard attendance during the handover due to COVID-19.

The HBC contained detailed handover requirements but allowed the handover process to be accelerated depending on the hirer's experience. This was not in keeping with the principles of safety and hirer proficiency as outlined by the NWSF, which the HBC claimed to have adopted. The quality of prior experience on a Broads cruiser can be subjective, as pointed out by the NWSF, and accepting such experience to accelerate the handover process is fraught with risks. As evidenced during the handover of *Diamond Emblem 1*, the subjective interpretation of expediting the handover led to several critical features of the vessel not being demonstrated or explained.

In addition to the physical handover, the video tutorial produced by Ferry Marina explaining *Diamond Emblem 1*'s key features was viewed by the nominated skipper before travelling to Norfolk, but not the driver. Although most of the video focused on the boat's domestic and ancillary systems, it provided a helpful overview of the lower helm controls. This included the functionality of the lower helm propulsion control lever and the engine stop button. However, as was the case for the physical handover, it did not show the upper helm control position, nor did it provide any guidance on how to communicate between the two helm control positions.

The video did explain the process for transferring control between the lower and upper helm positions. However, the crucial fact that the propulsion control lever could not be moved without pulling it out from the neutral position if the helm position changeover lever was pointing to the other helm position was not explained; this was despite the instructor inadvertently doing this during the video. Had this situation been highlighted during the video and handover, and the driver made aware of it, she would have been able to quickly identify the reason why she was unable to move the upper engine propulsion lever immediately before the accident. She could then have checked to make sure that the helm control had been transferred to the upper helm control position and taken appropriate action to prevent the second hard impact with the embankment wall and the accident.

None of the family group, including the nominated skipper, fully understood the dual-functionality of the propulsion control lever. In addition, the illegible marking of the propulsion control lever hindered the driver's comprehension of its function. Critically, the driver was unaware of the upper engine stop button, having not noticed it, and shouted below for someone to stop the boat, then watched helplessly as the vessel reversed at speed and hit the wall on the opposite side of the river. Although labelled as such **(Figure 3b)**, the label for the stop button at the upper helm control position was small, while the button was black and merged with the black colour of the panel. It is likely that there would have been a different outcome to this accident had the boat's safety features been better explained and more prominently identified, in particular the upper helm position engine stop button.

The handover provided to the family group hiring *Diamond Emblem 1* was cursory and incomplete, as was the video tutorial. Current UK regulations permit novices without any previous boating experience to hire large and technically sophisticated cruisers and operate them in tidal rivers. Therefore, it is imperative that the handover process is complete and rigorous, and that it ensures that hirers have sufficient proficiency to handle the vessel in their charge in a safe manner.

2.7.2 Nomination of drivers

Ferry Marina's handover process did not require the members of the hire party to name drivers in addition to the skipper. The nominated skipper and driver, as well as the nominated skipper's teenage son, took turns driving *Diamond Emblem 1*. However, others in the party were reported to have experienced driving the boat for short periods, including the two other teenage children on board and Laura's mother.

Knowledge, experience and competence are essential when suddenly faced with a set of circumstances that require immediate action to avoid a mishap. The HBC required those expected to drive a vessel to be nominated and appropriate instructions given during the handover. Unfortunately, the handover process followed by Ferry Marina did not require drivers to be nominated. A more formal process of ensuring that the drivers were formally identified would have helped to ensure that they were provided with adequate knowledge of the boat's control systems. This would have increased the ability of drivers to deal with a loss of propulsion control.

2.7.3 Onboard documentation

The two documents provided to the hire party as part of the handover process offered some useful information to support the safe operation of the boat. The Skippers' Manual **(Annex D)** largely contained generic information about the handling and navigation of motor cruisers, as well as guidance on touring in the Broads area. It also highlighted some hazards and best practices, including notes to ensure ropes were not allowed to fall overboard, as mentioned in section 2.3 above, and regarding the use of lifejackets, as discussed further in section 2.7.4 below.

In addition, the 4-page Your Boat Information leaflet **(Annex E)** was specific to *Diamond Emblem 1* and provided details of emergency procedures and various onboard technical systems, including a description of the helm position changeover process. However, the document did not fully explain the functionality of the dual helm control system, in particular that the engine control was only partially interlocked. This allowed the propulsion control lever at either helm control position to be moved by disengaging it irrespective of which helm control position was selected as active. By clearly describing this design aspect, the document would have provided another opportunity to highlight the complexity of the control system to operators of the boat, which in this instance may have prevented the loss of control leading to the accident.

2.7.4 Use of lifejackets

Lifejackets were issued to each member of the family including the children and their issue was recorded in the handover form. The Skippers' Manual provided to the hire party contained explicit instructions to use lifejackets while on deck and the business' risk register in the context of man overboard accidents also referred to the use of lifejackets. The HBC reinforced this requirement in several places. However, lifejackets remained unused by the group throughout the hire period, indicative of their lack of awareness of the risks associated with falling overboard.

Drowning accidents are not uncommon in UK inland waters and navigation authorities have consistently campaigned for lifejacket use. Regular safety campaigns conducted by the Broads Authority were indicative of their concern about members of the public not wearing lifejackets. In this instance, wearing a lifejacket may not have made a difference, given that the boat's propeller was rotating astern and would have drawn Laura under the water and into it. However, in most situations a lifejacket could mean the difference between survival and drowning and wearing them on deck is essential.

2.8 RISK REGISTER

Ferry Marina's risk register had been developed in consultation with an external RA company and it encompassed a range of their business activities. However, the vast majority of the identified risks related to activities conducted by employees; only 7 of the 49 risks included in the register assessed the activities of customers on board its fleet of hire boats.

Although the risk of a hirer falling into the water and drowning had been identified, none of the stated control measures considered the prevention of someone falling overboard. The mitigations instead focused on the use of lifejackets and buoyancy

aids and man overboard procedures. However, hand and guardrails and handholds were identified as a control measure to mitigate the risk of employees falling overboard while cleaning boats' exteriors.

The risk register was lacking in its meaningful assessment of all the risks associated with the operation of hired motor cruisers. The risk of passengers falling overboard, particularly in the vicinity of a rotating propeller, was not adequately assessed or controlled. Furthermore, the risks associated with the operation of dual helm control boats, such as loss of control and lack of visibility from the helm positions, were not considered.

A comprehensive and robust risk register would have identified and assessed the risks associated with the operation of *Diamond Emblem 1*. An effective risk management process would have further ensured that the identified control measures were properly implemented; this accident should have been prevented had this all been in place.

2.9 BOAT SAFETY SCHEME RECORD-KEEPING AND DOCUMENTATION

The scope of the BSS 4-yearly examination was significantly enhanced in 2017 by the introduction of the 12-page checklist. The requirement to maintain permanent records of the enhanced checks was not followed by some BSS examiners despite clear instructions to do so since 2018.

It is not suggested that *Diamond Emblem 1*'s examination in 2017 missed safety deficiencies that contributed to this accident. It is also accepted that BSS checks only reflect the state of the vessel on the day of the examination. Nonetheless, a permanent record of the checks made during the examination, highlighting any identified deficiencies, would undoubtedly enhance the integrity of the examination, as recognised by the BSS with their stated withdrawal of the laminated checklists in 2017. Ensuring the retention of permanent records would also facilitate the identification of deficiency trends by the BSS, thereby identifying areas of weakness in a single boat or across a boat class.

It is encouraging that the BSS is periodically reviewed and enhanced in response to the safety requirements for hire boats, as evidenced by the review completed in Autumn 2021 and the public consultation on the revised BSS Core Examination Checking Procedures commenced in March 2022. As compliance with the revised HBC is intended to become a mandatory condition for licensing in most of the inland navigation authorities, it is expected that the BSS will be further strengthened to meet the requirements of safety in inland waters.

In light of this accident, a sensible extension to the BSS's requirements would be to ensure that hire boats with multiple helm positions or control systems follow the technical standards outlined in ISO 25197:2020 with respect to the positive indication of the active helm position and for the transfer of command from one station to another to be completed at the helm station intended to be active. Furthermore, the introduction of a requirement to incorporate interlocks to prevent inadvertent engine operation from an inactive helm position would have prevented the loss of control on board *Diamond Emblem 1* leading up to the accident.

2.10 OVERSIGHT OF SAFETY

The licensing conditions of the Broads Authority required the submission of a DoC to demonstrate compliance with a construction standard. Subsequently, successful completion of 4-yearly BSS examinations was required to maintain the licence.

There were several lapses in the safety management of vessels operating in the Broads, as demonstrated by:

- The conflicting information on the capacity of *Diamond Emblem 1*, which included references to the load associated with 8, 10 or 12 adults; of the 9 people on board at the time of incident, some of the group were children and this loading was not contributory to this accident. However, the differences in the boat's loaded capacity information reflected the inconsistent approach to the regulation and oversight of passenger craft;

- The DoC for vessels of *Diamond Emblem 1*'s class had been accepted despite being unsigned;

- Acceptance of incomplete DoCs, despite clear guidance and templates available in the RCD;

- DoCs older than 7 years were not retained by the Broads Authority for boats continuing to operate in its waters;

- Verification of a hire operator's safety procedures not being conducted upon a change of ownership, despite the Broads Authority requirement to be informed of the change within 14 days as part of the licensing conditions;

- Audits conducted every 3 years, while recording the results on an audit form that stated these were to take place annually.

The Broads Authority had the legal framework to regulate the activities in the waters under their jurisdiction. However, company and vessel audits did not consider the technical operation of the boats in any depth and instead relied on BSS examinations and the DoC document provided by the boat builder. Therefore, the hire boat companies were, to a large extent, self-regulating in the design and commercial operation of their boats. The rigour and expertise required to ensure that systems were safe and the procedures followed were compatible with the guidelines of the HBC could therefore have been better.

The British Marine and VisitEngland QAB scheme **(Annex J)** provided a means of demonstrating that hire boat operators are committed to quality and safety. This included various requirements for handovers and safety-related policies and processes, which exceeded the Broads Authority's own requirements, such as a policy for the review of risk assessments and the nomination of a company Designated Person. Supplementing the Broads Authority's internal inspection regime with a requirement for such a scheme to be part of its Hire Boat and Hire Operators licensing provisions would provide a further level of assurance of hire boat operators in the Broads.

With the requirements of the revised HBC becoming mandatory in 2022, navigation authorities, where they have the power to adopt its requirements, would greatly benefit from a structured and uniform approach for the verification of HBC compliance.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *Diamond Emblem 1* hit a boat moored at Great Yarmouth Yacht Station then made heavy contact with the embankment wall on the opposite side of the River Bure because its driver was unable to control the motor cruiser at the time. [2.2, 2.4]

2. Laura Perry died because she was thrown overboard by the force of the boat's impact with the wall and then became entangled in a rope and trapped in way of the boat's unguarded propeller and rudder, causing multiple injuries and leading to her drowning. [2.3]

3. Laura would possibly have been recovered quicker and sustained less severe injuries if the mooring rope she became entangled in had been properly secured onto the vessel and not fallen overboard. [2.3]

4. It is likely that Laura would have been prevented from falling into the water if *Diamond Emblem 1* had been fitted with an adequate guardrail around the boat's stern. [2.3, 2.6.3]

5. Analysis of the accident circumstances indicated that any side effects from the prescribed medications Laura had been taking were unlikely to have affected the outcome of the accident. [2.3]

6. The driver at the upper helm control position was unable to control *Diamond Emblem 1* because the boat's helm position changeover lever was most likely set to the lower helm control position. This could have been due to the control not having been correctly passed to the upper helm. [2.4]

7. The failure to transfer control to the upper helm position may have been due to: insufficient knowledge of the control changeover process; the helm position changeover lever setting being misinterpreted due to the lever's counterintuitive orientation; a possible lack of supervision; or ineffective communication between the upper and lower helm control positions. [2.4, 2.5]

8. The difficulties in communicating between the helm control positions would have been exacerbated by the noisy environment, their physical separation and the lack of a direct means of communication between them. [2.5]

9. The circumstances of this accident highlight the importance of an effective system of communication when navigating a boat, particularly when control needs to be transferred between helm control positions. [2.5]

10. The driver would have almost certainly recognised that the control had not been transferred to the upper helm position if each helm control position incorporated a clear visual positive indication of the active helm. [2.6.1]

11. Actions to ensure that vessels with multiple helm control positions cannot inadvertently be controlled by an inactive helm position would significantly reduce the likelihood of future accidents. [2.6.1]

12. Misleading, illegible and counterintuitive labels on *Diamond Emblem 1* created an environment detrimental to its safe operation. [2.6.2]

13. *Diamond Emblem 1*'s DoC was unsigned and referred to unavailable 'empirical data' to comply with the essential requirement for *Prevention from falling overboard* instead of the relevant standard. [2.6.3]

14. The location of the aft external staircase, close to the unprotected edge of the aft deck, and the narrow aft deck exposed the vessel's occupants to the risk of falling overboard every time they used them. [2.6.3]

15. *Diamond Emblem 1*'s conformance with the RCD's essential requirements was incomplete in several respects and the hazards inherent in the boat's design were not considered during the RCD conformance checks. [2.6.4]

16. As vessels operating in RCD category D waters do not require third party oversight for establishing compliance with construction standards, vessel owners and navigation authorities should ensure that the required paperwork is complete, accurate and verifiable. [2.6.4]

17. *Diamond Emblem 1*'s technical manual and owner's manual were inconsistent and incomplete, and did not demonstrate that the risks associated with operating the boat had been adequately considered or addressed. Their absence on board reflected a lack of appreciation of the need to communicate the risks and their mitigations to the hirers. [2.6.5]

18. Ferry Marina's risk register was lacking in its meaningful assessment of all the risks associated with the operation of hired motor cruisers and did not adequately assess or control the risks associated with this accident. [2.8]

19. Large motor cruisers with sophisticated controls are increasingly common and are often driven by members of the public with limited or no proficiency in boat handling. It is considered likely that accidents such as this will recur unless a thorough risk assessment and mitigation is undertaken. [2.6.4]

20. The handover provided to the family group was cursory and incomplete, as was the video tutorial. Neither resulted in the transfer of essential knowledge; no one on board fully understood the functionality of the dual helm controls and the driver was unaware of the upper engine stop button. [2.7.1]

21. The upper engine stop button was in a different location on the console compared to the button on the lower helm control position and could have been more prominently identified. [2.7.1]

22. Ferry Marina's handover process did not require drivers to be nominated, contrary to the requirements of the HBC. [2.7.2]

23. The loss of control leading to the accident may have been prevented if the documentation provided to the hire party had fully explained the functionality of the dual helm control system. [2.7.3]

24. It is essential that effective handovers and appropriate documentation are provided to boat hirers to ensure that they are properly prepared to safely operate the boat. [2.5, 2.7.1]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. Navigation authorities would greatly benefit from a structured and uniform approach to the verification of compliance with the revised HBC when it becomes a mandatory condition for licensing in most inland navigation authorities. It is also expected that the BSS will be further strengthened to meet the requirements of safety in inland waters. [2.9, 2.10]

2. The Broads Authority would achieve a further level of assurance of hire boat operators by making the British Marine and VisitEngland Quality Accredited Boatyard Scheme a requirement of its Hire Boat and Hire Operators licensing provisions in order to supplement its internal inspection regime. [2.10]

3.3 OTHER SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT

1. Lifejackets remained unused by the group throughout the hire period, indicative of their lack of awareness of the risks associated with falling overboard. [2.7.4]

2. Retention of the records of all checks carried out during BSS examinations would enhance the integrity of the examination and facilitate the identification of deficiency trends. [2.9]

SECTION 4 – ACTION TAKEN

4.1 MAIB ACTIONS

On 27 October 2020, The Chief Inspector of Marine Accidents made the following recommendations to the **Association of Inland Navigation Authorities**:

2020/129 Revise the Code of Practice for Hire Boats to include:

- *A requirement for hire boat companies to assess the risk of people falling overboard and implement suitable control measures, particularly for areas that are in frequent use or where the risk of a fall is identified as high (Hire Boat Code Section 2.6 and Annex II).*

- *A requirement for hire boat companies operating vessels with multiple helm positions to comply, where possible, with international standards for a positive visual indication of the active helm position and interlocks to prevent inadvertent engine operation from an inactive helm position (3.2.2).*

- *Guidance on conduct of handover to include a thorough demonstration of a vessel's engine and steering controls where more than one helm position exists (3.3.3).*

- *A requirement for in-water trial, before handover, to assess the competence of those expected to drive the boat, irrespective of their previous experience or length of hire of the vessel (3.3.4).*

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

The Association of Inland Navigation Authorities has:

Accepted MAIB recommendation 2020/129 except for bullet point two (positive visual indication of the active helm and interlocks in multiple helms).

British Marine has:

Carried out a complete audit of all available data for its members and instructed them to hold valid certificates to demonstrate compliance with the Quality Accredited Boatyard Scheme in time for the season that started in April 2021.

The **Boat Safety Scheme** has:

Issued instructions to all Boat Safety Scheme examiners to adhere to the requirement of maintaining a record of all the checks carried out during examinations for a minimum of 6 years.

The **Broads Authority** has:

- Increased the levels of ranger staff and patrols between April and November to maintain a 7-day launch presence on the network to encourage safety.
- Allocated additional Hire Boat Licencing Officer time from December 2021 onwards to allow for increased auditing, investigation and licencing compliance.
- Delivered a suite of free online instructional safety videos in conjunction with other organisations.
- Increased the number of multi-agency ‘Super Safety Events’ to help educate boaters in a variety of safety issues, and which include random spot checks on boats to identify safety issues.
- Developed closer relationships with third-party organisations relating to hire boats and safety.
- Adopted the provisions of the revised Hire Boat Code into the Broads Authority’s Licensing Conditions from 1 April 2022.
- Provided representation at the Boat Safety Scheme Management Group.

SECTION 5 – RECOMMENDATIONS

The **Association of Inland Navigation Authorities**, in consultation with its members, is recommended to:

2022/113 Provide its members with comprehensive best practice guidance on processes for the administration and oversight of compliance with The Code for the Design, Construction and Operation of Hire Boats, commonly referred to as the Hire Boat Code, in order to support their adoption of the code as mandatory in 2022.

The **Broads Authority** is recommended to:

2022/114 Make the British Marine and VisitEngland Quality Accredited Boatyard Scheme a requirement of the Broads Authority's Hire Boat and Hire Operators licensing provisions in addition to its own internal inspection regime.

2022/115 Review its licensing conditions for hire boat operators to ensure that:

- Licences are only issued when a complete set of the required signed and dated documentation is submitted by the operators.
- An appropriate level of verification is conducted on a change of ownership of companies to ensure that the new owners are operating their vessels in accordance with the applicable requirements.

2022/116 Retain a copy of Declarations of Conformity and other associated information demonstrating compliance with the requirements of the Recreational Craft Directive for all boats operating in their waters.

A J & J Cator t/a Ferry Marina is recommended to:

2022/117 Review and amend its hire boat handover procedures to ensure that at the commencement of all hire periods:

- A comprehensive and thorough handover is conducted to include all aspects of the boat's propulsion and steering control systems, especially where multiple helm control positions are present;
- An in-water demonstration is conducted both to ensure that users have a practical understanding of the boat's control systems and to allow the competence of those expected to drive the boat to be assessed, irrespective of their previous experience or the length of the hire period; and
- Detailed and accurate records of all handovers are maintained.

2022/118 Ensure that appropriate documentation is made available to operators of their hire craft that provides comprehensive details of the:

- Boat's specific technical and safety systems, including a detailed explanation of the functionality of the control systems;

- Best practices in onboard communications required to safely navigate and control the boat; and

- Hazards and risks associated with operating the boat, including the required controls and actions to be taken to mitigate the risks.

2022/119 Undertake a suitable and sufficient risk assessment relating to the risks of people falling overboard from all areas on each of its hire craft, and implement appropriate control measures, which not only meet the requirements of the Recreational Craft Directive and other applicable standards, but, if considered necessary, also exceed the minimum standards to ensure that the risks are mitigated to a tolerable level.

2022/120 Implement a means of providing positive visual indication of the active helm control position on any boats they operate with multiple helm control positions so as to comply, where possible, with the requirements of the technical standards outlined in ISO 25197:2020.

2022/121 Incorporate interlocks on any boats they operate with multiple helm control positions to prevent inadvertent engine operation from an inactive helm control position.

2022/122 Ensure that safety critical controls, such as engine stop buttons, on any boats that they operate are easily identifiable, including the provision of clear labels.

The **Boat Safety Scheme** is recommended to:

2022/123 Conduct a review of the Boat Safety Scheme requirements for hire boats with multiple helm control positions or systems with the intention of:

- Aligning the requirements with the technical standards outlined in ISO 25197:2020 to require positive visual indication of the active helm control position and that the transfer of command between helm control positions can only be completed at the intended active helm control position; and

- Including a requirement to incorporate system interlocks in order to prevent inadvertent engine operation from an inactive helm control position.

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