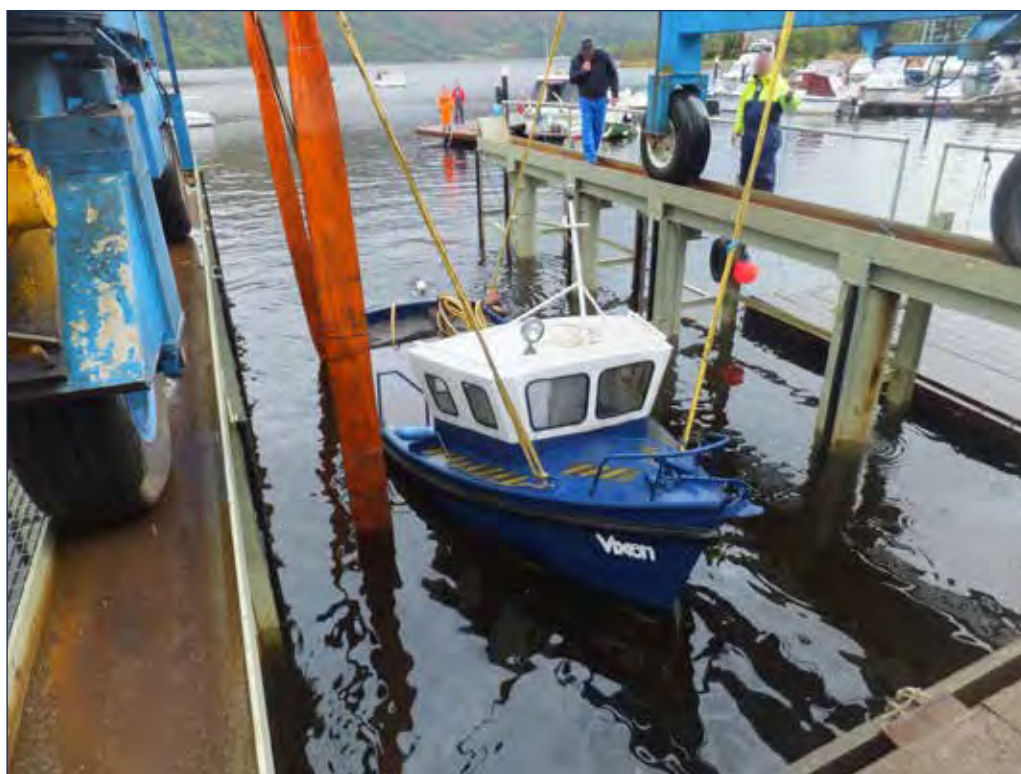


Report on the investigation of
the foundering of the small passenger ferry

Vixen

in Ardlui Marina, Loch Lomond

on 19 September 2012



Extract from
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.

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GLOSSARY OF ABBREVIATIONS, ACRONYMS AND TERMS

| | | |
|----------|---|--|
| AINA | - | The Association of Inland Navigation Authorities |
| °C | - | Celsius |
| HP | - | Horsepower |
| ISO | - | International Standards Organisation |
| kg | - | kilograms |
| kW | - | kilowatt |
| LOA | - | Length overall |
| LSA | - | Life-saving appliance |
| m | - | metres |
| mm | - | millimetres |
| MCA | - | Maritime and Coastguard Agency |
| MSN | - | Merchant Shipping Notice |
| N | - | Newtons |
| RAF | - | Royal Air Force |
| RIB | - | Rigid Inflatable Boat |
| RYA | - | The Royal Yachting Association |
| SCV Code | - | Small Commercial Vessel and Pilot Boat Code |
| T | - | Tonnes |

Terms

| | | |
|------------------------|---|---|
| Civic Government Act | - | The Civic Government (Scotland) Act 1982 |
| The Act | - | The Merchant Shipping Act 1995 |
| The Inland Waters Code | - | The Inland Waters Small Passenger Boat Code |
| The Loch | - | Loch Lomond |
| The Park | - | Loch Lomond and The Trossachs National Park |
| The Park Authority | - | Loch Lomond and The Trossachs National Park Authority |

Times: All times in this report are local (UTC +1)

SYNOPSIS



At approximately 1110 on 19 September 2012 the 6.5m steel-hulled passenger ferry *Vixen* foundered with six passengers and the skipper on board as it crossed Loch Lomond. There were no injuries and no pollution. *Vixen* foundered because the weight of the passengers, bilge water and the dynamic effect of propulsion was sufficient to submerge the weed hatch, which was sited above the rudder and propeller. The fixings that had originally secured the weed hatch cover had corroded and there was little to prevent water flooding in. *Vixen* sank quickly, around 50m from the shore.

Five of the six passengers donned lifejackets and jumped out of the boat. One passenger, who was a weak swimmer, was not provided with a lifejacket; she and the skipper remained on board as the boat sank beneath them. They were dragged underwater, but managed to swim back to the surface. Some of the passengers swam ashore; the remainder, and the skipper, were quickly rescued by a member of the public who was in another boat nearby.

The MAIB investigation found that *Vixen* was in poor condition. The weed hatch was not watertight and was too close to the waterline – the boat was therefore overloaded. There was no specified limit for the maximum number of passengers that could be carried safely. The bilge alarm, which should have warned that the boat was flooding, had been disabled. Similarly, the bilge pump no longer worked in its automatic mode. The boat's hull had corroded, with several holes in areas above the waterline. The investigation also found that some of the lifejackets were not accessible in the emergency, and none had the recommended minimum buoyancy.

Vixen was being operated contrary to the legal requirements of the Maritime and Coastguard Agency, the Argyll and Bute Council and the Loch Lomond and Trossachs National Park Authority. The Maritime and Coastguard Agency had previously issued *Vixen's* operators with a prohibition notice because it had found that the skippers did not have the correct qualifications. The boat should also have been licensed with the Argyll and Bute Council. Finally, *Vixen* did not display the necessary registration marks required by the National Park Authority's byelaws.

The investigation found that there was no effective oversight of small commercial passenger vessels on Loch Lomond because the available legislation and the Inland Waters Small Passenger Boat Code were not being applied. The Maritime and Coastguard Agency and the local government authorities have been recommended to work together to apply their different legislation and engage the support of Certifying Authorities to improve the safety of small commercial passenger boats on Loch Lomond. The National Park Authority has been recommended to support this initiative by enforcing the requirements of its existing byelaws. Transport Scotland has been recommended to encourage all councils in Scotland to introduce effective boat hire licensing systems where there are similar commercial operations.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *VIXEN* AND ACCIDENT

| SHIP PARTICULARS | |
|-------------------------------------|---|
| Vessel's name | Vixen |
| Type | Passenger ferry |
| Registered owner | Privately owned |
| Manager(s) | Owner managed |
| Construction | Steel |
| Length overall | 6.80m |
| VOYAGE PARTICULARS | |
| Port of departure | Ardleish Jetty, Ardeish, Stirling, Scotland |
| Port of arrival | Ardlui marina, Argyll and Bute, Scotland |
| Type of voyage | Inland waters |
| Manning | 1 |
| MARINE CASUALTY INFORMATION | |
| Date and time | 19 September 2012, around 1110 |
| Type of marine casualty or incident | Serious Marine Casualty |
| Location of incident | Ardlui Marina |
| Place on board | Stern |
| Injuries/fatalities | Nil |
| Damage/environmental impact | Nil |
| Ship operation | On passage |
| Voyage segment | Mid-water |
| External & internal environment | Light winds, partly cloudy |
| Persons on board | Seven |



Vixen

1.2 BACKGROUND

Vixen was operated by the owners of the Ardlui hotel and marina, situated in Ardlui at the northern end of Loch Lomond. The vessel ferried passengers between Ardlui and Ardleish, which was about 750m away on the east side of the Loch (**Figure 1**). *Vixen* was kept at Ardlui; any people wanting to cross the Loch from Ardleish hoisted a signal ball close to the jetty to request the ferry operator to bring the boat across and collect them (**Figure 2**). Each trip took about 5 minutes at a speed of around 6 knots. The ferry service operated between April and September each year, mainly carrying hikers who were following the West Highland Way. Each passenger paid £3 for a single trip and it was estimated that around 1000 passengers were carried during each operating season.

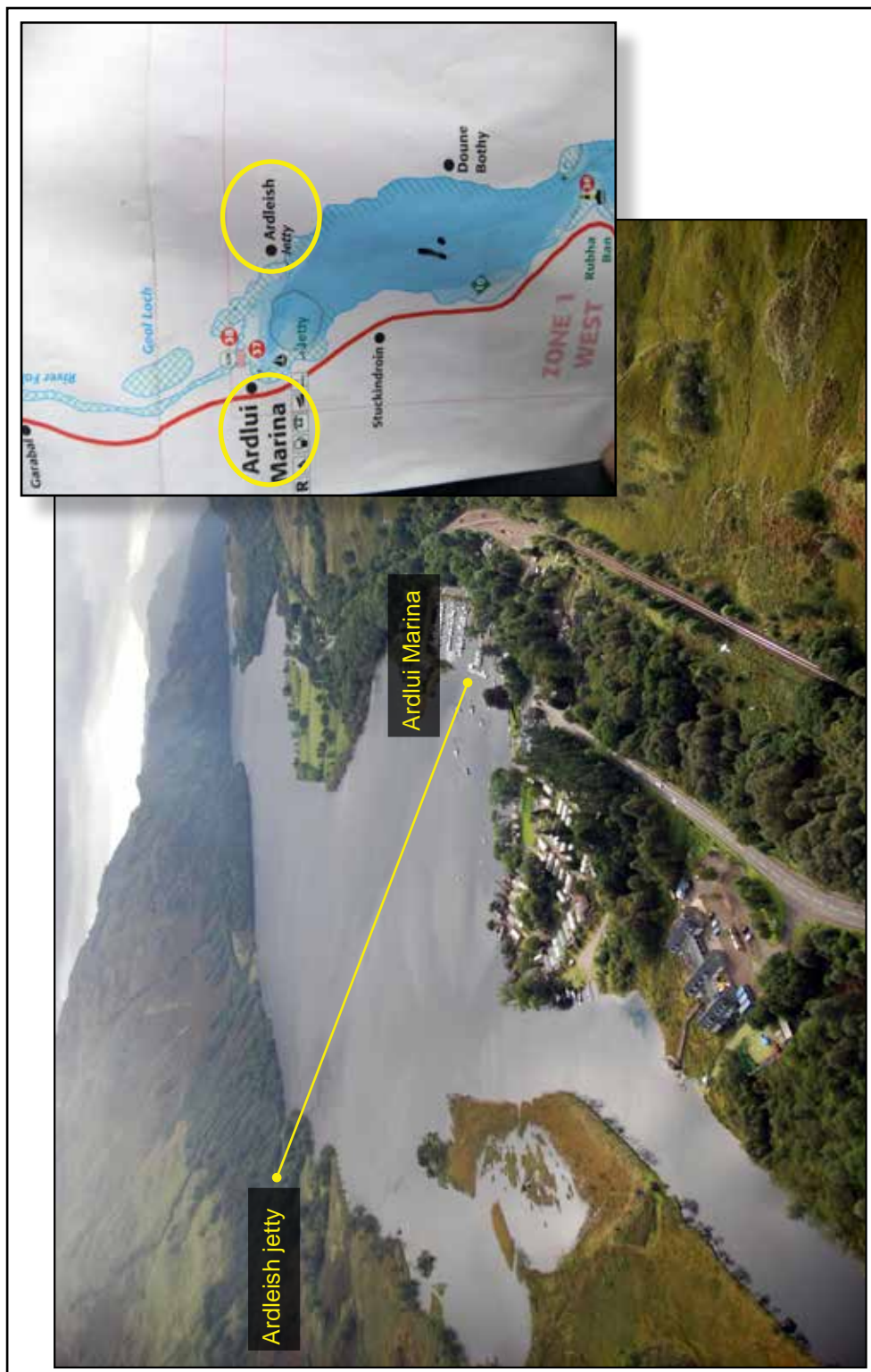


Figure 1 and inset: Ardlui to Ardleish ferry route



Figure 2: The signal ball used to request the ferry

1.3 NARRATIVE

1.3.1 Prior to the accident

On 9 September 2012, the main skipper and his father, both part owners of the Ardlui hotel and marina business, went abroad on holiday.

The Ardlui hotel's groundsman, who occasionally acted as *Vixen's* skipper, carried out several successful trips with the vessel on the day before the accident (18 September). After the final trip, the groundsman secured *Vixen* starboard side alongside the jetty at Ardlui.

1.3.2 The day of the accident

At around 1100 on 19 September, six hikers - a group of three men, another group of two men and a woman - arrived at Ardleish jetty a few minutes apart and hoisted the signal ball to request the ferry.

Vixen's nominated skipper for the day saw the raised signal ball and boarded the boat (**Figure 3**). The skipper started the engine, untied the head and stern lines, pushed the bow from the quay and set off towards the Ardleish jetty.

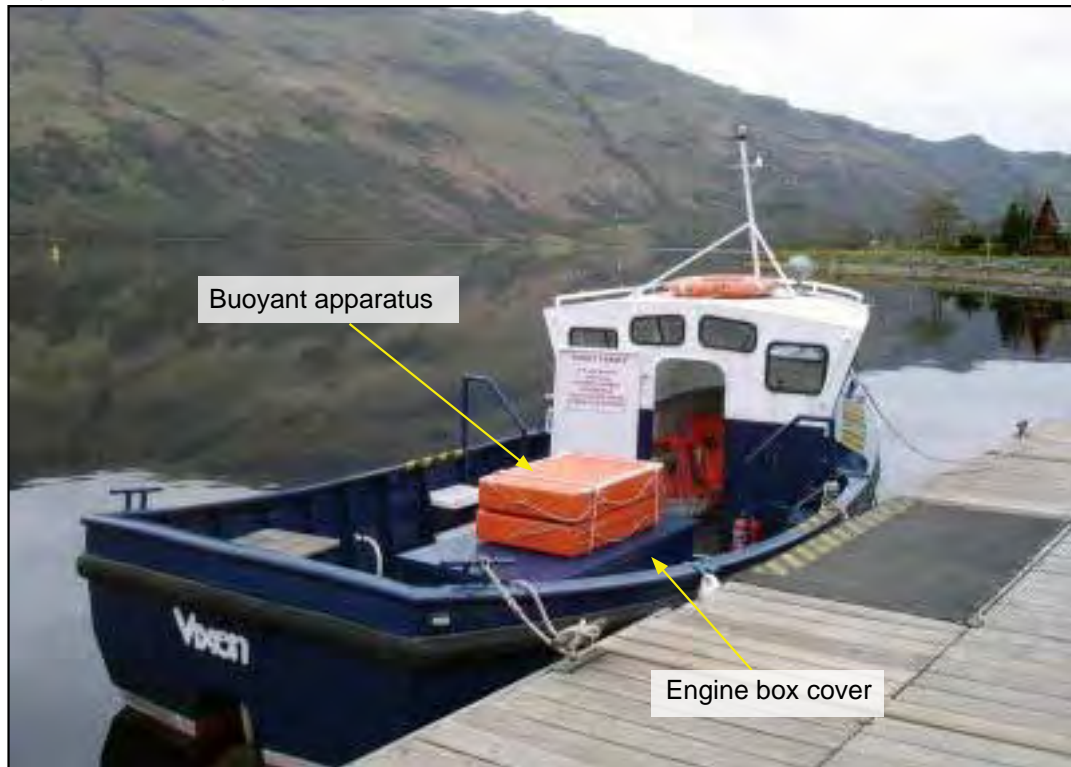


Figure 3: *Vixen* alongside in Ardlui before the accident

At around 1105, the skipper berthed *Vixen* port side alongside the southern side of Ardleish jetty (**Figure 4**). The skipper held the boat alongside by hand as the six passengers, all with rucksacks, embarked *Vixen*. The skipper told the passengers to remove their rucksacks and to sit down in the boat for the trip. The passengers



Figure 4: Ardleish Jetty

all sat on the seats which were situated at the stern of the boat. The female passenger sat forward on the starboard side facing the wheelhouse (**Figure 5**). The passengers placed their rucksacks either on the deck in front of them, or on top of the engine box (**Figure 3**). The skipper manoeuvred *Vixen* astern away from Ardluish jetty, turned it to port and increased to a speed of around 6 knots, and steered a heading back to Ardlui marina.



Figure 5: Passengers sitting on *Vixen*'s starboard side immediately prior to the accident

At about 1110 the skipper reduced *Vixen*'s speed as he passed the line of yellow buoys that marked the limit of the marina's anchorage. One of the male passengers sitting in the centre at the stern saw that his boots were covered in water. He told the female passenger about the water shortly afterwards when he saw that the water level had risen to a depth of about 200mm at the stern. The female passenger moved forward to the wheelhouse to tell the skipper about the water. She later described seeing water flooding into the stern 'like a waterfall' from somewhere beneath the bench seat. When she returned to her seat the water was around 300mm deep at the stern.

The skipper looked out of wheelhouse and saw the water; he increased *Vixen*'s speed in an attempt to beach the boat on the shore in Ardlui Marina. A few seconds later the engine stopped. The skipper reached inside the wheelhouse and passed out the five lifejackets that were immediately to hand. He untied the two buoyant apparatus that were located on top of the engine box and threw them both overboard. The five male passengers donned the lifejackets. The other lifejackets and buoyancy aids were stored in the forward part of the boat and no attempt was made to recover these.

Around 20 seconds later, with the water level inside *Vixen* about 200mm from the top of the gunwale, the skipper told the passengers to get out of the boat. The male passengers stepped onto the gunwale and jumped into the loch. The female passenger and the skipper remained on board as the boat sank beneath them;

they were pulled under the water and then swam back to the surface. The female passenger's right arm was briefly caught by a thin rope while she was underwater, but she was able to get free.

The skipper of a motor cruiser moored in Ardlui Marina saw *Vixen* sink. He started the boat's engine and let go its mooring lines. Another man volunteered to assist the skipper, and with the two men on board the motor cruiser headed out onto the Loch.

Three of the male passengers swam straight to the shore and were helped out of the water by people on the jetty. The two other male passengers and the female passenger clung to the buoyant apparatus. The skipper swam to another vessel anchored nearby and held onto its stern boarding platform. The motor cruiser's skipper manoeuvred his vessel close to the buoyant apparatus where he and his assistant rescued the female passenger and two male passengers, before moving on to rescue *Vixen*'s skipper.

At 1119 an Ardlui Hotel employee telephoned the emergency services and asked for an ambulance to be sent to the marina.

The motor cruiser's skipper and his assistant landed *Vixen*'s passengers and skipper ashore; they then went back out onto the Loch and recovered the passengers' floating rucksacks.

The emergency services operator alerted the police, the Loch Lomond and Trossachs National Park Authority (The Park Authority), and the Loch Lomond Rescue Boat, based in Luss, about the accident. The Park Authority's three launches headed north up the loch to assist with the emergency. The emergency response was stood down when it was confirmed that everyone was safely ashore.

1.4 ENVIRONMENTAL INFORMATION

1.4.1 Weather and ephemera

The weather and environmental conditions at the time are shown in a photograph (**Figure 6**) which was taken a few minutes before the accident.

- Light – daylight
- Weather – partly cloudy
- Wind – Beaufort Force 2
- Water surface – rippled
- Water temperature – 13°C

1.4.2 Previous rainfall

The recorded rainfall for the 4 days before the accident is shown in **Table 1**. The records were obtained from a privately operated weather station in Buchanan, located about 10 miles south-east of Ardlui. The records for the rainfall in Buchanan for the month of September are shown at **Annex A**.

| Date | 15 Sept. | 16 Sept. | 17 Sept. | 18 Sept. | 19 Sept. |
|---------------|----------|----------|----------|----------|----------|
| Rainfall (mm) | 2.4 | 18.9 | 15.6 | 0.3 | 4.2 |

Table 1 - Rainfall in Buchanan around the time of the accident



Figure 6: Environmental conditions at the time of the accident

1.5 SALVAGE

Vixen sank in a depth of between 6m and 7m. When the vessel was located by divers the boat was found to be upright with the stern embedded in soft mud. *Vixen* was lifted using airbags on 2 October 2012, transferred to the boat lift in Ardlui Marina and lifted out of the water (**Figure 7**).

1.6 THE KEY PERSONNEL

1.6.1 The skipper (at the time of the accident)

The skipper on the day of the accident assisted *Vixen*'s owners by operating the vessel when requested. He lived on site at the marina where, prior to his retirement, he had been the marina's sales manager. He held a Royal Yachting Association (RYA) National Powerboat Certificate Level 2. His qualification had not been endorsed for commercial work (more commonly referred to as a commercial endorsement).



Figure 7: *Vixen's* salvage

1.6.2 The occasional skipper (the groundsman)

The Ardlui hotel's groundsman occasionally acted as *Vixen's* skipper. He held an RYA Practical Motor Cruising Courses – Helmsman Certificate. It had not been commercially endorsed.

1.6.3 The main skipper (a company partner)

The main skipper was a partner in the hotel and marina business; he was the senior partner's son. His primary responsibility was the management of the marina, which included *Vixen's* operation. He was abroad at the time of the accident.

He held a RYA National Powerboat Certificate Level 2 that had not been commercially endorsed.

1.6.4 The senior partner

The Ardlui hotel and marina's senior partner (the father of the main skipper) acted as *Vixen's* skipper infrequently. He was abroad at the time of the accident. He held an RYA Yachtmaster Offshore Certificate, which had not been commercially endorsed.

1.7 VIXEN

1.7.1 General background

Neither *Vixen's* current owners nor the previous known owners were able to provide any significant documented history for the vessel. *Vixen* had a length overall (LOA) of 6.8m and was made of steel. A steel wheelhouse was fitted at the forward end. There was no watertight subdivision of the hull or fixed buoyancy. *Vixen* was

powered by a 3 cylinder Volvo diesel inboard engine. The vessel was thought to have been built in about 1990, possibly as a creel fishing boat. *Vixen*'s previous owner bought the vessel from a boat yard in north-west Scotland for a project on Loch Lomond which was later cancelled. *Vixen* was sold to its current owners at the Ardlui hotel and marina in 1997, and had been operated as a ferry since that time.

1.7.2 Passenger capacity and seating arrangement

The maximum number of passengers that *Vixen* could carry safely had not been established and was not posted on board. *Vixen* most frequently carried two or three passengers and their rucksacks. Occasionally, such as on the day of the accident, more passengers were carried. It was reported that *Vixen* had occasionally carried up to eight passengers.

The passengers were provided with fixed bench seating at the stern of the boat (**Figure 8**). This could comfortably seat a maximum of around 6 passengers. Additional passengers could also sit on the edge of the engine box cover (**Figure 3**).

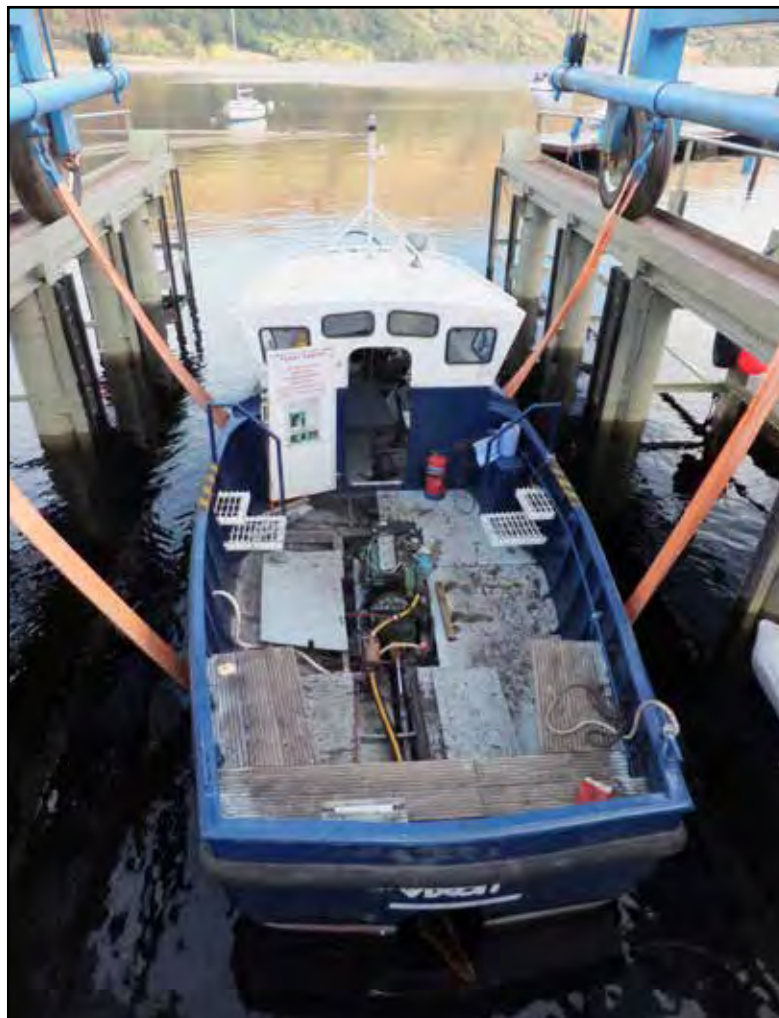


Figure 8: *Vixen*'s passenger seating arrangement

1.7.3 The weed hatch

Beneath the bench seat at *Vixen's* stern was a weed hatch that provided access to the rudder and propeller (**Figure 9**). This allowed weed and other items obstructing the propeller to be removed without having to take the boat out of the water. The weed hatch coaming was around 330mm above the water line when the vessel was berthed with no passengers or crew on board (**Figure 10**).



Figure 9: The weed hatch

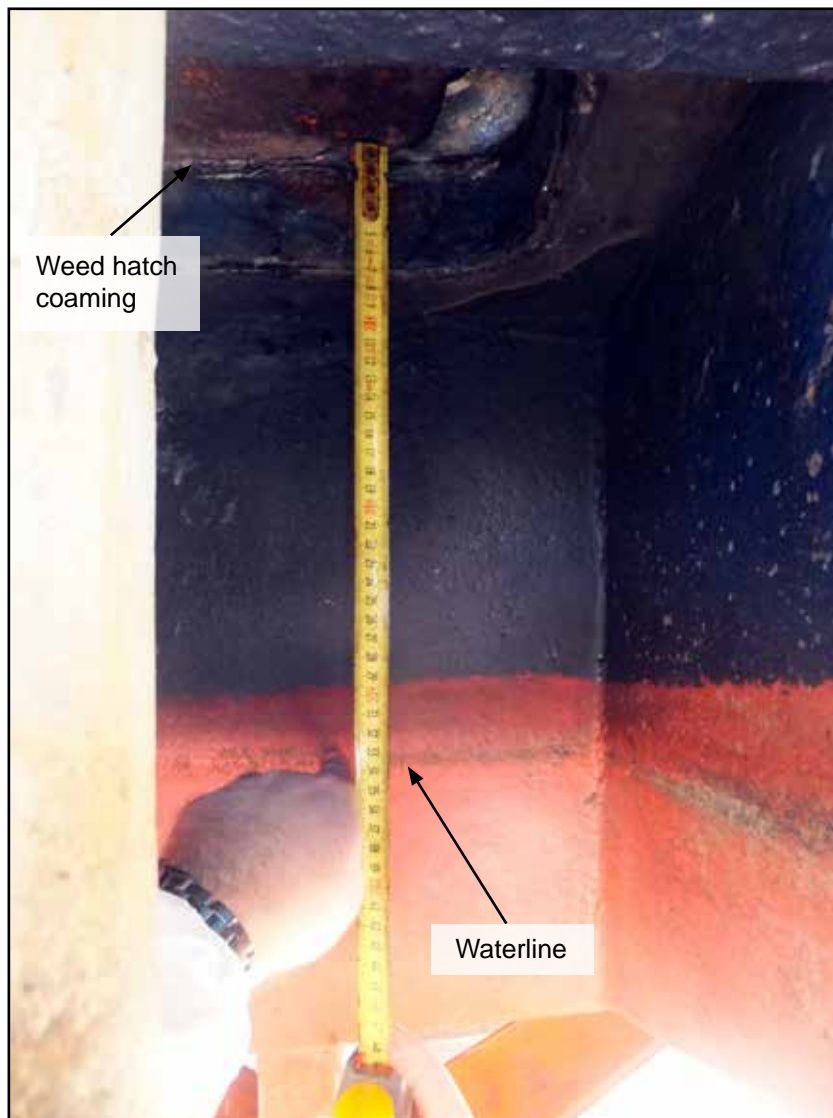


Figure 10: Weed hatch to waterline distance - alongside

The weed hatch opening measured 255mm by 170mm. The hatch cover was found on the deck in the aft part of the boat after the boat was salvaged. Both of the hatch cover's hinges had completely corroded away and there was no evidence of a locking or securing device on the side opposite to the hinges (**Figure 11**). The inner surface of the hatch cover did not have any sealing material fitted to make it watertight when closed over the weed hatch coaming.

The build-up of rust, both on the hatch coming and on the hatch lid, prevented the hatch cover from fitting over the coaming properly (**Figure 11**). Witness marks found in the paintwork suggested that, prior to the accident, the hatch cover might have rested on top of the coaming. It was also possible, but less likely, that the hatch cover had lain on the deck for an unknown period of time before the accident.

1.7.4 Ballast

Vixen had been fitted with permanent cement ballast at the stern on both port and starboard sides (**Figure 12a**). Steel weights were placed in the mid section, mostly on the port side (**Figure 12b**). It was not known when the ballast was fitted.



Figure 11: The weed hatch cover



Figure 12a: Permanent cement ballast at stern



Figure 12b: Permanent metal ballast in mid section

1.7.5 The bilge pumping system and operation – as fitted

Vixen's bilge pumping system was originally fitted in 2009. The submersible electric bilge pump was fitted in the bottom of the keel section, with a separate float switch above the pump suction inlet (**Figure 13**). The bilge pump, wired directly to the battery terminals, would operate automatically at any time when the float switch was lifted by rising bilge water.

The bilge pump could also be activated manually, regardless of the position of the float switch, by a rocker switch located in the wheelhouse (**Figure 14**).

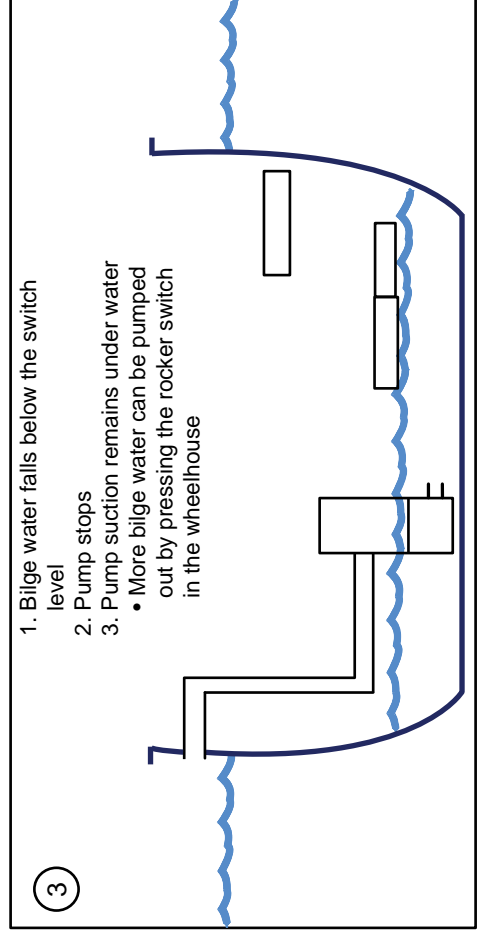
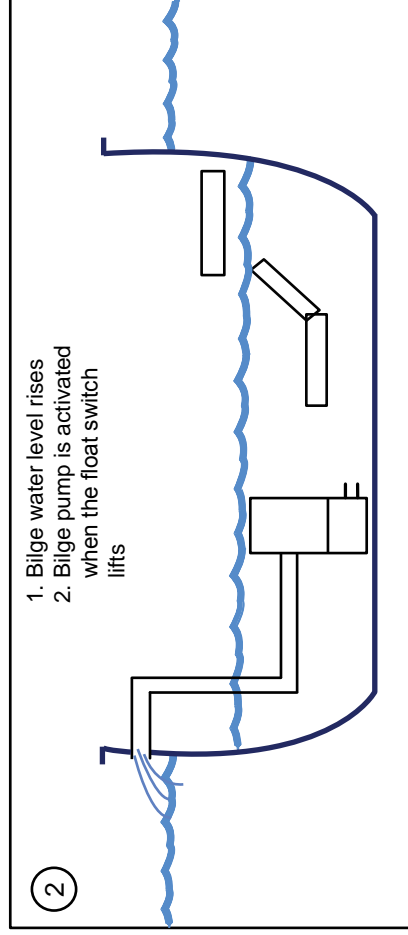
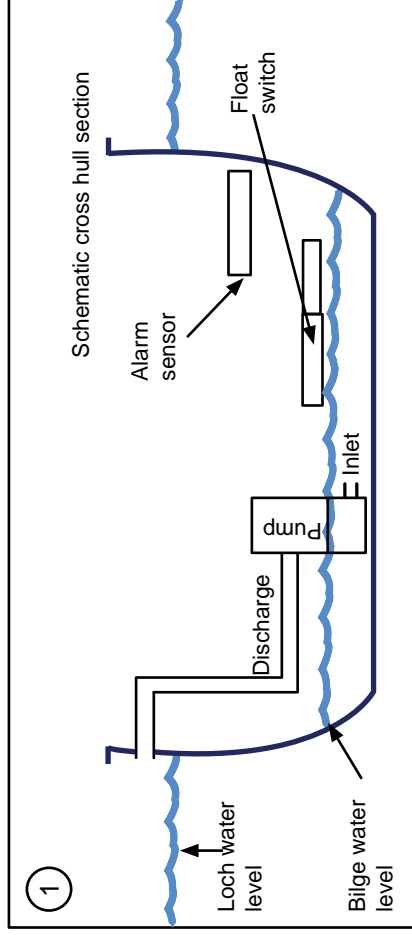
1.7.6 The bilge pumping system – as found after salvage

After *Vixen* had been salvaged, its bilge pump was found firmly wedged against the propeller shaft stuffing box by a metal block (**Figure 15**). The float switch and pump were tested once the mud, which had gathered after the sinking, had been removed. The float was found to move freely. Power was temporarily restored to the circuit and both the pump and float switch were found to operate normally.

The pump had been raised deliberately from its original position, probably in order to reduce the risk of clogging the pump with debris and sludge that collected in the bilge¹. The bilge pump suction was found to be higher than the float switch. Consequently, once the water level rose sufficiently to activate the float switch, the bilge pump would run continuously; it would never be possible for the pump

¹ Some of the debris found in *Vixen's* bilge could not be attributed to the sinking or subsequent salvage. This included broken components, rubbish and other items which must have been present in the bilge before the accident.

Bilge system as originally fitted



Bilge system as found

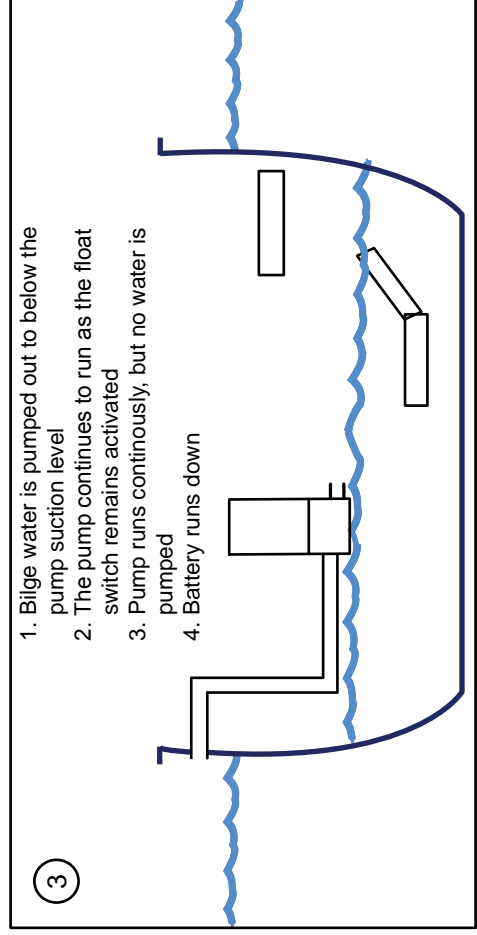
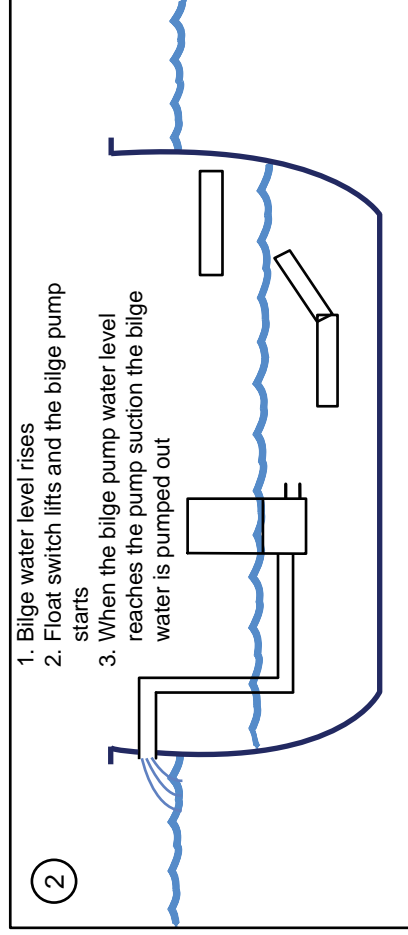
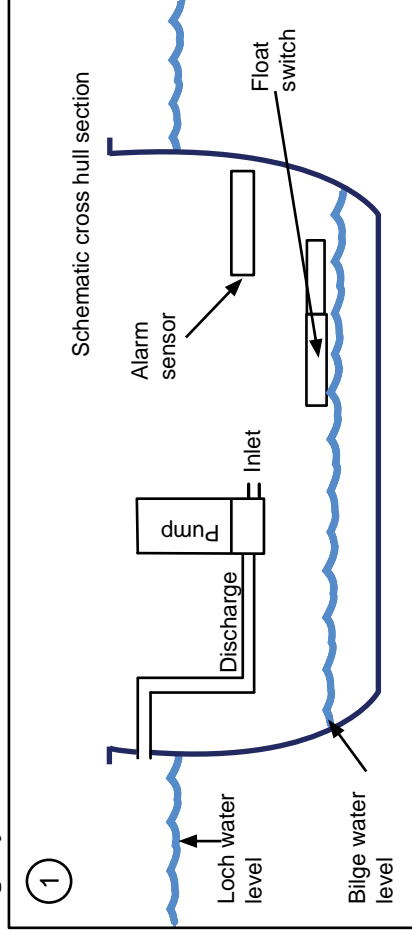


Figure 13: Schematic diagram of Vixen's bilge system as fitted and as found following the salvage

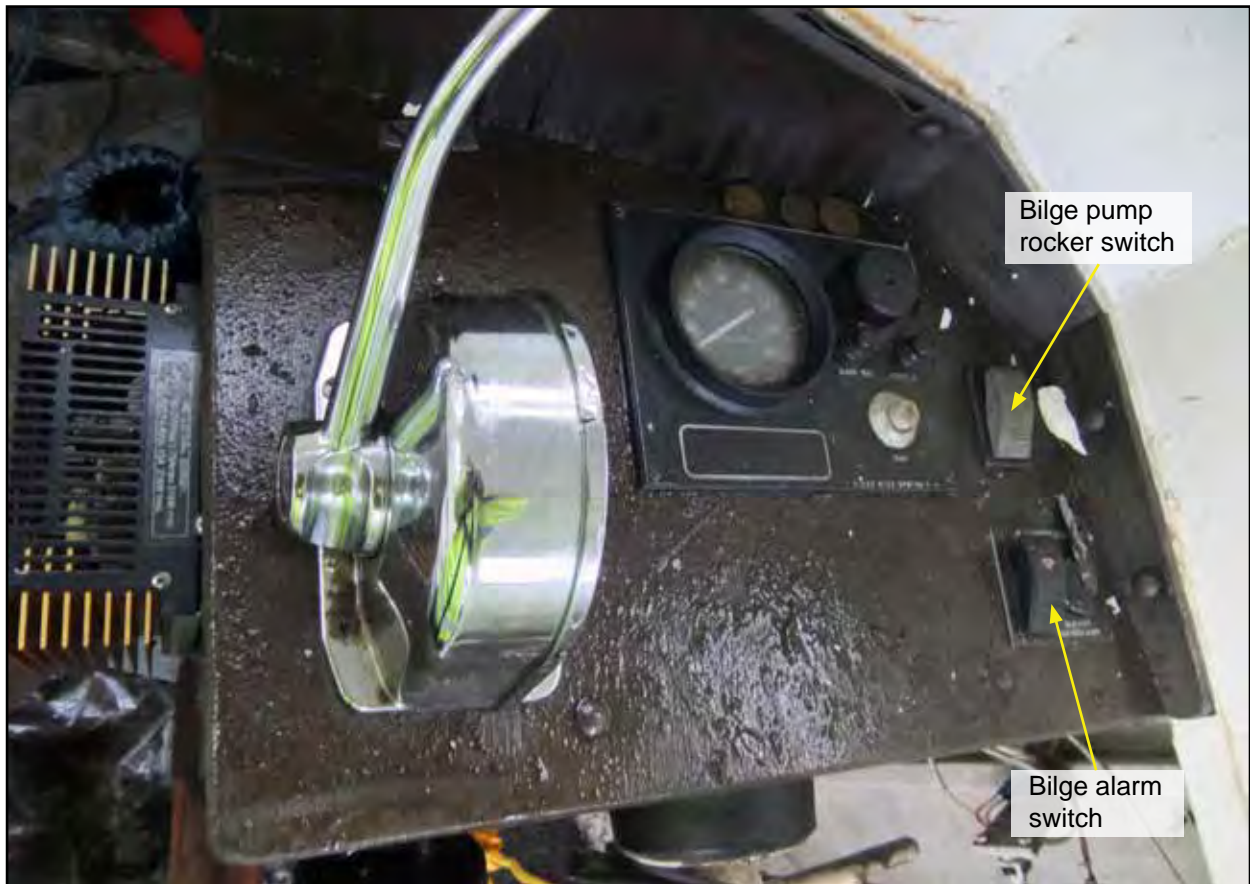


Figure 14: Bilge pump rocker switch



Figure 15: Bilge pump as found post-salvage

to reduce the level of water below the float switch in order to turn itself off. In this condition, the pump could run continuously, discharging the battery as soon as the main engine was shut down. However, there was sufficient charge in the battery to start the engine on the morning of the accident.

The float switch was positioned close to the side of the keel. If it was held down, either due to the debris that was found in the bilge (**Figure 16**) jamming the float, or deliberately, the system would not have worked automatically and would not have discharged the battery. However, the pump could still have been turned on by operating the rocker switch in the wheelhouse. The main skipper routinely operated the bilge pump by using the rocker switch. However, the person acting as skipper on the day of the accident, and the groundsman, reported only occasionally using the rocker switch to operate the bilge pump. Heavy rainfall on the 16th and 17th September may therefore have resulted in an increased amount of water laying in the bilge.

The overall effect of raising the bilge pump increased the volume of water that remained in the bilge after the pump had lost suction.



Figure 16: Vixen's bilge and float switch

1.7.7 The bilge alarm

A new bilge alarm system was fitted to *Vixen* in March 2010. The alarm was activated by a sensor fitted in the bilge (**Figure 17**). The bilge alarm was powered from the main battery and was activated by a switch in the wheelhouse (**Figure 14**). The alarm system was also protected by an in-line fuse.



Figure 17: Bilge alarm sensor

The inspection of *Vixen* carried out after the salvage found that the main bilge alarm switch was in the 'off' position and the system's in-line fuse was missing. The bilge alarm system was subsequently tested; a new fuse was fitted and the system was turned on, the alarm both sounded and a warning lamp lit.

1.7.8 Inspection following the salvage

The following defects were identified during the inspection of *Vixen* after the salvage.

- There were several small penetrations in the hull plating above the waterline (**Figure 18a**).
- The steel at the gunwale top had corroded away completely in some areas (**Figure 18b**).
- The weld between the main seawater inlet fitting and the hull was not watertight (**Figure 18c**).
- The electrical connectors fitted in the bilge were not sealed against water ingress and were unsuitable for use in a wet environment (**Figure 18d**).



Figure 18a: Hull penetrations above the waterline



Figure 18b: Gunwhale top corrosion



Figure 18c: Seawater inlet hull weld connection



Figure 18d: Electrical connections in bilge

1.7.9 Maintenance

Vixen's engine was most recently serviced in April 2012 by a marine engineer who worked at the Ardlui marina during the spring and summer months. During the winter of 2008/2009, *Vixen* was lifted out of the water for an extensive overhaul. The boat's hull was sand-blasted and painted, the engine and its ancillary equipment were overhauled, and new wooden deck boards and a new engine box and cover were fitted.

1.7.10 Risk assessment

No written risk assessment of the passenger ferry operation had been carried out, either prior to *Vixen* entering service, or since.

1.8 LOADING SIMULATION

Vixen was refloated and ballast weights were added to establish *Vixen's* effective freeboard (the distance from the top of the weed hatch coaming to the waterline) in different conditions (**Figure 19a**).

The location and weight of the skipper and each of the passengers were known; each of the passengers estimated the weight of their rucksacks. Allowances were made for the weight of the boat's fixtures that had been lost during the sinking, which included: the engine box and its lid; two buoyancy aids; the lifebuoy and the removed lifejackets. The volume of fuel was the same as when *Vixen* sank. The volume of water in the bilge immediately before the accident could not be determined.

| Condition | Passenger and crew loads | Rucksacks | Bilge conditions | Effective freeboard (waterline to top of weed hatch coaming) |
|-----------|--------------------------|-----------|--|--|
| Light | Nil | Nil | Empty | 332mm |
| Loaded 1 | 6 passengers 1 crew | 6 | Empty | 141mm |
| Loaded 2 | 6 passengers 1 crew | 6 | Bilge full to bilge pump suction level | 130mm (Figure 19b) |
| Loaded 3 | 6 passengers 1 crew | 6 | Bilge full to bilge alarm activation level | 98mm (Figure 19c) |

Table 2 - Loading simulation results



Figure 19a: Loading simulation

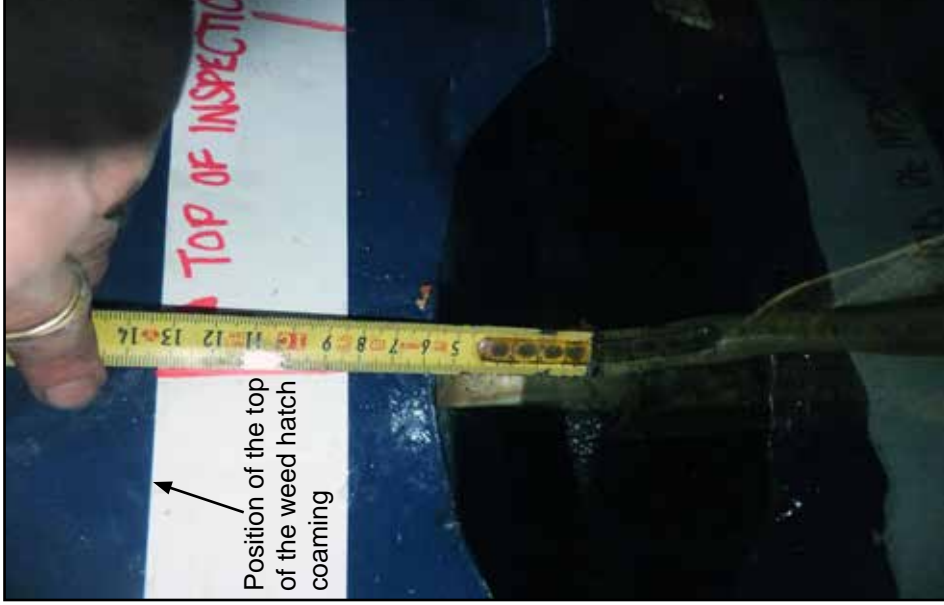


Figure 19b: Loading condition 2



Figure 19c: Loading condition 3

1.9 SAFETY EQUIPMENT

1.9.1 Lifejackets and buoyancy aids

Five 100 N² lifejackets (**Figure 20a**) were located inside the port side of *Vixen's* wheelhouse, inside plastic bags. Six other buoyancy aids of various sizes (**Figure 20b**) were found on board *Vixen* after the accident. Of these, two 100 N buoyancy lifejackets were found on the port side of the wheelhouse; three 45 N buoyancy aids were found tied to a horizontal line secured on the starboard side of the wheelhouse (**Figure 20c**) and one child's 45 N buoyancy aid was found at the forward end of the wheelhouse.

1.9.2 Buoyant apparatus

Two buoyant apparatus, each one approved for six persons, were located on top of *Vixen's* engine box and were tied down with quickly releasable bungee cords (**Figure 3**).

1.9.3 Lifebuoy

A lifebuoy was located on top of *Vixen's* wheelhouse (**Figure 3**).

1.9.4 Fire extinguisher

A 6kg dry powder fire extinguisher was stowed on the deck adjacent to the wheelhouse. The fire extinguisher was fitted in August 2009. The next service, due in August 2010, had not been carried out. The next discharge test was required in 2014 (**Figure 21**).

1.10 COMMERCIAL ENDORSEMENT OF QUALIFICATIONS

The Merchant Shipping (Inland Waters and Limited Coastal Operations) (Boatmasters' Qualifications and Hours of Work) Regulations 2006 (Merchant Shipping Notice (MSN) 1808) (**Annex B**) stated the various different qualifications accepted for operating a ferry carrying 12 passengers or less on inland waters. These included the RYA's Yachtmaster and Powerboat Level 2 schemes; the 'Practical Motor Cruising Courses – Helmsman Certificate' held by the hotel's groundsman was not listed. The regulation also required that qualifications were commercially endorsed. To obtain a commercial endorsement the applicant had to pass the following:

- An approved medical examination
- A course in Basic Personal Survival Techniques
- A course in Professional Practices and Responsibilities³.

² 100 Newtons (N) refers to the amount of buoyancy provided by a lifejacket or buoyancy aid. Lifejackets must be designed so that they can roll an unconscious person over in the water so that their mouth and nose are clear of the water. A buoyancy aid is not required to do this.

³ The PPRC was introduced in 2012, so anyone who already had a commercial endorsement would not need to pass it until their next 5-yearly renewal.



Figure 20a: Lifejackets worn by passengers



Figure 20b: Lifejackets and buoyancy aids found on board

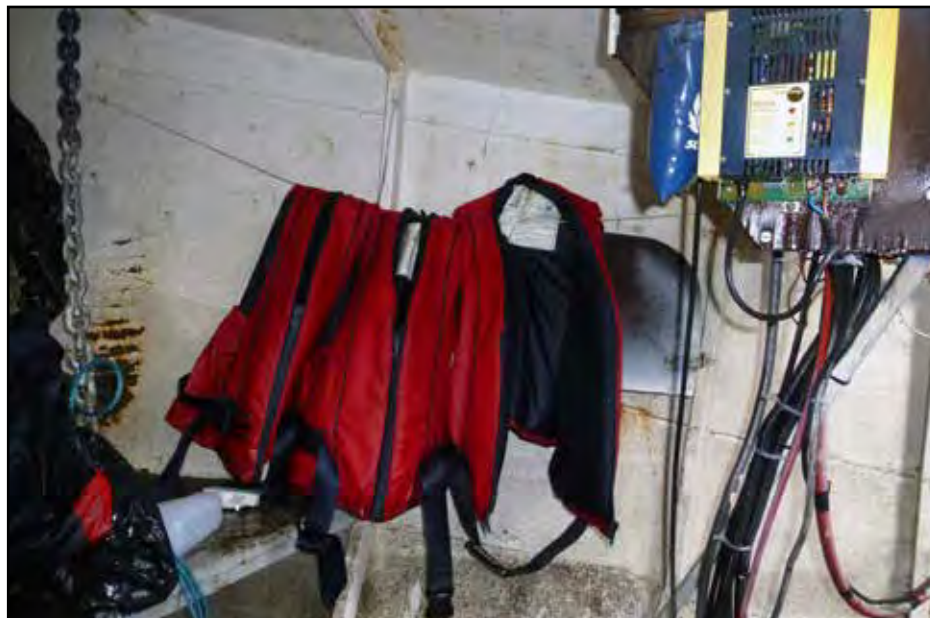


Figure 20c: Buoyancy aids secured inside the wheelhouse



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1.11 MARITIME AND COASTGUARD AGENCY (MCA)

1.11.1 Merchant shipping legislation

The MCA is responsible for implementing the Government's maritime safety policy throughout the UK and on UK registered ships. The MCA is the national competent authority for setting vessel standards, certifying crew qualifications, and associated health and safety at work requirements on ships. These standards are set in primary legislation in the Merchant Shipping Act⁴ and in more detailed secondary legislation. The MCA has the responsibility for enforcing the Merchant Shipping Act and its associated secondary legislation (the Merchant Shipping Regulations).

The MCA has adopted several codes of practice⁵ for the operation of small, commercially operated vessels that go to sea carrying no more than 12 passengers. These codes set out approved alternatives that are more suited to small vessels than the Merchant Shipping Regulations which would otherwise apply. The MCA has delegated the survey and certification of these small commercial vessels to Certifying Authorities⁶, commercial organisations acting on the MCA's behalf. The MCA may also delegate limited enforcement powers to some Certifying Authorities, which allows them to stop and detain vessels that are found to be unsafe.

The MCA's principal focus is on vessels that go to sea, and there are no statutory codes of practice applicable to vessels that operate on inland waters. Section 94 of the Merchant Shipping Act permits certain parts of the Act to apply to vessels on inland waters (**Annex D**); section 98 can be applied to prohibit the use of boats which are found to be dangerously unsafe. The MCA can also invoke section 100 of the Act to enforce penalties if an existing prohibition notice has been breached.

The main secondary legislation applying to vessels on inland waters is *The Merchant Shipping (Inland Waters and Limited Coastal Operations) (Boatmasters' Qualifications and Hours of Work) Regulations 2006* (**Annex B**). Prohibition notices can be served on the operator where discrepancies are found against these regulations. If other discrepancies are found, such as those relating to the condition of the vessel, MCA surveyors make recommendations to the operator to correct them.

Each year, the MCA inspects around 31 small passenger boats, similar to *Vixen*, on inland waters in Scotland and Northern Ireland.

1.11.2 Previous inspections

On 25 June 2007 the MCA carried out a targeted inspection of *Vixen*. The inspection found a number of deficiencies. These were:

- *Fuel line not to ISO Standard*
- *Fire Extinguisher not as required*

⁴ The Merchant Shipping Act 1995

⁵ As detailed in Marine Guidance Note (MGN) 280 'Small Vessels in Commercial Use for Sport or Pleasure, Workboats and Pilot Boats – Alternative Construction Standards' and the Blue, Yellow, Brown and Red Codes – collectively referred to hereafter in this report as 'approved codes of practice' for simplicity.

⁶ Approved Small Vessel Certifying Authorities are listed in Marine Information Note (MIN) 421 (M) (**Annex C**).

- *No Fire Hole in Engine Casing*
- *Recommend [ed to fit a] bilge alarm.*

The MCA surveyor recommended that the owner rectify the deficiencies.

On 19 June 2012, following an accident involving a commercially operated boat on Loch Lomond⁷, the MCA carried out several targeted inspections of small commercial vessels operating on the loch. The MCA surveyor inspected the qualifications held by *Vixen*'s skippers and found that they did not meet the requirements of the regulations⁸. The MCA wrote to the owner (**Annex E**) enclosing a Schedule of Prohibition Notice that stated:

“Vessels (sic) owner must not operate the vessel on page one [Vixen] without an appropriately qualified master onboard.”

1.12 LOCAL GOVERNMENT AUTHORITY LICENSING

1.12.1 Authority to issue licences

The Civic Government (Scotland) Act 1982 (Civic Government Act) (**Annex F**) enables local government authorities to act as Licensing Authorities in their geographic area of responsibility. The Act gives local government authorities the option to require operators to hold licences for businesses such as metal dealing, street trading and taxi and private car hire services. The Act also contains a provision which enables local government authorities to issue boat hire licences. Where a local government authority has adopted a boat hire licensing scheme it becomes a criminal offence to operate without such a licence.

The three local government authorities that border Loch Lomond are the Argyll and Bute Council, the Stirling Council and the West Dunbartonshire Council. Each council had the option to licence commercial boat operations originating from its geographical area. The Argyll and Bute Council was the administrative council for the operation of *Vixen*. If *Vixen* had been based in Ardleish, the administrative council would have been the Stirling Council.

1.12.2 Argyll and Bute Council – Boat Hire Licensing

The Argyll and Bute Council had introduced a Boat Hire Licensing scheme that required (**Annex G**), inter alia:

“Where a person uses or hires a boat to carry for reward 12 or fewer persons for pleasure, recreational, educational or sporting purposes, a Boat Hire Licence is required.”

“The licence holder shall ensure that the maximum number of persons to be carried in the boat or vessel at any one time (including the person in charge of the boat or vessel or any other crew) must not exceed the number stated in the licence.”

⁷ See section 1.17.2

⁸ Statutory Instrument 2006 No.3223 -The Merchant Shipping (Inland Waters and Limited Coastal Operations) (Boatmasters' Qualifications and Hours of Work) Regulations 2006 – Structure and Requirements – MSN 1808

“The licence holder shall make sure that the names of the licence holder and the words “To carry persons including crew”... is marked or painted in a conspicuous position where it can be clearly seen by the passengers...”

“The licence holder shall ensure that the registered number allotted to the vessel by Argyll and Bute Council is clearly marked or painted on the outside of each bow...”

“You will be required to produce a certificate issued by a suitably qualified person stating that the vessel is suitably designed, constructed, maintained and equipped and in a safe condition for its intended use.”

Vixen did not have a boat hire licence. The Argyll and Bute Council's records showed that the head of the Governance and Law department wrote to Vixen's owners on or around 25 October 2011 (**Annex H**). The letter advised the owners *“regarding the provisions and implications relating to boat hire for those who operated boats on Loch Lomond”*. The letter stated that, inter alia:

“...it is an offence to operate a vessel which falls into the relevant categories without holding a boat hire licence.”

Vixen's owners did not recall receiving the letter; the Council did not follow up on the requirement for a licence. The Council had no mechanism for inspecting the condition of vessels or checking the qualifications held by operators before it issued boat hire licences; it relied solely on the information supplied by the operators. Similarly, the Council relied on others, such as the police, the Park authorities and the MCA, to alert them to any problems with their licensed boats.

1.12.3 West Dunbartonshire and Stirling Councils

Neither the West Dunbartonshire Council nor Stirling Council had a boat hire licensing scheme at the time of the accident.

1.13 LOCH LOMOND AND THE TROSSACHS NATIONAL PARK

1.13.1 Overview

Loch Lomond is the largest body of fresh water in mainland Britain. Loch Lomond and the Trossachs National Park (the Park) was created in July 2002 under the National Parks (Scotland) Act 2000 to safeguard the area around Loch Lomond, parts of which were considered to be coming under severe pressure from visitors and recreational activities. A National Park Authority was set up to co-ordinate the delivery of the Park's four statutory aims:

- *To conserve and enhance the natural and cultural heritage*
- *To promote the sustainable use of the natural resources of the area*
- *To promote understanding and enjoyment (including enjoyment in the form of recreation) of the special qualities of the area by the public,*
- *And to promote sustainable social and economic development of the communities of the area.*

At the time of the accident, the Park Authority employed five full-time ranger staff and operated three boats to patrol Loch Lomond.

1.13.2 Byelaws

The Park's original byelaws were introduced in 1996 and amended in 2006 by the Park Authority (**Annex I**). The byelaw's purpose was to reduce disturbance to wildlife, local people and visitors, and to promote safety. The byelaws set the standards required for the type and use of lifejackets, and for navigation safety on the loch.

Section 3.1.3 (1) Trade or Business stated:

“No person shall conduct any activity by way of trade or business with, or in expectation of personal reward from members of the public on the shore, without the prior written permission of the Authority⁹.”

New businesses were required to provide the Park Authority with a business plan and a risk assessment in order to gain permission to operate. The byelaw did not require existing businesses to develop or provide similar plans or risk assessments.

New byelaws were proposed in 2012 that would provide the Park Authority with a greater ability to ensure that existing businesses were able to show their compliance with current standards.

1.13.3 Registration

The Park's byelaws required owners of power-driven craft to register their boats with the Park Authority. At the time of the accident there were approximately 5,000 craft registered for use on Loch Lomond. The Park Authority estimated that the maximum number of registered boat owners on the loch, at any one time, to be around 1,000.

The operator of a registered vessel was required to adhere to the Park's byelaws. These required the registration number and annual renewal marks to be clearly visible on each side of the boat. The byelaws also allowed the Park Authority to inspect a power-driven craft to confirm that the details given on the registration application form were correct.

The Park Authority provided Argyll and Bute Council with boat registration information that enabled them to identify commercially-operated vessels which fell within the scope of their licensing scheme.

1.13.4 Vixen's registration

Vixen was initially registered with the Park Authority in 1997. It was re-registered each year, most recently in February 2012 (**Annex J**). *Vixen* did not display the required registration number or its allocated annual marks.

⁹ The Authority means the Loch Lomond and Trossachs National Park Authority

1.14 THE ASSOCIATION OF INLAND NAVIGATION AUTHORITIES (AINA)

The Association of Inland Navigation Authorities (AINA) is the UK's forum for organisations with statutory or other responsibility for the management and operation of inland waters for navigation and wider use. AINA members include organisations such as the Canal & River Trust, the Environment Agency, the Broads Authority and national park authorities (including the Loch Lomond and Trossachs National Park), local government authorities, private canal companies, utility companies, and a variety of public and charitable trusts.

1.15 INLAND WATERS SMALL PASSENGER BOAT CODE

1.15.1 Status of the Code

The Inland Waters Small Passenger Boat Code (referred to in this report as the Inland Waters Code) (**Annex K**) was published jointly by AINA and the MCA in 2007. The Inland Waters Code introduced a national standard for small commercial vessels (carrying up to 12 passengers) operating in the UK's inland and estuarial waters. The Inland Waters Code is a best practice guide for the use of operators, designers, builders, competent authorities and users. It is not a statutory code, but may be applied under mandatory licensing regimes by local government (or other competent) authorities.

Under the Code, Loch Lomond would have been classed as Category C Waters, defined as *"Tidal rivers and estuaries and large, deep lakes and lochs where the significant wave height could not be expected to exceed 1.2m at any time"*.

1.15.2 Required standards

The Inland Waters Code sets out standards for the construction, equipment, stability, operation, manning and maintenance of small passenger boats. If *Vixen* had been required to comply with the Code's requirements the vessel would have had to have met the following requirements:

- Construction and structural strength, including that:
 - *"A weed hatch...may be fitted where there is risk of weed and debris fouling the propeller. Where fitted, weed hatches should be at least 150mm above the normal laden waterline, and **watertight** when the vessel is both static and in motion."*
 - *"The operator should be satisfied themselves as to the soundness and integrity of the vessel's hull, including an appropriate out-of-water examination of the hull, at least every five years...and this should be documented." [sic].*
- Bilge pumping/draining
 - *"All vessels should be fitted with a powered or hand operated bilge pumping system adequate for the size of the vessel, so that any compartment can be drained. Auto start bilge pumps are recommended, provided they are inspected regularly."*

- Stability
 - *“A vessel should be tested in the fully loaded condition...to ascertain the angle of heel and the position of the waterline which results when all persons which the vessel will carry are assembled along one side of the vessel. The vessel has an acceptable standard of stability if the test shows that the angle of heel does not exceed 7 degrees.”*
 - *“In all cases, the maximum permissible weight of passengers derived from the tests conducted should be recorded for reference.”*
 - *“It should also be demonstrated that an open boat, when operating in Category C and D waters, when fully swamped, is capable of supporting its full outfit of equipment, the total number of passengers which it will carry, and a mass equivalent to its engine and a full tank of fuel.”*
- Freeboard:
 - When fully loaded in Category C waters a minimum freeboard of 360mm.
- Life-saving appliances (LSA) required in Category C waters:
 - Lifejackets or buoyancy aids of at least 150N buoyancy for all passengers.
 - Two lifebuoys.
- Fire-fighting appliances:
 - A properly maintained fire extinguisher.
- Health and Safety:
 - When the operator employs a skipper/crew, the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 (SI 1997/2962) apply.

1.16 TRANSPORT SCOTLAND

Transport Scotland is the national transport agency for Scotland, and is accountable to the Scottish Parliament.

1.17 PREVIOUS ACCIDENTS

1.17.1 Hotel ferry (Loch Lomond)

In January 2006 a small ferry operated by the owners of a hotel (not Ardlui), crossed Loch Lomond in reasonably calm conditions with a driver and two passengers on board. The boat was 6.4m in length and of traditional design with a small cuddy forward and a 14.9kW inboard engine.

A sudden, very violent squall heeled the ferry, causing it to take water over the gunwale. It subsequently capsized and sank. None of the occupants were wearing lifejackets and they were tipped into the loch, where the water temperature was only 3°C. Fortunately, they were quickly located by a Royal Air Force (RAF) helicopter that, coincidentally, was on exercise in the area. The survivors were airlifted to hospital suffering from hypothermia. The boat was not recovered and its suitability for commercial use was never verified. The boat operated from Stirling Council's region, and it was not required to have a boat hire licence.

1.17.2 Loch Lomond RIB

In June 2012 a Rigid Inflatable Boat (RIB) with four passengers embarked was undertaking a thrill ride trip on Loch Lomond. As the skipper turned the boat across its own wake, he and two of the passengers, including a 7 year old boy, were thrown overboard. The kill cord stopped the engine and the skipper was able to swim back to the RIB and climb on board. The uninjured skipper then manoeuvred the RIB to recover the two passengers from the water. The skipper then returned the RIB to Balloch, West Dunbartonshire. The two passengers sustained minor injuries.

The RIB had previously been issued with a boat hire licence by Argyll and Bute Council. The RIB operation subsequently transferred to West Dunbartonshire, where the council did not require the operator to have a boat hire licence.

1.17.3 *Swan*

In 2004, the converted ex-admiralty whaler, *Swan*, with nine passengers and a skipper on board, flooded and capsized on the River Avon at Bath. *Swan* was driven too close to the weir and taken under the cascading flow of water. The water flooded in, causing *Swan* to capsize and tip the passengers and skipper into the water. There were several injuries but no fatalities.

The MAIB investigation found that the stretch of the River Avon where the accident occurred had no navigation or licensing authority. The investigation also found that there was no effective risk assessment carried out on the boat's operation and it did not meet the guidance on levels of safety equipment to be carried.

The MAIB recommended that all fully navigable waters should be under the control of a navigation or licensing authority. All inland waterway navigation and licensing authorities were encouraged to insist on compliance with the Inland Waters Small Passenger Boat Code as a condition of the granting of a boat licence.

1.17.4 *Breakaway 5*

On 19 July 2003, the hire boat *Breakaway 5* capsized on the Norfolk Broads, trapping two of her ten passengers in the upturned hull; one passenger drowned. The subsequent inclining test concluded that the loss of stability was caused by the weight and distribution of the passengers on board. The MAIB recommended that local authorities assume responsibility for ensuring hire boats operated safely within their area by introducing licensing regimes supported by inspections of hire craft by competent bodies. A copy of the *Breakaway 5* report, containing the above recommendations, was sent to all councils in the UK.

SECTION 2 - ANALYSIS

2.1 AIM

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

2.2 THE CAUSE OF *VIXEN*'S FLOODING

2.2.1 Source of flooding

During the accident, a witness reported seeing water “*flowing like a waterfall*” at the centre part of the stern between the deck and the bench seating. The weed hatch cover was in extremely poor condition: there was no sealing gasket, the hinges had severely corroded, and there was no evidence that the closing mechanism had been secured. Even if it had been jammed onto the coaming, the weed hatch cover would have done little to prevent water ingress. In the absence of any other significant hull defects in the after part of the vessel, the witness's observation was almost certainly that of water flooding through the weed hatch at *Vixen*'s stern.

2.2.2 Reduced freeboard

The simulation of *Vixen*'s loading condition at the time of the accident showed that the combination of the six passengers all sitting at the stern, their rucksacks, and accumulated water in the bilge, reduced the effective freeboard significantly.

It was not possible to determine how much water had gathered in *Vixen*'s bilge. Large parts of the boat were open, so any rain water from the preceding days would have collected in the bilge. It was also found that the main sea water inlet connection leaked. It is therefore certain that, unless the bilge was routinely pumped out, water would accumulate there.

On the day of the accident the bilge was not checked, the bilge alarm and automatic pumping mode were disabled and the pump had not been operated using the manual rocker switch. The bilge could therefore have contained any amount of water up to the underside of the deck boards.

When *Vixen* was underway, the dynamic effect of the propulsion would have pushed the stern lower into the water, increasing the boat's stern trim. This induced trim would have increased further as the bilge water moved aft, sinking the stern even lower in the water. It is considered that the combination of the static and dynamic factors submerged the weed hatch sufficiently to allow water to overcome the weed hatch cover (assuming it was in position) causing *Vixen* to flood.

Vixen's weed hatch would have lowered further in the water as the water flowed in and the rate of flooding increased. With little reserve of buoyancy and no pumps to remove the water, *Vixen* continued to flood progressively until it sank completely. The boat was not able to remain afloat when fully swamped as required by the Inland Waters Code.

2.3 CONDITION AND OPERATION OF *VIXEN*

2.3.1 Stability, freeboard and passenger loading

The owners introduced *Vixen* into service as a small passenger ferry without establishing the vessel's maximum safe passenger-carrying capacity, or whether its stability or freeboard were adequate for the role

During *Vixen*'s 14 years in service its stability or freeboard were never checked against any recognised standard to confirm the vessel was suitable for commercial work. If the requirements of the Inland Waters Code (following its publication in 2007) had been applied, heel tests and minimum freeboard checks would have established the maximum passenger-carrying capacity and identified the shortcomings of the weed hatch.

Even if the weed hatch cover had been fastened onto its coaming, its height above the vessel's normal waterline was less than the minimum required by the Inland Waters Code. With six passengers on board, and the vessel berthed in calm water, the effective freeboard was measured at between 98mm and 130mm. The Inland Waters Code required that weed hatches should be at least 150mm above the loaded waterline when the vessel was in motion, and stressed that the hatch should be watertight.

The Inland Waters Code provided the most relevant safety standards for small passenger vessels operating on Loch Lomond. *Vixen* did not meet the Code's requirements and, because it had insufficient freeboard, was effectively overloaded when carrying six passengers and their rucksacks.

2.3.2 Maintenance

With no regulatory oversight to enforce a minimum standard, the owners maintained *Vixen* to their own requirements. This accident has demonstrated that those standards were insufficient for the safe operation of a commercial ferry.

Bilge pump

Debris (that was not attributable to the effects of the sinking) was found in *Vixen*'s bilge, and it was evident that the area was not routinely or effectively cleaned. The bilge pump had been raised at some point since it was fitted, probably to prevent it becoming clogged with debris, which had made the automatic operating mode redundant. With the pump above the float switch, it would start to operate as soon as there was enough water in the bilge to activate the float switch, but would never be able to reduce the water level sufficiently to reset the switch. In this situation, the pump would have run continuously and the battery would quickly have been discharged. The engine was reported to have started satisfactorily on both the day before, and the day of the accident, without the battery needing to be charged. The bilge pump was tested after the vessel was recovered, and found to work correctly. It is therefore concluded that the float switch must have been wedged in the 'off' position in some way. Although the float was found to be free to move after the mud and detritus from the sinking had been cleaned away, it was considered most likely that during operation the float switch had been jammed by some of the debris found in the bilge. There was little clearance between the float and the keel structure, and not much force would have been needed to stop the float from lifting

as the level of bilge water rose. Any debris causing the float to jam could easily have been dislodged when the mud was removed from the bilge after the boat had been salvaged.

While the float switch could have been jammed deliberately to prevent the pump from running continuously and discharging the battery, no evidence was found to support this theory.

Had the bilge been kept clean, the bilge pump could have remained in the bottom of the bilge and the float switch would not have been jammed. A work-around solution to the problem of debris gathering in the bilge was developed rather than establishing a routine to ensure that the bilge was cleaned.

Bilge alarm

The bilge alarm had been taken out of service; the fuse had been removed and the system was turned off. If the alarm had been operating effectively, it would probably have provided the skipper with sufficient warning for him to activate the bilge pump and perhaps prevent the accident.

It could not be determined when or why the bilge alarm was deactivated. However, the most common reason for disabling bilge alarms is because they give a high number of 'false' alarms. In this case, that could be as a result of being positioned too low or that the electrical connections in the bilge were not suitable for use in a wet environment.

The circumstances of this accident indicate that *Vixen's* skippers did not appreciate the critical safety role of the bilge alarm, and the importance of routinely checking that it works correctly.

General structural condition

The owners did maintain *Vixen's* engine and some other areas of the boat, such as the decking, but they did not consider any further assessment of *Vixen's* hull and its fittings to be necessary. In addition to the defective weed hatch, hull penetrations above the waterline, the corroded bulwark top, and a leaking weld around the cooling water inlet were all indications that further repairs to *Vixen's* hull were required.

Maintenance system

The shortcomings with *Vixen's* bilge pump, bilge alarms and structure demonstrated that the owners did not have an effective system to manage *Vixen's* maintenance and to ensure that defects were identified and rectified appropriately. A routine independent and professional survey of *Vixen* would have provided the owners with an objective and technically competent assessment of *Vixen's* structural condition and safety-critical equipment.

2.3.3 Safety equipment

Each of the five male passengers wore 100N buoyancy lifejackets that were issued by the skipper before *Vixen* sank. The female passenger, who was the weakest swimmer, was not given a lifejacket and the skipper did not have one to hand. Two more 100N lifejackets were available in the wheelhouse, but they were not

accessible in the time available before *Vixen* sank. A further three buoyancy aids of 45N buoyancy were available on the starboard side of the wheelhouse, but were tied to a line that made them difficult to release in an emergency. The Inland Waters Code required that vessels on Class C waters carried lifejackets or buoyancy aids of at least 150N buoyancy. None of the personal flotation devices on board *Vixen* met this requirement.

The female passenger and the skipper were pulled under the water as *Vixen* sank, but were able to swim back to the surface. It was extremely fortunate that they were able to do so. Had the female passenger been snagged by the line around her arm, she might have drowned. Had more lifejackets been immediately available to those on board, the female passenger and the skipper would have been able to abandon the vessel sooner and avoided being dragged underwater with the sinking vessel.

While these factors did not affect the outcome of this accident, had *Vixen* foundered in the middle of Loch Lomond or in poor weather conditions, wearing the correctly sized lifejacket or buoyancy aid might have become vital to the passengers' and skipper's survival.

The two buoyant apparatus were quickly released and thrown overboard. These provided significant buoyancy for the three passengers that did not swim for the shore. They were a valuable contribution to the success of the rescue operation.

The investigation also identified that the dry-powder fire extinguisher had not been serviced since it was fitted in August 2009. Consequently it was less likely to work if needed in an emergency.

2.3.4 Operation

Skipper's qualifications

None of *Vixen's* four skippers' qualifications were commercially endorsed as required by the regulations, and the basic qualification held by one of them was insufficient. The MCA had identified to the senior skipper that the skippers' qualifications were not commercially endorsed, and had issued a prohibition notice.

It is arguable whether the additional requirements of the commercial endorsement would have influenced the action of the skipper on the day of the accident. However, the lack of qualifications and the willingness to continue operating *Vixen* even after a prohibition notice had been served, indicated a particularly poor appreciation of the required safety and operating standards.

Operation of the bilge pump and bilge alarm

The bilge system and the bilge alarm had both been modified since their installation, as described earlier in the report. The effect of this was that neither system operated as would normally be expected.

The main skipper routinely operated *Vixen's* bilge pump by activating the manual rocker switch in the wheelhouse. The two skippers who were in charge of *Vixen* prior to the accident thought that the bilge pump worked automatically, and rarely used the manual mode. As they pumped the bilge out less frequently than the main skipper, it is likely that more rain water had accumulated in the bilge than was usual, thus reducing the vessel's freeboard.

The bilge alarm's fuse had been taken out and the system was turned off. If either of the skippers had tested the bilge alarm they would have discovered that it did not work.

The two skippers had limited knowledge of the boat's systems, and neither of them conducted any of the safety checks that should be routine on a commercially operated vessel. This showed a complacent attitude towards routine operations and a disregard for the testing and operation of safety-critical equipment. The combination of equipment defects, weak crew knowledge and poor management oversight meant that this accident became almost inevitable. This should not be accepted on a commercial ferry carrying around 1000 passengers per year.

Vixen's owners had not ensured that: the safety-critical systems on board were understood and correctly operated by their vessel's skippers; that the systems were maintained effectively; or, when appropriate, that the details of known equipment defects were circulated to the duty skipper.

2.3.5 Boat hire licensing

Vixen did not have a boat hire licence. The vessel's owners were obliged to license *Vixen* with the Argyll and Bute Council, whose staff had sent letters to the owners reminding them of their legal responsibility to do so.

The licensing process required that a certificate be issued by a suitably qualified person, which stated that the vessel was suitably designed, constructed, maintained and equipped, and was in a safe condition for its intended use. As detailed above, if the vessel had been surveyed by a competent person, the numerous defects identified during this investigation would probably have been detected. The owners would then have been required to take corrective action before the boat went back into service.

2.3.6 Summary

The owners thought that their own knowledge was sufficient to maintain and operate *Vixen* safely. However, they overlooked critical areas which subsequently contributed to the vessel's foundering.

Vixen's maximum passenger carrying capacity had never been determined, with the result that on the day of the accident, the vessel had a dangerously low freeboard and was more vulnerable to flooding. Ineffective maintenance had led to both the automatic bilge pumping and bilge alarm systems being bypassed or turned off. These safety-critical systems were not being routinely tested and two of the skippers did not know that both systems had serious faults. *Vixen* also had significant structural defects.

There were also problems with the safety equipment on board *Vixen*. Not all the lifejackets were immediately available, nor were they of the recommended buoyancy. Further, the dry powder fire extinguisher on board had not been serviced.

All of these shortcomings would have been identified if the vessel had been required to meet the standards of the Inland Waters Code.

None of the skippers were correctly qualified and two had not routinely tested safety-critical systems. The owners had not responded to the prohibition notice issued by the MCA. Similarly, the boat had not been licensed as required by the local council.

2.4 REGULATORY OVERSIGHT

2.4.1 The Maritime and Coastguard Agency

MCA surveyors carried out a targeted inspection of *Vixen* 3 months before the accident. They found that the vessel's skippers were not qualified in accordance with legislation relating to crew qualifications, and issued a prohibition notice stating that *Vixen* must not be operated without a qualified skipper on board. However, the short falls in the skipper's qualifications were not addressed and the vessel continued to operate as before.

The MCA was limited in its ability to inspect *Vixen*'s structural condition, stability, freeboard or safety equipment because there was no detailed secondary legislation which specifically applied to commercial vessels operating on inland waters against which to assess the vessel. For seagoing vessels, the secondary legislation – the Merchant Shipping Regulations, or the approved codes of practice for small commercial vessels – provides the detailed requirements for construction, stability, operation, safety equipment and so on. The MCA's surveyors can then identify exactly what must be done in order to comply with the regulations. The Inland Waters Code provided an equivalent level of detail, but was not statutory. Consequently, the MCA surveyors' remit for the inspection of small passenger boats on inland waters was limited to examining crew qualifications under the available regulations, or finding overwhelming evidence that a vessel was unsafe in accordance with the general provisions of the Merchant Shipping Act.

While there was little practical difference between surveying a small passenger boat which went to sea and one that remained on inland waters, the absence of applicable regulation had a significant impact on the MCA's ability to survey vessels on inland waters. This was reflected by the limited scope and the relatively small number of commercially-operated inland waterway vessels surveyed or inspected by the MCA.

2.4.2 Local government authorities

The Argyll and Bute Council had a boat hire licensing system in place, as permitted by the Civic Government Act, which required commercial boat operators to obtain a licence. However, despite council staff identifying that a licence was required, *Vixen* continued to operate without one. This shortcoming was not identified or corrected.

The Argyll and Bute Council's requirements for a boat licence included the need for a survey report issued by a "suitably qualified person" stating that the vessel was "suitably designed, constructed, maintained and equipped and in a safe condition for its intended use". This wording was taken from the Civic Government Act. However, there was no definition for what the word 'suitable' meant, or the standard to which the boat should be surveyed. Consequently, even if *Vixen* had been licensed, there was little guarantee that the vessel would have been surveyed to an appropriate standard or that the fabric and equipment be maintained to a level commensurate with the intended operation (ie the carriage of passengers).

The Civic Government Act was more generally applied to businesses such as taxi services, where existing legislation for vehicle and driver standards were well established and administered. There was no equivalent mechanism for issuing boat hire licences or monitoring compliance against defined standards.

The MCA and AINA developed the Inland Waters Code for exactly these circumstances. The Code, while not statutory, was designed from the outset to be applied under mandatory licensing regimes by local competent authorities. The Argyll and Bute Council could have adopted the Inland Waters Code and made compliance with it a mandatory part of its boat hire licensing system under the Civic Government Act.

While the Argyll and Bute Council had a boat hire licensing system in place, neither the Stirling nor the West Dunbartonshire Councils had any such requirements. A ferry, which capsized in 2006, was operated by an hotel in the Stirling Council's area; a RIB, from which two passengers were thrown overboard in 2012, was operated out of the West Dunbartonshire Council's area. This difference in licensing requirements, if allowed to persist, could have the effect of encouraging any sub-standard operators to move their operations to parts of Loch Lomond where no licensing is required. For example, in the situation at the time of the accident, a licence would not have been needed if *Vixen* had been based at Ardluish instead of Ardlui.

The MAIB previously recommended that local government authorities should establish a licensing system following the capsizing of *Breakaway 5* in 2003 and the foundering of *Swan* in 2004. The MAIB also recommended that licensing authorities should use the Inland Waters Code as a defined standard in their licensing systems.

While local government authorities have the legislative ability to operate a boat hire licensing scheme and access to a standard which can be applied, a number of such authorities have yet to allocate the appropriate resources needed to survey boats and monitor compliance.

2.4.3 Loch Lomond and Trossachs National Park Authority

The Park Authority does not have a primary role in ensuring the safety of vessels on Loch Lomond. However, its remit included an obligation to promote safe boating which was reflected in its byelaws. The Park Authority also operated a boat registration scheme to help meet this aim. While this provided a record of boats operating on the Loch, and encouraged greater compliance with the byelaws, it did not invoke any specific safety standards for the vessels themselves. *Vixen* was registered, but it did not show the required registration marks; *Vixen's* operators had not complied with the few requirements that existed, and this had not been challenged.

The Park Authority did not require commercial operators, whose activity pre-existed the introduction of the byelaws, to demonstrate that they had formally considered the safety of their operation, or obtained licences where necessary. These aspects of safety management are included in the Inland Waters Code and so would be addressed if the Code was applied as a common standard.

It was accepted that, with the limited resources of five rangers and three boats available on Loch Lomond, the Park Authority could only have limited oversight of the 5000 registered craft on the Loch. However, the rangers and the boat registration scheme were an important resource. With the limited role of the MCA's surveyors and the councils based some distance away from Loch Lomond, the Park's rangers were the officials most likely to identify boats on the Loch that might not be operating safely. The Park's rangers should therefore be able to provide information, either to the licensing authorities, or the MCA when they have such concerns.

The Park Authority's aims of promoting safe boating, by ensuring that vessels carrying members of the public are operated safely, would best be achieved by supporting the local government authorities bordering Loch Lomond in establishing effective boat hire licensing schemes. The Park Authority should contribute to this by enforcing the existing boat registration scheme more rigorously on commercially-operated vessels and, as part of this, check that these vessels have been licensed by the appropriate local government authority.

2.4.4 Effective oversight of small passenger vessels on inland waters

This accident demonstrates that effective oversight of commercially-operated passenger vessels on Loch Lomond is needed. *Vixen* was being operated contrary to the legal requirements of the MCA, the Argyll and Bute Council and the Park Authority. The vessel was in poor condition, it was overloaded and was being operated by unqualified crew.

The preceding sections of this report have identified a legislative structure for licensing small, commercially-operated passenger vessels on inland waters, and a standard against which they can be assessed. However, it was clear that the MCA, the local government, and Park authorities did not have the appropriate resources to conduct the necessary surveys.

The MCA has delegated its responsibility for surveying small commercial vessels that go to sea to nominated Certifying Authorities, who conduct surveys in accordance with the approved (statutory) codes of practice. In principle, it should be possible for the Certifying Authorities to provide a similar service to local government authorities under the provisions of the Civic Government Act. This should be applied so that local government authorities can specify compliance with the Inland Waters Code as a condition of licensing.

The MCA should still be able to exercise the existing primary and secondary legislation of the Merchant Shipping Act to prohibit the use of dangerously unsafe vessels and require commercial operators to be correctly qualified.

The MCA and the local government authorities should therefore work together to apply their different legislation and engage the support of the Certifying Authorities to improve the safety of small commercial passenger boats on Loch Lomond.

In turn, the Park Authority should support this initiative by enforcing the requirement under its existing byelaws for commercial vessels to display the correct registration renewal marks. The Park Authority should also inform the relevant authorities if: unlicensed vessels are operating; any vessels are found breaching the conditions of any prohibition notices; or, if any licensed vessels are known to be operating in a potentially unsafe manner.

2.4.5 Transport Scotland

Transport Scotland should ensure that all Scottish local government authorities with oversight of commercial boat operations on inland waters, are strongly encouraged to introduce the licensing arrangements proposed in this report.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT WHICH HAVE RESULTED IN RECOMMENDATIONS

1. The weed hatch cover at the stern of *Vixen* was in poor condition and would have done little to prevent water ingress. It was almost certainly the source of flooding. [2.2.1]
2. *Vixen*'s effective freeboard around the weed hatch was reduced by all the passengers sitting at the stern, the weight of water accumulated in the bilge and the dynamic trim while the boat was underway. This was considered to be sufficient to submerge the defective weed hatch causing *Vixen* to flood. [2.2.2]
3. The Inland Waters Code provided the most relevant safety standards for small passenger vessels operating on Loch Lomond. *Vixen* did not meet the Code's requirements and, because it had insufficient freeboard, was effectively overloaded when carrying six passengers and their rucksacks. [2.3.1]
4. With no regulatory oversight to enforce a minimum standard, the owners maintained *Vixen* to their own requirements. This accident demonstrated that those standards were insufficient for the safe operation of a commercial ferry. [2.3.2]
5. *Vixen*'s owners had not ensured that the safety-critical systems on board were understood and correctly operated by their vessel's skippers; that the systems were maintained effectively; or, when appropriate, that details of known equipment defects were circulated to the duty skipper. [2.3.4]

3.2 OTHER SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION ALSO LEADING TO RECOMMENDATIONS

1. The owners should consider how lifejackets of the recommended buoyancy are stored on board, and ensure that they are quickly and easily accessible in an emergency. They should also ensure that all other safety equipment, such as fire extinguishers, is properly maintained in accordance with the manufacturer's instructions and the Inland Waters Code. [2.3.3]
2. *Vixen*'s owners should take urgent action to ensure that: the vessel meets the standards set out in the Inland Waters Code; is operated by properly qualified skippers, and; is licensed as required by the Argyll and Bute Council. [2.3.6]
3. While there was little practical difference between surveying a small passenger boat which went to sea and one that remained on inland waters, the difference in the applicable regulation had a significant impact on the MCA's ability to survey vessels on inland waters. This was reflected by the limited scope and the relatively small number of commercially-operated inland waterway vessels surveyed or inspected by the MCA. [2.4.1]
4. While local government authorities have the legislative ability to operate a boat hire licensing scheme and access to a standard (the Inland Waters Code) which can be applied, a number of such authorities have yet to allocate the appropriate resources necessary to survey such vessels and to monitor compliance. [2.4.2]

5. The Park Authority's aims of promoting safe boating, by ensuring that vessels carrying members of the public are operated safely, would best be achieved by supporting the local government authorities bordering Loch Lomond in establishing effective boat hire licensing schemes. [2.4.3]
6. This accident demonstrates that effective oversight of commercially-operated passenger vessels on Loch Lomond is needed. *Vixen* was being operated contrary to the legal requirements of the MCA, the Argyll and Bute Council and the Park Authority. The vessel was in poor condition, was overloaded and was being operated by unqualified crew. [2.4.4]
7. The MCA and the local government authorities should work together to apply their different legislation and engage the support of the Certifying Authorities to improve the safety of small commercial passenger boats on Loch Lomond. This initiative should be supported by the Park Authority enforcing the requirements of its existing byelaws. [2.4.4]
8. Transport Scotland should ensure that all Scottish local government authorities with oversight of commercial boat operations on inland waters are strongly encouraged to introduce the licensing arrangements proposed in this report. [2.4.5]

SECTION 4 - ACTION TAKEN

4.1 *VIXEN'S OWNERS*

The **partners in the company which owns *Vixen*** have:

- Removed Vixen from service, and purchased a replacement vessel for their ferry operations.
- Applied to Argyll and Bute Council for a boat hire licence.
- Ensured that all their ferry skippers hold RYA Powerboat Level 2 certificates that are commercially endorsed.

SECTION 5 - RECOMMENDATIONS

The **company partners responsible for the operation of *Vixen*** are recommended to:

- 2013/214** Take further action to ensure and enhance the safe operation of its ferry service between Ardlui and Ardleish by:
- Operating and maintaining any commercial ferries they may utilise, in accordance with The Inland Waters Small Passenger Boat Code.
 - Obtaining an operating licence for any commercial ferries they may operate, as required by the Argyll and Bute Council.

The **Argyll and Bute Council** is recommended to:

- 2013/215** Review and amend the requirements of its boat hire licensing scheme to:
- Adopt the Inland Waters Small Passenger Boat Code as the standard applied for small passenger boats carrying fewer than 12 passengers on categorised waters.
 - Require such boats to be regularly surveyed by a competent person employed by a Certifying Authority or similar organisation as may be recommended by the Maritime and Coastguard Agency.

The **Stirling Council and West Dunbartonshire Councils** are recommended to:

- 2013/216** Take action to:
- Establish a boat licensing system for inland waters falling under the Council's area of responsibility and which adopts the Inland Waters Small Passenger Boat Code as the standard applied for small passenger boats carrying fewer than 12 passengers on its categorised waters.
 - Require such boats to be regularly surveyed by a competent person employed by a Certifying Authority or similar organisation as may be recommended by the Maritime and Coastguard Agency.

The **Maritime and Coastguard Agency** is recommended to:

- 2013/217** Advise and work with the Argyll and Bute Council, the Stirling Council, the West Dunbartonshire Council and appropriate Certifying Authorities to:
- Use the Inland Waters Small Passenger Boat Code as a basis for establishing robust licensing schemes on Loch Lomond.
 - Facilitate the effective survey of small passenger boats operating on Loch Lomond in accordance with the requirements of the Civic Government Act and the Inland Waters Small Passenger Boat Code.

Loch Lomond and the Trossachs National Park Authority is recommended to:

2013/218 Provide support to the Maritime and Coastguard Agency and local government authorities in efforts to improve the oversight, licensing and safety of small passenger vessels operating on Loch Lomond by:

- Establishing proactive measures to enforce the requirement under existing byelaws for commercial vessels to display the correct registration renewal marks.
- Developing protocols to enable Park Rangers' concerns about the licensing, safety or condition of small commercially operated vessels to be passed to the relevant authority for action.

Transport Scotland is recommended to:

2013/219 Use the lessons from this investigation to provide guidance and encouragement to Councils in Scotland on the importance of establishing (where applicable) robust licensing regimes for small passenger vessels carrying fewer than 12 passengers on inland waters.

**Marine Accident Investigation Branch
June 2013**

Safety recommendations shall in no case create a presumption of blame or liability

