Report on the investigation of

the loss of

Kirsteen Anne

Firth of Lorn

31 December 2002

with the loss of her two crew

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Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

The fundamental purpose of investigating an accident under these Regulations is to determine its circumstances and the cause with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

Note

This report is not written with liability in mind and is not intended to be used in court for the purpose of litigation. It endeavours to identify and analyse the relevant safety issues pertaining to the specific accident, and to make recommendations aimed at preventing similar accidents in the future.

CONTENTS

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

BA	-	British Admiralty
CB	-	Commercial band
GPS	-	Global positioning system
GRP	-	Glass reinforced plastic
HM	-	Her Majesty’s
kg	-	kilogram
lb	-	pounds mass
LOA	-	Length overall
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MRCC	-	Maritime Rescue Co-ordination Centre
MSN	-	Merchant Shipping Notice
OOW	-	Officer of the watch
RNLI	-	Royal National Lifeboat Institution
SFIA	-	Sea Fish Industry Association
UTC	-	Universal Co-ordinated Time
VHF	-	Very High Frequency

SYNOPSIS

On 31 December 2002, *Kirsteen Anne* and her crew of two failed to return to Oban from a fishing trip as planned. A search began and the vessel was found partly submerged that evening; there was no sign of her crew. A preliminary examination was started on 3 January 2003.

Kirsteen Anne was salvaged by the HM customs cutter *Searcher,* and examined by MAIB inspectors, who also conducted an inclining experiment to determine her stability characteristics. There were no witnesses to the vessel's loss.

It is concluded that *Kirsteen Anne* capsized as a result of poor stability caused by modifications made to her since she was built, the weight of the fishing gear carried, and a build-up of water in the bilge.

Recommendations made to the MCA are aimed at the introduction of a stability standard for fishing vessels under 15m, the improvement of the Code of Practice applicable to these vessels, the inclusion of vessel stability in health and safety risk assessments, and raising the awareness of stability among fishermen.

Kirsteen Anne

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *KIRSTEEN ANNE* AND ACCIDENT

Vessel details

Registered owner	:	Sidney MacDougall
Port of registry	:	Oban, Scotland
Flag	:	British
Type	:	Fishing Vessel
Built	:	1967
Construction	:	Glass reinforced plastic
Length overall	:	6.5m
Gross tonnage	:	2.18
Engine power and/or type	:	22kw, Perkins 4108
Service speed	:	6.5 knots

Accident details

Time and date	:	Between 1500 and 1620 on 31 December 2002
Location of incident	:	56° 26.78N, 005° 33.53W. 110° Lismore Light 1.68m
Persons on board	:	Two
Injuries/fatalities	:	Two fatalities
Damage	:	Salt water saturation

1.2 BACKGROUND

All times are UTC and all courses are true.

Kirsteen Anne was purchased on 30 September 2002. The new owner was not a fisherman: he intended his son to use the vessel. She was not used for fishing, however, until December 2002, and then only periodically. One hundred and fifty creels had been bought with the boat, many of which were in poor condition. These had been laid in 5 fleets, each containing about 30 creels south of Kerrera. A further 90 creels had recently been purchased and had been laid on 30 December at the south-east end of Lismore. The following day, the crew intended to haul, re-bait and move the fleets from the south of Kerrera closer to the fleets off Lismore **(Figure 1)**. The fleets already positioned off Lismore were also to have been re-baited. The intended catch was velvet crabs. It was anticipated that *Kirsteen Anne* would return to Oban no later than about 1700.

1.3 THE CREW

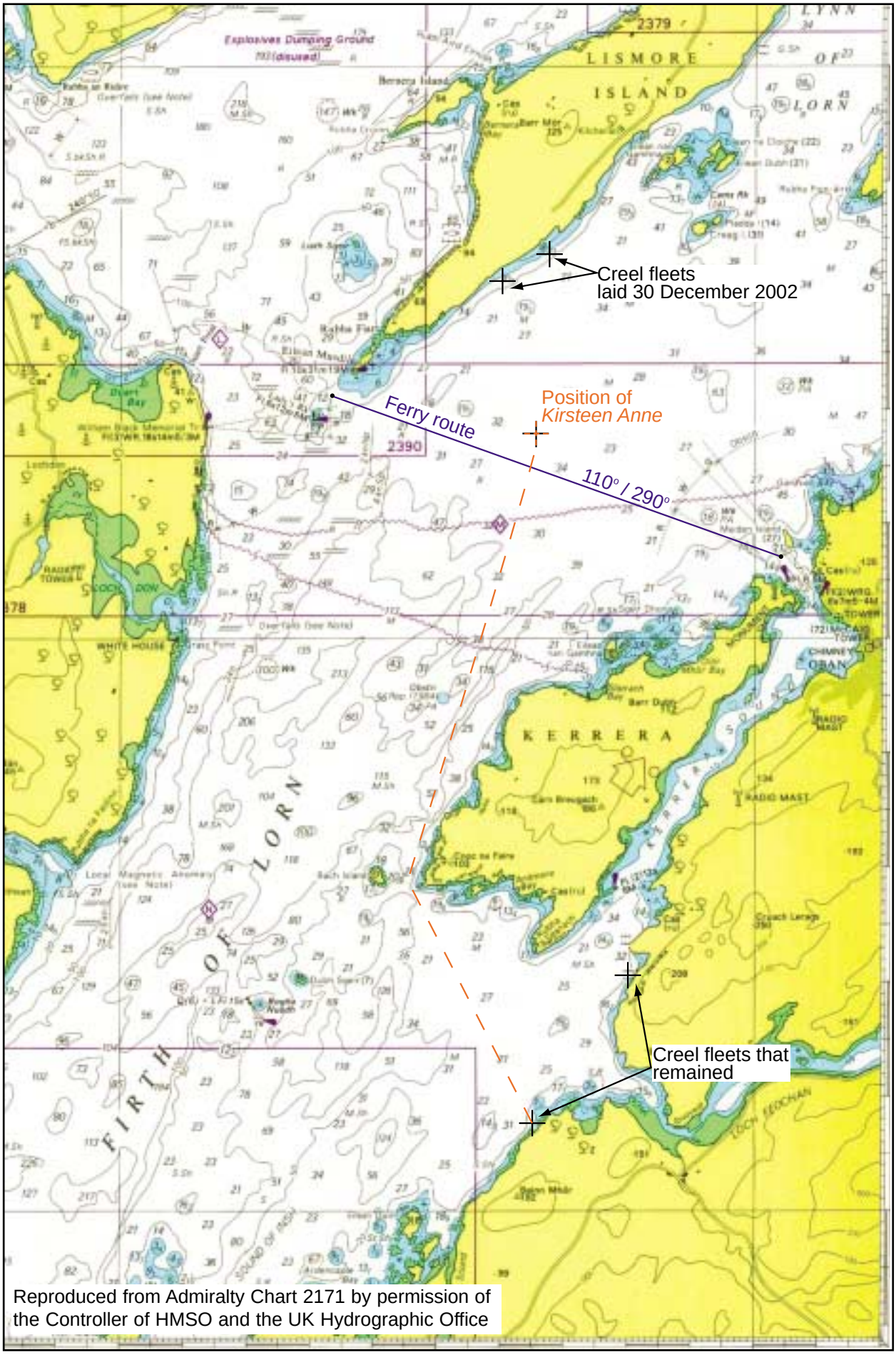
Kirsteen Anne carried a crew of two, one of whom was the owner's son. Under the Fishing Vessel (Certification of Deck Officers and Engineer Officers) Regulations 1984, the vessel was not required to have any certificated persons on board, and it is not clear which of the two crew members was in charge. Both had taken the vessel to sea on previous occasions, either by themselves or with the owner. For the sake of clarity in this report, the owner's son is referred to as crew A, and the other crew as crew B.

Crew A was 22 years of age and had been fishing for about 3 years, mainly in *Silver Spray*, also a creel boat. Crew B was 30 years of age and had been a fisherman in a variety of fishing vessels, including creel boats, for the previous 10 years. Both had completed the mandatory courses in basic sea survival, fire-fighting, and first-aid. Crew B had also completed a course in the use of VHF radio. Neither had completed a safety awareness course. The two men were wearing wellington boots and jeans, and both carried a mobile telephone. Newly purchased oilskin trousers and jackets were available on board.

1.4 NARRATIVE

Kirsteen Anne sailed from North Pier, Oban, at 1100 on 31 December 2002. The crew hoped to sail earlier, but were unable to do so as the boat was lying on the bottom because of the height of tide. For the trip, two boxes of bait had been taken on board, along with six iron weights, which were going to be fitted to the fleets of creels. Up to five *'keeps'*, two 'D' shaped and three rectangular-shaped, were also carried.

Figure 1



Reproduced from Admiralty Chart 2171 by permission of the Controller of HMSO and the UK Hydrographic Office

At 1352, crew A sent a text message to his girlfriend, using his mobile telephone, stating that he was halfway to Lismore. At about the same time, crew B telephoned a friend and said that he was to the west of Kerrera and was heading to the east of Lismore. He also said that it was *'a wee bit lumpy',* but did not mention any problems experienced with the boat. Shortly after 1500, the mother of crew A sent him text messages requiring responses, but none were received. She then tried to telephone him, but was informed by a pre-recorded message that the telephone she was calling was switched off. Between about 1500 and 1510 a friend of crew B tried to telephone, but was informed that the number was busy. The wife of crew B also tried to telephone, at about 1645, and heard a similar recorded message.

Concerned that his son could not be contacted, the owner visited several vantage points to try and see if he could see *Kirsteen Anne*. He could not, and at 1830 he notified the coastguard that the boat was overdue. A search, co-ordinated by MRCC Clyde was quickly initiated and, at 2201, a Royal Navy Sea King helicopter sighted *Kirsteen Anne* south-east of Lismore Light. The vessel was partially submerged with only her bow visible above the water **(Figure 2)**. There was no sign of her crew. No calls from the vessel via VHF radio were heard by the coastguard or reported by other vessels.

Figure 2

Photograph of *Kirsteen Anne* when found

1.5 UNDERWATER SURVEY OF THE VESSEL AND FISHING GEAR

The Strathclyde police diving unit conducted an underwater search of *Kirsteen Anne* and her fishing gear during 1 and 2 January, and a search of the seabed on 3 January. The vessel remained partly submerged and was tethered to the seabed by the fleets of creels she had been carrying. A diagram showing the disposition of the creels in relation to the vessel and the seabed is shown at **(Figure 3)**. During the search of the vessel, the deck covers to the rudder space and bilge were found on deck on the port side of the stern transom **(Figure 4)**, and the GRP engine cover was missing.

On 2 January, flotation bags were secured to the vessel, and the creel fleets cut. The HM Customs cutter *Searcher* then towed *Kirsteen Anne* to the Ardantrive boat yard on Kerrera. The fleets of creels tethered to the vessel were also recovered, and it was apparent that these had been re-baited in anticipation of re-laying.

1.6 SUBSEQUENT FINDS

Several days after the accident, fleets of creels laid by *Kirsteen Anne* were recovered; three off Lismore, and two south of Kerrera **(Figure 1)**.

On 20 January 2002, the body of crew A was trawled up in the vicinity of where *Kirsteen Anne* was found, along with several artefacts, including the GRP engine cover and three '*keeps'*, one of which was full of velvet crabs. A postmortem revealed that the cause of death had been drowning. The body of crew B has not been found.

Figure 3

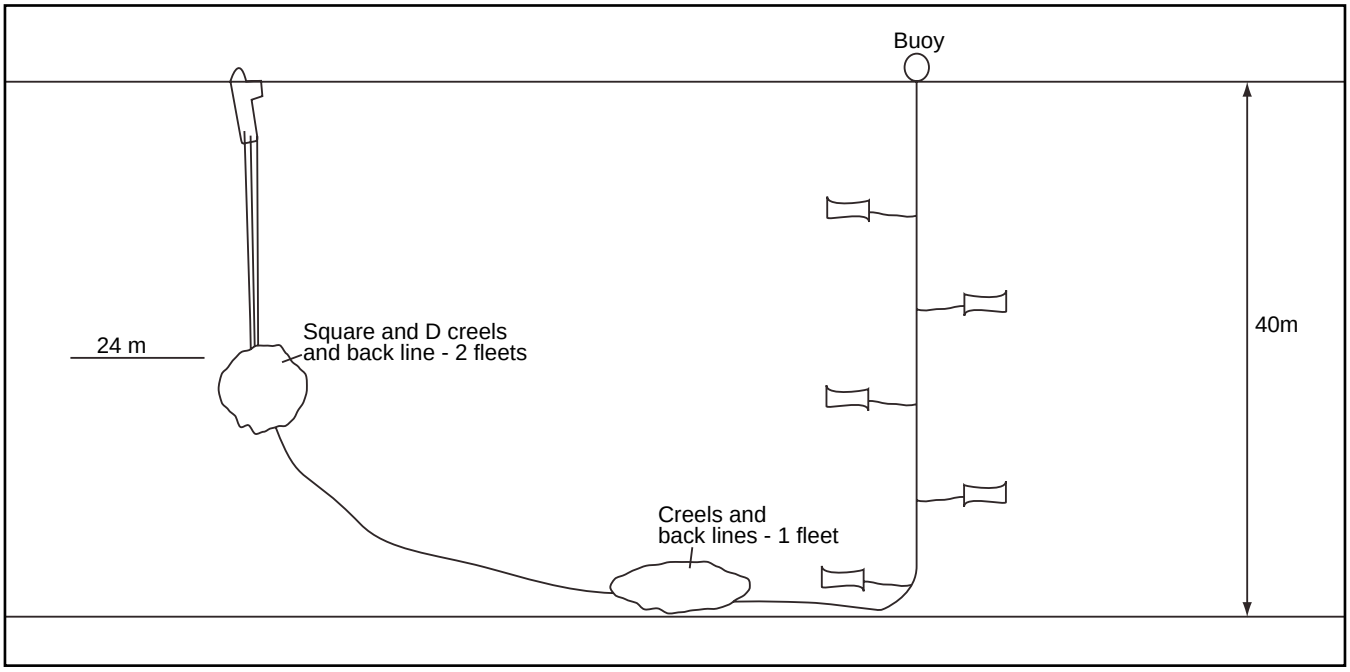
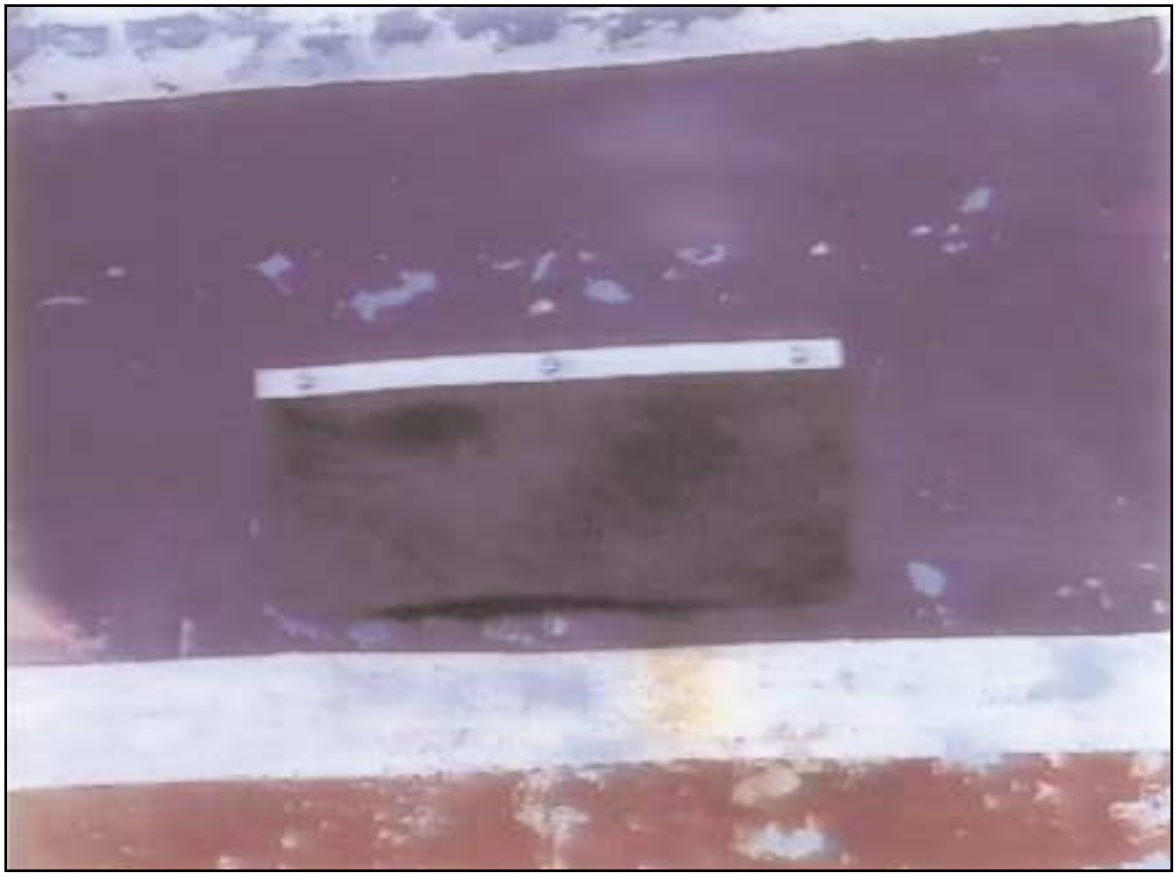


Diagram showing the disposition of the vessel and fleets of creels - not to scale

Figure 4

Photograph showing deck cover on stern transom

Figure 5



Photograph of freeing port with rubber flap

1.7 POSSIBLE SIGHTING

During the afternoon of 31 December 2002, *Isle of Mull* was operating a ro-ro ferry service between Oban and Craignure. The chief officer, who was the OOW, believes, but is not certain, that after sailing from Craignure at 1500, he saw a fishing vessel similar to *Kirsteen Anne* in the vicinity of the position in which she was later found. He remembers a fishing vessel being to the north of the ferry's planned track of 110° across the Firth of Lorn **(Figure 1)**, which appeared to be heading back to Oban. At about 1520, as the ferry overtook the fishing vessel at a distance in excess of 200m and at a speed of about 14.5 knots, two men were seen on board, one in the wheelhouse, and one on the aft deck, possibly working with the creels. The fishing vessel, which appeared to be low in the water, seemed to stop as the ferry passed her beam.

On the return passage to Craignure, which left Oban at 1600, the second officer was the OOW and does not remember seeing any fishing vessel close to the ferry's reciprocal track of 290°.

1.8 VESSEL DESCRIPTION

Kirsteen Anne, an ex Cheverton 21, was built in Gosport, Hampshire in 1967. She was modified in 1995, when the gunwale was raised and a GRP deck was fitted; four seawater freeing ports (one on each side and two on the stern transom) were also cut into the gunwale at deck level. The previous owner had enlarged the freeing ports on the side to 13cm wide x 5cm high, and the ones on the transom to 14cm x 3cm. He had also fitted pieces of rubber on the outside of the freeing ports to help reduce seawater ingress when submerged **(Figure 5)**. A 'cat-catcher' for stowing creels was also fitted on the stern.

The vessel had an enclosed forepeak, or 'cuddy', forward of a wheelhouse. The wheelhouse had been partially extended and modified during the winter of 2001-2002. A hydraulically-powered creel hauler was sited outboard of the starboard side of the wheelhouse, and a catch tank was fitted behind the wheelhouse on the port side.

The main engine with a wet exhaust was fitted on engine beds attached to the hull framing of the vessel. The engine protruded through the deck and was covered by a removable GRP casing.

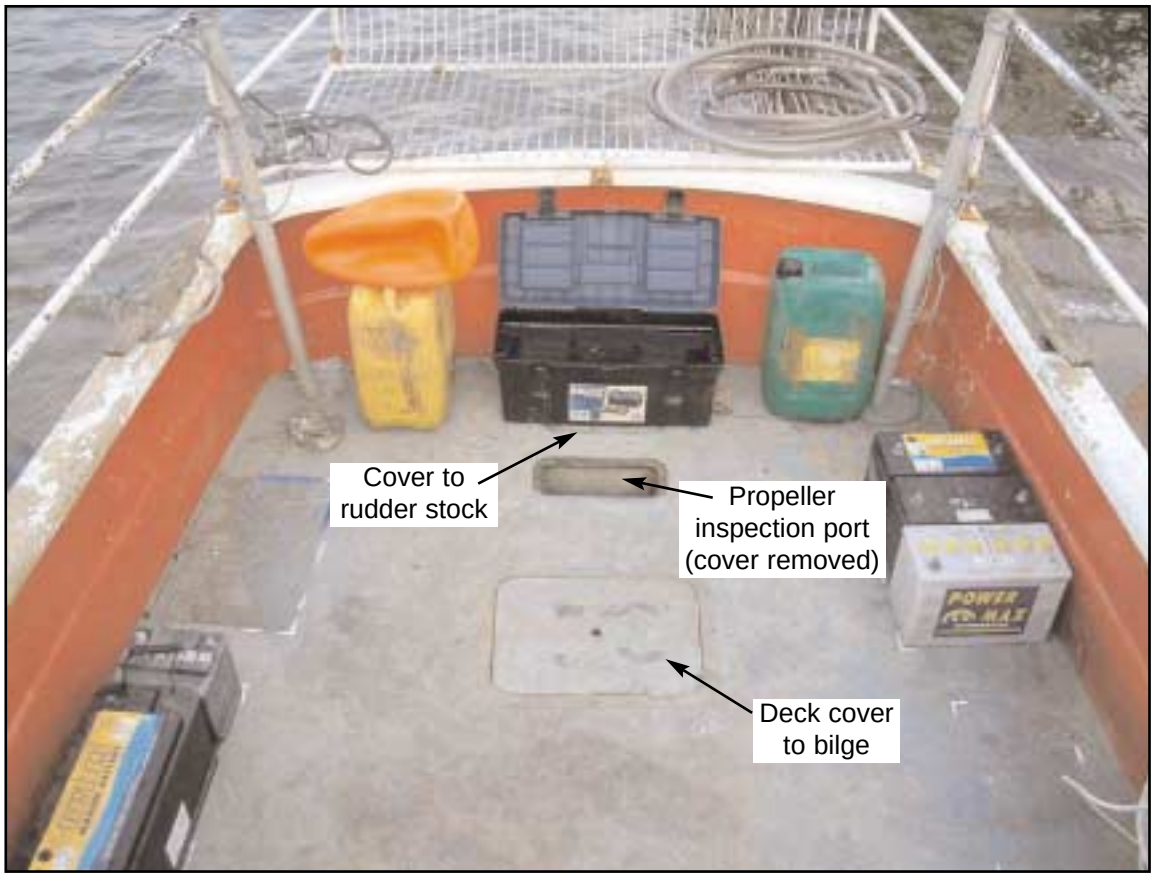
Two bilge pumping arrangements were fitted; a manual 'whale gusher' pump, discharging through an outlet above the waterline on the port side of the vessel, and an electric bilge pump, discharging through an outlet above the waterline on the starboard side. The electric bilge pump could be operated either automatically, by an integral float switch, or manually, by a switch located in the wheelhouse. Both the electric and hand-operated pumps drew water from under, and immediately forward of, the engine. A high-level bilge alarm was not fitted.

Although the deck was GRP and sealed around its edges, access covers to the rudder stock and bilge area on the aft deck **(Figure 6)** were not watertight. The middle of the three covers shown could be removed to allow inspection of the propeller.

The vessel was fitted with a VHF and a CB radio.

Ballast comprised two 25.4kg (56lb) weights in the bilge area around the rudder stock, a bag of sand, and a layer of cobbles in the bilge below the main engine. It is reported the crew had removed several of these cobbles.

Figure 6



Photograph showing location of deck openings

1.9 RECENT HISTORY

After changing ownership, several problems with *Kirsteen Anne* were experienced, including:

- The main engine was occasionally difficult to start, particularly in the mornings, and had to be jump-started using a spare battery. The engine, however, was reported to be reliable once working, and enabled the vessel to reach a maximum speed of about 6.5 knots.

- During late November to early December, the vessel broke down on two occasions in the vicinity of her mooring. One of the breakdowns was caused by a hydraulic problem with the steering arrangement, and the other by engine failure.

- During the week before Christmas, the vessel had to be towed from inside a reef, to safety, after catching a rope around her propeller while working creels. The vessel's crew at the time were crew A and his father. The rope caught had been a riser from one of their own fleets, which had been inadequately weighted to prevent slack line on the surface. Crew B later dived on the vessel when in Oban, but found no damage.

- On 24 December, the crew were seen pumping water via a hand-operated bilge pump at least every hour, and it is believed they fitted a wooden wedge in a hole in the rudder stock caused by a missing grease nipple to stop seawater from coming in. Crew B had also spoken to friends about the possibility of water also coming through the stern gland, but it is reported he had checked and confirmed that this was not the case.

On 30 December, 90 creels were loaded on to *Kirsteen Anne* at the fishing pier in Oban, before being laid off Lismore. On that occasion, the vessel was crewed by crew B and her owner, because crew A had a dental appointment. No mechanical problems or excessive water ingress were observed during this trip. The previous owner carried a maximum of 60 creels on board because he considered the vessel to be unstable with more.

The owner had seen the electric bilge pump working during previous visits to the vessel, and was not aware of it not working on 30 December.

1.10 VESSEL SURVEY AND INCLINING TEST

1.10.1 Survey

MAIB inspectors surveyed *Kirsteen Anne* on a slip in Ardantrive boat yard during 3-4 January and 13 January 2003. The key findings were:

- Wire from the electric pump bilge switch had been severed.
- The bilge pump's impeller had come away from its shaft, making the pump inoperable.
- The pump for the deck wash and vivier tank had been partially dismantled and was inoperable.
- The bilge pump switch was in the off position, as was the navigation light switch.
- The VHF and GPS power switches were 'on'.
- The engine control lever in the wheelhouse was in a central position, indicating the engine was idling or stopped **(Figure 7)**.
- Both the master control switch, and the engine ignition switch, were in the 'on' position.
- The lever controlling the hydraulics to the creel-hauler, which was mounted on the main engine, was in the off position **(Figure 8)**.
- Three distinct indentations were noted amidships, below the waterline on the starboard side, the lowest of which had punctured the hull **(Figure 9)**.
- Eighty creels (52 D shaped, and 28 rectangular), and approximately 1200m of back lines were recovered.
- A wooden bung used in lieu of a missing grease nipple was in place on the starboard side of the rudder stock **(Figure 10).**
- A 75mm hole was found in the GRP between the top corner of the propeller inspection port and bilge **(Figure 11)**.
- With the boat towed through the water at very slow speed in an unloaded condition, water was observed to ingress from the rim of the propeller inspection port cover. No water ingress from the rudder stock or propeller stern gland was evident.

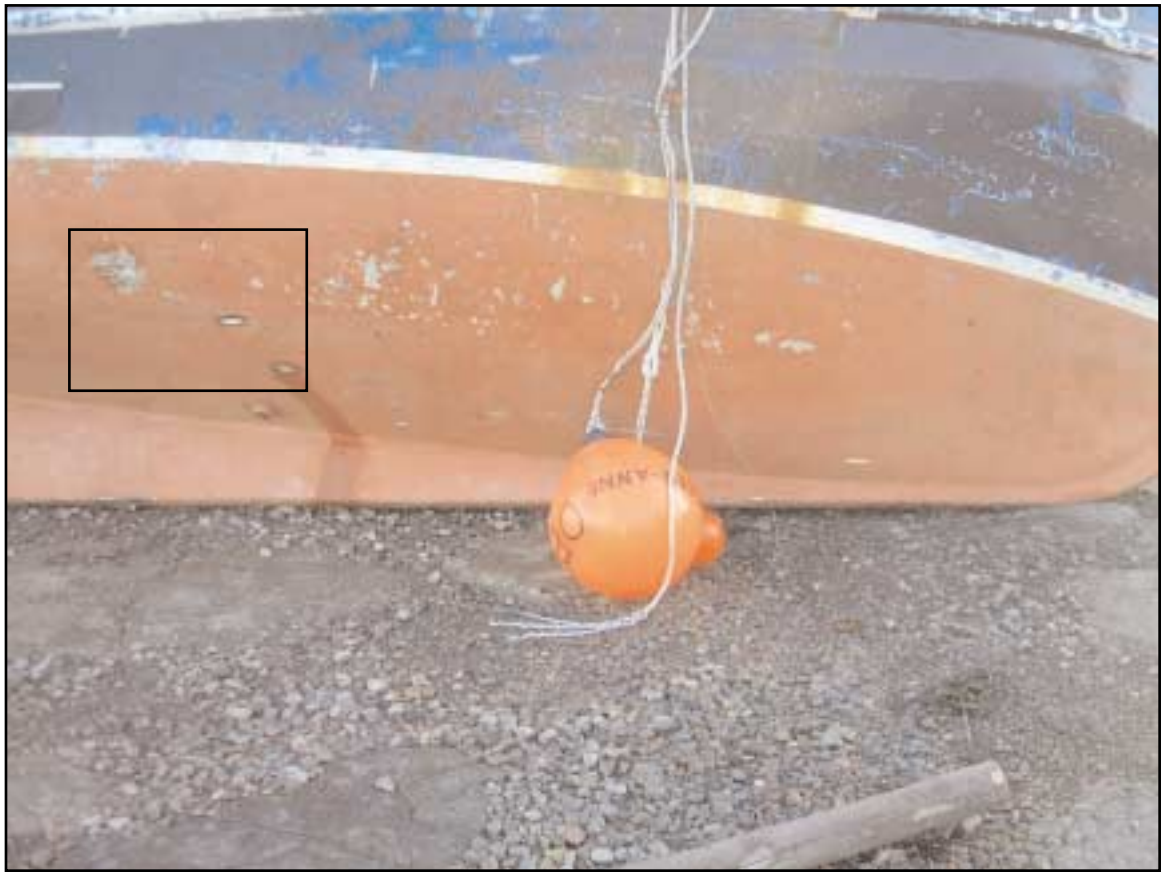
Figure 7

Photograph showing the position of the engine control lever

Figure 8

Photograph showing the position of the hydraulic control lever

Figure 9



Photograph showing the marks and puncture on the starboard side

Figure 10

Photograph showing a wooden bung in the rudder stock

Figure 11

Photograph showing hole at the top of the propeller inspection port

1.10.2 Inclining experiment and stability analysis

An inclining experiment to determine her stability characteristics was conducted on 26 February 2003. The results and analysis from this experiment are at **Annexes A** and **B**.

1.11 ENVIRONMENTAL CONDITIONS

The weather in Oban was fine, and the sea conditions in Oban Bay appeared to be relatively calm. An entry made at 1215 in the deck log on board mv *Isle of Mull* on 31 December stated:

Wind variable 2-3. Clouds. Fine/clear. Sea moderate. Visibility good. Temp 4.6 C.

A creel fisherman working on eastern Lismore, however, stated that on the afternoon of 31 December, the wind was a fresh north-easterly, and the sea was short and choppy. At the start of the search for the vessel, the wind was north-east force 6 to 7 (22 to 33 knots) and the sea was moderate (1.25 to 2.5m).

High water at Oban was 1556 and it was 65% spring tides. In the vicinity of where the vessel was found, the predicted tidal stream on 31 January 2002 was as follows:

1450 – 028° at 0.2 knot

1550 – 049° at 0.1 knot

1650 – 145° at 0.1 knot

1750 – 184° at 0.2 knot

1850 – 204° at 0.2 knot

The predicted tidal stream to the west of Kerrera during the afternoon was north-easterly at a maximum rate of about 1 knot.

Sunset was at 1554 and evening civil twilight was at 1642.

1.12 REGULATION

1.12.1 Code of Practice for the Safety of Small Fishing Vessels

In April 2001, the *Code of Practice for the Safety of Small Fishing Vessels under 12m registered length* came into force. It was issued as part of MSN 1756(F). A copy of this new Code was sent to *Kirsteen Anne's* previous owner in March 2002. MSN 1756(F) states that to comply with this Code vessels' owners are required:

- *to carry safety equipment on the vessel appropriate to its length and construction;*

- *to complete, or arrange for the completion of, an assessment of the health and safety risks arising in the normal course of work activities or duties on the vessel in accordance with the provisions of the Merchant Shipping and Fishing Vessel (Health and Safety at Work) Regulations 1997;*

- *to certify annually that the vessel complies with the Code, by declaring that the safety equipment has been properly maintained and serviced in accordance with the manufacturer's recommendations and that an appropriate and up to date health and safety risk assessment has been completed; and*

- *to present the vessel for inspection by the MCA in accordance with the provisions of the Code.*

The previous owner did not self-certify the vessel or conduct a risk assessment, and the MCA has no record of ever having inspected her. The MCA has stated that its aim is to have inspected all small fishing vessels by 2005. After buying *Kirsteen Anne* and re-registering her with the MCA, the new owner was not made aware of the Code's existence, or the need for self-certification or risk assessment.

In November 2002, the Code of Practice was amended to include vessels up to 15m(LOA). As a result, the under 12m (Registered Length) Code became the under 15m (LOA) Code. No changes were made to the requirements for vessels of under 12m.

Unlike the Code of Practice for fishing vessels between 15m and 24m, and the various codes for small commercial vessels, the Code of Practice for the Safety of Small Fishing Vessels under 15m contains no stability requirements for existing vessels. It does, however, require new vessels to meet a stability standard issued by the SFIA, or an equivalent standard, before construction is begun.

1.12.2 Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997

These regulations place duties on all 'employers' and 'workers' on board ships, and there are no exemptions for types of ship. Employers and workers are defined as:

'employer' means a person by whom a worker is employed under a contract of employment;

'worker' means any person employed by an employer under a contract of employment…

'contract of employment' means a contract of employment, whether express or implied, and if express, whether oral or in writing.

The regulations require employers to protect the health and safety of workers and others affected by their activities so far as is reasonably practicable, by the application of laid down principles. These principles include the avoidance of risks, and the evaluation of unavoidable risks and the taking of action to reduce them. Annex 1 to MGN 20, however, also states:

The requirement to assess risk does not extend to any consequential peril to the ship resulting from the particular work activity, nor to any external hazards which may imperil the ship, either of which may cause harm to those on board or to others.

1.13 SAFETY EQUIPMENT

Numerous items of safety equipment, including three lifejackets recently purchased by the owner, one red parachute flare, three red hand flares, and one lifebuoy were recovered from *Kirsteen Anne*. A liferaft was not carried. Although one had been borne when operated by her previous owner, this had been removed before the vessel was sold. The relevant checklist of safety equipment required by the Code of Practice for a vessel of her size is at **Annex C**.

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 ACTIVITY AT THE TIME OF THE ACCIDENT

It is evident that the crew had lifted the three creel fleets from the south of Kerrera, and were moving them to Lismore as planned. This is supported by the text message sent by crew A, the telephone call made by crew B, and the co-location of the fleets with the vessel.

At the time of the accident, it is most improbable that *Kirsteen Anne* was fishing. The position in which she was recovered was neither the intended area in which to shoot her creels, nor an area used by creel fishermen, because of its proximity to a ferry route, its use by trawlers, and its bottom type. Furthermore, the pot-hauler was not in use and the engine was in neutral or idling. Had the crew been shooting her creels, the engine would have had to be going ahead to achieve sufficient spacing.

It is feasible that the vessel seen by the OOW of *Isle of Mull* was *Kirsteen Anne*. His description of the vessel was similar, and the timing and position of the possible sighting was achievable, given the vessel's last reported position, planned movement, and potential speed. The position in which *Kirsteen Anne* was found was within 1000m of the direct route from the south-west of Kerrera to the fleets laid off Lismore, and within 600m of the ferry's planned track. The position of the engine control lever is also coincidental with the OOW's recollection of the vessel stopping as she was overtaken.

Given the crew's intentions, the improbability of her fishing in the area in which she was found, and her possible sighting at about 1520, it is highly likely that *Kirsteen Anne* was either on passage to the south-east of Lismore as intended, or was heading back towards Oban.

2.3 CIRCUMSTANCES OF LOSS

Although the absence of witnesses to the loss of *Kirsteen Anne* and her crew makes it impossible to define the precise circumstances of the accident, it is almost certain that the vessel was lost as a result of poor stability while on passage. It is likely, given the attitude of the vessel in the water when found, the location of the deck covers, and the disposition of the creels, that she was lost after capsizing to port and sinking by the stern. Another possibility, however, was that the water ingress, because of her low freeboard, was sufficient to cause the vessel to lose buoyancy and sink by the stern. Both options would have caused air to be trapped in the cuddy, which kept her afloat. It is highly improbable the

vessel turned turtle i.e. rolled completely over at any stage, otherwise the deck covers would have been lost overboard. The lack of a distress call via VHF radio, and the non-wearing of lifejackets, indicates that the loss was sudden and without warning.

2.4 VESSEL STABILITY

2.4.1 General

Examination of the data, and resulting analysis from the inclining experiment **(Annexes A and B)**, shows the predicted stability performance of *Kirsteen Anne*, in the estimated loaded condition when lost, was very poor in comparison to the stability criteria required by larger fishing vessels. Although the vessel possessed some righting moment, it was not enough to ensure an adequate margin of safety during fishing operations.

2.4.2 Modifications

Since being built in 1967 as an open dory boat, substantial modifications had been made to the vessel, affecting her stability. In particular, the raising of gunwales, the fitting of the deck (which was not sealed), the insertion of freeing ports (which should only be fitted in conjunction with a sealed deck), the alterations to the wheelhouse, and the fitting of a catch tank, cat-catcher, hydraulic pot-hauler, and ballast, would all have significantly changed her initial stability characteristics and made her unsuitable for sea work.

2.4.3 Top weight, freeboard, and water ingress

As the vessel was carrying about 90 water-soaked creels aft, not only would their weight have reduced her stability, they would have also reduced her freeboard and caused her to trim by the stern. This stern trim would have been exacerbated when she was moving ahead. Accordingly, the freeboard aft would have been reduced, and it is therefore highly probable that water entered the vessel via the freeing ports on the aft transom. Water would also have entered through the propeller port inspection cover, as observed during the MAIB survey. As the deck covers to the rudder space and aft bilge area were not watertight, it is likely that some of this water drained down to the bilge. Water would also have entered the bilge directly through the hole at the top of the propeller inspection port. It is not known if there was any water in the bilge from the previous day's trip.

Trimmed by her stern, any water entering the bilge would naturally have collected aft, thereby adding weight and further reducing her freeboard. As the creels obscured the aft deck, a bilge alarm was not fitted, and the electric bilge pump and float switch were not working, the crew might not have been aware of such water accumulation, unless the change in trim or the handling of the vessel was noticeable. In a choppy sea, as described by crew B and the creel fisherman east of Lismore the same afternoon, the vessel's motion would have made this difficult. Even if the crew were aware of water ingress, it is not certain

how much of the water could have been removed by the hand-operated bilge pump, given the forward position of its outlet hose and the vessel's trim. Analysis of the inclining experiment shows that only 0.26 tonnes of water was needed to cause marginal stability. This equates to between 5 and 6cm of water in the bilge.

2.4.4 Other factors

The marks and hull puncture found on *Kirsteen Anne's* starboard side must have been caused by contact with another object. This damage might have occurred during the vessel's recovery when it is reported there was contact between the cutter *Searcher* and *Kirsteen Anne*. There is also a possibility, however, that the puncture was caused during the recovery of the fleets south of Kerrera. The hulls of many creel boats are strengthened in the vicinity of the pot-hauler to prevent such occurrences. If the puncture to the hull was caused before capsize, this would have increased the water ingress to the bilge.

The vessel overtaken at a close distance by *Isle of Mull* might have been *Kirsteen Anne*, and in such situations the wake of a larger vessel can de-stabilise smaller ones. In this case, however, examination of the wake produced by *Isle of Mull* at 14.5 knots **(Figure 12)** shows the wake to be relatively small. It is considered such wake would have dissipated very quickly in the reported sea conditions, and therefore had only a negligible effect on vessels in close proximity.

Figure 12

Photograph showing the wake of mv *Isle of Mull* at 14.5 knots

2.4.5 Summary

Given the poor stability characteristics of *Kirsteen Anne* in her loaded condition, along with the likelihood of increased water ingress into the bilge as the day progressed, and the motion induced by the sea conditions, it is possible that the capsize was triggered by a sudden change in the weight distribution on board. A shift of the creels, or movement of the crew about the deck, would have been sufficient to achieve this.

2.5 CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS

2.5.1 General

It is not known if either of the crew was aware of this Code of Practice. The owner was new to fishing and was not aware of the Code, which relies on three actions to promote safety: a health and safety risk assessment; self- certification by the owner; and inspection by the MCA. None of these had been undertaken on *Kirsteen Anne*. Had they been, it is highly likely they would have made little, if any, difference to the vessel's operation regarding stability.

2.5.2 Risk assessment

Although the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations (MGN 20 M+F) requires employers to make a suitable and sufficient assessment of the risks to the health and safety of workers arising in the normal course of their activities or duties, this requirement does not extend

...to any consequential peril to the ship resulting from a particular work activity, nor to any external hazards which may imperil the ship, either of which may cause harm on board or to others."

Consequently, although the assessment of risk with the regard to stability is possible, using stability standards established in other codes, and this would undoubtedly contribute to a vessel's safe operation, owners are not required to do so. Also, because of the nature of the fishing industry in which share-fishing is common, and contracts of employment frequently do not exist, the application of the health and safety regulations is questionable.

2.5.3 Self-certification

Self-certification is limited to the confirmation '*that the safety equipment carried on board the vessel has been suitably maintained…*and ..*that the safety and other specified equipment continues to comply with the checklist of safety equipment appropriate to the length and construction of the vessel'*. It also requires the health and safety risk assessment to be checked. It does not, however, require any statement or check regarding stability.

2.5.4 MCA inspection

MCA inspections are aimed at checking compliance with the Code of Practice, but vessel stability is not even mentioned in the Code. It is, therefore, uncertain whether the poor stability characteristics of *Kirsteen Anne* would have been noticed, even had such an inspection taken place.

2.5.5 Safety equipment

Lifejackets were required by the Code, and were available on board, but were not worn. A liferaft was not required by the Code **(Annex C)** and was not carried. Had the crew been wearing lifejackets, and a liferaft been available, their chances of survival would have been increased. The size and layout of some fishing vessels makes it impractical to carry a liferaft, and, therefore, it is recognised that it would not be feasible to require such vessels to do so. However, the omission of safety equipment from the checklists provided with the Code of Practice by the MCA, does not mean that such equipment should not be carried, if it is possible to do so. In such circumstances, the carriage of safety equipment needs to be determined as part of the owner's risk assessment. This is not made clear in the Code of Practice.

2.5.6 Awareness

Although compliance with the Code would not have prevented this accident, the owner's awareness of the Code could have contributed to the safe operation of the vessel. When buying the vessel, the owner had a responsibility to determine what was required to comply with the law. However, the issue of such guidance at the time of change of ownership would have been of benefit in this respect, particularly as the Code had only recently been introduced.

2.6 STABILITY REQUIREMENTS FOR VESSELS UNDER 15M

The MAIB report into the capsize of the fishing vessel *Charisma*, in January 2002, highlighted that fishing vessels of less than 12m registered length were virtually the only type of vessel not to have basic stability requirements stipulated in its relevant Code of Practice. It also highlighted that since 1991, 54 UK fishing vessels under 12m have capsized and, as a result, 30 fishermen had lost their lives. Since the loss of *Charisma*, two further vessels under 12m, including *Kirsteen Anne*, have capsized with the loss of three more lives.

By comparison, the number of incidents of other commercial vessels of similar size capsizing over the same period, was considerably lower. Discounting rigid inflatable craft, which have different stability characteristics to traditional hull forms, and vessels that were girded during towing operations, only two power-driven vessels capsized. These resulted in the loss of two lives.

It is inconsistent that small commercial vessels of less than 15m are required to maintain a stability standard and be skippered by certificated personnel, yet similar sized fishing vessels are not. Had *Kirsteen Anne* met a similar stability standard to that required for commercial vessels of similar size, or for fishing vessels over 15m, it is highly likely this particular accident would have been avoided.

The losses of vessels under 15m, because of poor stability, that are known to the MAIB, represent only a small percentage of the several thousand vessels under 15m registered in the UK. However, the MAIB is concerned that the extent of the problem might be greater than indicated. It is considered that the introduction of a mandatory stability standard for existing vessels would help to ensure these vessels operate with a margin of safety, thus contributing to the prevention of losses, such as *Kirsteen Anne* and *Charisma,* in the future.

However, because of the potential consequences such a measure would have on many vessels, the MAIB accepts that the adoption of a stability standard can only be justified after a formal safety assessment of its benefits and feasibility has been undertaken.

It is also recognised that the assessment of stability is problematic with the value of methods, such as roll and heel tests, being limited in many circumstances. While full inclining tests are time-consuming and expensive. A simple, but sufficiently accurate, method of assessing the stability of fishing vessels under 15m is lacking, and the development of such a method would benefit their future safety.

2.7 STABILITY ADVICE AND TRAINING

Fishermen in vessels under 15m rely totally on their experience and training to determine their vessel's stability and seaworthiness. Basic stability advice is available to fishermen in publications such as the RNLI's *'Safety on the Sea – Capsize Safety for Fishing Vessels'*. Stability is also covered, albeit briefly, in a one-day safety awareness course, administered by the SFIA, which is not mandatory. Crews of fishing vessels under 15m will not necessarily have read the RNLI publication, or attended the safety awareness course, and might, therefore, be unaware of the importance of stability and the factors affecting it.

*Kirsteen Anne'*s crew, although experienced, were relatively new to the vessel, and had limited opportunities to determine what was safe to carry and what was not. The carriage of 90 water-soaked creels, and associated fishing gear, was more than had been considered safe by the vessel's previous owner, and undoubtedly contributed to her loss. Without any laid down minimum stability standard, and improved knowledge of stability among fishermen, it is likely that ignorance of stability requirements will remain, and the loss of life on small fishing vessels will continue.

SECTION 3 - CONCLUSIONS

3.1 CAUSES AND CONTRIBUTORY FACTORS

The following are the safety issues which were identified as a result of the investigation. They are not listed in any order of priority.

1. It is almost certain that the vessel was lost as a result of poor stability while on passage. [2.3]

2. The predicted stability performance of *Kirsteen Anne* was very poor in comparison to the stability criteria required by fishing vessels over 15m. [2.4.1 and **Annex B**]

3. The vessel's stability had been significantly affected by several modifications. [2.4.2]

4. Loaded with about 90 creels, the vessel's stability, including freeboard, would have been reduced. She would have been trimmed by her stern, and water would have entered via the aft freeing ports and propeller inspection port. [2.4.3]

5. The crew might not have been aware of the water ingress. [2.4.3]

6. Only 0.26 tonnes of water, equating to between 5cm and 6cm in the bilge was required to cause marginal stability. [2.4.3]

7. Given *Kirsteen Anne's* poor stability, a shift of the creels, or the crew's movement about the deck, would have been sufficient to trigger capsize. [2.4.5]

8. The crew might have been unaware of the importance of stability and the factors affecting it. [2.8]

3.2 OTHER FINDINGS

1. The owner was not aware of the Code of Practice for Safety of Small Fishing Vessels, and therefore of the need to conduct risk assessment or self-certification. [2.5.1]

2. Had risk assessment and self-certification been conducted by the owner, and an inspection made by the MCA, it is doubtful whether any of these measures would have made any difference to the vessel's operation regarding stability. [2.5.1]

3. Although the assessment of risk with regard to stability would undoubtedly contribute to the safe operation of a vessel, the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations (MGN 20 M+F) do not require owners to do so. [2.5.2]

4. The self-certification required by the Code of Practice does not include any statement or check regarding stability. [2.5.3]

5. The inspections conducted by the MCA are aimed at ensuring compliance with the Code of Practice, not the stability of the vessel. [2.5.4]

6. It is not clear in the Code, that the carriage of safety equipment needs to be determined as part of the owner's risk assessment. [2.5.5]

7. Not wearing lifejackets, and not having a liferaft available, reduced the crew's chances of survival. [2.5.5]

8. It would have been of benefit to issue guidance on the need to comply with the Code of Practice on change of ownership. [2.5.6]

9. The introduction of mandatory stability criteria for existing vessels under 15m would contribute to the prevention of similar losses in the future. [2.6]

10. Accurate assessment of the stability of fishing vessels under 15m is problematic.[2.6]

SECTION 4 - ACTION TAKEN

One of the recommendations of the MAIB report into the capsize of *fv Charisma* on 30 January 2002 was:

> *The MCA in consultation with the fishing industry develop and promulgate guidance for the loading of fishing vessels under 15m LOA.*

This recommendation was discussed on 21 January 2003 at a meeting of the Stability Review Group of FISG, and it was agreed this matter would be completed and presented in November 2003.

Following the deaths of the crew from *Kirsteen Anne*, and the death of another fisherman in a similar sized vessel a week later, the MAIB considers the stability problems evident in such vessels warrants additional action.

SECTION 5 - RECOMMENDATIONS

The Department for Transport and the Maritime and Coastguard Agency are recommended to:

1. Develop a simple method of assessing stability, including freeboard, of small fishing vessels, and issue guidance accordingly.

The Maritime and Coastguard Agency is also recommended to:

2. Conduct a formal safety assessment of the introduction of a mandatory stability requirement for existing fishing vessels under 15m.

3. On a vessel's change of ownership, provide new owners with information regarding the relevant Code of Practice and other key regulations to be followed.

4. Ensure the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations apply to all vessels regardless of the contractual arrangements of the crew, and that hazards which imperil a vessel are included in risk assessments.

5. Note, on the safety equipment checklists contained in the Code of Practice for Safety of Small Fishing Vessels, that the equipment required is a minimum, and that risk assessment should be used to identify additional items. In particular, a liferaft should be carried whenever possible.

6. Investigate how stability awareness can be raised among the owners and crew of fishing vessels under 15m.

Marine Accident Investigation Branch
July 2003

ANNEX A

Details of inclining experiment

Inclining Experiment of Kirsteen Anne

Date: Wednesday 26 February 2003

Time: 1445 – 1545 High tide was at 1530

Place: Kerrera boat yard, near Oban

Weather: Dry, but breezy.
Water was choppy but shelter from wind and waves was achieved behind slipway pier. The wind was force 3-4 from the east.

Mooring: The vessel had a bow line anchored to a moored vessel and a stern line from the centre of the cat catcher to a grounded barge

Those present: Graham Wilson MAIB (fwd pendulum)
Nicholas Hance MAIB (aft pendulum)

Freeboards measured-

Waterline fwd: 0.976 m below the lower gunwhale
(measured along the sloping line of the stem)
Waterline aft port: 0.123 m below deck *
Waterline aft stbd: 0.205 m below deck *
At stbd freeing port 0.195 m below deck *
At port freeing port 0.120 m below deck *
(*measured from centre of freeing port down to waterline)

Draughts-

Draft fwd: 0.976 m (At stn 0 to baseline USK stn 9)
Draft aft: 0.986 m (At stn10 to baseline USK stn 9)
Mean draft: 0.981 m (to the baseline)
Trim: 0.01 m (by stern)

MAIB hydrometer
Specific gravity fwd: 1.0265 average sg 1.027
Specific gravity aft: 1.0270

Hydrostatics at draught reading for correction for missing MAIB inspectors

LCF 3.225 m MCT 0.040 1 cm tem TPC 0.103

	Wt	LCG	LCG (lcf)	LMom
MAIB inpector 1	0.076	5.220	1.995	0.152
MAIB inpector 2	0.070	2.640	-0.585	-0.041
	0.146			0.111

Parallel sinkage 1.417 cm Trim inc. 2.767 cm by the stern
Draft and trim during inclining experiment

Mean Draft: 0.995 m (to the baseline) Trim: 0.04 m (by stern)

Hydrostatics:

Disp. 4.056 te KMT 1.556 m LBP 5.79 m
LCB 3.309 m VCB 0.722 m

Time	Movement	Weight in tonnes	Distance in metres	Applied Moment	Deflection fwd pend in mm	Deflection aft pend in mm	def/mom* fwd	def/mom* aft
1500	-							
1503	A1-port	0.025	1.88	0.047	41.0	50.0	872.340	1063.830
1506	A2-port	0.025	1.88	0.047	41.0	50.0	872.340	1063.830
1510	A2-stbd	0.025	1.88	0.047	42.0	50.5	893.617	1074.468
1514	A1-stbd	0.025	1.88	0.047	40.5	50.5	861.702	1074.468
1521	D2-stbd	0.024	1.68	0.040	40.0	46.5	992.063	1153.274
1528	D1-stbd	0.025	1.68	0.041	42.0	49.5	1020.408	1202.624
1531	D1-port	0.025	1.68	0.041	41.0	49.0	996.113	1190.476
1536	D2-port	0.024	1.68	0.040	40.0	47.5	992.063	1178.075
1540	-							
							7500.648	9001.045

*change in deflection per unit change of moment = m
length of pendulum = l
max angle of heel 3.2 degrees

$$GM = \frac{l}{m\,\Delta}$$

Average def/mom fwd 937.581
Average def/mom aft 1125.131

Fwd pendulum length 1560 mm
Aft pendulum length 1808 mm

GM fwd 0.410 m
GM aft 0.396 m

GM 0.403 m
(0.406 m by independent check)

Displacement 4.056 tonnes
VCG 1.153 m above baseline
LCG 3.306 m Corrected for trim, aft of stn 0

No free surface correction required

Kirsteen Anne Weights on/off for Stability Analysis

WEIGHTS SUMMARY	Wt(t)	LCG (m)	L Mmt	VCG (m)	VMmt	FS (t.m)
As inclined	4.056	3.306	13.410	1.153	4.676	
Weights off	-0.549	3.816	-2.093	1.346		
Weights on	0.900	3.587	3.228	1.812	1.631	
Totals (ex fluids)	4.408	3.300	14.545	1.431	6.307	
Fluids-						
Fuel tank (120-125 litres approx)	0.08	4.195	0.336	0.851	0.068	(Included on model)
Catch tank			0.000		0.000	(Included on model)

WEIGHTS ON	Wt (t)	LCG (m)	L Mmt	VCG (m)	V Mmt	FS (t.m)
Hydraulic oil tank (20 litres approx)	0.017	2.000	0.034	0.900	0.015	
Battery in forepeak	0.024	2.400	0.058	1.900	0.046	
Assumed anchor	0.008	0.800	0.006	0.800	0.006	
2 crew	0.150	1.700	0.255	2.150	0.323	
Clothing	0.010	1.700	0.017	1.700	0.017	
Oil drums x 2	0.030	1.000	0.030	0.900	0.027	
Rope & creels (wet)	0.532	4.632	2.465	1.924	1.024	
Creel weights	0.081	3.000	0.243	1.25	0.101	
Spare weights	0.027	3.000	0.081	1.250	0.034	
3 keeps@7kg each	0.021	1.880	0.039	1.830	0.038	
Totals	0.900	3.587	3.228	1.812	1.631	0.000

WEIGHTS OFF	Wt(t)	LCG (m)	L Mmt	VCG (m)	VMmt	TCG (m)	T Mmt
Inclining weights	0.299	4.040	1.206	1.255	0.375	-0.231	-0.069
Aft pendulum scaffold	0.017	5.860	0.000	1.750	0.000	0.000	0.000
Aft trough	0.031	5.720	0.177	1.240	0.038	0.000	0.000
Fwd trough	0.031	2.140	0.066	1.240	0.038	0.550	0.017
MAIB inspector 1	0.076	5.220	0.397	1.600	0.122	0.000	0.000
MAIB inspector 2	0.070	2.640	0.185	1.600	0.055	0.550	0.039
Portable electric bilge pump	0.005	4.400	0.022	1.210	0.055	-0.550	-0.003
Hydraulic oil tank	0.020	2.000	0.040	0.900	0.055	-0.080	-0.002
Totals	0.549	3.816	2.093	1.346	0.738	-0.032	-0.018

Estimated Creel loading

Fleet 1	Rope length/ creel no.	Wet wt per m/ creel	Weight (tonnes)	LCG (m)	Lmom	VCG (m)	Vmom
Rope	407.00	0.000086	0.035	3.000	0.105	1.450	0.051
D Creels	30	0.005	0.150	5.850	0.878	2.050	0.308
Fleet 2							
Rope	430.00	0.000086	0.037	3.000	0.111	1.450	0.054
D Creels	30	0.005	0.150	4.900	0.735	2.050	0.308
Fleet 3							
Rope	464.00	0.000086	0.040	3.000	0.120	1.450	0.058
Prawn Creels	30	0.004	0.120	4.300	0.516	2.050	0.246
			0.532	4.632	2.465	1.924	1.024

Inclining Weights details

	Weight (tonnes)	LCG (m) aft stn 0	Lmom	VCG (m) above base	Vmom	TCG (m) +ve to stbd	Tmom
A1	0.025	2.79	0.06975	1.23	0.03075	0.94	0.0235
A2	0.025	2.93	0.07325	1.23	0.03075	0.94	0.0235
A3	0.025	3.07	0.07675	1.23	0.03075	0.94	0.0235
B1	0.028	3.34	0.09185	1.26	0.03465	-0.93	-0.025575
B2	0.028	3.51	0.09828	1.26	0.03528	-0.93	-0.02604
B3	0.019	3.68	0.06992	1.26	0.02394	-0.93	-0.01767
C1	0.018	4.10	0.0738	1.27	0.02286	0.88	0.01575
C2	0.042	4.47	0.18774	1.26	0.05292	-0.88	-0.03696
C3	0.015	4.81	0.07215	1.25	0.01875	0.88	0.0132
D1	0.024	5.14	0.12336	1.27	0.03048	-0.84	-0.02016
D2	0.025	5.30	0.12985	1.27	0.031115	-0.84	-0.02058
D3	0.026	5.46	0.13923	1.27	0.032385	-0.84	-0.02142
Totals	0.299	4.04	1.20593	1.26	0.37463	-0.23	-0.068955

Kirsteen Anne Downflood Points

	LCG	VCG	TCG
Port midships freeing port	3.620	1.150	-1.100
Stbd midships freeing port	3.500	1.150	1.110
Port aft freeing port	5.860	1.150	-0.850
Stbd aft freeing port	5.860	1.150	0.840
Propeller inspection hatch outside ed	5.400	1.150	0.160
Propeller inspection hatch centreline	5.400	1.150	0.000
Engine bay fwd end	2.800	1.180	0.290
Engine bay aft end	3.500	1.180	0.290
Deck hatch aft	4.800	1.150	0.270

Dimensions in metres

Photograph showing *Kirsteen Anne* in her estimated loaded condition

ANNEX B

Stability analysis

Stability Analysis for Kirsteen Anne

To establish the stability characteristics of Kirsteen Anne at the time of the accident, an inclining experiment had to be conducted. This was carried out on 26 February 2003 at the boat yard on the island of Kerrera, where the vessel had been lifted out of the water after salvage.

To built up the condition in which the vessel was lost, known weights and estimates were used to create weights-on. A weights-off list for the added equipment used for the inclining experiment was also compiled.

The creel loading was derived from the weights taken of the recovered creels, ropes and anchor weights. The items were soaked in water to ensure a better representation of the likely weight on the day of the accident. For the purposes of the analysis the catch tank was assumed empty and the fuel tank was assumed to be 75% full.

A MAST model of Kirsteen Anne was derived using a manufacturer's lines plan, which was validated against the actual vessel. Three main conditions were analysed and GZ curves produced:

- Loading when the vessel was lost including 75% fuel
- Loading with one fleet of creels removed (30 creels), 75% fuel
- Flooding to cause marginal stability/ vessel loss

Due to the nature of Kirsteen Anne, two scenarios were modelled for the first two conditions. In case 1 the hull envelope was taken up to the gunwhale and freeing ports were highlighted as downflood warning points when they immersed. In case 2 the hull was only taken up to the deck and the engine opening, deck hatch and propeller inspection trunk were highlighted as downflood warning points. In reality neither scenario will be accurate, but the actual stability behaviour will be somewhere between the two scenarios. The last condition was modelled simulating flooding in the main hull to determine when the vessel's stability would become marginal. As an indicator of when the stability became marginal, it was decided to use the heeling moment applied by a crewman moving from one side of the vessel to another as the limiting criteria. The stability criteria applied to over 15m fishing vessels is included with the results for comparison.

Results-

The predicted stability performance with the full load of creels onboard is very poor and is only improved slightly when a fleet of creels is removed. Although the vessel possesses some righting moment, it is by no means adequate to ensure a margin of safety during fishing operations.

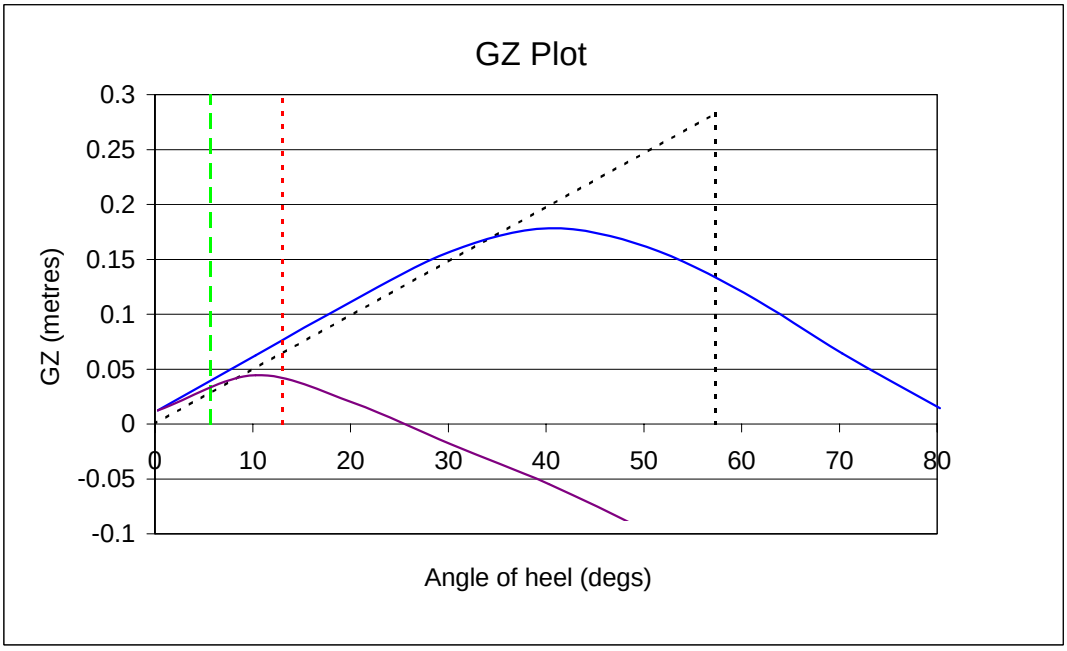
The flooding scenario demonstrates that only 0.26 tonnes of water is needed to cause marginal stability. Bearing in mind the very poor watertight integrity of the deck, coupled with the low freeboard, it is highly likely that sea water entered the hull on the day of the accident. Approximately, 0.26 tonnes equates to a 5-6 cm depth of water in the bilge.

Vessel: Kirsteen Anne
Condition: Loaded with 75% fuel (Case 1-hull up to g'whale, Case 2-hull up to deck)
Water SG: 1.025
Longitudinal dimensions about stn 0 (+ve aft, -ve forward) Dimensions in metres
Vertical dimensions about baseline (USK stn 9) (+ve above) Trim by the stern positive

	Deadweight Item	Weight	LCG	Longitudinal	VCG	Vertical	Free Surface
		tonnes	metres	moment t.m	metres	moment t.m	moment t.m
1	Weights Off	-0.549	3.816	-2.095	1.346	-0.739	
2	Weights On	0.9	3.587	3.228	1.812	1.631	
3	Fuel Tank	0.08	4.195	0.336	0.851	0.068	0.017
	DEADWEIGHT TOTAL	0.431	3.408	1.469	2.227	0.96	0.017
	LIGHTSHIP	4.056	3.306	13.409	1.153	4.677	
	DISPLACEMENT	4.487	3.316	14.878	1.256	5.636	0.017
	Free Surface Correction (Total Free Surface Moment/Displacement)				0.004		
				VCG fluid	1.26		

STABILITY DATA

Heel angle degrees	Trim on LBP	Draft Midships	Righting mom tonne.metres	GZf Case 1 metres	GZf Case 2 metres
0	0.061	1.036	0	0	0
10	0.062	1.015	0.223	0.05	0.032
20	0.076	0.952	0.448	0.1	0.007
30	0.087	0.845	0.649	0.145	-0.031
40	0.097	0.699	0.746	0.166	-0.067
50	0.117	0.531	0.669	0.149	-0.11
60	0.137	0.348	0.479	0.107	-0.157
70	0.156	0.159	0.235	0.052	-0.204
80	0.214	-0.028	0.009	0.002	-0.249



STABILITY SUMMARY				Criteria*	Case 1	Case 2
Angle of immersion of (degs) (Case 1- port freeing port, Case 2- deck hatch)					5.620	12.984
Area under GZ curve between 0 &	30	degrees (metre.radians)		0.055	0.039	0.008
Area under GZ curve between 0 &	40	degrees (metre.radians)		0.09	0.067	0.008
Area under GZ curve between 30	40	degrees (metre.radians)		0.03	0.028	0.000
Maximum GZ (metres)				0.2	0.160	0.032
Angle of heel at which maximum GZ occurs (degrees)				30	40.430	9.636
Positive GZ heel range (degrees)					80.300	21.730
GMF (metres) (upright)				0.35	0.283	0.335

* The >15m fishing vessel stability criteria are shown for comparison only

Vessel: Kirsteen Anne

Condition: 75% fuel, only 2 fleets of creels (Case 1-hull up to g'whale, Case 2-hull up to deck

Water SG: 1.025

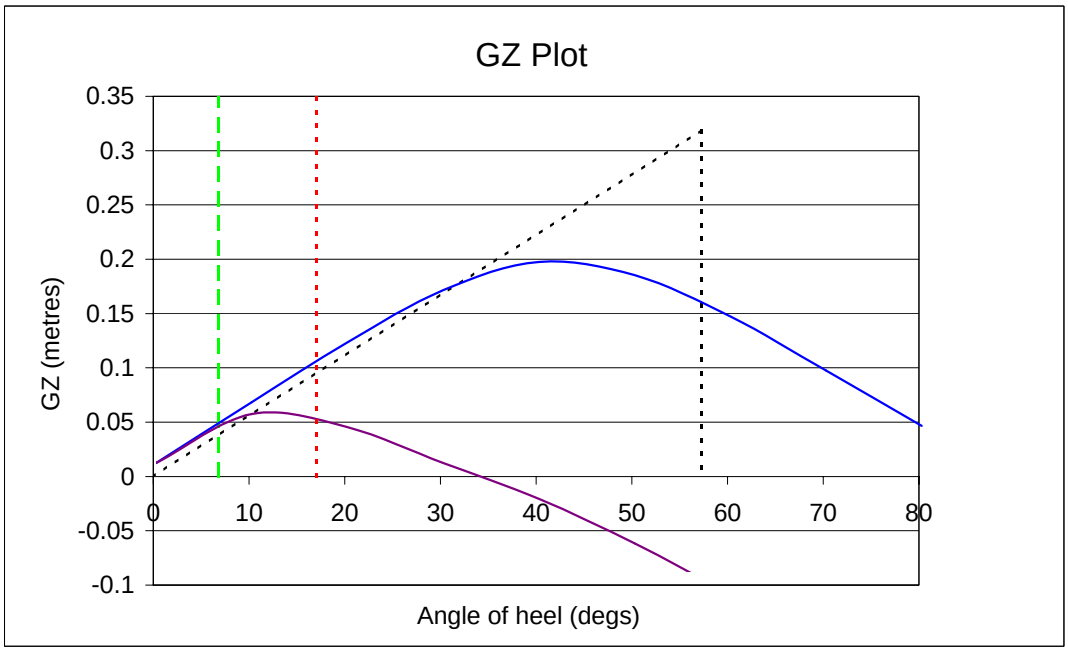
Longitudinal dimensions about stn 0 (+ve aft, -ve forward) Dimensions in metres

Vertical dimensions about baseline (USK stn 9) (+ve above) Trim by the stern positive

	Deadweight Item	Weight tonnes	LCG metres	Longitudinal moment t.m	VCG metres	Vertical moment t.m	Free Surface moment t.m
1	Weights Off	-0.549	3.816	-2.095	1.346	-0.739	
2	Weights On	0.686	3.542	2.43	1.835	1.259	
3	Fuel Tank	0.08	4.195	0.336	0.851	0.068	0.017
	DEADWEIGHT TOTAL	0.217	3.09	0.67	2.709	0.588	0.017
	LIGHTSHIP	4.056	3.306	13.409	1.153	4.677	
	DISPLACEMENT	4.273	3.295	14.08	1.232	5.265	0.017
	Free Surface Correction (Total Free Surface Moment/Displacement)				0.004		
				VCG fluid	1.236		

STABILITY DATA

Heel angle degrees	Trim on LBP	Draft Midships	Righting mom tonne.metres	GZf Case 1 metres	GZf Case 2 metres
0	0.035	1.017	0	0	0
10	0.035	0.996	0.238	0.056	0.045
20	0.048	0.934	0.474	0.111	0.033
30	0.056	0.826	0.677	0.159	0
40	0.057	0.677	0.791	0.185	-0.033
50	0.068	0.506	0.739	0.173	-0.074
60	0.082	0.321	0.576	0.135	-0.121
70	0.101	0.132	0.361	0.085	-0.169
80	0.157	-0.057	0.145	0.034	-0.217



STABILITY SUMMARY				Criteria*	Case 1	Case 2
Angle of immersion of (degs) (Case 1- port freeing port, Case 2- deck hatch)					6.755	17.053
Area under GZ curve between 0 &	30	degrees (metre.radians)		0.055	0.043	0.015
Area under GZ curve between 0 &	40	degrees (metre.radians)		0.09	0.074	0.015
Area under GZ curve between 30	40	degrees (metre.radians)		0.03	0.030	0.000
Maximum GZ (metres)				0.2	0.186	0.046
Angle of heel at which maximum GZ occurs (degrees)				30	41.667	12.190
Positive GZ heel range (degrees)					84.814	30.011
GMF (metres) (upright)				0.35	0.319	0.394

* The >15m fishing vessel stability criteria are shown for comparison only

Vessel: Kirsteen Anne

Condition: Partially flooded, 75% fuel (Case 1-0.5 te flooding, Case 2-0.25 te flooding)

Water SG: 1.025

Longitudinal dimensions about stn 0 (+ve aft, -ve forward) Dimensions in metres

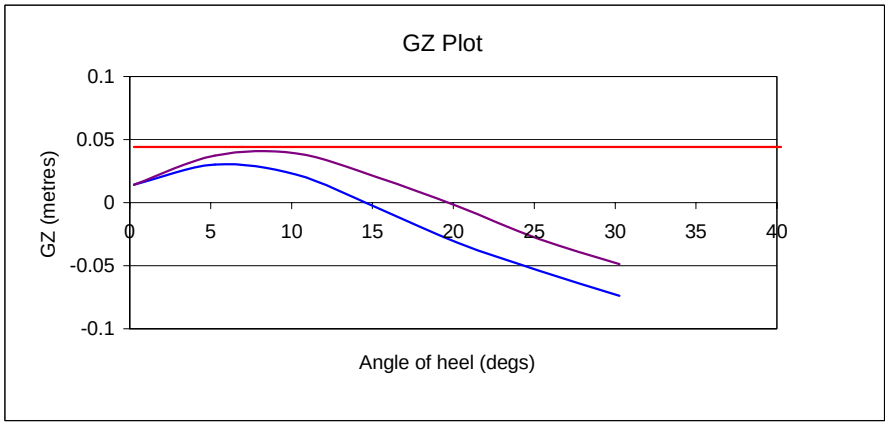
Vertical dimensions about baseline (USK stn 9) (+ve above) Trim by the stern positive

	Case 1- Deadweight Item	Weight	LCG	Longitudinal	VCG	Vertical	Free Surface
		tonnes	metres	moment t.m	metres	moment t.m	moment t.m
1	Weights Off	-0.549	3.816	-2.095	1.346	-0.739	0
2	Weights On	0.9	3.587	3.228	1.812	1.631	-
3	Fuel Tank	0.08	4.195	0.336	0.851	0.068	0.017
4	Derived hull for flooding	0.519	2.858	1.483	0.572	0.297	0.661
	DEADWEIGHT TOTAL	0.95	3.108	2.952	1.323	1.257	0.678
	LIGHTSHIP	4.056	3.306	13.409	1.153	4.677	-
	DISPLACEMENT	5.006	3.268	16.361	1.185	5.933	0.678
	Free Surface Correction (Total Free Surface Moment/Displacement)				0.135		
				VCG fluid	1.321		

	Case 2- Deadweight Item	Weight	LCG	Longitudinal	VCG	Vertical	Free Surface
		tonnes	metres	moment t.m	metres	moment t.m	moment t.m
1	Weights Off	-0.549	3.816	-2.095	1.346	-0.739	0
2	Weights On	0.9	3.587	3.228	1.812	1.631	-
3	Fuel Tank	0.08	4.195	0.336	0.851	0.068	0.017
4	Derived hull for flooding	0.26	2.624	0.682	0.528	0.137	0.387
	DEADWEIGHT TOTAL	0.691	3.113	2.151	1.588	1.097	0.404
	LIGHTSHIP	4.056	3.306	13.409	1.153	4.677	-
	DISPLACEMENT	4.747	3.278	15.56	1.216	5.774	0.404
	Free Surface Correction (Total Free Surface Moment/Displacement)				0.085		
				VCG fluid	1.301		

STABILITY DATA

Heel angle degrees	Trim on LBP	Draft Midships	Righting mom tonne.metres	GZf Case 1 metres	GZf Case 2 metres
0	0.034	1.091	0.001	0	0
5	0.037	1.088	0.078	0.016	0.023
10	0.081	1.088	0.038	0.008	0.025
15	0.163	1.088	-0.091	-0.018	0.006
20	0.256	1.078	-0.231	-0.046	-0.017
25	0.358	1.064	-0.342	-0.068	-0.043
30	0.472	1.04	-0.443	-0.088	-0.063



STABILITY SUMMARY			Criteria*	Case 1	Case 2
Area under GZ curve between 0 &	30	degrees (metre.radians)	0.055	0.002	0.005
Area under GZ curve between 0 &	40	degrees (metre.radians)	0.09	0.002	0.005
Area under GZ curve between 30	40	degrees (metre.radians)	0.03	0	0
Maximum GZ (metres)			0.2	0.016	0.027
Angle of heel at which maximum GZ occurs (degrees)			30	5.806	7.788
Positive GZ heel range (degrees)				11.722	16.442
GMF (metres) (upright)			0.35	0.225	0.316

------ Lever resulting from one crewman moving from one beam to the other

* The >15m fishing vessel stability criteria are shown for comparison only

ANNEX C

Checklist of requirements

CODE OF PRACTICE FOR THE SAFETY OF SMALL FISHING VESSELS: CHECK LIST OF REQUIREMENTS

ALL DECKED Vessels up to 10m Registered Length

Item	Remarks/compliance	Expiry/Service Date
Lifejackets - 1 per person		
2 Lifebuoys (1 with 18m buoyant line attached) or 1 Lifebuoy (fitted with 18m buoyancy line) + 1 Buoyant Rescue Quoit		
3 Parachute Flares		
2 Hand-held Flares		
1 Smoke Signal (buoyant or hand held)		
1 Fire Bucket + Lanyard		
1 Multi-purpose Fire Extinguisher (fire rating 5A/34B)		
1 Fire Blanket (light duty) in galley or cooking area (if applicable)		
1 Fire Pump + Hose or 1 Fire Bucket		
1 Multi-purpose Fire Extinguisher for oil fires (fire rating 13A/113B)		
VHF Radio – fixed or hand held		
Bilge Pump		
Bilge Alarm		
Navigation Lights & Sound Signals		
Compass		
Waterproof Torch		
Medical Kit		

Notes:
(i) Equipment need not be MCA approved provided it is fit for its intended purpose.
(ii) "Decked vessels" means a vessel with a continuous watertight weather deck that extends from stem to stern and has positive freeboard throughout, in any condition of loading the vessel.
(iii) VHF using Digital Selective Calling (DSC) is highly recommended in view of cessation of the Coastguard's Channel 16 dedicated headset watch on 1st February 2005.