Report of investigation into swamping of

unnamed cabin cruiser

in Lady Bay on Loch Ryan,

3 September 2003,

and associated wave generation issues

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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 TERMS

D&GC	:	Dumfries and Galloway Council
GRP	:	Glass Reinforced Plastic
F_h	:	Froude Number (based on water depth)
hp	:	Horsepower
HSC	:	High speed craft
HSC Code	:	International Code of Safety for High Speed Crafts
HSS	:	High speed superferry
IMO	:	International Maritime Organization
kW	:	kilowatt
m	:	metre
MCA	:	Maritime and Coastguard Agency
mm	:	millimetre
SWIM	:	Ship Wash Impact Management (project of MCA)
UTC	:	Universal co-ordinated time
VDR	:	Voyage data recorder
VHF	:	Very high frequency

SYNOPSIS

In the early afternoon of 3 September 2003, the owner of a small cabin cruiser, with two friends, made preparations for a short fishing trip on Loch Ryan, south-west Scotland. Shortly after the boat was launched in Lady Bay, and while still close to the shoreline, the boat was struck by two waves which swamped her and swept her ashore. The boat suffered damage and the owner was injured.

Several minutes before, at about 1500 (UTC+1), a high-speed ferry passed Lady Bay on a scheduled voyage from Stranraer to Belfast.

During the MAIB investigation, the general issue of ferry-generated waves on Loch Ryan was reviewed. The issues identified were found to be common with the causes of this accident.

Ferries have been operating out of Loch Ryan since the middle of the nineteenth century. Fast ferries were introduced in the early part of the 1990s.

Waves generated by the wash from fast ferries have been recognised as a problem during the mid-1990s, usually because of large waves breaking on the shoreline of the loch. Small boats had also been affected by these waves when within 50 metres of the shoreline.

Consequential changes in operational procedures by the ferry operators have significantly reduced the frequency of reported problems.

The investigation invited submissions from members of the public on the subject of large unexpected waves on Loch Ryan. It has been concluded that while significant reductions have been made to wash-generated waves on the loch, this accident and other data show that some dangers remain.

Three recommendations are made, all addressed to Dumfries and Galloway Council, which, if accepted and implemented, will initiate some immediate remedial actions and set in motion a course of action to put in place a system of safety management on and around Loch Ryan under the umbrella of a statutory harbour authority.

Figure 1

The cabin cruiser

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF VESSEL AND INCIDENT

Vessel Details

Name of vessel	:	Unnamed **(Figure 1)**
Type	:	Pleasure vessel (cabin cruiser)
Port of registry	:	Unregistered
Length	:	6m
Material of construction	:	GRP
Engine	:	97kW (30hp) outboard engine plus 18.5kW (25hp) stand-by outboard engine
Owner	:	Mr Raymond McLeod 5 Main Street Kirkcolm Dumfries & Galloway DG9 0LL
Crew	:	One person in boat at time of launching

Accident Details

Accident type	:	Swamping
Position	:	Lady Bay, Loch Ryan south-west Scotland
Injuries	:	One person injured
Damage	:	Mechanical and water damage to boat and fittings
Weather	:	Dry, calm, good visibility

1.2 NARRATIVE (Times are UTC+1)

On 3 September 2003, the owner and two friends decided to spend an afternoon fishing from his cabin cruiser, on Loch Ryan.

The trailer carrying the cabin cruiser was hitched to a four-wheel drive car and driven from the owner's house in Kirkcolm to Lady Bay, on Loch Ryan, arriving just after 1400.

On arrival at Lady Bay, the car and trailer were reversed down the slip to prepare for launching. However, the car became stuck at the water's edge and its engine could not be restarted.

The high-speed ferry, *Stena Voyager,* left her berth in Stranraer at 1440 for a routine passage to Belfast. She made her way north along the dredged channel and towards Cairnryan at a maximum speed of 12.5 knots **(see Figure 2)**. As she passed Cairnryan, her speed was 17 knots, which was gradually increased to 22 knots. When just north of Cairn Point, she accelerated from 22 knots to 25 knots in less than 1 minute, and continued to accelerate to 40 knots within a further 2 minutes.

A friend of the cabin cruiser's owner kept a tractor near to the slip in Lady Bay. This was borrowed by the three men, and used to tow their car clear of the waterline. The boat was manhandled from its trailer into the water and the trailer taken to the car park.

At about 1500, *Stena Voyager* passed Lady Bay at a speed of 41 knots.

At this stage, the cabin cruiser's owner was in the boat, which was by now afloat a few metres from the beach, with the engine running.

The boat's bow was pointing towards the beach when one of the friends, who was still moving the car, saw a wave approaching the boat from her stern. He shouted a warning to the owner, who had difficulty hearing him because of the noise made by the boat's engine.

However, the owner turned and saw a wave a few metres away approaching the stern of the boat. The wave contacted the boat, swung her stern around and drove it towards the beach. A second wave then struck the boat. The result was that the boat grounded in very shallow water.

These events were observed at a distance from another boat on the loch.

The owner scrambled clear of the boat between the first and second waves striking, and jumped into the water. In doing so, he injured an arm and his back. However, he managed to climb clear of the water.

The three men were then able to reach the boat and bail it out. Further work resulted in the boat being loaded on to its trailer and returned to the owner's home by road.

Figure 2

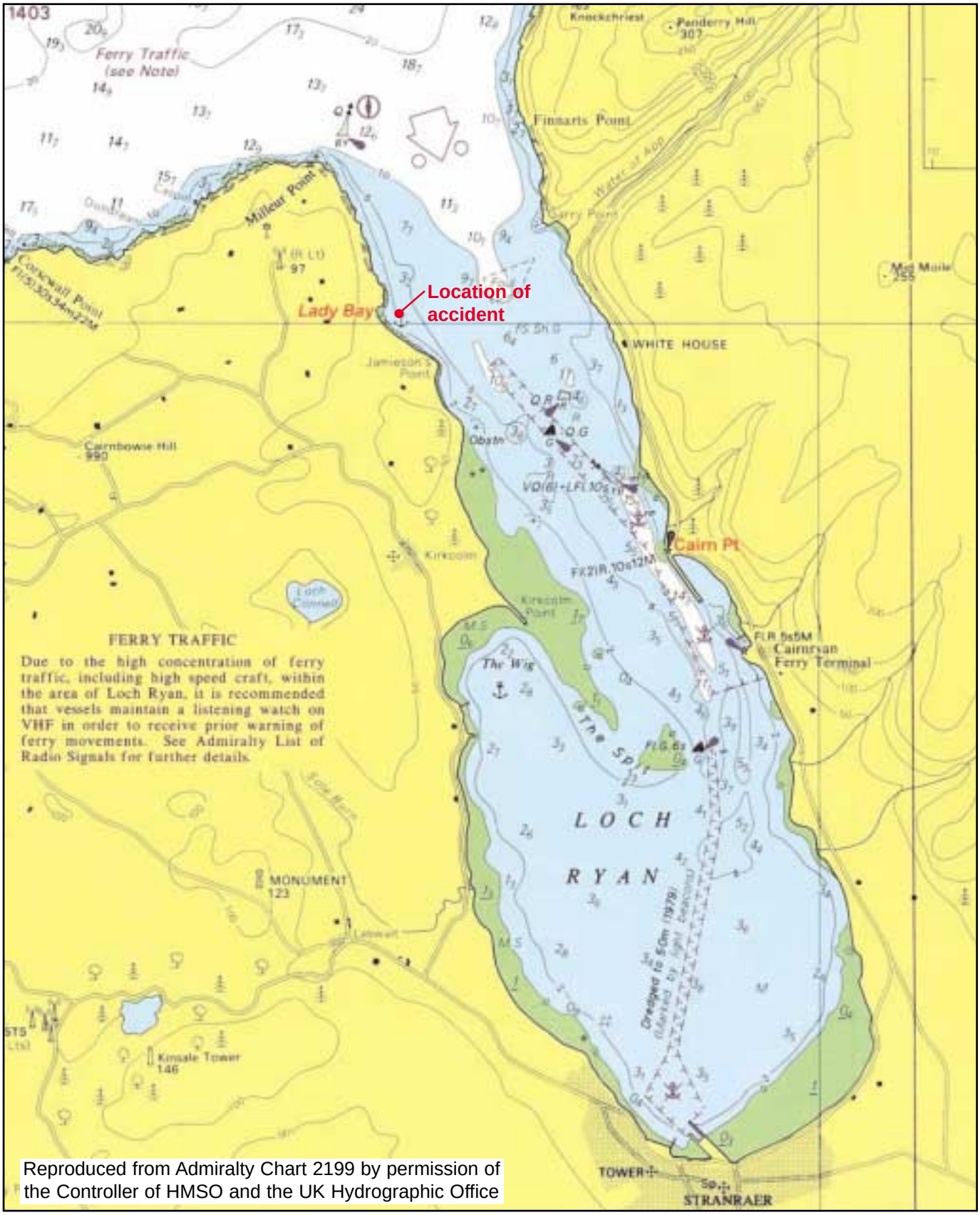


Chart of Loch Ryan showing the location of the accident

1.3 THE CABIN CRUISER (Figure 1)

This vessel is about 6 metres in length and is constructed of glass reinforced plastic (GRP). It is designed for leisure purposes and able to be transported by road on a trailer.

At the forward end is a small cabin, entered by a doorway from the aft open deck, fitted with seating and a cooker. To the starboard side of the aft deck, against the aft bulkhead of the cabin, is the helm position. This is fitted with engine/gearbox controls, a steering wheel operating a cable-type steering system, and a helmsman's seat.

There are two lockers at the aft end of the open deck, one each side. The starboard locker houses the batteries.

The main outboard engine is mounted centrally on the stern. A false transom to the starboard side of this is used to mount a small auxiliary outboard engine.

At the time of the accident, the vessel was also equipped with a small, portable, petrol-fuelled generator, used for recharging the batteries. The vessel also carried loose equipment brought on board on the day, such as fishing tackle. Also on board were three lifejackets, some flares and a mobile telephone.

Until this accident, the vessel had been used on only a few occasions by her owner, who purchased it only a few months before the accident. However, the owner has 20 years experience of using small boats on Loch Ryan.

1.4 LOCH RYAN (Figure 2)

Loch Ryan is Scotland's most southerly sea loch, and lies on the west coast of Scotland between the Rhins Peninsular and the western Southern Uplands. It is about 8 miles long, between 1 and 2 miles wide, and open to the sea only at its northern end.

The sheltered waters of the loch, and its geographical position, have long provided an important sea-trading route between Scotland and Ireland.

Evidence of maritime activity goes back to medieval times, possibly even earlier, but the modern use of the loch as a base for a ferry service to Ireland began in the nineteenth century. This activity centred on Stranraer, at the southern end of the loch, and a railway/ferry link at the east pier.

Some of the advantages of the loch were also recognised during the two world wars. The area was used as a military port, a significant base for shipbuilding and repair, and the construction of elements of Mulberry Harbour for the military invasion of Europe in 1944. It was also a centre for flying boat operations during the latter hostilities.

Most of the loch's shoreline is under the authority of Dumfries and Galloway Council. However, about 2 miles to the north of Cairnryan, on the loch's east shoreline, is the border with South Ayrshire.

Some stretches of the shoreline are used for tourism and recreational activities. Facilities include caravan sites, and launching facilities for small boats. Beaches and shallower water over sandbanks are also areas frequently used by walkers and those with a marine interest. However, the number and extent of the beaches are rather limited by the cliff-like nature of part of the shoreline.

1.5 LADY BAY

One of the boat-launching facilities is at Lady Bay, on the north-west shoreline of Loch Ryan. Dumfries and Galloway Council has set this out as a public facility.

There is a boat-launching slip, a surfaced area for car parking, and concrete steps between the car park and beach. The beach area is a mixture of sand and rock.

Two warning signs are displayed on posts. These warn of the possibility of waves being generated by passing high-speed ferries **(Figure 3)**.

Vehicular access to Lady Bay is by an unsurfaced track, which is steep and narrow in places with several tight bends. Signposts are positioned on the road leading to this track.

Figure 3

Warning sign

From the car park at Lady Bay, it is possible to see about 2 miles to the south-east, almost to Cairn Point on the opposite side of the loch **(Figure 4)**. However, because of adjacent cliffs, visibility to the north is very restricted, and the opposite side of the loch cannot be seen much further north than Finnart's Bay **(Figure 5)**.

Figure 4

View to the south from the car park at Lady Bay

Figure 5

View to the north, restricted due to the adjacent cliffs

1.6 CATEGORISATION OF WATERS

Under The Merchant Shipping (Categorisation of Waters) Regulations 1992, the waters of Loch Ryan are categorised as follows:

Category C: Within a line from Cairn Point to Kirkcolm Point.

Category D: Within a line from Finnart's Point to Milleur Point.

These two categories are defined as follows:

Category C waters:

> Tidal rivers and estuaries, and large, deep lakes and lochs where the significant wave height could not be expected to exceed 1.2 metres at any time.

Category D waters:

> Tidal rivers and estuaries where the significant wave height could not be expected to exceed 2.0 metres at any time.

These definitions and classifications are set out in Merchant Shipping Notice (MSN) 1776(M), which came into force on 1 April 2003.

This MSN further states that these categories apply specifically to the operation of Class IV, V and VI passenger ships, and also determine which waters are not regarded as 'sea' for the purpose of regulations made, or treated as made, under Section 85 of the Merchant Shipping Act 1995.

1.7 FERRY OPERATIONS

Ferries have been operating from Stranraer since the middle of the nineteenth century. High-speed ferries began operations in 1992 and, with some changes to class of vessel, continue.

Operations from Cairnryan are managed by P&O European Ferries (Irish Sea) Ltd, who operate one fast ferry, to Larne, Northern Ireland, and conventional ferries.

Stena Line Ltd manages similar operations from Stranraer. They operate one conventional ferry and one fast ferry, running to Belfast, Northern Ireland. This fast ferry, or HSS (High Speed Superferry), operation began in July 1996. These vessels are the largest high-speed craft presently in service.

SeaCat operations began in 1992 using an Incat catamaran. In 1999 this operation moved from Loch Ryan to Troon, Ayrshire.

1.8 HIGH SPEED CRAFT OPERATIONS

Between Stranraer and Cairnryan, all ferries operate at reduced speed to navigate the dredged channel. Just north of Cairnryan, the fast ferries from both Stranraer and Cairnryan accelerate to seagoing speed, well above what is known as “critical speed”.[1]

Similarly, on their arrival in the loch, the fast ferries maintain super-critical speed until just north of Cairnryan, where they decelerate.

Both fast ferries operators have passage plans in place, which follow this pattern of acceleration and deceleration on Loch Ryan, and which require the speed changes to be performed as quickly as possible. This is with the aim of limiting the time each ferry spends transiting the critical speed range.

1.9 HIGH SPEED CRAFT CODE

The International Maritime Organization (IMO) has developed a set of rules for the safe operation of high-speed craft. This is the *International Code of Safety for High Speed Craft* (HSC Code). This is mandatory under The Merchant Shipping (High-Speed Craft) Regulations 1996.

One section of the Code sets out part of the philosophy followed during its compilation. This is:

> *In developing the Code, it has been considered desirable to ensure that high-speed craft do not impose unreasonable demands on existing users of the environment or conversely suffer unnecessarily through lack of reasonable accommodation by existing users. Whatever burden of compatibility there is, it should not necessarily be laid wholly on the high-speed craft.*

The high-speed craft running from and within Loch Ryan are all operated under the HSC Code. They are each issued with a Permit to Operate by the ships’ flag administration, one condition of which is that the operator should pass to the MCA any complaints about wash. Implicit in this requirement is a review of the complaint by the MCA and a re-assessment of passage plans.

1.10 PORT OPERATIONS

P&O manages ferry-handling facilities at Cairnryan as a private port facility. There is no harbour authority covering this facility.

Stena Line operates the bulk of the port operations at Stranraer. Although the west pier at Stranraer is under the authority of a harbourmaster appointed by the local authority, the status of the facilities operated by Stena Line is

[1] Please refer to Section 1.11

uncertain. This uncertainty can be attributed to the long history of ferry operations from Stranraer, and various changes of operators. However, it appears that there is no harbour authority covering the whole of the Stranraer port facility, or the remainder of Loch Ryan.

1.11 FERRY WASH

Several studies have been made of the wash generated by high-speed vessels. Some of these have been made by the UK's Maritime and Coastguard Agency (MCA) but there have been a number of others by authorities in Australia, New Zealand, Canada, Denmark, USA, Japan etc.

In general, three regimes of wash and speed are identified. These are sub-critical wash, critical wash and super-critical wash, with each having a different impact on the shoreline.

Of these, critical wash has the greatest impact.

The studies agree that a gently sloping shoreline causes all waves to grow in height and break, possibly to a degree dangerous to people on the shoreline.

They show that the generation of waves by ships of any type is related to their speed and the depth of water in which they operate. Other factors also make a contribution, but the experts who compiled these study reports are unanimous that this speed/water depth relationship is an important one.

To present this relationship in a simple manner, each of the reports presents a table or graph of ship speed against water depth.

Observations of waves generated by a ship show that when the range of speed at which large waves are generated is plotted, a band of conditions exists which may be expressed in terms of a number, known as the depth Froude Number (F_h)

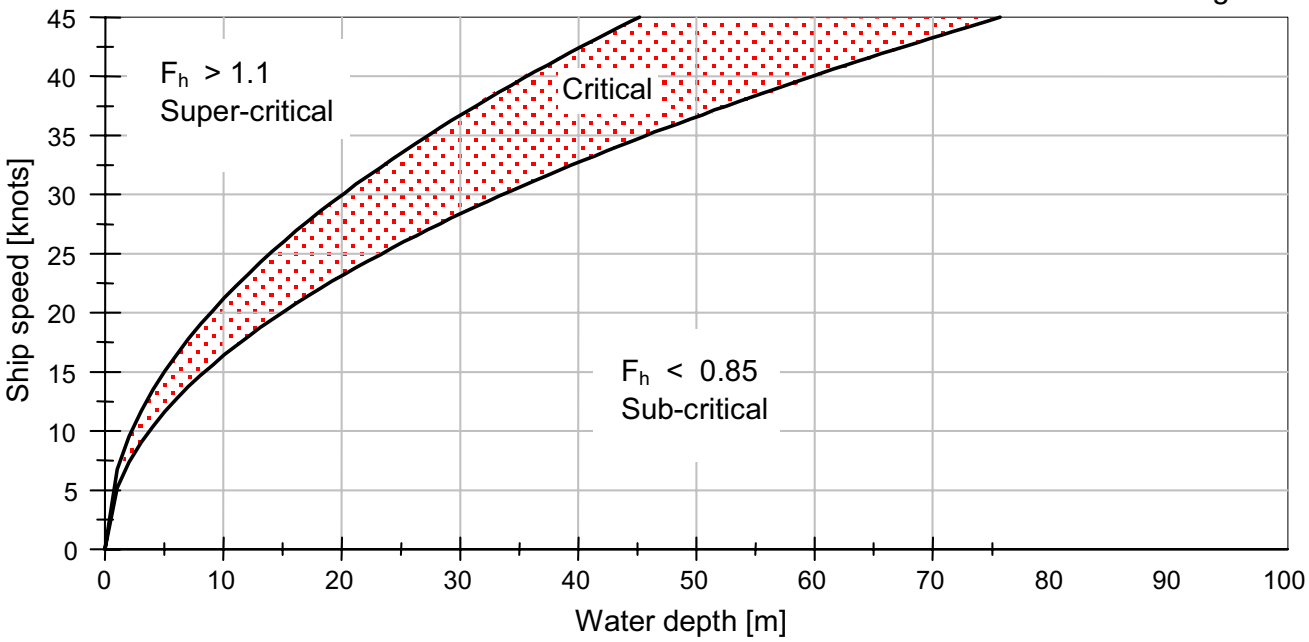
F_h has no units, it is a number calculated from:

$$F_h = \frac{V}{(gh)^{1/2}}$$

Where: V = speed of the ship in metres/second (m/s)
g = gravitational constant (9.81m/s^2)
h = depth of water (m)

Repeated observations plotted in this way show that there are values of F_h between which the waves may be at their most troublesome. These are between 0.85 and 1.1, the critical speed range. Either side of this range, the speeds are referred to as super-critical and sub-critical **(Figure 6)**.

Figure 6



Ship speed / water depth curves

Implicit in these studies, but clarified in only some, is that conventional ferries can produce similar waves if they are operated at particular speed/water depth conditions.

Clear video and witness records of waves breaking on the shoreline of Loch Ryan, particularly during the early years of high-speed craft operations, support the safety concerns expressed by these international and domestic studies.

Large waves attributed to high-speed craft operations at critical speeds have caused accidents in other parts of the UK. Two of these have been investigated by the MAIB*; one was fatal.

Both incidents confirmed the importance of a vessel avoiding speeds in water depths where the relationship between speed and depth is within the critical range. The recommendations from one of these investigations resulted in risk assessments in passage planning, with regard to wash, being introduced as a condition for a Permit to Operate being issued for a high-speed craft under the HSC Code.

1.12 REMEDIAL ACTIONS

Since the introduction of high-speed ferries on the routes running from Stranraer and Cairnryan, changes have been made to operating procedures, with the aim of limiting wash-generated waves.

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1. Purdy Report No 17/2000
2. Portsmouth Express Report No 14/2003 published 3 June 2003

These changes have resulted in the high-speed craft operating from Stranraer running at sub-critical speeds in the dredged channel between Stranraer and Cairn Point. Just north of this point they pass through the critical speed range as rapidly as possible.

The high-speed craft running from Cairnryan follow similar procedures, and confine their transition of the critical speed to an area just north of Cairn Point.

These procedures have become part of the vessels' passage plans, which are accepted by the MCA, and which are required to be followed to limit wave generation.

As part of the Permit to Operate, any reports of excessive wave generation are to be passed to the MCA, which has assumed the obligation of considering the circumstances of any such report and, if deemed necessary, requiring HSC operators to amend procedures.

The main local authority, Dumfries and Galloway Council, has erected warning signs at several access points around the Loch, warning of dangers from waves generated by fast ferries.

1.13 PLANS FOR CAIRNRYAN

A proposal, agreed in 2003, is for Stena Line and P&O to share facilities at Cairnryan. This would result in all Stena Line ferry operations transferring from Stranraer. The target date for this transfer is 2005.

One operational advantage in this move, is that Stena Line ferries would no longer need to transit the dredged channel between Cairnryan and Stranraer. This would give a saving on transit times for both its conventional and fast ferries.

1.14 LOCH RYAN ADVISORY MANAGEMENT FORUM

The Loch Ryan Advisory Management Forum was established in May 1997, following reports to Dumfries and Galloway Council's Wigtown West Area Committee on 7 April. The reports highlighted a number of issues which had been raised by members of the public, and other organisations, concerning the current use of the loch and the impact of this use on its environment and coastline. It was considered that these issues could not be dealt with in isolation and needed to be seen as part of a much wider picture.

The forum is open to any organisation, society or group with an interest in the use, management and well-being of the loch and its surrounding environment. It is based on the voluntary partnership principle and has no statutory powers or responsibilities.

1.15 SUBMISSIONS TO THE MAIB

To assess the extent of likely problems caused by large unexpected waves on Loch Ryan, the MAIB invited submissions on the subject from any interested parties. This was done by using public notices in several newspapers having significant circulation in the Dumfries and Galloway area.

The response to these public notices was limited. However, some of the newspapers also elected to print an editorial piece on the subject of the likely dangers caused by waves on Loch Ryan. The response to these articles was much greater.

As the invitation for submissions was of a general nature, the responses were similarly general. Naturally, they offered observations from the respondents' particular experience and area of interest. All demonstrated an impressive level of knowledge on the part of their authors. All were of value and covered a wide range of opinions on the subject. These have been carefully considered during the investigation.

Most submissions were from people with experience of using small boats on Loch Ryan. In view of the nature of the accident involving the cabin cruiser on 3 September, these views and observations were particularly valuable. In general, they offered a consensus that small boats are not significantly affected by ferry wash, unless they are within 50 metres of the shoreline or in the process of being launched or recovered. Outside of this region, it was suggested that small boats could comfortably ride out any ferry wash with no threat to safety.

A number of submissions also identified Lady Bay as a public launching place which posed particular risks, from ferry wash, when launching or recovering small boats, largely because cliffs at the north end of the bay shielded inbound ferries from view.

SECTION 2 - ANALYSIS

2.1 AIM

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

2.2 HSS *STENA VOYAGER*

The passage plans for all high-speed ferries operating from Loch Ryan require them to restrict their transitions of the critical speed range to an area between Cairn Point and Old House Point.

This part of the passage covers a change in water depth, charted as from 14m to 7.5m. This is convenient, as a vessel travelling north at sub-critical speed in 14m depth, can quickly transit the critical speed range as she moves in the shallower water. This transit becomes possible, without the vessel needing to accelerate, provided the speed at the beginning of the transition is selected carefully.

The movements of *Stena Voyager*, after leaving Stranraer at 1440 on 3 September, were recorded on her voyage data recorder (VDR). This showed she was at a speed of 22 knots in 14m depth, just off Cairn Point, and accelerating through the critical speed range. However, in passing into the shallower part of the channel, 7.5m, and accelerating, she automatically moved to a super-critical speed.

The vessel's VDR also shows that the remainder of the vessel's passage in the loch was at speeds well above the critical range.

It is possible that while running at critical speed, she could have generated waves which might have been of significant size when they reached the shoreline. However, these waves needed then to travel north-west along the loch to reach Lady Bay if they were the waves which affected the cabin cruiser. The many research studies of these types of waves suggest this is a possibility, but only if critical speed was maintained for a significant time, allowing the wave to extend from the vessel's track.

From this information, it is concluded that, although *Stena Voyager* ran briefly within the critical speed range while off Cairnryan, this was probably insufficient to generate any substantial waves affecting Lady Bay.

2.3 THE CABIN CRUISER

The timing of *Stena Voyager* passing Lady Bay, and the observations of several witnesses, support the account of the cabin cruiser's owner. It is probable that his boat was struck by waves generated by the wash from *Stena Voyager.*

What is uncertain is the size of the waves involved. Descriptions of them are not consistent, although accounts of their effects on the cabin cruiser are.

The owner of the cabin cruiser was well versed in the possible dangers from ferry generated waves on Loch Ryan. Indeed, he was so familiar with this issue that he did not read the warning signs at Lady Bay.

Clearly, the problems he experienced launching his cabin cruiser caused him to be distracted and to forget about the movements of the ferries. This demonstrates that if alertness and awareness are absent, knowledge of the waves alone is insufficient to prevent accidents.

2.4 THE WAVES IN LADY BAY

Ferries running at super-critical speed can be expected to generate a wash that results in waves of about 600mm height striking the beach at Lady Bay. This was confirmed by observation during the investigation **(Figure 4)**.

Although an isolated observation such as this cannot eliminate the possibility that larger waves may occur, its agreement with earlier carefully measured wave heights does suggest that the figure of 600mm is typical. However the complete mechanism of wash-generated waves is not yet fully understood, and it is possible that unexpectedly larger waves might still occur. The Ship Wash Impact Management (SWIM) project might assist in furthering an understanding of this issue.

A wave 600mm high is still a hazard to users of the shoreline and small boats, particularly while launching. Therefore, efforts are still required to minimise this risk.

2.5 HISTORY OF WASH COMPLAINTS

High-speed craft have operated from Stranraer since the early 1990s, and there appears to have been very few serious complaints about the wash and waves generated by the Incat catamaran.

Records of complaints, held officially and unofficially since 1996, however, show a significant increase in numbers coinciding with the introduction of the HSS *Stena Voyager* in 1996. Indeed, many of the complainants specifically identify that vessel as the source of the waves which affected them.

Since the complaints of the first 2 years of operation of *Stena Voyager*, during which about 12 to 15 incidents were reported each year, the frequency of complaints has substantially reduced; typically two or three per year.

The accuracy of these records, both official and unofficial, is viewed with care.

There are several reasons for this:

1. Reporting Procedures

Until 2001 there was no formal method for reporting wash/wave incidents to either the MCA or the operators of the high-speed craft. This shortcoming was recognised, and the MCA introduced a Ship Wash Incident Report Form.

Whilst the MCA stockpile these report forms at various locations around the UK, obtaining a copy, to make a report, requires knowledge that the MCA is the authority able to handle the data. Persons with that knowledge probably do not need the form to make a report; they are able to direct their complaint at the relevant authority. Others might be so unsure of the MCA's function that they make no report. This might result in under-reporting.

2. Acceptance of Problem

To a degree, regular users of Loch Ryan have come to learn to accommodate the ferries and the wash they generate. This is demonstrated by many of those who made submissions to the MAIB setting out the methods they use to keep their boats safe while on the loch. Even the owner of the cabin cruiser involved in the accident of 3 September was clear that his boat would have had no difficulty, provided he kept clear of the 50-metre strip of water next to the shoreline when the ferry wash reached the beach.

This suggests that, probably unconsciously, many users of the loch have made efforts to live with problems caused by ferries on the loch; the philosophy of the HSC Code has thus been accommodated to a reasonable level.

3. Recognition of the Commercial Importance of Ferries

There is little doubt that the ferries operating out of Cairnryan and Stranraer are a commercial benefit to the area and to the many individuals directly employed thereon. It would be understandable if some, who otherwise might have adverse observations to make about ferry wash and waves, remained silent, because of the overriding need to retain the ferry operations in the area. However, apart from various statements about the financial value of the ferries, no submissions contained any material to support this supposition.

4. Population Density

With the exception of the Stranraer area, the population density around Loch Ryan is low, giving a corresponding low number of regular users of its waters and shoreline. These small numbers result in few observers of wave incidents and similarly few reports. Although these numbers are likely to increase during the summer months, because of visitors to the area, these visitors are less likely to know the reporting procedures, so any complaint they might want to make is likely to be unheard.

5. Compensation Culture

To some extent, possible under-reporting of incidents by visitors could be balanced by a determination by some to obtain financial recompense for losses experienced during wave accidents.

6. Perception of Risk

It is extremely difficult for anybody to describe accurately a wave of any type, particularly somebody who is not a mariner. Such descriptions are often punctuated with terms such as: enormous, frightening, giant, dangerous, huge etc. While probably quite true, as regards the impression made on the observer, these terms give no absolute measure of a wave's size or the level of hazard it might present.

7. Recollection of Early Problems

It is apparent that some who offered submissions to this investigation were very much affected and influenced by their memories of the waves observed during the first 2 years of HSS operation. These waves were sometimes very large and damaging, and made a firm impression. However, it is not clear how much these impressions affected any individual's views of the present state of ferry operation and wave generation.

These factors suggest that the recorded data on the number of incidents involving wash-generated waves is inaccurate. To some extent, this is also shown by the incident involving the cabin cruiser, on 3 September, which was not reported by her owner to the operators of the high-speed craft he thought was involved.

2.6 RECORDING OF INCIDENTS

Two official bodies have played some role in recording wash/wave incidents on Loch Ryan; the MCA and Dumfries and Galloway Council (D&GC). In addition, the ferry operators have maintained their own records.

There have been some shortcomings in the recording of official figures. This is probably explained by the geographical locations of the MCA and D&GC, displaced as they are some considerable distance from Loch Ryan.

Further, neither organisation has a permanent presence in the Loch Ryan area capable of continuously monitoring marine safety matters.

A centre for expertise in fast ferry operation within the MCA is based at the Belfast Marine Office. Glasgow Marine Office is the nearest centre for marine surveying on the mainland. Each of these two offices has an understanding that the other has the major responsibility for monitoring wash/wave incidents on Loch Ryan. As a result, comprehensive monitoring of any problem is unlikely to be achieved.

The absence of any body, independent of the ferry operators, permanently located in the Loch Ryan area, and with a responsibility for marine safety matters, is seen as a significant barrier to the proper and reasonable measurement, assessment and rectification of any wash/wave problem in the loch. It is also a possible barrier to the introduction of modern safety management techniques covering all activities on and around the loch.

2.7 EXTENT OF FERRY WASH PROBLEMS

The data available to this investigation suggests that, following an initial flurry of incidents during the 2 years after the introduction of the HSS in Loch Ryan in 1996, the frequency of incidents has fallen substantially. This must be seen as being the result of a better understanding of the generation of waves, improved training and the application of passage planning and route assessment on the part of ferry operators.

These steps are similar to those taken to tackle the problems of waves generated by fast ferries in other parts of mainland UK, such as Harwich. As far as the MAIB is aware, based on the absence of reports of further incidents, these steps have provided an acceptable solution to the problem in these other areas.

Other mainland UK ports from which HSC regularly operate, namely Harwich, Holyhead, Poole, Folkestone, Troon, etc have substantial differences in geography compared with Loch Ryan. The major feature of the HSC operating facilities on Loch Ryan, which is not shared by the ports mentioned, is the long stretch of enclosed water between the port facilities and the sea. Solutions found to be effective in these other ports might not be completely suitable for Loch Ryan.

To date, there have been no unacceptable consequences from any incident in Loch Ryan which can be attributed solely to the effects of waves generated by ferry wash. There are, however, substantial levels of concern among some users of the loch about the possibility of a serious accident in the future.

2.8 RISKS TO OTHER VESSELS

Unless within 50 metres of the shoreline, small craft using the loch appear to be at no serious risk from critical and super-critical wash generated by ferries. This appears to be commonly understood among the boating and fishing community surrounding the loch, and accepted by even the harshest critic of high-speed and other ferry operations.

Boat users who are strangers to the loch are less likely to be so aware of the issue.

Anybody from outside the area wishing to use a boat on the loch is free to do so without any apparent hindrance. There are several boat-launching slips marked on maps distributed for the purpose of making tourists aware of these facilities. Lady Bay is one of these facilities.

Anyone launching a boat from this, or any other slipway on the loch, needs to be aware of the potential hazards caused by wash-induced waves. A stranger to the area might have no more than the wording of a warning sign to highlight this hazard. This might not give him the appropriate level of knowledge.

It is accepted that the users of any vessel on the loch have a responsibility to make themselves aware of the likely dangers from the sea before embarking on an excursion or voyage. Conventionally, the dangers are those generated by nature in the form of wind, waves and tidal streams, matters of concern that are common to mariners throughout the world and are frequently discussed and considered by the marine community.

Waves induced by ferries are man-made and, particularly in confined and sheltered waters, do not fall into the category of natural risk to mariners.

So that anyone intending to use Loch Ryan or its shoreline can be certain that they have considered all of the possible hazards, they need to be aware of the possibility of unexpectedly large waves being generated, their timing and the possible level of risk. This level of understanding cannot be achieved from the contents of the present warning signs.

2.9 RISKS TO USERS OF THE SHORELINE

The MCA has a responsibility to ensure the safety of ships and users of the sea. The relevant local authorities, Dumfries and Galloway Council and South Ayrshire Council, have a responsibility for the safety of the general public on property under their control down to the low waterline around Loch Ryan.

Although the MCA has the responsibility for monitoring the route assessments of high-speed craft, including those aspects that might affect the safety of users of the shoreline, it cannot properly do so unless it is fully aware of the intended uses of all parts of the shoreline.

By retaining Lady Bay, and other similar facilities, as a stretch of shoreline accessible to the general public for the purpose of launching boats and other pursuits, the local authorities are suggesting these areas are fit and suitable for a particular purpose.

Any high-speed craft route assessment made for, and presented to, the MCA needs to give consideration to users of the shoreline. However, this might not be comprehensive unless there is a substantial input to the assessment from the local authorities.

Local authorities could:

a) clearly identify areas of the shoreline that they view to be public areas;

b) clearly identify acceptable levels of risk to the safety of members of the public using these areas; and

c) offer possible methods of reducing risks to people on the shoreline.

The levels of risk that might be acceptable appear not to have been considered formally by either of the local authorities bordering Loch Ryan. In judging these risks, weight needs to be given not only to the possible public activities, such as launching boats or walking, but also to the vulnerability of some users, such as small children.

Should the local authorities, in consultation with the MCA and the ferry operators, consider the risks to members of the public to be too great, they need to be robust in making their contribution to reducing the risks, which might include closing particular areas to the general public.

To assess properly whether this or similar action is necessary, it is recommended that Dumfries and Galloway Council consults with the MCA and the ferry operators for the purpose of assessing an acceptable level of risk for users of Lady Bay and other council facilities on the shoreline of Loch Ryan. Although the views of other users of the loch should be considered, including those submitted by, and through, the Loch Ryan Advisory Management Forum, this assessment should be done as soon as possible, and primarily by D&GC.

2.10 LOCAL CONDITIONS

In making assessments as to the likely sea conditions which small passenger-carrying vessels might encounter on Loch Ryan, the MCA considers Loch Ryan’s waters to be other than the sea. A layman, not versed in regulatory terminology and observing the enclosed nature of these waters, might instinctively, and quite reasonably, come to the same conclusion.

Whereas a mariner, or even an experienced amateur boat user, will usually consider the sea as a potentially dangerous place, the enclosed waters of Loch Ryan might, as shown by the MCA's assessment, be judged differently. Certainly, these waters can reasonably be expected to offer the experienced mariner less challenging conditions than the open sea.

Any conditions beyond what might reasonably be expected, and which might stretch the capability of a reasonably equipped boat and user, need to be brought to the attention of loch users; whether they are local people or visitors to the area.

Efforts to alert users of the loch to hazards that might be caused by ship-generated waves, have been made by Dumfries and Galloway Council, with assistance from the ferry operators.

Many residents of the area around Loch Ryan, whether boat users or not, have been made aware of the wave issue from local newspapers and discussion.

Visitors, however, might have no warning other than that provided by the warning signs.

2.11 WARNING SIGNS

One control measure introduced to limit the risk to users of the shoreline of Loch Ryan is the display of warning signs.

Warning signs may have some value to visitors to the area who, unlike a significant proportion of the local community, are not aware of wash-generated waves. However, the value of signs depends on their placement, prominence, clarity and accuracy of information contained thereon. Above all, their effectiveness depends on their being read, understood and acted on.

Local users, as demonstrated by this incident, while aware of the warning signs, take little heed of them as they judge that their knowledge of the wave issue is adequate. The target reader, therefore, is probably the visitor to the area who must be assumed to have no knowledge of the issue of ferry wash and waves.

The aim of warning signs is, to a degree, the education of visitors to potential dangers. In view of the possible size of waves, and the delay between the ferry passing and the waves striking the shoreline, it is considered that the wording of the existing signs is inadequate.

The wording of these signs gives only a very limited indication of the possible severity and type of hazard. Even less does it indicate when the waves might appear. Few non-mariners would realise that the waves might appear several minutes after a ferry has passed; even fewer would realise they could appear from a smooth water surface.

For any warning sign to be effective as a valid risk control measure, it must indicate fully the degree of the hazard, and set out clearly the actions that should be avoided.

It is difficult to imagine how a sign containing only text, could give persons unfamiliar with the wave issue an accurate understanding of the problem, without resorting to large amounts of small print; which is unlikely to be read. A graphical representation of the problem might serve better. This is an approach followed in the Harwich and Felixstowe area where wash from high-speed craft has previously caused problems.

It is considered that the present warning signs around Loch Ryan are of little value, even to persons who read them conscientiously. As such, the concept of warning signs has not been given a fair test as to whether it is a worthwhile and effective control measure for reducing the risks generated by waves. It is recommended that, as an immediate step, all the existing signs be replaced by some which vividly and immediately convey the necessary message. Any signs that offer sufficient information to understand the nature and level of danger need to be carefully and imaginatively worded and illustrated. Examples are the images used on road signs.

2.12 VHF RADIO WARNINGS

All ferry movements into and from Loch Ryan are announced on VHF radio. This gives adequate warning to any vessel, provided it is equipped with a VHF radio. Many leisure craft are not so equipped; neither are they required to carry a VHF radio.

However, mobile telephones are almost universal items of equipment among the population, whether mariners or not. While issuing warnings of ferry movement on telephones is impractical, an enquiry line, where boat users could obtain times of ferry movements, could be of value. The number of the enquiry line could reasonably be a piece of the information put on warning signs.

While such information will be of no value to those who do not, or will not, read the warnings, it will at least allow conscientious boat users to obtain the best available information so that they can make best provision for their own safety.

2.13 OTHER FERRY TRAFFIC

Other investigations undertaken by the MAIB have identified wash from fast ferries as a major contributor to the particular accident. In each case, there has been little doubt as to the vessel involved.

During this investigation, the owner of the cabin cruiser involved in the accident, and other witnesses, clearly attributed the relevant waves to the passing of the HSS *Stena Voyager*.

However, for the more general issue of wave generation, it is considered sensible to reiterate a finding of some of the scientific studies of waves; that any vessel operating within the critical speed range can generate waves which can be significant in size, and troublesome to other users of the environment. As with the waves from high-speed craft, the intensity of such waves is related to the size of the vessel.

Thus, any vessel of significant displacement running in the critical speed range, for the water's depth, could cause wave problems which have been frequently attributed to only high-speed craft. This is shown on the speed/depth curves in **Figure 6**, where a vessel running at 15 knots in water 7 metres deep is within the critical speed range. A conventional ferry might comfortably and regularly operate under such conditions.

This suggests the need to consider the possibility that any type of vessel might be the 'culprit' in a wash wave incident.

In the Loch Ryan area, there is a body of opinion which, while offering differing views on a number of matters, appears to be reasonably consistent in attributing problem waves only to high-speed ferries. This is clearly unfair.

2.14 OBSERVATIONS OF LOCH USERS

The investigation revealed a large range of opinions on matters relating to ferry-generated waves on Loch Ryan. Some of these opinions were expressed with passion; all were expressed with what appeared genuine conviction.

These diverse views, from people having almost daily experience of the loch and its conditions, make the true severity of any wave problem difficult to assess.

Scientific research produced by many well-respected academics world-wide, clearly shows that high-speed ferries can generate waves which are potentially dangerous. This is supported by other investigations conducted by the MAIB.

However, the same research also indicates that the worst conditions are related to ferry speed/water depth, and local conditions such as shelving nature of the shoreline. Other variables appear also to be significant such as vessel displacement, trim and hull form.

Despite the substantial level of research, it is apparent that the theories of wave generation and behaviour are not yet sufficiently developed to be able to predict reliably the outcome of a ferry passage. It is possible that the work undertaken for the SWIM project might improve this situation.

In the meantime, there may be instances where waves larger than expected strike the shoreline of Loch Ryan. Only those who are in a position regularly to make observations of the shoreline, and the consequences of ferry movements, can reliably report on these events.

From the large range of opinions presented, the MAIB is unable to offer a firm conclusion as to whether or not large waves remain a serious and frequent problem to the safety of users of Loch Ryan and its shoreline. However, there is sufficient indication that occasionally this might be the case, and that further amendment to operational procedures might be necessary.

It is considered that only a locally-based and independent organisation can be in a position to monitor, regularly and directly, the waters of Loch Ryan. It is also likely that only such an organisation is in a position to make a fair and reasoned judgment of the issue.

2.15 HARBOUR AUTHORITIES

No body or administration has responsibility for, or authority over, navigation on the waters of Loch Ryan. This is quite unusual for such a substantial area of water, used for significant commercial maritime activity, enclosed on three sides and forming a natural harbour.

Harbour authorities have substantial powers and responsibilities, which are set out in The Port Marine Safety Code.

The Code sets out the general duties of a harbour authority as follows:

A. *Harbour authorities have a duty to take reasonable care, so long as the harbour is open for public use, that all who may choose to navigate it may do so without danger to their lives or property.*

B. *This includes an obligation to conserve, and facilitate the safe use of, the harbour; and a duty of care against loss caused by the authority's negligence.*

C. *Each harbour authority has an obligation to have regard to efficiency, economy and safety of operations as respects the services and facilities provided.*

D. *Harbour authorities typically have an express duty to take such action as the harbour authority consider necessary or desirable for or incidental to the maintenance, operation, improvement or conservancy of their harbour.*

In view of the absence of any authority having an overall responsibility for the safety of navigation on Loch Ryan, it might be beneficial to establish a harbour authority with responsibility for the whole of the loch.

Existing ferry operators appear to operate safely using informal agreements for traffic movements. Although these arrangements have given these waters and the ferries a good safety record, a formal system controlled by an independent body should ensure safety is maintained, particularly if traffic volume increases.

Other users of Loch Ryan, whose safety would also need to be considered by a harbour authority, apart from having an immediate independent authority with whom they could raise safety issues, would also have confidence that their concerns were being considered by an independent body with local knowledge.

There are many other safety and environmental issues which a harbourmaster, appointed by a harbour authority, can be made responsible for: emergency plans and procedures; regulation of dangerous goods in transit; counter-pollution; waste disposal. By placing these matters under the umbrella of a harbour authority, a uniform approach could be achieved, which would ultimately benefit the safety of the inhabitants of the loch's coastline.

A harbourmaster could also be a suitably qualified and independent person to make the necessary regular observations of wave generation on the loch. His independent professional judgment could then be applied to making any changes which might be necessary to ensure the safety of users of the loch; afloat and ashore.

Establishing a competent harbour authority covering Loch Ryan is likely to take significant time. However, as a long-term measure to enhance the safety of the loch and its environs, it is one that should be seriously considered. The body which is best-placed to pursue this aim appears to be Dumfries and Galloway Council.

The geographical limits of responsibility of the proposed competent harbour authority would need to be discussed and decided as part of the consultation process to be followed in introducing the authority. However, the present seaward limit of Loch Ryan, as defined by The Merchant Shipping (Categorisation of Waters) Regulations 1992, namely a line from Finnart's Point to Milleur Point, appears suitable.

Any consideration and significant developments of this policy should also offer organisations representing local small boat users, and other stakeholders, ample opportunity to contribute to the eventual aims and objectives.

Although the formation of a statutory harbour authority will take some time, it is recommended that such a course of action is vigorously pursued to a conclusion. In the meantime, there should be no barrier to any application for a Harbour Order which might be required to cover the proposed expanded operation at Cairnryan.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES

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

3.1.1 Ferries running at super-critical speed can be expected to generate a wash that results in waves of about 600mm height striking the beach at Lady Bay. Such waves can be a hazard to users of the shoreline and small boats, particularly while launching.

So that anyone intending to use Loch Ryan or its shoreline can be certain that they have considered all of the possible hazards, they need to be aware of the possibility of unexpectedly large waves being generated, their timing and the possible level of risk. This level of understanding cannot be achieved from the contents of the present warning signs.

3.1.2 To date, there have been no unacceptable consequences from any incident in Loch Ryan that can be attributed solely to the effects of waves generated by ferry wash. There are, however, substantial levels of concern among some users of the loch over the possibility of a serious accident in the future.

The problems that the owner experienced launching his cabin cruiser caused him to be distracted and forget about the movements of the ferries. This demonstrates that, if alertness and awareness are absent, knowledge of the waves alone is insufficient to prevent accidents.

The levels of risk which might be acceptable appear not to have been formally considered by either of the local authorities bordering Loch Ryan. In judging these risks, weight needs to be given, not only to the possible public activities, such as launching boats or walking, but also to the vulnerability of some users, such as small children.

The MAIB is unable to offer a firm conclusion as to whether or not large waves remain a serious and frequent problem to the safety of users of Loch Ryan and its shoreline. However, there is sufficient indication that occasionally this might be the case, and that further amendment to operational procedures might be necessary.

3.1.3 There is no independent body or organisation with overall responsibility for the safety of marine operations on Loch Ryan. This is quite unusual for such a substantial area of water, used for significant commercial maritime activity, enclosed on three sides and forming a natural harbour. The absence of such a body or organisation, permanently located in the Loch Ryan area, is seen as a significant barrier to the proper and reasonable measurement, assessment and rectification of any wash/wave problem in the loch. It is also a possible barrier to the introduction of modern safety management techniques covering all activities on and around the loch.

SECTION 4 - RECOMMENDATIONS

Dumfries and Galloway Council is recommended to:

2004/153 Replace the existing signs warning of waves generated by fast ferries, with signs which fully reflect the nature, level and timing of the potential hazard.

2004/154 Liaise, as a matter of urgency, with other relevant and interested local authorities, to perform a risk assessment of the hazards to users of the shoreline of Loch Ryan, with particular regard to the possible consequences of ship-generated waves breaking on the shoreline. Should the results of this assessment indicate an unacceptable level of risk, the Council should initiate steps to reduce the risk. All results, and any actions taken, should be made known to all likely regular users of the loch and its shoreline.

2004/155 Take the lead role in establishing a statutory harbour authority responsible for all of Loch Ryan to a northern boundary defined by a line between Finnart's Point and Milleur Point. When taking this forward, the Council should take account of existing harbour responsibilities and usage, and reflect the interests of all stakeholders, including other local authorities, existing ferry operators, fishermen, small boat users and all other persons following marine or leisure-related activities on, in and around Loch Ryan.

Marine Accident Investigation Branch
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