Report on the investigation of the
man overboard fatality from
the angling boat

PURDY

at Shipwash Bank, off Harwich
on 17 July 1999

FILE:MAIB 1/10/194

Marine Accident Investigation Branch
Carlton House
Carlton Place
Southampton
SO15 2DZ

Tel: 023 80 395502

Report No 17/2000

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 causes 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.

CONTENTS

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

BST	-	British Summer Time
°C	-	degrees Celsius
GPS	-	Global Positioning System
GRP	-	Glass Reinforced Plastic
HSC	-	High-Speed Craft
HSS	-	High-speed Sea Service
IMO	-	International Maritime Organization
kW	-	kilowatt - unit of power
m		metre
MAIB	-	Marine Accident Investigation Branch
MCA	-	Maritime and Coastguard Agency
MSA	-	Marine Safety Agency
PTOHSC	-	Permit to Operate High-Speed Craft
RNLI	-	Royal National Lifeboat Institution
Ro-Ro	-	Roll-on, roll-off (ferry)
SWATH	-	Small Waterplane Area Twin Hull
UK	-	United Kingdom
VHF	-	Very High Frequency (radio)
VTS	-	Vessel Traffic Services

Reproduced from Admiralty Chart 4014 by permission of the Controller of HMSO and the UK Hydrographic Office

SYNOPSIS
(all times are BST)

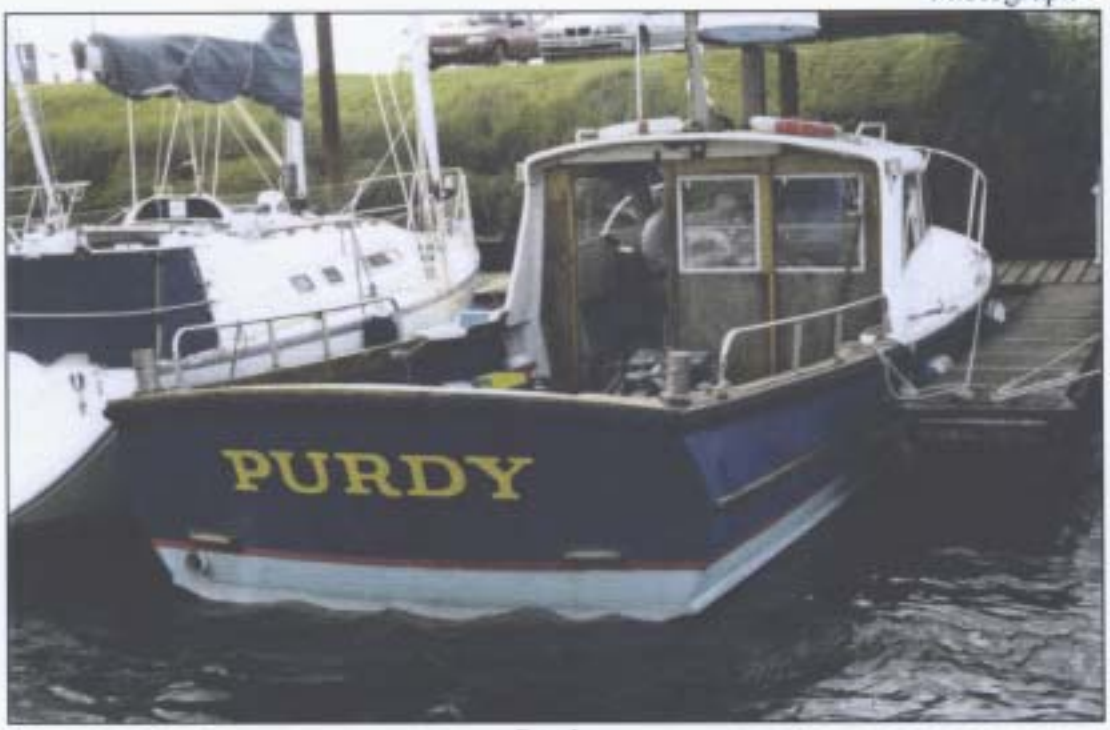
Harwich Haven Authority notified the Marine Accident Investigation Branch (MAIB) at 1125 on 17 July 1999, that a rod-fishing boat had reported having been swamped by a very large wave, with one person lost overboard, off Harwich earlier that day. After gaining further information an investigation began on 19 July, conducted by MAIB inspector, Captain Nick Beer.

Purdy, a 10m long, Aquabelle angling boat with the skipper and one guest on board, was preparing to anchor and begin fishing on a shallow sandbank off the East Anglian coast when *Stena Discovery* passed inbound for the port of Harwich. *Purdy*'s skipper turned his boat towards the wash from the high-speed ferry. The weather was fine with good visibility and a slight sea. As the first wash waves approached *Purdy* they appeared to grow in height to 4m and begin to break. The first wave crashed over *Purdy*'s bow swamping the vessel and washing the guest, who had been sitting on the engine casing aft, overboard.

The skipper threw a lifebuoy towards the man in the water and tried to manoeuvre the boat towards him. The man disappeared from view. Despite extensive searches carried out by the skipper and the rescue services, his body was not recovered until 12 days after the accident. He had been wearing heavy leather boots and no lifejacket.

An interim recommendation was addressed to both the Maritime and Coastguard Agency (MCA) and Stena Line BV to carry out route assessment trials with respect to wash generation. Further recommendations are addressed to the MCA to ensure that all operators of high-speed craft undertake route assessment trials with respect to wash generation as a requirement for the issuance of a Permit to Operate. Guidance criteria should be developed on maximum permitted generated wave heights for measuring the efficacy of the route assessment results.

Photograph 1



Purdy

Photograph 2

HSS Stena Discovery

VESSEL AND ACCIDENT INFORMATION

Vessel 1

Name	:	*Purdy* **(Photograph 1)**
Type	:	Aquabelle, angling boat
Port of Registry	:	Not registered
Length	:	10m
Propulsion	:	Inboard diesel engine
Owner	:	W G Hayman, 229 Felixstowe Road, Ipswich IP3 9BN
Crew	:	Skipper and one crewman on board

Vessel 2

Name	:	*HSS Stena Discovery* **(Photograph 2)**
Type	:	High-Speed SWATH Ro-Ro Ferry
Port of Registry	:	Hoek van Holland
Year of Build	:	1997
Place of Build	:	Rauma, Finland
Length	:	121.75m
Gross Tonnage	:	19,638
Deadweight	:	1,500 tonnes
Capacity	:	1500 passengers and 375 cars
Propulsion	:	4 Gas Turbines driving four Waterjet Units
Propulsion Power	:	70,000kW
Speed	:	40 knots
Crew	:	45 (maximum)
Operator	:	Stena Line BV

Accident

Date of Accident	:	17 July 1999
Time of Accident	:	0936 (BST)
Place	:	Shipwash Bank off Harwich, 51° 54.53'N 001° 34.88'E
Type	:	Large wave caused swamping and man overboard
Wind	:	Southerly force 3
Sea Conditions	:	Slight sea and swell
Injuries	:	One fatality
Damage	:	Slight damage to angling boat
Pollution	:	None

SECTION 1 - FACTUAL INFORMATION (all times are BST)

1.1 Background to the Accident

In 1996, a revolutionary new design of high-speed ferry (HSS 1500), capable of carrying 1500 passengers and 375 cars at service speeds of over 40 knots, was introduced on the Holyhead to Dun Laoghaire route by Stena Line Ltd. *HSS Stena Explorer* was quickly followed by *HSS Stena Voyager* on the Belfast/Stranraer route. A year later, on 2 June 1997, Stena Line BV, using experience being gained by Stena Line Ltd in the Irish Sea, introduced *HSS Stena Discovery* on the route between Harwich and Hoek van Holland.

The large wash waves that can be produced by high-speed craft (HSC) were a subject of concern before the advent of the HSS 1500. As experience has been gained in the operation of HSC in general, and HSS 1500 in particular, international research programmes to study the wash/wake problem have been commissioned. The subject is highly complex and not yet fully understood. Before *Stena Discovery* commenced service, partly to minimise the effect of wash, Stena Line BV and Harwich Haven Authority agreed operational guidelines, including route and speed profiles for the approaches to Harwich. Even so, potentially dangerous wash incidents were experienced on the beaches to the north of Felixstowe and a number of other adverse effects were noted, including draw-off when the HSS 1500 passed close to deep-draughted vessels. As a result of these incidents, during the two years of the vessel's operation, Stena Line BV commissioned specific research programmes, and the operational guidelines were the subject of frequent development. Warning notices were placed on the main affected beaches **(Photograph 3)**.

The operational guidelines in force at the time of the accident, restricted *Stena Discovery* to making her approach to the haven by passing to the south of Shipwash Bank and then using the main deep water channel. Time spent at speeds in the critical range of between about 16 and 34 knots, depending on the water depth, had to be minimised. To do this, with the agreement of the authorities, she generally maintained high speed until a specific point close to the entrance to the haven, where she very rapidly reduced speed through the critical range. On 17 July 1999, *Stena Discovery* approached Harwich in accordance with the latest guidance.

Purdy's owner regularly took friends and acquaintances on fishing expeditions off the entrance to Harwich Haven. On 17 July, he and one acquaintance, Mr Sibley, were out for a day's fishing expedition. They had left Levington Marina at about 0730, and having had no success at their first choice of fishing ground off Rough Tower, at about 0900 they had moved to the vicinity of another regular fishing position off the southern end of the Shipwash Bank. It was close to low water and the shape of the shallower parts of the bank could be seen in the slight sea conditions **(Figure 1 - Chart extract)**.

1.2 Narrative of Events

At 0930 *Purdy* arrived in the vicinity of the southern end of Shipwash Bank and was choosing a location in which to anchor and begin angling. A fishing vessel was operating close to *Purdy*'s first choice position, so the skipper decided to move further to the south to give the other vessel clearance. At the same time *Stena Discovery* rounded the South Shipwash buoy and headed north-

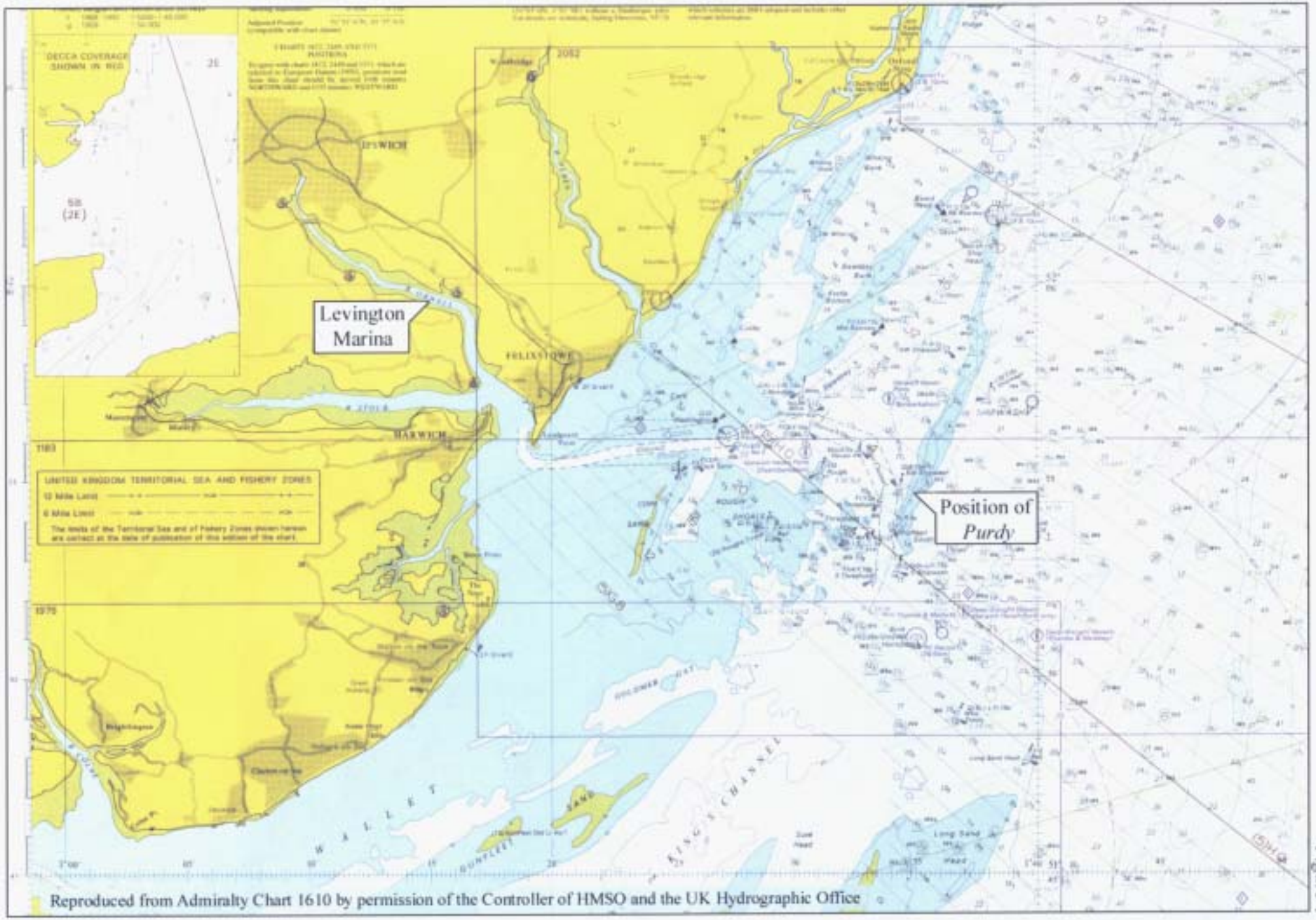

Levington Marina
Position of *Purdy*
IPSWICH
FELIXSTOWE
HARWICH
UNITED KINGDOM TERRITORIAL SEA AND FISHERY ZONES
12 Mile Limit
6 Mile Limit
The limits of the Territorial Sea and of Fishery Zones shown hereon are correct at the date of publication of this edition of the chart.
DECCA COVERAGE SHOWN IN RED
WALLET
KING'S CHANNEL
Long Sand
Reproduced from Admiralty Chart 1610 by permission of the Controller of HMSO and the UK Hydrographic Office

Figure 1

Photograph 3

north-west to leave Rough buoy on her port side. Her master and mate were on duty on the bridge.

At 0933 *Stena Discovery* passed to the west of *Purdy* at a range of just over a mile. *Purdy* at this time was in position 51° 54.53'N 001° 34.88'E. The skipper, knowing from previous experience to expect some troublesome wash from the HSS 1500, was prepared. He saw the wash approaching and turned his boat to head into it. The skipper was in the wheelhouse steering *Purdy*, and Mr Sibley was on the open after deck sitting on the engine casing. The weather was good with a gentle southerly breeze, slight sea and good visibility. Neither man was wearing a lifejacket.

As the wave approached *Purdy* it apparently grew to 4m or more in height and started rolling/breaking. The skipper shouted a warning to Mr Sibley to "hang on". Very soon afterwards the wave crashed down on to *Purdy*'s foredeck and rolled over the after deck, swamping the vessel and washing Mr Sibley over the side. The time was about 0936.

As the wave passed, the skipper felt juddering and then, although he cannot be certain, he believes that *Purdy* was affected by a second wave.

The skipper, who had fallen to the deck, came to and found that there was a considerable amount of water in the wheelhouse and the boat was listing heavily to starboard. He called to Mr Sibley. Receiving no reply, he looked aft but could not see him. He went out on to the deck and called again. Mr Sibley, who was in the water about 30m away, answered. The skipper threw a lifebuoy towards him. The diesel engine was still running; the flywheel was throwing spray up over the after deck. There was no electrical power.

The skipper had two priorities: saving the boat, which he thought was sinking, and attempting to rescue Mr Sibley. He divided his time. He operated the hand pump from the deck for brief periods while at the same time keeping sight of Mr Sibley. By ducking into the wheelhouse, he attempted to steer the vessel towards the man in the water. At some early stage he tried to make a distress call but there was no power to his main VHF radio.

He managed to turn the boat so that he could see Mr Sibley in the water close on his port bow. The skipper's attention was then distracted for a moment. When he next looked, he could not see Mr Sibley. In order to raise the alarm the skipper tried different radio sets in turn and found that one worked off its own batteries. He used that to transmit a distress call which was received by the coastguard station at 0945.

He continued to search for Mr Sibley without success. A rescue helicopter and other vessels, including those from local RNLI lifeboat stations at Harwich and Walton, quickly joined him. *Purdy*, with one of the lifeboat's crew on board, returned to Levington Marina where she arrived at about 1115. The search continued throughout the day without success.

Mr Sibley's body was recovered 12 days later. A postmortem examination was carried out from which the pathologist concluded that the cause of death had been drowning. Mr Sibley was wearing heavy leather boots and no lifejacket.

1.3 Environmental Conditions

At the time of the accident there was a southerly wind of force 3 and a slight sea and swell. The visibility was good. It was cloudy; the air temperature was 18°C; and the sea temperature was 17°C. Low water at Harwich had occurred at about 0900. The tidal stream in the area of the accident was less than half a knot in a generally southerly direction and the tidal height was about 0.8m.

1.4 *Purdy* (Photograph 4)

1.4.1 Description

Purdy is a 10m in length Aquabelle angling boat. Her hull is constructed of glass reinforced plastic (GRP). She has an open after deck with the diesel engine sited centrally and fitted with an engine canopy. Her wheelhouse is forward with steps down into a small cabin. The wheelhouse is separated from the after deck by a wooden partition bulkhead with a sliding door. The engine is controlled from the wheelhouse, where there is a helmsman's chair. There is an electrically driven bilge pump and a Whale hand pump which is controlled from the after deck **(Photograph 5)**. She appeared to be well maintained and equipped. Her wheelhouse equipment includes a Koden CVS 106 Echo Sounder, Navstar A-300D Navigator and a Furuno radar. There is a belt-driven autopilot. Communication facilities include two VHF radios and a mobile phone. At the time of the accident, there were more than ten lifejackets on board, stowed in the cabin. There were two lifebuoys which were stowed on the wheelhouse top. Because the vessel was being used for leisure purposes at the time of the accident, no statutory construction or equipment requirements were applicable.

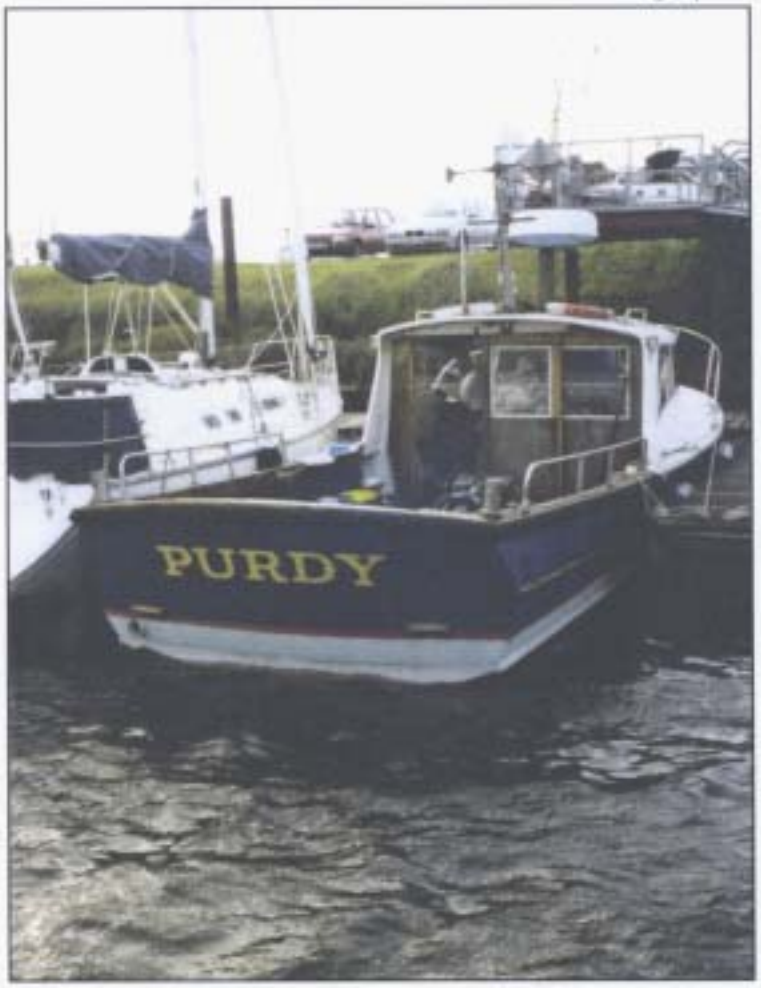
1.4.2 Location at the time of the accident

Purdy's position taken from Harwich Haven VTS radar recording at 0936, the approximate time of the accident, was 51° 54.53'N 001° 34.88'E. On the Admiralty chart of the area, #2052 Orford Ness to the Naze, and cross-checking using the latest survey information obtained from the Hydrographic Office, *Purdy* was well within the area indicated by the 5m depth contour and on the edge of a bank with charted depths of less than 1m **(see Chart extract)**. *Purdy*'s draught was about 1m and the height of tide about 0.8m. It is impossible to be precise, but it is likely there was less than 3m of water beneath *Purdy*'s keel at the time of the accident and possibly as little as 2m or even less.

1.4.3 Crew

The 69 year old skipper had owned and operated angling boats for over 30 years. He had owned *Purdy* for 15 years. He had recently retired from undertaking commercial angling voyages and from membership of the National Federation of Charter Skippers. He held a Boatmaster's Grade 3 Licence which was last reissued on 19 July 1994 but had expired before the accident. The skipper used his boat frequently taking friends and acquaintances on angling trips off the coast of Harwich. He did not need qualifications to undertake the leisure voyage intended on the day of the accident.

Photograph 4



Purdy

Photograph 5

Whale hand pump

Mr John Sibley, aged 47 years, was an enthusiastic amateur fisherman. At the time of the accident he was wearing a waterproof fisherman's boiler suit, underclothes and heavy leather boots. He had travelled on *Purdy* with the skipper on a number of previous occasions.

1.4.4 Navigation on *Purdy*

The skipper navigated *Purdy* using his local knowledge, the echo sounder, radar and the GPS navigator. He generally visited positions where he had fished on previous occasions. His six favourite angling locations were recorded in the memory of his GPS navigator. After failing to find good angling off Rough Tower, the skipper had been intending to try a favourite position near the southern end of Shipwash Bank. The position was held in the GPS's memory, and the instrument told him the required course and distance to go. As he approached his destination he saw a fishing vessel operating close to the bank. He moved further south to be clear of the other vessel's operation. He estimated his position in relation to the bank by eye, as he could see the shape of its shallower parts. At the time of the accident he was still repositioning, and had turned his attention from the requirement to find a suitable angling location, to cope with the temporary problem of the expected wash from *Stena Discovery*. Although his echo sounder was on to provide him with relevant information when selecting his fishing ground, he was not concentrating on it at the time of the accident.

The skipper was unaware of any warnings of dangers associated with shallow off-lying banks and the wash from *Stena Discovery*. He had been aware, from the local press, of the reported problems experienced on the beaches

1.5 Stena Line BV and *Stena Discovery*

Stena Line BV is part of Stena Line AB. It operates four vessels on the Hoek van Holland/Harwich route. *Stena Discovery* is the only HSS operated by Stena Line BV.

Stena Discovery was delivered to Stena Line BV in May 1997 and began service on the Hoek van Holland/Harwich route on 2 June. She replaced two conventional ro-ro passenger ferries. She makes two round trips each day and lays up for a few hours overnight in Hoek van Holland. Each crossing is scheduled to take 3 hours and 40 minutes berth to berth. About 40 minutes turn-around is allowed at each port call.

Stena Line BV and *Stena Discovery* are fully accredited under the International Safety Management Code (ISM Code). The designated person for *Stena Discovery* is one of two managers in the Hoek van Holland offices who have marine experience. *Stena Discovery* sails with a master, chief officer and second officer. The officers and crew work a 1500 to 1500 day-on/day-off routine. They are able to sleep during the lay-up time, in specially provided hotel-type accommodation close to the designated berth in Hoek van Holland. This normally runs from about midnight to 0630 each morning. There is no sleeping accommodation on the vessel. Each work period lasts for 6 days and is followed by a period of leave.

One of the four masters assigned to *Stena Discovery* is designated as senior master and has certain extra responsibilities. Regular meetings are arranged between the senior masters from all three

HSS 1500s, where experiences and ideas are exchanged and discussed. There is frequent contact between the shore-based managers of Stena Line BV and Stena Line Ltd, when information and experience is passed on.

On the day of the accident, *Stena Discovery* approached Harwich in accordance with the latest guidance.

1.6 The HSS 1500 Design (Photograph 6)

The proliferation of commercial high-speed craft which has occurred over the last 10 years has brought with it a growing realisation of the wash problems which these craft can generate. HSC designs have become larger and faster with a consequent increase in the wash problems.

The HSS 1500 was developed as a viable ship design in 1995, and the first vessels were brought into service by Stena Line Ltd on routes in the Irish Sea in 1996. The HSS 1500 design is based on a lightweight catamaran hull form of 121m overall length. A large mixed payload of cars and commercial vehicles can be carried, as well as up to 1500 passengers. Four gas turbines, which are capable of generating propulsion power of 70,000kW, propel the ship through two waterjets in each hull, at maximum speeds in excess of 40 knots. The three HSS 1500s which operate in UK waters were, at the time of the accident, the largest high-speed craft operating anywhere in the world.

The HSS 1500 catamaran hull form resulted from extensive research and development, including numerous model tests and simulations designed to optimise performance with regard to resistance, seakeeping and manoeuvring, while at the same time meeting transportation and economic objectives. The effects of shallow water on wavemaking and, therefore, resistance were known and appreciated to some extent at this time, but the full effects of the generated waves at the shore or on off-lying sandbanks were not anticipated. They began to become clear only after the vessels came into operation.

Very soon after the first HSS 1500 was put into operation, reports that unacceptable levels of wash were causing danger to users of the shoreline, began to be received. Before the end of 1996, trials were instigated which resulted in changes to the routes and operating methods and a consequent reduction in reported incidents.

The publicity which has surrounded the problems arising from the unacceptable levels of wash has served to encourage operators and others to invest in research into the precise causes and remedies. Most recently before the accident the Maritime and Coastguard Agency (MCA) commissioned research based on fast ferry operations in Belfast Lough including those of the HSS 1500 *Stena Explorer*.

With the experience gained in the Irish Sea over three years, on the Harwich/Hoek van Holland route over two years, and from the various research programmes which have been completed to date, operating methods have been gradually developed which reduce the impact of wash on beaches and on other shore facilities to within acceptable limits. The changes necessary to bring this about, have to some extent been introduced as a result of feedback from incidents which have

Photograph 6

HSS 1500 design

occurred on beaches and along shorelines. Reports of incidents and media criticism have generally resulted in a robust and effective response from Stena Line.

1.7 HSS 1500 - Wash creation - Basic theory

Wash creation is a complex subject which has taxed naval architects and hydrodynamicists for many years. This report will deal with the subject only to the extent necessary to explain the possible ways a wave such as that experienced by *Purdy* on 17 July 1999, could have been generated.

An HSS 1500, like any other craft, will make waves and suffer wave resistance whenever it is moving through the water. The wash waves generated by an HSS 1500 at slow speeds of less than say, 12 knots, in water depths of say, greater than 8 or 9m, will have minimal effect on the shoreline or other users. HSS 1500s are designed to operate efficiently in deep water at their service speed of approximately 40 knots. In deep water the wash waves created, although containing large amounts of energy, are of long wavelength and medium amplitude, and therefore are of little danger to other craft. In shallow water, complex factors combine and the wave-making capability can be dramatically increased at certain critical speeds. Speed, water depth and hull design are therefore important factors in wash generation.

For a given water depth there is a critical speed range within which the HSS 1500 will generate waves containing the most energy. At speeds above or below the critical range (supercritical or sub-critical) waves of lesser, although sometimes considerable, magnitude are formed. The arbitrary critical speed range for the depths encountered on the passage into or out of Harwich is between about 16 knots and 34 knots. When arriving or leaving the port, the speed of the HSS 1500 must, necessarily, pass through the critical range. Techniques have been developed on all HSS craft to minimise the effects by passing through the range as quickly as possible. The passage through the critical speed range can be physically observed by those on board, as the vessel trims noticeably more at the stern.

The waves formed by the HSS 1500 are of two basic types: divergent (coming from the bow and stern at an angle to the track and spreading out from the vessel) and transverse (forming astern of the vessel, perpendicular to the track). The wave formation developed by the HSS 1500 varies according to whether it is travelling in the supercritical, critical or sub-critical speed range. At critical and sub-critical speeds both divergent and transverse waves are formed, and at supercritical speeds only divergent waves are formed.

The energy in the waves formed by HSS 1500 will dissipate as the waves travel from the point of generation. Rough sea conditions and shallow water will accelerate this process. However, a typical long wavelength medium amplitude wave generated in deep water may travel many miles. Initially, the waves travel at just less than the speed of the vessel, but thereafter, their speed is affected by water depth and other factors.

While the high-speed, long period waves remain in deep water they are difficult to see. As such a wave progresses into shallower water from its point of generation, it slows, its height and steepness increase, and its wavelength decreases. At a critical moment, as the wave grows steeper, higher

and of shorter length, the top of the wave will begin to break. The energy contained in a wave is dissipated very rapidly and sometimes with dramatic effect when running from deep water over a shallow sandbank. A large breaking wave so formed is an obvious danger to small craft.

1.8 Permit to Operate High-Speed Craft

The international rules under which the HSS 1500 and other high-speed craft (HSC) are designed and operated, are contained in the International Maritime Organization's (IMO's) *International Code of Safety for High Speed Craft* (HSC Code). Under the HSC code, before an HSC enters service, a Permit to Operate High-Speed Craft (PTOHSC) must be obtained from the flag state. In considering whether to issue a PTOHSC, the flag state requires a statement from the port state to confirm that the proposed permit meets the requirements of the code in relation to aspects within its jurisdiction. Among other items, the port state, in consultation with the port or ports to be visited, must consider and confirm agreement with the craft operator's arrangements with respect to minimising the effects of wash from the craft. Under the HSC Code the vessel must be operated in accordance with specific route and craft operating manuals, either of which may contain guidelines and rules on minimising the generation and effects of wash.

1.9 The History of *Stena Discovery*'s Wash/Wake Problems

Stena Discovery was granted a Permit to Operate High-Speed Craft (PTOHSC) by the Head of Netherlands Shipping Inspection before coming into service. The then UK's Marine Safety Agency (MSA) (now MCA) sought a statement from Harwich Haven Authority before issuing this permit, in which it asked for assurances that, among other things, the arrangements proposed by the operator with respect to wake/wash control were acceptable. A letter was sent to the MSA by the harbour master dated 29 May 1997, in which he stated:

> *Discussions have been held with the operators of the Stena Discovery, Stena Line BV, to establish a satisfactory arrival/departure routeing for the vessel, and a speed profile designed to minimise wash effect in the interests of marine safety and the environment. The performance of the vessel and its effects locally will be carefully monitored at sea and on the beaches during its initial operating periods, and any necessary adjustments to route or speed will be made by agreement with the operators.*

Initially *Stena Discovery* approached Harwich from the north using the Shipway after passing to the north of Shipwash Bank. She avoided intermediate speeds in accordance with advice gained from the model tests carried out during the design stage of the craft. In July 1997, soon after the service had started, reports of large waves impacting on the beaches to the north of Felixstowe and further to the north at Aldeburgh began to be received. A yachtsman reported a series of very large breaking waves on the Cork Sandbank; he noted that the waves were potentially life-threatening to crews of small boats. A review of *Stena Discovery*'s approach routeing then took place, and trials and a research programme were initiated. As a result, new operating procedures were introduced on 31 October 1997. Additionally, the harbour master wrote to all the local yacht clubs and fishermen's associations to warn them, among other things, of the danger of crossing shallow sandbanks near the time of the passage of *Stena Discovery*.

The operators of HSS 1500s were aware that off-lying banks could form a useful protective shield to reduce, or stop, the impact of wash waves on the shoreline. Off Harwich, the Shipwash helps protect the beaches at Dovercourt and Felixstowe. Stena Line BV and Harwich Haven Authority are aware of their potential function in this respect. However, nobody foresaw that waves as high as 3 or 4m might impact on the sandbanks. Apart from the report from the yachtsman, mentioned above, which indicated waves of up to 2m in height, there had been very little feedback from fishermen and yachtsmen having experienced large waves on these shallow off-lying banks.

After 31 October 1997, *Stena Discovery* was encouraged to approach Harwich from the south, maintaining supercritical speeds (about 40 knots) until a designated rapid speed reduction area was reached. The southern approach route was preferred, partly because Shipwash Bank provided more protection to the beaches from wash/waves generated at sea. *Stena Discovery* was only permitted to use the northern approach in rough weather conditions. For the outward passage the HSS 1500 was permitted to increase speed as soon as she was clear of Landguard Point, and to use the Shipway as long as supercritical speed was maintained throughout. These measures appeared to be largely successful in eradicating the problem at Aldeburgh and minimising it on the Felixstowe town beaches, but large waves continued to occur on the beaches, to the north of Cobbold's Point up to the area of the River Deben/Bawdsey. Monitoring of the situation continued.

The operating rules were further adjusted on 19 November 1997, 27 April 1998, 11 May 1998 and 27 May 1998 as a result of isolated incidents which had been reported. Further, in July 1998, a large number of warning notices were placed on the Felixstowe beaches and those further north.

On 8 August 1998, a very large wave was experienced on a crowded bathing beach to the north of Felixstowe. This was the first reported occasion that a dangerous wave had been created by *Stena Discovery* while outbound. Investigations showed that the master had increased speed too soon, and the vessel had remained in the critical speed range too long. A further change to the operating rules was introduced, and a further set of research trials was undertaken. The report of that test programme was released on 25 March 1999, and additional minor adjustments to the operating rules were made.

1.10 The Operating Rules in Force at the Time of the Accident

A table which indicates the vessel's critical speed range for different water depths is displayed near the conning position on every HSS 1500. All HSS 1500 masters have undergone shore-based training to understand the factors which generate large wash waves, and how to minimise their creation and effects. It is essential to make the necessary transfer from supercritical to sub-critical speeds and vice versa as quickly as possible and in an area where waves generated will have least effect.

Harwich Haven Authority's operating rules for the HSS 1500's inward passage, which were in force at the time of the accident, were as follows:

(a) *Preferred route to be from the south via the Sunk Light vessel. The northern route via Shipway is to be avoided except in severe northerly wind conditions. (See (f) below.)*

(b) *Supercritical speed to be maintained:*

(i) *to the Platters buoy when the expected height of tide is less than 2.0m;*

(ii) *to the Cross buoy when expected predicted height of tide is more than 2.0.*

(c) *At the speed reduction position, speed is to be reduced rapidly to sub-critical speed and maintained. In both cases, harbour speed of 8 knots applies from Beach End. A reasonable tolerance will be permitted in difficult weather condition.*

(d) *If speed reduction becomes necessary early due to traffic or mechanical problems, speed must be reduced to sub-critical and maintained there until Beach End.*

(e) *Large alterations of course and close passing are to be avoided during speed reduction.*

(f) *If northern approach is selected, Stena Discovery is to inform Harwich VTS on departure Hock van Holland. Harwich VTS to inform Thames Coastguard and the Town Clerk, Aldeburgh, passing estimated time of arrival (ETA) at North Shipwash buoy. Irrespective of tidal height, the HSS is to reduce to sub-critical speed 1 mile north of North Shipwash buoy, and maintain it until Beach End.*

These operating rules were largely reflected in those contained in *Stena Discovery*'s Route Operating Manual, although the slow-down positions varied slightly. The Route Operating Manual indicates a slow-down position between 5/6 channel buoys and the Rolling Ground buoy when the tide is 2m or less in height, and before 1/2 channel buoys when the tidal height is greater than 2m. These apparent discrepancies were not influential in the circumstances leading up to this accident.

1.11 *Stena Discovery*'s Track and Speed (Figure 2 - Chart extract)

The track and speed information indicated on the chart extract was taken from *Stena Discovery*'s electronic chart display by the master after the incident. The chart display system does not permanently record historical track information. The most recent four tracks are retained in the memory, with heading and speed information at 30 second intervals. No means are provided to print-off, or otherwise permanently store, a record of all the track information. On this occasion, before it was overwritten by another track record, the position, course and speed information was read-off and noted by the master.

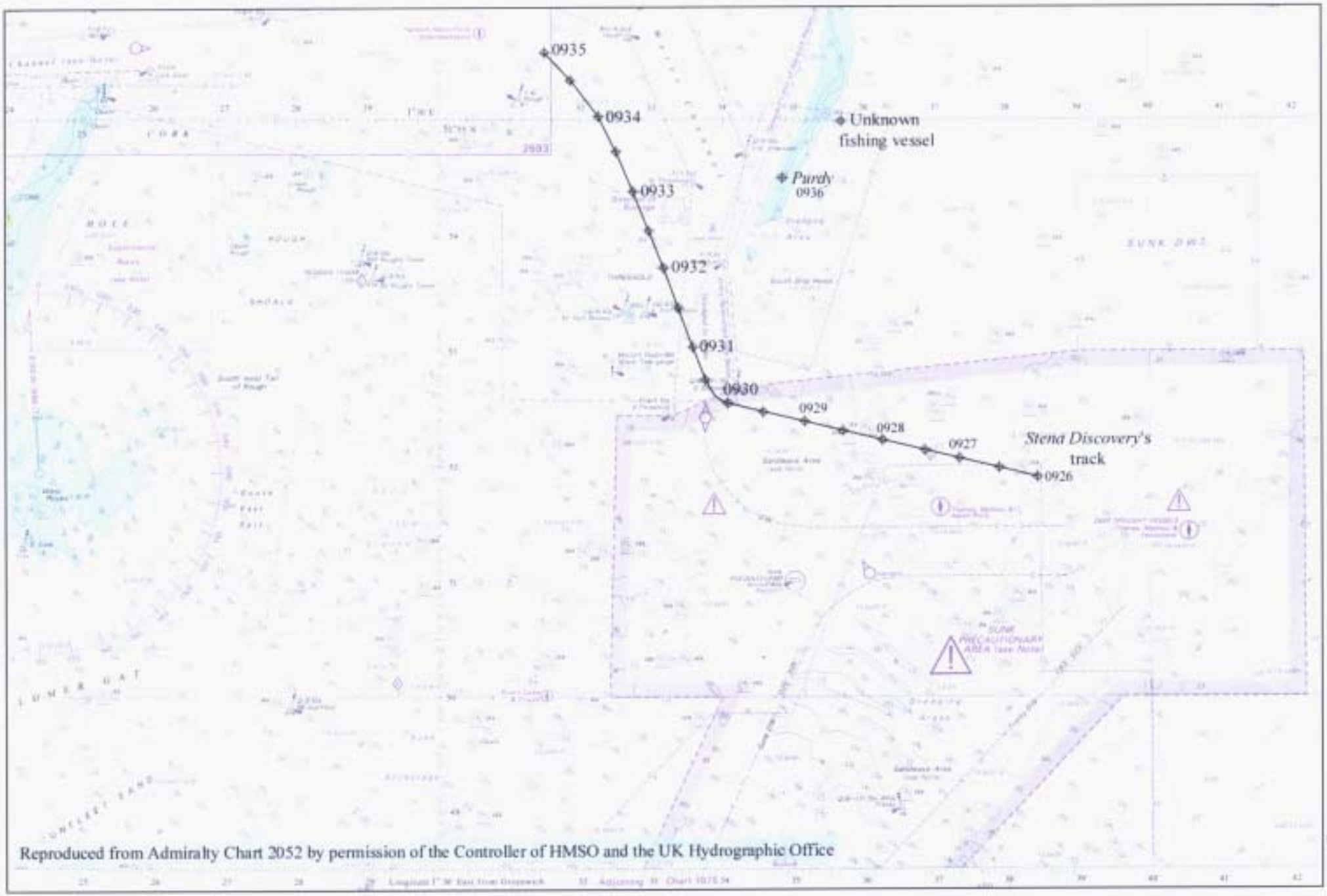

0935
0934
0933
0932
0931
0930
0929
0928
0927
0926
Unknown fishing vessel
Purdy
0936
Stena Discovery's track
Reproduced from Admiralty Chart 2052 by permission of the Controller of HMSO and the UK Hydrographic Office

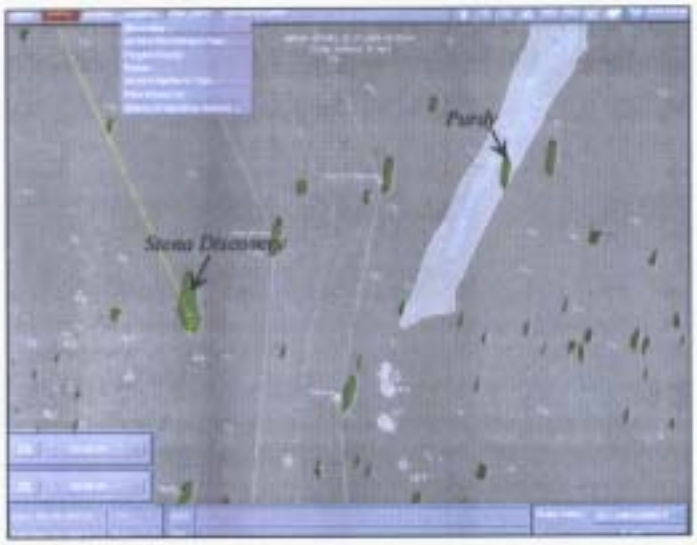
Figure 2

Position, course and speed information retrieved from the *Stena Discovery*'s electronic chart system:

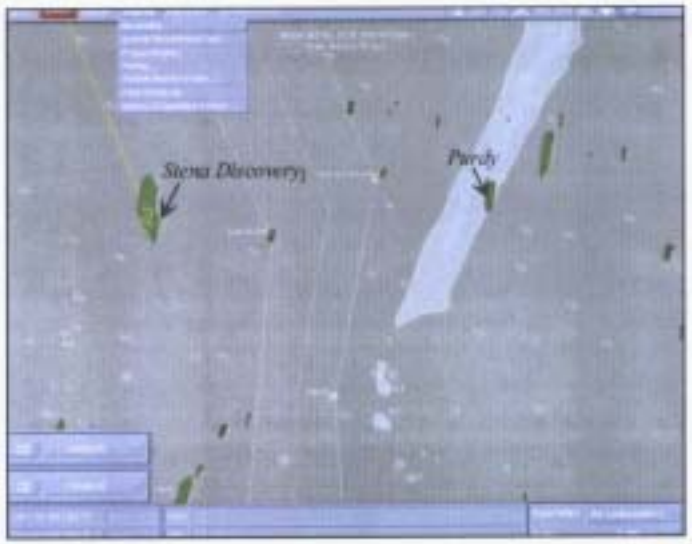
Time	Lat. N	Long. E	SPEED	COURSE
09-26-00	51.51,891	01.38,457	42,2	284
09-26-30	51.51,980	01-37,907	42,3	284
09-27-00	51.52,070	01.37,353	42,7	285
09-27-30	51.52,162	01.36,797	42,7	285
09-28-00	51.52,247	01.36,246	42,1	281
09-28-30	51.52,317	01.35,685	42,4	282
09-29-00	51.52,399	01.35,128	42,7	283
09-29-30	51.52,481	01.34,568	42,8	283
09-30-00	51.52,578	01.34,025	39,6	296 PASSING S. SHIPWASH
09-30-30	51.52,784	01.33,715	33,1	336
09-31-00	51.53,076	01.33,581	38,9	344
09-31-30	51.53,396	01.33,401	41,8	337
09-32-00	51-53,723	01.33,185	42,9	337
09-32-30	51.54,057	01.32,965	43,4	337
09-33-00	51.54,392	01.32,745	43,6	337
09-33-30	51.54,730	01.32,527	43,7	337
09-34-00	51.55,044	01.32,257	41,7	324
09-34-30	51.55,320	01.31,899	43,0	321
09-35-00	51.55,571	01.31,498	41,7	307

The event was also recorded by the VTS radar. The radar recording confirms the accuracy of the information supplied by Stena Line BV and also indicates the precise position of *Purdy* which is shown on the chart extract.

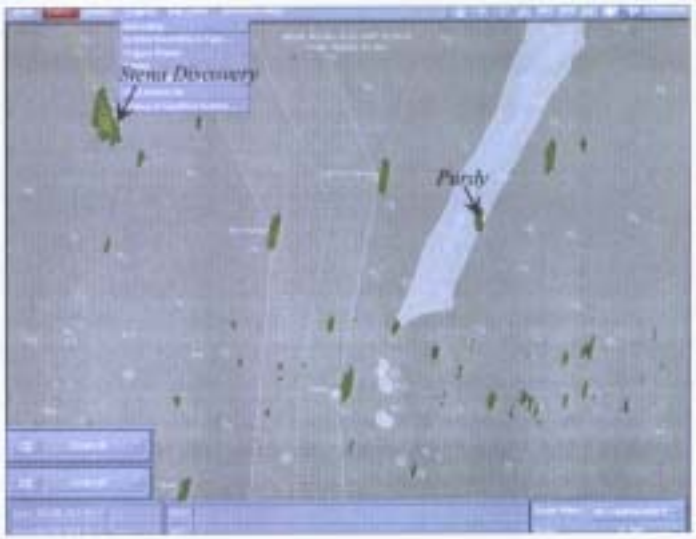
Series of radar snapshots



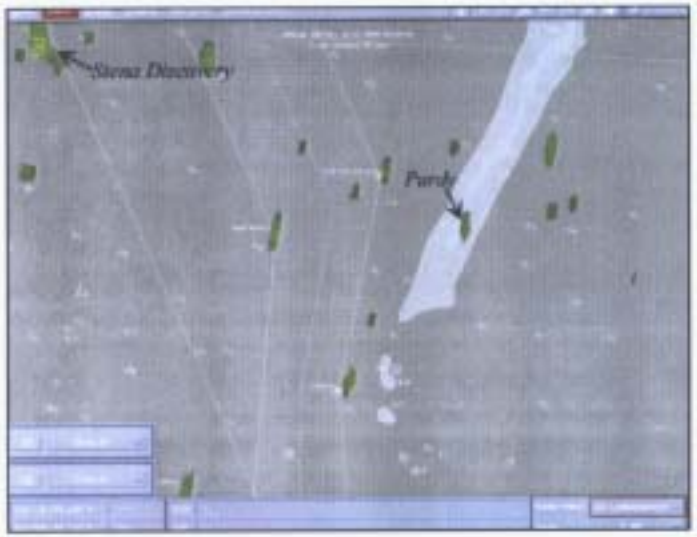
09:32:44



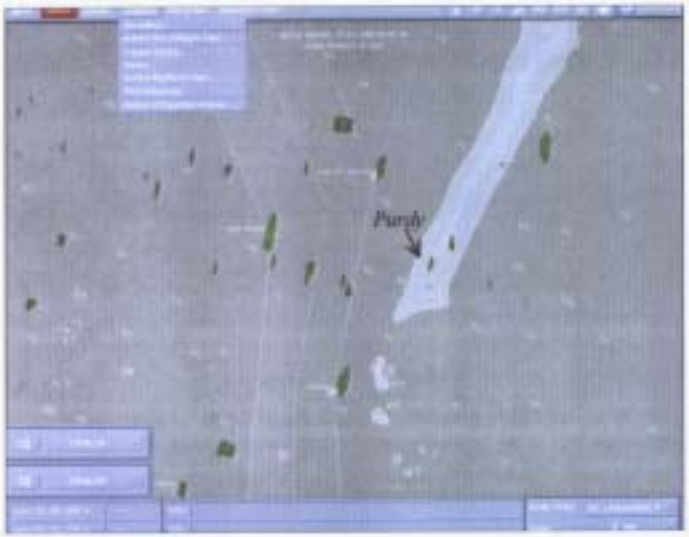
09:33:26



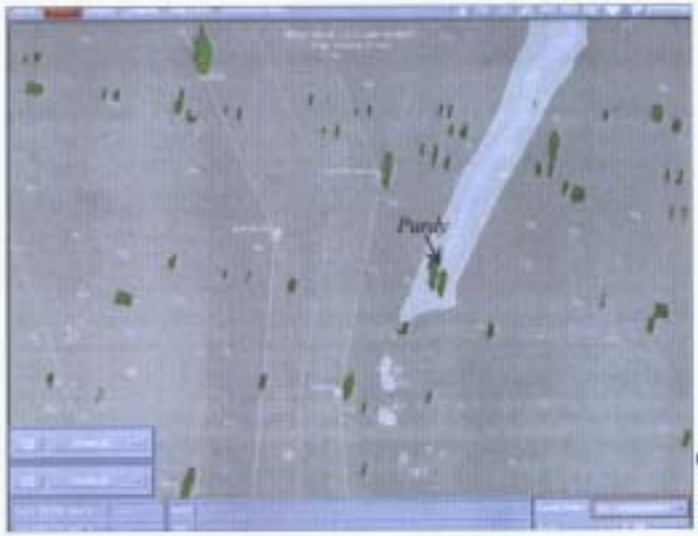
09:34:03



09:34:40



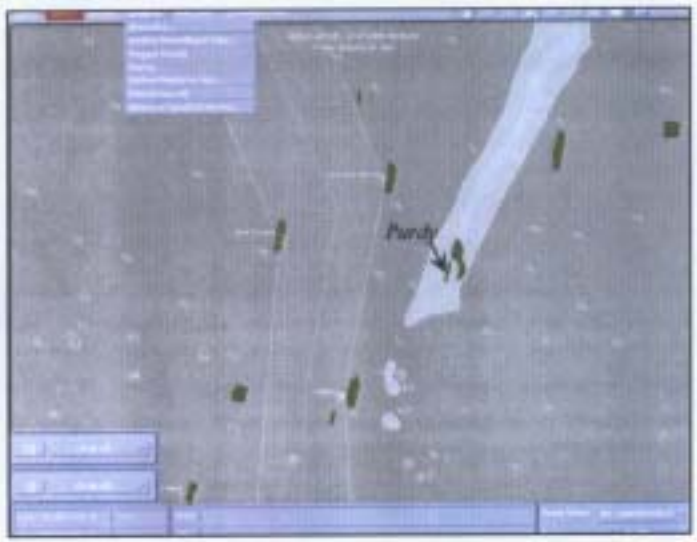
09:35:16



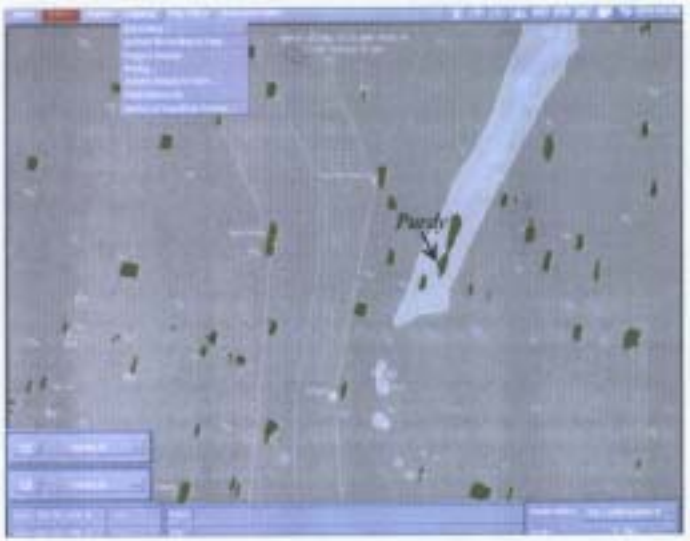
09:35:53

Figure 3

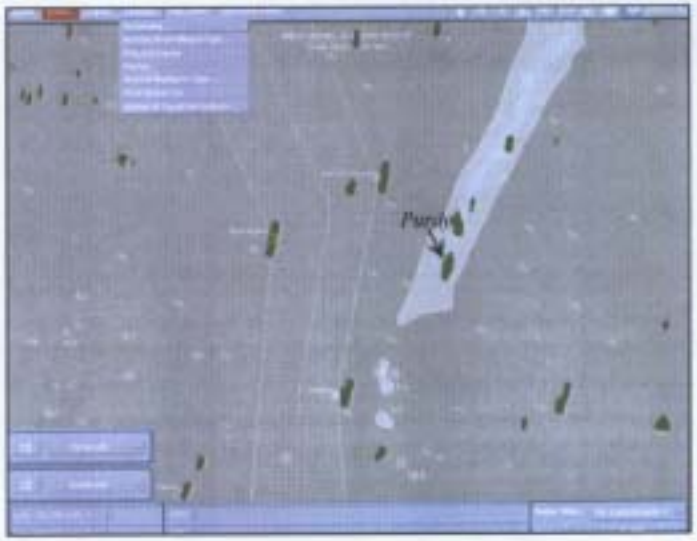
Series of radar snapshots (cont..)



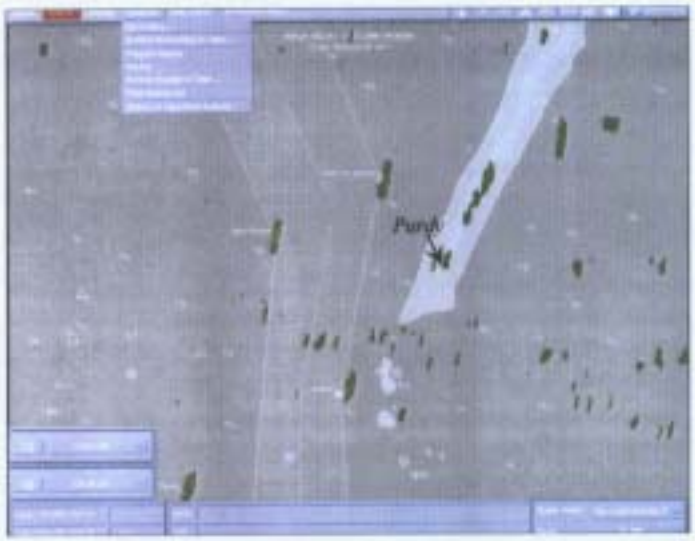
09:36:24



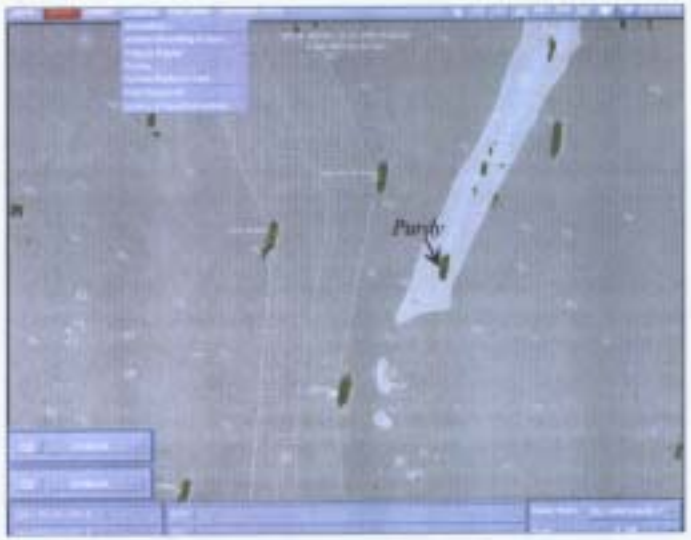
09:37:00



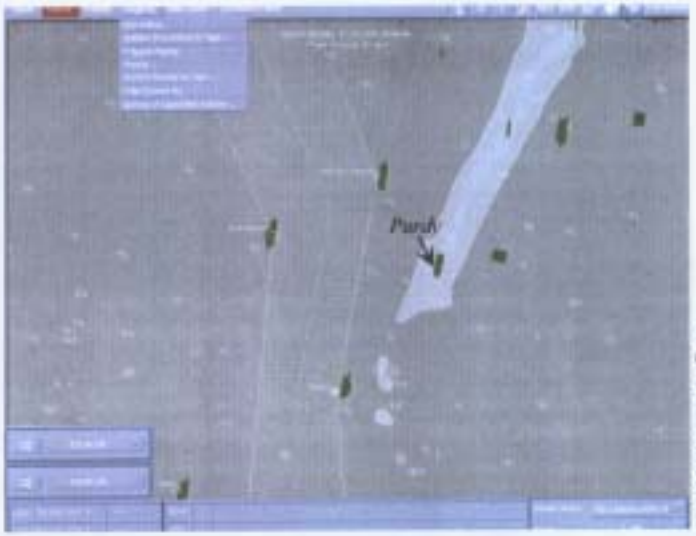
09:37:37



09:38:56



09:39:33



09:40:46

Figure 3 (cont..)

It can be seen from the table and from the chart extract that *Stena Discovery* slowed considerably during her 54° course alteration made to the south of South Shipwash buoy, just after 0930. The lowest speed recorded is 33.1 knots at 093030 in a position where the water depth was approximately 17.5m. Because the speed information was recorded at discrete 30 second intervals the actual lowest speed reached during the turn was probably less than 33 knots.

1.12 VTS Radar Coverage

The accident occurred just outside the seaward limit of the area under the control of Harwich Haven Authority. Nevertheless, it was within the coverage area of its VTS radar. *Stena Discovery*'s echo had been acquired and was being tracked by the radar at the time. The following series of snapshot radar pictures cover the periods immediately before and after *Purdy* encountered the wave. *Stena Discovery* can be seen making a course of about 337° towards Rough buoy, and *Purdy* can be seen stationary to the south of the bank. The inspector believes that the echo seen approaching *Purdy* from the south and subsequently moving north, is that from the wave that swamped *Purdy*.

Figure 3 - Series of radar snapshots

1.13 Harwich Haven Authority's Attempts to Warn of the Dangers

Before *Stena Discovery* began service, Harwich Haven Authority did not fully realise the HSS 1500's potential to create dangerous wash waves. The safety concern with respect to wash at the inception of the service was, primarily, the need to reduce speed in the harbour to avoid the danger of large vessels surging on their moorings. There was also serious concern about the impact of the wash on the bathing beaches at Felixstowe and Dovercourt. The possibility of wash effects on shallow offshore banks, particularly Cork Sand, was appreciated, but at that time an effect greater than the surge created by the average large ferry or container ship was not anticipated. Prior warnings about the HSS 1500 were placed in the 1996 and 1997 *Yachting Guide to Harwich Haven and its Rivers*, but at that time, the concern was directed at yachts crossing ahead or too close to the HSS 1500 with respect to her high speed.

A number of reports indicating that there was a risk to small boat users were received after the HSS 1500 started service. These referred mainly to waves which occurred on both sides of Cork Sand and increased wave action at the Deben Bar. Before this accident, no report had been made to Harwich Haven Authority about wave action from the HSS 1500 at Shipwash Bank. However, as it became clear that effects could occur on the off-lying banks, the harbour master began to warn yachtsmen verbally at various functions, including one at the Levington Marina where *Purdy* was based. The 1998 *Yachting Guide* carried specific warnings about the Cork Sand and the Deben Bar Knolls. The harbour master also sent a letter to all the local yacht clubs and fishermen's associations, warning of slightly larger waves and deeper troughs over shallow banks when the HSS 1500 was passing in the vicinity. The 1999 edition of the *Yachting Guide* further increased the level of warning. Boat owners were warned of the danger of temporarily lowered sea levels and breaking wash in the vicinity of Cork Sand and Deben Bar Knolls. A total of 20,000 copies of

the *Yachting Guide* were printed each year and distributed free to local clubs and marinas, as well as marinas in Germany and Holland. The marina where *Purdy* was moored received 900 copies.

Harwich Haven Authority has collated reports of wash/wake effects on beaches and off-lying banks, and has kept the HSS 1500's operating rules under constant revision. The adjustments made to the inbound routes in light of experience, appear to have successfully reduced the problem on the beaches and at the shoreline to within acceptable limits. To avoid dangerous situations on off-lying banks, the authority has attempted to inform local boat users of the known dangers.

In addition, the Admiralty chart of the area draws the mariner's attention to Admiralty Notices to Mariners No 23 on High-Speed Craft which includes the following warning:

> *Reports have also been received that some HSC could generate a significant shallow water wave effect as they accelerate or decelerate in the approaches to ports; this can have a serious impact on the shoreline, small craft and their moorings.*

The list of HSC in the notice at the time of the incident included *Stena Discovery*, and a warning given on the charts of the area, is indicative that the problem exists in that area.

Despite these attempts to inform users of the harbour, *Purdy*'s skipper was unaware of any of these warnings. He knew only of the problems being experienced on the bathing beaches.

SECTION 2 - ANALYSIS

2.1 Consideration of the Possible Sources of the Wave

The wave that struck and swamped *Purdy* could, conceivably, have been generated by another vessel in the vicinity. However, after scrutiny of the VTS radar recording, the inspector has ruled out this possibility. The only other large vessel in the vicinity in the period leading up to the accident was a dredger operating at very slow speed to the north-west of *Purdy*. The wave that struck *Purdy* appears to have come from approximately south-west; the direction through which *Stena Discovery* had recently passed.

Purdy's skipper was the only witness to the event. He had turned his boat to head into what he assumed was the normal wash/wake from the HSS 1500. This was a correct and seamanlike action to take in the circumstances. He then saw the wave grow to very large proportions as it approached *Purdy* before it crashed down on to the foredeck and swamped the boat.

HSS 1500's are known to have the capability, under particular circumstances, to produce waves of sufficient magnitude to cause the effects described. The skipper's report is consistent with a powerful fast-moving wave of low amplitude which grew higher and began to break as it entered the rapidly shelving water on the southern edge of Shipwash Bank.

The inspector believes, therefore, that the wave was generated by *Stena Discovery* during or after the alteration of course which was made to the south of South Shipwash buoy.

The VTS radar recording shows the relative positions and movements of *Stena Discovery* and *Purdy* in the period leading up to the time of the accident. *Stena Discovery* passed about 1.3 miles from *Purdy* about three to four minutes before the wave struck. A wash wave generated by *Stena Discovery* at about this time would have taken about three to four minutes to reach *Purdy*'s position at an average speed of between 20 and 26 knots. Although it is impossible to be precise either on the position at which the wave was generated, or on the speed of the wave, these figures are approximately consistent with those to be expected, based on research.

2.2 Hypotheses on the Generation of the Wave

The purpose of this analysis is to show in practical terms how the wave that swamped *Purdy* could possibly have been generated. The following three hypotheses on the generation of the wave do not constitute an exhaustive investigation of all the possibilities. The subject is complex, and a wave formed by a combination of other forces acting on the HSS 1500 may have been responsible.

1. A diverging wave produced at supercritical speed

Before and after the alteration of course, made to the south of the South Shipwash buoy, *Stena Discovery* was making speeds close to 40 knots. These speeds were well above the critical range for the depth of water. At supercritical speeds diverging waves with an initial height, trough to

crest of perhaps, 1.5m at one ship length (121.75m) and 1.0m at two ship lengths[1] from *Stena Discovery*, could have been generated. As an approximation, given the bottom topography, such waves might have contained sufficient energy to grow to, say, 3m before breaking over the shallow Shipwash Bank. It is not considered conceivable that they could have grown to 4m in accordance with the eyewitness evidence. However a 3m high breaking wave could have caused the effect and damage that occurred, and the skipper could have been mistaken in his judgment of the wave height.

2. The superposition of two diverging waves

Stena Discovery was travelling at supercritical speeds before and after the alteration of course south of South Shipwash buoy. The alteration of course was 54°. Evidence from trials carried out on the HSS 1500 routes in the Irish Sea [2] have shown that diverging waves, created before a sharp turn, can combine with those created after, to form larger waves by superposition **(Figure 4)**. Additionally refraction effects caused by the bathymetry and shallow water might have focussed the wave energy in the area of the Shipwash Bank **(Figure 5)**. If superposition and/or focussing of the diverging waves created before and after the turn occurred, breaking waves of the height described by the skipper could have resulted.

3. A wave produced at critical speed

The data retrieved from *Stena Discovery*'s electronic chart display indicates a dramatic reduction of speed during the turn made to the south of South Shipwash buoy. The data was taken at discrete 30 second intervals. The slowest speed recorded, 33 knots in 17.5m water depth, is within the critical speed range. However this is not necessarily the slowest speed reached in the manoeuvre. The VTS radar recording indicates that *Stena Discovery* overshot the turn on this occasion before regaining her required new heading. It is possible that the vessel dropped speed momentarily to well within the critical range and that the drop in speed set up a critical speed wave pattern including a large wave which began to travel towards the Shipwash Bank. Such a wave could have grown to a height in excess of 4m when encountering the shallow water of the bank.

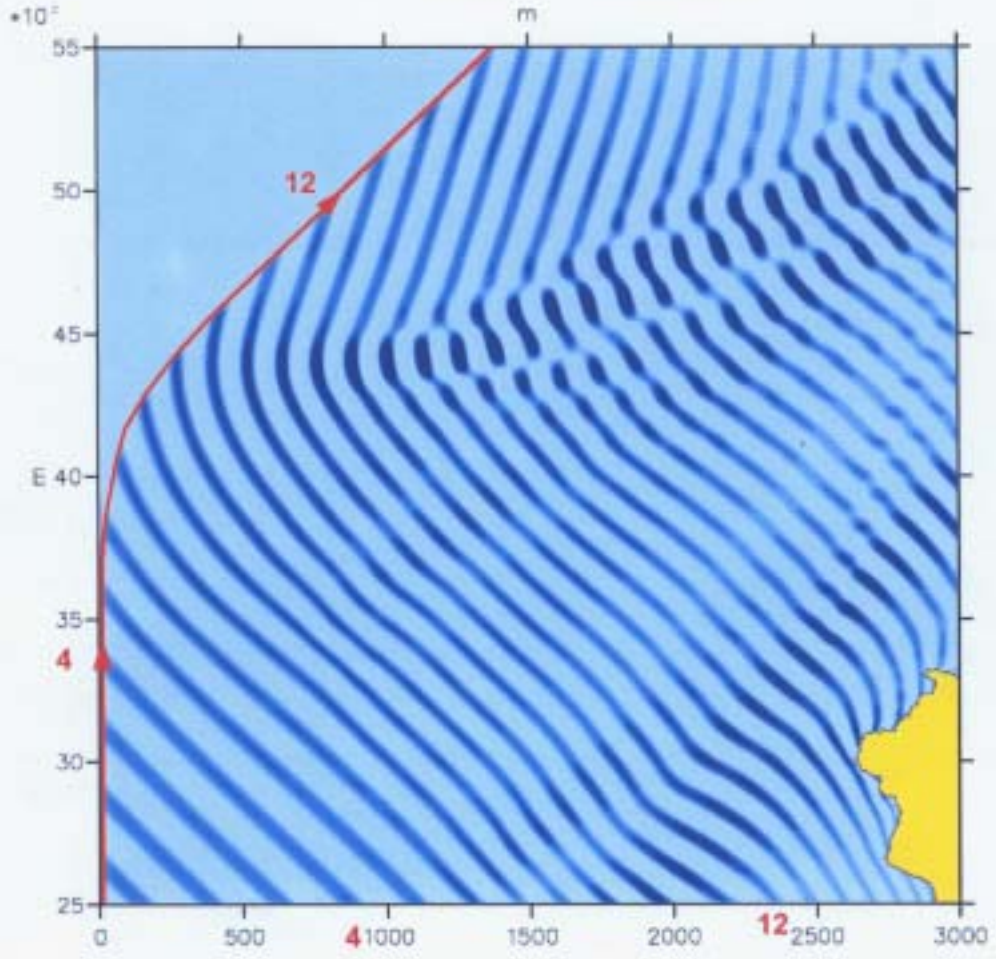
During route assessment trials undertaken by Stena Line BV after this accident, on 27 August 1999, an estimated 3.5m to 4m wave was observed to break on the southern end of Shipwash Bank close to *Purdy*'s position on 17 July. On this occasion, *Stena Discovery* had just passed inward to Harwich. Although the detailed track and speed data has not been made available by Stena Line BV, the weather and tidal conditions were similar to those of 17 July. It can be expected that this event will be thoroughly studied and the results of that study released with the general results of the route assessment trials.

---

[1] Based on Kofoed-Hansen,H, T Jensen, J Kirkegaard and J Fuchs 1999 "Prediction of wake wash from high-speed craft in coastal waters". In Procedures of the International Conference of Hydrodynamics of High-Speed Craft, November 1999, RINA, London

[2] Kirk McClure Morton for the Maritime and Coastguard Agency. Research Project 420 - Investigation of High-Speed Craft on Routes near to Land or enclosed Estuaries. 1998

Figure 4



Showing superposition of diverging waves on the inside of an alteration of course
(Note: This does **not** show *Stena Discovery*'s track)

2.3 Role of *Purdy* in the Accident

Purdy's skipper was experienced in both the boat and the area of operation. The voyages he undertook, including the one in question, were leisure activities and there are, therefore, no applicable rules or regulations. In particular, although he carried a chart of the area, there was no requirement for him to carry the annual notices to mariners in which the warning concerning HSC operations is contained. In fact there was no requirement on him to have read and understood any of the warnings which had been promulgated concerning the wash generated by the HSS 1500. However, although no statutory rules applied to the voyage, the practice of good seamanship dictated that he should have been more proactive in obtaining these and any other warnings relevant to his operation in the Harwich Haven area. In the event, the only knowledge the skipper had of the HSS 1500's wash problems had been gained through his own prior experience and from press reports of waves on the bathing beaches.

Although he had experienced significant wash waves at sea from the HSS 1500, and he knew from the press reports that these waves could become dangerously large when reaching the beaches, he did not recognise the danger of his particular situation on 17 July. He knew he was close to very shallow water, although he was not aware of the precise depth under his keel at the time of the accident.

The skipper was not contravening any rule or regulation by being where he was at the time of the accident. However, common sense seamanship should have given him warning of the potential danger in which he had placed *Purdy*.

Lifejackets were carried on board *Purdy*. However, neither the skipper nor the crewman wore them on the day of the accident. The weather and sea conditions had been good, which probably encouraged them to think that wearing them was unnecessary. The events proved otherwise. Whatever the conditions, it is always possible that someone will fall over the side from the open deck of a small boat, especially where bulwark and railing heights are low. Anyone who falls into the sea has dire need of a lifejacket; to overcome the weight of clothing and footwear; to conserve body heat; to conserve strength to assist in their recovery to the boat. A lifejacket cannot be put on after the event. Had a lifejacket been worn by Mr Sibley, it would have increased his chances of survival.

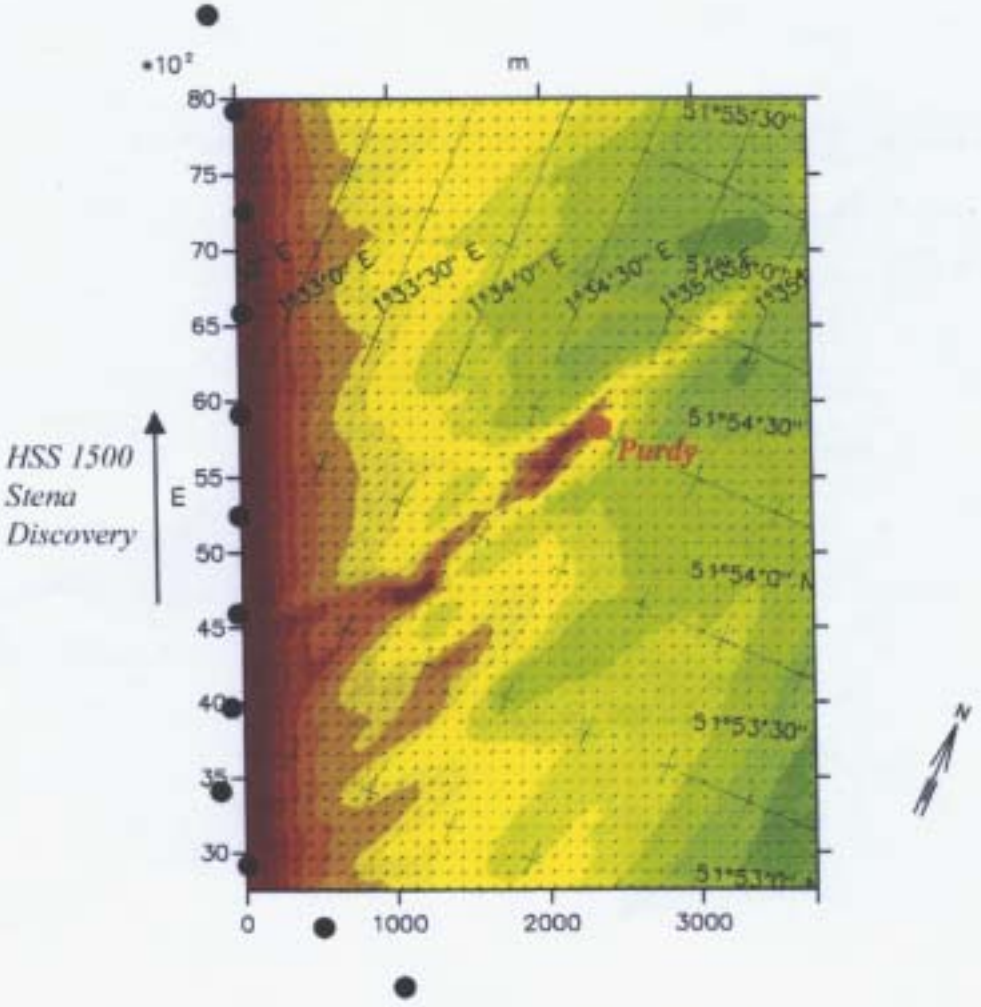
A lesson to be drawn from this and other accidents, is that a lifejacket should always be worn when on the open deck of any small boat.

The skipper could have done more to ensure the safety of his boat and her occupants.

2.4 Safety Management of *Stena Discovery*'s Operation

When *Stena Discovery* started service at Harwich, the two other HSS 1500s had been operating for several months in the Irish Sea. Feedback on potentially dangerous wash/wake incidents had already been received, and their operating routes and speeds had been adjusted to minimise the problems. Therefore, it is surprising that before *Stena Discovery* was introduced into service, greater efforts were not made to understand all of the lessons learned on Irish Sea routes by Stena

Figure 5



Example of predicted wave field on the Shipwash Bank. The figure shows the maximum wave height for the ship course 337°.

Line Ltd, and that a process of documented risk assessment, which should come before the introduction of a novel craft on any route, to identify all hazards and minimise the risks involved, was not carried out with respect to the effects of wash. The importance of avoiding intermediate speeds was known and applied, but largely, it appears that *Stena Discovery* started service in the expectation that experience would be gained, incidents would occur and lessons would be subsequently learned.

As experience on the route was gained and feedback received, there was a growing awareness that dangers existed for small craft in the vicinity of Cork Sand and Deben Bar Knolls. The problems at these locations were then considered, along with those experienced at the shoreline, and changes to the operating rules were made. Warnings concerning the risks on or near to Cork Sand and Deben Bar Knolls were promulgated by a number of means to try to reach all those considered to be at risk. That incidents had occurred at these locations clearly indicated the potential for similar incidents on other off-lying banks, including Shipwash.

It is likely that Stena Line BV was aware that wash would impact on Shipwash Bank; and that the bank, to some extent, would protect bathing beaches from wash created at sea during the vessel's approach to Harwich. This feature is used successfully by Stena Line Ltd on banks off Dun Laoghaire. However, it did not expect waves larger than, say, a large conventional ferry or fast container ship might produce It certainly did not expect waves as high as 4m.

It was not until this accident that the full potential danger of the HSS 1500 wake/wash on off-lying sandbanks was realised. This indicates a shortfall in the safety management of this operation by Stena Line BV.

SECTION 3 - CONCLUSIONS

3.1 Findings

1. Mr Sibley was washed over the side from *Purdy* at about 0936 on 17 July 1999 by a large wave. [1.2]

2. Mr Sibley was not wearing a lifejacket. [1.2]

3. *Purdy* was well equipped and maintained. [1.4]

4. *Purdy*'s skipper was very experienced, although unqualified. [1.4]

5. At the time of the accident, there was a southerly wind of force 3, good visibility and a slight sea and swell. [1.3]

6. It is likely that *Purdy* had less than 3m of water beneath her keel and possibly less than 2. [1.4]

7. *Stena Discovery* had passed just over a mile from *Purdy* about 3 minutes before the wave struck. [1.2]

8. *Stena Discovery* had been operating on the Hoek van Holland/Harwich route since June 1997. [1.1]

9. High-speed craft, like *Stena Discovery*, were known to have the capability to produce waves that can be accentuated and become dangerously high in shallow water. [1.6]

10. *Stena Discovery* had a valid Permit to Operate which covered the port of Harwich. [1.9]

11. *Stena Discovery*'s route and speeds on approach to Harwich had been revised several times in response to information of incidents on the beaches and some off-lying banks. [1.9]

12. The changes to *Stena Discovery*'s approach had been largely successful in reducing the impact of waves on the beaches to within acceptable limits. [1.6, 1.9]

13. On 17 July, *Stena Discovery* was operating on a route and at speeds in accordance with the current guidance. [1.1, 1.11]

14. Very little feedback had been received, before the accident, about the danger of wash waves on off-lying banks. However attempts had been made to give appropriate warnings. [1.9]

15. *Purdy*'s skipper was not aware of warnings concerning the danger of *Stena Discovery*'s wash on off-lying sandbanks. [1.4]

3.2 Causes

3.2.1 The Immediate Cause

The accident occurred when a wash wave, generated by *HSS Stena Discovery* and having grown to about 4m in height as it encountered the shallow waters on the southern end of the Shipwash Bank, broke over and swamped the angling boat *Purdy*.

3.2.2 Other Factors and Underlying Causes

1. The wave was generated by *Stena Discovery* during or after, the alteration of course made to the south of South Shipwash buoy. Its height and steepness were probably accentuated by focussing, due to the particular bathymetry, and superposition, with wash waves generated before the turn. [2.1]

2. The skipper of *Purdy* had not been aware of the broadcasted dangers associated with shallow banks and the passage of *Stena Discovery*. [2.3]

3. The skipper had placed *Purdy* in a dangerous position with regard to the wash waves that *Stena Discovery* was known to produce. [2.3]

4. Mr Sibley was not wearing a lifejacket. Had he done so, his chances of survival would have increased. [2.3]

5. The skipper could have done more to ensure the safety of his boat and her occupants. [2.3]

6. Wash generation by HSS 1500s is complex and is not yet fully understood. [2.4]

7. It is likely that Stena Line BV was aware that wash would impact on Shipwash Bank and that this would, to some extent, protect the bathing beaches at Dovercourt and Felixstowe. However, it did not expect waves of 4m height to be produced. [2.4]

8. There was a shortfall in safety management by Stena Line BV in that no documented risk assessment of the route with regard to wash generation was carried out prior to *Stena Discovery* commencing operations, despite prior knowledge of the problems being experienced on Irish Sea routes. [2.4]

SECTION 4 - RECOMMENDATIONS

During the course of the investigation, in August 1999, the following safety recommendations were issued:

1. To The Maritime and Coastguard Agency

As an interim solution:

MCA to insist, through the Netherlands Shipping Inspectorate, that Stena Line Holland BV must:

1. instruct masters of the HSS ferry to change their passage plan and reduce speed to ensure safe entry to Harwich Haven including the reduction of wash on adjacent sandbanks;

2. begin monitoring the wash in the approaches to Harwich Haven, to ensure the action taken reduces it to within safe limits.

Additionally, the MCA to:

3. instigate through the Thames Coastguard, a marine safety broadcast on VHF radio to warn small boat users of the dangers associated with the wash of the HSS.

Towards a permanent solution:

MCA to:

1. insist, through the Netherlands Shipping Inspectorate, that Stena Line Holland BV carry out a full risk assessment of the approach to Harwich Haven with reference to wash and, as a result, propose a route and speed profile that constitutes a permanent solution;

2. liaise with the Netherlands Shipping Inspectorate to ensure that the Permit to Operate and Route Operations Manual are endorsed with the requirement for a full risk assessment with reference to wash, and for all likely areas of wash to be identified, and action taken to avoid it.[3]

2. To Small Boat Users

All users of small craft are reminded of the dangers that can arise unexpectedly from the wash of passing vessels. In deciding whether to wear lifejackets, it should be remembered that no

[3] The above recommendations were implemented by the MCA and Stena Line Holland BV has since carried out field trials under controlled conditions and laid buoys to monitor wash wave heights as part of the required risk assessment.

harm comes from wearing them in even the most benign conditions, and that they may save lives if an unexpected event occurs.

Other recommendations made at the completion of the investigation:

The Maritime and Coastguard Agency is recommended to:

1. Consider instigating procedures whereby a full route assessment with respect to wash is undertaken by all operators of high-speed craft who apply for a permit to operate.
2. Consider establishing maximum wave height criteria for measuring the efficacy of the route assessment results.
3. Consider the implementation of international regulations in this respect by raising the subject at the International Maritime Organization when the *High-Speed Craft* Code is next reviewed.

The Hydrographic Office is recommended to:

4. Review the content of Admiralty Notices to Mariners Number 23, to give appropriate warning concerning the risks of large waves on shallow off-lying banks.

Marine Accident Investigation Branch
July 2000