Report on the investigation of the grounding of the jack-up barge

Octopus

towed by the tug

Harald

Stronsay Firth, Orkney Islands

8 September 2006

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

Report No 18/2007
August 2007

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 13(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

Further printed copies can be obtained via our postal address, or alternatively by:
Email: maib@dft.gsi.gov.uk
Tel: 023 8039 5500
Fax: 023 8023 2459
All reports can also be found at our website:
www.maib.gov.uk

CONTENTS

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AIS	-	Automatic Identification System
CATZOC	-	Categorization of Zones of Confidence
CHP	-	Civil Hydrography Programme
CHRC	-	Civil Hydrography Review Committee
COSH	-	Committee on Shipping Hydrography
DETR	-	Department of the Environment, Transport and the Regions
DfT	-	Department for Transport
DNSOM	-	Directorate of Naval Surveying, Oceanography and Meteorology
ECDIS	-	Electronic Chart and Display Information System
ECS	-	Electronic Chart System
EEZ	-	Exclusive Economic Zone
EMEC	-	European Marine Energy Centre Ltd.
ETV	-	Emergency Towing Vessel
HMOG	-	Hydrographic and Meteorological Guidance
HSRB	-	Hydrographic Strategic Review Body

IHMC	-	International Hydrographic Management Consulting Limited
IHO	-	International Hydrographic Organisation
kw	-	kilowatt
LEA	-	Limited European Area
LIDAR	-	Laser Induced Direction and Range
m	-	metres
MCA	-	Maritime and Coastguard Agency
MoD	-	Ministry of Defence
NAVTEX	-	Navigational information telex
SOLAS	-	International Convention for Safety of Life at Sea
UKHO	-	United Kingdom Hydrographic Office
UNCLOS	-	United Nations Convention on the Law of the Sea
UTC	-	Universal Co-ordinated Time
VHF	-	Very High Frequency
WGS84	-	World Geodetic System 1984

Figure 1

Harald

Figure 2

Jack up-barge *Octopus*

SYNOPSIS

The jack-up barge *Octopus* was being towed from Kirkwall to Seal Skerry Bay in the Orkney Islands by the tug *Harald*, to act as a platform for the installation of a prototype tidal turbine. The tug and tow altered their route to pass to the west of Little Green Holm Island, due to the strong tidal streams experienced during the passage, a route not usually used by deep draught vessels. As the tug and tow rounded the south of Little Green Holm Island the barge, which was being towed with its legs extended to a depth of 13m, grounded on an uncharted bank of 7.1m.

Octopus sustained buckling damage to 4 barge legs, resulting in substantial cost and project delays. There were no injuries and no damage to the tug *Harald.*

The applicable Admiralty chart for the area indicated a depth of greater than 20m with the closest sounding indicating a depth of 26m. The source data diagram on the chart indicated that the area was last surveyed, by leadline, in the 1840s.

The MAIB report recommends that:

The DfT and MCA:

- Review the future work schedule for the UK Civil Hydrography survey programme, taking into account the priorities identified by MCA Research Project 512, the Committee on Shipping Hydrography and the MCA, particularly in light of the increasing use by large cruise vessels of sea areas not surveyed to modern standards.

The UKHO and the MCA:

- Agree wording and put forward to the IHO/IMO a proposal that the relevant working groups investigate ways of ensuring that ECDIS displays provide a clear warning or indication to the mariner whenever the survey data used to produce the electronic chart in use is of poor quality.

Industry bodies responsible for vessels that operate in remote waters, such as cruise vessels, offshore supply vessels and vessels engaged in renewable energy installation:

- Promulgate to the ship owners through their membership the safety lessons identified in this report, to emphasize to shipmasters and navigating officers, the need to carefully consider chart source data and, in the case of Electronic Navigational Charts (ENC), “Category of Zone of Confidence” (CATZOC) when planning and executing navigational passages.

The marine consultants responsible for overseeing the marine aspects of the tidal turbine project fully consider, when planning the passage of deep draught vessels:

- The potential effect of tidal conditions.
- The quality of survey data, available for the area concerned.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *HARALD* AND ACCIDENT

Vessel details (Figure 1)

Registered owner	:	Orkney Towage Company
Manager(s)	:	Orkney Towage Company
Port of registry	:	Kirkwall
Flag	:	British
Type	:	Tug
Built	:	1992
Classification society	:	Lloyd's Register
Construction	:	Steel
Length overall	:	32.08m
Engine power and/or type	:	2 x Ruston 6RK270M 1492kw each
Service speed	:	12 knots
Bollard Pull Ahead	:	55 tonnes
Tow winch		10 m/min at 30 ton pull

Accident details

Time and date	:	1755 UTC 8 September 2006
Location of incident	:	59 09.5 N 002 49.3 W.
Persons on board	:	Six
Injuries/fatalities	:	None
Damage	:	None

1.2 PARTICULARS OF OCTOPUS AND ACCIDENT

Vessel details (Figure 2)

Registered owner	:	Kello (Belgium)
Manager(s)	:	Kello (Belgium)
Type	:	Jack-up barge
Construction	:	Steel
Dimensions	:	30.4m x 15.5m x 2.4m
Capacity	:	550 tonnes
Leg length	:	26m

Accident details

Damage	:	4 barge legs buckled causing substantial cost and project delays.

1.3 NARRATIVE

All times are UTC+1

1.3.1 Pre-voyage

On 7 September 2006, after 3 weeks on station, the jack-up barge *Octopus* had been moved by the tug *Harald* from her position in Seal Skerry Bay, west of Eday in the Orkney Islands, via the Falls of Warness, to Kirkwall.

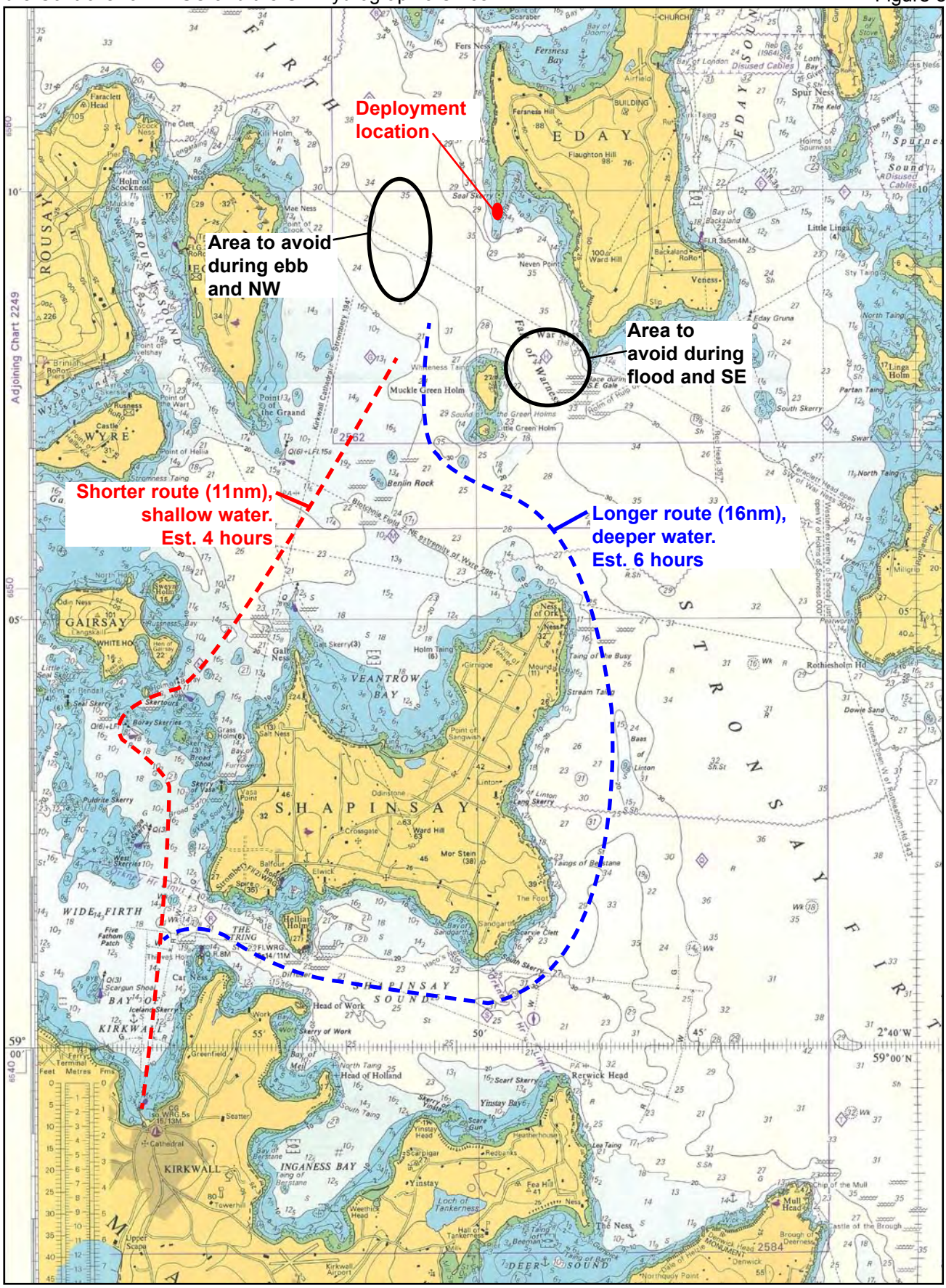
During the barge's stay in Kirkwall, the crane stowed on the deck was unloaded, and a drilling rig loaded in its place. Also, the tug's skipper, who had brought *Octopus* to Kirkwall, handed over command to the vessel's other skipper for the return to Seal Skerry Bay. The barge's departure was delayed by one tide due to unplanned maintenance of *Harald*'s port main engine turbo charger, which failed during the previous voyage.

The tug and barge were initially planned to pass to the east of Shapinsay through the Falls of Warness, this route being considered preferable to the shorter shallower route west of Shapinsay. The east route also opened up the sub-options of passing either east or west of the Green Holm islands. During route planning meetings before the voyage, the preference was to pass east of the Green Holm islands although the agreed method statement route **(Figure 3)** indicated a passage to the west.

The tow master responsible for coordinating the voyage, and the tug skipper agreed to use the route they had taken from Seal Skerry Bay to Kirkwall in reverse, to return the barge to her required position, a distance of 16 miles. The route east of Shapinsay was agreed and the sub-options of passing either east or west of the Green Holm islands were to be considered by the tug skipper and tow master depending upon the tide and wind conditions encountered en route.

Reproduced from Admiralty Chart 2250 by permission of
the Controller of HMSO and the UK Hydrographic Office

Figure 3



Route options considered during initial project planning

1.3.2 The voyage

At 1300 on 8 September 2006, the tug *Harald,* towing the jack-up barge *Octopus,* sailed from Kirkwall for Seal Skerry Bay. It was the day before spring tides, the visibility was good, and wind was light and variable. As planned, the tug *Erlend* escorted the tug and tow on passage. *Harald*'s skipper planned the voyage with Admiralty paper charts, and used the charts for navigation together with a Seatrack monochrome chart plotter. The echo sounder was running throughout the voyage, although the depth trace prior to the grounding was illegible – possibly due to the turbulence caused by the fast flowing tides.

Once clear of the approaches to Kirkwall, the tow master requested the tug skipper's agreement to lower the barge legs from 5m to around 9m. This was to improve *Octopus*'s stability in the anticipated swell east of Shapinsay.

The tow's progress through the water was slightly reduced as the barge trimmed forward when the legs were extended. As the tug and tow approached the Falls of Warness at 1730, the following spring ebb tide, flowing at about 6 knots, set the tug and barge to the west. The tug skipper was aware that the westerly set continued through the Falls of Warness and would set them towards the Green Holm islands. He therefore discussed the situation with the tow master on the barge by VHF radio, and they agreed to pass to the west of Little Green Holm Island, a route *Harald'*s skipper had used many times before. As the tug and tow altered course to the west-north-west to pass west of the Green Holm islands, their speed increased to 8 knots over the ground aided by the ebb tide **(Figure 4)**.

Following the decision to pass west of the Green Holm islands, the tow master and tug skipper agreed to lower the barge legs to 13m to reduce the expected rolling as they crossed the tidal flow to the north of the Falls of Warness. They also agreed to have the barge legs at the required depth for the installation on arrival in Seal Skerry Bay.

At 1755, half an hour after low water, *Octopus* grounded on her forward two legs, 3 cables south-south-west of Little Green Holm Island **(Figure 5)**. The charted depth at the position of the grounding was assessed to be greater than 20m, the closest sounding indicating a depth of 26m. The force of the grounding caused some of the barge personnel to fall, however no one was injured and neither the tug nor the barge deck cargo was damaged.

1.3.3 Post grounding actions

*Harald'*s skipper reacted quickly to the grounding by using astern propulsion and paying out the towing cable. The escort tug *Erlend* promptly connected a tow to the stern of *Octopus* to relieve the strain on the barge legs and to hold her in position awaiting the rising tide and reduction in the tidal flow.

Erlend's skipper informed Orkney Towage of the grounding but did not request any assistance. The workboat *Ailsa,* awaiting the arrival of the tug and tow in Seal Skerry Bay, headed for the grounding position.

Shortly after the grounding, *Octopus*'s personnel were transferred to *Ailsa.* While the workboat was alongside *Octopus*, her skipper confirmed the depth of water as 8m, which included a height of tide of 0.5m.

Approximate route taken by *Harald/Octopus* prior to grounding

Figure 5

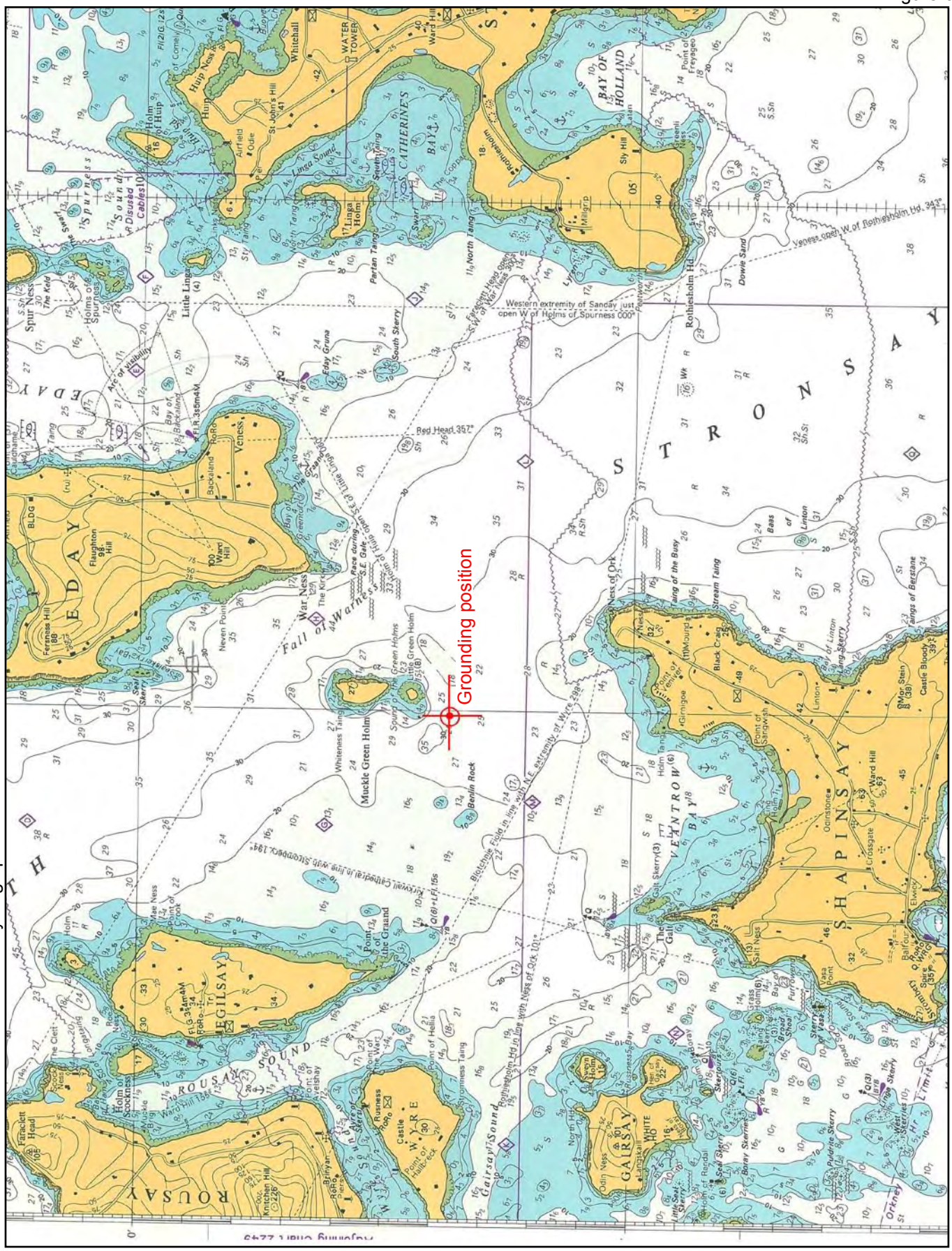
Octopus aground

Octopus refloated 40 minutes after the grounding, and was returned to Hatston Pier in Kirkwall where all four legs were found to be damaged. The damage to the barge cost an estimated £1m to repair. The delay in returning *Octopus* to Seal Skerry Bay also resulted in extensive delays to the project when the seabed frame, constructed during the initial installation stage, collapsed in the strong tides.

Following the grounding, the UKHO initiated NAVTEX warnings of the shoal danger in the area. A week after the grounding, the Orkney Harbour Authority pilot boat carried out a survey of the area, which confirmed the presence of an uncharted shoal area with a minimum depth of less than 8m, the bank covering an area of approximately 2.5 x 2.5 cables.

The MCA, UKHO and the Shetland Coastguard were advised of the survey's findings, and the area of the grounding was subsequently re-surveyed by the MCA's Emergency Towing Vessel (ETV) *Anglian Sovereign*. The more accurate survey data obtained during this survey was used to generate the chart correction data issued in Admiralty Notices to Mariners (NTM) Week 41, published on the UKHO Web site on 5 October 2006 and in paper format on 12 October 2006. The revised charted depth in the location of the grounding was shown in the NTM as 7.1m **(Figure 6)**.

Figure 6



Extract from BA Chart 2250

1.4 THE PROJECT

European Marine Energy Centre Ltd. (EMEC) provides a purpose built open sea test facility for marine energy converters connected to the National Grid. The test facilities were being used by the marine turbine manufacturer OpenHydro to install and test its Open-Centre Turbine in the fast flowing waters of the Falls of Warness. The jack-up barge *Octopus* provided a platform for the installation.

During the initial phase of the project in August 2006, *Octopus* had been towed from Kirkwall to Seal Skerry Bay by the harbour tug *Kirkwall Bay*. However, this tug was considered underpowered and the tug *Harald* was subsequently used to tow *Octopus* into position.

1.5 PLANNING

OpenHydro and McClaughlin & Harvey developed a combined method statement on 9 August 2006 prior to the initial transfer of *Octopus*. This document defined the roles and responsibilities of the operation, including details for positioning the jack-up barge. Following the initial attempt to position the barge, the method statement was reviewed on 18 August 2006 when the use of tugs with greater bollard pull, the use of stand-by tugs and strengthened towing connections were all agreed.

As the operation of jacking up the barge onto the sea bed was limited to a maximum wave height of 0.5m, the primary concern during planning was to use available weather windows to ensure the wave heights were suitable. The effect on wave height when wind was combined with the strong tides was fully considered.

Following the initial installation, the incumbent marine superintendent left the project due to ill health and Melbourne Marine Services was subsequently employed to take responsibility for the marine management of the project.

As part of the planning process, Melbourne Marine Services used the Admiralty Total Tides Program and the Meteorological Office 5-day High Resolution Weather forecast.

The method statement was further reviewed on 1 September 2006, following a meeting between Melbourne Marine Services and the tow master and tug skipper, and prior to the barge being transferred from Seal Skerry Bay back to Kirkwall.

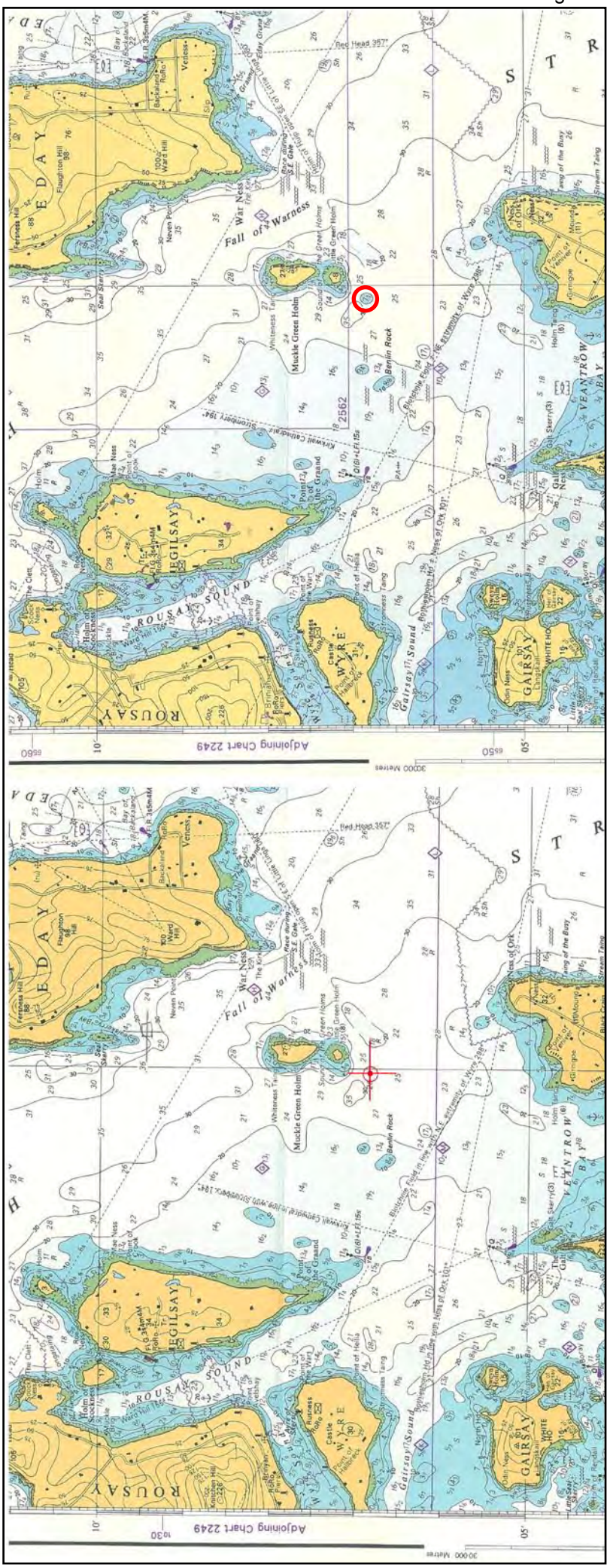
The tow master held pre-sailing meetings with the tug skippers and barge master prior to each voyage to ensure the plan was understood by the personnel involved.

1.6 THE PASSAGE PLAN

1.6.1 The chart

Harald's skipper planned the route from Kirkwall to Seal Skerry Bay using British Admiralty paper charts before transferring the route to the tug's electronic chart plotter.

The UKHO British Admiralty (BA) Chart 2250, Edition Number 3 dated 28 July 2005, Orkney Islands, Eastern Sheet, is the largest scale chart of the area of the grounding with a scale of 1:75000. The detail of the area where the grounding occurred is shown before and after the discovery of the shoal in **Figure 7**.



Admiralty Chart 2250 before and after the grounding

The source diagram for BA Chart 2250 **(Figure 8)** shows the area to have been surveyed during *British Government Survey (leadline) 1839-1848.* Lieutenant Commander George Thomas, master commanding, was on board HMS *Mastiff* when the survey of the grounding area was carried out in 1843 and 1844. The original survey record fair sheet **(Figure 9)** showed that the survey results were correctly transferred to the chart, and that the 7.1m bank was missed due to the sampling nature of the leadline survey undertaken.

A note on BA Chart 2250 states that:

> *Many of the depths in these areas have not been systematically surveyed. Depths in these areas are from miscellaneous lines of passage sounding or old leadline surveys. Uncharted dangers may exist.*

The Mariners Handbook, NP100, Chapter 2, guides the mariner in assessing the reliability of a chart, stating:

> *No chart is infallible. Every chart is liable to be incomplete, either through imperfections in the survey on which it is based, or through subsequent alterations to the seabed. However, in the vicinity of the recognised shipping lanes charts may be used with confidence for normal navigation needs. The mariner must be the final judge…*

Further guidance is given in Admiralty Sailing Directions, NP 52, North Coast of Scotland, which states that:

> *Charts should be used with prudence: there are areas where the source data are old, incomplete or of poor quality.*

When the commercial survey vessel *Ping* surveyed the area north of the grounding position in early 2006, the survey resulted in 69 NTM warning of changes to charted depth, although none were of the exceptional nature of the shoal where *Octopus*'s grounding occurred **(Figure 10)**. The southern limit of the 2006 survey of the area around the Island of Eday was less than 200m north of the 7.1m shoal patch **(Figure 11).**

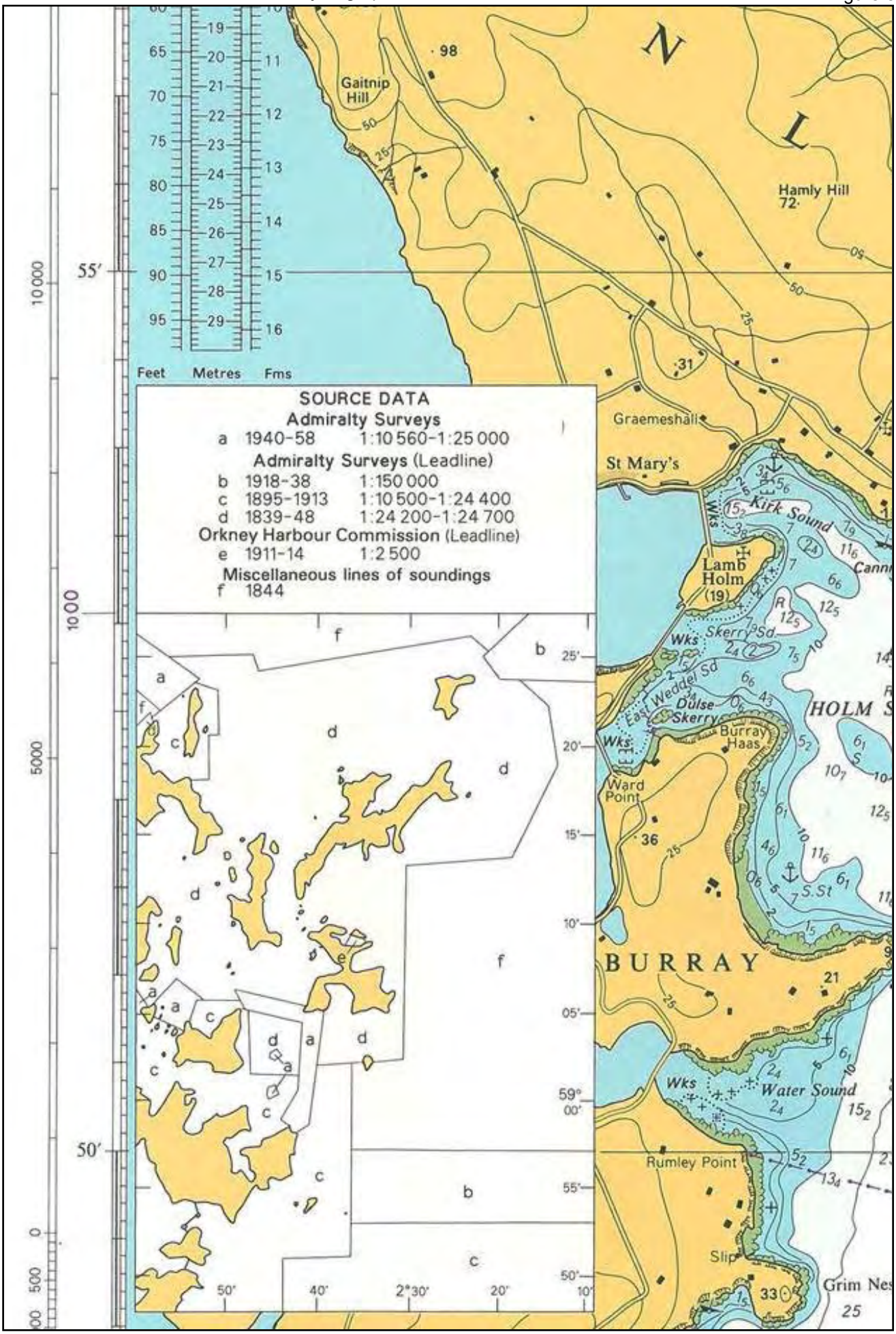
A survey was also completed of the area to the east of the Orkney Islands during 2006; much of this area was previously stated as un-surveyed, with miscellaneous lines of soundings from 1844 as the source data.

1.6.2 The chart plotter

The chart plotter in use at the time of the accident used Seatrack software. The plotter was used as an aid to navigation, the primary navigation being by paper chart. The Seatrack system is primarily aimed at the leisure market, with the software installed on an owner supplied Personal Computer.

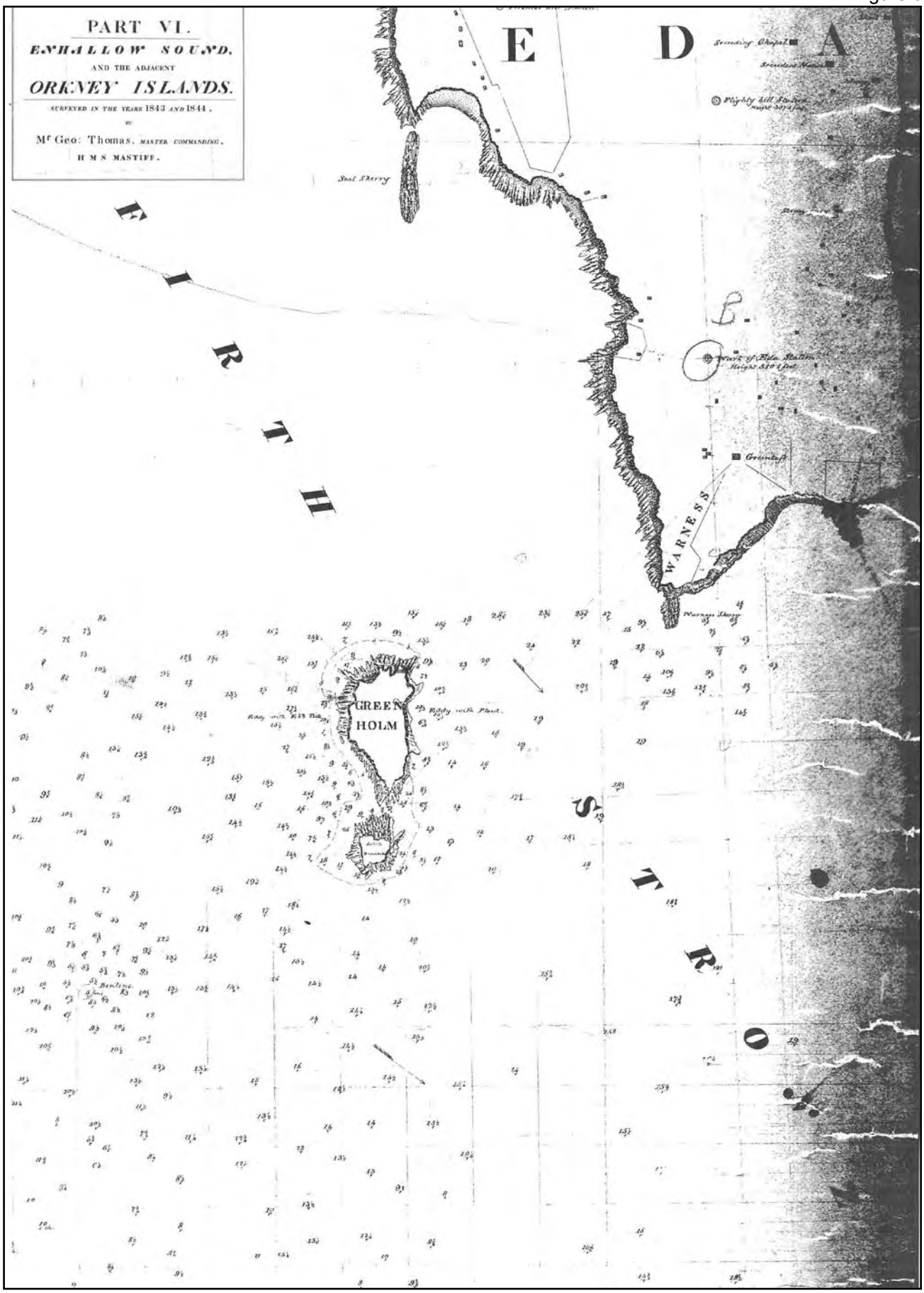
The Seatrack chart plotter software in use at the time of the grounding was replaced shortly after the incident with a new computer and software.

Figure 8

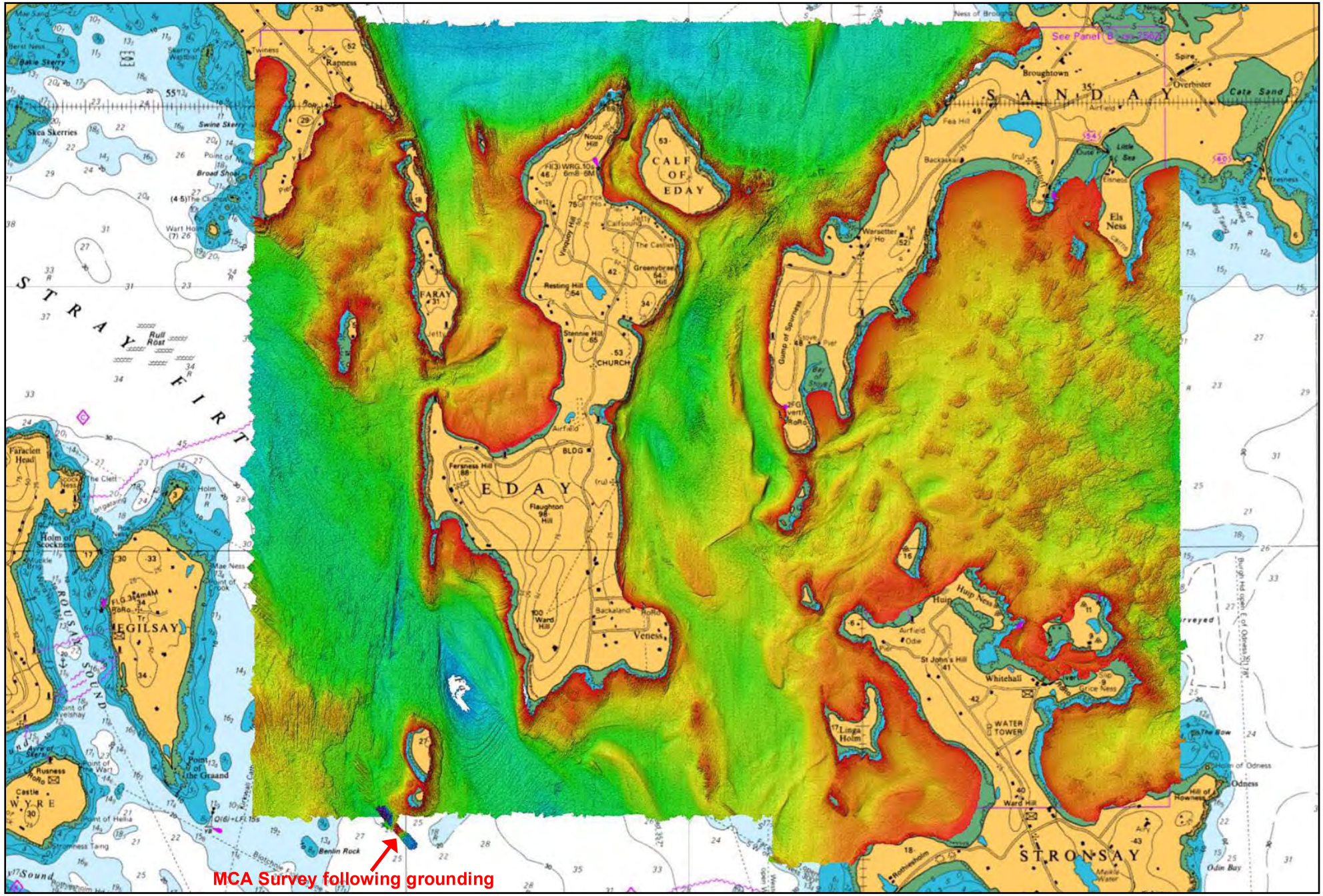


BA Chart 2250 Source data

Figure 9

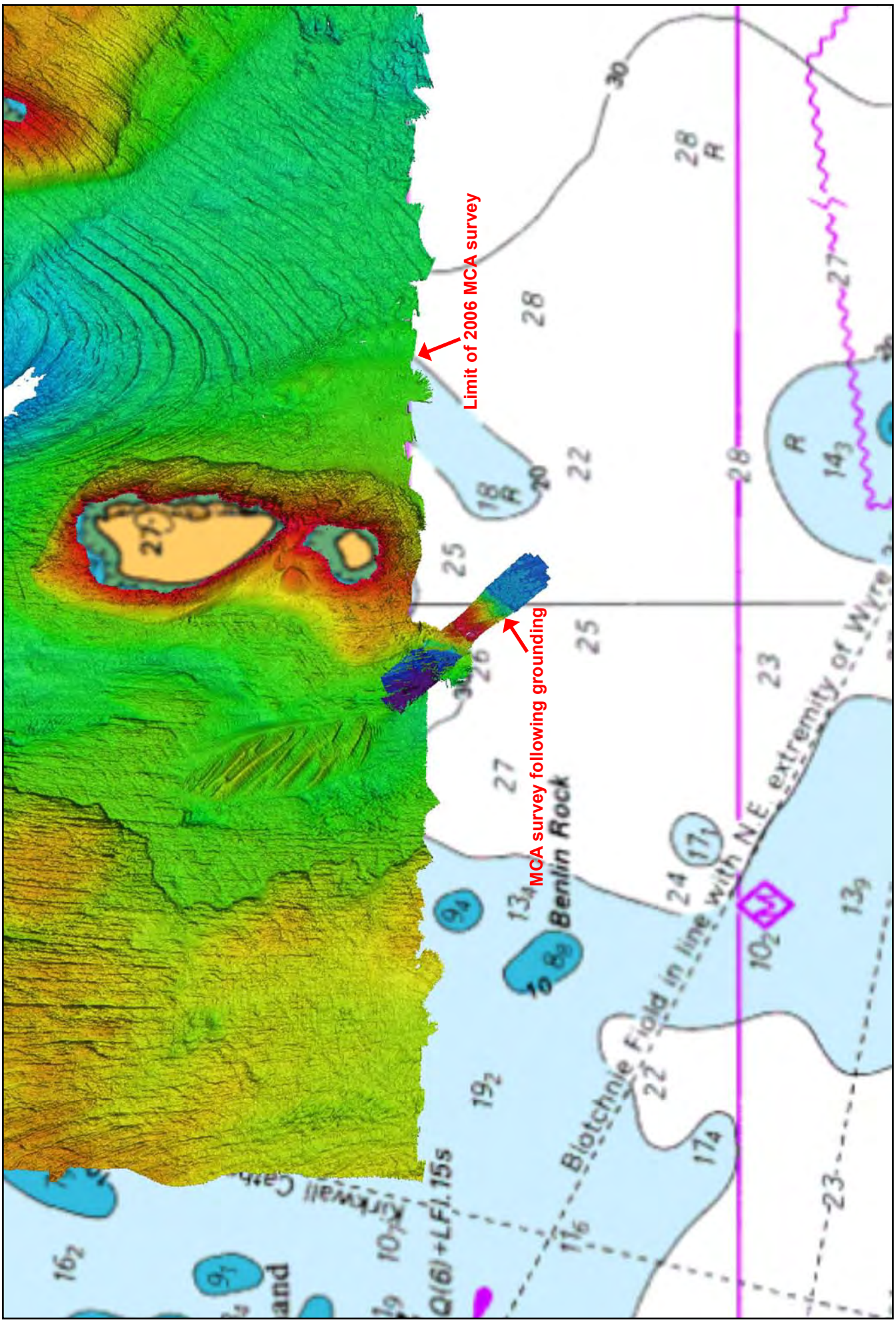


Extract of survey fair sheet of 1843/4



2006 MCA survey results - with additional MCA survey following the grounding

Figure 10



2006 MCA survey results - with additional MCA survey following the grounding

1.6.3 Category of Zone of Confidence

Vector electronic charts require the addition of Category of Zone of Confidence (CATZOC) to allow the mariner the opportunity to gauge the reliability of the charted information. The allocation of a value to the CATZOC attribute of the M_QUAL (quality of data) object is mandatory. Possible values are: A1, A2, B, C, D and Not Assessed. The transfer of the traditional source data to CATZOC is being progressed, as resources permit, by national hydrographers.

Progress in Scottish waters is further limited due to some coastal areas requiring transfer to the geodetic system WGS84 prior to allocating a CATZOC. The area of the Orkney Islands had not yet been allocated a CATZOC by the UKHO.

1.6.4 Passage guidance

Admiralty Sailing Directions NP52 North Coast of Scotland – Sixth Edition notes:

> *5.271 Despite the dangerous sea and Tidal conditions, described at 5.267 which may prevail in certain conditions in the vicinity of War Ness, and which should always be anticipated, this channel is preferred to the passage W of Muckle Green Holm.*
>
> *5.267 Tidal streams in the channels either side of Muckle Green Holm are very strong….During both SE going and NW going tidal streams violent turbulence extends across the entire East of Muckle Green Holm when the wind is against the tidal stream.*

1.6.5 Local knowledge

The tugs *Harald* and *Erlend* were manned by longstanding local crews employed by the Orkney Towage Company. The skipper held a Certificate of Competence for tugs with Limited European Area (LEA) endorsement. Although the work of the tugs was primarily to the south of the Orkney Islands, operating with the tanker berthing and transfer operations of Scapa Flow, other towage work around the islands was infrequently undertaken. The skippers' experience was based on this occasional work and their extensive previous knowledge working on smaller local craft and fishing vessels.

1.7 HYDROGRAPHIC SURVEY IN THE UK AREA

1.7.1 Hydrographic Responsibilities

The United Kingdom has an obligation under the Safety of Life at Sea (SOLAS) Convention, Chapter V, Regulation 9, to survey its internal waters and territorial sea, to the best of its ability, using the most effective modern equipment available, and to then produce nautical charting to international standards. The UK also has an obligation to ensure safe navigation, not only in its territorial sea and in close proximity to the coast, but also within those areas beyond the territorial waters for which the UK has obligations under the United Nations Convention on Law of the Sea (UNCLOS) to protect the environment.

On 31 March 2006, the DIJE[1] (Defence Intelligence Joint Environment) contract for managing the Civil Hydrographic Programme (CHP) ceased by mutual consent, and direct responsibility for managing the CHP passed to the MCA. At that time, the CHP had an annual budget of £5.4m.

[1] DIJE had subsumed the former DNSOM (Directorate of Natural Surveying, Oceanography and Meteorology)

1.7.2 Civil Hydrography Programme

Prior to 1976, civil survey requirements were determined by the Royal Navy's Director Naval Plans and the UK Hydrographer. Following a review by the Hydrographic Study Group, it was recommended that a wider consultation of civilian surveying and the sourcing of civilian funding were required.

In May 1976, the first Hydrographic Strategic Review Body (HSRB) met[2]. At that time, the only civil-funded surveys, as part of a national programme, were funded by the Department of Energy but undertaken by the Royal Navy for oil-rig tow-out routes to the North Sea. The HSRB set the civil survey work programme for the forthcoming 2 years.

In order to widen consultation further, a Department of Trade sub-committee of the HSRB was established in late 1976 which included organizations such as the General Lighthouse Authorities and the General Council of British Shipping. The first meeting of this committee, the Committee on Shipping Hydrography (COSH), took place on Friday 15 October 1976, and was arranged and chaired by the Department of Trade. The committee made recommendations for the period 1978-80. However, at that time, the committee had no budget and only made recommendations to the HSRB as to where surveys should be undertaken to support UK shipping safety.

At the second COSH meeting in February 1978, a COSH Terms of Reference was established "To consider the hydrographic survey requirements of UK Shipping and the views of UK shipping interests on matters under consideration by the Hydrographic Strategic Review Committee".

In 1979, after considerable lobbying, the Royal Navy obtained permission to increase the size of the home waters survey fleet but, while the vessels were being built, civil hydrography was put out to commercial tender. The first record of such a tender being awarded was in 1982, to Gardline.

In 1982, the UK government decided that financial responsibility for civil hydrography should be borne fully by the Department of Trade instead of the MoD from 1984/85 onwards. From 1982 to 1985, funding of between £5 million and £5.7 million per year was divided between the Department of Trade (later the Department for Transport) and the Royal Navy.

Since COSH now had a budget, its membership was extended to include the UK Hydrographer, the British Ports Association and others. It also declared new Terms of Reference, "To consider, and keep under review, the need for hydrographic surveys around the United Kingdom; to identify priorities; and to make recommendations". In 1982, it was also decided to form the Civil Hydrographic Review Committee, which received these recommendations.

In 1983, the responsibilities of the Department of Trade Marine Division passed to the Department of Transport Marine Division.

Since the CHP's inception the annual level of funding has fluctuated around the current figure of £5.4 million, but has largely remained unchanged.

---

[2] This comprised: the Ministry of Defence (MoD), Department of Trade, Department of Energy, Department of Environment, Foreign and Commonwealth Office, Department of Education and Science, and the Treasury.

1.7.3 Research

In 1997, the Department of Maritime Studies of the University of Wales, Cardiff, was tasked by the Department of the Environment, Transport and the Regions (DETR) to:

- Assess objectively the scope for establishing a limit to the depths at which the DETR should be responsible for hydrographic surveys, and to recommend what the depths should be.
- Apply any recommended limit to the existing set of survey priorities and establish the impact of the new limit on those priorities.

The University of Wales report defined a proposed outer limit of CHP responsibility and provided an indication of survey priority within that area. The executive summary of the report's findings **(Annex A)** is attached.

In April 2003, the MCA contracted International Hydrographic Management Consulting Limited (IHMC) to carry out Research Project 512, titled "A Long Term Strategy for the UK Civil Hydrography Programme". The primary objective of the project was to identify the optimum level of annual surveying effort required to bring all surveys in UK waters up to full modern standards within an agreed timescale, and to identify the level of funding required to support the strategy. IHMC's report was subsequently tabled and accepted at the annual meeting of the Civil Hydrographic Review Committee[3] (CHRC) in January 2004.

The IHMC executive summary **(Annex B)** noted.

> *The total survey task has been examined for eight specific areas around the British Isles, totalling 723,181 km². Assuming an augmented rate of production according to the recommendations in various sections of the report, 6000 to 7000km² can be surveyed annually, if resurveys are not considered. With 14 % currently surveyed, the unsurveyed area is approximately 620,000 km². It is therefore estimated that even using the most modern methods currently available, with the existing budget allocation it will take 90 to 100 years to bring all the surveys to modern standards. The result of a direct mathematical calculation requires considerable explanation, however, as many of the more difficult areas are already surveyed and a considerable amount of the unsurveyed area is in deeper water. This is, nevertheless, counterbalanced by the huge extents of coastline not surveyed and slow to survey from surface vessels. If LIDAR[4] surveys prove to be as effective as they have been demonstrated to be in other countries, then the time period could be reduced. It can also be assumed that other survey methods will become more efficient.*
>
> *The present status of surveys and rate of progress in carrying out surveys is clearly unacceptable, considering the reputation of the United Kingdom as a maritime state. Based on the assumption that the task should be completed within 15 years, the MCA allocation needs to be increased by six times to achieve this objective. Although not mentioned elsewhere in the report, there are other alternatives that could be considered. One would be to double the budget on an urgent basis and schedule a review for five years hence to assess progress. These are issues that can only be decided upon by the respective organizations.*

---

[3] CHRC comprises the MCA, UKHO, DfT and, previously, the MoD.

[4] Laser Induced Direction and Range

The Report contained a total of 18 recommendations set out in high, medium and low priorities. Eight were identified as high priority, nine as medium and one as low.

The recommendations contained in the report were accepted by the CHRC, in accordance with the priorities set out in the report.

1.7.4 COSH action post grounding

At the COSH meeting[5] minutes of October 2006 the MCA stated that:

- *It had now become critical that the uncharted area between the Sanday Sound and Approaches to Kirkwall should be surveyed. This was agreed by COSH Members. However, as approximately 40 cruise ships as well as numerous installation companies would be utilising this area before the next survey season commences in April/May 2007, it was agreed that more funding should be sought in order to commence surveying immediately.*
- *With the current funding for the Civil Hydrography Programme at £5.4m per annum it has been estimated that it will take 100 years to survey the UK coastline (source: independent research conducted by International Hydrographic Management Consultancy). An increasing number of vessels and installation companies operating in areas where the current data is over 100 years old means that there is an increased risk of incidents such as the "Octopus" occurring again.*
- *In order to be proactive and decrease the risk in future, the Chairman, with the full support of COSH Members, agreed to write to the MCA Executive Board and the DfT seeking further funding for the Civil Hydrography Programme in order to extend the Programme to cover more high risk areas.*
- *The Hydrography manager reported that there were a number of lessons to be learned from this incident. It had come to light that the fishermen had known about the shoal but had not informed anyone. The MCA therefore needed to speak to appropriate local people in areas where surveys were being conducted, as information such as knowledge of shoals or other concerns may be highlighted.*
- *It was agreed that the MCA Hydrography manager and the UKHO liaison officer would develop a risk matrix, which would utilise AIS data, of survey priorities to present to CHRC. However, this could not be taken forward without the Archive Catalogue data from the UKHO. It was agreed that the MCA would visit the UKHO to try to work together to resolve the technology problems that were being experienced in releasing the Archive data to the MCA.*

1.7.5 Survey standards

MCA and their commercial contractors survey to IHO S-44 Order 1 and Hydrographic and Meteorological Guidance (HMOG) standards.

[5] COSH membership is shown at Annex D

1.7.6 CHP survey effort

All survey work is managed by the MCA, in close liaison with the UKHO. Using a risk based approach, survey priorities are divided between moving sea bed activity, mostly in the South East of England, and the survey and resurvey of prioritised areas to modern standards. The majority of the MCA budget is spent in commissioning hydrographic survey contracts with commercial surveying companies. Contracts are awarded following tenders, with between five and seven companies routinely bidding for each contract.

The current MCA methodology for survey prioritisation uses a risk based approach, as recommended in the 1997 University of Wales Report. To assist in survey prioritisation, the MCA, in conjunction with the UKHO, intends to develop a risk matrix, which combines survey source data from the UKHO's Archive Catalogue with information of shipping movements derived from the Automatic Identification System (AIS). The MCA anticipated that, in time, AIS traffic data would replace the existing method of identifying trends in traffic density.

The MCA's own dedicated surveying resource is the Emergency Towing Vessel (ETV) *Anglian Sovereign* which has the ability to carry out modern multi-beam sonar survey work when not engaged in her primary role as an ETV or conducting other operational requirements. *Anglian Sovereign* is normally available to carry out survey work on 120 days annually.

The current status of Civil Hydrography around the UK coast is shown on UKHO chart Q6090 **(Figure 12)**.

1.7.7 Other surveying activity

1. The MoD

   The MoD establishes survey requirements for naval operations and activities around the UK coast. Defence priorities are not open to civil examination or discussion. The military survey programme operates separately from the CHP, although the two are interconnected. The Royal Navy's Hydrographic vessels are deployed worldwide with the exception of HMS *Gleaner*, which surveys mainly the UK Coast. Data is supplied for use on Admiralty charts and publications where appropriate. The UKHO liaises closely with the MCA to ensure there is no duplication of survey effort where this is possible.

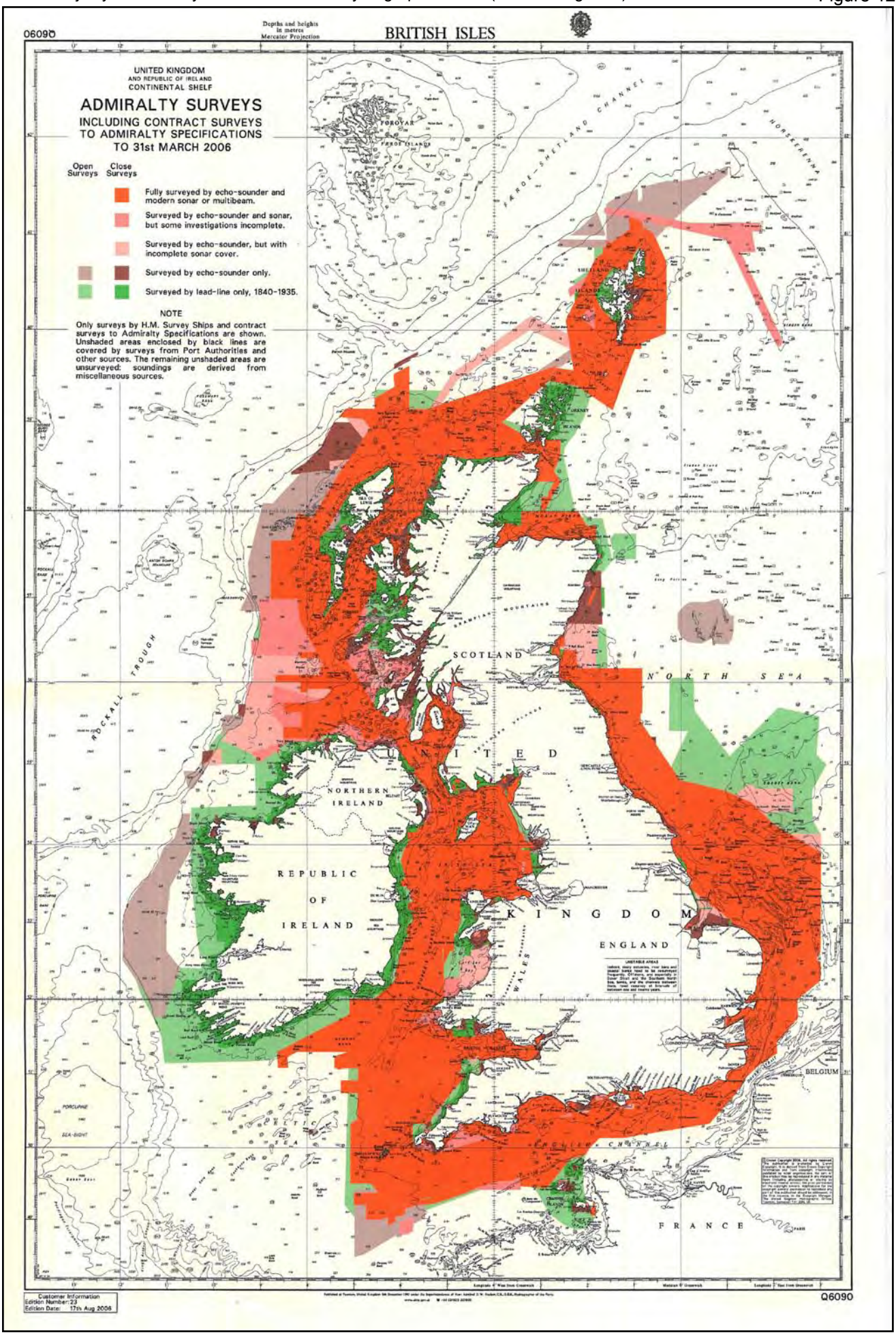
2. Harbour Authorities

   Port Authorities are responsible for survey data within their own Statutory Harbour Authority areas. Bi-lateral agreements on sharing survey data exist between most UK ports and the UKHO.

3. Supplementary survey data

   Additional survey information is obtained from commercial operators, such as major oil companies, and from reports sent by maritime users through Hydrographic Notices.

Figure 12



1.8 INTERNATIONAL HYDROGRAPHIC ORGANISATION

The International Hydrographic Organisation (IHO) Special Publication No.55 (S-55), dated 26 October 2006, aims to present a clear picture of the worldwide coverage of surveys and nautical charts. The database covers the waters of 90% of the coastal states of the world. The summary on 'Status of Hydrographic Surveys for Areas between 0 and 200m' published in IHO S-55 of October 2006 is attached at **Annex C**. The IHO table of survey status for depths up to 200m is reliant upon the accuracy of information supplied by the national hydrographer.

A sample of national survey records for depths up to 200m, drawn from IHO S-55, is shown in Table 1.

Table 1

	A1	**B1**	**C1**
Spain	95	5	0
Denmark	95	5	0
France	86	0	14
Italy	67	26	7
United Kingdom	45	24	31
Japan	40	53	7

A1 - Percentage adequately surveyed for depths of 0-200m

B1 - Percentage requiring re-survey at larger scale or to modern standards for depths of 0-200m

C1 - Percentage which has never been systematically surveyed for depths of 0-200m

In IHO S-55, the UK's survey priorities are noted as:

1. Top priority is a routine re-survey programme, principally in the south North Sea and Dover Strait

2. Priorities elsewhere for modern survey are:

   a. International routes: gaps in West part of English Channel; tanker route from Fair Island Channel around the North of Scotland

   b. Regional: approaches to the Firth of Forth

   c. Internal: areas on West coast of Scotland frequented by cruise liners.

The IHO has stated as a major deficiency in survey standards worldwide, that:

> *"Although coverage of both paper and electronic charts has increased, in many cases there has not been a concomitant improvement in the source data from which they are derived. The appearance of deeper draught shipping has also exposed the inadequacy of navigational products in many areas."*

1.9 CRUISE VESSEL TRAFFIC IN THE ORKNEY ISLANDS

In 2000, 57 cruise vessels, with a combined passenger capacity of around 15,000, called at the Orkney Islands.

The Orkney Islands Council Annual Performance Report of 2004/2005 states:

- *A year on year rise of cruise liner traffic has been evident in the period 1st April 2004 to 31st March 2005, with passenger numbers visiting Orkney increasing from 22,916 to 30,708, an increase of 34%. This increase is due to a record number of liners calling i.e. 75, and the fact that some of the larger liners had passenger numbers in excess of 2,000.*

- *Figures published by Cruise Europe in January 2006 indicate that yet again Orkney is the most popular destination in Scotland for Cruise liners and the 4th most popular call in the UK.*

In 2007, 69 cruise vessels were scheduled to call at the Orkney Islands, representing a passenger capacity of more than 39,000.

1.10 PREVIOUS ACCIDENTS

The MAIB database has no record of any vessels grounding on uncharted banks in UK territorial waters.

On 11 December 2004, the UK registered tanker *British Enterprise* grounded in the approaches to Istanbul. The vessel was aground for 5 days. There had been at least two other groundings in the anchorage in previous years.

Following the findings of the MAIB investigation into the grounding of *British Enterprise*, extensive areas of the Turkish coast were resurveyed.

SECTION 2 - ANALYSIS

2.1 AIM

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

2.2 THE ACCIDENT

The grounding occurred when the jack-up barge *Octopus*, with a draught of 13m, grounded on an uncharted 7.1m shoal. The charted depth at the grounding position, based on a 19th Century leadline survey, was 26m.

2.3 FATIGUE

Fatigue was not a factor in this accident. All personnel were apparently well rested prior to the voyage.

2.4 THE VOYAGE

2.4.1 The plan

The plan for the movement of *Octopus* from Seal Skerry Bay to Kirkwall was contained in the combined method statement produced by OpenHydro and McClaughlin & Harvey, in agreement with Melbourne Marine Services' marine consultant and the tug skippers. Passage planning considerations concentrated on the possibility of increased wave heights when wind and tide combined to cause excessive rolling of the barge, and on the wave height limitations on jacking up the barge.

Navigation planning was left to the knowledge and skill of the local tug skippers under the supervision of the marine consultant. The passage plan relied on the accuracy of the chart survey data for planning routes where the operation of vessels with draughts of up to 13m was untested. The local knowledge of the tug skippers did not lead them to comprehend that the area had not been systematically surveyed, or to anticipate the possibility that depths significantly less than charted could exist. The tug skippers were aware that discrepancies existed between actual and charted information close to the shore in some areas, but as no major depth reductions had been reported in recent years, the possibility of an uncharted bank existing in the area was not considered.

2.4.2 BA Chart 2250

The information available on BA Chart 2250 in the vicinity of the grounding was an accurate reflection of the information provided by the fair sheet from Lieutenant Commander George Thomas's survey of 1843 and 1844. The source diagram on the chart indicated the area to have been surveyed by British Government (leadline) 1839-1848. Additionally, the chart carried the warning that, *many of the depths in these areas have not been systematically surveyed. Depths in these areas are from miscellaneous lines of passage sounding or old leadline surveys. Uncharted dangers may exist.* Further warning about over reliance on old survey information was issued in NP 52 and NP 100.

Had either the tow master, barge master, or the skippers of the tugs involved, been able to see the 1840 survey fair sheet, it is possible that they would have been more circumspect about the dangers implied by the limited survey information available.

Had they been alert to the implication of the source data diagram they could then have more fully considered the options for the safe movement of *Octopus* from Kirkwall to Seal Skerry Bay. These options might have included:

- Surveying a deep draught route.
- Routing only along the tried and tested shipping route of the Falls of Warness.
- Limiting the maximum draught of *Octopus* while on passage.
- Planning to transit the critical areas of the route during periods of slack tide and benign weather.
- Waiting for the tidal strength to reduce from spring tide values to ensure the Falls of Warness route was achievable.

2.4.3 Local knowledge

The route to the east of the Green Holm islands through the Falls of Warness is the normal route for deep draught vessels because it has greater recorded depths than the route west of the Green Holm islands. The westerly route was used mainly by ferry traffic, with a draught of around 4m, and small fishing vessels. Although some local fishermen were apparently aware of the shoal 3 cables south-south-west of Little Green Holm Island, which they used for pot fishing during neap tides, its existence was not more widely known and it had not been reported to the UKHO. Further, unlike the close by Benlin Rock, charted depth of 8m, which produces a race in strong tides, the 7m shoal did not generate any effect that would draw mariners' attention to it. It is likely, therefore, that the local traffic, which passed over the shoal patch on numerous occasions, did so without being aware of its existence.

Harald's skipper felt he had extensive knowledge of the area, but he was unaware of the shoal's existence. Had he heeded the warnings on BA Chart 2250 and in the Mariners Handbook, he might have realised that his knowledge of traffic passing west of Little Green Holm Island pertained only to shallow draught vessels, and could not be applied to the 13m draught *Octopus*.

2.4.4 Recognised shipping routes

The guidance in the Mariners Handbook, NP 100 (see Section 1.6) indicates that, *in the vicinity of the recognised shipping lanes charts may be used with confidence for normal navigation needs*. NP 100 does not go on to quantify the term *'vicinity'*, nor does it add guidance on what constitutes a traffic lane.

The North Coast of Scotland Pilot, NP 52, section 5.271 indicates that any vessel transiting north-west into Westray Firth should use the preferred passage of the Falls of Warness to transit to the east of the Green Holm islands, although a master could choose the route to the west to avoid strong tidal streams or traffic, or simply for sightseeing. In this case, the route west of Little Green Holm Island cannot be construed as being in the vicinity of the *'recognised shipping lane'* to the east of the island, and therefore caution should have been applied.

In judging whether or not an area is a *'recognised shipping lane'*, consideration should be given as to whether the route is regularly used by vessels of the size and draught of the one whose passage is being planned. In this instance, traffic up to approximately 8m draught regularly used the passage to the east of Little Green Holm Island, and vessels of up to 4m draught frequently used the passage to the west.

2.4.5 Decision to divert west of Little Green Holm Island

The minimum depths expected once clear of the port of Kirkwall were in excess of 20m, and the tow master's decision to increase the draught of *Octopus* from 5m to 13m to increase stability, reduce rolling, and save time at the destination, was based on the charted information available and the advice of the tug skipper.

The subsequent choice of routing to the west of Little Green Holm Island was made due to the strength of tide being experienced on passage. Routes both east and west of Little Green Holm had been evaluated prior to the voyage, and both options were considered to be acceptable, with the final decision being made on the tide and swell conditions encountered during the voyage.

2.4.6 The method statement

The method statement did not identify the maximum permitted draught for the voyage, and the depth at which the legs were extended was left to the discretion of the tow masters and tug skippers. In using the routes either side of the Green Holm Islands, the plan did not take into account the limitations of the chart in use, and did not question the local tug skipper's knowledge of operating deep draught vessels in the area. During the planning stages, the option to pass to the west of little Green Holm Island did not acknowledge that this route was primarily used by shallow draught vessels, whereas the route to the east had been tested by deeper draught vessels via the Falls of Warness.

As the hazard of incorrect charted depth had not been identified, the options outlined at 2.4.2 were not considered.

2.5 STANDARD OF UK SURVEY

2.5.1 Orkney Islands Survey Standard

Much of the area in the Orkney Islands is surveyed to 19th Century standards with leadline surveys still prevalent in the area. The area in the Falls of Warness where the grounding occurred was last surveyed more than 150 years ago. As MCA budgets allow, the area is surveyed to modern standards. Surveying the waters to the east of the Islands was progressed in 2006, as was the area to the north of the grounding. However, this survey stopped 200m short of the shoal patch. The surveys had led to numerous depth alterations and changes, although none of these corrections were of the same magnitude as the reduction in depth from 26m to 7.1m.

That the UKHO was not aware of the shoal patch in the area was primarily due to the lack of hydrographic survey. However, the area was frequently transited by vessels fitted with echo sounders and some of these could have been aware of the shoal patch. Also, the area to the south of the Green Holm Islands was infrequently used by local fishermen, and they might have been aware of its presence. While a depth of 7m might be of little concern to the local user, it could have been catastrophic to a cruise vessel or tanker of sufficient draft. Had any of the local traffic reported the possible existence of an uncharted shoal in the area, either by Hydrographic Note or to the local Coastguard, earlier action could have been taken to accurately survey the hazard.

2.5.2 MCA survey progress

The CHP budget in 1982 was around £5m. The 2003 IHMC report recommended, *as a high priority*, the doubling of the CHP budget to attempt to improve the rate at which 19th Century surveyed areas would be resurveyed to modern standards, yet in 2006 the MCA's budget for hydrographic survey was still only £5.4m.

Since the setting of the budget for the CHP of around £5m in 1982, the real value of this figure has reduced considerably over the intervening period. While savings have been achieved by the use of modern survey methods and by the use of contracted surveying in lieu of RN assets, the static budget still represents a significant reduction in funding over time.

Although the IHMC's 2003 report was tabled and accepted at the annual meeting of the CHRC in January 2004, no subsequent request for additional funding has been made to DfT.

Further, at the time of this investigation, work had still to start on the MCA's new risk matrix for identifying survey priority, by combining AIS data with survey source data.

2.6 ELECTRONIC CHART INFORMATION

Progress in transferring chart survey source data into CATZOC for use with electronic charts is being progressed worldwide as resources allow. At this early stage in the process, while the definitions of CATZOC are in the Mariners Handbook, and the data is available to ECDIS users, the industry's understanding of the system appears limited.

While the modern British Admiralty metric-style colour charts might give a misleading impression of their accuracy to inexperienced mariners, the current system of displaying source data, with its associated warnings, does ensure the information can be read by those who know what they are looking for. Of more concern is that many electronic navigation and charting systems using vector chart presentations, either do not display source data at all, or contain the information in sub-menus. MAIB's experience from previous accidents is that the training of watchkeepers in the use of ECDIS and ECS systems is, at best, patchy and that many are only able to use the systems' most basic functions. Specific concerns include:

- CATZOCs do not provide the navigator with the detail currently shown in the source data diagrams on paper chart.
- On ECDIS displays, CATZOC data is available, but has to be operator selected. Depending on the make/model of the ECDIS, this selection could be in any of the sub-menus.
- ECS displays that use official electronic charts, are not always able to display CATZOC information, even when it is available, and basic ECS systems that use unapproved charts may not display CATZOC at all. Numerous vessels now carry ECS as a supplementary aid to their approved paper charts, but by default it has become the primary method of navigation for some navigators.

In this accident, *Harald*'s skipper was navigating using both paper charts and a monochrome electronic vector chart plotter with Seatrack software. The Seatrack software system was primarily aimed at the leisure market and did not display CATZOC.

2.7 CRUISE SHIPS AND OTHER DEEP DRAUGHT VESSELS

For a cruise vessel to call into Kirkwall, from either the east or west, it must pass through an area for which the chart is reliant on a 19th Century leadline survey as its data source.

The recent increase in size, draught and number of cruise vessels transiting areas of 19th Century leadline survey is of concern. Had one of these deeper draught cruise vessels chosen to route west of Little Green Holm Island, the consequences could have been catastrophic.

The increase in renewable and offshore traffic operating in the Orkney Islands also increases the likelihood of previously uncharted hazards posing a risk to navigation.

SECTION 3 – CONCLUSIONS

The following safety issues have been highlighted by this investigation. They are not listed in any order of priority.

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

- Melbourne Marine Services
  - The tug skipper and the tow master relied upon 19th Century leadline surveyed charts for the passage of a deep draught vessel outside of a *recognised traffic route*. [2.4.1, 2.4.4]
  - The passage plan and execution underestimated the effect of tidal stream on the tug and tow. [2.4.2, 2.4.6]
- Surveys
  - Depths that are significantly less than charted might exist around the UK coastline. The hazard of the bank was not identified as this was not charted. [2.4.2]

3.2 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION ALSO LEADING TO RECOMMENDATIONS

- An increase in commercial activity, particularly of large cruise vessels, is noted in the Orkney Islands. [2.4.4]
- Electronic charts
  - The significance of CATZOC is not fully understood by many operators. [2.6]
  - The use of CATZOC is an ECDIS menu option and is therefore not immediately available to the navigator. [2.6]
  - CATZOC is unavailable on many unapproved ECS and chart plotters. [2.6]

SECTION 4 - ACTION TAKEN

None

SECTION 5 – RECOMMENDATIONS

2007/165 **The Department for Transport** and **The Maritime and Coastguard Agency** are recommended to:

- Review the future work schedule for the UK Civil Hydrography survey programme, taking into account the priorities identified by MCA Research Project 512, the Committee on Shipping Hydrography and the MCA, particularly in light of the increasing use by large cruise vessels of sea areas not surveyed to modern standards.

2007/166 **The United Kingdom Hydrographic Office** and **The Maritime and Coastguard Agency** are recommended to:

- Agree wording and put forward to the IHO/IMO a proposal that the relevant working groups investigate ways of ensuring that ECDIS displays provide a clear warning or indication to the mariner whenever the survey data used to produce the electronic chart in use is of poor quality.

M2007/167 **Cruise Lines International Association, Passenger Ship Association, International Marine Contractors Association** and **British Wind Energy Association** are recommended to:

- Through its membership, promulgate to ship owners the safety lessons identified in this report in order for them to emphasize to their shipmasters and navigating officers the need to carefully consider chart source data and “Category of Zone of Confidence” (CATZOC) when planning and executing navigational passages.

2007/168 **Melbourne Marine Services** and **Orkney Towage Limited** are recommended to fully consider, when planning the passage of deep draught vessels:

- the quality of survey data.
- the potential effect of tidal conditions.

Marine Accident Investigation Branch
August 2007