ACCIDENT REPORT

Report on the investigation of

the grounding of the chemical tanker

Key Bora

in the approaches to Kyleakin pier, Isle of Skye, Scotland

on 28 March 2020

SERIOUS MARINE CASUALTY REPORT NO 15/2021 DECEMBER 2021

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

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NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

2/O	-	Second Officer
BA	-	British Admiralty
BRM	-	Bridge resource management
C/O	-	Chief Officer
CHP	-	Civil Hydrography Programme
DfT	-	Department for Transport
DH	-	Duty Holder
DP	-	Designated Person
ECDIS	-	Electronic chart display and information system
EIA	-	Environmental impact assessment
ENC	-	Electronic navigational chart
ETA	-	Estimated time of arrival
GTGP	-	Port Marine Safety Code, Guide to Good Practice
HEO	-	Harbour Empowerment Order
HW	-	High water
IMO	-	International Maritime Organization
kts	-	Knots
LNG	-	Liquid natural gas
LOA	-	Length overall
LW	-	Low water
m	-	metre
MBES	-	Multibeam echo sounder
MCA	-	Maritime and Coastguard Agency
mm	-	millimetre
MPA	-	Marine Protected Area
MSMS	-	Marine safety management system
NLB	-	Northern Lighthouse Board
nm	-	Nautical mile
NRA	-	Navigation Risk Assessment
OOW	-	Officer of the Watch

PMSC	-	Port Marine Safety Code
SHA	-	Statutory Harbour Authority
SMS	-	Safety management system
t	-	Tonne
UKC	-	Under keel clearance
UKHO	-	United Kingdom Hydrographic Office
UTC	-	Universal time coordinated

TIMES: all times used in this report are UTC unless otherwise stated.

Image courtesy of MarineTraffic (marinetraffic.com)

Key Bora

SYNOPSIS

At 1505 on 28 March 2020, the Gibraltar registered chemical tanker *Key Bora* ran aground at Kyleakin pier, Isle of Skye, Scotland. *Key Bora*'s hull was holed by the grounding and floodwater entered empty ballast tanks; there was no injury or pollution.

Key Bora was approaching Kyleakin pier, and the master was conning from the starboard bridge wing console. This was the first time that the vessel and the master had arrived at this pier and the berthing had been planned to coincide with low water, when slack tidal stream was expected. When *Key Bora* was very close to the pier, it ran aground on a charted 4.9m obstruction. After 12 minutes aground, *Key Bora* floated free and was berthed using its own power.

Key Bora ran aground because its passage plan had been based on inaccurate information, including a dredge survey that did not show the charted hazard where the vessel grounded, and misleading tidal stream information. Additionally, the vessel's electronic chart display and information system had not been used effectively by the crew to warn of danger ahead.

The investigation also identified significant weaknesses in the safety management of the Kyleakin pier, owned and operated by the aquaculture company Mowi Scotland Limited. This included that the site was not being operated in accordance with the Port Marine Safety Code, and there was no marine safety management system. Mowi Scotland Limited had cited both items as risk mitigation measures in its application to Marine Scotland to build the pier; however, these measures had not been implemented before operations commenced. This happened because there was no process in place to ensure that risk mitigation measures, described in the licence application, were in place before operations commenced.

Since the accident, Marine Scotland has added a standard condition to all marine licences requiring licensees to carry out the licensable activity in accordance with the licence, the application, and all plans and programmes submitted as part of the application. This report makes a recommendation to Mowi Scotland Limited to ensure that marine operations at Kyleakin follow the guidance in the Port Marine Safety Code, and to consider upgrading the facility to a statutory harbour authority.

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF *KEY BORA* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Key Bora*
Flag	Gibraltar
Classification society	Bureau Veritas
IMO number	9216024
Type	Chemical tanker
Registered owner	Key Shipping AS, Norway
Manager	V.Ships UK Limited
Construction	Steel
Year of build	2006
Length overall	92.86m
Registered length	86.9m
Gross tonnage	2627t
Minimum safe manning	10
Authorised cargo	Liquid chemicals

VOYAGE PARTICULARS	
Port of departure	Esbjerg, Denmark
Port of arrival	Kyleakin, Scotland
Type of voyage	International
Cargo information	500t-lecithin; 1500t-rapeseed oil; 1090t-fish oil
Manning	12

MARINE CASUALTY INFORMATION	
Date and time	28 March 2020 at 1505 UTC
Type of marine casualty or incident	Serious Marine Casualty
Location of incident	Kyleakin, Isle of Skye, Scotland
Place on board	Hull
Injuries/fatalities	None
Damage/environmental impact	Hull breached/no environmental damage
Ship operation	Underway
Voyage segment	Arrival
External & internal environment	Daylight, overcast with the wind from northwest force 3, sea state smooth, with good visibility
Persons on board	12

1.2 NARRATIVE

1.2.1 Events prior to the grounding

Key Bora sailed from Esbjerg, Denmark, on 26 March 2020 laden with a liquid chemical cargo bound for Kyleakin, Isle of Skye, Scotland **(Figure 1)**. During the morning of 28 March 2020, the master notified the agent that the arrival time would be 1500 that afternoon, planned to coincide with low water when slack tidal stream was anticipated. The master also informed the agent that the vessel's arrival draughts would be 5.4 metres (m) forward and 6.2m aft.

Image courtesy of Google Earth (earth.google.com)

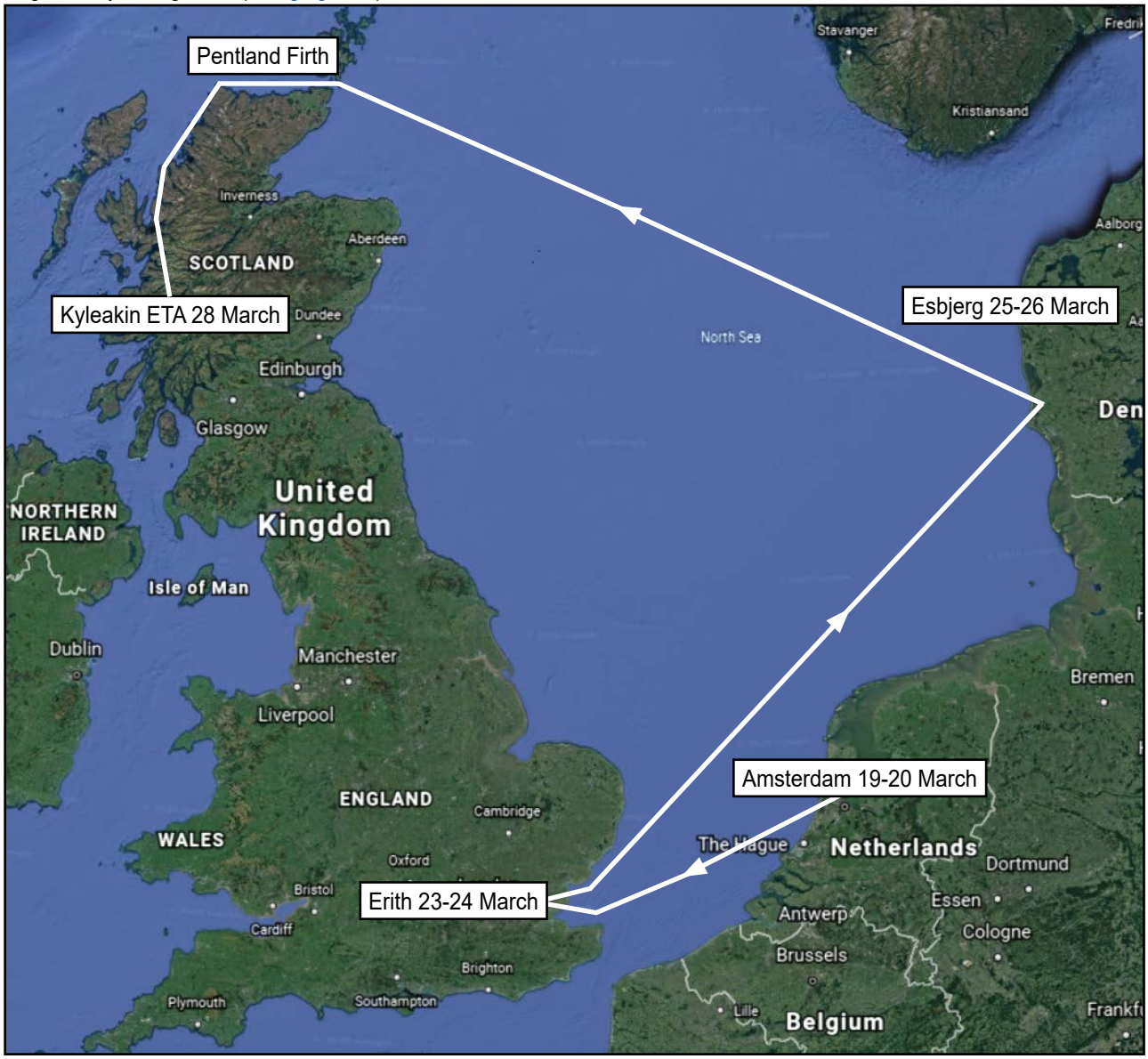

Figure 1: *Key Bora*'s voyage

At 1410 when *Key Bora* was 3 nautical miles (nm) from Kyleakin, the master came to the bridge and took over conning the vessel from the officer of the watch (OOW). A pre-arrival brief was held on the bridge attended by the master and the second officer (2/O), who was the OOW. In the approaches to Kyleakin the visibility was good, the sea state was smooth and there was a gentle north-westerly breeze.

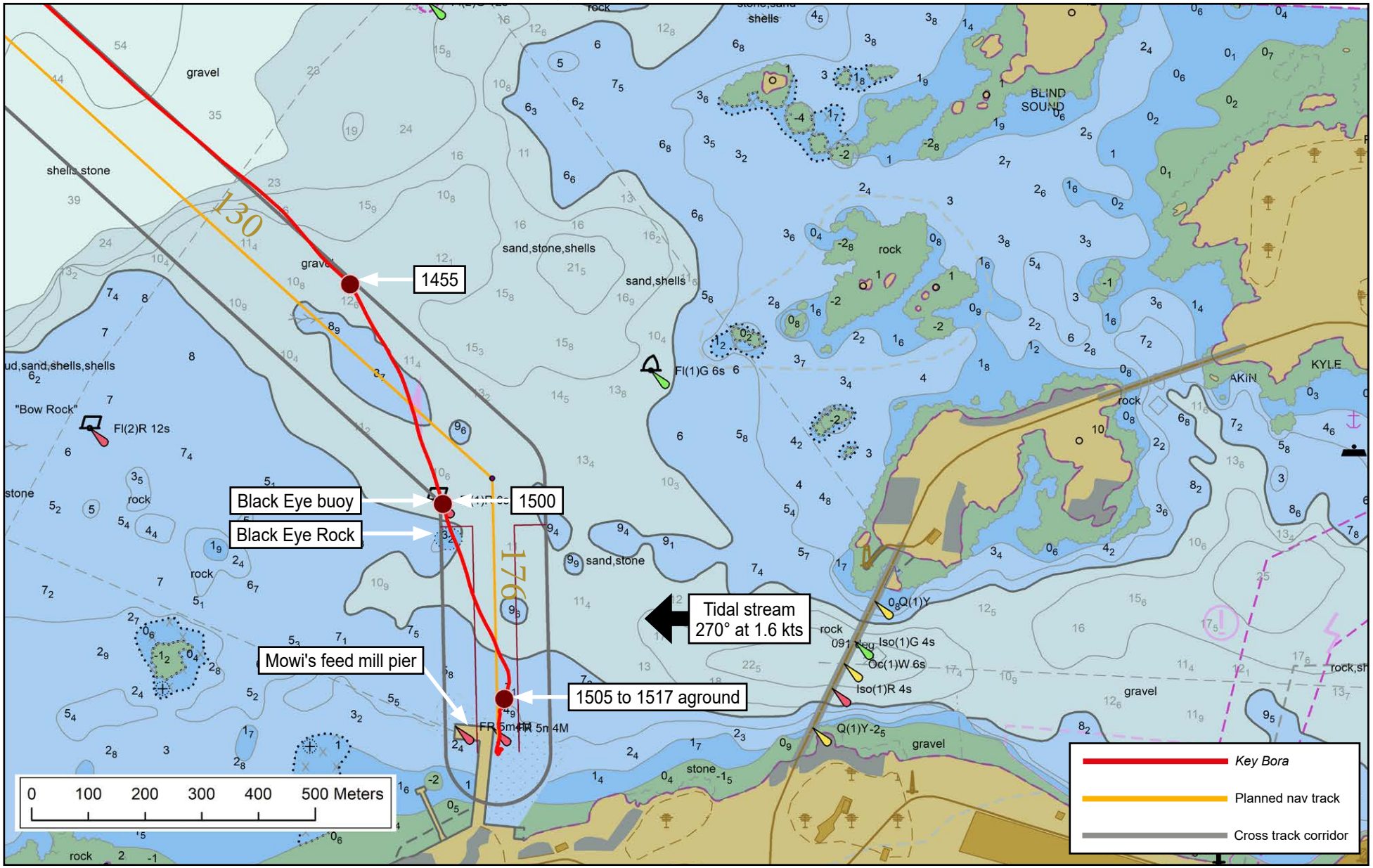

Figure 2: *Key Bora*'s approach to Kyleakin

At 1445, the master reduced *Key Bora*'s speed to 4 knots (kts). At about the same time[1], the chief officer (C/O) arrived on the bridge to take over as OOW. The 2/O and C/O conducted their handover, then the 2/O left the bridge and went to the forecastle in preparation for berthing.

After taking over as OOW, the C/O commenced monitoring the passage towards the berth using the electronic chart display and information system (ECDIS). At 1455, as *Key Bora* approached Black Eye buoy, the speed was further reduced to 2kts **(Figure 2)**. At about the same time, the master moved to the starboard bridge wing console where he could control the vessel's heading and speed; he could also see Black Eye buoy and visually assess the approach to the berth. From the ECDIS display **(Figure 3)**, the C/O noticed that the vessel was passing very close to the buoy, so he warned the master of this potential danger.

Having passed Black Eye buoy, the master assessed that the vessel was also clear of Black Eye Rock and started concentrating on the approach to the pier, 400m away. As *Key Bora*'s speed reduced, the master made a succession of alterations of course to port in an attempt to counter the effect of the apparent tidal stream. With about 100m to go to the berth, the master found he had to steer 134° for *Key Bora* to regain its 176° planned navigational track.

In the final approach, the C/O advised the master of a 4.9m charted depth just north of the pier; the master responded that the echo sounder was reading 7.0m depth of water so he was content to proceed with the berthing.

Image courtesy of V.Ships Ltd (vgrouplimited.com)

Figure 3: Screenshot of *Key Bora*'s ECDIS display as vessel passed Black Eye buoy

[1] *Key Bora* was operating in UTC+1 so the OOW handover was scheduled for 1600 local time. This report is in UTC, which was the local time in the UK on the day of the accident.

1.2.2 The grounding

At 1505, and 50m north of the pier, *Key Bora* shuddered, the bow swung to the south and it came to a stop **(Figure 4)**. Realising that the vessel was aground, the master attempted to manoeuvre clear using the engines, rudder and bow thruster, but without success.

Image courtesy of V.Ships Ltd (vgrouplimited.com)

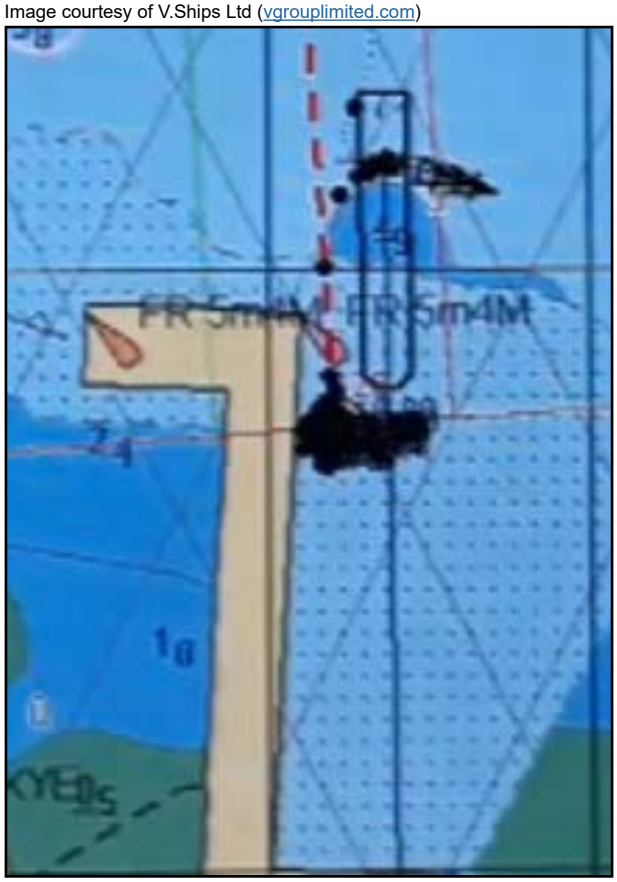

Figure 4: Screenshot of *Key Bora*'s ECDIS display as vessel grounded on the 4.9m hazard

The C/O went to the cargo office where he observed that the water level was rising in No.5 main ballast tank that had been empty, so he started the ballast pumps in an attempt to control the flooding. The C/O then went to the upper deck and, using a sounding line, checked the depth of water around the vessel and found depths of 7.0m at the bow and both sides, and 7.5m aft. The C/O briefed the master about the observed depths and that No.5 main ballast tank was flooding; there were no other reports of damage, with steering and propulsion responding normally.

The master continued to try and manoeuvre the vessel clear from the obstruction and, at 1517, *Key Bora* refloated and was berthed at the pier using its own power.

1.2.3 Post-accident events

Once alongside, *Key Bora*'s master informed the company's designated person (DP) about the grounding. The following day, a diver inspection revealed hull damage, including shell plating ruptures **(Figure 5)**. Once the cargo had been discharged, and with dispensation from its classification society, *Key Bora* proceeded to Glasgow for dry docking and repairs.

Image courtesy of V.Ships Ltd (vgrouplimited.com)

Figure 5: Grounding damage to *Key Bora*'s hull

1.3 *KEY BORA*

1.3.1 Background

Key Bora was a 2,627 gross tonne (gt) double-hulled liquid chemical tanker, employed to deliver cargoes between European ports. *Key Bora*'s typical operating pattern was 24 to 48 hours at sea followed by 12 to 36 hours in port. During February 2020, *Key Bora* had conducted 17 port calls to either load or discharge cargo – on every occasion, a pilot was embarked to advise on navigation and berthing.

Key Bora's bridge **(Figure 6)** had a centreline console that comprised of engine, rudder and bow thruster controls, flanked by two radar displays and the ECDIS display. There was also a conning control console on each of the enclosed bridge wings.

Key Bora's primary means of navigation was a Transas 4000 ECDIS that was configured to receive positional information from one of the vessel's two differential global positioning system receiver sets. The ECDIS also received inputs from the vessel's speed log, gyro compass and echo sounder. *Key Bora*'s radars were not interfaced to the ECDIS. The electronic navigational charts (ENC) were updated automatically. At the time of the accident, all the navigational equipment was operating correctly.

Image courtesy of V.Ships Ltd (vgrouplimited.com)

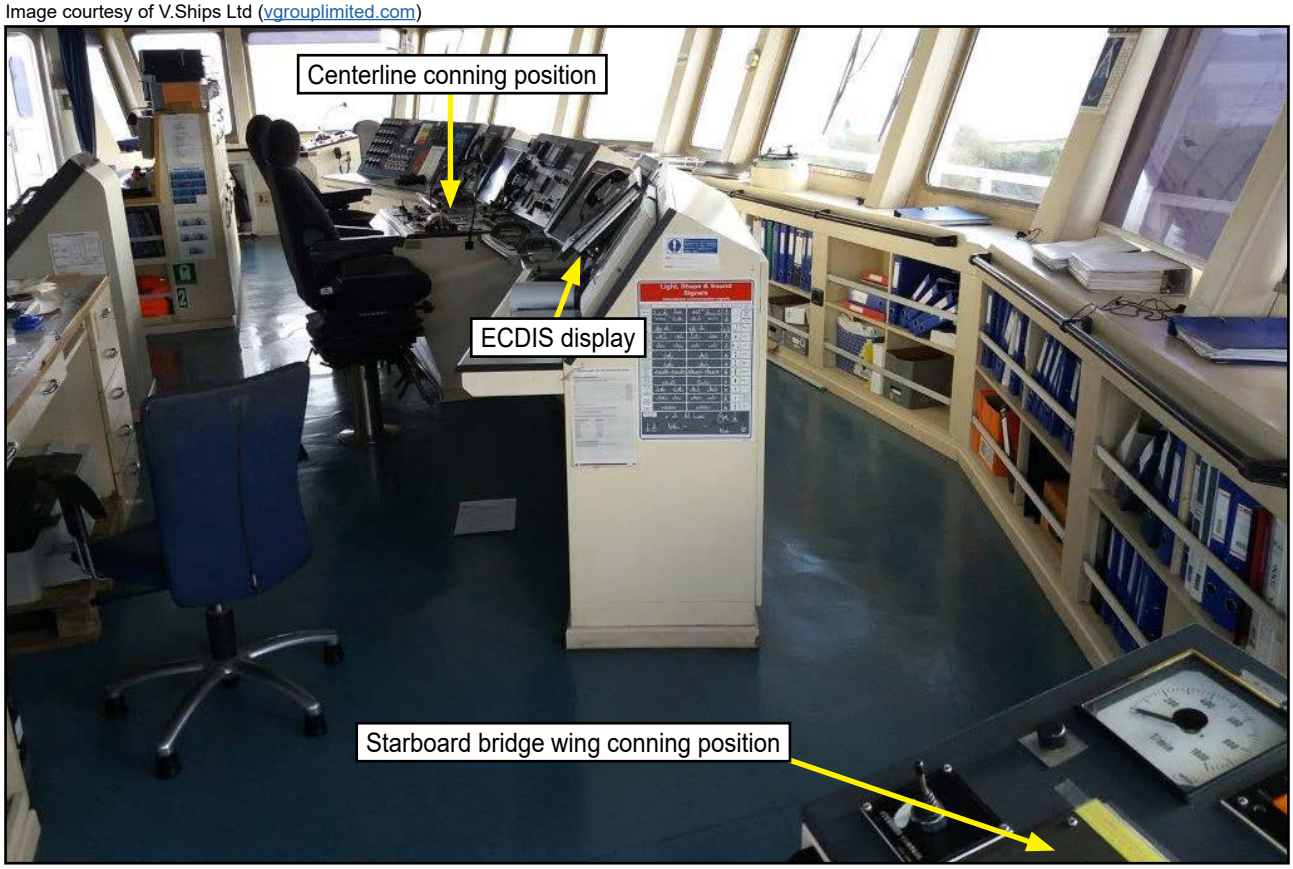

Figure 6: *Key Bora*'s bridge viewed from starboard bridge wing conning position

1.3.2 Ownership and safety management

Key Bora was owned by Key Shipping AS, Norway, registered in Gibraltar and managed by V.Ships UK Limited (V.Ships). V.Ships' Document of Compliance, confirming that the company's safety management system (SMS) met the requirements of the International Maritime Organization's (IMO) International Safety Management Code (ISM Code), was issued by the Government of Gibraltar on 1 July 2017 and was valid until 30 June 2022.

V.Ships provided a generic SMS for use by all vessels under management, which was published electronically and could be accessed by the crew on any of the vessel's computers.

1.3.3 Crew

Key Bora's crew comprised of 6 officers and 6 crew who were all suitably qualified for their roles in accordance with the minimum safe manning certificate.

The master was a 48-year-old Polish national who had worked at sea for 30 years. He had over 15 years' experience in chemical tankers, including 8 years as master. This was his first contract with V.Ships, and he had joined *Key Bora* in February 2020. The master did not keep watches at sea. The Turkish C/O, Romanian 2/O and Turkish third officer kept a 1-in-3 watchkeeping schedule at sea.

1.3.4 Bridge resource management

Effective bridge resource management (BRM) was described in the following extract from the International Chamber of Shipping's Bridge Procedures Guide: '*a bridge team which has a plan that is understood and is well briefed, with all members supporting each other, will have good situational awareness. Its members will then be able to anticipate dangerous situations arising and recognise the development of a chain of errors, thus enabling them to take action to break the sequence*.'

There are six recognised tools that can be used to achieve effective BRM: a shared mental model or plan, effective communication, challenge and response, short-term strategy, situational awareness and error management.

Key Bora's master and deck officers had all completed an IMO approved BRM course.

Key Bora's SMS reinforced the importance of BRM and included a layered system of bridge manning to meet increasing levels of anticipated workload. These manning states ranged from Level 1 for open sea daylight passage, to Level 8 for highly demanding navigation scenarios. For pilotage in the approaches or departure from harbour, the SMS prescribed Level 4 manning, which required the presence on the bridge of the master, the OOW, a helmsman and a lookout. The SMS also emphasised the importance of good communications and situational awareness for effective BRM.

When a pilot was embarked, the practice on board *Key Bora* was for only the master and the pilot to be on the bridge. The other deck officers were either supervising the fore and aft berthing teams or resting, to compensate for the pressures of watchkeeping and the frequent arrivals and departures. On this occasion, the master and C/O were on the bridge although the C/O had not attended the pre-arrival brief.

1.3.5 Navigational audits

V.Ships' SMS stated that on board navigational audits were required to '*check that navigational practices and bridge procedures are correct and consistently applied*.' The master was responsible for this process, which was required to be conducted within 4 weeks of joining. The master of *Key Bora* had not completed a navigational audit since joining the vessel in February 2020.

1.4 PASSAGE PLANNING

1.4.1 Guidance

The IMO's Resolution A.893(21) *Guidelines for Voyage Planning* provided guidance for passage planning, stating that every voyage should be planned, taking all hazards into account and ensuring sufficient sea room for safe navigation. The IMO guidelines explained that the '*development of a plan for voyage or passage, as well as the close and continuous monitoring of the vessel's progress and position during the execution of such a plan, are of essential importance for safety of life at sea, safety and efficiency of navigation and protection of the marine environment*.'

Key Bora's SMS required the master to review all relevant navigational information for the passage. It also required the master to consult with the V.Ships office '*prior to visiting infrequently visited ports and if receiving contradictory information from more than one source*.' The SMS required the navigation officer[2] to plot the intended passage, marking all areas of danger and safe passing distances from identified hazards. To ensure that each step of the SMS's planning process had been followed, it was guided by a series of passage planning checklists **(Annex A)**.

1.4.2 Pre-arrival information package

Key Bora's agent for the Kyleakin operation was Frank Armitt and Son Limited (the agent) based in Runcorn. The agent's services were delivered remotely, and the staff did not have any local maritime experience.

On 20 March, the agent sent an email to *Key Bora*'s master, entitled '*relevant jetty information*'. This package of pre-arrival information **(Annex B)** had been sent to every vessel that had berthed at Kyleakin pier since operations had commenced there in March 2019. The information about the pier had been provided to the agent by Mowi Scotland Limited (Mowi), the owner and operator of the Kyleakin facility.

The agent's pre-arrival email to the vessel notified the master that there were no pilotage services available, but that soundings of the jetty were attached. It further stated that '*vessels are always afloat while alongside, with max LOA*[3] *160m and max draft* [sic] *6.5m*.' The email also advised the master that:

> *Contrary to the advice provided on some tidal stream atlases, please be advised that the tide floods from East to West. The tidal streams run about 3 to 3.5 knots past Kyle of Lochalsh, with the east going stream starting 4 hours and 20*

[2] *Key Bora*'s 2/O was assigned navigation officer duties.

[3] Length overall.

minutes before HW[4] Ullapool on Neaps. The west going stream starts 4 hours after HW Ullapool on Springs and 6 hours after HW Ullapool on Neaps. Slack water is for a short period at HW and LW[5].

The agent's email providing pre-arrival advice also had the following attachments:

- A post-dredge multibeam echo sounder (MBES) survey of Kyleakin pier dated 30 August 2018, which did not show the 4.9m obstruction.
- Figures from the pier's Navigational Risk Assessment (NRA), showing the recommended approach/departure route to/from the north and east jetty.
- A photocopied extract of the UK Admiralty paper chart (BA2540) showing the Kyleakin/Kyle of Lochalsh area, which did not show the 4.9m obstruction.
- The 2020 tide tables for Kyleakin.

1.4.3 Preparation of *Key Bora*'s passage plan for arrival at Kyleakin

Key Bora's 2/O constructed the passage plan from Esbjerg to Kyleakin using the vessel's ECDIS and the SMS checklists **(Annex A)**. When planning the approach to the pier on the ECDIS, the 2/O had calculated that the safety contour and safety depth between the end of sea passage and the berth would be 6.48m. The abort point[6] for the passage plan was identified in the vicinity of Bow Rock buoy. The 2/O also observed that the ENC in use displayed a 4.9m charted depth, 50m north of the pier, which would prevent *Key Bora* from safely berthing at low water.

The 2/O discussed the 4.9m charted depth with the master. The ECDIS ENC data was compared with the local survey chart and the photocopy extract of Admiralty chart BA 2540 provided by the agent, neither of which showed the 4.9m feature. Having reviewed the matter, the master directed the 2/O to complete the passage plan ignoring the 4.9m charted depth on the ENC. This decision was based on the fact that the agent's pre-arrival information was from a trusted source and appeared relevant, accurate and current. The master also assumed that the ECDIS ENC was still to be updated with the latest information. The master had not berthed in Kyleakin before, and this matter was not raised with V.Ships, despite an SMS obligation to notify the manager when the vessel was scheduled to operate in a port or harbour for the first time.

1.4.4 ECDIS safety contour and look ahead function

Safe and unsafe areas on an ECDIS are delineated by the safety contour. This is determined by calculation of the safety depth value that takes the vessel's draught, squat, minimum acceptable under keel clearance (UKC) and the height of tide into account. If the calculated safety depth does not correspond to a contour on the ENC in use, ECDIS will automatically default to the next deeper contour.

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[4] High water.

[5] Low water.

[6] The abort point was identified as the position where, if for any reason such as equipment failure etc, the vessel would be able to turn without assistance of tugs and return to open water.

For the approach to Kyleakin, *Key Bora*'s ECDIS safety depth was set at 6.48m. As this depth did not match one of the five charted depth contours[7] on the ENC in use, the ECDIS defaulted to the deeper, charted 10m contour. This meant that if the vessel followed the planned navigational track, it would have to cross the 10m safety contour to reach the berth. In these circumstances, *Key Bora*'s SMS referred the crew to advice in Admiralty Nautical Publication, *The Admiralty Guide to ECDIS Implementation, Policy and Procedures (NP232)*. This described two methods of configuring ECDIS to safely cross the safety contour:

- NP232's Method 1 left the deeper contour displayed (in this case 10m) and required the operator to visually assess that the passage was safe.

- NP232's Method 2 required the operator to set the safety contour to the next shallow contour (in this case the 5m contour) and construct a manual safety contour or 'no-go line' delineating the boundary between safe and unsafe water.

As *Key Bora* approached Kyleakin, the ECDIS safety contour had defaulted to 10m and the crew had not planned how to delineate safe and unsafe areas in the berthing approach.

Forewarning of navigational danger when using ECDIS was primarily provided by using the look ahead feature. *Key Bora*'s SMS required the crew to use this as the '*final layer of safety should a navigational danger be missed…*' The SMS recommended that in restricted waters the look ahead feature should be set 5° either side of the vessel's course made good, extending out to a distance run of between 1 and 6 minutes ahead. *Key Bora*'s ECDIS look ahead feature had not been configured for the vessel's entry to Kyleakin.

1.4.5 Tidal stream

The effect of tidal stream in the area is significant and flows east and west at rates of up to 2kts. In preparing the plan, slack water had been anticipated by the 2/O and the master based on the pre-arrival email that stated that it occurred around the times of high and low water **(Annex B)**. Low water at Kyleakin on 28 March 2020 was at 1515 with a height of 1.1m, and the plan was to arrive around this time. The next daylight slack water was assessed to be just over 19 hours later at 1023 on 29 March 2020, with a height of 4.7m.

On board *Key Bora*, tidal stream data was available from the Admiralty tidal stream atlas[8], or the 'TotalTide' software. Both these references showed that, at the intended time of arrival, the tidal stream would be setting in a westerly direction at a rate of about 1.6kts. Using these references, slack water would have been at about 1325[9].

[7] ENC GB50743D had five contours at depths of 0m, 2m, 5m, 10m and 15m.

[8] NP218, Tidal stream atlas: north coast of Ireland and west coast of Scotland.

[9] Tidal diamond information indicates that slack waters was approximately 4.5 hours after HW Ullapool (0855).

1.5 HYDROGRAPHIC INFORMATION

1.5.1 National obligations and UK Hydrographic Office actions

The IMO's International Convention for the Safety of Life at Sea (SOLAS), Chapter V, Regulation 9 requires IMO member states to provide nautical and hydrographic services that are suitable for safe navigation. This is provided in the UK through the Civil Hydrography Programme (CHP). The CHP is managed by the Maritime and Coastguard Agency (MCA), with responsibility for analysis and publication of data being provided by the UK Hydrographic Office (UKHO).

The sea area around Kyleakin had been routinely surveyed using MBES as part of the CHP in 2013 and 2019. When the results of the 2019 survey were analysed by the UKHO, a new isolated feature with a spot charted depth of 4.9m was identified, 50m north of the recently constructed pier at Kyleakin. Once this data had been scrutinised and validated by the UKHO, a chart correction was issued which inserted the 4.9m feature on to the ENC **(Figure 7)**.

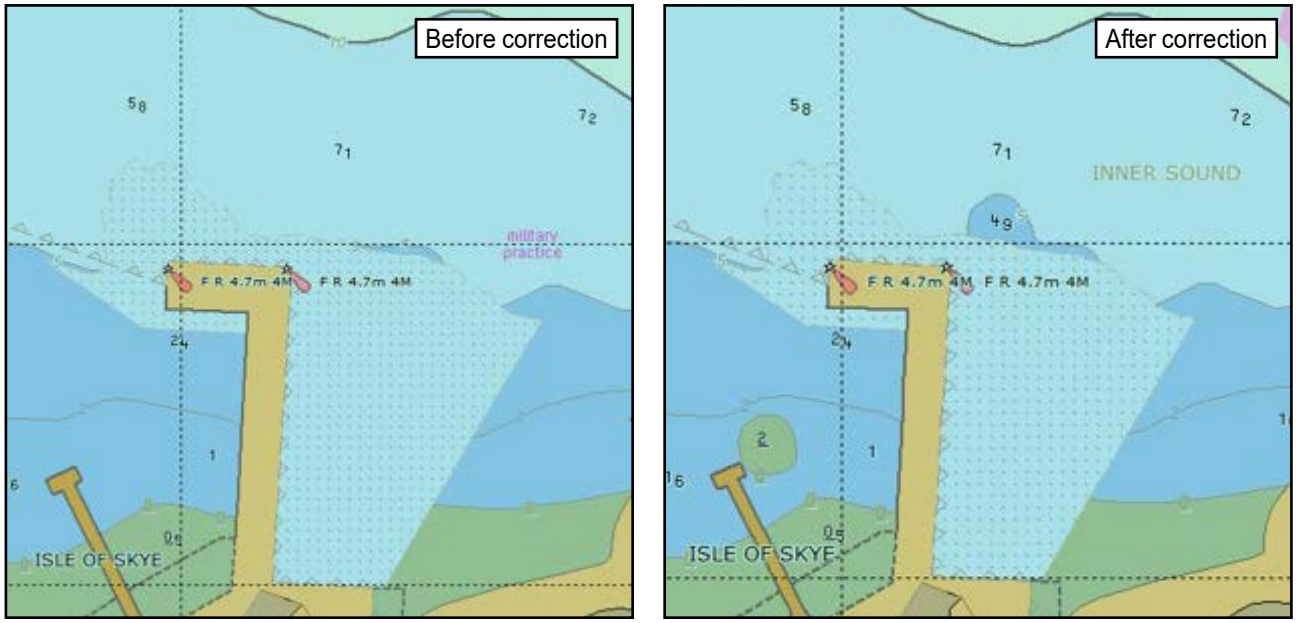

Figure 7: Copy of the ENC before and after 20 March 2020 correction

The UKHO's ENC correction had been automatically downloaded into *Key Bora*'s ECDIS system on 20 March, 8 days prior to the accident. ECDIS includes a 'view update' operator function to indicate when changes have been made to an ENC. Neither *Key Bora*'s 2/O or the master had checked the update status of the ENC as part of the planning process and both were unaware that the 4.9m obstruction was a recent correction.

With the co-operation and assistance of the UKHO, the MAIB was granted access to the 'raw' data from the 2013 and 2019 CHP surveys of the area. This showed that the seabed feature identified during the 2019 survey in the location of the grounding and subject to the 2020 chart correction had not been present during the 2013 survey. **Figure 8** shows a comparison of the 2013 CHP data soundings (yellow) and the 2019 CHP data soundings (white).

Image courtesy of the UK Hydrographic Office, showing the 2019 Civil Hydrography Programme survey, with the 2013 spot depths superimposed

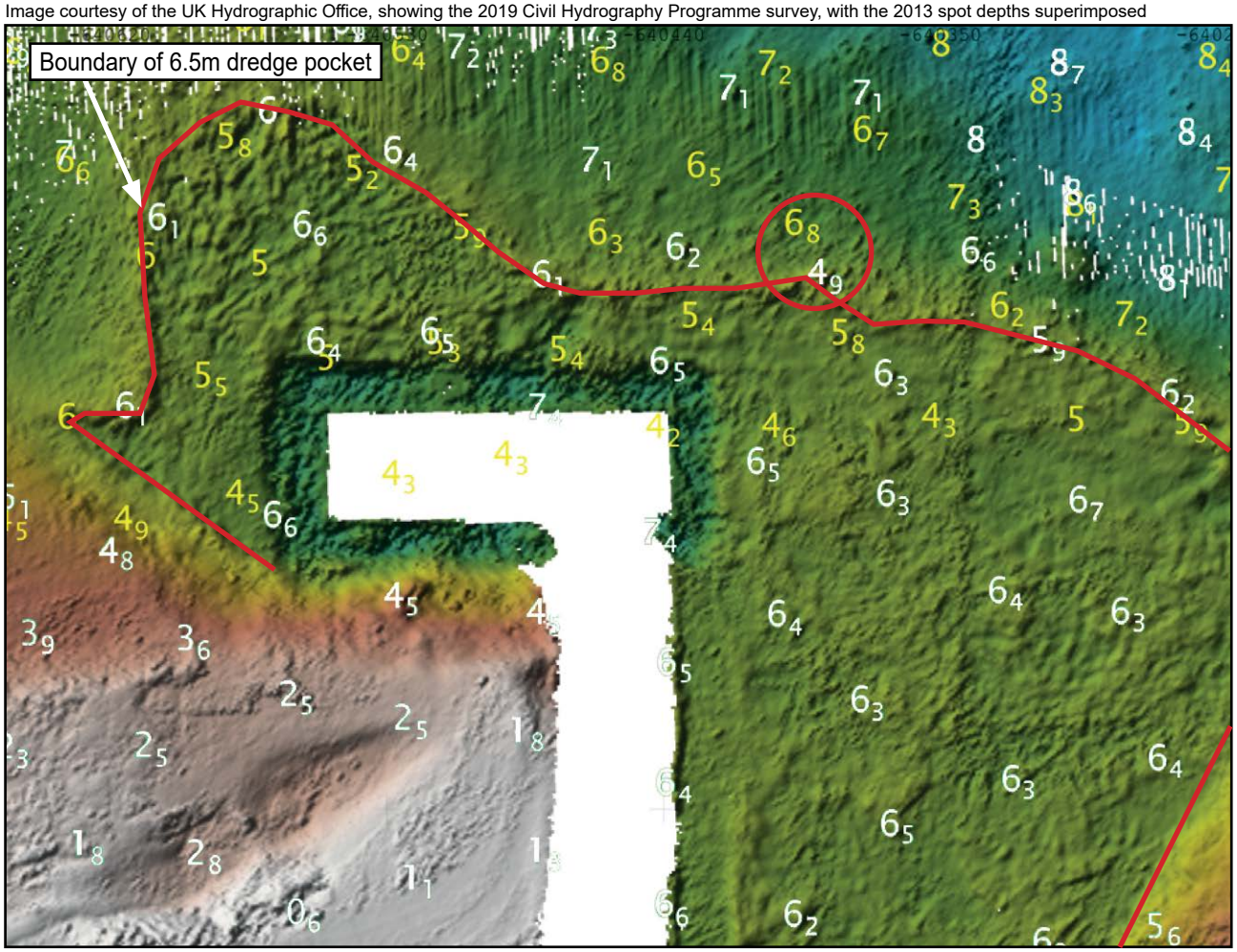

Figure 8: Comparison of soundings from the 2013 (yellow) and 2019 (white) Civil Hydrography Programme surveys

1.5.2 Black Eye buoy

The Northern Lighthouse Board (NLB) is the General Lighthouse Authority for the waters around Scotland and the Isle of Man and is responsible for the buoyage in the approaches to Kyleakin and the Kyle of Lochalsh.

Black Eye buoy was one of a series of lateral markers laid by the NLB as an aid to navigation for vessels passing east and west under the Skye Bridge and through the Kyle of Lochalsh. These channel marking buoys were laid prior to the Kyleakin development. Although named after the adjacent hazard, Black Eye buoy, which was 400m north of the pier, was intended to assist transiting vessels to remain clear of all hazards to the west and south **(Figure 9)**.

1.6 KYLEAKIN FACILITY

1.6.1 Overview

The Kyleakin Feed Mill Pier **(Figure 10)** was a major infrastructure development by the aquaculture company Mowi. Employing over 12,000 staff globally, Mowi managed operations in 25 countries and was the world's largest producer of Atlantic salmon with an annual turnover of 3.8 billion euros. The Kyleakin factory manufactured fish feed and the pier facilitated the inward supply of raw materials, and the outward distribution of the manufactured fish feed to aquaculture sites in Scotland.

Image courtesy of V.Ships Ltd (vgrouplimited.com)

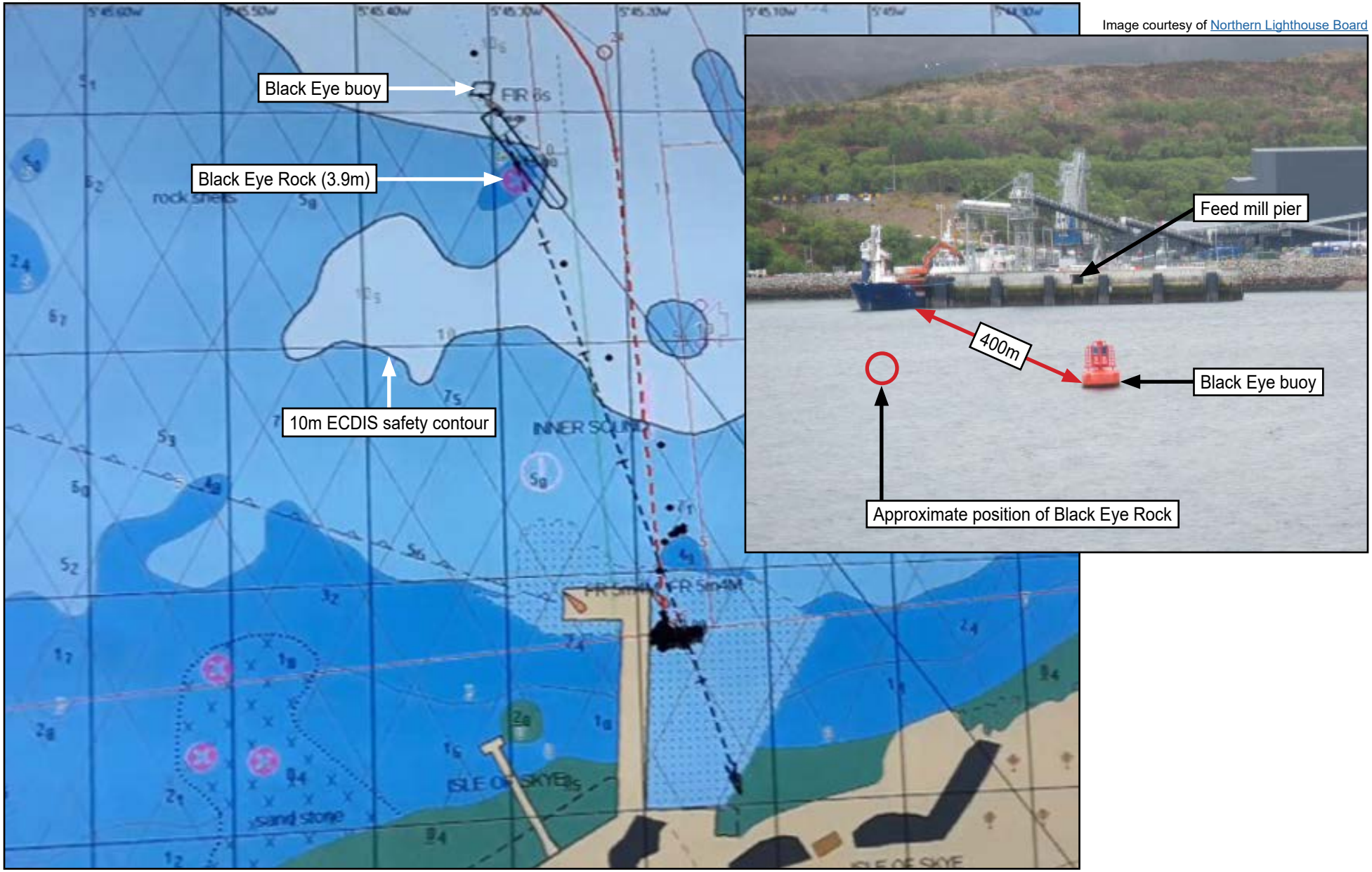

Figure 9: ECDIS screenshot of *Key Bora* passing Black Eye Rock, with inset photograph of approach

Image courtesy of SalmonBusiness (salmonbusiness.com)

Figure 10: Aerial view of the Kyleakin Feed Mill and pier

Kyleakin was located within Loch Duich and Loch Alsh nature conservation marine protected area (MPA), which provided protection for the local biodiversity.

Kyleakin pier was not served by a dedicated approach channel. Instead, vessels approaching from the west were advised to follow the buoyed channel intended for passage under the Skye Bridge, before turning south in the vicinity of Black Eye Rock **(Figure 2)**. During the approach, the breadth of navigable water was a function of the height of tide at the time, but reduced significantly between Bow Rock and the pier.

1.6.2 Marine licence application

Development of a new marine facility required a marine licence under the Marine (Scotland) Act, 2010. The purpose of marine licencing, managed by Marine Scotland, was to ensure that the environment, human health and the legitimate use of the sea were protected by a formal process of assessing the intended activity.

In 2016, Mowi submitted an application to Marine Scotland for the development of the feed mill and associated pier capable of accommodating vessels up to 100m in length and 6.5m draught. The application included the intent to dredge to 6.5m charted depth around the new pier, and for the facility to handle dry and liquid bulk cargoes as well as liquid natural gas (LNG).

The MCA was a statutory consultee throughout the application process, advising Marine Scotland on the navigational safety aspects of the development.

Mowi's application was underpinned by an environmental impact assessment (EIA). A component part of the EIA was an NRA that was undertaken by the marine consultancy ABPmer[10] in November 2016. When considering the grounding risk, the NRA report concluded that:

> *During a vessel manoeuvre to or on departure from the pier, it is possible for a grounding incident to occur if the vessel's Master misjudges the prevailing conditions. This impact is most likely to happen on the side berth (Eastern berth) where there is shallow water in close proximity to the berth. Adverse weather conditions such as high wind and large waves together with strong tidal conditions has the potential to negatively impact vessel manoeuvring with a strong north-westerly wind and ebb tide presenting the conditions when grounding is most likely to occur.*

The NRA also set out a series of mitigation measures to reduce navigational risks to as low as reasonably practicable. These proposed mitigations, for the operational phase, were reflected in the EIA **(Table 1)** and included, inter alia:

- the availability of the latest hydrographic information;
- a marine liaison officer;
- a marine safety management system;
- compliance with the Port Marine Safety Code (PMSC); and,
- a tidal flow atlas.

The mitigation for a sectored light **(Table 1)** was removed as a result of advice from the NLB that had assessed such a light to be potentially confusing for other mariners.

Although not compulsory, the NRA's mitigation measures were included as '*reasons and considerations*' in Scottish Ministers' decision letter to approve Mowi's application for the marine licence as part of the Kyleakin redevelopment plan. Post the approval, it was Mowi's responsibility to ensure that the mitigation measures were in place prior to operations commencing, but there was no obligation to inform Marine Scotland that the measures had been implemented.

1.6.3 Construction and dredging

Initial dredging works at Kyleakin commenced in November 2017, with the pier construction works starting in March 2018. The dredging operations were undertaken by Foyles Dredging Limited (Foyles) primarily using excavators operating from spud leg barges. Progress of the dredging was assessed by regular MBES surveys; this data was used to prioritise next steps and was not intended for navigation. In support of the dredging programme, Aspect Land and Hydrographic Surveys Limited (Aspect Surveys) undertook over 20 MBES surveys of the area.

[10] ABPmer's Kyleakin Feed Mill Pier Navigational Risk Assessment, for Marine Harvest (Scotland) Ltd, dated November 2016.

Image courtesy of Mowi (mowi.com)

16.6.2 Operational Phase

Table 16.7 : Proposed Mitigation Measures for Operational Phase

Proposed Mitigation Measure	Description
Availability of latest hydrographic information	Results of the hydrographic surveys should be provided to the UK Hydrographic Office (UKHO) so that navigational charts for the area can be updated.
Dedicated VHF channel	To prevent over use of the main navigational channels, will require a licence from OFCOM.
Dredging programme	The approaches to the berths will be dredged as part of the construction phase. Surveying completed during the operational phase will determine the need for maintenance dredging
Hydrographic surveying	Scheduled surveys should be completed in line with PMSC requirements.
Marine liaison officer / pier master	Will promulgate safety information to vessels navigating in the area. They will be the Kyleakin Pier point of contact during an emergency situation.
Marine safety management system	The MSMS should detail the procedures for promulgating weather information and requirements of marine personnel.
Oil spill contingency plans	To detail the response to any marine pollution event.
PMSC compliance	Ensures all risk is reduced to as low as reasonably practicable by risk assessment and subsequent mitigation.
Port emergency plan	Will detail responses to emergency situations, along with contact details for local authorities.
Sectored light	This should be used for vessels approaching the side berth. A sectored light consists of at least 2 lights, red and white. When the vessel is in the white sector of the light the navigator can be confident that they are in safe water. If the vessel is in the red sector of the light, it indicates that the vessel should change its course and is outside of the dredged approach area to the berth. Any Aid to Navigation lighting is subject to approval of the NLB prior to installation.
Tidal flow atlas	Provision of a tidal atlas for use on-board vessels, which provides tidal flow speed and direction through each hour of the tidal cycle.

Table 1: Proposed mitigation measures for operational phase of Mowi Scotland Limited's feed mill facility at Kyleakin, extracted from the EIA Volume 2, Chapter 16, table 16.7

The final survey was conducted on 30 August 2018. This survey data was passed to the agent by Mowi and formed part of the pre-arrival information sent to *Key Bora* **(Annex B)**.

1.6.4 Post-accident survey

Following *Key Bora*'s grounding, Mowi requested Aspect Surveys to review their MBES survey data recovered during the dredging operations. This analysis showed the presence of several 'boulder-like' obstructions outside the boundary of the area that had been designated to be dredged to 6.5m **(Figure 11)**. In April 2020, after the grounding, Aspect Surveys conducted a further MBES survey of the approaches to the pier, which revealed a large 3m long granite boulder that extended 1.9m above the surrounding seabed, in the location of *Key Bora*'s grounding **(Figure 12)**. In August 2020, contractors removed all of the obstructions from the approaches to the pier and disposed of them ashore.

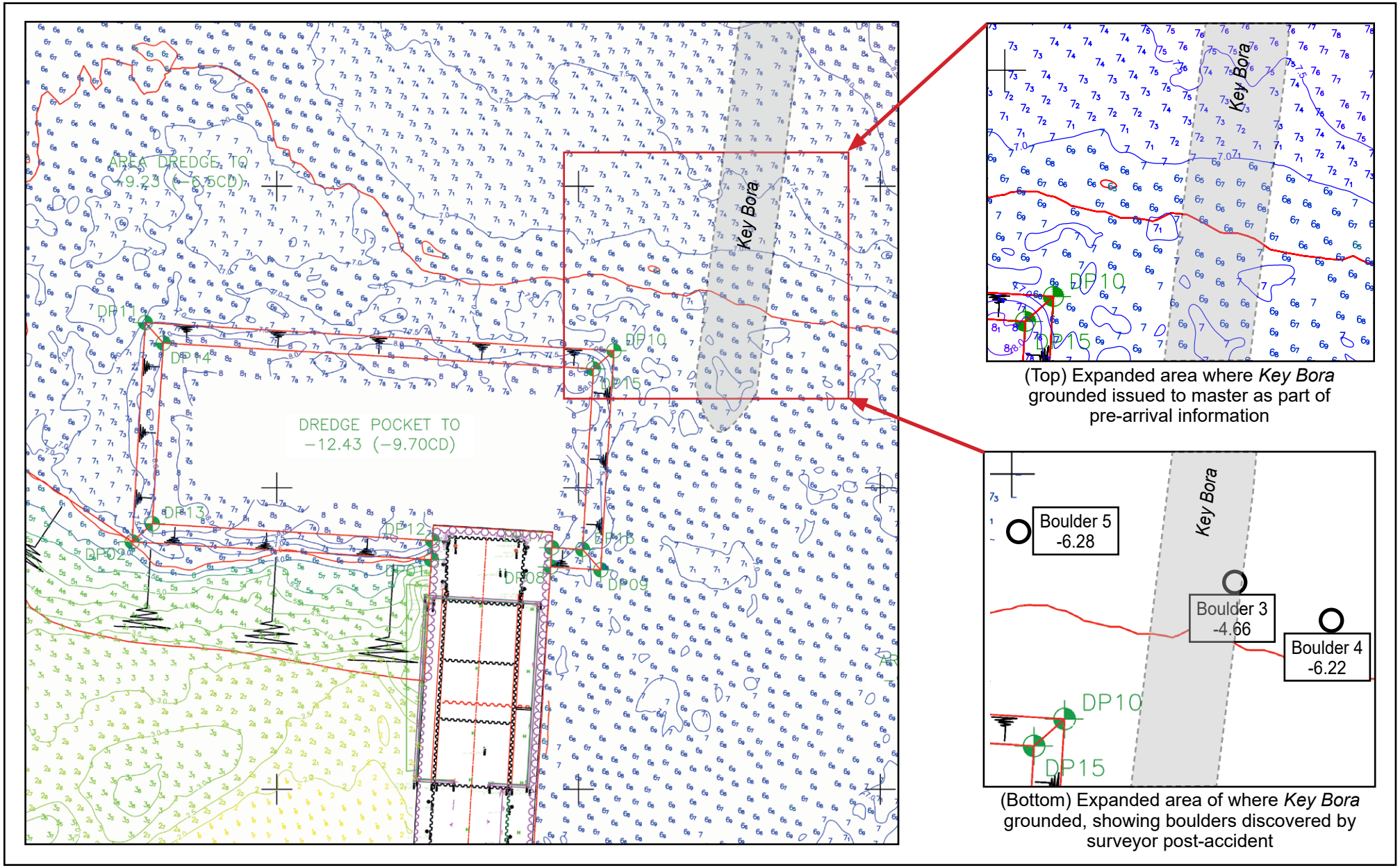

Figure 11: Post-dredge survey, dated 30 August 2018, with insets showing expanded area of where *Key Bora* grounded (top) and the boulder discovered post-grounding (bottom)

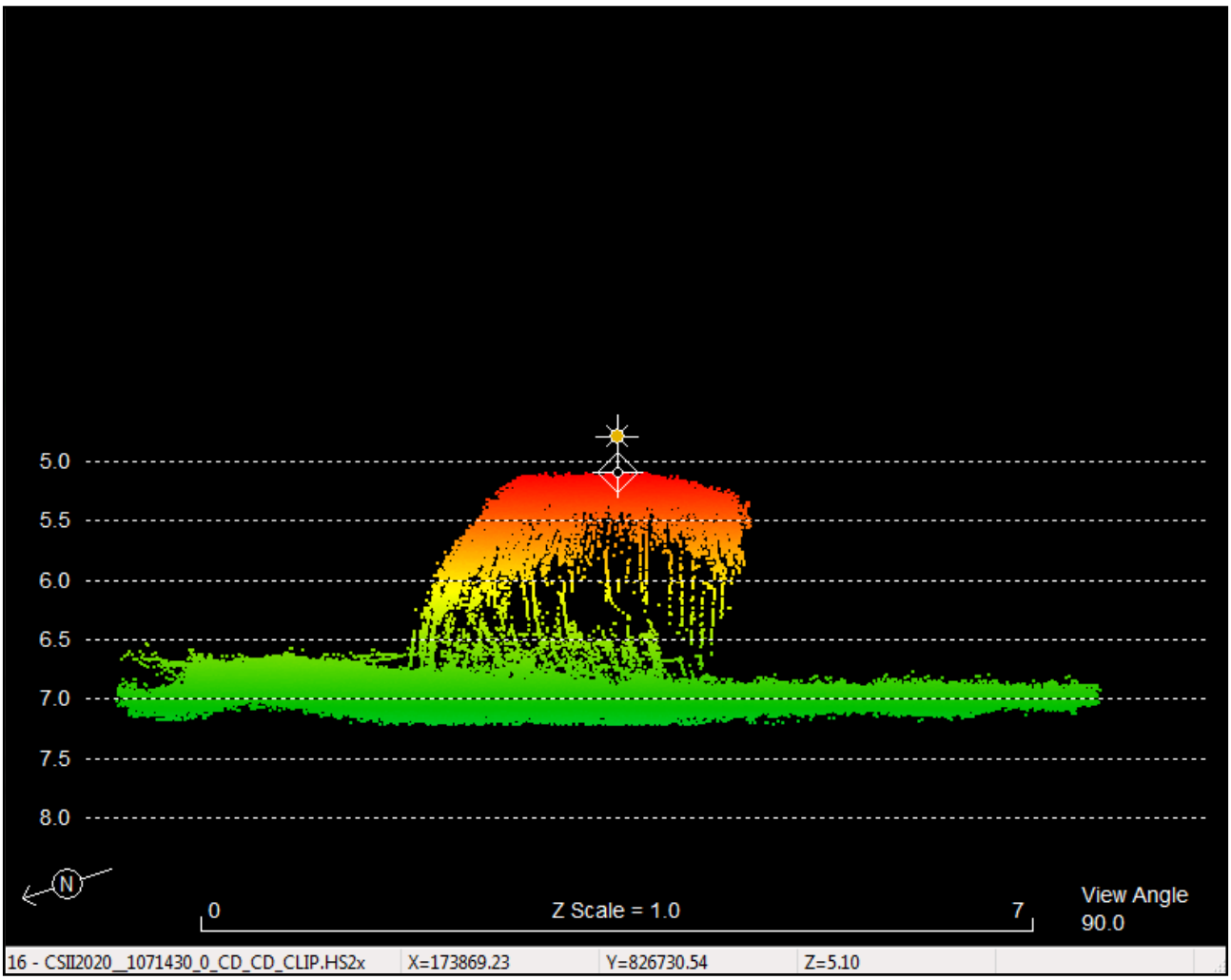

Figure 12: MBES image of the 4.9m boulder in the grounding position

1.7 HARBOUR AUTHORITIES

UK harbours are designated as either statutory or non-statutory. Statutory harbour authorities (SHA) are responsible for the management of a harbour with powers defined in a Harbour Order[11]. Such powers could include navigational safety, the control of vessel movements, responding to emergencies, the provision of navigational aids and enforcing local byelaws. For new harbours of facilities, a harbour empowerment order (HEO) is usually necessary to establish the statutory powers for the SHA.

Non-statutory harbours are maritime facilities such as wharves, jetties or minor fishing harbours and ferry ports where operations are not governed by statute. Non-statutory harbours do not have the same range of explicit legal duties as an SHA but are still required to comply with the Health and Safety at Work Act 1974 and follow the guidance in the PMSC.

Since Mowi's feed mill pier at Kyleakin entered service in March 2019 it had received almost 100 vessels, importing over 100,000t of cargo and exporting a similar volume of fish feed. When fully operational, the plant was predicted to facilitate 676 vessel

[11] As defined in the Harbours Act, 1964, as amended.

movements a year[12]; including LNG tankers approximately twice per month. When these statistics are compared using Department for Transport (DfT) freight data, it showed that the activity at Mowi's Kyleakin pier exceeded the local SHAs of Kyle of Loch Alsh and Kyleakin[13] and was broadly equivalent to the SHA ports of Padstow, Falmouth and Stornoway **(Table 2)**.

At the time of the accident, Mowi's feed mill pier at Kyleakin was being operated as a non-statutory harbour.

Image courtesy of the DfT (www.gov.uk/government/organisations/department-for-transport)

Port	Port Region	GrossWeight
Gill's Bay Scotland	Scotland East Coast	79.55
Buckie	Scotland East Coast	84.01
Burry Port	Bristol Channel	103.47
Troon	Scotland West Coast	104.00
Wisbech	Wash & Northern E Anglia	109.22
Barrow	Lancs and Cumbria	110.78
Neath	Bristol Channel	122.39
Scrabster	Scotland East Coast	127.67
Mistley	Haven	141.23
Lancaster	Lancs and Cumbria	152.49
River Ouse [4]	Humber	158.04
Wallasea	Thames and Kent	160.53
Silloth	Lancs and Cumbria	166.70
Chichester	Sussex and Hampshire	167.41
Inverkeithing	Scotland East Coast	175.18
Padstow	West Country	181.17
Stornoway	Scotland West Coast	188.77
Llandulas	West and North Wales	220.55
Falmouth	West Country	227.00
Corpach	Scotland West Coast	

Table 2: Department for Transport table of gross weight of cargo handled by similar sized ports to Kyleakin, based on 2018 data (volumes in thousands of tonnes)

[12] ABPmer's Kyleakin Feed Mill Pier Navigational Risk Assessment, for Marine Harvest (Scotland) Ltd, dated November 2016.

[13] The statutory harbour authorities of Kyle of Lochalsh and Kyleakin are both operated by the Highlands Council.

1.8 THE PORT MARINE SAFETY CODE

The PMSC sets out guidance for a national standard for all aspects of safety in port facilities; its aim was to enhance safety for those who use or work in ports, their ships, passengers, and the maritime environment. Since its inception, the application of the Code has been updated and broadened to include not only harbour authorities, but also marine facilities, berths and terminals.

Guidance on safe port operations in the PMSC was subdivided in to ten measures, specifically:

1. appointing a duty holder (DH) accountable for compliance;
2. appointing a designated person (DP) to provide assurance;
3. reviewing powers and seeking additional powers where necessary;
4. complying with the duties and powers;
5. undertaking a marine risk assessment;
6. operating an effective marine safety management system (MSMS);
7. monitoring, reviewing and auditing the risk assessments and MSMS;
8. employing competent people;
9. publishing a safety plan; and,
10. complying with the direction of the General Lighthouse Authorities.

To comply with the PMSC, SHAs were required to consider all ten measures; non-statutory harbours were advised to identify which of the measures were applicable to their activities, but recommended to fulfil items 4, 5 and 6 as a minimum.

Further guidance on the implementation of the PMSC was provided in its associated *Guide to Good Practice* (GTGP). Chapter 8 of the GTGP described the '*Management of Navigation*', including guidance on the content of a port passage plan for a harbour or marine facility.

1.9 RELEVANT PREVIOUS ACCIDENTS

1.9.1 *Key West* – grounding

On 15 September 2019, the Gibraltar registered chemical tanker *Key West*, ran aground on Black Eye Rock when approaching Kyleakin Feed Mill Pier.

The MAIB conducted a preliminary assessment[14] into this grounding and found that *Key West*'s master had to abort his approach to the Kyleakin pier as there was no-one ashore to tend the mooring lines. After assurance that Mowi staff were available to assist with berthing, *Key West*'s master commenced a second approach but, with about 400m to run, the same concern arose. On the second occasion, the

[14] In accordance with the Merchant Shipping (Accident Reporting and investigation) Regulations, 2012, Section 7.

master applied astern propulsion to delay arrival, rather than head back to the open sea. As *Key West*'s speed reduced, it was swept west by the tidal stream and ran aground on Black Eye Rock **(Figure 13)**.

Reproduced from Admiralty Chart BA2540 by permission of HMSO and the UK Hydrographic Office

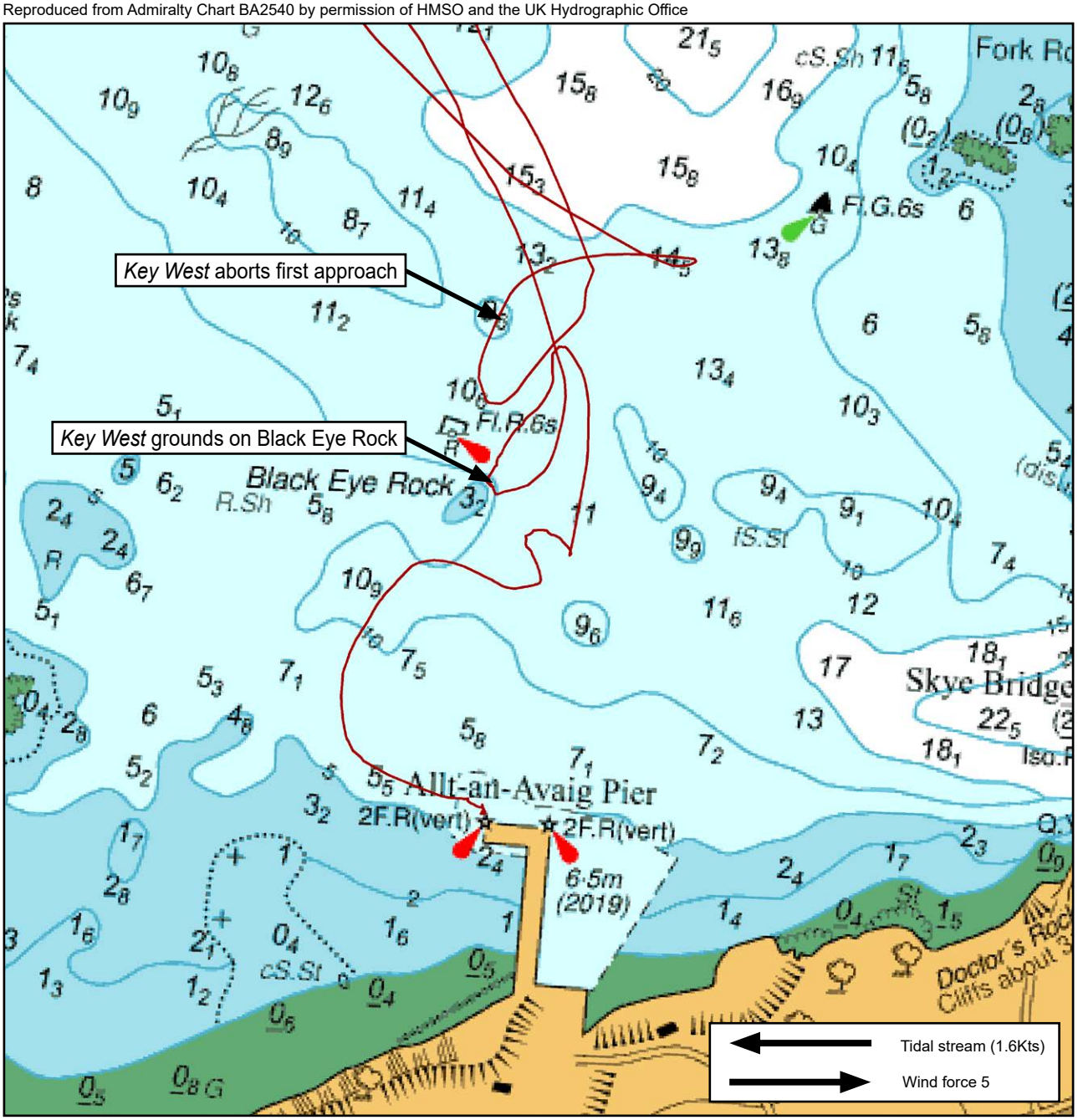

Figure 13: *Key West*'s grounding on Black Eye Rock

During the MAIB's preliminary assessment it was identified that key mitigation measures from the NRA for the facility were not in place, including: the appointment of a marine manager, implementation of an MSMS, the creation of a tidal flow atlas and compliance with the PMSC. On 25 March 2020, the MAIB's Chief Inspector wrote to Mowi advising them '*to take urgent action to improve marine safety by implementing the mitigating measures set out in the NRA*.'

At the same time, the Chief Inspector wrote to the MCA and Marine Scotland urging them to '*work together to ensure that important safety measures identified in risk assessments and marine licences are implemented prior to operations commencing*.'

After the *Key West* grounding and before the *Key Bora* grounding described in this report, Mowi had appointed a marine manager to oversee operations at Kyleakin; however, there was no DH or DP appointed and work was still ongoing to deliver an MSMS, a tidal flow atlas and PMSC compliance.

The crew of *Key Bora* was unaware of the circumstances of the grounding of *Key West*.

1.9.2 *Carrier* – grounding

On 3 April 2012, the cargo ship *Carrier* grounded at Raynes Jetty, Llanddulas, north Wales. *Carrier* was damaged beyond repair and there was a spillage of 33,000 litres of gas oil (MAIB report 8/2013[15]). The MAIB's investigation found that the jetty owners did not have an MSMS in place as recommended by the PMSC. As a result, the marine operations at the jetty had not been adequately planned or controlled. The MAIB's report included a recommendation to the DfT to broaden the application of the PMSC to include non-statutory harbours[16]. This recommendation was accepted by the DfT and the application of the PMSC was broadened in 2016, to include all UK harbour authorities and other marine facilities and terminals.

1.9.3 *Beinn Na Caillich* – boat transfer fatality

On 18 February 2020, the Ardintoul aquaculture site assistant manager drowned after falling into the water from a feed barge access ladder during a boat transfer (MAIB report 6/2021[17]). He was attempting to climb on to the barge from the workboat *Beinn Na Caillich* and fell into the water after being crushed between the boat and the barge.

The MAIB's investigation concluded that the conduct of the boat transfer had not been properly planned or briefed and was not adequately controlled. There were no risk assessments or procedures in place for the transfer of personnel between shore sites and the aquaculture installations by boat. The MAIB's report made safety recommendations to Mowi, the vessel and aquaculture site owner, to apply the latest edition of the Workboat Code of Practice to its fleet and implement an SMS that complied with the principles of the ISM Code. A recommendation was also made to Mowi to ensure that appropriate marine expertise was provided to the senior management team to oversee the safety of its operations.

[15] https://www.gov.uk/maib-reports/grounding-of-general-cargo-vessel-carrier-at-raynes-jetty-in-llanddulas-wales.

[16] MAIB recommendation 2013/115.

[17] https://www.gov.uk/maib-reports/crush-incident-during-transfer-from-workboat-beinn-na-caillich-to-a-feed-barge-with-loss-of-1-life.

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 SUMMARY

When approaching the pier at Kyleakin, *Key Bora* ran aground on a charted obstruction. This occurred primarily because the passage plan had been based on inaccurate navigational information. Although there were indications during the vessel's final approach to the berth that conditions were not as expected, these did not trigger a decision to abort. The vessel was damaged and holed with floodwater entering empty ballast tanks.

This section of the report will discuss the causes and circumstances of the grounding, including planning and execution of the passage, and the safety management of marine operations at Kyleakin.

2.3 THE PRESENCE OF THE BOULDER AND HYDROGRAPHIC ACTIVITY

Post-accident investigation has shown that the boulder obstruction that *Key Bora* grounded on **(Figure 12)** was not present during the 2013 CHP survey but was detected during the 2019 CHP survey. Although the exact origin of the boulder was unknown, given that it was not present in 2013, it is almost certain that it ended up there during Mowi's extensive dredging operations in 2018. During this work there were frequent MBES surveys; however, these were to assess the effectiveness of the excavation, and not intended for navigation. Furthermore, the boulder obstruction was outside the area contracted for dredging, therefore unlikely to have been scrutinised or assessed by the contractor.

Following UKHO scrutiny of the 2019 CHP raw data, the ENC was updated with the new information, and *Key Bora*'s ECDIS system was updated automatically just prior to the accident. Thus, and albeit with hindsight, the reality of the situation was that the UK's CHP programme, backed up by a contemporary ECDIS, provided accurate and reliable survey data for the area in the vessel's primary means of navigation.

2.4 THE DECISION TO PRIORITISE THE LOCAL INFORMATION

When planning the Kyleakin arrival, it became apparent to the 2/O that there was a charted depth of 4.9m, which would preclude berthing at the intended low water time. The decision to arrive at low water was based on the agent's pre-arrival information, indicating that slack tidal stream coincided with low and high water.

The 2/O raised the issue of the 4.9m depth with the master and together they reviewed it by comparing the ENC data with the information provided by the agent. The master and the 2/O discovered that the ENC's 4.9m sounding was not on the dredge survey or the photocopy of the Admiralty paper chart, both of which had been provided by the agent. Given that it was from an apparently reliable source and appeared accurate and current, the agent's information was used in preference to the ENC.

It is probable that this decision can, in part, be attributed to the human factor of adopting 'best data' when resolving conflict. However, for navigational planning it would be intuitively safer to apply the most dangerous data when faced with a decision of this nature. As a result, the decision to prioritise the agent's data, where no hazard was shown, increased the navigational risk.

The tone of the agent's email, using the compelling terminology '*contrary to the advice provided*' also probably undermined confidence in the official information. Information in the agent's email had been provided by Mowi and was therefore assumed to be reliable; there was never any intent to mislead. However, it was critically inaccurate in relation to both the 4.9m patch and the tidal stream.

Key Bora's ECDIS was configured to receive and update ENC data with little input from the crew. This was a helpful feature of the system, ensuring that the primary means of navigation was up to date. There was also a 'view update' function to allow the operator to check the status of electronic chart corrections. However, neither the master nor the 2/O had interrogated the system in this way, and neither was aware that the 4.9m sounding was a very recent correction. However, where ENCs are being automatically updated, it would not be reasonable for navigation officers to check the currency and validity of every feature. As a result, *Key Bora*'s team was unaware how recent the change was, and this was not considered in the planning process.

The provision of local data from a harbour authority or as part of a pilot's plan is not unusual. Indeed, a pilot's local knowledge provides a key mitigation for navigational safety. However, the local information on this occasion was not from a pilot or a local authority, instead it had arrived from a distant agent, albeit originating from Mowi. This is a situation where an external review would add confidence to the decision, indeed there was an SMS requirement for the master to alert the company where vessels were directed to a port or harbour for the first time, or where contradictory advice existed. Irrespective on whether the master was aware of the SMS obligation, not seeking an external review, especially given the absence of pilotage services, added further to the cumulative navigational risk.

Key Bora's passage planning process had ignored an accurate ENC and relied instead on the agent's apparently contemporary and reliable survey information, resulting in the navigation risk being significantly underestimated. Any decision to ignore the information on an official hydrographic chart must be taken with extreme care and could only reasonably be based on compelling advice, ideally from a harbourmaster or embarked pilot.

2.5 EXECUTION OF THE PLAN

As *Key Bora* approached the pier, a succession of course alterations were necessary to maintain track; this alerted the master to the presence of tidal stream, which was not expected. These course alterations came soon after the C/O had alerted the master to the vessel passing very close to Black Eye buoy, another clue to the close proximity of danger and potential risk. Either of these events alone would have been sufficient to abort the berthing, especially as there was no pilot on board or tugs available. However, *Key Bora* was, by this time, past the planned 'no-go' point and committing to berthing, at least in planning terms. Moreover, analysis of *Key Bora*'s predicted movement from ECDIS **(Figure 14)** showed that it would almost certainly have been swept onto the pier had it not grounded.

Figure 14: Screenshot from *Key Bora*'s ECDIS immediately prior to it grounding, predicting that it would strike the jetty

Furthermore, the ECDIS look ahead function was switched off, which resulted in an absence of any alarm to warn of danger. However, given that the master had committed to the berthing and was ignoring the ENC's 4.9m sounding, it is highly likely that an associated ECDIS alarm would also have been ignored.

Immediately prior to grounding, having received a verbal warning of the potential danger from the 4.9m sounding from the C/O, the master stated that he intended to proceed with the berthing as the echo sounder was reading sufficient depth. However, the echo sounder was of little use as a navigational safety barrier as it would only be effective with a shelving seabed and sufficient room to avoid the detected danger. Neither of these conditions existed so the 7m echo sounder reading did little more than give the master false confidence in the plan to press ahead with the berthing **(Figure 15)**.

Although there were indications during the vessel's final approach to the jetty that conditions were not as expected, these did not trigger a decision to abort the approach. This happened because *Key Bora* had passed the passage plan's abort point and the echo sounder reading underpinned the decision to press on. Furthermore, any late decision to abort would potentially have induced a risk of grounding similar to the earlier *Key West* accident.

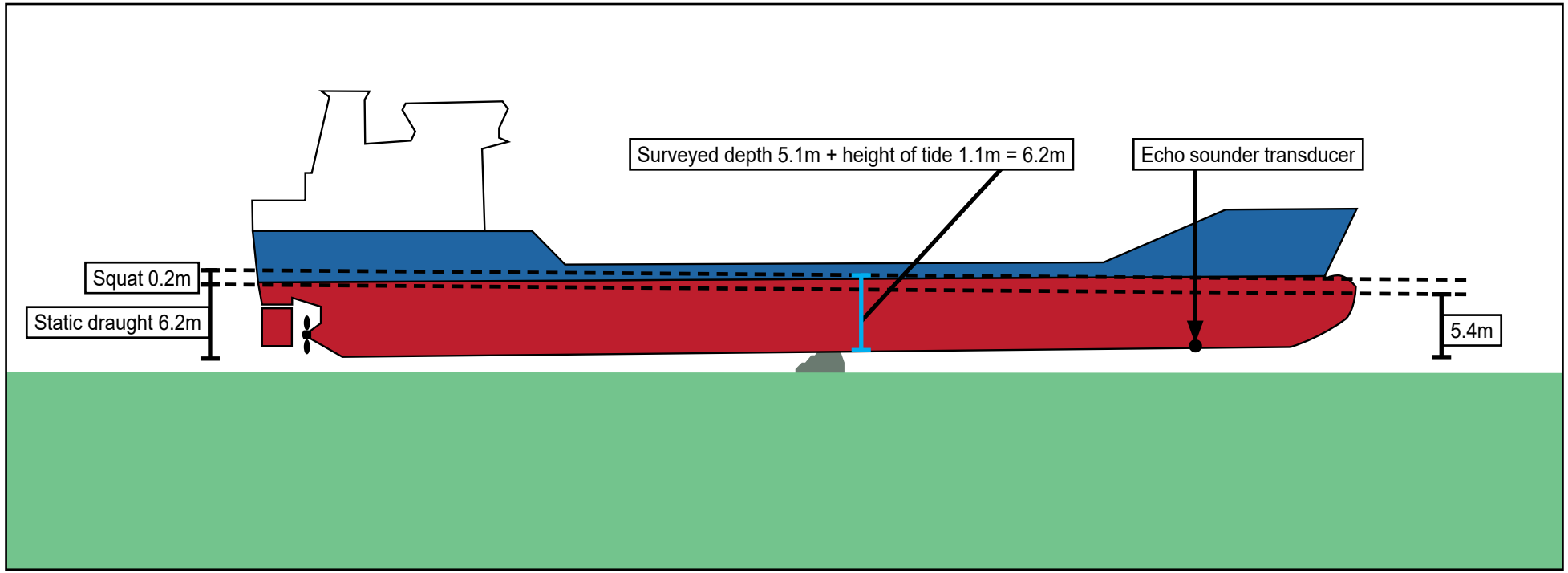

Figure 15: Illustration of *Key Bora* aground

2.6 BRIDGE RESOURCE MANAGEMENT

Effective BRM is key for time-critical decision-making and should include a suitably manned bridge, where all personnel share a common understanding of the plan, and where decisions can be challenged and errors corrected. The need for shared awareness and effective decision-making is particularly pertinent without a pilot on board.

Key Bora's SMS required the master, OOW, helmsman and lookout on the bridge for the conditions experienced in this situation. However, on board *Key Bora*, only the master and OOW were present and, for other pilotage water operations, it was common practice for only the master and the pilot to be on the bridge. This happened because of limited manpower availability due to the pressures of frequent entry and exit from harbour, requiring mooring stations to be manned, as well as seagoing watchkeeping routines. Reducing bridge manning below the SMS's minimum requirement introduced risks where the master was vulnerable to becoming very focused on ship handling, resulting in losing the overall awareness of the situation.

The master also needed to be supported and challenged by a well-briefed team. The timing of the arrival was unfortunate as it meant the C/O, who was the OOW, was not present at the pre-arrival brief. Nevertheless, the C/O briefed the master about his observations on the ECDIS display, including a challenge regarding the 4.9m sounding. However, the master pressed ahead [Section 2.5] based on his confidence in the other information held, including his false confidence in the depth sounding.

On board navigational audits can provide a method of ensuring that safe bridge practices, prescribed in the SMS, are being followed. These can either be conducted by external auditors or through an internal check by the master. In this case, the SMS obligated the master to undertake an audit within 4 weeks, but this had not occurred.

Key Bora's SMS provided clear guidance on BRM and navigational audits. Although this was not being followed, it is unlikely that strict adherence to the SMS would have prevented the grounding. Nevertheless, adhering to the principles of BRM can improve awareness of all bridge team members and aid decision-making.

2.7 ECDIS SAFETY

For the approach to Kyleakin, *Key Bora*'s calculated ECDIS safety depth was 6.48m and, as this was not an ENC contour, the system had defaulted to the next deepest contour of 10m. This meant that it was not possible for the vessel to reach the berth without crossing the 10m safety contour **(Figures 2** and **9)** on several occasions; however, neither of the workaround methods to resolve this [Section 1.4.4] was actively used on the bridge. **Figure 16** shows a reconstruction of the ECDIS passage plan, including the 10m safety contour (NP 232 method 1) and a hand-drawn safety contour with the 5m contour selected (NP 232 method 2). Had method 1 been adopted, *Key Bora* would have had to cross the 10m safety contour several times during the approach, which would have caused an ECDIS alarm and alerted the crew to danger. Equally, method 2 would also still have shown the 4.9m hazard as impassable.

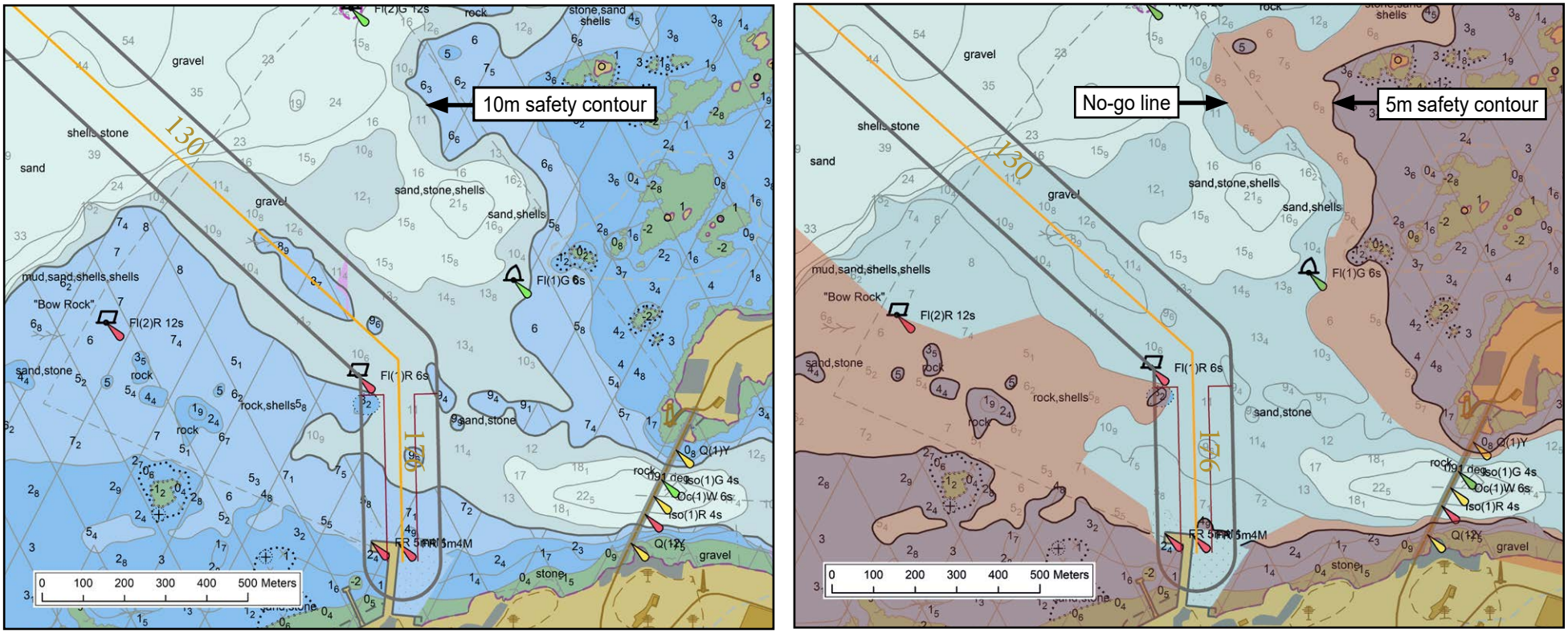

Figure 16: Comparison of ECDIS display with 10m safety contour (left) and 5m safety contour and no-go area based on 6.48m safety depth (right)

Without a robust method of utilising ECDIS in the approach, and the look ahead function also not in use, the primary navigation system was not being effectively utilised to support safe navigation. This analysis is underpinned by the fact that, prior to the grounding, the vessel had already been placed in significant navigational danger when passing over or extremely close to Black Eye Rock, without alarm or corrective action. Nevertheless, any ECDIS alarm may have been ignored given the decision not to avoid the ENC's 4.9m sounding.

2.8 MARINE LICENCING

Mowi's marine licence application for the development of the Kyleakin site was supported by the navigational safety measures included in the NRA, that was part of the EIA. The MAIB's preliminary assessment into the grounding of *Key West* in September 2019 identified that key NRA risk mitigation measures, included in the licence application, were not in place at the time of the accident.

Post this accident and the MAIB Chief Inspector's letter [Section 1.9.1], Mowi has taken steps to address these omissions, including the appointment of a marine manager at the site. Nevertheless, when *Key Bora*'s grounded, three of the remaining mitigation measures were still not in place, including provision of an MSMS and compliance with the PMSC.

Key amongst the navigational risk mitigation measures was compliance with the PMSC. Without consideration of the PMSC's principles, the Kyleakin facility was, in effect, operating without a governance structure to assess and mitigate risks. Although a marine manager had been appointed, there was no DH accountable for safe operations, or a DP to provide Mowi with independent advice. The inaccurate pre-arrival information, which was a significant factor in this accident, demonstrates how, without the safeguards of the PMSC, navigational risk can be unintentionally created without the involved agencies (in this case Mowi and the agent) understanding the potential significance of these actions.

Another key mitigation measure was the employment of a marine manager, which was subsequently actioned after the *Key West* grounding. However, the absence of a marine manager during the construction and commissioning phase of the site probably resulted in insufficient focus by Mowi on the marine aspects of the development. This is understandable given the major land-based infrastructure development at the factory; however, Mowi not prioritising marine safety was also reflected in the *Beinn Na Caillich* accident [Section 1.9.3].

As the licencing process drew to a close, and despite the Scottish Ministers' Decision Letter referring to them, there was no obligation on Mowi to report to Marine Scotland on the implementation of the proposed risk mitigation measures. Equally, there was no watertight process to ensure that risk mitigation measures were in place prior to operations commencing at the facility. Moreover, the measures themselves were not mandatory, which further undermined their importance in the approval process.

In summary, the absence of a marine manager, Mowi's lack of focus on marine safety and the absence of a process requiring implementation of risk mitigation measures resulted in marine operations commencing at Kyleakin without necessary and appropriate risk mitigation measures being in place.

2.9 STATUTORY CONTROL OF THE PIER

No consideration was given by Mowi, Marine Scotland or the MCA during the licensing process, to operating the Kyleakin pier as an SHA, despite its handling capacity exceeding the two adjacent SHAs and it being within an environmentally sensitive MPA.

There is no specific guidance as to when a marine facility should seek an HEO to establish an SHA. However, the advantages of doing so are that it legally establishes the role of a harbourmaster who would be responsible for: navigational safety, the control of vessel movements, responding to pollution events and other emergencies, maintaining navigational aids; and who has the powers to make and enforce local byelaws.

While both SHA and non-statutory harbours would be guided by compliance to the PMSC, without the statutory power there would be no clear accountability for overseeing the navigational safety of the Kyleakin facility, where the marine operations include LNG tanker movements and exceed those of nearby SHAs in capacity terms. Furthermore, the grounding of two chemical tankers in its first year of operations suggests that the formal accountability of an HEO would improve the safe operation of Mowi's Kyleakin pier and its approaches.

SECTION 3 – CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *Key Bora* ran aground primarily because the passage plan for the approach to the pier was based on inaccurate survey data. [2.4]

2. Although not intended for navigation, the dredge survey data was prioritised on board *Key Bora* ahead of the more accurate ENC information because it had been received from an apparently reliable source and appeared to be accurate, authentic and timely. [2.3, 2.4]

3. *Key Bora*'s arrival was arranged to coincide with a time when slack tidal stream was expected; this decision was also based on unintentionally misleading pre-arrival information provided by the agent. [2.5]

4. Despite indications that conditions were not as expected, no action was taken to abort the passage. [2.5]

5. *Key Bora*'s bridge team did not adhere to the principles of BRM, which probably increased the navigational risk. [2.6]

6. ECDIS, which was *Key Bora*'s primary means of navigation, was not used effectively to support safe navigation or warn of danger. [2.7]

7. The master did not inform the company that *Key Bora* was arriving at Kyleakin for the first time or that there was a conflict between the pre-arrival navigation information and that shown on the ENC. This almost certainly happened because the master underestimated the cumulative navigational risks associated with the arrival at Kyleakin. [2.5]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The boulder obstruction where *Key Bora* grounded was almost certainly left over from the 2018 dredging operations, MBES surveys of the area were not intended to be used for navigation, and it lay outside the area contracted for dredging. [2.3]

2. The Kyleakin pier was not being operated in accordance with a MSMS or the PMSC, both of which had featured as risk mitigation measures in the licence approval process. This happened because there was no process to assure that agreed mitigation measures were in place prior to operations commencing. [2.8]

3. Analysis of harbours managing similar levels of risk indicated that a Harbour Empowerment Order would be appropriate in Kyelakin but this was not considered during the planning/licensing process. [2.8]

4. Contrary to the assumption on board *Key Bora*, the evidence in this case demonstrated the effectiveness of the MCA and UKHO civil hydrography programme to deliver timely and accurate survey data. [2.3]

5. Reliance on the crew to conduct navigational audits of their own processes was suboptimal in providing company level assurance of safe onboard practices. [2.6]

SECTION 4 – ACTION TAKEN

4.1 ACTIONS TAKEN

Marine Scotland has:

- As a result of this incident, added a standard condition to all marine licences requiring licensees to carry out the licensable activity in accordance with the licence, the application, and all plans and programmes submitted as part of the application.

The Northern Lighthouse Board has:

- Moved Black Eye buoy 115m to the east-south-east towards Black Eye Rock to improve the navigational safety of vessels approaching the Kyleakin pier.

V.Ships has:

- Conducted a navigational audit of *Key Bora*'s bridge team practices.

- Conducted an internal investigation into the accident and issued fleet guidance highlighting the safety issues emerging from this accident, in particular the use of local hydrographic information in lieu of local surveys, and the conduct of navigation during pilotage.

Mowi (Scotland) Limited has:

- Conducted an investigation into the accident, produced a report circulated to involved parties.

- Appointed a Duty Holder and Designated Person, in compliance with guidance in the Port Marine Safety Code.

- Resurveyed the approaches to the pier and removed the previously uncharted 'boulder-like' obstructions.

- Produced 'Sailing Directions' for vessels arriving and departing from Kyleakin, including tidal stream data.

- Implemented a Marine Safety Management System for the pier.

SECTION 5 – RECOMMENDATIONS

Mowi Scotland Limited is recommended to:

2021/134 Ensure that marine operations at Kyleakin follow the guidance in the Port Marine Safety Code and its associated Guide to Good Practice.

2021/135 Consider applying for a Harbour Empowerment Order in order to establish a statutory harbour authority, delivering the associated maritime safety benefits, at Kyleakin.

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

Marine Accident Report

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