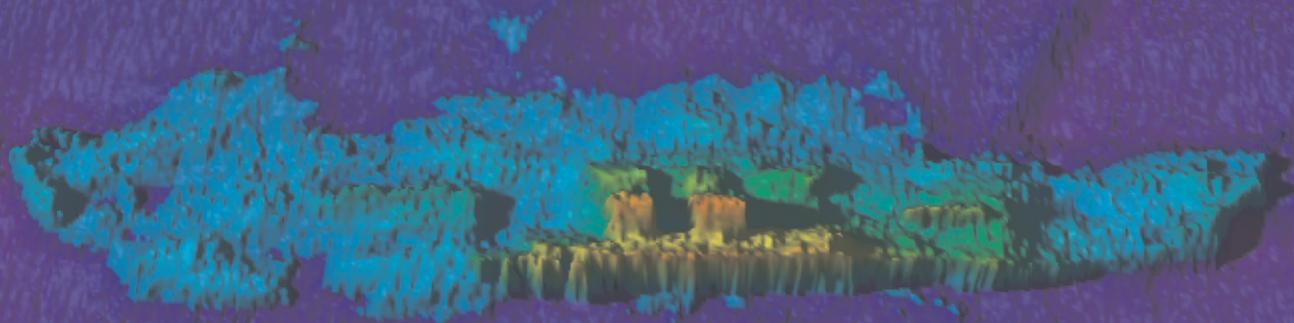




SS *Mendi* Geophysical Survey:
Data Processing and Assessment

Technical Report

FINAL



**SS MENDI GEOPHYSICAL SURVEY:
DATA PROCESSING AND ASSESSMENT**

FINAL

Technical Report

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**SS MENDI GEOPHYSICAL SURVEY:
DATA PROCESSING AND ASSESSMENT**

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SUMMARY

Wessex Archaeology was commissioned by the South African Heritage Resources Agency and English Heritage to assess the geophysical data collected over the wreck of the *Mendi* during the Regional Environmental Characterisation survey off the south coast of England in the summer of 2007 by Gardline Geosurvey Limited. The assessed datasets comprised sidescan sonar and multibeam bathymetry data collected over the wreck in July 2007.

This report describes the methodologies used to process and interpret each data type and the initial results of the geophysical assessment.

A desk-based assessment of the wreck of the *Mendi* had previously been conducted by Wessex Archaeology between November 2006 and April 2007 (WA 2007). The results of the geophysical assessment were integrated with the site descriptions included in the desk-based assessment.

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ACKNOWLEDGEMENTS

The archaeological assessment of geophysical data over the wreck of the *Mendi* was commissioned by the South African Heritage Resources Agency and English Heritage and Wessex Archaeology is grateful to Jonathan Sharfman and Mark Dunkley for their support for and co-operation throughout this project.

The geophysical datasets were provided by Gardline Geosurvey Limited, having been collected as part of the Department of the Environment, Food and Rural Affairs' Marine Environment Protection Fund programme of regional seabed mapping. Wessex Archaeology is grateful to the Marine Environment Protection Fund secretariat for permission to use the data for this assessment. The support of the Marine Environment Protection Fund Steering Group in agreeing an adjustment of the planned geophysical survey lines to allow the collection of data for the *Mendi* is also gratefully acknowledged.

Dr Stephanie Arnott undertook the processing and archaeological interpretation of the data and compiled this report with illustrations by Kitty Brandon. The project was initiated and managed for Wessex Archaeology by John Gribble.

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

- 1.1.1. Wessex Archaeology (WA) was commissioned by the South African Heritage Resources Agency (SAHRA) and English Heritage (EH) to undertake the processing and archaeological assessment of geophysical data collected over the wreck of the *Mendi* during the summer of 2007.
- 1.1.2. The *Mendi* was a British troopship carrying 803 officers and men of the South African Native Labour Corps from Cape Town to France. Shortly before 05:00 on the 21st February 1917 she was rammed by the steamer *Darro*, approximately 11 nautical miles off St Catherine's Point on the Isle of Wight. The *Mendi* sank in less than 20 minutes with the loss of 649 lives (WA 2007).
- 1.1.3. A desk-based assessment by WA into the history of the *Mendi* and its loss was commissioned by English Heritage to coincide with the 90th anniversary of the disaster. This appraisal also gathered information about the wreck site and its current condition from divers and other sources, with a view to informing future archaeological investigation of the wreck. It was envisaged that such investigation would comprise an initial geophysical survey, followed by remote operated vehicle (ROV) and/or diver surveys of the site (WA 2007).
- 1.1.4. During the summer of 2007 a Regional Environmental Characterisation (REC) survey conducted along the south coast of the United Kingdom as part of the Department of the Environment, Food and Rural Affairs' (DEFRA) Marine Environment Protection Fund (MEPF) programme of regional seabed mapping. The MEPF programme is supported by funding from the Marine Aggregate Levy Sustainability Fund (MALSF).
- 1.1.5. When it was realised that the survey would cover the known position of the *Mendi*, at the request of WA and EH the MALSF Steering Group agreed to an adjustment of the planned survey lines to allow the collection of data for the *Mendi*.
- 1.1.6. Datasets collected during the REC survey included multibeam bathymetry, sidescan sonar, magnetometer and sub-bottom profiler. The multibeam bathymetry and sidescan sonar data collected over the wreck are the subject of this assessment. The magnetometer and sub-bottom profiler datasets were not examined as they are not suitable for describing a known wreck site.
- 1.1.7. The results of the assessment will be used to inform the ROV and/or diver survey of the *Mendi* being planned by WA for the summer of 2008.

2. FIELDWORK METHODOLOGIES

2.1. TECHNICAL SPECIFICATIONS

- 2.1.1. The multibeam bathymetry and sidescan sonar data were collected by Gardline Geosurvey Limited in July 2007.
- 2.1.2. Positioning was provided by the Starfix DGPS system with an absolute accuracy in the region of $\pm 3\text{m}$, with relative accuracy being greater (Gardline 2008).
- 2.1.3. The sidescan sonar data were provided in the form of raw xtf files. The data were acquired with an Edgetech 4200 fish recording both high frequency and low frequency data at 410kHz and 100kHz respectively. The range was set to 100m. A Simrad HPR 400 USBL acoustic tracking system was used to track the position of the towfish (Gardline 2008).
- 2.1.4. After the initial pass over the wreck along the original survey line, a further pass was made along each side of the wreck, to ensonify it from both sides and obtain more detailed information than could be gleaned from a single pass.
- 2.1.5. The multibeam bathymetry data were acquired using a Simrad EM3002D system. The data from each line were received as text files containing the easting, northing and depth of every sounding. The data were requested ungridded and unprocessed but with tidal corrections applied. Wreck sites often contain objects that extend upward or outward into the water column but return only a small number of widely spaced soundings. These soundings, which may be archaeologically significant, may have been rejected by the geophysical contractor during the data cleaning process. This process typically rejects soundings that are more than two standard deviations above or below their neighbours. This methodology was developed for studying large bathymetric data sets where a bad sounding was likely to be caused by a reflection from an object suspended in the water column or from marine life.

3. DATA QUALITY

- 3.1. The quality of each dataset was graded during interpretation according to the criteria shown below

Good	Data which is clear and unaffected by weather conditions or sea state. The dataset is suitable for the interpretation of standing and partially buried metal wrecks and their character and associated debris field. This data also provides the highest chance of identifying wooden wrecks and debris.
Average	Data which is affected by weather conditions and sea state to a slight or moderate degree. The dataset is suitable for the identification and partial interpretation of standing and partially buried metal wrecks, and the larger elements of their debris fields. Wooden wrecks may be visible in this data, but their identification as such is likely to be difficult.
Poor	Data which is affected by weather conditions and sea state to a severe degree or is severely affected by noise. This category also contains datasets where the seabed coverage is below 100%. The dataset may be suitable for the identification of standing and some partially buried metal wrecks, if they are in areas covered by the data. Detailed interpretation of the wrecks and debris field is likely to be problematic. Wooden wrecks are unlikely to be identified.
Variable	This category contains datasets with the quality of individual lines ranging from good or average to below average. The dataset is suitable for the identification of standing and some partially buried metal wrecks. Detailed interpretation of the wrecks and debris field is likely to be problematic. Wooden wrecks are unlikely to be identified.

- 3.2. The sidescan data were of good quality with internal structure of the wreck seen in all three lines.

- 3.3. The multibeam bathymetry data were generally of good quality although some noise was present.

4. GEOPHYSICAL DATA PROCESSING

4.1. SIDESCAN SONAR PROCESSING

- 4.1.1. The sidescan sonar data were processed by WA using Coda Geosurvey software. This allowed the data to be replayed with various gain settings in order to optimise the quality of the images. Individual objects that could be discerned within or adjacent to the wreck were tagged, measured and described. This detailed information will be used to plan and support the future archaeological survey of the site.
- 4.1.2. The sidescan sonar data from all lines were joined together into a mosaic wherein the navigation information was smoothed and georeferenced images of the wreck exported. These images will form the baseline against which the ROV and/or diver surveys will be tracked and run in the proposed visual and photographic surveys of the site.

4.2. MULTIBEAM PROCESSING

- 4.2.1. The multibeam bathymetry data were processed by WA using the IVS Fledermaus software suite. The raw data files were first built into a pfm file to allow editing of the soundings.
- 4.2.2. Soundings with inaccurate positioning or those that appeared to have anomalous depths - the result of any errors in the vessel's motion reference unit and positioning system - were rejected.
- 4.2.3. When all soundings in the area of the wreck had been checked the accepted soundings only were exported as a text file. This file was then gridded with a cell size of 30cm and coloured by depth. A three dimensional surface was created that was visualised in Fledermaus to enable measurements of object dimensions, orientation and depth.
- 4.2.4. A georeferenced image was produced that was compared to the sidescan images and the historical plans of the ship to produce an initial interpretation of the wreck site (**Figure 1**).

5. ASSESSMENT

5.1. PRE-2007 INFORMATION

- 5.1.1. The *Mendi* is recorded in Lloyd's Register as having a length of 112.84m, a breadth of 14.08m and a depth of hold of 8.22m. 'Depth' i.e. below the waterline is described as being 7.10m (WA 2007).
- 5.1.2. Although a wreck has been known at the position since the 1940s, the wreck was only identified as the *Mendi* in 1974. Since then, and despite its relative depth and distance offshore, it has been regularly dived by recreational divers. Descriptions of the site collected by WA in 2007 suggest that the entire length of the hull survived the sinking intact and today still remains largely coherent. However, the

superstructure and upper decks of the vessel have collapsed down into the hull, and onto the adjacent seabed.

- 5.1.3. The earliest diver reports indicate that the wreck was lying upright but laid over on its starboard side. It was reported to stand as much as 12m proud of the seabed, with much of the decking having collapsed and the boilers standing proud of the main wreckage. Two pairs of tube boilers and the engine were observed
- 5.1.4. In the late 1980s or early 1990s the most distinguishable parts of the wreck were apparently the bow, the stern and the boilers, with the stern described as standing over 8m high.
- 5.1.5. In 2002 the wreck was surveyed for the United Kingdom Hydrographic Office (UKHO) by Gardline and the anomaly dimensions found to be 121m long by 31m wide. The least depth was recorded as 28.9m in a general water depth of 36m, suggesting that the wreck structure stood up to 7.1m above the seabed. The wreck was noted as being partially intact and on its side, with two small areas of debris to the north. No seabed scour was reported around the wreck structure.
- 5.1.6. The following year the wreck was reported by Gardline as having been swept clear at 29.7m depth. The wire sweep fouled at 30.0.
- 5.1.7. A diver who visited the site in 2003 or 2004 reported that the wreck still stood proud of the seabed with large sections of the port side intact. The wreck was canted to starboard and the top of the vessel was quite flat as though she had been cabled (WA 2007).
- 5.1.8. However, conflicting descriptions from 2005 illustrate the problems related to information received from divers, many of whom gave descriptions of the site from memory, often some time after their dives. One diver states that in 2005 the wreck was scattered with little upright structure other than in the area of the boilers and the bow. A second account describes the wreck as still standing at least 12m above the seabed.
- 5.1.9. The most detailed description of the wreck collected by WA during the desk-based assessment was made by Dave Wendes, a diver who has visited the site on several occasions and has included a description of it in a guide to the area's wrecks published in 2006. Mr Wendes states that the wreck lay half over on its starboard side with the bow lying to the west. According to him, although the bow was upright when he first visited the site, it has now collapsed and is lying on its starboard side. Amidships he describes four boilers and the engine being visible, and reports that they are largely inverted. Between the bow and the boilers there is a break in the hull, while approximately amidships on the starboard side there is an area of collapsed hull plates, frames and girders. He reports the wreck standing 7-8m off the seabed amidships (Wendes pers. comm.).

5.2. 2007 SURVEY RESULTS

- 5.2.1. From the sidescan sonar data the wreck can be seen lying oriented approximately east to west – with the bow in the west and the stern in the east. There is no apparent scouring and the surrounding seabed appears to be featureless (**Figure 1**).

- 5.2.2. The wreck stands proud of the seabed by a considerable amount toward the western end or bow. As the shadow extends beyond the extent of the range, however, this height can only be estimated at over 6.3m.
- 5.2.3. The hull of the wreck appears fairly coherent although it has collapsed in many areas, with a chaotic internal structure and outlying debris. It is not possible to accurately measure the length and width of the wreck in this dataset as parts of the wreck are obscured by shadows. Estimated measurements are 129m long by a maximum of 28m wide.
- 5.2.4. In the multibeam data the wreck is oriented approximately east to west (084 – 264 degrees). It measures 116m long by 27m wide at the widest point. Excluding the areas of outlying debris, the main bulk of the wreck appears to have a width of approximately 14m. The minimum depth is 29.9m with a general seabed depth of 36.6m. These dimensions are very similar to those in the 2002 Gardline sidescan sonar data.
- 5.2.5. The multibeam data shows a section of hull approximately halfway along the southern side of the wreck with a significant profile (**Figure 2**). This area has a maximum height of 6.6m above the seabed and is approximately 55m long. In the sidescan data the feature appears to have a height of over 6.3m and a length of 56m.
- 5.2.6. One possible interpretation of this feature is that the vessel has now fully collapsed onto its starboard side and what is visible in the data may be the bottom of the hull which due to its position underneath the boiler and machinery spaces was reinforced with closer spaced frames and girders (as detailed on the vessel plans), and is therefore more resistant to collapse. An alternative and perhaps more likely scenario is that the upstanding boilers and engine have protected the adjacent hull structure and led to its relatively greater degree of preservation, compared with the remainder of the hull.
- 5.2.7. The new geophysical data indicates that the bow and stern of the wreck are much lower than the midships section. The maximum height of the western end or bow section of the wreck is approximately 1.6m above the seabed. The stern has a maximum height above the seabed of 2.5m.
- 5.2.8. The bow appears to be broken away from the rest of the wreck - which tallies with Dave Wendes' description - and a large amount of scattered debris is present in this area. This break in the hull aft of the bow may be the result of the damage suffered when the *Mendi* was rammed by the *Darro*. Survivors' accounts suggest that the bow of the *Darro* cut to within a couple of feet of the midline of the *Mendi*.
- 5.2.9. In the midships section of the wreck there are four large, similar objects that are closely spaced. Visible in both the multibeam and sidescan sonar data these objects are situated adjacent to the upstanding section of hull plating and are likely to be the vessel's boilers. The two objects closest to the hull plating are higher than those further inboard (**Figures 2 and 3**). It is possible either that all four objects are boilers or alternatively that the highest two objects are boilers while the lower objects are some other structure associated with the boiler space. The highest objects measure approximately 6m by 5m by 5m high above the surroundings. They do appear to have rounded tops, consistent with being cylindrical boilers. The lower objects have similar lengths of 6m but are only approximately 3m wide and 2m high.

- 5.2.10. Aft of the boilers and approximately in line with them is another upstanding object. From comparison with the vessel plans it is possible that this may be part of the engine. The feature is approximately 7.5m long, 6m wide and 2.5m higher than the adjacent seabed on the northern or port side of the vessel.
- 5.2.11. Two other conspicuous features are visible in the multibeam data, one toward the bow and one toward the stern. They are situated at the approximate location of two of the vessel's cargo holds and may be related to the hatch coaming or strengthened areas associated with these structures. These features are not distinctive in the sidescan sonar data. In the multibeam data the forward object measures 13.5m along the vessel and has a width of 6m and a height of 1.6m. The aft object has a length of 8m, a width of 3m and is 1.8m high.
- 5.2.12. Two linear objects extending from the north side of the vessel and slanting towards the stern in the east may be the vessel's masts. These features are visible in both the datasets but more obvious in the sidescan sonar data as they are of low relief. The measurements of each from the sidescan sonar data are 16m long for the foremast and 22m for the mainmast from the edge of the main portion of the wreck. They each have a width of approximately 0.4m. The shadows suggest that the height of the mainmast above the seabed may be up to 1m while that of the foremast may be up to 0.5m.

5.3. SUMMARY

- 5.3.1. The wreck appears to be in a very different condition to that described in the majority of the dive reports, suggesting it has changed significantly within the past two or three years. How much of this potential deterioration is due to the wreck being cable swept in 2003 is impossible to say based on the available data.
- 5.3.2. Where the bow and stern once represented significant high points on the wreck, this is now not the case. It appears that David Wendes' report of the collapse of the bow from its original upright position onto its starboard side is correct. Similar structural collapse seems to be occurring elsewhere on the wreck.
- 5.3.3. The boilers remain clearly visible and a feature that is thought to be the engine can be discerned. The masts of the vessel have not generally been mentioned in the diver reports, with just one undated reference from the late 1980s or early 1990s describing the foremast as largely intact (WA 2007). Features thought to be both the main and foremasts are visible in both the multibeam and sidescan sonar data.
- 5.3.4. Many other internal structures can be seen in the geophysical data, although these have yet to be identified. Yet other features, such as the stern gun known to have been fitted to the *Mendi*, haven't been possible to identify from the current datasets.
- 5.3.5. The hull of the wreck appears to still be largely coherent with much of the collapsed wreckage from the superstructure concentrated within the hull. However, the assessment suggests that particularly in the bow and stern areas of the wreck have been subject to a marked deterioration in last 3-5 years, and this may be indicative of a more general degrading of the wreck as a whole.
- 5.3.6. This assessment has built on the results of the 2007 desk-based appraisal in suggesting a range of targets areas on the wreck for investigation during a ROV and/or diver survey. For example, it has highlighted evidence for a break in the hull aft of the bow, and suggested that this may be physical evidence of the accident that resulted in the sinking of the *Mendi*. It has identified features on the wreck (such as

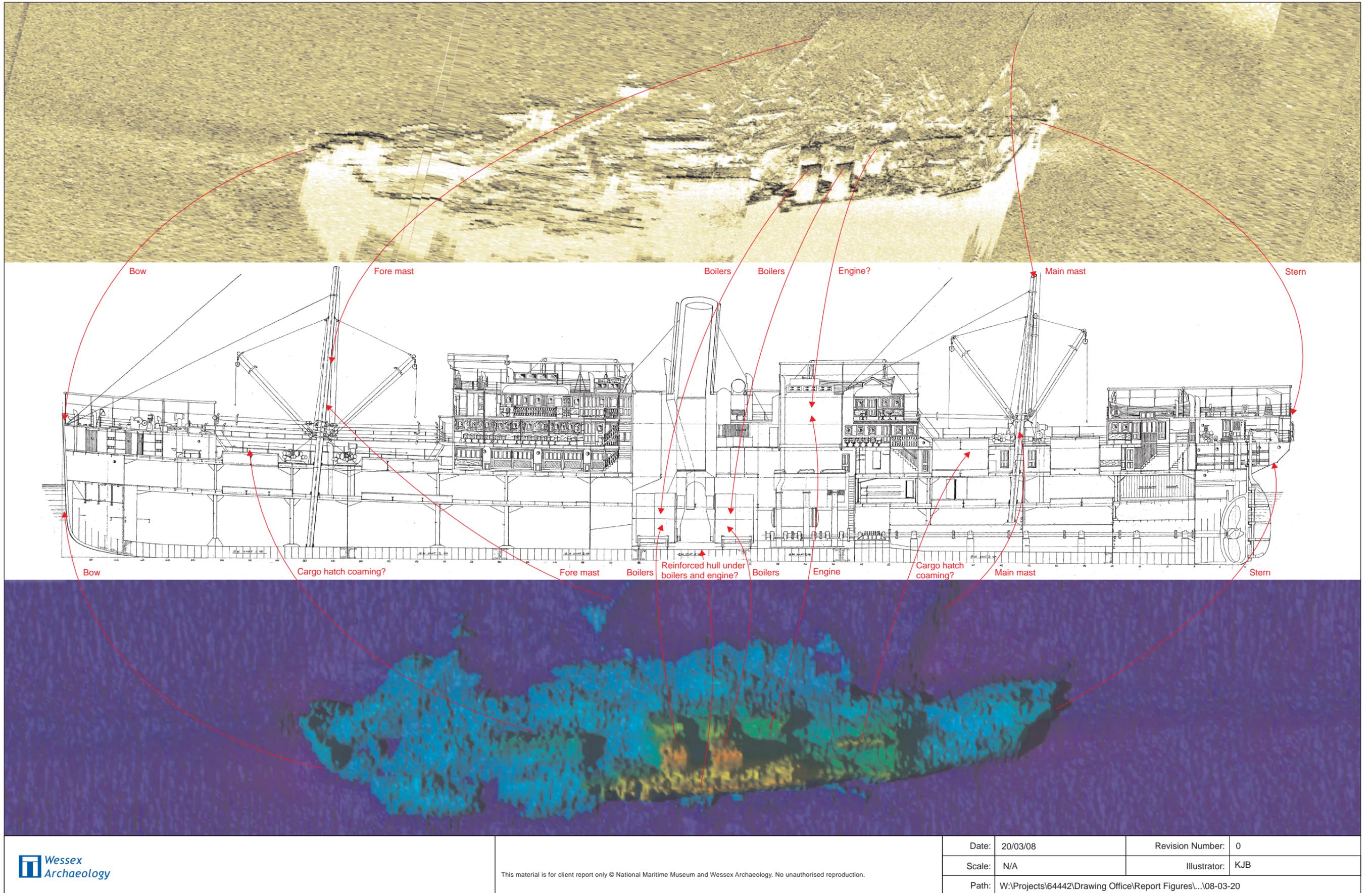
the possible hatch coamings) which cannot be securely identified from the geophysical data, but which were central to the story of the sinking in terms of how they affected the ability of those billeted below decks to evacuate the holds rapidly after the collision.

- 5.3.7. In identifying an apparent marked deterioration in the condition of the wreck, this assessment provides the basis for further survey work which could provide better evidence of the condition and relative stability of the site, the possible impacts of human intervention on the site since its discovery and the prognosis for its future survival.
- 5.3.8. Lastly, this assessment of the geophysical data provides georeferenced base data for the wreck of the *Mendi* which will be invaluable in designing future investigations of the site, and which can be used in conjunction with acoustic tracking systems to provide real time navigation for either ROV or divers around the site.

6. REFERENCES

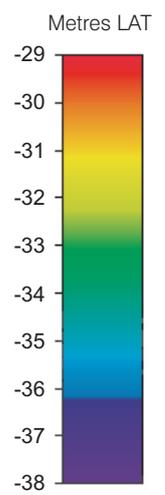
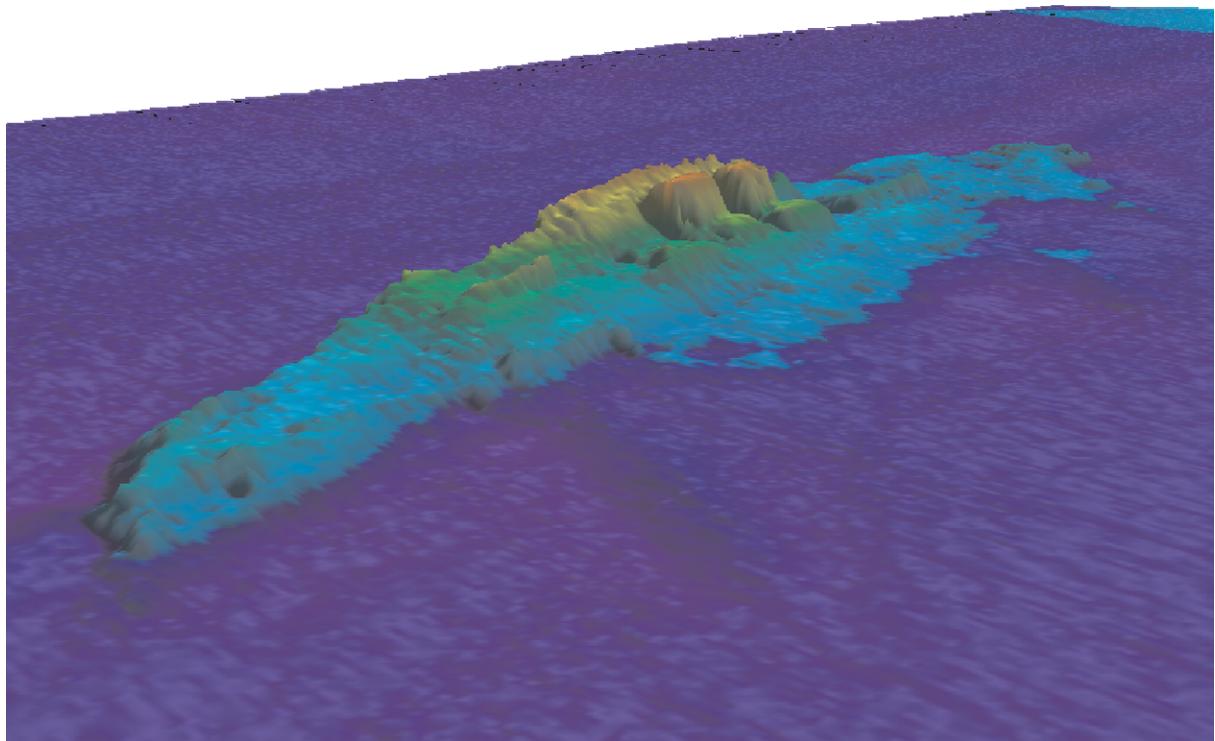
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Multibeam bathymetry and sidescan sonar data of the wreck of the *Mendi* with vessel plan detailing the internal structure

Figure 1



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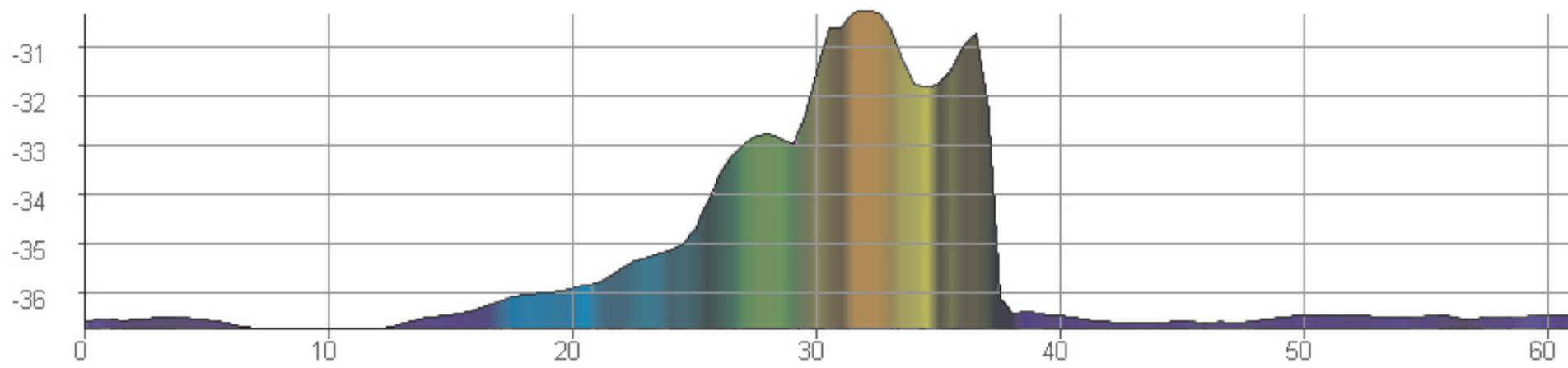
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Oblique view of the *Mendi* from the starboard side in the bathymetry data, looking towards the south-west, with the stern in the lower left corner

Figure 2

Depth (m)



Distance along profile (m)



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Midships profile across the *Mendi* in the bathymetry data, looking east, showing the upstanding port side and boilers

Figure 3



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