Maritime & Coastguard Agency

SS Richard Montgomery: Survey report 2024

December 2nd 2024

Contents

Abbreviations

CD	Chart Datum
DFT	Department for Transport
EAG	Expert Advisory Group
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
LIDAR	Light Detection and Ranging
MBES	Multibeam Echo Sounder
MCA	Maritime and Coastguard Agency
MOD	Ministry of Defence
NEQ	Net Explosive Quantity
PPK	Post-Processed Kinematic
SIS	Seafloor Information System
SSRM	SS Richard Montgomery
UKHO	United Kingdom Hydrographic Office
VORF	Vertical Offshore Reference Frame
VTS	Vessel Traffic Monitoring Service

1 Executive Summary

1.1 Background

1.1.1 The SS Richard Montgomery (SSRM) is a US Liberty ship which went aground in the Thames estuary in august 1944 whilst carrying a cargo of munitions. Although immediate efforts were made to salvage the cargo, the vessel broke in two, flooded and sank before the salvage operations could be completed.

1.1.2 The wreck lies adjacent to the Medway approach channel and is approximately 1.5 miles from the town of Sheerness and 5 miles from Southend. Around 1,400 tons of explosives remain on board the wreck which is designated under Section 2 of the Protection of Wrecks Act 1973.

1.1.3 Surveys of the wreck are undertaken to provide information on its condition, to identify any changes or deterioration and to inform future management of the wreck. This report details the results of the 2024 full survey.

Figure 1. Photograph of M/V Lode during the 2024 SSRM Full survey.

1.2 Survey Overview

1.2.1 This report primarily compares the data from this year's (September 2024) full survey with that gathered during the May 2024 snapshot survey and the October 2023 full survey.

1.2.2 The survey was conducted on the 15th, 21st and 22nd of September 2024.

1.3 Key Results

1.3.1 The whole forward section of the wreck keeps tilting towards the east. Between 2022 and 2024 there is a horizontal shift of 43-55 centimetres when comparing different locations on the top of the foremast. This is an ongoing development and the increase in tilt can be seen over several years.

1.3.2 There has been a 2.3-meter decrease of sediment in the forward sections hold 2, between the 2024 snapshot and full survey. It appears that several cubic meters of sediment has flowed into the interior of the wreck through two funnels.

2 Introduction

2.1 Background

2.1.1 The SS Richard Montgomery (SSRM) was a US Liberty Ship of the EC2-S-C1 class, constructed by the St. John's River Shipbuilding Company in Jacksonville, Florida in 1943. In August 1944, the ship left the US with a cargo of munitions and travelled across the Atlantic in convoy bound for the UK and then on to France.

2.1.2 On arrival in the Thames estuary on 20th of august 1944, orders were received to anchor off great Nore. Unfortunately, this was too shallow for the heavily laden vessel and, as the tide fell, the SSRM dragged its anchor and went aground on Sheerness Middle Sand, a sandbank running east from the Isle of Grain and to the north of the Medway approach channel. By that evening, the vessel was already reported to be badly hogged (curved-up in the centre and sagging at the ends) and an explosive like sound was heard. This sound was the steel hull plates splitting forward of the bridge.

2.1.3 On 23 august, stevedores from Gravesend were engaged to discharge the cargo. However, on the afternoon of the following day, the ship's hull cracked even further, and the bow holds flooded. By 8 September, the ship broke its back completely. Divers reported that the crack extended down both sides of the hull, with the vessel clearly open on the starboard side, but the cargo discharge continued. Royal navy personnel were brought in to finish the cargo removal, but they were hampered by deteriorating weather and safety fears as the vessel gradually sank. The salvage operation was abandoned with approximately 1,400 tons net explosive quantity (NEQ) of munitions remaining within the forward section of the vessel in holds 1, 2 and 3.

2.1.4 The vessel remains on Sheerness middle sand, lying in two sections in its own scour pit and sitting on exposed bedrock which is believed to be London clay. The SSRM lies across the tide and all three masts are visible above the water at all states of the tide (see Figure 2).

Figure 2. Photograph of the three masts of SSRM seen during low tide.

2.2 Management

2.2.1 The SSRM wreck is designated as a dangerous wreck under Section 2 of the Protection of Wrecks Act 1973. There is a prohibited area around the wreck, and it is an offence to enter within this area without the written permission of the Secretary of State for Transport. The wreck is clearly marked on the relevant admiralty charts, the prohibited area is marked with four lit cardinal

buoys and twelve red danger buoys, and the wreck is under 24hr surveillance by Medway Vessel Traffic Monitoring Service (VTS).

2.2.2 Although the wreck is thought to be stable if left undisturbed, it is routinely monitored. Regular surveys of the SSRM are undertaken to provide information on its condition, identify any changes or deterioration and inform future management strategy. The survey results are shared with the independent Expert Advisory Group (EAG) formed in 2017 to advise the Department for Transport (DFT) on managing the SSRM. There are plans to reduce the height of the three masts, which should prevent further deflection of the connected decks, minimise future potential deterioration and mitigate the risk of collapse onto the decking below.

2.2.3 A variety of methods have been used to monitor the wreck. Since 2002, multibeam sonar technology has been the favoured method of survey. Although occasional diving operations are carried out on the wreck (most recently in 2013), multibeam sonar is faster, more cost-effective and provides greater levels of detail, repeatability, and reliability than diver surveys. This is in part due to the very poor visibility and high tidal range in the Thames estuary which makes diving operations very challenging.

2.3 This Report

2.3.1 This report is a summary of the September 2024 full survey. The result from this survey is compared mainly to the result of the most recent surveys; the May 2024 snapshot survey and the October 2023 full survey. The year-on-year comparisons of survey data are used to help identify and quantify any deterioration of the wreck and it provides a longer view of the condition and rate of deterioration of the wreck structure.

2.3.2 The data analysis covers the entirety of the wreck and identifies 97 features on the wreck which have been used in successive surveys as markers for measuring levels of change. In addition to this there are six key areas which have repeatedly demonstrated levels of accelerated deterioration and are therefore a specific focus of each survey (Figure 3).

2.3.3 This report also includes the results of the surrounding seabed survey. The seabed survey aims to identify changes in the local seafloor topography that may have implications for the wreck's stability or for the neighbouring Medway approach channel. It also aims to locate items of debris on the seabed within

the survey area, including debris that may have originated from the wreck and debris from other sources.

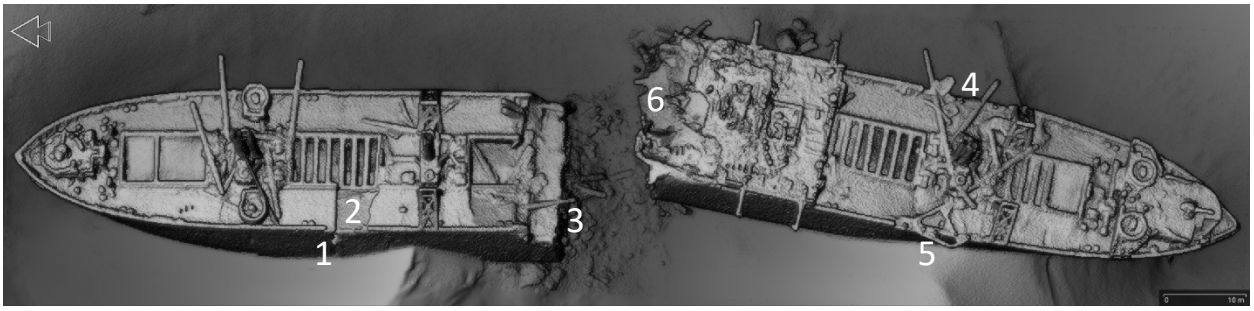

Figure 3. SSRM top-down image showing the six key areas.

3 The Survey

3.1 Survey Requirements

3.1.1 The scope of work as defined by the Maritime and Coastguard Agency (MCA) includes the following objectives:

a) Comprehensive multibeam echosounder (MBES) survey of the entire wreck.

b) MBES survey of the prohibited area and the seabed out to at least 400m distance from the wreck, including the edge of the dredged channel in the vicinity of the prohibited area.

c) Laser scan survey of the masts and other structures which are visible above the waterline.

d) Process the data and directly compare it to previous survey results to identify and highlight any areas of structural change or deterioration.

e) Produce a detailed survey report which includes details of any changes noted and comparisons with results from previous surveys.

3.2 Survey Area

3.2.1 The survey area for the full survey is shown by the white line in Figure 4.

Figure 4. Location and extent of the SS Richard Montgomery full survey area.

3.3 Survey Operations

3.3.1 The MBES seabed survey outside the exclusion zone took place on the 15th of September 2024. The laser scanning of the masts as well as the MBES survey of the area inside the exclusion zone (including the wreck itself) was performed on the 21st and 22nd of September.

3.4 MBES

3.4.1 The MBES data was collected with a Kongsberg EM2040D MBES.

Table 1: M/V Lode equipment specifications used for data collection in 2024 SSRM full survey.

Equipment specifications – M/V Lode	
Primary horizontal & vertical positioning	Kongsberg seapath 330 with Trimble VRS now RTK corrections
Primary heading sensor	Kongsberg seapath 330
Acquisition / processing	Eiva Navipac and Kongsberg SIS
Multibeam echosounder (MBES)	Kongsberg EM2040D dual swath
MBES motion reference unit	Kongsberg MRU5
Sound velocity measurement	Valeport mini svs Valeport swift svp
Laser scanner system	Ouster os1
Acquisition	Eiva naviscan

3.4.2 Global Navigation Satellite System (GNSS) data from Kongsberg Seapath navigation system was logged using Kongsberg Seafloor Information System (SIS) software. The recorded GNSS data was post processed using Terrapos resulting in a Post-Processed Kinematic (PPK) GNSS solution combined with the ordnance survey active networks, with 3 reference stations completely covering the survey area. This improves the real-time positioning to a ±5 cm accuracy by using Rinex data from the reference stations together with clock and satellite corrections to recompute the real time positioning. The post-processed solution then replaces the online navigation and GPS height, after thorough quality control and comparison with the online navigation in EIVA NaviEdit.

Reduction to the project vertical datum was performed by using the GNSS height solution and applying a geoid model in EIVA NaviEdit. The geoid model is derived from the United Kingdom Hydrographic Office (UKHO) VORF model and is used to reduce the bathymetry data to Chart Datum (ETRS89, UTM31N).

The vertical uncertainty values for the Applanix POS MV system are less than ±0.05m, when post processed.

3.4.3 This survey has maximised the data density to ensure full and complete ensonification of the SSRM and the surrounding seabed. Almost the entire

seabed was covered by 90 or more valid soundings per square meter. The wreck itself was covered by 3000-25000 soundings/m^2 (Figure 5). The masts were covered by 7000-100000 soundings/m^2.

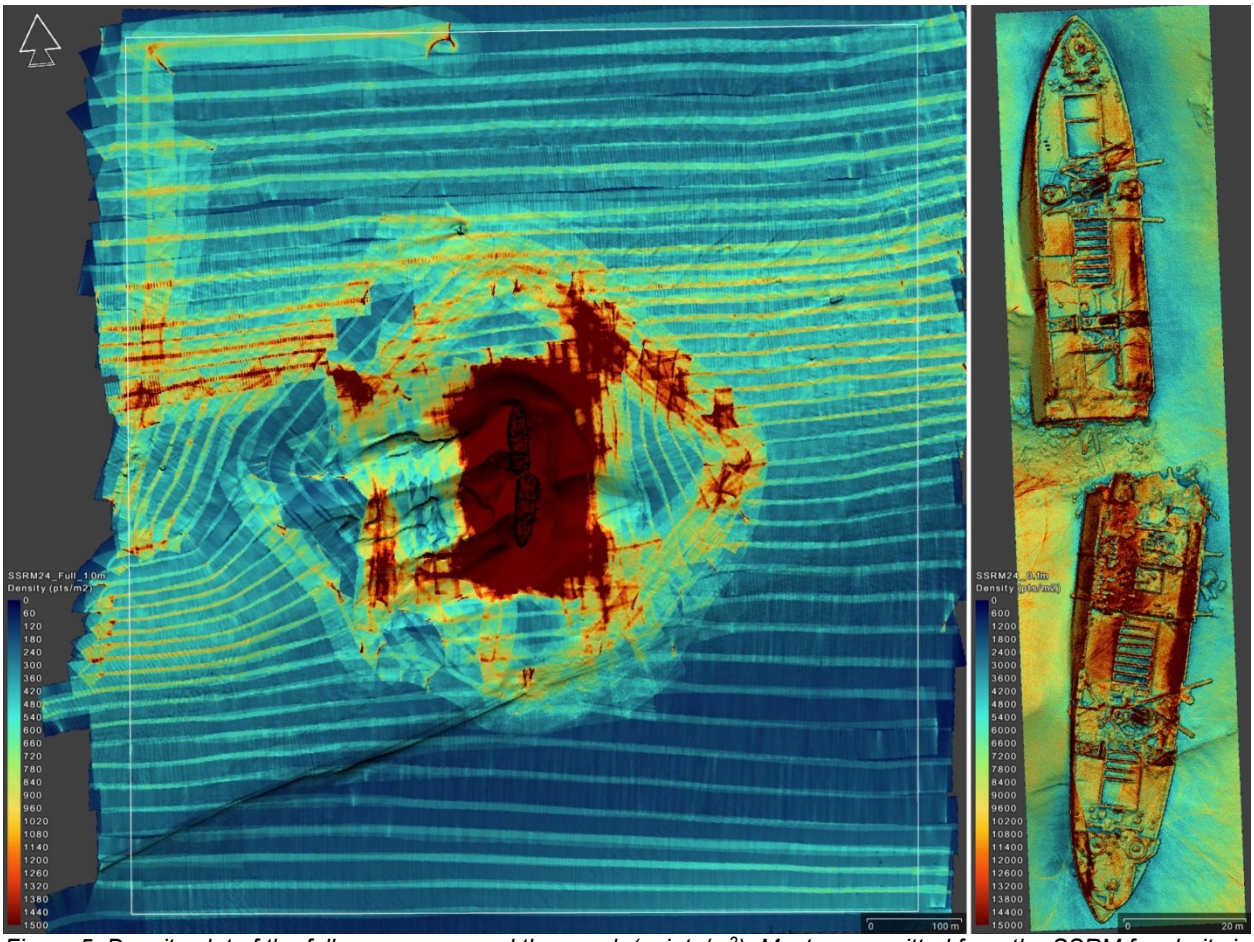

Figure 5. Density plot of the full survey area and the wreck (points/m^2). Masts are omitted from the SSRM for clarity in the density values.

3.5 Laser Scanning

3.5.1 Laser scan lines were acquired using an Ouster OS1 digital lidar sensor mounted on M/V Lode. Multiple lines were run in various directions within the vicinity of the wreck to achieve full coverage and data density around the masts.

3.5.2 The laser data from the 2024 full survey was overlaid on the data gathered during the 2023 full survey. This shows that the three masts are well defined within the laser data and that there is a good correlation with the 2023 data.

3.5.3 The cross-section analysis shows no structural differences but there is a change in position of the masts on the forward section of the wreck (not restricted to only the masts, see section 4.3.3).

4 Results – The Wreck

This section of the report details the output of the survey data acquired from the wreck (Figure 6). Results of survey data from different years are combined and compared to identify changes in the structure of the wreck.

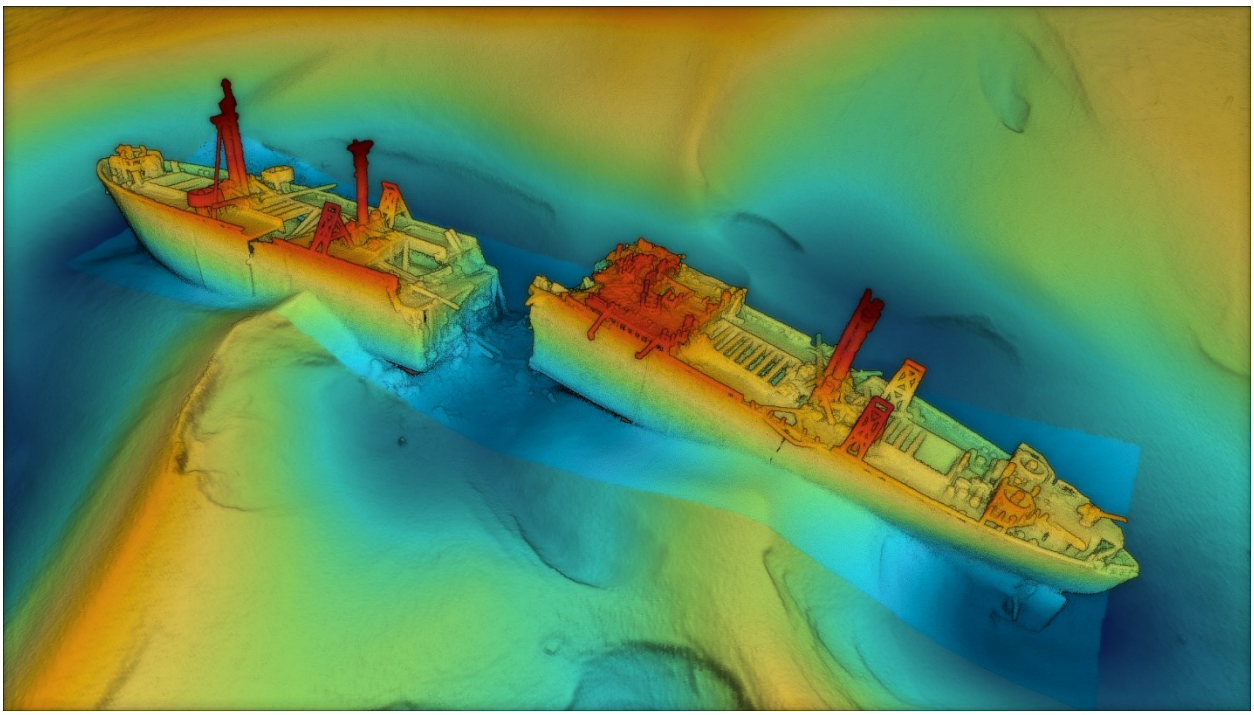

Figure 6. Overview picture of SSRM. Point cloud data, including lidar, overlaid on a digital terrain model of the surrounding seabed.

4.1 Key Areas

4.1.1 Several areas across the wreck have been highlighted during previous surveys as key areas of significant structural change (Figure 3).

4.1.2 **Key area 1 – Crack in the hull** (port side, forward section) (Figure 7).

4.1.3 **Key area 2 – Collapse of cargo hold 2 deck** (port side, forward section) (Figure 7).

The forward section of the Richard Montgomery is seriously hogging almost exactly halfway along the no. 2 hold hatch. This hogging has resulted in a crack appearing on the upper part of the port side while the lower part of the starboard side is significantly buckled giving the appearance that the forward part of the wreck is splitting in two and pivoting about the starboard rim of hold 2. The flexing of the upper deck has caused a portion of the upper deck and half of the hold 2 hatch cover supports to collapse through into the 'tween deck space.

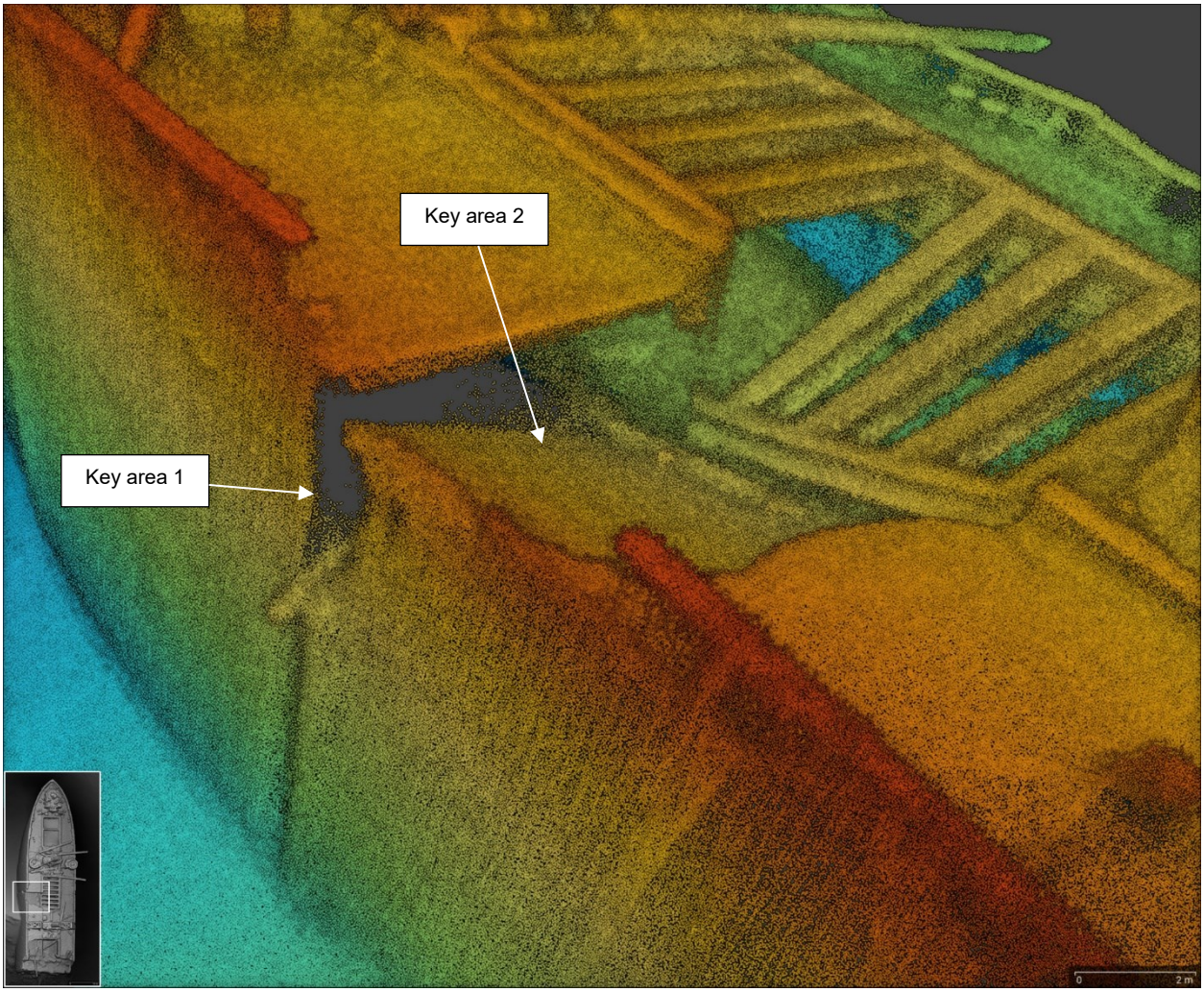

Figure 7. Point cloud image of key areas 1 and 2.

4.1.4 **Key area 3 – Aperture** (aft end, forward section) (Figure 8).

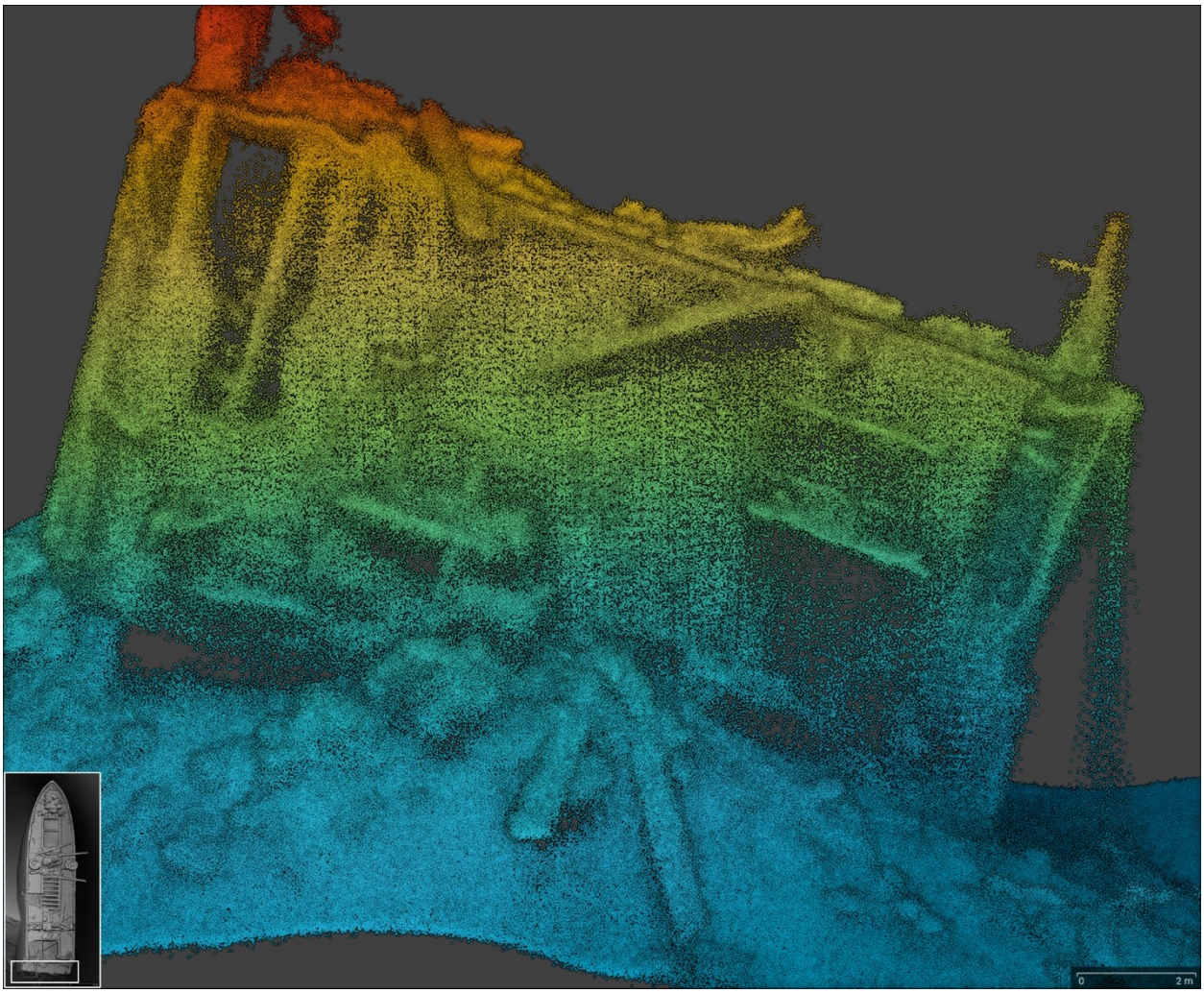

Figure 8. Point cloud image of the aperture, key area 3.

4.1.5 **Key area 4 – Split in the hull** (starboard side, aft section near the aft mast house) (Figure 9).

Key areas 4 and 5 represent the two ends of the same feature, namely a transverse crack across the rear hull section. Like the forward section, the rear section is hogging and potentially breaking in two about halfway along its length. The split appears to be occurring just forward of the mast with the mast remaining upright with respect to the stern part as it drops away from the forward part.

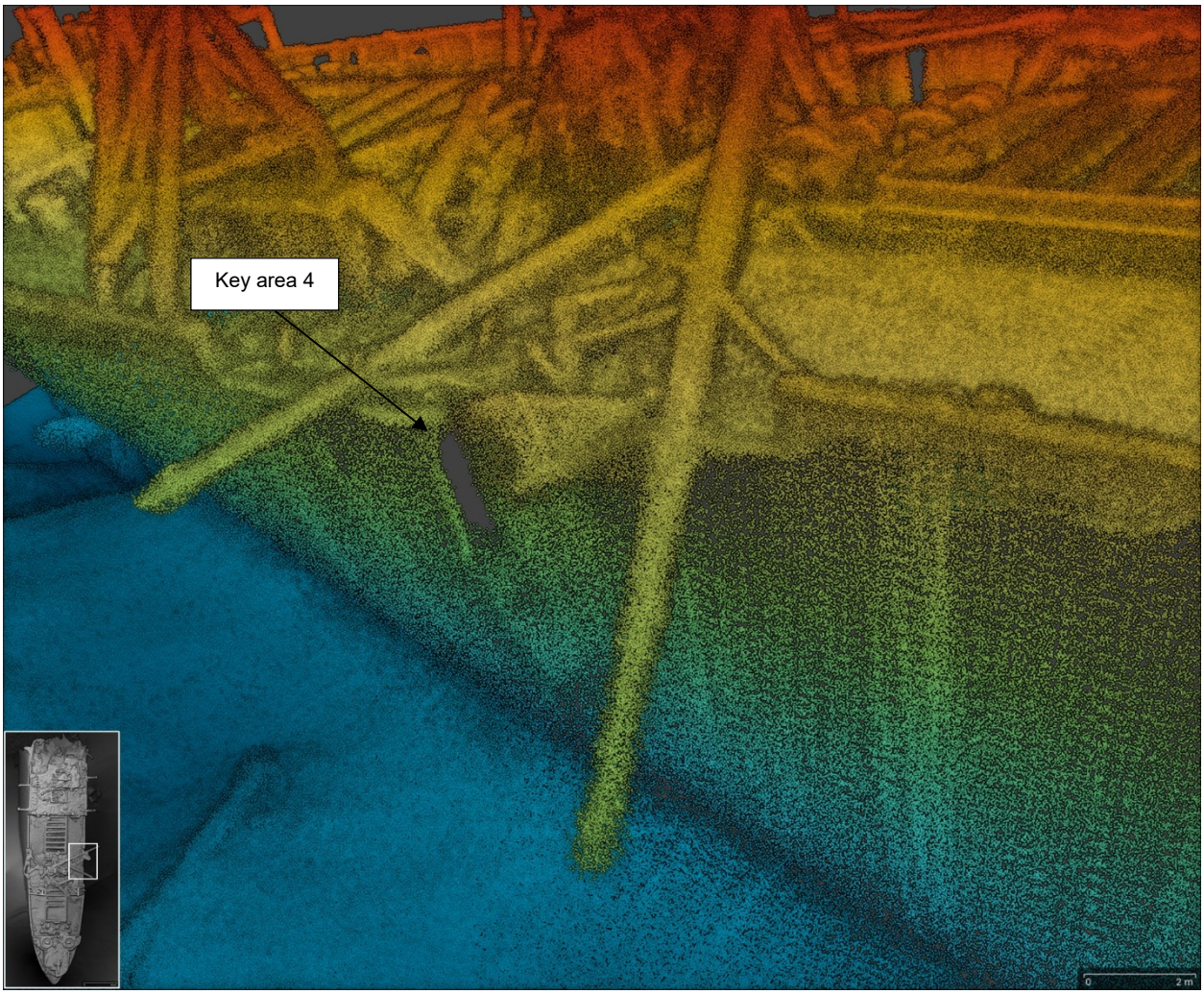

Figure 9. Point cloud image of the split in the hull, key area 4.

4.1.6 **Key area 5 – Split in the deck and split in the hull** (aft section, port side) (Figure 10).

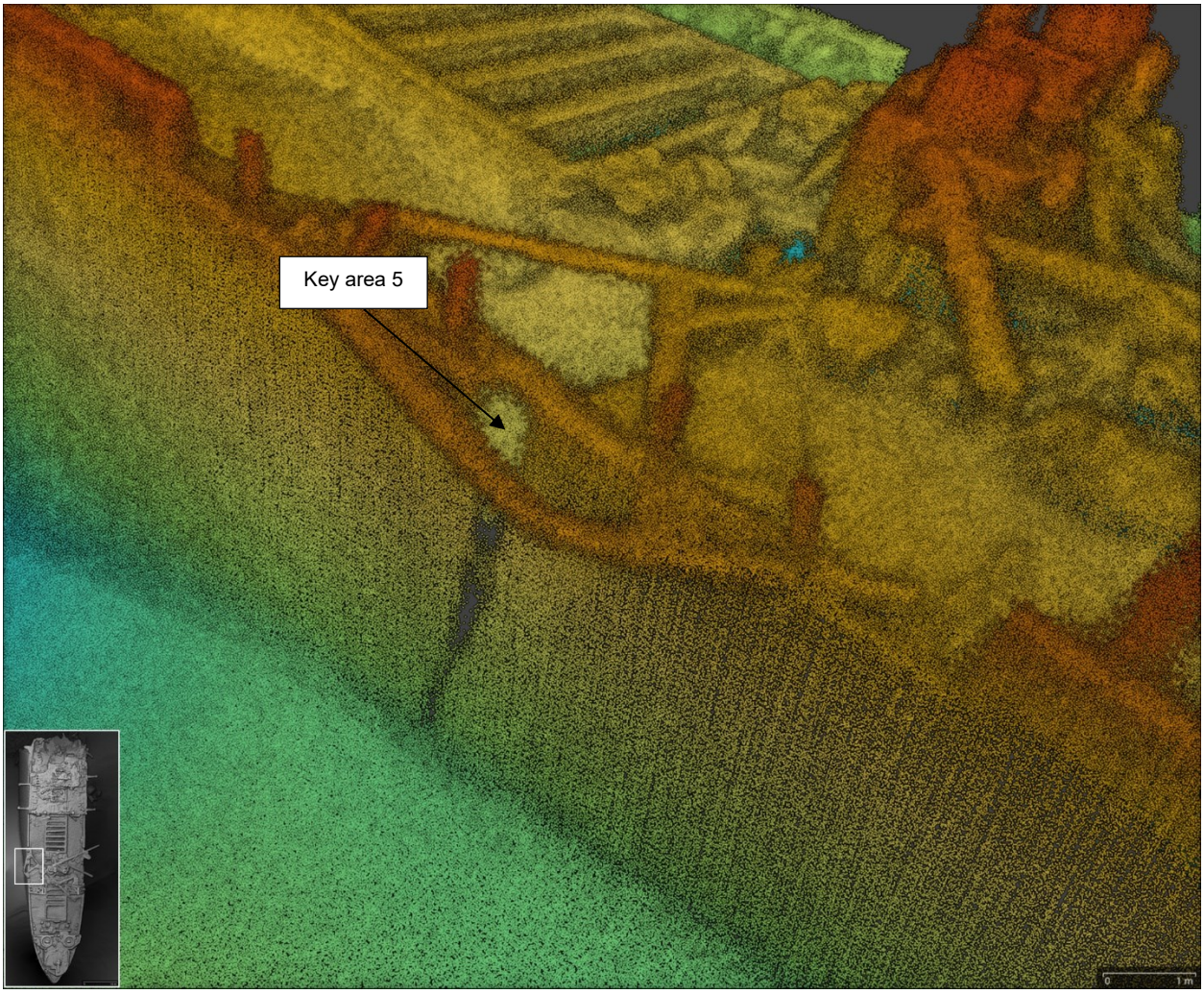

Figure 10. Point cloud image of the split in deck, key area 5.

4.1.7 **Key area 6 – Boiler room casing, collapsing bridge deck and the collapsing boat deck** (forward end, aft section) (Figure 11).

This area was left unsupported when the ship broke in two back in 1944. Consequently, it has been badly affected by wave and current action and is steadily collapsing and falling into the gap between the two halves of the vessel. This area has showed significant degradation in earlier surveys.

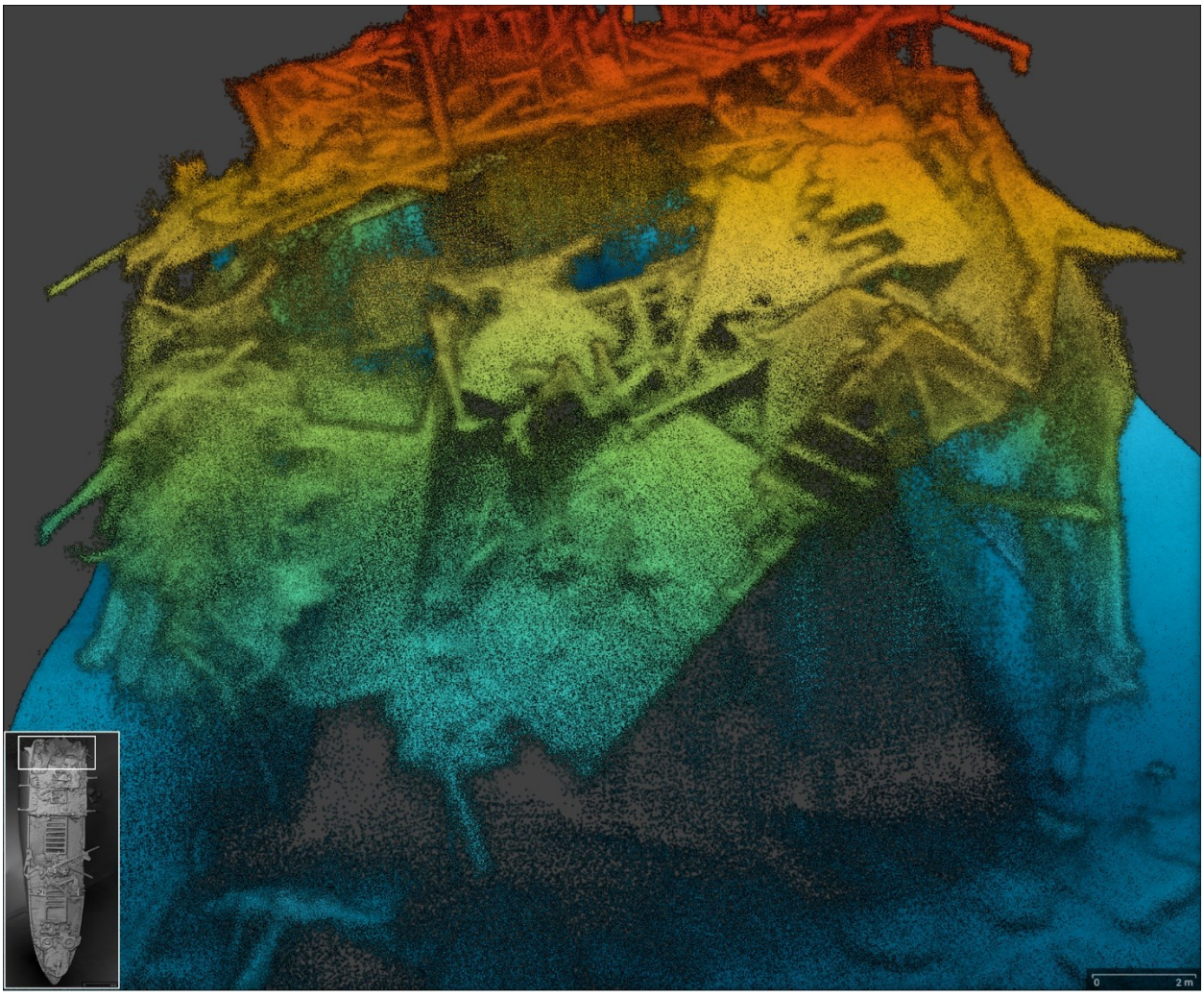

Figure 11. Point cloud image of the collapsing bridge area, key area 6.

4.2 Features

Over the whole of the wreck, 97 specific features have been used in successive surveys as comparison points for quantifying change and deterioration (Figure 12 and Figure 13).

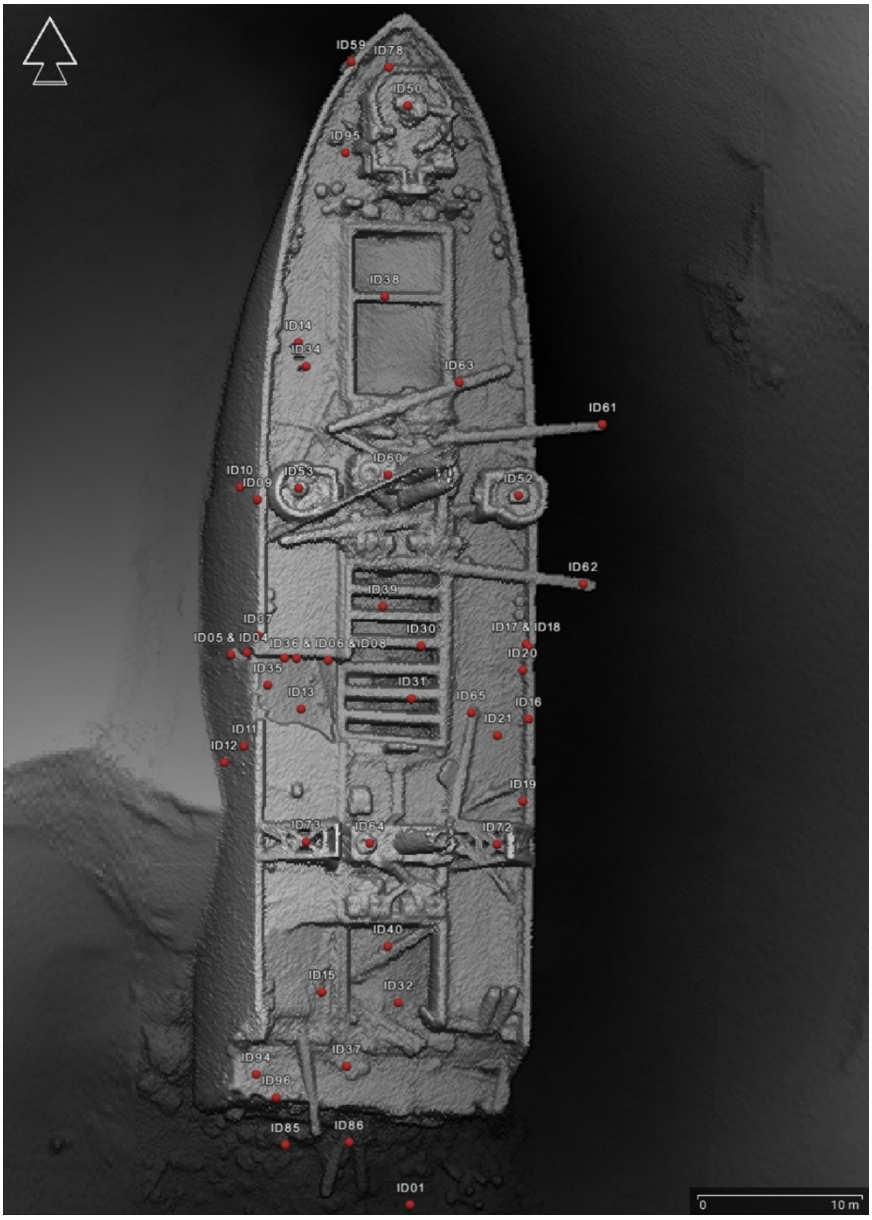

Figure 12. ID features on the forward section.

Figure 13. ID features on the stern section.

4.3 Key Areas and Features – Comparisons

4.3.1 The key areas and other changes of importance can be found below. For the full list of features and the observed changes see the “ID number reference chart” appendix.

4.3.2 Bow and stern

The degree to which to bow and stern may be being undercut as the supporting sediment is eroded away is a potential concern. For information on the seafloor please refer to section 5.1. Both sections of SSRM are leaning to the east and

are partially submerged in sediments on the west side. The bow section show indication to have been undercut to the degree where it has started to move (increase in tilt) whereas the stern section remains unchanged.

4.3.3 Increase in tilt of the bow section

By comparing this year's survey data with that from 2022 and 2023 it is apparent that the tilt of the bow section is increasing. This increase of tilt is most visible when comparing the laser scans of the top of the masts since they are furthest from the centre of the wreck. Measurements were made at three different locations on the foremast, and they show a horizontal shift of 43 to 55 centimetres towards the east between the 2022 and 2024 survey data (Figure 14). Although the reason for the increase in tilt is a subject of debate there is no question that this is an ongoing event.

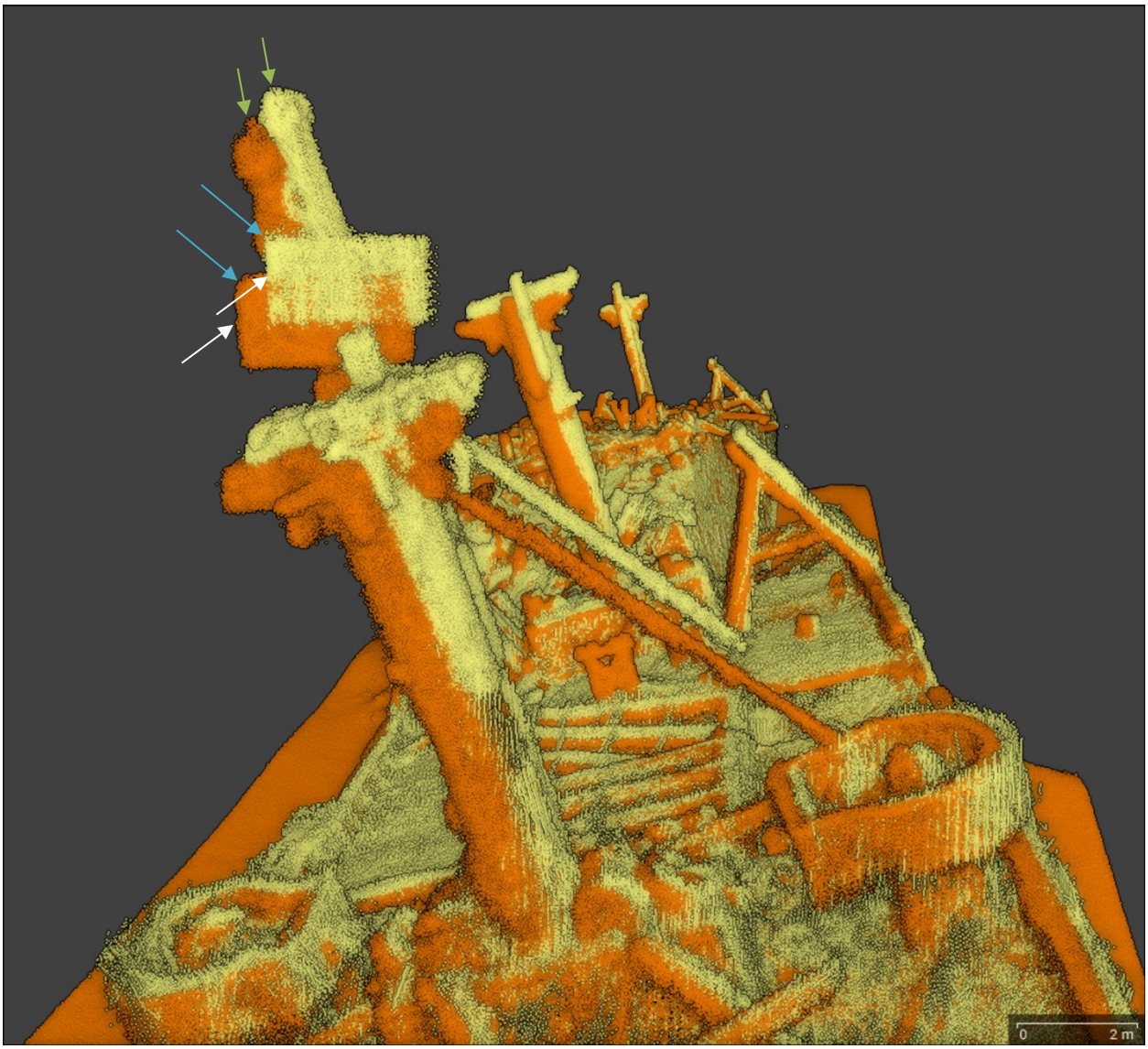

Figure 14. Point cloud data comparing the 2022 full survey (yellow) with the 2024 full survey (orange). Note the positional changes of objects on the closest section (the bow). Arrows pointing towards areas of the mast which were used to determine the horizontal shift.

4.3.4 Key areas 1 and 2 – Crack in hull and collapse of cargo hold 2 deck

The crack in the hull is well defined in the 2023 full survey, 2024 snapshot survey and 2024 full survey (Figure 15). However, it is not possible to say whether the crack has become wider or not due to the error margin of the data points in the point cloud. If it has become wider as earlier comparisons shows it is by at most a few cm.

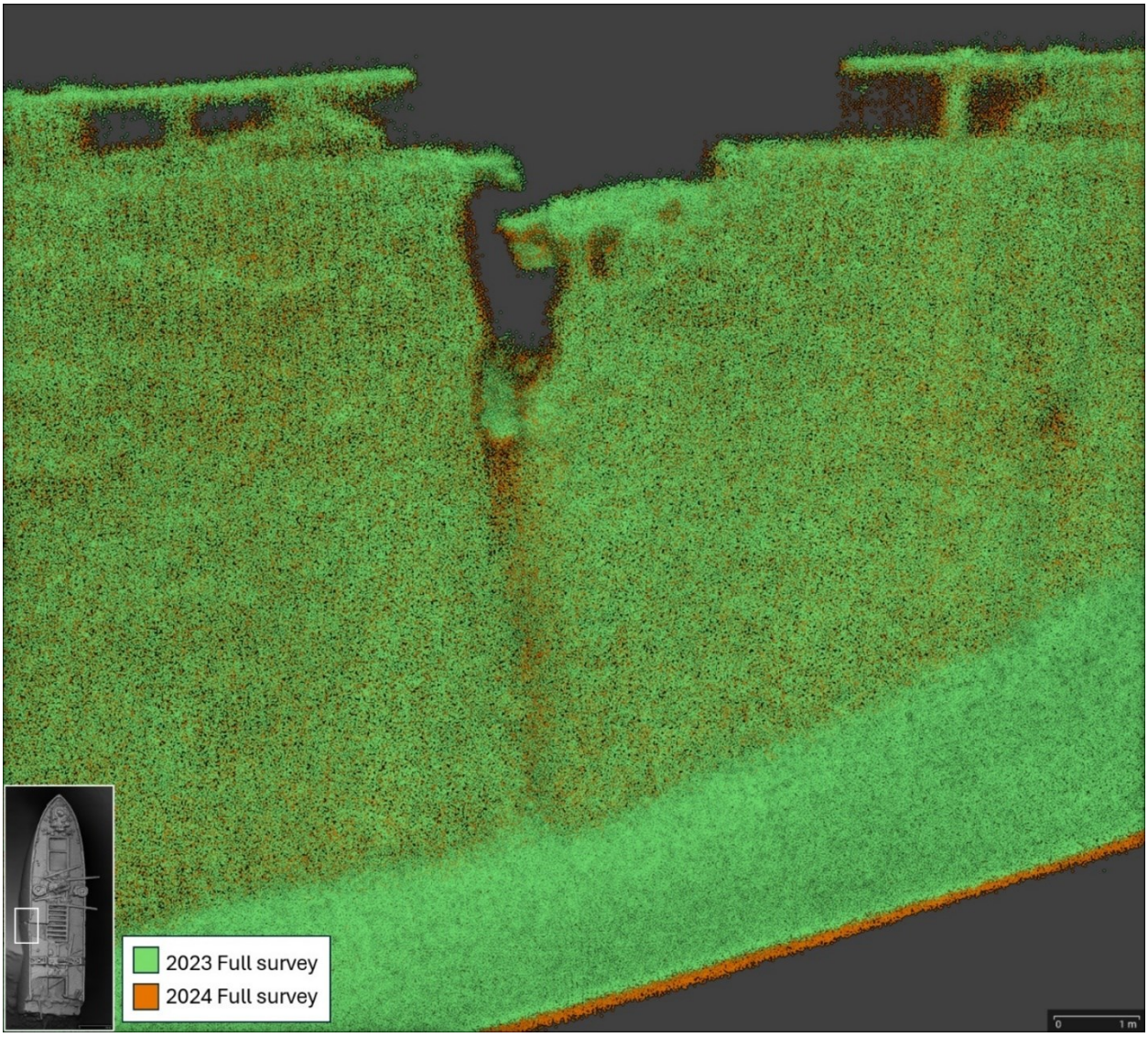

Figure 15. Point cloud cross section comparison of the wreck showing key area 1, the crack in the hull.

Overlaying the 2024 and 2023 full survey data on a cross section shows the extent of the upper deck collapse (Figure 16). The upper deck does not seem to have collapsed further, but the hatch supports over the collapsed part of hold 2 have dropped, see section 4.5.2.

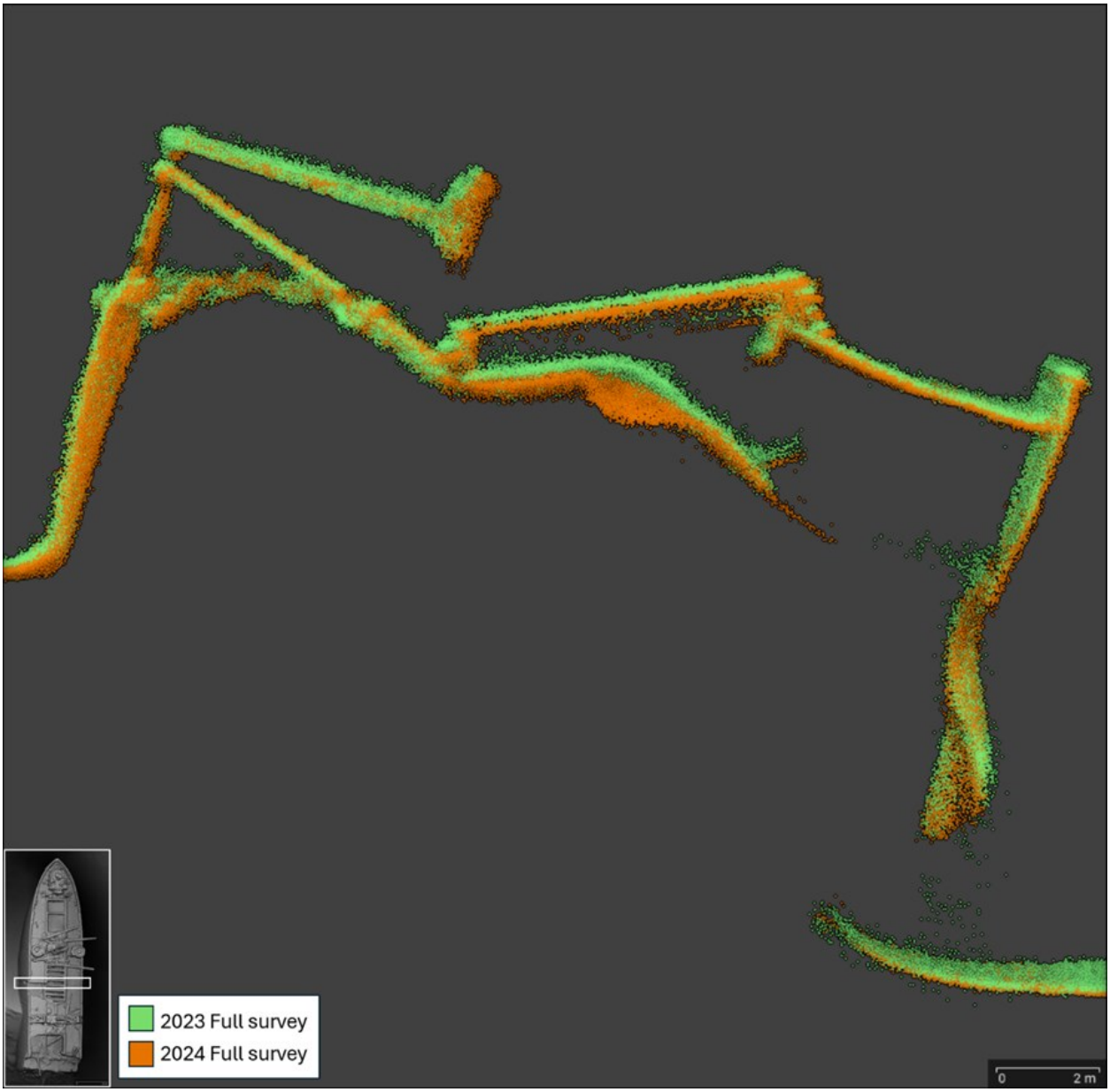

Figure 16. Point cloud cross section of the wreck showing key area 2, the collapsed cargo hold 2 deck. The collapsed deck shows no difference between the 2023 and 2024 full survey. The cross section is 1 meter thick.

4.3.5 Key area 3 – Aperture

Figure 17 shows the apertures on the bulkhead at the aft end of the forward section. No structural differences were found between the 2024 snapshot and 2024 full survey.

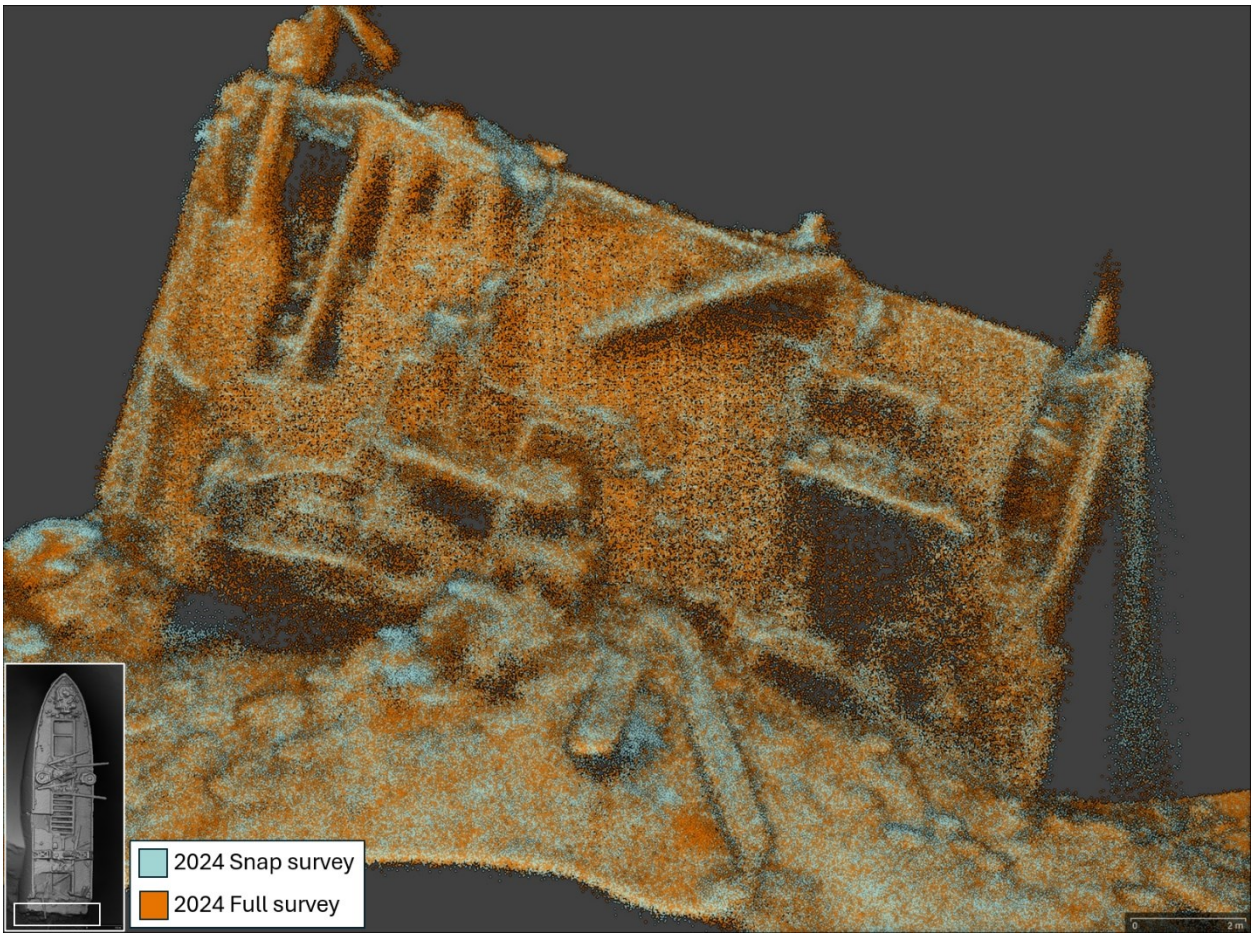

Figure 17. Aperture in the bulkhead to rear of hold 3. The cross section is 10 meters thick.

Due to the nature of the aperture's location, the density of good quality soundings required for identifying any objects inside them is not enough.

4.3.6 Key area 4 and 5 – Split in the hull and split in the deck & hull

No notable differences can be seen between the 2023 full survey and 2024 full and snapshot surveys (Figure 18, Figure 19 and Figure 20).

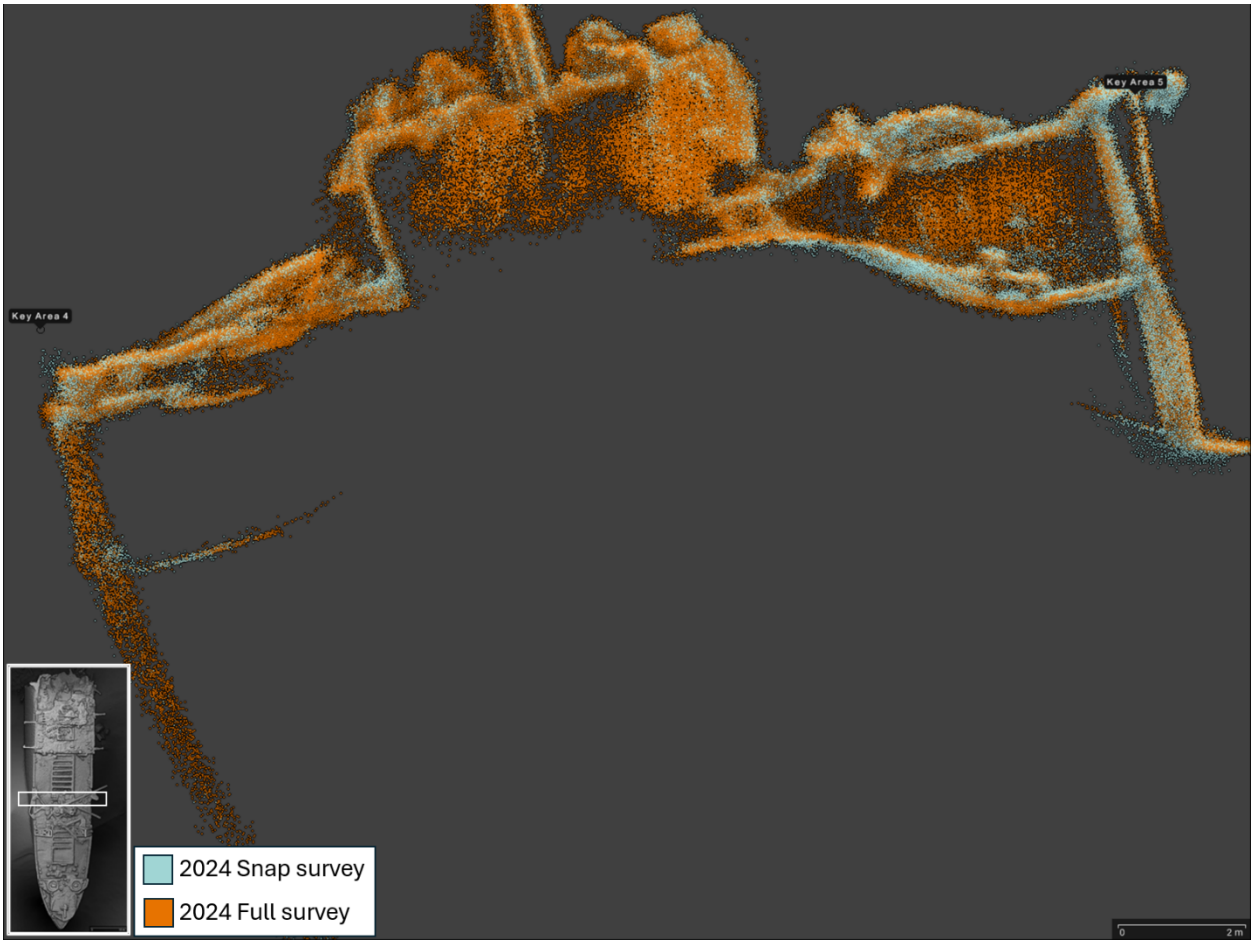

Figure 18. Southward facing cross section showing the split in the hull and collapse of the deck at key area 5. No difference can be seen between the two surveys.

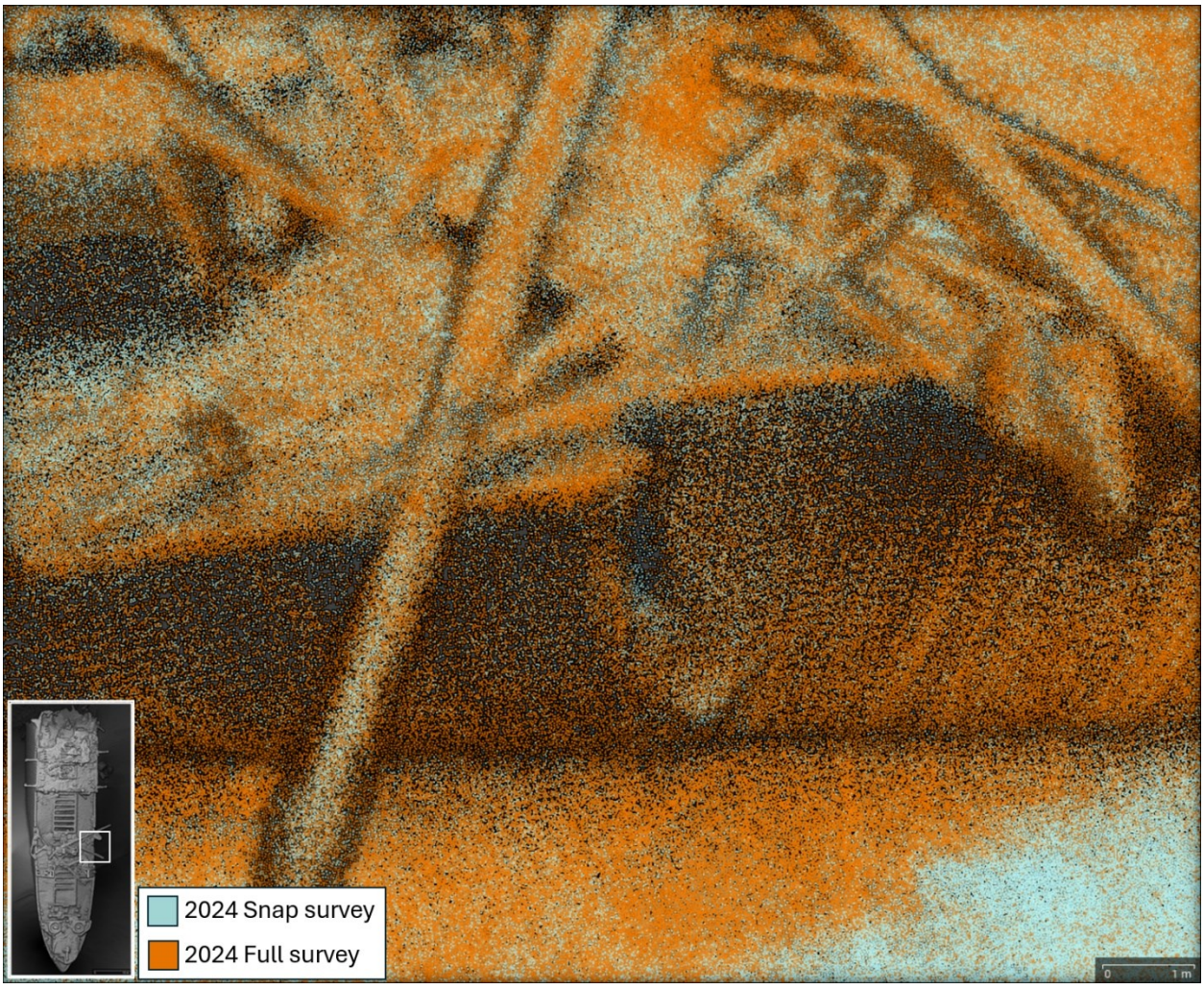

Figure 19. Point cloud view of key area 4 – the split in the hull. No difference can be seen between the 2024 snapshot and full survey.

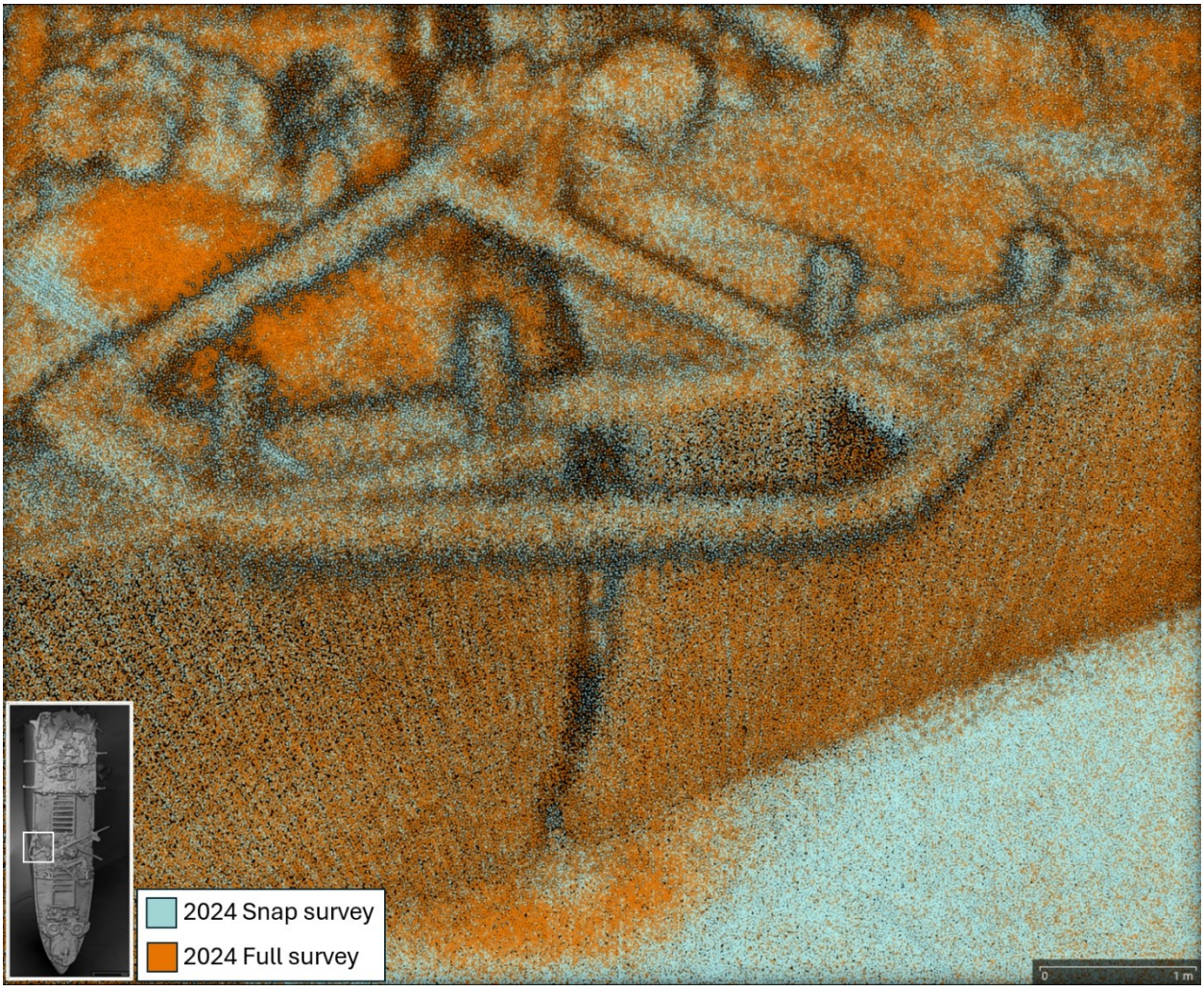

Figure 20. Point cloud view of key area 5 – the split in the hull and split in the deck. No difference can be seen between the 2024 snapshot and full survey.

4.3.7 Key area 6 – Collapsing bridge deck area

The boiler room casing, collapsing bridge deck and the collapsing boat deck usually shows rather big changes. Between the 2024 snapshot survey and full survey however, there is only one notable change (Figure 21). An object has tilted by approximately 15 cm.

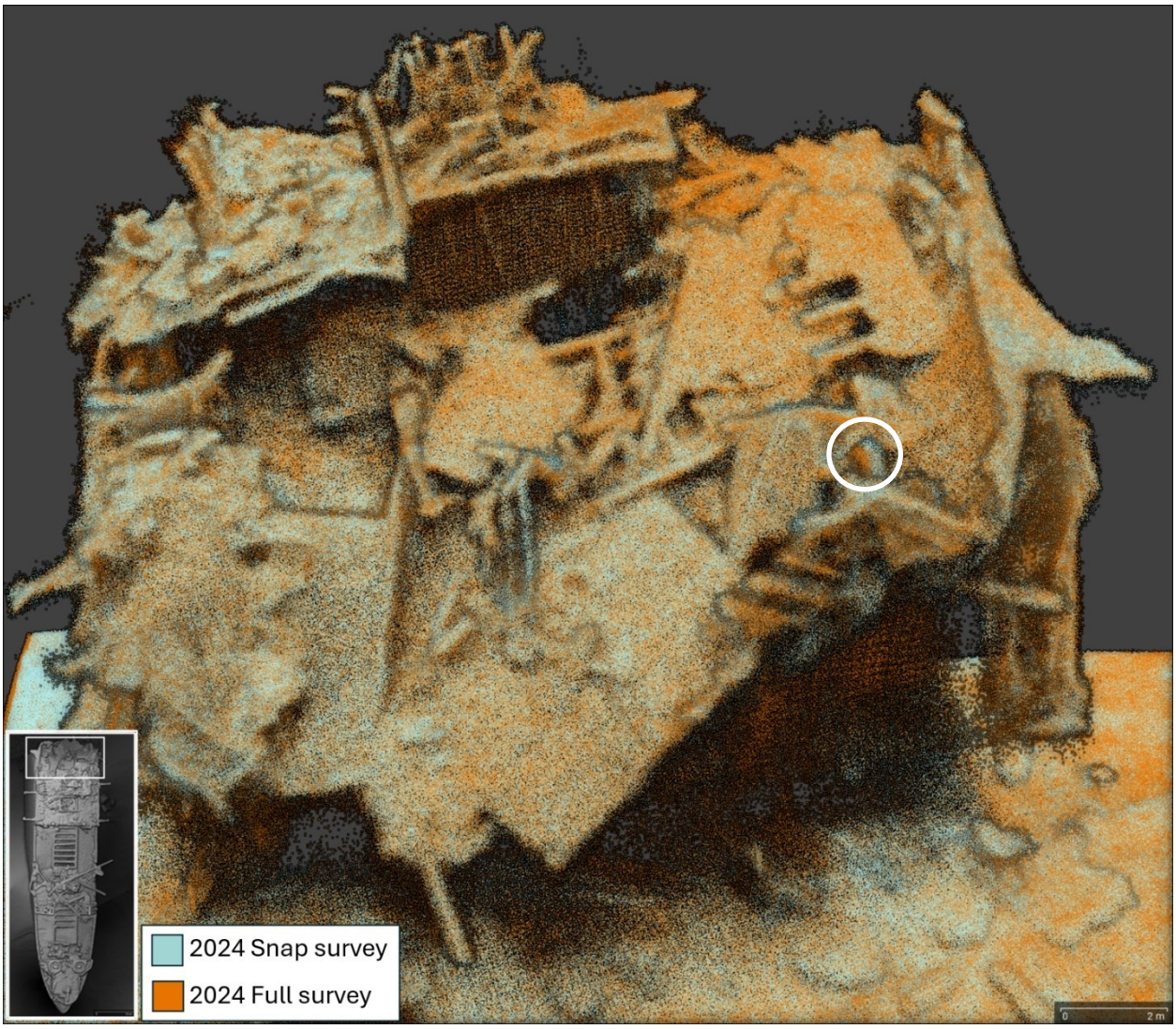

Figure 21. Point cloud view of key area 6. The only difference between the 2024 snapshot and full survey is shown by the white circle where an object has tilted by 15 cm.

4.4 Debris Between the Hull Sections

4.4.1 Between the 2024 snapshot and full survey three objects have seemingly disappeared from the area between the two sections of the SSRM (Figure 22). Two objects are round with a diameter of 40 and 65 centimetres and one object is reminiscent of a pole with a length of 2 meters and a diameter of 30 centimetres.

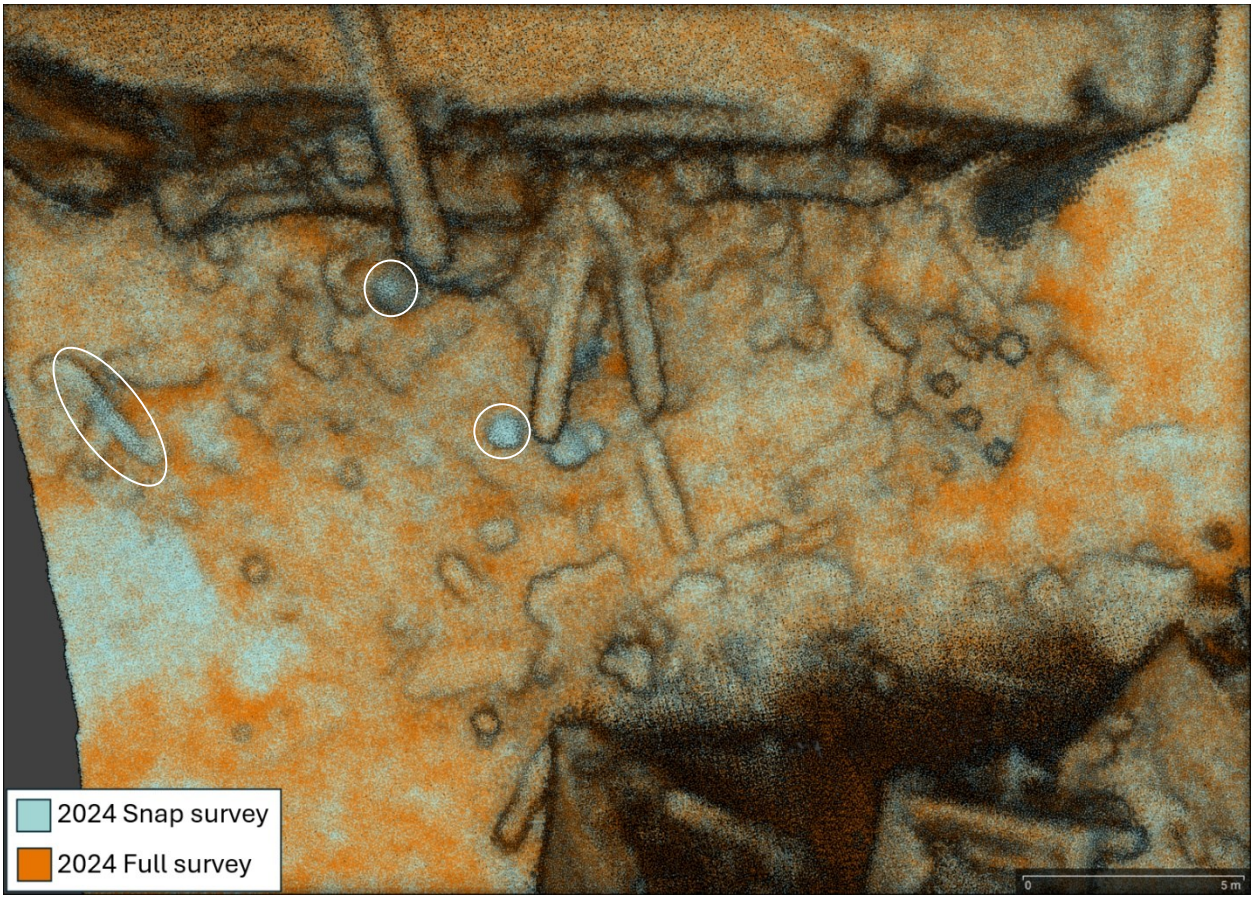

Figure 22. Point cloud image of the area between the two bow and stern sections of SSRM. Between the 2024 snapshot and full survey three objects (marked by white circles) have disappeared.

4.5 Cargo

When the SSRM grounded it was carrying some 6,127 imperial tons of cargo, mainly munitions. Of these, 2,954 tons were salvaged from the rear two holds (holds 4 and 5) and a small portion from the no 3 hold ‘tween deck space (area between two decks).

The small portion salved from the no 3 hold ‘tween deck space was the 2 tons of bursters leaving 86 tons of fuses in 1,522 wooden cases and 117 tons of fine assemblies in 11,230 metal crates in this space. It is likely that the cylindrical debris seen in this area in previous surveys are some of the metal crates holding the tail fin assemblies.

All the holds on liberty ships are divided into a ‘tween deck area located between the upper deck and the second deck, and the lower hold underneath the second deck. Hatch covers cover both the hatch on the upper deck and the opening through the second deck into the lower hold. Sedimentation is visible

to various degrees in all five holds. Since lower holds cannot be visible in the data, it is difficult to determine if sedimentation has occurred in these areas.

Cargo was carried in the lower holds, in the ‘tween deck spaces and on the upper deck. Contemporary records indicate that the SSRM held cargo in all holds and all ‘tween deck spaces but only carried a very small amount on the upper deck.

4.5.1 Hold 1

Hold 1 is the forward most of the five holds on SSRM and, in addition to the ‘tween deck space and the lower hold, hold 1 also contained a third layer of storage at the bottom of the lower hold known as the deep tanks in which additional cargo or ballast could be carried.

The hatch cover is missing as are all but one of the hatch cover supports. Sediment has settled in the ‘tween deck space to a considerable depth, filling the starboard side to the top of the starboard side hatch coaming. The port side remains clear above the horizontal from the starboard hatch coaming. Apart from some undulations in the sediment surface there is no difference between the level identified by the 2024 snapshot and full survey (Figure 23 and Figure 24).

There is no indication that the second deck nor the second deck hatch covers have collapsed. However, it is possible, but is very unlikely, that the sediment has filled both the ‘tween deck area and the lower hold.

Figure 23. Cross section through the hull at the forward end of hold 1.

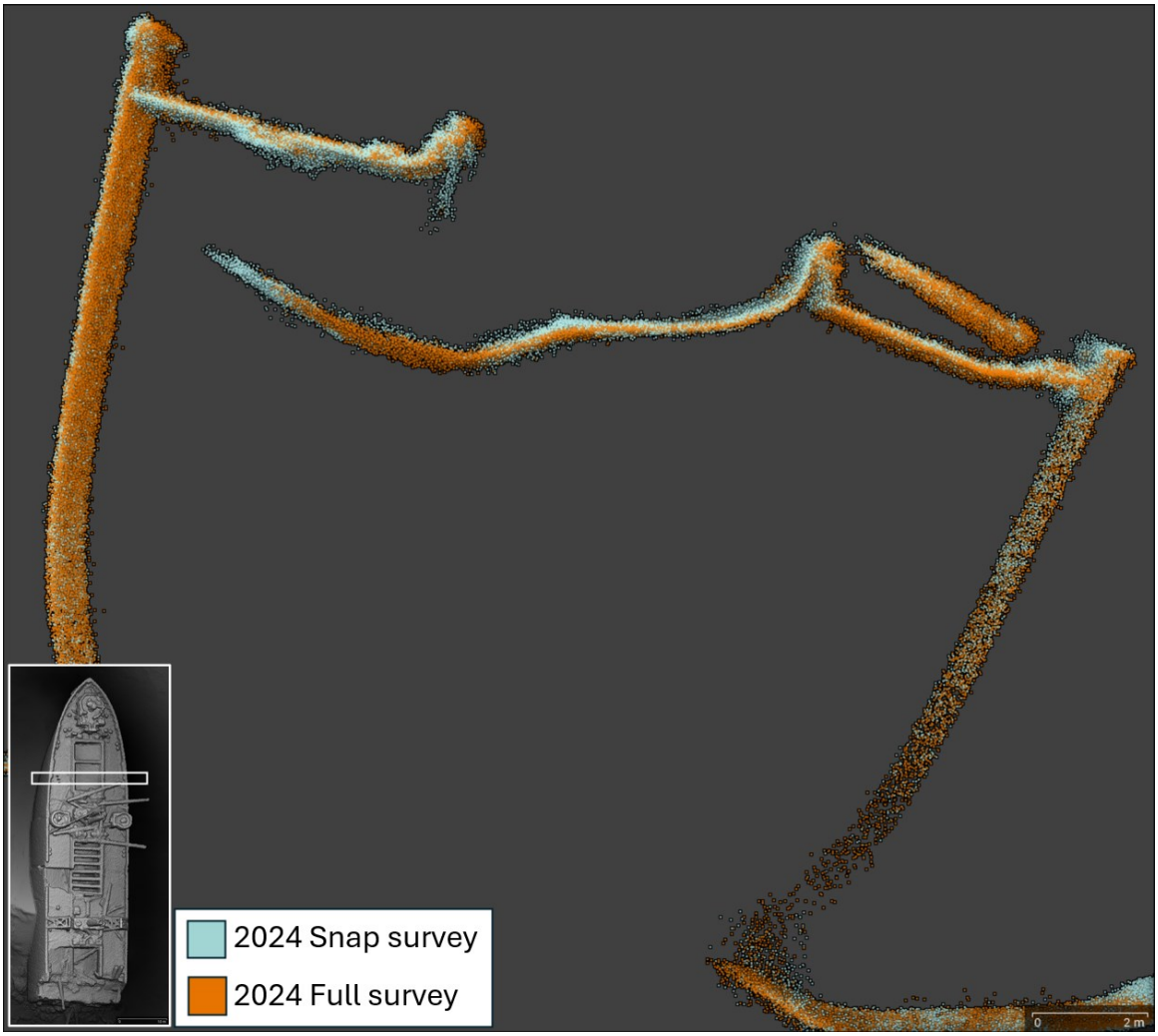

Figure 24. Cross section through the hull at the aft end of hold 1.

4.5.2 Hold 2

Hold 2 is the second from forward hold. As with hold 1, the outer hatch cover is missing although all the cover supports are in place. The forward section of the wreck is splitting near the mid-way along the hold 2 hatch, and this has resulted in part of the upper deck collapsing into the 'tween deck space bringing the connected hatch cover supports with it.

Between the two most recent full surveys (2023 and 2024), it appears that the hatch supports connected to the collapsed part of the hold 2 deck have dropped by approximately 13-17 cm (Figure 25). The hatch supports attached to the forward, non-collapsed section of the hold 2 deck has not dropped.

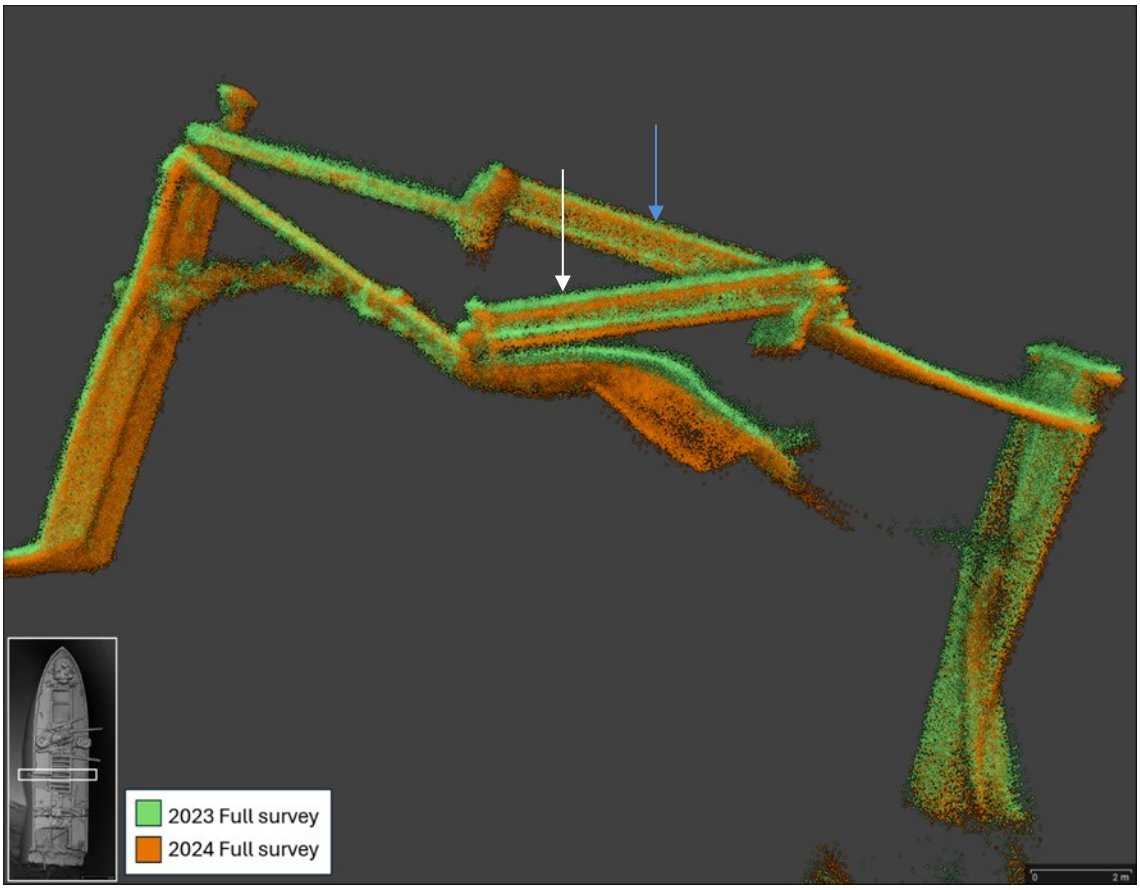

Figure 25. Point cloud cross section of the wreck showing the collapsed cargo hold 2 deck and hatch supports (white arrow), which have dropped by 13-17 cm between the 2023 and 2024 full survey. The hatch supports attached to the non-collapsed part of the hold 2 deck has not dropped (blue arrow). The cross section is 3 meters thick.

The sediment in hold 2 has decreased, this is visible in Figure 16 and Figure 25 but is much more prominent when shown as an along-wreck cross section (Figure 26). The sediment appears to have flowed into the wreck through two funnels and the vast majority of this decrease happened between the 2024 snapshot and full survey, although the reduction of sediment may have started as early as 2022. During the four and a half months that passed between the 2024 May (snapshot) and September (full) survey the sediment was reduced by 2.3 meters at one location in hold 2.

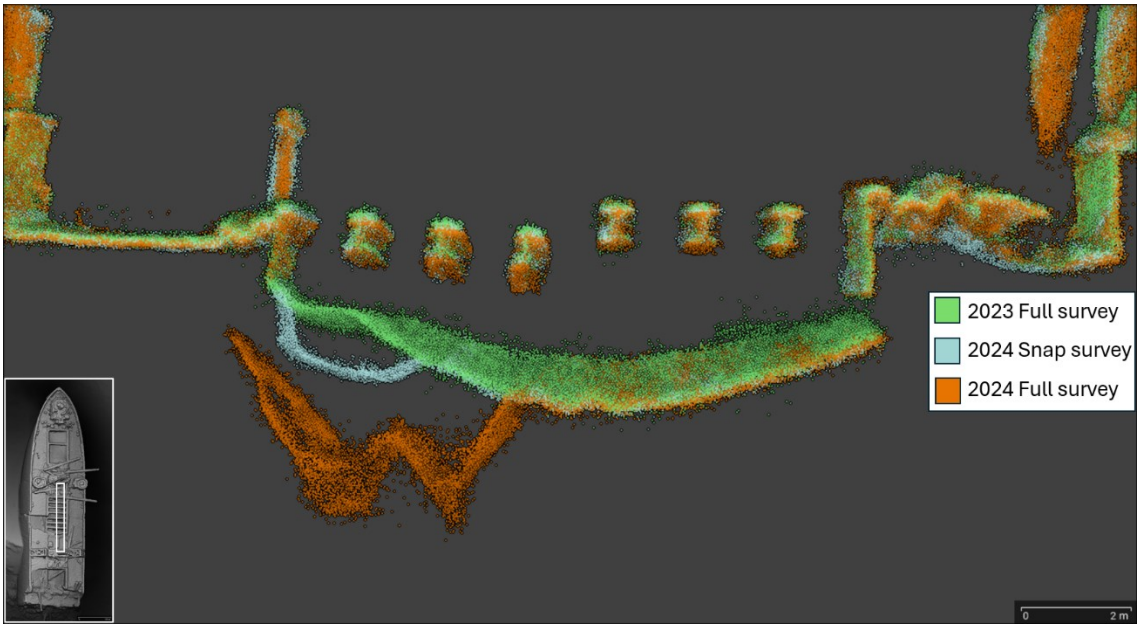

Figure 26. Point cloud along-wreck cross section of hold 2. There has been a 2.3m (height) reduction of sediment between the May (snapshot) and September (full) 2024 surveys. The cross section is 1 meter thick.

4.5.3 Hold 3

Hold 3 is the rearmost hold of the forward section. The rear bulkhead of this hold forms the rear of the forward section, the vessel having broken in two immediately aft. Although the lower hold remained with the forward section, the bulkhead at the rear of the 'tween deck space and the section of the upper deck above it were carried away leaving this area open. The outer hatch cover has gone as have all the cover supports although there is a beam, most likely a cover support, lying on the starboard side.

Sediment accumulation is largely limited to the forward part that still retains the protection of the upper deck (Figure 27). Similar to hold 1 and 2, there is no clear indication that the hatch leading to the second deck has collapsed.

The amount of sedimentation in hold 3 is fluctuating. Between the 2023 full survey and 2024 snapshot survey the sediment level had decreased by approximately 45 cm. When comparing the 2024 snapshot and full survey the opposite can be seen, the sediment level increased by 40 cm (Figure 28).

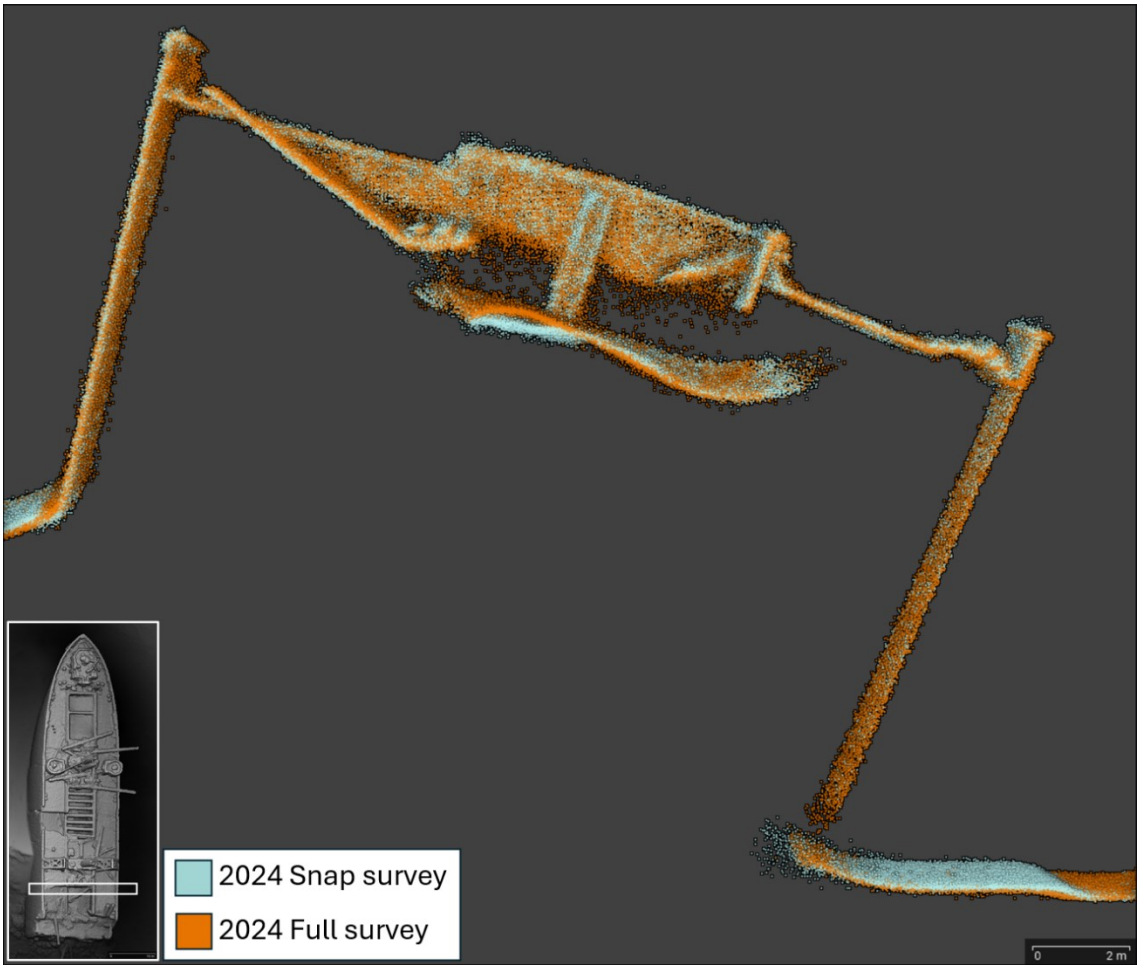

Figure 27. Cross section through the hull at the forward edge of hold 3.

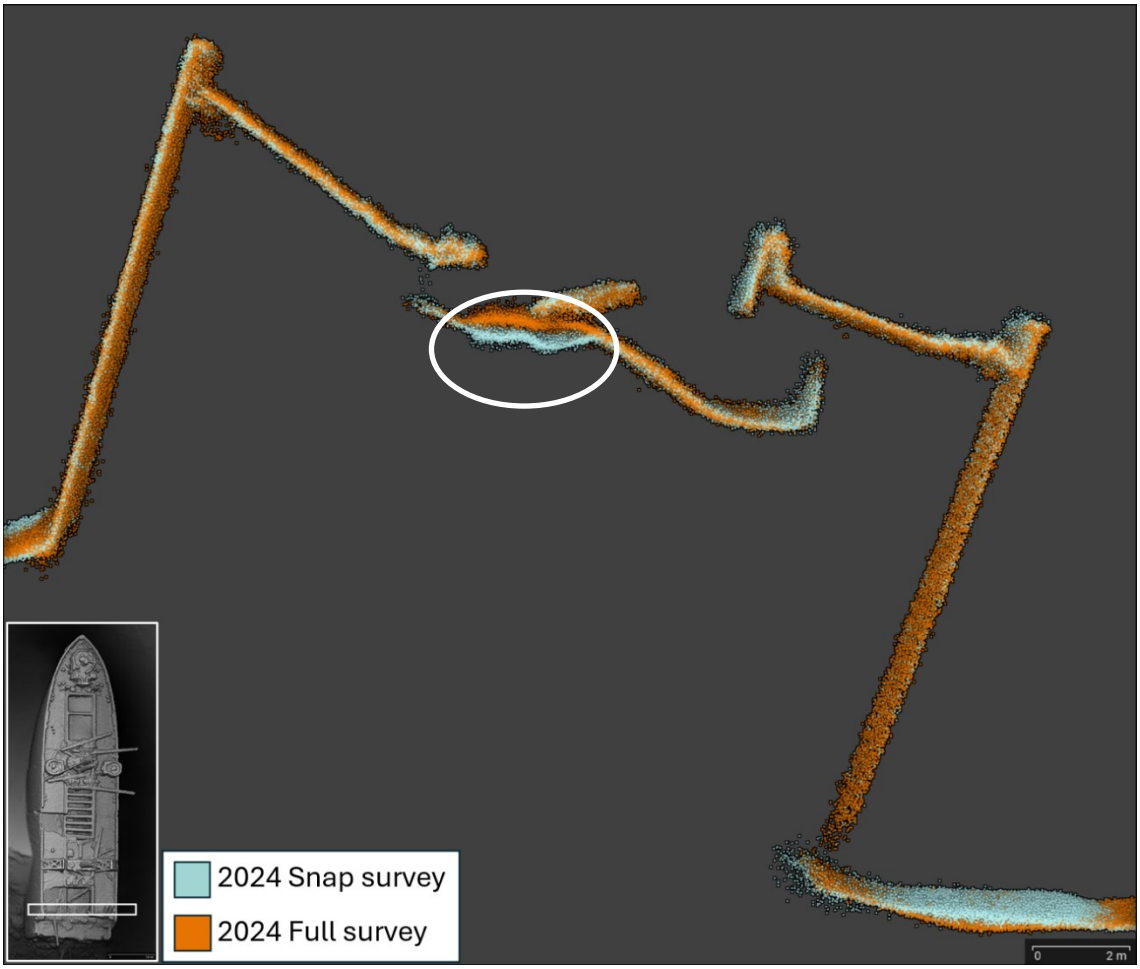

Figure 28. Cross section through the hull at the middle of hold 3. Difference in sediment level circled.

4.5.4 Hold 4

Hold 4 is the most forward of the two holds in the stern section. Since the two stern holds are reported to have been emptied during salvage operation conducted soon after the grounding it is not known if the lower hatch covers were replaced. However, since the upper hatch supports are in place it seems likely that the salvors did replace the covers once they were finished.

The sediment level in the forward part of hold 4 is largely unchanged between the 2024 snapshot and full surveys (Figure 29).

Figure 29. Cross section through the hull at the forward end of hold 4.

The rear of the hold 4 area shows the sediment layer descending below the level of the second deck due to some form of collapse, probably a partial collapse of the lower hatch cover which occurred between 2010 (where the survey showed the sediment above the second deck) and the 2017 survey where the sediment was just below the second deck (Figure 30). The sediment level at the full survey 2024 does not differ by a noteworthy amount from that of the 2024 snapshot survey (Figure 31).

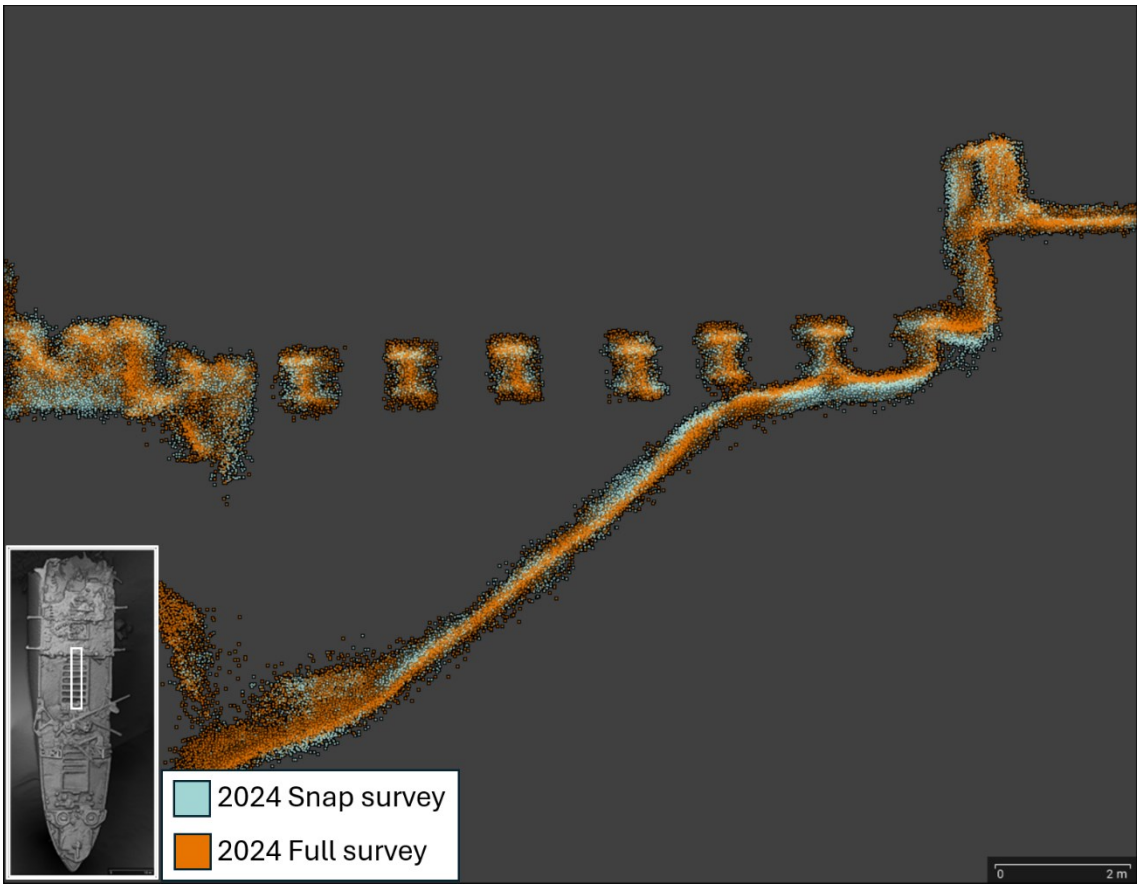

Figure 30. Along-wreck cross section of hold 4.

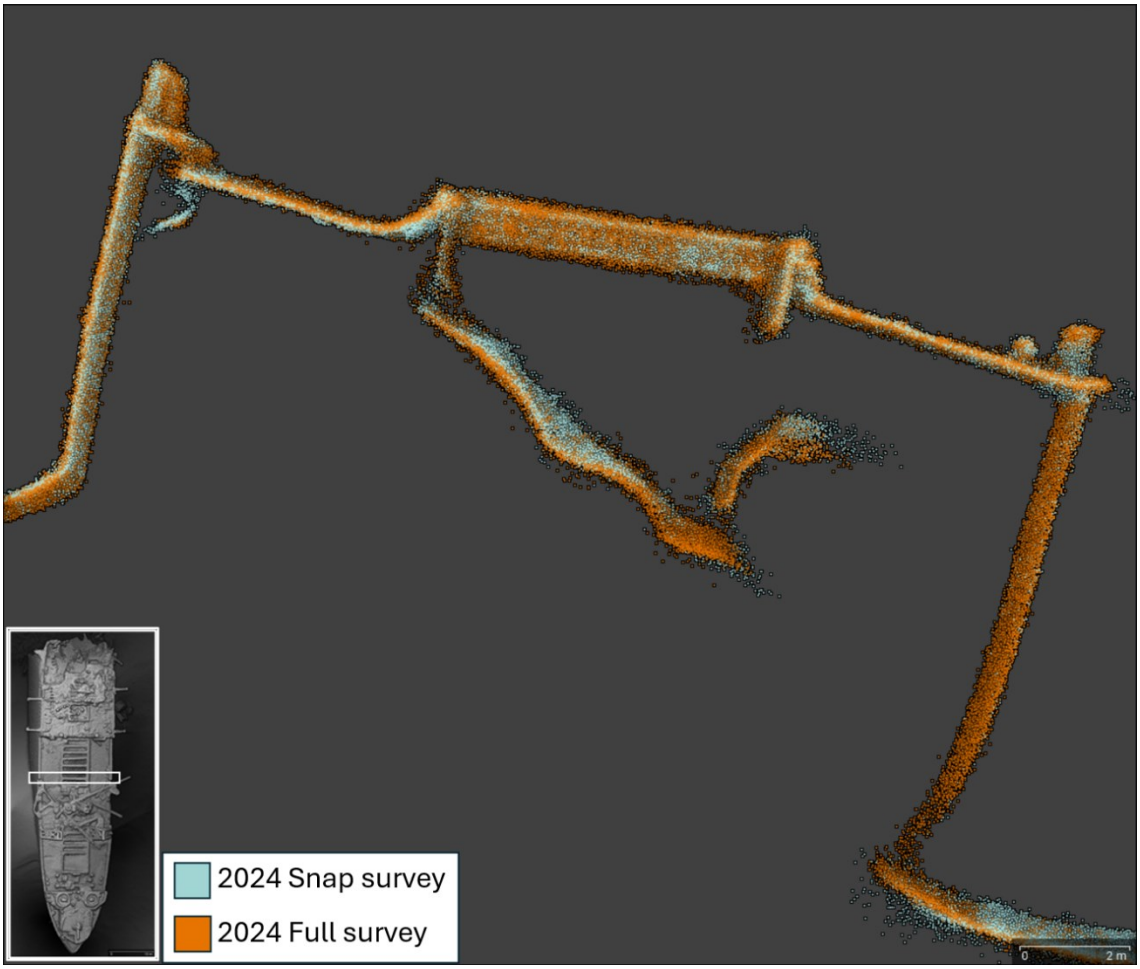

Figure 31. Cross section through the hull at the rear end of hold 4.

4.5.5 Hold 5

Hold 5 is the rear most hold. The forward four of the six hatch cover supports remain in place. Sediment levels in the forward section, port side of the hold have increased by 60 cm between the 2024 snapshot and full survey (Figure 32). There is no indication that the second deck or the lower hatch cover have collapsed. In the middle of the hold, by the fourth hatch cover support the sediment levels have increased by 90 cm (Figure 33). In the rear end of hold 5 there is little to no difference in sedimentation levels.

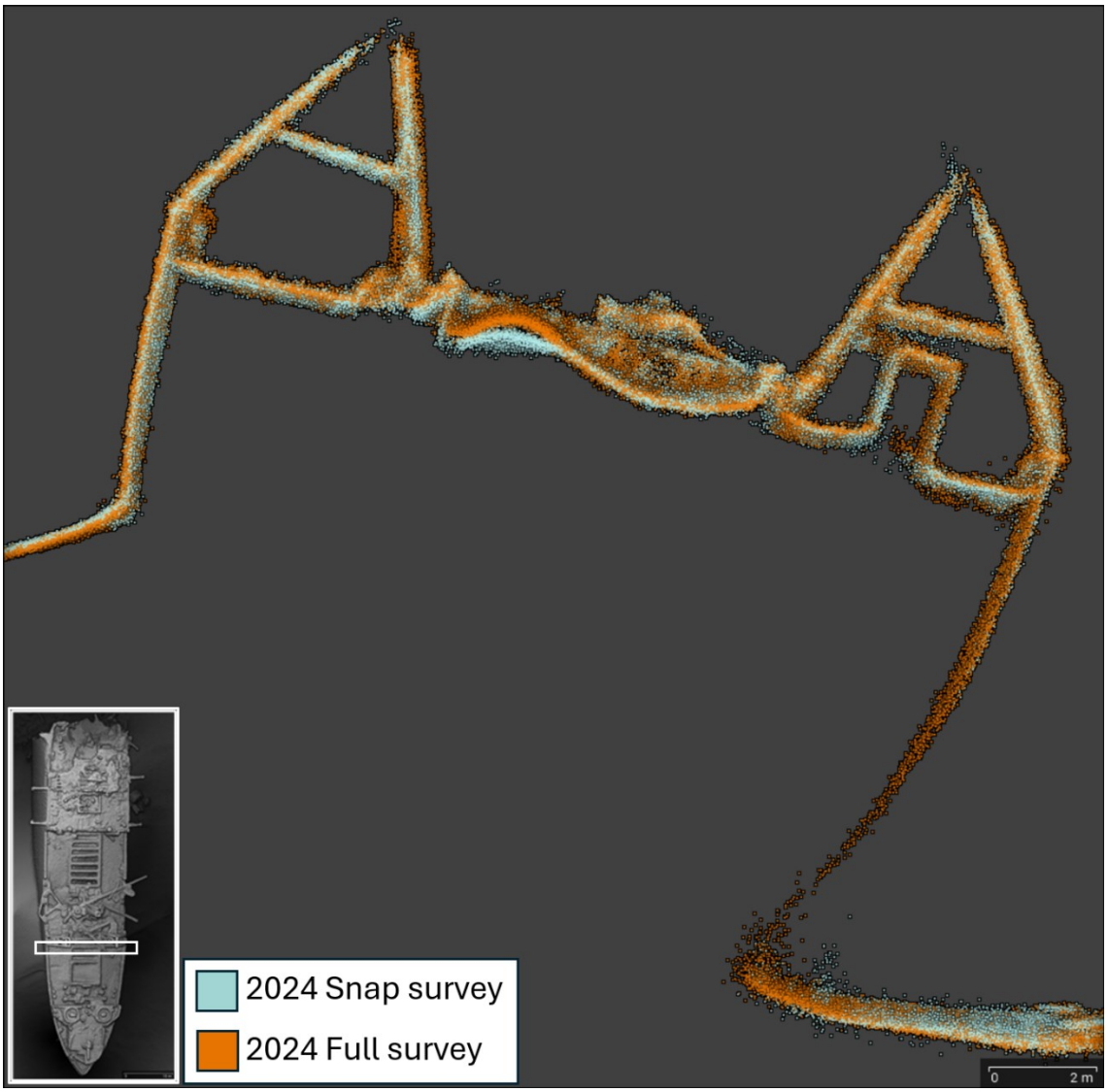

Figure 32. Cross section through the hull at the forward end of hold 5 where the sediment level has increased by 60 cm on the port side.

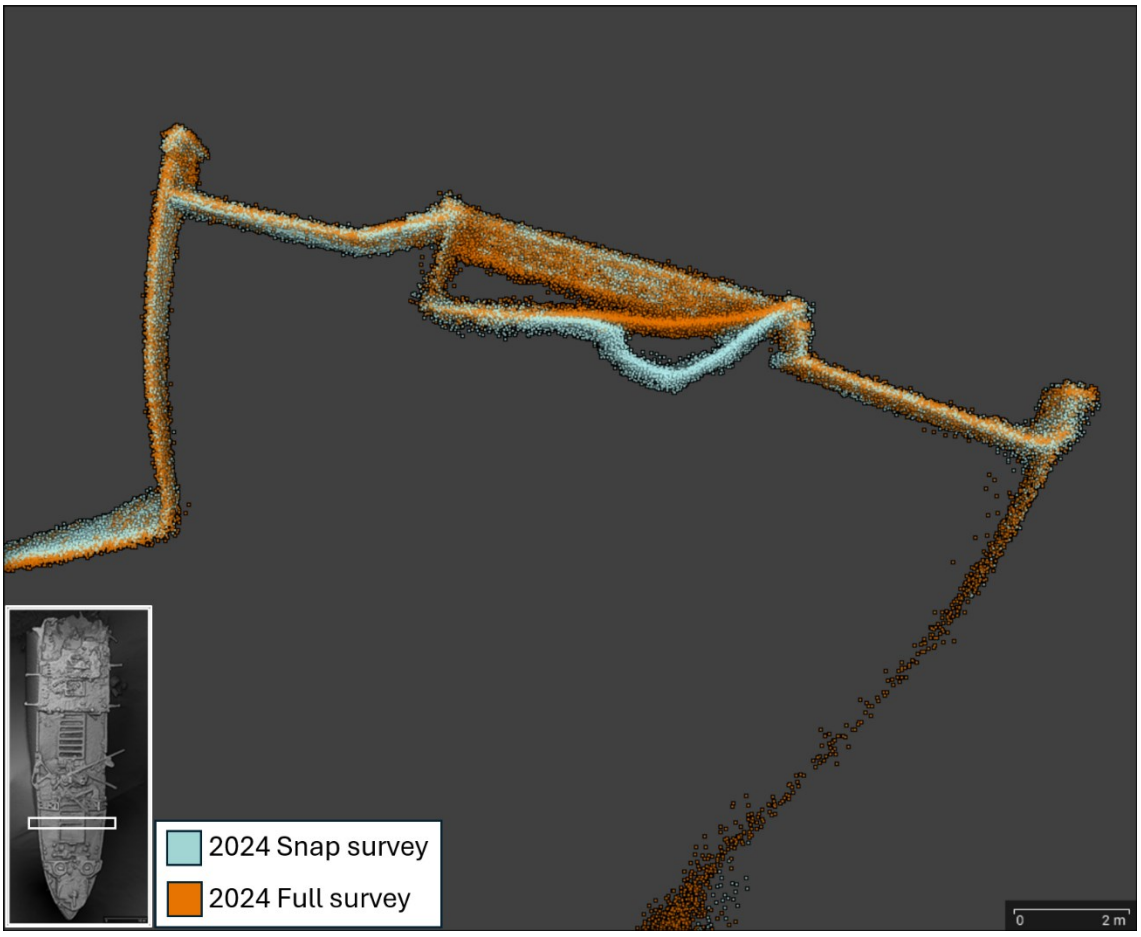

Figure 33. Cross section through the hull at the middle of hold 5 where the sediment level has increased by 90 cm on the starboard side.

5 Seabed Survey 2024

The seabed data collected is of high quality and adheres to the density requirement. Previously identified seabed targets from the Gazetteer of Observations were overlaid and the presence of the targets was noted, and new targets added.

5.1 General

An overview of the full survey area is illustrated in Figure 34.

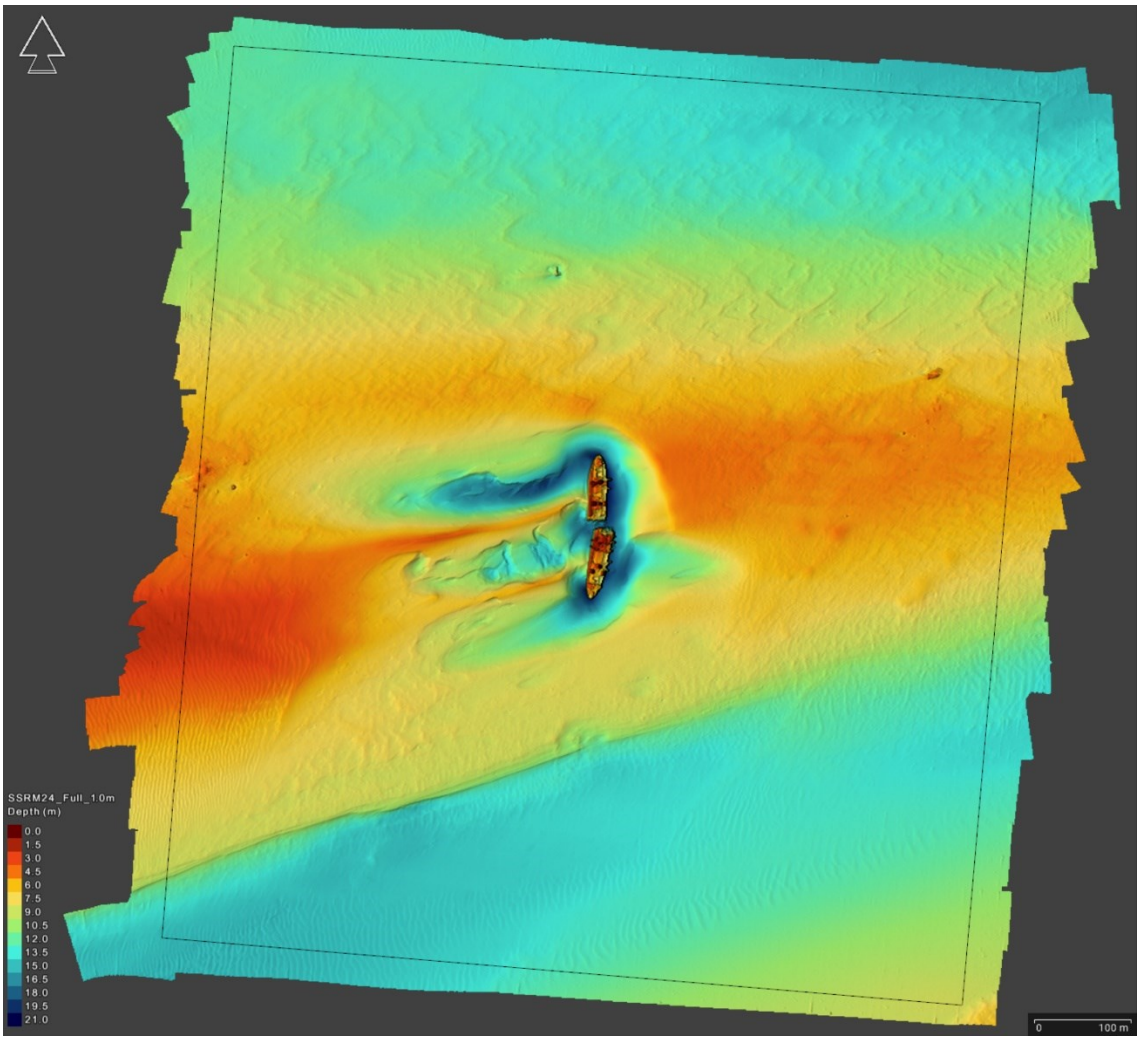

Figure 34. Minimum surface of SSRM and the surrounding seabed.

The analysis of the results of the survey of the seabed around the wreck was carried out with the calculation of a difference surface where the surfaces from the 2024 and 2023 full surveys were used (Figure 36).

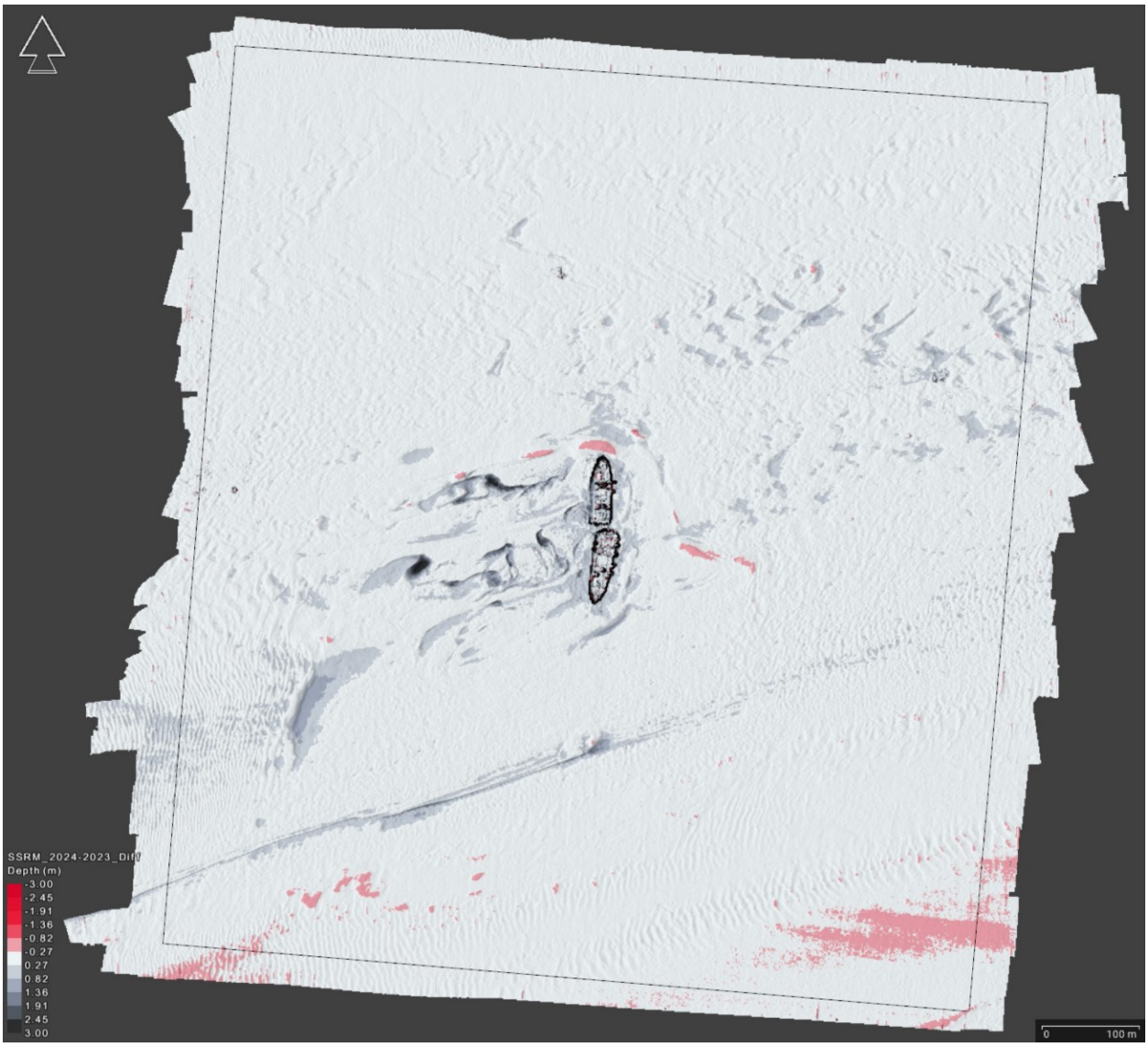

Figure 35. Difference model showing sediment changes that occurred between the 2023 and 2024 full surveys. Areas in red have had the depth reduced and dark grey areas have had an increase in depth.

In the immediate area surrounding SSRM there is a general increase in the depth. Most changes are small and within a range of 0-0.6 meters. One area to the west of the forward section shows larger increases in depth, the most prominent change can be found by the hull close to the main mast where there has been an increase in depth by 1.6 meters between the 2023 and 2024 full surveys (Figure 36). Just north of the wreck one of the few areas where a decrease in depth has occurred can be seen, the decrease is less than 0.82 meters.

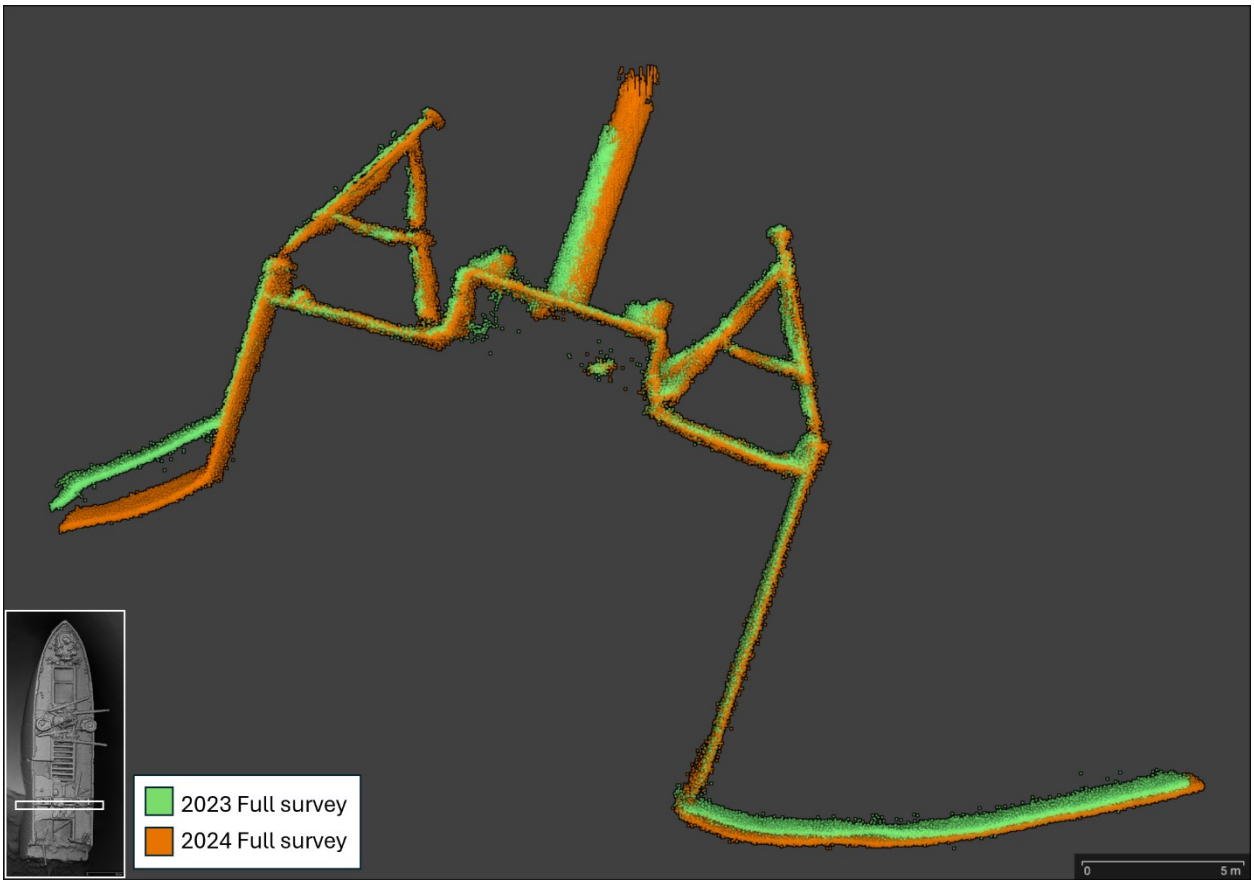

Figure 36. Cross section by the main mast of SSRM, forward section of the wreck. On the west (port) side of the wreck an increase in depth of 1.6 meters can be seen. This change in sediment levels occurred between the 2023 and 2024 full surveys.

Changes to the wider seafloor around SSRM has occurred mainly directly west of the wreck where some of the deeper parts of the scour has deepened further by 2-3.5 meters some 45-175 meters from the wreck (Figure 35).

5.2 Seabed Contacts

Five new targets were added to Appendix B – Gazetteer of Observations which contains the seabed contacts list (Figure 37). Of the 159 targets in the list 123 targets were found to be present. Six objects were deemed to be 'plausible', and one object was found at a slightly different location. 29 objects weren't visible, probably due to the objects being covered by sediment. The seabed contacts, especially the smaller or lower lying ones, are subject to a pattern of being buried an uncovered by moving sediments. Consequently, their presence or not in any year's data set is largely a function of the movement of sediment around and over them. Images of all seabed contacts can be found in Appendix C – Seabed Contacts Report Images 2024.

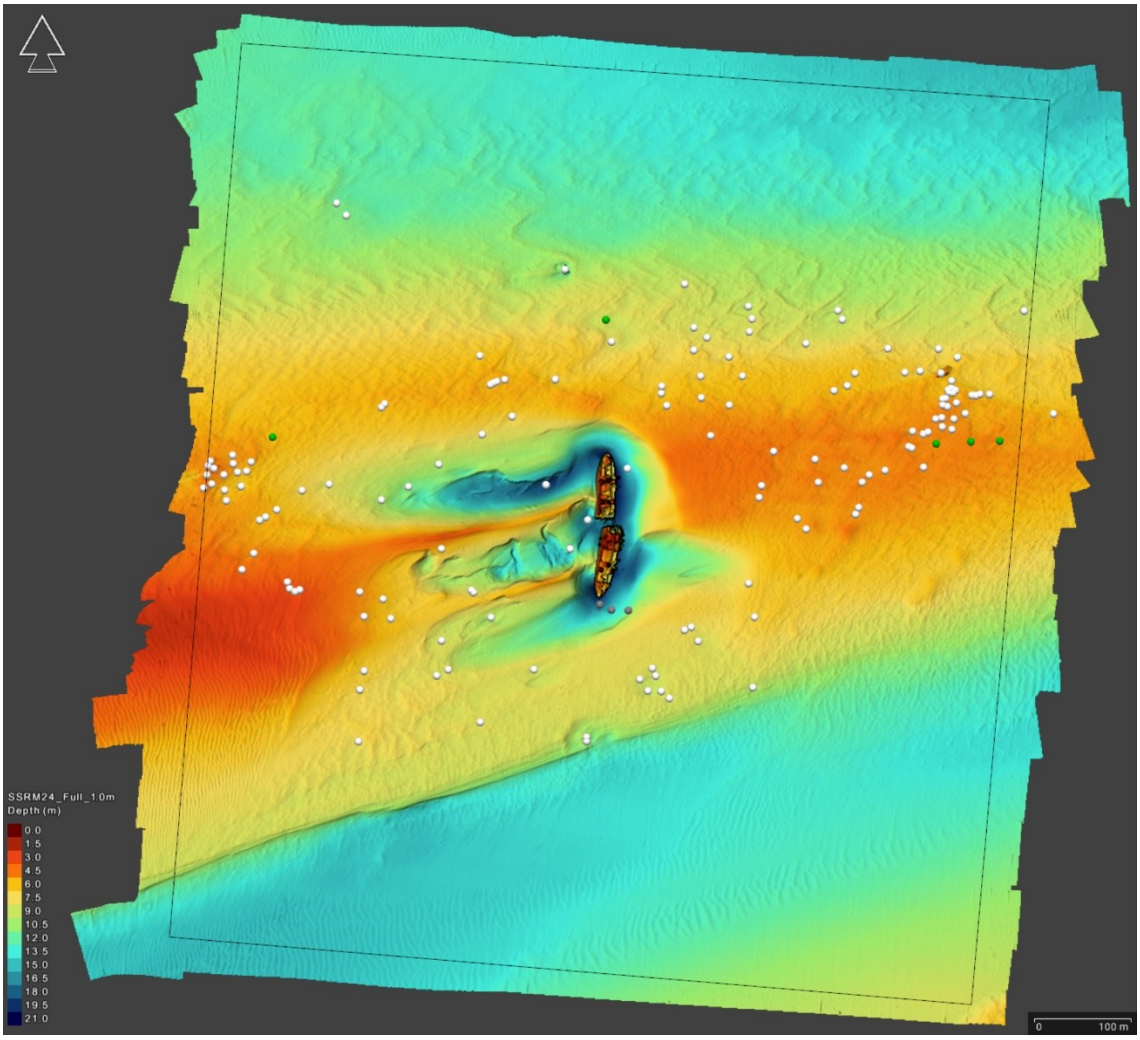

Figure 37. The SSRM survey area with seabed contacts, 2023 contacts in white, 2024 snapshot survey new contacts (3) in grey and 2024 full survey new contacts (5) in green.

6 Conclusions

6.1.1 The 2024 full survey successfully covered all significant portions of the wreck with high quality MBES and laser data. All key areas and features are well ensonified, providing good resolution of the whole wreck. The surrounding seabed was very well ensonified.

6.1.2 The forward section of the wreck continues to increase its tilt towards the east. Several locations on the top of the foremast were used to determine that the horizontal shift that occurred between the 2022 and 2024 full surveys was between 43 and 55 centimetres.

6.1.3 Almost no changes were found in the six key areas of the wreck when comparing the results from the 2024 full and snapshot survey. The only noticeable difference is in key area 6, the collapsing deck in the forward end of the aft section where an object has had a slight increase in tilt.

6.1.4 Three objects have disappeared in the area between the hull sections sometime between the 2024 snapshot and full survey.

6.1.5 There has been a drastic change of the sediment levels in hold 2 between the 2024 snapshot and full survey. The height of the sediment has been decreased by up to 2.3 meters and this sediment appears to have flowed into the interior of the wreck through two funnels.

6.1.6 The seabed survey shows that a slight increase in depth in the immediate area surrounding the wreck has occurred between the 2023 and 2024 full surveys. In the full survey area most of the seabed remains largely unchanged. Only a few places have had a slight reduction in depth. Some sections of the wrecks' scour have had an increase in depth by up to 3.5 meters.

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