

The Suitability of Pre-Disturbance Geophysical Surveys for Underwater Cultural Heritage in England

Introduction

A number of significant problems have been identified in three example marine geophysical surveys undertaken in advance of seabed dredging or disposal in English waters. The aim of the three surveys was to locate the presence of any significant cultural material lying on or within the seabed in the survey areas. One survey failed to detect large and modern cultural material that was known to be in the area and in another cultural material was found and disturbed later during the subsequent dredging work.

The JNAPC Code of Practice for Seabed Development¹ states:

Where developers are undertaking marine surveys as part of their development, using for example geo-physical, geo-technical or visual techniques, it is advantageous for the methodologies and techniques employed to be approved by a curator (or consultant) as being appropriate for an archaeological investigation.

The issues identified in the three cases below raise questions about the suitability of the methodologies and techniques that were used.

London Gateway (2010)

Starting in 2010, dredging was undertaken for the London Gateway project to widen, deepen and re-route the existing shipping channel in the Thames Estuary to accommodate larger vessels. Pre-dredging archaeology surveys were undertaken some years earlier and the dredging plan was adapted to avoid the archaeological features identified by the surveys.

However, in 2011 the remains of a crashed WWII Junkers JU88T bomber were picked up by a dredger in the outer Thames Estuary. This was a significant find as only two of these aircraft survive intact². A total of 45 pieces of aircraft wreckage were found attached to the dredge head, recovered from an unknown location somewhere along the previous dredge track. A later side scan sonar survey in the area detected two anomalies that were identified by divers as scattered aircraft wreckage firmly embedded in the seabed. Because of the conditions on site it was decided to recover the wreckage from the seabed using a bucket dredger.

In this example the initial survey methodology was insufficient to be able to detect the remains of a crashed aircraft. The aircraft could have been found during the first survey as it was detected in a later survey. The Marine Aggregate Dredging and the Historic Environment guidance note suggest that:

*In seeking to match the benefits and costs of evaluation, Applicants may find it useful to adopt a staged approach. In essence, initial low-cost extensive investigations are used to identify specific targets for intensive investigation.*³

In this case the staged approach resulted in the uncontrolled partial salvage of a rare WWII German bomber that should have been found earlier and managed properly.

¹ JNAPC Code of Practice for Seabed Development, Joint Nautical Archaeology Policy Committee, 2006

² Gane T. & Scott G., 2014, Archaeology from the Sky, the Air War over the Thames Estuary, Wessex Archaeology, ISBN 978-1-874350-78-1

³ Wessex Archaeology, 2003, Marine Aggregate Dredging and the Historic Environment, guidance note prepared for English Heritage and the British Marine Aggregate Producers Association (BMAPA)

Plymouth Disposal Site (2013)

A new disposal site was needed near Plymouth for dredged material and in 2013 CEFAS was tasked by the MMO to undertake a site selection exercise. CEFAS identified a suitable location approximately 9 km south west of Plymouth Breakwater. A pre-disturbance multibeam survey was completed in July 2013 by CEFAS and the results reported.⁴

As part of the public consultation I read the survey report and noted a number of problems:

- No heritage specialist was included as part of the multibeam survey team
- No side scan sonar or magnetometer data was collected
- Multibeam backscatter data was collected but this should not be used in place of a side scan
- There was no mention of the remit to include heritage in the survey plan
- No description of equipment or calibration results as is expected for a survey of this kind
- No comments on heritage issues were included in the report
- There was no mention of the four known wrecks in the area in the survey report

The poor survey design used here goes against Historic England's own guidelines⁵:

In particular, specifications for surveys should be drawn up with archaeological advice.

The CEFAS characterisation report⁶ included an archaeological interpretation of the survey results done by CEFAS themselves, which also goes against Historic England guidelines⁷ :

Survey results should be interpreted by suitably competent archaeologists working in collaboration with the other specialists engaged in the survey.

Page 119 of this report notes that the other known wrecks were not detected during the survey:

Review of the bathymetric and MBES backscatter data from the site specific survey (Section 4.3) showed only one wreck observable in the data on the seabed. This wreck has been identified as the SS Medoc. The Unicorn and W-Woollven were not seen in the acoustic data.

The limitations of this particular survey were noted in the report itself (p120):

'This also indicates that, while the presence of any large archaeological features, including wreck material, would have been seen in the geophysical data, smaller features of potential archaeological interest (less than 2 x 2 m acoustic bathymetry data resolution and 0.3 x 0.3 m backscatter) may be present, but not seen in the data.'

The note above suggests that they have missed 2m x 2m sized objects when they actually missed a 27m long, 4m high iron built trawler (Fig. 1) which is very easy to identify as it is lying on a flat mud seabed. The wreck is and always has been clearly visible to multibeam sonar, as shown in the 2016 Plymouth University survey (Fig. 2). If a 27m long iron ship was missed in this survey, what else was missed?

The problems with the multibeam survey data collection and processing were reported in a letter to the MMO from 3H Consulting as part of the consultation process. The letter to the MMO also noted that the Characterisation report appears to have been written by CEFAS who have no expertise in underwater heritage and in it no explanation was given about why the wrecks were not detected during the survey.

⁴ Report: *RV Cefas Endeavour: Survey CEND15/16*

⁵ Wessex Archaeology, 2003, *Marine Aggregate Dredging and the Historic Environment*, guidance note prepared for English Heritage and the British Marine Aggregate Producers Association (BMAPA)

⁶ CEFAS South West Dredged Material Disposal Site Characterisation Report (C7041), Feb 2017

⁷ Wessex Archaeology, 2003

The conclusion of the consultation was documented in an MMO Evaluation Report⁸.

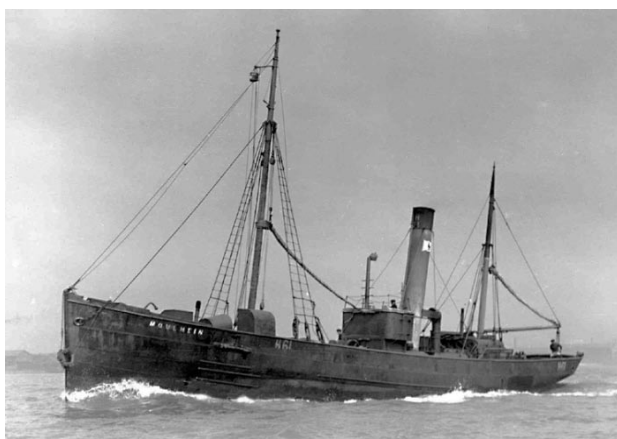


Fig. 1: The Moulmein, sister ship of the Unicorn

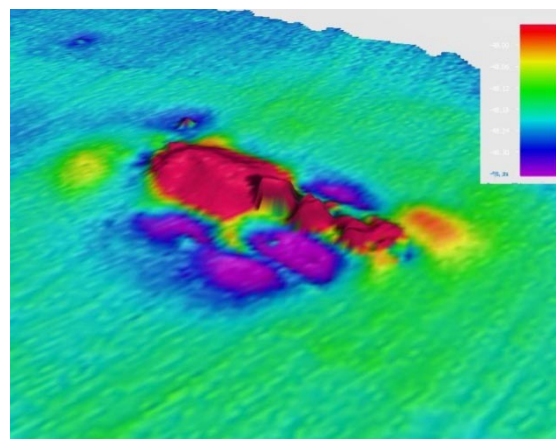


Fig. 2: Multibeam image of the Unicorn from April 2016 by Plymouth University

The report noted the response to the consultation which highlighted the problems with the survey:

ii. Consultation comments: Two responses expressed concerns in regard to the survey methods and assessment methods used and the subsequent conclusions made. It was stated that the conclusions were not safe and not all archaeological features might have been identified in the area.

However, the problems were dismissed and Historic England apparently accepted the results:

iii. MMO response: As a result of the consultation exercise, further information has been presented in an updated Site Characterisation Report. Historic England has been consulted on the updated chapter and responded to advise that there were no issues with the survey methods used. The MMO is content that there will be no significant risk to the historic marine environment

Goodwin Sands (2015)

Dover Harbour Board (DHB) is proposing to dredge up to 2.5 million m³ of seabed from the South Goodwin Sands. Pre-dredging survey geophysical data was acquired by EGS between 10th July and 2nd August 2015. The data set comprised side scan sonar, multibeam echo sounder and sub-bottom profiler (chirp and boomer) data. The data was processed by Wessex Archaeology⁹. They noted problems with the side scan sonar data which provides the primary search information used to identify cultural material on the seabed¹⁰ (p3).

The SSS [side scan sonar] data have been rated as 'Variable' using the above criteria table with a majority of files displaying significant noise interference from cable snatching due to strong tides and currents within the area, in addition to noise caused by shallow water depths. Some files were of good quality. Overall the data quality was found to be suitable for the identification of standing and partially buried wrecks; however detailed interpretation was not possible.

⁸ MMO Evaluation Report, South West Dredged Material Disposal Site Characterisation Report (C7041), 06 March 2017 (p19)

⁹ Wessex Archaeology, 2016, Goodwin Sands, Archaeological Review of Geophysical Data, Report Ref 111510.01

¹⁰ Goodwin Sands Environmental Statement_Volume_III_Appendices_Part_II-5 Appendix 7.1 WFD Compliance Assessment, Royal Haskoning DHV

In this instance 'Variable' can actually only mean 'poor':

Variable = This category contains datasets with the quality of individual lines ranging from good to 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.

No magnetometer data was collected and the side scan sonar data was unfit for purpose so no data was available to detect any small-sized cultural objects. The data was only sufficient to detect metal wrecks which would have previously been detected on RN hydrographic surveys. The low frequency boomer sub-bottom profiler data was processed but this too would not show small objects as the sound waves simply pass straight through them. The high frequency pinger sub-bottom data was not processed and no explanation was given (p3). But the 'pinger' used on the survey was a Knudsen chirp 3260 echo sounder and not a true sub-bottom profiler, so not a suitable tool for archaeological prospection.

Conclusion

Analysis of these three pre-disturbance surveys has highlighted a number of significant problems:

- Use of inadequate survey methodology so significant cultural objects are not detected
- Use of personnel for data collection who are not appropriately qualified or experienced resulting in poor quality work and failure to detect objects
- Processing of poor quality data which results in failure to detect significant cultural objects
- Use of inappropriate survey instruments leading to failure to detect significant cultural objects
- Omission of high quality magnetometer data leading to failure to detect significant cultural objects
- The apparent failure by Historic England to specify appropriate geophysical methods and techniques
- The apparent acceptance of poor quality or inappropriate surveys by statutory regulators

The requirements for pre-disturbance geophysical surveys can be defined by specifying the smallest object that is to be detected on the seabed or buried within it, known as the Minimum Detectable Target (MDT). The survey methodology can then be defined knowing the conditions on site and the capabilities of the instruments available. It is important to understand that the most significant archaeological objects are the most difficult to detect because older shipwrecks and aircraft are hard to locate with sonar and they often include very little iron that could be detected with a magnetometer. So a low-cost wide-area investigation may not detect the cultural material that is rarer, and thus the most important to find. Archaeological prospection surveys for small targets demand very high quality standards, often matching the requirements of unexploded ordnance (UXO) surveys and exceeding the requirements for all other types of survey.

Being able to only detect large iron or steel shipwrecks on this type of survey is of no value as this work has already been done by the Royal Navy and others who map the seabed to locate hazards to navigation. If you wish to locate aircraft, medieval ships, Roman ships, Viking ships or unarmed pre-16th century vessels then the highest quality geophysical surveys are required. If aircraft and early ships are considered to be important cultural heritage then we need to design our surveys and require the use of appropriate equipment in order to find them, both of which we are apparently failing to do.

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28th March 2017 (R2)

