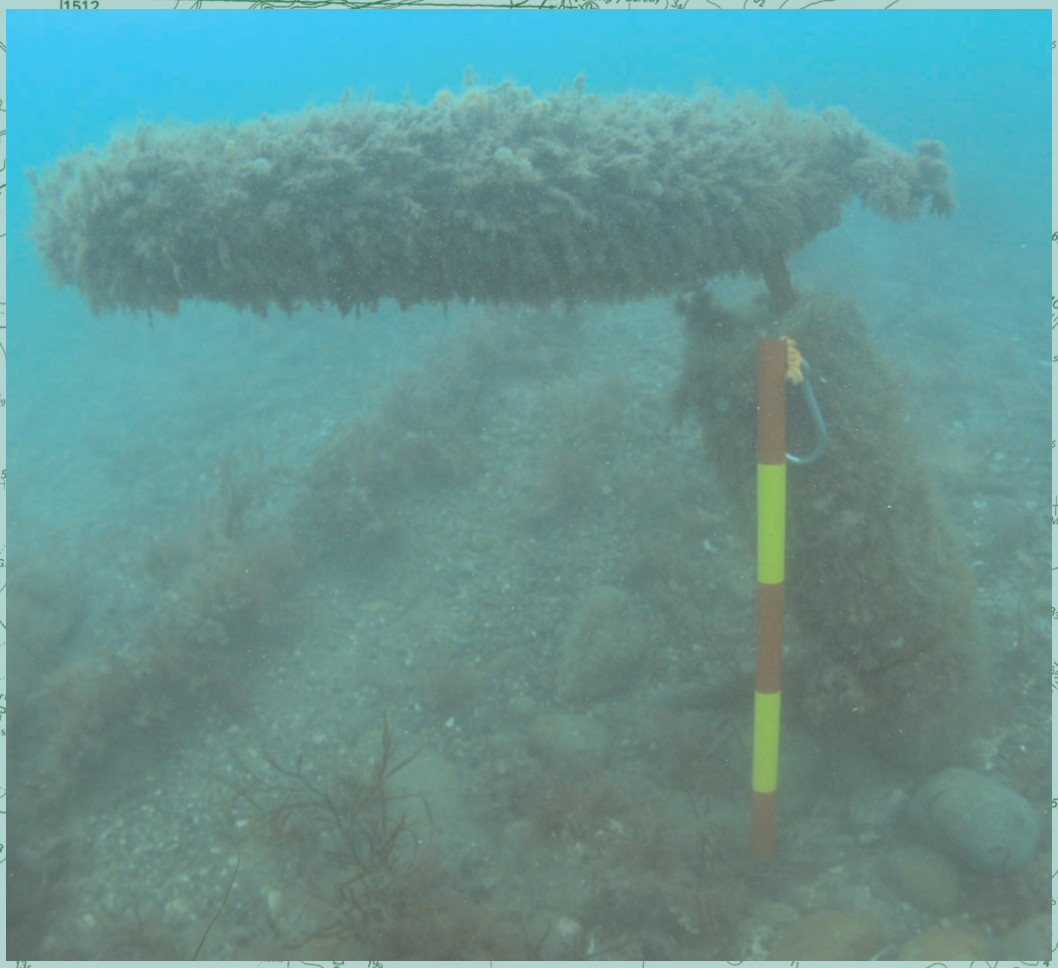
Wessex Archaeology

Diamond, Cardigan Bay

Designated Site Assessment:

Archaeological Report



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July 2007

ARCHAEOLOGICAL SERVICES IN RELATION TO THE PROTECTION OF WRECKS ACT (1973)

DIAMOND, SARN BADRIG, CARDIGAN BAY

DESIGNATED SITE ASSESSMENT: ARCHAEOLOGICAL REPORT

Prepared by:

Wessex Archaeology
Portway House
Old Sarum Park
Salisbury
Wiltshire
SP4 6EB

Prepared for:

Cadw
Plas Carew, Cefn Coed
Parc Nantgarw
Cardiff
CF15 7QQ

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DESIGNATED SITE ASSESSMENT: ARCHAEOLOGICAL REPORT

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Summary

Wessex Archaeology was commissioned by Cadw to undertake a designated site assessment of the *Diamond*: a designated wreck site located on the underwater reef of Sarn Badrig (St Patrick's Causeway), Cardigan Bay, Wales. The work was undertaken as part of the Contract for Archaeological Services in Relation to the Protection of Wrecks Act (1973).

The Written Scheme of Investigation required WA to complete a detailed site drawing of the Licensee's desired target area for excavation in 2007, and to repeat the monitoring photographs undertaken in 2004.

Diving operations were conducted between 22nd and 25th May 2007. Datum points relating to an east-west baseline across the site with offsets towards the desired target area for excavation were established on site. It was possible to accomplish a drawing of a total of 120m² to a scale of 1:20, including the Licensee's desired target area for excavation.

All monitoring photographs were repeated and are assessed within this report. This showed that the erosion of upstanding metal features is progressing rapidly, leading to their collapse in very short term. Slight changes in seabed level have been observed between 2004 and 2007, seemingly sufficient to partially uncover one or two timbers close to the seabed surface.

Recent dendrochronological dating confirmed previous assumptions that the wreck is in fact not the *Diamond*. Research by the Licensee and his team has showed that the wreck is probably a mid or late 19th century merchant vessel, possibly involved in the trans-Atlantic cotton trade out of Liverpool.

DIAMOND, SARN BADRIG, CARDIGAN BAY

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Acknowledgements

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Wessex Archaeology would also like to thank the following people:

- Ian Cundy and Sue Barker for their information on the site and enthusiasm towards future work;
- Tony Isles for his information and his ongoing interest in the site.

The fieldwork was carried out by Dietlind Paddenberg, Margaret Christie, Niall Callan and Simon Adey-Davies with the assistance of vessel skipper David Burden. Dietlind Paddenberg supervised the fieldwork and Simon Adey-Davies supervised the diving. The report was compiled by Dietlind Paddenberg. Kitty Brandon prepared the illustrations and the project was managed for Wessex Archaeology by Steve Webster.

Data Licences

The chart used in **Figure 1** and on the front cover was obtained from the UK Hydrographic Office. The following notice applies:

DIAMOND, SARN BADRIG, CARDIGAN BAY

DESIGNATED SITE ASSESSMENT: ARCHAEOLOGICAL REPORT

Ref: 53111.03uu

Contents

Figures

Plates

DIAMOND, SARN BADRIG, CARDIGAN BAY

DESIGNATED SITE ASSESSMENT: ARCHAEOLOGICAL REPORT

Ref: 53111.03uu

1. BACKGROUND

1.1. INTRODUCTION

1.1.1. This document constitutes a Designated Site Assessment: Archaeological Report for a programme of archaeological work undertaken as part of the Contract for Archaeological Services in Relation to the Protection of Wrecks Act (1973). The document has been prepared by Wessex Archaeology (WA) for Cadw. It constitutes an assessment of a wreck designated as the *Diamond*, which is located on the underwater reef of Sarn Badrig (St Patrick's Causeway), Cardigan Bay, Wales (**Figure 1**).

1.1.2. The site known as the *Diamond* is the wreck of a 19th century merchant vessel. Although recorded as the *Diamond* there is now some doubt as to the accuracy of this identification. The 2007 work was conducted in accordance with a Written Scheme of Investigation (WSI) provided by WA and agreed by Cadw, which was designed as part of an ongoing effort by Cadw and the site Licensee, Ian Cundy, to discover the vessel's true identity (WA 2007). Diving operations were conducted between 21st and 25th May 2007.

1.2. DOCUMENT PARAMETERS

1.2.1. This document has been produced from diver-generated data and a limited desk-based study of readily available sources concerning the history of work on the site. WA considers this to be a working document designed to open up debate on the topic in question. Every attempt has been made to ensure that the facts within the report are correct; however errors arising from the preliminary character of the desk-based study may be present.

1.3. SITE HISTORY

1.3.1. The site was discovered in 2000, by Tony Iles and his daughter Helen, during a magnetometer search. This followed two decades of searching for the *Diamond* carried out by this family, and a parallel search carried out by Tony Iles' brother-in-law, marine archaeologist Mike Bowyer. Between 2000 and 2002, the site was regularly dived by Helen, Tony and Jenny Iles and Ian Draisey. After a pre-designation assessment had been carried out by the Archaeological Diving Unit (ADU) in 2001, the site was designated under the Protection of Wrecks Act (1973) on 1st April 2002.

1.3.2. From 2002, the site was regularly dived by the licensed Malvern Archaeological Diving Unit (MADU; contact: Ian Cundy), who also carried out archive research. In 2003, a weighted and tagged datum line was laid over the full length of the site, major features were tagged, and some video footage was recorded. The attempt by

Nigel Nayling (Department of Archaeology, University of Wales in Lampeter) to recover timber samples failed due to weather conditions. The conclusion of the work was that the site is probably not the *Diamond* (Cundy 2002; 2003).

1.3.3. In 2004, the site was dived by WA and MADU, resulting in the preparation of a geo-referenced preliminary site-plan of all exposed archaeological features produced by tracked diver survey and accurate to within +/- 0.75m. Numbered datums were fixed to most features, and the recording of basic measurements, orientations and descriptions, digital video and still images and monitoring photographs was undertaken. Tracked diver surveys were conducted to the WNW and ESE of the site and two sample trenches were excavated, using manual techniques, for the recovery of timber and sheathing samples for wood and metallurgical analysis. The hypothesis that the site is probably not the *Diamond* was corroborated (WA 2004; 2006; Cundy 2004).

1.3.4. During the winter of 2004/2005 further archive research was carried out by MADU, specifically the compilation of a database of all wrecks that are known to have sunk within the northern end of Cardigan Bay, and an investigation into the iron tanks found on site. Parallel archive research was carried out by Mike Bowyer (Cundy 2005; WA 2006).

1.3.5. In 2006, the site was dived by MADU and MA student Mary Harvey (Bristol University). Trench 1 of 2004 was re-excavated under the guidance of Nigel Nayling and samples for dendrochronological analysis were recovered. A number of marine biological observations were recorded. Mary Harvey compiled a MA thesis on 'Processes and Problems of Shipwreck Identification' using the alleged *Diamond* as a case study (Cundy 2006; Harvey 2006).

1.4. AIMS AND OBJECTIVES

Area Recording

1.4.1. Prior to the 2007 work, the site had been subject to a broad characterisation, by both WA and the Licensee, such that the general spread of artefacts and vessel structure had been plotted and characterised (WA 2006). The next stage of work proposed by the Licensee is for an exploratory trial excavation, designed to assist with the identification of the vessel (Cundy 2007). However, in order for this to be considered further the area to be subject to the excavation needed to be drawn pre-excavation to an acceptable standard.

1.4.2. As a change to the WSI, the desired target area for the excavation, and hence the detailed recording, was not the western end of the vessel (the alleged stern end), but an area in the middle of the ship, just west of the iron tank **WA46** towards the iron reinforcement feature **WA51**, covering this part of the vessel from the southern hull towards the keel (Cundy 2007). This became clear after consultation with the Licensee on site and the work tasks were changed accordingly.

1.4.3. The tasks associated with this objective were as follows:

- Initial site inspection/orientation dive;
- Installation of a baseline down centre of site in a manner that would enable at least the end datums to be used over a number of years, and establishment of

enough datums within the area to be surveyed to enable recording during this visit;

- Recording of the site by planning frame and/or off-set measurements. The intention was to plan the wreck at a scale of 1:20 starting at the desired target area for excavation. Only archaeological material (i.e. the vessel structure, fittings and cargo) would be drawn, this would include an outline of the ballast mound(s), but not a stone-by-stone drawing of either the ballast or the natural seabed. If the material was too spread out to warrant a 1:20 plan then the lead archaeologist may switch to a larger scale (such as 1:50) subject to consultation with the Project Manager and Cadw;
- It was proposed that drawing would initially concentrate upon achieving a detailed plan of the desired target area for excavation of the vessel. Thereafter if it appeared possible to complete the plan to the same standard for the whole vessel then work would proceed accordingly. If this was not thought possible then the outline of the rest of the hull would be plotted by off-set in order to place the detailed plan within its context and work would switch to the recording of some of the main features of the site (e.g. the iron boxes) for the remaining time available;
- Context numbers would be allocated as features were drawn, and the diver/surface recorder would fill in as much detail as possible during and after the dive, but detailed context recording would not be the main thrust of this work.

Feature Recording

1.4.4. This would involve tape measurements, photography and written records. Tasks were as follows:

- Production of a plan of the features at an appropriate scale – 1:20 or for objects containing a lot of detail possibly 1:10;
- Recording of measurements as required in order to accurately position the planned feature on the site plan;
- Photographing and production of written details on a context sheet.

Monitoring

1.4.5. Monitoring photographs taken in 2004 would be repeated.

2. EXISTING SITE DATA

2.1.1. The position of the centre of the designated circle as given in the Statutory Instrument (SI) is as follows:

Lat.	**52º 46.531’ N**
Long.	**04º 11.025’ W**
WGS 84	

2.1.2. The SI number is 2002 No.(W) and from the centre point (given above) the designated area consists of a circle with a radius of 200 metres. Mr Ian Cundy of the Malvern Archaeological Diving Unit, who held a licence during previous years, has applied for a renewal in 2007. The nominated archaeologist is Douglas McElvogue.

2.1.3. The position below is for the centre point of the known site. It was generated by tracked diver survey in 2004 (WA 2006). It represents the mean position of all of the archaeological features recorded with the exception of two features that lie outside of the site. It has been converted from UTM using Quest Geodetic Calculator Version 2.4.1 and was estimated to have an accuracy of +/- 0.75m.

Lat.	**52º 46.534' N**
Long.	**04º 11.021' W**
WGS 84	

2.1.4. In addition to the documentation available in 2004, the following additional information was available prior to the 2007 assessment:

- The Licensee's reports for the 2004, 2005 and 2006 seasons (Cundy 2004; 2005; 2006);
- Nigel Nayling's 'Dendrochronology Reports' (Nayling 2005; 2006);
- The Licensee's application for work on the site during the 2007 season (Cundy 2007);
- Mary Harvey's MA dissertation 'Processes and Problems of Shipwreck Identification: Case study of a 19th century merchant vessel, Cardigan Bay, Wales' (Harvey 2006).

2.1.5. The following table gives an overview of the scientific analyses that have, to date, been conducted on material from the site:

Year	Analysis	Institution
2004	Metallurgical analysis of sheathing samples and sheathing fastenings	Metallurgical laboratory at Cardiff University
2005	Wood analysis of timber samples	Nigel Nayling, Dendrochronology Laboratory, University of Wales Lampeter
2006	Geological analysis of petrographic samples	Nigel Cossons, Gifford
2006	Dendrochronological analysis of timber samples	Nigel Nayling, Dendrochronology Laboratory, University of Wales Lampeter

3. METHODOLOGY

3.1.1. A four-person diving team, using surface supplied diving equipment, was deployed from the diving support vessel *Xplorer*, a 12-metre inshore survey catamaran. Both one- and two-point anchoring systems were used on the site.

3.1.2. Digital still photographs were taken using a housed Canon G2 digital camera with a 0.56 wide-angle adapter using natural light only. The plates are digital still images and have been processed using Corel Photo-paint to remove a green colour cast and to improve contrast. Video images were taken using a hat mounted single chip Colourwatch Digital Inspection Camera, recording onto miniDV tape.

3.1.3. Datum points in form of 0.5m long iron bars were installed using a tape and a hammer. These were then connected by a 10mm polypropylene baseline. All datum points were labelled with a plastic tag wearing a burnt in and written coordinate. In addition to diver visual inspection (limited by poor visibility of 1m-2m) the correct positions of the baseline datum points were double-checked by accurate position fixes using a Sonardyne Prospector Long Baseline (LBL) acoustic tracking system.

3.1.4. This system gives coordinates projected in Universal Transverse Mercator (UTM) zone 30. All data acquired during diving operations, other than images, were recorded in real time within an MS Access database linked to the tracking system via ARCmap 9.

3.1.5. A section of the site was drawn at a scale of 1:20 by using a 1m² planning frame and off-set measurements. Due to time constraints, a geo-referenced outline of the shipwreck was produced by tracked diver survey using the LBL acoustic positioning system rather than off-set measurements.

3.1.6. Details of the methodologies used during the 2007 PWA survey are detailed in a separate document (WA 2003a). All work was carried out in accordance with the relevant guidance in the Standards and Guidance papers of the Institute of Field Archaeologists.

4. RESULTS

4.1. TASKS UNDERTAKEN

4.1.1. The following tasks were undertaken:

- An initial site inspection and orientation on site was conducted;
- Five datum points were installed in distances of 10m along the middle of the wreck site running approximately from west-northwest to east-southeast, covering a total of 50m and thus the whole length of the vessel;
- The westernmost datum point was tagged as zero-point ('0'), and the following datum points to the east were labelled 10E, 20E, 30E, 40E and 50E respectively;
- Two intermediate datum points were installed and labelled at 5E and at 25E. The 5E point was chosen because it was initially thought that drawing would start at the western end of the wreck. The 25E datum was installed when it became clear that work would focus on the area between 20E and 25E;
- A coloured baseline was attached to the datum points in two 25m sections, with the first section running from 0 to 25E and the second section running from 25E to 50E. The baseline was fixed at all datum points apart from the intermediate datum 5E;
- Two offset datum points were installed 10m south of the baseline at 20E/10S and 25E/10S in order to cover the Licensee's desired target area for excavation. These were temporarily connected to the baseline by tapes;
- A site section of 120m² (between datum points 17E and 29E on the baseline, and 17E/10S and 29E/10S to the south) was drawn in a scale of 1:20 by planning frame and offset measurements. Additionally, basic measurements were recorded for some features, such as the heights of upstanding structures;

- The outline of the hull was plotted by tracked diver survey and recording;
- A total of five photographs had been selected during WA's 2004 survey for the purposes of future monitoring of erosion, deposition, damage and deterioration. All five photographs have been repeated this year in accordance with the location of the photographer and direction of view reported for the 2004 survey.

4.2. DIVING CONDITIONS

4.2.1. Six project days from 14th to 19th May 2007 were lost due to adverse weather, which made the transfer of the vessel from Penzance to North Wales impossible. Vessel transfer from Penzance to Milford Haven took place on 20th May 2007, and from Milford Haven to Pwllheli on 21st May 2007. Loading and setting up of diving/recording equipment was also carried out on 21st May.

4.2.2. A total of 892 minutes bottom time was achieved over 3.5 diving days between 22nd and 25th May 2007 (**Appendix I**; at midday the vessel had to be transferred to the next project site). The sea-state varied from calm to moderate during the period of operations, and the diving operations were not affected by swell. Recorded in-water visibility varied from 1m-4m, allowing for limited use of still and video photography.

4.2.3. Even though strong tidal currents are experienced at times on Sarn Badrig (WA 2006), these did not affect WA's site operations in 2007. Diving was possible throughout the day and did not depend on tides. However, tidal limitations for the vessel leaving and entering Pwllheli Harbour had to be taken into account.

4.3. GEOLOGY, TOPOGRAPHY AND FLORA

4.3.1. The site is situated on the northern side of the underwater reef of Sarn Badrig (St Patrick's Causeway). It lies close to the top of the reef, and approximately four kilometres west of the present shoreline. At times the underwater reef is visible on the water surface as a slightly accentuated line (**Plate 8**). Sarn Badrig is the main underwater feature of the area. Away from the causeway, the seabed is mostly flat (Holden 2003: 15).

4.3.2. Sarn Badrig is one of three low, smooth-topped ridges within Cardigan Bay that project seaward for up to 15 kilometres at seabed level. These ridges or reefs are covered by gravel, cobbles and boulders, and are formed of clast-supported, clayey diamictons (Tappin *et al.* 1994). Garrard and Dobson (1974) inferred that the ridges were the remnants of late glacial median moraines of piedmont glaciers extending from the valleys in the adjacent Cambrian Mountains. However, this interpretation has been questioned and an alternative explanation is that the ridges are the remnants of late-glacial sandur (Tappin *et al.* 1994).

4.3.3. Sarn Badrig itself extends for approximately 15 kilometres south-west of Mochras Point. It forms the boundary between the largely flat-bottomed Tremadoc Bay and Barmouth Bay. Parts of the ridge are dry during Low Water Spring (LWS) tides. In the area of the wreck the seabed shelves very gently to the north across the site. There is little variation in depth along the east-west axis of the site (WA 2006).

4.3.4. The seabed consists of poorly sorted coarse sand, with fine-medium gravel, cobbles and some small boulders. Examination of the remains of black bream 'nests' (see below) and the results of excavation during the 2004 survey demonstrated that 0.05m-0.15m below this is there is a poorly sorted layer with a larger component size of coarse gravel and cobbles with darker coarse sand (WA 2006). The thickness of this layer is unknown.

4.3.5. No survey of site flora or fauna was undertaken due to time constraints. An irregular cover of low marine flora (seldom exceeding a height of 0.15m-0.20m), predominantly red seaweed, was noted over most hard surfaces. A number of sea creatures were observed, including a common lobster (*homarus gammarus*), a pair of dogfish, two large spiny spider crabs (probably *maia squinado*) and other crabs, tompot blenny (*blennius gattorugine*), shanny (*blennius pholis*), straight-nosed pipe fish (*nerophis ophidion*) and other fish.

4.3.6. Evidence of the remains of black sea-bream 'nests', comprising shallow scoops in the seabed up to 0.20m deep and approximately 1m diameter, were observed on the southern and western sides of the site during the 2004 (WA 2006) and 2007 surveys. Although the absence of marine growth suggested that these 'nests' were of recent construction, they did not appear to be active and no schools of juvenile fish were noted.

4.4. ARCHAEOLOGICAL FEATURES

4.4.1. As already observed during WA's 2004 work, the site proved to be difficult holding ground (WA 2006). Just before the site section drawing was completed on 24th May 2007, *Xplorer*'s anchor was dragged across the seabed due to a sudden increase in wind and sea swell. The ongoing dive had to be aborted. When the anchor was recovered after the diver was safe it turned out that it had become tangled in the eastern end of the baseline at the 50E datum point just outside of the actual site.

4.4.2. The anchor ripped out the entire baseline, including the datum points at 0, 10E, 20E, 25E, 40E and 50E. Due to time constraints, the baseline was not reinstalled during WA's visit. It was possible, however, to accomplish the detailed section drawing of a total of 120m², including the Licensee's desired target area for excavation (**Figure 2**).

4.4.3. The baseline was 'caught' by the anchor at its end, outside of the main body of the wreck. As a result no damage was done to the site during this incident.

4.4.4. A site inspection revealed that two datum points on the baseline (5E and 30E) covering a distance of 25m were still in place. They represented a long enough section to enable a reliable re-installation of the baseline. The Licensee's desired target area for excavation (approximately between 20E and 25E) is covered by this section. The two offset datum points at 20E/10S and 25E/10S are also still in place.

4.4.5. According to Mr Iles, limited site excavations by hand fanning prior to the designation of the site revealed several overlaps of copper sheathing, all indicating that the western end of the vessel is indeed its bow end. This was confirmed by WA's detailed recording of the target site section, which contained a line of copper sheathing exposed above the seabed (**WA52**). The joint in square 18E/7S also has the

outer overlap coming from the west, and the inner end of the sheathing coming from the east. Another such overlap was observed during the excavation of Trench 1 in 2004 (WA 2006: 12).

4.4.6. This makes the identification of the 'Z-shaped iron bar' **WA33** as a possible iron breasthook less likely, because this was originally interpreted as indicating the bow end of the vessel lying to the east (WA 2006: 9; 20-21). However, it was noted at the same time that the feature is apparently not *in situ*, and it may also represent strengthening for the transom of the vessel.

4.4.7. With regard to the identification of the vessel, further evidence was provided by the Licensee's activities in 2006. Together with Nigel Nayling of the University of Wales Lampeter, dendrochronological sampling and dating was conducted on the site. Initial results suggest that 'the timber comes from the northern part of the North American continent' and that it 'must have been felled some time after AD 1828' (Nayling 2006). How much later cannot be determined, because no sapwood, bark edge or heartwood/sapwood boundary was found on any of the samples.

4.4.8. However, the result finally rules out the possibility of the wreck being the *Diamond*, which was reportedly sunk in 1825.

4.4.9. It should be noted that the site plan shown in **Figure 2** represents a pre-disturbance site drawing in most parts, but not where a trench has been excavated in 2006 in order to recover timber samples for the dendrochronological analysis. This trench has not been surveyed but can be located approximately using the sketch provided by Bill Turner, a team member of the Licensee (Cundy 2006: 4). According to the Licensee, pre-excavation status has been re-established after completion of the fieldwork (Cundy 2006: 3).

4.4.10. The comparison of the site plan (**Figure 2**) with the sketch accomplished during the timber sample recovery in 2006 (Cundy 2006: 4) shows a small discrepancy with regard to the numbering of the cuprous fastenings **WA56-57**. According to the tags on site the numbering of **WA56-57** on WA's site plan (**Figure 2**) is correct (see also WA 2006, Figure 2).

4.4.11. The 2007 plan and hull outline has been incorporated with the 2004 survey data in order to up-date the site plan (**Figure 3**). This is an amalgamation of planned survey data (collected in 2007 and accurate to within *c*.0.05m) and tracked survey data (collected in 2004 and accurate to with *c*.0.75m), it represents an interim stage between the tracked plan and a full drawn pre-excavation plan of the wreck.

4.5. ASSESSMENT OF MONITORING PHOTOGRAPHS

4.5.1. The condition of the wreck site has clearly changed compared to WA's 2004 survey. The two most prominent examples include the iron box **WA27**, i.e. the northerly of two features interpreted as water tanks, and the iron knee rider **WA51** shown on the front page of WA's reports (WA 2004; 2006); as demonstrated by WA's monitoring photographs (**MP**s) of 2004 and 2007.

4.5.2. The iron box **WA27** (**MP1**) has almost completely collapsed since WA's 2004 survey, leaving only the upright reinforcement elements which would have formed

the corners of the box (**Plate 1**). These uprights were not fully intact and the breaks which were evident looked relatively fresh. This assumption was confirmed by Ian Cundy, who was not yet aware of the collapse of the box which was still intact during his last dive on the site in 2006.

4.5.3. Roughly halfway along the southern edge of the site and within the drawn section is an iron knee rider **WA51** (**MP3**; wrongly referred to as **WA55** in WA 2006: 19) adjacent to a line of copper sheathing (**WA52**). The knee rider has suffered heavy damage since WA's 2004 survey (**Plate 2**). It is bent over at a 90 degree angle halfway along its length. At the point of the bend, the outer layers of concretion have broken off, exposing a corroded iron core which is approximately 2cm in diameter (as opposed to the overall diameter of *c.* 15cm).

4.5.4. It remains unproven whether this damage has been caused by natural site deterioration or by accidental and/or deliberate human interference such as failed mooring attempts and diver activities. No positive evidence of unauthorised disturbance (such as abandoned fishing line, net or pots) was observed. A small corroded piece of iron was actually observed coming off an iron feature during WA's survey, indicating that natural site deterioration is at least a dominant factor involved.

4.5.5. Also within the drawn section lies an irregular row of eight copper fastenings (**WA56-63**). A line of four of these (**WA58-61**) had been chosen as **MP2** in 2004. The fastenings were still intact during this year's survey, and standing up from beneath the seabed. They had a moderate covering of marine growth, covering almost all of the exposed part of the fastening. In WA's 2004 survey, these pins had practically no growth on them (**Plate 3**).

4.5.6. During the survey of 2004, it was suggested that the seabed level on site seemed to be eroding, even though it was not known whether this is a site-wide or a more localised phenomenon (WA 2006). More evidence for seabed erosion was found during this year's survey. Within the drawn section, two small pieces of timber were exposed on the seabed within squares 20E/7S and 21E/7S. According to the Licensee, no timber is normally visible on site. Any exposed wood will obviously deteriorate rapidly.

4.5.7. Furthermore, slightly exposed timber was observed within the area of the former Trench 2 (**MP5**). Even though the trench was reinstated and all features buried prior to excavation were reburied at the end of the 2004 season, the picture does not look very different to the condition as excavated in 2004 (**Plate 4**). As stated in the 2004 report, Trench 2 appeared to be located within a slight scour immediately to the north of the northern edge of the site. Hence, the exposure might be due to either long term erosion within this scour and/or any instability caused by the 2004 excavation.

4.5.8. A comparison of height measurements along the row of upstanding cuprous fastenings **WA56-WA63** which were recorded during the drawing of the site plan (**Figure 2**) shows only marginal changes compared to 2004 (**Appendix II**). Most of the visible heights differed by approximately 0.01m (**WA57**, **WA58**, **WA60**, **WA61**, **WA63**), whereas one bolt (**WA56**) and the iron reinforcement just north of the row of bolts (**WA54**) seemed to be exposed by a further 0.04m compared with 2004. Another cuprous bolt (**WA60**) either eroded or became covered by more sediment, as its height was 0.05m shorter than previously observed.

4.5.9. Tony Iles mentioned that large spider crabs (probably *Maja Squinado*, 'spiny spider crab') started to populate Northern Welsh underwater regions in huge numbers in the course of the last year. Accordingly, WA noticed at least two individuals on the *Diamond* site. This is documented within **MP4**, where one of them was caught climbing along the iron features **WA18** and **WA19** interpreted as knee riders. Compared to 2004, these features seem to be unchanged (**Plate 5**).

4.5.10. To summarise, the erosion of the upstanding metal features is progressing, in some cases rapidly, leading to significant changes. Furthermore, slight changes in seabed level have been observed between 2004 and 2007, seemingly sufficient to partially uncover timbers close to the seabed surface. No intermediate observations have taken place in order to identify short term cycles of erosion and deposition.

4.5.11. Ian Cundy (**Plate 6**) and his team intend to continue their work on the site. Public interest is also still high, as demonstrated by the fact that a TV crew spent one day onboard *Xplorer* in order to document the 2007 work on site and interview Deanna Groom, who is in charge of the maritime archive of the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW), the Licensee and WA staff (**Plate 7**).

5. VESSEL IDENTIFICATION

5.1. SUMMARY OF PREVIOUS EVIDENCE

5.1.1. According to Lloyd's Register of Shipping and Lloyd's List of 1824 and 1825 the *Diamond* was built in New York in 1823 and lost on the Sarn Badric reef in Cardigan Bay on 2nd January 1825. The *Diamond* was a three-masted square rigged vessel with a length of 36.5m, a beam of 9m and a tonnage of 491.62 tons, built of white oak and locust and sheathed with copper. She was designed to make fast passages across the Atlantic carrying passengers and cargo (cf. Harvey 2006: 22).

5.1.2. After the 2004 survey, the overall character of the exposed material on the seabed can be summarised as follows (WA 2006):

Area and distribution of surviving ship structure:	A flattened oval approximately 44m by 10m, orientated E-W. Most archaeological features are distributed around the periphery of this oval.
Character of ship structure:	Wooden framed vessel with iron reinforcements, cuprous sheathing and iron and cuprous fastenings. Frames mainly oak, some larch; planking elm and pine. Beam ≤ 9m, length ≤ 44m, *c.* 500-800 tons.
Depth and character of stratigraphy:	Shallow layers of mobile sediment over ship structure observed within excavation trenches. Deeper deposits are probable in the centre of the site.
Volume and quality of artefactual evidence:	Only isolated small finds were seen during WA fieldwork, and all were associated with the ships structure. None were recovered. A cuprous bolt with Muntz metal patent stamp was probably recovered from the site prior to designation.
Apparent date of ship's construction and/or loss:	Unknown. Construction probably post-1832 (patent of Muntz-metal).
Apparent function:	Merchant sailing vessel, cargo unknown (although cotton has been suggested by the Licensee).
Apparent origin:	Unknown, probably of European construction.

5.1.3. The data gathered by WA indicated that this vessel is not a 'composite vessel' in the usually accepted sense, i.e. it is not a vessel combining metal frames with timber planking or vica versa. Suggestions made previously that the wreck may be 'composite' appeared to be based upon a misidentification of the knee-riders as iron frames, a misunderstanding as to the definition of the term or a rather looser use of it than is generally accepted (WA 2006).

5.2. SUMMARY OF NEW EVIDENCE

5.2.1. In 2006, six dendrochronological samples were taken from the wreck by the Licensee and Nigel Nayling, who subsequently analysed the samples. The dating indicated that 'the timber must have been felled some time after AD 1828'. How much later could not be determined 'as no sapwood, bark edge or heartwood/sapwood boundary was found on any of the samples' (Nayling 2006). However, a date of around 1840 has been suggested by the Licensee (Cundy 2006: 8).

5.2.2. In order to date the samples, a ring-width mean was calculated from the five datable synchronised timber series and compared with oak ring-width means from Britain and Ireland. This proved to be unsuccessful. However, the mean was then compared with international tree-ring chronologies, 'and correlations found with tree-ring chronologies from the Great Lakes region of the Northern American continent', indicating a North-American origin of the timbers (Nayling 2006).

5.2.3. A petrographic sample has been produced by geologist Nigel Cossons from one of the ballast stones recovered from the site prior to the designation (Cundy 2006: 6). This confirmed that the ballast is dolerite. According to its molecular structure, it is unlikely that the dolerite originated in North Wales. Further research is currently being undertaken (Cundy 2006: 6).

5.2.4. In the ADU's assessment of the site against non-statutory criteria it was stated that the *Diamond* was 'thought to be the oldest known example of an American composite built hull' (ADU 2001; ACHWS 2004). It was established during the 2004 survey that the wreck on site is in fact not a composite vessel (see above). Furthermore, Tony Iles stressed during his visit to the site in 2007 that there is no evidence that the real *Diamond* was a composite vessel.

5.2.5. The ADU stated in its pre-designation site assessment that 'the reported retrofitting of substantial iron frames into the *Diamond* is possibly a unique example of one aspect of the evolution of merchant sailing vessels' (ADU 2001: 2). However, apart from this wreck, several other examples are known where wooden sailing vessels have been fitted with reinforcing iron knee riders. Examples are the *John Preston*, built during 1855 in Wales (Webster forthcoming), and the Manacles Wreck, a probable mid-19th century wreck off Cornwall (WA 2003b: 5-6).

5.3. CONCLUSIONS

5.3.1. The wreck on the site was originally thought to be the *Diamond*, which sank in 1825. Conclusive evidence indicates that it is in fact not the *Diamond* but is another 19th century merchant vessel. This evidence may be summarised as follows:

- The wreck on site is *c.*8m longer than the *Diamond*;

- Iron reinforcements recorded on site are not recorded for the *Diamond*;
- A pin allegedly recovered from the site carries a Muntz Metal stamp, which provides a *terminus post quem* of 1832 (year of patent assignation), seven years after the sinking of the *Diamond*;
- Wood samples proved to be elm, oak and pine rather than oak and locust;
- The dendro date of the wreck on site proved to be 1828 without sapwood, suggesting a felling date for the timbers of later than 1828, possibly around 1840.

5.3.2. According to Harvey (2006: 36) in cooperation with the Licensee, circumstantial evidence combined with the dendrochronological result provides the conclusion that the vessel on site was built of imported North American timber with a *terminus post quem* date of 1840. Though it should also be noted that the North American origin for the timber could equally mean a North American origin for her construction. Harvey (2006: 37) considers her to have most likely been employed in the trans-Atlantic trade out of Liverpool. Further evidence is required in order to support this theory.

5.3.3. It is possible that the vessel carried a cargo of cotton on her last journey. Cotton trade was a common feature along this coast during the 19th century, and Tony Iles recovered a small sample of cotton from the site prior to its designation. A cargo of cotton would furthermore support the interpretation of the iron boxes as water tanks, because 'wooden casks were notoriously leaky' and with a cargo of cotton it was of 'paramount importance to keep the cargo dry' (Harvey 2006: 15).

5.3.4. These possible water tanks have a strong resemblance to those found on the *Jhelum* which currently lies, partially sunk, on the Falkland Islands (Cundy 2005: 1; Stammers and Keaton 1992). The Licensees looked at all the other 27 ships built by Joseph Steel & Son, the builder of the *Jhelum*. However, none of these turned out to match any of the ships that sunk in Cardigan Bay according to the Licensee's database. The Licensee suggested that more research could be undertaken to see if any of these ships had their names changed since they were commissioned (Cundy 2005: 1).

5.4. ASSESSMENT AGAINST DESIGNATION CRITERIA

5.4.1. The following table provides an overview of previous and new evidence with regard to the site designation criteria. The previous evidence refers to the pre-designation assessment conducted by the ADU in 2001 (ADU 2001):

Criteria	Previous Evidence	New Evidence
Period/ Rarity	*Diamond* was one of the first vessels that operated a regular passenger and cargo service between Great Britain and the United States and is a representative proto-liner of the North Atlantic. The *Diamond* is thought to be the oldest known example of an American composite built hull. It has also been claimed that the iron tanks for fresh water storage are the earliest known example and are possibly unique survivors, however iron water tanks had been in use by the Navy for at least thirty years before this vessel was built.	The wreck on site may have operated between Great Britain and the United States – though the evidence for this is slight. It is however, certainly not one of the first vessels of its kind, and possibly one of many involved in the cotton trade out of Liverpool. Neither the *Diamond* nor the wreck on this site have been composite vessels. However, the wreck on this site had iron reinforcements fitted to its wooden hull, either as a design feature or an addition. The iron water tanks have been compared to those of the *Jhelum*, which was built during 1849 in Liverpool.
Documen-tation	The applicant [M. Bowyer] and his relatives have done some research into the wreck using secondary sources and have discovered a useful amount of information, including a possible connection with the Macy family who set up Macy's department store in New York.	Partial pre-disturbance recording, small excavation trenches, material analyses and documentary research have been conducted by the Licensee (I. Cundy and his team) and by WA, leading to the conclusion that the wreck on site is not the *Diamond*, therefore this line of research is now redundant.
Group value	No other vessels were associated with the loss of the *Diamond* but it is one of many casualties of the Sarn Badric reef in Cardigan Bay.	This remains as one of the site's most notable criteria. The wreck forms part of a multi-period underwater heritage resource, and thus cannot be seen in isolation.
Survival/ condition	The ship structure above seabed has been destroyed except for the iron components, but there is evidence to suggest that the wooden hull may survive beneath the sand to above the turn of the bilge. Reports that cotton from the cargo is still recognisable on site indicate the potential for good survival of organic material.	The ship structure above seabed has been destroyed except for the metal components, but small excavation trenches proved that the buried part of the wooden hull survives beneath the sand. The amount of the surviving hull structure would have to be determined by further excavation.
Fragility/ vulnerabi-lity	Whilst the iron elements of the wreck are fairly robust, the organic material buried in the sediments could be vulnerable to the undisciplined digging. The wooden structure of the ship will only remain stable whilst it is buried; any exposure will initiate deterioration.	The iron elements of the wreck are subject to rapid erosion and collapse. The wooden structure of the ship will only remain stable whilst it is buried; any exposure will initiate deterioration. Significant deterioration was noted between 2004 and 2007, and this may continue.
Diversity	The composite structure of the *Diamond* is a survivor of a period of rapid development in shipbuilding. Many variations in construction methods using iron and wood were tried in merchant vessels before composite techniques reached their zenith in the late nineteenth century. The reported retrofitting of substantial iron frames into the *Diamond* is possibly a unique example of one aspect of the evolution of merchant sailing vessels.	Neither the *Diamond* nor the wreck on site this had a composite structure. However, the wreck on site had iron reinforcements fitted to its wooden hull. Many variations in construction methods using iron and wood were tried in merchant vessels before composite techniques reached their zenith in the late 19th century. The fitting of substantial iron frames into the wreck on site is, however, not a unique example of this aspect of the evolution of merchant sailing vessels.

Criteria	Previous Evidence	New Evidence
Potential	It is reported that substantial parts of the collapsed hull may remain buried beneath the sediment on the site. A study of the construction of the ship structure will add to the knowledge of how vessels were developed for fast Atlantic trading.	Substantial parts of the collapsed hull may remain buried beneath the sediment on the site. A study of the construction of the ship structure will probably add to the knowledge of how vessels were developed for Atlantic trading, but it is not yet certain that this vessel was involved in that trade.
Conclu-sions	The wreck is not a strong candidate for designation but it embodies interesting features related to the combination of American shipbuilding and British engineering. It also has the potential to provide related information on the development of the regular North Atlantic trading in the first half of the 19th century. Vernacular craft are under-represented in the list of protected wrecks and so this interesting example could be considered for designation.	It may be appropriate to reconsider the site's designated status, as it is now confirmed not to be the wreck of the *Diamond*, but rather one of many mid- or late 19th century merchant vessels, possibly involved in the trans-Atlantic cotton trade out of Liverpool.

6. ASSESSMENT ARCHIVE

6.1.1. The project archive consisting of hard copy files and computer records, together with miscellaneous hardcopy photographs and plans are currently stored at WA under project code 53111.

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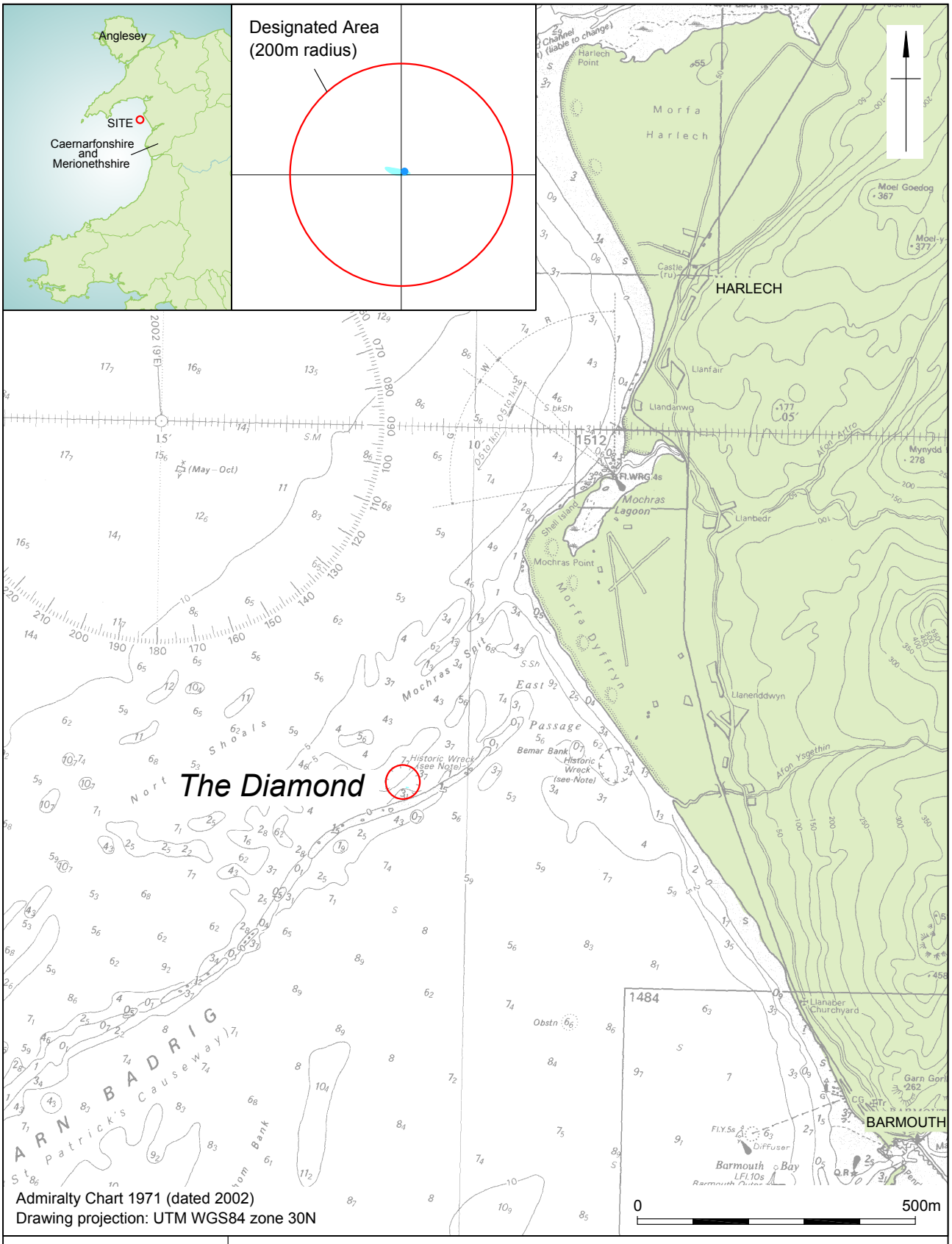
APPENDIX I: DIVE DETAILS

Dive	Date	Diver	Start time	Max. Depth (m)	Bottom Time (min.)	Estimated Visibility (m)
176	22/05/07	Paddenberg	14:02	9.0	177	1
177	23/05/07	Christie	09:17	7.0	146	1-3
178	23/05/07	Callan	13:12	8.5	176	3-4
179	24/05/07	Paddenberg	08:49	6.5	130	2-3
180	24/05/07	Christie	12:21	8.5	136	3
181	24/05/07	Callan	15:37	8.2	60	2-3
182	25/05/07	Paddenberg	10:02	7.0	67	3-4

APPENDIX II: MEASUREMENTS OF SELECTED CUPROUS FASTENINGS

WA No.	Dive Obs. No. 2004	Dive No. 2004	Dive Obs. No. 2007	Dive No. 2007	Description	Length upstanding 2004	Length upstanding 2007	Difference 2004 - 2007
51	1901	172	Site plan	180	Iron reinforcement	1.15m	Bent over at a height of 0.67m	Collapsed
54	1842	170	10046	179	Iron reinforcement	0.76m (rectangular section 0.17 x 0.11m)	0.80m (rectangular section 0.17 x 0.12m)	+0.04m
56	1840	170	10041	179	Cuprous fastening	0.50m	0.54m	+0.04m
57	1839	170	10041	179	Cuprous fastening	0.493m	0.48m	-0.01.3m
58	1838	170	10044	179	Cuprous fastening	0.22m	0.22m	±0
59	-	-	10044	179	Cuprous fastening	-	0.28m	?
60	1836	170	10048	179	Cuprous fastening	0.185m	0.18m	-0.00.5m
61	1834	170	10048	179	Cuprous fastening	0.26m	0.25m	-0.01m
62	1841	164, 165	10047	179	Cuprous fastening	0.26m	0.21m	-0.05m
63	1835	170	10049	179	Cuprous fastening	0.12m	0.11m	-0.01m



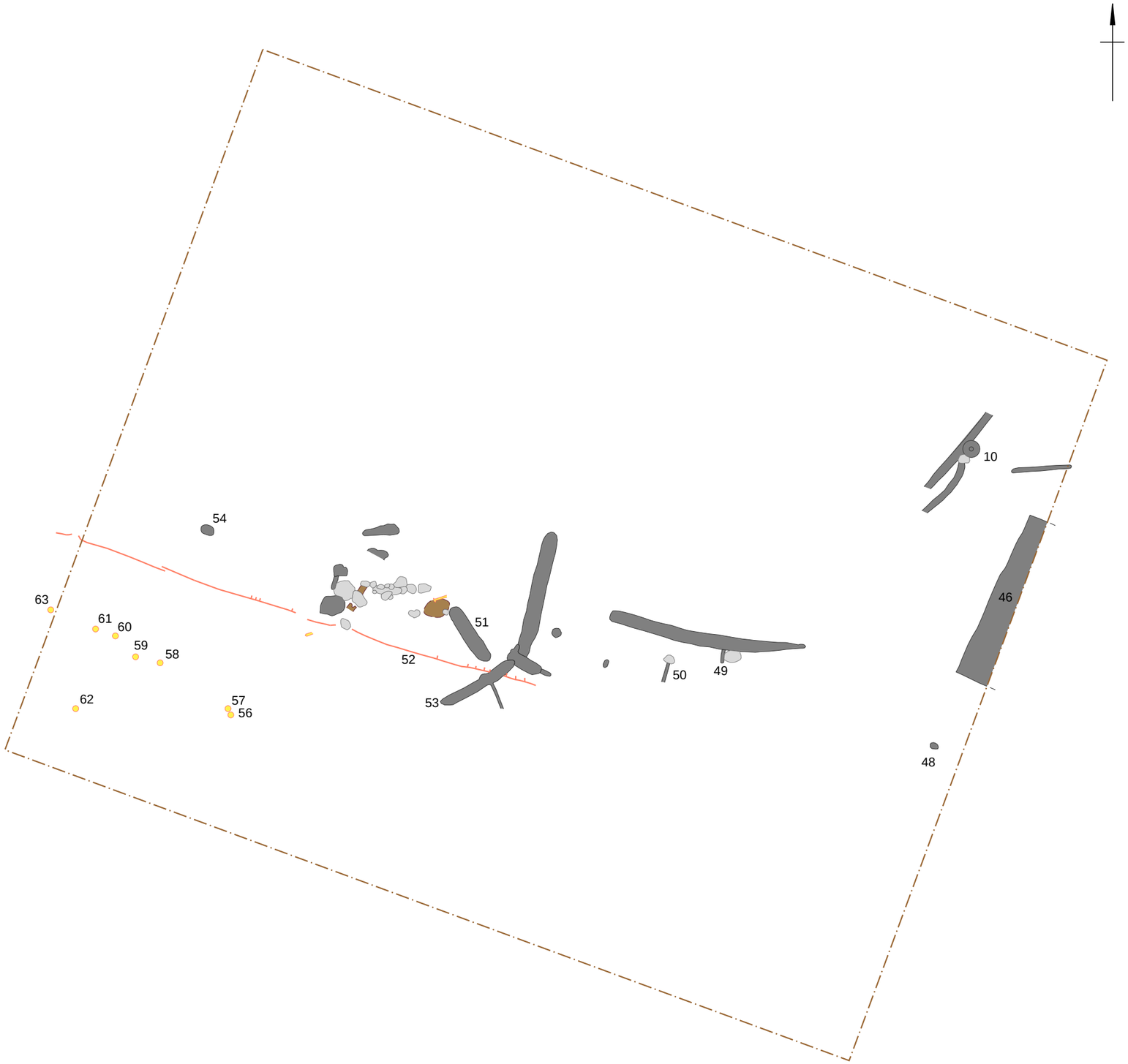
- Tracked diver position for N. water tank: 52°46.534' N 04°11.021' W (WGS. 84)
- Approximate extent of wreck

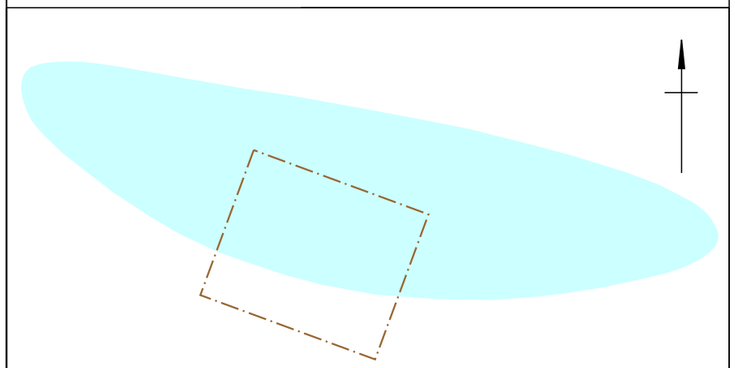
Wessex Archaeology

Date:	19/06/07	Revision Number:	0
Scale:	1:100,000 & (inset) 1:10,000	Illustrator:	KJB
Path:	W:\53111\Drawing Office\...\2007\...\z30_2007_Diamond.dwg		

Diamond site location

Figure 1





Wessex Archaeology

Planned area
Timber
Iron
Cuprous metal
Stone
Approximate extent of wreck

0 1 2m

Revision Number:	0
Illustrator:	KJB
Date:	05/07/07
Scale:	1:60
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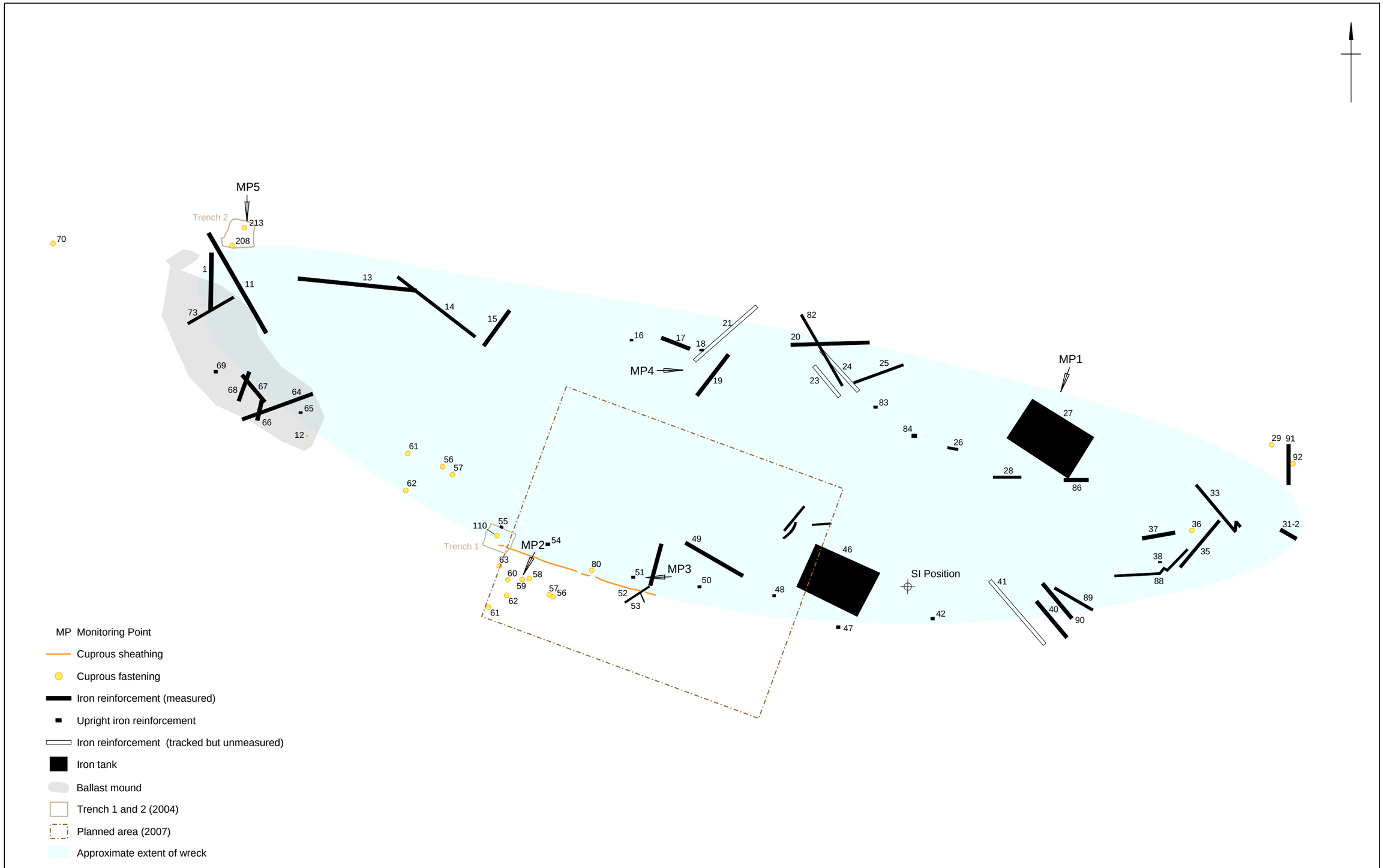
z30_2007_Diamond\Archaeological report	

2007 site plan

Figure 2



Wessex Archaeology

0 5m

Drawing projection: UTM WGS84 Zone 30N.

Date:	06/07/07	Revision Number:	0
Scale:	1:150	Illustrator:	KJB
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2007 site plan and hull outline incorporated with 2004 site survey plan and interpretation

Figure 3

2004

2007

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
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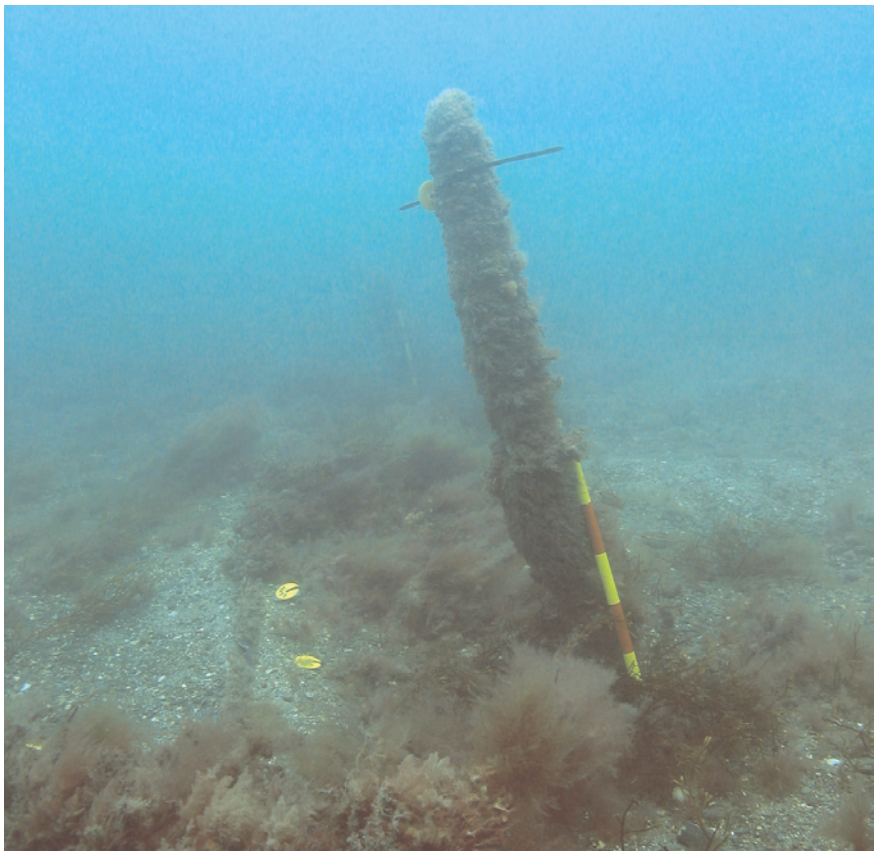
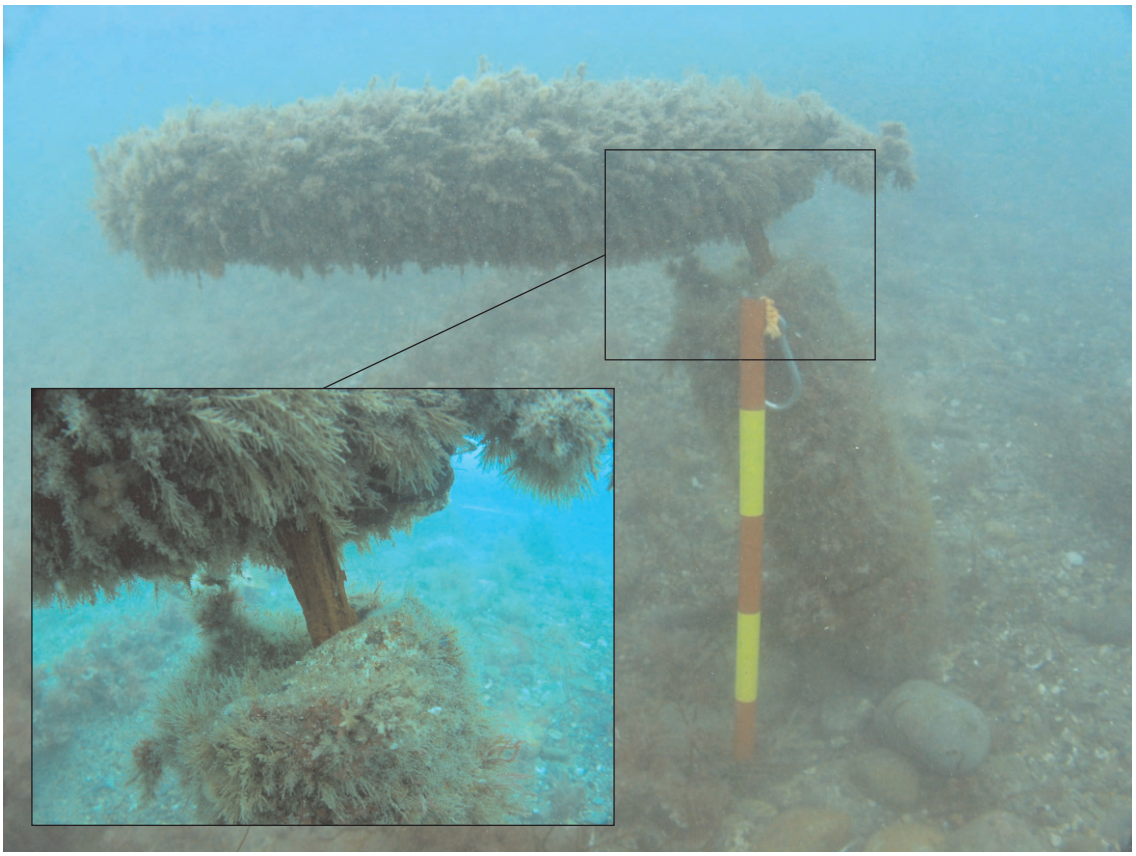
MP1 (**WA27** from the north) in 2004 (top) and in 2007 (bottom)



2004



2007

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
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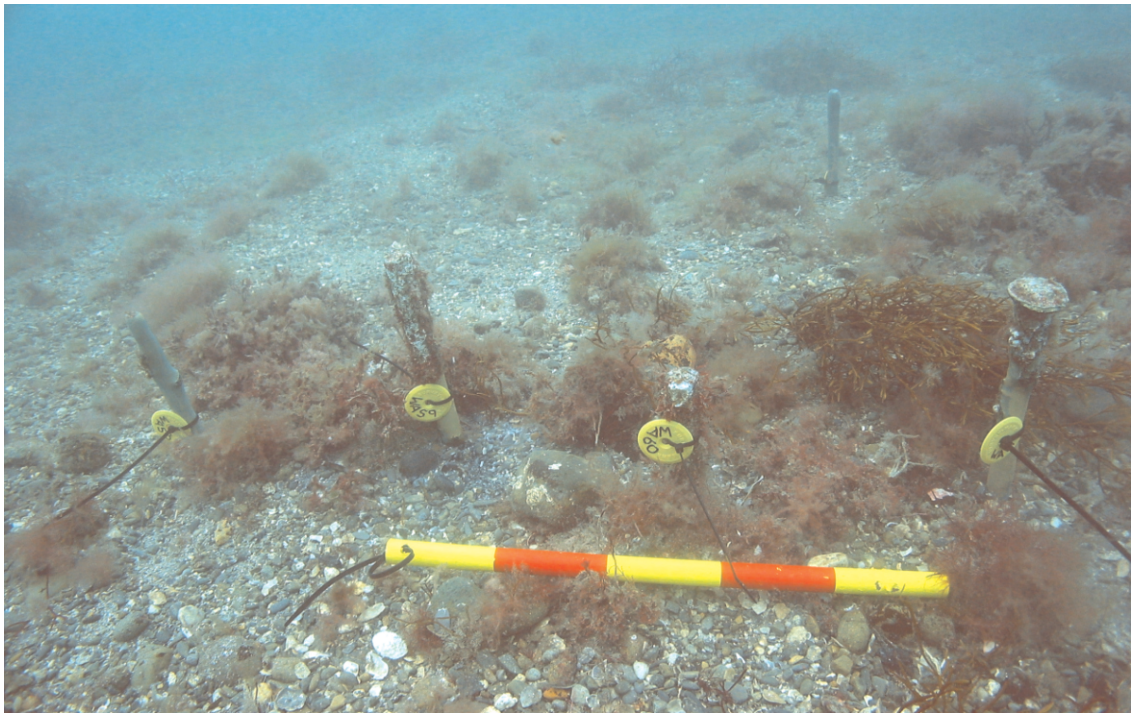
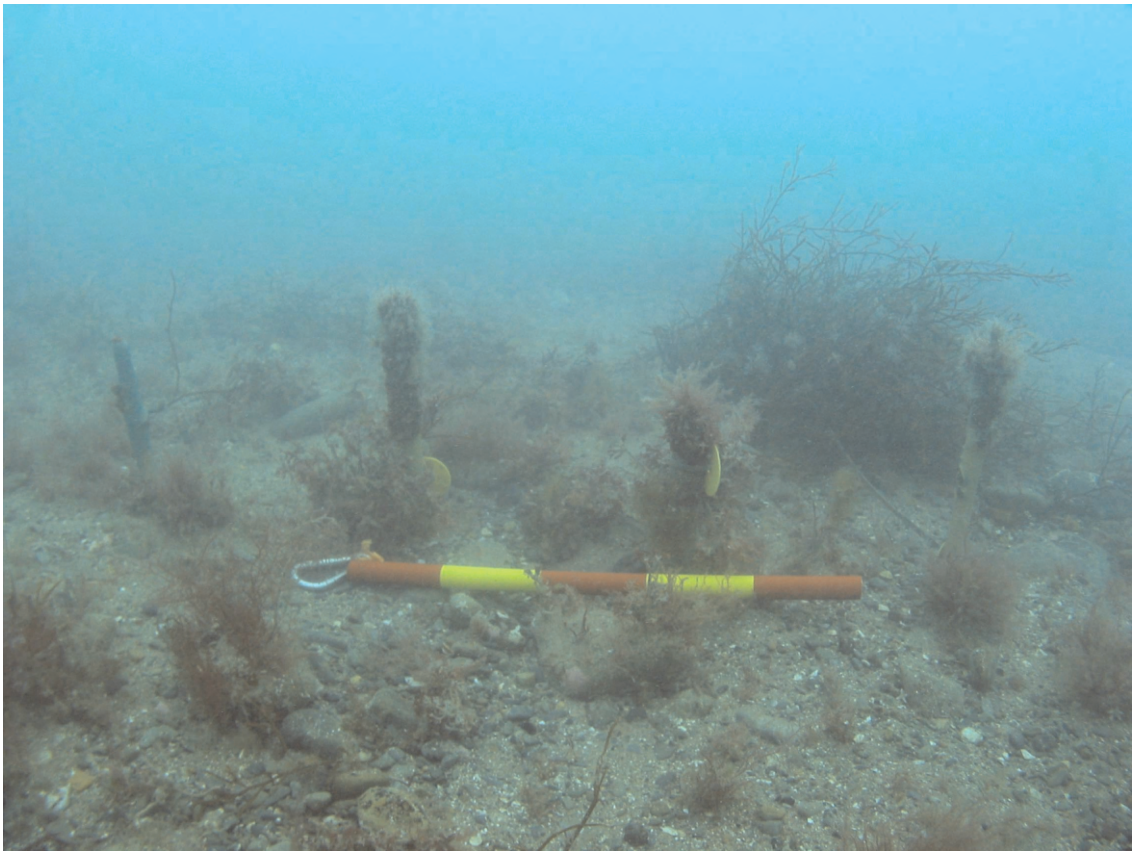
MP3 (**WA51-52** and **WA54** from the east) in 2004 (top) and in 2007 (bottom)



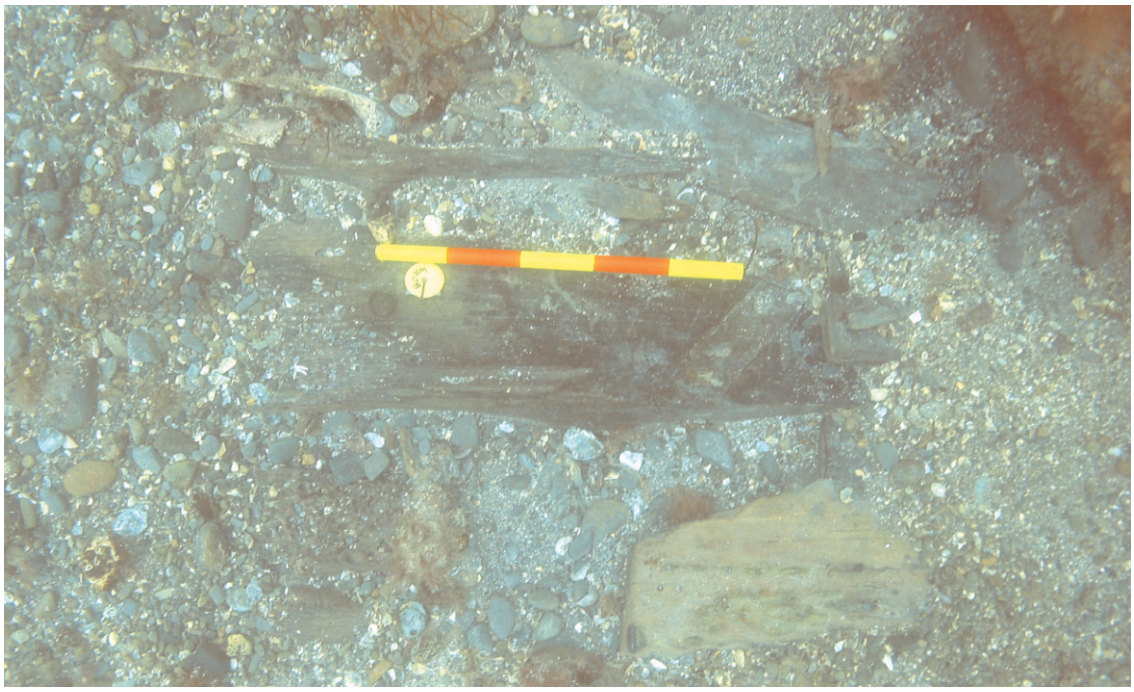
2004



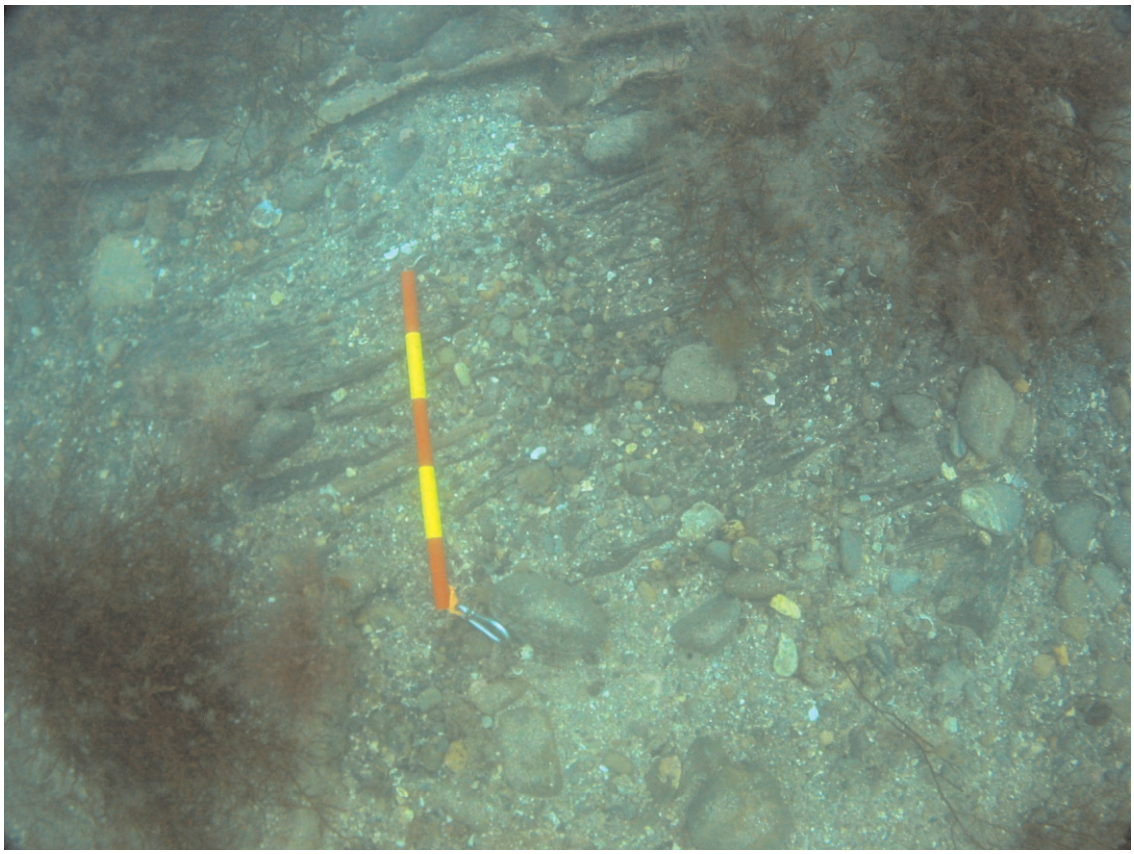
2007

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
	Path:	U:\PROJECTS\53111\DO\Report Figs\2007\z30_2007_Diamond\Archaeological report\Plates1-7_A4.cdr		

MP2 (**WA58-61** from the east) in 2004 (top) and in 2007 (bottom)



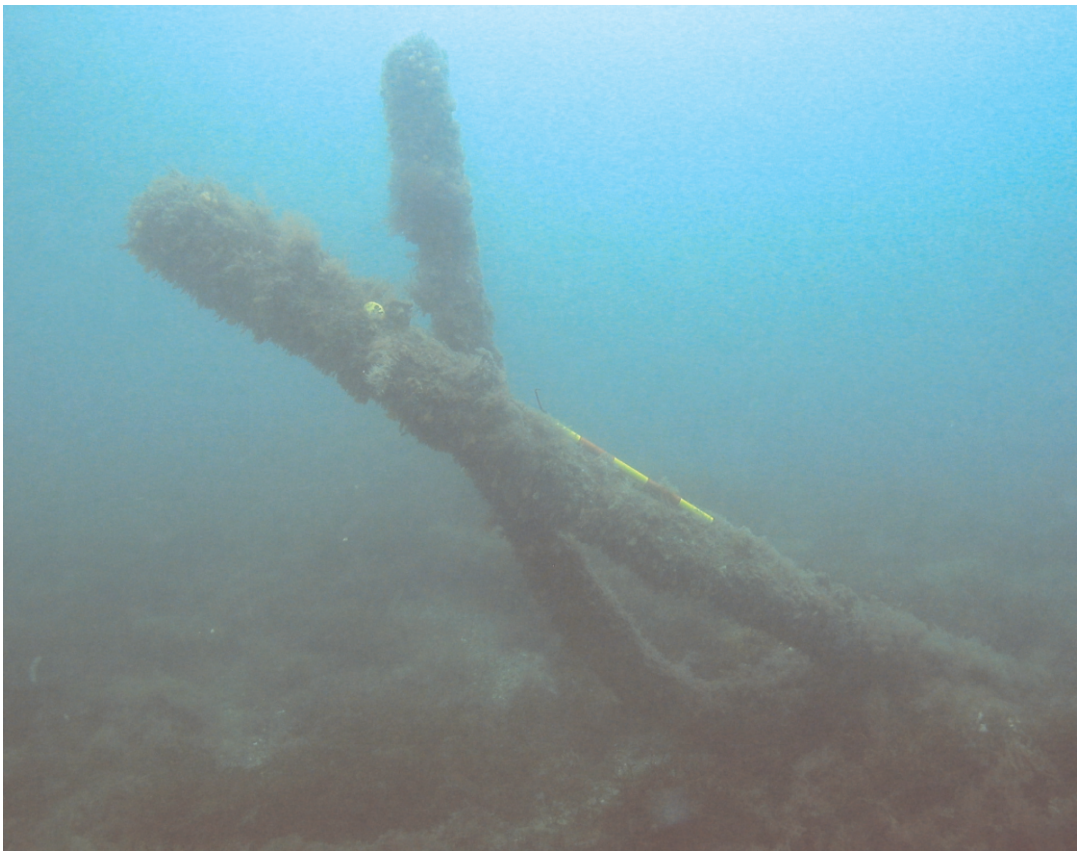
2004



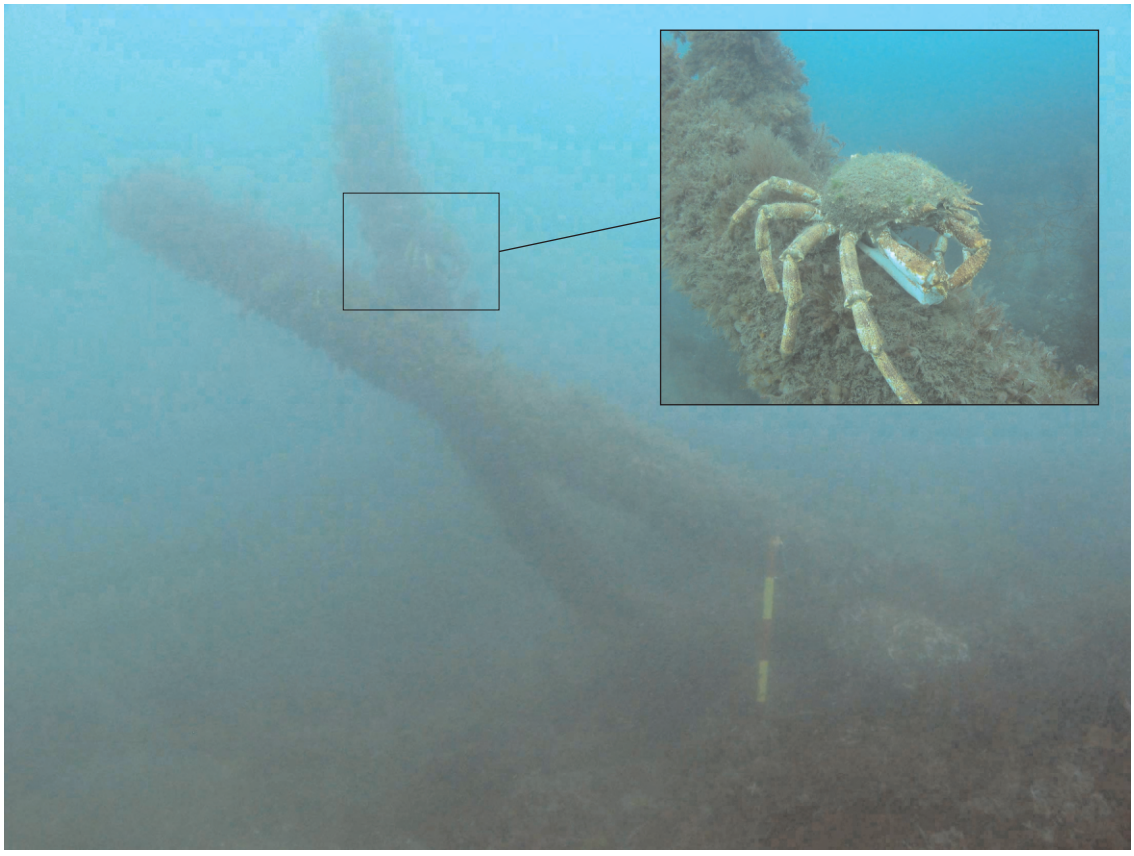
2007

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
	Path:	U:\PROJECTS\53111\DO\Report Figs\2007\z30_2007_Diamond\Archaeological report\Plates1-7_A4.cdr		

MP5 (Trench 2) in 2004 (top) and in 2007 (bottom)



2004



2007

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
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MP4 (**WA18-19** from the west) in 2004 (top) and in 2007 (bottom)

Plate 6. Tony Iles, Ian Cundy and WA staff onboard *Xplorer*

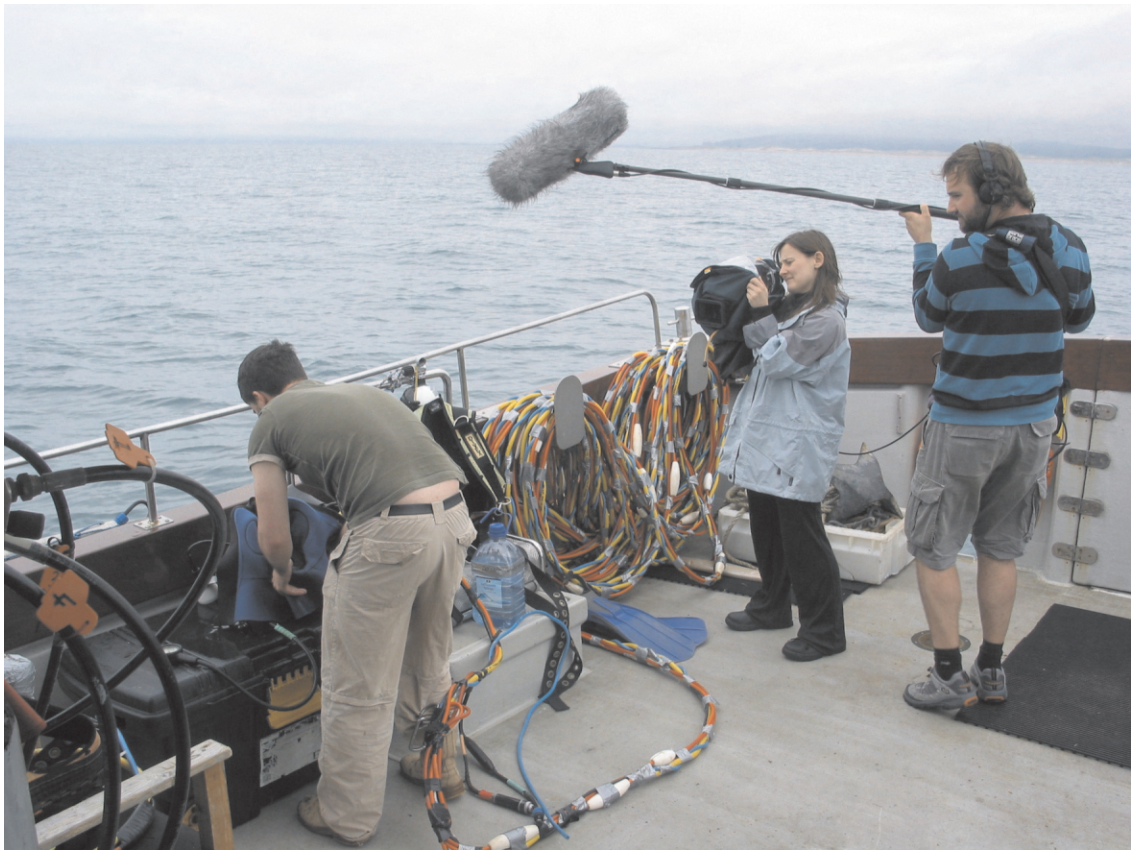
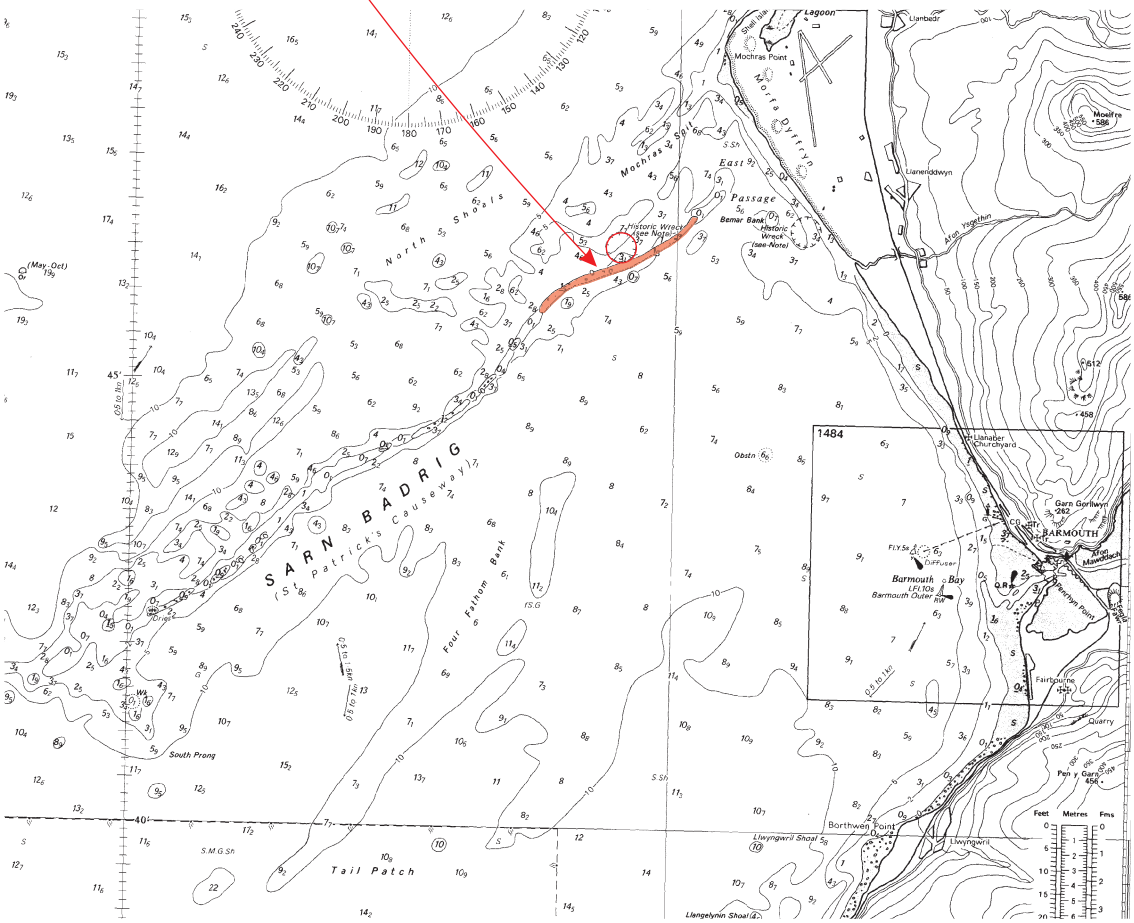


Plate 7. TV crew onboard *Xplorer*

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
	Path:	U:\PROJECTS\53111\DO\Report Figs\2007\z30_2007_Diamond\Archaeological report\Plates1-7_A4.cdr		

Site location showing underwater reef



Admiralty Chart 1971 (dated 2002)

Wessex Archaeology	Date:	09/07/07	Illustrator:	KJB
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WESSEX ARCHAEOLOGY LTD.
Head Office: Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB.
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk
London Office: Unit 701, The Chandlery, 50 Westminster Bridge Road, London SE1 7QY.
Tel: 020 7953 7494 Fax: 020 7953 7499 london-info@wessexarch.co.uk www.wessexarch.co.uk