

# Standard and guidance for nautical archaeological recording and reconstruction

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Published December 2014

Updated October 2020

- Minor formatting changes made – reference section moved to Appendix 6 of the separate appendices document

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# Standard and guidance for nautical archaeological recording and reconstruction

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## STANDARD

**The recording of nautical archaeological remains will use appropriate methods and practices to provide a sufficiently detailed record of a vessel or vessel remains as found, to allow for an informed and reliable reconstruction where possible. If a reliable reconstruction is not possible, as in the case of a single find of part of a vessel, then a sufficient record should be attained to allow for an informed interpretation of the overall building characteristics, general date and possible size of the parent vessel.**

**Reconstruction will supplement as-found records with known or reasonably postulated attributes of the vessel to enable a drawn, digital or physical 3D model of the vessel to be built. The reconstruction process will create a valid model or drawings to allow reliable interpretation of the vessel.**

### Definitions

Nautical archaeological remains are considered to be the physical remains of any waterborne vessel irrespective of the material they are constructed from, the totality of the remains or the environment where they are found.

Nautical archaeological remains include all features and finds directly associated with a vessel's construction, fastening, fittings, propulsion, steering, anchoring and mooring. All other archaeological finds or features found in association with nautical remains, such as personal belongings, navigational equipment, ordnance, human remains and cargo are considered to be separate from this standard. Such finds and features are covered by separate standards.

Nautical archaeological remains range from fully articulated vessels in a good state of preservation to disarticulated remains with poor preservation. They include remains of individual constructional parts of a vessel sometimes found as isolated finds or reused in a non-nautical context. The physical properties of nautical archaeological remains can change, as in the case of the Sutton Hoo vessel. This does not preclude them from the Standard.

*As found* is considered to be a record of the nautical archaeological resource as recorded in situ.

First stage reconstruction is considered to be the as-found record but with obviously distorted parts restored to shape, displaced parts reinstated, fragmented timbers made whole, and the vessel rotated to a vertical and horizontal plane (consideration of the correct waterline plane is considered in the second level of reconstruction). All first reconstruction is reliant on full and unequivocally interpretable archaeological evidence.

Second stage reconstruction is considered to be an interpretation of the original vessel based on an interpretation of the archaeological record.

Third stage reconstruction is considered to be further interpretation of the vessel based on documentary or iconographic evidence not directly linked to the site or vessel.

A nautical archaeological specialist is a recognised named person who has quantifiable (peer reviewed publications, academic qualifications, MCIfA) and qualifiable experience (named projects at MCIfA level of responsibility) in researching, excavating, recording, interpreting, reconstructing and publishing nautical finds.

## **Purpose of nautical recording and reconstruction**

The primary aim of recording nautical archaeological remains is to complete an accurate as-found record of the vessel or parts thereof so they can be properly interpreted by a nautical specialist. The aim of reconstruction is an understanding of the vessel's hull form and construction.

Occurrence of nautical recording and reconstruction

Nautical recording and reconstruction may occur:

- a. in response to a proposed development which threatens the archaeological resource
- b. as part of the planning process (within the framework of appropriate national planning policy guidance notes) and/or development plan policy
- c. as part of an Environmental Impact Assessment (EIA)
- d. outside the planning process
- e. within a programme of research not generated by a specific threat to the archaeological resource
- f. in connection with the preparation of management plans by private, local, national, or international bodies

Nautical recording and reconstruction may therefore be instigated or commissioned by a number of different individuals or organisations, including local planning authorities, national advisory bodies, government agencies, private landowners, developers or their agents, archaeological researchers, etc.

## **GUIDANCE**

### **1 Introduction**

- 1.1** Archaeological remains situated within intertidal and sub-tidal areas may be less visible and accessible than remains on dry land; however, this does not affect their relative importance and they should be managed in accordance with the principles that apply to terrestrial archaeological remains (English Heritage and RCHME 1996).
- 1.2** Historic Scotland has determined its position with respect to the underwater heritage (Historic Scotland 1999) and with Royal Assent to the National Heritage Act the remit of English Heritage (EH) has been extended out to the 12-mile territorial limit around England. This thereby allows management of the underwater archaeological resource throughout British waters. The release of EH initial policy paper *Taking to the water* (Roberts and Trow 2002) and ClfA's *Identifying skills needs* survey has acknowledged that, in the short to medium term, there may be a demand for professional maritime archaeologists that outweighs supply. This has been acknowledged by the Department for Culture, Media and Sport, the Welsh Assembly Government, the Scottish Executive, and the Department of Environment, Northern Ireland in the consultation document *Protecting our Marine Historic Environment* (2005).

- 1.3 In the light of these changes, it is appropriate to issue guidance on the recording and reconstruction of nautical finds and the appointment of a suitably qualified nautical specialist in any archaeological excavation where nautical finds are encountered.
- 1.4 This guidance seeks to define best practice for the execution of recording and reconstruction of nautical finds, in line with the by-laws of ClfA and in particular the *Code of conduct*. It seeks to expand and explain general definitions in the *Code* for the practice of fieldwork and reporting.
- 1.5 The Standard and guidance applies to all types of nautical archaeological recording and reconstruction whether generated by academic research, by local interest, through the planning process, by management proposals or by any other proposals which may affect the archaeological resource within a specified area.
- 1.6 In addition, the guidance seeks to amplify directions given in appropriate national planning policy guidelines (see Appendix 6), and be compatible with current guidelines issued by regulatory authorities.
- 1.7 This document provides guidance for work carried out within the UK, Channel Islands and Isle of Man. Although general guidance is given, this document cannot be exhaustive, particularly in its treatment of legislative issues. Archaeologists must ensure they are familiar with the specific legislation and common law pertinent to the area in which they are working. Archaeologists, commissioning bodies and others may find it useful to consult the relevant documents listed and can obtain further guidance from the appropriate advisory bodies (see Appendix 7).

## 2 Principles: The Code of conduct and other regulations of ClfA

- 2.1 An archaeologist recording and reconstructing nautical finds must adhere to the five major principles enshrined in the ClfA's *Code of conduct* and the rules governing these principles:
  1. A member shall adhere to high standards of ethical and responsible behaviour in the conduct of archaeological affairs.
  2. A member has a responsibility for the conservation of the historic environment.
  3. A member shall conduct his or her work in such a way that reliable information about the past may be acquired, and shall ensure that the results be properly recorded.
  4. A member has responsibility for making available the results of archaeological work with reasonable dispatch.
  5. A member shall recognise the aspirations of employees, colleagues and helpers with regard to all matters relating to employment, including career development, health and safety, terms and conditions of employment and equality of opportunity.
- 2.2 This guidance on nautical archaeological recording and reconstruction should be read in conjunction with other relevant ClfA Standards and guidance, as well as those published by other heritage agencies, for example:

- a. AHDS, 2002 *Digital Archives from Excavation and Fieldwork: Guide to Good*

*Practice*

- b. ClfA *Standard and guidance for field evaluation*
- c. ClfA *Standard and guidance for excavation*
- d. ClfA *Standard and guidance for the collection, documentation, conservation and research of archaeological materials*
- e. ClfA Paper No. 4, *The marine archaeological resource*
- f. English Heritage, 2004 *Dendrochronology: Guidance on producing and interpreting dendrochronological dates*
- g. English Heritage, 1996 *Waterlogged wood: guidelines on the recording, sampling, conservation and curation of waterlogged wood*
- h. UK Institute of Conservation, Archaeological section, and RESCUE, 1988 *First aid for finds*.

- 2.3** The recording and reconstruction of nautical archaeological remains will satisfy the stated aims of the project and comply with the *Code of conduct* and other relevant regulations of ClfA.

### **3 Procedures**

- 3.1** Within the planning framework in the UK, Channel Islands and Isle of Man the preservation of archaeological deposits is a material consideration in the planning process.
- 3.2** Certain developments fall within special regulations or statute differing from the standard planning process (eg some projects initiated by public utilities, statutory undertakers, Crown Commissioners, Ministry of Defence, etc). Certain of these organisations subscribe to codes of practice (eg water companies) or agreements (formal or informal) with the lead national archaeological bodies to take into consideration the effects of development proposals on the archaeological resource.
- 3.3** Environmental Impact Assessment (EIA) applies to projects potentially having significant environmental effect (as defined in EC Directive 85/337, and as implemented in the UK via the various Statutory Instruments, etc). It requires a systematic analysis of such effects before a decision to permit the project is taken. Developers are required to provide information for the deciding agency to consider in the decision-making process, and further give bodies with relevant environmental responsibilities an opportunity to comment before consent is given. EIA is mandatory in relation to certain projects, and may be extended to others. Appraisal and desk-based assessments of the archaeological element must form part of EIA and field evaluation may also be required (see Appendix 1 for definitions).
- 3.4** In EIA projects work is usually initiated by the developers or through their advisors, rather than the local planning authority.
- 3.5** In a research context, the area for potential investigation or study will have been identified and selected by an archaeologist based on specific aspects or themes relating

to their own defined research interests. This could include work undertaken through universities, central government agencies, local authorities, museums, independent trusts, private companies, groups or individuals.

- 3.6** Management proposals by private landowners or others may also result in nautical recording and reconstruction, to obtain information in order to enhance or protect the environmental or archaeological resource.
- 3.7** However it arises, an archaeologist should only undertake nautical recording and reconstruction that is governed by a written specification or project design (see Appendices 2 and 3) agreed by all relevant parties, as this is the tool against which performance, fitness for purpose, and hence achievement of standards, can be measured.
- 3.8** The specification or project design is therefore of critical importance and it is a requirement to seek and use nautical specialist advice when writing a brief which includes or possibly could include nautical finds.

#### **4 Briefs/project outlines, specifications and project designs**

- 4.1** The planning and preparation stages of any project are key to its success. This section addresses the initial design stages of a nautical recording and reconstruction project. The following statements assume that briefs (or project outlines in Scotland) and specifications are issued by those requiring the work done (planning archaeologist, curators, developers or their agents, among others). Project designs can either be a response to the brief/project outline or specification, or be initiated, for example as part of a research proposal. This may be summarised as follows.
- 4.2** A brief (or project outline in Scotland) is an outline of the circumstances to be addressed, with indication of the scope of works that will be required. It does not provide sufficient detail to form the basis for a measurable standard, but it could form the basis for a specification or a project design.
- 4.3** For nautical recording and reconstruction within the planning framework, the brief/project outline will usually be prepared by the planning archaeologist or curator in consultation with a nautical specialist and issued by the commissioning body, the developers or their agents to the potential contractor(s). The brief/project outline or specification may be prepared by the applicants or their agents, but it is essential that the planning archaeologist has agreed the proposals after consultation with a nautical specialist.
- 4.4** Briefs/project outlines, specifications and project designs must be prepared by suitably qualified and experienced persons, utilising specialist nautical advice. The person writing the brief should have an understanding of the nature and complexity of the site, should comprehend the purpose of the proposed work and should be able to assess the potential impact of the work upon it.
- 4.5** A specification sets out a schedule of works in sufficient detail for it to be quantifiable, implemented and monitored (ACAO 1993 Appendix D 15). It should be sufficient to form the basis for a measurable standard.
- 4.6** A project design also sets out a schedule of works in sufficient detail to be quantifiable,

implemented and monitored, and therefore also forms the basis for a measurable standard. However, a project design may include additional information that covers contractual details such as staffing levels or cost relevant to the commissioning but not necessarily the monitoring body. Project designs are normally produced by those undertaking the work and can be a response to the brief/project outline or specification, or be initiated as part of a research or management proposal independent of the planning framework (see Appendix 6).

- 4.7** In the case of EIA, the brief/project outline or specification will usually be prepared by the developers or their agents, discussed with the planning archaeologist/curator and issued to tenderers. This may also apply to management proposals.
- 4.8** Proposals for nautical recording and reconstruction not prompted by a threat to the archaeological resource will normally take the form of a project design, prepared by the researching archaeologist, and agreed with any commissioning body. If there is no external commissioner there must nevertheless be a written design so that the validity of any models or questions posed can be properly assessed, or so that any legal requirements (eg related to Designated Historic Wrecks or Scheduled Ancient Monuments) can be properly applied.
- 4.9** Where a brief or specification states that the archaeologist shall base their investigation on drawings or data supplied by others, for example geophysical survey data, historical plans or documentation relating to a vessel build, the archaeologist shall be provided with accurate copies of these drawings or data and assess their fitness for purpose prior to finalising a project design or contractual arrangement.
- 4.10** When preparing a specification or project design an archaeologist must give full consideration to all available practicable methods of nautical recording and/or reconstruction and decide upon the most appropriate and best available to meet the purpose of the work, seeking specialist advice where necessary. The specification or project design must be expressed in sufficiently robust terms and in sufficient detail to withstand challenges on archaeological or legal grounds. The project design should include an agreed collection and disposal strategy for artefacts and ecofacts, and agree the deposition and curation of the archaeological archive.
- 4.11** In planning and execution of destructive investigations where there is no immediate threat to the archaeological resource, the archaeologist must ensure that the investigation causes the minimum damage or destruction necessary to meet the stated research aims of the project.
- 4.12** It follows that some nautical recording and reconstruction projects may be properly terminated (with due regard for the future stability of the resource) before the project design is fulfilled when some significant criterion is met, for example recognition of such an overriding constraint as to render proposed development impractical. In such circumstances the archaeologist should inform the relevant bodies and seek to ensure that appropriate management measures are taken.
- 4.13** The specification or project design must be suited to the project under consideration; any methods advocated must reflect the type of remains and associated buried deposits which are likely to occur. They should not become inflexible irrespective of site and standard templates should therefore be used with care. Other considerations include 'reasonableness' in relation to scale of proposal, value for money, etc.



- 4.14** Any archaeologist preparing a specification or project design must examine all appropriate sources and be fully apprised of and abide by relevant legislation.
- 4.15** When preparing a specification or project design consideration should be given to the need to include appropriate contingency arrangements with respect to field procedures, and thus to resourcing. In many cases it may prove impossible to conserve the resource and/or to meet the project objectives without a reasonable degree of flexibility to apply professional judgement in the field. Commissioners and curators should be advised that overly rigid requirements might unavoidably result in a failure to meet archaeological and non-archaeological objectives. Contingency arrangements should not be open-ended but should be properly specified in their own right as a function of prior knowledge of the site, the physical context of the site and the primary objectives of the field evaluation. Contractors must be in a position to justify in detail the eventual implementation of contingency arrangements. The principle of BATNEEC (best available technique not entailing excessive cost), as enshrined in Environment Agency guidance, should be used.
- 4.16** A specification or project design should contain, as a minimum, the following elements:
- a. non-technical summary
  - b. site location (including map) and descriptions
  - c. context of the project
  - d. archaeological and historical background
  - e. general and specific aims of fieldwork
  - f. legislative requirements
  - g. methodology – to include recording strategy and where applicable reconstruction philosophy
  - h. collection and disposal policy for artefacts and ecofacts
  - i. arrangements for immediate and long-term conservation of artefacts
  - j. post fieldwork methodology and where applicable reconstruction philosophy
  - k. report and record drawing preparation
  - l. publication and dissemination proposals
  - m. copyright
  - n. archive deposition
  - o. timetable
  - p. staffing
  - q. health and safety
  - r. monitoring procedures
  - s. contingency arrangements (if applicable)
- 4.17** An archaeologist responding to a tender that includes a brief/project outline may refer to these elements in the project design if they are set out in sufficient detail.
- 4.18** In all cases, the local archaeological curator (and where appropriate, the national agency curator) must be informed of fieldwork in his or her area. Unless there are overriding reasons against it, local archaeological societies and the like should also be informed of fieldwork.
- 4.19** The specification or project design should identify relevant data standards for record organisation and content that will be used for the information recording systems employed by the project.

## 5 Fieldwork

- 5.1 The specification or project design must be agreed by all relevant parties before work commences. All work must conform to the agreed specification or project design. Any variations must be agreed in writing by all relevant parties.
- 5.2 Sufficient and appropriate resources (staff, equipment, accommodation, etc) must be used to enable the project to be completed successfully, within the timetable, to an acceptable standard, and comply with all statutory requirements. Any contingency elements must be clearly identified and justified. It is the role of the archaeologist undertaking the work to define appropriate staff levels.
- 5.3 All techniques used must comply with relevant legislation and be demonstrably fit for the defined purpose(s).
- 5.4 All staff, including subcontractors, must be suitably qualified and experienced for their project roles, and employed in line with relevant legislation and ClfA regulations (see Appendix 6). The site director and/or manager should preferably be an accredited member of ClfA. In Northern Ireland if excavation is involved a qualified archaeologist must obtain a licence to undertake work from the Environment and Heritage Service.
- 5.5 All staff, including subcontractors, must be fully briefed and aware of the work required under the specification, and must understand the aims and methodologies of the project.
- 5.6 All equipment must be suitable for its designated purpose and in sound condition, complying with Health and Safety Executive regulations and recommendations. It should be noted that some items of equipment are subject to specific statutory controls (diving equipment in particular is subject to the Diving Operations at Work Regulations – see Appendix 6).
- 5.7 Unless undertaken as part of a process of controlled excavation, nautical recording and reconstruction should not normally result in the loss of historic fabric, including surfaces, of the vessel. Where the removal of items forms part of the brief/project outline, specification or the project design, the standards and approach to fieldwork, conservation, curation, storage, reporting and ownership are those defined in ClfA's *Standard and guidance for archaeological excavations*. Project collection and discard policies, strategies and techniques must be fit for the defined purpose, and understood by all staff and subcontractors (see also ClfA *Standard and guidance for the collection, documentation, conservation and research of archaeological materials*).
- 5.8 Full and proper records (written, graphic, electronic, and photographic as appropriate) should be made for all work, using pro forma record forms and sheets as applicable. Digital records created as part of the project should comply with specified data standards. An archaeologist must ensure that digital information, paper and photographic records should be stored in a secure and appropriate environment, and be regularly copied or backed up, and copies stored in a separate location. See also section on recording below.
- 5.9 Before new records are prepared, existing sources of information should be found and examined for their adequacy. Such information may be found in surveys, drawings, photographs, published and unpublished accounts and descriptions. For nautical remains from a historically documented period, design and constructional drawings or written descriptions might exist. These can be used as a guide in the pre-fieldwork planning stage

and in the post-fieldwork assessment. They should be used with caution as rarely do such drawings or descriptions record the actual construction of or modifications to a vessel and therefore are not a true reflection of the vessel at time of loss or abandonment.

- 5.10** Health and Safety regulations and requirements cannot be ignored no matter how imperative the need to record archaeological information; hence Health and Safety will take priority over archaeological matters. All archaeologists undertaking fieldwork must do so under a defined Health and Safety Policy. Archaeologists undertaking fieldwork must observe safe working practices; the Health and Safety arrangements must be agreed and understood by all relevant parties before work commences. Risk assessments must be carried out and documented for every project, in accordance with the Management of Health and Safety at Work Regulations. Archaeologists should determine whether field projects are covered by Construction (Design and Management) Regulations and ensure that they meet all requirements under the regulations. In addition, they must liaise closely with the principal contractor and comply with specified site rules. Archaeologists are advised to note the onerous responsibilities of the role of a planning supervisor. For further guidance refer to the bibliography (Appendix 6).
- 5.11** The archaeologist undertaking nautical recording and reconstruction must ensure that he or she has adequate insurance policies, public and employer's liability cover, and some relevant form of civil liability indemnity or professional liability cover.

## **6 Post-fieldwork analyses and reports**

- 6.1** All assessment and analytical work must be carried out by suitably qualified and experienced staff, who must be apprised of the project design before commencing work. Where nautical archaeological remains are expected or have been encountered the staff should include a nautical archaeological specialist.
- 6.2** The level of recording and analysis of artefacts and ecofacts should be appropriate to the aims and purpose of the project.
- 6.3** All data generated as a result of assessment and/or analysis should be included in the project archive.
- 6.4** All reports must address the aims and purposes of the project design and/or specification.
- 6.5** All reports should be written in a clear, concise and logical style and technical terms should be explained. Consideration should be given during the preparation of the report to the requirements of public inquiries or courts of law if appropriate.
- 6.6** As a minimum, a site summary or data structure report (see Appendix 1 and Appendix 6) should be submitted to the appropriate Historic Environment Record, the National Archaeological Record and, where appropriate, the central government conservation organisation within six months of completion of the fieldwork or earlier, as may be specified by contractual or grant conditions. In Scotland, a summary interim report must be published in an annual, regional or national digest. For the UK, Channel Islands and Isle of Man as a whole, it is considered that fuller publication of the majority of projects is required.
- 6.7** In Scotland the primary product of fieldwork is the data structure report (see Appendix

1) with a costed assessment or project design for further fieldwork and/or post-excavation and publication. This report does not have a precise equivalent elsewhere in the UK (see Appendix 1). Copies of the data structure report should be lodged with the local archaeological curator.

**6.8** Reports should not include recommendations unless required by the planning archaeologist or the specification and/or project design. However, it would be reasonable for a client to seek independently the opinion of archaeological contractors. Contractors should have regard as to whether the provision of such advice is a contractual requirement and the legal implications thereof.

**6.9** Reports should contain as a minimum:

- a. non-technical summary
- b. introductory statements
- c. aims and purpose of the evaluation
- d. methodology including reconstruction philosophy where applicable
- e. an objective summary statement of results
- f. conclusion, including a confidence rating
- g. supporting illustrations at appropriate scales
- h. supporting data, tabulated or in appendices, including as a minimum a basic quantification of all artefacts and ecofacts (number and weight), and structural data
- i. index to and location of archive
- j. references

## **7 Monitoring**

**7.1** All nautical archaeological work must be monitored by the archaeological organisation undertaking the project and if appropriate by the national conservation agencies, planning archaeologist and commissioning body, or their nominated representatives. The guidance below is directed in general at monitors from outside the organisation undertaking the work, but many of the points apply equally to internal monitors or managers.

**7.2** A nautical archaeological monitor should be suitably experienced and qualified, or have access to appropriate specialist nautical archaeological advice.

**7.3** Monitoring must be undertaken against the written specification and/or project design.

**7.4** Nautical archaeological monitors, where they are not representing the commissioning body, should bear in mind the need for flexibility, within the stated parameters, in contractual matters such as staff numbers, budgets or timetable.

- 7.5 All monitoring visits must be documented, and agreed by each party.
- 7.6 Non-compliance with the agreed specification or project design must be pointed out by the monitor to the archaeologist undertaking the work, and their client if appropriate, at the earliest opportunity.
- 7.7 Monitors should be aware of their professional duties regarding ClfA Standards and guidance: field evaluation, Health and Safety, and in particular advising against and reporting on bad and unsafe practice.
- 7.8 All nautical archaeological monitoring arrangements must be agreed at the outset of the project; the archaeologist undertaking fieldwork must inform the planning archaeologist or other monitor of the commencement of work with reasonable notice.
- 7.9 Although monitors may choose to visit at any time, they should normally inform the archaeologist undertaking the work of any intended visits in advance. Monitors must respect reasonable requests from the client commissioning the work to attend only at prearranged times and, if necessary, in the company of the client's representative.
- 7.10 Any costs for monitoring to be charged by the planning archaeologist or other monitor must be agreed in writing at the outset of the project.

## **8 Archives, ownership and deposition**

- 8.1 The requirements for archive preparation and deposition must be addressed at the outset of the project.
- 8.2 Unless undertaken as part of a process of controlled excavation, nautical recording and reconstruction should not normally involve the removal of artefacts from the site. Where this does take place, ClfA's *Standard and guidance for archaeological excavations* relating to artefacts should be referred to and the recipient museum or other repository contacted at the project planning stage. Special arrangements for the deposition of the site archive should be detailed in the specification and/or the project design.
- 8.3 The rules of ownership applicable to material which has come from a vessel (ie all those classified as 'wreck') are dealt with under the Merchant Shipping Act 1995 (see Appendix 6). In cases of wreck material, the Receiver of Wreck in the Maritime and Coastguard Agency should be contacted.

## **9 Other considerations**

- 9.1 It is advisable that nautical recording and reconstruction projects are governed by a written contract or agreement, to which the specification of project design may be attached. Such contracts or agreements should include reference to the defined area of study outlined on a map; to the specification or project design; to conditions for access; programme, methods, timetable for payment, copyright and signed and dated by all parties together with other intellectual property arrangements.
- 9.2 It is normal practice for both the copyright and ownership of the paper and digital archive from archaeological work to rest with the originating body (the archaeological organisation undertaking the work). The originating body deposits the material with the recipient museum or repository on completion of the contracted works, and normally

transfers title and/or licenses the use of the records at this stage. These arrangements may be varied by contract, and for the avoidance of doubt it is advisable to include statements on ownership and copyright in a written contract agreement.

- 9.3** Material copies or cited reports should be duly acknowledged, and all copyright conditions (such as those for Ordnance Survey maps, the National Grid and charts of the UK Hydrographic Office) observed.
- 9.4** All matters relating to publicity must be agreed at the outset of the project between the commissioning body and the archaeological organisation or individual undertaking the project.
- 9.5** The archaeologist undertaking the work must respect the requirements of the client or commissioning body over confidentiality, but the archaeologist must emphasise their professional obligation to make the results of archaeological work available to the wider community within a reasonable time.

## **10 Recording**

- 10.1** The primary aim of recording nautical archaeological remains is to complete an accurate as-found record of the vessel or parts thereof so they can be properly interpreted by a nautical specialist. The methodology employed to record a given find/site will vary with its state of preservation, the complexity and importance of the site and its burial environment, but should be a visual record (scale drawings, sketches, photographs, point data). Survey drawings produced at a scale less than 1:1 should be annotated with or accompanied by a table of 1:1 measurements. Due to the inherent inaccuracies in lifting measurements off a scale drawing it is generally not acceptable practice to rely only on such drawings for detailed interpretation of nautical archaeological remains.
- 10.2** There are two aspects to understanding a vessel; its construction and its 3D shape otherwise known as hull form. Both are required to gain a full understanding of any nautical find or parts thereof.
- 10.3** The level of documentation required should be considered. For recording, three levels of documentation are put forward.

### **Level 1**

Basic overall dimensions and record of hull form with limited photographic coverage or sketching. The nature and relationship of fittings and ancillary components should be noted. This record will allow for an informed interpretation of the vessel remains, or parts thereof.

### **Level 2**

Basic overall dimensions with a record of hull form, scantling, fittings and fastenings, accompanied by an extensive photographic record with scale drawings of significant features, fittings and/or ancillary components. This record will allow correct interpretation of the vessel or parts thereof and may allow a simple reconstruction of the vessel or part thereof.

### **Level 3**

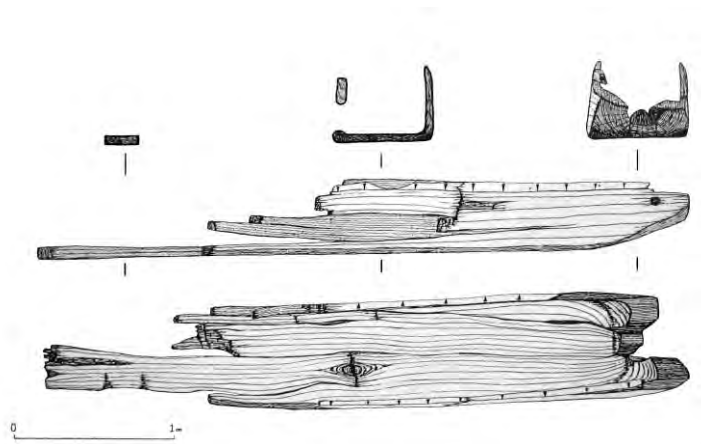
A complete scaled survey including hull form and photographic record of the remains of the whole vessel, recording all significant features, fittings and ancillary components. This record should contain data on the size, shape, material and condition of all elements of the vessels structure, fittings and ancillary components including a record of constructional features, all

fastenings (size and type), tool marks (type and size), shipwrights' marks, carpentry features (joints, bevels, chamfers), wood features, (grain, sapwood, knots, pins, bark), wear and compression marks, means of propulsion and steering, fittings (internal and external) and outer and internal coatings (paint, paying, caulking). Where sufficient remains are available this record should be to a standard to enable a reliable reconstruction leading to a full interpretation of the vessel.

**10.4** The level of record should be commensurate with the level of significance of the site and vessel.

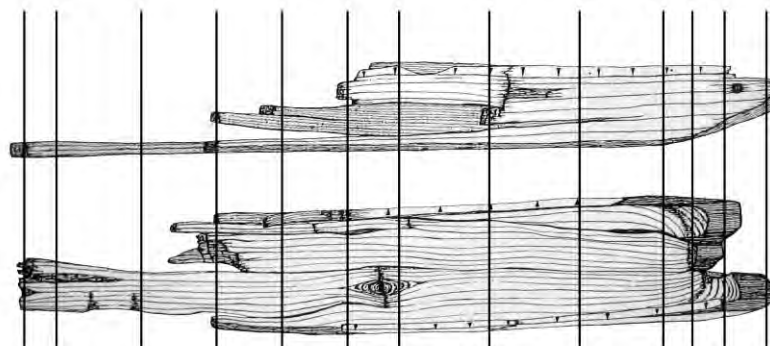
## 11 Hull form recording

**11.1** The shape of the vessel is represented in its simplest form by a scale plan with longitudinal and transverse sections supported by detail at a larger scale (see Fig. 01).



*Fig. 01*

**11.2** Transverse sections are required to record the 3D shape of the vessel. These should be positioned and recorded along the full length of the vessel, with more where there is a greater change in shape (see Fig. 02).



*Fig. 02*

**11.3** It is acceptable to record other features such as stratigraphy, diagnostic timbers, constructional features, frames and fastening positions in plans and sections but the outer face of the vessel, and parts thereof, should always be highlighted as it is the outer face of a timber (moulded face) or of the vessel that defines the hull form of the original vessel.

## **12 Reconstruction methodology**

**12.1** Depending on its totality, the full original shape, structure, propulsion and steering of the remains being investigated might not always be able to be reconstructed. However, in order to achieve the primary research aim, an understanding of the vessel's **hull form and construction**, an attempt at reconstruction should be considered.

**12.2** If reconstruction is to be attempted, the following sequence is recommended:

- documentation of each individual constructional feature
- building a physical scale model of the coherent but incomplete vessel formed by scaled versions of each timber
- use of valid data and reconstruction techniques, as laid out in the reconstruction philosophy, to reconstruct the original full form of the vessel at the chosen scale
- reconstruction of the full structure, propulsion and steering, in so far as is possible, of the scale model

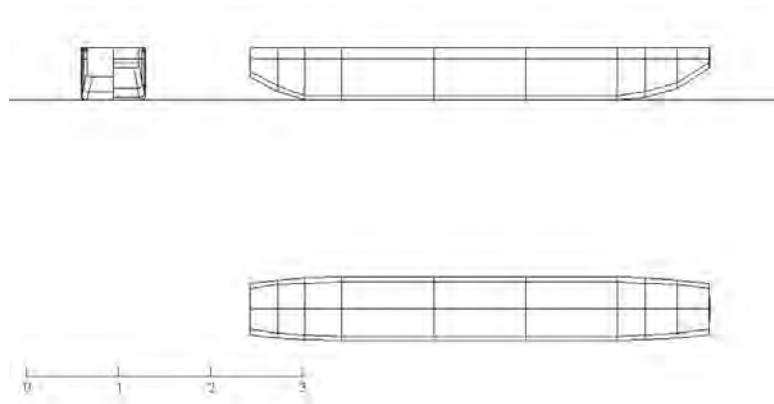
**12.3** It is accepted that full-scale reconstruction of a vessel will give the best results. This will be outside the area of most projects due to limitations on facilities and available finances. A full-scale reconstruction is colloquially known as a replica.

**12.4** If full-scale reconstruction is not viable then a scale model or computer model can be built. Again, care must be taken to ensure that certain archaeological controls are maintained and that the reconstruction, scaling and modelling process is fully transparent.

**12.5** It might not always be possible or warranted to build a physical model at scale. It is valid to reconstruct a vessel on paper or digitally.

**12.6** Peer review should be considered at each stage of reconstruction. Reconstructions are generally presented as drawings and usually accompanied by a series of naval architectural drawings called a sheer plan or lines plan (see Fig. 03).





*Fig. 03*

These are devices used to represent the three-dimensional form of a vessel in a two-dimensional arrangement of lines called water (horizontal plane), buttock (vertical plane) and diagonal (at an angle to the vertical) lines. All the lines and sections can be combined into a body plan, a naval architectural device. Lines plans/drawings aid the graphical interpretation of a vessel's hull-form but can be used to generate computer-derived estimates of a vessel's performance.

**12.7** A general criterion for naval architectural lines drawings is that they are fair, for example the lines run smoothly from one to the other in clean sweeping curves without any anomalies. This is not a criterion for an archaeological lines drawing. Such anomalies or irregularities might be actual features that help explain the archaeological process and inform reconstruction processes. If this is the case, then such anomalies must be explained.

**12.8** However, the drawings do have to be 'fair' in the sense that where the lines (buttock, waterlines and diagonals) intersect in one view they must do so in the same position in the accompanying view. If this is not the case the point of intersection is a false statement and not 3D reality. There is, however, always some unfairness in hand drawings. It is by these criteria that the lines planes/drawings are produced.

### **13 Reconstructing hull form**

**13.1** To understand a vessel's hull form (shape) its 3D shape must be recorded. This is done by recording transverse sections that can be combined into a body plan.

**13.2** The production of a body plan is reliant on the survival of a significant amount of hull timbers or identification of timbers from a known position. It is usually the case that not all the parts of a vessel survive. Indeed, it is common that only the bottom part of a vessel survives, from the turn of the bilge up. Rarely does the total side of a vessel up to and including the sheer strake survive. In other cases, parts of the bows or stern might also be missing.

**13.3** The less of a vessel that survives the more important the recording of single attributes becomes. The variation in widths of a plank or angle of the bevel of the top or bottom of

a plank can allow the shape of the hull in their locality to be interpreted and possibly projected. The same is true for variations in the length of each face of steel plates and the angle at which they meet.

- 13.4** The extent of the surviving hull remains must be considered when reconstructing a vessel. The archaeologist should consider the extent of archaeological remains and whether they are sufficient and meaningful enough to allow for full and proper reconstruction.
- 13.5** Due to the nature of nautical archaeological remains longitudinal symmetry is often considered theoretically justifiable, though caution should always be expressed prior to late-19th-century industrial standardisation or when recording vernacular/ethnographic vessels.

## **14 Computer-aided analysis**

- 14.1** The production of a body plan can allow a table of offsets to be produced. The offsets can then be loaded directly into a computer-based hull-design programme, thus allowing computer-aided analysis of the hull form.
- 14.2** The use of a computer hull-dynamics programme to analyse nautical archaeological remains, as opposed to long-hand calculations, is now acceptable.
- 14.3** The use of computer software for analysis of archaeological remains has proved successful but must be used appropriately. It allows calculations, the development of coefficients and varied analysis to be done quickly. It is not, however, a short cut. A high level of recording has to be maintained to make the computer-based work relevant. Care should be taken not to allow software to drive recording, reconstruction and research.
- 14.4** Caution must be exercised in the use of such computer software and the results must always be questioned archaeologically. It is too easy on a computer to redesign a vessel based on a body plan from first reconstruction. Archaeological control over the form of the final product must always be maintained.

## **15 Reliability and validity of reconstructions**

- 15.1** An archaeologist producing a reconstruction must question its reliability.
- 15.2** The archaeologist overseeing reconstruction must state clearly the level of archaeological evidence at hand when attempting a reconstruction. This will depend on the source material, the variability of which can be considerable and must be considered in each individual case.
- 15.3** The validity of each reconstruction must be stated. The validity of an individual reconstruction will depend on the 'archaeological controls' used to attain that reconstruction. The controls have to be taken from the archaeological source and not elsewhere. To have full confidence in a reconstruction the archaeological controls must fit back into the reconstruction or lines drawings with minimum or justifiable alterations (shrinkage values or distortion).
- 15.4** The validity and reliability of a reconstruction will also depend on the reconstruction philosophy. A statement of philosophy should accompany the reconstruction. This will

clearly state the use of comparative data, the most reliable being of the same building tradition and of contemporary or earlier date.

## **16 Inter-reliability of reconstructions**

- 16.1** The viability of each reconstruction must be considered, as well as the viability of comparing and contrasting reconstructions based on varying levels of evidence and confidence in using that evidence.
- 16.2** Hull analysis should at least allow the development of hull-form coefficients and ratios that will allow the hull to be compared and interpreted by others. A descriptive use of coefficients and ratios as parameters to describe the overall shape of the vessel is given in Annex 1.
- 16.3** A standard form of interpretation is required to be kept throughout the reconstruction, an important aspect when comparing vessels of different hull forms, but more importantly of varying levels of survivability.

## **17 Historical significance**

- 17.1** Whilst the documentation of nautical finds is important, it is less significant if not accompanied by a study of the historical period relative to the find. Any nautical archaeological report or study should be accompanied by a relevant survey of the history of the vessel under consideration.
- 17.2** Themes for consideration should include:
- political history
  - economic history
  - social history
  - technological development

## **18 Research**

- 18.1** The investigation of nautical archaeological remains and presentation of the accompanying descriptive work is not an end in itself but forms an essential database when considering overall patterns of usage and construction.
- 18.2** The data sets derived from individual or a collection of vessels can be used in research agenda looking at hull form, material culture, construction, construction sequences, performance, cultural variations in construction, dendrochronology and environmental sampling. This is not an exhaustive list.

## **19 Aspects of dendrochronology**

- 19.1** Dendrochronology has the capability to date a site and/or vessel. All dendrochronology should be carried out in accordance with the relative guidelines by a qualified dendrochronologist. However, caution must be exercised in what part of a vessel is

actually being dated and what it will mean.

**19.2** Primary structure will give the most confident date for the building of the vessel. Secondary structure can only confidently give a date for usage.

**19.3** Dendrochronological analysis can also provenance the timbers used within a vessel. This can say where a vessel might have been made but more probably where the timber came from and therefore inform us about timber resources and their management. Timbers identified as repairs might indicate where the vessel had travelled, and also the time of repair.

**19.4** The dendrochronology of a nautical find can also help to characterise timber usage and forest environment (English Heritage 2004).

## **20 Nautical archaeological specific environmental sampling**

**20.1** Sampling strategies should be developed in accordance with the relative and appropriate archaeological guidelines.

**20.2** The sampling strategy should take into account previous work on the site.

**20.3** Priority should be given to an understanding of:

- a. ship-borne life
  - i. diet
  - ii. ship-borne diseases
- b. cargos
  - i. provenance
  - ii. trade routes
- c. previous uses
- d. repairs and rebuilds
- e. identification of sea routes

**20.4** A high priority should also be given to an understanding of the wrecking process and post-depositional history of the vessel.

## **ANNEX 1:**

### **Descriptive use of coefficients**

Coefficients of form are dimensionless descriptions of hull form that allow comparison with other vessels independent of differences in size. The use of form coefficients as an analytical tool has been in use for at least two decades (McGrail 1987, 193–203). The data is relative in most cases and it is important to calculate the data so it is at hand for any further studies. The nature of the archaeological find must also be considered. Obvious damage, shrinkage and distortions due to drying must be taken into account.

#### **Slenderness coefficient (CS)**

McGrail (1987, 194, 197) defines this as what is commonly known as the length to breadth ratio (L/B) as discussed by McKee (1983, 79, 81). It is a definition of the overall narrowness of the boat, a narrow boat having a coefficient 3.75 or higher. A high slenderness coefficient, 5 or more, is also indicative of high speed potential (Rawson and Tupper 1976, 572). This last point is not necessarily applicable to all vessels, some of which are man powered. A low slenderness coefficient is not indicative of directional stability. Directional stability is also reliant on the depth and area of the immersed body.

#### **Beam/draught coefficient (B/D)**

This is a definition of the general volume of the vessel. Boats with a low B/D can be considered as deep (McKee 1983), or volume dominated (McGrail 1976). A high B/D means the boat is shallow and not volume dominated. Deep boats are good for carrying bulky cargos, and on the whole have good transverse stability and relative manoeuvrability.

#### **Block coefficient (CB)**

This is the ratio of the immersed volume of the hull to that of a rectangular block whose sides are equal to the extreme breadth, the mean draught and the length of the hull. The larger the value the greater the area of the hull that occupies the rectangular block. It can therefore be used to compare general hull shapes, eg a large oil tanker would have a CB of 0.88 and a racing yacht one of 0.34 (Barnaby 1969, 19). The oil tanker, which is slab-sided for most of its length, makes more use of the area available within the block than the racing yacht does, which has fine lines fore and aft, and is not slab-sided. It is also generally accepted that a low value CB, less than 0.65, indicates good speed potential. This is relative to the size of the vessel. The wave-making resistance of a displacement vessel means longer vessels naturally have a higher speed potential despite their shape (Marchaj 1964, 248).

#### **Prismatic coefficient (CP)**

The CP is the ratio of the immersed volume of the area of the midship section multiplied by the waterline length. It gives an impression of how the hull form fills the outline formed by its maximum sectional area projected over its length. In general it exceeds 0.55 (Barnaby 1969, 25).

#### **Coefficient of fineness of water plane (CW)**

This is the ratio between the area of the water plane (waterline length x breadth) and a rectangle formed by the waterline length and breadth. A figure of 0.7 or less indicates a fine vessel whilst one of 0.9 indicates a slab-sided vessel. The CW of most pre-modern vessels is low compared to a modern-day equivalent (McGrail 1998, 197). This is due to the nature and restrictions of the method, material and level of technology used in the construction of such vessels.

### **Displacement volume**

This is the volume of water displaced by the immersed volume of the vessel. It is otherwise known as the vessel's displacement. It can be calculated as a true working displacement or for the sake of study be standardised at the point when the waterline is 60% of the total depth of the same vessel. It is an indicator of relative size and load-carrying potential.

### **Volumetric coefficient (CV)**

This is the ratio between displacement and the cube of the waterline length. It has been shown that a vessel with sufficiently low CV can be driven at relatively high speeds without excessive squat or wave making (McGrail 1987, 137). This is not planning. It is also a useful indicator between deep-draughted vessels and shallow-draughted vessels.

### **Seaworthiness coefficient**

A means by which the relative seaworthiness of a flat-bottomed vessel can be calculated. It is based on the premise that flared sides increase the transverse stability and buoyancy of a vessel the deeper she sits in the water. The effect of free-surface bilge water on transverse stability is lessened, as it is less than that of the flotation plane (McGrail 1987, 194). It is therefore important to the safety of a flat-bottomed vessel. The coefficient is a measurement of the flare of the sides of the vessel compared to the breadth of the bottom of the vessel.

### **Midship section coefficient**

The ratio of the midship section area to the area of a rectangle whose sides are equal to maximum breadth and draught. It usually exceeds 0.85 for ships other than yachts, the fin keels of which distort the overall rectangle. A low value, less than 0.85, indicates good speed potential (McGrail 1987, 197).

### **Log conversion percentage**

A percentage of timber removed from the parent log in construction and therefore a relative indication of that process. It is the volume of the parent log, minus the remaining timber, divided by the volume of the parent log, the result of which is multiplied by 10 (McGrail 1987, 311–12). A relatively high figure would suggest the log boat has excess timber whilst a lower percentage suggests a log boat has had more timber removed, thus suggesting that the wood conversion phase was more effective. This can be used for vessels other than log boats.

### **Load space coefficient**

A coefficient that compares the load-carrying volume of the log boat with the overall volume of the parent log. It is a measure of the overall efficiency of construction in terms of load carrying potential (McGrail 1987, 10)

### **Centre of buoyancy**

The fore and aft location where the buoyant forces acting on the hull have no rotational force. It is expressed here as a percentage between the fore- and aft-most extent of the waterline.

### **Centre of floatation**

The geometric centre of the area enclosed by the vessel's waterline. It is important for defining pitching motions.

### **Midsection coefficient**

A ratio of the largest immersed area of any section of the hull to the product of the waterline beam and draught.

### **Displacement to length coefficient**

A coefficient which gives an idea of the power/sail area required for the vessel and roughly how comfortable it would be. For sail power the following guide can be used:

Light multi-hulls 40–50  
Ultra-light racers 100–150  
Light racers 150–200  
Light cruisers & offshore racers 200–275  
Medium-weight cruisers 275–325  
Heavy cruisers 325–400

### *Power ratio*

Light displacement 75–200  
Medium displacement 200–300  
Heavy displacement 300–400

## **Annex 2:**

### **Glossary of terms**

This is a glossary of terms used in this document and is not an exhaustive glossary of nautical terms.

**Bilge** – usually defined as the change between the bottom part of a vessel and its side.

**Body plan** – the two-dimensional representation of the transverse sections through a vessel's hull.

**Buttock line** – a vertical longitudinal section of a vessel.

**Caulk / caulking / caulked** – a method of making planking and other things watertight by forcing caulking materials into the seam after assembly. Such material in the modern sense is long stranded cotton, though in other periods it could be made from any type of available organic matter – for example, horse hair, cattle hair and old rope, commonly termed oakum.

**Diagonal** – a longitudinal sectional line coming down at an angle from the centre line being neither horizontal nor vertical.

**Fastenings** – the bolts, nails, treenail, dowels, etc that hold the framing and planking together.

**Fairing** – when the buttock, waterlines and diagonals all correspond.

**Frame** – the transverse timbers that form the skeleton of the vessel. A frame can be a single timber or made up of component parts, ie floor, futtocks and top timbers.

**Lines / waterlines / buttock lines / diagonals** – the graphical representation of a vessel's hull form expressed as sectional cuts through the 3D shape of a vessel. Lines consist of waterlines, buttock lines and diagonals.

**Primary structure** – classed as the skeleton or main structure around which the rest of the vessel is built. This includes the keel, keelson, stem post, stern post and main frames or their equivalent.

**Secondary structure** – classed as the skin or secondary structure which is easily repaired, or can be transitory, such as hull planking/plating, fastenings, fittings and decking.

**Sheer** – the rise of the upper most edge of the side of a vessel.

**Sheer line** – the line of the top-most edge of the hull. This does not include the superstructure.

**Sheer plan** – the graphical representation of a vessel's side view, otherwise known elevation of a vessel.