



ENGLISH HERITAGE

MORPHE PPN 1

Management of Research Projects in the Historic Environment

PPN 1: Marine Archaeological Geophysical Survey

Version	Date	Comments
2.0	May 2011	2 nd edition with enhanced risk, stage and product details

Preface

MoRPHE Project Planning Notes (PPNs) form an integral part of the Management of Research in the Historic Environment (MoRPHE) Project Management Methodology issued by English Heritage in 2006.

They are intended to be presented together with, and read in conjunction with, the 'MoRPHE Project Managers Guide' which gives generic guidance on project management. The Project Managers Guide can be downloaded from the English Heritage website www.english-heritage.org.uk/morphe

1.0 Introduction

This Project Planning Note is intended to cover the archaeological & historical assessment, evaluation and recording of wreck sites through remote sensing and geophysical survey.

It is intended to be used in conjunction with draft guidelines on Assessing, Evaluating and Recording Wreck Sites (Wessex Archaeology 2005) and Marine Geophysics Data Acquisition, Processing and Interpretation Guidance Note (Plets et al forthcoming) prepared for English Heritage with support from the Aggregates Levy Sustainability Fund (ALSF).

2.0 Planning

This section provides readers with guidance on the planning of a project.

2.1 Setting Objectives

Whether driven by development-led archaeology or research, a principle aim of an artefact-based (i.e. wreck) site investigation is to define the character and extent of the site which may lead to judgement-led decisions as to its 'importance'.

Here, a staged-approach is advocated as an appropriate means of investigation as different investigative approaches are required for vessels of different age, construction and exhibiting differing levels of survival.

A general progression from desk based research followed by geophysical and/or diver-based survey is advocated, with targeted ground-truthing (e.g. diver investigations) drawing heavily on the information gathered in the desk based and geophysical work.

2.2 Useful techniques for estimating time and budget

Although mobilisation and de-mobilisation will need to be built into the overall budget, consideration must be given to the charter of an appropriately-sized vessel and the nature of the targets and seabed to be surveyed.

It is also recommended that stand-by time is addressed within the project budget to provide for adverse weather conditions; winds greater than Force 4 or 5 on the Beaufort Wind Scale, causing moderate to rough sea states, can make the collection of geophysical data with equipment such as a side scan sonar or multibeam sonar problematic. Work undertaken in these conditions is likely to result in lower quality data.

Following fieldwork, the amount of geophysical data collected will determine the amount of post-processing required (to be undertaken by a suitably qualified marine archaeological geophysicist or overseen by an appropriately qualified archaeologist), while proprietary software may need to be purchased to enable this.

2.3 Risks and their management

For geophysical data collection, it might be appropriate to engage the services of a suitable marine sub-contractor employing the equipment to specifications pre-determined for optimum archaeological data collection and interpretation.

However, general risk issues for project management are as follows;

- ◆ Equipment reliability
- ◆ Skills of project team
- ◆ Unexpected discoveries
- ◆ Volume of data acquired

SELECTING SURVEY VESSELS

For survey vessels themselves, it should be noted that that Small Vessels operating commercially under the British Flag or in British waters must comply with the Merchant Shipping Regulations or an [MCA Code of Practice](#). In practice, this will ensure sea-worthiness of the survey vessel. Although the risk of down-time caused by strong winds has been addressed above, bad visibility due to fog can prevent such survey operations as the risk of collision at sea increases.

2.4 Likely list of products or outcomes

In addition to the technical report that will usually accompany geophysical data acquisition and interpretation, consideration will have to be given to the presentation of interpreted data. This might be in the form of flat images suitable for publication or datasets suitable for inclusion into 3D proprietary software.

Two key archives from a project will be the survey data archive and the research data archive. The survey archive is the raw instrumental data, ordered, stored and with metadata. The research data archive is the additional products derived from analysis and interpretation of the survey data.

A list of typical products and likely project stages (see below) is given in Table 1.

2.5 Likely project stages

Execution refers to the stages during which the basic research is undertaken. For a geophysical survey, the following stages are of the most importance: (1) desk-based assessment, (2) fieldwork, (3) data processing and analysis, (4) assessment of data potential for further analysis. Each of these stages should conclude with a formal review examining their outcomes against the original project design in order to authorise the execution of the next stage.

Desk-based Assessment

All geophysical fieldwork should be preceded by a DBA that examines existing archaeological, geological and oceanographic archives or databases. Such DBA will avoid duplication of data and assesses the archaeological potential of the survey area. Although a DBA will already have been performed in order to write the project design, it is important that existing information is studied in great detail. Not only should information about the site be gathered, but papers and reports detailing geophysical investigations under similar conditions should be reviewed as these can help with the preparation of the field work.

Fieldwork

The data collection is the central and most important stage of most archaeological surveys. Before going out to survey a site, it is important to check that all required permissions have been obtained; this is usually the responsibility of the project manager. A survey design and plan should have been set out in the project design, outlining the justification for the geophysical methods and techniques that will be used and suggested survey lines/grids. This survey plan should be discussed with the helmsman beforehand and adjusted accordingly if necessary.

If the geophysical survey is part of a larger archaeological project, the survey should be timetabled well in advance of any planned destructive survey (e.g. underwater excavation) leaving sufficient time for geophysical data processing and interpretation. However, guided by findings made during the entire fieldwork stage of the project (destructive or non-destructive fieldwork) the geophysical team should be prepared to conduct another survey (more detailed or extending the area) at the end of the data collection stage if deemed useful or necessary. Depending on the site and history of surveying in the research area, three types of fieldwork can be discriminated: (a) pilot/test survey, (b) full survey and (c) additional site revisit. A guide to the choice of geophysical methods and detail on the actual fieldwork procedure for each technique can be found in the documents referred to in Section 1.

a) Pilot/test survey

Occasionally it can be beneficial and efficient to have a preliminary test survey to assess the suitability of the chosen geophysical techniques for the site evaluation. Such a pilot survey should not take longer than a day and is therefore mainly recommended for sites that are relatively easy to reach and close to a harbour/pontoon/dock from where the equipment and survey team can be boarded onto the research vessel. The preliminary information acquired should help the decision on which geophysical techniques will give the best results and aid the planning of the survey lines. This will avoid resources being deployed wastefully. The test survey should also give a clearer picture of the archaeological potential of an area before a decision of further data collection is made.

Depending on the resources available, a pilot survey can also be conducted as part of the initiation phase (or even before the start-up stage) instead of during the execution phase in order to investigate the potential of the project before committing oneself to project. Additionally, results from the pilot survey can be included in the project design.

b) Full survey

Once the survey lines, based on the results from the DBA and possible test survey, have been agreed on and all permissions have been acquired, the full survey can go ahead. Depending on the aims and objectives of the project, this survey may be a large or small area survey, a very detailed or more exploratory survey, using a single technique or a combination of methods. General and more detailed guidance for such geophysical surveying can be found in Part I, II and the attached appendices of these guidance notes. Key to any archaeological surveying is the ability to be flexible and recognise when the survey strategy should be adapted in order to provide better results.

c) Additional site revisit

In some cases, the results of the main field survey, possibly with the addition of ground-truthing results, may indicate that an additional survey may be desirable or necessary. This could either be a more detailed survey of parts of the previously surveyed area or an extension of the previously surveyed area. It is important to include the possibility of such surveys into the project design and accompanying budget.

Data processing and analysis

The processing and analysis of the raw data can either be done onboard the survey vessel or back onshore. The best option is often to perform crude processing and interpretation onboard, allowing the survey strategy to be adapted if necessary, leaving the more detailed and labour intensive data manipulation and analysis for a later stage, back onto dry land. For more details on specific processing and analysis procedures for each geophysical technique, please see the documents referred to in Section 1.

During the data processing and analysis it might become apparent that the geophysical data have further research potential, on top of the anticipated aims and objectives stated in the project design. In this case, this potential should be described in an updated project design or could be turned into a separate project proposal, depending on funds available. These results should be mentioned in the final project report and could result into a separate publication.

Final (digital) archiving and dissemination

A comprehensive guide to the archiving of geophysical data can be found in the ADS guide *Geophysical Data in Archaeology: a Guide to Good Practice* (Schmidt, 2002). Although aimed at terrestrial survey work, many of the concepts and ideas discussed in this guide can equally be applied to marine geophysical data for archaeological applications. The ADS guide is concerned with how to

preserve the large amount of data that is being produced by a geophysical survey in a digital format, so it is available for potential future reprocessing and re-interpretation, preventing duplication of existing information. All geophysical survey data are currently digital and are usually no longer accompanied by a paper print-out. Although the digital formats make processing and visualisation easier, they can be a challenge from an archival viewpoint; disks and other digital media eventually degrade and continuously changing technology mean that the data format or media may no longer be readable in the future. As such, the essence of digital archiving lies in short-term security measures (e.g. secure back-up, data refreshment, and data storage) coupled with long-term preservation strategies (e.g. migration from one medium and format to the next through changing technology) and thorough documentation (Schmidt, 2002).

In order for the archived material to be re-usable, the digital geophysical data needs to be fully documented and accompanied by technical documentation with, as a minimum, information on (Schmidt, 2002):

- ◆ Project background, methods and results
- ◆ Description of the survey's coordinate system
- ◆ Digital data documentation:
 - ◆ Survey documentation (e.g. size of grids, traverse spacing, instruments used)
 - ◆ A list of all file names with an explanation of codes used in file names
 - ◆ Data storage (e.g. format of data, how do the files fit together, hardware, operating system and software (version) used to create them)
 - ◆ Data analysis (e.g. filters applied to the data, images with interpretation drawings)
 - ◆ Description of known errors or areas of weakness in the data.

2.6 Team Structure and Skills

For project staff who are expected to periodically work on boats, the risk of severe personal injury at sea can be mitigated by undertaking training and certification in seafaring. For more information, please contact the Maritime and Coastguard Agency (mcga.gov.uk > working at sea > training and certification).

2.7 Project Design

A project design should include the following:

Health and safety statement. A detailed risk assessment should be performed for each aspect of the acquisition of the geophysical data and deployment of the instruments at sea. All personnel should be aware of the risks involved and measures that need to be taken. Depending on the research vessel used, the seagoing personnel might be required to attend a sea-survival course before sailing. Check with the helmsman well in advance of the planned survey whether this is a legal requirement.

Methods statement. In the case of the acquisition of the geophysical data, detailed information needs to be given on the technical aspects of the navigation system, the type of geophysical instruments deployed, the line spacing and sample interval together with a map of the suggested survey lines. Furthermore, information needs to be given on the anticipated processing that will be needed, together with the software that will be used for the processing and interpretation stages of the project. This statement should clearly outline a timetable with all the proposed stages in the project (with estimated start and end dates) and the expected outcome/product of each stage.

Detailed budget, including staff costs, contractor costs, non-staff costs, overheads, etc. For the geophysical survey, this should include the rental of the survey vessel, rental of survey equipment (sometimes including an operator for the equipment), processing and interpretation time and possible purchasing of software.

Details on planned publication, dissemination and (digital) archiving of both the raw data and final products, together with the required metadata (data about the data) and documentation. At this stage consideration should be given to the requirements for archive preparation and deposition and the file formats that will be used for the secure archiving and dissemination of the geophysical data and final report.

Table 1. Typical stages and products in a marine geophysical survey project

Stage	Research and project management products	Archive products	Dissemination products
Start up	Project Proposal		
Review Point R1: Are the research objectives clear and in line with relevant research programmes? Is the research area defined? Are likely target vessel type, age, construction considered?			
Initiation	Project Design Risk Log Survey contractor appointed / research team identified Survey vessel identified and use costed Risk assessment performed Appropriate training received Methods statement completed	Digital archive identified and agreed File formats agreed Site / survey number assigned	
Review Point R2: Have all project team got relevant safety training? Is survey vessel appropriate? Does schedule allow appropriately for weather related stand-by time?			
Execution Stage 1 Desk based assessment	DBA report Updated Project Design		OASIS entry created
Review Point R3.1: Have all appropriate sources been considered? Are results of DBA reflected in Updated Project Design?			
Execution Stage 2a Pilot test survey (optional)	Test survey completed Updated Project Design	Test of archive arrangements completed	
Review point R3.2a: Are results of the test reflected in the Updated Project Design?			
Execution Stage 2b Full survey	Survey data collected Assessment of survey data Updated Project Design Highlight report	Survey data archive established / updated	OASIS entry created / updated Survey report drafted Dissemination plan drafted

/continues overleaf

Table 1. continued

Review point R3.2b: Is survey data suitable for the research questions asked? Is a site revisit needed? Does site archive meet requirements of digital archive?			
Execution Stage 2c Additional site revisit (optional)	Additional survey data collected.	Survey data archive updated	
Review point R3.2c: Is survey data suitable for the research questions asked?			
Execution Stage 3 Data processing and analysis	Processing and analysis completed	Research data archive created	Survey report drafted*
	Update Project Design		Dissemination plan completed
	Highlight report		
Review point R3.3: Has analysis provided new understanding in line with research objectives? Are survey and research archives ready for transfer? Is dissemination plan appropriate?			
Execution stage 4 Archive and dissemination		Survey data archive and Research data archive transferred to digital archive	Survey report completed*
			Main report completed*
			Dissemination activities
			OASIS entry completed
			Project data submitted for charting use
Review Point R3.4 Is all data securely archived?			
Closure	Research agendas updated	Project management archive completed	
	End of project report*		

* see Annex 1 for details

3.0 Project Execution

The following sections give more detailed guidance on execution stages of a project.

3.1 Desk-based Research

Desk-based assessments serves to determine the archaeological potential of a predefined study area or site using existing records and are defined in the IFA's Standard & Guidance Notes (2008). Broad specifications for marine

DBA's (and geophysical survey) are given in the guidance note on [Marine Aggregate Dredging and the Historic Environment](#) (BMAPA & EH 2003). The assessment or evaluation of this data may provide contextual information for artefact-based sites.

3.2 Geophysical Survey

A geophysical survey can serve to:

- ♦ Detect previously unknown wreck sites or locate recorded losses of unknown position and can confirm the position of known sites;
- ♦ Gain more information on located, but unidentified anomalies or features, possibly identifying them without having to conduct a visual inspection;
- ♦ Provide more information on known archaeological sites to aid further evaluation (e.g. determine site extent, topography, areas of interest or diagnostic features).

There are many different types of geophysical survey tool available for use in the marine environment and it is not the purpose of this document to describe their relative applications. However, each of the techniques has their advantages and disadvantages with respect to the assessment and evaluation of wreck sites, so should be applied for a particular archaeological purpose to address specific questions. In determining the required geophysical survey tool, particular reference must be made to the documentation referred to in Section 1 and 3 above.

It must be remembered that position fixing is central to all forms of archaeological investigation, but it is even more crucial at sea because the object of investigation cannot be seen from the surface, or related to visible landscape features. The majority of sea-users today use satellite derived positioning systems on their vessels, more commonly called Global Positioning Systems (GPS), to determine their position. All positions acquired with a GPS receiver are based on the terrestrial reference system or datum WGS 84 and for all practical purposes the WGS 84 datum is likely to be the definitive datum for many years to come with local transformations being used to maintain compatibility with other systems.

4.0 Geophysical Survey Review

The review or assessment of geophysical survey data must be undertaken by a suitable qualified marine geophysicist trained in archaeological interpretation to facilitate the correlation of archaeological base-line information with identified seabed anomalies, as well as identifying 'new' features of possible cultural interest.

This assessment is likely to inform a visual (Diver-based or ROV) inspection of identified features and/or anomalies.

5.0 Dissemination

While information on 'new' seabed anomalies contained within 'grey literature' may ultimately be provided to the NMRC, there is currently no suitable provision for the archiving of digital bathymetric data. Although English Heritage is addressing this, we currently recommend that the digital archive is maintained for five years following completion of the project.

English Heritage recommends that an [OASIS](#) record is completed. Consideration should also be given to the provision of survey data for [charting use](#).

6.0 Further information

The Marine and Coastguard Agency website provides guidance on all maritime safety issues. See <http://www.mcga.gov.uk>

The Maritime & Coastguard Agency also has overall responsibility for the UK's hydrographic obligations under the Safety of Life at Sea Convention (SOLAS), but works in close partnership with the UK Hydrographic Office (UKHO) to ensure that these obligations are met. Certain hydrographic functions, however, are undertaken directly by the MCA (for example, performing hydrographic surveys under the 'Civil Hydrography Programme'). See <http://www.dft.gov.uk/mca/mcga07-home/mcga-dqs-hmp-hydrography.htm>

Institute for Archaeologists (2010). Draft Standard & Guidance for Archaeological Geophysical Survey
<http://www.archaeologists.net/sites/default/files/node-files/geophysicsSG.pdf>

Schmidt, A. (2002). Geophysical Data in Archaeology: A Guide to Good Practice. ADS series of Guides to Good Practice. Oxford: Oxbow Books

<http://ads.ahds.ac.uk/project/goodguides/geophys/>

7.0

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8.0 Contact details

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Annex I: Product Descriptions

The survey report

The survey report is the most important end product of the geophysical survey. As for the project design report, the survey report should be a comprehensive, free-standing document. The statements made in the report about the results should be based on the assessment of the geophysical data, which was undertaken by suitable qualified marine geophysicists trained in archaeological interpretation or maritime archaeologists trained in the interpretation of marine geophysical data.

The minimum requirements for the report are:

- ◆ Project name, authors, contractor, client and data
- ◆ (Non-technical) summary of the project
- ◆ Background information and reason for the survey (aims and objectives as described in the project design)
- ◆ Methods, including information on the types of equipment used, survey set-up, data processing and software used.
- ◆ Results. These should include an objective description of results as well as a discussion of the analyses and interpretations. These should be accompanied by plots of raw and processed data and interpretative diagrams. It should always be clear from the plots or accompanying figure captions, whether the display is showing raw, processed or interpreted data. In addition, each plot should be annotated fully, including scale bars, north arrows, grid coordinates (if applicable) and a key for any symbols and colour scales used.
- ◆ Conclusions, discussing the results in relation to the aims and objectives set out in the project design, the value of the geophysical data and the implications of the findings for the current and future research.
- ◆ Statement of indemnity
- ◆ Acknowledgements
- ◆ References and a reference to the location of the archived data.

The main project report

If the geophysical survey stands as an independent research project, then the survey report is often the main project report. If, on the other hand, the geophysical survey is part of a larger (archaeological) project, sections of the survey report will need to be included into the main project report. The amount of geophysical data represented in the report will depend on the proportion of its contribution to the main project. It is important that the contribution of the geophysics is not ignored, even if results were inconclusive or negative. At the least, a summary of the survey report should be included. If the survey report will become widely available at the dissemination stage, one can simply refer to the location where the survey report can be obtained from. Alternatively, the survey report can be included as an appendix or modified to fit into the main project report.

End of Project Report

This report is mainly aimed at the stakeholders, informing them about the project's closure date, lessons learned, evaluation of the project, location of the archived material, outstanding issues and suggestions for future work.

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our Customer Services department:
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