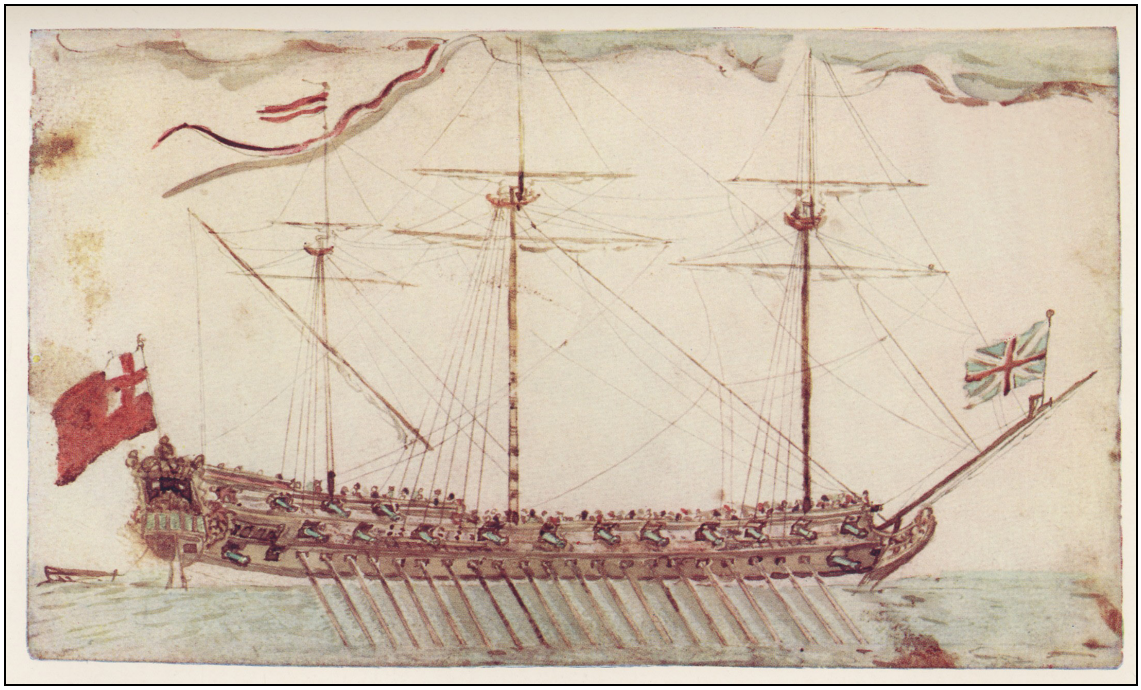
Royal Anne Galley
Cornwall
Marine Environmental assessment



Project Design for
PHASE 2 Field ASSESSMENT

Historic Environment Service (Projects)

Cornwall County Council

A Submission to English Heritage

Title	**Royal Anne Galley Marine Environmental Assessment: Project Design for Phase 2 Field Assessment**
Authors	Kevin Camidge, Charlie Johns, Philip Rees with Matthew Canti, Miles Hoskin, Ian Panter and JonRees
Derivation	Royal Anne Galley Marine Environmental Assessment: Project Design for Phase 2 Field Assessment and Phase 3 Monitoring
Origination date	01/02/07
Revisers	-
Date of last revision	26/02/08
Version	Rev 01
Status	Draft
Summary of Changes	The original project design was for Field assessment (Phase 2) and Project Design (Phase 3). This revised project design is for the Phase 2 Field assessment only
Circulation	-
Required action	
File Name Location	G:CAU\Projects\Sites\Maritime\Royal Anne Galley Phase 2 Project Design 2006087: Revised PD for Phase 2 Field Assessment
Approval	-

Historic Environment Service, Environment and Heritage,

Cornwall County Council

Kennall Building, Old County Hall, Station Road, Truro, Cornwall, TR1 3AY

tel (01872) 323603 fax (01872) 323811 E-mail hes@cornwall.gov.uk

www.cornwall.gov.uk

Cover illustration

The *Charles* Galley: watercolour by Jeremy Roche *c*1688

Contents

List of figures

Abbreviations

ACHWS	Advisory Committee on Historic Wreck Sites
ACoP	Approved Code of Practice
ADU	Archaeological Diving Unit (St Andrews University)
CCC	Cornwall County Council
CEFAS	The Centre for Environment, Fisheries & Aquaculture Science
CISMAS	Cornwall and Isles odf Scilly Maritime Archae0logy Society
CMER	Coastal and Marine Environmental Research
DBA	Desk-based Assessment
DCMS	Department for Media, Culture and Sport
DEFRA	Department for Environment, Food and Rural Affairs
DES	Derwentside Environmental Services
DO	dissolved oxygen
EH	English Heritage
FEPA	Food and Environment Protection Act
GIS	Geographical Information System
HES	Historic Environment Service, CCC, formerly CAU
JNCC	Joint Nature Conservancy Council
LAT	Lowest Astronomical Tide
MEA	Marine Environmental Assessment
MFA	Marine and Fisheries Agency
RAG	*Royal Anne* Galley
RIB	rigid inflatable boat
s/s	stainless steel

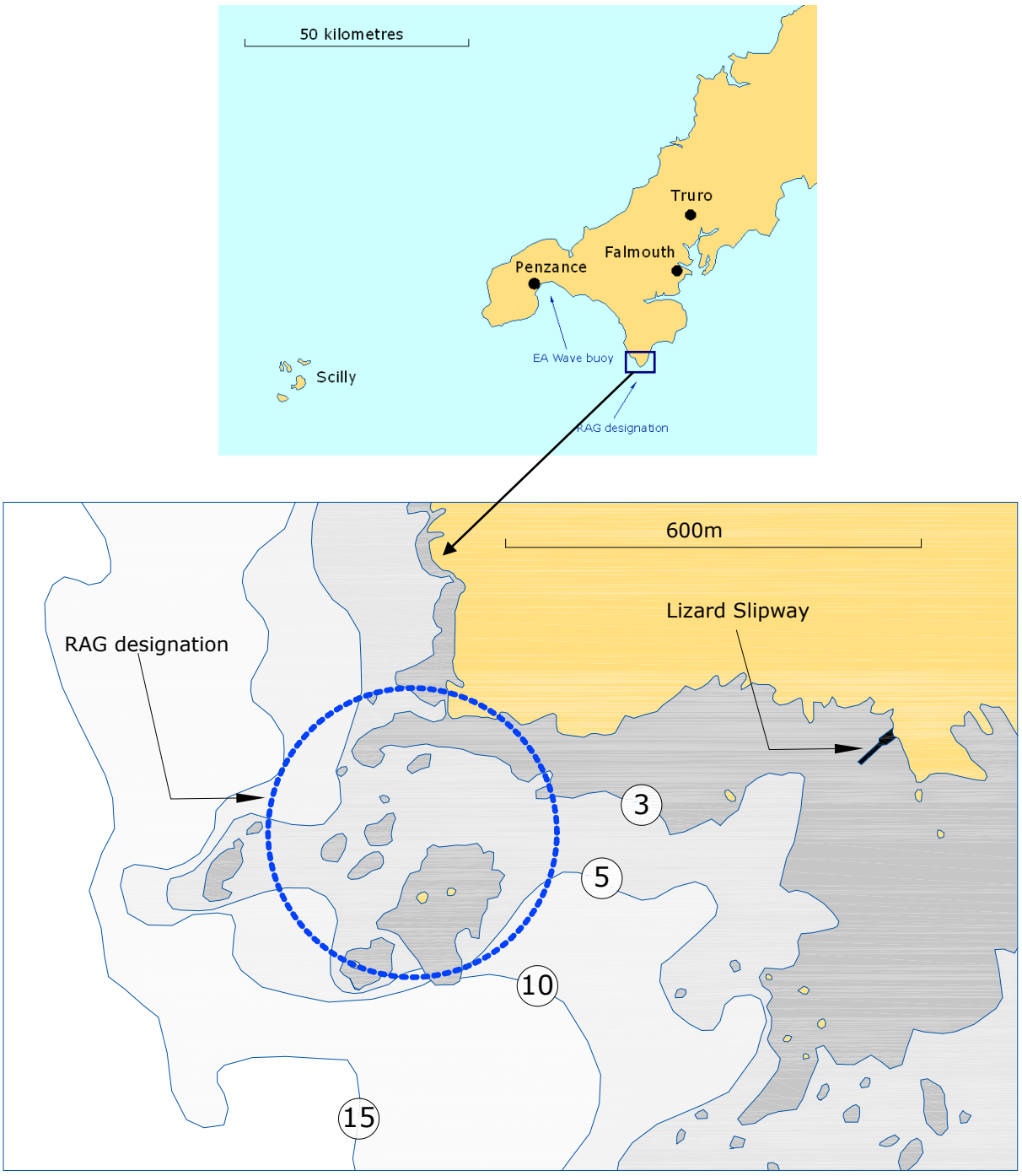


Fig 1 Location map

1 Introduction

In 2005 English Heritage (EH) commissioned Historic Environment Service (Projects), Cornwall County Council (HES), and Penzance-based maritime archaeologist Kevin Camidge (KC) to undertake a desk-based assessment of the *Royal Anne* Galley, a designated site under the Protection of Wrecks Act 1973, resulting in a report completed in May 2006 (Camidge *et al*, 2006), which outlined a strategy for field assessment and monitoring of the site. The desk-based assessment was the first phase of a proposed Marine Environmental Assessment (MEA) of the site. EH subsequently commissioned a Project Design for field assessment (Phase 2) and monitoring (Phase 3), which was submitted at the end of January 2007. However, because of financial constraints, EH then requested a re-cast project design that encompassed only the Phase 2 field assessment.

The outcome of the proposed Phase 2 field assessment will be the assessment report accompanied by proposals for future monitoring (Phase 3). Fieldwork will require a Licence, recommended by the ACHWS.

The result of this project will allow English Heritage to make an informed judgment on best practice for field assessment and therefore to establish site stability and preservation potential. English Heritage's Marine Environmental Assessment programme is planned to enable commissioned projects to generate information that can contribute towards the objectives of the EU Culture 2000 project *Managing Underwater Cultural Heritage* (MACHU).

1.1 Layout of project design

This project design is based on the revised brief and format described in the EH documents '*Commissioned Archaeology Programme Guidance for Applicants: Release 1.2, October 2002'* and '*Management of Archaeological Projects' 1991*' (MAP 2) and '*Management of Research Projects in the Historic Environment*' (MoRPHE).

1.2 Designation

On 6 June 2006 the designated area around the *Royal Anne* Galley was extended to include the Quadrant site (Statutory Instrument 2006 No 1470). The position of the designation is unchanged (49 57.48N 5 12.99W) but the radius of the protected circle has been increased to 200m.

2 Scope and constraints of the project

2.1 The study area

The designated site of the *Royal Anne* Galley lies off the Lizard Point where extremely dynamic sea conditions exist for most of the year. In addition the site sits within the 5m depth contour, surrounded by rocks, many of which are just submerged at high water.

The site is also subject to significant swells, which often make diving impossible even when sea conditions are benign elsewhere. It is subject to considerable tide, and diving operations are limited by a narrow 'tidal window'. Approach to the site in anything other than a small inflatable or RIB is extremely hazardous. Numerous visits by the Archaeological Diving Unit, St Andrews University (ADU), and more recently by the diving contractor, have failed to deploy surface supply divers on the site. Moreover, the number of days when conditions are suitable for diving on the site is limited to a maximum of 20 to 30 days per year. It is not uncommon for conditions to be unsuitable for periods of six to eight weeks, even in the summer.

For these reasons it will be extremely difficult to collect environmental data on this site. One of the most difficult problems will be mobilisation and planning. Hire equipment, boats and divers all have to be pre-booked. But access will depend on predicting suitable conditions on site. It seems possible that considerable stand-by costs are likely to be incurred. Wherever feasible, rapid deployment when suitable conditions present themselves will be the best option.

Due to the difficulties of accessing the site much thought was given to the best way of allowing for likely stand by of boat and divers as well as the booking of hire equipment. Accordingly the project has been planned assuming no delays or added costs due to weather delays – if these are encountered a variation to the project, reflecting the actual increased costs, will need to be considered.

We had originally planned, in the first draft of this project design, that Rob Sherratt, formerly the licensee for the *Royal Anne* whose knowledge of the site and its environs were been invaluable to the project, would provide and skipper the RIB but sadly he died in diving accident earlier this year.

2.2 Scope of the proposed field assessment

The field assessment will run for one year from spring 2008. The scope of the re-cast field assessment includes:

- Bathymetric survey;
- Biological assessment;
- Water samples (reduced to a single take);
- Sediment samples;
- Installation of dispersal objects (bricks and spheres);
- A project report with recommendations for further monitoring.

3 Position and extent of the survey

The existing survey of the site is based on a local control point network (shown in blue on Figure 4 below). The survey covers an area of 30m x 30m and the environmental survey should be centred on this area. The local control points consist of a number of iron pins driven into natural fissures in the rock. None of these control points have been systematically inspected since 2002. An accurate position and orientation for the local control network needs establishing. This will be one of the first tasks undertaken by this assessment. The position will be established using taut buoy lines and GPS.

The environmental assessment will be centred on the area surveyed and excavated by the licensee between 1993 and 2000. The extent of the area assessed will vary according to the type of data collected. For example the oceanographic data will be collected from a single location, while bathymetric data will be collected over a much wider area. In each case the precise area is defined in the individual sections below.

4 Aims and objectives

4.1 The overarching aim

As set out in the specification to undertake the Marine Environmental Assessment (MEA) the project will form one of a series of initiatives that will lead to the development of archaeological management plans for designated wreck sites that will inform English Heritage's future research, amenity and education developments for the benefit of the wider community (English Heritage 2004).

4.2 Objectives for the Phase 2 Field assessment

The objectives for the Phase 2 Field Assessment are based on the original specification but modified in the light of the Phase 1 Desk-based Assessment (DBA) (Camidge *et a*l 2006).

- Georeference the existing site plan
- Collect data relating to:
  - Bathymetry
  - Wave, tide and currents
  - Water temperature and suspended sediment
  - Water quality
  - Sediments (physical, chemical and timber degradation)
  - Flora and fauna
  - Object dispersal
- Establish the effect of the above on the preservation of archaeological material.
- Identify material most at risk (cf English Heritage 2004).
- Identify features of interest for monitoring
- Identify attributes to monitor (cf English Heritage 2004).

5 Methodology

5.1 Bathymetric survey

The purpose of the bathymetric survey is to measure depth and chart the seabed terrain. The data used to make bathymetric maps today typically comes from an echosounder (sonar) mounted beneath or over the side of a boat. The amount of time it takes for the sound to travel through the water, bounce off the seafloor, and return to the sounder tells the equipment how far down the seafloor is.

Two days of bathymetric survey will be undertaken by Seastar Survey Ltd of Southmapton during May/June of 2008. This data will then be processed, checked and plotted. The final survey plan will take into account the tidal restriction on and access to the site and SeaStar would make best use of high tides and weather conditions to get full coverage as required.

5.1.1 Vessel Operations

A small rigid inflatable vessel (approximately 5 m RIB) or similar will be used for the bathymetric survey work. This data could also be collected by airborne LIDAR but the

costs would be considerably more. It would not be possible to collect the bathymetric data using multibeam sonar on this site as access is not possible in anything larger than a RIB.

Data will be collected using a narrow beam echo sounder (a Garmin GPSMAP 188C Colour Sounder), and a Furuno GP80 DGPS Beacon Receiver. Data will be stored on a waterproof laptop computer. An area 50m x 50m centred on control point [A] will be surveyed at fine resolution, with a survey line separation of 2m. A larger area around this, extending as far as the quadrant site will be surveyed with a line separation of 5m (Fig 2). This should enable the existing survey to be placed into the context of the surrounding topography.

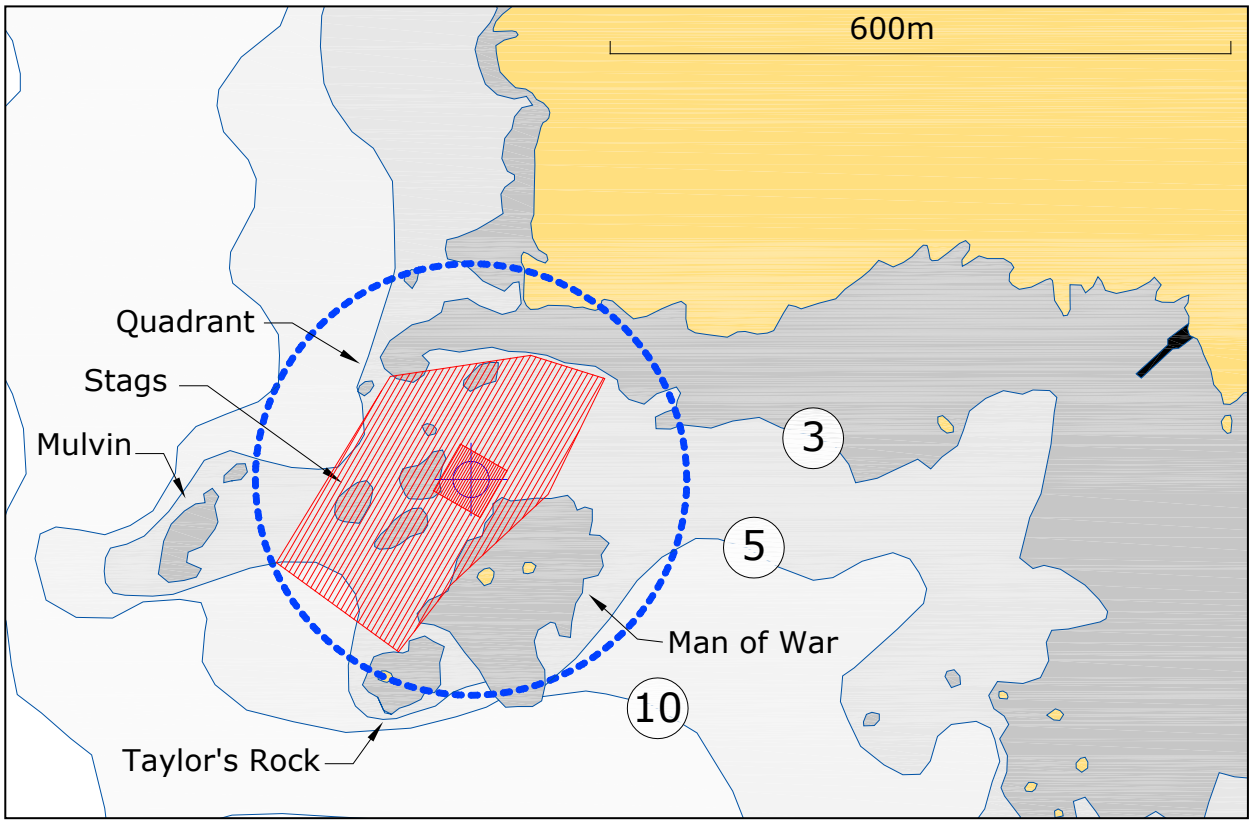


Fig 2 Location A: bathymetric survey grids (shown in red). The smaller grid is 50m x 50m with survey line spacing of 2m. The larger grid has a survey line spacing of 5m.

5.1.2 Survey Navigation and Data Logging

Survey navigation will be undertaken using a Leica RTK GPS (GX1230 Real Time Rover System) and logged using Hypack survey navigation software (version 6.2b) running on a waterproof laptop.

The RTK GPS would be used to collect navigation data in ETRS89 Latitude and Longitude. A data transformation using the Ordnance Survey models OSTN02 and OSGM02 would then be performed within the Hypack software (converting the navigation data to OSGB36 and ODN). All raw and processed positions would be logged throughout all survey operations.

The system accuracy exceeds the Special Order specifications, as set out in the IHO Standards for Hydrographic Surveys

A known position (OSGB36 grid coordinates) near to the survey area would be obtained from the Ordnance Survey (OS super plan). A detailed navigation check would be

performed against this know location at the start and end of the survey, and at any time a significant change to the survey systems occurred. In addition a brief check would be made before the start and at the end of each survey day to ensure a high level of accuracy of horizontal control throughout.

5.1.3 Single Beam Echosounder

For all the single beam echosounder survey work a Midas Surveyor GPS Echosounder (210 kHz), digital echosounder (pole mounted to the side of the survey boat) will be used. A record of the data would be logged digitally using the Hypack survey management software and internally in the Midas Surveyor unit as a backup.

Possible errors relating to vessel motion would be minimised by the use of our TSS CMS 25 Compact Motion Sensor, which would allow us to account for any vessel motion to an accuracy of ±5 cm. The motion reference unit would be mounted on the echosounder transducer pole to avoid the need for offsets in the navigation setup and minimise the risk of errors.

The speed of sound throughout the entire water column would be measured at the start and end of each survey to correctly calibrate the echosounder using our Marimatech HMS 1820-P CTD.

An echosounder draft check would be completed prior to the start and at the end of each survey day. Both the sound velocity profile and the bar check would be recorded as part of the quality control records.

5.1.4 Tides

Tide reductions of the bathymetry data would be achieved using RTK heights. All RTK heights would be logged and reduced relative to Ordnance Datum (Newlyn) within Hypack survey management software using the Ordnance Survey OSGM02 model.

The quality of the resolved 3D position and continuity of the RTK solution would be constantly monitored and recorded within the Hypack survey software. If the quality of the RTK data drops off the survey operation would be suspended until full quality returns.

As part of our quality control procedures a tide curve plot of the RTK height would be produced for each survey day.

5.1.5 Processing and Charting

All data processing, charting and reporting would be undertaken by SeaStar Survey staff at our offices in Southampton.

The single beam bathymetry data would be processed and charted using Hypack software. All data and charts would be supplied in formats specified by the client (single beam raw data provided in XYZ format).

The processed data will be supplied in digital and paper format as geo-referenced 1m contour plots (A1) at an appropriate scale.

5.1.6 Survey lines

The bathymetric survey covers an area of about 44,000m^2 (Fig 2). The total length of all proposed bathymetric survey lines is roughly 14 kilometres. The bathymetric survey will be conducted at a speed of approximately 3 knots.

An area 50m x 50m centred on control point [A] will be surveyed at fine resolution, with a survey line separation of about 2m. A larger area around this, extending as far as the quadrant site will be surveyed with a line separation of 5m (Fig 1).

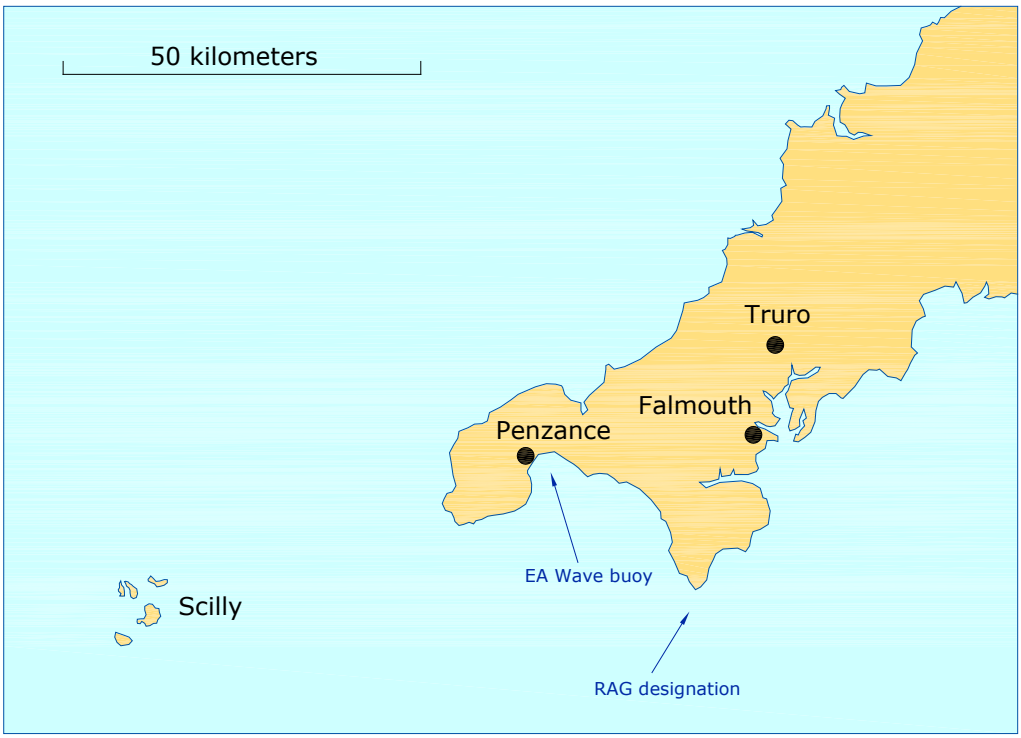


Fig 3 Relative positions of the Environment Agency wave monitoring buoy and the Royal Anne Galley designation

5.2 Dispersal trials

Workers on historic wreck sites have often reported the movement or 'disappearance' of artefacts exposed on the seabed. A number of attempts to quantify and measure these phenomena have been reported.

The usual technique is to place tracer objects on the seabed at known locations and to record their positions at set time intervals. At Kinlochbervie, practice golf balls and halved tennis balls respectively weighted with washers and bolts were used. These relatively light objects did not move far over an annual cycle; indicating relatively benign conditions over the period measured (Robertson 2004).

More recently, ceramic bricks have been deployed on the protected wreck sites *Hazardous Prize* and St Peter Port Harbour. The bricks were of two types, engineering and architectural bricks of different (but unknown) densities. The bricks were used whole, cut in half and into thirds. They were painted to aid location and tagged so that each brick could be individually identified (Holland 2005 and personal correspondence). This work is ongoing but latest reports indicate that some movement of bricks has been noted. Some bricks could not be relocated, indicating that they were missed by the divers, have become buried or have moved to outside the study area (Holland 2005).

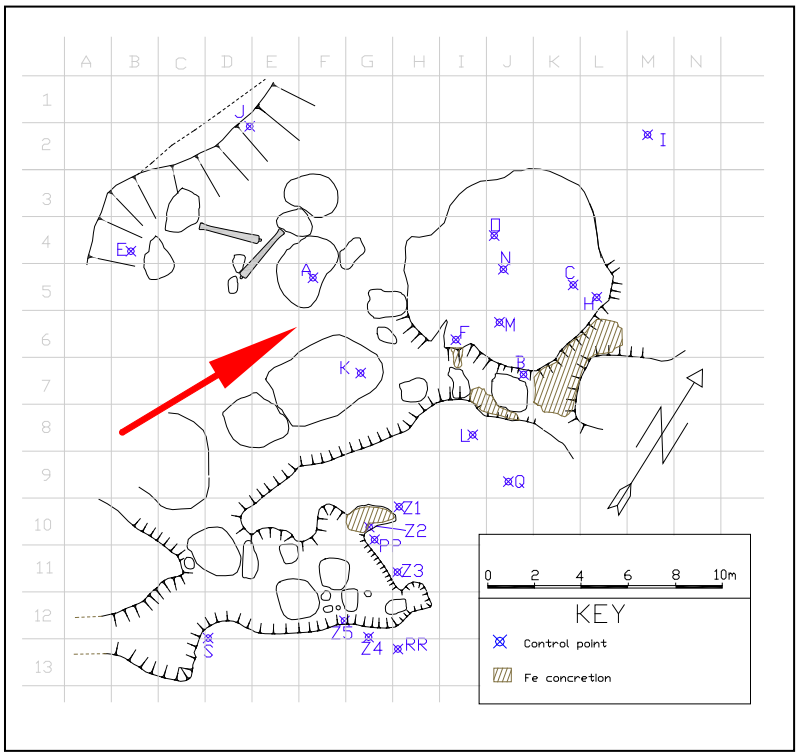


Fig 4

Royal Anne Galley site plan. The proposed starting location of the tracer objects is indicated by the red arrow.

This technique is a useful indicator of potential artefact mobility. It has the advantage of simplicity and low cost. This means it could be used widely on historic wreck sites and direct comparisons of the forces acting at the seabed of each site made. More sophisticated techniques involving active electronic or acoustic tracking of the tracer objects have been suggested; while this would reduce the incidence of 'lost' tracers it would involve considerable extra cost. As an example, acoustic ID tags which are detectable using sidescan sonar exist – but these cost in the region of £300 for each tag.

It is proposed that two different tracer objects are employed in this trial. The first group will consist of class 'A' engineering bricks conforming to BS EN 771-1. These have a water absorption of ≤ 4.5% and a minimum density of 2200 kg/m^3. By using bricks a direct comparison between this trial and that on the *Hazardous* and St Peter Port trials will be possible. The bricks will be painted yellow to aid visibility on the seabed and numbered so that individual bricks can be tracked. The deployment of bricks may need a permit and HES will determine this with the Marine and Fisheries Agency (MFA). Secondly, numbered white ceramic balls (steatite) of 50mm diameter and a density of 2700 kg/m^3 will also be used. These will model distribution of objects which are more easily rolled than the rectangular bricks. The proposed starting location of the tracer objects is shown on Fig 4.

Both types of tracer object (20 of each) will be placed on the seabed in a symmetrical arrangement close to control point A. These will be monitored during every dive on the site throughout the three years of the environmental study. Once the objects start to move, their new locations will be plotted by measuring the distance and bearing from control point A. A radius of 5m around control point A will be searched thoroughly during each diving inspection, and a further radius from 5-10m will also be searched by divers but in less detail. This methodology may need to be modified during the trial once we establish the magnitude of the displacements after the first inspection.

5.3 Water quality

One water quality sample will be taken in June 2008 which will be analysed by Derwentside Environmental Services (DES). It will be taken in a container provided by DES and analyzed for pH, salinity, nitrates, phosphates, metals, dissolved oxygen (DO) and chlorophyll.

The water quality interpretation and reporting will be carried out by Ian Panter of York Archaeological Trust.

5.4 Sediment chemistry

Four sediment samples will be taken in June 2008 (see Fig 5). These will be analysed by Derwentside Environmental Services (DES). They will be taken in containers provided by DES and analyzed for pH, salinity, DO, nitrates, sulphate, sulphide, ammonia, phosphate and ferrous ions. The sediment chemistry interpretation and reporting will be carried out by Ian Panter of York Archaeological Trust. The sampling strategy will involve removing the top 0.10m of sediment then taking the sediment sample from 0.10 – 0.20m below the seabed. The exact method of sample collection will be agreed with Ian Panter and DES.

Sampling may need a permit from the MFA and consent from the Crown Estate and HES will confirm this.

Sample No	Notes
1	Sediment sample from near the surviving iron guns
2	Sediment sample from gulley west of control point A
3	Sediment sample from the area excavated 1993-2000
4	Sediment sample from an undisturbed area of the site.

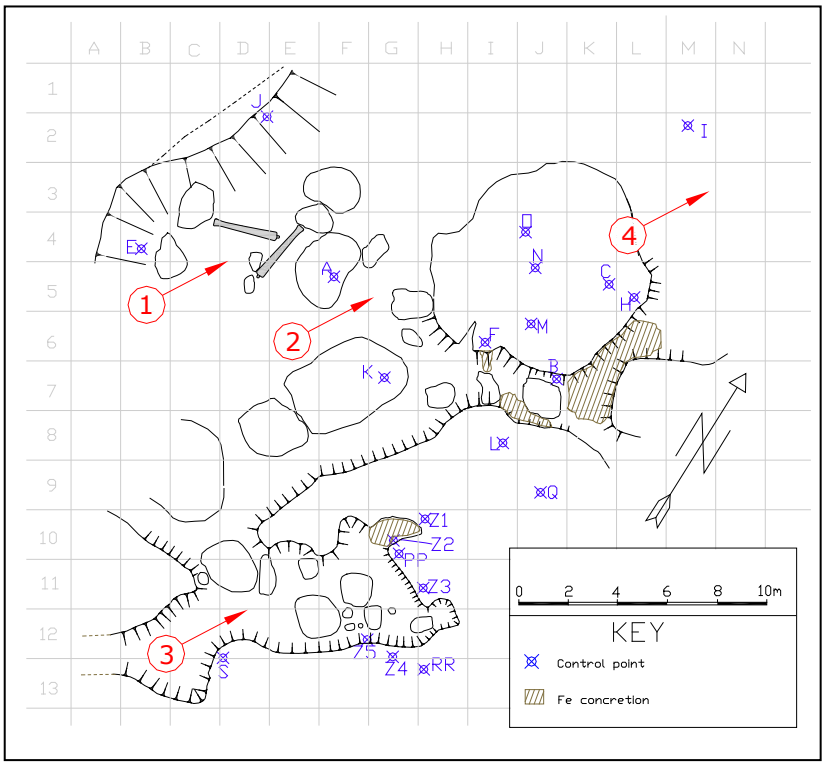


Fig 5

Plan of the Royal Anne Galley. The numbered red arrows indicate the locations from which the sediment samples will be taken.

5.5 Sediment physical composition

The sediment samples will also be analysed for physical composition. The same sample locations as those used for the sediment chemistry samples will be used as shown in Fig 5 above. Relatively large sediment samples will be taken (1kg) due to the known large particle size of the sediment on this site. This analysis will be undertaken by Matthew Canti of English Heritage at Fort Cumberland, comprising particle size analysis by sieves and sedigraph, complemented by some microscopy on loose samples to determine basic sediment constituents.

5.6 Biological degradation of timber

Over 400 objects have been recovered from excavation on this site to date. However, only one item of organic composition has been found (RAG 180 - this was a few small slivers of timber). Nothing of the fabric of the vessel itself has been identified. The most probable reason for the poor survival of timber and other organic material is the nature of the seabed on this site. The seabed consists mainly of hard rock gullies containing shallow deposits of coarse sand and cobbles to a maximum depth of 0.30m. These shallow deposits are unlikely to support the stable anoxic conditions favourable to the preservation of timber and other organic material. Confirmation of these conclusions can be had by deploying standard timber sample blocks on the site as part of the environmental assessment.

Previous studies (*Colossus*, MoSS and *Mary Rose*) have used a mixture of oak and pine blocks for these studies. But in each case the attack has been similar in the oak and pine samples, although the pine (being softer) is attacked slightly sooner and more severely than the oak. It is unlikely that any extra information would be gained by using both pine and oak blocks. It is highly likely that the *Royal Anne* would have been constructed almost entirely from oak.

Standard oak sample blocks will be deployed on the surface of the seabed and buried within the sediment on the site. This will be undertaken in two separate locations on the site. These will be at the same locations as sediment samples 1 and 2 to minimise the disturbance to the site. The sample blocks will be recovered after one and two years' exposure and analysed to determine the amount and nature of the degradation, identifying where possible the organisms responsible for the degradation. The amount of attack will be determined by weight loss and visually from X-rays of the recovered sample blocks. The seabed surface blocks will be secured to the seabed using stainless steel pins (the method employed in the *Colossus* stabilisation trials), the buried blocks will require small holes to be dug into the sediment immediately adjacent to the blocks secured to the seabed. In each case spare blocks will be carried in case any blocks are lost.

Using the wood blocks may need a permit from the MFA and HES will confirm this at the outset of the project.

5.7 Flora and fauna

The biological survey will be undertaken by Dr Miles Hoskin (MH) of Coastal and Marine Environmental Research (CMER).

Rationale for a marine biological assessment

Knowledge of the benthic marine flora and fauna at the site of the *Royal Anne* Galley (RAG) is important to obtain for a number of reasons:

The presence of species that are designated as important for nature conservation may have implications for the conduct of future archaeological investigations of the site.

Pursuant to i, plans for future archaeological investigations of the RAG site may require an environmental permit (eg as per requirements of the Coast Protection Act (CPA) 1949 and/or the Food and Environmental Protection Act (FEPA) 1985), application for which would most likely require an environmental impact assessment (EIA); an initial marine biological evaluation of the site would be a useful contribution to the EIA. HES will look into this at the outset of the project.

Knowledge of the benthic flora and fauna of the site would inform an assessment of the environmental conditions affecting the preservation and distribution of archeological materials (eg dispersal of small artifacts within kelp holdfasts; effects of encrusting or boring species on the rate of degradation of materials, etc.).

If it were discovered that marine archaeological items (eg iron cannon and cannon balls) supported conspicuous species that were absent or rare on adjacent natural substrata, this might help locate other undiscovered items that are currently concealed by biological over-growth.

Scientific objectives

Because of budget considerations the proposed marine biological assessment of the *Royal Anne* Galley site will be limited to the immediate area of confirmed archeological remains (an area of approximately 25m by 25m); achievable objectives are as follows:

Map the distribution of broad habitat and assemblage-types within the 25 x 25m site of the RAG (noting both natural substrata and substrata provided by marine archaeological materials).

Determine the identities and abundances of benthic macrofauna and flora in each of the important assemblages present at the RAG site (to be identified via work pursuant to Objective 1).

Produce a multivariate classification of macro-benthic assemblages (if necessary results of this analysis could be superimposed onto a physical map of the site).

Relate statistically significant assemblages to established biotopes in the Joint Nature Conservancy Council's (JNCC) Marine Habitat Classification for Britain and Ireland (Connor *et al* 2004).

Assess the importance of the site for nature conservation in terms of the presence of priority habitats and species (*eg* species protected under the Wildlife and Countryside Act (1981) or listed in the UK Biodiversity Action Plan).

Interpret potential effects of natural *versus* archaeological substrata on the composition of biological assemblages.

5.7.1 Work programme

Key step	Work required	Work done by:	To be completed by:
1	Desk-based assessment of the benthic assemblages and species likely to occur at the RAG site, including any species of importance for nature conservation.	MHo	Spring 2008
2	Marine biological reconnaissance of the RAG site (and general site familiarization in terms of distribution of archaeological items, safety considerations for marine biological diving, etc.).	MHo/SeaStar	Spring/summer 2008
3	Bathymetric surveys to map the RAG site in terms of ecologically important physical variables; *e.g.* depth of water, substratum, tidal flows, wave exposure, etc.).	SeaStar/KC	Summer 2008

Key step	Work required	Work done by:	To be completed by:
4	A systematic underwater video survey of the RAG site. Ideally, this should provide complete coverage. The video survey should be undertaken at approximately the same time of year as marine biological surveys are planned in 2008.	SeaStar	Summer 2008
5	Identify and map the broad habitat and assemblage-types present at the RAG site using information gained via Steps 2 to 4 (*Objective 1*).	MHo/KC	Winter 2008
6	Biological survey report, with proposals for more detailed marine biological survey.	MH	Winter 2008

Fig 6 Biological survey work programme

5.7.2 Notes of methods of sampling and analysis

The general approach for surveys to characterise assemblages at the RAG site will be stratified random sampling. The 'strata' in the design will be the different broad habitat-types identified via preliminary investigations of the site (see Fig 6, Steps 2 to 5). Once the broad habitat-types have been identified and mapped, replicate 'patches' of each habitat will be targeted for sampling and replicate random samples (quadrats or cores) obtained from each patch (see Figure 7, below). For ease of statistical analysis, the survey design will be balanced with respect to both the number of patches per habitat and the number of samples per patch. See Kingsford and Battershill 1998 and Davies *et al* 2001 for a fuller discussion of the application of stratified random sampling in marine biological surveys.

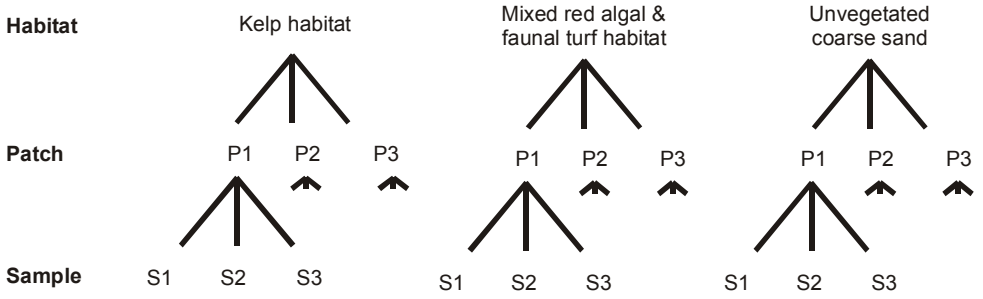


Fig 7 Schematic representation of a hypothetical scheme of stratified sampling for a site with three broad habitat-types.

Quadrats (including photo-quadrats) and sediment cores are standard devices for sampling the benthos of hard and soft substrata, respectively (Kingsford & Battershill 1998, Eleftheriou and McIntyre 2005). Determining the sizes of sampling units (*ie* quadrat area, core cross-section and depth) and the number of samples to be collected will depend on a number of scientific, logistical and budgetary considerations; the objective is to achieve the optimum balance between the accuracy of data and the cost of sampling, both of which increase in proportion to the number and size of samples. This detailed planning cannot be done until the marine biological reconnaissance of the site has been completed and knowledge is available on (i) the number of broad habitat-types present at the site and (ii) the range of body-sizes possessed by the different flora and fauna within each habitat.

In relation to the first matter (number of habitats) for instance, given that time for surveying is constrained, the number of samples collected per habitat will be inversely proportional to the number of habitats present at the site (ie more habitats means fewer samples per habitat). Another consideration in this regard is whether species can be identified and counted via photo-quadrats, or whether this can only be reliably done *in situ*. Diver-time per sample for *in situ* counts is typically much greater than that required for

photo-quadrats, so the latter would normally allow for a relatively greater number of samples. The range of body-sizes for the species being sampled has implications for the size of sampling unit and potentially the number of differently-sized sampling units that are needed for each habitat. If all the organisms being sampled are similar in size, the general rule of thumb is that the sampling unit should be at least one order of magnitude larger (Andrew and Mapstone 1987); thus, organisms ~10 cm in size would require a 1 m x 1 m quadrat. When assemblages are the subject of investigation (rather than populations of a single species), a common problem is that different species have different body-sizes. If the range of body-sizes is very great, it may be necessary to use more than one size of sampling unit.

Data obtained from the surveys of the RAG site will be analysed and graphically summarised using multivariate routines in the PRIMER software-package developed by the Plymouth Marine Laboratories (Clarke and Warwick 2001). These are industry-standard statistical analyses for biological survey data that are routinely recommended in governmental advice on the conduct of marine monitoring programmes (*eg* Davies *et al* 2001, CEFAS/DTLR 2002).

6 Logistics

6.1 Boat

All access to the site will be by a charter boat from SeaStar, a Southampton-based marine survey company. The skipper of the vessel, Steve Duke, is qualified to as RYA/DoT Yachtmaster Offshore (Commercial).

6.2 Dive contractor

All diving operations for the environmental assessment will be undertaken by SeaStar. SeaStar an HSE registered dive contactor (HSE ref Steven Dewey). All diving operations will be under the control of their dive supervisor. SeaStar will provide the dive supervisor and diving team.

6.3 Equipment

Survey navigation will be undertaken using a Leica RTK GPS (GX1230 Real Time Rover System) and logged using Hypack survey navigation software (version 6.2b) running on a waterproof laptop.

The RTK GPS will be used to collect navigation data in ETRS89 Latitude and Longitude. A data transformation using the Ordnance Survey models OSTN02 and OSGM02 would then be performed within the Hypack software (converting the navigation data to OSGB36 and ODN).

For the bathymetric work a Midas Surveyor GPS Echosounder (210 kHz), digital echosounder (pole mounted to the side of the survey boat) will be used, with a TSS CMS 25 Compact Motion Sensor, to minimise possible errors. The motion reference unit would be mounted on the echosounder transducer pole to avoid the need for offsets in the navigation setup and minimise the risk of errors.

The speed of sound throughout the entire water column would be measured at the start and end of each survey to correctly calibrate the echosounder using our Marimatech HMS 1820-P CTD.

6.4 Archaeological supervision

Day to day supervision of the project will be undertaken by Kevin Camidge (maritime archaeologist) who will be onboard the boat during all diving operations. He will direct the diving operations, bathymetric survey and all sampling and monitoring operations. Charlie Johns of HES will be responsible for overall project management including obtaining of necessary permits and licences and ordering of equipment required for the project.

6.5 Licences

The site is designated under the Protection of Wrecks Act (1973). The collecting of sediment samples and the burying of the oak sample blocks will require a licence to excavate on the site. The collecting of bathymetric and oceanographic data on the site will similarly require a licence to survey.

A licence may also be required from DEFRA for the AWAC and the dispersal trials. The relevant legislation is the Food and Environment Protection Act Part II (FEPA) – deposit of tracers and other materials in the sea.

HES will obtain necessary licences at the commencement of the project.

6.6 Allowance for bad weather

It will be appreciated that work at sea is always subject to suitable weather conditions. The site is extremely exposed and previous experience on site suggests that some on-site time might be lost due to bad weather. Standard practice in the maritime contracting industry is to add a factor of 20% to 25% to allow for adverse weather (and this is on normal, more benign sites) but this could easily lead to the project price being unnecessarily inflated. The actual cost of being prevented from working due to the weather is quantifiable as a daily cost but the number of days this will apply to is not. Working the *Royal Anne* site has always been extremely difficult and due account of the exceptional conditions must be made. **Time lost due to bad weather is not factored into the project budget and will be dealt with as a Variation to the budget if it arises (see 10 Appendix: Risk Log).**

7 Reporting

A draft of the formal report formal report accompanied by proposals for future monitoring will be circulated to EH for comment in November 2008, with a view to be submitting the final report by the end of December 2008

7.1 Contents of the final report

The final report will present the results of the desk-based environmental and archaeological assessments. The report will have the following sections: -

• Summary	-	Executive Summary
• Introduction	-	Background, objectives, methods
• Phase 2 Field Assessment	-	A detailed account of the strategy and results including a discussion of the quality of the data material type and extent of the site.
• Discussion	-	Discussion of the results of the project including a statement of significance of the effect of environmental factors on archaeological material present.

• Proposals for Phase 3	-	Proposals for future monitoring
• Archive	-	A summary and index to the project archive
• References	-	List of primary and secondary sources and metadata
• Illustrations	-	Site location plan
	-	Illustrative maps, plans and photographs as appropriate

A paper copy and a digital (PDF) copy of the report, illustrations and any other files will be held in the Cornwall HER. Paper copies and digital copies of the report will be distributed to English Heritage, the Crown Estate, to local archives and national archaeological record centres.

7.2 Archive deposition

Archive disposition arrangements will be discussed and agreed with English Heritage at the outset of the project. Prior to its deposition the project archive will be fully indexed according to the standard HES procedures for the preparation and disposition of documentary project archives.

A digital archive will be provided for deposition with the HER (ie an update of HER records) and similarly with the Archaeology Data Service, York (ADS). The latter has been discussed with Keiron Niven of ADS.

8 Programming, management and resources

8.1 Personnel

8.1.1 Project Staff – expertise

HES *staff*

Peter Rose, BA (Hons), MIFA, HES Projects Team Leader

Peter is responsible for the overall co-ordination, management and delivery of HES' programmes and projects. His duties include; overseeing the promotion and development of projects, overseeing the management and delivery of projects and the management of staff and work programme, overall financial responsibility for the Service's projects., developing and maintaining systems, standards and procedures and pursuing continual improvement in service delivery, promoting and developing improved access to information from projects, contributing to strategic direction and policy of HES and the CCC Environment and Heritage Section.

Charlie Johns, BA MIFA, Senior Archaeologist

As a Senior Archaeologist with HES Charlie has special responsibility for projects in the Isles of Scilly and helping to develop the Service's maritime capacity. He lives at The Lizard and has extensive experience of undertaking DBAs, writing reports and managing projects. Maritime projects include the Isles of Scilly Rapoid Coastal Zone Assessment Survey (Johns et al 2004), assessments of the site of HMS Scylla for the National Marine Aquarium, Plymouth (Johns et al 2004), the Hayle Wave Hub for Halcrow (Johns et al 2006 and 2007), and the Falmouth Cruise Project (Johns et al forthcoming). Since 2005 he has co-directed the 'Islands in a Common Sea' research project in Scilly with Dr Jacqui

Mulville of Cardiff University (Johns et al 2006; Mulville 2007; Johns and Mulville 2007), and has been awarded the title Honorary Research Fellow in Cardiff University's School of History and Archaeology.

Bryn Perry Tapper, BA, Senior Archaeologist (GIS)

Since joining HES in 1999 Bryn has been developing the Geographical Information System (GIS) in conjunction with the Historic Environment Records Team. Bryn has had advisory roles with the successful World Heritage Site Bid project for Cornish Mining, the Cornwall & Scilly Urban Survey and the Cornwall Industrial Settlements Initiative. He has been involved in Historic Landscape Characterisation and numerous small-scale projects and surveys. He undertook the GIS mapping for the Isles of Scilly Rapid Coastal Zone Assessment and has given numerous presentations of the use of GIS in Cornish Archaeology. In 2006-7, Bryn provided GIS expertise during the ALSF-funded England's Historic Seascapes; Scarborough to Hartlepool Pilot Project (Tapper *et al* 2007; Val Baker *et al* 2007) and is currently the Project Officer for the 3rd round of English Historic Seascapes – Consolidating the Method (Johns and Tapper 2007).

Marine consultants

Kevin Camidge, Dip Arch MIFA, Marine Archaeologist

Kevin is an experienced marine archaeologist based in Penzance. In recent years he has carried out work for EH on HMS *Colossus* in the Isles of Scilly as well as leading the Heritage Lottery Fund supported survey of the *Colossus* Debris Field Survey Project by the Cornwall and Isles of Scily Maritime archaeological Society (CISMAS) in September 2004. He has dived on the site of the *Royal Anne* and undertaken extensive documentary research on the vessel.

Matthew Canti, BSc, MSc Geoarchaelogist

Matt has wide experience of carrying out practical geoarchaeology on a very large number of sites; responsible for EH policy on geoarchaeology; responsible for vetting geoarchaeology in all EH-funded projects and advising on numerous others; responsible for management of EH-funded postholders in geoarchaeology; extensive publications on micromorphology and related microscopy; publications/methods also regularly involve particle-size analysis, heavy mineral analysis, various forms of SEM analysis, X-ray diffraction etc.

His expertise is in polarised light microscopy (the main method used in soil micromorphology). Currently carrying out part-time PhD on applications of earthworm granules to archaeological science. He is a member of the editorial board of *Journal of Archaeological Science* and sub editor for *Environmental Archaeology*

Miles Hoskin, PhD, Marine biologist

Miles has a 1st Class Bsc. (Hons) in Biological Sciences from University of Plymouth in 1990 and a PhD in marine evolutionary ecology from University of Wollongong NSW Australia in 1996.

Since receiving his doctorate in 1996, Miles has worked as a consultant for Research on Ecological Impacts of Coastal Cities at the University of Sydney from 1997 to 2001, an independent consultant for Devon Wildlife Trust on the assessment of the effects of exclusion zones on benthic habitats, and Cornwall County Council on an experimental assessment of crustacean offshore St. Agnes, Cornwall in 2001.

In the period August 2001 to March 2003 he worked as a Maritime Conservation Officer for English Nature in their Maritime Technical Advisory Group before setting up his own

consultancy called Coastal & Marine Environmental Research at Falmouth in April 2003. This has included studies for Wildlife Trust (Joint Marine Programme) in relation to the Marine Bill and Environmental Statements for the Marine Aggregates Industry.

Miles has published a number of papers in journal publications as well as a number of consultancy reports. He is an accredited member of the Institute of Ecology and Environment and a visiting Fellow at the School of Biological Sciences at Plymouth University.

He is a PADI Dive Master and HSE registered dive contractor, with skills in underwater digital photography.

Ian Panter, BSc Conservation specialist

Following graduation from the Institute of Archaeology, University of London in 1980 Ian has pursued active research into the decay of organic materials, particularly wood, and the factors influencing preservation. Before taking up his current position with York Archaeological Trust as Principal Conservator he spent six years as the English Heritage Regional Science Advisor (Yorkshire region) advising curators, contractors and developers on a number of reburial and *in-situ* preservation issues. He has been instrumental in developing appropriate monitoring strategies for both terrestrial and marine environments and assisted the EH Maritime Archaeology Team in developing protocols for marine environmental assessments.

Phillip Rees MSc C.Sci C.Geol F.G.S, Marine Geologist

Phillip has recently been appointed as a Chartered Scientist for his work in the marine environment. He has not only has had extensive experience in conducting studies of the seabed in all parts of the world but in recent years has been involved in coastal engineering projects around the Cornish coast. He has recently co-ordinated a marine environmental study in Mount's Bay (Hyder Consulting Ltd 2004).

Mike Hall, Diver

Mike is a local with experience of diving on the *Royal Anne* site with Rob Sherratt.

SeaStar Survey Ltd, Boat Hire, Survey and Registered Dive Contractor

SeaStar Survey Ltd is an independent marine survey company based in Southampton. They specialise in supplying a range of environmental, oceanographic and hydrographic services including: marine environmental survey, oceanographic and hydrographic Surveys, video/still photography and analysis, survey vessel charter and scientific diving team (HSE registered).

8.1.2 Project staff - roles

HES *staff*

Peter Rose (PGR), Projects Assurance Officer

Peter will undertake the key validation checks, processes and documentation required for project designs, reports and archives prior to publication, dissemination and deposition as described below in Section 8.5.

Charlie Johns (CJ), Senior Archaeologist

Charlie will co-ordinate the project to ensure that it is carried out to the agreed standards. His tasks will include liaison with the EH Project Officer and the project staff, the monitoring of the project budget and ordering equipment and producing the interim and final reports.

Bryn Perry Tapper (BPT) Senior Archaeologist (GIS)

Bryn will generate illustrative material for the reports, including maps and interpretative models.

Marine consultants

Kevin Camidge (KC), Marine Archaeologist

Kevin will undertake day to day supervision of the project with Phil Rees. They will be onboard the boat during all diving operations. They will direct the diving operations, bathymetric survey and all sampling and monitoring operations and contribute to the annual and final reports.

Matthew Canti (MC), Geoarchaeologist

Matt will analyse the sediment samples for physical composition.

Miles Hoskin (MHo), Marine biologist

Miles will undertake the biological survey.

Ian Panter (IP), Conservation specialist

Ian will collate water and sediment chemistry data from the testing laboratory and report on the potential for *in situ* preservation

Phillip Rees (FPR), Marine Geologist

Phil will act in an advisory capacity to the project.

Mike Hall (MHa), Diver

Mike's experience will prove invaluable in locating the site of the *Royal Anne*.

SeaStar Survey Ltd (SS), Boat Hire, Survey and Registered Dive Contractor

SeaStar will undertake the bathymetric survey and processing, charting and reporting on the bathymetric data.

All diving operations for the environmental assessment will be undertaken by SeaStar of Southampton. All diving operations will be under the control of their dive supervisor. SeaStar will provide the dive supervisor and diving team.

8.2 Equipment and recording materials

Task	Equipment/materials required	Source
	Year 1 (2007): Phase 2 Field Assessment	
4 Bathymetric survey	RIB (SeaSTar)	SeaStar
	Data logger	SeaStar
	DGPS	SeaStar
	Echo Sounder	SeaStar
	Cables, s/s pins, shackles, tags etc	HES to hire
6 Deployment & field assessment	RIB	SeaStar
	Video camera	SeaStar
	Bricks	HES to purchase
	Ceramic spheres	HES to purchase
	Oak blocks	HES to purchase
	Photographic film/processing etc	SeaStar / HES
	Insurance for photo equipment	SeaStar

8.3 Staffing

8.3.1 List of project tasks

Task no	Date	Task	Performed by	Days
		Year 1 (2007)		
		Project management	CJ	5
		Project assurance	PGR	1
Task 1	April	Signposting (OASIS entry)	CJ	0.25
Task 2	April	Signposting (digital summary)	CJ	0.25
Task 3	April	Signposting (webwork)	BPT	1
Task 4	April	Obtain licences	CJ	1
Task 5	March-April	Equipment sourcing, acquisition,	KC	2
Task 6	March-April	DBA for biological study	MHo	1
Task 7	April-May	Meeting with dive team (Southampton)	KC	2
			CJ	2
			SS	2
Task 8	April May	Site reconnaissance	KC	1
			FPR	1
			MHa	1
Task 9	May-June	Bathymetric survey	KC	2
"	"	"	CJ	1
"	"	"	SeaStar	2
Task 10	June	Bathymetric plotting	SeaStar	3
Task 11	June	Deployment & field assessment	SeaStar	2
"	"	"	KC	2
		"	MHa	2
"	"	2	CJ	1
"	"	" (biological reconnaissance)	MHo	1
Task 12	September	Team meeting	KC	1
			FPR	1
			CJ	1
Task 13	October	Identify/map biological habitats etc	MHo	1
Task 14	"	Report on sediment amples	MC	*
Task 15	"	Report on water sample	IP	1
Task 16	November	Prepare formal report	KC	5
"	"	"	CJ	5
"	"	"	BPT	1
"	"	"	MHo	1
Task 17	November	Submit draft report for comment	CJ	0.25
Task 18	December	Assimilate comments and edit final report	CJ	2
Task 19	December	Submit final report	CJ	0.5
Task 20	December	Collate and deposit archive	CJ	2
Task 21	December	Monitoring meeting 1	CJ	2
"	"	"	KC	2
Task 22	December	Curation of digital archive	CH	fee

8.3.2 List of project staff and responsibilities

NAME	TITLE	TASK
Peter Rose (PGR)	Project assurance Officer, HES	Project Assurance
Charlie Johns (CJ)	Project Manager/Senior Archaeologist, HES	Project Management, OASIS entry (Task 1); Digital summary (Task 2); Obtain licences (Task 4); Meetning with dive team (Task 7); Bathymetric survey (Task 9), Deployment & field assessment (Task 11), Team meeting (Task 12), Formal report (Task 16), Submit draft report (Task 17); Assimilate comments & edit final report (Task 18); Submit final report (Task 19) Collate and deposit archive (Task 20), Review point meeting meetings (Task 21).
Bryn Perry Tapper (BPT)	Senior Archaeologist (GIS), HES	Webwork (Task 3); Formal report (Task 12).
Kevin Camidge (KC)	Marine Archaeologist	Equipment sourcing etc (Task 5), Site meeting with dive team (Task 7), Site reconnaissance (Task 8), Bathymetric survey (Task 9), Deployment & field assessment (Tasks 11), Team meeting (Task 12), Formal report (Task 16), Review point meetings (Task 21).
Matthew Canti (MC)	Geoarchaeologist, EH	Reporting – sediment samples (Task 14)
Mike Hall (MHa)	Local diver	Site reconnaissance (Task 8), Deployment & field assessment (Task 11).
Miles Hoskin (MH)	Marine biologist, CMER	DBA for biological survey (Task 6), Deployment & field assessment (Task 11), Identify & map habitats etc (Task 13), Formal report (Task 16).
Ian Panter (IP)	Principal Conservator, York Archaeological Trust	Reporting – water sample (Task 15).
SeaStar	Survey vessel & skipper	Bathymetric survey (Task 9),
SeaStar	Hydrographic surveyor	Bathymetric survey (Task 9), Bathymetric plotting & charting (Task 10).
SeaStar	Dive boat & skipper	Meeting with CJ & KC (Task 7); Deployment & field assessment (Task 11).
SeaStar	Dive supervisor & team	Deployment & field assessment (Task 11).
Phillip Rees (FPR)	Marine Geologist	Site reconnaissance (Task 8), Team meeting (Task 12)
Catherine Hardman (CH)	Collections Development Manager, The Archaeology Data	Curation of digital archive (Task 22).

NAME	TITLE	TASK
	Service (ADS)	

8.3.3 Project accommodation and infrastructure

The project will be co-ordinated from HES' Truro offices. HES has a computer network running Windows XP Professional. Report texts are generated in Word 2002. Mapping will derive from the OS Mastermap and historic maps via Arcview GIS. Line drawings will be generated using AutoCAD. HES members of the project team each have a Dell PC of adequate specification. The Service has adequate photocopying, scanning and printing facilities.

8.3.4 Equipment and materials

- Reports - Compact discs to store and transfer documents and drawings.
- Archive - Archive documentation cases for storage of the project's paper archive. Supplied by Conservation Resources UK (tel: 01865 747755). 2 x acid-free document cases for paperwork 12103 (311mm x 260mm x 76mm) Micro Chamber® active quality. CDs to transfer for the digital archive.

8.4 Copyright

Copyright of all material gathered as a result of the project will be reserved to the Historic Environment Service, Environment and Heritage, Cornwall County Council. Existing copyrights of external sources will be acknowledged where required.

Specialists will be expected to assign copyright to HES, but will receive a licence from HES for use of the material.

Use of the material will be granted to the client.

8.5 Standards and quality assurance

HES has successfully applied to become an IFA Registered Archaeological Organisation (RAO) and is included on the IFA Register of Organisations (16/08/07 to 31/03/08).

All recording work will be undertaken according to the Institute of Field Archaeologists *Standard and Guidance for Archaeological Excavations* (IFA 2001b). Site staff will be expected to follow the IFA *Code of Conduct* and *Code of Approved Practice for the Regulation of Contractual Arrangements in Field Archaeology*.

As part of Planning, Transportation and Estates, Cornwall County Council, the HES has certification in BS9001 (Quality Management), BS14001 (Environmental Management), OHSAS18001 (Health, Safety and Welfare), Investors in People and Charter Mark.

HES has an internal *Review of procedures for validation of key documents* that identifies the key validation checks, processes and documentation required for project designs, reports and archives prior to publication, dissemination and deposition.

For the production of reports the *HES report guidelines* provide the framework and guidance on structure, contents and conventions. The report guidelines also outline what should be covered in checking or editing a report. There are additional *HES illustration guidelines* on figures, drawings and maps.

8.6 Freedom of Information Act

As Cornwall County Council is a public authority it is subject to the terms of the Freedom of Information Act 2000, which came into effect from 1st January 2005.

8.7 Health and safety

8.7.1 Health and safety statement

The Historic Environment Service is a section of the Planning, Transportation and Estates, Cornwall County Council. The Unit follows the County Council's "Statement of Safety Policy" and also the Planning Directorate's "Statement of Safety Policy". For more specific policy and guidelines the Unit uses the manual "Health and Safety in Field Archaeology" (2002) endorsed by the Standing Conference of Archaeological Unit Managers and also the Council for British Archaeology's Handbook No. 6 "Safety in Archaeological Field Work" (1989).

All diving operations for the environmental assessment will be undertaken by SeaStar of Southampton. SeasStar are an HSE registered dive contactor (ref Steven Dewey). SeaStar will be diving to the HSE Science and Archaeology ACoP, which allows for the use of SCUBA and will always prepare job/site specific daily risk assessments at site prior to diving. SeaStar will provide the dive supervisor and diving team. All diving operations will be under the control of their dive supervisor, Sarah Chaddock, who is NAS 3 qualified.

8.8 Insurance

As part of Cornwall County Council, HES is covered by Public Liability, Employers Liability and Professional Negligence Insurance.

SeaStar carry carry £10,000,000.00 of Employers Liability Cover and £5,000,000.00 of Public and Products Liability Cover. Their insurance is supplied through Everard Insurance Brokers Ltd and underwritten by Towergate.

Miles Hoskin will be employed as a sub-contractor by SeaStar Survey Ltd and therefore covered by their insurance policy for this project.

8.9 Project monitoring / milestones

The project will be undertaken according to the Institute of Field Archaeologists' *Standards and Guidance for archaeological desk-based assessments and evaluations.* Progress review meetings will be set by EH.

At each stage the project manager will provide the EH Project Officer with a written progress report and time will be allowed for three meetings with the Project Officer during the course of the project.

8.10 Timetable

The project will commence in April 2008 and fieldwork will be completed by July and the final report, with recommendations for further monitoring, in December 2008.

2007-2008

No	Task	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Year 1: Phase 2 Field Assessment											
1	Signposting (OASIS entry)										
2	Signposting (digital summary0										
3	Signposting (webwork0										
4	Obtain licences & permissions										
5	Equipment sourcing etc										
6	DBA for biological study										
7	Meeting with dive team										
8	Site reconnaissance										
9	Bathymetric survey										
10	Bathymetric plotting										
11	Deployment and field assessment										
12	Team meeting										
13	Identify/map biological habitats etc										
14	Sediment samples analysis										
15	Water sample analysis										
16	Prepare Formal report										
17	Submit draft report to EH for comment										
18	Assimilate comments and edit final report										
19	Submit final report										
20	Collate & deposit archive										

No	Task	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21	Reviiew point meetings (tba)										
22	Curation of digital archive										

8.11 Budget (indicative costs)

8.11.1 Breakdown of staff costs per project task

Year 1 (2008): Phase 2 Field Assessment		
Project management	CJ 5 days @ £181	£905
Project assurance	PGR 1 day @ £223	£223
1Signposting (OASIS entry)	CJ 0.25 days @ 181	£45.25
2 Signposting (digital summary)	CJ 0.25 days @ £181	£45.25
3 Signposting (webwork)	BPT 1 day @ £181	£181
4 Obtain licences	CJ 1 day @ £181	£181
5 Equipment sourcing etc	KC 2 days @ £250	£500
6 DBA for biological study	MH 1 day @ £350	£360
7 Meeting with dive team (Southampton)	KC 2 day @ £250 CJ 2 day @ £181 SeaStar 2 x 1 day @ £310	£500 £362 £620
8 Site reconnaissance	KC 1 day @ £250 FPR 1 day @ £250 MHa 1 day @ £200	£250 £250 £200
9 Bathymetric survey	KC 2 days @ £250 CJ 1 day @ £181 Mobilisation of RIB & diving personnel Hire of RIB & skipper 2 days @ £465 Hydrographic surveyor 2 days @ £310	£500 £181 £2050 £930 £620
10 Bathymetric plotting, charting & report	SeaStar 3 days @ £360	£1080
11 Deployment and field assessment	KC 2 days @ £250 MHa 2 days @ £200 CJ 1 day @ £181 MHo 1 day @ £360 Hire of dive boat & skipper 2 days @ £210 Dive team 2 days @ £925	£500 £400 £181 £360 £420 £1850

12 Team meeting	CJ 1 day @ £181 KC 1 days @ £250 FPR 1 days @ £250	£181 £250 £250
13 Identify/map biological habitats etc	MH 1 day @ £360	£360
14 Sediment samples analysis	MC	EH contribution
15 Water samples analysis	IP 1 day @ £260	£260
16 Prepare formal report	KC 5 days @ £250 CJ 5 days @ £181 BPT 1 day @ £178 Mo 1 day @ £360	£1250 £905 £178 £360
17 Submit draft report	CJ 0.25 days @ £181	£45.25
18 Assimilate comments and edit final report	CJ 2 days @ £181	£362
19 Submit final report	CJ 0.5 days @£181	£90.5
20 Collation& deposition of archive	CJ 2 days @ 181	£362
21 Review point meeting meetings	CJ 2 days @ £181 KC 2 days @ £250	£362 £500
22 Curation of digital archive	CH / ADS fee	£615
Total		*£20,025.25*

8.11.2 Breakdown of project budget into staff and non-staff costs

Year 1 2007-8: Phase 2 Field Assessment

Unit costs		**SC**	**SP**	**Per day**	**Days**	**Cost**	**Total**
HES staff							
Project Assurance Officer	PGR	k	6	£223.00	1	£223.00	
Project manager	CJ	I	6	£181.00	5	£905.00	
Senior Archaeologist	CJ	I	6	£181.00	18.25	£3303.25	
Senior Archaeologist (GIS)	BPT	I	6	£181.00	2	£362.00	
Total salary cost						*sub-total A*	£4,793.25
External consultants							
Marine archaeologist	KC	-	-	£250.00	17	£4250.00	
Marine geologist	FPR	-	-	£250.00	2	£500.00	
Local diver	MHa	-	-	£200.00	3	£600.00	
Survey vessel & skipper	SeaStar	-	-	£465.00	2	£930.00	
Hydrographic surveyor	SeaStar	-	-	£310.00	2	£620.00	
				£360.00	3	£1080.00	
Marine biologist	MHo	-	-	£350.00	4	£1440.00	
Dive boat & skipper	SeasStar			£210.00	2	£420.00	
				£310	1	£310.00	
Dive Team	SeaStar	-	-	£925.00	2	£1850.00	
				310.00	1	£310.00	
Conservation specialist	IP	-	-	£260.00	1	£260	
Geoarchaeologist	MC	-	-	-	-	-	
Total salary cost						*sub-total B*	£12,570.00
Specialist fees							
Sample analysis	DES	-	-	n/a	n/a	£430.50	

Unit costs	**SC**	**SP**	**Per day**	**Days**	**Cost**	**Total**
Total specialists' fees					*Sub-total C*	£430.50
Non staff costs						
Travel for meeting 440 miles @ 0.40 per mile					£176.40	
Overnight accommodation & subsistence (CJ)					£102.87	
Licences / permits					£500.00	
Cables etc					£350.00	
Bricks					£40.00	
Spheres					£320.75	
Oak blocks					£75.00	
Photos/materials					£250.00	
Equipment insurance					£175.00	
Reprographics					£300.00	
Postage for samples					£50.00	
Total non staff costs					*sub-total D*	£ 2340.02
Consultants costs						
Overnight accommodation & subsistence (KC)					£102.87	
Data logger					£50.00	
DGPS					£50.00	
Bathymetric Survey Equipment					£500.00	
Video cam					£100.00	
KC travel: 9 x 50 miles @ 0.40per mile					£180.00	
SeaStar mobilisation of boat, personnel & equipment					£2050	
SeaStar fieldwork subsistence for Bathymetric Survey, 2 people @ £80					£165	
SeaStar fieldwork subsistence for Deployment & Field Assessment, 4 people @ £80					£330	

Unit costs	SC	SP	Per day	Days	Cost	Total
					sub-total E	£3,527.87
Overheads						
Unit overheads @ 25%						£1,783.32
External consultants/specialists @ 10%						£1,652.84
TOTAL						**£27,097.80**

Notes:

1. This estimate does not include standby time for bad weather etc, which would result in a variation (see **10: Appendix: Risk Log**).

9 References

Andrew, NL and Mapstone, BD, 1987. Sampling and the description of spatial pattern in marine ecology. *Oceanography and Marine Biology Annual Review* **25,** 39-90

Camidge, K, Johns, C and Rees, P, 2006. *Royal Anne Galley Marine Environmental Assessment: Phase 1 Desk-based Assessment*, HES, Truro

Council for British Archaeology, 1989. *Safety in Archaeological Field Work*, Council for British Archaeology, Handbook No. 6

CEFAS/DTLR, 2002. *Guidelines for the conduct of benthic studies at aggregate dredging sites,* CEFAS Library, Lowestoft

Clarke, KR and Warwick, RM, 2001. *Change in marine communities: an approach to statistical analysis and interpretation (2nd edition),* PRIMER-E Ltd, Plymouth Marine Laboratory, Plymouth

Connor, DW, Allen, JH, Golding, N, Howell, KI, Lieberknecht, LM, Northen, KO and Reker, JB, 2004. *The Marine Habitat Classification for Britain and Ireland, Version 04.05,* JNCC, Peterborough (internet version: www.jncc.gov.uk/MarineHabitatClassification)

Davies, J, Baxter, J, Bradley, M, Connor, D, Khan, J, Murray, E, Sanderson, W, Turnbull, C and Vincent, M, 2001. *Marine monitoring handbook.* UK Marine SACs Project, JNCC, Peterborough.

Eleftheriou, A and McIntyre, A, 2005. *Methods for the study of marine benthos (3rd edition).* Blackwell Science Ltd., Oxford

English Heritage, 1991. *Management of Archaeological Projects, 1991*, (MAP 2)

English Heritage 2006. *Commissioned Archaeology Programme Guidance for Applicants: Release 1.2, June 2006*

English Heritage, 2006. *Management of Research projects in the Historic Environment: The MoRPHE Project Manager's Guide,* English Heritage

English Heritage, 2004. *Marine Environmental Assessment of Designated Wreck Site Royal Anne Galley*. English Heritage Brief (Tender Document)

Holland, SE, 2005. Following the Yellow Brick Road, *Nautical Archaeology* **NAS 2005.4** and **2006.1**

Hyder Consulting (UK) Ltd 2004. *Penzance/Newlyn/Penlee Technical Investigations: Marine Environmental Surveys*. Report for Penwith District Council

Johns, C, Camidge, K, Holt, P and Tapper, BP, 2004. *HMS Scylla: Archaeological Assessment.* HES, Truro

Johns, C, Camidge, K and Rees FP, 2006. *Wave Hub off St Ives, Cornwall: archaeological assessment*. HES, Truro

Johns, C, Camidge, K and Rees FP, 2007. *Wave Hub off St Ives, Cornwall: addendum to the archaeological assessment*. HES, Truro

Johns, C, Larn, R, Tapper BP, 2004. *Rapid Coastal Zone Assessment for the Isles of Scilly*. HES, Truro

Kingsford, M and Battershill, C, 1998. *Studying temperate marine environments: a handbook for ecologists,* Canterbury University Press, Christchurch, New Zealand.

Robertson, P 2004. A Shipwreck near Kinlochbervie, Sutherland, Scotland, *The International Journal of Nautical Archaeology* **33.1**

Standing Conference of Archaeological Unit Managers, 2002. *Health and Safety in Field Archaeology*, SCAUM

Tapper, B, Val Baker, M, Johns, C and Herring P, 2007. *England's Historic Seascapes: Scarborough to Hartlepool and adjacent marine zones. Historic Seascape Characterisation Method,* Report to English Heritage, HES Report no 2007R022.

Val Baker, M, Tapper, B, Johns, C. and Herring, P, 2007. *England's Historic Seascapes: Scarborough to Hartlepool and adjacent marine zones. Historic Seascape Characterisation,* Report to English Heritage, HES report no 2007R021

10 Appendix: Risk Log

Risk no	Description	Probability	Impact	Countermeasures	Estimated time and cost	Owner	Updated
1	The site is extremely exposed and previous experience on site suggests that some on-site time might be lost due to bad weather. Working the *Royal Anne* site has always been extremely difficult and due account of the exceptional conditions must be made.	This is a **HIGH** risk	This is a **HIGH** impact as without the collection of data the remainder of the project cannot be undertaken	The final survey plan will take into account the tidal restriction on and access to the site and SeaStar would make best use of high tides and weather conditions to get full coverage as required.	Standard practice in the maritime contracting industry is to add a factor of 20% to 25% to allow for adverse weather (and this is on normal, more benign sites) The actual cost of being prevented from working due to the weather is quantifiable as a daily cost but the number of days this will apply to is not. - **£1,500 per day**	**KC/ SeaStar**	
2	The project being delayed due to staff illness or staff change.	This is a **LOW** risk. Normal CCC sickness allowances have been built into the 200 working day year. This should be sufficient to cover most eventualities.	This would have a **HIGH** impact. It is difficult to include provision for long-term sicknesses. Staff changes cannot be predicted, but would require more time and resources for either continuing with a reduced team or for taking on and training new staff.	Other than the existing standard CCC sickness allowance being built into the working year no other countermeasures can be taken. Staff changes cannot be predicted and will be dealt with as and when they arise. If the project team is reduced, an appraisal of the effect on the project progress and results will be carried out; this will inform decisions about whether a variation should be sought at this stage.	On the basis of a six month training period, during which the person being trained and the person doing the training are effectively working at half speed, taking on new staff will add the equivalent of six months salary plus overheads to the project costs. This is estimated as **£20,000**.	**CJ**	
3	Bathymetric equipment malfunction	This is a **MEDIUM** risk	This is a **HIGH** impact as without the collection of geophysical data…	Will have a hydrographic surveyor on the boat..	**£1,500 per day**	**SeaStar**	
4	Boat breakdown	This is a	This is a **HIGH**	SeaStar to have boat	**£1,500 per day**	**SeaStar**	

Risk no	Description	Probability	Impact	Countermeasures	Estimated time and cost	Owner	Updated
		MEDIUM risk	impact as will be unable to collect data	serviced before commencement of project.			

The total contingency fund recommended for the project (based on worst case scenarios) is **£30,000 per year**.