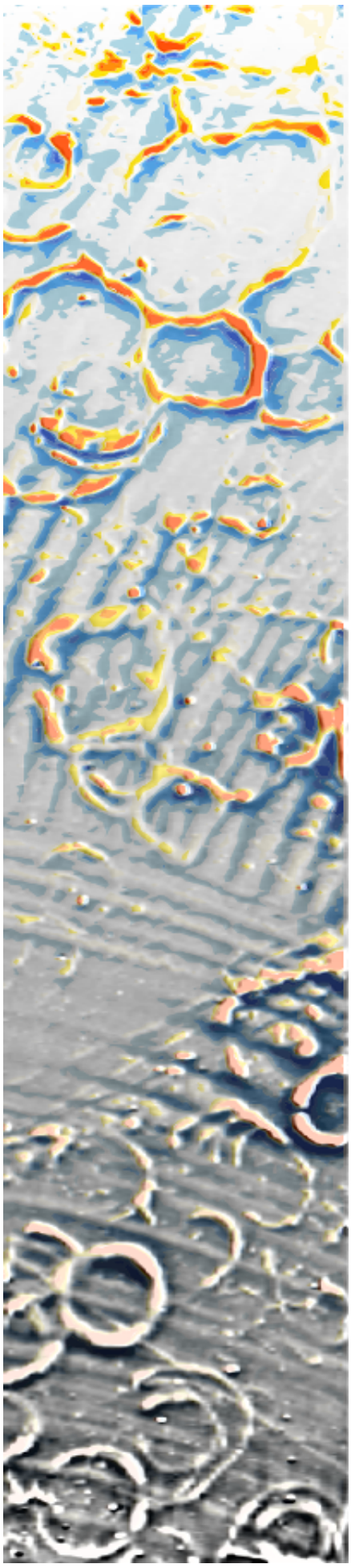

Gunwalloe Headland, Cornwall

Geophysical Survey Report

Produced for the National Trust

Unlocking Our Coastal Heritage Project

Project code NTC126

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Non-Technical Summary

A magnetic survey was commissioned by the National Trust to prospect land on the headland at Gunwalloe for buried structures of archaeological interest, under the aegis of the Unlocking Our Coastal Heritage project.

The survey revealed that the headland has been cultivated in the past and may also have been subdivided by one or more field boundaries. The existence of a band of occupation debris just within the rampart of the fort has been confirmed and seems likely to have continued much of the way along and is now being eroded by the sea. A likely prehistoric cremation site, perhaps a low barrow, was found and this appears to be similar to another found buried beneath the rampart. A small enclosure defined by a ditch appears to have been almost lost to the sea at the southern tip of the headland.

Digital Data

Item	Sent to	Sent date
CAD – Vector Elements	Jim Parry email	01/08/13

Audit

Version	Author	Checked	Date
Interim	MJR		
Draft Final	MJR, ACKR	ACKR	01/08/13
Final			
Revision			
OASIS			

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1 Introduction

Gunwalloe promontory fort, on The Lizard, was surveyed using a fluxgate gradiometer as part of the National Trust's Unlocking our Coastal Heritage project to prospect for buried structures of archaeological interest.

1.1 Location

Country	England
County	Cornwall
Nearest Settlement	Gunwalloe
Central Co-ordinates	165975, 20524

Approximately 0.6 hectares were surveyed across the open ground of the headland.

1.2 Constraints & variations

None were encountered although survey was not conducted close to cliff edges, to safeguard personnel.

2 Context

2.1 Archaeology

The following information is quoted verbatim from the brief (Parry, 2012):

2.1.1 Prehistoric

"The earliest evidence for human activity in the area comes from a single flint blade of Mesolithic or Neolithic origin which was recovered after it had eroded out of the cliff face.

The Bronze Age is more clearly represented by the relatively large number of barrows which survive along the coastal margin both north and south of the site as well as eastwards inland. Some of these are upstanding whilst others survive as cropmarks.

Continuity into the Iron Age is indicated by two site types both within the evaluation area and outside. Firstly the potential site of an Iron Age Cliff Castle. The Tithe Map of 1840 shows the fieldname 'The Castle' at Winnianton which suggests the site of a cliff castle. A univallate cliff castle is recorded at Winnianton in 1959 and is shown on the OS map of 1962. In 1969 the site is listed and records the extant remains of a cliff castle. The OS who visited the site in 1973 record the island site of a knoll-like promontory, traversed by a lynchet up to 7.0m high, set below the crest, and with a terrace of variable width at the base of the lynchet. Although superficially it appears to be man-made the feature is possibly of geological origin compounded with windblown sand and slip. The remains are visible on aerial photographs and were plotted as part of the NMP.

Secondly the site of a series of rectilinear and circular enclosures, located c.200m to the north of the evaluation site, which are indicative of a Late Iron Age / Romano-British rounds. Their identification has yet to be proven as they have only been recorded through aerial photography and were plotted as part of the NMP."

2.1.2 Medieval

"Both documentary and archaeological evidence have identified a potential settlement site dating from c.7th century at Gunwalloe. The earliest evidence relates to the recovery of bar-lug and grassmarked pottery (dating from the 7th to 12th centuries) found both eroding from the cliff face and from excavations (several

different excavations dating from 1909 to 2010), often found in association with middens and the remains of stone built structures. Recent AMS dates from one of the middens eroding from the cliff have given us a date between the 9th to 10th centuries for these features (Wood 2010). Previous excavation work has recovered extensive well preserved faunal remains in association with the middens. The previously limited excavations have also identified several possible phases of construction/occupation in relation to the stone structures recorded.

Documentary evidence identifies Winnianton as far back as the 11th century. The earliest source comes from the Domesday Book and records Winnianton as a Royal Manor (one of the chief manors of Cornwall at the time) though makes no direct reference to settlement. Later Court Roles for the Manors of Carminowe and Winnianton show the continuity of the site as a focus for activity right through the medieval and post medieval periods.

An ecclesiastical presence at Winnianton possibly dates back the 13th century, documentary evidence in 1219 AD refers to the 'Eecclesia de Winiton'. A later documentary reference to a chapel of 'St Wynwola iuxta Carmynow' on the site is dated to 1433 AD which likely relates to much of the surviving fabric of the current church bat Winnianton. There are also two early medieval stone crosses within the churchyard and a reference in 1732 AD to a holy well which has been lost to coastal erosion."

2.2 Environment

Superficial 1: 50000 BGS	None recorded, however, some windblown sand is likely to be present
Bedrock 1:50000 BGS	Givetian to Frasnian Porthscatho Formation - Interbedded Sandstone and Subequal / Subordinate Argillaceous Rocks (PORO)
Topography	Roughly level apart from eastern slope down to the east
Hydrology	Free draining
Current Land Use	Heathland
Historic Land Use	Some arable, rough pasture
Vegetation Cover	Coastal grassland
Sources of Interference	None

The Devonian bedrock supports soils of variable magnetic susceptibility with in general lower susceptibilities associated with sandstones than with slates or some mudstones. It seems likely that the headland will support the detection of buried structures by the magnetic technique to a moderate degree.

Use of a vertical gradiometer at this site will have suppressed deep variation from the bedrock geology and hence most anomalies will have their origin in the soil, or be due to variations in the surface of the bedrock if the soil is shallow. Magnetic debris in the soil can be expected to have a major effect upon the measurement.

3 Methodology

3.1 Survey

3.1.1 Technical equipment

Measured variable	Vertical component of vertical magnetic field component nT/m
Instrument	Bartington Grad 601-2
Configuration	Carried dual gradiometer
Sensitivity	0.1 nT
QA Procedure	Continuous observation
Spatial resolution	1.0m between lines, 0.25m along line interval

3.1.2 Monitoring & quality assessment

Quality monitoring is by continuous observation during data collection and examination of the data after download.

3.2 Data processing

3.2.1 Procedure

All data processing is minimised and limited to what is essential for the class of data being collected, e.g. reduction of orientation effects, suppression of single point defects (drop-outs or spikes) etc. The processing stream for this data is as follows:

Process	**Software**	**Parameters**
Shear collection	ArcheoSurveyor	
Heading correction	ArcheoSurveyor	Zero median line
Cross line interpretation	Surfer	0.25m x 0.25m cubic spline
Imaging and presentation	Manifold GIS	

Data is ported as data surfaces (not images) into Manifold GIS for final imaging and detailed analysis. Specialist analysis is undertaken using proprietary software.

General information on processes commonly applied to data can be found in standard text books and also in the 2008 English Heritage Guidelines "Geophysical Survey in Archaeological Field Evaluation" at http://www.helm.org.uk/upload/pdf/Geophysical_LoRes.pdf.

All archived data includes process metadata.

3.3 Interpretation framework

3.3.1 Resources

Numerous sources are used in the interpretive process which takes into account shallow geological conditions, past and present land use, drainage, weather before and during survey, topography and any previous knowledge about the site and the surrounding area. Old Ordnance Survey mapping is consulted and also older sources if available.

3.3.2 Magnetic

Interpretative logic is based on structural class and examples are given below. For example a linear field or gradient enhancement defining an enclosed or semi-enclosed shape is likely to be a ditch fill, if there is no evidence for accumulation of susceptible material against a non-magnetic structure. Weakly dipolar discrete anomalies of small size are likely to have shallow non-ferrous sources and are therefore likely to be pits. Larger ones of the same class could also be pits or locally-deeper topsoil but if strongly magnetic could also be hearths. Strongly dipolar discrete anomalies are in all cases likely to be ferrous or similarly magnetic debris, although small repeatedly heated and in-situ hearths can produce similar anomalies. Reduced field strength (or gradient) linear anomalies without pronounced dipolar form are likely to be caused by relatively low susceptibility materials, e.g. masonry walls, stony banks or stony or sandy ditch fills.

3.4 Standards & guidance

All work was conducted in accordance with the following standards and guidance:

- David et al, "Geophysical Survey in Archaeological Field Evaluation", English Heritage, 2008.
- "Standard and Guidance for Archaeological Field Evaluation", Institute for Archaeologists, 2008.

In addition, all work is undertaken in accordance with the high professional standards and technical competence expected by the Geological Society of London and the European Association of Geoscientists and Engineers.

All personnel are experienced surveyors trained to use the equipment in accordance with the manufacturer's expectations. All aspects of the work are monitored and directed by fully qualified professional geophysicists.

4 Catalogue

Label	Anomaly Type	Feature Type	Description	Easting	Northing
1	Strong variable dipolar (group)	Debris?	This coincides with the path past the graveyard and up onto the headland and is therefore likely to be due to hardcore or some similar material	165987.7	20610.1
2	Area enhanced	Fill	A slightly irregular band of elevated magnetic gradient approximately 2m wide and apparently just within, i.e. west of, the former rampart of the cliff castle. This may indicate an accumulation of burnt soil and / or occupation debris surviving where it has been protected by the former earthwork from cultivation	165973.9	20565.7
3	Area enhanced	Fill?	The survey may have just extended over the edge of a continuation of likely fill [2], right on the present edge of the headland	166006.0	20500.3
4	Linear enhanced	Fill - Ditch?	A possible narrow (< 1.5m) ditch fill, alternatively another part of [2] but this seems less likely unless the material of [2] also fills an earlier ditch	165971.3	20548.5
5	Linear enhanced	Fill - Ditch	Probable enclosure ditch fill < 1.5m wide extending west from the rear of the former rampart towards possible ring ditch [7]	165959.4	20541.1
6	Linear enhanced	Fill - Ditch	Probable enclosure ditch fill < 1.5m wide extending north from possible ring ditch [7] and therefore approximately parallel with [2] and the former rampart	165911.2	20551.7
7	Linear enhanced	Fill - Ditch	A likely fill appears to arc around a circular area of approximately 16m diameter and continuing through the northwest quadrant under later debris. It is likely that this is a ring ditch, perhaps once enclosing a barrow on the headland. The northern arc is perhaps implied by the southwards turn of [5]. Within the ring is strong magnetic area [8] which is unlikely to be contemporary - see [8]	165921.8	20515.2
8	Area strongly enhanced dipolar	Fill / structure	An approximately rectangular area of strong elevated magnetic gradient is within the arc of [7] and measures approximately 5m x 6m. It could be the site of a repeated fire, e.g. a large beacon, or alternatively something structural, e.g. the base of a building. Immediately to the northwest is what appears to be an accumulation of strongly magnetic debris (incl. perhaps ferrous) that appears to be within part of the arc of [7]	165923.7	20523.9

9	Strong variable dipolar (group)	Debris?	An area of approximately 16m x 6m is associated with strongly variable magnetic gradient typical of buried debris. The anomaly strength appears to be low for ferrous sources, however, a fired material like brick or tile, or perhaps burnt soil, might account for this	165937.2	20531.6
10	Linear enhanced	Fill? - Ditch?	Uncertain, however, if it is a ditch fill then it implies there was once a rectangular enclosure here that has mostly been lost to the sea	165988.0	20496.6

5 Discussion

5.1 Introduction

The sections below first discuss the geophysical context within which the results need to be considered and then specific features or anomalies of particular interest. Not all will be discussed here and the reader is advised to consult the catalogue (ibid) in conjunction with the graphical elements of this report.

5.2 Principles

In general, topsoil is more magnetic than subsoil which can be slightly more magnetic than parent geology, whether sands, gravels or clays, however, there are exceptions to this. The reasons for this are natural and are due to biological processes in the topsoil that change iron between various oxidation states, each differently magnetic. Where there is an accumulation of topsoil or where topsoil has been incorporated into other features, a greater magnetic susceptibility will result.

Within landscapes soil tends to accumulate in negative features like pits and ditches and will include soil particles with thermo-remanent magnetization (TRM) through exposure to heat if there is settlement or industry nearby. In addition, particles slowly settling out of stationary water will attempt to align with the ambient magnetic field at the time, creating a deposit with depositional remanent magnetization (DRM).

As a consequence, magnetic survey is nearly always more a case of mapping accumulated magnetic soils than structures which would not be detected unless magnetic in their own right, e.g. built of brick or tile. As a prospecting tool it is thus indirect. Fortunately, the mechanisms outlined above are commonplace and favoured by human activity and it is nearly always the case that cut features will alter in some way the local magnetic field.

5.2.1 Instrumentation

The use of a vertical gradiometer sensitises the measurement process to within a particular depth extent governed by the instrument sensitivity and the sensor separation. In this case the extent is approximately one meter, i.e. sufficient for the detection of buried archaeological structures of normal magnetic susceptibility. As especially strong response will be measured from magnetic sources at the surface; conversely variations in deep alluvium or within the shallow geology will not normally be detected.

5.3 Character & principal results

5.3.1 Geology

The geology of the headland is Devonian sandstone and clayey rocks without the thick covering of windblown sand immediately inland (e.g. within the graveyard of the church). Although the magnetic character of soil over sandstones can be variable, magnetic survey here stands a chance of revealing buried structures. Magnetic survey over the sand is unlikely to be successful (other geophysical methods would be better alternatives).

The background texture of the data on the headland has the expected slightly mottled character often apparent in soils derived from sandstone and overall anomaly strengths from features of archaeological interest are low (2 - 5 nT) unless there is more magnetic material introduced. An example of the latter would be [2] where prior excavation revealed a thick deposit of occupation debris, likely to have a high magnetic susceptibility and burnt soil associated with a rampart.

5.3.2 Land use

There is good evidence for cultivation on the headland, with regularly spaced probably sand-filled furrows

evident across much of the site. These seem to have a spacing of about 12m, i.e. twice the common ridge width of ridge and furrow. This might be because the cultivation was lazy beds or that the practice of turning in ridges (effectively halving the apparent furrow spacing) has not happened here.

In addition there are relict land divisions, e.g. [5] and probably [6], that suggest some subdivision of the headland into separate areas. These may however pre-date the visible cultivation.

5.3.3 Archaeology

There is good evidence for the accumulated occupation debris recently found within the rampart (Imogen Wood, *pers. comm.*) which is apparent as a band of strongly magnetic ground [2]. A 34m length is visible along the northeast edge of the survey and there are signs of it being present further south, on the edge of the cliff.

There are few other signs of internal features of the cliff castle which might reinforce the impression gained from other sites that their interiors are relatively empty compared to a band of activity just inside the defences, as seems to be the case here.

There is a possible enclosure [10] being lost to the sea at the southern tip of the survey. There is insufficient visible to be sure of form or function.

One of the most prominent aspects of the result is the discovery of a 19m diameter barrow or cairn defined by a ditch fill [7] and with a central area of strongly magnetic ground [8]. In conversation with Imogen Wood it would seem that this could be a cremation with cist beneath it, the latter not being detected.

If this is the case then the spread of debris [9], assumed to be of modern (e.g. wartime) origin, might also have a prehistoric element.

5.4 Conclusions

For such a small survey the results are quite spectacular, not least because a barrow has been found on the summit of the headland and that this appears to have a central area of heated soil. If so, it is likely a second example of the cist burial under a cremation found recently beneath the rampart of the promontory fort.

Here, as seen elsewhere, the headland was cultivated, perhaps in this case because in contrast to the surrounding area it has probably always been relatively free of sand.

5.5 Caveats

Geophysical survey is a systematic measurement of some physical property related to the earth. There are numerous sources of disturbance of this property, some due to archaeological features, some due to the measuring method, and others that relate to the environment in which the measurement is made. No disturbance, or 'anomaly', is capable of providing an unambiguous and comprehensive description of a feature, in particular in archaeological contexts where there are a myriad of factors involved.

The measured anomaly is generated by the presence or absence of certain materials within a feature, not by the feature itself. Not all archaeological features produce disturbances that can be detected by a particular instrument or methodology. For this reason, the absence of an anomaly must never be taken to mean the absence of an archaeological feature. The best surveys are those which use a variety of techniques over the same ground at resolutions adequate for the detection of a range of different features.

Where the specification is by a third party ArchaeoPhysica will always endeavour to produce the best possible result within any imposed constraints and any perceived failure of the specification remains the responsibility of that third party.

Where third party sources are used in interpretation or analysis ArchaeoPhysica will endeavour to verify their accuracy within reasonable limits but responsibility for any errors or omissions remains with the originator.

Any recommendations are made based upon the skills and experience of staff at ArchaeoPhysica and the

information available to them at the time. ArchaeoPhysica is not responsible for the manner in which these may or may not be carried out, nor for any matters arising from the same.

5.6 Bibliography

Parry, 2012, "Unlocking Our Coastal Heritage Project: Promontory Fort and Early Medieval Settlement Site, Gunwalloe – Brief for Geophysical Survey", the National Trust, unpublished

5.7 Acknowledgements

Jim Parry, National Trust archaeologist, and the National Trust wardens are thanked for their help and support throughout the survey. The site-specific advice given by staff of Cornwall Council HES is gratefully acknowledged.

6 Appendices

6.1 Project metadata

Project Name	Gunwalloe Headland, Cornwall
Project Code	NTC126
Client	The National Trust
Fieldwork Dates	8th May 2013
Field Personnel	M Edwards
Data Processing Personnel	R Dean, MJ Roseveare
Reporting Personnel	MJ Roseveare, ACK Roseveare
Draft Report Date	31st July 2013
Final Report Date	

6.2 Qualifications & experience

All work is undertaken by qualified and experienced geophysicists who have specialised in the detection and mapping of near surface structures in archaeology and other disciplines using a wide variety of techniques. There is always a geophysicist qualified to post-graduate level on site during fieldwork and all processing and interpretation is undertaken under the direct influence of either the same individual or someone of similar qualifications and experience.

ArchaeoPhysica meets with ease the requirements of English Heritage in their 2008 Guidance "Geophysical Survey in Archaeological Field Evaluation" section 2.8 entitled "Competence of survey personnel". The company is one of the most experienced in European archaeological prospection and is a key professional player. It only employs people with recognised geoscience qualifications and capable of becoming Fellows of the Geological Society of London, the Chartered UK body for geophysicists and geologists.

6.3 Safety

Safety procedures follow the recommendations of the International Association of Geophysical Contractors (IAGC).

Principal personnel have passed the Rescue Emergency Care – Emergency First Aid course and CSCS cards are being sought for those members of staff currently without them.

All personnel are issued with appropriate PPE and receive training in its use. On all sites health and safety management is performed by the Project Geophysicist under supervision by the Operations Manager.

Health and safety policy documentation is reviewed every 12 months, or sooner if there is a change in UK legislation, a reported breach of such legislation, a reported Incident or Near Miss, or changes to ArchaeoPhysica's activities. Anne Roseveare, Operations Manager, has overall responsibility for conducting this review and ensuring documentation is maintained.

We are happy to confirm that ArchaeoPhysica has suffered no reportable accidents since its inception in 1998.

6.4 Archiving

ArchaeoPhysica maintains an archive for all its projects, access to which is permitted for research purposes. Copyright and intellectual property rights are retained by ArchaeoPhysica on all material it has produced, the client having full licence to use such material as benefits their project.

Archive formation is in the spirit of Schmidt, A., 2001, "Geophysical Data in Archaeology: A Guide to Good Practice", ADS.

Access is by appointment only. Some content is restricted and not available to third parties. There is no automatic right of access to this archive by members of the public. Some material retains commercial value and a charge may be made for its use. An administrative charge may be made for some enquiries, depending upon the exact nature of the request.

The archive contains all survey and project data, communications, field notes, reports and other related material including copies of third party data (e.g. CAD mapping, etc.) in digital form. Many are in proprietary formats while report components are available in PDF format.

In addition, there are paper elements to some project archives, usually provided by the client. Nearly all elements of the archive that are generated by ArchaeoPhysica are digital.

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