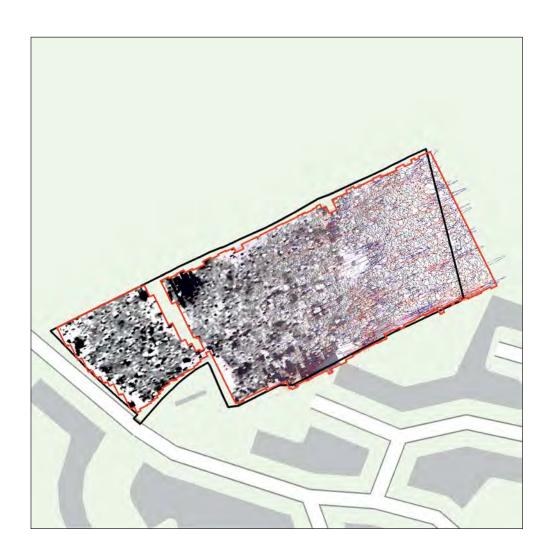


**Detailed Gradiometer Survey Report** 



Ref: 88460.01 February 2013





## **Detailed Gradiometer Survey Report**

Planning Application Ref: PA12/05796

## Prepared for:

Coastline Housing
4 Barncoose Gateway park
Redruth
TR15 3RQ

## by:

Wessex Archaeology Portway House Old Sarum Park Salisbury SP4 6EB

www.wessexarch.co.uk

February 2013

Report Reference: 88460.01



## **Quality Assurance**

WA Project Code	88460	Accession Code		Client Ref.	
Planning Application Ref.	PA12/05796	Ordnance Survey (OS) national grid reference (NGR)	171900, 15425		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date		
v01	Е	RDL	PAB	P. Legy .	06/02/13		
File:	X:\PROJECTS\88460\Geophysics\Report\ 88460_Geophysics_Report_draft.doc						
2	F	DDR	DDR	De Par.	08/02/13		
File:	X:\PROJECTS\88460\Geophysics\Report\ 88460_Geophysics_Report_draft ddr.doc						
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## **Detailed Gradiometer Survey Report**

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## **Detailed Gradiometer Survey Report**

## **Summary**

Wessex Archaeology was commissioned by Coastline Housing to undertake a detailed gradiometer survey on land off Glebe Place, Ruan Minor, Cornwall, centred on National Grid Reference (NGR) 171900, 15425.

A planning application PA12/05796 has been submitted for the erection of 36 affordable and mixed use housing. It is anticipated that the application if granted consent may have an archaeological condition attached to it. In order to help determine and inform the level of archaeological work that may be required prior to consent being granted an archaeological brief was issued by Cornwall Council Historic Environment Service. The brief recommended a geophysical survey should be undertaken in order to provide evidence for any recommendations for further archaeological recording.

The site comprises two pasture fields to the north of Glebe Place, approximately 0.25km north of the centre of Ruan Minor. The site occupies the south facing slope of a gently sloping ridge aligned northwest to southeast.

The gradiometer survey covered 1.2ha and has demonstrated the presence of a small number of anomalies of possible archaeological interest within the survey area, along with several trends, although the overall archaeological potential is low across the Site. The nature of the trends identified is unclear but it is suspected they are created as a result of agricultural activity in these fields.

The geophysical survey would appear to indicate that there is a low potential for the survival or presence of archaeological remains within the Site. There is no evidence of any possible Bronze Age barrows or Iron Age/Romano-British rounds as found in the wider landscape, and it is likely that historically the Site has remained and been used solely for agricultural purposes.

The geophysical survey was undertaken on 17<sup>th</sup> January 2013.



## **Detailed Gradiometer Survey Report**

## Acknowledgements

The detailed gradiometer survey was commissioned by Coastline Housing. The assistance of Amy Peters is gratefully acknowledged in this regard. The advice of Phil Markham of the Historic Environment Service at Cornwall Council is also gratefully acknowledged.

The fieldwork was directed by Laura Andrews and assisted by Jennifer Smith. Ross Lefort processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Kitty Foster. The project was managed on behalf of Wessex Archaeology by Damian De Rosa.



## **Detailed Gradiometer Survey Report**

### 1 INTRODUCTION

## 1.1 Project background

- 1.1.1 Wessex Archaeology was commissioned by Coastline Housing to carry out a geophysical survey of land off Glebe Place, Ruan Minor, Cornwall (**Figure 1**), hereafter "the Site" (centred on NGR 171900, 15425).
- 1.1.2 A planning application, PA12/05796, has been submitted for the erection of 36 affordable and mixed use housing. It is likely that the application if granted consent will have an archaeological condition attached to it. In order to help determine and inform the level of archaeological work that may be required, prior to consent being granted, an archaeological brief was issued by Cornwall Council Historic Environment Service (HES 2013). The brief recommended a geophysical survey should be undertaken in order to provide evidence for any recommendations for further archaeological recording
- 1.1.3 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.
- 1.1.4 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.
- 1.1.5 A written scheme of investigation (WSI) (WA 2013) setting out the methods by which Wessex Archaeology would undertake the geophysical survey was submitted to and approved by the Cornwall Council Historic Environment Service prior to the commencement of the work.
- 1.1.6 The geophysical survey was undertaken on 17th January 2013.

## 1.2 The Site

- 1.2.1 The Site is located on the northern rural edge of Ruan Minor, which is approximately 3km north-east of the Lizard, and comprises two pasture fields off Glebe Place, some 0.25km north of the centre of Ruan Minor (**Figure 1**).
- 1.2.2 Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of c.1.2ha.
- 1.2.3 The Site occupies the south facing slope of a gently sloping ridge that is aligned northwest to southeast. The ridge is flanked on both sides by stream valleys that meet the ocean at Carleon Cove (northern stream) and Cadgwith Cove (southern stream). The land on site slopes from c.65m above Ordnance Datum (aOD) in the north to around 60m aOD in the south. The survey extents are defined by field boundaries along the south, west and most of the north; the eastern extents and a small area of the northern extent by the limits of the proposed development.



1.2.4 The soils underlying the Site are likely to be typical brown earths of the 541n (Trusham) association (SSEW 1983). The bedrock geology in the eastern half of the site is recorded as complex geology composed of silica-poor peridotite and serpentinite and the west of the site is recorded as silica-rich granite and gneiss (gneissose granite) with some of the igneous rock transformed to metamorphic rock. Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

### 2 ARCHAEOLOGICAL BACKGROUND

### 2.1 Introduction

- 2.1.1 As detailed in the HEU archaeological brief the Site is on land recorded by the Cornwall and Scilly Historic Environment Record as being 'Anciently Enclosed Land' (AEL). The Cornwall Landscape Assessment 1994 describes AEL as:
- 2.1.2 Typical Historical/Archaeological Components: Much important archaeological material will survive below the surface, including the Bronze Age, Iron Age and Romano-British settlements and fields of the farmers who originally cleared this zone. (Page 142).
- 2.1.3 Potential for historical and archaeological research: Considerable. Each farming settlement will contain a wealth of historical, architectural and archaeological information. Surveys of field systems yield considerable agricultural, social, and tenurial information. Buried archaeological features can be expected virtually anywhere in this zone. (Page 143).

## 2.2 Cornwall and Scilly Historic Environment Records

- 2.2.1 A review of the Cornwall and Scilly Historic Environment Records detailed on the Heritage Gateway (<a href="http://www.heritagegateway.org.uk">http://www.heritagegateway.org.uk</a>) indicates a number of archaeological events within a c.1km radius of the Site a few of which are detailed below:
- 2.2.2 A low earth mound (HER 51337) c.400m to the east of the Site is visible on aerial photographs, and although the date and function of the feature are unknown it could be the remains of a Bronze Age barrow. Two further Bronze Age barrows are also detailed on the HER c.600m north of the Site at Treal. A possible bowl barrow (HER 10752) was surveyed in 1973 and found to be 16m in diameter and 0.6m high. The second mound (HER 10746) is visible on aerial photographs as a low mound.
- 2.2.3 A possible curvilinear enclosure 35m in diameter (HER 51335) is visible as a low earth bank on aerial photographs c.800m to the north-west of the Site. The date and function of the enclosure is again uncertain, but is thought to possibly be an Iron Age/Romano British round. Other possible Iron Age/Romano British rounds are recorded on the HER at Carleon (HER 10806) and Poltesco (HER 10802) although there is no physical evidence of these features and would only appear and to be inferred from 19<sup>th</sup> century documentation and maps. A possible rotary quern dating to the Romano-British period (HER 35123) was found in the Ruan Minor churchyard wall,
- 2.2.4 The settlement of Ruan Minor (HER 10765) is first recorded in 1259 and its name is derived from the name of the patron Saint of the parish church (HER 10819), which is thought to have been constructed sometime in the 13<sup>th</sup> century, although little evidence for the early construction of the church now survives. Ruan Minor itself has only seen limited development through the post-medieval period and into the modern day.



2.2.5 A medieval field system (HER 51334) is visible on aerial photographs c.900m to the northwest of the Site and is sited within an area of Ancient Enclosed Land, as the Site is also designated.

### 3 AIMS

### 3.1 General

3.1.1 The general aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

## 3.2 Site specific aims

- 3.2.1 The site specific aims in accordance with the HEU brief were to:
  - Undertake an appropriate archaeological geophysical survey
  - Produce a report containing the geophysical data and the data in interpreted form
  - Inform whether an archaeological evaluation or further archaeological recording of any potential buried remains is recommended.

### 4 METHODOLOGY

### 4.1 Introduction

- 4.1.1 The detailed magnetometer survey was conducted using a Bartington Grad601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English Heritage guidelines (2008).
- 4.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 17<sup>th</sup> and 18<sup>th</sup> January 2013. Field conditions at the time of the survey were good with dry conditions making walking easier.

### 4.2 Method

- 4.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS system, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).
- 4.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag method.
- 4.2.3 Most of the data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied to all survey areas, with no interpolation applied.
- 4.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.



### 5 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

#### 5.1 Introduction

- 5.1.1 The gradiometer survey has been successful in identifying anomalies of possible archaeological interest across the Site, along with a number of modern services. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1250 (**Figure 2**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale images and ±25nT at 25nT per cm for the XY trace plots.
- 5.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 3**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.
- 5.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

## 5.2 Gradiometer Survey Results and Interpretation

- 5.2.1 The western field contains no definite or probable archaeological features with ferrous anomalies dominating along with some geological features (4000). These geological features are positive with multiple peaks present across the spread of these anomalies. A trend lies south of 4000 that may prove to be archaeological. The remaining features are small positive anomalies (4001) that could either be archaeological or geological; there is no clear patterning in their distribution to suggest they are likely to be archaeological so have been classed as possible archaeology.
- 5.2.2 The larger field to the east has more geological features present with **4002** representing the largest geological anomaly. A group of positive anomalies located at **4003** may represent archaeological features, but as they are close to geological features have been classed as possible archaeology. The remaining features in this field are trends; most are likely to be agricultural in origin (plough scars) but others such as those at **4004** and **4005** may prove to be archaeological. There are two large ferrous anomalies near **4006**; one may represent a large, buried iron object (north of **4006**) but the other (south of **4006**) appears to be a pipe although it is not thought to represent a service.

## 5.3 Gradiometer Survey Results and Interpretation: Modern Services

5.3.1 No modern services were identified in this data. It is possible that services made from materials that are not detectable through gradiometer survey may lie in this area. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

### 6 CONCLUSION

- 6.1.1 The detailed gradiometer survey has been successful in detecting anomalies of possible archaeological interest within the Site, in addition to numerous trends. However, no anomalies of probable or definite archaeological interest could be identified.
- 6.1.2 The nature of the trends identified is unclear but it is suspected they are created as a result of agricultural activity in these fields.
- 6.1.3 The wide spread magnetic disturbance associated with the numerous small-scale ferrous anomalies have reduced the area in which it is possible to detect archaeological features.



It is possible that weak archaeological features could be obscured by these strong ferrous anomalies.

- 6.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey.
- 6.1.5 However, the geophysical survey would appear to indicate that there is a low potential for the survival or presence of archaeological remains within the Site. There is no evidence of any possible Bronze Age barrows or Iron Age/Romano-British rounds as found in the wider landscape, and it is likely that historically the Site has remained and been used solely for agricultural purposes.

### 7 ARCHIVE

#### 7.1 Archive

7.1.1 The project archive, is currently held at the offices of Wessex Archaeology at Old Sarum, Salisbury, Wiltshire, under Wessex Archaeology project number **88460** 

## 7.2 Copyright

7.2.1 The full copyright of the written/illustrative archive relating to the site will be retained by Wessex archaeology Ltd under the Copyright, Designs and Patents Act 1988 with all rights reserved. The Museum, however, will be granted an exclusive licence for the use of the archive for educational purposes including academic research, providing that such use shall be non-profit making, and conforms to the Copyright and Related Rights regulations 2003.

### 7.3 Security Copy

7.3.1 In line with current best practice, on completion of the project a security copy of the paper records will be prepared, in the form of microfilm. The master jackets and one diazo copy of the microfilm will be submitted to the National Monuments Record Centre (Swindon); a second diazo copy will be deposited with the paper records at the Museum, and a third diazo copy will be retained by Wessex Archaeology. Alternatively, the security copy may be in the form of a pdf file.

#### 8 REFERENCES

Cornwall Council, Historic Environment Service, 2013. : Land adjacent to Glebe Place, Ruan Minor, Helston, Cornwall TR12 7JW. Brief For Archaeological Geophysical Survey.

English Heritage, 2008. Geophysical Survey in Archaeological Field Evaluation. Research and Professional Service Guideline No 1, 2nd edition.

Heritage Gateway. (http://www.heritagegateway.org.uk)

Soil Survey of England and Wales, 1983. Sheet 5, South West England. Ordnance Survey, Southampton.

Wessex Archaeology 2013. Land adjacent to Glebe Place, Ruan Minor, Helston, Cornwall. Written Scheme of Investigation for Geophysical Survey. WA Ref 88460



#### APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

## Survey Methods and Equipment

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

## **Post-Processing**

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.



Typical data and image processing steps may include:

- Destripe Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot Presents the data as a trace or graph line for each traverse. Each traverse is
  displaced down the image to produce a stacked profile effect. This type of image is useful
  as it shows the full range of individual anomalies.
- Greyscale Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.



#### APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

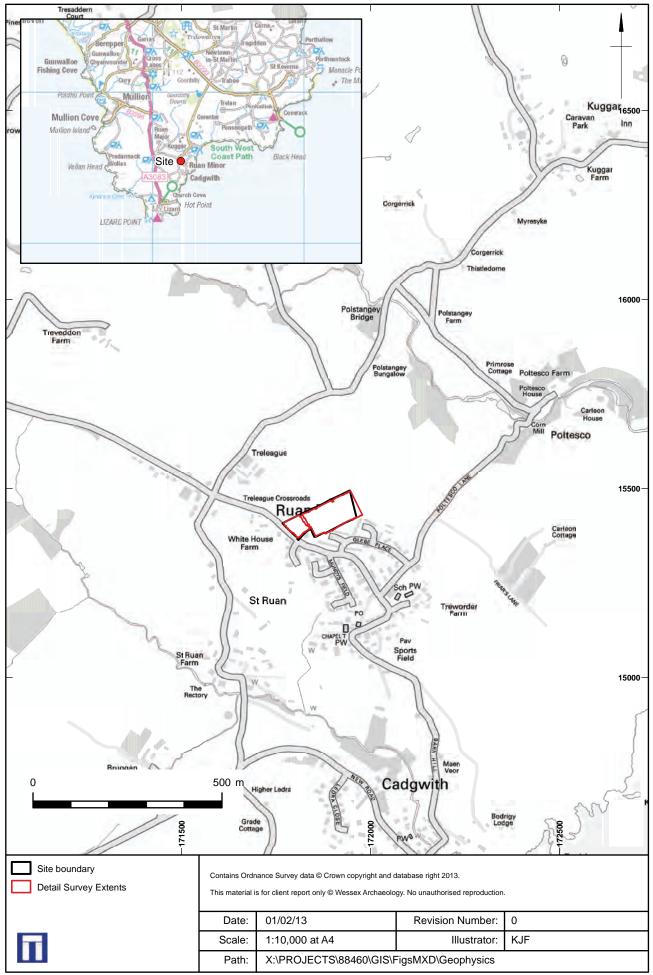
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further subdivided into three groups, implying a decreasing level of confidence:

- Archaeology used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology used for features which give a clear response but which form incomplete patterns.
- Possible archaeology used for features which give a response but which form no discernible pattern or trend.

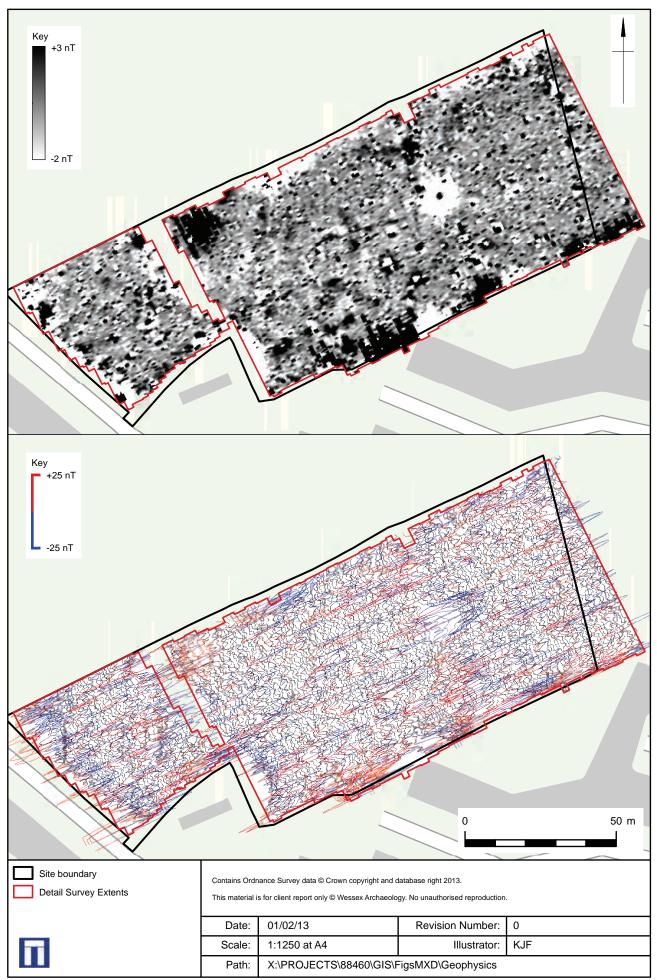
The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

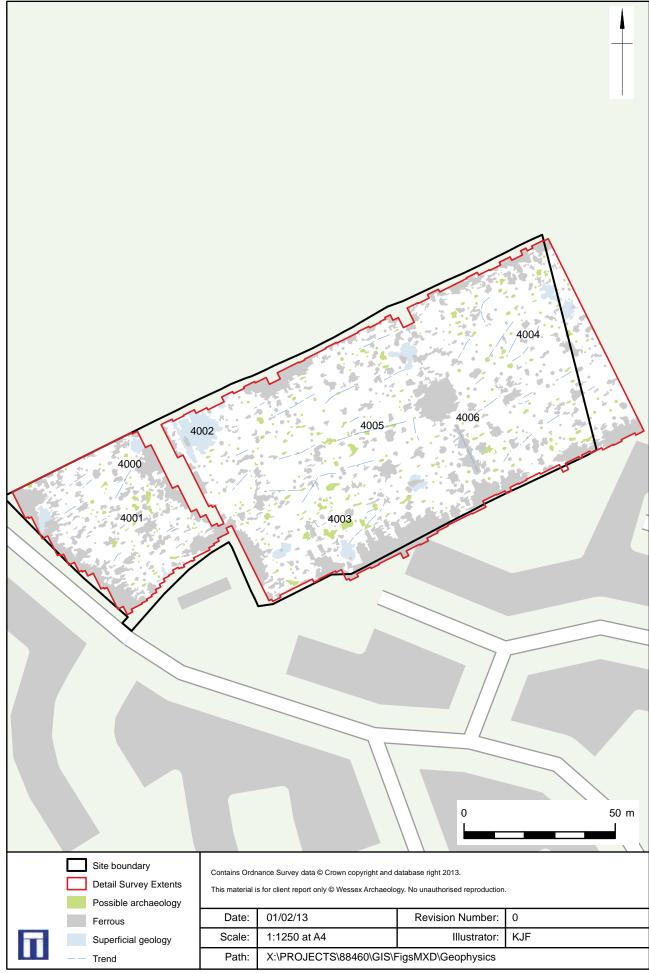
- Increased magnetic response used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend used for low amplitude or indistinct linear anomalies.
- Ferrous used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.



Site location Figure 1





Interpretation Figure 3







